Northern Water
Northern Integrated Supply Project

Larimer County Analysis – Technical Memorandum No. 10
Drainage Plan

Prepared for:
Larimer County

Prepared by:
Northern Integrated Supply Project
Water Activity Enterprise

February 2020

MEMORANDUM

Northern Integrated Supply Project
Glade Reservoir
Larimer County 1041 – Drainage/Erosion Control

B&V Project Number 403758
B&V File 188754/34.3000
February 14, 2020

To: Larimer County Planning Department

From: Tim Engemoen and Mike Johnson, Black & Veatch

Introduction

This Drainage and Erosion Control Report and Plan is written in support of Larimer County Planning Department's 1041 Permit for the Glade Unit construction and describes the hydraulic and hydrologic analyses completed for this project.

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 PVC 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 (the stormwater plan for these facilities is provided in a separate report). 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.

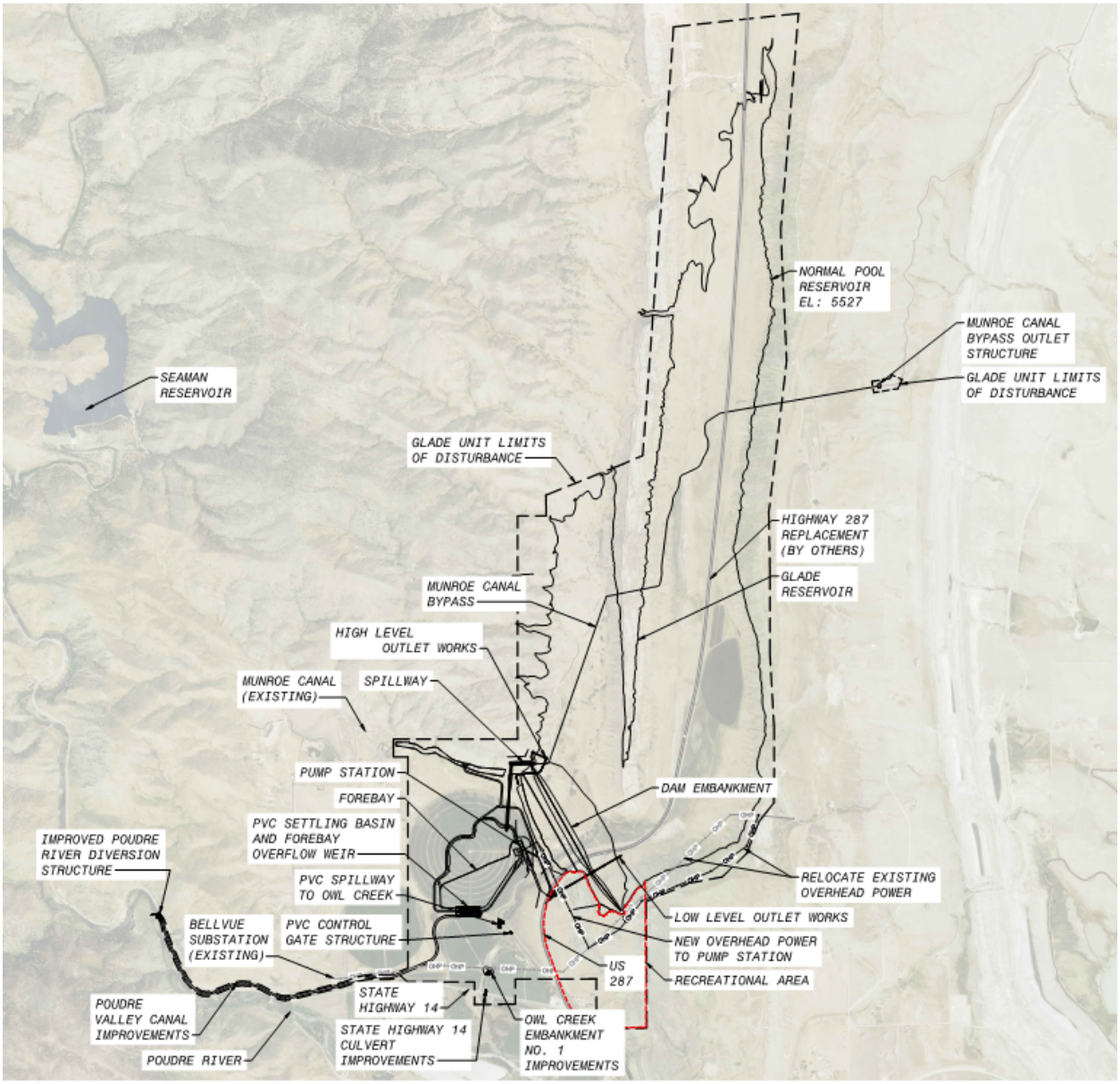

Figure 1 - Glade Unit Overview

Site Drainage Upstream of Glade Reservoir

The drainage areas that are tributary to Glade Reservoir are shown in Figure 2.

