Northern Water
Northern Integrated Supply Project

# Larimer County Analysis – Technical Memorandum No. 11
## Floodplain Report

Prepared for:
**Larimer County**

Prepared by:
**Northern Integrated Supply Project**
**Water Activity Enterprise**

**February 2020**

**MEMORANDUM**

Northern Integrated Supply Project
Glade Reservoir
Floodplain Report

B&V Project Number 403758
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February 14, 2020

To: Larimer County Planning Department

From: Mike Johnson and Tim Engemoen, Black & Veatch

# Introduction

This technical memorandum is written in support of Larimer County Planning Department's 1041 Permit for the Glade Unit construction, and documents impacts to the floodplain of the Poudre River with this new development.

# Project Background

The Northern Integrated Supply Project (NISP) will provide a new raw water supply to several municipal water providers in Northern Colorado. NISP includes the following facilities located in Larimer County: the Glade Unit; the Glade Pump Station; raw water distribution piping; and the relocation of U.S. Highway 287. The Glade Unit features the Glade Reservoir Dam, which is an earthen embankment that will impound an off-channel reservoir complete with the hydraulic structures required by the State Engineer's Office: the High Level Outlet Works (HLOW); Low Level Outlet Works (LLOW); and spillway. Glade Reservoir Dam is located just to the north of the junction of U.S Highway 287 and State Highway 14, about 10 miles northwest of Fort Collins. The Glade Unit includes an expansion of the existing Poudre Valley Canal (PVC) and a new forebay constructed downstream of the dam at an elevation that will allow delivery of water from the PVC by gravity. A Control Gate structure will be constructed to control flow to the existing portion of the PVC downstream of the forebay. The existing PVC Diversion Structure will be demolished and rebuilt to allow increased diversion of flow from the Poudre River. A portion of the existing Munroe Gravity Canal alignment will be inundated by Glade Reservoir, this open canal will be replaced by the Munroe Canal Bypass (MCB), a conduit and several control structures that will convey flow beneath the reservoir. The Glade Unit also includes: the Glade Pump Station, which will pump water from the forebay into Glade Reservoir; the Electrical/Control building that will distribute power throughout the site and provide control of the various hydraulic features; the Surge Building that will house surge tanks to protect the pump station discharge conduit; and numerous buried conduits with control valve vaults that connect these facilities. Raw water will be conveyed off site via several buried conduits that are being constructed under different NISP contracts. The Glade Unit will include recreational amenities for the general public, including a Visitor Center, campgrounds, a boat ramp, trails and restroom facilities.

Glade Reservoir will submerge a portion of the existing U.S. Highway 287 alignment which will be relocated to the east of the reservoir. An existing power transmission line and several power

distribution lines will be inundated by the reservoir which will be relocated as part of the Glade Unit construction. A general location map of the Glade Unit facilities is presented on Figure 1.

