June 17, 2020

Knight Piésold
KRRP Project Office
4650 Business Center Drive
Fairfield, California
USA, 94534
www.knightpiesold.com

Mr. Nick Drury
Kiewit Infrastructure West Co.
4650 Business Center Drive
Fairfield, California
USA, 94534

Dear Nick,

RE: KRRP Value Engineering Summary and Advancement to 90% Design

1.0 INTRODUCTION

In April 2019, the Klamath River Renewal Corporation (KRRC) engaged Kiewit Infrastructure West Co. (Kiewit) as the Design Build Contractor for the Klamath River Renewal Project (KRRP). Knight Piésold (KP) is engaged by sub-contract as Kiewit's Design Lead. Restoration and permitting for the project are being led by Resource Environmental Solutions (RES) and Camas, respectively. KP coordinates with them, and provides engineering support when requested, as required to advance the project. McMillen Jacobs (MJ) is the Owner's Engineer and manages the KRRP Team on behalf of KRRC.

Options for reducing KRRP implementation costs were discussed at the Partnering Meeting held on January 16, 2020. Subsequently, the KRRP Team collaborated to produce of a list of potential cost reduction options, and some options were authorized for Value Engineering (VE) analysis as part of the KRRC option decision process.

KP was tasked with leading seven VE analyses, which are listed below and described in the following sections of this letter:

- VE-1: Extended Drawdown
- VE-2: River Channel Design – J.C. Boyle and Iron Gate
- VE-3: River Channel Design – Copco No. 1 and Copco No. 2
- VE-4: Use of Onsite Materials
- VE-5: Fall, Camp, and Scotch Creek Crossing Concepts
- VE-6: Alternate Access in Lieu of Lakeview/Daggett Bridges (Klamath River)
- VE-7: Early Start Options

KP prepared and submitted a VE work plan for each of the VE analyses listed above, outlining the agreed upon scope and task approach. Progress on the VE analyses was tracked in weekly Task Force Meetings (TFMs) held between March through May of 2020. The TFMs were attended by key KRRP Team representatives, with minutes recorded and submitted by KP. The VE analysis results were presented in VE Summary presentations and various supporting documents, prepared, and submitted by KP. These VE analysis products were discussed with and reviewed by KRRP Team representatives during preparation and their comments were incorporated.

KP reference information for the VE work plans and TFM minutes is presented in Table 1.1. The VE summary presentations and key supporting documents are appended to this letter and are cited in the following sections. Acceptance of the VE options by KRRC has been communicated to KP via Kiewit. KP's

Knight Piésold CONSULTING

understanding of the VE options acceptance and basis for advancement to 90% Design is summarized in Section 9 of this letter. KP intends to proceed into the 90% Design phase on the basis described in Section 9 unless otherwise informed by formal correspondence.

Table 1.1 VE Work Plans and TFM Minutes (KP Reference Numbers)

VE Analysis	VE Work Plan	TFM Minutes (March through May 2020)								
		Mar 17	Mar 24	Mar 31	Apr 7	Apr 14	Apr 21	Apr 28	May 5	May 12
VE-1	VA20-00529	VA20-00586	VA20-00614	VA20-00694	VA20-00788	VA20-00786	VA20-00846	VA20-00936	VA20-01039	VA20-01040
VE-2	VA20-00658	-	-	-	VA20-00712	VA20-00728	VA20-00791	VA20-00861	VA20-00947	VA20-01010
VE-3	VA20-00673	-	-	-	VA20-00707	-	VA20-00792	VA20-00865	VA20-00950	VA20-01012
VE-4	VA20-00665	-	-	-	VA20-00713	VA20-00730	VA20-00797	VA20-00866	VA20-00951	VA20-01013
VE-5	VA20-00692	-	-	-	VA20-00848	VA20-00850	VA20-00851	VA20-00927	VA20-00997, 00998	VA20-01019, 01020
VE-6	VA20-00691	-	-	-	VA20-00847	VA20-00876	VA20-00853	VA20-00929	-	-
VE-7	VA20-00831	-	-	-	-	-	-	-	VA20-00940[1]	VA20-01063[1]

NOTES:

1. PRESENTATION TRANSMITTALS.

2.0 VE-1: EXTENDED DRAWDOWN

2.1 OBJECTIVES AND APPROACH

KP has conducted an analysis of an extended drawdown period. The extended drawdown period is defined as January 1 to June 15, compared to the drawdown period defined in the 60% Design of January 1 to March 15. The primary purpose of selecting an extended drawdown period is to reduce the rate of flow through the Iron Gate diversion tunnel and its associated risks, and the extent of required modifications to the facilities and outlets to facilitate reservoir drawdown. This is achieved by modifying the drawdown procedures and extending the duration of the drawdown period, thereby allowing for lower discharges and velocities through the outlet structures. KP has submitted the hydrologic results of this VE analysis to Kiewit and the Technical Working Group. The sedimentation modeling and interpretation is being done by others.

The following modifications were evaluated as part of the VE-1 Extended Drawdown analysis:

- J.C. Boyle:
  - Delayed opening of Diversion Culvert No.2 to reduce the flow passing to the downstream facilities as much as practicable.
- Copco No. 1:
  - A single new low-level outlet for reservoir drawdown, to be utilized until flow through the historical diversion tunnel can be safely reestablished.
- Iron Gate:
  - Evaluate historical diversion tunnel flows and obtain further operations information and documentation of historical flow criteria and limitations.
  - Use the existing gate located in the diversion tunnel to safely control reservoir drawdown. The upper portion of the existing gate has a lower hydraulic capacity than the proposed 60% Design

Knight Piésold CONSULTING

resulting in reduced flows and velocities through the tunnel. This reduces the tunnel modifications required to operate the diversion tunnel.

2.2 RESULTS – COPCO NO. 1 LOW-LEVEL OUTLET

Two outlet alternatives were investigated for drawdown discharges at the Copco No. 1 facility. These alternatives are summarized as follows:

- Outlet Alternative #1: single low-level outlet
  - The arrangement for Alternative #1 consists of a 10 ft diameter orifice inlet leading to a 15 ft high D-shape tunnel excavated within the dam centre section. Progress prints of Drawings C2200 and C2205 were created to show this alternative (see Appendix A1).
  - Evaluation of the hydraulic characteristics and air demand during the drawdown discharges were completed and are summarized in KP Letter VA20-00805 (not appended herein).
  - Inlet diameter of 10 ft is preferred to limit reservoir drawdown rate during the normal operation condition.
  - An independent review of the air demand requirements was completed by Dr. Falvey. No special air demand requirements were identified on the proposed low-level outlet arrangements.
  - This alternative does not allow access to the downstream end of the spillway and diversion tunnel outlet portal during drawdown of the reservoir and river diversion.
- Outlet Alternative #2: single low-level outlet with steel outlet conduit
  - The arrangement for Alternative #2 consists of a 10 ft diameter orifice inlet leading to a 10.5 ft high D-shape tunnel excavated within the dam centre section and extending to the spillway plunge pool through a 10.5 ft steel outlet conduit. This alternative is shown on Figure 1 in Appendix A1.
  - Preliminary hydraulic evaluations indicate that this arrangement will have similar discharge characteristics as Alternative #1 and the arrangement shown at 60% Design. Hydraulic characteristics will be evaluated in detail with hydraulic calculations and CFD simulations during the 90% Design.
  - This alternative may allow access to the diversion tunnel during drawdown.

Alternative #2 was selected as the preferred alternative to be advanced in the 90% Design phase.

The contractor would have the option to use either Alternative #1 or Alternative #2, with Alternative #2 shown on the 90% Design. For both Alternative #1 and #2, the historic diversion tunnel is required to be reopened as early as possible following the snowmelt freshet (i.e., opening around late May to mid-June) to complete the reservoir drawdown and divert the river flows through the diversion tunnel.

2.3 RESULTS – IRON GATE TUNNEL MODIFICATIONS

Tunnel modifications, including lining and venting options, were investigated for the Iron Gate diversion tunnel. A hydraulic analysis was completed to support the use of the existing gate for the drawdown and diversion of the Iron Gate reservoir. The analysis completed for Iron Gate is summarized as follows:

- Two stages of discharge control were investigated:
  - Discharge through the existing upper sluice gate, originally constructed in 1961.
  - Discharge through the existing 9 ft diameter orifice, constructed during tunnel rehabilitation works in 2008.
- A CFD model was developed for the hydraulic analysis and evaluation of additional venting capacity requirements with respect to the maximum reservoir conditions for three configurations:

Knight Piésold CONSULTING

  - 27-inch partial opening of the existing upper gate at a reservoir water surface elevation of 2,331.3 ft.
  - 57-inch full opening of the existing upper gate at a reservoir water surface elevation of 2,331.3 ft.
  - Existing gate fully removed and 9-foot orifice control at a reservoir water surface elevation of 2,273.0 ft.
- The CFD models were used to validate discharge rating curves for each of the configurations.
- The CFD models were used to determine that the existing 8-inch vents are ineffective and new air venting is required to regulate the airspace in the tunnel upstream of the orifice (to vent the roller between the gate and orifice) and downstream of the orifice (to vent the closed conduit hydraulic jump as well as open channel flows in the tunnel).
- Two venting alternatives were investigated:
  - Vertical vents drilled through the embankment.
  - Suspending ventilation from the tunnel crown (preferred alternative).
- An independent review was completed by Dr. Falvey. Verbal communication with Dr. Falvey indicated that his review did not identify any major issues with the proposed design. His written review memorandum regarding the preferred venting alternative is pending and is expected by the end of June.
- The CFD models were used to determine the requirements and placement of the tunnel lining and reinforcement.
- The tunnel modifications and vent pipe details for the preferred alternative are provided on Progress Prints C4180, C4181, C4182 and C4186 (see Appendix A2).
- Final arrangements and engineering design will be further developed and advanced during the 90% Design.

2.4 RESULTS – DRAWDOWN MODEL (HEC-RAS) AND ASSESSMENT

A hydrodynamic model using HEC-RAS was developed to assess the extended drawdown period for the J.C. Boyle, Copco No.1 and Iron Gate facilities. The primary purposes of the extended drawdown model are to:

- Inform the proposed drawdown operations and identify if drawdown can be achieved for each facility within the extended drawdown period of January 1 to June 15 under various flow conditions.
- Calculate the range of potential drawdown rates (i.e., the rate at which the water surface elevation within the reservoir is lowered), under various flow conditions.
- Estimate the range of reservoir water surface during the post-drawdown period (June 15 to October 1) under various flow conditions.

The base HEC-RAS model used for this assessment was developed for the 60% Design Report (KP and RES, 2020), Appendix G (NHC, 2020). Details on the development of the HEC-RAS model, including calibration and digital model modifications, are provided in NHC (2020). The inflows to the model are the 2019 BiOp flows, which are daily average flows available for a 36-year period (October 1980 to November 2016).

The results of the drawdown model assessment were provided during the weekly Task Force Meetings. The PowerPoint slide decks from these meetings are provided in Appendix A3.

Drawdown of Iron Gate reservoir was modelled based on the following assumptions and parameters:

- Starting condition: reservoir level at or just below the spillway crest on January 1.

- The powerhouse remains operational as drawdown is initiated to permit water passage through the powerhouse unit or the Howell-Bunger turbine bypass valve until the reservoir level is below the power intake level.
- Outflows pass through spillway, diversion tunnel gate, and turbine bypass valve.
- Combined outflows were limited to avoid exceeding the maximum reservoir drawdown rate target of 5 ft/day.

The results of 36 model years are as follows:

- In most model years, initial reservoir drawdown was achieved before June 15.
- The reservoir refilled after initial drawdown in most years, followed by subsequent drawdown(s).
- By June 15, the reservoir level had been drawn down to the target level at least once (i.e. initial drawdown) in 82% of the model years, but only in 62% of the years did the reservoir level stay at or below the target level from June 15 onward.
- The date on which the target reservoir level was reached and not exceeded again in 100% of the model years was July 16.

The HEC-RAS model will continue to be refined and advanced as part of the 90% Design, including:

- Refinements to the operating rules at J.C. Boyle.
- Revised low-level outlet geometry and operating rules for opening the historic diversion tunnel at Copco No. 1, which may change the inflows to the Iron Gate reservoir.
- Refinements to the Iron Gate diversion tunnel (e.g. tunnel lining and intake trash rack), which may change the outflow rating curve for the Iron Gate reservoir.

2.5 RESULTS – IRON GATE RESERVOIR LEVELS AND DAM REMOVAL STAGING

An updated table of reservoir levels was created for normal and flood flow conditions for the Iron Gate reservoir based on the following:

- Revised tunnel modifications (described above).
- Discretization of flood flows and levels in the first and second halves of the months of July, October, and November (as was done previously for the month of June).

The results are presented in Appendix A4. These reservoir water levels are substantially different from the corresponding values in the 60% Design because of the revised gate regulation and approach for Iron Gate diversion tunnel modification. As expected, additional minor revisions may result from refinements to the Iron Gate diversion tunnel during 90% Design.

2.6 RESULTS – IRON GATE DAM REMOVAL STAGING

KP developed a series of cross-section sketches illustrating the stages of removal for the Iron Gate dam embankment, with reference to temporally applicable flood levels and dam material zones (see Appendix A5). The final sketch in the sequence illustrates a scenario for the final controlled breach of the dam. These were prepared to be reviewed, added to, and adjusted by the Contractor as they continue project planning.

