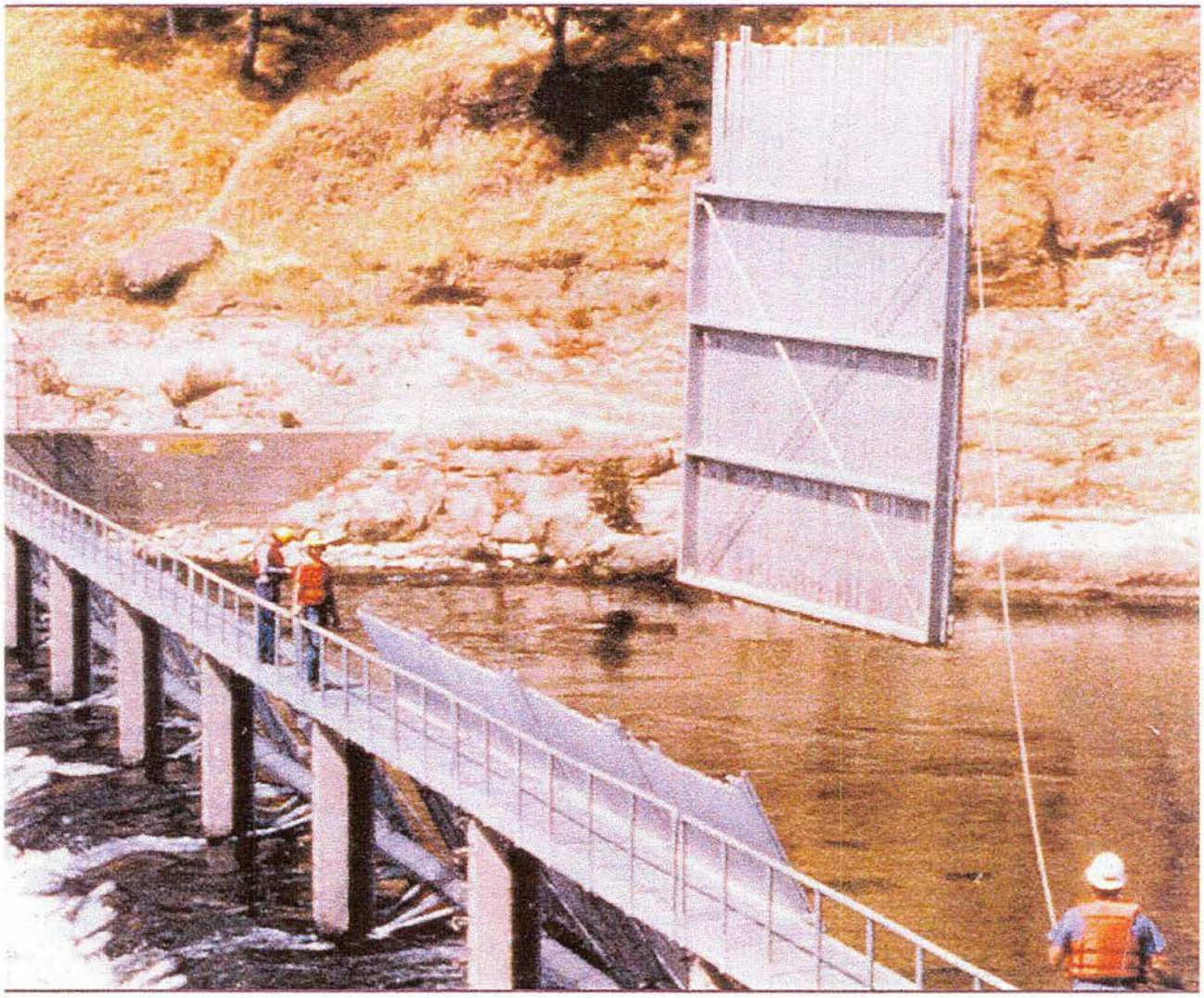
PAP-850

Fish Diversion Investigation

Nimbus Fish Hatchery



Value Analysis Workshop Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

June 8-11, 1999
Lake Natoma Inn
Folsom, California

Fish Diversion Investigation

Nimbus Fish Hatchery

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A Team Effort to Produce Results -

- U.S. Bureau of Reclamation
- California Department of Fish & Game
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Save the American River Association
- Surface Water Resources, Inc.

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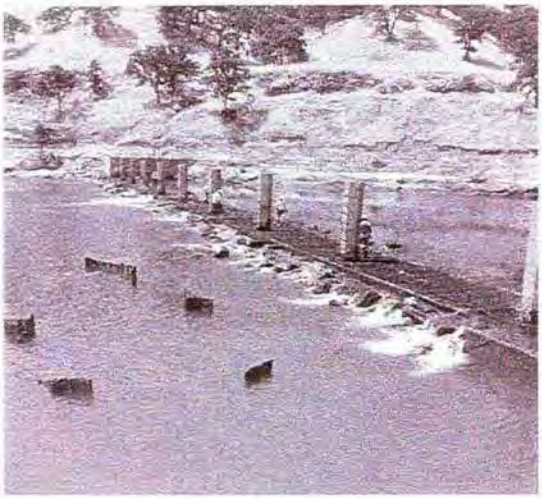
Executive Summary



The Value Analysis (VA) study for the Fish Diversion Investigation resulted in the development of nine proposals, ____ of which are recommended for further consideration (shown in bold). Three of the proposals pertained to the existing diversion structure, while six proposals examined alternatives that could be implemented at another site.

The proposals include the following:

Enhancements to Existing Fish Diversion Structure

1. **Make Permanent Repairs to Foundation of Existing Diversion Structure**
2. Replace Existing Diversion Structure Foundation and Fish Screen Assembly
3. **Replace Existing Diversion Structure with Solid Foundation and ~~I~~nclined Screen on Downstream Surface**

Enhancements not Involving Existing Diversion Structure

4. **Collect Fish near Tailrace of Nimbus Dam and Transport by Truck to Nimbus Hatchery**
5. **Collect Fish near Tailrace of Nimbus Dam and Transport through a Pipe to Hatchery**
6. Collect Fish near Tailrace of Nimbus Dam and Spawn Onsite
7. Build New Fish Barrier and Ladder Downstream of Nimbus Hatchery
8. Abandon Existing Diversion Structure, Improve Entrance to Existing Nimbus Fish Ladder and Prepare Backup Fish Collection Facility at Nimbus Dam
9. Don't Install Fish Racks, Improve Entrance to Nimbus Fish Ladder and Test Method during Early Part of Run

The VA study was conducted at the Lake Natoma Inn, Folsom, California, from June 8 - 11, 1999. The workshop participants are listed on the following pages.

Executive Summary

(Continuation of exec. summary)

VA Team Recommendations

Following development of the various proposals, each group selected the best proposal and provided recommendations for implementation. The group handling Enhancements to the Existing Fish Diversion Structure selected Proposal 1 - Permanent Repairs to Foundation of Existing Diversion Structure using sheet pile cut-offs with a concrete slab foundation that makes use of the existing picket-rack structure for implementation (figure__, p.__). However, Proposal 3 - Replacement of Existing Diversion Structure with New Foundation and Declined Bar Racks was also selected for implementation (figure __, p.__). The idea being that Proposal 1 would be implemented as phase 1 to provide a short term solution to the present pier-scour problems. Then, Proposal 3 would be implemented at a later time as a follow-on or phase 2. The primary reason for this approach was that the group realized the need for laboratory and field development of Proposal 3 given the uncertainties about performance. Ultimately Proposal 3 is expected to provide solutions to the remaining O&M and safety problems previously identified.

In addition, the group that explored Enhancements Not Involving the Existing Fish Diversion Structure recommended two alternatives (Proposals 4&5) both of which consist of abandoning the existing fish barrier in favor of a new ladder located at the right abutment of Nimbus Dam. The idea being that Nimbus Dam could be used as the barrier to upstream migration of Salmon and Steelhead. The up-migrants could then be attracted to a ladder at the right abutment of the dam, collected, and either piped or trucked back down to the fish hatchery. However, two types of ladders were also identified and include: A conventional pool-weir type fish ladder (figure__, p.__) and a modular-spiral type fish ladder (figure__, p.__), both of which are presented in the descriptions of Proposals 4 and 5. The difference between Proposals 4 and 5 is the manner in which fish are transported back to the hatchery. Proposal 4 designates trucking transport, while Proposal 5 designates a piping or open channel concept as the means of transport. It is important to realized that the spiral ladder concept was envisioned to be pre-fabricated and of similar design to those previously available from Aeroceanics, Inc. or American Fishways, Inc. Furthermore, the existing hatchery fish ladder would remain in service and provide capture of additional Salmon and Steelhead that find the entrance and subsequently use the ladder. Final selection of the ladder type to be implemented at Nimbus Dam was postponed until preliminary cost information is available. Preliminary cost estimates for these recommended alternatives have been included in the respective proposal descriptions.

Value Analysis Team

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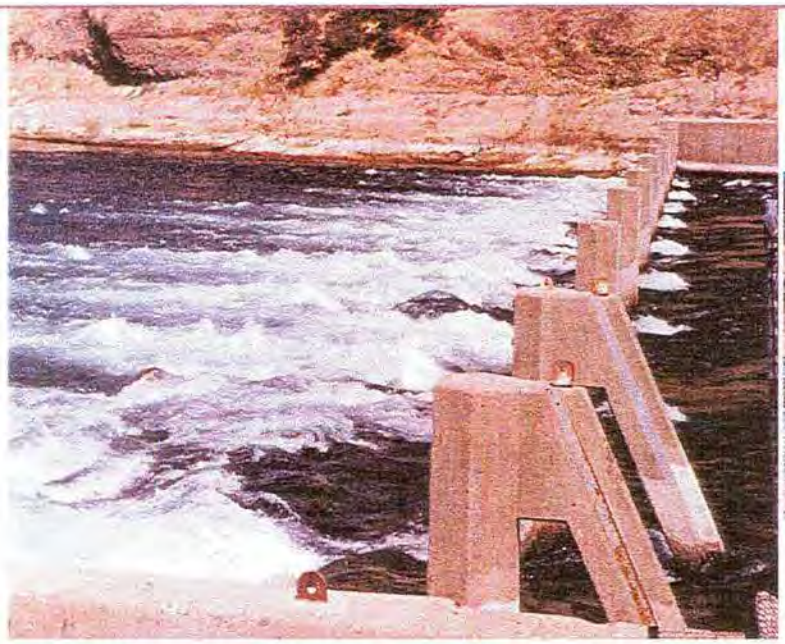
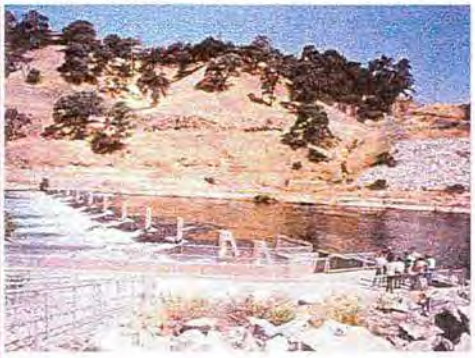
Purpose of Value Analysis Study



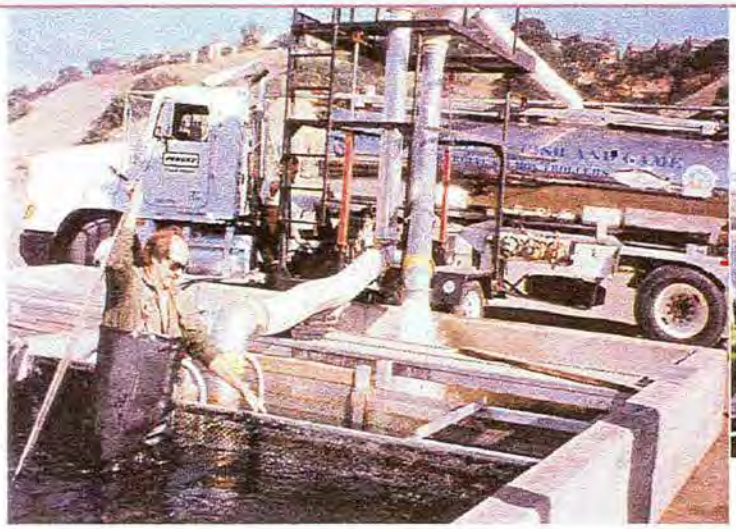


The initial purpose of this Value Analysis (VA) Study was to identify the optimum design for the rehabilitation of the fish diversion structure at the Nimbus Fish Hatchery near Folsom, California. Construction for the existing structure was completed in 1955. It has a history of scour problems near its piers that has resulted in a decrease in efficiency of fish capture. Increasing operation and maintenance costs and the safety aspects of the annual installation of the fish racks were also identified as major problems that needed to be addressed.

The VA study team quickly expanded the scope of investigation to examine alternative solutions to the required function of providing a specified number of fish eggs each year for spawning. Alternative methodologies and criteria were examined so as to provide the best solutions from both a short and long-term perspective. The alternatives presented in this report describe both solutions that pertain to the existing diversion structure and alternative solutions exclusive of the existing Nimbus hatchery facility.

The primary reference document for this VA study was ***Concept Study - Fish Rack Structure Modifications***, October 1996, prepared by Reclamation's Technical Service Center in Denver, Colorado. A listing of the alternatives which were developed are shown in the background section of this report. Another document, Nimbus Hatchery Fish Diversion Structure Repair, performed in 1997, provided a history of difficulties, and is provided in Appendix A.