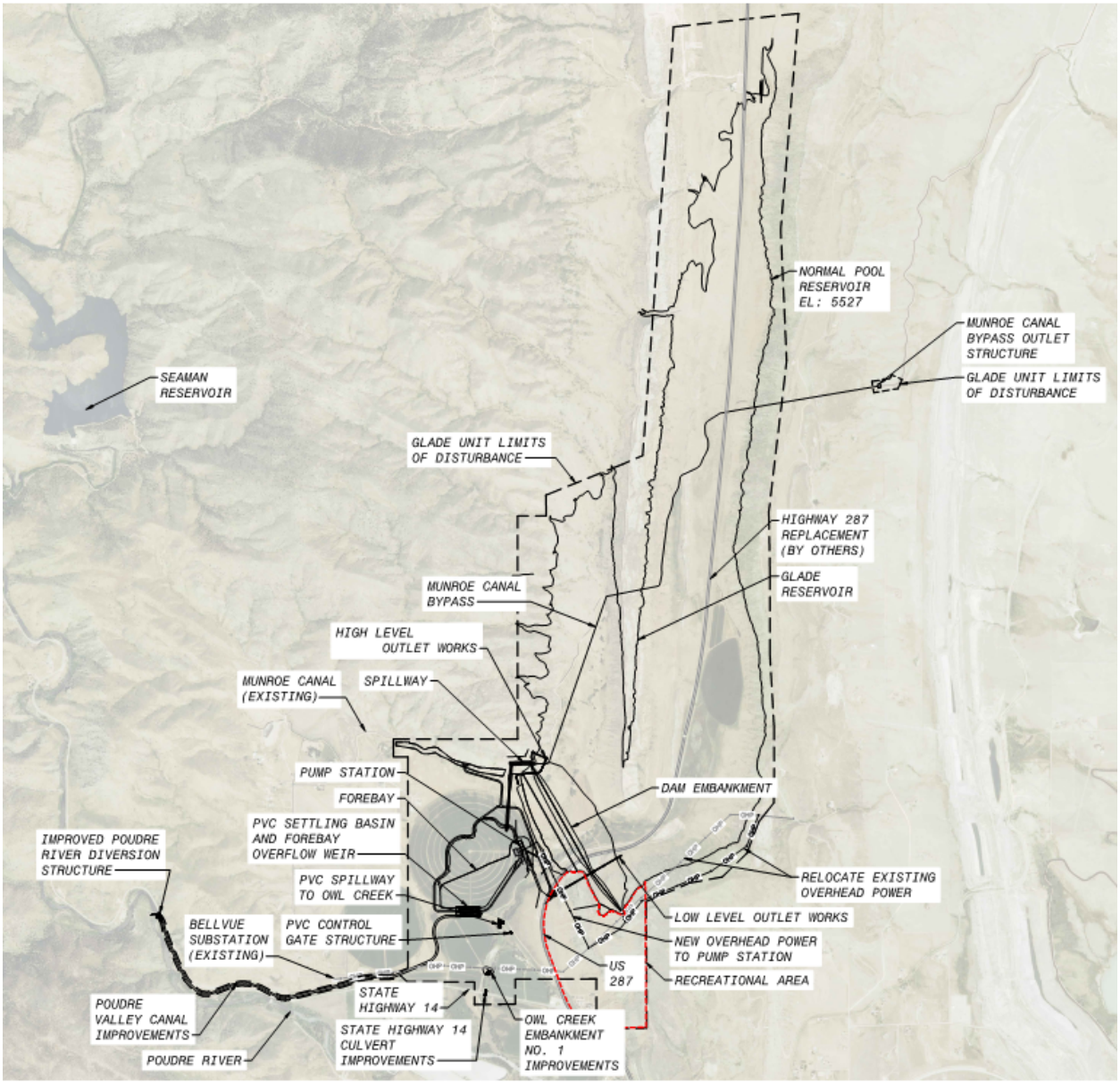


*Figure 1 - Glade Unit Overview*

# Impacts to Existing Floodplain

The existing 100-year floodplain for the Poudre River is shown below in Figure 2 (also included as Figure 2 of Attachment C to the 1041 Permit Project Description). The only facilities that are part of the Glade Unit that will be constructed within the Poudre River flood plain is the PVC Diversion Structure. The existing diversion structure consists of a check dam and gate structure that has a capacity of

approximately 350 cubic feet per second (cfs). This structure will be demolished and replaced with a new structure that has a capacity of 1,300 cfs.

