Technical Memorandum

Date	November 27, 2024
Project:	Chehalis River Basin Flood Damage Reduction Project
To:	Chehalis Basin Flood Control Zone District
From:	HDR Engineering, Inc.
Subject:	**Access Roads and Best Management Practices**
Attachments:	Attachment 1. Figures Attachment 2. Proposed Erosion Mitigation Actions Attachment 3. Existing Conditions – Access Roads

1.0 Background

The Chehalis River Basin Flood Damage Reduction project objective is to develop recommendations for a series of measures aimed at reducing damage to the communities of the Chehalis River Basin from Pe Ell to Centralia during major flood events. Among these measures is a proposed Flood Retention Expandable (FRE) structure on the Chehalis River, south of the town of Pe Ell.

The Chehalis River Basin Flood Damage Reduction, Revised Project Description Report (RPDR) documents the relocation of and revisions to the proposed FRE facility and supporting infrastructure located within the Proposed Project area as originally documented within the Combined Dam and Fish Passage Conceptual Design Report (HDR Engineering, Inc. [HDR] 2017) and FRE Dam Alternative Report (HDR 2018).

The RPDR describes, supports, contrasts, and illustrates the revisions and enhancements to the proposed FRE in a single comprehensive document.

2.0 Introduction and Purpose

The Draft Environmental Impact Statements (EISs) prepared by the Washington Department of Ecology (WDOE); pursuant to the State Environmental Policy Act and the U.S. Army Corps of Engineers (USACE); pursuant to the National Environmental Policy Act evaluate anticipated impacts associated with construction and operation of a revised FRE facility (i.e., the Chehalis River Basin Flood Damage Reduction Project) in the Chehalis Basin, Washington State. The Chehalis River Basin Flood Control Zone District (District) is the project proponent.

As Appendix G to the RPDR, this technical memorandum describes existing forest roads that could be used as alternative access routes around the active construction area and as quarry access, best management practices (BMPs) to reduce impacts of sedimentation from

the use of existing roads during construction, and permanent access roads intended to be used mostly for forest practices, recreation, as well as access to the facilities.

At the current level in the project design, the configuration, location, and usage of access roads can only be approximated based on a general understanding of construction processes and accompanying BMPs for environmental protection. During the final design phase, road analysis and design, geotechnical field work and testing, access road related specifications and layout drawings, and materials quantities will be further refined and more detailed plans for the access roads developed. The rough order of magnitude (ROM) estimates provided herein reflect the current conceptual level of design for the FRE facility and assumptions regarding the requirements for access road design. HDR has used professional judgment to provide the recommended quantity estimates for the project description to be evaluated in the EIS; however, this value can only be used as a guideline at this point in the design process.

The District's proposed approach for access road construction is to minimize disturbance by using existing roads to provide permanent access around the flood inundation area and temporary access to and around the FRE construction site. Existing roads used for project purposes will be improved and maintained using BMPs. The access roads can be categorized as follows:

- Access roads used during construction of FRE facility:
    - FRE construction temporary site roads revegetated after construction
    - Temporary haul roads from quarries and staging areas revegetated after construction
    - New and existing permanent roads to be used during construction
- Permanent access roads used during operation and maintenance of FRE facility:
    - New and existing permanent roads used and developed during construction that will be used for:
        - Facility Maintenance
        - Flood Operations
        - Debris management after a flood event
- Permanent access for commercial forestry practices
    - New and existing permanent roads used and developed during construction
- Permanent access for recreation sites
    - New and existing permanent roads used and developed during construction
- Orphaned Access Roads:
    - Permanent access roads that are inaccessible when the reservoir area is inundated, and structure is in use
- Abandoned Access Roads
    - Existing roads revegetated after construction is complete

Existing roads will be improved to provide access during construction and operations of the FRE facility. Improvements to existing roads will range from minor resurfacing repair and vegetation trimming to roadbed widening and/or reconstruction in areas with steep grades or sharp corners. All roads are expected to require new or additional aggregate base course and/or wearing surface course to be placed on the road as an improved roadway cross-section and grading to reshape the driving surface and provide positive drainage. Improvements will focus on improving mobility and safety for the type of vehicles that will be travelling the roads. Some access may potentially have to be established or relocated, requiring new road construction. At the proposed FRE site, the design attempts to minimize new road construction and the associated impacts. Most of the new roads would be in the near vicinity of the proposed excavation objective for the FRE structure. Within the temporary inundation area, outside the vicinity of the FRE excavation, new roads are not anticipated at this time.

Attachment 1 includes figures that depict the associated access roads to the FRE facility:

- Figure A-1: Proposed FRE Facility, Permanent Roads – Provides an illustration of roadways proposed for permanent access and distinguished between permanent existing roads and permanent new roads. The figure also identifies existing roads that will be abandoned/restored after completion.
- Figure A-2: FRE Facility Site Vicinity Existing Access Roads – Shows the existing road network and potential alternative routes (zoomed out)
- Figure A-3: FRE Facility and Inundation Area Access Roads – Shows the roads directly affected by the FRE facility and temporary inundation area (zoomed in)
- Figure A-4: FRE Facility and Inundation Area Access Roads and Water Crossings – Shows location of access roads, existing and proposed water crossings.
- Figure A-5: Location of Debris Management Yard and Access Roads – Shows the access roads around the area where the debris, after a flood event, will be sorted.
- Figure A-6: FRE Facility and Permanent Access Roads – Shows existing access roads prior to construction.

Temporary access routes for FRE construction are presented in Appendix K, Constructability Report.

This memorandum provides ROM estimates of the location and extent of roads to be used for construction and long-term operation of the proposed FRE. Finally, a ROM of the estimated number of truck loads required for improving roads and that affect roads during construction is provided in Table 2 of Section 8.0 within this document.

3.0 Existing Access Road Conditions and Use

Existing access roads in the vicinity of the proposed FRE structure and temporary inundation pool were reviewed in two separate site visits held in June and August of 2023. During these two site visits, it was determined that all access roads to be used for construction and permanent access around the inundation pool are gravel surfaced, from onsite sources (See Attachment 3 for site photos). Typical roads are 15’ to 30’ wide in varying conditions. Current access roads that are actively being used for logging are in good condition, requiring limited improvements for construction activities. Several access roads that are no longer used for logging operations are in varying conditions, some needing more improvements than others.

