INFILTRATION GALLERIES
A VIABLE ALTERNATIVE TO "PUSH-UP" DIVERSION DAMS

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ABSTRACT

This paper deals with Infiltration Galleries as alternatives to gravel "push-up" diversion dams. The Bureau of Reclamation (Reclamation) has recently completed projects in conjunction with conservation entities and water users to demonstrate the application of infiltration galleries in rivers and streams that contain anadromous fish. The projects demonstrate that infiltration galleries buried in the stream bed can provide irrigation flows and reduce impacts to the stream, if the following three design considerations are met:

1. The intake or collection portion of the infiltration gallery is located far enough upstream as to provide the necessary head to provide for the desired diversion rate.

2. The permeability of the existing stream bed material is tested and the envelope surrounding the intake screen is composed of a properly graded gravel.

3. The system is designed with valves and bypass piping to allow isolation of portions of the collection system to allow for flow regulation and system flushing.

BACKGROUND

Partnership

Reclamation was asked by the Northwest Power Planning Council in 1991 to lead a cooperative effort with irrigators and state agencies. Irrigation water conservation demonstration projects in four areas of the Columbia River drainage were to be selected and designed. The projects were to test the "...physical, economic, environmental. and institutional viability of water conservation for improving instream flows and water quality in critical salmon production areas."

A cooperative agreement was negotiated between Reclamation and the Grant Soil

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and Water Conservation District (SWCD) for the projects developed in the John Day River Basin of central Oregon. The Grant SWCD was tasked with coordinating project activities with State and Federal agencies, local governments, interest groups and private landowners.

Problem

There are several agricultural diversion dams along the John Day River in eastern Oregon. Several of the diversions must be rebuilt every year using heavy equipment in the river to push-up the river gravels to create diversion berms. In low water years the dams incorporate several other materials to seal the gravel in an effort to create a diversion pool.

This method of diversion creates several problems. Salmon returning to spawn upriver encountered an unnatural barrier with inadequate provisions for passage. Over a given year, approximately 300 spring chinook and 1,000 steelhead pass upstream through the upper reach of the main stem of the John Day River. Because the berms are not impervious, a high structure is required to divert water at an adequate rate, and water passing through and around the berm increase downstream turbidity. Pushing riverbed materials from the upstream banks to replace the berms which washed out annually results in a wider channel at the diversion sites. Sediment deposition upstream of the berm and erosion downstream of the berm create a dynamic stream condition which results in the need for more and more berm material each year and a correspondingly higher barrier, and a shallow warmer pool upstream. With the decline of Salmon and Steelhead in the Pacific Northwest and the recent listing of Bull Trout under the Endangered Species Act, more attention is being focused on fish passage problem in rivers and streams.

PLAN

One of the planned demonstrations in the John Day Basin was to design and install Infiltration Galleries to replace selected irrigation diversions on the John Day River. The successful completion of the galleries would have several benefits: The riparian habitat would no longer be disturbed by in-river construction, fish passage would no longer be an issue, sediment load and turbidity would be reduced, the banks would be restored and stabilized, and high maintenance fish screens would no longer be necessary. Benefits to the water users would include reduced maintenance costs.

Project

Infiltration Galleries were installed at two locations in the Upper John Day Basin.

The first installation replaced an 80 foot wide "push-up" gravel dam at the L-H Diversion. Figure 1 details the basic layout and concept of an infiltration gallery.

In this installation, 12-inch diameter stainless steel well screen was used for the collector or intake pipes. The well screen was buried in the stream bed and connected to the manifold pipe which was buried along the bank of the river. Isolation valves were used to allow each collector line to be flushed out independent from the rest of the system. A bypass line, back to the river, was installed to allow regulation of the irrigation diversion. The bypass line also allows flows to return to the stream during non-irrigation periods if circulation flows are deemed necessary to keep the gallery from silting closed.

The length of each collector screen was determined using the permeability of the material in the backfill envelope, screen size opening, calculated head, and a safety factor of 2. Careful consideration is required in selecting the permeability factor as the permeability factor is on a log scale. For example choosing a permeability factor of 10 to the 3rd power for the backfill material instead of a factor of 10 to the 4th power will result in the requirement of 1,000 feet of intake screen instead of 100' of intake screen (more detailed design information is available upon request).

The L-H Diversion is located in an area of the river which had been heavily dredged for gold earlier in the century. Possible head-cutting of the river was a design concern so a sheet pile curtain was installed 30-feet downstream of the buried collectors to ensure that the stream grade remains stable. The sheet pile was installed a couple of inches below the stream bed and is only visible at the side of the river where it was keyed into each bank to prevent side cutting.