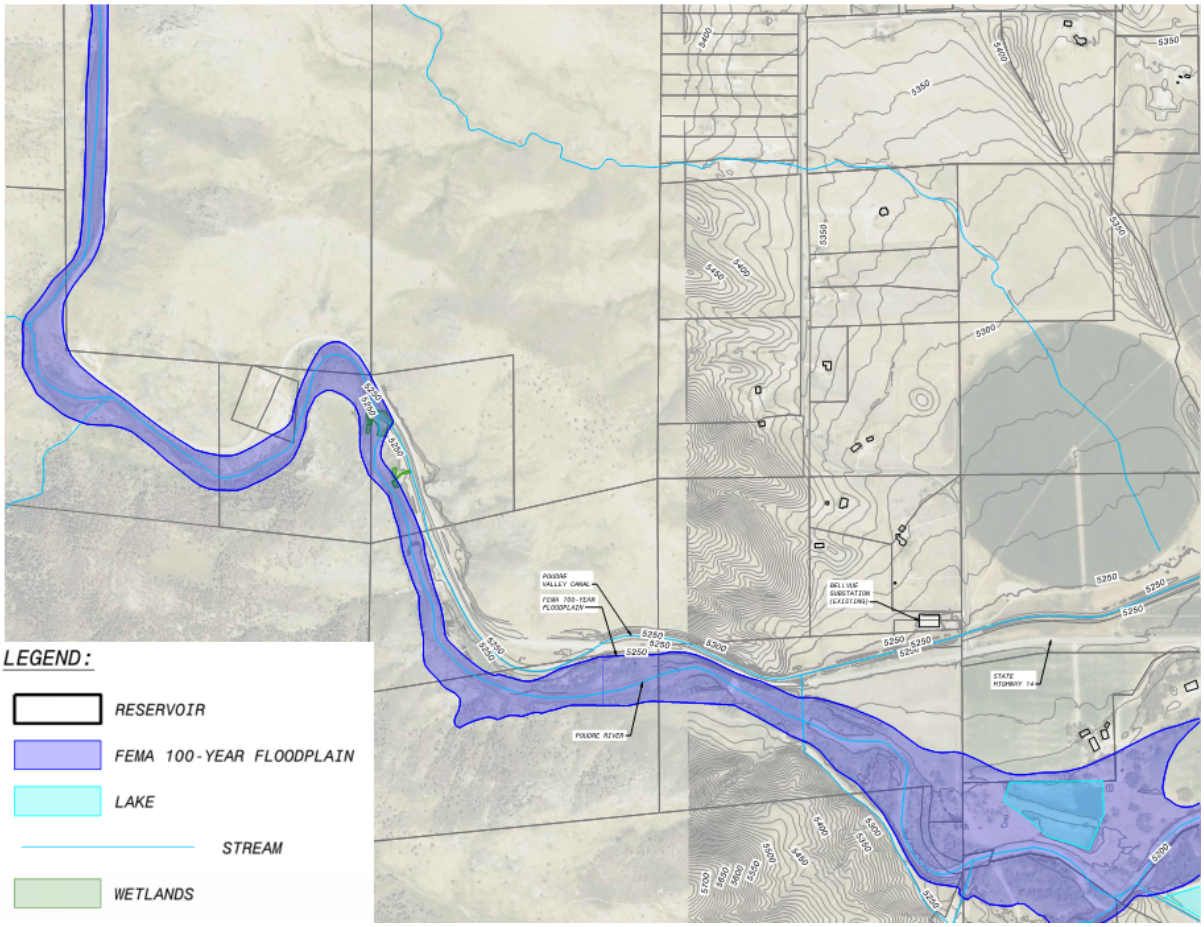


*Figure 2 - Poudre River 100-Year Floodplain*

## Hydrology and Hydraulics

Based on the Flood Insurance Rate Map Panel 0750F, the Special Flood Hazard Area at this location is designated Zone A, with no base flood elevations determined. To establish the flood flow with a 1% Annual Exceedance Probability, stream gage mean daily flow data and historical peaks were analyzed to develop a flow duration curve and to perform a flood frequency analysis, respectively. Specifically, the Cache La Poudre River USGS Gage No. 06752000 was used for the analysis. Figure 2 shows the flow-duration curve for this gage. The 100-year flood discharge was estimated to be 7,400 cfs. A HEC-RAS model was set up to determine water levels upstream and downstream of the weir. The corresponding water surface elevations are approximately 5,254.95 feet and 5,251.55 feet, respectively.