The upper Chehalis River Basin within the proposed temporary pool area has experienced landslides in the past, making several of the proposed routes inaccessible. These areas will need significant improvements to be usable for construction and post-construction activities. The existing access roads appear to be developed using typical State of Washington and Federal forestry road criteria and general requirements. Active logging activities were observed while on site, including fully loaded semi-trucks utilizing the existing access roads. There are three bridges currently being utilized, two upstream and one downstream of the proposed FRE structure that will need to be assessed to determine their structural integrity for construction activities and post construction maintenance operations. Future geotechnical investigations of the existing access roads (potholing) and structural analysis of bridges (full bridge inspection and analysis) will be required to validate assumptions and load capacity. This will occur in subsequent design phases. If determined necessary, future bridge modifications and/or construction will be designed in accordance with the most recent version of the Washington State Department of Transportation's (WSDOT) requirements and guidelines, outlined within their Bridge Design Manual Load and Resistance Factor Design (LRFD).

Existing culverts have been identified and will be assessed at future design stages of the project to determine proper design criteria. Furthermore, additional culvert installation may be required following further hydraulic studies of the inundation area. Culvert design and installation will be performed in accordance with state, local, and owner specifications, especially Washington Administrative Code 220-660-190 and Washington Department of Fish and Wildlife's Water Crossing Design Guidelines (2013) to account for proper fish passage. As the design is furthered, fish passage will be reviewed and incorporated to meet federal, state, and local requirements.

4.0 Access Roads Used during Construction

Roads associated with the FRE site construction are predominantly existing roads to remain permanent following construction. However, temporary extensions will also have to be developed for construction access as shown in Appendix K, Constructability Report.

Access to the revised FRE construction site would be provided via the existing forest access road, FR1000. The District anticipates that construction workers would park off-site in existing lots and be shuttled to the construction area to limit construction-related traffic and vehicles. Construction worker access is part of the means and methods by the contractor and cannot be estimated by the engineer. However, contractor parking sites will be confirmed during future design phases.

4.1 Temporary Construction Access

These roads would be used to place materials during the construction process and are necessarily dictated as means and methods of the construction operation by the contractor. Temporary roads within the active construction site would be abandoned/restored after construction.

4.2 Haul Roads from Quarries and Staging Areas

There are three proposed quarry sites that are part of the Proposed Project; New North, South, and West quarry locations. These sites are in areas that can be reached by utilizing

existing access roads. Existing access roads to be utilized for material transport and various other construction activities and will require improvements to facilitate safe material transport. The HDR Geotechnical Design Report (RPDR Appendix E) shows the locations of the proposed quarries and their access roads.

It is assumed that aggregate material for these road improvements will be acquired from onsite sources.

5.0 Access Roads Used During Operation of the FRE Facility

This Section describes roads that are being used after the FRE facility has been constructed and is in operation.

5.1 Access Around Temporary Inundation Area

To the extent possible, the District proposes to use existing roads to provide permanent access around the temporary inundation area. FR1000 is the main route into the area from the town of Pe Ell. Up to 4 miles of FR1000 and 15 miles of PC-DO-WY-0999/FR1700 would occasionally be temporarily inundated during FRE operations during a flood event. Alternate existing access roads above the temporary inundation pool would be used to gain access to locations around the pool. The specific alternate access routes will be assessed in future design phases.

5.2 Improvements for Access Roads within Temporary Pool Zone

HDR anticipates that normal reservoir flood operation will not negatively affect the overall integrity of the existing aggregate surfaces of the roads. Basic shear stress and hydraulic analyses have been performed within the inundation area, for reservoir filling and drawdown. These analyses showed that earthen material less than 0.2 mm in diameter (fine sands) are most likely to be displaced or transported during a fill/drawdown event; aggregate greater than 0.2 mm in diameter would remain in place. Based on these analyses, well vegetated areas adjacent to the access roads, including side slopes, also would remain stable up to a minimum 2.5 ft/s of water velocity. Table 1 identifies potential failure modes due to potential transport of material less than 0.2 mm in diameter and associated actions that would be implemented during construction to avoid and minimize impacts from potential failure modes.

Table 1. Potential Failure Modes and Constructed Improvements to Avoid and Minimize Impacts

Potential Failure Mode	Constructed Improvements to Avoid and Minimize Impacts
Undermining at and Erosion Adjacent to Culverts Due to Reservoir Fill and Drawdown	Application of matting or stone riprap treatments at upstream and downstream ends of culverts.
Undermining at and Erosion of Access Roads Due to Reservoir Horizontal Hydraulic Velocity	Access Roads within this zone (and access required for FRE Operations) will be constructed and improved with durable clean stone at gradations designed to withstand predicted hydraulic stresses.
Access Road Overtopping	Application of geofabrics and articulated matting structures overlayed by clean crushed stone size to withstand overtopping stresses.
Pool Fill Vertical Velocity	Application of geofabric overlayed with clean, durable crushed stone on access roads reached with Fine Sands <0.2mm, silt and clay.

Proposed aggregate mitigation improvements will be accomplished using onsite produced stone materials during construction of the proposed FRE structure. Other mitigation methods outlined in Table 1 will need to be imported (i.e., geogrid, fabrics and matting).

Additional potential erosion control actions will be assessed during future design phases including roadway side slopes and associated vegetation, as well as soft subgrades that exist within the current road network. Areas determined to be lacking in vegetation will be improved, while areas of existing roadways with soft subgrades will be reconstructed using geogrids, fabrics, and aggregates employed to increase roadway stability prior to the first inundation event.

Examples of proposed mitigation actions are further outlined in Section 8.0 – Access Road BMPs and Attachment 2.

