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ANADROMOUS FISH EVALUATION PROGRAM
Fish Facility Design Review Work Group
Minutes
January 24 and 25, 2001

ATTENDEES:

Name	Organization
Noah Adams	U.S. Army Corps of Engineers (Corps)
Steve Anglea	Battelle Pacific Northwest Laboratory (Battelle)
Jim Bluhm	Corps
Dave Coleman	Corps (McNary)
Kevin Crum	Corps
Brad Eby	Corps (McNary)
Rick Emmert	Corps
Kim Fodrea	Bonneville Power Administration (BPA)
Mike Gessel	National Marine Fisheries Service (NMFS)
Mike Halter	Corps
Kenneth Ham	Battelle
Lisa Hetherman	Corps
Bill Hevlin	NMFS
Dave Hurson	Corps
Rebecca Kalamasz	Corps
Dan Katz	Corps
Mark Lindgren	Corps
Lynn McComas	NMFS
Sean Milligan	Corps
Paul Ocker	Corps
Charles Palmer	Corps
Steve Pettit	Idaho Fish and Game Department (IDFG)
Chris Pinney	Corps
Steve Rainey	NMFS
Lynn Reese	Corps
Ann Setter	Oregon Department of Fish and Wildlife (ODFW)
Marvin Shutters	Corps
Larry Swenson	NMFS (Conference Call)
Tim Wik	Corps
Tonia Elsey	Corps

The Fish Facility Design Review Work Group (FFDRWG) meeting was held in the Harvest Room on January 24, 2001, and the Castle Room on January 25, 2001, at the U.S. Army Corps of Engineers (Corps), Walla Walla District, 201 North Third Avenue, Walla Walla, Washington. Rebecca Kalamasz organized the meeting, and

Tonia Elsey served as note taker. The meeting was audio taped in order to facilitate completion of the minutes.

Rebecca Kalamasz distributed the agenda (see appendix 1) and indicated that most of the afternoon would be devoted to discussion and resolution of questions relating to removable spillway weirs (RSW). She stated that minutes are available for the last meeting and requested any revisions be sent to her. The next meeting is April 25 and 26. However, this might not be the best time for a meeting as it is right before research starts and after resolution of pre-season issues. If anyone would like to change that meeting to May or before April, please contact Rebecca so she can inform the region. Last year, the meeting was held at Lower Granite Lock and Dam (Lower Granite).

Steve Rainey and Bill Hevlin thought a field trip meeting at Lower Granite would be a good idea. Rebecca Kalamasz asked participants to consider this and send her comments. Rebecca indicated that at the last meeting suggestions were made to streamline discussions. One idea was for the speaker to identify topics they would present so that questions pertaining to those items could be addressed at the appropriate discussion time. She asked participants to try this idea for this meeting.

1. MODEL UPDATES AND ISSUES.

a. McNary Lock and Dam (McNary) Deflectors. Rick Emmert indicated the general model has been completed at Waterways Experiment Station (WES) for McNary. The sectional model testing has been completed at North West Hydraulic Consultants in Vancouver. The general model testing has been initiated. The Corps has initiated preparation of some National Environmental Policy Act (NEPA) documents and preparation for contracts for this upcoming fall and winter. Contract preparation is occurring in two areas for McNary: one to procure gate hoists and the other for end bay deflectors. Verification is needed of the model base for collected field data. Then, a base case test will be done, which will document the existing tailrace conditions for the existing spill pattern. Then, the Corps will look at how to change the spill pattern for uniform spring operation. The Corps would like to shuffle some gate hoists around at McNary prior to the spring season because the spill pattern may change enough that it may be necessary to operate bay 20 with an underflow operation. Right now, the operation is split and water coming out of that gate impacts directly on top of the deflector. Rick does not think it is very good for juvenile fish to pass through there. The Corps would like to switch the gate hoists around so gate 12 can be operated. The Corps would look at this change in the new spill pattern for this year.

Dave Hurson indicated there was a need to switch some gate hoists because some of them are designed for lifting only half of a gate versus a whole gate.

Rick Emmert indicated there are four hoists needed once the four deflectors are added to the McNary spillway. These would replace three that are old and can only lift one way. Dave Hurson indicated that one hoist was missing. That would leave two cranes lifting two gates.

Rick Emmert indicated that once they have looked at a new spring spill pattern, they would want to put deflectors on the end bays on the general model and re-look at another spill pattern. Steve Rainey indicated they were interested in looking at the 2001 spill pattern. Rick Emmert stated that would be available the end of January or the first week of February. Dave Hurson stated he thought that it would be more like the last week of February, because they would have to adjust flows, look at a flat pattern under existing conditions at whatever level they are, and obtain numbers. Steve Rainey asked if they were going to try and tweak it for 2001, for instance, and have it ready to show what it looks like. Dave Hurson stated the Corps for 2001 would be looking at the existing patterns versus the Columbia River Inter-Tribal Fish Commission (CRITFC) request, seeing if it can be flattened a little bit, increasing flows for dissolved gas.

Rick Emmert indicated that what they saw at Lower Granite in early December was, the existing spill pattern had some eddies and had some conditions that did not look so good. Dave Hurson indicated that those problems haven't existed at McNary. Steve Rainey agreed that McNary probably does not have those problems, but the first time they got a really good look at the general model at John Day it was off. Dave Hurson indicated they would look at that. They would start out with looking at existing spill level and then re-adjust the gates to see if it could be flattened to something that would maybe give a little bit less gas. They may look at a nighttime spill pattern versus a daytime pattern to see if, at 12 hours at night, it could be flattened out if an eddy problem is found. If there is a problem, the Corps will probably look at two schedules.

Steve Rainey asked if McNary currently had just one. Dave Hurson stated that it did only have one that was a little bit peaked in the middle.

Rick Emmert stated that once they got past this they wanted to do some follow-up testing and look at simulating a divider wall that would split the powerhouse flow from spillway flow. The main reason for looking at that was to make sure that there is no impact from the presence of a wall that impacts the decision on the adjacent deflector elevation.

Steve Rainey stated that the other thing that has not been mentioned is taking a subjective look at the existing outfall locations and making some dye releases. Rick Emmert stated that they would want to look at the outfall location under all of the spill factors.

Steve Rainey indicated the Biological Opinion (Bi-Op) made reference to a report on that issue that might be generated to do some preliminary investigations.

Lynn Reese stated he was thinking a letter report, could be written to look at it and then discuss it. Steve Rainey stated that they would look at it and discuss the context of past modeling and how the criteria have changed. Maybe it can be done informally without a written product.

Rick Emmert stated that it would depend on what was really seen. The presence of the wall may affect the off side. Steve Rainey stated that it was clear at the opposite end of the powerhouse; it might have some influence if it were long enough. There is a big eddy just downstream of the bend and also a real shallow south shore distinct bow wave at McNary that was not seen before, until the model was watered up. The north shore is really shallow too, to the extent that you have a dye plume that is close to that big eddy and that is a real shallow zone. The Corps expects to look at that closely.

Dave Hurson stated the Corps might want to look at relocating the plume down the center of the river. He also stated that when there is high spill the tugboats come right up the center of the river, so spill could remain quite heavy. In terms of an eddy on the way downstream, there is a possibility that nothing can be done to not get some dye coming to that eddy.

Steve Rainey stated that this would all be pretty clear in the general model. Dave Hurson stated that on the present site two turbine units have been made longer than what was originally planned for the flow condition at the facility.

Steve Rainey stated it was designed before the concerns related to ambient velocities rather than the dye and where the fish would go. Dave Hurson stated that dye could be put anywhere in the spillway, and it would get over in that eddy downstream because it is a real long slow eddy. The group discussed the divider walls.

Rick Emmert stated the testing schedule is a little bit delayed because of cold weather and an eddy has been identified that was not present in the field data.

Steve Rainey stated the first full week of March would be best for them.

Dave Hurson stated that, ideally, they would like to get one full level a day, and they can (unclear) overnight. It will take a long time for that model to change; it has a huge forebay.

Steve Rainey stated that it would be good to look at the 2001 spill schedule, try to refine it, look at the divider wall to get a sense for impact in the general model for the deflectors, and make decisions relating to lateral flow and localized conditions. But as far as a final spill schedule, or end bay deflectors, that is not quite as urgent. The final design of the end bay deflectors is real important.

Dave Hurson stated that a go or no go was needed on the end bay deflectors because they are in plans and specifications now and will be advertising.

While they do not need a finalized spill pattern, they do need approval on construction because they do not have time to wait a year on that part. Steve Rainey agreed.

Rick Emmert provided a contract schedule for this construction. Marvin Shutters stated that they have started to gather construction timeframes. Bill Hevlin asked Marvin to contact him or Gary. There was discussion on the construction schedule and options for end bay deflectors design.

Rick Emmert asked when spill stopped. Dave Hurson replied with June 30 for voluntary spill, depending on river flow. Rick also stated that they are doing a supply contract.

Steve Rainey stated that it all comes back to what the System Configuration Team (SCT) has budgeted. There was discussion on what the future budget entails.

b. Little Goose Lock and Dam (Little Goose) Deflectors. Rick Emmert talked about the models being built for Little Goose to look at deflectors and spill patterns. The sectional model is complete. The general model is moving well, the templates are in place for upstream topography, and the downstream topography is complete.

Steve Rainey asked if the projected schedule was available. Rick Emmert stated that the general model should be complete by the end of the fiscal year. The group discussed the budget.

Steve Rainey asked if there was going to be a section at FFDRWG about the section model results and how they look? Rick Emmert assured him that that would happen. There was some continued discussion on the short deflectors.

c. Lower Monumental Lock and Dam (Lower Monumental) Deflectors/Erosion/Outfall. Dan Katz distributed handout #1 (see appendix 1), Lower Monumental DGAS and Erosion. He stated that the basis of his presentation would be the upcoming spill season, the overall plan, and review of concerns with spill at Lower Monumental. The review included views of deflectors on end bays and two areas of erosion that have grown substantially in the last 3 years. There was discussion about the deflectors and erosion at Lower Monumental. Dave Hurson stated that there was a lot of erosion last year. There was continued discussion on Lower Monumental's gas cap and gas cap spill. Dan Katz pointed out that sometime around 1996 there was a rapid increase in erosion rates. One real concern is what could happen in high flows. There was discussion on the high flow years. Main concern is if the hole continues to grow there could be more at risk during high flows and end bay deflectors could possibly cause uplift underneath the slab, both downstream and upstream.

Dan Katz stated that during the last year they have done preliminary debris movement tests in the sectional model. Modifications to the stilling basin on the sectional model were made to test uplift. There was discussion on the testing to be done on the erosion and the stability of the stilling basin. Construction of the general model was completed in December, and the calibration of the spillway in the powerhouse has been completed. Verification of data as far as losses in the river will be done next week. Testing of interim spill patterns and the current spill patterns will take place in February, and flows will be evaluated early in March. The purpose of the sectional model and the general model and how they work together will help make decisions on spill for this year. The key in the sectional model is to look at uplift and determine if it is near a critical uplift that might be a structural concern. Bill Hevlin asked Dan to explain uplift. Dan Katz explained the uplift problems. The present erosion problem and structure soundness was discussed.

Dan Katz stated that in the general model they want to look at the spill pattern in two dimension, spill patterns of the last few years and new spill patterns.

Steve Rainey asked if by new spill pattern he meant new spill pattern for 2001? Dan Katz replied yes for this season.

Dave Hurson asked if there was any videotape of the erosions. Dan Katz replied, yes, and there was discussion about viewing the video.

Kim Fodrea asked Dan to describe the model. Dan Katz described the sectional model as being a plywood floor on the stilling basin and showed on the handout the location of the erosion holes. In the general model, the floor is concrete.

There was general discussion on the erosion spots of the dam. Steve Rainey asked if pressure taps were used for the uplift study. Dan Katz stated that they used transducers rather than pressure taps or piezometers.

Dan Katz continued on with the discussion of the 2001 interim spill coordination. There was discussion on McNary and Lower Monumental spill tests and doing them both at the same time.

Steve Rainey stated that recommended spill pattern operations could be to Operations Division by April 1. There was discussion on spill amounts and what amounts of spill are a threat, turbulence levels, and whether or not a lesser number of bays would show any change.

Steve Rainey stated that they were going to be looking at The Dalles spillway survival issue as it is such a shallow stilling basin. Measurement of localized turbulence is of importance there and will be important at Lower Monumental as well. Being able to take readings at the hydraulic model is an important issue. The discussion continued on spill patterns and testing. There was discussion on whether this would be an agenda item for the Technical Management Team (TMT) or a FFDRWG conference call with the TMT.

Steve Pettit indicated the discussion made him want to put a placeholder in the RSW discussion because there is great concern that spill volume can be reduced to the point where any benefit is eroded by predation. Discussion continued on the subject of low spill volume.

Rick Emmert stated that obviously the erosion work supercedes the deflector work and asked when there would be enough information to begin design. He asked when the model testing would be complete? Dan Katz stated that they would look at alternative solutions around April through July 2001. Steve Pettit asked if they would be looking at outfall and documenting as they did each of the tests. Steve Rainey stated he thought that would come after the final determination of end bay deflector height.

Rick Emmert stated that they have tracking installed that would give outfall information for other tests. Steve Rainey asked if the tracking would provide time lapse, and a sense for velocity at the location. Dan Katz stated that they have overhead cameras that are tied together to track from one view to the next. Discussion continued on running tests and looking at alternatives for Dissolved Gas Abatement Study (DGAS) and erosion.

Dave Hurson asked if they went back through and checked topography on the north side of the river along the gravel. He felt the model did not seem shallow enough. Rick Emmert and Mark Lindgren stated that they were looking at alternatives combined. Discussion continued on the deflectors, erosion, and DGAS. Steve Rainey stated that they would appreciate a few paragraphs to describe what efforts they were going to make to try to circumvent having to shut down spills. Discussion continued on the testing and where funds would come from for different problems like threatened stability of structures. Dave Hurson pointed out that if a training wall were installed between bays seven and eight the erosion holes would be filled up with concrete because the training wall would go right over the top of the holes.

Steve Rainey asked Mark Lindgren if he anticipated that some of the different options might come together in a week or two. Mark Lindgren stated that they would be talking about them but they would not have them all flushed out. Bill Hevlin stated that spillway concerns are written in the Bi-Op for 2002. Steve Pettit stated he thought that fixing the spilling basin at Lower Monumental was more important than doing a removable spillway test.

There was discussion on whether or not to try and use Columbia River Fish Migration (CRFM) funds.

Steve Pettit indicated the concerns spread over all kinds of work, the delayed mortality proposal, and the juvenile transport proposal. All of these have a control that assumes you are maximizing river migration potential.

There was discussion on the Corps 5-year plan and the 5-year Bi-Op.

Rebecca Kalamasz indicated they are going to pursue the action already discussed, go to WES, try to identify the critical risk here, and request separate letters from the different agencies supporting this action pursuing several sources.

Steve Rainey asked if the timing of the new deflector installation is encumbered by the need to get this cap taken first. His impression is that if the erosion problem were taken care of, it could potentially be on the same schedule as Little Goose and do construction in the 2002 - 2003 work window.

Mark Lindgren stated that priority wise the erosion issue is ahead of (unclear). The erosion issue almost has to be settled before the second issue.

Steve Rainey asked if the capping of the erosion problem could be considered a separate and unrelated critical path and proceed with scheduling the construction of the 2002 - 2003 work window. Then only if there is something from the capping that encumbers it would it be shoved back a year.

Mark Lindgren stated that they have to reach a certain point of understanding how they are related before they can be separated. Once it is understood how they are related and how to handle them, then putting them on a separate path might be feasible. Discussion continued on how to handle this.

2. The RSW

a. Construction Status

Kevin Crum distributed handout #2 (see appendix 1), Lower Granite - Removable Spillway Weir Construction Schedule Issues/Update. This handout is the same information that was discussed last week at SCT. It shows the schedule for construction. In a month's time, they went from on schedule to about 7 weeks behind. They have been keeping a close eye on things and have ear marked January 9,2001, as the decision point as to whether they could progress with the test getting the RSW installed before April. There is too much fabrication left to do to make that deadline. The good news is the surface collector work is completed. Another contractor took out the connection to the spillway and the transition to the collector in front of unit six. The modules were installed for the wall that closes off to the dam as well as the small closure piece between the Simulated Wells Insert (SWI) and the new wall. The trash boom was realigned. All that work is done except a little cleanup work. They installed the access to the stairs and ramps.

Steve Pettit asked if the device itself was still hanging there? Kevin Crum indicated that the rest of it in front of six was still there, but there is no way to pass water through it because it is no longer connected. Steve Rainey stated that it serves as an upper intake occlusion, which should reduce some entrainment into the turbine intakes.

Kevin Crum stated that the focus for RSW at this time is getting everything at the first spillway installed, which is the seal system and the horizontal and vertical elements. The landing pad for the RSW also needs to be installed. There was discussion on what was left to do on the RSW.

Kevin Crum distributed handout #3 (see appendix 1), Lower Granite Surface Bypass Collector (SBC) Modifications for 2001. Kevin Crum stated that coordination and cooperation needed to be made with the contractor as to when the work could be finished. First point is the extension of the end of March work window; the request has already been initiated. Bill Hevlin asked if during that extra 15 days, if the laying of the concrete pad and some additional grout work would be the only work going to be done? Kevin Crum stated that no grout work would be done, just the laying of the pad. There was discussion on what it will take to sink the concrete pad.

Kevin Crum stated discussion was needed on when the installation of the RSW could resume. One of the considerations is hydraulic testing. The sooner it can be there, the sooner they can conduct the RSW hydraulic tests. There may be surprises with the ridges seen in the models when they start running flow over it; those need verification. Steve Pettit asked if the device sitting on the forebay floor will have an impact on the hydraulic passing over the spillway. Kevin Crum stated the landing pad would not affect flow. The landing pad is only there to receive the RSW to get it out of the way. Steve Pettit asked if there was some other reason for wanting to extend the work window? Kevin Crum stated that the extension was to finish this up this year and get behind the construction issue. Dave Hurson stated that they were looking at coming in June to hook the RSW onto the wall.

Steve Pettit stated that was the part about which they were most concerned. With the low flow migration conditions they might see a 1987, 1992, 1994 migration scenario where the spring migration is contracted so that it just kind of melts right into the summer migration. There will be a significant number of late arriving migrants well into June. They would rather avoid any construction impact on the spring migration. There was discussion on the different ways this could impact spill and migration. Dave Hurson pointed out that hooking the RSW to the dam would only take about 2 days. Discussion continued on shifting spill to other bays and possible spills at night. Steve Pettit stated that their main concern was that there was a lot of construction going on in the spillway environment.

Rebecca Kalamasz asked if there was a sequence of construction activities. Kevin Crum stated that they had a schedule. Steve Pettit asked how all the holes were going to get drilled. Kevin Crum stated that is all being done now. Dave Hurson asked what exactly would be done in June. Kevin Crum stated that everything listed on the handout they would like to have done by April. If all the seals can be installed, all drilling and grouting done, the pad installed, all drilling and grouting done, the only thing left to do would be the installation of the RSW. Discussion continued on the necessary steps to installing the RSW. It would be finished before the fish season with the 2-week extension. The 2-week extension is actually just to be in the river to finish the installation of the concrete pad. Discussion continued on the 2-week extension for installing the pad.

Steve Pettit asked if the request was in person or by telephone. Kevin Crum stated it was by phone. Steve Pettit asked what the reaction was from the salmon managers. Bill Hevlin stated that at SCT it was just an information session. Steve Pettit stated that he could take it back for a conference call next week.

Dave Hurson stated the simple option is for going back in and installing in June. If we end up not having spring flow, it would not impact spill. If there were a spill season that went through June 20 it, could come out right after that, install it in a week, and then have a 2-day spill to test it. Discussion continued on the testing of the RSW, mortality levels, and balloon tag studies. Bill Hevlin stated he preferred to view these as two separate actions, the first one being the extension from March 15 to April 1. If it is just to lower the pad and completing that, he could not see any problems or fish impacts. The second action is installing this in June or some other month. He could see some impacts to either if there is spill or if there is no spill. Discussion continued on the possible impacts and on the concerns with doing the wave tests and balloon tag tests.

Kevin Crum stated that he would get more detail on the time needed to finish the project. Rebecca Kalamasz summarized the discussion by saying that the pre-season extension for the pad installation is not a big issue. Steve Pettit stated he would put it on next Tuesday's conference call. The call is at 9 a.m. and the number is 503-230-3344. He will insure Kevin receives the weekly code. Kevin Crum asked if they would need a handout. Steve Pettit stated it would be nice to have one copy sent electronically to the Fish Passage Center; they can disseminate it to the entire Fish Passage Advisory Committee (FPAC) membership. Discussion continued on what FPAC would need to know specifically.

Lynn Reese commented on the hydraulics of the RSW under a partially installed mode. Hydraulic conditions around the perimeter, basically what the fish will see, working on a numeric model version with 7,500 cubic feet per second (cfs) going through the spillway, roughly one bay when the Bi-Op spill is spread all the way across. That information should be available within the next week. Steve Pettit asked if that was with or without the device. Lynn Reese stated that would be without the device. Steve Pettit asked if the seal beam was metal or concrete. Kevin Crum stated it was concrete with a metal cap. Discussion continued on hydraulic testing. Lynn Reese stated that he could see no real problems.

b. Monitoring Plan. Tim Wik stated they needed to talk about some of the options they have for operations and monitoring this spring given that the RSW is not in place. The first option (the best option) would be to operate the spillway similar to what they were going to do if the RSW test would go forward. That is 40-percent spill, 24 hours a day, alternating with a 15-percent spill, 24 hours a day. There has been discussion about the 15-percent not being adequate, which is flexible. The idea is to get similar conditions this year as to what might be run next year when the RSW is in place, looking at a couple different spill levels. The Behavioral Guidance System (BGS) will be in place, as well as, the SBC and SWI inclusion in front of four, five, and six. That is a roughed out comparison between Bi-Op spill and passage routes in this particular scenario. The Bi-Op spill condition assumes that there is an equal percentage of fish passing day and night. Steve Rainey asked if the bottom bullet Bi-Op is Bi-Op spill 12 hours. Tim Wik stated that is 60K, 12 hours a day, and assumes 100K total flow. Steve Pettit asked why this baseline information is critical? Tim Wik stated it was the only time they would have a chance to see what that combination of structures and spill is going to do for passage at Lower Granite. Once the RSW is in, there probably will not be a test. There was discussion on the values of this testing for possible changes at other projects. Steve Pettit stated that these tests need to be sent to SCT or FPAC as soon as possible, in detail. Discussion continued. Steve Pettit stated that it would be worth a telephone call to Gene Matthews or Bill (unclear) to let them know what the test plans are in lieu of RSW testing and to ask if they have any problems with it. Discussion continued. Ann Setter stated that from Portland, Oregon's standpoint they did not really see any need for a spill test, but the idea of testing with occlusion verses next year with an RSW is valid, and there is good information to be gained. It would be worthwhile to outline it better and take it back to the group. Discussion continued. Steve Rainey stated that the issue of the RSW installation should be covered on the conference call, but the issue of spill with implications to research and the implications of calling out the occlusion performance and what that does to spill could be discussed at FPAC. Discussion continued. Steve Pettit stated he felt this would be better presented face to face as opposed to conference call. Bill Hevlin asked if it would be worthwhile to ask for input from SRWG about how this altered spill schedule affects the transport in river study. Rebecca Kalamasz stated that the spill at Lower Granite affects that study only in the sense that it affects the numbers of fish that enter the fish facility to tag. They have not had trouble getting fish, so there should not be a problem. The study is being adjusted with respect to the no spill option because the delayed mortality component of that study is one objective. There are multiple objectives. Steve Pettit stated that John Williams has told him that they could not have 24-hour spill at Lower Granite because they would not get enough fish to mark. Discussion continued.

Tim Wik showed a slide indicating there is some support in the Bi-Op for doing a spill test evaluation at Lower Granite. Action 83 evaluates the effect of spill, duration, and volume. Little Goose and Lower Granite will be specifically considered for daytime spill studies. The one objective for the day is the contracts for tag purchases. They need to know what is going on as far as what they are going to be doing with monitoring this year. This needs to move forward. There currently is a contract with Battelle for hydro-acoustic monitoring that was awarded before it was known the RSW's would not be in place this year, they are monitoring various passage routes. If doing nothing is decided, they have obviously spent all that money. Steve Rainey stated that the default operation is to spill the cap, if they spill at all. Discussion continued on whether they spill or not and pros and cons of spilling tests for future improvements.

Mark Lindgren stated that the summer Fish Guidance Efficiency (FGE) test showed a pretty good increase in FGE underneath the SBC in the included units. Discussion continued on whether or not it was FGE that increased. Steve Rainey stated the key to this is how much of the study is "nice to know" and how much of it is something that is going to be used as a springboard and go on in a direction of increased survival. If the SBC, which acts as an SWI inclusion upper intake were taken out in the next few years, something far more abbreviated would be put back in to create the same hydraulic conditions. Sort of like what they have at The Dalles versus a big floating device. Discussion continued on SWI, FGE, occlusion, and the different tests done.

Steve Rainey stated that in the FFDRWG meeting the following was discussed: 15 percent with RSW, 40 percent with RSW, and 40 percent without RSW. so there was an RSW curve and a non-RSW curve. The other approach was the least we could spill and have good (unclear) and egress was 22K with the RSW. He proposed comparing that to spilling the cap at night because that is the default spill condition. Discussion continued on different spills.

Steve Rainey asked if they could look at the benefit of upper intake occlusion by looking at entrainment levels without the BGS? Lynn Reese stated the message to him is, if we have enough flow to do the spring test it might be considered. The other is, if we do not have enough flow to do that, we want this to be the fallback plan for a spring test. Steve Rainey stated that informally we have discussed that if an acoustic study can not be done with the RSW should the acoustic study still be done at Lower Granite or switch it down to The Dalles Lock and Dam (The Dalles). There maybe advantages to staying at Lower Granite.

Tim Wik stated that what he sees happening is some form of a spill test at Lower Granite, 40 percent, 15 percent or something along those lines. If there is no spill on April 1, then perhaps an FGE study with some monitoring already in place with the BGS out is the alternative. Steve Rainey thought that maybe the best way to proceed is to try and summarize in a page what that fallback contingency evaluation would be. FGE horizontal distribution, what those fallback tests would include, and a short description of the benefit. Tim Wik stated that the decision on radio tags needs to be made rather quickly so the vendor has time to get them made by the time they are needed. Noah Adams stated that if the purchase order for radio tags is not in place by December, they can not get the April delivery dates.

Tim Wik stated that the original number one plan for the RSW test was a balloon tag test, a standard radio telemetry and hydro-acoustic monitoring, and the 3D acoustic tag tracking. What he sees as the main options for this spring are the hydro-acoustic and the standard radio telemetry. He talked about the 3D acoustics tag tracking and Tim distributed handout #4 (see appendix 1), Alternative Research Options at Lower Granite during 2001. Noah Adams stated this handout was a summary to give an idea of two options that can be done at Lower Granite. Option A is to install with reduced tags and addressing seven issues. Option B (unclear) application but continuing to work on refining some of the software issues so that we are prepared for 2002. Option A will allow a reduction in tag numbers as well as some personnel and still allow full implementation of the system and working through a lot of the precision and accuracy concerns that were brought up at last year's implementation. Option B would allow working through a lot of the software application issues and some of the modeling as far as how to model a 3D hydrophone that will give the precision needed. Those assumptions would not be able to be tested if there is nothing in the water. Lynn Reese asked how much savings there would be if they dropped 400 tags. Noah Adams stated the tags were $225 each. Discussion continued on hydrophones and tags. Steve Rainey stated that his own personal feeling was you can debug to some extent with option B, but can debug it further with option A. Tim Wik stated there has been some discussion with Rock Peters and Tom Carlson. Rock was not really supportive of any field test this year until the bugs have been worked out of the data already collected. Noah Adams stated that some of it was with the data already collected, and some of it was with the computer modeling on the hydrophone density and working with the programmers to design the application that allows the designing of geometry for the hydrophone arrays ahead of time for installation (unclear) prior to the field season instead of waiting until after the field season. Discussion continued on the hydrophones and radio telemetry. Steve Rainey stated that they were trying to look closer at integration to the extent that they can really look at a more precise 3D location of fish when they do something distinct. If the trackers can say this happened or this is a trend, this will probably pertain to design. At the same time they could integrate that with the modeling and look at what is going on hydraulically at that point. That would be a huge step forward in terms of what we need to make decisions about changing the design for better performance and better survival.

Noah Adams stated that the benefit at Lower Granite is all the fish come into the array. If it is done at The Dalles or Bonneville, you only get 30 percent of the fish that come into the array. At Lower Granite, 95 percent of the fish moved into the array. Steve Rainey stated he thought option A was the best option because they were actually doing some tests in the field as well as making some refinements. Discussion continued on acoustic testing and the radio tags and their assembly.

Steve Rainey stated that they had talked about doing an integration output with American modeling in 2001 with the sonic tags and still have not gotten a good look back at 2000 integration.

Bill Hevlin stated that they were interested in the radio tags and hydro acoustics and need to consider the (unclear) tags more.

Tim Wik stated they would plan on going forward with the purchase of radio tags at this time. Noah Adams stated he would forward final numbers.

Lynn Reese gave a short overview of the work that is being done by WES on correlation of the biological data with the hydraulic numeric modeling that's going on.

Steve Rainey asked about the integration that was supposed to occur for 2000 between U.S. Geological Survey (USGS) and University of Idaho (UI). Lynn Reese stated that there was quite a bit of work trying to get the correct coordinate system to fit together and thinks that it was all finally worked through to where all the key players have the data. There are just a few finer points that have to be done to insure that the latest data is out. Noah Adams stated that there were some initial challenges as far as the coordinating system, but they have been resolved. They have the data and are currently writing up the information. Problems have been worked out and they are on schedule for the draft report coming out February 16, 2001. Discussion continued on integration, analysis, tracking and screening fish, numerical modeling, and the draft report. Steve Rainey stated that numerical modeling has given FFDRWG some good looks at flow field intensities near spill bay one. Steve Anglea stated that in this year's hydro-acoustic report, Bob Johnson has integrated the multi-beam data with the hydraulics for that region, and that will be included in the final report. There will be a video attached showing the fly in down into the Lower Granite forebay and the telemetry, structures, water vectors and fish vectors, and showing how they go together. Discussion continued on numerical models. Steve Rainey stated that the big expense for the numeric model is putting it together and getting it calibrated. Once that is done you can feed it all kinds of information and use it. Once it is there, it is not that much to go back in and make some different runs. Discussion continued on numerical models. Bill Hevlin asked that somebody let him know if John Nessler was going to be giving a talk in Portland, as he would like to attend.

Dan Katz distributed handout #5 (see appendix 1) summarizing the short piece of video he was showing on Lower Monumental. The video showed what the divers found in the stilling basin. The video showed the erosion and undermining underneath the spill at bays one and two.

3. <u>Construction and Modifications</u>.

a. <u>McNary Collection Channel Bulkheads</u>. Kevin Crum distributed handout #6 (see appendix 1), Construction Updates.

(1) <u>McNary Cylindrical Dewatering Prototype</u>. Triad Mechanical is working on this project. The contractor left the site last fall and would not come back until problems were resolved. The problems are resolved, the contractor is back to work, and it looks like they have about 3 weeks of work to complete it. There should be plenty of time to be ready for the debris effort and the biological effort. There was discussion on what exactly the contractors are doing.

(2) <u>McNary Juvenile Collection Channel Bulkheads</u>. Knerr Construction is working on this. It was supposed to be done in 1 year, but only 12 of the 42 slots were completed because the dewatering bulkhead was redesigned. A couple of them were built and tested. As of this week, the contractor is done with the last one.

(3) McNary Perforated Plate Replacement Contract. This project is being done by S & R Industries. This project is about one month behind. They were required to have the two prototypes done by mid-December, and they ran into a quality control issue. They are also having a problem finding bolts. There was discussion on the perf plate replacements.

(4) Goose-Granite Perforated Plate Replacement Contract. This project is being done by GTE Metal Erectors. At Little Goose there are 11 screens completed, and at Lower Granite there are only 5 screens completed with four in progress. The contractor says he can complete on time, however, the Corps is not so sure. There was discussion on the perf plate replacements.

There was general discussion about tomorrow's agenda. Bill Hevlin asked if the trash boom got in at Little Goose. It was stated that yes, it was installed. Steve Rainey stated that this year, in particular, there may not be any debris, but there could be some significant predators. Rebecca Kalamasz stated that there was an electro fishing test scheduled, not a radio test. Discussion continued on the debris containment. Ann Setter asked about the modification of the orifice. Steve Rainey stated that it was a proposal presented at Anadromous Fish Evaluation Program (AFEP).

Thursday, January 25, 2001

1. Program Updates.

a. Auxiliary Water Supply.

(1) Ice Harbor. Kevin Crum distributed a one-page handout #1A (see appendix 1), Ice Harbor Emergency Auxiliary Water Supply. Kevin noted that Cary Rahn is the new Project Manager. He explained that he was filling in for Cary. Kevin stated that the plans and specifications were all complete. They still have specifications that need to include the schedule for the construction. There was a debate at the last meeting about construction windows. That is still being looked into, coordination needs to be done, *etc*. That all was put on hold somewhat because funding was not available for this fiscal year until this week. Funds became available at the first of the week so the contract can go forward now. Kevin went through the schedule for construction shown on the handout. Elements that can be started on right away are the crane components and the electrical components. Kevin provided a description of what work will be done. The south shore is getting mostly electrical work, and north shore work is installation of the cranes, additional electrical work, and mainly isolating the pump system. There was discussion on the contract and the work that is to be done at Ice Harbor Lock and Dam (Ice Harbor).

Dave Hurson stated that everything has to be sequenced so that everything is done in the right order. Discussion continued on the work to be done.

Steve Rainey suggested that updates at the FFDRWG meetings would help, and they need to let Larry know in advance of each FFDRWG meeting.