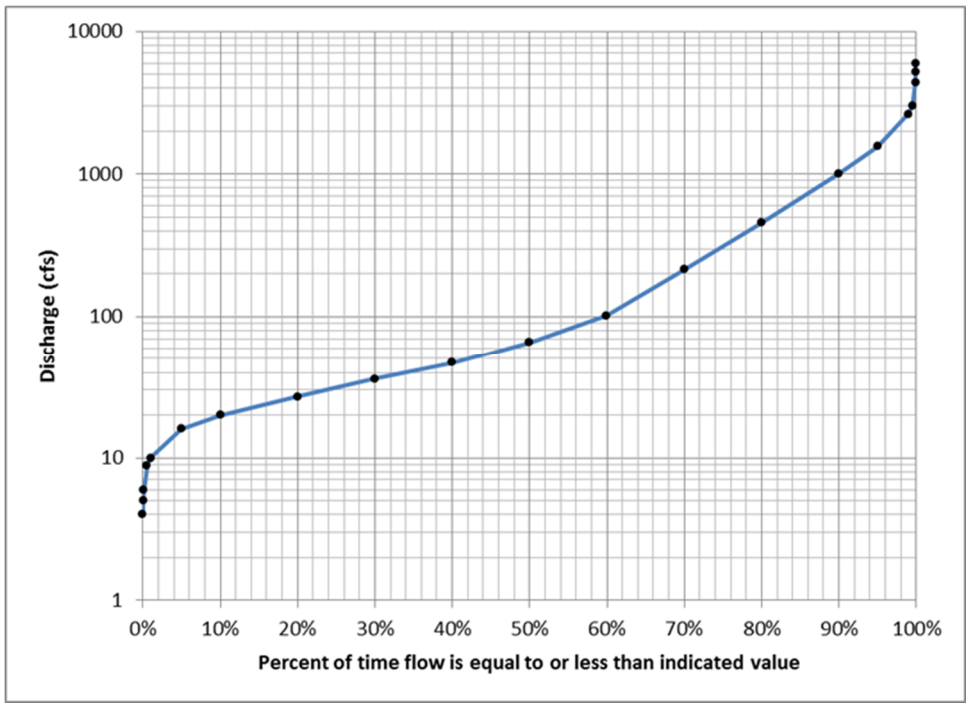


*Figure 3 – Flow-Duration Curve for USGS Gage No. 06752000*

## Existing Diversion Structure

The existing diversion structure is shown in Figure 3. The structure consists of a check dam across the Poudre River and a gated diversion structure that is used to divert flow into the PVC. The elevation of the crest of the existing check dam is El 5249.1 and the existing length of this check dam is approximately 190 feet. The diversion structure is a concrete structure equipped with radial gates. Sluicing of solids that are diverted into the canal is accomplished via an existing sluiceway located approximately 450 feet downstream from the existing diversion structure. The existing check dam, diversion structure and sluiceway will all be demolished and replaced with new construction.