This work was included as part of the VE-1 analysis because of the changes in Iron Gate reservoir water surface levels associated with the revised approach for diversion tunnel modification and gate control. The reservoir staging sketches will be updated during 90% Design to reflect anticipated flood water surface levels and expected normal river flows and associated water surface levels.

3.0 VE-2 RIVER CHANNEL DESIGN – JC BOYLE AND IRON GATE

3.1 OBJECTIVES AND APPROACH

The final 60% Designs of the J.C. Boyle and Iron Gate river channels through the removed dam sites represent an opportunity for value engineering (VE) due to the large quantities of excavation and backfill of riverbed and/or erosion protection material (E7) required.

KP's VE scope for the J.C. Boyle and Iron Gate volitional channels included the following:

- Development of post-removal peak flow rates for the J.C. Boyle and Iron Gate reaches.
- Determination of the applicability of the natural river channel materials for erosion protection and fringe roughness.
- Development of Civil3D model options that reduce overall excavation quantities.
- Completion of 2D velocity HEC-RAS models to confirm fish passage and optimize erosion protection designs.
- Preparation of progress prints and summary PowerPoint presentation to illustrate departures from the 60% Design.

The proposed design changes to the channels were completed through an iterative approach with input and review from Kiewit and RES.

3.2 RESULTS – J.C. BOYLE CHANNEL DESIGN

A revised preliminary design was developed for the river channel through the J.C. Boyle dam site. The revised design was accepted for advancement to 90% Design.

The key changes proposed for the J.C. Boyle river channel because of VE-2 are summarized in Table 3.1. An overview of the J.C. Boyle and Iron Gate channel designs is provided in Appendix B1. Progress prints for the J.C. Boyle river channel are presented in Appendix B2.

Table 3.1 Summary of J.C. Boyle VE-2 Results

Item	60% Design	VE Results
Alignment	-	Shifted towards right bank to utilize natural channel rock outcrops and minimize required erosion protection volume.
Excavation Volume	91,000 yd^3	110,000 yd^3
Type E7 Volume	10,800 yd^3	1,250 yd^3
Type E6 Volume	2,800 yd^3	200 yd^3
Volitional Channel Slope	2%	1%
2-yr flow WSE above channel bottom	5.0 ft	8.3 ft
5-yr flow WSE above channel bottom	6.5 ft	9.3 ft
100-yr flow WSE above channel bottom	10.0 ft	12.2 ft
Type E7 min. D_{50}	2.5 ft	Lower half = 1.0 ft
		Upper half = 0.5 ft

3.3 RESULTS – IRON GATE CHANNEL DESIGN

A revised preliminary design was developed for the river channel through the Iron Gate dam site. The revised design was accepted for advancement to 90% Design.

The key changes proposed for the Iron Gate river channel because of VE-2 are summarized in Table 3.2. An overview of the J.C. Boyle and Iron Gate channel designs is provided in Appendix B1. Progress prints for the Iron Gate river channel are presented in Appendix B3.

Table 3.2 Summary of Iron Gate VE-2 Results

Item	60% Design	VE Results
Alignment	-	Shifted towards right bank to utilize natural channel rock outcrops and minimize required erosion protection volume.
Side Slope (Embankment Cut)	1.5H:1V	2H:1V
Excavation Volume	914,000 yd^3	935,000 yd^3
Type E7 Volume	6,500 yd^3	4,900 yd^3
Type E6 Volume	1,700 yd^3	1,500 yd^3
Volitional Channel Slope	1%	0.7%
2-yr flow WSE above channel bottom	9 ft	10 ft
5-yr flow WSE above channel bottom	13 ft	12 ft
100-yr flow WSE above channel bottom	20 ft	17 ft
Type E7 min. D_{50}	2.0 ft	Lower half = 2.0 ft
		Upper half = 1.0 ft

4.0 VE-3: RIVER CHANNEL DESIGN – COPCO NO. 1 AND COPCO NO. 2

4.1 OBJECTIVES AND APPROACH

The final 60% Designs of the Copco No. 1 and Copco No. 2 river channels through the removed dam sites represented an opportunity for value engineering (VE) due to the large quantities of excavation and backfill of riverbed and/or erosion protection material (E7) required.

KP's VE scope for the Copco No. 1 and Copco No. 2 river channels included the following:

- Development of post-removal peak flow rates for the Copco No. 1 and Copco No. 2 reaches.
- Development of alternative channel alignment to reduce overall excavation quantities.
- Evaluation of the hydraulic characteristics of the river channels to optimize erosion protection designs.
- Preparation of progress prints and summary PowerPoint presentation to illustrate departures from the 60% Design phase.

The proposed design changes to the channels were completed through an iterative approach with input and review from Kiewit and RES.

4.2 RESULTS – COPCO NO. 1 CHANNEL DESIGN

A revised preliminary design was developed for the river channel through the Copco No.1 dam site. The revised design was accepted for advancement to 90% Design.

The key changes proposed for the Copco No. 1 river channel because of VE-3 are summarized in Table 4.1. Progress prints for the Copco No.1 river channel are presented in Appendix C1.

Table 4.1 Summary of Copco No. 1 VE-3 Results

Item	60% Design	VE Results
Alignment	-	Channel width optimized to reduce rock excavation upstream of the dam location. Channel bed optimized to use granular material excavated upstream of the dam.
Excavation Volume	47,400 yd^3	22,050 yd^3
Type E7 Volume	2,150 yd^3	1,190 yd^3
Type E8 Volume	300 yd^3	Eliminated
Volitional Channel Slope	2%	2%
2-yr flow WSE above channel bottom	5.0 ft	6.0 ft
5-yr flow WSE above channel bottom	6.0 ft	7.5 ft
100-yr flow WSE above channel bottom	11.5 ft	12 ft
Type E7, D_{50} diameter	3.5 ft	5 ft

4.3 RESULTS – COPCO NO. 2 CHANNEL DESIGN

A revised preliminary design was developed for the river channel through the Copco No. 2 dam site. The revised design was accepted for advancement to 90% Design. Additional optimizations to channel design are ongoing and are expected to slightly reduce the fill volumes further.

The key changes proposed for the Copco No. 2 river channel because of VE-3 are summarized in Table 4.2. Progress prints for the Copco No.2 river channel are presented in Appendix C2.

Table 4.2 Summary of Copco No. 2 VE-3 Results

Item	60% Design	VE Results
Alignment	-	Channel alignment adjusted to follow the natural thalweg. Expansive excavation upstream and downstream of dam site removed. Channel fill limited to dam site excavation.
Excavation Volume	19,640	10,850
Type E7 – Riverbed Material Volume	8,600	5,940
Type E7 – Erosion Protection Material Volume	4,000	3,280
Volitional Channel Slope	1.4%	0.8%
100-yr flow WSE above channel bottom	24 ft	17 ft
Type E7, D_{50} diameter	2 ft	1.75 ft, 3.5 ft

Knight Piésold CONSULTING

5.0 VE-4: USE OF ONSITE MATERIALS

5.1 OBJECTIVES AND APPROACH

The Use of Onsite Materials analysis focused on identifying possible onsite borrow sources for erosion protection material, riverbed material, and some granular fill, to replace the importation of these materials from offsite sources as was assumed in Kiewit's 60% Design cost estimate. Various locations at each of the dam sites were known to have deposits of large rocks that were thought to be possible candidates for onsite borrow sources. The adequacy of these sites was assessed by a site reconnaissance and assessment.

KP's VE scope for the use of onsite materials included the following:

- Complete a desktop study using available information to determine possible viable borrow sources.
- Meet with Kiewit to prioritize identified borrow sources for site investigations.
- Complete an onsite assessment of the identified and available riverbed backfill and erosion protection borrow source material.
- Estimate approximate volumes of onsite material available.
- Identify potential onsite borrow sources for current design.

A desktop study was completed to identify possible erosion protection and riverbed material borrow sources. The proposed sites were discussed with Kiewit and the sites were refined; Kiewit also requested that the investigation be expanded to include specific potential granular fill sites.

The site investigation was completed by two KP representatives. Each borrow source alternative was visually assessed for material type and particle size. To supplement the visual and hand field particle size measurements, photogrammetry analysis was used to assist in the classification the material gradation within the potential borrow sources. Samples were also collected for laboratory testing.

5.2 RESULTS – BORROW SOURCE SITE INVESTIGATION REPORT

The results of the material classification and volumes estimates were presented in a draft site investigation report, which is provided in Appendix D1. The site investigation report will be updated once the laboratory analyses are completed. The preliminary material classification and volumes estimates are included below in Table 5.1 (borrow sources summary) and Table 5.2 (an assessment of material requirements by facility).

The preliminary results presented in Table 5.2 indicate that enough material quantity likely exists onsite to meet the design needs for erosion protection, riverbed, and bedding materials. The possible borrow sources of granular fill potential borrow sources investigated during the site program are still being assessed; summary tables will follow during the 90% design.

The scope of this site investigation and surface assessment was to determine if there were surficial borrow sources near the dam sites that could potentially produce the onsite material required for the project, primarily the erosion protection material. The site investigation and surface assessment was intended to quantify the potential borrow areas surface material and this summary only addresses the surface of in situ material. Ground disturbance was limited to collection of free and loose material at the surface by hand. GPS coordinates were taken while sampling. The expected volume estimates provided are based on visual observations, aerial imaging and historic drawings and photographs, and the accuracy of the presented gradations and volumes reflect these limitations. KP suggests that a narrow and focused test pit investigation be conducted within the actual potential borrow sources that Kiewit proposes to use to best

Knight Piésold CONSULTING

understand how the site should be mined to meet borrow objectives and gain a better understanding of the material character below the surface. This would increase confidence for volumes and gradations available at each site. Based on its surface assessment, KP has established material type, approximate gradation, and estimated expected volume. Surface assessments are useful but lack subsurface truthing. Borrow source access, cultural resources and mining slope stability concerns were not considered in this analysis.

Table 5.1 Identified Borrow Sources Summary

Borrow Source	Approximate Gradation	Surface Area (yd^2)[1]	Assumed Depth (yd)	Expected Volume (CY)
Iron Gate Dam Downstream Face Sub-area 1	D_{50} = 28" D_{85} = 40"	2,980	1.67	4,400 – 4,800
Iron Gate Dam Downstream Face Sub-area 2	D_{50} = 20"	1,950	1.67	2,900 – 3,200
Iron Gate Dam Downstream Face Sub-area 3	D_{15} = 3" D_{50} = 9" D_{85} = 12"	5,900	1.67	9,000 – 9,800
Iron Gate Lakeview Road	D_{15} = 1" D_{50} = 6" D_{85} = 14"	825	2 – 4	1,600 – 3,200
Copco No. 1 Access Road Sub-area 1	D_{15} = 3" D_{50} = 15" D_{85} = 28"	365	0.5 – 2	200 – 700
Copco No. 2 Downstream Right Bank	D_{15} = 36" D_{50} = 48" D_{85} = 72"	3,000	2 – 5	9,000 – 18,000[2]
Copco No. 2 Downstream Left Bank	D_{15} = 12" D_{50} = 40" D_{85} = 60"	1,940	1 – 3	2,000 – 6,000[2]
J.C. Boyle Downstream of Dam Sub-area 1	D_{15} = 1" D_{50} = 9" D_{85} = 20"	850	0.5 – 2	500 – 1,500
J.C. Boyle Downstream of Dam Sub-area 2	D_{15} = 8" D_{50} = 24" D_{85} = 36	250	0.5 – 1.5	150 - 400
J.C. Boyle Downstream of Dam Sub-area 5	D_{50} = 24"	2,020	0.5 – 1.5	1,000 – 1,500

Table 5.2 Assessment of Erosion Protection and Riverbed Material Requirements by Facility

Material Type	Design D_{50} (in)	Neat Line Required Volume (CY)	Anticipated Borrow Source	Adequate Source Volume
J.C. Boyle				
Erosion Protection - E7	D_{50} = 12	625	JCB Downstream Dam Sub-Area 2 JCB Downstream Dam Sub-Area 5	Yes
Erosion Protection - E7	D_{50} = 6	625	JCB Downstream Dam Sub-Area 1 JCB Downstream Dam Sub-Area 5	Yes
Bedding – E6		100	JCB Downstream Dam Sub-Area 1 with site processing	Yes
Copco No. 1				
Erosion Protection – E7	D_{50} = 60	1,190	Copco No. 2 Downstream Right Bank	Yes[1]
Copco No. 2				
Riverbed Material – E7		5,670	Copco No. 2 Downstream Right Bank Copco 1 Access Road Sub-Area 1	Yes[1]
Erosion Protection – E7	D_{50} = 21	1,620	Copco No. 2 Downstream Right Bank Copco No. 2 Downstream Left Bank	Yes[1]
Erosion Protection – E7	D_{50} = 42	1,660	Copco No. 2 Downstream Left Bank	Yes[1]
Iron Gate				
Erosion Protection – E7	D_{50} = 12	2,450	IG DS Dam Face Sub-Area 2 IG DS Dam Face Sub-Area 3	Yes
Erosion Protection – E7	D_{50} = 24	2,450	IG DS Dam Face Sub-Area 1	Yes
Bedding – E6		500	Iron Gate Lake View Road IG DS Dam Face Sub-Area 3 with site processing	Yes

NOTES:

1. PENDING EXPANSION OF WORK LIMITS FROM 60% DESIGN.

6.0 VE-5: FALL, CAMP, AND SCOTCH CREEK CROSSINGS

6.1 OBJECTIVES AND APPROACH

As part of the VE process, the proposed replacements of stream crossing structures (i.e. culverts, bridges) on Fall Creek below the proposed fish hatchery, and on Camp and Scotch Creeks at Copco Road, were reviewed. The VE analysis addressed the need for crossing replacements, and the required dimensions and preferred structure type for those crossings identified as needing replacement.