Conduct of the VA Study and Report Format



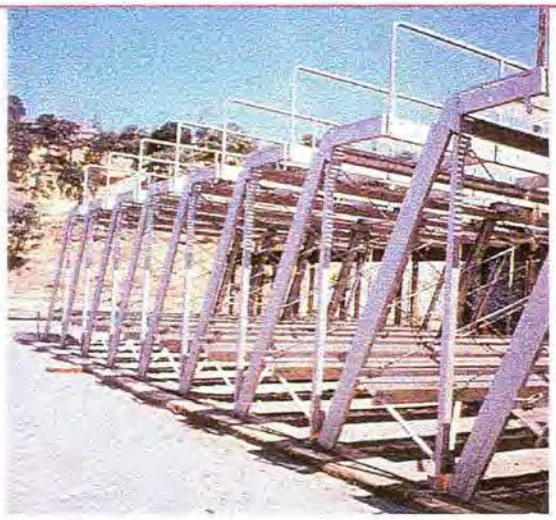
Conduct of VA Study: This VA study was requested by the Division of Planning, U.S. Bureau of Reclamation, Mid-Pacific Regional Office, for the purpose of identifying creative "out of the box" solutions to the previously mentioned problems of riverbed pier scour and rising operation and maintenance costs associated with this facility. The VA study was held in the Sierra Room, Lake Natoma Inn, Folsom, California, from June 8-11, 1999, (see Agenda, Appendix B). The first day began with a field trip where Terry West, Nimbus Fish Hatchery Manager, gave a briefing regarding the diversion structure and problems associated with its operation and maintenance.

Careful attention was given to the selection of an interdisciplinary group of experienced subject matter experts from the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, California Department of Fish & Game, U.S. Army Corps of Engineers, Save the American River Association, and Surface Water Resources, Inc. Please refer to the Team Member Listing for their respective fields of expertise. Each participant was provided with an advance copy of Reclamation's October 1996 Concept Study-Fish Rack Structure Modifications Report, previously referenced.

The VA study format was based on the SAVE International (a society for the advancement of Value Engineering/Analysis) function-based methodology which has a proven successful track record. Reclamation's Division of Planning felt that a value analysis at this pre-design stage could help in verifying project objectives, validate proposed solutions, and determine if other operational items or Stakeholder needs should be considered. Once the VA study began, the team pursued a more holistic examination of the need to secure a predetermined annual number of spawned eggs. Hence, the examination of solutions "off-site" of the Nimbus fish hatchery and it's adjacent fish ladder and diversion structure.

Report Format: This VA report is presented in a running narrative format paralleling the conduct of the study so the reader can follow the logic of the VA team members in arriving at their recommendations. The purpose of this "fast track" report is to document the activities of the VA team during the four-day study period. Therefore, only minor editorial changes were made to their VA proposals. However, the cost estimates and CADD illustrations were prepared after the conclusion of the study.

Background of the Diversion Facility



The Nimbus fish hatchery is located on the American River approximately 1/4 mile downstream of the Nimbus Dam, near Folsom, California. It was built to compensate for spawning areas of salmon and steelhead that were inundated by construction of the Nimbus Dam.

The diversion structure consists of eight piers on 30-foot spacings, including two riverbank abutments, which spans the river and guides upstream migrants to the fish ladder and into the hatchery. Fish rack support frames and walkways are installed each fall via an overhead cable system. A pipe rack is then put in place which supports the pipe pickets (3/4-inch steel rods spaced on 2-1/2-inch centers). The pipe rack rests on a submerged rack support frame which has numerous voids underneath.

The pipe racks need be cleaned manually two or three times weekly and contribute to an ever increasing O&M concern. In addition, it takes six people approximately three days to install or remove the pipe rack support frames and pipe racks.

Since there is no concrete foundation between the piers, riverbed scour underneath the rack support frame allows for the undesired passage of migrants upstream where they cannot be utilized for spawning purposes.

The fish rack structure piers and adjacent fish ladder were constructed in the 1954-55 period. The most serious problem has been the scour and undermining of the piers during flood periods. Steel fabric mats to contain gravel and cobble scour hole fill material are often destroyed by the next flood event. Attempts to fill the scour holes with large sand bags have been unsuccessful.

The *1966 Concept Study - Fish Rack Structure Modifications* listed the following criteria that should be applicable to any work on the fish diversion structure:

Structure shall be fish tight to prevent upstream migrants from moving into the tailrace area of the dam.

Structure shall be strong enough to withstand overtopping and not significantly raise the tailwater at Nimbus Dam, thus adversely affecting power generation.

Maximize the dependability of the structure and minimize maintenance.

Structure shall be durable so vandals will not be able to cause damage to it or affect it's operation.

The *Concept Study* recommended the following alternatives to address the scouring and O&M problems associated with the diversion structure:

- ***Foundation Stabilization***
  - *Concrete slab with sheet pile cutoffs*
    - *Driven sheet piles*
    - *Place and backfill sheet piles*
    - *Jet grouting*
    - *Slurry trenching*
  - *Roller compacted concrete (RCC) or soil cement backfill foundation*
- ***Fish Rack Structure***
  - *Adjustable overtopping weir*
  - *Air bladder to control fish rack movement*
  - *Hydraulically-operated cylinders to control rack movement*
  - *Electric hoists with wire ropes*
  - *Pinned rack using existing cableway system*
  - *Overflow weir (velocity weir)*

The Value Analysis Job Plan

The Value Analysis methodology is an organized study of functions to satisfy the user's needs at the lowest life cycle cost through the use of function analysis, applied creativity and Team synergy.

It is not simply a cost cutting exercise, since the required functions of a project, service or item are retained. The value analysis technique was developed during the World War II era when a substitute material was needed for a critical part and the question was asked "What else will satisfy the required function?"

The components of the Value Analysis Job Plan consist of six phases:

1. Information Gathering - Basic Questions... What is it?, What does it do versus what must it do?, What does it cost?

This phase of the Job Plan insures that all VA Team members completely understand the function requirements and/or purpose of the project. Specific criteria and performance requirements are identified to help clarify the required functions. Stakeholders are encouraged to actively participate during this phase.

2. Speculation - Basic Question... What else will satisfy the required functions?

The VA Team members are encouraged to utilize their synergistic "people skills" in a creative brainstorming session to look for the "second right answer." Innovative "out of the box" ideas are developed by thinking in a constraint-less environment. Criticism is not allowed during this phase of the VA Job Plan.

3. Analysis - Basic Questions... Which ideas will satisfy the required function(s) of the project and yet are implementable? What will the alternatives cost?

The speculative ideas that were generated during the previous phase are screened for acceptability and implementability from a Stakeholder perspective. Criteria and alternative matrices can be utilized, if necessary, to reach a VA Team consensus.

4. Development - Basic Question... Will the recommended proposals meet all the requirements?

It is imperative that the alternatives meet the agency's administrative, regulatory and funding requirements, including, most importantly, the stakeholder needs. Also, it is imperative that a concise, readable document is prepared which will be easily read and understood by the layman/decision makers.

5. Presentation - Basic Question... Do you have a presentation that will sell your good ideas?

You need to present your good ideas in a clear, concise and convincing manner. Consider the Stakeholder needs and try to view things from her/his perspective as best you can.

6. Implementation - Basic Question... How can the VA Team assist the project decision-makers to insure that the Stakeholder needs are met in an expeditious and cost-effective manner?

Be available, upon request, to clarify the recommendations of the VA Team and provide any assistance

A Five Minute Explanation of...

The Six Phase Value Analysis Job Plan

Information	Speculation	Analysis	Development	Presentation	Implementation
Questions What is the project about? Did you visit the field site and meet with the local Stakeholders? Does the Value Analysis (VA) Team have enough information? Do the project features address and satisfy the Stakeholders needs? What does the project provide versus what must it provide? What are the absolute regulatory, physical, social and economic constraints?	Questions ***What else will satisfy the required functions of the project?*** Did you use the Function Analysis Working Diagram (FAWD) to completely understand the project as you sought out a better way to satisfy the Stakeholder needs? Did the VA Team have a "Win-for All" attitude and did they use "Out of the Box" creative thinking to be truly innovative?	Questions Will the preliminary recommendations satisfy the project requirements and the Stakeholder needs? Did the VA Team decide on which selection criteria to consider and weight them appropriately when making their final recommendations?	Questions Will the final recommendations meet the regulatory, environmental, Stakeholder, and funding needs? Did the VA Team have sufficient information to document their recommendations?	Questions Is the VA Team preparing a report that is clear, concise and convincing to the decision makers? Did they prepare visual aids and presentation material for briefings?	Question Is the VA Team prepared to follow up on their efforts to insure that the recommendations are seriously considered?

Identification of Needs and Problems

An integral part of the Information Phase of the VA Job Plan consists of determining the needs of the various Stakeholders. For this particular project, the Stakeholders encompass a wide variety of agencies, organizations and disciplines. It was imperative that this VA study make the identification of needs and problems an initial priority of the team. The contribution by each person was not questioned by others since a diverse group of individuals can each perceive problems differently. The following lists are shown unedited and in the order presented as recorded on flip chart paper.

Identification of Needs and Constraints

- Be fish tight
- Guide fish
- Hold fish
- Pass fish
- Maintain river flows
- Do not affect downstream processes (erosion)
- Able to operate at high flows
- Don't reduce gravel recruitment
- Diversion structure must function October through December
- Ladder must function October-March
- Divert salmon October-December
- Minimize vandalism
- Pass trash
- Minimize hydro power impacts
- Be safe for workers and public
- Reduce O&M activities and costs
- Need to manage water temperature and flow
- Contribute to hatchery meeting mitigation needs
- Get adult salmon from the river to the hatchery
- Solution must survive flood flows
- Long-term solution
- Maintain and enhance existing spawning/ rearing habitat downstream
- Maintain the ability to control the number of fish diverted
- Improve the ability to control the fish passage upstream
- Maintain/ensure fish attraction
- Ability to maintain O&M during reasonable flow range
- The solution must be functional by September 15, annually
- Eliminate the need for annual ESA consulta tion, 404 permits, etc.

Existing Problems

- Having to reduce river flows for construction or O&M
- Health and safety of O&M
- Foundation not stable
- Labor intensive O&M
- Unreliable fish diversion capability
- O&M has adverse downstream impacts
- Vandalism
- Getting dead fish off the weir
- Getting trash off the weir
- High and normal flows cause damage to structure
- Safety concerns with the overhead crane
- Submerged sheet pile, rebar, etc. downstream
- Flows not uniformly distributed across river which causes erosion

Potential Future Problems

- Limited ability to reduce flows during con struction and future O&M
- Changing biological requirements
- Trend toward structure free rivers
- Proposal to remove Nimbus Dam
- Uncertainty with regard to future management objectives
- Sedimentation problems in the river during construction
- Limitations on the use of concrete in the river
- More active public and media involvement
- Must take fish every season
- Only need to get eggs to hatchery (and milt)
- Be cost effective

Brainstorming for Solutions

Function Analysis and the Function Analysis Working Diagram (FAWD): The next phase of the VA Job Plan consisted of the speculation of ideas relative to the previously identified needs and solutions. To mentally prepare for this activity, the team was given a presentation on the "heart" of the Value Methodology, that is, Function Analysis. The term function, as used in this context, refers to the needs of Stakeholders, which must be satisfied, such as interagency quotas, fish diversion/rack operations, etc. Because the function analysis process describes these project needs in a concise verb-noun format, the resolution of multiple Stakeholder needs and conflicts can be effectively identified and addressed at an early stage.

A Function Analysis Working Diagram (FAWD) was prepared prior to the VA study to help "dissect" the project and highlight areas for brainstorming activity. In a FAWD diagram, (see next page) verb-noun function activity blocks are arranged in a left to right format with the desired higher order function on the left side of the page. The next right-most block is developed by asking "HOW" until one reaches the right side of the FAWD diagram. Verification is obtained by asking "WHY" as one proceeds from right to left. The primary purpose of the FAWD diagram was to help the VA team members gain a better understanding of the project.

The VA team was shown the video The Business of Paradigms, by Joel Barker, to encourage members to "think out of the box" in seeking new and innovative solutions.