5.3 Access After Inundation Events

After each inundation event the road network will need to be inspected for damage, and repaired, if found to be damaged by the inundation event, to return the access roads to a usable condition per applicable federal, state, and local standards. Until returned to service, inundated roads will be closed with traffic control devices to prevent vehicles from traveling on them while alerting drivers to detour routes. Inspections will need to be performed as soon as possible when the ground is safe for travel. Inspectors will access the site by foot, All-Terrain Vehicle (ATV), or other vehicle depending on the integrity of the road and document conditions while proposing improvements to return to a usable condition.

Erosion mitigation efforts outlined in Section 5.2 will be implemented during construction to minimize erosion to the access roads and associated stormwater management systems, while limiting the transportation of materials downstream. However, in the event that localized erosion occurs during the life of the project geotextiles, fabrics, and aggregates imported from on-site and off-site locations will be installed and/or bladed onto the roadbed to re-establish the driving surface. Existing structures such as bridges, road approaches, and culverts will be inspected for integrity and cleaned or repaired to restore function, if necessary. Attachment 2 shows examples of proposed BMPs to be implemented in road improvement areas. These BMP’s will be installed to further limit the disturbance to the road network after a flood event.

5.4 Debris Management after a Flood Event

The Vegetation Management Plan identifies a location for debris (logs and large wood materials) that might remain after a large flood event. This debris management area will be used to collect floating debris from the reservoir as it is being dewatered. Figure A-4, Attachment 1, shows the proposed location of the debris management staging yard and the access roads around it. The location of the proposed debris management staging yard will be inundated during the flood event but with the lowering of the reservoir will become exposed for debris management operations. The road leading to this location will also be initially inundated during the flood event and inspected and repaired as necessary before use.

Immediately upstream of the outlet work’s trash rack structure, accumulated material will be removed from one of two locations, an upper and lower zone. Removed material will be

hauled to the designated debris staging yard, then hauled off site utilizing existing and proposed access roads.

6.0 Access for Commercial Forest Practices

Currently, the area around the FRE facility is mostly used for commercial forestry. The main haul route for the logging operations from the town of Pe Ell is Forest Service Road (FR) 1000 (Figure A-3) of which parts will be blocked by the FRE facility. This route will be affected by the FRE facility during construction and after construction when the FRE facility is in operation. A permanent reroute is required for FR 1000 near the right abutment of the revised FRE facility. Figure A-1 and A-7 show a potential reroute option along FR 1000.

The District's proposal is to maintain existing roads within the inundation area for forestry use. Exact hauling routes that need to be relocated will have to be evaluated, determined and coordinated with the commercial logging operational requirements of these roads.

7.0 Access Roads to Recreation Sites

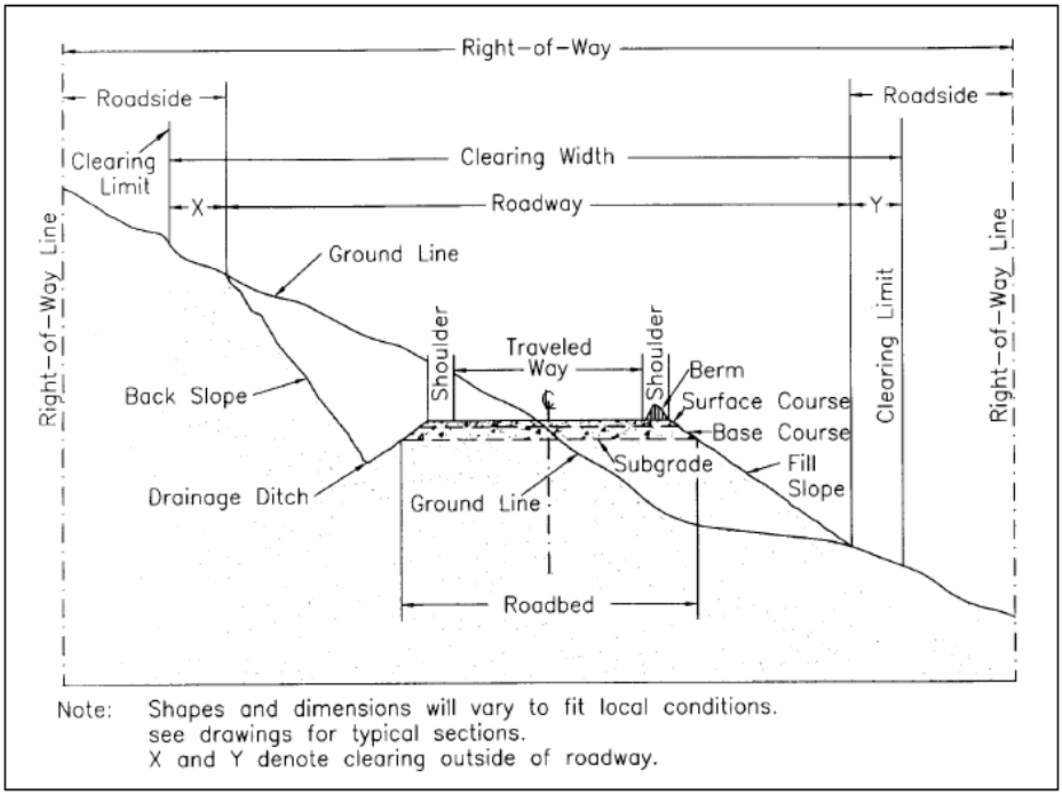
The District is committed to pursuing the development of public recreational access and sites that would support recreational uses largely consistent with those currently provided in the project area. These uses included day uses such as fishing, hiking, biking, whitewater boating, and horseback riding. The District is interested in also potentially providing developed recreation such as picnicking, scenic overlooks, interpretive and educational, trail, and developed camping opportunities, where appropriate, which do not currently exist in the project area. Access roads within the temporary inundation area would remain open for public access to any of the recreation improvements discussed in the FRE Facility – Conceptual Level Recreation Improvement Options Memo. Further, following flood events when the temporary inundation area is utilized, the access roads that were inundated will be inspected and required maintenance preformed before public use of the roads is permitted. The inundated roads will remain open to public access as long as they are safe and have not been damaged by operation of the FRE facility during a flood event. See Technical Memorandum located in Appendix P "FRE Facility-Conceptual Level Recreational Improvement Options," dated December 17, 2021 for more detailed information.