KP, along with sub-consultants Geoserv and NHC, conducted site investigations and developed conceptual designs for the crossings. Following discussions with regulatory agencies (CDFW and NOAA), the following site summaries describe our present understanding of regulatory acceptance status and remaining engineering work required.

6.2 RESULTS – FALL CREEK

Two crossings of Fall Creek below the fish hatchery were assessed for existing fish passage conditions:

- Fall Creek at Substation Access Road – existing bridge
- Fall Creek at Daggett Road - existing culvert

A stream morphology and fish passage assessment was conducted on Fall Creek on April 22, 2020. The findings were presented in a field assessment memo (see Appendix E1). The field assessment determined that the existing bridge at Substation Access Road is fish passable and not in need of replacement, whereas the existing culvert at Daggett Road is a fish passage barrier and should be replaced to support fish migration to/from the proposed fish hatchery.

Fall Creek at Daggett Road was identified by the Project Team as a potentially suitable site for a concrete box culvert. A box culvert concept was presented that provided adequate hydraulic capacity during flood events, in addition to meeting fish passage criteria (see Appendix E2). The Fall Creek box culvert design was reviewed by the agencies and described as insufficient from a fish resting habitat perspective. Although there are natural constrictions and high velocity zones upstream of the existing crossing, NOAA representatives stated that due to the importance of this cold-water tributary and the upstream hatchery, that a wider span option (e.g. open bottom arch culvert) would be preferred. KP is currently developing the open bottom, steel-plate arch culvert concept for NOAA's review.

6.3 RESULTS – CAMP CREEK AND SCOTCH CREEK

The Camp Creek and Scotch Creek crossings are both located near the present stream confluences with the Iron Gate Reservoir, and over 1 mile upstream from the future stream confluences with the Klamath River mainstem following Iron Gate dam removal. Both crossing sites are situated on delta deposits established since the Iron Gate reservoir formation. There is some uncertainty in understanding the long-term stream channel profile response that may occur following reservoir drawdown.

The Camp and Scotch Creek crossings were identified as potentially suitable sites for concrete box culverts. Box culvert concepts were presented that provide adequate hydraulic capacity during flood events, in addition to meeting fish passage criteria (see Appendix E3). Following agency review, both NOAA and CDFW were satisfied with the general design concept of the box culvert crossings; however, they did note long-term channel profile uncertainty and the difficulty in correctly estimating potential channel profile response prior to drawdown. Several alternatives are being discussed to address the possible post-drawdown channel condition. The contractual aspects of adopting a specific crossing type alternative and the timing of design are also being considered.

7.0 VE-6: ALTERNATE ACCESS IN LIEU OF LAKEVIEW/DAGGETT BRIDGES

7.1 OBJECTIVES AND APPROACH

The temporary construction access bridges proposed in the 60% Design for crossings of the Klamath River at Lakeview Road (near the Iron Gate powerhouse) and Daggett Road (near the Copco No. 2 powerhouse) were reviewed from a cost perspective following the 60% Design submittal. An inspection of potential alternate access routes was undertaken as part of a VE analysis. Maps of the alternate routes are provided in Appendix F1.

A field inspection of the alternate routes was conducted on April 23 and 24, 2020.

Information collected and submitted regarding the alternate access routes is listed on the applicable Transmittal shown in Appendix F2 and listed below:

- Existing bridges rating table

- Video files and photographs collected on the field inspection

7.2 RESULTS – LAKEVIEW ROAD ALTERNATE ACCESS

The temporary construction access bridge shown in the 60% Design will no longer be required. Construction access to the Iron Gate Dam site will be routed through Ager Beswick Road and a network of private roads which access the south bank of the Klamath River at Iron Gate dam (see alternate access route map provided in Appendix F1).

The design of the alternate route may follow a similar approach to the 60% Design for Copco Road. The route may be reviewed for vertical/horizontal geometry, road surface condition, stability and presence of any stream crossings which may require repair or adjustment to accommodate anticipated project live loads (e.g. existing culverts with insufficient cover, bridge structures with signs of deterioration). The Project Team may develop the design to accommodate project vehicles and address any potential improvements or repairs required. The scope and timing of these improvements or repairs is yet to be determined, based on direction from Kiewit.

7.3 DAGGETT ROAD ALTERNATE ACCESS

The Project Team conducted an inspection of the alternate route to the south side of Copco No. 2 (see Appendix F1), to examine the potential of removing the need for a temporary construction access bridge at Daggett Road (shown in the 60% Design package). The Project Team has reviewed possible alternate access road routes and decided to move forward with the temporary construction access bridge at Daggett Road.

8.0 VE-7 EARLY START OPTIONS

8.1 INTRODUCTION

VE-7 involved the analysis of a series of items related to the Early Start of selected construction activities in the pre-drawdown period. The Early Works schedule proposed by Kiewit is presented in Appendix G1. A few additional VE items not specifically related to the Early Start were also included.

The VE analysis tasks are listed below:

- J.C. Boyle Pipeline Cut – Timber Bridge Scour Assessment related to Cutting the Water Pipeline
- J.C. Boyle Tunnel Forebay – Minimize Concrete Removal
- Copco No. 1 – Construct Dam Access through Powerhouse
- Copco No. 2 – Early Removal of Dam and Cofferdam by Temporarily Stopping Discharge at Copco No. 1 Dam
- Tunnel Closure at All Facilities – Eliminate Use of Bat Doors as Tunnel Closures

The objectives, approach, and results for each of these VE analyses are described in the following sections. A summary is presented in Appendix G2.

8.2 J.C. BOYLE PIPELINE CUT

For isolation of the J.C. Boyle Facility downstream components, KP was tasked with assessing the feasibility of removing a portion of the water conveyance pipeline where it crosses the Klamath River to allow it to discharge directly into the Klamath River. KP assessed the potential for the pipeline flows to scour or adversely affect channel stability at and immediately upstream of the existing timber bridge.

Knight Piésold CONSULTING

The trajectory of the flow plunging from the cut pipe was estimated. Conceptual erosion mitigation measures were developed, comprised of rock riprap armoring on the right bank of the Klamath River, and an energy dissipation pad of large rocks constructed across the river channel. The conceptual erosion mitigation measures are depicted in Appendix G2.

The erosion mitigation measures were conceptual in nature and intended to provide a basis for discussion with the KRRP regulatory interface team. Engineering design has yet to be undertaken, and the concepts may be refined. The general VE concept has been accepted for discussion with the regulatory interface team followed by advancement to 90% Design.

8.3 J.C. BOYLE TUNNEL FOREBAY

This VE task explores an alternative scheme in which a portion of the J.C. Boyle tunnel forebay concrete is left in place and buried with granular material. KP has assessed and prepared progress prints and material takeoffs for this alternative, which includes tie-in to the partial fill scour hole grading.

The alternative scheme is included in the VE-7 summary in Appendix G2. The progress prints are provided in Appendix G3. A PowerPoint presentation on the tunnel forebay scheme (and the downstream tunnel barricades) is presented in Appendix G4. Table 8.1 compares the quantities for the VE-7 tunnel forebay scheme to the 60% Design quantities. The VE concept has been accepted for advancement to 90% Design.

Table 8.1 Summary of J.C. Boyle Forebay VE-7 Results

Item	60% Design	VE Results
Concrete Removal	Full	Partial. All concrete below existing ground left in place.
Grading	Fill scour hole to full fill elevation. Tie into full scour hole grading.	Bury concrete with 3' of fill. Tie into partial scour hole grading.
Concrete Removal Volume	2,450 yd^3	850 yd^3
Type E9 Cut/Fill Volume	22,700 yd^3	8,200 yd^3

8.4 COPCO NO. 1 DAM ACCESS

A low-level adit is planned to be constructed starting from the downstream face of the Copco No. 1 Dam during the pre-drawdown period to pass flows for reservoir drawdown in the following year. In the final 60% Design, access to the adit portal site is via a temporary bridge downstream of the powerhouse, and a temporary access road along the left bank of the river up to the diversion tunnel outlet and base of the dam. Kiewit and KP are considering an alternative scheme in which access to the base of the dam and adit portal site is achieved through the existing powerhouse.

KP has assessed and prepared concept sketches for this alternative, which are shown in Appendix G2. The following specific items are shown in Appendix G2:

- Progress prints for the alternative access route
- List of Powerhouse modifications required
- Annotated images of the Powerhouse interior indicating key dimensions

The VE concept has been accepted for advancement to 90% Design.

8.5 COPCO NO. 2 DAM REMOVAL

Kiewit is considering to remove the Copco No. 2. Dam and historical cofferdam during a period when very low flow or zero flow conditions can be created operationally in the Klamath River. This approach requires further consultation with the U.S. Bureau of Reclamation (USBR) and PacifiCorp and has been accepted as a possible option for replacement of the dam removal concept shown in the 60% Design at this time.

Kiewit would conduct the removal of the Copco No. 2 dam and historical cofferdam under low inflow conditions to the Copco No. 1 reservoir (Copco Lake), by planning reservoir operations in which the inflows could be possibly reduced through flow regulation at Keno and Klamath Lake. The Copco Lake level would be drawn down to the minimum operating level (or other designated level) in advance of this operation, using the existing operational power generation facilities. Then generation would cease, and the inflows would be temporarily stored in Copco Lake for a desired period of time. The Copco Lake level would rise as reservoir water is stored until the level reaches near the crest of the spillway gates (or other designated level), at which time generation would resume. The period of time in which power generation is ceased and the inflows are stored in Copco Lake provides time for the river section between Copco No. 1 and Copco No. 2 dam to be drained and then for Kiewit to de-construct Copco No. 2 dam and its historical cofferdam without the need for special diversion or other flow control measures. The ability to drain the river section between Copco No. 1 and Copco No. 2 has been done previously and takes as little as two hours.

As a planning tool, KP prepared an analysis under VE-7 which compares average inflow to Copco Lake to the duration of time in which the inflow could be stored within a specified water surface elevation range in the reservoir. The curve is presented in Appendix G2. It indicates, for example, that under the median inflow condition for the month of August, it would take approximately 7.5 days for the Copco Lake level to rise from the designated starting level to the designated final level used for the analysis. Downstream flows to Copco No. 2 could cease for this time period. Environmental flows downstream of Iron Gate Dam would be met during this period by using Iron Gate reservoir storage.

Kiewit and KP will coordinate with the U.S. Bureau of Reclamation (USBR) to determine what flow regulation measures may be provided at Keno and Klamath Lake, and estimate the duration of time that inflows can be temporarily stored in Copco Lake under a range of inflow conditions and reservoir level ranges. These will be presented in a series of curves relating inflow to duration of flow cessation. These curves can be used to obtain preliminary estimates of flow cessation duration based on current assumptions regarding inflows and acceptable reservoir level range. The curves can further be used to support revised flow cessation estimates as new information is obtained based on ongoing discussions with USBR regarding inflow control from Keno and Klamath Lake and with PacifiCorp regarding facility operations. Since it may require one or two temporary flow outages downstream of Copco No. 1 to complete the Copco No. 2 dam and its historical cofferdam deconstruction, this would also be discussed with USBR and PacifiCorp. This work is considered as an alternative to the 90% Design path, which remains focused on the 60% Design approach. Consultations and support may be performed as part of ongoing Operations Working Group discussions. Both alternatives remain available to the Contractor.

8.6 TUNNEL CLOSURES

All existing Project facility tunnel openings need to be permanently closed to prevent future human access. In the 60% Design Criteria, all tunnel closures were required to have specified bat access openings in the tunnel barricades. This requirement has since been revised by the KRRP Permitting Team and bat access is no longer required.

Knight Piésold CONSULTING

The tunnel openings that require closure and the type of closure proposed for each are presented in the Tunnel Closures section of Appendix G2). The primary type of closure is soil/rock fill, also including concrete rubble fill where available locally. Other closure types may be recommended where machine access is not possible (carbon steel barriers) or where river flows need to be kept from entering over the long-term.

An example is provided below for the downstream outlet closure of the J.C. Boyle water conveyance tunnel. The 60% Design included a steel barricade with bat door at the downstream end of the J.C. Boyle tunnel at the transition to the penstock. The new VE concept for blocking the downstream tunnel portal entails placing locally demolished concrete rubble within the tunnel and burying the concrete with a minimum 3 ft of Type E9 – General Fill. A summary PowerPoint presentation of the J.C. Boyle forebay and tunnel closure as it relates to VE-7 is included in Appendix G4, and progress prints for the tunnel closure are provided in Appendix G5. Table 8.2 summarizes the key changes proposed for the J.C. Boyle downstream tunnel closure as a result of VE-7.