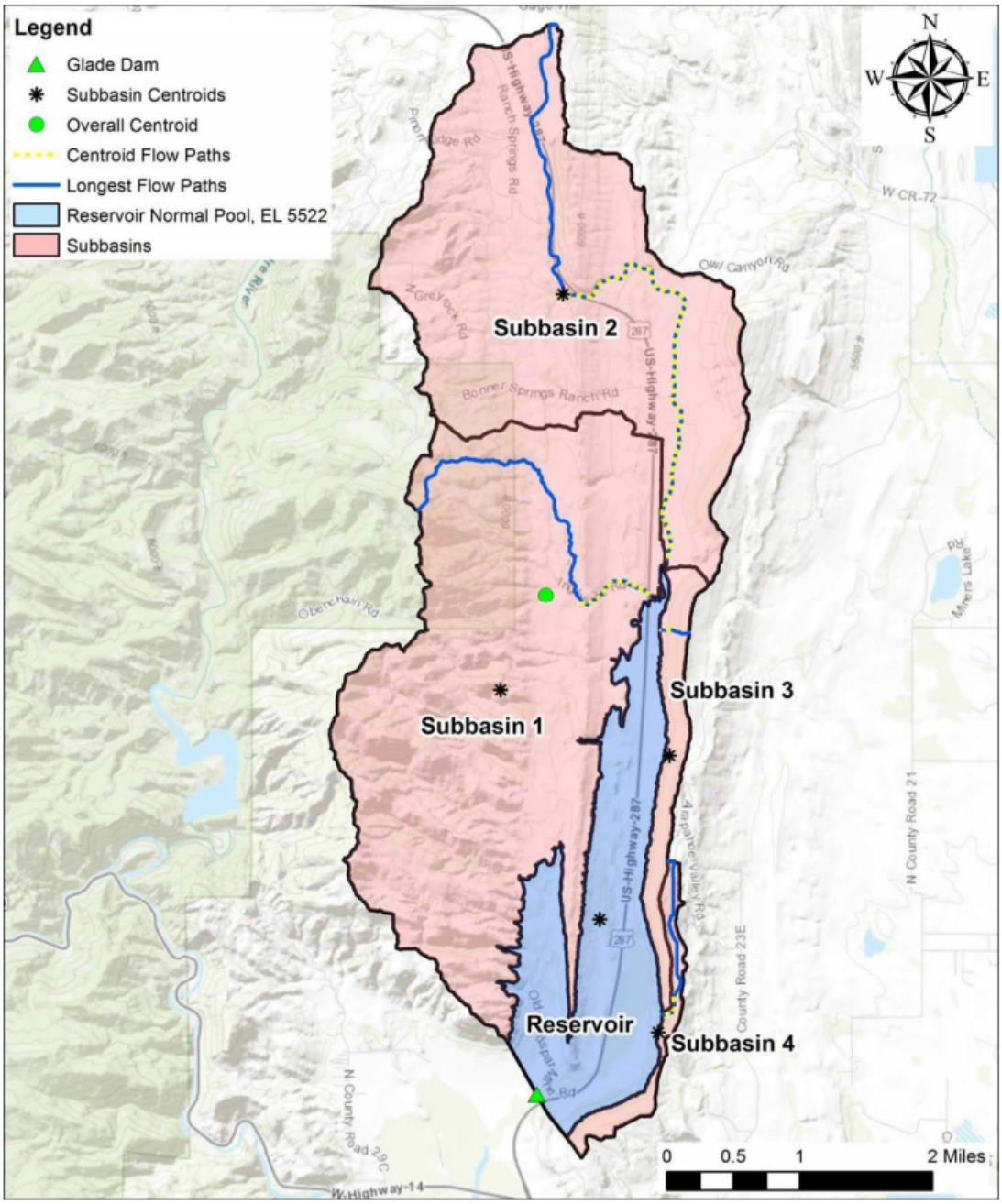

Figure 2 - Drainage Areas Upstream of Glade Reservoir

These drainage areas are also shown in Figure 17 that is included with Attachment C to the 1041 Permit Project Description. The general flow regime on the site is from north to south and the total drainage area is 16.3 square miles.

The inflow design flood (IDF) for an extreme hydrologic hazard classification is based on the critical duration probable maximum precipitation (PMP) event. 72-hour general storm, 24-hour hybrid storm, 6-hour local storm, and 2-hour local storm PMP depth-duration relationships were estimated using the Colorado-New Mexico Regional Extreme Precipitation Study PMP Tool. Forty-eight-hour, 6-hour, and 2-hour precipitation frequency (PF) depth-duration relationships were estimated using the Colorado-New Mexico Regional Extreme Precipitation Study Precipitation Frequency Tool.

Based on the estimated Glade Reservoir drainage basin characteristics and hydrologic analysis using CO-NM REPS PMP data, the IDF was determined to result from the 24-hour duration PMP storm event. Reservoir peak inflows for the various PMP storm durations and distributions were estimated to range between about 16,600 and 57,700 cfs. Total reservoir inflow runoff volumes were estimated to range between about 12,000 and 17,500 acre-feet. Due to the reservoir surcharge storage capacity, the inflow flood with the largest inflow runoff volume (i.e., the 24-hour duration PMP) produced the highest reservoir elevation (i.e., El. 5532.2) and was adopted as the IDF. With a dam crest at El. 5535.2, there would be 3 feet of residual freeboard, which conforms to minimum freeboard design criteria for the IDF event.

Based on use of CO-NM REPS precipitation frequency data, the 48-hour duration storm events produced the highest reservoir elevations and associated peak outflows for the precipitation frequency Annual Exceedance Probability (AEP), durations, and distributions evaluated. As such, the 48-hour duration is the critical duration for precipitation frequency events. Reservoir peak inflows for the various precipitation frequency events were estimated to range between about 1,200 cfs and 40,000 cfs. Total reservoir inflow runoff volumes were estimated to range between about 570 and 11,700 acre-feet.

Glade reservoir will provide a significant amount of attenuation for the IDF and reduce the outflow from the reservoir. The spillway crest is set at El 5532, and the resulting maximum outflow from the IDF is 1,200 cfs. When the spillway activates, flow is routed to the Forebay via the spillway chute. Once the Forebay level reaches El. 5245, the Forebay Overflow activates and discharges flow into the Poudre Valley Canal (PVC). Once the level in the PVC reaches El 5247, the Owl Creek Spillway activates and flow is directed into the Owl Creek Drainage. This drainage is being improved so that this flow can be safely conveyed under Highway 14.

Refer to Figure 13 included in Attachment C to the 1041 Permit Project Description for the structures that are part of the drainage flow path. Appendix A includes the full analysis of this drainage area.