8.0 Access Road BMPs

To the extent possible, the District will minimize disturbance of surfaces by using existing roads to provide access to and around the construction site during operation of the FRE facility. However, some permanent road improvements will be necessary to provide sufficient load-bearing capacity for construction equipment. Improvements likely would include

amendment with quarry spoils and subsequent long-term maintenance activities. Designed improvements would require implementation of applicable BMPs to minimize erosion and sediment inputs to the river and its tributaries. Road improvements will be subject to the appropriate regulatory requirements of the owners of the roads. A typical forest service road cross section is provided on Figure 1. The roadway dimensions are expected to vary depending on location and will be determined during the subsequent design and permitting phase for the project. At this time, HDR assumes all existing, new and temporary construction road widths are equal to 30 feet.

Figure 1. General Cross Section of a Typical Forest Service Road (Forest Service 1985)



8.1 General Construction Best BMPs

The District will adhere to Construction BMPs for the improvement of existing roads, construction of new roads, and ongoing maintenance of all roads. At a minimum, BMPs and other resource protection actions will include the following list as well as those identified in Attachment 2:

- All new and improved roads would be constructed to conform to regulatory guidelines that apply to each set of roads at the time of permitting. In most cases federal, state, and local regulations shall be implemented. Standards such as the following will be further researched for approved BMP methods and installation:
    - Washington State Forest Practice Rules (Title 222 Washington Administrative Code) standards, may apply to road construction.
    - Federal DOT Gravel Road Maintenance and Design Manual.
    - Forest Service Specifications for Construction of Roads and Bridges.

  - US Forest Service Environmentally Sensitive Road Maintenance and Practices for Dirt and Gravel Roads.
  - Washington DNR Forest Road Guidelines.
  - Washington DNR Forest Road Practices.
  - As applicable, these standards would be considered during future design of permanent and temporary access roads or existing road improvements.

- Installation of high-visibility fence to define construction limits.
- Maintenance of access to private properties to the extent possible by installing signs, marking detour routes, flagging, and providing information to property owners, including notification in advance of construction activities.
- Development of traffic control plans.
- Stabilization of construction entrances.
- Implementation of a spill prevention control and countermeasures plan for temporary fuel tanks, construction equipment, and on-site diesel generator, including identified refueling locations, spill control measures, and necessary containment equipment and materials.
- Compliance with dust control policies and plans, including the use of water trucks.
- Implementation of adaptive management for stormwater control during construction.
- Measurement of identified pollutants such as turbidity and pH during construction at identified permit-required compliance points.

8.2 Erosion Control BMPs during Construction

During construction, the District will require its contractors to comply with the National Pollutant Discharge Elimination System (NPDES) permit, Washington Administrative Code 173-201A: Water Quality Standards for Surface Waters of the State of Washington, and other federal, state, and local codes and regulations as incorporated into an NPDES permit issued for the project. BMPs would be implemented in accordance with WDOE's Stormwater Management Manual for Western Washington, current Washington State Department of Transportation's Standard Specifications for Road, Bridge, and Municipal Construction and Standard Plans, and Lewis County Standards.

As part of the construction contract, the District would require the contractor to prepare and implement a temporary erosion and sediment control plan for all aspects of construction, including clearing and grading within the FRE facility construction footprint, temporary access road, and improvements to existing access roads (e.g., to selected quarry site). Implementation of the plan would minimize stormwater impacts, such as high storm flow runoff, soil erosion, waterborne sediment from exposed soils, and degradation of water quality from on-site pollutant sources. All sub-contractors will be required to comply with the temporary erosion and sediment control plan.

At a minimum, and for consideration as part of the Proposed Project, the following BMPs would be implemented to minimize the potential for erosion and sediment production:

- Using straw bales, silt fencing, vegetation strips, brush barriers or other suitable sedimentation control or containment devices.
- Washing truck tires to reduce tracking of sediments and aquatic invasive species from construction sites.

- Covering exposed soil stockpiles and exposed slopes using mulch, nets and blankets, plastic coverings, temporary seeding and sodding, and compost blankets.
- Using straw mulch (certified free of noxious weeds and their seeds) and erosion control matting to stabilize graded areas where appropriate.
- Retaining vegetation where possible to minimize soil erosion.
- Seeding or planting appropriate vegetation on exposed areas as soon as possible after work is completed.
- Constructing temporary sedimentation ponds to detain runoff water where appropriate.
- Using Baker tanks, sediment traps, flow control structures, oil/water separators, ditches, and level spreaders to control erosion.
- Using berms, ditching, and other on-site measures to prevent soil loss.
- Monitoring downstream turbidity during construction to document the effectiveness of implemented measures.
- Visually monitoring for signs of erosion and implementation of additional erosion control measures, as required.
- Relative to excavated slopes that may be prone to instability during construction:
    - Excavation would begin from the upper portion of the slope first to avoid stability issues.
    - Steep rock slopes would include pattern rock bolts for stability.
        - Over-steepened slopes included as part of the permanent design would be stabilized to meet slop design criteria. Options include:
        - Introduction of horizontal drainage into vulnerable slopes to improve stability.
        - Berms or ecology block walls placed at the toes of steep slopes.
        - Introduction of tieback walls to retain slopes.
- The District will require its contractor and sub-contractors to comply with all permit requirements and monitor erosion during construction.

9.0 Quantity Estimates for Access Road Usage and Improvements

9.1 Construction Vehicle Trips Estimate Using the Access Roads

During construction of the FRE facility, the access roads will be used by construction vehicles transiting between the FRE facility and quarries. To determine the final selection of the quarry sites and other construction materials, additional geotechnical explorations and material testing, as well as structural analysis will have to be completed during the subsequent phases of work. At this stage in the design, the exact number of vehicle trips needed to construct the FRE facility cannot be fully determined, however, an estimate is provided based on similar sized projects.