Table 8.2 Summary of J.C. Boyle Downstream Tunnel Closure VE-7 Results

Item	60% Design	VE Results
Barrier Type	Steel Barrier	Concrete Rubble (locally sourced)
Type CR1 Volume	None	160 yd^3
Type E9 Volume (additional)	None	190 yd^3
Type E13 Volume	None	85 yd^3
Geotextile	None	400 ft^2

The general approach for soil/rock/rubble fill placement has been accepted. The steel barriers and other closure means are still under consideration for some locations.

9.0 VE SUMMARY

Acceptance of the VE options by KRRC has been communicated to KP via Kiewit. KP's understanding of the VE options acceptance and basis for advancement to 90% Design is summarized in the bulleted list below. In summary, all VE items are understood to be accepted as presented in this letter, except for those shown in italicized highlighted text in the list below.

VE-1:

- Copco No.1 Low-Level Outlet: preferred VE alternative accepted for advancement to 90% Design.
- Iron Gate Tunnel Modifications: preferred VE alternative accepted for advancement to 90% Design.
- Drawdown Plan: VE staged approach for Iron Gate diversion tunnel gate openings accepted for advancement to 90% Design.
- Revised Water Levels for Iron Gate Reservoir: VE results accepted for advancement to 90% Design.
- Staged Embankment Removal: VE results accepted for advancement to 90% Design.

VE-2:

- J.C. Boyle River Channel Design: VE concept accepted for advancement to 90% Design.
- Iron Gate River Channel Design: VE concept accepted for advancement to 90% Design.

VE-3:

- Copco No.1 River Channel Design: VE concept accepted for advancement to 90% Design.

Knight Piésold CONSULTING

- Copco No. 2 River Channel Design: VE concept accepted for advancement to 90% Design.

VE-4:

- Use on Onsite Materials: VE borrow sources accepted for advancement to 90% Design.

VE-5:

- Fall Creek at Substation Access Road: no replacement required; design scope removed.
- *Fall Creek at Daggett Road: Replacement is required; the type of crossing to be designed is pending agency feedback.*
- *Camp Creek at Copco Road: Replacement is required; the type and timing of crossing yet to be determined by KRRP team.*
- *Scotch Creek at Copco Road: Replacement is required; the type and timing of crossing yet to be determined by KRRP team.*

VE-6:

- Alternate Access Route in Lieu of Lakeview Bridge (Klamath River): accepted; Lakeview Bridge design. removed from 90% design scope; design support to be provided for alternate route improvements as required.
- *Alternate Access Route in Lieu of Daggett Bridge (Klamath River): VE outcome determined that the temporary construction bridge would be needed and remains included in the 90% Design.*

VE-7:

- J.C. Boyle Cut Pipe: VE concept accepted for agency consultation.
- J.C. Boyle Tunnel Forebay: VE concept accepted for advancement to 90% Design.
- Copco No. 1 Access through Powerhouse: VE concept accepted for advancement to 90% Design.
- *Copco No. 2 Early Dam and Cofferdam Removal: VE concept not accepted as the primary approach for dam removal; the 60% Design approach is retained for advancement to 90% Design.*
- *Tunnel Closures: VE concept generally accepted for advancement to 90% Design (soil/rock/rubble fill placement has been accepted; the steel barriers and alternative barriers are still under consideration).*

Yours truly,
Knight Piésold

Prepared: Craig Nistor
Craig Nistor

Reviewed: N Bishop
Norm Bishop

Approval that this document adheres to the Knight Piésold Quality System: CN

Appendices:

Appendix A	VE-1: Extended Drawdown
Appendix B	VE-2: River Channel Design – J.C. Boyle and Iron Gate
Appendix C	VE-3: River Channel Design – Copco No. 1 and Copco No. 2
Appendix D	Use of Onsite Materials
Appendix E	VE-5: Fall, Camp, and Scotch Creek Crossing Concepts
Appendix F	VE-6: Alternate Access in Lieu of Lakeview/Daggett Bridges
Appendix G	VE-7: Early Start Options

Copy To: Erik Esparza and Gary Jara (Kiewit)
Stuart Flett and Sam Mottram (KP)

/cjn

APPENDIX A

VE-1: Extended Drawdown

Knight Piésold CONSULTING

APPENDIX A1

VE-1 Submittals: Copco No. 1 Low Level Outlet

(Pages A1-1 to A1-3)

ATTACHMENT A

100% FINAL Design ReportAppendix LMay28(Part1)

Pages 21-28 and 80-94

REDACTED: Pages 21-28 and 80-94 of 100% FINAL Design ReportAppendix LMay28(Part1) consist in their entirety of information about the location, character, or ownership of historic resources that, if disclosed, may cause a significant invasion of privacy; cause a risk of harm to the historic resource; or impede the use of a traditional religious site by practitioners. These pages are labeled as "Privileged" in accordance with 18 C.F.R. § 388.112, 18 C.F.R. § 388.107 and 36 C.F.R. § 800.11(c).

APPENDIX A3

VE-1 Submittals: Drawdown Model and Assessment

(Pages A3-1 to A3-25

Iron Gate

Updated Results Upper Gate Only

Drawdown (HEC-RAS) Update

Overview

- Updated model runs for Iron Gate
  - Limit reservoir drawdown rate to 5 ft/day
  - No Removal of Lower Gate
  - Alternative start dates:
    - Apr 1

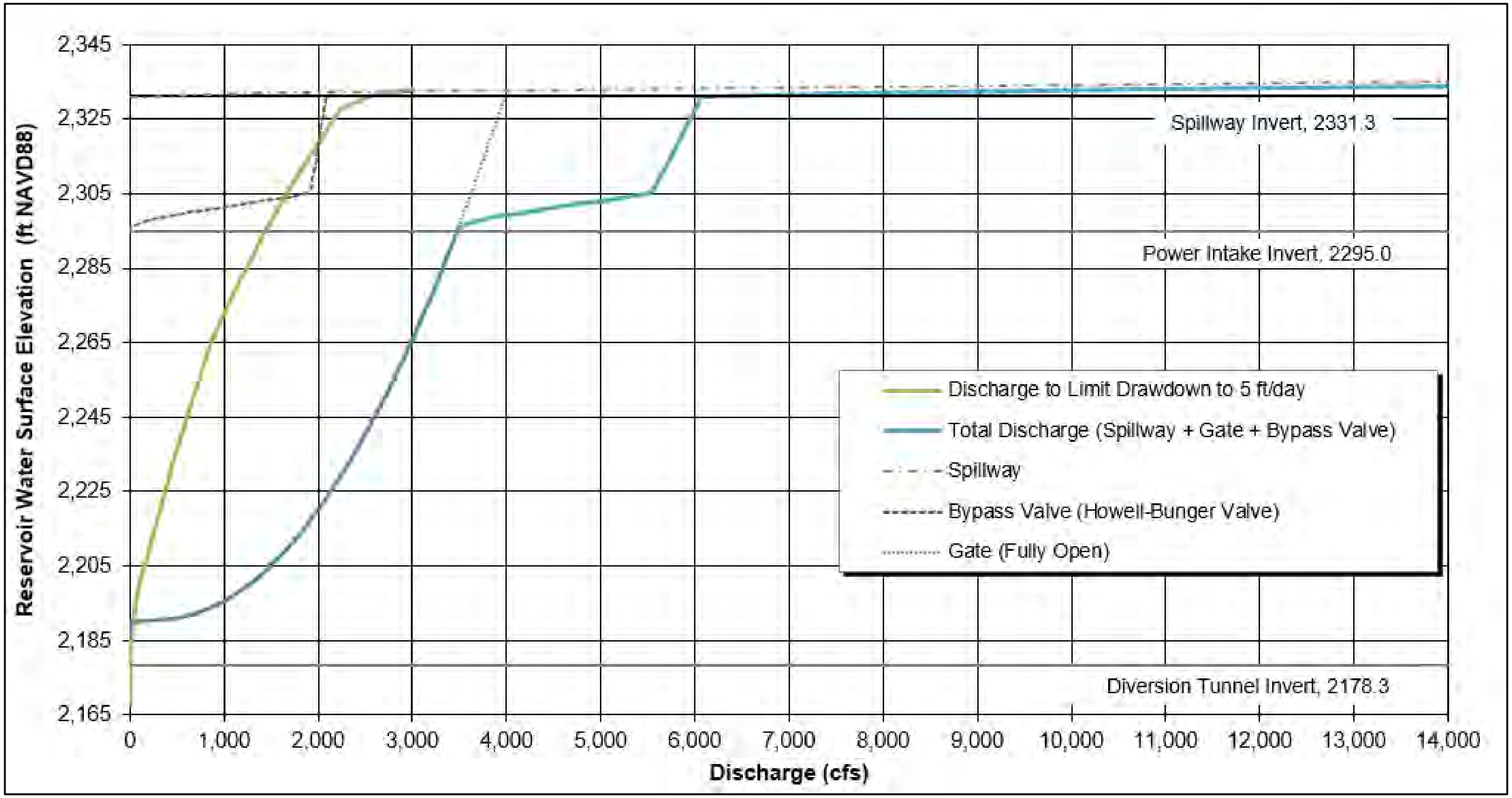
Iron Gate

Operating Rules

- Initial WSE: spillway crest 2331.3 ft
- Drawdown is initiated on *Jan 1* by opening power tunnel intake (penstock/bypass valve). *(Feb 1, Mar 1, Apr 1, Dec 1)*
- Drawdown rate controlled by operation of existing upper diversion tunnel gate. Drawdown rate limited to 5 ft/day where practicable.
- Drawdown is 'achieved' when WSE is at the crest of the cofferdam (elevation 2208 ft)

Iron Gate

Rating Curve



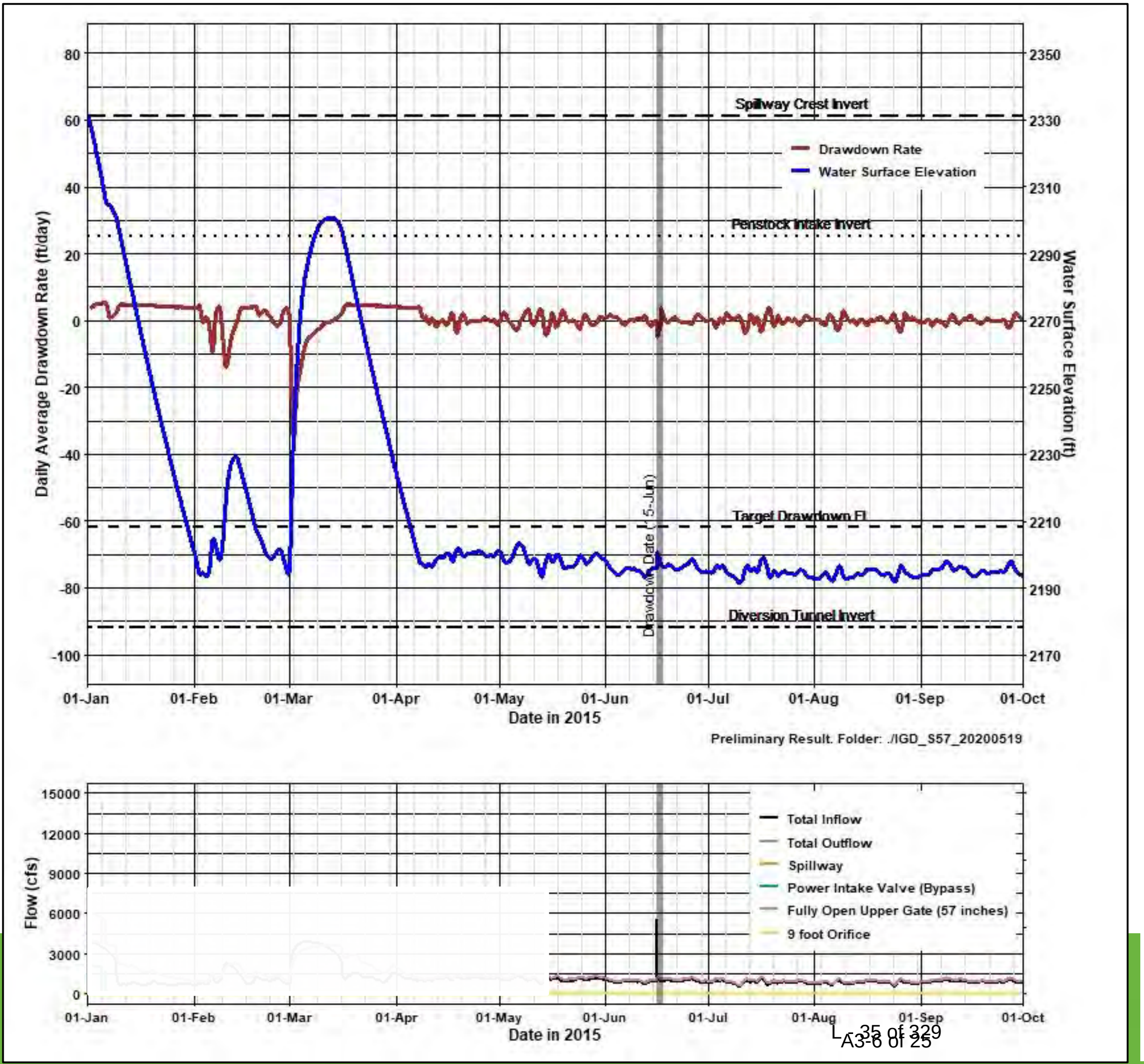
- Upper Gate (fully open to 57 inches) developed with CFD
- Spillway and Bypass valve (Howell-Bunger) empirical equations
- Outflow limiting drawdown to 5 ft/day calculated based on 2018 bathymetry