Brainstorming for Solutions

Brainstorming Session: The Speculation Phase of the VA Job Plan consists of an "out of the box" brainstorming session during which no ideas are discarded since each new thought, no matter how "far out," may be a "springboard" for an idea by another person. Upon examining the FAWD diagram, the VA team decided to brainstorm on three main categories as shown below (in the order they were identified):

Existing Site

- Lower elevation of foundation
- More permanent foundation
- Self-contouring pipe rack
- Longer pipes
- Concrete blocks
- Sheet pile cutoff
- Articulated cable concrete
- Suspended barrier/rack
- Roller Compacted Concrete foundation
- Grout-filled bags
- Use existing pipe racks
- Perforated plates
- Slots or louvers
- Electrical barrier
- Sound barrier
- Light barrier
- Bubble barrier
- Water blast to deter fish
- Velocity barrier
- Visual barrier
- Wire barrier
- Drop structure (slope)
- Floating pipe rack
- Artificial "forest"
- Gated weir (high)
- Velocity chute
- Bladder-supported gates
- Dual channel
- Different rack material
- Reduced rack length
- Temporary vs permanent structure
- Combination (partially effective barrier)
- Revolving door (water wheel) screen
- Constructive riffle
- Improved ladder attraction
- Channel construction
- Environmentally friendly
- Non-toxic coatings/materials
- Multiple-level design

New Collection Site at Nimbus Dam

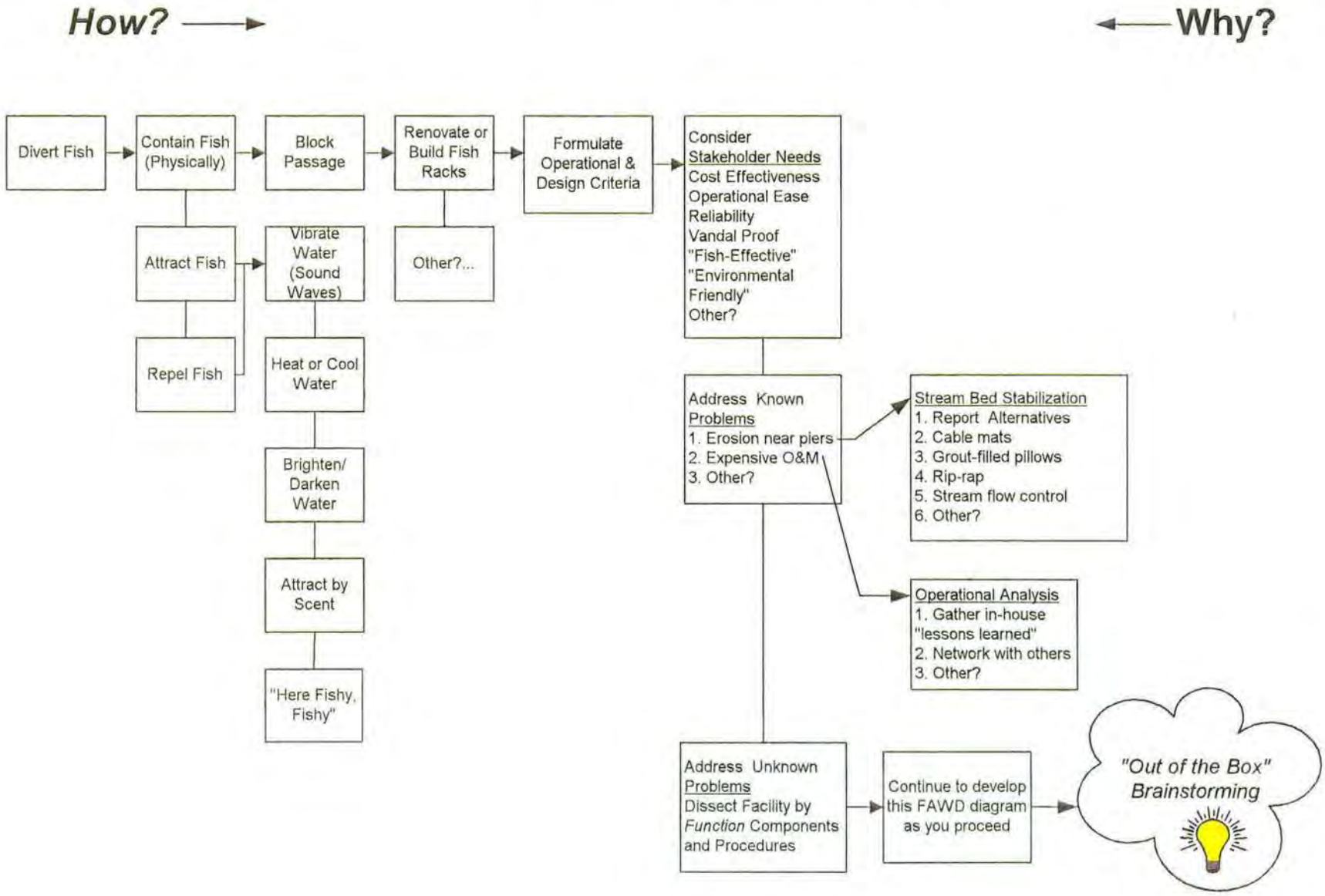
- Collect and truck at Nimbus
- Nimbus power plant tailrace entrance
- Collect at Nimbus and pipe to hatchery
- Collect spawn and transport
- Fish lift
- Fish ladder
- Downstream velocity barrier
- Ladder into Folsom South Canal
- Need for barrier? (make ladder attractive)

"Far Out" Ideas

- Alternative mitigation via flows
- American River below Nimbus
- Tributaries above Folsom Reservoir
- Folsom South Canal spawning canal
- Abandon American River & restore offsite
- Mitigate via physical habitat restoration

Fish Diversion Structure Investigation
Nimbus Fish Hatchery
Folsom, CA

Function Analysis Working Diagram (FAWD)



Development of Value Analysis Proposals - Team Makeup

Formation of Two Work Groups: Once the brainstorming ideas were identified, discussion was had with respect to how to best categorize and evaluate the listing into a manageable format. The team prepared their own Function Analysis Working Diagram (see next page) which served as a discussion document. From the ensuing discussions, it was decided to form two groups; one that addressed problems pertaining to the existing diversion structure and another that would examine solutions not pertaining to the existing site. Each working group formulated their own method to evaluate the brainstorming list and identify individual items for transformation into VA proposals. The two VA working groups were comprised of the following individuals:

Enhancements to Existing Fish Diversion Structure

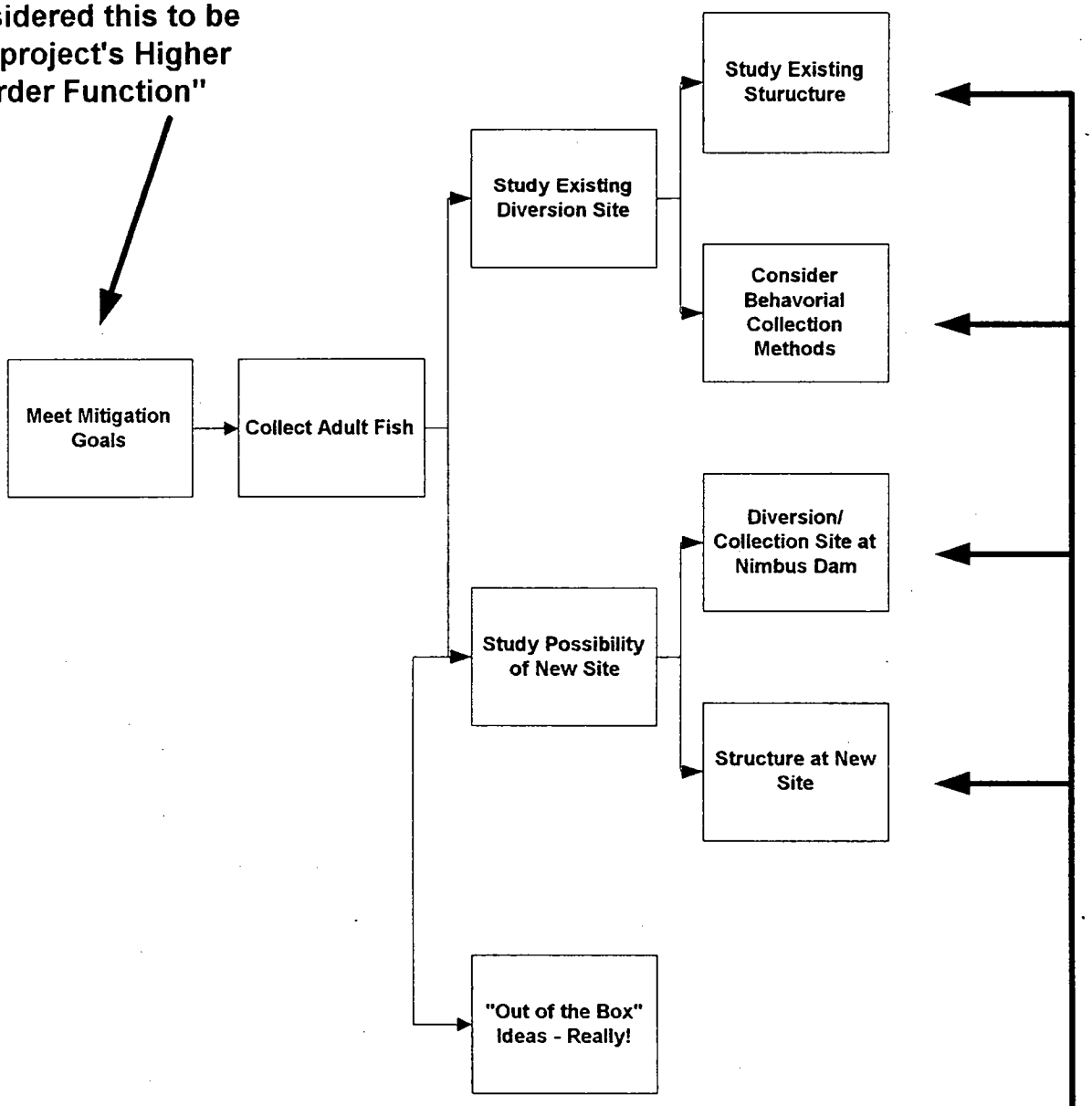
- **Roderick Hall,** *Environmental Specialist,* ***Bureau of Reclamation*** *(Group Leader)*
- **Paul M. Bratovich,** *Fishery Resources,* ***Surface Water Resources, Inc.***
- **Richard Jones,** *Field Engineer,* ***Bureau of Reclamation***
- **Joe Kubitschek,** *Hydraulic Engineer,* ***Bureau of Reclamation***
- **David Robinson,** *Fisheries Biologist,* ***Bureau of Reclamation***
- **Felix Smith,** *Community Volunteer,* ***Save the American River Association***
- **Terry West,** *Nimbus Fish Hatchery Manager,* ***California Dept. of Fish & Game***

Enhancements not Involving Existing Diversion Structure

- **Mark Lindgren,** *Hydraulic Engineer,* ***U.S. Army Corps of Engineers***
- **Floyd Summers,** *Program Manager,* ***Bureau of Reclamation***
- **Andrew Hamilton,** *Fish and Wildlife Biologist,* ***U.S. Fish & Wildlife Service***
- **David Read,** *American River Modeler,* ***Bureau of Reclamation***

FAWD Diagram Developed by the VA Team

"We, the VA team, considered this to be the project's Higher Order Function"



"As the VA team, we developed our FAWD diagram to focus on these major study areas from which to develop our VA proposals."

VA Proposals - Enhancements to Existing Fish Diversion Structure

Photo

Development of Evaluation Criteria: The working group for this set of VA proposals developed the following list of criteria by which to numerically evaluate the list of brainstorming ideas that were identified. The numerous work sheets are not shown for the sake of brevity.

Evaluation Criteria

- Performance Effectiveness (Fish guidance, selected diversion)
- Operation and Maintenance Ease (Requirements, worker safety, public safety)
- Constructability (Time constraints, cost difficulty)
- Long-term functionality
- Operational flexibility
- Function within design flow range (2500 to 7,500 cfs)
- Flood survivability (180,000 cfs)
- Need to reduce flows for proper O&M
- Long-term adverse affect on downstream ecological processes

The titles of the three proposals developed by this working group are shown below and are presented in detail following this page.

Enhancements to Existing Fish Diversion

- Structure Make Permanent Repairs to Foundation of Existing Diversion Structure
- Replace Existing Diversion Structure Foundation and Fish Screen Assembly
- Replace Existing Diversion Structure with Solid Foundation and Inclined Screen on Downstream Surface

Make Permanent Repairs to Foundation of Existing Diversion Structure

VA Proposal No. 1

Function of Proposal:

1. Guide spawning fish at a presently controllable barrier
2. Reduce maintenance costs
3. Reduce existing safety problems
4. Eliminate scour/erosion problems caused by present diversion structure

Existing Situation or Design:

1. Fish spawned at Nimbus Hatchery
2. Requires annual installation of barrier frames and picket racks to direct spawners to fish ladder entrance
3. Spawners ascend ladder (about 20 ft vertical via 200 ft linear) to holding ponds
4. Maximum of 2,000 fish per day allowed into ladder
5. Diversion duration is 60 days, October 1 through December 31
6. Total maximum diversion is 9,000 Chinook salmon (fall run) and 3,000 steelhead (Most steelhead would enter existing ladder at hatchery)
7. Hatchery production goal is to send out 4 million salmon smolts and 400,000 steelhead, annually
8. Installation and maintenance of barrier pickets requires up to 6 men per day, totaling 900 hours in a 45-day period. This "diverts" manpower from spawning work

Proposed Change:

The primary modification consists of constructing a stable foundation (cut-off walls down to Merthen formation). In addition, a dual channel concept is incorporated into the foundation for the purpose of improving access for inspection, seasonal removal/installation, and reducing exposure to present safety hazards. Use existing bar rack structure. Sloping foundation.