For constructing road improvements, it is assumed that tandem dump trucks will be utilized for all material hauling throughout construction of the FRE facility. HDR also assumes that all permanent and temporary roadways will have acceptable grades for this type of traffic. Any existing roads that are currently around the project area that do not meet acceptable criteria for tandem dump truck use, will be reconstructed. The assumed standard capacity of a

tandem dump truck is 16 cubic yards (CY). Based on this capacity and the preliminary quantity estimates in Table 2, there will be roughly 5,200 tandem loads of surface course and 9,000 tandem loads of base course hauled from on-site aggregate sources to the constructed roadways. Furthermore, there will be roughly 80,000 tandem loads of cut and fill material handled throughout the roadway construction and improvement process.

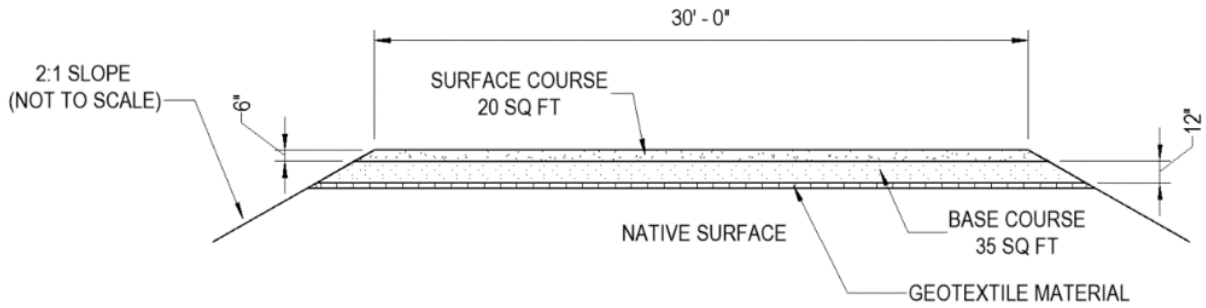
Table 2. Aggregate and Cut/Fill Quantity Estimates

Type	Distance (miles)	Cut (cubic feet)	Fill (cubic feet)	Base Course (cubic feet)	Surface Course (cubic feet)
Permanent Potentially Inundated	15	19,100	14,800	3,900	2,200
Permanent NOT Inundated	4	5,200	4,100	1,100	600
New Temporary	2	2,600	2,000	500	300
Abandoned	1	NA	NA	NA	NA

9.2 Quantity Estimates

The ROM estimates provided herein reflect the current conceptual level of design for the FRE facility and assumptions regarding the requirements for access road design. Conservative assumptions were used to develop the conceptual quantities. This ROM estimate, based on cross-sections of Figure 2, assumes existing roadways will be removed and reconstructed. Quantities were developed by multiplying the road lengths by the area of the typical roadway cross-section shown in Figure 2.

Figure 2. Preliminary Roadway Cross-Section



10.0 References

HDR Engineering, Inc.

2017 Combined Dam and Fish Passage Conceptual Design Report. June 2017.

2018 Combined Dam and Fish Passage Supplemental Design Report FRE Dam Alternative Report. September 2018.

2021. Access Road Update and Best Management Practices Technical Memorandum (Draft). December 17, 2021.

U.S. Department of Agriculture, Forest Service, National Technology & Development Program

2012 Environmentally Sensitive Road Maintenance Practices for Dirt and Gravel Roads. April 2012.

U.S. Department of Agriculture, Forest Service, Engineering Staff

1985 Forest Service Specifications for Construction of Roads & Bridges. April 1985.

Washington State Legislature

2023 Title 222 Washington Administrative Code, Forest Practices Board. Updated August 21, 2023.

Attachment 1. Figures

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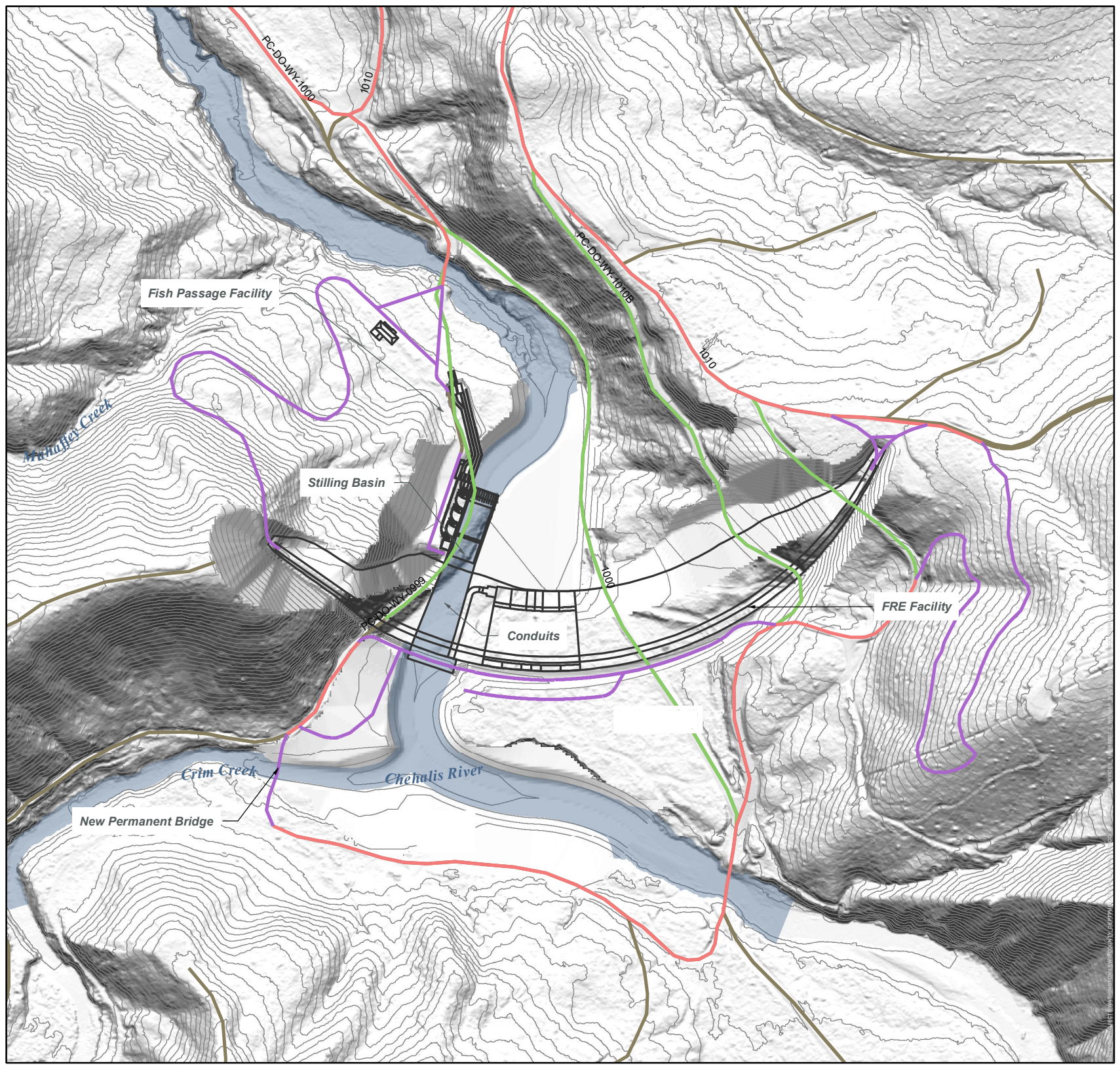
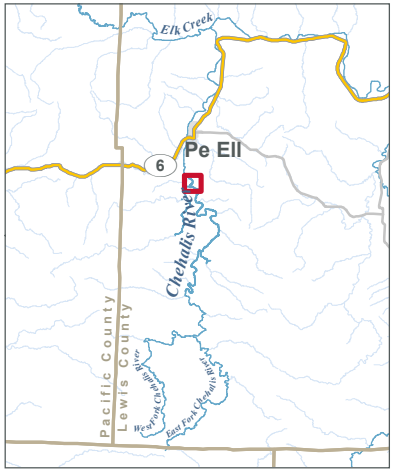