Iron Gate

5 ft/day and Jan 1 start

Iron Gate

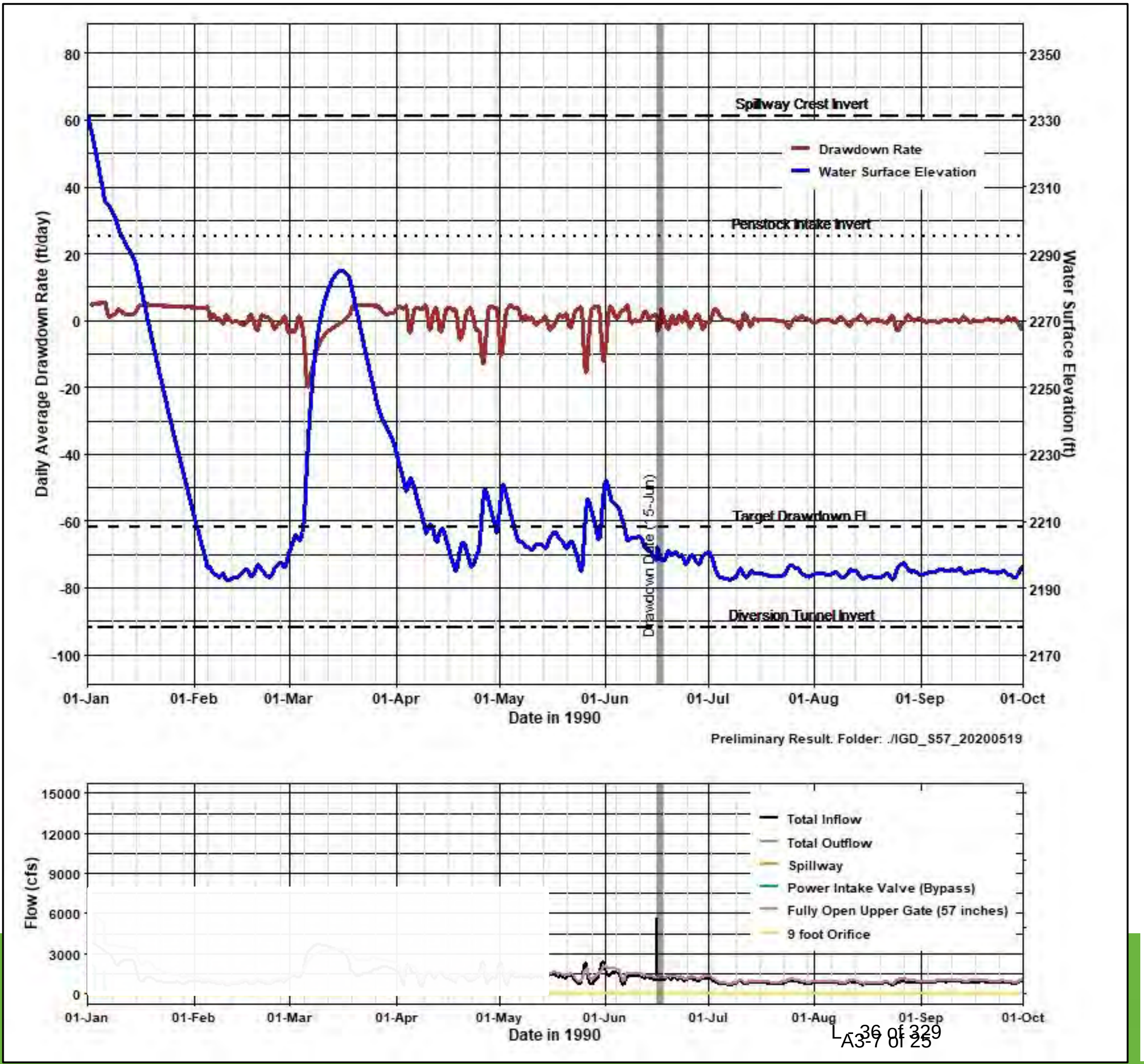
Preliminary Results: 2015 – Driest Volume Year



- Target Drawdown WSE reached:
  - End of Jan, and early Apr
- Reservoir refills from freshet
  - Drawdown limited to 5ft/day after 2nd refilling
- Post June15/July WSE
  - around 2190 ft
- Outflows through individual outlets not properly represented in current model when drawdown limited to 5 ft/day (total outflow is correct) – to be visited in 90%

Iron Gate

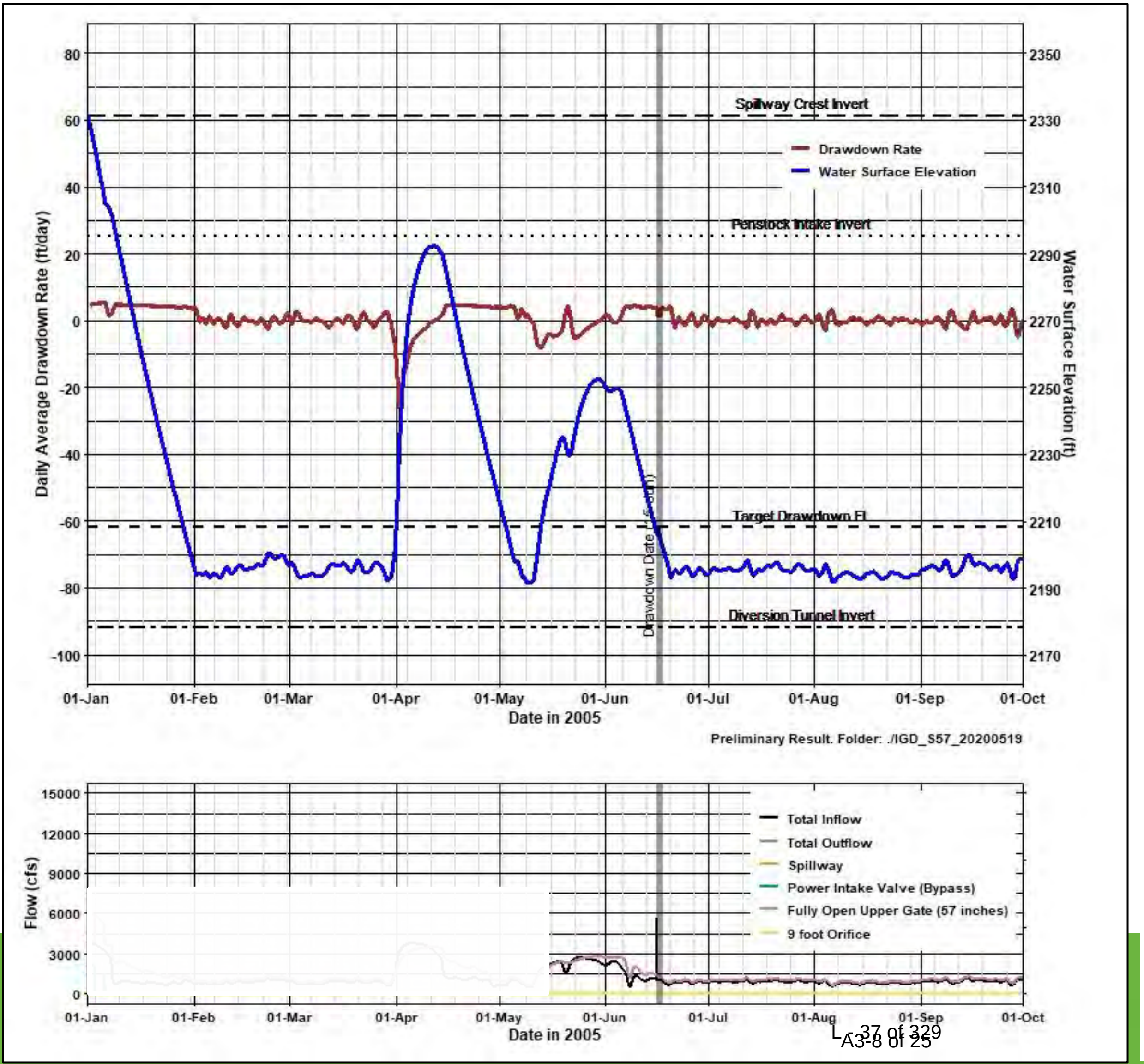
Preliminary Results: 1990 – Dry Volume Year



- Target Drawdown WSE reached:
  - Early Feb, and mid Apr
- Reservoir refills from freshet
  - Drawdown limited to 5ft/day after 2nd refilling
- Post June15/July WSE
  - around 2190 ft
- Outflows through individual outlets not properly represented in current model when drawdown limited to 5 ft/day (total outflow is correct) – to be visited in 90%

Iron Gate

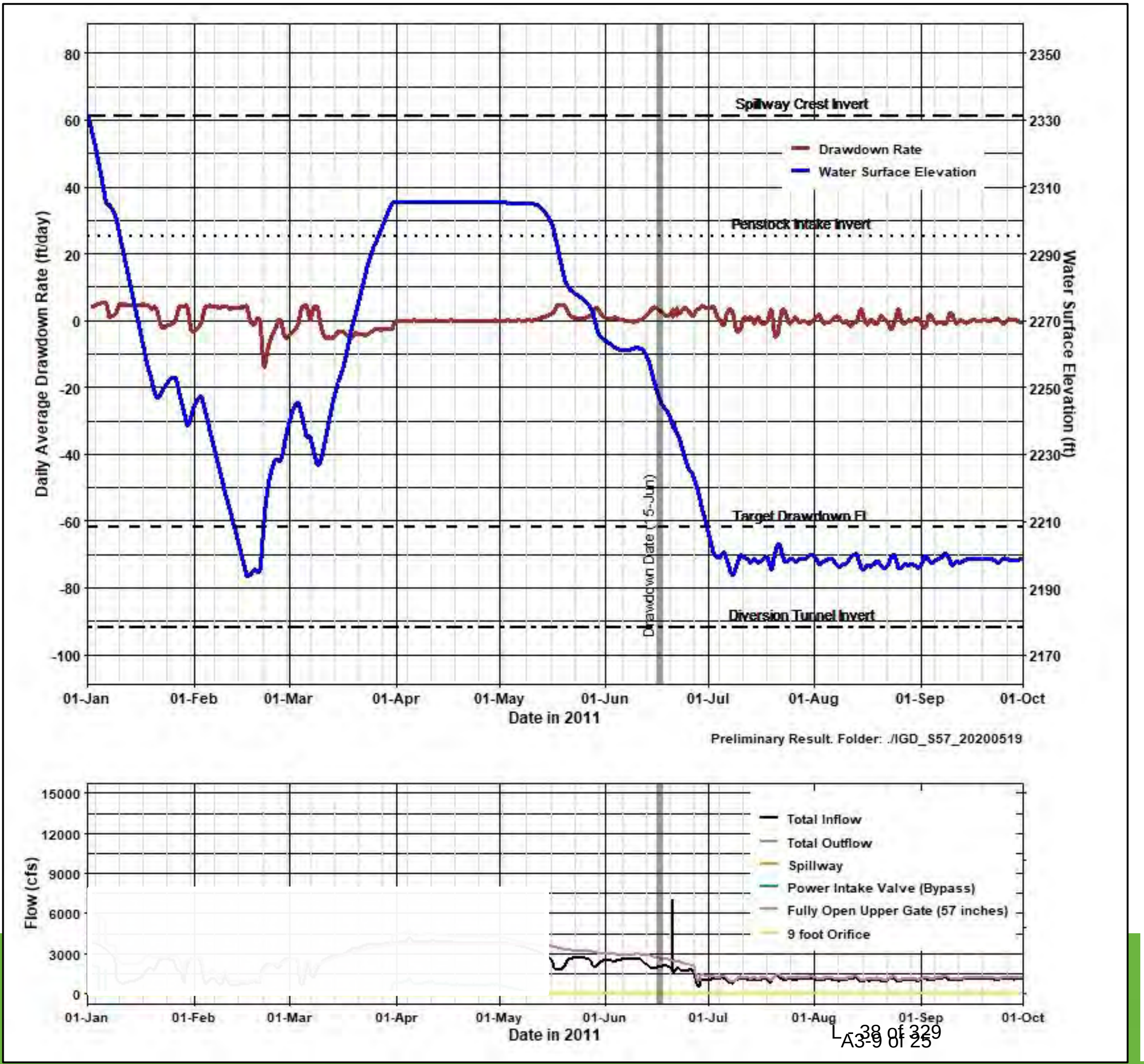
Preliminary Results: 2005 – Avg. Vol. Year



- Target Drawdown WSE reached:
  - Early Feb, early May and mid-Jun
- Reservoir refills from freshet
  - Drawdown limited to 5ft/day after 2nd refilling
- Post June15/July WSE
  - around 2190 ft +/-
- Outflows through individual outlets not properly represented in current model when drawdown limited to 5 ft/day (total outflow is correct) – to be visited in 90%