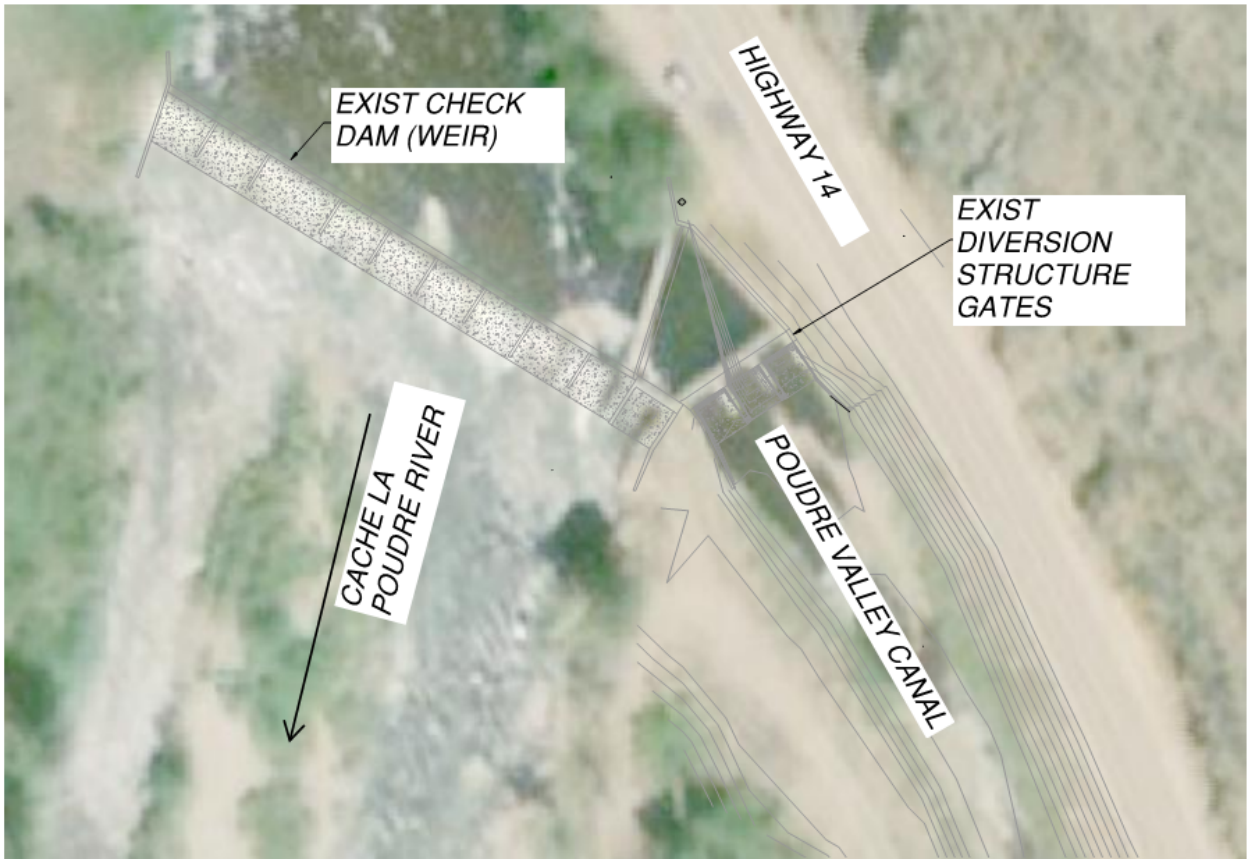


*Figure 4 – Existing Facilities within the Poudre River Floodplain*

## Proposed Improvements

As previously stated, the upgraded diversion structure is the only facility associated with the Glade Unit that will be constructed within the Poudre River floodplain. A new weir will be constructed across the Poudre River with the same crest elevation and length as the existing check dam. Riprap will be placed on the downstream side of the weir at a 10:1 slope to ensure safe passage of small boats. The new diversion structure will be constructed with gates and top of concrete walls set at approximately El. 5256.0 to allow approximately 1 foot of freeboard during the 100-year event. The invert of the gates will be at approximately El. 5241.0 to correspond to the invert elevation at the upstream end of the PVC. The water surface in the PVC must be approximately El. 5249.3 to convey 1,300 cfs to the Forebay, and the new gates will be designed to open to this elevation to allow free-flow through the gate structure. Trash racks will be installed on the upstream side of the gate structure.

High velocities are expected downstream of the gates under certain operating conditions of the gates; therefore, an energy dissipation structure will be incorporated into the Diversion Structure downstream of the gates to prevent damage to the canal. The energy dissipation structure has been designed to handle high velocity flow that can occur at the gate structure, assuming up to a 100-year level upstream of the gate and a low tailwater on the downstream end of the dissipation basin. Under these conditions,

velocities can be higher than 29 feet per second (ft/s), with Froude numbers of more than 6. Based on the design range of velocities and Froude numbers expected downstream of the gate, a Reclamation Type III dissipation basin was selected for this application to fully dissipate energy in the flow stream.

The Diversion Structure will include a fish ladder to facilitate adequate fish passage around the diversion weir structure. Design criteria are based on two parameters: maximum flow velocity and energy dissipation factor (EDF) rates.

A sluiceway will be constructed on the upstream end of the structure. The sluiceway will be separated from the rest of the structure by a short wall; the top of this wall will be located at approximately El. 5245.50. The short wall will allow trapping large sediment, rocks, and debris on the sloped apron located upstream of the wall. The apron is sloped toward the sluice gate to facilitate the removal of the accumulated material. A 14-feet-wide by 10-feet-high slide gate will be used for this to allow diverting of material through the sluiceway. A sloped apron will be constructed downstream of the gate to direct the sluiced material toward the Poudre River allowing the continued movement of sediment through this section of the river.

Larimer County floodplain permitting, and evaluation of compliance with all floodplain regulations, will be completed as design progresses to the point where complete evaluation of all effects is possible. Preliminary modeling indicates, and the design intent is, that the new Diversion Structure is not anticipated to cause any rise in the existing floodplain elevation.

Figures 4, 5, and 6 depict the new weir and diversion structure.