(2) Lower Monumental. Kevin Crum distributed handout # 2A (see appendix 1), Lower Monumental Lock and Dam. Kevin stated that they identified some problems with the design on which they were working. They are now at plans and specifications. The decision was made that the alternative being developed needed to be stopped because there were issues with the pump, the intake in the tailrace, whether it needed to be screened, and the location being close to the adult entrance near unit six. Some of the work done at Lower Granite has given them some good ideas that they would like to take advantage of at Lower Monumental. Kevin stated they have a contractor taking a detailed look at the fishways, and they are also going to do a detailed hydraulic model. That will be done at both Little Goose and Lower Granite. There was discussion on the detailed look at the fishways. Sean Milligan stated the walk throughs have given them a much clearer understanding of how things work or need to work. Discussion continued on the auxiliary water supply system.

Steve Rainey asked if there would still be access to the gates?

Dave Hurson stated that the only place there are gates on the Snake River is at Ice Harbor. Discussion continued on the gates.

Kevin Crum stated that most of the information needed was on the handout. Dave Hurson stated that this year they are looking at buying all new gear boxes and pumps.

(3) Little Goose and Lower Granite. Kevin Crum distributed handout #3A (see appendix 1), Little Goose – Lower Granite Phase II Technical Report. Kevin stated that they received no comments on the Little Goose and Lower Granite summary report handed out at the last FFDRWG meeting. They have started plans and specifications with Sverdrup, as mentioned on Lower Monumental. They are going to do a detailed hydraulic analysis of those systems. At Little Goose they are installing new pumps in the intakes. That is a fairly large job, and budget costs right now are over $6 million, but all the other alternatives were just as high or higher. At Lower Granite, the recommended alternative was to use the three existing pumps, and there is enough capacity to run two pumps and keep one as a spare. Pump one is still being repaired.

Steve Rainey asked if that was the one that is variable speed that just never operated?

Dave Hurson stated that it was never designed to operate at low tail water. Discussion continued on the pump system at Lower Granite.

Steve Rainey asked if at Lower Granite the electrical system was in pretty good shape?

Dave Hurson stated that some electrical upgrades are being done for the pumps. Kevin Crum stated there was a Value Engineering (VE) study going on at Little Goose and the rest of the schedule should be at 60 percent. This should be reviewed at the April FFDRWG meeting. Advertising could be done at the end of this fiscal year to start installing during the next winter window. Kevin stated that was not correct. They would advertise before the next winter window, let contractors in, and then have bid opening in March 2002.

Larry Swenson asked about correspondence regarding what kind of pumps to use and whether they should be submersible. Larry asked if anything more had been learned.

Kevin Crum stated that he had not heard anything but thought that was one of the things they were reviewing. The project has a real preference, they do not want submersibles. They are quite a bit less expensive, but that is a recommendation that comes out of VE. Discussion continued on the different pumps at the various dams.

Steve Rainey asked if the bid opening for Ice Harbor was going to be in December.

Kevin Crum stated that for Ice Harbor it would be earlier, the intent was to have it in December, but, because there were not any funds at the start of the fiscal year, they were not able to do that. Discussion continued on how much funding had been requested for the project.

Larry Swenson asked how the detailed hydraulic analyses tie into the preparation of the plans and specifications at Lower Monumental and Little Goose.

Kevin Crum stated that they were trying to expedite the hydraulic work and somewhat slow down the plans and specifications so there would not be an issue. They will have an initial look at the hydraulics in March. There was discussion on the hydraulic modeling and calibrations.

Larry Swenson asked about the modeling being done at Lower Monumental and Little Goose. Dave Hurson stated it could be done right now with existing conditions. Larry Swenson then asked if after the modifications planned, are done will the models not be any good?

Dave Hurson stated they were looking at adding backup water supply, not changing the existing system. Kevin Crum stated that it would be basically modeling what exists now. They found in some cases on the Columbia River operational changes were enough to get them backup water. He was optimistic because they have done those models and have a lot of experience so the first look at the model is going to be pretty close.

(4) McNary Upgrade Study Team.

Dave Coleman stated that he and Jim Bluhm are Co-Program Managers on a study team called MUST (McNary Upgrade Study Team) with BPA and the Corps. The reason for the study team is McNary is an old dam built in 1953 and has never had any rehabilitation. There are problems with the turbines. The Corps is considering ending their useful lives by replacing the windings with state-of-the-art which will increase generation using the same amount of water. Using state-of-the-art turbines instead of the 1953 turbines would be more efficient - get more megawatts per gallon of water. Replacing the existing system with the latest technology wil yield more megawatts. Another problem McNary has is a hydraulic bottleneck on the river. Ice Harbor and Priest Rapids can run more water through their generators than McNary. John Day can pass more water. They are going to try and do this and make it a friendlier fish passage. There was discussion on this study.

Dave Coleman stated that the next meeting would be on the 15th. The big concern right now is the economics and how much in-depth study should be done. The next phase is trying to put a finger on how much water will be at McNary. There was discussion on turbines and quantity of water.

Rebecca Kalamasz asked for questions associated with the general concept and the schedule.

Steve Rainey stated that they appreciated being advised of this. His question was, what kind of a role and at what point would they envision for the agencies, and would it be to get updates periodically?

Dave Coleman stated that around April they should have the turbine and generator economic evaluation squared away and, at that time when they have more of plan, they will be meeting with Pete Poolman and get his staff involved with the environmental issues and fish issues, *etc*. Dave also stated that this is a brand new project that is just getting started so there is no real plan for anything to be done; it is only in the study stage.

Rebecca Kalamasz stated that they were going to move the Separator Improvements above the Debris Program update, then they would do Extended Screens at Lower Monumental, then return to the original agenda.

b. Separator Improvements - McNary. Dan Katz stated that this was a status report on the separator program. Dan distributed handout #4A (see appendix 1), Evaluation Separator. Dan stated last December the biological test reports were due. Coming up this spring, they have some modifications and testing at McNary and Ice

Harbor. At McNary it is some modification to the existing separator and insert that will be able to be removed.

(Larry Swenson rejoined the meeting by phone.)

Operations have requested that they make the Ice Harbor test facility a permanent facility. They have been instructed to look at painting Ice Harbor instead of removing it. Painting would cost about the same as removing it. They want it to become permanent so it can be used as an emergency bypass around the existing facility, and there would be no impact if left there.

Steve Rainey stated that what they have there currently is the main juvenile bypass and sample loop, which is the test separator. Steve asked how this could be an emergency bypass.

Dan Katz stated that it could serve as bypass around the entire sample facility. There is a main bypass, a sample facility, and a test facility, and they have requested that they leave the option of passage around the sample facility.

Steve Rainey stated you could do passage around the sample facility by maintaining flow all the way through the existing juvenile bypass system.

Dave Hurson stated he thought they were talking about if something happened to the drop gate or anything downstream, then, they would have a way to bypass that while they fix it. There was discussion about the test facility.

Rebecca Kalamasz asked if there was anything else that had to be done besides the painting; any kind of maintenance? Dan Katz stated that to his understanding the only thing necessary was the painting. Lynn McComas stated that there are a lot of mechanical components, but they are pretty much the same specifications as the permanent facilities. The maintenance is very minor.

Dan Katz stated that one task was to get ready to do painting this year. The second task is to prepare the final separator report. This is the last year of testing and evaluating various separator alternatives. By the end of this fiscal year they intend to produce the final report that will summarize all the biological test results and provide a recommendation for either modifications or replacement of existing operational separators. They are also looking at criteria for separator design at Lower Granite. For Fiscal Year 2002, the facility at Ice Harbor will be painted, and prepare plans and specifications prepared for a high velocity separator at Lower Monumental. There was discussion about the high velocity separator at Lower Monumental.

Steve Rainey asked what kind of efficiencies were at Little Goose and if they are similar to Lower Monumental? Dave Hurson stated that it was much better.

There was discussion about the differences between Little Goose and Lower Monumental.

Dan Katz stated that this was not a final decision yet because they had another season of testing operational separators at McNary. Discussion continued.

Dave Hurson asked when the final separator report on Ice Harbor would be done?

Lynn McComas asked if he meant for all the years that they have tested. Dave said, Yes. Lynn stated that he had two reports still sitting in Seattle waiting to be edited, but Rebecca has the draft of both. This year includes McNary and Ice Harbor together because that is how it was funded. Rebecca Kalamasz stated that he was on schedule; they are just having trouble getting through the editing office on the final report. Steve Rainey asked how long it had been sitting up there? Lynn McComas stated that this year they finished 1997; he sends them to Seattle every year. The discussion continued on the reports not yet back from Seattle. Rebecca Kalamasz stated she had drafts.

Dan Katz stated that they are going ahead for planning purposes pending final results of the tests at McNary. They are looking at constructing a high velocity separator at Lower Monumental in the fall of 2002 and operating in the spring of 2003. Some good separation conditions were found at Ice Harbor that improves efficiency and more or less eliminates injury rates. Now they want to see if they can go a little bit better and look at some non-hydraulic conditions with those best hydraulic conditions. That is the purpose of the Ice Harbor testing. The non-hydraulic conditions are lighting above the separator and sub-screen color. There was discussion on light testing.

Dan Katz talked about the modifications of the operational separator at McNary. Lynn McComas showed some Corps drawings. Bill Hevlin asked where the shelf was going to go. Lynn McComas showed on the slide where the shelf would go, stating that above that was the de-watering. The A and B section is a separator, they were going to concentrate their test on the A section. Lynn pointed out that the bars are contained in a frame and can be lifted out by undoing four bolts. Lynn went over the slides, and there was discussion on the modifications. Steve Rainey stated before the insert there was up-welling that provided quite a bit of flow down into the down well. Now, instead of a lot of flow, there will be a reduced flow going through that orifice, so there will be less flow. His main concern is how it will work hydraulically. Discussion continued on the slides and modifications. Dave Hurson asked how deep the water level over the bars would be. Lynn McComas stated it would be about the same point, but they would adjust the insert. Discussion continued on water levels, dewatering, upwelling, and fluctuations. Dan Katz stated that adding dewatering gives more flexibility. It is possible to shut it off and put it back the way it was. The idea is to have a separate valve control. Discussion continued on the water levels. Steve Rainey stated his concern was that in a permanent facility where you can not avoid some amount of surging, you will have to have an automated ability to adjust how much flow you are pulling out immediately upstream at the separator bars or have somebody tweaking that all the time and standing there watching it. Dave Hurson stated he thought the ideal thing to do was to have an Ice Harbor style flume de-waterer to control the drop gate. Discussion continued. Dan Katz stated that they were not trying to put in the ideal (unclear) control here. They are trying to add a little bit more flexibility so that they have a potential for running less flow into the separator. Steve Rainey asked if he meant for this test that they were not trying to solve permanent problems of surging. Dave Katz stated that was right. The discussion continued on the water depth during this testing. Bill Hevlin asked how many blocks there were in the study design. Lynn McComas stated that there were four, in and out is two, lights on and off is two. Dave Hurson asked how many repetitions? Lynn McComas stated that it works out to about six repetitions of each one. Dave Hurson asked how often during the season, and if it would be every 2 days for the whole spring? Lynn McComas stated that was right. Rebecca Kalamasz stated then it would be 24 times. Lynn McComas stated that was correct. Dave Hurson asked what they would use for their sample and if it would be just a daily, 24-hour sample? Lynn McComas stated that was the next thing they were going to get into. They are not going to handle the fish; they are only going to look over the shoulder of the small ladder. There was discussion on samples and fluctuations.

Dan Katz stated that he could see two hydraulic concerns. One is coming down the volume exiting, and what that does to the velocities upstream. Dan stated he had not run exact numbers on that, but they are approximately cutting the flow in half and also reducing the volume. There was discussion on this first concern. Steve Rainey suggested they talk about trajectory. Dan Katz showed a slide explaining that it was just a crude look at the trajectory of the jet from the orifice. There was discussion on the trajectory. Lynn McComas stated the only fish they would handle would be to test for physiological changes or stress testing. Steve Rainey commented he would like to arrange for Larry to come out and observe these hydraulic conditions in advance and touch all the bases, and when they are running a lot of fish through this thing, they need to establish a density criteria at which time you say we are just holding these fish up. There needs to be some sort of fail safe basis for saying we need to discontinue temporarily or discontinue for the rest of outmigration. These bases need to be touched just in case that kind of thing happens. There was discussion about density and possible problems. Lynn McComas said he was having a problem finding a hospital that would give him decent turn around time for the physiological testing. Rebecca Kalamasz stated she could get a hospital. Discussion continued. Steve Rainey asked when they would start their study. Lynn McComas stated their start date was April 19. Dave Hurson asked when it would be ready to field test? Brad Eby stated they thought they could have water up to the separator by March 1 this year.

c. Debris Program.

(1) McNary Gatewell Debris Model. Sean Milligan gave a brief update on the debris model at McNary. He passed around a sample of debris. When they looked at the model, it appeared that the blend of debris they came up with works very well as far as how it visually behaves in the model. It does not tend to float or sink, so it follows

the flow like most debris. The first phase of testing the model was just baseline testing trying to establish the debris concentration that they wanted to test to compare alternatives in the second phase. They started out with very high concentrations and testing to see how long it takes to plug the screen to the standard of 1.5 head differential on Vertical Barrier Screen (VBS) screens. They are measuring debris quantity by weight. They have finished the baseline testing and are ready to move into the next phase of testing, which is looking at some different alternatives. During baseline testing there did not appear to be any new or unusual magical alternatives emerge as the solution. One of the alternatives to look at is orifice shelter. There was discussion on the McNary debris model. Steve Rainey explained to Larry Swenson that what Sean was showing was a schematic of VBS, showing the different panels and how debris is plugging on them. The upper four of six are accumulating debris more quickly than the lower two. Discussion continued on the debris model.

(2) The VBS. Sean Milligan showed a digital picture of the VBS. The debris modeling takes longer than anticipated. They think it will be close to the end of March when they finish getting data to come to a definite alternative. There will be debris testing at Lower Granite in order to do some comparison between Lower Granite and McNary, in March before Portland District starts testing at John Day. There was discussion on the test at Lower Granite. Sean stated that everyone needs to be aware that after all their efforts in testing, none of the alternatives may be the magic answer for handling debris. Discussion continued. Sean stated that there was a variety of different tests or alternatives that they were going to try. Steve Rainey asked if they would all be summarized in the report. Sean Milligan stated, yes, it would be, and the report would be out sometime after the end of March. Discussion continued on the debris testing. Bill Hevlin asked what an orifice shelter looked liked. Sean Milligan drew him a picture and explained what it was and how it worked. Discussion continued on the pros and cons of the orifice shelter.

d. Extended Screen – Lower Monumental. Sean Milligan stated that the extended screens at Lower Monumental were actually new as opposed to being an update. They are looking at the potential for installing an extended length screen system at Lower Monumental. The primary reason for looking at that is because it is in the Bi-Op. The plan is not to just jump in and design new screens for Lower Monumental. They first want to look at the problem and see how it should be addressed. Key issues include geometrical differences or similarities between Lower Monumental and other projects that already have extended screen systems, look at the potential for modeling, amounts of debris, gatewell flows, porosity plates, which size holes, *etc*. They plan to have a preliminary outline for addressing the issues by the end of March, 90-percent report by the end of June, and a final report by mid August.

e. Adult Collection Channel Fallback. Kevin Crum distributed handout #5A (see appendix 2), Adult Fallback Alternatives Concept Study (50-percent submittal) and handout #6A (see appendix 1), McNary Adult Fallback – Collection Channel. Kevin stated they had a task order with HDR Engineering to look at three things. They are looking at a 36-inch Passive Integrated Transponder Tag (Pit-Tag) design at McNary and also the debris issue in the facility piping in the fish facility below McNary. Kevin stated that by the next FFDWRG meeting they would be really close to final reports on recommendations on what is actually going to be done. They are doing a study on the fish that fall back through the screen system and get into the collection channel. They are looking for ways to move them out of there and where they need to go. In the report, they asked for hand sketches, so the diagrams are just rough ideas of different concepts. Any comments should be sent to Chuck Palmer. They looked at five alternatives in the report. One was a moving array of strobe lights to try to get a behavioral response and move fish downstream to exit through the fish facility bypass. Another was a fixed strobe light array where sequential lights would do the same thing. Another was a mechanical crowder system that periodically would kick into gear and physically move the fish downstream. They looked at a couple of steep pass ladders at the end of the collection channel where the fish would move volitionally out of that area and either go to the forebay or to the tailrace. When it was reviewed, neither of the strobe light options looked very good. There were too many obstructions of the orifices in the collection channel. They did not like the mechanical crowder either. They are turning their attention to the steep pass ladders at the end of the collection channel. There is a lot less complexity, a lot less expense, and a lot less maintenance overall. There was discussion about the concept study. Steve Rainey asked what kind of ride the fish have to the tailrace? Dave Hurson stated that a slide is being proposed. Steve Rainey stated he thought the concept study was moving in the right direction. Kevin Crum stated that they were looking for comments to be sent back by February 8. Rebecca Kalamasz asked why they did not have both, to the forebay and the tailrace in the springtime to the tailrace in the summer and to the forebay in the fall? Dave Hurson stated that in the fall the fish go all the way down below Bonneville and John Day. There was discussion on the fish going upstream or downstream and the tailrace versus the forebay.

f. Juvenile Fish Facility Improvements.

(1) McNary Facilities – 36 inch Pit Tag Detection Design. Kevin Crum stated that HDR Engineering, under the same task order, is looking for locations for 36-inch Pit-Tag detection on the juvenile line. Kevin distributed handout #7A (see appendix 1), McNary Fish Facility Improvements – 36 inch Pit-Tag Detection Design stating that a short version of the scope was on this handout. He also distributed handout #8A (see appendix 2), Pit-Tag Detector Preliminary Design Study (30-percent submittal) stating that comments needed to be sent in to Chuck Palmer by February 8, 2001 at the given E-mail address. They looked at five different locations for the system and developed a matrix of the advantages and disadvantages. The recommended location in the report is location two, which is upstream from the separator. Steve Rainey thought that was the best location. Kevin Crum stated that the schedule is tied to the technology. They plan to have everything done by the next FFDRWG meeting with a final report in March. Dave Hurson asked the source of funding? Rebecca Kalamasz stated that it was originally sent to Portland District and we were not informed until November, so there were no funds set aside in the SCT prioritization. The Corps is scrambling to find money left over from projects. The Corps is already over program so it is unlikely, they

will have money to do this unless some money comes from somewhere really quickly. They have been talking with NMFS to see if it can be phased in, maybe in small increments, depending on the cost. Dave Hurson asked what they were asking them to do. Rebecca Kalamasz stated that there were two phases to the study. There is the Pit-Tag detector development for a full flow bypass system and one for surface collection type facilities. There was discussion on the Pit-Tag detector development. Steve Rainey asked if Earl was ready to go. Rebecca Kalamasz stated that he was just waiting for money. Dave Hurson stated that according to Memorandum of Agreement (MOA) they are responsible for the funding with BPA. Discussion continued on the funding of the Pit-Tag detector development. Kevin Crum stated the one thing that needed to be re-emphasized on the Pit-Tag was the primary bypass where the fish will be detected and then bypassed to the river under primary bypass criteria. There was discussion on the primary bypass detector.

(2) Debris Plugging. Kevin Crum distributed handout #9A (see appendix 1), McNary Fish Facility Improvements – Debris Plugging, and handout #10A (see appendix 2), Debris Plugging Preliminary Design Study (30-percent submittal). After the last FFDRWG meeting in October, the scope was expanded to cover some issues. They had HDR Engineering look at three levels of design. Level one was not changing the existing piping levels, configuration, or sizes. They are looking at way to get access to the pipes and ensure they are not clogging. Level two was not changing to a different criteria, keeping with the secondary bypass criteria. However, they are looking at re-routing lines, bringing them above ground where they go underground, which is where most of the problems are, and providing access to clean them. Level three was to redesign the whole facility from the separator on down with primary bypass criteria. There was discussion on the different levels. Steve Rainey asked if there was a turn-around time on the preliminary study? Kevin Crum stated that comments are needed back to Chuck Palmer by February 8, 2001.

The meeting adjourned at 1:20 p.m.

APPENDIXES.

a. Appendix 1 includes those handouts distributed by speakers and referenced in the minutes, including the following:

(1) Agenda. Rebecca Kalamasz.

(2) Handout #1. From Dan Katz, Lower Monumental DGAS and Erosion.

(3) Handout #2. From Kevin Crum, Lower Granite - Removable Spillway Weir Construction Schedule Issues/Update.

(4) Handout #3. From Kevin Crum, Lower Granite SBC Modifications for 2001.

(5) Handout #4. From Tim Wik, Alternative Research Options at Lower Granite Dam during 2001.

(6) Handout #5. From Dan Katz, Lower Monumental Lock and Dam Erosion Video Notes.

(7) Handout #6. From Kevin Crum, Construction Updates; McNary Cylindrical Dewatering Prototype, McNary Juvenile Collection Channel Bulkheads, McNary Perforated Plate Replacement Contract, and Goose-Granite Perforated Plate Replacement Contract.

(8) Handout #1A. From Kevin Crum, Ice Harbor Emergency Auxiliary Water Supply.

(9) Handout #2A. From Kevin Crum, Lower Monumental Lock and Dam.

(10) Handout #3A. From Kevin Crum, Little Goose - Lower Granite Phase II Technical Report.

(11) Handout #4A. From Dan Katz, Evaluation Separator.

(12) Handout #6A. From Kevin Crum, McNary Adult Fallback - Collection Channel.

(13) Handout #7A. From Kevin Crum, McNary Fish Facility Improvements - 36" Pit Tag Detection Design.

(14) Handout #9A. From Kevin Crum, McNary Fish Facility Improvements - Debris Plugging.

b. Appendix 2 includes a complete copies of reports distributed by speakers and referenced in the minutes, including the following:

(1) Handout #5A. From Kevin Crum, McNary Lock and Dam, Adult Fallback Alternatives Concept Study.

(2) Handout #8A. From Kevin Crum, McNary Lock and Dam, Pit Tag Detector Preliminary Design Study.

(3) Handout #10A. From Kevin Crum, McNary Lock and Dam, Juvenile Fish Facility, Debris Plugging Preliminary Design Study.

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Appendix 1
Agenda

Walla Walla District - FFDRWG Meeting
Agenda
January 24th & 25th, 2001
Harvest and Castle Room

Wednesday, January 24

9:30 – 11:30	**Model Updates and Issues** McNary Deflectors – Cain/Emmert Little Goose Deflectors - Cain/Emmert Lower Monumental Deflectors/Erosion/Outfall – Katz/Lindgren
11:30 – 12:30	**Lunch**
12:30 – 6:00	**RSW** Construction Status – Crum Monitoring Plan – Wik/Crum

Thursday, January 25

8:00 – 9:30	**Program Updates** Auxiliary Water Supply – Crum - Ice Harbor and Lower Monumental - Little Goose and Lower Granite Debris Program - Milligan - McNary Gatewell Debris Model - VBS Separator Improvements – McNary – Katz/McComas
9:30 – 9:45	**Break**
9:45 – 11:30	**Program Updates (continued)** Adult Collection Channel Fallback - Crum Juvenile Fish Facility Improvements - McNary Facilities - Reese - Less Intrusive PIT Tag Detection – Reese Extended Screens - Lower Monumental – Milligan
11:30 – 12:30	**Construction and Modifications** McNary Collection Channel Bulkheads – Crum ESBS Screen Replacement - Crum

Adjourn

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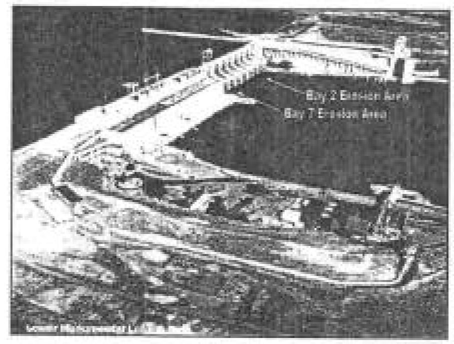
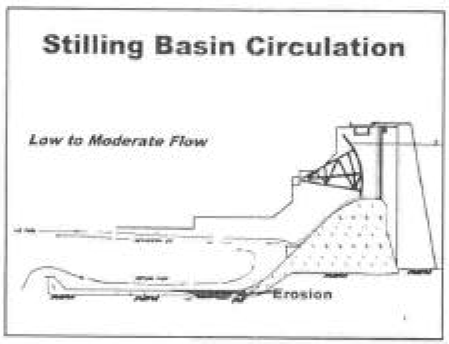
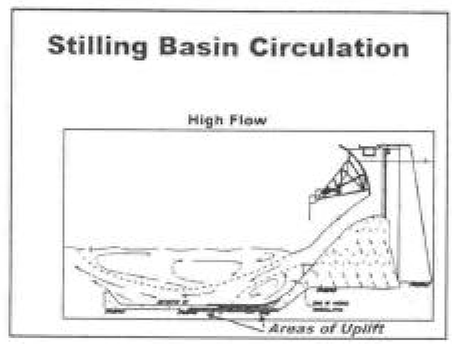
Appendix 1
Handout #1
Lower Monumental DGAS and Erosion

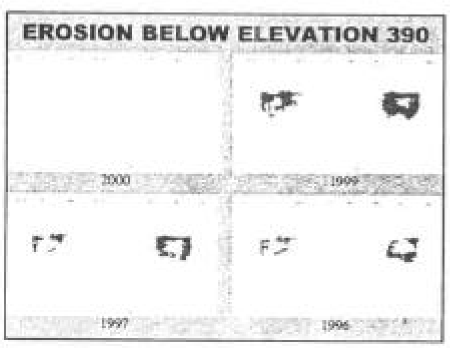
Lower Monumental DGAS and Erosion

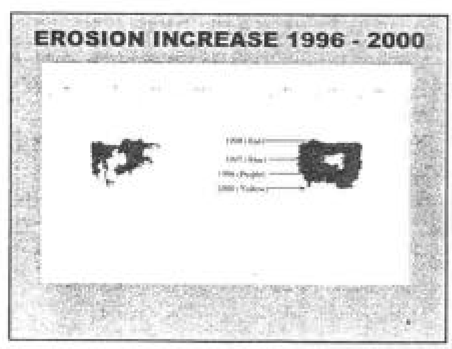
24 January 2001
FFDRWG Meeting
Walla Walla











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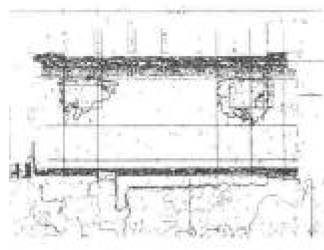
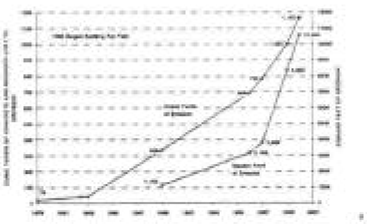
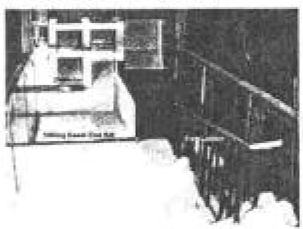
Plan View of Spillway Stilling Basin Eroded Areas (Aug. 2000)



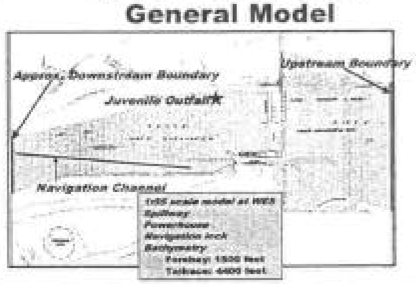
Volume and Area of Erosion Below Design El. 392



Sectional Model Downstream View



Lower Monumental General Model



General Model Status

- Construction: completed December '00
- Calibration: completed January '01
- Verification: to be completed end of Jan. '01
- Testing: Begin 5 Feb '01

Sectional Model Status

- Preliminary debris movement tests completed
- Modifications to test uplift in progress
- Uplift testing: February '01

2

Lower Monumental Spillway Stilling Basin and Tailrace Modifications

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2001 Interim Spill Coordination

- Sectional Model: Uplift Tests - Feb.
- General Model: Interim Spill - Feb.
- Structural Analysis of Uplift - Feb.
- Fish Agency and Internal Review - Feb. and March
- View models at WES: March 5-9 (Tentative)
- Recommend spill pattern to Operations Division by 1 April

Purpose of 2001 Interim Spill Tests

- Sectional Model: Uplift Tests - Feb.
  - Determine if uplift is near safety threshold
    - Present erosion
    - Anticipated erosion
- General Model:
  - Determine if stilling basin flow pattern will increase hole size
  - If needed, find new spill pattern
    - Dam Safety
    - Annual Repair Costs
    - DGAS and Fish Passage
    - Navigation

3

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Appendix 1
Handout #2
Lower Granite - Removable Spillway Weir

②

Lower Granite -Removable Spillway Weir
Construction Schedule Issues/Update

1. Dix Corporation, Spokane WA, was awarded the RSW contract in September 2000. The major subcontractor for fabrication is Thompson Metal Fab Inc., located in Vancouver WA. The fabrication shop is located adjacent to the Columbia River, convenient for delivery of the RSW to the river for transport to Lower Granite.

2. **Schedule:** The contract required delivery and installation of the RSW by 15 March 2001. The contractors initial schedule (October 2000) indicated delivery on that date.

- *28 November 2000:* Meeting with contractor in NWW. The contractor submitted a revised schedule that indicated the delivery on **9 April 2001**, about 3-weeks behind schedule. The COE corresponded with the contractor to add shifts to gain on the schedule. The contractor began working (2) 10-hr shifts, 6 days per week. Thompson hired additional fabrication shops to occupy their bays to expedite assembly.
- *19 December 2000.* Meeting at Thompson Metal Fab. Discussed the contractor schedule. It became apparent that they were not gaining ground on the fabrication even with increased shifts. The COE estimated the fabrication was about 5 weeks behind schedule.
- *9 January 2001.* Meeting at Thompson Metal Fab. (ee photo). Contractor submitted a revised schedule showing **7 May 2001** delivery; about 7 weeks behind required schedule. The COE confirmed that the contractor cannot work past 15 March for in-water efforts (without approval), and will need to evacuate the area near spillbay #1 by 1 April due to fish out-migration and spill. **It was acknowledged by all attending, that given the constraints of the work windows and lack of more options to expedite the fabrication process the RSW couldn't be installed prior to the April fish outmigration.**

3. **Discussion points for Jan 24/25 FFDRWG:**

- The Contractor indicates the work on-site (at Granite) can be completed prior to the fish season. This work consists of the alignment hardware and seal attachments to the face of the dam at spillbay #1, and the landing pad upstream of the spillway (See graphic). The COE will coordinate with agencies requesting extending the in-water work window 15 days (to the end of March 2001) to ensure the landing pad construction can be completed.
- The COE will coordinate final installation plan of the RSW when flows and fish numbers allow.
- Discuss M&E plans, altered operations if necessary, and other coordination issues related to the delayed delivery of the RSW.

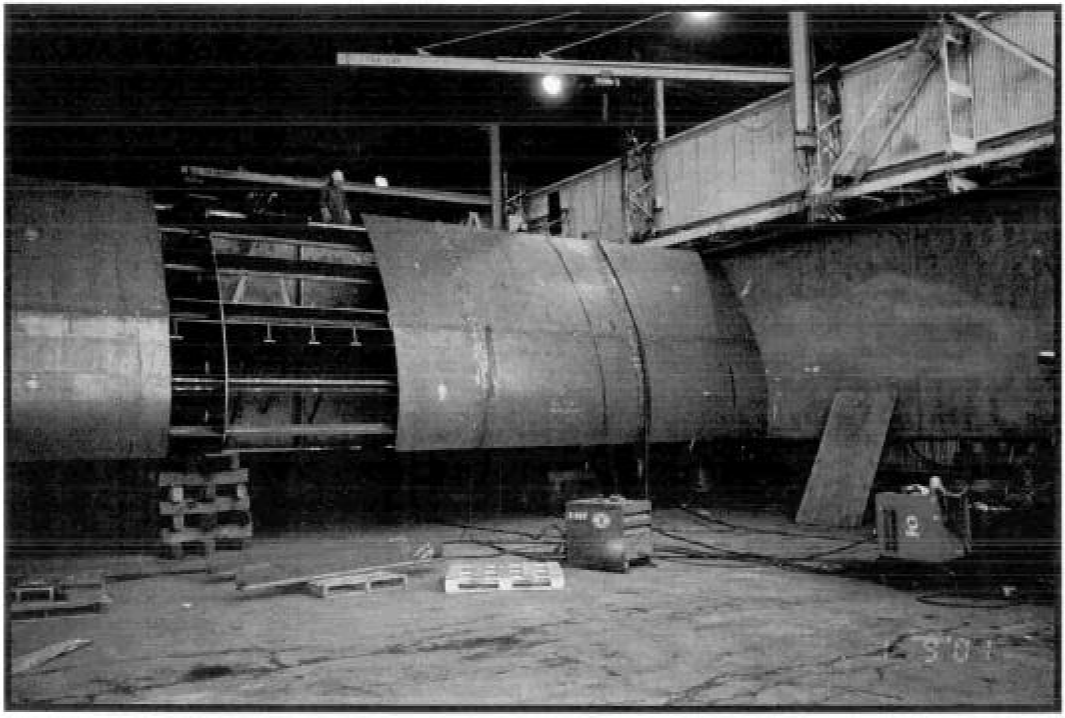
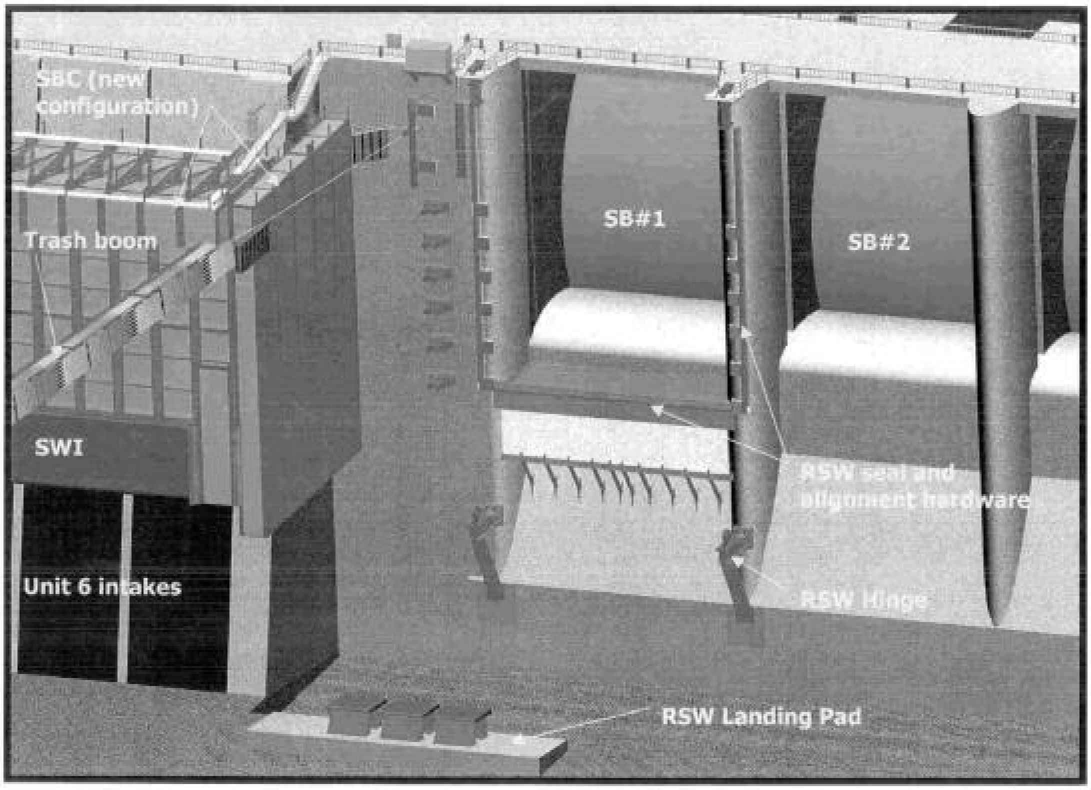


Photo of RSW module taken 9 January 2001



Configuration without RSW attached to hinges (no RSW)

Appendix 1
Handout #3
Lower Granite SBC Modifications for 2001

③

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

Lower Granite SBC Modifications for 2001

Description: Goebel Construction

Status: Work is essentially complete – new modules are installed, stairs and access are complete, trash boom has been realigned. Dive crew is available for any miscellaneous diving needed (fish monitoring equipment installations).