Iron Gate

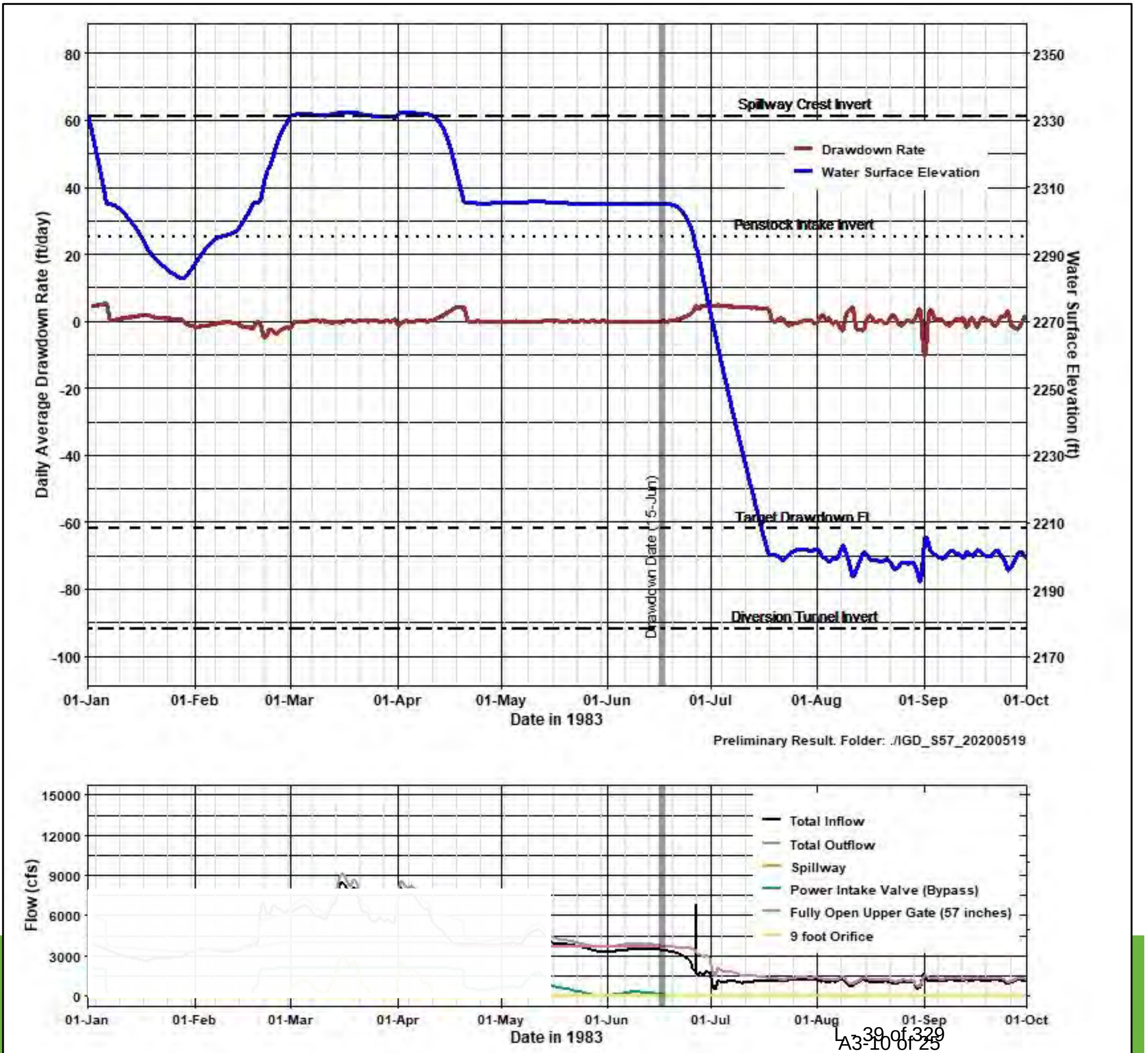
Preliminary Results: 2011 –Wet Year



- Target Drawdown WSE reached:
  - Mid Feb, and early Jul
- Reservoir refills from freshet
  - Drawdown limited to 5ft/day after 2nd refilling
- Post June15/July WSE
  - around 2190 ft +/-
- Outflows through individual outlets not properly represented in current model when drawdown limited to 5 ft/day (total outflow is correct) – to be visited in 90%

Iron Gate

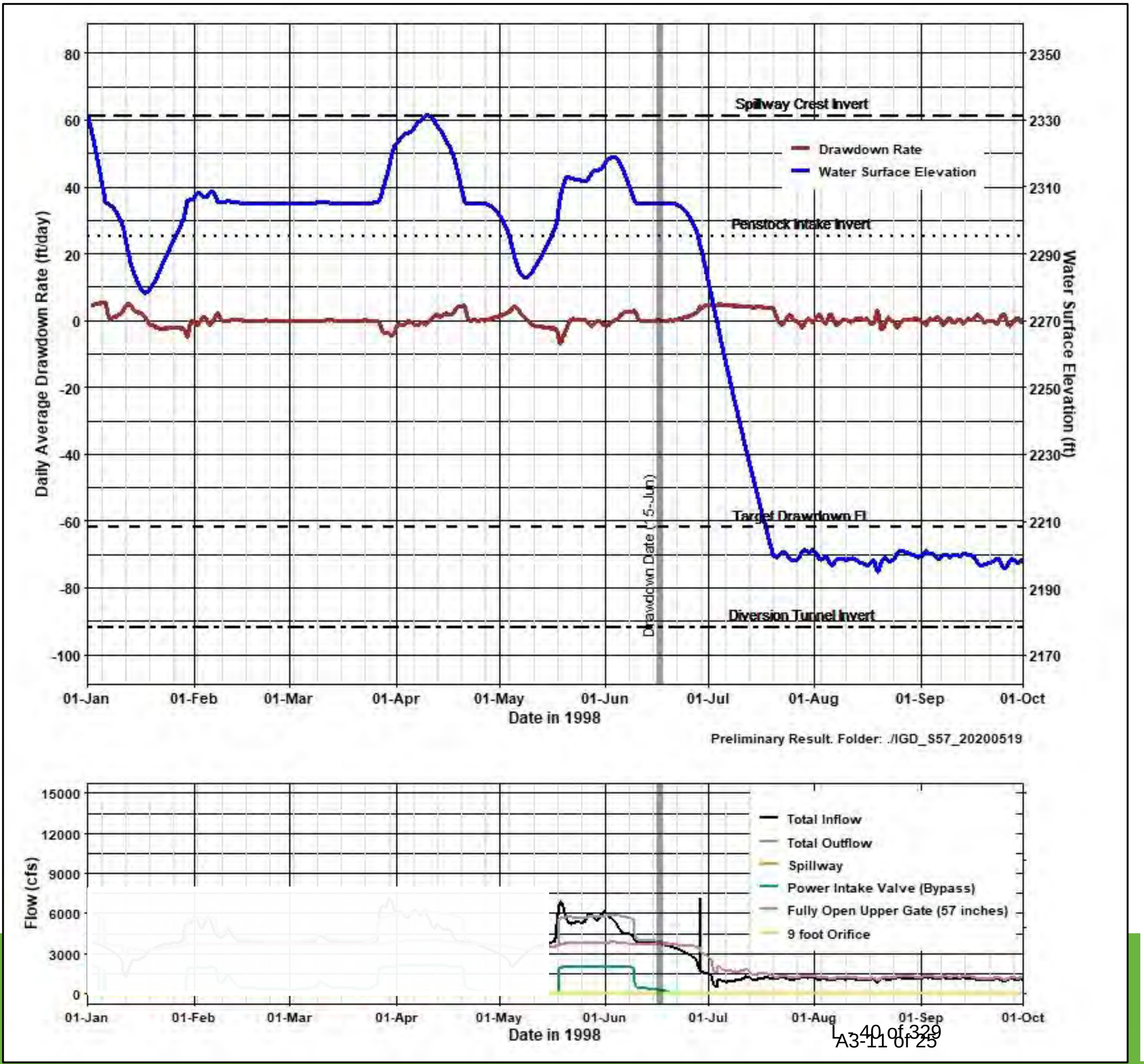
Preliminary Results: 1983 –Very Wet Year



- Target Drawdown WSE reached:
  - Mid-July
- Drawdown limited to 5ft/day
- Post June15/July WSE
  - around 2190 ft +/-
- Outflows through individual outlets not properly represented in current model when drawdown limited to 5 ft/day (total outflow is correct) – to be visited in 90%

Iron Gate

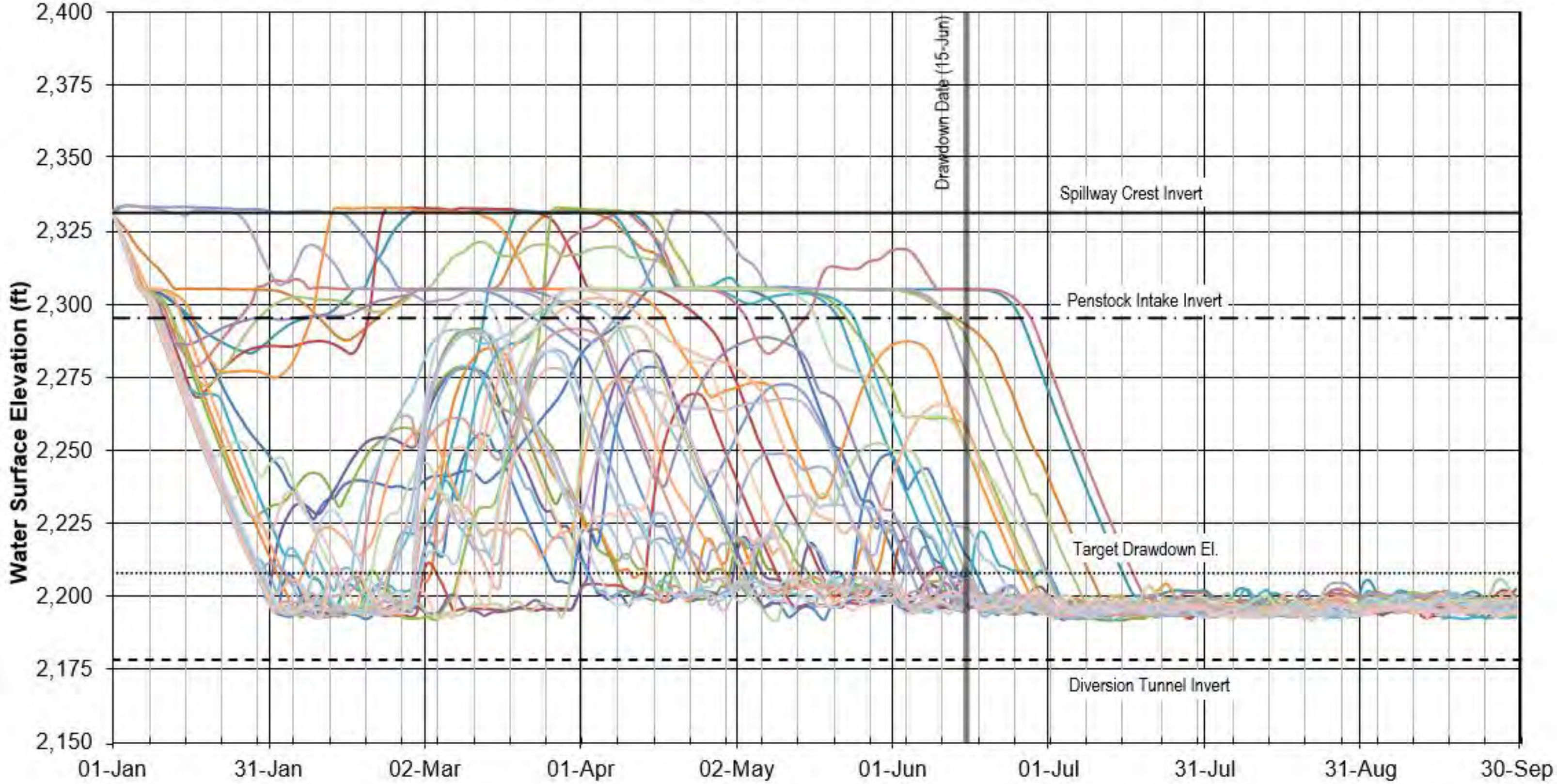
Preliminary Results: 1998 –Very Wet Year



- Target Drawdown WSE reached:
  - Mid-July
- Drawdown limited to 5ft/day until 9 ft orifice is the control
- Post June15/July WSE
  - around 2190 ft +/-
- Outflows through individual outlets not properly represented in current model when drawdown limited to 5 ft/day (total outflow is correct) – to be visited in 90%