Site Drainage Downstream of Glade Reservoir

The drainage areas that are tributary to the Forebay are shown in Figure 3. This is a detailed map of the sub-basins that comprise Basin 5 as shown on Figure 17 included in Attachment C to the 1041 Permit Project Description. Because the Forebay and the PVC are hydraulically connected via the Forebay Overflow Weir, the drainage areas which drain into the PVC upstream of the Forebay are included in this analysis. Total drainage area analyzed is 3.8 square miles.

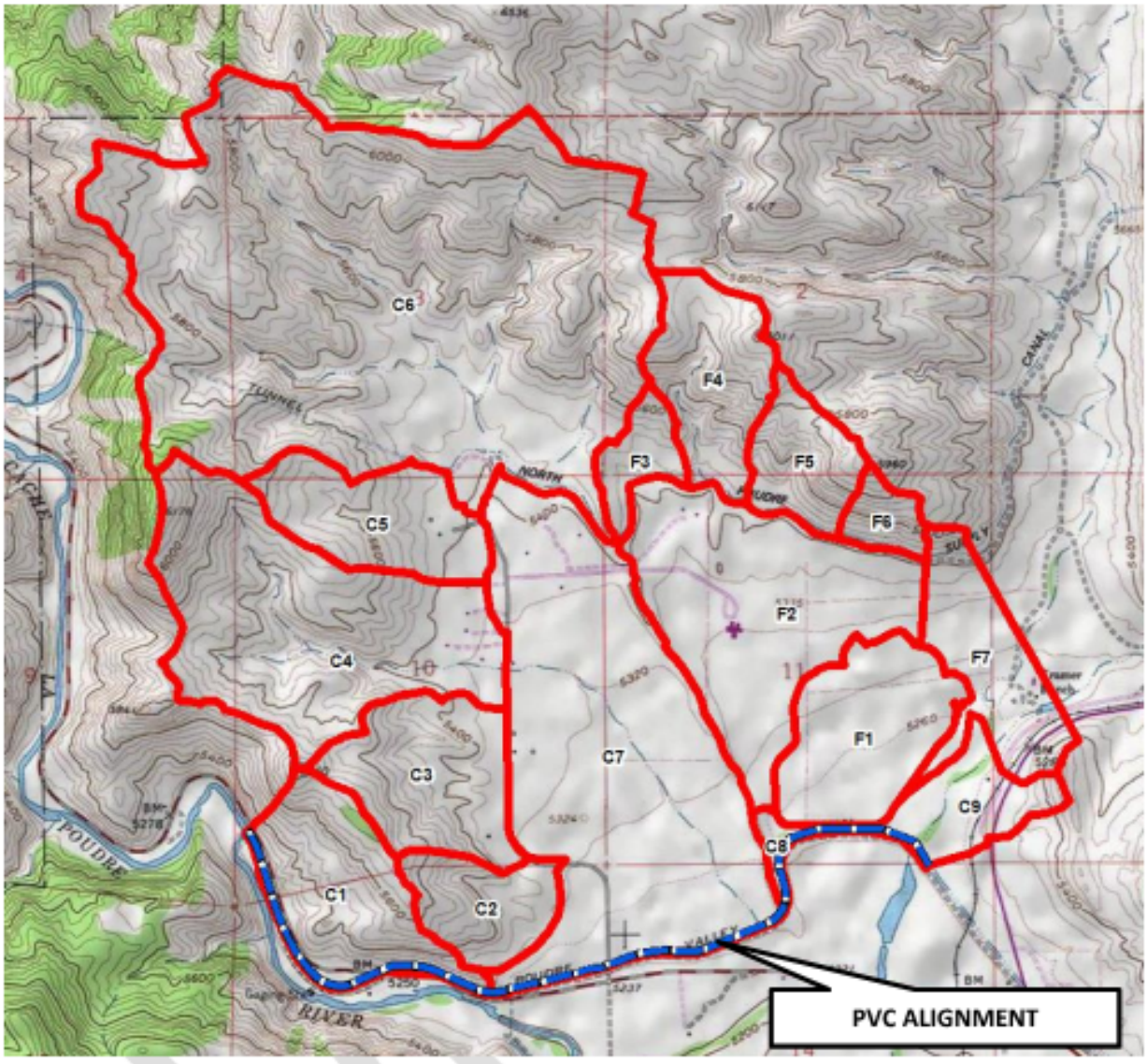

Figure 3 - Drainage Areas Downstream of Glade Reservoir

The IDF for a low hydrologic hazard classification like the Forebay is based on the critical duration 100-year event. 72-hour general storm, 24-hour hybrid storm, 6-hour local storm, and 2-hour local storm 100-year depth-duration relationships were estimated using the Colorado-New Mexico Regional

Extreme Precipitation Study PMP Tool. 48-hour, 6-hour, and 2-hour precipitation frequency (PF) depth-duration relationships were estimated using the Colorado-New Mexico Regional Extreme Precipitation Study Precipitation Frequency Tool.

The three storms were modeled using HEC-HMS for the forebay drainage area. It was determined that the critical storm was a 2-hour local storm as it produced the highest water surface elevation in the future forebay and the largest discharge outflow at the spillway into Owl Creek. The results of this analysis for the 2-hour local storm included a maximum water surface in the Forebay of El 5249.32 and a maximum discharge rate of 1,855 cfs into Owl Creek. Thus, even though the drainage area upstream of Glade Reservoir is significantly larger than the