RSW Issues/Discussion points

1. Coordinating work with the contractor to focus on installation of the "fixed" elements on the face of the dam, and the bottom landing pad. COE has obtained the state 401 certification to conduct excavations. Excavation is starting today (Jan 24). COE also coordinating extension of work window from 15 March to 31 March.

2. Discussion needed on when install of RSW can resume. Considerations are:
   - Hydraulic: COE recommends finish installation of the RSW to conduct hydraulic test in June, to allow time to view operation and begin any corrective measures as soon as possible. Potential issues are:
     - Hydraulic "ridge" formations identified in the modeling – visually verify.
     - Potential spillway crest cavitation damage. Verify by dive inspection (upstream), and downstream of tainter gate.
     - Seal issues – verfiy seal transition at spillway crest. Verify seal around peirs and below RSW.
     - If issues become apparent, need time to set up conditions in hydraulic models, conduct tests, coordinate with agencies, as soon as possible.

   - Biological: Hydraulic visual inspection may lead to changes in approach on biological tests. Need information soon as possible, to adjust approach if needed (for FY 02 testing plan).

   - Fiscal: Extension of contract dates will increase cost of overall project. Costs to store RSW awaiting installation, costs for contractor and COE administrative support, and potential for claims may be mitigated by cooperation to finish installation as soon as practicable.
     - Additional costs to RSW displace funds for other CRFMP projects. COE recommends to keep RSW installation costs in FY01, to reduce impacts to projects in FY 01 and 02.

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Appendix 1
Handout #4
Alternative Research Options at Lower Granite Dam During 2001

4

Alternative Research Options at Lower Granite Dam during 2001.

Date: 01/24/01

Title: Three Dimensional Fish Tracking in Conjunction with the Operation of the Lower Granite Removable Spillway Weir (RSW) Tests, 2001.

Study Codes:	SBE-W-00-5
Principal Investigator:	Kenneth M. Cash and Noah S. Adams
Project Leader:	Dennis W. Rondorf

The possible delay in completion of the Removable Spillway Weir (RSW) may result in a decreased research effort at Lower Granite Dam in spring of 2001. We have developed alternative research proposals that will allow us to gather baseline data on potential spill tests while testing improvements to 3D acoustic telemetry systems designed to improve the precision of 3D data. These tests will optimize the system for full implementation in 2002 at Lower Granite Dam as well as other locations throughout the basin (i.e. Bonneville and The Dalles dams). Improvements that need to be tested in 2001 include:

1) Software updates that allow integration of hydrophone position data with every raw signal received from acoustic tag.

2) Changes have been made to tracking algorithms that will improve data resolution and decrease position error caused by multipath.

3) Additional tools have been developed for 2001 field studies that will decrease processing time and the number of personnel necessary to accomplish this task.

4) Refining methods for speed of sound in water measurements using beacon tags and sound velocimeters

5) Determining if increasing hydrophone density improves coverage and increases precision of 3d data.

6) Statistical error analysis tools are currently being developed to map the precision of hydrophone arrays with different geometries. It is necessary to test whether these tools are applicable to field studies by mapping the precision of a hydrophone array using beacon tags and comparing this data with the results of statistical error analysis.

7) The need for accurate and precise measurement of hydrophone position has resulted in high costs for contractors to complete this task. The USGS is currently investigating options that would decrease reliance on other contractors and decrease overall cost of 3d studies. The USGS has surveying equipment available and personnel can be trained in standard surveying techniques. We are currently comparing costs of directly leasing real time kinematic global positioning systems and collecting the data with USGS personnel. It will be necessary to test and refine these methodologies during the course of actual field studies.

One option (option A) would allow us to test all of the items listed above. The second option (option B) would only allow us to test the first three items in the list. Option B would leave many of the most important questions unanswered in 2001. Option A allows us to obtain baseline data in the spillway during 2001 and will much better prepare for full implementation in 2002 at Lower Granite Dam and other areas throughout the basin.

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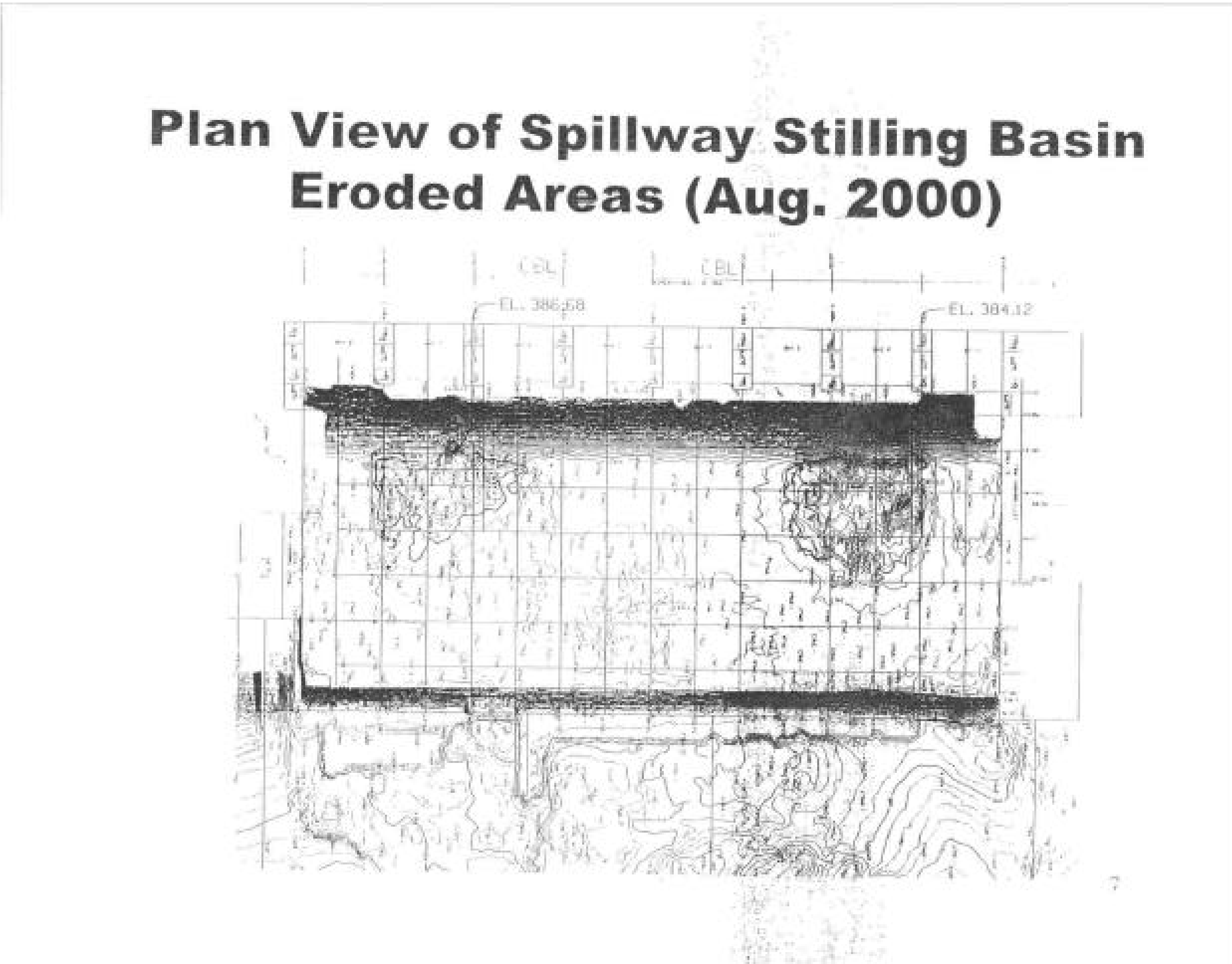
Appendix 1
Handout #5
Lower Monumental Erosion Video Notes

(5)

Notes on review of Tape 1, January 2000 stilling basin diving inspection of Lower Monumental Lock and Dam

Tape 1

Time on Friday, 01-07-00	Observation
13:39:40	Diver is at Bay 1 south training wall
13:47:15	Diver has traversed Bay 1 heading north along N/S construction joint, nearing erosion hole between bays 1 and 2
13:47:48	Diver is at edge of erosion hole near Bay 2
13:49:40	Diver identifies interface between concrete stilling basin floor and underlying basalt
13:50	Diver reports he is at edge of undermined concrete. Reports at least 1-foot of undermining on south side, with loose rock, about 8-inch diameter or less.
13:52	Good view of undercut
13:54:11	Diver reports cobbles are worn but not polished smooth. Diver also says debris is less than 8-inces deep, and the concrete is only 18-inches thick around the outside of the hole. Diver reports undercutting is up to 3-feet on the northeast side of the hole in Bay 2. Here, the concrete thickness is about 4-feet. Rebar is exposed.
13:56:20	Undercut looking N/E
13:57:27	3 foot undercut bedrock, with exposed rebar in concrete
13:58:30	Construction joint on south west side (possibly mis-identified as southeast side). Following trench to east.
14:02:14	Diver reached ogee face (reverse curve at toe of spillway). Diver proceeds along ogee face toward south wall. Diver repeatedly reports exposed rebar (note: possible fish passage concern, since there is no deflector in bay 1?)
14:06:10	Diver reaches south spillway training wall.


Plan View of Spillway Stilling Basin
Eroded Areas (Aug. 2000)
EL. 386.68
EL. 384.12

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Appendix 1
Handout #6
Construction Updates

(6)

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

Construction Updates:

1. McNary Cylindrical Dewatering Prototype

<u>Construction Contractor:</u> Triad Mechanical.

<u>Status:</u> A change order was issued in mid-October to remove the drum section and correct design and fabrication problems. A dispute caused substantial delay in resolving the design and fabrication issues. At present, the system has not been tested due to the drum assembly issues (clearance issues prevent the drum to rotate). The contractor has recently mobilized and has began to resolve the issues. It is anticipated the effort will be complete the second week of February.

- Biological testing will begin in the spring of 2001.

2. McNary Juvenile Collection Channel Bulkheads

<u>Construction Contractor:</u> Knerr Construction.

<u>Status:</u> Last winter, 12 of the 42 slots were completed due to problems with the dewatering system. The COE redesigned, fabricated and tested a new "dewatering" bulkhead.

- The new system worked well, and the contractor is completing the last bulkhead installation this week (Jan 22-26).

McNary Perforated Plate Replacement Contract

<u>Status:</u> Successful low bid is S&R Industries.

a. Two prototype screens have been retrofitted with the new perf plates. Contractor is presently about 1-month behind schedule.
b. Complete remaining ESBS screens by 30 June 2001. Use prototypes to keep units screened and operational during the fish season.

<u>Issues:</u> COE trucks to haul equipment have successfully hauled the screens to the work area. Bolts for the new attachment are not available (one domestic supplier), and may cause delay. Contractor has indicated he can make up lost ground before contract deadline.

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

Goose-Granite Perforated Plate Replacement Contract

Status: Contractor: GTE Metal Erectors. Replacement work is proceeding. Goose has 11 screens completed, 1 in progress. Granite has 5 screens completed, 4 in progress. Contractor states he can complete on time, but COE is not as optimistic.

Issue: Contract completion date is 31 March. If contractor is not complete, need to coordinate using the prototype screen while working on one screen (at a time) until replacement is done.

DRAFT

Appendix 1
Handout #1A
Ice Harbor Emergency auxiliary Water Supply

(1 A)

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

Ice Harbor Emergency Auxiliary Water Supply PM – Cary Rahn

Status: Plans are complete. Specifications will be revised to include schedule for construction, plan for activities, based on accessibility. Funds have recently been obtained (in January 2001) to initiate the contract. Schedule impact due to funds arriving later in FY 01.

Schedule:
Advance notice: February 2001
Advertise contract: March 2001
Open Bids: April 2001
Start Construction: Procure crane and electrical components - August 2001
Initiate fishway modifications: Winter 2001-02. Schedule being developed. Anticipate access and construction in fishways to be over several winter periods.
Complete Construction: TBD. The adult fishways are down for minimal time each winter for maintenance. Cost engineering is working on a schedule to maximize work effort while maintaining adult egress. This will determine number of winter window periods needed to complete the work.

Ice Harbor - North Shore
Upgrade and isolate the existing pump systems, modify the diffusers to allow more flow, install cranes for access and maintenance, and maintain existing systems and upgrade spare parts inventory.

Ice Harbor - South Shore
Upgrade and isolate the existing pump systems and maintain existing systems and upgrade spare parts inventory.

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Appendix 1
Handout #2A
Lower Monumental Lock and Dam

2A

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

Lower Monumental Lock and Dam - PM – Cary Rahn

Status: A-E (Inca) has initiated efforts on new alternatives. Detailed hydraulic analysis will be conducted on the identified alternatives. A report will be prepared similar to the Phase II Technical Report prepared for Goose/Granite.

Schedule:
Site visit: 16 December 2000
Conduct initial detailed hydraulic analysis – March 2001
60% Alternatives Report - March 2001
Subsequent submittals: dependent on what alternatives are identified, schedule TBD

Initiate P&S: (depending on funds and priorities) Oct 2001.

Advertise: December 2001
Contractor inspection of adult systems: Jan-Feb 2002
Open Bids: March 2002
Start Construction: June 2002

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Appendix 1
Handout #3A
Little Goose - Lower Granite Phase II Technical Report

3A

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

Little Goose – Lower Granite Phase II Technical Report – PM Cary Rahn

Status:

- **Final Phase II Technical Report** was completed in Sept 2000. A summary of the report was provided at the October 2000 FFDRWG. No A&T comments have been received on the material provided.
- **Phase III (P&S)** initiated with Sverdrup for both Goose and Granite in December 2000. A VE is being conducted on the recommended alternative at Goose (Jan 01).
  - A detailed hydraulic analysis has been initiated at Goose-Granite. Site visits were conducted at Goose (Jan 17) and Granite (Jan 18). The initial hydraulic analysis is due for review March 2001.

Goose recommendation: Install three new pumps in the roof of the existing intakes. Pump flow to diffusers 1 and 2, which are isolated from the AWS system during operation. Budget cost 6.663M

- **Status:** no changes in recommendation at this time.

Granite recommendation: One pump spare capacity exists, (assuming pump 1 is operational after current repair). Two of the three pumps can meet FFP criteria. Install oil heaters for the speed reducers to increase reliability. Install electrical upgrades (auto transfer switch, reconfigure the pump supply system, physically separate motor control centers for the pumps). Expand spare parts inventory to increase reliability. Budget cost $350,000

- **Status:** no changes in recommendation at this time. Ops is currently repairing pump #1. It is recommended to fund (CG) installation of Falk gear reducer and base supports, so all machinery are like equipment. The spare gear reducer will be the same machinery (Falk).

Schedule (Goose/Granite):

Initiate task order to prepare P&S: December 2000 (Completed)
Value engineering study: January 2001.
Prepare 60% P&S and tech review March 2001.

Prepare 90% P&S May 2001
Prepare BCOE and tech review – July 2001
Advertise Oct 2001

Contractor inspection of adult systems: Jan-Feb 2002
Open Bids: March 2002
Start Construction June 2002
Complete construction: (dependent on funds/priorities)

- Goose: TBD: assume winter(s) 02-03 and 03-04.
- Granite: Winter 02-03

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Appendix 1
Handout #4A
Evaluation Separator

4A

Evaluation Separator
FFDRWG Meeting
Walla Walla
January 25 2001

FY01 Tasks

- December 00 - Biological Test Reports due.
- Winter/Spring 01 - Existing operational separator modifications & testing - McNary
- Winter/Spring 01 - Lighting & substrate color tests - high velocity separator - Ice Harbor

FY01 Tasks

- Prepare to paint test separator at Ice Harbor (convert to permanent status)
- Prepare Final Separator Report
  - Summarize test results
  - Recommend modification or replacement of existing operational separators to improve efficiency and reduce delay.
  - Recommend criteria and configuration for separator design for application at Lower Granite.

Proposed FY02 Tasks

- Construction contract - paint test facility at Ice Harbor.
- Prepare plans and specs for second generation high-velocity separator at Lower Monumental.

Proposed FY03 Tasks

- Fall '02 - Spring '03: Construct second generation high-velocity separator at Lower Monumental.
- Spring '03: Begin operation of new separator at Lower Monumental

Conclusions - Ice Harbor Tests 1999 - 2000

- High velocity
  - Separates efficiently
  - Eliminates delay
  - Has acceptable injury rate
- Separation may be sensitive to non-hydraulic conditions

1

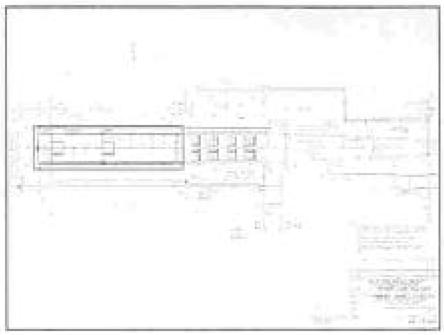
Ice Harbor Test Separator

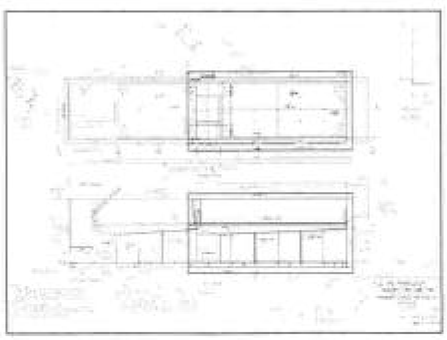
- Proposed testing FY01
  - lighting
  - substrate color

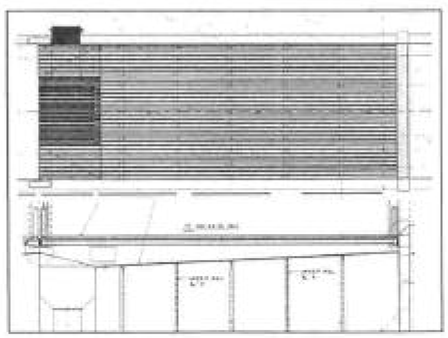
Ice Harbor Test Separator

McNary Existing Operational Separator

- FY01 Proposed Modifications & Test
  - Insert on the "A" side.
  - In- line rectangular exit.
  - shallow floor.
  - Revised bars.
  - Revised operational characteristics.







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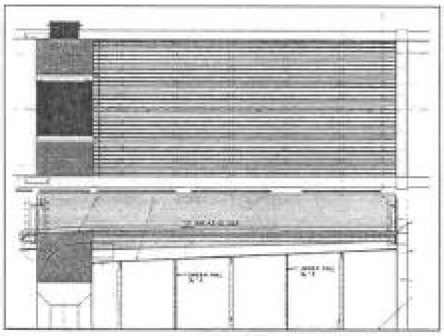

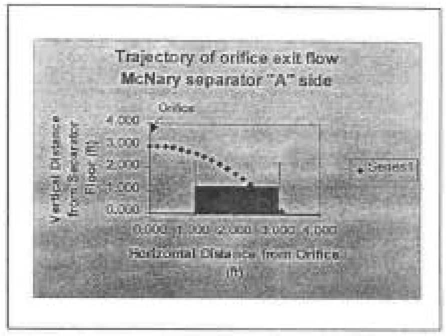
Trajectory of orifice exit flow
McNary separator "A" side
Orifice
Vertical Distance from Separator Floor (ft)
4.000
3.000
2.000
1.000
0.000
0.000 1.000 2.000 3.000 4.000
Horizontal Distance from Orifice (ft)
Series1

3

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Appendix 1
Handout #6A
McNary Adult Fallback - Collection Channel

6A

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

McNary Adult Fallback - Collection Channel

PM – Chuck Palmer

Description: Periodically adult salmon and steelhead fall-back through the turbine intakes and into the juvenile collection system. There is concern that the adult fish are trapped and delayed in the juvenile collection channel and system.

Status: A task order with HDR Engineering (task order 10, task 1.) has been initiated to prepare a report that will describe the problem, detail the approaches used to reduce the impacts, and list advantages/disadvantages of each solution. The report will consider the effects on juvenile salmon and steelhead that may also be present in the system, the desired outcome for the adults (forebay/tailrace release), and potential for fish injuries (adult and juvenile). In addition, operational and maintenance constraints, potential for debris to foul the system or interfere with the operations, and a list of risks and potential failure modes that may exist for will be identified for each concept.

- 50% report – handout. Please provide comments to Chuck Palmer by **8 February 2001**. Chuck.R.Palmer@nww.usace.army.mil

Collection Channel alternatives studied:

- Fixed strobe light array in collection channel to move fish downstream to bypass
- Moving strobe light array in channel to move fish downstream to bypass
- Mechanical fish crowder to move fish downstream to bypass
- Alaska steep-pass ladder and false weir that allows volitional travel to forebay
- Alaska steep-pass and false weir that allows volitional travel to tailrace.

Summary

- The strobe light options do not appear to be viable.
- The mechanical crowder does not appear to be viable.
- The volutional systems (steep pass ladders) provide more advantages, less complexity

Schedule:

Jan FFDRWG	**24-25 January 2001**	50% report A&T handout-review
50% review	**8 February 2001**	comments due to COE (C. Palmer)
Alt selection(s)	**9 February 2001**	select (3) alternatives to develop
100% report	**March 2001**	COE review
April FFDRWG	**3rd week April**	100% report A&T handout -review
100% review	**TBD (May)**	comments due to COE (C. Palmer)
Alt selection	**TBD (end of May)**	select final alternative
Final report	**TBD (June)**	final report -recommended alternative

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Appendix 1
Handout #7A
McNary Fish Facility Improvements - 36" Pit Tag Detection Design

7A

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

McNary Fish Facility Improvements - 36" Pit Tag Detection Design

PM - Chuck Palmer

Description: Develop preliminary designs for adding a 36-inch diameter PIT tag detection system on the main transportation flume. Consult with the necessary COE, biologists and fishery agency personnel. Detail required pipes, supports, platforms, personnel access from existing facility or new dedicated stairway and electrical systems. Install a pit-tag detection system on the main fish transportation flume leading from the collection channel to allow direct (primary) bypass to the river without having to pass fish through the holding facilities.

Status: A task order with HDR Engineering (task order 10, task 2b.) has been initiated to prepare a Design Documentation Report (DDR) that will develop location and design for the pit tag system (structural supports, piping, electrical).

- 30% report - handout. Please provide comments to Chuck Palmer by **8 February 2001**. Chuck.R.Palmer@nww.usace.army.mil

Alternatives Studied:

- Five locations were identified in the report

Summary:

- Recommend location #2 (see report)

Schedule:

Jan FFDRWG 30% review	**24-25 January 2001** **8 February 2001**	30% report A&T handout-review comments due to COE (C. Palmer)
Final report	**March 2001**	Final - preliminary design

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Appendix 1
Handout #9A
McNary Fish Facility Improvements - Debris Plugging

(9A)

Fish Facility Design Review Work Group
Walla Walla District
January 24-25, 2001

McNary Fish Facility Improvements - Debris Plugging

PM - Chuck Palmer

Description: Scope and document preliminary design for modifications to eliminate or minimize debris-plugging problems in the 10-inch Chinook and Steelhead secondary bypass lines. Three levels of effort are being investigated in the report.

Level 1 - Mitigate debris plugging with least disruption to the existing facility and at least cost. Modifications are limited to either pipe joint replacement, existing pipe slip lining, or possible pipe type replacement (PVC to HDPE).
Level 2 - Mitigate the debris plugging and improve capability to maintain and service fish pipes. Maintain the existing piping to the extent possible, but investigate rerouting below grade piping to above grade allowing access for debris removal. Level 1 pipe treatments would also be considered in this level.
Level 3 - Major modification based on NMFS primary bypass criteria. Investigate redesign of system with 24-inch diameter piping, radiuses, and flow criteria.

Status: A task order with HDR Engineering (task order 10, task 2a.) has been initiated to prepare a Design Documentation Report (DDR) to develop alternatives. Then, one alternative will be selected for design development.

- 30% report - handout. Please provide comments to Chuck Palmer by **8 February 2001**. Chuck.R.Palmer@nww.usace.army.mil

Alternatives Studied: Eighteen alternatives were identified in the report

Summary:
- Level 1 - Rework existing piping joints - cost range less than 250K
- Level 2 - Reroute lines, install new piping - cost range 250K - 500K+
- Level 3 - Redesign facility piping to primary bypass criteria - cost range 1.5 - 2 Million

- New pit tag system should allow primary bypass of juveniles (within NMFS criteria) without going through these facility secondary lines. If pit tag development is successful, (as anticipated) it is recommended to install new sections of secondary piping with both steelhead and Chinook lines constructed above ground. Realign the steelhead line. Look into piping linings to smooth joints and transitions. Create access for inspection and cleaning.

Schedule:

Jan FFDRWG 30% review	**24-25 January 2001** **8 February 2001**	30% report A&T handout-review comments due to COE (C. Palmer)
Final report	**March 2001**	Final - preliminary design

Appendix 2
Handout # 5A
McNary Lock and Dam Adult Fallback Alternatives Concept Study

5A

MCNARY LOCK AND DAM

ADULT FALLBACK ALTERNATIVES CONCEPT STUDY

50% SUBMITTAL

November 2000

Prepared by:
HDR Engineering

With support of:
R2 Resource Consultants
and
Fish Passage Solutions

FOR FFDRWG REVIEW 1-24-01

HDR

November 22, 2000

Mr. Chuck R. Palmer
USACE, Walla Walla District
201 N. 3rd Avenue
Walla Walla, WA 99362

RE: McNary Adult Fallback 50% Conceptual Study (10132 016 002 02)

Dear Mr. Palmer:

This submittal is our 50% Conceptual Study for the McNary Adult Fallback project, in accordance with the scope of work for Task Order No. 10 of Contract No. DACW68-00-D-0001. We have developed and evaluated three conceptual solutions for consideration by the District. We look forward to meeting with District staff on December 21, 2000 to present our findings and discuss our evaluation.

If you have any questions or comments concerning this submittal prior to our meeting, please feel free to call me at 503-768-3773.

Sincerely,
HDR Engineering, Inc.

John H Plump, Jr.
Senior Project Manager

HDR Engineering, Inc.

Employee-owned

Suite 500
10300 SW Greenburg Road
Portland, Oregon
97223

Telephone
503 768-3700
Fax
503 768-3737

MCNARY LOCK AND DAM

ADULT FALLBACK ALTERNATIVES CONCEPT STUDY

50% SUBMITTAL

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SECTION 1. INTRODUCTION

1.1 Background

At McNary Lock and Dam, a Juvenile Fish Facility (JFF) guides downstream migrant salmon and steelhead around the powerhouse turbines to the tailrace. Downstream migrant juvenile fish are diverted by intake screens into turbine bulkhead slots. The juveniles exit the bulkhead slots through orifices that discharge into a collection channel that traverses the length of the powerhouse. The fish are then directed into a bypass pipe that delivers them to the juvenile holding facilities and then to the tailrace. Periodically, adult salmon and steelhead "fall-back" from the dam forebay and pass through the JFF. Some of these adults have been observed holding in the collection channel attempting to pass upstream into the gatewell orifices. There is concern that the migration of these adult fish is being delayed as they hold in the collection channel.

1.2 Study Objectives

The objectives of this study are to review the reported problems associate with adult fall-back into the JFF and to prepare a concept report that investigates and identifies options for resolving and/or mitigating the problems.

SECTION 2. PROBLEM DEFINITION

Thousands of adult salmon and steelhead fall back through the juvenile fish bypass system at McNary Dam each year (Table 2-1). These are fish that have migrated upstream over the dam via the Oregon or Washington shore fish ladders. After leaving the fish ladder exit, fish pass in front of the powerhouse and enter into the turbine intakes through the trash racks as do juvenile fish migrating down the river. After passing through the trash racks, many adult and juvenile fish are guided into the bulkhead slots by the extended length bar screens. Those that are not guided pass through the turbines to the tailrace.

Table 2-1: Annual totals of adult salmonids that fell back through the juvenile fish collection facility at McNary Dam1989 through 1999.

Year	Adult Chinook	Jack Chinook	Hatchery Steelhead	Wild Steelhead	Sockeye	Coho	Total
1989	846	7	4687	*	2450	22	8012
1990	1363	**	4026	*	1630	0	7019
1991	1603	**	9232	*	265	55	11,155
1992	1454	**	4666	3456	430	76	10,082
1993	764	224	2647	1658	305	4	5602
1994	236	368	2636	1540	29	6	4815
1995	518	654	3654	1539	31	12	6408
1996	1263	499	4933	1408	66	3	8172
1997	1096	590	4890	1512	197	9	8294
1998	507	256	2354	1582	18	7	4724
1999	715	185	3255	2870	33	36	7094

* Wild steelhead were not enumerate separate from hatchery steelhead.

** Jack chinook were not enumerated separate from adult chinook.

1991 and 1992 were the years of the 1st and 4th largest steelhead runs over the McNary Dam since 1953.

Fish guided up the bulkhead slots rise near the water surface. Six to eleven feet below the surface (depending on the forebay elevation (335 to 340 MSL)), there are two orifices in each bulkhead slot that allow fish to egress to the juvenile fish collection channel. Under current operation, only the south orifice in each turbine bay slot is typically open, though in some bulkhead slots both may be open, or the north orifice may be open if the orifices are being cycled to prevent debris clogging. The orifices are 12-inches in diameter, and are controlled by an air- cylinder operated knife valve.

Upon passing through the orifice, fish are accelerated to 17 to 25 feet per second in the orifice through the three-foot thick concrete wall between the bulkhead slot and the ice-trash sluice. The valve is on the sluice side of the wall about 12-inches from the wall. Downstream of the valve, a short flume discharges the orifice flow to the collection channel that occupies the eastern two thirds of the ice-and-trash sluice. Fish and water plunge into the collection channel with the plume dissipating considerably before reaching the eastern wall of the channel.

Once in the channel, juvenile fish tend to migrate relatively quickly downstream past the dewatering screens and into the collection system transport pipe to the juvenile fish collection facility. Adult fish may pass downstream readily as well. However, some fish hold up in the upper end of the collection channel, and jump at the orifice flow (most prevalent at Unit 14) in an attempt to continue migrating upstream.

Adult and jack (precocious male) salmon that enter the collection channel are all moving upstream on their spawning migration. Most fish migrating over McNary Dam are destined for spawning grounds upstream of the dam. However, some chinook may be destined for rivers downstream of McNary Dam like the Umatilla River fall chinook. These fish have bypassed their natal stream and need to fall back past the dam to continue their migration to their spawning stream. The majority of salmon that fall back through the system are chinook salmon although coho and a few sockeye are also occasionally counted (Table 1). In tagging studies in 1990 and 1991, Wagner, et. al found that most chinook salmon that fell back migrated up the Umatilla River.

Steelhead that fall back through the juvenile fish facility may include a large proportion of spawned out "kelts" that are migrating back to the sea during the spring months (Table 2-2). The majority of steelhead that spawn above McNary Dam are summer steelhead that run in the summer and fall, though there are some earlier upstream migrants that pass at the same time kelts are headed downstream. Steelhead spawn in the spring (mainly in March and April) and the spawned out kelts migrate downstream shortly after spawning. Their arrival time at McNary Dam depends on how far upstream of the dam they spawned. Some kelts are in poor condition and undoubtedly do not survive to spawn again. Some are in very good condition, and if they are successful in reaching the ocean, could return to spawn again. In short coastal streams, up to half the returning steelhead may be repeat spawners, but in the Columbia River, usually less than 5% are repeat spawners.