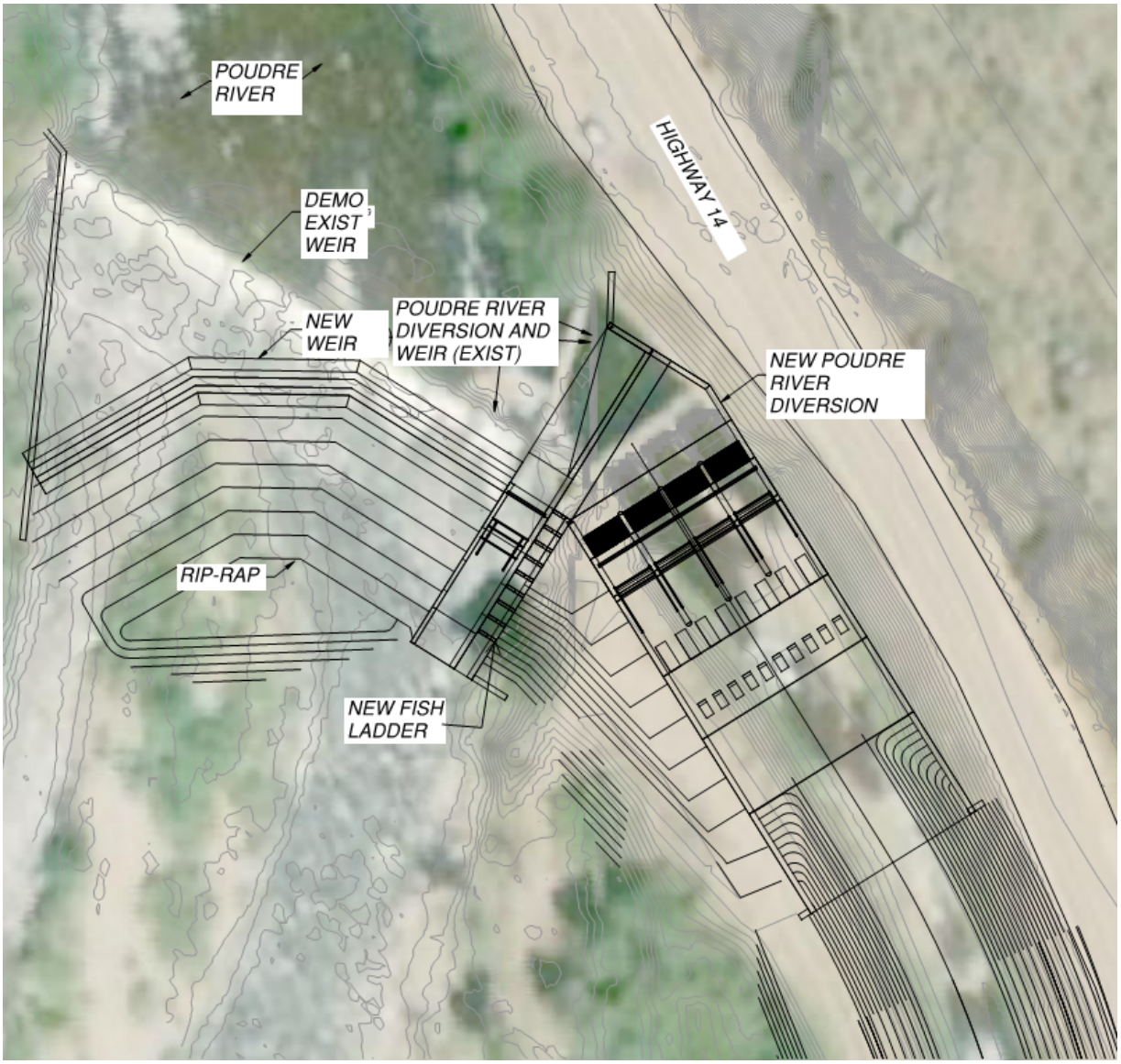


*Figure 5 – Site Plan of Proposed Weir and Diversion Structure*

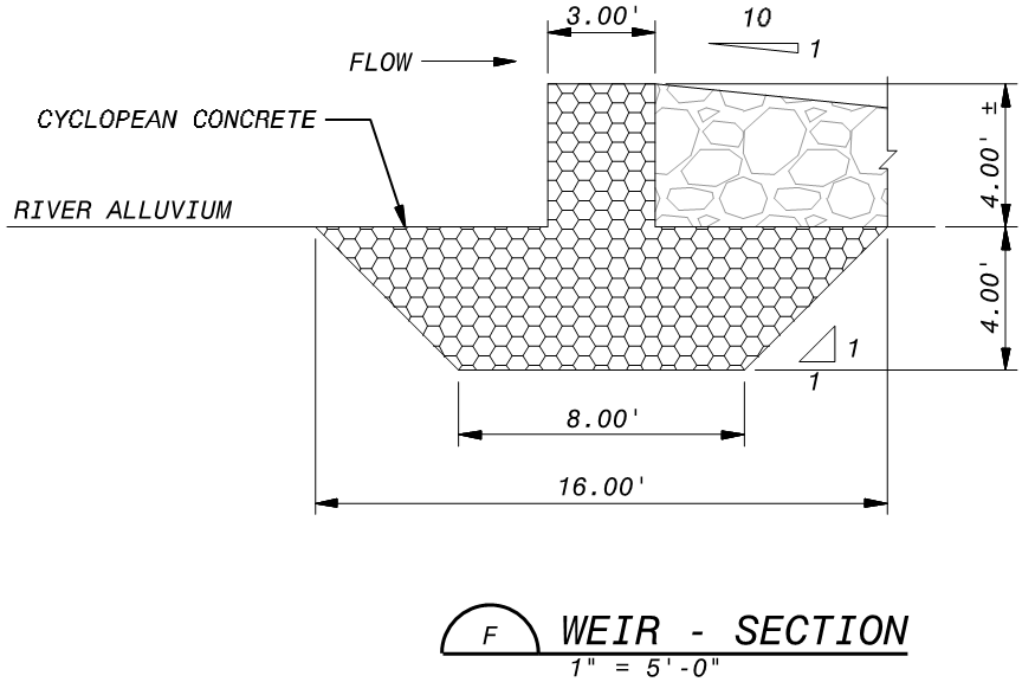