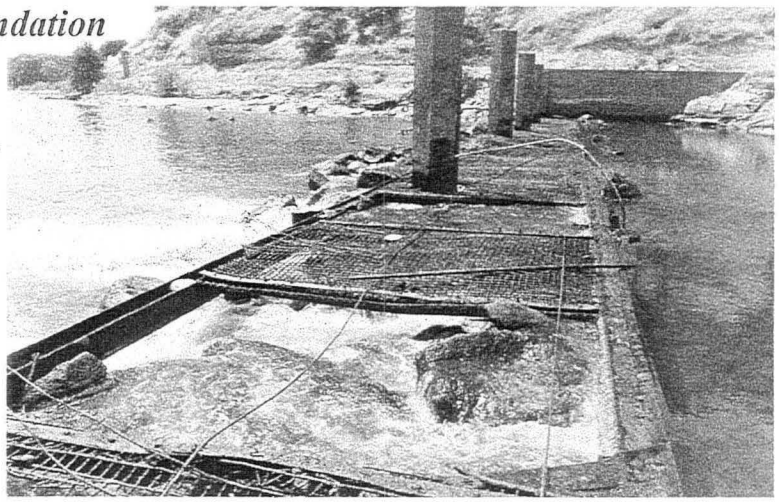
Advantages:

1. Stabilizes foundation of structure
2. Eliminates exposure to existing seasonal maintenance hazards associated with plugging holes
3. Reduces exposure to existing safety hazards associated with inspection and seasonal removal/installation of fish rack support frames, walkways, and pipe racks
4. Existing structure/barrier concept is proven (has been identified to perform adequately from a fish guidance and diversion standpoint)
5. Allows performance at higher flowrates (up to 7,500 cfs)
6. Improves positive barrier performance
7. Eliminates need to reduce flows, and therefore ESA considerations for seasonal installation
8. Maintains existing impact on Nimbus Dam tailwater elevation

Make Permanent Repairs to Foundation of Existing Diversion Structure

VA Proposal No. 1

. . . *continued*



Disadvantages:

1. No improvement to existing cleaning requirements/problems
2. No improvement to seasonal installation/ removal requirements
3. Removal required for river flows above 7,500 cfs
4. No reduction in existing exposure to safety hazards during installation/removal

Justification:

Improves or solves existing problems associated with scour/erosion while retaining full performance features of existing structure

Cost Savings:

Eliminates cost and effort associated with seasonal manual sealing of barrier following installation

Strategy/Timetable:

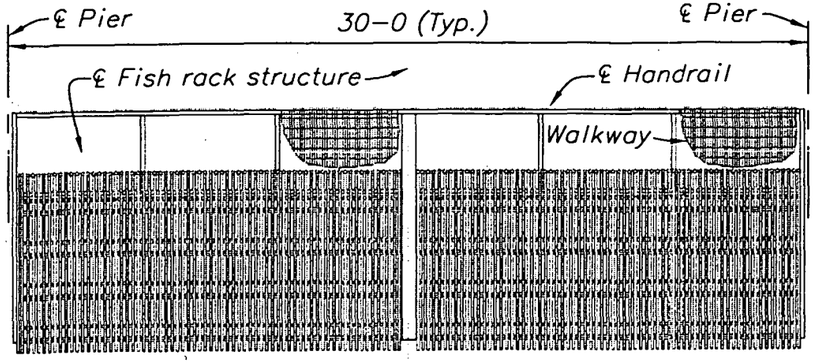
September 30, 1999--Complete conceptual design
September 30, 2000--Complete design and specifications
January 1, 2001--Award construction contract

Necessary Coordination:

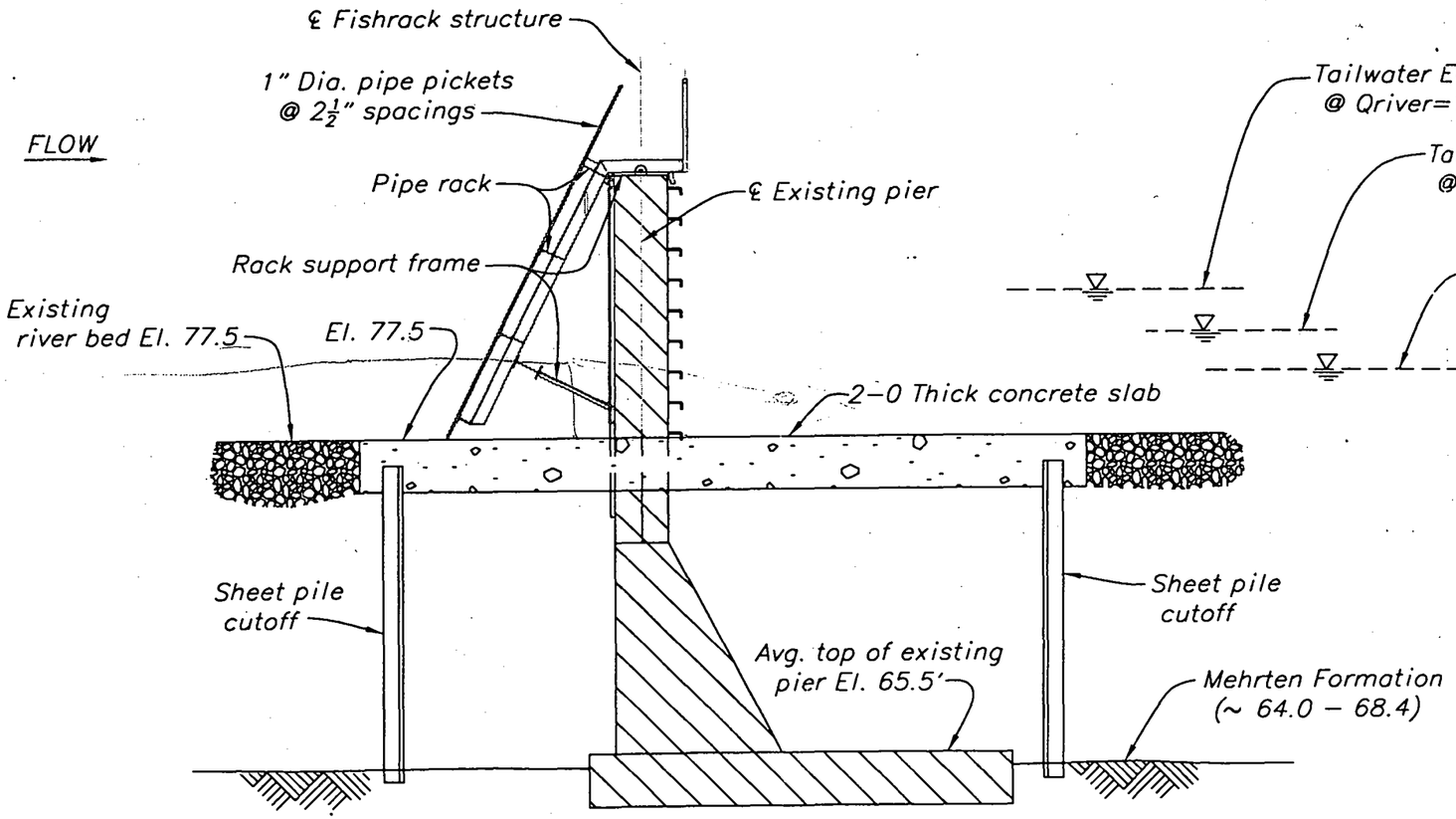
1. Concept review and input from Fish Facilities Work Group
2. American River Forum and other stakeholders
3. Regulatory Agencies - CDFG, USFWS, & NMFS
4. General Public

Uncertainties:

1. River Stability
2. Design requirements for structure to operate at higher flows
3. Future changes in resource agency criteria
    - Mitigation needs
    - Operating requirements



FISH RACK STRUCTURE – PLAN VIEW



SECTION @ PIER

ALWAYS THINK SAFETY

FIGURE 1. – Recommended Proposal 1
Permanent Repairs to Foundation
of Existing Diversion Structure

CODE: D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE:
NIMBUS HATCHERY FISH BARRIER
VALUE ANALYSIS WORKSHOP
PROPOSAL 1 - Permanent Repairs to
[redacted]dation of Existing Diversion Structure

23-Jul-99 PROJECT:
CENTRAL VALLEY - CALIFORNIA

LOCATION:
NIMBUS FISH HATCHERY - American River

FILENAME:
C:\123R5W\WORK\PROP1EST.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Concrete		550	CY	$450.00	$247,500
	2	Cement		155	TONS	$120.00	$18,600
	3	Reinforcement		66000	LBS	$0.70	$46,200
	4	Sheet Pile Cutoffs (install by driving)		75	TONS	$1,800.00	$135,000
	5	Install Coffer Dam (earth)		13000	CY	$20.00	$260,000
	6	Remove Coffer Dam (earth)		13000	CY	$15.00	$195,000
	7	Dewatering holes for pile installation (assume 4 months)		2000	LF	$530.00	$1,060,000
		Mobilization @ 5% of items		1	LS	$78,000.00	$78,000
[redacted]		Subtotal					$2,040,300
		Unlisted Items @ 10%					$204,000
		Contract Cost					$2,244,300
		Contingencies (20%)					$449,000
		Field Cost					**$2,693,300**

[redacted] QUANTITIES PRICES

BY CHECKED

DATE PREPARED APPROVED DATE PRICE LEVEL

07/23/99 07/23/99

Replace Existing Diversion Structure Foundation and Fish Screen Assembly

VA Proposal No. 2

Function of Proposal:

1. Guide spawners to hatchery ladder barrier
2. Reduce maintenance cost
4. Reduce existing safety problems
5. Eliminate problems in river caused by repair of existing diversion structure

Existing Situation or Design:

1. Fish spawned at Nimbus Hatchery
2. Requires annual installation of barrier frames and picket racks to direct spawners to fish ladder entrance
3. Spawners ascend ladder (about 20 ft vertical. via 200 ft linear) to holding ponds
4. Maximum 2,000 fish per day allowed into ladder
5. Diversion duration is 60 days, October 1 through December 31
6. Total maximum diversion is 9,000 Chinook salmon fall run and 3,000 steelhead, annually (Most steelhead would enter existing ladder at Hatchery)
7. Hatchery production goal is to send out 4 million salmon smolts and 400,000 steelhead
8. Installation and maintenance of barrier pickets requires up to 6 men per day, totaling 900 hours in 45-day period. This "diverts" manpower from spawning work

Proposed Change:

Construct a new foundation and bar rack or perforated plate type superstructure to replace the existing diversion structure. The foundation would consist of a sheet pile and/or RCC cutoff wall and a concrete cap anchored in bedrock. The elevation of the cap will be sloped toward the ladder to maintain attraction flows during low water. A gated by-pass channel would be incorporated into the foundation to pass "normal" flows around the "screens" when they are not in use allowing O&M in the dry. A walkway would be incorporated into each screen section for cleaning and other O&M activities. Above normal flows would pass through both the by-pass flow and through the screens. The screens would be left in place year-round and will be designed to have a "break away" feature that would allow the screens and walkway sections to rotate downstream to reduce forces from high flows. The screens would also be designed to allow them to be lifted out of the water during moderate flows when they are not diverting fish to prevent fish and trash from accumulating. If desired, a break away walkway could be constructed over the by-pass channel.

Replace Existing Diversion Structure Foundation and Fish Screen Assembly

VA Proposal No. 1

. . . continued

Advantages:

1. Eliminate undermining of the superstructure and associated maintenance
2. Eliminate need to lower river elevation to conduct maintenance
3. Eliminate worker safety issues associated with maintaining undermining of the superstructure
4. Operate at flows greater than 5,000 cfs
5. Eliminate need to install and remove each year
6. Fully meets performance criteria
7. Reduces Nimbus Dam tailwater elevation with associated power benefits

Disadvantages:

1. Trash and dead fish must be removed while in use, with associated safety issues
2. Screens and walkway susceptible to damage during floods
3. Reduce downstream migration of gravel placed in river for maintenance

Justification:

Allows the operation of the Nimbus Hatchery without adversely effecting downstream anadromous fish, including endangered species. Reduces O&M associated with foundation repair and inherent safety issues.

Cost Savings:

Could increase power generation revenues and reduce O&M costs

Implementation Strategy/Timetable:

September 30, 1999--Complete conceptual design
September 30, 2000-Complete design and specifications
January 1, 2001--Award construction contract

Necessary Coordination:

1. Concept review and input from Fish Facilities Work Group
2. American River Forum and other stakeholders
3. Regulatory agencies - CDFG, USFWS, & NMFS
4. General public

Replace Existing Diversion Structure with Solid Foundation and ~~Inclined Fish Screen~~ Declined Bar Rack on Downstream Surface

VA Proposal No. 3

Function of Proposal:
1. Guide spawners at a controllable barrier
2. Reduce operation costs for collection
3. Reduce maintenance costs
4. Eliminate existing safety problems
5. Eliminate problems in river caused by present diversion structure

Existing Situation or Design:
1. Fish spawned at Nimbus Hatchery
2. Requires annual installation of barrier frames and picket racks to direct spawners to fish ladder entrance
3. Spawners ascend ladder (about 20 ft vertical via 200 ft linear) to holding ponds
4. Maximum 2,000 fish per day allowed into ladder
5. Diversion duration is 60 days, October 1 thru December 31
6. Total maximum diversion is 9,000 Chinook salmon fall run and 3,000 steelhead, annually . (Most steelhead would enter existing ladder at hatchery)
7. Hatchery production goal is to release 4 million salmon smolts and 430,000 yearling steelhead, annually
8. Installation and maintenance of barrier pickets requires up to 6 men per day, totaling 900 hours in 45-day period. This "diverts" manpower from spawning work

Proposed Change:
Construct a solid foundation control structure with a crest elevation to be determined by further analysis. Alignment and crest elevation are expected to be similar to the existing structure. Install a screen along the downstream crest of the structure. Locate an adult passage corridor in the area contained under the screen area. Extend screen to a downstream point just above the tailwater surface elevation allowing fish to enter the passage corridor. Modify ladder entrance and locate it at the terminus of the adult passage corridor. Integrate a bypass channel into the control structure that will dewater the crest of the control structure allowing access for maintenance.

Advantages:
1. Conduct maintenance activities out of water, thus reducing exposure of staff to dangerous conditions while maintaining required instream flows
2. Minimize need for debris cleaning of rack structure
3. Minimize effect on downstream erosion and ecological process
4. Minimizes use of mechanical and electrical features resulting in reduced long term O&M costs

5. Minimize structural features that are accessible to public and subject to vandalism
6. Low profile should provide good flood survivability
7. Conceptually would provide good guidance of fish, minimize fish damage from jumping into rack structure, would be fish tight, and allow control of access to upstream and ladder sections within design flow criteria
8. Provide potential to operate during summer season at lower Nimbus tailrace elevation creating opportunity for increased power production, offsetting project costs
9. Provides flexibility to manage hatchery to comply with existing and future endangered species requirements

Disadvantages:

1. Concept is unproven. Response of adult fish to this concept and suite of structural elements and has not been tested. Regulatory agency approval will likely require greater effort.
2. Developmental costs are likely to be higher. Physical model will be needed to develop hydraulic design elements. May need to develop prototype and test fish response.
3. Year-round in-river features are more susceptible to damage

Justification:

Meets identified needs and constraints.