During the fall, chinook and pre-spawning steelhead make up the majority of the fallbacks through the juvenile fish facility. Because the steelhead are for the most part headed upstream, many will hold up in the collection channel, and many will jump at the orifice flows in an attempt to continue their migration. Under current conditions, these fish either jump until they are exhausted, then drift downstream through the juvenile fish collection system, or they seek another way out and migrate downstream through the system.

As fish move down the channel, they approach the dewatering system at the south end of the powerhouse. There, collection channel flow is reduced from about 600 to 650 cubic feet per second (cfs) to 30 cfs for transport from the powerhouse to the fish collection facility. Three dewatering screens are used. The first is a side-dewatering screen in which about 100 cfs is removed through the west wall of the channel. Then the channel floor slopes upward for about 100 feet. A full width floor screen that occupies this area dewaters another 500 or so cfs. Finally, where the channel transitions from 9-foot width to 3-foot width, a wedge-shaped floor screen removes the final amount of water to provide 30 cfs transport flow down the bypass pipe to the collection facility.

Table 2-2: Monthly counts of adult salmonids released from the juvenile fish separator at McNary Dam, 1999.

Month	Adult Chinook	Jack Chinook	Hatchery Steelhead	Wild Steelhead	Sockeye	Coho	Total
March	0	0	5	12	0	0	17
April	0	0	158	190	0	0	348
May	77	13	136	128	1	0	355
June	23	12	3	25	3	0	66
July	5	14	23	21	22	0	85
August	28	6	304	193	4	0	535
September	224	26	1223	545	1	7	2026
October	194	85	794	625	2	18	1718
November	130	28	457	927	0	11	1553
December	34	1	152	204	0	0	391
Total	**715**	**185**	**3255**	**2870**	**33**	**36**	**7094**

Dr. John Nestler, in studying dynamics in the collection channel, has identified a potential problem with the dewatering screens. There is a lot of vibration and noise associated with the water being diverted through the screens. Dr. Nestler hypothesized that this vibration and/or noise may be responsible for the delay of juvenile fish in passing into the bypass pipe. It is also possible that vibration and noise are responsible for adult fish being reluctant to pass downstream, and it is possible that fish jumping at the orifices near the north end of the collection channel have migrated down to the south end, found conditions they don't like, and are trying to exit via the north end of the channel.

Once the 30 cfs of fish and water have passed down the bypass pipe, they can either be diverted into the main bypass pipe to the river, or by use of the switch gate, diverted over the separator. In the separator, large (adult-sized) fish and debris are removed by the facility technician and put in a 14-inch bypass line back to the tailrace. Juvenile fish are separated by size by the separator. The A-side has separator bars 5/8-inch apart, and most small salmon (chinook, coho, and sockeye) pass between these bars. Larger juvenile chinook and steelhead go between the B-side bars that are 1 ¼ -inch apart.

Fall back of adult fish through the juvenile fish collection/bypass system has occurred since the facility went into operation in 1978, but numbers were recorded starting in 1989 (see Table 1). The numbers and species of fallbacks have been recorded over the years. In 1991 and 1992, the Corps contracted with the Washington Department of Fish and Wildlife (WDFW) to study the problem to determine if there were problems, and if there were solutions to the problems.

2.1 1991, 1992 WDFW Fall Back Studies

WDFW found that there were some injuries and some mortality (typically less than 1%) related to adult salmon and steelhead falling back through the system. The majority of the injuries were due to passage at high velocity through the 12-inch orifices. By percentage, the larger chinook showed the highest injury rate followed by steelhead. Fish that approach the orifice would either be drawn rapidly head-first, tail-first, or in some instances, sideways through the orifice. They could be wrapped around the relatively sharp edge of the orifice. WDFW found that the majority of injuries were bruises and descaling consistent with this type of passage. Forty to 50% of the fish observed in the WDFW study had injuries of this nature, although mortality due to these injuries was less than 1%. The Corps has reported condition of fallbacks for several years, and condition of fallbacks in 1999 are described in Table 2-3.

Table 2-3: Condition of adult salmonids released from the juvenile fish separator at McNary Dam, 1999.

Condition	Adult Chinook	Jack Chinook	Hatchery Steelhead	Wild Steelhead	Sockeye	Coho	Total
Good	600	165	2972	2720	16	33	6506
Fair	42	9	143	75	5	1	275
Poor	57	7	100	57	12	2	235
Dead	16	4	40	18	0	0	78
Total	**715**	**185**	**3255**	**2870**	**33**	**36**	**7094**

It should be noted that many fish, both adult and juvenile, enter the screen bypass system in poor condition. They may be injured (bites from birds or mammals, or scratches from debris or trash racks), or they may be severely infected with fungus on wounds from previous injuries or diseases. While some of these fish die within the collection system, they were not counted as injuries or mortalities from fall back.

WDFW described changes in juvenile fish facility operation to protect adult fish. The main change was to operate fish screens later in the year to prevent fish from going through the turbines. Through 1986, transport at McNary Dam ended about the end of September. Fish screens were pulled for maintenance starting about the end of October. In 1987, the screens were operated through October 29 to determine the abundance of late migrating juvenile fish. Few juvenile salmonids were collected, but the highest rate of adult salmonids fallback was recorded that October. This stimulated the 1991/1992 WDFW study.

The study showed that the highest monthly rate of fallback occurred in October coinciding with the tail end of the fall chinook run and the peak of the steelhead migration. The largest steelhead fall back occurred in November 1990 just before the juvenile collection system was shifted to bypass. Of nearly 7,300 fall backs monitored, over 2,300 were tagged. Of those, 29% re-ascended the fish ladders and passed above the dam. Steelhead that were tagged were observed re-ascending the fish ladders the next spring. Researchers have noted that steelhead, which will spawn the following spring, over winter from John Day Reservoir up to the lower Clearwater River, the lower reaches of Hells Canyon, or in the mid-Columbia River (Bjornn, et al, 1999). These fish move upstream in the spring to complete their migration to the spawning ground. Of the 71% that remained downstream, some migrated to spawning areas below McNary Dam (the largest number to the Umatilla River). Some fish destined for spawning areas above McNary Dam undoubtedly do not re-ascend over the dam to fulfill their destiny.

As a result of the WDFW research, the period when the fish screens were left in and the juvenile fish bypass system was operated for adult fish bypass was extended to the end of December. This left a short maintenance period of January and February to repair and maintain the 42 fish screens, 42 vertical barrier screens, and the collection channel and juvenile fish collection facilities.

2.2 Current Problem

From visual observations, it appears that a significant number of adult fish stay in the northern end of the collection channel, and jump at the orifice flows that enter the collection channel (primarily at Unit 14). Some fish have jumped out of the collection channel and have been stranded on the walkway along the west side of the collection channel. Project personnel have strung netting along the walkway and along the handrail. They have also installed clear Plexiglas covers over the flumes from the orifices so fish cannot jump up into the rapidly flowing water. These measures have greatly reduced the injury rate to fish.

However, there remains the concern that fish are trapped in the collection channel, that their migration is being delayed and that they may exhaust their energies to the point where they cannot reach their destined spawning grounds or survive to spawn. Currently, there is very little data available to quantify the delay and/or injury to those adults holding in the collection channel. John Nestler, WES, has reported that high levels of sound or vibration in the area of the primary and secondary dewatering screen cause fish to hesitate in migrating downstream into the bypass pipe. It may be that adult fish are reluctant to enter this area because of the sound or vibration. Further investigation should be made of this condition.

SECTION 3. ALTERNATIVE DEVELOPMENT

As an initial step, the project team identified five potential concepts for promoting the egress of adult fish from the juvenile fish collection channel. These five concepts were then screened down to three concepts that were developed to the point of conceptual drawings and commensurate cost estimates. The initial five concepts are described below along with the potential advantages and disadvantages of each.

3.1 Project Concepts

3.1.1 Fixed strobe light array to drive fish downstream through the JFF

For this concept, an array of strobes would be mounted along the collection channel and synchronized to flash in a downstream sequence in order to drive the fish towards the dewatering screens and into the bypass pipe. The strobes would be submerged and would be attached to brackets mounted on the wall of the collection channel. Approximately 200 strobes would be required along the length of the collection channel (possibly staggered spacing with 100 on one side of the channel and 100 on the other side). The flashing of the strobes would be electronically controlled and the timing would be adjustable.

- **Advantages:** This system would not require any fish handling in the collection channel, and the light array could be deployed with minimal structural changes. Adult fish driven over the separator would be removed as they are now by the separator technician. The number of fish handled should be about the same as it is now, only fish would move across the separator in a timely manner rather than some fish delaying for days or weeks in the collection channel.
- **Disadvantages:** There is a considerable amount of turbulence and air bubbles are concentrated where each orifice flow enters the collection channel. There are also times when the turbidity, especially in Snake River water as it approaches the powerhouse, may be a problem. These factors may cause the lights to work less effectively than desired. The optimum spacing for the strobe lights is unknown and may vary with water turbidity and season. The duration and intensity of strobe flashes are also unknown. Studies have shown that strobe lights can attract fish as well as repel them. Since the strobe spacing will be fixed, there is some uncertainty about the effectiveness of the strobes. When the light system is activated, it may result in mass movement of adult and juvenile fish to the separator resulting in additional crowding, stress, and handling problems. The number fish coming across the separator could fluctuate drastically if the strobe light system were not run on a regular basis.

3.1.2 Moving strobe light array to drive fish downstream through the JFF:

An array of three strobe lights would be arranged across the channel on a trolley that would travel the length of the channel (one or two segments with trolleys might be required). The strobe lights would be set just below the water surface with the control equipment located on the trolley. The trolley would ride on a rail suspended over the collection channel. With the trolley traveling down the channel and strobe lights flashing at intervals, the desired effect would be to drive adult fish down the channel through the dewatering screen area and down the bypass pipe to the juvenile fish collection facility. A power source would have to be sized and installed for the light array and trolley.

- **Advantages:** This system would have similar advantages to the fixed strobe light array. In addition to the advantages noted for the fixed system, the moving system would provide more flexibility in herding the fish using the flashing strobe lights because the timing and spatial sequencing of the strobes could be adjusted as needed.
- **Disadvantages:** Similar to the fixed strobe array, the turbidity and air bubbles may interfere with light transmission in the water and reduce the effectiveness of the strobes. Also, the herding of the fish could result in mass movement of adult and juvenile fish to the separator imparting additional crowding, stress, and handling problems. The mechanical aspects of this design present additional maintenance concerns.

3.1.3 Mechanical fish crowder to drive fish downstream through the JFF

A mechanical crowder could be installed in the collection channel to crowd fish to the dewatering area so they would go through the bypass to the collection facility. This would require a track (probably on both sides of the channel). A crowder device could run on that track to crowd fish to the dewatering system. At that point, the channel narrows, and structure for the side-dewatering screen cleaner would complicate design of the crowder system. Once crowded to the dewatering area, fish would have to volitionally migrate on downstream through the dewatering area into the bypass pipe to the collection facility.

- **Advantages:** A crowder could be used to crowd fish south from Unit 14 where the majority of the jumping at orifice flow occurs. This relies less on the behavioral response of the fish
- **Disadvantages:** A crowder would require manual operation, requiring additional personnel. It probably could not be designed to crowd fish through the dewatering area. A crowder would require added maintenance and additional spare parts.

3.1.4 Alaska steep-pass fish ladder and false weir to the forebay

An Alaska steep-pass fish ladder could be installed at the far north end of the collection channel with the entrance near Bay C of Unit 14. Pumped water could be provided to supply the Alaska steep-pass ladder, and to supply a false weir through the wall to the forebay. Water from the false weir would flow down a pipe so fish could slide into the forebay. The exit of the slide would be placed at 344 MSL providing a drop of 4 to 9 feet into the forebay.

- **Advantages:** Fish that now jump at the orifices from Unit 14 gate slots would be allowed an egress to the forebay. Assuming that those fish want to continue migrating upstream, they would be allowed to continue their migration. Fish that want to migrate downstream would continue to pass down the collection channel and down to the collection facility where they would be handled and returned to the tailrace as they are now. The system could be operated continuously or on an intermittent basis when adult fallbacks are prevalent.

- **Disadvantages:** A pumped water supply would be required. An electrical power supply would also be needed. The pump intake could be placed in the forebay where it would pump against a head of 5 to 10 feet. A sealed pump would be required to ensure that no grease or oil got into the pumped water supply or into the collection channel or forebay. The pump intake would likely have to be screened to NMFS/state criteria. Fish would egress in the forebay near Unit 14. They might fall back through the turbine intakes into the collection channel, through the turbines, or through the spillway if spill was occurring.

3.1.5 Alaska steep-pass fish ladder and false weir to the tailrace

For this concept, a short Alaska steep-pass ladder would attract the adult fish from the north end of the collection channel to false weir that discharges the fish via a pipe to the tailrace. A gravity water supply from the forebay would provide flow for the fish ladder and false weir. The water supply intake would require a trash rack to prevent debris clogging, but would not require screening to prohibit entry by juvenile salmonids because they would pass safely into the collection channel or to the tailrace. A PIT tag detector could be installed on the pipe to detect any juvenile or adult fish that have PIT tags.

- **Advantages:** This system would allow adult fish that are jumping at the orifice flow from the orifices of Unit 14 to egress out of the collection channel over the false weir. With a gravity water supply and no fish screens, the system would likely require minimal maintenance. For those adult fish migrating to locations downstream of McNary, this concept does not require the fish to pass a second time into the turbine intakes.

- **Disadvantages:** Fish that are destined for upstream spawning grounds would have to re-ascend the fish ladder and could fallback again. Traversing the tailrace deck with an elevated transportation pipe may interfere with project operations. (A location between the non-overflow section and Spillway Bay 22 might minimize the interference with project operations. This alternative routing will be investigated and reported in a later phase of this study.

3.2 Screening of Concepts

The project team screened the five concepts described in Section 3.1 to three alternatives that were then developed to the conceptual level of design. Two of the concepts were eliminated from further consideration. The eliminated concepts included the fixed strobe array and the mechanical crowder.

The fixed strobe array was eliminated because it was less flexible than the moving strobe concept in its ability to vary the timing and spacing of flashing of the strobes. It would also likely be very expensive, given the need for 200 strobes along with the electronic equipment to synchronize the timing of these lights.

The mechanical crowder was eliminated because the maintenance requirements would be high. In addition, the costs would also be high, particularly if the system needed to pass through the dewatering region of the collection channel where the screens are operating and the channel is dimension are changing.

3.3 Project Alternatives

After screening the concepts, three alternatives were developed for future consideration. These include: 1) the moving strobe array; 2) the steep-pass ladder from the north end of the collection channel leading fish to the forebay; and 3) the steep-pass ladder from the north end of the collection channel leading fish to the tailrace. These alternatives are described in the following sections.

3.3.1 Alternative 1 - Moving Strobe Array

This alternative is shown in Plate 1. The concept relies on the avoidance behavior of the fish to bright flashing strobe lights. The strobe lights are attached to a trolley that traverses the length of the collection channel. The trolley travels on a monorail attached to the collection channel wall. A hot rail provides power to the trolley and the strobe system. The strobe system includes a power converter suspended from the trolley and a strobe arm extending to the center of the channel where three strobe lights are submerged just below the water surface.

The trolley drive system would have the ability to vary the speed of the trolley and the flash rate of the strobe lights would be independently adjustable over an appropriate range. Either manually initiated or on a specific time schedule, the trolley and strobe system would travel the length of the collection channel, herding the fish towards the bypass pipe.

Biological Considerations
The biggest potential drawback of the moving strobe light array is that it may be too effective at driving fish down the channel. If it is, it could slug the separator with adult and juvenile fish when it operates. This may overwhelm the separator operator as he/she is forced to remove adult fish with a large number of adults and juveniles on the separator. It may also result in crowding of adult fish with juvenile fish or juvenile with juvenile fish resulting in higher levels of stress in the collection process. As the system passes through the dewatering region of the collection channel, the fish, particularly the juveniles, may be more susceptible to injury as they react to the strobe lights and encounter the screens.

3.3.2 Alternative 2 - Alaska Steep-Pass Ladder to the Forebay

As noted earlier in this report, a number of adult salmon and steelhead are observed at the north end of the powerhouse, jumping at the flow exiting from the gate slot orifices. Alterative 2, shown in Plate 2 utilizes a fish ladder to pass the fish from the collection channel to the McNary Dam forebay. Due to the spatial limitation within the collection channel, an Alaska steep-pass ladder is proposed. The ladder would rise in two lifts up to a false weir. The two lifts are separated by a small resting pool. The water level in the collection channel varies over an elevation range of 327 feet to 329.5 feet.

The water supply for the fish ladder is pumped from the forebay into a distribution box that passes up to 9 cfs into the fish ladder and passes an additional 5 cfs through a false weir discharging about 5 cfs to the forebay. Fish that ascend the fish ladder and the false weir are transported with the flow that is returned to the forebay.

The forebay level varies from a minimum level of 335 to a maximum level of 340 feet. The water surface elevation in the distribution box is 344 feet. Thus, the pump has a static head requirement ranging from 5.5 feet to 9 feet. A gate valve is provided to control the flow into the distribution box and a slide gate on the forebay wall provides a means to isolate the system.

The pump intake is screened to exclude juvenile fish and debris. A frame projecting into the forebay holds three removable screens that can be raised to the powerhouse deck and cleaned. The screens are sized to meet the NMFS juvenile salmonid screening criteria with only 2 of the 3 screens in place, allowing screen cleaning with the system operating.

Biological Considerations

This alternative would provide a passive route for fish to continue upstream. Added flow at the upper end of the collection channel would provide better conditions for juvenile salmonids to move downstream as well as providing attraction for adult salmonids that desired to move upstream. Potential drawbacks would include the use of pumped flow to attract fish upstream and to provide flow for the fish ladder, false weir, and slide into the forebay. Fish released to the forebay by this route might wander in front of the powerhouse and fall back through the turbine intakes, or they might wander in front of the spillway and fall back by that route. Adult fish that are holding in the collection channel but are not attempting to go upstream may not escape the collection channel through this new route.

3.3.3 Alternative 3 - Alaska Steep-Pass Ladder to the Tailrace

This alternative is similar in concept to Alternative 2. Adult salmon and Steelhead are attracted into a fish ladder that delivers them to the tailrace in the vicinity of the north ice-and-trash sluice outlet (Plates 3 and 4). For this alternative, a short Alaska steep-pass ladder leads attracts the salmon to a false weir that returns the fish via a 24-inch transport pipe to the tailrace. A gravity water supply feeds the fish ladder and false weir.

A slide gate mounted on the wall of the powerhouse controls the flow into the system and can be used for system isolation. The intake does not have fish screens since any fish entering the system will be returned to the tailrace either through the juvenile bypass system or through the return pipe to the tailrace.

The water level in the distribution box is at elevation 331.5 feet. A 340-foot long, 24-inch diameter pipe delivers the fish and 5 cfs of flow from the distribution box to the end of the ice-and-trash sluice (Plate 4). The pipe discharges at elevation 273 feet. The flow in the pipe remains supercritical and shallow over its entire length with velocities up to 22 feet/second. The minimum clearance over the tailrace deck is 25 feet to allow for equipment to pass under the pipe without interference.

Biological Considerations

Like the Alaska steep-pass to the forebay, this alternative would require a short section of fish ladder to attract fish out of the collection channel over a range of collection channel operations. Fish would be attracted up the ladder to a false weir. They would jump over the weir into a 24-inch pipe slide to the tailrace. These fish would be put back in the river below the dam, so if they were destined for downriver tributaries, they could progress on downstream. Fish destined for upstream spawning areas would have to re-ascend the fish ladder. They would be returned to the tailrace near the north powerhouse fishway entrance, so they should be able to find their way over the dam readily. The volume of flow into the collection channel (9 cfs) would improve conditions at the upper end of the channel, and would attract adult fish wishing to migrate upstream into the adult fish bypass.

3.4 Alternative Cost Estimates

Conceptual level cost estimates were prepared for each of the three alternatives. The cost estimates were $402, 600, $406,100, and $314,600 for alternatives 1,2, and 3 respectively as presented in tables 4,5, and 6. Each cost estimate includes a 35% contingency given the conceptual level of the design work.

Table 3-1: Alternative 1 Construction Costs

CONSTRUCTION COST ESTIMATE
PROJECT: McNary Dam Adult Fallback Study   Date: November 7, 2000
Alternative 1 - Moving Strobe Lights

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
3	Drill 1" f Holes in concrete w/ Expansion Anchors	185	EA	$ 30	$ 5,600	HDR
5	Trolley Rail Support and Anchor Plate	4,700	LB	$ 2	$ 9,400	HDR
5	Trolley Rail	1,215	LF	$ 100	$ 121,500	HDR
11	Trolley, Strobe Light Support Arm, and Trolley Controls	1	LS	$ 66,100	$ 66,100	American Crane and Equip. Co.; HDR
13	Strobe Light Power Converter and Controls	1	LS	$ 23,000	$ 23,000	Mike Ramey of R2 Resources; HDR
16	Trolley Hot Rails	1,215	LF	$ 22	$ 26,700	American Crane and Equip. Co; HDR.
	Electrical Wiring and Conduit	1	LS	$ 7,000	$ 7,000	HDR
	Overhead and Profit:	15%			$ 38,900	
	Subtotal				**$ 298,200**	
	Contingency:	35%			$ 104,400	
	TOTAL				**$ 402,600**	

Table 3-2: Alternative 2 Construction Costs

CONSTRUCTION COST ESTIMATE

PROJECT: McNary Dam Adult Fallback Study — Date: November 7, 2000

Alternative 2 - Alaska Steep-Pass Fishway to Forebay

Spec. Division	Component	Quantity	Unit	Unit Cost	Total Cost	Source
2	Cofferdam in Forebay	1,700	SF	$ 30	$ 51,000	HDR
3	Demo Hole in Powerhouse Wall (Inlet & Outlet)	2	EA	$ 10,000	$ 20,000	HDR
5	Support Towers for Fish Ladder	3,000	LB	$ 2	$ 6,000	HDR
	Support Towers for Resting Pool Tank	8,200	LB	$ 2	$ 16,400	HDR
	Aluminum Resting Pool Tank	2,300	LB	$ 5	$ 11,500	HDR
	Fishway Ladder	65	LF	$ 300	$ 19,500	Swan Island Sheet Metal Works, Inc.
	Intake Screen	1	LS	$ 5,000	$ 5,000	HDR
	Intake Screen Guide	1	LS	$ 15,000	$ 15,000	HDR
	Aluminum Floor Diffuser and Finger Trap Assembly	850	LB	$ 5	$ 4,300	HDR
	Water Suppy Pump Platform	9,000	LB	$ 2	$ 18,000	HDR
11	30 Hp Water Suppy Pump	1	LS	$ 42,000	$ 42,000	ITT A-C (Queen Pump)
15	Suction and Discharge Piping	1	LS	$ 25,000	$ 25,000	HDR
	18" Butterfly Valve	1	LS	$ 3,300	$ 3,300	Dezurik (Torangeau Norwes)
	24" Sluice Gate	1	LS	$ 9,600	$ 9,600	Waterman
16	Electrical for 30 Hp Pump	1	LS	$ 15,000	$ 15,000	HDR
	Overhead and Profit:	15%			$ 39,200	
	Subtotal				**$ 300,800**	
	Contingency:	35%			$ 105,300	
	TOTAL				**$ 406,100**	

Table 3-3Alternative 3 Construction Costs

CONSTRUCTION COST ESTIMATE

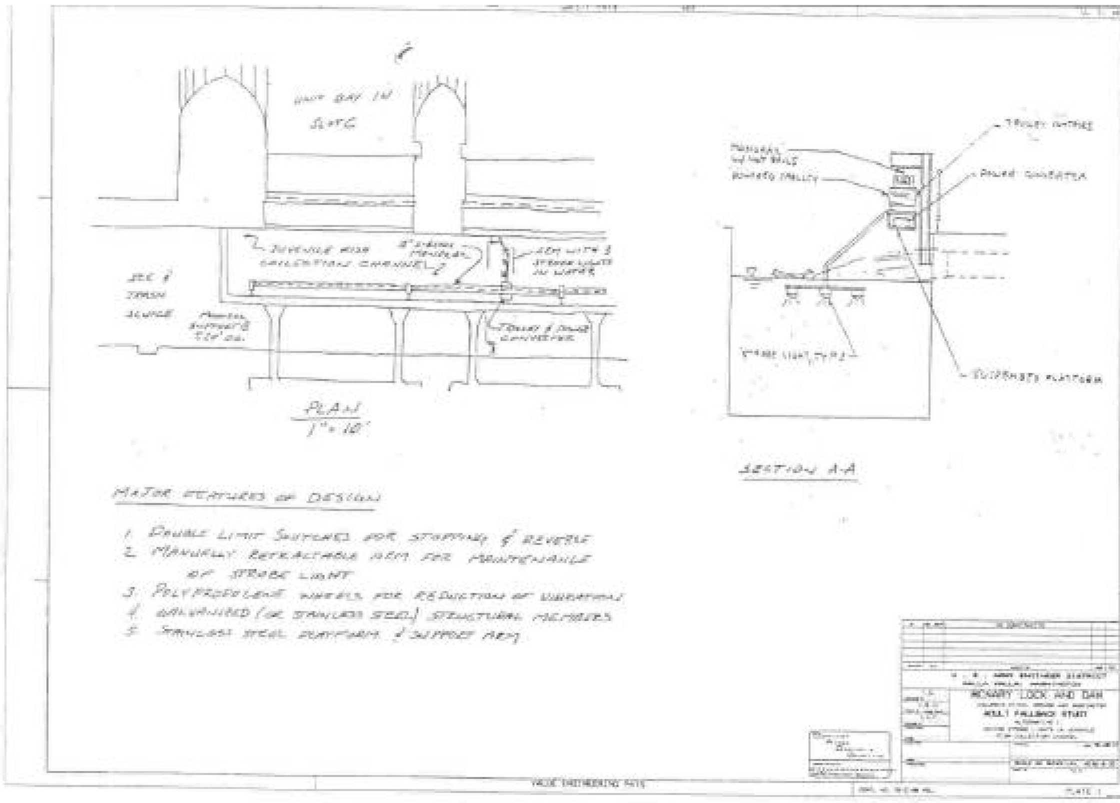
PROJECT: McNary Dam Adult Fallback Study   Date: November 7, 2000

Alternative 3 - Alaskan Steep-Pass Fishway to Tailrace

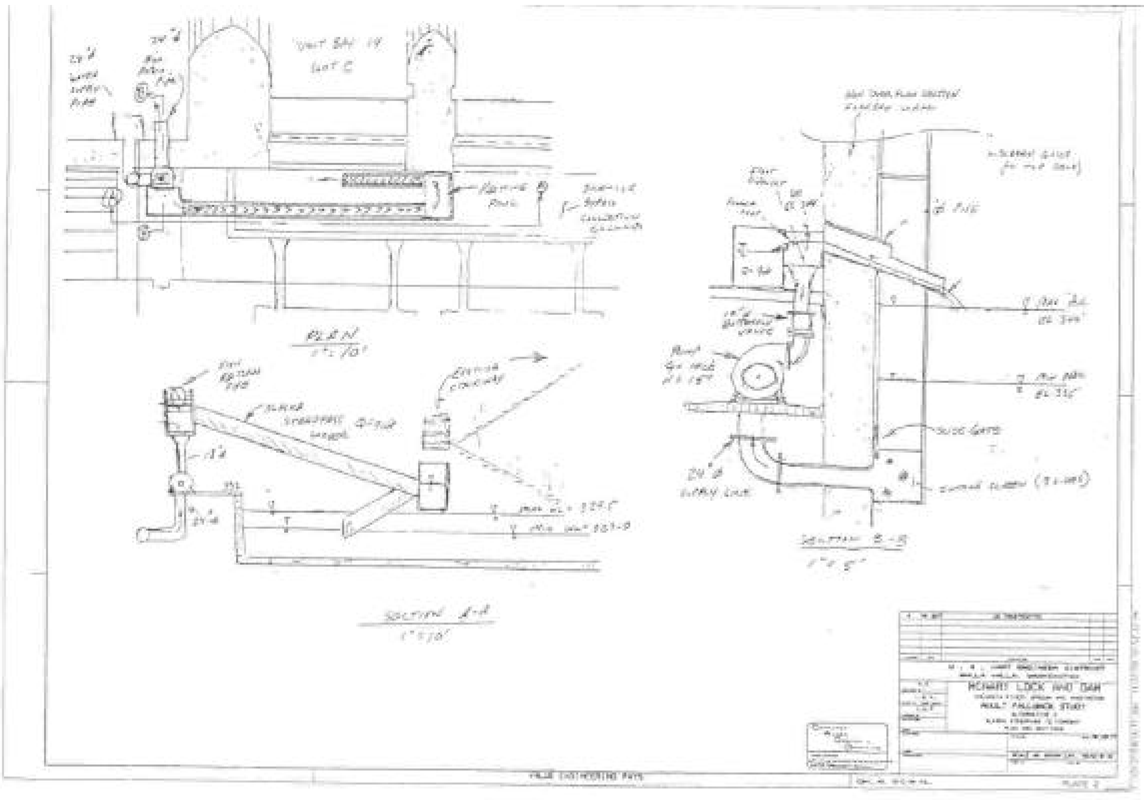
Spec. Division	Component	Quantity	Unit	Unit Cost	Total Cost	Source
2	Cofferdam	1,700	SF	$ 30	$ 51,000	HDR
3	Core Drill Holes in Powerhouse Walls	2	EA	$ 10,000	$ 20,000	HDR
5	Support Towers for Fishway	350	LB	$ 2	$ 700	HDR
	Support Tower for Floor Diffuser and Finger Trap Assembly	1,100	LB	$ 2	$ 2,200	HDR
	Brace Supports for Outlet Pipe on Outside of Powerhouse wall	6,000	LB	$ 2	$ 12,000	HDR
	Tower Supports for Outlet Pipe	9,000	LB	$ 2	$ 18,000	HDR
	Aluminum Flume	3,100	LB	$ 5	$ 15,500	HDR
	Fishway Ladder	30	LF	$ 300	$ 9,000	Swan Island Sheet Metal Works, Inc.
	Aluminum Floor Diffuser and Finger Trap Assembly	850	LB	$ 5	$ 4,300	HDR
	Intake Screen	1	LS	$ 25,000	$ 25,000	HDR
15	24" Inlet Piping	1	LS	$ 10,000	$ 10,000	HDR
	24" Outlet Piping	350	LF	$ 70	$ 24,500	HDR
	24" Sluice Gate	1	LS	$ 10,400	$ 10,400	Waterman
	Overhead and Profit:	15%			$ 30,400	
	Subtotal				**$ 233,000**	
	Contingency:	35%			$ 81,600	
	TOTAL				**$ 314,600**	

SECTION 4. SUMMARY AND RECOMMENDATION

(To be completed for 100% submittal)


PLAN
1" = 10'
SECTION A-A
MAJOR FEATURES OF DESIGN
1. DOUBLE LIMIT SWITCHES FOR STOPPING & REVERSE
2. MANUALLY RETRACTABLE ARM FOR MAINTENANCE OF STROBE LIGHT
3. POLYPROPYLENE WHEELS FOR REDUCTION OF VIBRATIONS
4. GALVANIZED (OR STAINLESS STEEL) STRUCTURAL MEMBERS
5. STAINLESS STEEL PLATFORM & SUPPORT ARM
MCNARY LOCK AND DAM
PLATE 1

DRAFT



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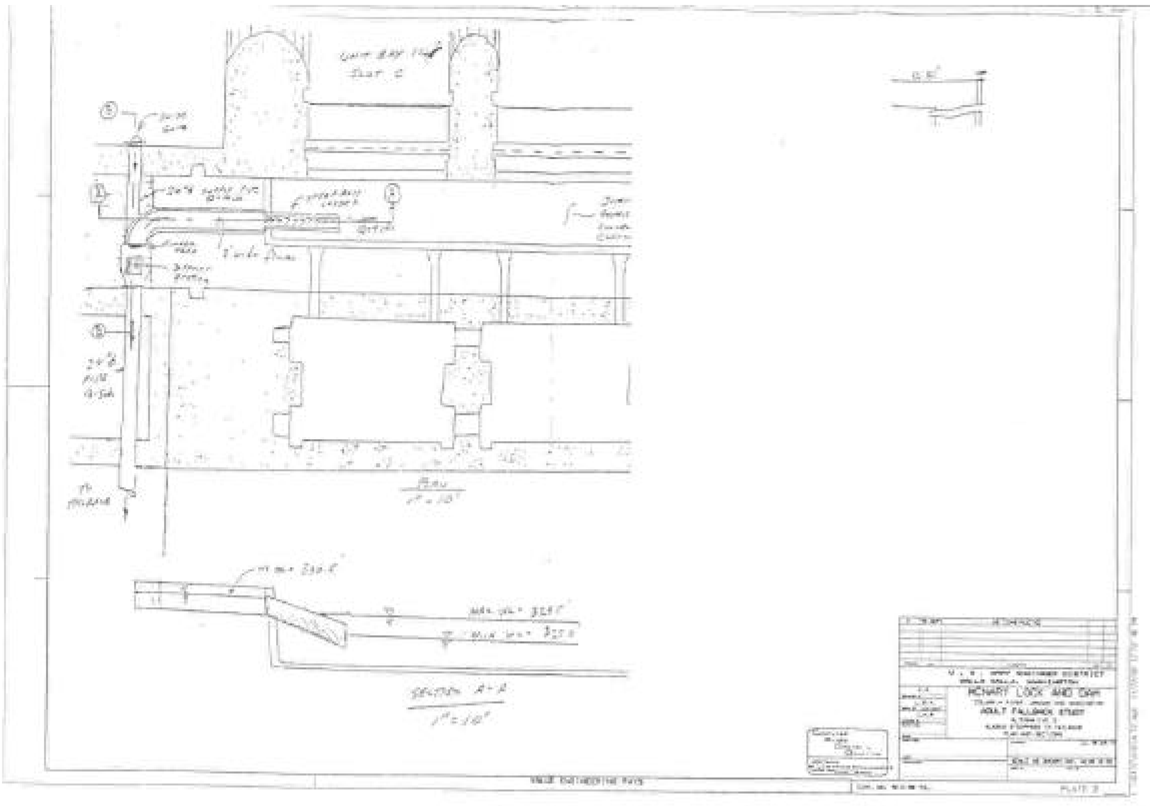
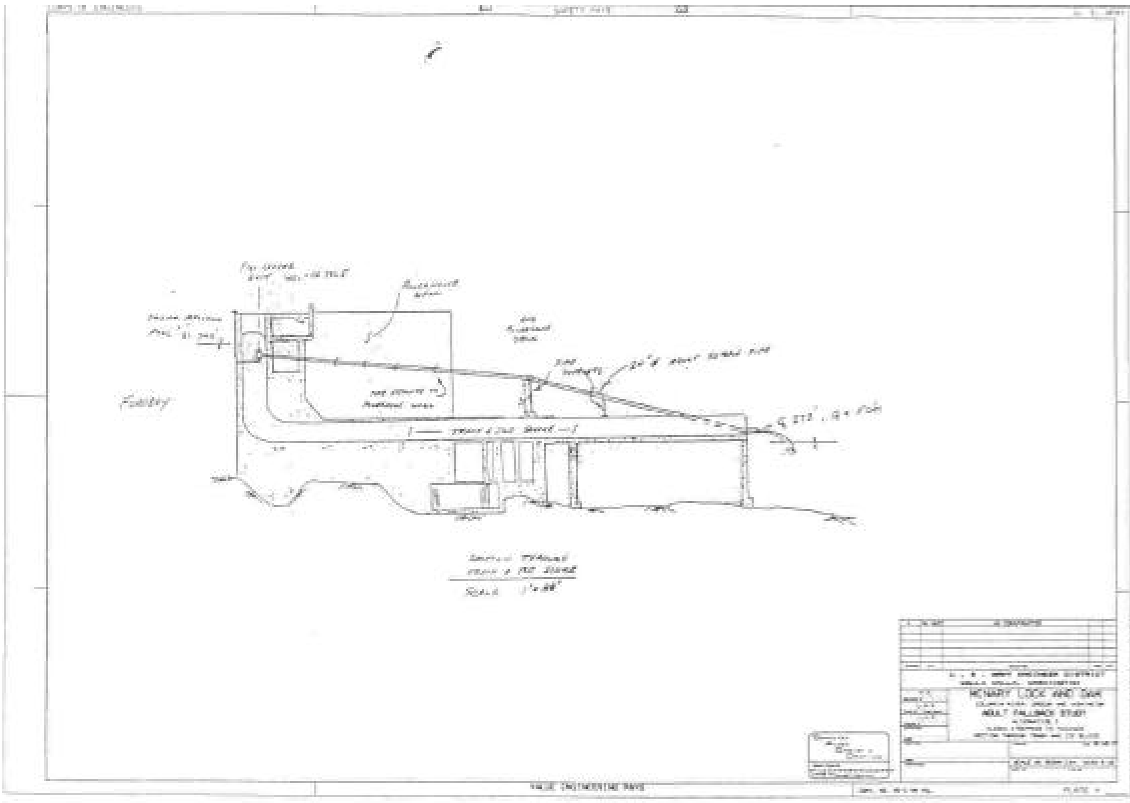



MCNARY LOCK AND DAM
ADULT FALLBACK STUDY

Appendix 2
Handout #8A
McNary Lock and Dam Pit Tag Detector Preliminary Design Study

(8A)

MCNARY LOCK AND DAM

PIT TAG DETECTOR
PRELIMINARY DESIGN STUDY

30% SUBMITTAL

November 2000

Prepared by:
HDR Engineering

With support of:
ENSR

FOR FFDRWG REVIEW 1-24-01

HDR

November 27, 2000

Mr. Chuck R. Palmer
USACE, Walla Walla District
201 N. 3rd Avenue
Walla Walla, WA 99362

RE: McNary PIT Tag Detector 30% Conceptual Study (10132 016 002 03)

Dear Mr. Palmer:

This submittal is our 30% Conceptual Study for the McNary PIT Tag Detector project, in accordance with the scope of work for Task Order No. 10 of Contract No. DACW68-00-D-0001. I have also enclosed a bound set of preliminary design calculations and quantity take-off's for District review. We look forward to meeting with District staff on December 21, 2000 to present our findings and discuss our evaluation.