FIGURE A-1
FRE FACILITY
PERMANENT ROADS

- FRE FACILITY
- EXISTING ROAD
- EXISTING ROADS THAT WILL BE ABANDONED/RESTORED
- EXISTING ROADS THAT WILL BE USED PERMANENTLY FOR ACCESS
- NEW PERMANENT ROAD
- PROPOSED STREAM



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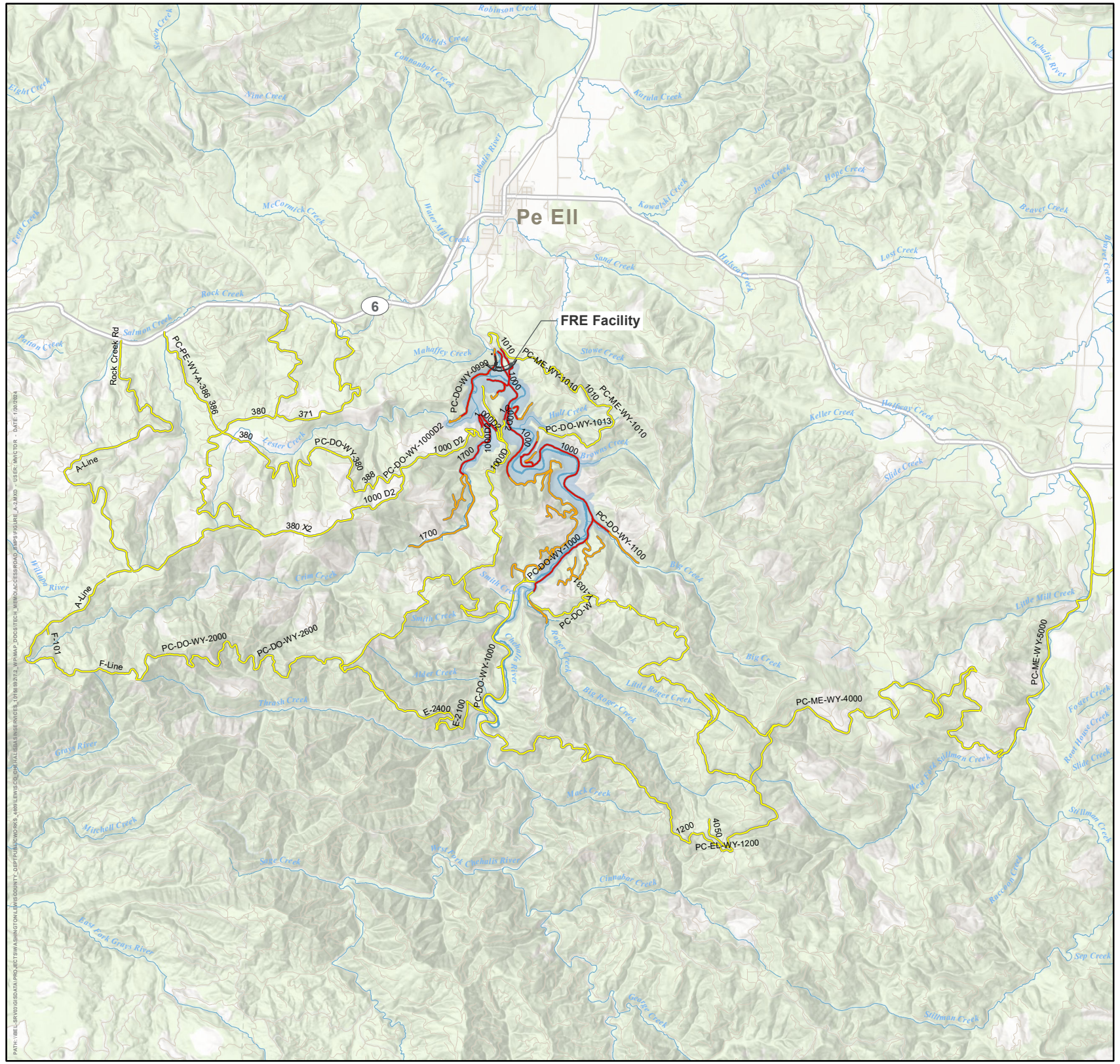
0 300 600