area downstream of the reservoir, the area downstream results in a larger outflow to Owl Creek. This is because the Forebay offers significantly less attenuation than Glade Reservoir. The intent of the design is to ensure there won't be an increase in peak flow rates for the drainage basins downstream of the reservoir.

When the water surface in the Forebay reaches El. 5245, the Forebay Overflow activates and discharges flow into the Poudre Valley Canal (PVC). Once the level in the PVC reaches El 5247, the Owl Creek Spillway activates and flow is directed into the Owl Creek Drainage. This drainage is being improved so that this flow can be safely conveyed under Highway 14.

Refer to Figure 13 included in Attachment C to the 1041 Permit Project Description for the structures that are part of the drainage flow path. Appendix B includes the full analysis of this drainage area.

Drainage Basin No. 6

In addition to the drainage basins which have been analyzed upstream and downstream of Glade Reservoir, there is another drainage basin which occupies a portion of the site impacted by the Glade Unit. This area is shown on Figure 17 included in Attachment C to the 1041 Permit Project Description and is labeled Basin 6 and is also shown below in Figure 4. This basin includes the land along Highway 14 south of the PVC and the area which is planned to be occupied by the recreational facilities. Some of this basin will drain to Owl Creek while other portions of this basin will drain directly into the Poudre River. Because the recreational area layout and design haven't been completed, this basin has not yet been analyzed to determine the hydrologic impact on the drainage from this area.