If you have any questions or comments concerning this submittal prior to our meeting, please feel free to call me at 503-768-3773.

Sincerely,
HDR Engineering, Inc.

John H Plump, Jr.
Senior Project Manager

HDR Engineering, Inc.

Employee-owned

Suite 500
10300 SW Greenburg Road
Portland, Oregon
97223

Telephone
503 768-3700
Fax
503 768-3737

MCNARY LOCK AND DAM

PIT TAG DETECTOR
PRELIMINARY DESIGN STUDY

30% SUBMITTAL

November 2000

Prepared by:
HDR Engineering

With support of:
ENSR

Table of Contents

SECTION 1. INTRODUCTION

1.1 Background

On the downstream south shoreline of the McNary Lock and Dam is a Juvenile Fish Facility that was placed into operation in 1994. The facility includes a collection channel and related dewatering/control system (within the powerhouse), a combination smooth/corrugated fish transportation flume system (from the powerhouse to the fish facilities), and juvenile fish holding, loading and bypass facilities (located in the Spillway Park area). Within the juvenile fish facilities are thirteen active Passive Integrated Transponder (PIT) Tag Detectors. These PIT Tag Detectors were state-of-the-art at the time of installation and have been modified and improved in recent years. However, new PIT Tag Detector technology is currently being developed by the National Marine Fisheries Service (NMFS) that allows PIT tag detection on larger diameter pipes.

1.2 Study Objectives

A PIT Tag Detector capable of performing on a 36-inch diameter pipe is currently under development. The objective of this study is to evaluate possible locations for adding a PIT Tag Detection system on the main transportation flume of the McNary Juvenile Fish Facility and to prepare preliminary designs for its installation.

SECTION 2. DESIGN ASSUMPTIONS

2.1 Excitation Antenna

- Preliminary information from Destron Fearing and NMFS indicate that four antenna coils will be required to detect fish in a 36-inch diameter pipe. The axial pipe length of one wrapped coil will be approximately one foot. The number of coils, their length and geometry are determined by fish orientation and grouping. Future hydraulic testing may indicate that two coils would suffice, but it is not likely.
- The four coils need not be located adjacent to one another. They can be separated by pipe bends. For heavy fish grouping the coils should be spaced further apart.
- A flat plate antenna has a greater risk of noise interference than a coiled antenna.

2.2 Electrical Shields

- Electrical shields are necessary to reduce electrical emissions from the antenna coils to the surrounding environment and also to protect the PIT-tag detector from outside electrical interference.
- A minimum spacing of 10 feet should separate the protective shields enclosing the antenna coils. The shields should extend approximately 2.5 feet past the coil ends, making the total shield length for one unit a minimum of 6 feet.
- The shields should be constructed of sheet aluminum with welded seams. They should be separated from the antenna coils by two-thirds pipe diameter. This makes the minimum rectangular size 7 feet wide by 7 feet high by 6 feet long and the minimum cylindrical size 7 feet diameter by 6 feet long. The shield shape is not important as long as it is roughly equidistant from the antenna coils on all sides and is structurally stable.
- The sheet aluminum used for the shields should be three-eighths inch thick.
- A larger shield might be more desirable from an accessibility standpoint and would remain electrically similar to a smaller shield. Accessibility inside the shields is required for installation, operation, and maintenance of the pipe and antenna coils. Because the access space must be large enough to carry tools and equipment, it might be prudent to set the width at 8 feet.
- The shields cannot vibrate excessively due to the elements (wind, rain) or resonance from within the pipe. The shield can rest on the tower supports that carry the pipe and access walkway.
- Internal and/or external bracing can be utilized to prevent vibration. To ensure the shields do not vibrate on the braces, they should be welded, not riveted or bolted.
- It would be best to place the braces inside the shields to minimize the opportunity for wind-induced eddy shedding that could cause vibration.
- Each shield must be well grounded.

2.3 Pipe Structure

- The current steel pipe needs to be replaced by a non-conductive pipe in order for the PIT-tag detector to operate. Replacing the steel pipe with plastic pipe will affect the structural integrity of the transportation flume. Support trusses may be required to supplement the plastic pipe carrying the flume load. The designers of the original steel flume, the Hydroelectric Design Center, should be contacted to determine the extent of engineering required.
- The joints connecting the existing steel pipe to the non-conductive pipe need to be smooth to ensure no debris clogging or disruption of flowlines.
- The ability to insert test fish in the 36-inch line is required since a PIT-tag detector of this magnitude has not yet been proven. Hatches located upstream of the electrical shields would allow for video camera monitoring and/or insertion of test fish. At a minimum, one hatch should be placed upstream of all four PIT-tag detectors.

2.4 Support Structure

- A support structure will be required to assume the load currently carried by the steel pipe, and to support the electrical shields and an access walkway and/or tower-ladder.
- The support beam(s) should be located at least 4 feet from the centerline of the transportation flume. The electrical shields can rest on the support beams.
- Cradles can extend from the support beams to hold the non-conductive pipe. The cradles can be made of conductive material and should be located between the shields at least 4 feet from the antenna coils.
- Accessibility inside the shields is required for installation, operation, and maintenance of the pipe and antenna coils. The access door(s) on the shields should be equipped with a RF gasket and make a solid electrical connection. Latches should be provided to secure the door in an open or closed position.
- Access to the shields could be in the form of a walkway extending from the switch gate location or a separate tower-ladder in the vicinity of the detectors. This walkway could be cantilevered off the existing support towers. If the walkway extends from the switch gate, the elevator in the main facility can be utilized.
- A protective roof over the shields is not necessary if the shields are designed to carry a snow load and can withstand changes in weather.
- A stainless steel container (Hoffman Box) placed adjacent to each shield is necessary to house the electrical outlets and equipment required at each antenna coil. These boxes will be approximately 2 feet by 2 feet by 2 feet.
- The electrical requirements at each container will be two 110 volt, 15 amp circuits. The electrical receptacles will be located inside the containers.

- Two fiber optic cables per container will connect the PIT-tag detectors to the main equipment room, located on the ground floor of the juvenile fish facility. These cables will be housed in electrical conduit.
- Overhead lights, or street lamps, should be provided adjacent to the PIT-tag detectors.

2.5 Future Provisions

- It would be prudent to plan for the possibility of additional antenna coils in the future. Because PIT-tag detectors on a 36-inch pipe are as yet untested, additional coils could be necessary to count all the PIT-tagged fish.
- Space for an additional PIT-tag detection unit should be provided.
- Ability to adjust the access walkway around a future unit should be considered.
- Electrical requirements of an additional unit should be evaluated when sizing the current system needs.
- It might be determined that lights in the transportation flume would help orient the fish approaching the PIT-tag detectors. These lights could be provided by transparent hatches on the 36 inch pipe.

2.6 Other Factors to Consider

- The number of antenna coils required for a 36-inch pipe and the electrical shield size has been assigned based on the experience of NMFS and Destron Fearing personnel. To confirm the design guidelines, testing should be scheduled prior to prototype construction.
- The fish-loading rate in the 36-inch transportation flume is approximately 8,000 to 12,000 fish per hour. The rate of PIT-tagged fish passing through the system should be determined by COE.
- Will lights be necessary to help orient the fish in the pipe?
- The maximum water velocity in the flume for PIT-tag detection is 4 mps (13 fps). The current water velocity in the transportation flume is 8.5 fps.
- PIT-tag axes can be oriented up to ±45 degree from the antenna coil axis and still be accurately detected.
- Because the detectors are very sensitive to vibration, especially in the 2-5 kHz range, a vibration dampening undercoating sprayed inside the shields might be effective.

SECTION 3. DESIGN CRITERIA

3.1 Design Codes and Standards

Structural design on the project will be done per the following design specifications:

1. Steel Design – Allowable Stress Design Manual of Steel Construction, 9th Edition; published by the American Institute of Steel Construction
2. Aluminum Design – Aluminum Design Manual, 2000 Edition; published by the Aluminum Association, Inc.
3. Design Loading (Dead, Live, Snow, Wind, Seismic) will be determined using the Uniform Building Code, 1997 Edition with State of Oregon Revisions; published by the International Conference of Building Officials

3.2 Design Loads

The design loading for the PIT Tag Detector shields, supporting structure and walkway will be as follows:

1. Dead Load:
   - Steel: 490 pounds per cubic foot
   - Aluminum: 175 pounds per cubic foot
   - Water: 62.4 pounds per cubic foot
2. Live Load:
   - Walkway: Use "Special Loading Provisions" for Stage Accessories – Catwalks: 40 pounds per square foot
3. Snow Load:
   - Basic ground snow load: Assume 20 pounds per square feet
   - Snow exposure factor: 0.6
   - Snow Importance Factor: 1.0 (Miscellaneous Structures)
4. Wind Load:
   - Exposure C
   - Basic wind speed: 90 mph
   - Combined height, exposure and gust factor coefficient: 1.31
   - Pressure coefficient: 1.4 (square or rectangular tanks)
   - Wing stagnation pressure: 20.8 pounds per square foot
   - Wind Importance Factor: 1.0 (Miscellaneous Structures)

5. Seismic Load:

- Seismic Zone 2B
- Soil Profile: Generally Sand, Gravel & Cobbles over Hard Dense Basalt (source: McNary Dam – Basis of Design 1946 - Appendix C – Soil Data and Analysis) Soil Profile Type SA
- Seismic Zone Factor: 0.2
- Seismic coefficient: 0.16
- Seismic Importance Factor: 1.0 (Miscellaneous Structures)
- Overstrength and ductility coefficient: 2.2 (Vessel on braced legs)
- Period of vibration: T = Ct x (hn)3/4

  C_t: 0.02 (non moment resisting frame)

  $h_n^{3/4}$: (height) $35^{3/4} = 14.4$

  T = 0.02 x 14.4 = 0.288 seconds

SECTION 4. LOCATION EVALUATION AND RECOMMENDATION

4.1 Possible PIT Tag Detector Locations

The locations are shown on Plate No. 1 at the end of this report.

1. Location #1 – On the 36-inch steel pipe immediately downstream of the powerhouse.
2. Location #2 – On the 36-inch steel pipe downstream of the powerhouse and immediately upstream of the first 90-degree bend approaching the main switch gate in the Juvenile Fish Facility.
3. Location #3 – On the 36-inch steel pipe between the first and second 90-degree bends before the main switch gate in the Juvenile Fish Facility.
4. Location #4 – On the 36-inch steel pipe after the second 90-degree bend and before the main switch gate.
5. Location #5 – On the 30-inch corrugated metal pipe (CMP) bypass downstream of the main switch gate and upstream of its transition from CMP to HDPE pipe.

4.2 Location Evaluation Factors

1. Structural/Construction
   - Number of new tower supports required (fewer is better)
   - Pipe replacement complications
   - Construction access
   - Potential for vibration/proximity to a structural support
   - Exposure to weather elements (less is better)
2. Accessibility
   - Distance to sampling facility (less is better)
3. Electrical
   - Availability of power supply (closer to the existing panels is better)
   - Proximity to transmission lines and other sources of electrical interference (closer is worse)
4. Performance
   - Water velocity (lower is better)
   - Flow separation/angularity (less is better therefore greater distance from bends is better)

- Ability to cross-check performance with the other detectors

5. Geometrical

   - Distance available to increase antenna separation (better for detection with fish grouping)
   - Potential space to add detectors

4.3 Location Evaluation

The possible locations for installing a new fish detector at McNary Dam were determined based on discussions at the October 4, 2000 agency site visit/meeting (see meeting minutes in Appendix A). The locations were further refined during a brainstorming session on October 25, 2000 with HDR Engineering, ENSR and NMFS personnel (see meeting minutes in Appendix B). The location evaluation factors were developed from the conversations with NMFS personnel.

Applying the factors quickly eliminates some alternate locations from further consideration. Because this size detector (for a 36-inch diameter pipe) is a yet unproven design, it is considered necessary to allow for cross checking of the data with other detectors already located at the Juvenile Fish Facility. This factor eliminates Location #5 from consideration because there are no detectors upstream or downstream with which to verify data. Geometric constraints, such as the space required for 4 coils and shields, does not allow for locating the detector at Locations #3 or #4. Hydraulic performance factors, such as proximity to pipe bends also make these locations very undesirable.

Locations #1 and #2 are both feasible. However if Location #1 were selected, access to the detector would require measures such as installing a door in the powerhouse wall, building a tower/ladder up to the pipe, or using a mobile personnel lift. Also the detector would be located immediately downstream of a bend since the 36-inch pipe makes some S- turns before exiting the powerhouse. This bend proximity could sacrifice performance because it would affect fish orientation.

Because consideration of the location factors eliminated Locations #3, #4, and #5, and because of the access difficulties and performance sacrifices at Location #1, efforts focused on placing the detector at Location # 2, in the straight stretch of 36-inch pipe upstream of the first 90-degree bend.

SECTION 5. PRELIMINARY STRUCTURAL DESIGN

The preferred location of the PIT Tag Detectors is in the straight sections of pipe between the second, third and forth easternmost support towers supporting the transportation flume. The existing steel pipe is the primary element providing longitudinal stability between the towers. The PIT Tag installation requires the steel pipe to be replaced with non-conductive pipe, assumed to be high-density polyethylene (HDPE) plastic pipe, which will not provide the longitudinal stability of the existing steel pipe. Steel wide-flange girders will be placed between towers to support the walkway and detector shields and to provide the longitudinal stability lost by the removal of the steel pipe. Preliminary calculations indicate that 2 - W 16x100 girders will be required between each of the towers.

Transverse crossbeams will be supported on the main girders on which the walkway and detector shields will be placed. Preliminary design was done assuming these cross beams are 4" x 4" tube steel spaced at 6'-0" along the girders. Two intermediate pipe support saddles, which will also be supported by the wide-flange girders, will be added to each span to provide the vertical support needed for the HDPE pipe. All of the support structure (girders and crossbeams) is assumed to be standard carbon steel.

Each of the four PIT Tag detector coils initially installed will be enclosed within aluminum shield boxes to help provide electrical isolation. The box is assumed to be constructed from 3/8-inch plate aluminum and is 7'-6" high, 8'-0" transverse to the pipe, and 6'-0" along the pipe. The plate walls will be connected by continuous welds to aluminum angle and tee framing members at the corners and mid-walls. Entrance to the interior of the detector shields will be provided with standard 6'-8" x 2'-6" aluminum doors.

An aluminum walkway to provide access to and between the detector shields is included along the south side of the pipe. Both sides of the walkway will be protected with an aluminum pipe railing 3'-6" high. Aluminum is used to provide additional electrical isolation near the pipe. An aluminum ladder mounted on the south leg of the center support tower will provide access up to the walkway.

This preliminary design is shown on Plates No. 2 and 3 at the end of this report.

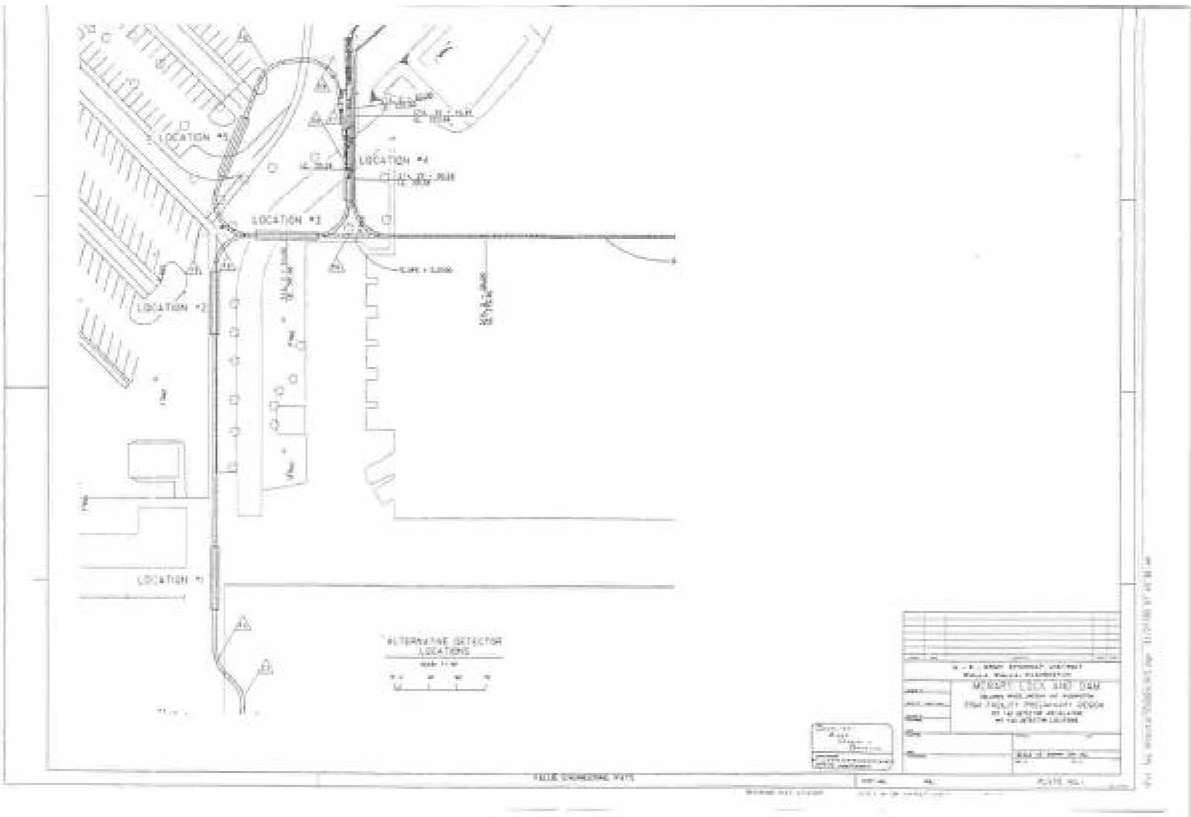
SECTION 6. COST ESTIMATE

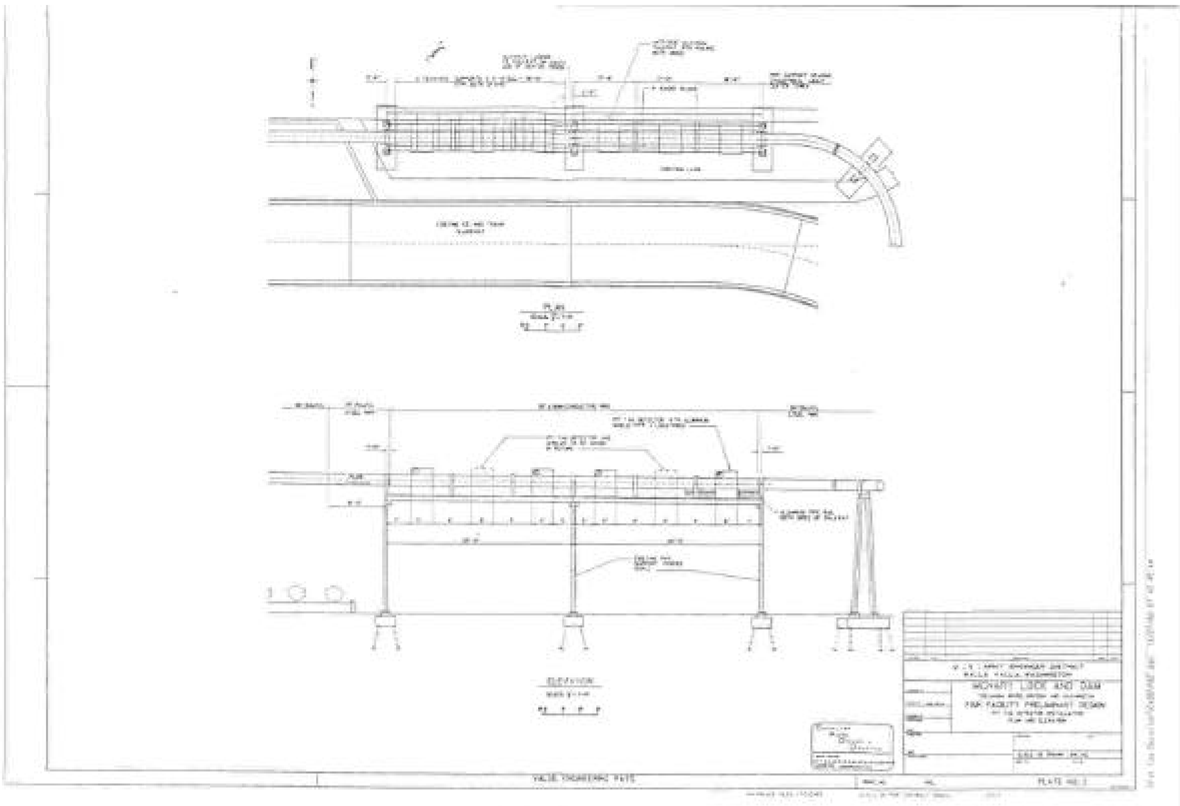
The following table presents the conceptual cost estimate prepared for the recommended PIT Tag Detector location.

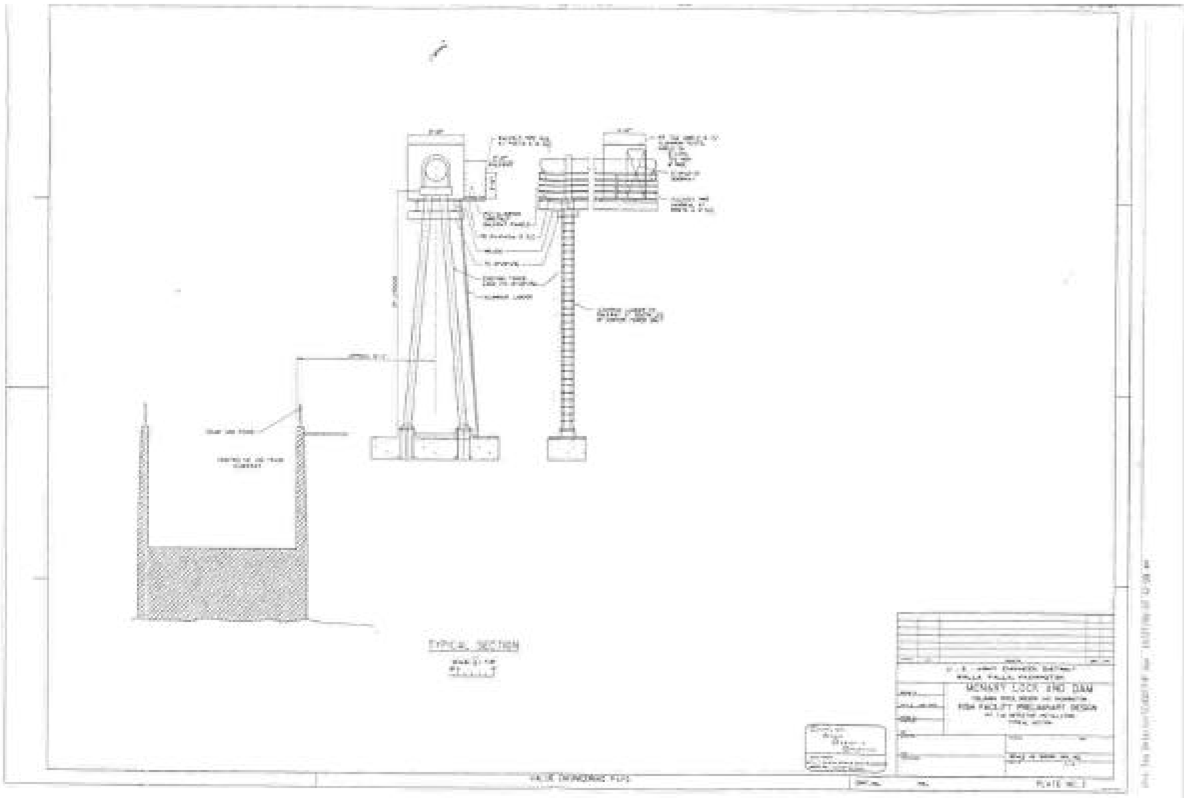
Division	Item	Units	Quantity	Unit Cost	Total Cost
Division 5 - Metals					
	Support Structure				
	TS 12x12x3/8 Support Corbels	LB	1650	$2	$3,300
	W 16x100 Girders	LB	21200	$2	$42,400
	TS 4x4x1/2 Cross Beams	LB	3900	$2	$7,800
	Pipe Support Saddles	LB	12600	$2	$25,200
	Isolation Shields				
	1/4" Aluminum Plate	LB	4500	$5	$22,500
	Aluminum Framing and Bracing	LB	2500	$5	$12,500
	Walkway & Railing				
	Aluminum Anti-Skid Walkway Planks & Hardware	SF	320	$25	$8,000
	Aluminum Pipe Railing	LB	1000	$5	$5,000
	Aluminum Ladder	LF	40	$30	$1,200
Division 6 - Wood & Plastics					
	36" ϕ Non-Conductive Pipe (Assume High-Density Polyethylene)	LF	101	$75	$7,575
Division 16 - Electrical					
	Pull Box, NEMA 4, 24"L x 24"W x 10"D	EA	5	$3,750	$18,750
	2" Dia Plastic Conduit	LF	2000	$25	$50,000
	120/240 V, 60 Amp Panelboard & Load Center Circuit Breakers	Ea	5	$100	$500
	#10 Wire, 600 Volt, Type THW, Copper, Stranded	CLF	100	$50	$5,000
	#4 Wire, 600 Volt, Type THW, Copper, Stranded	CLF	10	$125	$1,250
	Fiber Optic Cable,Maximum, Bulk Plenum Quad	CLF	10	$300	$3,000
	Fiber Optic, Multi-channel Rack Enclosure (10 Modules)	EA	1	$1,000	$1,000
	Fiber Optic Connector	EA	24	$40	$960
	Fiber Optic Pigtail	EA	12	$35	$420
				Sub-Total Costs	$216,355
				Contingency @ 35%	$75,724
				Sub-Total Costs + Contingency	$292,079
				Engineering & Design @ 10%	$29,208
				Supervision & Administration @ 10%	$29,208

Total Conceptual Cost Estimate Shield, Walkway, & Electrical Installation: $350,495

(Does not include material or installation cost of the pit tag detectors)


LOCATION #5
LOCATION #4
LOCATION #3
LOCATION #2
LOCATION #1
ALTERNATIVE DETECTOR LOCATIONS
MCNARY LOCK AND DAM
FISH FACILITY PRELIMINARY DESIGN


PLAN
ELEVATION
MCNARY LOCK AND DAM


TYPICAL SECTION
MCNARY LOCK AND DAM
FISH FACILITY PRELIMINARY DESIGN
PLATE NO.

Appendix A

October 4, 2000 Meeting Minutes

ENSR®

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MEMORANDUM

TO: Memorandum For the Record
FROM: Chris T. Long
DATE: November 7, 2000

SUBJECT: **Draft Meeting Minutes**
Project Name: McNary Adult Fallback Study and Juvenile Fish Facility Improvements Preliminary Design, Contract No. DACW68-00-D-0001, T.O. No. 10
Meeting Date: October 4, 2000, 8:00 AM to 1:00 PM
Location: McNary Dam, Juvenile Fish Facility

Participants:

Name	Organization	Phone Number
Chick Sweeney	ENSR	(425) 881-7700
Dave Hurson	COE – Walla Walla District	(509) 527-7125
Steve Rainey	NMFS	(503)-230-5418
John McKern	FPS/HDR	(509) 525-6283
John Plump	HDR	(503) 768-3773
Earl Prentice	NMFS	(206) 842 4289
Sean Casey	DFCO	(651) 552-6580
Don Warf	PSMFL	(509) 735-2773
Chuck Palmer	COE – Walla Walla District	(509) 527-7571
Lynn Reese	COE – Walla Walla District	(509) 527-7531
Brad Eby	COE – Walla Walla District	(509) 922-3211 / 2242
Ed Nunnallee	NMFS	(206) 526-6652
Rosanna Tudor	WDFW	(541) 922-3630
Lori Spencer	WDFW	(541) 922-3630
Paul Hoffarth	WDFW	(541) 922-3630
David Bissel	HDR	(503) 768-3742
Chris Long	ENSR	(425) 881-7700

1. When the staff from ENSR and HDR joined the meeting at 10:15 AM Steve Rainey was discussing surface bypass collection with those already in attendance.
2. John Plump introduced himself as the Project Manager and asked that everyone else introduce himself or herself by stating their name and for whom they worked.
3. John Plump stated the key tasks in the project at hand were 1) the adult fallback problem, 2) the installation of a new PIT-tag detector, 3) the debris plugging problem,

and 4) the creation of a spare parts inventory list. The purpose of this meeting though was limited to discussing tasks #2, and #3.

4. John Plump stated that ENSR would be providing the hydraulic expertise and that David Bissell at HDR would handle the structural expertise.
5. Chick Sweeney began the discussion on the PIT-tag detector installation by describing location options. He relayed how the detector would monitor passage of smolts going to the tailrace.
6. Dave Hurson interjected that if the detector were placed downstream of the switch-gate it would be "easier" to monitor were the fish go. He thought the logistics of having the PIT-tag detector upstream of the switch-gate would become a database-tracking problem. Located upstream, it would require checked files to determine if the fish had traveled through the sampling facility. It the detector was located downstream from the diverter gate it would allow for separate counting of the fish.
7. Steve Rainey stated that the diverter gate is only used a limited number of times each year and that it routes flow from the separator. A goal of NMFS is attaining the flexibility to more frequently operate the switch-gate so there can be more frequent sampling. He noted that a 26-inch pipe at Bonneville gets a high detection rate (100%), but that it is tracking slower moving adult fish traveling upstream. This system would be tracking juveniles moving downstream. He asked what size and how many coils would be needed for a 36-pipe pipe.
8. John McKern thought that a location upstream of the switch-gate would be best. He asked how the project would account for fish counted downstream and not upstream.
9. Earl Prentice voiced that 4 coils would be necessary and that the shields would be 6 feet in length. Ten-foot spacing would be required between the shields. He stated that fish grouping and orientation determine the number of coils, their length, and geometry. Most likely the system would need to be field verified. Juveniles tend to hold in low velocity zones and therefore it is best to place the detector in a location with a uniform velocity profile.
10. Someone mentioned the terminal velocity at the end of the fish bypass pipe is 15 fps. The NMFS criteria allow a maximum impact velocity of 25 fps.
11. Earl stated that PIT-tags could be read with their axis ±45 degrees from the axis of the antenna coils. This is a recent development due to improvements in the system. The older criterion was ±30 degrees.
12. Chick asked for a general listing of the "pros" and "cons" for locating the new detector upstream of the 90-degree bends approaching the switch-gate. Proponents included: 1) a long stretch of straight pipe coming from the powerhouse, 2) allowing a cross check on the new system efficiency based on the existing PIT-tag detectors downstream of the separator and, 3) water velocities in a reasonable range (8 fps). The one criticism voiced was the accessibility issue. Some scaffolding would need to be erected to access the detector.
13. Sean Casey from Destron Fearing stated the acceptable velocities for use in PIT-tag detection are 12 mps for juveniles in small diameter pipe and 4 mps in large diameter pipe. The need for slower velocities in the large diameter pipe is because the detector is more susceptible to tag orientation.