Feet

FIGURE A-2
FRE FACILITY SITE VICINITY EXISTING ACCESS ROADS



- Main Channel OHWM
- Secondary Highway
- Rural / Forest Service Road
- Alternative Access
- Orphaned Access
- Potentially Inundated
- 100 Year Event Inundation Area (604 ft El)

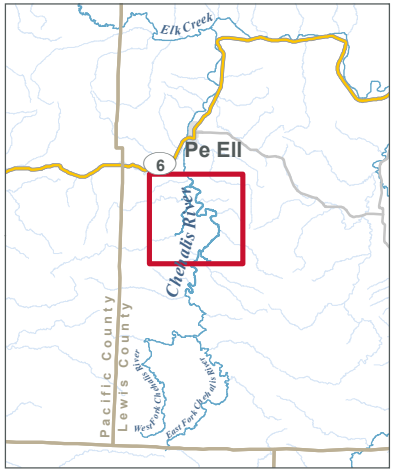
N

0 1 2

Miles

FIGURE A-3
FRE FACILITY AND INUNDATION AREA ACCESS ROADS

- Existing Access Road
- Temporary Construction Access
- Orphaned Access
- Potentially Inundated
- Alternative Access
- Rural / Forest Service Road
- Main Channel OHWM
- 100 Year Event Inundation Area (604 ft El)



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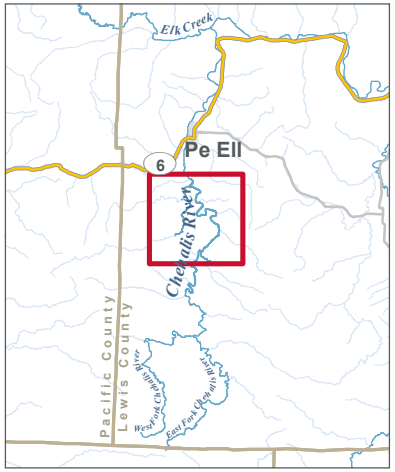
0 1,600 3,200

Feet

FIGURE A-4
FRE FACILITY AND INUNDATION AREA ACCESS ROADS AND WATER CROSSINGS

- Existing Water Crossing
- FRE Facility
- Existing Access
- Temporary Construction Access
- Orphaned
- Potentially Inundated
- Alternative
- Rural / Forest Service
- Main Channel OHWM
- 100 Year Event Inundation Area (604 ft El.)



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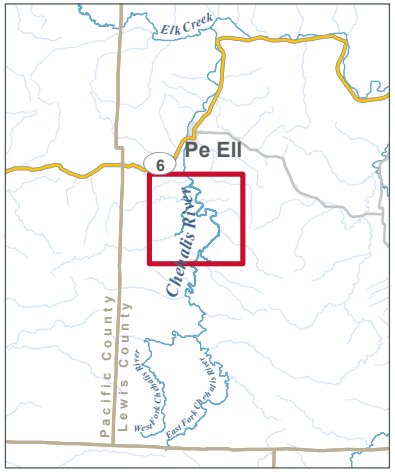
0 1,600 3,200

Feet

FIGURE A-5 LOCATION OF DEBRIS MANAGEMENT YARD AND ACCESS ROADS

- FRE Facility
- Existing Access
- Temporary Construction Access
- Orphaned
- Potentially Inundated
- Alternative
- Rural / Forest Service
- Main Channel OHWM
- 100 Year Event Inundation Area (604 ft El.)
- Debris Management Yard



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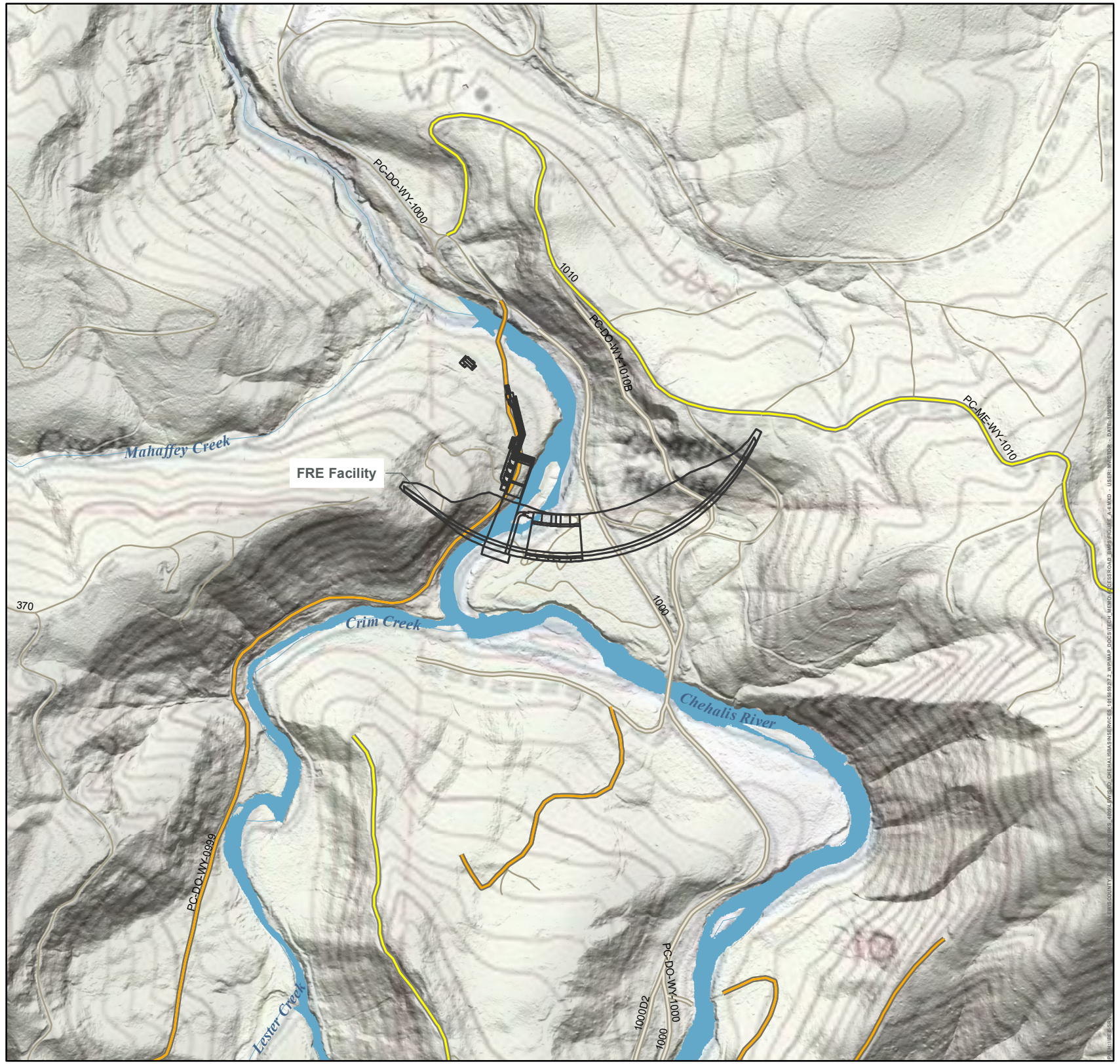
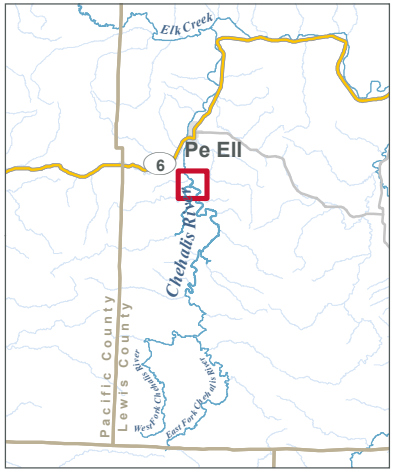