Cost Savings:

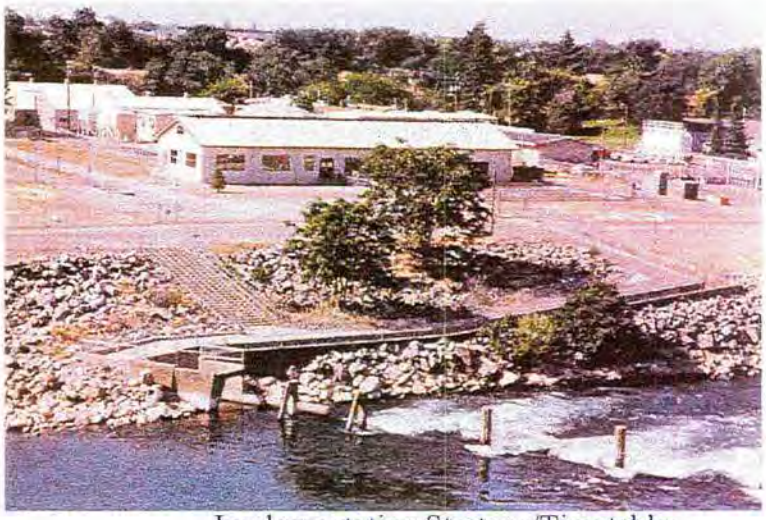
1. Implementation/construction should be similar to Conceptual Study alternatives that provide permanent foundation
2. O&M cost savings should be substantial
3. Risk of severe injury or death to personnel is minimized
4. Reduced tailwater elevations could increase/offset power revenues

Implementation Strategy/Timetable:

1. Complete conceptual design - 6 months
2. Conduct hydraulic modeling and finalize design - 8 months
3. Award contract - 4 months
4. Construction - 18 months

Necessary Coordination:

1. Concept review and input from Fish Facilities Work Group
2. American River Forum and other stakeholders
3. Regulatory agencies - CDFG, USFWS, & NMFS.
4. General public



Disadvantages:

1. Requires more people to handle adults during season
2. Untried approach at Nimbus
3. Limited area for construction
4. Impacts to dam?
5. Requires 250-300 cfs of additional flow from forebay

Justification:

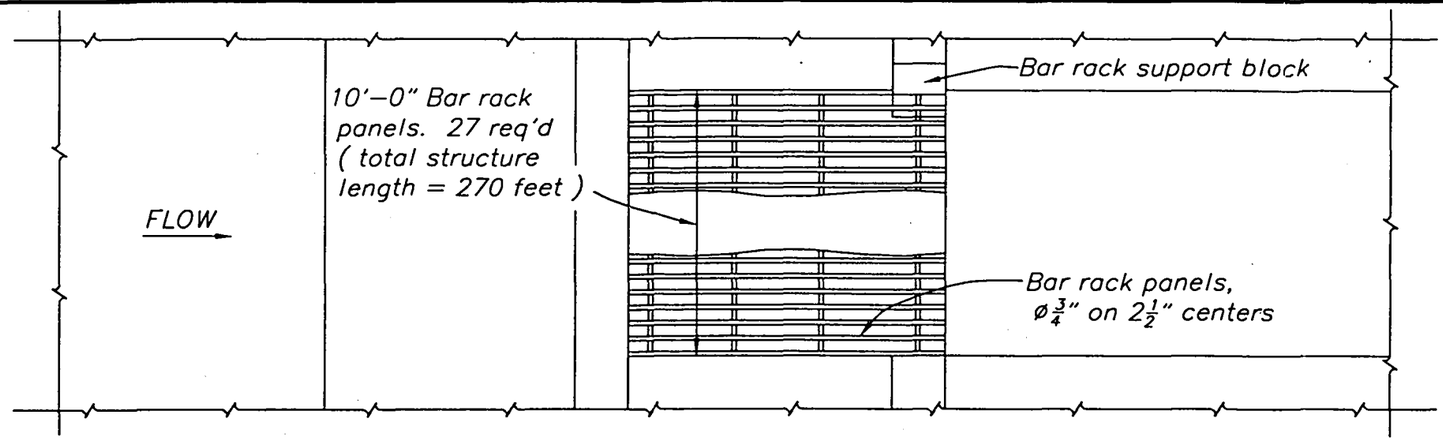
1. Eliminates or improves all identified needs and problems
2. Positive fish blockage and collection

Cost Savings:

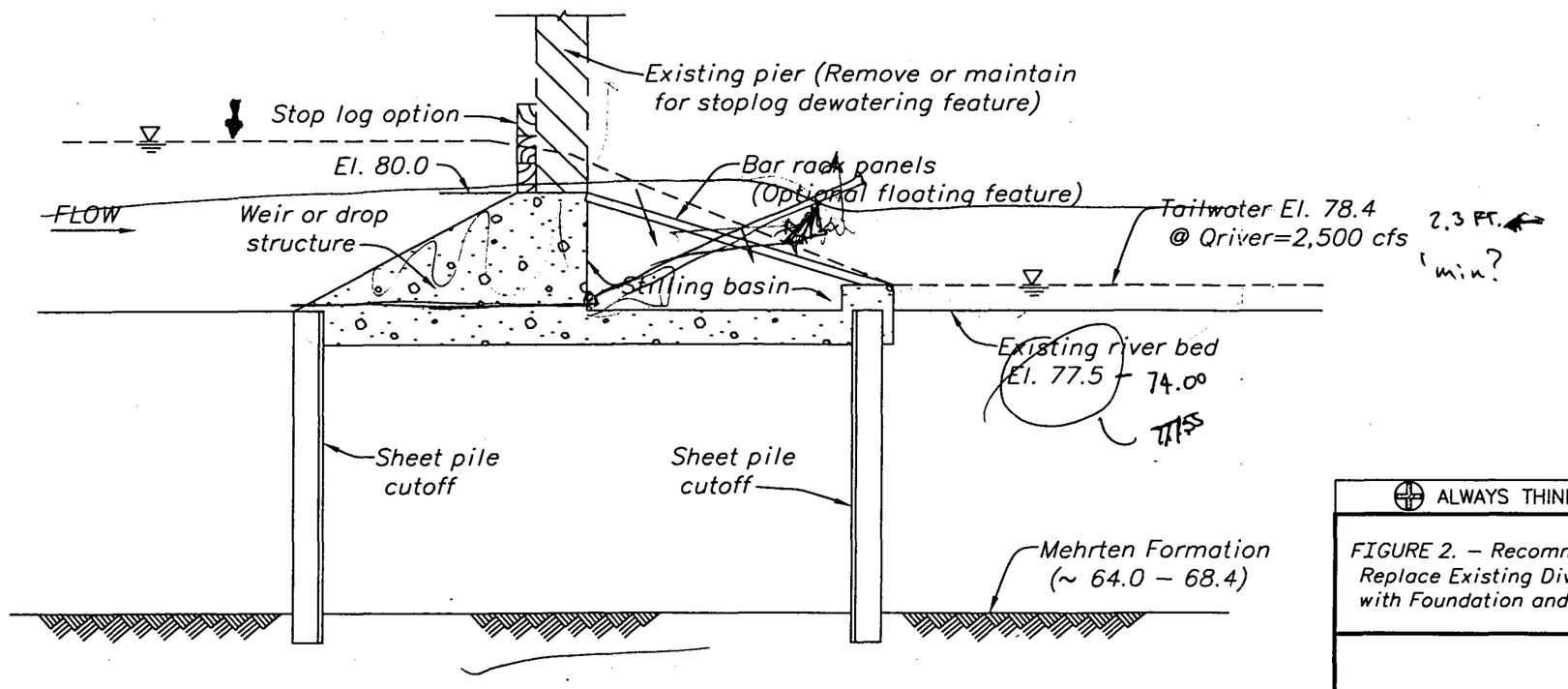
Implementation Strategy/Timetable:

1. Design Memo 6 months
2. P&S 9 months
3. Construction 1 year

Necessary Coordination:



PLAN VIEW



SECTION @ PIER

ALWAYS THINK SAFETY

FIGURE 2. – Recommended Proposal 3
Replace Existing Diversion Structure
with Foundation and Declined Bar Rack

CODE: D-8170

ESTIMATE WORKSHEET

FEATURE: 23-Jul-99 **PROJECT:**

NIMBUS HATCHERY FISH BARRIER
VALUE ANALYSIS WORKSHOP
PROPOSAL 3 - Replace Existing Diversion [illegible]ture w/ Foundation and Inclinded Bar [illegible]k

CENTRAL VALLEY - CALIFORNIA

LOCATION:
NIMBUS FISH HATCHERY - American River

FILENAME:
C:\123R5W\WORK\PROP3EST.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Bar Racks (Steel)		35000	LBS	$5.00	$175,000
	2	Concrete		900	CY	$450.00	$405,000
	3	Cement		250	TONS	$120.00	$30,000
	4	Reinforcement		95000	LBS	$0.70	$66,500
	5	Sheet Pile Cutoffs (install by driving)		75	TONS	$1,800.00	$135,000
	6	Install Coffer Dam (earth)		13000	CY	$20.00	$260,000
	7	Remove Coffer Dam (earth)		13000	CY	$15.00	$195,000
	8	Dewatering holes for pile installation (assume 4 months)		2000	LF	$530.00	$1,060,000
		Mobilization @ 5% of items		1	LS	$116,000	$116,000
		Subtotal					$2,442,500
		Unlisted Items @ 10%					$244,250
		Contract Cost					$2,686,750
		Contingencies (20%)					$537,350
		Field Cost					**$3,224,100**

QUANTITIES PRICES

BY CHECKED

DATE PREPARED APPROVED DATE PRICE LEVEL

07/23/99 07/23/99

Collect Fish near Tailrace of Nimbus Dam and Transport by Truck to Nimbus Hatchery

VA Proposal No. 4

Function of Proposal:
To provide sufficient number of adult fish to Nimbus hatchery to meet mitigation goals

Existing Situation or Design:
A physical barrier using pipe picketts, installed using an existing overhead crane. This system would require considerable effort to repair the existing foundation, has a relatively high O&M operation cost, and has been identified as a potential safety risk. The current system has also experienced vandalism.

Proposed Change:
Provide the necessary adult fish by using Nimbus dam as the fish barrier and the existing powerhouse flows to attract fish to the fish ladder entrance. Combine with a fish lift which will allow the fish to be loaded into a truck and delivered to the Nimbus hatchery facility.

In summary:
Collect Fish at Nimbus Dam near Powerhouse Discharge
Provide attraction flow (250 cfs)
Provide holding tank with lift to load truck
Transport to hatchery in trucks
Have ladder controls and video at hatchery
Maintain current ladder operation

Advantages:
1. Eliminates problems associated with existing structure.
High O&M
Safety issues
2. More reliable fish diversion
3. Easier to control vandalism
4. Potential for opening more river to recreation, including improved fishing

Collect Fish near Tailrace of Nimbus Dam and Transport through a Pipe to Nimbus Hatchery

VA Proposal No. 5

Function of Proposal:
1. Collect spawners at a presently controllable barrier (Nimbus Dam)
2. Minimize operation cost for collection
3. Minimize maintenance cost
4. Eliminate existing safety problems
5. Eliminate problems in river caused by existing diversion structure

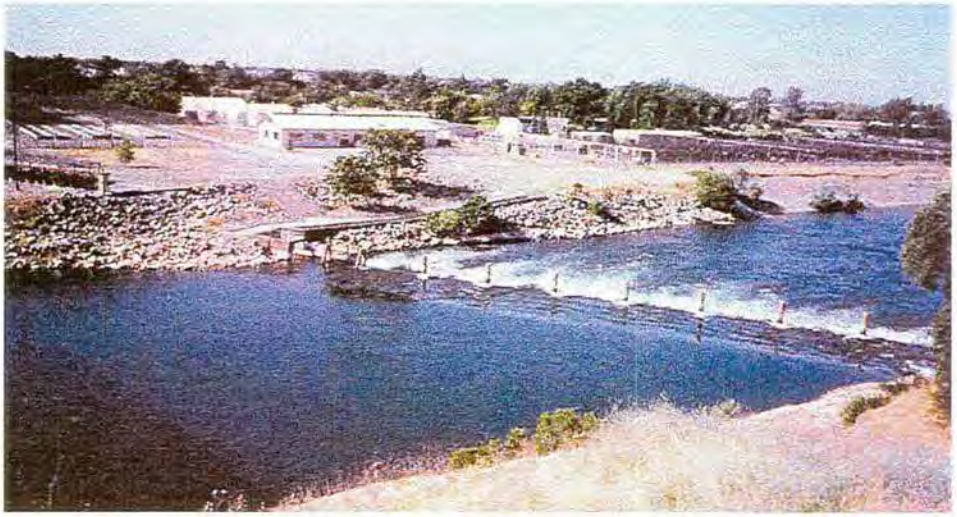
Existing Situation or Design:
1. Fish are spawned at Nimbus hatchery
2. Requires annual installation of barrier frames and picket racks to direct spawners to fish ladder entrance
3. Spawners ascend ladder (about 20 ft vertical. via 200 ft linear) to holding ponds
4. Maximum 2,000 fish per day allowed into ladder
5. Diversion duration is 60 days, October 1 thru December 31
6. Total maximum diversion is 9,000 Chinook salmon, fall run, and 3,000 steelhead (Most steelhead would enter existing ladder at hatchery)
7. Annual hatchery production goal is to send out 4 million salmon smolts and 400,000 steelhead
8. Installation and maintenance of barrier pickets requires up to 6 men per day, totaling 900 hours in 45-day period. This "diverts" manpower from spawning work

Proposed Change:
Use a false weir and a 14 inch diameter pipe to sluice the adult fish along the north shore, across the river at the bridge and discharge into a pool which enters into the ladder at the Nimbus diversion (10-15 cfs) Alternate routing across spillway and along south share.

