MOHAVE COUNTY
DEVELOPMENT SERVICES

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MEMORANDUM

Registered Professional Engineer (Civil) CERTIFICATE NO 35744 NICHOLAS S. HONT Date Signed 07/15/14 ARIZONA U.S.A.

Nicholas S. Hont

EXP. 12/31/2015

To: Mike Hendrix, PE, County Administrator, County Engineer

From: Nick Hont, PE, Development Services Director, Deputy County Engineer
David West, PE, Flood Control District Engineer

Date: July 15, 2014

Re: Design Concept Report for the repair or replacement of the water delivery system at the Willow Beach Fish Hatchery, Mohave County, Arizona

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This memo presents engineering considerations and alternative solutions toward reestablishing continuous trout rearing operations at the Willow Beach Fish Hatchery. This assessment and design concept report was developed based on information received during and after a meeting at the Willow Beach Fish Hatchery with the United States Fish and Wildlife Service (USFWS) on June 3, 2014, subsequent site visits, research and engineering evaluations.

STATEMENT OF THE PROBLEM

The Willow Beach Fish Hatchery cannot presently maintain continuous water supply and circulation of adequate quantity and quality necessary to rear trout to a minimum size suitable for release in supporting sport fishing recreation, which represents a longstanding recreational activity in the Lake Mead National Recreation Area. Based on information received from the USFWS, the flow required for full-scale trout-raising operations is 4,800 gallons per minute (gpm). Other documents have requested flows as high as 6,000 gpm.

Our engineering staff performed a limited elevation survey of the existing system and found that the configuration of the intake pipe currently in use does not match the profiles shown on the as-built drawings. USFWS had previously indicated that this might be the case. The upper intake pipe comes up the bank of the river to an approximate elevation of 635 and then bends at an elbow exposed during the recent low flow events and goes underground to the pump house.

The intake pipe system would have to function as a siphon during low water conditions to provide the required water supply. For the system to function properly as a siphon, the integrity of the intake pipe is critical, and any leakage of air into the intake system would interrupt the siphon. The conditions of the existing techite and CMP pipes are unknown, however neither material is recommended for use in a siphon application. For the system to function as a siphon, the elevation of the outlet into the wet well is also critical. Modifications in the wet well may be required to extend the outlet pipe to a point below the pump intake level to ensure that the water level in the wet well is never below the outlet of the intake pipe. For these reasons, while the system could have the capacity to function as a siphon during low flow conditions, the siphon does not appear to be a reliable option.

The evaluated project options listed below were initially considered in an initial Mohave County Memo, dated April 2014. Based on additional info received from the USFWS representatives during a meeting on June 3, 2014, we performed additional research in regards to the feasibility, reliability and estimated cost of each option as well as a limited engineering analysis. The unknowns about the configuration and condition of the existing system still did not allow us to perform a complete analysis of the repair and upgrade options for the existing system. Based on the available info, we found that the design and installation of a new alternative system provides more certainty, and the alternatives that do not require extensive reliance on the existing intake system may be more desirable.

PROJECT DELIVERY METHOD

In order to get the best value, an alternative project delivery method, such as design-build should be considered. It could provide an opportunity for having an engineer and contractor working together to analyze the most cost effective alternative and project constructability coupled with benefit of design-builder presenting a guaranteed maximum price prior to advancing toward final design and construction.

SOLUTION ALTERNATIVES

The table below presents the evaluated alternatives with a brief description for each, estimated cost range, service life, and reliability. Alternatives rated as having high reliability are expected to function without significant special maintenance and without a significant potential for failure during the estimated service life. To verify feasibility, we performed a brief engineering analysis and cost estimate for each alternative presented below. Our findings presented herein are based on the limited information available to date, and we wish to emphasize that additional information and analysis could result in significant design changes.

ALTERNATIVE NO. 1	Floating Pump Platform Assembly	
Cost	**Service Life**	**Reliability**
$300 Thousand to $450 Thousand	**10 – 20 Years**	**High**

The alternative consists of a floating platform mounted pump system using a platform anchored adjacent to the hatchery. This would allow the intake to move with fluctuating water levels and while remaining in the water. Floating pump platforms are commonly used in both agricultural and commercial operations, and a similar system on a smaller scale was used to supply road construction water a few miles from the hatchery for a period longer than two years. This system could be configured with redundancy, such as a delivery system with two 5,000 GPM pumps or three 3,000 GPM pumps to allow for full operation even with one pump out of service. The system could be designed to bypass the wet well and deliver water directly to the raceways. However, the existing system could be kept and maintained for further redundancy during normal flow conditions. The system would likely require periodic maintenance efforts because the platform system would be exposed to both fluctuations in the river and quagga mussels.