14. Ed Nunnallee wondered if lights might be necessary to aid the fish with orientation in the pipe after coming through a bend at the powerhouse. Steve Rainey thought the darkness of the pipe might make for better fish orientation.
15. The NMFS expressed interest in the idea of a detector in the 36-inch pipe so they can collect a good "overall" fish system efficiency.
16. Ed Nunnallee explained that the detector should not be allowed to vibrate, especially in the range of 1-8 kHz. There is precedence for good fish detection on a large pipe; for instance the 24-inch line at Rocky Reach Dam is working very well. However there have been problems with vibration on a detector at the Ballard Locks.
17. Someone asked the rate of PIT-tagged fish entering the juvenile facility. Brad Eby did not know right away, but did say the rate of total fish entering the facility was 8,000 – 12,000 fish per hour. Someone said that if the fish were heavily grouped, the coils would need to be further apart.
18. It was explained that a flat plate antenna for exciting the PIT-tags is more susceptible to noise than are antenna coils.
19. Brad Eby explained the operation of the switch-gate. When the gate is thrown and water is diverted to the bypass line, a slug of water moves into the line and a hydraulic jump forms for approximately 20 – 40 seconds before the whole line goes supercritical. The gate does not switch into a dry system.
20. A four-coil detection system would require 54 feet of pipe. However, the coils would not have to be situated in a row, rather they could be separated by pipe bends. The electrical shields must be well grounded. The steel pipe would need to be replaced with plastic pipe for the detector to operate. A "manway" would need to be provided along the detector for operation and maintenance access. Possible locations for the detector were 1) in the smooth steel flume upstream of the switch-gate and 2) in the corrugated metal pipe downstream of the switch-gate.
21. Chick Sweeney asked to clarify project responsibilities. It was expressed that ENSR would provide a concept report and NMFS would provide technical expertise and guidance.
22. The report to come out of the project would not be a construction document, but rather conceptual in nature. Typical items included in the report would be pipe requirements, shield sizes, design parameters, access locations, and tower locations. The report would be completed by December 15, 2000.
23. When the PIT-tag detector discussion was complete, John Plump asked if the group wanted to continue with the debris plugging issues before touring the facility grounds, or if they wanted to view the possible site locations of the fish detector and carry on with the debris plugging issues after lunch. It was decided to continue the meeting with the debris plugging discussion and then walk the grounds.
24. Chick Sweeney began the discussion by stating the problem. The discharge lines going to the tailrace are plugging. Branches get stuck at various locations in the pipe network, and after one gets stuck more accumulate quickly. Currently the facility uses "ice pigs" to free the plugs. The design team is charged with making amendments to the system to alleviate this plugging. Issues to be considered are changing the radius of pipe bends and re-locating the discharge lines above grade.

25. Brad Eby stated that there was not actually any blockage occurring in the big pipe loops. Rather it mostly occurred at the lower end of the 10-inch discharge pipes; especially those located underground.
26. Someone stated that the answer to the problem does not lie in making larger radius bends but instead going to a larger pipe or an open flume.
27. Steve Rainey stated NMFS reasons for investigation of the discharge pipes. He noted that optimizing the pipe network and providing an adequate outfall location was a concern of NMFS. The issue was more than just debris plugging for the agency, but this would not affect the agreed upon SOW for now.
28. Dave Hurson voiced that day lighting the steelhead line may require moving the existing PIT-Tag detector on this pipe.
29. It was restated that addressing the pipe joints so that they do not hang up sticks was the priority since it is at the joints that the problems originate. It was also voiced that adding more or larger pipes would require more water.
30. Brad Eby stated that the pipe joints the maintenance crew at the facility had filed no longer caused problems. They can now go weeks without having a plugging incident.
31. Steve Rainey noted that the NMFS criteria for the pipes are a minimum diameter of 24 inches and the number of pipe bends should be minimized.
32. The meeting was adjourned at 1:00 PM to tour the facility.

Originator – Chris T. Long

These minutes are an interpretation of discussions held. Any additions or corrections to these minutes should be provided to the Originator within ten (10) days of receipt of these minutes, or the minutes will be assumed to be correct as written.

Distribution: Meeting Participants

- ✓ Because additional detectors may be necessary in the future, breakaway latches should be placed in the walkway to allow sections of the walkway to be removed in the likely location of the future detectors.
- ✓ Two 15 amp, 110 volt circuits should be provided in each Hoffman Box.
- ✓ Each Hoffman box should contain two electrical receptacles. Fiber optic cables, with two strands per antenna coil should run from the Hoffman boxes to the Juvenile Facility Equipment Room.

- **Pipe Structure**
  - ✓ The steel pipe in the location of the detectors must be replaced with non-conductive material.
  - ✓ The water velocity in the 36-inch pipe is 8 fps.

6. At approximately 11:30 AM each bullet in the Design Guidelines had been addressed and John, Chick and Chris excused themselves to participate in a conference call with the Walla Walla District regarding the debris-plugging problem at the Juvenile Facility.
7. When John, Chick, and Chris returned everyone ate a lunch provided by ENSR.
8. After eating there was further discussion regarding the requirement that there be no vibration of the detectors. Ed stated that vibrations in the 2-5 kHz range must be avoided. Chick wondered if we could use accelerometers to measure the level of vibration currently in the 36-inch steel pipe. All agreed this was a good idea. Earl stated that the Navy took vibration measurements on the PIT-tag detector at the Ballard Locks that experienced trouble due to vibration. He did not know if the report with the vibration information had been published but said he would check on it. If he found any information he would forward it to Chris.
9. There was further discussion regarding the necessity and location of a hatch in the 36-inch pipe for insertion of test fish. Ed and Earl thought it would be a good idea to have at least one hatch since this design is not yet proven. If hatches are not provided at each shield, there was discussion about placing one hatch on the 36-inch pipe just as it leaves the dam. Access could be provided via a Scissors Truck. Also the idea of running a flexible hose containing fish from the dam to the hatch was mentioned.
10. The meeting was adjourned at 12:30 PM.

Originator – Chris T. Long

These minutes are an interpretation of discussions held. Any additions or corrections to these minutes should be provided to the Originator within ten (10) days of receipt of these minutes, or the minutes will be assumed to be correct as written.

Distribution: Meeting Participants

Appendix B

October 25, 2000 Meeting Minutes

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MEMORANDUM

TO: Memorandum For the Record
FROM: Chris T. Long
DATE: November 7, 2000

SUBJECT: Draft Meeting Minutes
Project Name: McNary Adult Fallback Study and Juvenile Fish Facility Improvements Preliminary Design, Contract No. DACW68-00-D-0001, T.O. No. 10
Meeting Date: October 25, 2000, 10:00 AM to 12:30 PM
Location: ENSR Redmond, WA office

Participants:

Name	Organization	Phone Number
Chris Long	ENSR	(425) 881-7700
Chick Sweeney	ENSR	(425) 881-7700
John Plump Jr.	HDR	(503) 768-3773
Terry Stones	HDR	(503) 768-3700
Ed Nunnallee	NMFS	(206) 526-4652
Earl Prentice	NMFS	(206) 842-4289

1. The meeting began at 10 AM with the attendees introducing themselves to each other. Chick Sweeney stated the purpose of the meeting was to brainstorm on the requirements of designing a PIT-tag detector for the Juvenile Fish Facility at McNary Dam. He relayed that at the Site Visit on October 4, 2000 it was difficult to obtain all the design specifics because there were so many people and organizations present. This meeting would be a more conducive setting for brainstorming on design solutions.
2. Earl Prentice agreed with Chick's statement and made a caveat regarding his and Ed's involvement in the design process. They were glad to share their experience and information they had concerning PIT-tag detectors, but they had never designed one to operate on a 36-inch pipe. And because of the fast-track nature of the design and their current lack of funding, it was unlikely testing could be accomplished before the prototype was constructed. Because of this their design guidelines would likely be conservative.
3. John Plump stated that the current PIT-tag detectors at the McNary facility were retrofitted this year to read the new ISO 134.2 kHz tags.
4. The location of the detector was discussed. Earl relayed to the group that discussions with a staff member knowledgeable of the PTAGIS said there would not be any database problems associated with placing the detector upstream of the main switch gate. Dave Hurson had expressed some concern with this at the October 4 Site Visit.

5. It was decided to review the preliminary set of Design Guidelines ENSR had prepared for the new PIT-tag detector. These were reviewed bullet by bullet and amendments made where necessary. The revised Design Guidelines are attached to this memo. The main points made during this exercise are listed below.

- Antenna Coils
  - ✓ Four coils will most likely be required to detect fish in a 36-inch pipe. Fewer coils might work, but without testing prior to prototype construction it would be a little risky.
  - ✓ The axial pipe length wrapped with coils will be about 1 foot.
  - ✓ The coil weight will be approximately 2 pounds.
  - ✓ We should provide for the possibility of additional detectors in the future.
  - ✓ The PIT-tag axis can be oriented ±45 degrees from the antenna coil axis.
- Electrical Shields
  - ✓ The purpose of the electrical shields is to reduce electrical emissions from the detectors to the environment and to protect the detectors from outside electrical interference.
  - ✓ The shields should extend about 2.5 feet past the ends of the coils, making the shield length approximately 6 feet.
  - ✓ The shields should be spaced at least two thirds pipe diameter from the antenna coils.
  - ✓ The shield dimensions could be 7 feet high by 8 feet wide by 6 feet long.
  - ✓ The shields do not have to be exactly equidistant from the antenna coils.
  - ✓ The thickness of the aluminum sheets used for the shields should be three-eighths inch.
  - ✓ If the shield width was set at 8 feet, it would give more room for a maintenance technician to work on the detectors.
  - ✓ A "manway" must be provided inside the electrical shields.
  - ✓ Overhead protection from the elements is not necessary if the shields are designed to withstand the weather and will resist vibration.
  - ✓ Bracing for the shields should be welded and not riveted or bolted.
  - ✓ It would be best to place the shield braces inside the shields so that air eddy shedding does not create vibrations.
- Support Structure
  - ✓ The video monitoring and test fish insertion hatches should not be located inside the shields. It would be best if one insertion hatch were placed upstream of each detector.
  - ✓ The cradles supporting the non-conductive pipe can be constructed of conductive material. They should be placed between the electrical shields.
  - ✓ A clearance of 4 feet should be provided between the antenna coils and the support beams, assuming they are a made of conductive material.
  - ✓ Equipment containers, called Hoffman Boxes, should be installed adjacent to each detector. The dimensions of the box are 2 feet by 2 feet by 2 feet.
  - ✓ Latches should be provided to keep the shield access doors in an open or closed position.

Appendix 2
Handout #10A
McNary Lock and Dam Juvenile Fish Facility Debris Plugging Preliminary Design Study

(10A)

MCNARY LOCK AND DAM
Juvenile Fish Facility

DEBRIS PLUGGING
PRELIMINARY DESIGN STUDY

30% SUBMITTAL

January 2001

Prepared by:
HDR Engineering

With support of:
ENSR

FOR FFDRWG REVIEW 1-24/25 01

January 12, 2001

Mr. Chuck R. Palmer
USACE, Walla Walla District
201 N. 3rd Avenue
Walla Walla, WA 99362

RE: DDR for Debris Plugging Modifications, 30% Submittal - McNary JFF Improvements (10132 016 002 04)

Dear Mr. Palmer:

This submittal is our 30% Design Documentation Report for the Debris Plugging Modifications Study at the McNary Juvenile Fish Facility. This work was accomplished in accordance with the scope of work for Task Order No. 10 of Contract No. DACW68-00-D-0001. We have developed, evaluated, and cost estimated several options under three different levels of improvements. We look forward to meeting with the District staff on January 19, 2001 to present our findings and discuss our evaluation.

We have deliberately not included a recommendation in this report, since we felt it was important to discuss the experiences, opinions, and professional judgements of key District staff. However, the team does have these preferences among the numerous options:

> Level 1 alternatives represent the least costly methods for improving the debris plugging problem. Among these six options, slip lining the entire length of the two return-to-river pipes appears to be the "best" solution to effectively improve the debris plugging situation, while minimizing the disruption to facility operation. This is Option 5 on the Evaluation Matrix Table on page 23 of the DDR.
>
> Level 2 alternatives effectively mitigate the debris plugging situation while also improving the capability to maintain and service the fish release pipes. Among these eight options, there appears to be some advantages to changing the slope of the Chinook line so that it no longer is buried but keeping its horizontal alignment as currently exists. (This is Option B under the Level 2 Pipe Layout Options.) Doing so would mean that the PIT-tag detector on this line would not be relocated and that the pipe would be located overland until it joins the relocated steelhead line on the existing bridge piers. This would facilitate maintenance.

HDR Engineering, Inc.
Employee-owned
Suite 500
10300 SW Greenburg Road
Portland, Oregon
97223
Telephone
503 768-3700
Fax
503 768-3737

Among the Level 2 Pipe Treatment Options, the slip lining and HDPE replacement options are preferred by the team because they are assessed as being the most effective at minimizing both debris plugging and facility disruption. These are Options 12 and 13 on the Evaluation Matrix Table on page 23 of the DDR.

There are no Level 3 alternatives that the team recommends, since the installation of a PIT-tag detector on the 36-inch Main Fish Transportation Flume appears both feasible and imminent. This will eliminate the necessity for enlarging the fish release pipes from 10-inches to 24-inches as they will no longer need to serve as primary bypass release pipes to allow enumeration of PIT-tagged fish which are neither being barged or sampled at the JFF.

If you have any questions or comments concerning this submittal prior to our meeting, please feel free to call me at 503-768-3773.

Sincerely,
HDR Engineering, Inc.

John H Plump, Jr.
Senior Project Manager

MCNARY LOCK AND DAM
Juvenile Fish Facility

DEBRIS PLUGGING
PRELIMINARY DESIGN STUDY

30% SUBMITTAL

January 2001

Prepared by:
HDR Engineering

With support of:
ENSR

Table of Contents

Section 1 Introduction

1.1 Project Authority

This Design Documentation Report (DDR) was prepared for the U.S. Army Corps of Engineers, Walla Walla District (Corps) under Task Order No. 10 for Contract No. DACW68-00-D-0001.

1.2 Study Purpose and Scope

On the downstream south shoreline of the McNary Lock and Dam is a Juvenile Fish Facility that was placed into operation in 1994. The facility includes a collection channel and related dewatering/control system (within the powerhouse), a combination smooth/corrugated fish transportation flume system (from the powerhouse to the fish facilities), and juvenile fish holding, loading and bypass facilities (located in the Spillway Park area). The juvenile fish facilities are comprised of various sizes of holding, and sorting tanks with a network of flumes and circular pipe interconnecting these tanks. The piping network that is used in the transport of fish is built out of PVC and HDPE pipe and ranges in size from 6 to 14 inches in diameter.

The piping network that is used to transport fish has experienced plugging in the past. The plugging problem is especially prevalent in the smaller pipes and around the wye connections and joints in the larger sized pipe. The purpose of the DDR is to prepare a preliminary design that will focus on modifications to eliminate or minimize the debris plugging problems. During this initial phase of the DDR, several potential alternatives have been identified and evaluated. Following a review of the alternatives by the Corps, one alternative will be selected for further design. The next phase of the DDR will be complete with drawings and specifications in sufficient detail for a contractor to estimate quantities, to determine materials and equipment required, and to develop costs to perform the construction work.

Section 2 Design Guidelines

2.1 Design Conditions and Constraints

The existing Chinook and Steelhead 10-inch discharge lines have been designed for flows of approximately 3 cfs each. However, these flows are not metered and have not been confirmed. The system is presently operated by adjusting dropgates until flow in the lines occupies approximately half-pipe depth as observed through observation ports cut into the tops of the lines.

The existing piping system delivers flow and fish to the barge-loading facility and/or existing outfalls in the McNary Dam tailrace. The locations and alignments of these facilities are to be maintained. Fish passing through the facilities are counted by PIT-tag detectors located on the existing pipes. While there are plans being considered to provide an additional PIT-tag detector on the main fish transportation flume system, upstream from the fish sorting, sampling, and barge-loading facilities, the existing PIT-tag detectors must also be maintained.

In addition to these constraints, flow in the transport pipes or flumes should satisfy the general criterion for stable open channel flow of having a Froude Number less than 0.86 or greater than 1.13, except for short distances when in transition from sub- to super-critical flow.

The primary problem at the McNary fish facility is to stop or eliminate debris plugging as much as possible in the Steelhead and Chinook bypass lines. The plugging is especially prevalent in and around the joints between pipe segments in the bypass lines. This plugging is further complicated by the fact that, although the majority of the bypass lines are aboveground and overland, a portion of the lines are located over the Columbia River on support pilings or buried underground. Each of these pipe locations will have different constructability or retrofit conditions.

Given these conditions and constraints, the following categories or criteria were developed to be used in evaluating the different design alternatives that are presented in Section 3. The first nine are included in the evaluation matrix that is presented in Section 4.

- Future Pipe Accessibility To Remove Debris
- Potential For Future Plugging
- Cost
- Operation And Maintenance Complications
- Compliance With PIT-Tag Technology
- Compatibility With 36-Inch PIT-Tag Installation
- Compliance with NMFS criteria for primary bypass

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- Compliance with NMFS criteria for secondary bypass
- Supplementary water requirements
- Hydraulic Considerations
- Pipe Alignment
- Structural Considerations
- Constructability and downtime involved to retrofit the facility

2.2 Application of National Marine Fisheries Service Design Criteria

Fish that are not loaded on barges at McNary are released either through: (1) a 36-inch diameter corrugated metal pipe, which bypasses the sampling facilities and discharges to the tailrace through a 30-inch diameter HDPE outfall pipe; or (2) the 10-inch diameter Chinook and Steelhead lines, which leave the sampling facility and wye into a single 14-inch diameter HDPE outfall pipe. The second route has been the default primary bypass for non-barged so that bypassed fish can be counted by the PIT-tag detectors on the Chinook and Steelhead lines. There are no PIT-tag detectors upstream from the sampling facility or on the bypass. Installation of a PIT-tag detector on the 36-inch diameter line approaching the sampling facility is being considered. This would allow direct enumeration of fish bypassing the sampling facility, making it a preferred primary bypass route for fish that are not being barged or otherwise sampled. The historical and planned uses of these release facilities are important to consider when determining how to apply bypass design criteria.

National Marine Fisheries Service (NMFS) adopted criteria in 1995 for the development of functional designs of downstream migrant fish passage facilities for hydroelectric, irrigation, and other water-withdrawal projects.[1] These criteria cover both systems intended as primary facilities, having discharges greater than 25 cfs, and those considered as small, or secondary facilities, having discharges less than 25 cfs. While the existing Chinook and Steelhead lines might be considered primary release routes on the basis of historical use, they carry flows considerably less than 25 cfs and may be relegated to secondary release status, only for sampled fish, with implementation of the proposed 36-inch PIT-tag detector.

The applicable NMFS bypass design criteria are presented in the following:

"H. Bypass Conduit Design

1. Bypass pipes shall have smooth surfaces and be designed to provide conditions that minimize turbulence. Bypass conduits shall have a smooth joint design to minimize turbulence and the potential for fish injury and shall be satisfactory to the NMFS.
2. Fish shall not be pumped within the bypass system.
3. Fish shall not be allowed to free-fall within a confined shaft in a bypass system.
4. Pressures in the bypass pipe shall be equal to or above atmospheric pressures.

[1] National Marine Fisheries Service Environmental and Technical Services Division. 1995. *Juvenile Fish Screen Criteria*. Portland, Oregon.

5. Bends shall be avoided in the layout of bypass pipes due to the potential for debris clogging. Bypass pipe centerline radius of curvature (R/D) shall be greater than or equal to 5. Greater R/D may be required for super-critical velocities.
6. Bypass pipes or open channels shall be designed to minimize debris clogging and sediment deposition and to facilitate cleaning as necessary. Therefore, the required pipe diameter shall be greater than or equal to 24 inches {0.610 meters (m)}, and pipe velocity shall be greater than 2.0 fps (0.610 mps), unless otherwise approved by the NMFS, for the entire operational range (also see Section K, Modified Criteria for Small Screens, Part 4).
7. Closure valves of any type are not allowed within the bypass pipe, unless approved by NMFS.
8. The minimum depth of open-channel flow in a bypass conduit shall be greater than or equal to 0.75 feet (0.23 m), unless otherwise approved by the NMFS (also see Section K, Modified Criteria for Small Screens, Part 5).
9. Sampling facilities installed in the bypass conduit shall not impair normal operation of the facility.
10. The bypass pipe hydraulics should not produce a hydraulic jump within the pipe. "

"K. **Modified Criteria for Small Screens** (**Diversion flow less than 25 cfs**)

* The following criteria vary from the criteria listed above and apply to smaller screens. Twenty-five cfs is an approximate cutoff; however, some smaller diversions may be required to apply more universal criteria listed above, while some larger diversions may be allowed to use the "small screen" criteria listed below. This will depend on site constraints.

1. The minimum bypass pipe diameter shall be 10 inches, unless otherwise approved by NMFS.
2. The minimum allowable pipe depth is 0.15 feet (1.8 inches or 4.6 cm) and is controlled by designing the pipe gradient for minimum bypass flow. "

2.3 Structural Design Criteria

2.3.1 Design Codes and Standards

Structural design on the project will be done per the following design specifications:

1. Steel Design – Allowable Stress Design Manual of Steel Construction, 9th Edition; published by the American Institute of Steel Construction
2. Design Loading (Dead, Snow, Wind, Seismic) will be determined using the Uniform Building Code, 1997 Edition with State of Oregon Revisions; published by the International Conference of Building Officials

2.3.2 Design Loads

The design loading for the Debris Plugging project will be as follows:

1. Dead Load:

- Steel: 490 pounds per cubic foot
- Water: 62.4 pounds per cubic foot
- HDPE:

  10-inch 50 psi rated HDPE pipe; 4.75 lbs/ft (dry); 38.8 lbs/ft (wet)
  14-inch 50 psi rated HDPE pipe; 8.05 lbs/ft (dry); 74.8 lbs/ft (wet)
  24-inch 50 psi rated HDPE pipe; 23.62 lbs/ft (dry); 219.7 lbs/ft (wet)
  34-inch 50 psi rated HDPE pipe; 47.44 lbs/ft (dry); 325.2 lbs/ft (wet)

2. Snow Load:

- Basic ground snow load: Assume 20 pounds per square feet
- Snow exposure factor: 0.6
- Snow Importance Factor: 1.0 (Miscellaneous Structures)

3. Wind Load:

- Exposure C
- Basic wind speed: 90 mph
- Combined height, exposure and gust factor coefficient: 1.31
- Pressure coefficient: 1.4 (square or rectangular tanks)
- Wing stagnation pressure: 20.8 pounds per square foot
- Wind Importance Factor: 1.0 (Miscellaneous Structures)

4. Seismic Load:

- Seismic Zone 2B
- Soil Profile: Generally Sand, Gravel & Cobbles over Hard Dense Basalt (source: McNary Dam – Basis of Design 1946 - Appendix C – Soil Data and Analysis) Soil Profile Type SA
- Seismic Zone Factor: 0.2
- Seismic coefficient: 0.16
- Seismic Importance Factor: 1.0 (Miscellaneous Structures)
- Overstrength and ductility coefficient: 2.2 (Vessel on braced legs)
- Period of vibration: T = Ct x (hn)3/4

  C_t: 0.02 (non moment resisting frame)
  $h_n^{3/4}$: (height) $35^{3/4} = 14.4$
  T = 0.02 x 14.4 = 0.288 seconds

Section 3 Alternatives Description

When evaluating the following alternatives, it is suggested that the reviewer also refer to Table 1 in Section 4. This table presents all of the alternatives in a matrix format.

3.1 Level 1 Alternatives

The goal of the Level 1 Alternatives is to solve the problem of debris plugging in the Steelhead and Chinook return-to-river pipes with a minimal of effort and costs. Level 1 alternatives address the plugging problem without changing the alignment or size of the fish release pipes and flumes. Within this first level of action, steps will be taken to minimize plugging in both the buried and aboveground sections of the Chinook and Steelhead return-to-river pipes. Two options were identified for mitigating the plugging in the buried section of pipe and three options in the aboveground sections.

Buried Pipe	Option A – Buried Pipe Joint Replacement
	Option B – Slip Lining
Aboveground Pipe	Option 1 – Aboveground Joint Replacement
	Option 2 – Slip Lining
	Option 3 – Replace with 10-inch HDPE

3.1.1 Buried Pipe Options

According to personnel at the Juvenile Fish Facility (JFF), most problems with clogged pipes occur in the region of the buried Chinook and Steelhead 10-inch pipes. Some joints in these pipes have been repaired or replaced, but the area continues to be a problem. Two options to mitigate plugging in this area follow.

3.1.1.1 Option A – Buried Pipe Joint Replacement

The locations of all joints in these two buried pipes would be identified and excavated. The joints could then be repaired or replaced. Certainly all slip joints, which are notorious at the facility for catching sticks and causing problems, should be replaced. The pipe material in these two lines is high-density polyethylene (HDPE), so the option for replacement is fuse welding pipe joints and then trimming the inside of the joint. Replacing the joints may involve cutting the old joint out which would require shifting the pipe at each joint and adding new pipe somewhere along its length. Proper pipe bedding materials and placement should also be investigated and improved at this time. Improperly designed or installed pipe bedding materials can lead to pipe settling that can cause joint misalignment.

Due to the nature of the fish facility in the underground section (restricted access due to space, and support requirements from towers in the area), excavating the area around the buried pipe may be impossible or price prohibitive. Picture 1 below shows the approximate route of the chinook and steelhead pipe through the underground section. As can be seen in the picture, the existing infrastructure may cause access or excavation problems. The cost estimate for reworking the buried pipe does include pricing for

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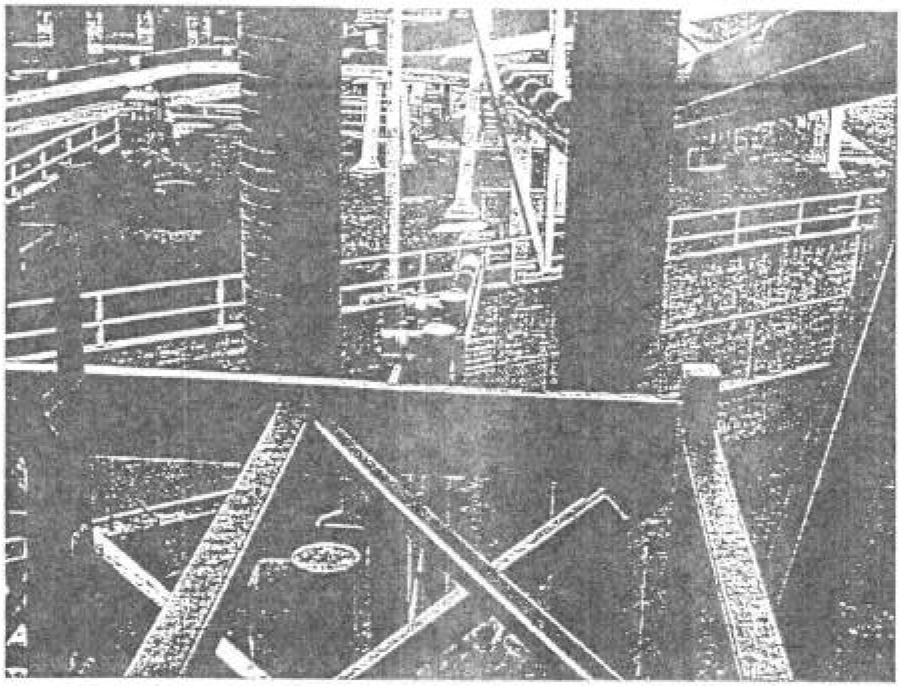
excavation, pipe fill, bedding requirements, and fill, but does not include any estimation for problems that may be encountered due to the existing infrastructure.



Picture 1 – Alignment of Steelhead and Chinook Lines through the Buried Pipe Area.

Pipe Alignment
The pipes will maintain their present layout. No change is recommended.

Hydraulics Considerations
Excavation to repair or replace buried pipe joints will not appreciably alter the system hydraulics.

Structural Considerations
No structural changes are anticipated except for potential rework or replacement of the pipe bedding material and possible retrofitting problems due to existing surface and subsurface infrastructure.

3.1.1.2 Option B – Buried Pipe Slip Lining

A second solution for addressing debris plugging in the buried section of pipe is to line the interior of the 10-inch ID pipe with a sleeve. Sleeve liners are available in several materials and thickness, but one constructed of HDPE is recommended. This product is available with a wall thickness as thin as 6 millimeters. The cost estimate for this option includes sliplining only up to the point where the underground pipes daylight onto the tailrace. To slip line the remaining 425-ft of pipe out to the outfall, would increase the cost estimate by approximately $55,100 (includes 35% contingency, 10% for engineering & design, and 10% for supervision and administration).

Pipe Alignment
The pipes will maintain their present layout. No change is recommended.

Hydraulics Considerations
Use of a slip lining will reduce the inside diameter of the 10-inch return-to-river pipes by 9%, assuming a lining wall thickness of 6mm. This reduction in area will raise the normal water level in the pipe. Assuming the Steelhead pipe is lined with a sleeve spanning from the location where the pipe first drops underground to its outfall location, the normal water level will increase from 5.7 inches to 5.9 inches (assuming 3 cfs, a Manning's coefficient of 0.01, and a constant slope). (See the hydraulic computation spreadsheet located in Appendix A).

In addition to a decrease in flow area, the surface roughness of the pipe will change slightly. However because PVC and HDPE are both considered "smooth plastic", the system hydraulics will not alter appreciably as a result of this.

Structural Considerations
Since the pipe layout is not changed or modified, there are no structural considerations.

3.1.2 Aboveground Pipe Options

Though most of the difficulty with clogging occurs in the region of the buried pipes, the potential exists for problems in the pipes that are aboveground. The facility manager placed a camera in this section of pipe for the Steelhead return-to-river pipe during the week of December 11, 2000 and found several sticks hanging-up on joints. Three options to mitigate plugging in these regions follow.

3.1.2.1 Option 1 – Joint Replacement

The flanges that were primarily causing sticks to hang-up in the aboveground 10-inch pipes are the standard slip joints. These joints are constructed by wrapping a strip of heated PVC (poly-vinyl chloride) plastic around the ends of PVC pipes placed end to end. When the heated strip cools is constricts on the pipes forming a seal. A problem that can occur with this type of joint is that one or both ends of the pipes can buckle. This buckle has the potential to catch debris as it passes.

To mitigate this problem a different joint can be applied at all locations of slip joints and other identified joints in the aboveground section of 10-inch pipe. The joint of preference is a Van Stone flange. This joint is a combination of a glued fitting and a plastic flange on each pipe. When the pipes are bolted together, a relative seamless connection is formed. Replacing the joints will involve cutting the old joint out which would require shifting the pipe at each joint and adding new pipe somewhere along its length.

Pipe Alignment
The pipes will maintain their present layout. No change is recommended.

Hydraulics Considerations
Repairing or replacing pipe joints in the aboveground 10-inch line will not appreciably alter the system hydraulics.

Structural Considerations
Because the size, material, and location of the pipes will not change, the structural requirements of the system will not be altered.

3.1.2.2 Option 2 – Slip Lining

Another method of addressing the plugging difficulty would be to line this section of pipe with an HDPE sleeve. This sleeve would be similar to the one described in section 3.1.1.2. The liner would continue from the buried section of pipe to the drop-gate from the 1.5-foot flumes leading from the main separator.

Pipe Alignment
The pipes will maintain their present layout. No change is recommended.

Hydraulics Considerations
Use of a slip lining will reduce the inside diameter of the 10-inch return-to-river pipes by 9%, assuming a lining wall thickness of 6mm. This reduction in area will raise the normal water level in the pipe. Assuming the Chinook pipe is lined with a sleeve spanning from the dropgate to its outfall location, the normal water level will increase from 5.0 inches to 5.2 inches (assuming 3 cfs, a Manning's coefficient of 0.01, and a constant slope). (See the hydraulic computation spreadsheet located in Appendix A).

In addition to a decrease in flow area, the surface roughness of the pipe will change slightly. However because PVC and HDPE are both considered "smooth plastic", the system hydraulics will not alter appreciably as a result of this.

Structural Considerations
Although sliplining will add slightly to the dead weight of the pipe, the additional weight is anticipated to not require any structural changes. The thermal expansion of PVC and HDPE is $3x10^{-5}$ 1/°F and $9x10^{-5}$ 1/°F, respectively. There could be some structural considerations due to the differences in thermal expansion rates between the two materials. If this option is selected for further evaluation, this will be investigated during the next phase.

3.1.2.3 Option 3 – Replace with 10-inch HDPE

Because HDPE pipe can be fused welded and then have the inside bead or joint trimmed, it will form a smoother joint when pipe ends are connected than PVC pipe. Therefore replacing all the 10-inch fish return-to-river pipes from PVC to HDPE can help with the debris plugging issue. The pipes would be replaced from the drop-gate from the 1.5-foot flume to the beginning of the buried section of pipe.