Advantages:
1. Less labor required at dam
2. Less impacts to dam operation
3. Less handling of fish.

Disadvantages:
1. Controlling public access to pipe
2. Visual impacts

Justification:
1. Less handling - no building lift necessary



Cost Savings:

1. Investment - not quantified. Estimated same as to rebuild barrier
2. Annual - not quantified. Estimated reduction of operation and maintenance during diversion period from six personnel to two personnel. No change in spawning work. Substantial reduction (90 percent) in annual maintenance cost.

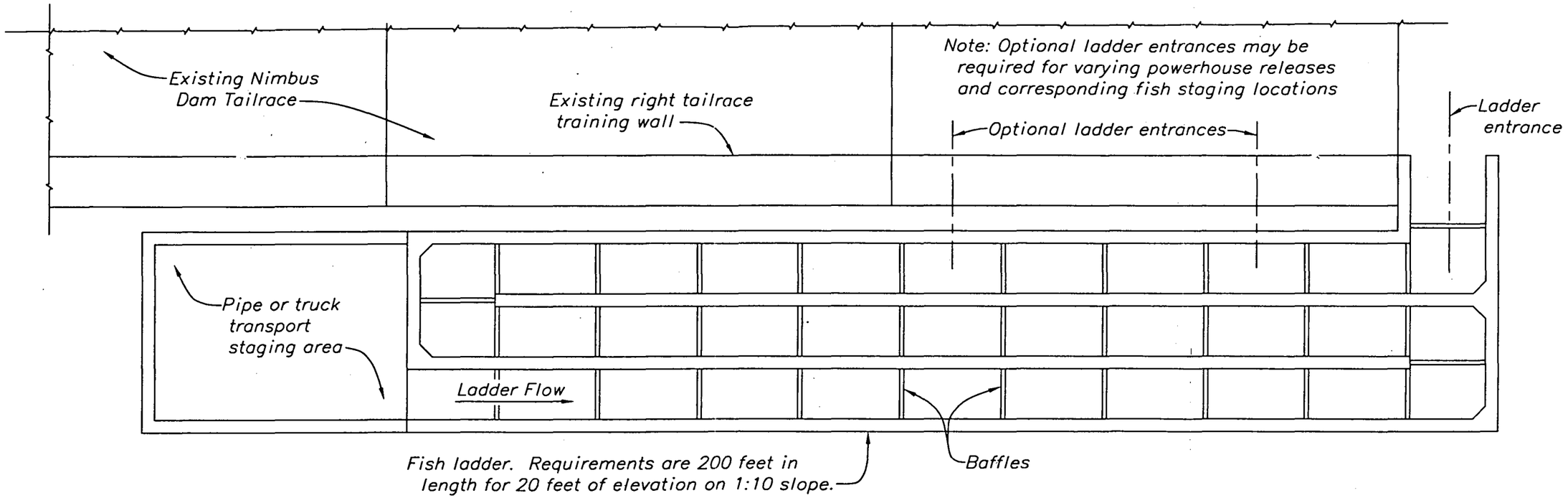
Implementation Strategy/Timetable:

After planning study and decision:

1. Design - data acquisition and design, estimate 12 months
2. Construction, estimate 18 months
3. Totally implementable in two years; could be done in 18 months with urgency

Necessary Coordination:

1. Fish design criteria - FWS, NMFS, CDF&G
2. Acceptability - River users, fishermen
3. Power generation - BR-CVO, WAPA
4. Public Involvement - Local media for education



PLAN VIEW

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SCALE OF FEET

ALWAYS THINK SAFETY

FIGURE 3.—Recommended Proposal 4&5 Collect Fish at Nimbus Dam with Conventional Fish Ladder

CODE: D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE:
NIMBUS HATCHERY FISH BARRIER
VALUE ANALYSIS WORKSHOP
PROPOSAL 4 & 5 - Collect Fish at Nimbus
w/ Conventional Ladder at Right
tment & Pipe Back to Hatchery
Note: Proposal 4 is this estimate less pipe costs.

23-Jul-99 PROJECT:
CENTRAL VALLEY - CALIFORNIA

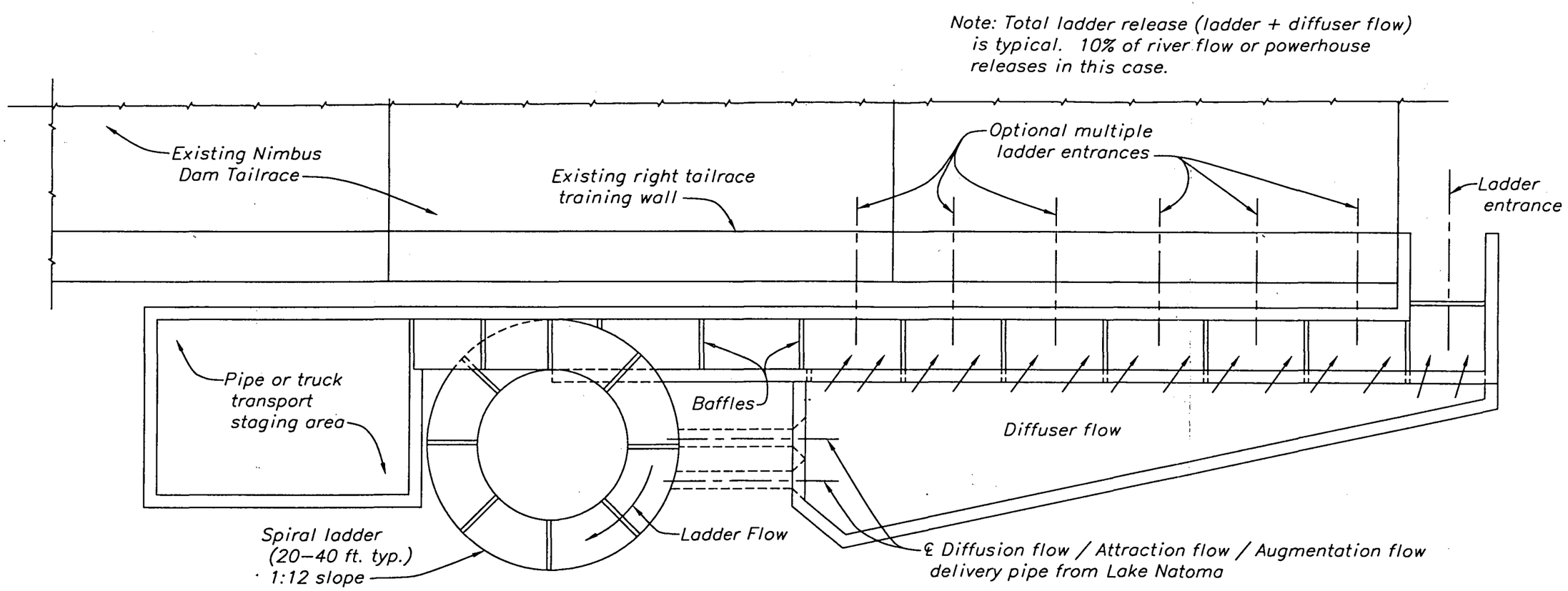
LOCATION:
NIMBUS DAM & FISH HATCHERY

FILENAME:
C:\123R5W\WORK\PROP4EST.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Concrete		950	CY	$450.00	$427,500
	2	Cement		250	TONS	$120.00	$30,000
	3	Reinforcement		115000	LBS	$0.70	$80,500
	4	Pipe (steel)		212500	LBS	$1.85	$393,200
	5	Excavation		3500	CY	$8.00	$28,000
	6	Backfill		1350	CY	$6.00	$8,100
	7	Compacted Backfill		1350	CY	$8.00	$10,800
		Mobilization @ 5% of other items		1	LS	$36,000.00	$36,000
		Subtotal					$1,014,100
		Unlisted Items @10%					$101,500
		Contract Cost					$1,115,600
		Contingencies (20%)					$223,100
		Field Cost					**$1,338,700**

QUANTITIES BY PRICES CHECKED

DATE PREPARED 07/23/99 APPROVED DATE 07/23/99 PRICE LEVEL



PLAN VIEW

8 0 8 16
SCALE OF FEET

ALWAYS THINK SAFETY

FIGURE 4.—Recommended Proposal 4&5 Collect Fish at Nimbus Dam with Spiral Ladder

CODE: D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE:
NIMBUS HATCHERY FISH BARRIER
PROPOSAL 4 & 5 - Collect Fish at Nimbus Dam w/ Spiral Ladder at Right Abutment & Back to Hatchery
Proposal 4 is this estimate less pipe costs.

23-Jul-99 PROJECT:
CENTRAL VALLEY - CALIFORNIA

LOCATION:
NIMBUS DAM & FISH HATCHERY

FILENAME:
C:\123R5W\WORK\PROP5EST.WK4

PLANT ACCT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Concrete		775	CY	$450.00	$348,750
	2	Cement		220	TONS	$120.00	$26,400
	3	Reinforcement		93000	LBS	$0.70	$65,100
	4	Pipe (steel)		212500	LBS	$1.85	$393,100
	5	Diffuser Racks (steel)		9500	LBS	$7.00	$66,500
	6	Excavation		3500	CY	$8.00	$28,000
	7	Backfill		1350	CY	$6.00	$8,100
	8	Compacted Backfill		1350	CY	$8.00	$10,800
		Mobilization @ 5% of other items		1	LS	$50,000.00	$50,000
		Subtotal					$996,750
		Unlisted Items (10%)					$99,700
		Contract Cost					$1,096,450
		Contingencies (20%)					$219,300
		Field Cost					**$1,315,750**

QUANTITIES BY PRICES CHECKED

DATE PREPARED 07/23/99 APPROVED DATE PRICE LEVEL 07/23/99

Collect Fish near Tailrace of Nimbus Dam and Spawn Onsite

VA Proposal No. 6

Function of Proposal:

1. Collect spawners at a presently controllable barrier
2. Minimize operation costs for collection
3. Minimize maintenance costs
4. Eliminate present safety problems
5. Eliminate problems in river caused by present diversion structure

Existing Situation or Design:

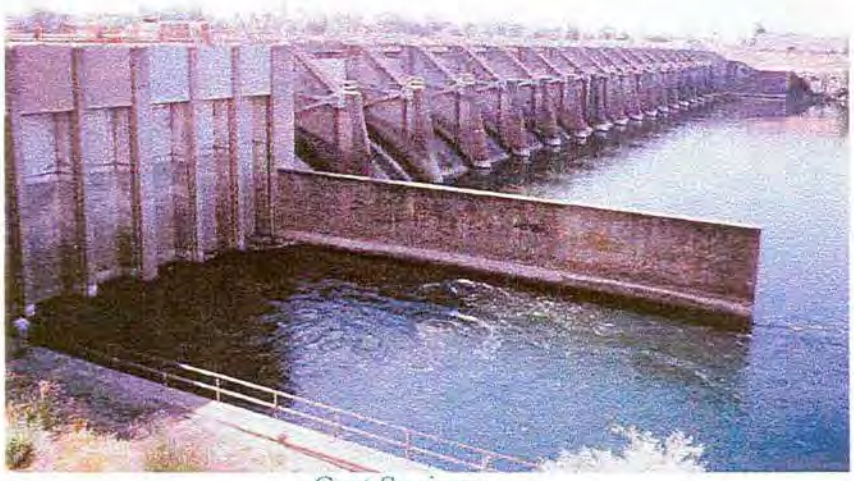
1. Fish spawned at Nimbus Hatchery
2. Requires annual installation of barrier frames and picket racks to direct spawners to fish ladder entrance
3. Spawners ascend ladder (about 20 feet vertical via 200 ft linear) to holding ponds
4. Maximum 2,000 fish per day allowed into ladder
5. Diversion duration is 60 days, October 1 thru December 31
6. Total maximum diversion is 9,000 Chinook salmon, fall run, and 3000 steelhead (Most steelhead would enter existing ladder at hatchery)
7. Annual hatchery production goal is to send out 4 million salmon smolts and 400,000 steelhead
8. Installation and maintenance of barrier pickets requires up to 6 men per day, totaling 900 hours in 45-day period. This "diverts" manpower from spawning work.

Proposed Change:

1. Divert and collect spawners at Nimbus powerplant, adjacent to north (right) abutment
2. Spawn fish onsite at Nimbus dam
3. Hold eggs until suitable and transport from Nimbus dam to hatchery
4. Requires construction of fish ladder, ladder entrance, water supply by siphon from upstream side of Nimbus dam, spawning pad and equipment. Also, purchase of refrigerated and properly equipped truck to transport eggs.