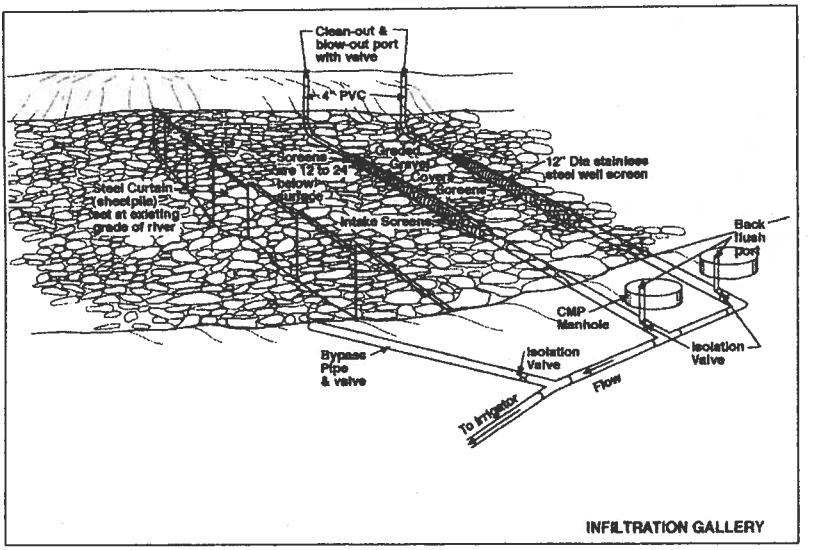

Figure 1. The Infiltration Gallery uses well screen buried in the river gravels to collect water for irrigation. A system of valves and bypass pipes allow flow regulation and system flushing. A sheet pile curtain set at the bottom of the existing river channel ensures that the well screens won't become exposed from head cutting in the river.

At the L-H Gallery 1,000 feet of 15-inch PVC pipe was installed in the existing ditch to convey the water across the dredged gravels in the flood plain. The required diversion rate at the L-H site was 1.3 cfs (cubic feet per second) which was accomplished using the collector screens and the 15-inch manifold pipe.

The second installation of an Infiltration Gallery, the Fields Diversion, was 17 miles upstream from the L-H site in an area where the river channel was more stable and only 40-feet wide. The legal diversion requirement was 1.7 cfs. Two separate stainless steel collector screens were used under the stream bed. The collectors were placed more parallel to the flow of the river because of the narrower channel. The end of the collector lines were brought into the same manhole where isolation valves and PVC risers allow each collector to be flushed independent from the rest of the system. Each collector screen was 50-feet long and backfilled with a well-graded gravel envelope. With a more stable stream bed at the Fields site, a sheet pile curtain was not deemed necessary.

Implementation Difficulties

Interest in participation in a cooperative program was initially mixed. Ken Delano, manager of Grant (County) Soil and Water Conservation District brought the potential participants together for a series of meetings. After discussions, water users decided to become partners in the program.

A standard application for the instream work was simultaneously submitted to the Oregon Division of State Lands (DSL) and the Army Corps of Engineers. This included a construction and rehabilitation plan and a firm construction timetable. DSL notified all appropriate local entities, State agencies, and interested parties of the application and requested comments. In this reach of the John Day River, Oregon Department of Fish and Wildlife (ODFW) guidelines limit stream disturbance measures to the period July 15-August 31. This is to protect adult salmon moving through the area to spawn upstream.

Coffer dams used during construction were made of stream bed material and were constructed with a backhoe. At the L-H Diversion a heavy upstream rain washed the material in the coffer dam over the installed collector screens. This material had to be excavated and removed. Ground water posed some problems but pumps were deployed and the rest of the installation went well.

Results

Fish passage is now assured at all flows. The infiltration galleries make a much smaller impact on the river dynamics than diversion berms. Heavy equipment is no longer necessary in the river. The water users can divert up to the legal water-right with less maintenance and greater ease. The Oregon Fish and Wildlife Department reaps cost savings by eliminating the need for fish screens at the gallery sites. The long term operation and viability of the Infiltration Galleries will continue to be monitored.

CONCLUSION

If sited and engineered properly Infiltration Galleries can be viable alternatives to diversion dams. Many benefits can occur for the water user and the stream ecology with the use of a low-impact Infiltration Gallery. Selecting permeability factors of the envelope material is an important step in the success of an Infiltration Gallery and should be given ample consideration in the design process. Early in the planning process all entities which have an interest in the river or water use must be contacted so that outside input and interests can be considered. This early coordination helps project managers meet the projected completion dates.