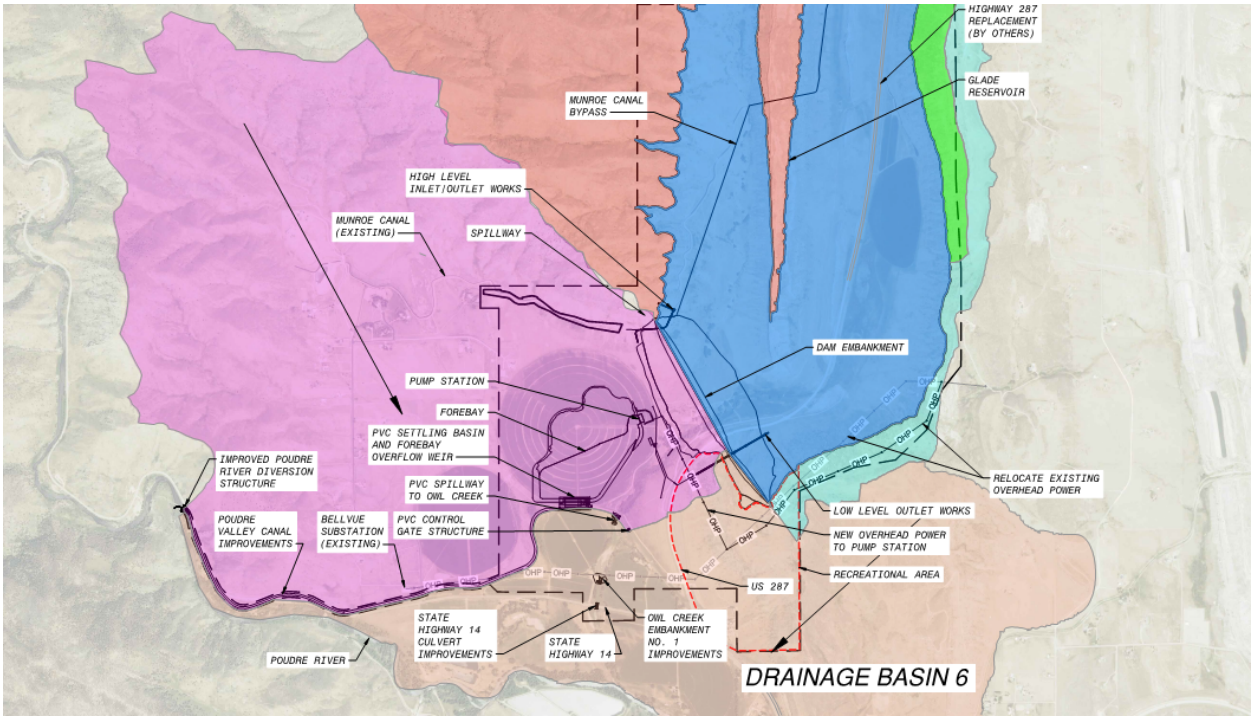

Figure 4 - Drainage Basin 6

The drainage analysis and designs will be completed as recreation infrastructure design progresses in compliance with the Larimer County Stormwater Design Standards.

Environmental Compliance

Environmental compliance during construction is described as part of the Final EIS Conceptual Mitigation Plan and includes a significant listing of Best Management Practices (BMPs) which are required due to federal, state, and local permitting activities.

The following BMPs will be implemented during construction for protection of existing streams and wetlands.

- Clearing of vegetation will be limited to that required for construction.
- Dredged or excavated materials not utilized for construction would be placed on an upland site above the ordinary high-water mark in a confined area except as specifically authorized by the construction contracts.
- Implement a soil, sediment, and erosion control plan to prevent erosion of disturbed areas into waterways.
- Construction debris such as excess fill material, wood, vegetation, concrete, and other materials will be disposed of in such a manner that debris cannot enter a waterway or wetland.
- Equipment will be allowed into wetlands and waterways only as authorized by the Record of Decision and the 404 Permit.

- Concrete truck wash-out areas will be managed to prevent contamination of waters.
- Containment areas will be required for all petroleum products, chemicals and other deleterious materials stored on-site.
- Contractor will be required to develop a contingency plan in the event of a spill.
- A storm water management plan will be developed in accordance with the State of Colorado Water Quality Program in accordance with the guidelines of the Colorado Department of Public Health and Environment (CDPHE). This permit will incorporate construction dewatering discharge requirements, erosion and sediment controls and other BMPs that apply to storm water runoff from a construction site.

APPENDIX A

GLADE RESERVOIR FLOOD HYDROLOGY REPORT, PREPRARED BY BLACK & VEATCH/AECOM, OCTOBER 2019

APPENDIX B

FOREBAY HAZARD CLASSIFICATION ANALYSIS

PREPARED BY BLACK & VEATCH/AECOM

NOVEMBER 2019

(ONLY THE HYDROLOGY PORTION OF THIS REPORT IS INCLUDED)