Advantages:

1. Allows tight control of numbers of fish diverted to meet hatchery goals
2. Reduces number of people required for O&M of diversion. Estimated from present six personnel to one or less full time.
3. Eliminates annual and long-term maintenance at present diversion structure
4. Eliminates problems of dealing with spawned/dead fish and trash impinging on present racks
5. Eliminates diving work required to maintain pipe racks, plug holes in eroded gravel, reset racks opened by fishermen to let fish pass



Disadvantages:

1. Uncertain effectiveness of fish finding ladder. Current information from other sites provides high confidence in effective design.
2. Requires construction in confined area (small space for new structures)
3. Requires construction of spawning and egg handling area and facilities in confined area at powerplant

Justification:

1. Enables fish mitigation requirements for American River Division of CVP to be met
2. Replaces deteriorating diversion structure by removing river barrier
3. Improves flexibility of hatchery manager to meet current and changing future fish management objectives and strategies
4. More cost effective than present diversion methods, and optimizes value of cost allocated to CVP water contractors

Cost Savings:

1. Investment - not quantified. Estimated same as to rebuild barrier
2. Annual - not quantified. Estimated reduction of operation and maintenance during diversion period from six to two personnel. No change in spawning work. Substantial reduction (90%) in annual maintenance cost.

Implementation Strategy/Timetable:

After planning study and decision:

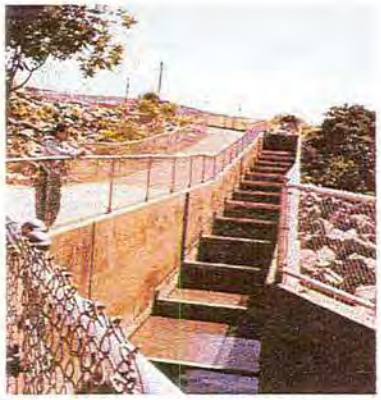
1. Design - data acquisition and design, estimate 12 months
2. Construction, estimate 18 months
3. Totally implementable in two years; could be done in 18 months with urgency

Necessary Coordination:

1. Fish design criteria - FWS, NMFS, CDF&G
2. Acceptability - River users, fishermen
3. Power generation - BR-CVO, WAPA
4. Public Involvement - Local media for education.

Build New Fish Barrier and Ladder Downstream of Nimbus Hatchery

VA Proposal No. 7



Function of Proposal:
To direct adult salmon into Nimbus fish hatchery with low maintenance structure that does not affect hydropower production at Nimbus dam.

Existing Situation or Design:
Deteriorating fish barrier at upper end of hatchery requires high maintenance and unacceptable reductions in flow for installation.

Proposed Change:
Build barrier and new fish ladder below hatchery

Advantages:
Preserves existing hydropower production at Nimbus. Can be designed to solve many problems with existing barrier.

Disadvantages:
In-river structure with all associated problems and costs. Probably disrupts natural production of salmon at Sailor Bar. Requires new fish ladder.

Justification:
Justification is mainly that it preserves hydropower production

Cost Savings:
Increased power revenues over upstream site

Implementation Strategy/Timetable:

Necessary Coordination:
See VA proposal number 6

Abandon Existing Diversion Structure, Improve Entrance to existing Nimbus F ish Ladder and Prepare Backup Fish Collection Facility at Nimbus Dam

VA Proposal No. 8

Function of Proposal
Direct adult salmon into Nimbus Hatchery at old site with no barrier and improved ladder entrance. If it doesn't provide enough fish, use Nimbus dam and either truck or boat eggs or adults.

Existing Situation or Design:
See prior description

Proposed Change:
Abandon the old barrier. Improve the entrance to the existing ladder. Construct necessary facilities for backup fish collection at Nimbus dam.

Advantages:
River barrier not needed

Disadvantages:
Extra cost of intake structure to existing ladder.
Extra cost of Nimbus structures.

Justification:
Possibility of eliminating existing barrier

Cost Savings:
Existing barrier location, construction and O&M

Implementation Strategy/Timetable:
Construct Nimbus structures and test and evaluate, then evaluate performance of existing ladder without a barrier. Then construct improved intake structure to existing ladder, if necessary.

Necessary Coordination:
See Alternative 6

Appendix A

History of Diversion Structure Repairs

NIMBUS FISH HATCHERY DIVERSION STRUCTURE REPAIR

The Nimbus Fish Hatchery has a fish diversion structure across the river to divert spawning salmon up the fish ladder. The structure has suffered a lot of damage over the years during high flows. Several contracts have been issued to repair the damage but none have turned out to be more than temporary fixes until the next flood occurs. In 1997 we experienced flood flows of 115,000 cfs in the river that have again damaged the foundation. We anticipated damage to the structure and scheduled an inspection at the first opportunity to determine a plan so we could schedule an appropriate repair later in the summer. We anticipated that there would be some holes under the structure but were not anticipating anything like the damage that was discovered during the inspection on June 24, 1997. We found several holes and a general loss of material on the left (south) side of the diversion structure but on the right (north) side of the river there were huge holes that a person could easily swim through. There was also some bending of the steel channel where the pickets seat to make the seal at the foundation and some twisting of the steel on the right side that stabilizes the structure. Our rough estimate for a repair would be to replace 3000 cubic yards of rock and make minor repairs to the steel channel. The last few fixes have been done by filling the voids with cobbles which are removed with the next flood. We are proposing to place 2000 cubic yards of riprap in the large holes and another 500 cubic yards of cobbles to fill in around the riprap and smaller holes.

In 1982 I found some information that 1573 tons of 6-10" cobbles were purchased for $4877 ($3.10 per ton) to repair the diversion structure foundation. Another estimate showed $5.78 per ton to furnish and place.

In 1986 I found where it shows that 1000 cu yds of rip-rap for $4500 and 2300 tons of 6-12" cobbles for $16,790 was purchased & delivered to the hatchery parking lot. They also rented 2 loaders with operators to help with the work.

Construction:

1. Construct a road to the river near the crane that is used to install the racks and pickets for the diversion structure. This work is to be done with CCAO maintenance crews. Civil Maintenance team leader (Joe Wall 989-7238) to accomplish.

2. Locate a riprap source and stockpile in the hatchery parking lot and/or between the parking lot & Hazel Avenue. Will look at furnish and deliver by a contractor. Rock in the 3' minus range would be preferable. We need 1500-2000 yds of rock stockpiled that is clean enough to haul directly into the river. A possible source is Cal West Rock Products (209 274-2436) out of Ione.

3. Stockpile 300 yds of cobbles in the hatchery area and another 200 yds in the area adjacent to the hatchery on 19 acres owned by Reclamation. We intend to get all the cobbles required from that area. Processing of the cobbles will have to be done by renting equipment or hiring a contractor. Fish & Game has a plan to place spawning gravels in the river next year but may be willing to process material this year and stockpile for next year. The cobbles on our 19 acres may be of sufficient quality to

produce our cobbles and the gravel for Fish & Game. The fines could be left on our property and a washing operation should be able to filter through the existing dredger tailings with very little done to accommodate. I would see no reason why the gravels could not be stockpiled on our property for Fish and Game. Reclamation and Fish & Game would haul the cobbles to the hatchery for stockpiling and could also possibly haul to the hatchery while a contract is under way to place rock in the river. Nick Villa (358-2943) of Fish & Game has volunteered to use some of their trucks to haul cobbles. Maury Fjelstod (358-2933) and Dave Rhodes (685-9733) are the contacts for getting 10-wheel trucks to haul cobbles. As of 6-11-97 I do not like the idea of setting up a screening operation to make gravels but am still pursing the idea of screening and cleaning and then hauling to the hatchery.

4. Hire a contractor to place riprap and cobbles in the river. The first opportunity to do this will be from mid August to mid September. The river flows will probably have to be cut to about 500 cfs for the work but should be raised to the maximum flow the contractor can handle. The flows will probably be left constant for the duration of the contract which is anticipated to take about 3 days with the contractor working 2 shifts. Fish & Game will decide if they want to vary flow during non work hours. The work will be done during the week somewhere between Monday through Friday. The contractor will be required to steam blast all of his equipment that will be working in the river. We will want the contractor to prove that his equipment has very little leakage. I am not sure how this should be accomplished. I would like riprap placed in all the areas that can handle that size of material. We should try to place the minimum amount of rock upstream that will stabilize and seal off the area under the channel where the pickets seat. I think we will have to fill in all of the area to the piers along with some of the area downstream of the piers to stabilize what we have done upstream. There may be some difficulty getting to the downstream area if we can not drive over the channel for the pickets. The distance between the H piles is about 10' from U/S to D/S.

5. Straighten or replace the H bearing pile for the pickets. This appears to be fairly minor and should be able to be done with hydraulic jacks or cut out and replace. The H pile is a BP 8 at 36 pounds per foot.

6. After work is complete, Reclamation will restore the road and clean up the hatchery area.

Other items of concern:
1. Department of Parks & Recreation is intending on contracting to construct a bike trail through the area needed for stockpiling and the haul road to the river. They were wanting to do this as soon as our 60" hatchery pipeline contractor out of the area but will not contract until probably October. Doug Healy (988-3614) is the State Park contact.

2. Our pipeline contractor (Azteca) will need to be contacted to work out details of working together in the area although they should be complete. Rick Jones (989-7258) of Reclamation is in charge of that contract.

3. Environmental concerns and permits to work in the river will be handled by Reclamation. Rod Hall (989-7279) and John Robles (989-7271) are the Reclamation contacts.

At this time, some of the key players in accomplishment of this task are:

Bruce Barngrover	Dept of Fish & Game	358-2934
Nick Villa	Dept of Fish & Game	358-2943
Terry West	Nimbus Hatchery Mgr - Dept of Fish & Game	358-2820
Ranse Reynolds	Nimbus Hatchery - Dept of Fish & Game	358-2820
Joe Johnson	Nimbus Hatchery - Dept of Fish & Game	358-2820
Cris Vyverberg	ESD - Dept of Fish & Game	653-8711
Maury Fjelstod	Dept of Fish & Game	358-2933
Dave Rhodes	Dept of Fish & Game	685-9733
Jim Goodwin	Civ Engr - Reclamation	979-2268
Rod Hall	Environmental - Reclamation	989-7279
Rick Jones	Field Engr - Reclamation	989-7258
John Robles	Environmental - Reclamation	989-7271
Bill Sanford	Civ Engr - Reclamation	989-7217
Dave Gore	MP Region	979-2257
Dave Read	Hydro System Controller - Reclamation	979-2684
Joe Wall	Civ Maint team leader - Reclamation	989-7238
Doug Healy	Dept of Parks & Rec	988-3614
Felix Smith	SARA	966-2081
Jack Sohl	SARA	486-9528
Ed Netzel	Teichert - equipment rentals	386-5899
Sunrise Load	8512 Oak Harbor Court Fair Oaks 95628	638-7006
Steve Mitchell	Teichert - Checked with him on equipment	386-6811

NIMBUS HATCHERY FISH DIVERSION STRUCTURE REPAIR - 1997

Background

The Nimbus Fish Hatchery has a fish diversion structure across the river to divert spawning salmon up the fish ladder. Without a fish-tight structure, the salmon would tend to find their way through the structure rather than go up the fish ladder to spawn. The structure has suffered a lot of damage over the years during high flows. Several contracts have been issued to repair the damage but none have turned out to be more than temporary fixes until the next flood occurs. In 1997 we experienced flood flows of 115,000 cfs in the river that have again damaged the foundation. We anticipated damage to the structure and scheduled an inspection at the first opportunity to determine a plan so we could schedule an appropriate repair later in the summer. We anticipated that there would be some holes under the structure but were not anticipating quite as much damage as was discovered during the inspection on June 24, 1997.

Structure

The structure was initially constructed in 1955 and has 8 concrete piers that are located 30' on centers across the river. There is an additional distance of 30' from the first and last piers to the concrete abutments. The south abutment also has an additional 35' distance that needs to be brought up to elevation 77'. The total distance to fill to elevation 77' is 305'. In 1963, modifications were made to the structure that included placing BP 8 H bearing piles across the river from the left to right abutments. These piles were driven into the mehrten formation on a 10' square pattern starting 5' from each concrete abutment and 2.5' downstream and 7.5' upstream of the center of the piers. BP 8 bearing cap beams were then attached on top of the bearing piles to form two parallel lines crossing the river at elevation 77'. The bearing cap beams were attached with the flanges placed vertically so that the pickets from structure could rest on the web of the beam. There was also 4 x 4 x ½" angle iron connecting the piles at elevation 77' in the upstream-downstream direction.

Existing Condition of Fish Diversion Foundation

During the June 24, 1997 inspection, we found several holes and a general loss of material on the south side of the diversion structure but on the north side of the river there were large holes that a person could easily swim through (6' depth max). There was also damage to the BP 8 H pile flange where the pickets seat to make the seal at the foundation and some twisting of the steel on the north side that supports the steel structure which was added in 1963. Damage to the H pile flange consists of bending of about 30' of flange but the beam is still straight. We do not need to repair or be too concerned about the steel on the north side of the river.

Repairs to Diversion Structure

Repair will consist of constructing a road to the river immediately upstream of the weir on the south side of the river. Reclamation has completed 95% of the road but the remainder can't be completed until all of the required permits are obtained. The next step will be to construct a bench across the river at elevation 77' immediately upstream of the upstream H beam. Reclamation will obtain 1000 cu yds of 3' minus rip-rap and 500 cu yds of 5-12" cobbles and stockpile within 500' of the river in the vicinity of the hatchery parking lot. The bench across the river is to use as much rip-rap as possible and then fill the remainder with cobbles to form a

bench that can be used by equipment to place rip-rap and cobbles between the H beams to elevation 77' and inside of the walls of the right concrete abutment. The working bench is anticipated to be 20' wide but a 15' wide bench would be adequate if that is acceptable for the equipment. The interior of the walls forming the right abutment is 10' x 20' and will require about 10 cu yds of rock to fill to the top of the walls. It is anticipated that 20 cu yds of rip-rap will be need to be placed immediately downstream of the downstream H beam. A 30' section of the H beam flanges located on the south half of the river have been damaged and need to be repaired by replacing or bending back so that the pickets will seat in the H beam again. Reclamation will repair the H beam during the week of the foundation repair and may required to work while foundation repair is occurring. Reclamation will then remove the road and rip-rap the south river bank.