Pipe Alignment
The pipes will maintain their present layout. No change is recommended.

Hydraulics Considerations
Any change in system hydraulics will result from a difference in surface roughness. Because PVC and HDPE are both considered "smooth plastic", the system hydraulics will not alter appreciably.

Structural Considerations
Switching from PVC pipe to HDPE pipe is not anticipated to require any structural changes. However, fusing and trimming the pipe does require it to be built on the ground and then hoisted into place. Due to the nature of the fish facility (low beams, and restricted access due to space), there could be unforeseen constructability problems.

3.2 Level 2 Alternatives

The objective of the Level 2 Alternatives is to mitigate the debris plugging difficulties to a further degree than was possible in Level 1. The main distinction between Level 2 and Level 1 alternatives is that now the alignments of the Steelhead and Chinook return-to-river 10-inch pipes would change. The buried section would be rerouted. The existing buried pipe would be plugged on either end and abandoned. Two layout options have been identified. In tandem with a new layout option, a pipe replacement option must also be selected. The pipe replacement options are similar to those available in the Level 1 Aboveground Section. The pipe sizes do not increase or decrease in Level 2.

Pipe Layout	Option A – Reroute Steelhead and Chinook lines
	Option B – Reroute Steelhead line only
Pipe Treatment	Option 1 – Aboveground Joint Replacement
	Option 2 – Slip Lining
	Option 3 – Replace with 10-inch HDPE
	Option 4 – Replace with U-flume

3.2.1 Pipe Layout Options

Two options for pipe alignments have been identified. Option A was identified at the project kick-off meeting, which occurred on October 4, 2000, and Option B was determined through internal design team meetings.

3.2.1.1 Option A – Reroute Steelhead and Chinook Lines

The route of the Steelhead and Chinook 10-inch lines would be altered from a location adjacent to the JFF main head tank to a location on the support piers in the tailrace. This new alignment would make it unnecessary to bury the pipes, thereby making the pipes more accessible for maintenance.

Pipe Alignment

The proposed pipe alignment is shown in Plate 1. Both 10-inch return-to-river pipes would change their present route at a location on a line parallel to the concrete retaining wall between the JFF and the piers supporting the outfall pipes over the tailrace. This change in plan layout would only slightly alter the slope of the Steelhead pipe. A more dramatic change in slope would occur on the Chinook line. The change in slope of the Chinook line would begin at the location where the same supports suspend both Steelhead and Chinook pipes. At the point both lines are adjacent to the head tank they would be at the same approximate elevation. As they run parallel to one another along the retaining wall they would Y-connect into a 14-inch pipe similar to their present configuration.

Hydraulics Considerations

This change in pipe layout will decrease the length of the Chinook and Steelhead lines by approximately 50 feet each. In addition to a length change, the slope of the Chinook line will increase in the stretch between the dropgate and the main headtank. The effect this change in slope will have on the hydraulics (water depth and velocity) in the pipe will be addressed in the next phase of this study.

Structural Considerations

New tower supports would be required for the pipes between the head tank and retaining wall. At the retaining wall, cantilevered steel supports would be required to support the 14" HDPE pipe. A support beam will be required as the pipe curves from the retaining wall to a location on the existing tailrace. The existing PIT Tag detectors for each line will also need to be relocated.

3.2.1.2 Option B – Reroute Steelhead Line and Change Slope of Chinook Line

The route of the Steelhead 10-inch line would be the same as identified in Option A. However, the alignment of the Chinook line would be different. This new alignment would also make it unnecessary to bury the pipes, thereby making them more accessible for maintenance.

Pipe Alignment

The proposed pipe alignment is shown on Plate 1. The Steelhead 10-inch return-to-river pipe route would change to the layout identified in Option A. This alignment change would only slightly alter the slope of the Steelhead pipe. In Option B the Chinook pipe would maintain its present route up to a location just before passing over the abandoned Ice and Trash Chute. At this point it would change to a more gradual slope. The pipe would maintain its present plan view alignment, but rather than entering the ground past the Ice and Trash Chute it would continue aboveground. The pipe would then make a 90-degree turn and follow the Adult Fallback return-to-river pipe with a similar slope. The pipe would join with the Steelhead 10-inch pipe on the bridge piers and combine into one 14-inch pipe, similar to the present configuration.

Hydraulics Considerations
This change in pipe alignment would decrease the length of the Steelhead line by approximately 50 feet. The length of the Chinook line would not change appreciably. However, an increase in the Chinook pipe slope would occur in the region of the retaining wall. This increase in slope would affect the hydraulics (water depth and velocity) in the pipe. Analyzing this affect requires a level of effort reserved for the next phase of the study.

Structural Considerations
New tower supports would be required for the 10-inch steelhead pipe between the head tank and retaining wall. At the retaining wall, cantilevered steel supports would then be required to support this pipe. A support beam would be required to carry the pipe from the retaining wall the existing tailrace. The PIT Tag detector for the steelhead line will also need to be relocated. The chinook line would also require new tower supports as it routes its way along its proposed alignment.

3.2.2 Pipe Treatment Options

The layout of the return-to-river pipes is addressed in Section 3.2.1, but not any treatment to the pipe and the joints. Four options have been identified to allow treatment of the pipe and its joints.

3.2.2.1 Option 1 – Joint Replacement

The features that are primarily catching sticks in the aboveground 10-inch pipes are the standard slip joints. These joints are constructed by wrapping a strip of heated PVC (poly-vinyl chloride) plastic around the ends of PVC pipes placed end to end. When the heated strip cools is constricts on the pipes forming a seal. A problem that can occur with this type of joint is that one or both ends of the pipes can buckle. This buckle has the potential to catch debris as it passes.

These joints should be replaced with a "Van Stone flange;" a combination of a glued fitting and a plastic flange on each pipe. When the pipes are bolted together, a relative seamless connection is formed. Replacing the joints may involve cutting the old joint out which would require shifting the pipe at each joint and the adding new pipe somewhere along its length.

Pipe Alignment
One of the Level 2 Pipe Layout plans, Options A or B, must be chosen in tandem with the pipe treatment option.

Hydraulics Considerations
Repairing or replacing pipe joints with Van Stone flanges in the 10-inch line will not appreciably alter the system hydraulics. Changing the pipe alignment however will affect the hydraulics. This change is described in Sections 3.2.1.1 and 3.2.1.2, depending on the alignment used in combination with joint replacement.

Structural Considerations
Because the size, material, and location of the pipes will not change, the structural requirements of the system will not be altered.

3.2.2.2 Option 2 – Slip Lining

This option is the installation of an HDPE sleeve inside of the existing PVC as described earlier.

Pipe Alignment
One of the Level 2 Pipe Layout plans, Options A or B, must be chosen in tandem with the Option.

Hydraulics Considerations
Use of a slip lining will reduce the inside diameter of the 10-inch return-to-river pipes by 9%, assuming a lining wall thickness of 6mm. This reduction in area will raise the normal water level in the pipe. Assuming the Chinook pipe is lined with a sleeve spanning from the dropgate to its outfall location, the normal water level will increase from 5.0 inches to 5.2 inches (assuming 3 cfs, a Manning's coefficient of 0.01, and a constant slope). (See the hydraulic computation spreadsheet located in Appendix A.)

In addition to a decrease in flow area, the surface roughness of the pipe will change slightly. However because PVC and HDPE are both considered "smooth plastic", the system hydraulics will not alter appreciably as a result of this.

Changing the pipe alignment will also affect the local hydraulics. This change is described in Sections 3.2.1.1 and 3.2.1.2, depending on the alignment used in combination with slip lining.

Structural Considerations
Although sliplining will add slightly to the dead weight of the pipe, the additional weight is anticipated to not require any structural changes. The thermal expansion of PVC and HDPE is $3x10^{-5}$ 1/°F and $9x10^{-5}$ 1/°F, respectively. There could be some structural considerations due to the differences in thermal expansion rates between the two materials. If this option were selected for further evaluation, it would be investigated during the next phase of the study..

3.2.2.3 Option 3 – Replace with 10-inch HDPE

As HDPE pipe is installed in an application, it is usually fused welded which makes a smooth and rounded joint internal and external to the pipe. This internal weld or bead can also be trimmed to make a smooth weld where the pipe ends are connected. Therefore, replacing all the 10-inch fish return-to-river pipes from PVC to HDPE can help with the debris plugging issue. The pipes would be replaced from the drop-gate from the 1.5-foot flume to the beginning of the buried section of pipe.

Pipe Alignment
One of the Level 2 Pipe Layout plans, Options A or B, must be chosen in tandem with the Option.

Hydraulics Considerations
Any change in system hydraulics will result from a difference in surface roughness. Because PVC and HDPE are both considered "smooth plastic", the system hydraulics will not alter appreciably.

Structural Considerations
Switching from PVC pipe to HDPE pipe is not anticipated to not require any structural changes. However, fusing and trimming the pipe does require it to be built on the ground and then hoisted into place. Due to the nature of the fish facility (low beams, and restricted access due to space), there could be unforeseen construct ability problems.

3.2.2.4 Option 4 – Replace with U-Flume

A fourth pipe treatment option would be to replace the pipes with a 10-inch U-flume. The flume has advantages over pipe with respect to access and ease of debris removal. The joints would need to be treated with equal care however because any debris that did plug the flume would cause the water and fish to spill out of the flume and onto the ground.

The flume would start at each drop gate and proceed along the existing alignment in the fish facility. The flume would also replace the pipe that is being proposed in section 3.2.1.

Pipe Alignment
One of the Level 2 Pipe Layout plans, Options A or B, must be chosen in tandem with the flume option.

Hydraulics Considerations
A concern in using a U-flume to replace the return-to-river pipes is the depth of flow in the flume. The flow depth will be greatest in the region of flattest slope. A hydraulic analysis of the circular pipe carrying flow from the wye connection of the Chinook and Steelhead lines on the bridge piers and continuing to the outfall location yields a normal depth in the 14-inch ID pipe of 7.8 inches (assuming 3 cfs, a Manning's coefficient of 0.01, and a constant slope of 0.02). (See the hydraulic computation spreadsheet located in Appendix A.) This depth is just over one-half of the pipe diameter. To determine the corresponding depth in a U-flume, the geometry of the flume must first be ascertained. But based on the above analysis, the flume would not overtop if its side walls extended at least one diameter above a 14-inch ID flume invert.

Structural Considerations
Where the flume is proposed to replace existing pipe within the fish facility no additional structural supports are anticipated. However, the hardware required to attach the flumes to the existing supports is expected to change. New tower supports would be required as

the flume progresses its way to the head tank and out to the retaining wall. At the retaining wall, cantilevered steel supports would be required. A support beam will be required to carry the flume from the retaining wall to a location on the existing tailrace. At this point the flume would transition to the existing 14-inch pipe. New PIT Tag detectors would also be required for this option. Depending on the option selected, new tower supports would also be required for the Chinook line if it follows the current alignment.

3.3 Level 3 Alternatives

The motivating factor behind assessing a third level of alternatives is to bring the JFF into compliance with the NMFS primary bypass criteria. In addition, the larger pipe with the larger flow required would be less prone to plugging by debris than the existing 10-inch pipe.

Presently the only way to count the PIT-tagged fish entering the facility is to have them pass through the entire operation and be observed by a PIT-tag detector on one of the 10-inch pipes. Because NMFS criteria states that a pipe used as a primary bypass should be 24-inches in diameter, the Level 3 alternatives are designed to bring the JFF into compliance with this standard. It should be noted however that plans are currently underway to install a PIT-tag detector on the 36-inch steel pipe transporting fish to the facility from the powerhouse unit gatewells. If a 36-inch detector is installed and functions reliably, then the 10-inch return-to-river pipes will no longer be considered a primary bypass and they will not need to be increased to 24-inch pipe to meet NMFS criteria.

Pipe Layout	Option A – Reroute Steelhead and Chinook lines
	Option B – Reroute Steelhead line only
Pipe Replacement	Option 1 – Replace with 24-inch HDPE to Dropgate
	Option 2 – Replace with 24-inch HDPE to Separator

3.3.1 Pipe Layout Options

The same two options for pipe alignments identified as Options A and B in Level 2 are the alignments proposed for this third level of modification.

3.3.1.1 Option A – Reroute and Replace Steelhead and Chinook Lines with 24-inch HDPE

The route of the Steelhead and Chinook 10-inch lines from a location adjacent to the JFF main head tank to their Y-connection on the support piers in the tailrace would be altered. The size would be changed from 10-inch to 24-inch HDPE pipe. This new alignment would make it unnecessary to bury the pipes thereby making the pipes more accessible for maintenance.

Pipe Alignment

The proposed pipe alignment is shown in Plate 1. Both return-to-river pipes would change their present route at a location on a line parallel to the concrete retaining wall between the JFF and the piers supporting the outfall pipes over the tailrace. This change in plan layout would only slightly alter the slope of the Steelhead pipe. A more dramatic change in slope would occur on the Chinook line. The change in slope of the Chinook line would begin at the location where the same supports suspend both Steelhead and Chinook pipes. At the point both lines are adjacent to the head tank they would be at the same approximate elevation. As the 24-inch pipes run parallel to one another along the retaining wall they would Y-connect into a 34-inch pipe that would continue to an outfall location that is similar to their present configuration.

Hydraulics Considerations

This change in pipe layout will decrease the length of the Chinook and Steelhead lines by approximately 50 feet each. In addition to a length change, the slope of the Chinook line will increase in the stretch between the dropgate and the main headtank. The effect this change in slope will have on the hydraulics (water depth and velocity) in the pipe would be addressed in the next phase of the study.

Structural Considerations

New tower supports would be required for the 24-inch pipes between the head tank and retaining wall. At the retaining wall cantilevered steel supports would then be required to support this pipe. A support beam would be required as the pipe curves from the retaining wall to a location on the existing tailrace. This new beam would also require a new pier support in the river. The existing beam that carries the load on the tailrace for the 14-inch pipe out to the outfall would need to be removed and replaced with a larger beam.

3.3.1.2 Option B – Reroute Steelhead Line and Replace Steelhead and Chinook Lines with 24-inch HDPE

The route of the Steelhead 24-inch line would be the same as identified in Option A. However, the alignment of the Chinook line would be different. This new alignment would make it unnecessary to bury the pipes thereby making them accessible for maintenance.

Pipe Alignment

The proposed pipe alignment is shown in Plate 1. The Steelhead 10-inch return-to-river pipe would be upsized to 24-inch and would change to the layout identified in Option A. This alignment change would only slightly alter the slope of the Steelhead pipe. In Option B the Chinook pipe will be upsized to 24-inch pipe and would maintain its present route up to a location just before passing over the abandoned Ice and Trash Chute. At this point it will change to a more gradual slope. The pipe would maintain its present plan view alignment, but rather than entering the ground past the Ice and Trash Chute it would continue aboveground. The pipe would then turn and follow the Adult Fallback return-to-river pipe with a similar slope. The pipe would join with the Steelhead 24-inch pipe on the bridge piers and be combine into one 34-inch pipe.

Hydraulics Considerations
This change in pipe alignment would decrease the length of the Steelhead line by approximately 50 feet. The length of the Chinook line would not change appreciably. However, an increase in the Chinook pipe slope would occur in the region of the retaining wall. This increase in slope would affect the hydraulics (water depth and velocity) in the pipe. This will be addressed in the 90% report.

Structural Considerations
New tower supports would be required for the 24-inch steelhead pipe between the head tank and retaining wall. At the retaining wall cantilevered steel supports would then be required to support this pipe. A support beam would be required to carry the pipe from the retaining wall to the existing tailrace. The existing beam that carries the load on the tailrace for the 14-inch pipe out to the outfall would need to be removed and replaced with a larger beam to accommodate the larger pipe. The chinook line would also require new tower supports as it makes its way along its proposed alignment.

3.3.2 Pipe Replacement Options

Because the intent of this level of modification includes making the return-to-river pipes compliant with NMFS criteria for primary bypass in conjunction with eliminating the debris-plugging problem, each of the two options involves replacing the existing 10-inch pipe with 24-inch pipe.

3.3.2.1 Option 1 – Replace with 24-inch HDPE to Dropgate

This option involves replacing both the Steelhead and Chinook 10-inch return-to-river pipes with 24-inch diameter pipe. The starting point for replacement would be at the location of the drop-gate from the 1.5-foot flumes. The pipes would remain 24-inches in diameter until they combined to form one pipe before extending into the tailrace on the support piers. The pipes would likely combine into one 34-inch pipe.

Pipe Alignment
One of the Level 2 Pipe Layout plans, Options A or B, must be chosen in tandem with the Option.

Hydraulics Considerations
A major hydraulic implication of the 24-inch pipe is the amount of supplementary flow required to maintain a minimum depth of 9 inches in the pipe as required by NMFS. Assuming the current operation of approximately 3-cfs, calculations show the normal water depth in a 24-inch pipe to be 3.6 inches. Approximately 19 cfs is required to achieve a normal depth of 9.1 inches (normal velocity is 17.3 fps). (See the hydraulic computation spreadsheet located in Appendix A.) This additional flow would need to be added in the vicinity of the dropgate. Cost of supplementary flow has not been included in the cost estimate. Substantial further hydraulic analysis will be necessary if this option is chosen to confirm compliance with NMFS criteria.

Structural Considerations

When completely full of water, a 24-inch pipe weighs 5 times as much as a 10-inch pipe that is full of water (220 lbs/ft vs. 39 lbs/ft). This will probably require a complete replacement of all pipe towers, hangers, and supports to accommodate the 24-inch pipe. A new 24-inch PIT Tag detector for each line will need to be installed. Last, it is uncertain if the 24-inch pipe and new 24-inch PIT Tag detectors can fit into or be restricted to the space requirements of the current fish facility.

3.3.2.2 Option 2 – Replace with 24-inch HDPE to Separator

Option 2 is similar in scope to Option 1, but rather than beginning the 24-inch pipe at the drop-gate from the 1.5-foot flume, the beginning point would be at the main separator. This would involve changing all piping downstream of the separator to 24-inches in diameter. The purpose for this option versus Option 1 is to bring the facility into compliance with primary bypass criteria for the entire reach of transport flume and pipe, which means utilizing a pipe diameter of 24-inches.

Pipe Alignment

One of the Level 3 Pipe Layout plans, Options A or B must be chosen in tandem with this option.

Hydraulics Considerations

A major hydraulic implication of the 24-inch pipe is the amount of supplementary flow required to maintain a minimum depth of 9 inches in the pipe as required by NMFS. Assuming the current operation of approximately 3-cfs, calculations show the normal water depth in a 24-inch pipe to be 3.6 inches. Approximately 19 cfs is required to achieve a normal depth of 9.1 inches (normal velocity is 17.3 fps). (See the hydraulic computation spreadsheet located in Appendix A.) This additional flow would need to be added in the vicinity of the dropgate. Cost of supplementary flow has not been included in the cost estimate. Substantial further hydraulic analysis will be necessary if this option is chosen to confirm compliance with NMFS criteria.

Structural Considerations

When completely full of water a 24-inch pipe weighs 5 times as much as a 10-inch pipe that is full of water (220 lbs/ft vs. 39 lbs/ft). This will probably require a complete replacement of all pipe towers, hangers, and supports to accommodate the 24-inch pipe. New 24-inch PIT Tag detectors for each line will need to be installed. In addition, the PIT Tag detectors that are on the existing flume that control the dropgate into the current 10-inch pipe will need to be replaced with models that are sized for 24-inch pipe. This also raises the issue of designing and installing a drop or rotational gate for a 24-inch pipe. The structural and dynamic requirements for this larger gate have not been analyzed for this report. Last, it is uncertain if the 24-inch pipe and new 24-inch PIT Tag detectors can fit into or be restricted to the space requirements of the current fish facility.

Section 4 Alternative Evaluation

4.1 Criteria Evaluation

Table 1 takes all of the alternatives that were discussed in Section 3 and presents them in an evaluation matrix. Each of the evaluation categories is discussed in the bulleted items that follow. Each alternative in the matrix is rated "Good", "Fair", and "Poor." The basis for the evaluation is included in the following descriptions.

- Access To Remove Debris

This rating focuses on ease of removing debris that may become caught in various locations in the fish bypass facility. Underground pipe would be rated "Poor" due to a lack of access, while flumes, which can be easily cleaned, would have a "Good" rating.

- Low Potential For Future Plugging

As the category implies, the various alternatives are rated for their potential to plug in the future. Sliplining would have a "Good" potential since it eliminates the surface effect of a pipe joint. Retrofitted joints would be rated "Fair" since the potential for flaws in the joint will still exist.

- Cost

This column is not rated. Instead, the dollar amount per level or alternative has been placed in this column. (A detailed cost estimate for each level or alternative is included in Appendix B.)

- Operation And Maintenance Complications

Ease of maintenance is evaluated in this column. Alternatives with 10-inch pipe would be rated "Good", while alternatives with 24-inch pipe would be rated "Fair", due to higher flow requirements and the need to supplement flow.

- Compliance With PIT-Tag Technology

This criteria evaluates how current PIT-Tag technology will fit into each of the levels or alternatives. Levels with 10-inch pipe would be rated "Good" since this is proven PIT Tag technology. Levels with 24-inch would be rated "Fair" due to the pipes larger size and the lack of experience dealing with PIT-Tag detectors over 10 inches in size.

- Compatibility With 36-Inch PIT-Tag Installation

This category rates how each level or alternative will function with the proposed 36-inch PIT Tag detector in the main fish transportation line. Levels 1 and 2 were all rated "Good". This is due to the fact that the 36-inch line will become the main PIT Tag detection line for the facility. This will relegate the smaller lines to a secondary function.

A 24-inch line is required under NMFS guidelines for primary bypass. If the 36-inch line becomes the primary bypass line for the fish facility, then a 24-inch line is not required. Therefore, the 24-inch line was rated "Poor."

- Compliance with NMFS criteria for primary bypass pipe diameter

The NMFS criteria for primary fish release routes, presented in Section 2, includes a minimum pipe diameter of 24-inches. If the proposed system return-to-river pipes meet this requirement, then they are awarded a "Good" rating. Otherwise they are relegated to a "Poor".

- Compliance with NMFS criteria for secondary bypass pipe diameter

According to NMFS criteria, if the flows through the fish return-to-river pipe are less than 25 cfs, then it is classified as a secondary bypass. Secondary bypass pipes must be at least 10 inches in diameter. A "Good" rating was given to pipes meeting this standard. Smaller pipes were given a rating of "Poor."

- Lack of need for supplementary water

The necessity of supplementary water to maintain a depth of flow to satisfy the NMFS standards is evaluated in this category. A "Good" rating was given if the system can operate with current flows. A "Poor" rating was given if supplementary flow would be needed to maintain a minimum depth of flow in the pipes.

Table 1 – Alternatives to Eliminate Debris Plugging

Level	Option #	Pipe Layout	Pipe Treatment Buried	Pipe Treatment Aboveground	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Level 1	1	N/A	Option A - Buried Pipe Joint Replacement	Option 1 - Aboveground Joint Replacement	Poor	Fair	$171[1]	Fair	Good	Good	Poor	Good	Good
	2	N/A	Option A - Buried Pipe Joint Replacement	Option 2 - Slip Lining			$227[1,2]						
	3	N/A	Option A - Buried Pipe Joint Replacement	Option 3 - Replace with 10-inch HDPE	Fair	Good	$140[1]	Fair	Good	Good	Poor	Good	Good
	4	N/A	Option B - Slip Lining	Option 1 - Aboveground Joint Replacement	Fair	Fair	$138[3]	Fair	Good	Good	Poor	Fair	Good
	5	N/A	Option B - Slip Lining	Option 2 - Slip Lining	Good	Good	$168[3]	Good	Good	Good	Poor	Fair	Good
	6	N/A	Option B - Slip Lining	Option 3 - Replace with 10-inch HDPE	Good	Good	$119[3]	Good	Good	Good	Poor	Fair	Good
Level 2	7	Option A - Reroute Steelhead and Chinook lines	N/A	Option 1 - Joint Replacement	Fair	Fair	$233	Fair	Good	Good	Poor	Good	Good
	8	Option A - Reroute Steelhead and Chinook lines	N/A	Option 2 - Slip Lining	Good	Good	$288	Good	Good	Good	Poor	Fair	Good
	9	Option A - Reroute Steelhead and Chinook lines	N/A	Option 3 - Replace with 10-inch HDPE	Good	Good	$325	Good	Good	Good	Poor	Good	Good
	10	Option A - Reroute Steelhead and Chinook lines	N/A	Option 4 - Replace with U-flume	Good	Good	$477	Good	Good	Good	Poor	Good	Good
	11	Option B - Reroute Steelhead line only	N/A	Option 1 - Joint Replacement	Fair	Fair	$231	Fair	Good	Good	Poor	Good	Good
	12	Option B - Reroute Steelhead line only	N/A	Option 2 - Slip Lining	Good	Good	$233	Good	Good	Good	Poor	Fair	Good
	13	Option B - Reroute Steelhead line only	N/A	Option 3 - Replace with 10-inch HDPE	Good	Good	$324	Good	Good	Good	Poor	Good	Good
	14	Option B - Reroute Steelhead line only	N/A	Option 4 - Replace with U-flume	Good	Good	$546	Good	Good	Good	Poor	Good	Good
Level 3	15	Option A - Reroute Steelhead and Chinook lines	N/A	Option 1 - Replace with 24-inch HDPE to drawgate	Good	Good	$911[4]	Good	Good	Good	Good	Good	Poor
	16	Option A - Reroute Steelhead and Chinook lines	N/A	Option 2 - Replace with 24-inch HDPE to separator	Good	Good	$1,190[4]	Good	Good	Good	Good	Good	Poor
	17	Option B - Reroute Steelhead line only	N/A	Option 1 - Replace with 24-inch HDPE to drawgate	Good	Good	$1,150[4]	Good	Good	Good	Good	Good	Poor
	18	Option B - Reroute Steelhead line only	N/A	Option 2 - Replace with 24-inch HDPE to separator	Good	Good	$1,223[4]	Good	Good	Good	Good	Good	Poor

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

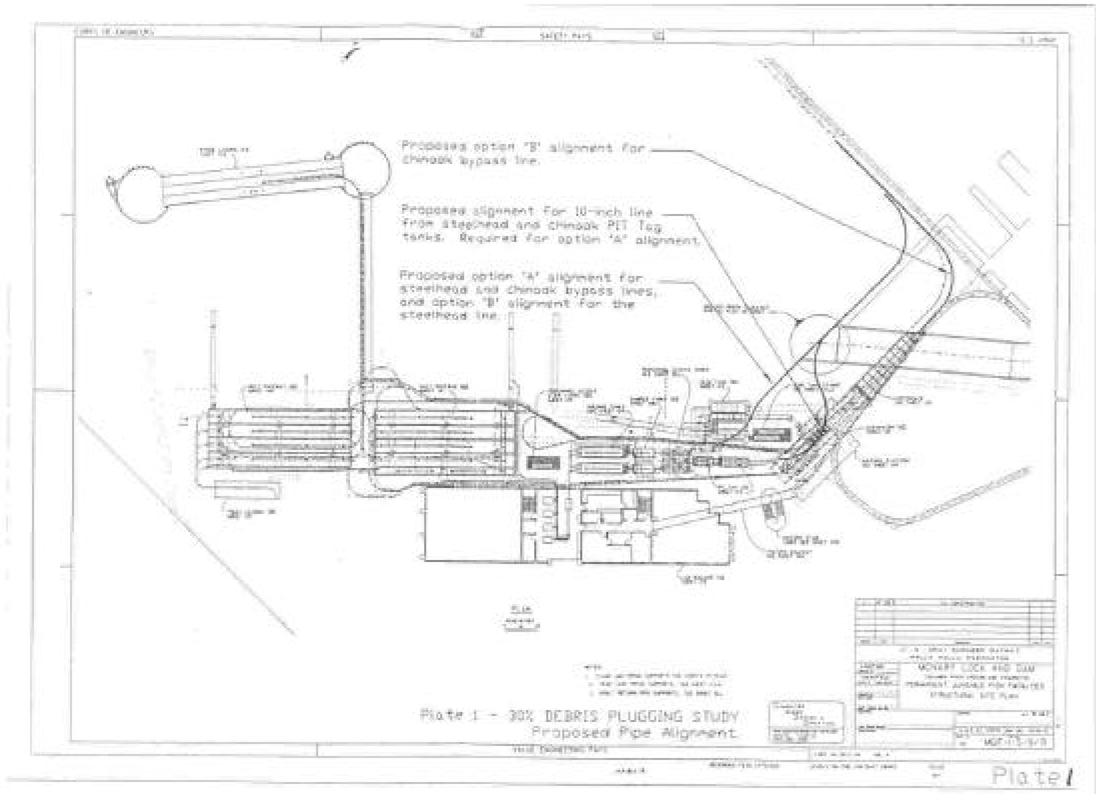

Proposed option 'B' alignment for chinook bypass line.
Proposed alignment for 10-inch line from steelhead and chinook PIT Tag tanks. Required for option 'A' alignment.
Proposed option 'A' alignment for steelhead and chinook bypass lines, and option 'B' alignment for the steelhead line.
Plate 1 - 30% DEBRIS PLUGGING STUDY
Proposed Pipe Alignment
MCNARY LOCK AND DAM
Plate 1

Table [illegible] - Juvenile Fish Bypass Pipe Retrofitting - Hydraulic Computations

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Steelhead Pipe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Steelhead Pipe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Chinook Pipe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Chinook Pipe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Steelhead and Chinook	Combination of Steelhead and Chinook [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Chinook Pipe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Chinook Pipe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Appendix B

Detailed Cost Estimates.

Level 1 A1; Buried Pipe Joint Replacement; Aboveground Joint Replacement
Level 1 B1; Slip Lining; Aboveground Joint Replacement
Level 1 A2; Buried Pipe Joint Replacement; Slip Lining
Level 1 B2; Slip Lining; Slip Lining
Level 1 A3; Buried Pipe Joint Replacement; Replace with 10-inch HDPE
Level 1 B3; Slip Lining; Replace with 10-inch HDPE
Level 2 A1; Reroute Steelhead and Chinook lines; Joint Replacement
Level 2 B1; Reroute Steelhead line only; Joint Replacement
Level 2 A2; Reroute Steelhead and Chinook lines; Slip Lining
Level 2 B2; Reroute Steelhead line only; Slip Lining
Level 2 A3; Reroute Steelhead and Chinook lines; Replace with 10-inch HDPE
Level 2 B3; Reroute Steelhead line only; Replace with 10-inch HDPE
Level 2 A4; Reroute Steelhead and Chinook lines; Replace with U-flume
Level 2 B4; Reroute Steelhead line only; Replace with U-flume
Level 3 A1; Reroute Steelhead and Chinook lines; Replace with 24-inch HDPE to Dropgate
Level 3 B1; Reroute Steelhead line only; Replace with 24-inch HDPE to Dropgate
Level 3 A2; Reroute Steelhead and Chinook lines; Replace with 24-inch HDPE to Separator
Level 3 B2; Reroute Steelhead line only; Replace with 24-inch HDPE to Separator

Unit Costs

Division	Description	Unit	Cost, $	Source
02	Sliplining 10" Pipe	LF	$80.00	HDR; Gelco Services Inc; Assumes 300-FT Length (Min Cost $24,000)
02	6" HDPE Pipe	LF	$8.50	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $340), Fused Welds
02	8" HDPE Pipe	LF	$11.50	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
02	10" HDPE Pipe	LF	$14.50	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
02	14" HDPE Pipe	LF	$22.00	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $880), Fused Welds
02	24" HDPE Pipe	LF	$59.00	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $2,360), Fused Welds
02	34" HDPE Pipe	LF	$85.00	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $3,400), Fused Welds
02	6" HDPE Pipe Connection	EA	$115.00	HDR; RS Means; Fused Joint / Weld
02	8" HDPE Pipe Connection	EA	$245.00	HDR; RS Means; Fused Joint / Weld
02	10" HDPE Pipe Connection	EA	$325.00	HDR; RS Means; Fused Joint / Weld
02	14" HDPE Pipe Connection	EA	$525.00	HDR; RS Means; Fused Joint / Weld
02	24" HDPE Pipe Connection	EA	$1,900.00	HDR; RS Means; Fused Joint / Weld
02	34" HDPE Pipe Connection	EA	$3,000.00	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	EA	100%	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	EA	200%	HDR; RS Means, HDR; 200% of the cost of new pipe.
02	Retrofit Pipe with Fused Joints	EA	$700.00	HDR; Gelco Services Inc.
02	Fused Joint Trimming	EA	$350.00	HDR; Gelco Services Inc.
02	Retrofit Pipe with Flanged Joints	EA	$700.00	HDR; Gelco Services Inc.
02	Open Flume	LF	$90.00	HDR; Plasti-Fab Inc.
02	Removal of Existing Pipe	LF	40%	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
02	TV of Bypass Line	LF	$2.50	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
02	Excavation	CY	$8.00	HDR; RS Means; Stored on Site.
02	Backfill	CY	$32.00	HDR; RS Means; Includes Compaction in 12" Lifts
02	Trench Bedding	CY	$30.00	HDR; RS Means; Includes Liner, Crushed Rock, & Compaction.
05	Steel			HDR
02	Shoring	SF	$10.50	HDR; RS Means
02	Mobilization	EA	$5,000.00	HDR

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 1 A1

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Retrofit Pipe with Fused Joints	8	EA	$700	$5,600	HDR; Gelco Services Inc.
2	Fused Joint Trimming	8	EA	$350	$2,800	HDR; Gelco Services Inc.
2	Removal of Existing Pipe	35	LF	$4	$140	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	20	LF	$15	$580	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$1,855	$1,855	HDR; RS Means, HDR; 100% of the cost of new pipe.
2	Retrofit Pipe with Flanged Joints	62	EA	$700	$43,400	HDR; Gelco Services Inc.
2	Shoring	2650	SF	$11	$27,825	HDR; RS Means
2	Excavation	200	CY	$8	$1,600	HDR; RS Means; Stored on Site.
2	Backfill	200	CY	$32	$6,400	HDR; RS Means; Includes Compaction in 12" Lifts
2	Trench Bedding	32	CY	$30	$960	HDR; RS Means; Includes Liner, Crushed Rock, & Compaction.
2	TV of Bypass Line	3290	LF	2.5	$8,225	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).