*Figure 6 – Section Through New Weir*

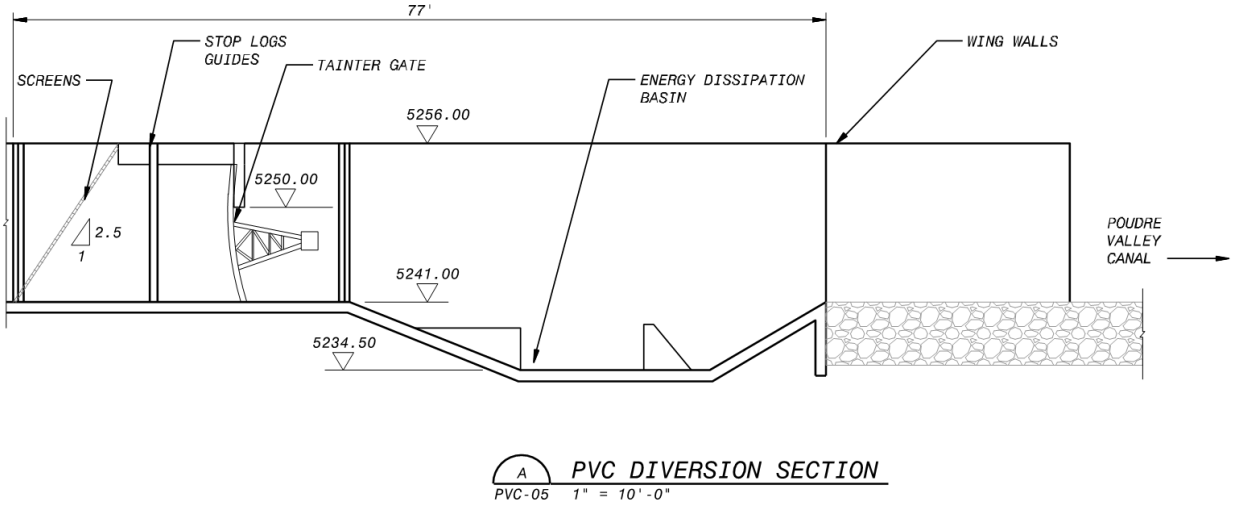


*Figure 7 – Section Through New Diversion Structure*