ALTERNATIVE NO. 2	Drill Additional Supply Wells	
Cost	**Service Life**	**Reliability**
$1.1 Million to $1.3 Million; Based on additional subsurface investigation may be reduced to $600 Thousand to $900 Thousand	**Greater Than 20 Years**	**High**

This alternative consists of a group of groundwater wells located near the river bank and supplying water directly to the trout operations. The water supply for the native fish program currently provides water

through a similar system. The available limited well tests provided by the USFWS indicated wells drilled in the alluvium could provide an average of approximately 250 gpm each. The well report indicates that the capacity of the existing Cold Water Well was approximately 350 gpm, while the Northwest Test Well was approximately 160-250 gpm. The two wells mentioned above are relatively close together with the Cold Water Well located much closer to the river. We recommend locating the proposed wells as close to the river as feasible to increase the well production rates. The proposed wells could be constructed to the south of the hatchery along the bank of the river in the shoulder of the roadway. The attached cost estimate, with the relatively high cost is based on the previous limited well test info and assumes drilling of up to 20 supply wells at a minimum spacing of 75 feet. However, to optimize the placement and size of the proposed wells, and in turn maximize the output, we strongly recommend an engineering subsurface investigation be performed prior to well installation. We believe the required number of wells can be reduced and the size of wells can be optimized by additional engineering evaluations. This could result in substantial cost savings, as indicated above. This alternative would allow a potentially quagga mussel free operation, and there would be no issues with vegetation buildup either. The use of a relatively large number of wells would also offer a degree of redundancy with a minimal chance for a catastrophic failure. This is because the relatively large number of wells would always allow at least a partial water supply, even if several wells were down for maintenance. The wells could be configured to supply water directly to the raceway supply line rather than the existing pump station.

ALTERNATIVE NO. 3	Replacement of Existing Pipes	
Cost	**Service Life**	**Reliability**
$1.1 Million to $1.3 Million	**Greater Than 20 Years**	**High**

This alternative would completely replace the existing pipes and intake screens by using the formerly presented USFWS construction drawings in combination with various other construction methods and materials to improve the reliability of the system and decrease the construction costs. The replacement pipes would follow the existing design profile, and the system would function as a gravity feed system rather than a siphon system during all flow conditions. We recommend using improved intake screens and adding airburst cleaning as needed. Replacement of both existing pipes would not unreasonably increase the cost of this alternative and would provide both redundancy and an relatively long service life. The costliest impact on this alternative is the excavation and dewatering required for installing the pipes.

ALTERNATIVE NO. 4	Combination of Pipe Lining and Pipe Replacement of the 24-inch pipe	
Cost	**Service Life**	**Reliability**
$350 Thousand to $500 Thousand	**10 – 20 Years**	**Medium**

The underground portion of the existing 24-inch intake pipe from the pump house would be lined, and the portion of the intake pipe in the river bed would be removed and replaced with a new 24-inch HDPE pipe. This alternative should also include the replacement of the intake screens and the addition of an airburst equipment to allow for routine screen cleaning. Lining of the existing pipe underground would be accomplished using a conventional pipe lining technique. The underground pipe lining would be at least 18 inches in size, and the underwater new pipe connection would be 24 inches in size. For the pipe to function as a siphon, the outlet of the intake pipe may need to be modified at the wet well to lower it below the low water level.

ALTERNATIVE NO. 5	Lining of Existing Pipes	
Cost	**Service Life**	**Reliability**
$350 Thousand to $500 Thousand	**10 – 20 Years**	**Low**

A lining system could be used to increase the integrity of the existing pipes and improve their hydraulic performance. This alternative should also include replacement of the intake screens and could include addition of airburst equipment to allow for routine screen cleaning. Lining of the existing pipes underground would be accomplished using conventional pipe lining techniques. The greatest disadvantage of this alternative is the unknown existing conditions and attempting to line the pipes under water. Considering the unknown conditions and locations of the existing pipes, the reliability of this option is also unknown. The installation would require divers with construction experience to connect the new inlet structure to the existing piping or to the new pipe lining.

ALTERNATIVE NO. 6	Repair and Rehabilitate Existing System	
Cost	**Service Life**	**Reliability**
Less Than $100 Thousand	**Less Than 10 Years**	**Low**

This option includes installation of a new intake structure in the river at the end of the existing pipe. The installation would require divers with construction experience to connect the new inlet structure to the existing piping. This solution would somewhat improve the functionality of the existing system in normal flow conditions and could extend the operations during very limited siphon situations. However, the integrity of the existing pipes is largely unknown, and they are not likely to work adequately in as a siphon in a low-water condition due to the lack of airtight joints. Considering the unknown conditions and locations of the existing pipes, the reliability of this option is considered low.