Sub-Total Costs	$105,660
Contingency @ 35%	$36,981
Sub-Total Costs + Contingency	$142,641
Engineering & Design @10%	$14,264
Supervision & Administration @10%	$14,264
Total Cost	$171,169

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 1 B1

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Sliplining 10" Pipe	220	LF	$80	$17,600	HDR; Gelco Services Inc; Assumes 300-FT Length (Min Cost $24,000).
2	Removal of Existing Pipe	35	LF	$4	$140	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	20	LF	$15	$580	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$1,855	$1,855	HDR; RS Means, HDR; 100% of the cost of new pipe.
2	Retrofit Pipe with Flanged Joints	62	EA	$700	$43,400	HDR; Gatco Services Inc.
2	TV of Bypass Line	3290	LF	2.5	$8,225	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
				Sub-Total Costs	$76,075	
				Contingency @ 35%	$27,326	
				Sub-Total Costs + Contingency	$105,401	
				Engineering & Design @10%	$10,540	
				Supervision & Administration @10%	$10,540	
				Total Cost	$126,482	

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 1 A2

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Retrofit Pipe with Fused Joints	8	EA	$700	$5,600	HDR; Gelco Services Inc.
2	Fused Joint Trimming	8	EA	$350	$2,800	HDR; Gelco Services Inc.
2	Removal of Existing Pipe	35	LF	$4	$140	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	20	LF	$15	$580	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$1,855	$1,855	HDR; RS Means, HDR; 100% of the cost of new pipe.
2	Sliplining 10" Pipe	970	LF	80	$77,600	HDR; Gelco Services Inc; Assumes 300-FT Length (Min Cost $24,000).
2	Shoring	2650	SF	$11	$27,825	HDR; RS Means
2	Excavation	200	CY	$8	$1,600	HDR; RS Means; Stored on Site.
2	Backfill	200	CY	$32	$6,400	HDR; RS Means; Includes Compaction in 12" Lifts
2	Trench Bedding	32	CY	$30	$960	HDR; RS Means; Includes Liner, Crushed Rock, & Compaction.
2	TV of Bypass Line	3290	LF	2.5	$8,225	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).

Sub-Total Costs	$139,860
Contingency @ 35%	$48,951
Sub-Total Costs + Contingency	$188,811
Engineering & Design @10%	$18,881
Supervision & Administration @10%	$18,881
Total Cost	$226,573

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Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 1 B2

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Sliplining 10" Pipe	1190	LF	$80	$95,200	HDR; Gelco Services Inc; Assumes 300 FT Length (Min Cost $24,000).
2	Removal of Existing Pipe	33	LF	$4	$140	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	33	LF	$12	$400	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $450), Fused Welds
2	10" HDPE Pipe	20	LF	$15	$580	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $600), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means, Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	325	$325	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$1,855	$1,855	HDR; RS Means, HDR; 100% of the cost of new pipe.
2	Retrofit Pipe with Flanged Joints	2	EA	$700	$1,400	HDR; Gelco Services Inc.
2	TV of Bypass Line	3290	LF	2.5	$8,225	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
				Sub-Total Costs	$113,675	
				Contingency @ 35%	$39,786	
				Sub-Total Costs + Contingency	$153,461	
				Engineering & Design @10%	$15,346	
				Supervision & Administration @10%	$15,346	
				Total Cost	$184,154	

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 1 A3

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Retrofit Pipe with Fused Joints	8	EA	$700	$5,600	HDR; Gelco Services Inc.
2	Fused Joint Trimming	8	EA	$350	$2,800	HDR; Gelco Services Inc.
2	Removal of Existing Pipe	35	LF	$4	$140	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	990	LF	$15	$14,355	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	325	$325	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$15,630	$15,630	HDR; RS Means, HDR; 100% of the cost of new pipe.
2	Retrofit Pipe with Flanged Joints	2	EA	$700	$1,400	HDR; Gelco Services Inc.
2	Fused Joint Trimming		EA	$350	$0	HDR; Gelco Services Inc.
2	Shoring	2650	SF	$11	$27,825	HDR; RS Means
2	Excavation	200	CY	$8	$1,600	HDR; RS Means; Stored on Site.
2	Backfill	200	CY	$32	$6,400	HDR; RS Means; Includes Compaction in 12" Lifts
2	Trench Bedding	32	CY	$30	$960	HDR; RS Means; Includes Liner, Crushed Rock, & Compaction.
2	TV of Bypass Line	1670	LF	2.5	$4,175	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).

Sub-Total Costs	$87,150
Contingency @ 35%	$30,508
Sub-Total Costs + Contingency	$117,666
Engineering & Design @10%	$11,767
Supervision & Administration @10%	$11,767
Total Cost	$141,199

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 1 B3

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Sliplining 10" Pipe	650	LF	$80	$52,000	HDR; Gelco Services Inc; Assumes 300-FT Length (Min Cost $24,000).
2	Removal of Existing Pipe	1000	LF	$4	$3,500	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	8" HDPE Pipe	35	LF	$12	$480	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	990	LF	$15	$14,355	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$15,630	$15,630	HDR; RS Means, HDR; 100% of the cost of new pipe.
2	Retrofit Pipe with Flanged Joints	2	EA	$700	$1,400	HDR; Gelco Services Inc.
2	Fused Joint Trimming	32	EA	$350	$11,200	HDR; Gelco Services Inc.
2	TV of Bypass Line	2325	LF	2.5	$5,813	HDR; RS Means; Based on 500 LF of pipe to be Inspected (Min Cost $1,250).

Sub-Total Costs	$110,173
Contingency @ 35%	$38,560
Sub-Total Costs + Contingency	$148,733
Engineering & Design @10%	$14,873
Supervision & Administration @10%	$14,873
Total Cost	$178,479

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 A1

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	10" HDPE Pipe	385	LF	$15	$5,583	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	14" HDPE Pipe	135	LF	$22	$2,970	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $880), Fused Welds
2	Removal of Existing Pipe	495	LF	$6	$2,970	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	14" HDPE Pipe Connection	2	EA	$525	$1,050	HDR; RS Means; Fused Joint / Weld
2	Retrofit Pipe with Flanged Joints	40	EA	$700	$28,000	HDR; Gelco Services Inc.
2	Fused Joint Trimming	19	EA	$350	$6,650	HDR; Gelco Services Inc.
15	HDPE Pipe Installation (Fish Facility)	1	EA	$6,858	$6,858	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$9,060	$9,060	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of PIT Tag Detector	2	EA	$5,000	$10,000	HDR
2	TV of Bypass Line	2225	LF	2.5	$5,563	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
5	Pipe Clamp (100 lbs ea plus bolts)	14	EA	$250	$3,500	HDR
5	Cantilever Supports	1565	LB	$2	$3,130	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	24	EA	$300	$7,200	HDR
5	Support Beam	1050	LB	$2	$2,100	HDR
5	Pipe Support Towers	14000	LB	$2	$28,000	HDR
3	Drill Foundation Hole	19	EA	$100	$1,900	HDR
5	Foundation Concrete	5.6	CY	$450	$2,520	HDR
5	Pipe Hanger Assemblies	13	EA	$250	$3,250	HDR
3	Drill and Dowell Into Head Tank Concrete	6	EA	$50	$300	HDR
5	Adjust Hangers on "K" Type Towers	12	EA	$50	$600	HDR
5	Miscellaneuos Connections	1350	LB	$2	$2,700	HDR
3	Drill and Dowell Into Wall	11	EA	$250	$2,750	HDR
				Sub-Total Costs	$144,028	
				Contingency @ 35%	$50,410	
				Sub-Total Costs + Contingency	$194,437	
				Engineering & Design @10%	$19,444	
				Supervision & Administration @10%	$19,444	
				Total Cost	$233,325	

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 B1

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	10" HDPE Pipe	350	LF	$15	$5,075	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	Removal of Existing Pipe	220	LF	$6	$1,320	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $450), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	2	EA	$325	$650	HDR; RS Means; Fused Joint / Weld
2	14" HDPE Pipe Connection	1	EA	$525	$525	HDR; RS Means; Fused Joint / Weld
2	Retrofit Pipe with Flanged Joints	55	EA	$700	$38,500	HDR; Gelco Services Inc.
2	Fused Joint Trimming	14	EA	$350	$4,900	HDR; Gelco Services Inc.
15	HDPE Pipe Installation (Fish Facility)	1	EA	$3,885	$3,885	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$6,630	$6,630	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of Pit Tag Detector	1	EA	$5,000	$5,000	HDR
2	TV of Bypass Line	2500	LF	2.5	$6,250	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
5	Pipe Clamp (75 lbs ea plus bolts)	24	EA	$200	$4,800	HDR
5	Cantilever Supports	840	LB	$2	$1,680	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	26	EA	$300	$7,800	HDR
5	Support Beams	8525	LB	$2	$17,050	HDR
5	Pipe Support Towers	8900	LB	$2	$17,800	HDR
3	Drill Foundation Hole	21	EA	$100	$2,100	HDR
5	Pipe Hanger Assemblies	3	EA	$250	$750	HDR
5	Drill and Dowell Into Head Tank Concrete	3	EA	$50	$150	HDR
5	Miscellaneuos Connections	1300	LB	$2	$2,600	HDR
3	Drill and Dowell Into Wall	11	EA	$250	$2,750	HDR
5	Retaining Wall Support	1000	LB	$2	$2,000	HDR
5	Adjust Pipe Support Assemblys	3	EA	$150	$450	HDR
5	Adjust Hangers on "K" Type Towers	3	EA	$50	$150	HDR
3	Concrete	6.5	CY	$450	$2,925	HDR

Sub-Total Costs	$142,790
Contingency @ 35%	$49,977
Sub-Total Costs + Contingency	$192,767
Engineering & Design @10%	$19,277
Supervision & Administration @10%	$19,277
Total Cost	$231,320

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 A2

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Sliplining 10" Pipe	605	LF	$80	$48,400	HDR; Gelco Services Inc: Assumes 300-FT Length (Min Cost $24,000)
2	10" HDPE Pipe	385	LF	$15	$5,583	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	14" HDPE Pipe	135	LF	$22	$2,970	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $880), Fused Welds
2	Removal of Existing Pipe	495	LF	$6	$2,970	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	14" HDPE Pipe Connection	2	EA	$525	$1,050	HDR; RS Means; Fused Joint / Weld
2	Fused Joint Trimming	19	EA	$350	$6,650	HDR; Gelco Services Inc.
15	HDPE Pipe Installation (Fish Facility)	1	EA	$6,858	$6,858	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$9,060	$9,060	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of Pit Tag Detector	2	EA	$5,000	$10,000	HDR
2	TV of Bypass Line	2225	LF	2.5	$5,563	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250)
5	Pipe Clamp (100 lbs ea plus bolts)	14	EA	$250	$3,500	HDR
5	Cantilever Supports	1565	LB	$2	$3,130	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	24	EA	$300	$7,200	HDR
5	Support Beam	1050	LB	$2	$2,100	HDR
5	Pipe Support Towers	14000	LB	$2	$28,000	HDR
3	Drill Foundation Hole	19	EA	$100	$1,900	HDR
3	Foundation Concrete	5.6	CY	$450	$2,520	HDR
5	Pipe Hanger Assemblies	13	EA	$250	$3,250	HDR
3	Drill and Dowell Into Head Tank Concrete	6	EA	$50	$300	HDR
5	Adjust Hangers on "K" Type Towers	12	EA	$50	$600	HDR
5	Miscellaneuos Connections	1350	LB	$2	$2,700	HDR
3	Drill and Dowell Into Wall	11	EA	$250	$2,750	HDR

Sub-Total Costs	$164,428
Contingency @ 35%	$57,550
Sub-Total Costs + Contingency	$221,977
Engineering & Design @10%	$22,198
Supervision & Administration @10%	$22,198
Total Cost	$266,373

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Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 B2

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Sliplining 10" Pipe	880	LF	$80	$70,400	HDR; Gelco Services Inc; Assumes 300-FT Length (Min Cost $24,000).
2	10" HDPE Pipe	350	LF	$15	$5,075	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580); Fused Welds
2	Removal of Existing Pipe	220	LF	$6	$1,320	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	8" HDPE Pipe	35	LF	$12	$480	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $480), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	2	EA	$325	$650	HDR; RS Means; Fused Joint / Weld
2	14" HDPE Pipe Connection	1	EA	$525	$525	HDR; RS Means; Fused Joint / Weld
2	Fused Joint Trimming	14	EA	$350	$4,900	HDR; Gelco Services Inc.
15	HDPE Pipe Installation (Fish Facility)	1	EA	$3,885	$3,885	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$6,630	$6,630	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of PIT Tag Detector	1	EA	$5,000	$5,000	HDR
2	TV of Bypass Line	2450	LF	2.5	$6,125	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
5	Pipe Clamp (75 lbs ea plus bolts)	24	EA	$200	$4,800	HDR
5	Cantilever Supports	840	LB	$2	$1,680	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	26	EA	$300	$7,200	HDR
5	Support Beams	8525	LB	$2	$17,050	HDR
5	Pipe Support Towers	8900	LB	$2	$17,800	HDR
3	Drill Foundation Hole	21	EA	$100	$2,100	HDR
5	Pipe Hanger Assemblies	3	EA	$250	$750	HDR
5	Drill and Dowel Into Head Tank Concrete	3	EA	$50	$150	HDR
5	Miscellaneuos Connections	1300	LB	$2	$2,600	HDR
3	Drill and Dowel Into Wall	11	EA	$250	$2,750	HDR
5	Retaining Wall Support	1000	LB	$2	$2,000	HDR
5	Adjust Pipe Support Assemblys	3	EA	$150	$450	HDR
5	Adjust Hangers on "K" Type Towers	3	EA	$50	$150	HDR
3	Concrete	6.5	CY	$450	$2,925	HDR

Sub-Total Costs	$174,565
Contingency @ 35%	$61,098
Sub-Total Costs + Contingency	$235,663
Engineering & Design @10%	$23,566
Supervision & Administration @10%	$23,566
Total Cost	$282,796

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 A3

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	10" HDPE Pipe	990	LF	$15	$14,355	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	14" HDPE Pipe	135	LF	$22	$2,970	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $880), Fused Welds
2	Removal of Existing Pipe	495	LF	$6	$2,970	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	35	LF	$12	$400	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	14" HDPE Pipe Connection	2	EA	$525	$1,050	HDR; RS Means; Fused Joint / Weld
2	Fused Joint Trimming	38	EA	$350	$13,300	HDR; Gelco Services Inc.
15	HDPE Pipe Installation (Fish Facility)	1	EA	$15,630	$15,630	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$8,900	$8,900	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of Pit Tag Detector	2	EA	$5,000	$10,000	HDR
2	TV of Bypass Line	1750	LF	2.5	$4,375	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250)
5	Pipe Clamp (100 lbs ea plus bolts)	14	EA	$250	$3,500	HDR
5	Cantilever Supports	1565	LB	$2	$3,130	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	24	EA	$300	$7,200	HDR
5	Support Beam	1050	LB	$2	$2,100	HDR
5	Pipe Support Towers	14000	LB	$2	$28,000	HDR
3	Drill Foundation Hole	19	EA	$100	$1,900	HDR
5	Foundation Concrete	5.6	CY	$450	$2,520	HDR
5	Pipe Hanger Assemblies	13	EA	$250	$3,250	HDR
3	Drill and Dowell Into Head Tank Concrete	6	EA	$50	$300	HDR
5	Adjust Hangers on "K" Type Towers	12	EA	$50	$600	HDR
5	Miscellaneuos Connections	1350	LB	$2	$2,700	HDR
3	Drill and Dowell Into Wall	11	EA	$250	$2,750	HDR

Sub-Total Costs	$138,875
Contingency @ 35%	$48,606
Sub-Total Costs + Contingency	$187,481
Engineering & Design @10%	$18,748
Supervision & Administration @10%	$18,748
Total Cost	$224,978

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 B3

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	10" HDPE Pipe	1230	LF	$15	$17,835	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	Removal of Existing Pipe	290	LF	$6	$1,740	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	35	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	2	EA	$325	$650	HDR; RS Means; Fused Joint / Weld
2	14" HDPE Pipe Connection	1	EA	$525	$525	HDR; RS Means; Fused Joint / Weld
2	Fused Joint Trimming	43	EA	$350	$15,050	HDR; Gaico Services Inc.
15	HDPE Pipe Installation (Fish Facility)	1	EA	$16,645	$16,645	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$6,830	$6,830	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of PIt Tag Detector	1	EA	$5,000	$5,000	HDR
2	TV of Bypass Line	1670	LF	2.5	$4,175	HDR; RS Means; Based on 500 LF of pipe to be Inspected (Min Cost $1,250).
5	Pipe Clamp (75 lbs ea plus bolts)	24	EA	$200	$4,800	HDR
5	Cantilever Supports	840	LB	$2	$1,680	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	26	EA	$300	$7,800	HDR
5	Support Beams	8525	LB	$2	$17,050	HDR
5	Pipe Support Towers	8900	LB	$2	$17,800	HDR
3	Drill Foundation Hole	21	EA	$100	$2,100	HDR
5	Pipe Hanger Assemblies	3	EA	$250	$750	HDR
5	Drill and Dowel into Head Tank Concrete	3	EA	$50	$150	HDR
5	Miscellaneous Connections	1300	LB	$2	$2,600	HDR
3	Drill and Dowel into Wall	11	EA	$250	$2,750	HDR
5	Retaining Wall Support	1000	LB	$2	$2,000	HDR
5	Adjust Pipe Support Assemblys	3	EA	$150	$450	HDR
5	Adjust Hangers on "K" Type Towers	3	EA	$50	$150	HDR
3	Concrete	6.5	CY	$450	$2,925	HDR

Sub-Total Costs	$138,305
Contingency @ 35%	$48,407
Sub-Total Costs + Contingency	$186,712
Engineering & Design @10%	$18,671
Supervision & Administration @10%	$18,671
Total Cost	$224,054

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 A4

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Open Flume	1070	LF	$90	$96,300	HDR; Plasti-Fab Inc.
2	Removal of Existing Pipe	1090	LF	$6	$0,540	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	Flume to Pipe Connection	7	EA	$525	$3,675	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$87,300	$87,300	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$25,350	$25,350	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of PIT Tag Detector	2	EA	$5,000	$10,000	HDR
2	TV of Bypass Line	310	LF	2.5	$1,250	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
5	Pipe Clamp (100 lbs ea plus bolts)	14	EA	$250	$3,500	HDR
5	Cantilever Supports	1565	LB	$2	$3,130	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	24	EA	$300	$7,200	HDR
5	Support Beam	1050	LB	$2	$2,100	HDR
5	Pipe Support Towers	14000	LB	$2	$28,000	HDR
3	Drill Foundation Hole	19	EA	$100	$1,900	HDR
5	Foundation Concrete	5.6	CY	$450	$2,520	HDR
5	Pipe Hanger Assemblies	13	EA	$250	$3,250	HDR
3	Drill and Dowell Into Head Tank Concrete	6	EA	$50	$300	HDR
5	Adjust Hangers on "K" Type Towers	12	EA	$50	$600	HDR
5	Miscellaneous Connections	1350	LB	$2	$2,700	HDR
3	Drill and Dowell Into Wall	11	EA	$250	$2,750	HDR

Sub-Total Costs	$294,465
Contingency @ 35%	$103,063
Sub-Total Costs + Contingency	$397,528
Engineering & Design @10%	$39,753
Supervision & Administration @10%	$39,753
Total Cost	$477,033

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 2 B4

Spec. Division	Item	Quanity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	Open Flume	1265	LF	$90	$113,850	HDR; Plasti-Fab Inc.
2	Removal of Existing Pipe	1005	LF	$6	$6,030	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	Flume to Pipe Connection	7	EA	$525	$3,675	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe installation (Fish Facility)	1	EA	$101,700	$101,700	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe installation (Over Water)	1	EA	$31,650	$31,650	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Relocation of Pit Tag Detector	2	EA	$5,000	$10,000	HDR
2	TV of Bypass Line	310	LF	2.5	$1,250	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
5	Pipe Clamp (75 lbs ea plus bolts)	24	EA	$200	$4,800	HDR
5	Cantilever Supports	840	LB	$2	$1,680	HDR
5	Chord Beam from Wall to Pier Beam	550	LB	$2	$1,100	HDR
5	Pipe Support Assembly	26	EA	$300	$7,800	HDR
5	Support Beams	8525	LB	$2	$17,050	HDR
5	Pipe Support Towers	8900	LB	$2	$17,800	HDR
3	Drill Foundation Hole	21	EA	$100	$2,100	HDR
5	Pipe Hanger Assemblies	3	EA	$250	$750	HDR
5	Drill and Dowell Into Head Tank Concrete	3	EA	$50	$150	HDR
5	Miscellaneuos Connections	1300	LB	$2	$2,600	HDR
3	Drill and Dowel Into Wall	11	EA	$250	$2,750	HDR
5	Retaining Wall Support	1000	LB	$2	$2,000	HDR
5	Adjust Pipe Support Assemblys	3	EA	$150	$450	HDR
5	Adjust Hangers on "K" Type Towers	3	EA	$50	$150	HDR
3	Concrete	6.5	CY	$450	$2,925	HDR

Sub-Total Costs	$337,260
Contingency @ 35%	$118,041
Sub-Total Costs + Contingency	$455,301
Engineering & Design @10%	$45,530
Supervision & Administration @10%	$45,530
Total Cost	$546,361

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 3 A1

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	24" HDPE Pipe	800	LF	$59	$47,200	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $2,360), Fused Welds
2	34" HDPE Pipe	445	LF	$85	$37,825	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $3,400), Fused Welds
2	Removal of Existing Pipe	1455	LF	$6	$8,730	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length).
2	8" HDPE Pipe	33	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $480), Fused Welds
2	10" HDPE Pipe	100	LF	$15	$1,450	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	24" HDPE Pipe Connection	3	EA	$1,900	$5,700	HDR; RS Means; Fused Joint / Weld
2	34" HDPE Pipe Connection	1	EA	$3,000	$3,000	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$55,625	$55,625	HDR; RS Means, HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$81,650	$81,650	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Pass Through Pit Tag Detector	2	EA	$40,000	$80,000	HDR; NMFS
2	TV of Bypass Line	1620	LF	$3	$4,050	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250).
5	Pipe Clamp (200 lbs ea plus bolts)	38	EA	$500	$19,000	HDR
5	Cantilever Supports to Pier Beam and Wall	1000	LB	$2	$2,000	HDR
5	Chord Beam from Wall to New Tower to Pier Beam	4700	LB	$2	$9,400	HDR
5	Provide HP Piles for New Tower in River	9850	LB	$2	$19,700	HDR
5	Provide Steel Pipe Casing for New Tower Supports	5800	LB	$2	$11,600	HDR
5	Install Steel Pipe Casing	2	EA	$1,000	$2,000	HDR
2	Excavation Inside Steel Pipe Casing	5	CY	$350	$1,750	HDR
3	Tremmie Concrete in Pipe Casing	10	CY	$200	$2,000	HDR
5	Miscellaneuos Connections	2200	LB	$2	$4,400	HDR
3	Drill and Dowell Into Wall	3	EA	$500	$1,500	HDR
5	Miscellaneous Connections	2000	LB	$3	$6,000	HDR
5	New TS Beam	40100	LB	$3	$120,300	HDR
5	Pipe Support Assembly	3	EA	$500	$1,500	HDR
5	Support Beam	2100	LB	$2	$4,200	HDR
5	Pipe Support Assembly	6	EA	$400	$2,400	HDR
5	Pipe Support Towers	3850	LB	$2	$7,700	HDR
3	Drill Foundation Hole	6	EA	$100	$600	HDR
3	Foundation Concrete	3.5	CY	$450	$1,575	HDR
5	Adjust and/or Install Pipe Hanger Assemblies	1	LS	$13,000	$13,000	HDR

Sub-Total Costs	$562,130
Contingency @ 35%	$196,746
Sub-Total Costs + Contingency	$758,876
Engineering & Design @10%	$75,888
Supervision & Administration @10%	$75,888
Total Cost	$910,651

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 3 B1

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	24" HDPE Pipe	1170	LF	$59	$69,030	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $2,360); Fused Welds
2	34" HDPE Pipe	310	LF	$85	$26,350	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $3,400); Fused Welds
2	Removal of Existing Pipe	1455	LF	$6	$8,730	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-FT Length)
2	Removal of Existing Flume	370	LF	$12	$4,440	RS Means; HDR
2	6" HDPE Pipe	33	LF	$12	$450	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $480); Fused Welds
2	10" HDPE Pipe	100	LF	$15	$1,450	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580); Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	24" HDPE Pipe Connection	5	EA	$1,900	$9,500	HDR; RS Means; Fused Joint / Weld
2	34" HDPE Pipe Connection	1	EA	$3,000	$3,000	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$61,255	$61,255	HDR; RS Means; HDR; 100% of the cost of new pipe.
15	HDPE Pipe Installation (Over Water)	1	EA	$58,700	$58,700	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Pass Through Pit Tag Detector	2	EA	$40,000	$80,000	HDR; NMFS
2	Gate Control Pit Tag Detector	2	EA	$50,000	$100,000	HDR; NMFS
2	TV of Bypass Line	1620	LF	2.5	$4,050	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250)
5	Pipe Clamp (200 lbs ea plus bolts)	27	EA	$500	$13,500	HDR
5	Miscellaneous Connections	2000	LB	$3	$6,000	HDR
5	New TS Beam	40100	LB	$3	$120,300	HDR
5	Pipe Clamp (150 lbs ea plus bolts)	22	EA	$350	$7,700	HDR
5	Cantilever Supports to Pier Beam and Wall	1000	LB	$2	$2,000	HDR
5	Chord Beam from Wall to New Tower to Pier Beam	3000	LB	$2	$6,000	HDR
5	Miscellaneuos Connections	4000	LB	$2	$8,000	HDR
3	Drill and Dowell Into Wall	1	EA	$400	$400	HDR
5	Cantilever Supports from Wall	7500	LB	$2	$15,000	HDR
3	Drill and Dowell Into Wall	3	EA	$200	$600	HDR
5	Pipe Support Assembly	16	EA	$400	$6,400	HDR
5	Support Beam	18900	LB	$2	$37,800	HDR
3	Drill and Dowell Into Wall	4	EA	$500	$2,000	HDR
5	Pipe Support Towers	5750	LB	$2	$11,500	HDR
3	Drill Foundation Hole	13	EA	$100	$1,300	HDR
3	Foundation Concrete	5.5	CY	$450	$2,475	HDR
5	Adjust and/or Install Pipe Hanger Assemblies	1	LS	$13,000	$13,000	HDR
5	Retaining Wall Support	1000	LB	$2	$2,000	HDR
5	Adjust Pipe Support Assembly	3	EA	$400	$1,200	HDR
				Sub-Total Costs	$709,955	
				Contingency @ 35%	$248,484	
				Sub-Total Costs + Contingency	$958,439	
				Engineering & Design @10%	$95,844	
				Supervision & Administration @10%	$95,844	
				Total Cost	$1,150,127	

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 3 A2

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	24" HDPE Pipe	1210	LF	$59	$71,390	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $2,360), Fused Welds
2	34" HDPE Pipe	310	LF	$85	$26,350	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $3,400), Fused Welds
2	Removal of Existing Pipe	1455	LF	$6	$8,730	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-Ft Length)
2	8" HDPE Pipe	33	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	20	LF	$15	$580	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	24" HDPE Pipe Connection	3	EA	$1,900	$5,700	HDR; RS Means; Fused Joint / Weld
2	34" HDPE Pipe Connection	1	EA	$3,000	$3,000	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$78,945	$78,945	HDR; RS Means, HDR; 100% of the cost of new pipe
15	HDPE Pipe Installation (Over Water)	1	EA	$58,700	$58,700	HDR; RS Means, HDR; 200% of the cost of new pipe.
2	Pass Through Pit Tag Detector	2	EA	$40,000	$80,000	HDR; NMFS
2	Gate Control Pit Tag Detector	2	EA	$80,000	$160,000	HDR; NMFS
2	TV of Bypass Line	1620	LF	$3	$4,050	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250)
5	Pipe Clamp (200 lbs ea plus bolts)	38	EA	$500	$18,000	HDR
5	ntilever Supports to Pier Beam and Wall	1000	LB	$2	$2,000	HDR
5	n from Wall to New Tower to Pier Beam	4700	LB	$2	$9,400	HDR
5	Provide HP Piles for New Tower in River	9850	LB	$2	$19,700	HDR
5	el Pipe Casing for New Tower Supports	5800	LB	$2	$11,600	HDR
5	Install Steel Pipe Casing	2	EA	$1,000	$2,000	HDR
2	Excavation Inside Steel Pipe Casing	5	CY	$350	$1,750	HDR
3	Tremmie Concrete in Pipe Casing	10	CY	$200	$2,000	HDR
5	Miscellaneous Connections	2200	LB	$2	$4,400	HDR
3	Drill and Dowel into Wall	3	EA	$500	$1,500	HDR
5	Miscellaneous Connections	2000	LB	$3	$6,000	HDR
5	New TS Beam	40100	LB	$3	$120,300	HDR
5	Pipe Support Assembly	3	EA	$500	$1,500	HDR
5	Support Beam	2100	LB	$2	$4,200	HDR
5	Pipe Support Assembly	6	EA	$400	$2,400	HDR
5	Pipe Support Towers	3850	LB	$2	$7,700	HDR
3	Drill Foundation Hole	6	EA	$100	$600	HDR
3	Foundation Concrete	3.5	CY	$450	$1,575	HDR
5	t and/or Install Pipe Hanger Assemblies	1	LS	$13,000	$13,000	HDR

Sub-Total Costs	$734,345
Contingency @ 35%	$257,021
Sub-Total Costs + Contingency	$991,366
Engineering & Design @10%	$99,137
Supervision & Administration @10%	$99,137
Total Cost	$1,189,639

Construction Cost Estimate
Project: McNary Dam Debris Plugging

Level 3 B2

Spec. Division	Item	Quantity	Unit	Unit Cost	Total Cost	Source
2	Mobilization	1	EA	$5,000	$5,000	HDR
2	24" HDPE Pipe	1580	LF	$59	$93,220	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $2,365); Fused Welds
2	34" HDPE Pipe	310	LF	$85	$26,350	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $3,400); Fused Welds
2	Removal of Existing Pipe	1455	LF	$6	$8,730	HDR; RS Means; Percentage of cost of new pipe (Min Cost Based on 40-FT Length)
2	Removal of Existing Flume	370	LF	$12	$4,440	RS Means; HDR
2	8" HDPE Pipe	33	LF	$12	$460	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $460), Fused Welds
2	10" HDPE Pipe	20	LF	$15	$580	HDR; RS Means; Assumes 40-FT Lengths (Min Cost $580), Fused Welds
2	8" HDPE Pipe Connection	2	EA	$245	$490	HDR; RS Means; Fused Joint / Weld
2	10" HDPE Pipe Connection	1	EA	$325	$325	HDR; RS Means; Fused Joint / Weld
2	24" HDPE Pipe Connection	5	EA	$1,900	$9,500	HDR; RS Means; Fused Joint / Weld
2	34" HDPE Pipe Connection	1	EA	$3,000	$3,000	HDR; RS Means; Fused Joint / Weld
15	HDPE Pipe Installation (Fish Facility)	1	EA	$104,575	$104,575	HDR; RS Means, HDR; 100% of the cost of new pipe
15	HDPE Pipe Installation (Over Water)	1	EA	$58,700	$58,700	HDR; RS Means, HDR; 200% of the cost of new pipe
2	Pass Through Pit Tag Detector	2	EA	$40,000	$80,000	HDR; NMFS
2	Gate Control Pit Tag Detector	2	EA	$80,000	$160,000	HDR; NMFS
2	TV of Bypass Line	1620	LF	$3	$4,050	HDR; RS Means; Based on 500 LF of pipe to be inspected (Min Cost $1,250)
5	Pipe Clamp (200 lbs ea plus bolts)	27	EA	$500	$13,500	HDR
5	Miscellaneous Connections	2000	LB	$3	$6,000	HDR
5	New TS Beam	40100	LB	$3	$120,300	HDR
5	Pipe Clamp (150 lbs ea plus bolts)	22	EA	$350	$7,700	HDR
5	Cantilever Supports to Pier Beam and Wall	1000	LB	$2	$2,000	HDR
5	Chord Beam from Wall to New Tower to Pier Beam	3000	LB	$2	$6,000	HDR
5	Miscellaneous Connections	4000	LB	$2	$8,000	HDR
3	Drill and Dowell Into Wall	1	EA	$400	$400	HDR
5	Cantilever Supports from Wall	7500	LB	$2	$15,000	HDR
3	Drill and Dowell Into Wall	3	EA	$200	$600	HDR
5	Pipe Support Assembly	16	EA	$400	$6,400	HDR
5	Support Beam	18900	LB	$2	$37,800	HDR
3	Drill and Dowell Into Wall	4	EA	$500	$2,000	HDR
5	Pipe Support Towers	5750	LB	$2	$11,500	HDR
3	Drill Foundation Hole	13	EA	$100	$1,300	HDR
3	Foundation Concrete	5.5	CY	$450	$2,475	HDR
5	Adjust and/or Install Pipe Hanger Assemblies	1	LS	$13,000	$13,000	HDR
5	Retaining Wall Support	1000	LB	$2	$2,000	HDR
5	Adjust Pipe Support Assembly	3	EA	$400	$1,200	HDR

Sub-Total Costs	$816,595
Contingency @ 35%	$285,808
Sub-Total Costs + Contingency	$1,102,403
Engineering & Design @ 10%	$110,240
Supervision & Administration @ 10%	$110,240
Total Cost	$1,322,884