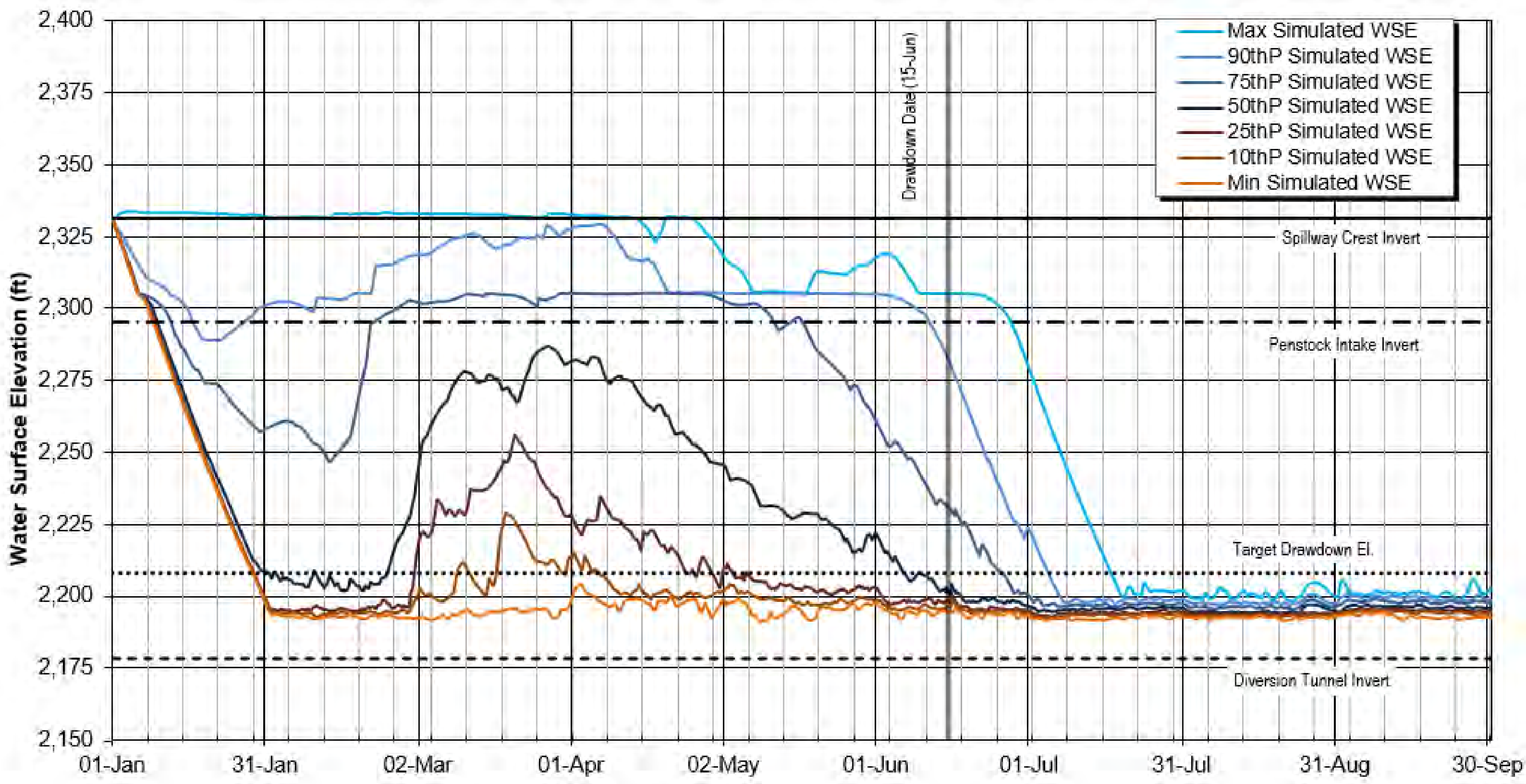
Iron Gate

Preliminary Results – All Model Years WSE



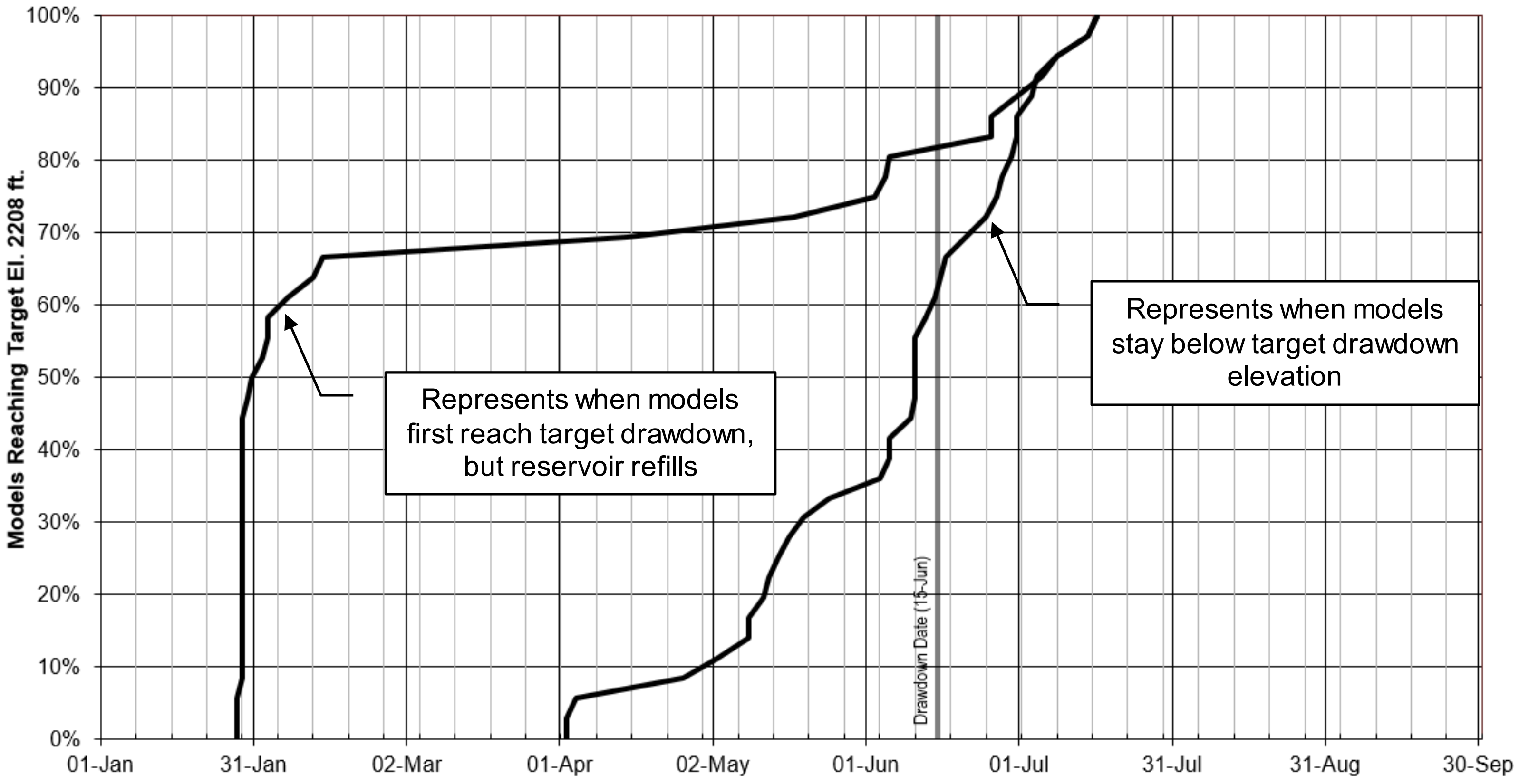
Iron Gate

Preliminary Results – Percentile WSE



Iron Gate

Preliminary Results – Target Drawdown Dates



Iron Gate

5 ft/day and Delayed/Early Start

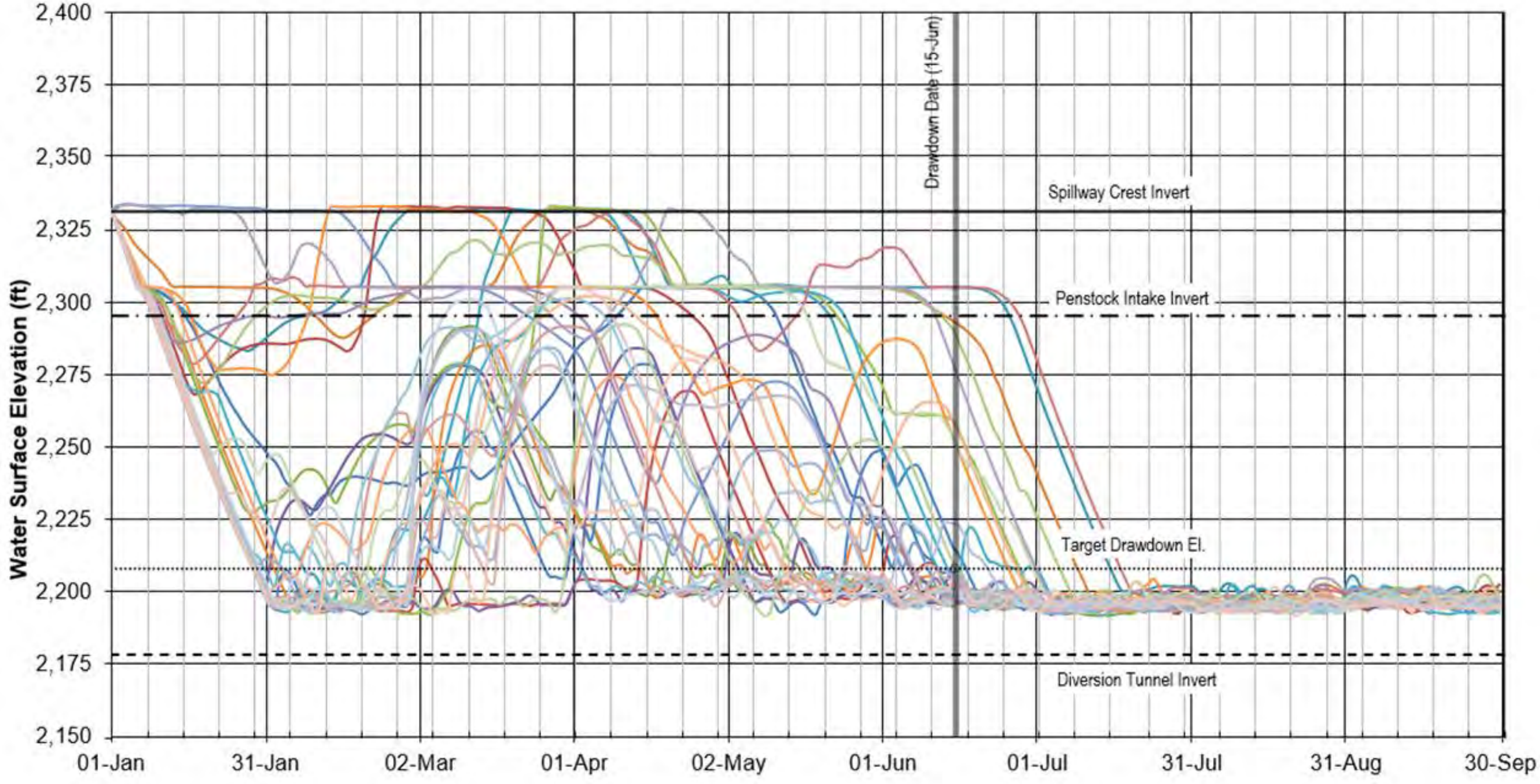
Iron Gate Delayed Start

Summary of Apr 1 Simulations

- No substantial change to the reservoir water surface elevations for dam deconstruction (memo VA20-00897, May 8)
- This is documented with the following slides

Iron Gate

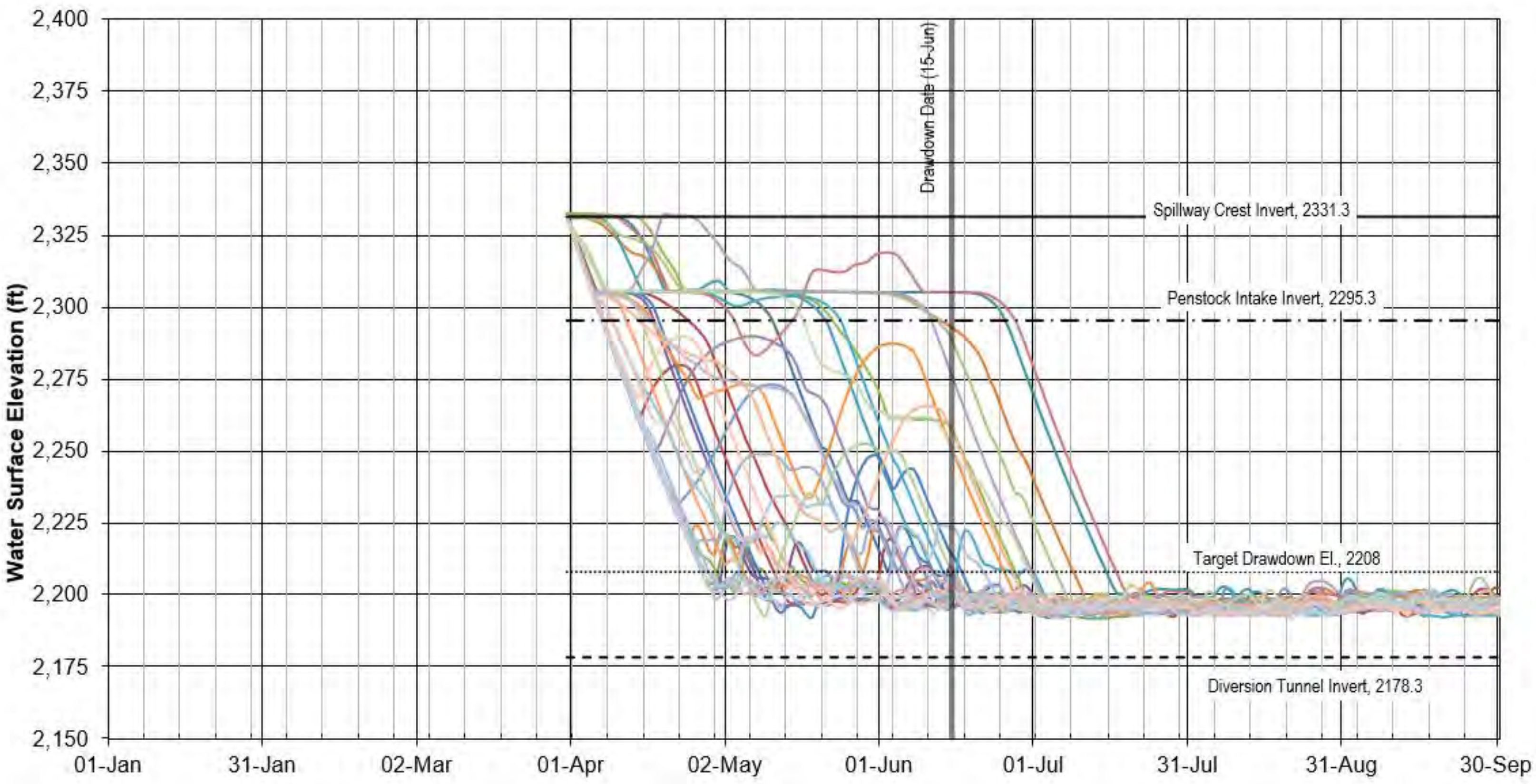
All Model Years WSE – Jan 1 Initiate Drawdown