Environmental

Reclamation will obtain all the required permits for working in the river. The contractor will be given copies of the permits and be required to follow the regulations. Some of the requirements are that the equipment will be steam cleaned prior to working in the river. Equipment that is leaking noticeable hazardous wastes will not be allowed in the river. All servicing and refueling will be done out of the river at the elevation of the parking lot.

Special Considerations

The river flows will be lowered to 1000 cfs or possibly 500 cfs from a Monday through Friday. If the contractor wants to start Monday morning, the river will be lowered Sunday night so that work may start the first thing Monday morning. The contractor is to work 2 shifts. Work hours allowed are from 0600 to 2300. The contractor may work in the river with normal river flows once the permits are obtained. The estimated date to start work in the river at lower flows is on Monday September 15, 1997. Reclamation will be responsible for obtaining rock that meets cleanliness standards for the river. Reclamation will make all required notifications to the public. Willows Construction Office will administer the contract.

Actual Work

Reclamation constructed a road to the river between the Hazel Avenue embankment and the fish diversion crane structure. The road terminated near the upstream side of the fish diversion structure. A D6 dozer was used for 3 days to construct. Reclamation then screened and cleaned cobbles from the adjacent 19 acres of Reclamation land. It took about 200 man hours for the civil maintenance crew to wash and stockpile 56 loads / 500 yards of cobbles adjacent to the fish diversion structure crane. We did a good job but we do not have the proper equipment or experience to perform this task and should purchase rock the next time we need clean cobbles. Reclamation supplemented these cobbles with an additional 45 tons (1.7 tons per yd) / 25 yards from American River Aggregates. Reclamation also purchased 548 tons (1.8 tons per yd) / 304 yards of 3' minus rip-rap from Longers and then fired him for slow delivery. We then purchased an additional 1340 tons / 745 yards from American River Aggregates located at 3417 Grantline Road, Rancho Cordova. American River Aggregates were an excellent company to work with and are highly recommended the next time we need rip-rap or cobbles. The next time we purchase rock to go in the river, we need to have a representative from Fish & Game inspect the aggregate for cleanliness prior to purchase. The rock made the river dirtier than we anticipated

but there were no complaints from Fish & Game or the public (only Jim Jones). Fish & Game wardens thought we were doing as good a job as possible and said that this was an excellent time to be doing the work since no fish were spawning and the detrimental effect to the river would be minimal. If we need to do this again, we will need to have access off the bike trail since a bike trail is scheduled to be built where the access road to the river was located.

On Monday September 15, 1997, Azteca Construction started work in the river. The flows were cut to 1000 cfs which was adequate for dumping rip-rap in the river and covering with cobbles so that a rubber-tired truck could haul and end dump at the area needed. The shift started at 0600 but they did not start hauling into river until 0900. The crew consisted of a supervisor, 3 operators, and 1 laborer. Rock was loaded with a 988B Cat loader into a Volvo BM A35 rock truck (20 yard articulating end dump). The truck then hauled rip-rap to the river where it was pushed into the river with a D8L Cat dozer to form a bench above grade immediately upstream of the H beam. Cobbles were then hauled by truck into the river fill in between the rip-rap. The dozer could sit at the end of the rock that was leveled, have the truck dump between the dozer and the south side of the river and then back over the pile of rock. They found that this method spread the rock too wide so after 7 hours they switched to a 235C Cat excavator for placing rock in the river. This worked well. Once they completed the bench across the river, they replaced the rock that had washed out of the interior of the concrete north abutment (10 yds). They then started filling voids in the bench as they worked back across toward the south side of the river. After they were about half way across the river I showed up and told them that they were to fill in between the H beams and that the upstream bench was suppose to have been level with the H beam. I told them that I would accept it if the upstream bench was level for at least 5' before it sloped upward. Rick Jones had previously talked to them about having the rock level from midway up the beam going upstream. That would be the best option. When I came back the next day, it appeared that they had filled in between the H beam and done exactly what Rick had asked. The rock had been tamped with the excavator bucket and cobbles were filled in between the rip-rap. It looked excellent. They also cleaned out the H beam where pickets bottom out in the river. If we have to perform this operation again, I would have the area downstream of the H beams filled with rip-rap and tamped. This whole operation could be done in 4 to 5 days with a single shift operation. They were able to work for 23 hours before they needed the flows cut from 1000 cfs to 750 cfs to lessen the depth of water for equipment operation. They worked swing shift on Monday 9-15 but that was the only swing shift required. It took 3 shifts to work their way across the river. After 33 hours, they requested that the flows be cut to 500 cfs and 5 hours later they had completed work in the river. The total work effort in the river was :

Supervisor (1) - 42 hours	D8L Cat dozer - 7 hours
Operator (3) - 101 hours	235C Cat excavator - 37 hours
Laborer (2) - 40 hours	988B Cat loader - 29 hours
Mechanic (1) - 2 hours	A35 Volvo end dump - 30 hours

Any additional contracts should require the contractor to construct the road to the river, coordinate the hauling of rock, return the river access road to existing conditions, fill downstream of the H beams, provide the rock, and clean-up the area after completion of work.

Appendix B

Value Analysis Workshop Agenda

Value Analysis Workshop
Nimbus Fish Hatchery
Diversion Structure

Lake Natoma Inn
Folsom, CA
June 8-11, 1999

TUESDAY, June 8

8:30 A.M. - Meet in Hotel Lobby for Transportation to Nimbus Fish Hatchery (Only for those traveling from outside the Sacramento Area)

9:00 A.M. - Meet at Hatchery for On-site Tour and Informal Briefings

Lunch

12:45 P.M. - Assemble in Hotel Conference Room to begin Value Analysis (VA) Workshop

- Introductions
- Explanation of VA Job Plan
- Identification of Needs, Problems/Constraints
- Development of Required Project Functions
- Video by Joel Barker - "The Business of Paradigms"
- Initiation of Brainstorming Session

WEDNESDAY, June 9

8:00 A.M. - VA Workshop

- Conclude Brainstorming Session
- Development of Selection Criteria
- Evaluate and Categorize Operational Procedures and Design Ideas to be Developed into VA Proposals

Lunch

- Form VA Proposal Development Groups and Begin Development of VA Proposals

THURSDAY, June 10

8:00 A.M. - VA workshop

- Continue Developing VA Proposals; Including Design Suggestions

Lunch

- Conclude Development of VA Proposals
- Prepare for Preview Presentation of VA Workshop Results

FRIDAY, June 11

8:00 A.M. -- VA Workshop

- Each VA Proposal Development Group give Presentation
- Conclude VA Workshop by 11:30 A.M.

Appendix C

Non-Structural Alternatives Tables

- Project Needs and Constraints
- Existing Problems
- Future Problems

This working group was formed for the purpose of examining alternatives that did not involve the existing diversion structure. Their first task involved developing two tables to assist them in focusing on the primary needs of the project of meeting the annual mitigation goals of collecting, and spawning, the required number of fry.

An integral part of the work groups efforts was a field trip to the Nimbus dam site to examine the physical space availability for their VA proposals.

Identification of Project Needs and Contraints	1. Nimbus	2. D/S Barrier	3. Pilot
Be fish tight	*Accomplish*	*Design to accomplish*	*Test to accomplish*
Guide fish	*No need*	*X*	*Test to accomplish*
Hold fish	*Accomplish*	*No need*	*Test to accomplish*
Pass fish	*No need*	*Design to accomplish*	*Test to avoid*
Maintain river flows	*Accomplish*	*Design to accomplish*	*Test to avoid*
Do not affect downstream processes (erosion)	*Accomplish*	*X*	*X*
Able to operate at high flows	*Avoid*	*Design to avoid*	*X*
Don't reduce gravel recruitment	*X*	*Design to accomplish*	*X*
Diversion structure must function Oct-Dec	*Accomplish*	*X*	*Test to accomplish*
Ladder must function Oct-Mar	*X*	*X*	*X*
Divert salmon Oct-Dec	*X*	*X*	*X*
Mininize vandalism	*X*	*Might increase*	*X*
Pass trash	*Accomplish*	*X*	*X*

Identification of Project Needs and Contraints	1. Nimbus	2. D/S Barrier	3. Pilot
Minimize hydropower impacts	X	X	X
Be safe for workers & public	X	X	X
Reduce O&M activites & costs	X	X	X
Need to manage water temperature & flow	X	X	X
Contribute to hatchery meeting mitigation needs	X	X	X
Get adult salmon from	X	X	X
Solution must survive	X	X	X
Long-term solution	X	X	X
Maintain & enhance existing spawning/rearing habitat	*Improve*	*No change or worse*	*Test to improve*
Maintain the ability to control the number of fish diverted	*Accomplish*	*Design to accomplish*	X
Improve the ability to control the fish passage	*Avoid*	X	*Test to avoid*
Maintain/insure fish attraction	X	*Design to accomplish*	X
Ability to maintain O&M during reasonable flow range	X	*Design to accomplish*	X
Solution must be functional by Sept 15	X	X	X
Eliminate need for annual ESA consultation, 404 permits, etc.	X	X	X

Existing Problems	Collect at Nimbus Dam 1. a,b.c	Velocity Barrier Downstream at Sailor Bar	Phased Eval. of Collection at Nimbus & Eval. of No Barrier Alternative
Having to reduce river flows for construction or O&M	*Reduces (const)*	*Design to reduce*	*No change to better*
Health & safety of O&M	*Solves, eliminates*	*Design to improve*	*No change to better*
Foundation not stable	*Eliminates*	*Design to improve*	*No change to better*
Labor intensive O&M	*Probably improve*	*Design to improve*	*Test*
Unreliable fish diversion capability	*Solves*	*Design to improve*	*Reduce*
O&M has adverse downstream impacts	*Eliminates*	*Design to improve*	*Reduce*
Vandalism	*Reduce*	*Might increase (block back more river)*	*Reduce*
Getting dead fish off the weir	*Eliminates*	*Design to improve*	*Same*
Getting trash off the weir	*Eliminates*	*Design to improve*	*Same*
High & normal flows cause damage to structure	*Eliminates*	*Design to improve*	*Same*
Safety concerns with the overhead crane	*Eliminates*	*Eliminate*	*Reduce*
Submerged sheet pile, rebar, etc., downstream	*No change*	*No change*	*No change*
Flows not uniformly distributed across river which causes erosion	*No change*	*No change*	*No change*

Future Problems	Collect at Nimbus Dam 1. a,b.c	Velocity Barrier Downstream at Sailor Bar	Phased Eval. of Collection at Nimbus & Eval. of No Barrier Alternative
Limited ability to reduce flows during construction & future O&M	*Const. - improve*	*Design to improve*	*No change to test*
Changing biological requirements	*Adapable*	*Design to adapt*	*Test*
Trend toward structure-free rivers	*Accomplished*	*Moves location*	*Test*
Proposal to remove Nimbus Dam	*No change*	*No change*	*No change*
Uncertainty with regard to future management objectives	*Adaptable*	*Design to adapt*	*Test*
Sedimentation problems in the river during construction	*Adaptable*	*Design to adapt*	*Test*
Limitations on the use of concrete in the river	*Adaptable*	*Design to adapt*	*Test*
More active public and media involvement	*Adaptable*	*Accomplish*	*Accomplish*
Must take fish every season	*Accomplish*	*Accomplish*	*Accomplish*
Only need to get eggs to hatchery (and MILT)	*Accomplish*	*No change*	*Test*
Be cost effective	___	___	*Test*

Appendix D

Additional Potential Considerations

Appendix D

Additional Potential Considerations Not Addressed During the VA Workshop

If the Proposal 1 recommendation (Permanent Repairs to Foundation of Existing Structure with sheet pile cutoffs and concrete cap using existing picket racks) is selected for phase 1 implementation to solve the existing scour/erosion problems, there will be a great deal of opportunity to test other "less conventional" alternatives (in addition to the decline bar rack recommended for phase 2 implementation) and still have the existing picket rack barrier as a back up.

Reclamation's Water Resources Research Laboratory (WRRL) in Denver, CO has been looking at guidance alternatives for similar applications in Montana. Based on WRRL experience, recent advancements in technology, and numerous field applications, such an approach affords the opportunity to at least consider an electrical barrier and/or a bubble curtain/sound barrier combination for guidance to the hatchery ladder for the following reasons:

1.) 100% exclusion is not required for the Nimbus Hatchery Fish Barrier application (electrical barriers have been shown to provide up to 95% effectiveness).

2.) The barrier is needed seasonally and only for a short period of time (Oct. - Dec.).

3.) Such concepts as electrical or bubble-curtain/sound barriers have the potential for solving the present seasonal installation/removal and debris removal/handling problems associated with a positive barrier.

4.) Such concepts would be cost effective compared with a conventional barrier of the type that presently exists (bar rack or pickets structure) and have high flood flow survivability.

It appears that any alternative ~~which~~ that does not require a physical (structural) barrier is the answer to solving many, if not all, of the present problems associated with seasonal installation/removal and debris handling. The foundation repairs would provide a good "bench-top" conducive to installing electrical or bubble curtain/sound barriers for field testing. Furthermore, use of the existing picket rack barrier would allow for testing of the various alternatives in a single bay, between piers, or in multiple bays while retaining the ability to replace the barrier at any time and for any reason.

Reclamation's WRRL would offer assistance in the future to explore any of these alternatives both in laboratory and/or field development. A draft proposal would be prepared to evaluate and further develop these ideas or at least discuss them with all those involved in the project.