MOHAVE COUNTY'S AVAILABLITY

Mohave County currently has contracts with several top-notch engineering consultants in Arizona and has a list of well-qualified contractors that have performed installation of several water delivery and underground pipe systems for the County. Our Professional Engineers are also well experienced in alternative project delivery methods, such as design-build, construction manager-at-risk and job order contracting. We available to proceed with the project upon receiving authorization and funding.

Appendix

Willow Beach Fish Hatchery

Engineers Estimate of Probable Construction Cost for Alternatives

Estimate Date : July 14, 2104

Alternative 1 -Floating Platform Mounted Pump System

Item	Description of Work	Unit	Quantity	Unit Price	Contract Amount
1	MOBILIZATION	LS	1	50,000	50,000
2	FLOATING PLATFORM MOUNTED PUMP SYSTEM	EA	1	150,000	150,000
3	PIPING FROM FLOATING PLATFORM TO HATCHERY	LF	150	200	30,000
4	EXTENSION OF POWER	LF	500	100	50,000
5	CONTROL SYSTEMS	EA	1	20,000	20,000
	GRAND TOTAL				**$300,000**

Alternative 2 - Drill Additional Supply Wells

Item	Description of Work	Unit	Quantity	Unit Price	Contract Amount
1	MOBILIZATION	LS	1	75,000	75,000
2	250 GPM SUPPLY WELLS	EA	20	35,000	700,000
3	WATER MAINS FROM WELLS	LF	2,500	100	250,000
4	CONTROL SYSTEMS	EA	1	50,000	50,000
5	ELECTRICAL SYSTEM UPGRADES	EA	1	150,000	150,000
	GRAND TOTAL				**$1,225,000**

Alternative 3 - Replace Existing Intake Pipes As Originally Designed

Item	Description of Work	Unit	Quantity	Unit Price	Contract Amount
1	MOBILIZATION	LS	1	100,000	100,000
2	NEW INTAKE SCREEN	EA	2	15,000	30,000
3	NEW 24" HDPE INTAKE PIPE	LF	250	500	125,000
4	EXCAVATION AND BACKFILL	CY	5,200	120	624,000
5	COFFERDAM/DEWATERING	LS	1	120,000	120,000
6	NEW CONCRETE WEIGHTS WITH STAINLESS STEEL ANCHOR CABLES	EA	10	5,000	50,000
7	BARGE FOR INSTALLATION OF NEW INTAKE AND PIPES	EA	1	50,000	50,000
	GRAND TOTAL				**$1,099,000**

Willow Beach Fish Hatchery

Engineers Estimate of Probable Construction Cost for Alternatives

Estimate Date : July 14, 2104

Alternative 4 - Combination of Lining Pipes Underground and Repacing Pipes Underwater

Item	Description of Work	Unit	Quantity	Unit Price	Contract Amount
1	MOBILIZATION	LS	1	75,000	75,000
2	NEW INTAKE SCREEN	EA	1	15,000	15,000
3	NEW 24" HDPE INTAKE PIPE	LF	180	250	45,000
4	LINE EXISTING 24" INTAKE PIPE with 21" HDPE	LF	70	400	28,000
5	HDPE FITTINGS	EA	2	2,500	5,000
6	NEW CONCRETE WEIGHTS WITH STAINLESS STEEL ANCHOR CABLES	EA	10	5,000	50,000
7	BARGE RENTAL FOR INSTALLATION OF NEW PIPES AND INTAKE	EA	1	25,000	25,000
	GRAND TOTAL				**$243,000**

Alternative 5 - Lining of Existing Intake Pipe System

Item	Description of Work	Unit	Quantity	Unit Price	Contract Amount
1	MOBILIZATION	LS	1	100,000	100,000
2	NEW INTAKE SCREEN	EA	1	15,000	15,000
3	"SWAGLINE" EXISTING 24" INTAKE PIPE	LF	250	550	137,500
4	DIVERS AND BARGE FOR INSTALLATION OF LINER AND NEW INTAKE	EA	1	100,000	100,000
	GRAND TOTAL				**$352,500**

Alternative 6 - Minor Rehabilitation of Existing System

Item	Description of Work	Unit	Quantity	Unit Price	Contract Amount
1	MOBILIZATION	LS	1	10,000	10,000
2	NEW INTAKE SCREEN	EA	1	15,000	15,000
3	REPLACE EXISTING 45 DEGREE ELBOW	EA	1	5,000	5,000
4	SIPHON MANAGEMENT SYSTEM	EA	1	10,000	10,000
5	DIVERS AND BARGE FOR INSTALLATION OF NEW INTAKE	EA	1	20,000	20,000
	GRAND TOTAL				**$60,000**