FIGURE A-6
FRE FACILITY AND EXISTING ACCESS ROADS

- FRE Facility
- Orphaned Access
- Existing Access
- Alternative Access
- Rural / Forest Service
- Main Channel OHWM



N

0 500 1,000
Feet

Attachment 2. Proposed Erosion Mitigation Actions

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Figure B1: Geocell Gravel Surfacing Stabilization (Industrial Fabrics Inc. 2021)

Figure B2: Geogrid Base for Roadway Stability in Soft Soils (The Constructor 2021)

Figure B3: Nonwoven Geofabrics to Stabilize Fine Materials Beneath Crushed Aggregate (Forest Service 2012)

Figure B4: Seeding/Hydroseeding (Phys.org 2023)

Figure B5: Stone Culvert Inlet/Outlet Protection (SC DHEC 2005)

Figure B6: Articulating Block Matting for Overtopping or Culvert End Protection (Outdoor Design Source)

Figure B7: Underdrains to Prevent Seepage Under Road Ditch (Forest Service 2012)

Figure B8: French Drains (Forest Service 2012)

Figure B9: French Mattress (Forest Service 2012)

Figure B10: Permeable Fill with Culverts (Forest Service 2012)

Figure B11: Grade Break Prevents Water from Flowing Down the Road (Forest Service 2012)

Figure B12: Low Water Ford Crossing (Forest Service 2012)

Attachment 3. Existing Conditions – Access Roads

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Figure 1: Typical Bridge Construction

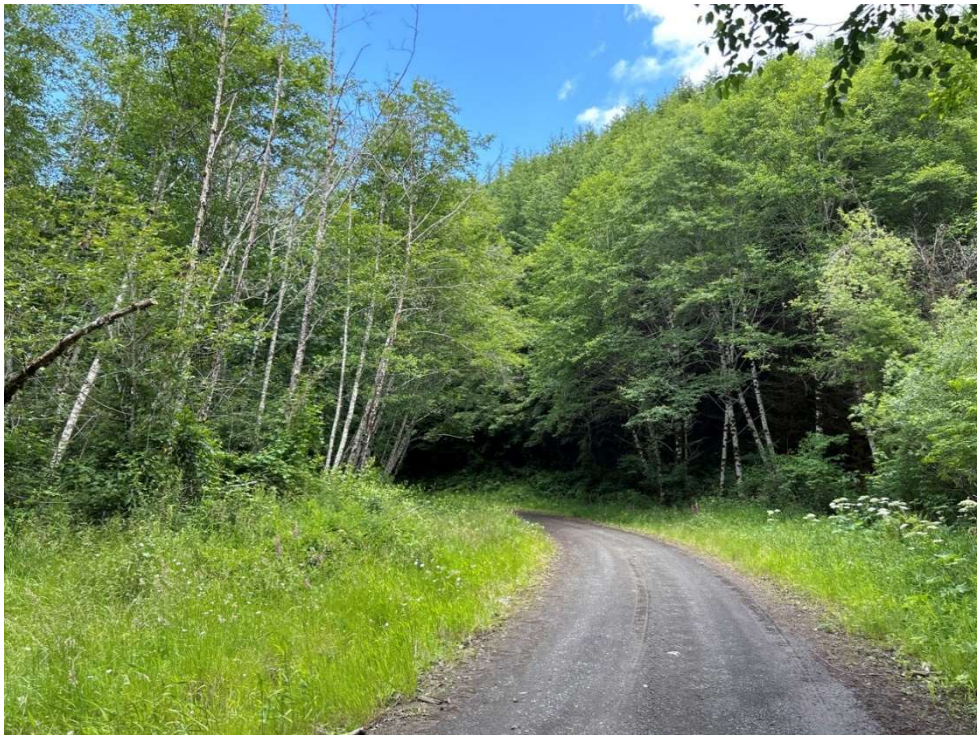

Figure 2: Typical Access Road – Low Volume Road

Figure 3: Typical Access Road – Low Volume Road

Figure 4: Typical Access Road – Medium Volume Road

Figure 5: Typical Access Road – High Volume Road

Figure 6: Typical Access Road – High Volume Road

Figure 7: Typical Access Road – Low Volume Road

Figure 8: Typical Access Road – Landslide Area

Figure 9: Typical Access Road – High Volume Road

Figure 10: Typical Access Road – No Use Road