- Based on simulations results for 2019 BiOp flows

Iron Gate

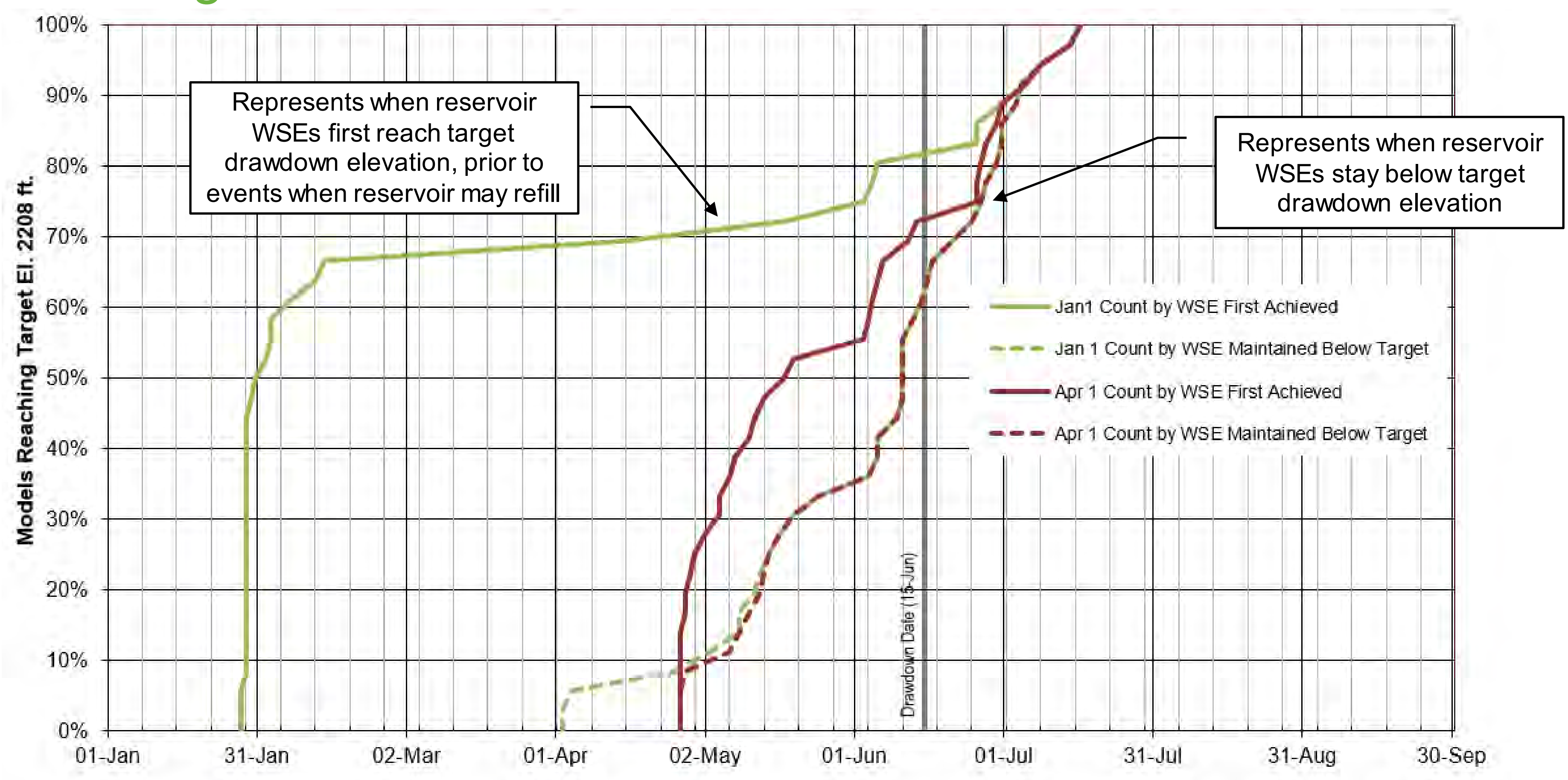
All Model Years WSE – Apr 1 Initiate Drawdown



- Based on simulations results for 2019 BiOp flows

Iron Gate

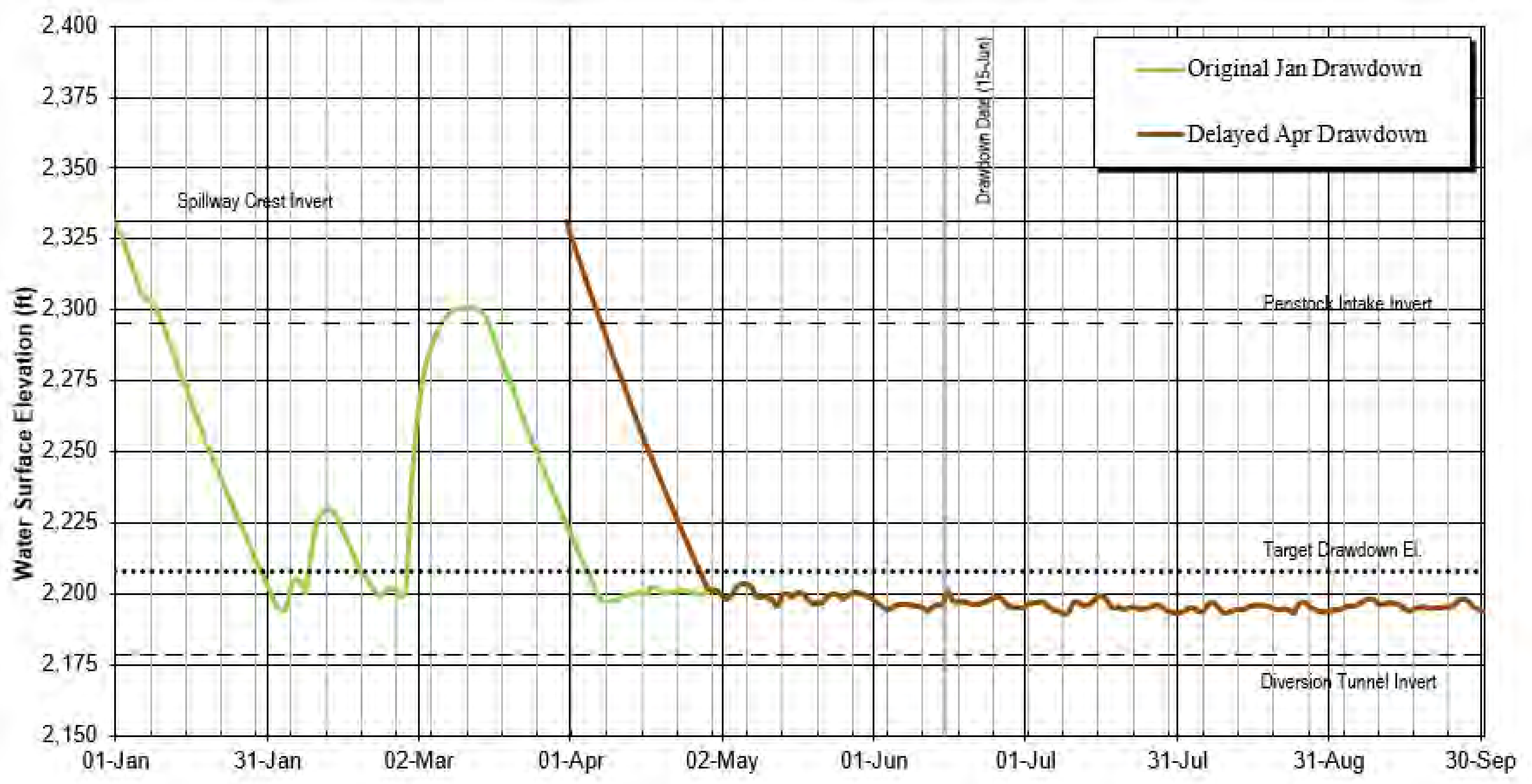
Target Drawdown Dates



- Based on simulations results for 2019 BiOp flows

Iron Gate

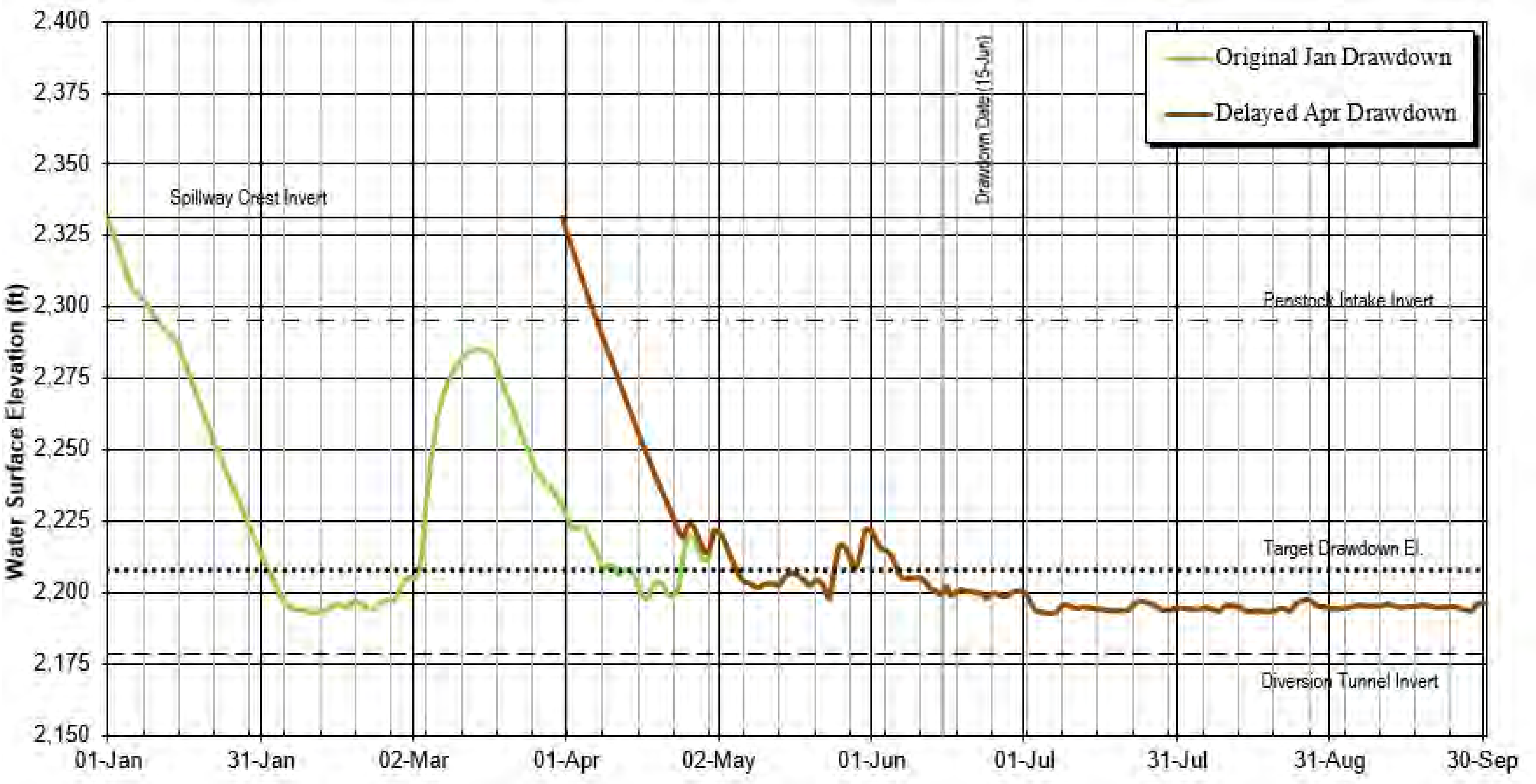
WY 2015 WSE



- Based on simulations results for 2019 BiOp flows

Iron Gate

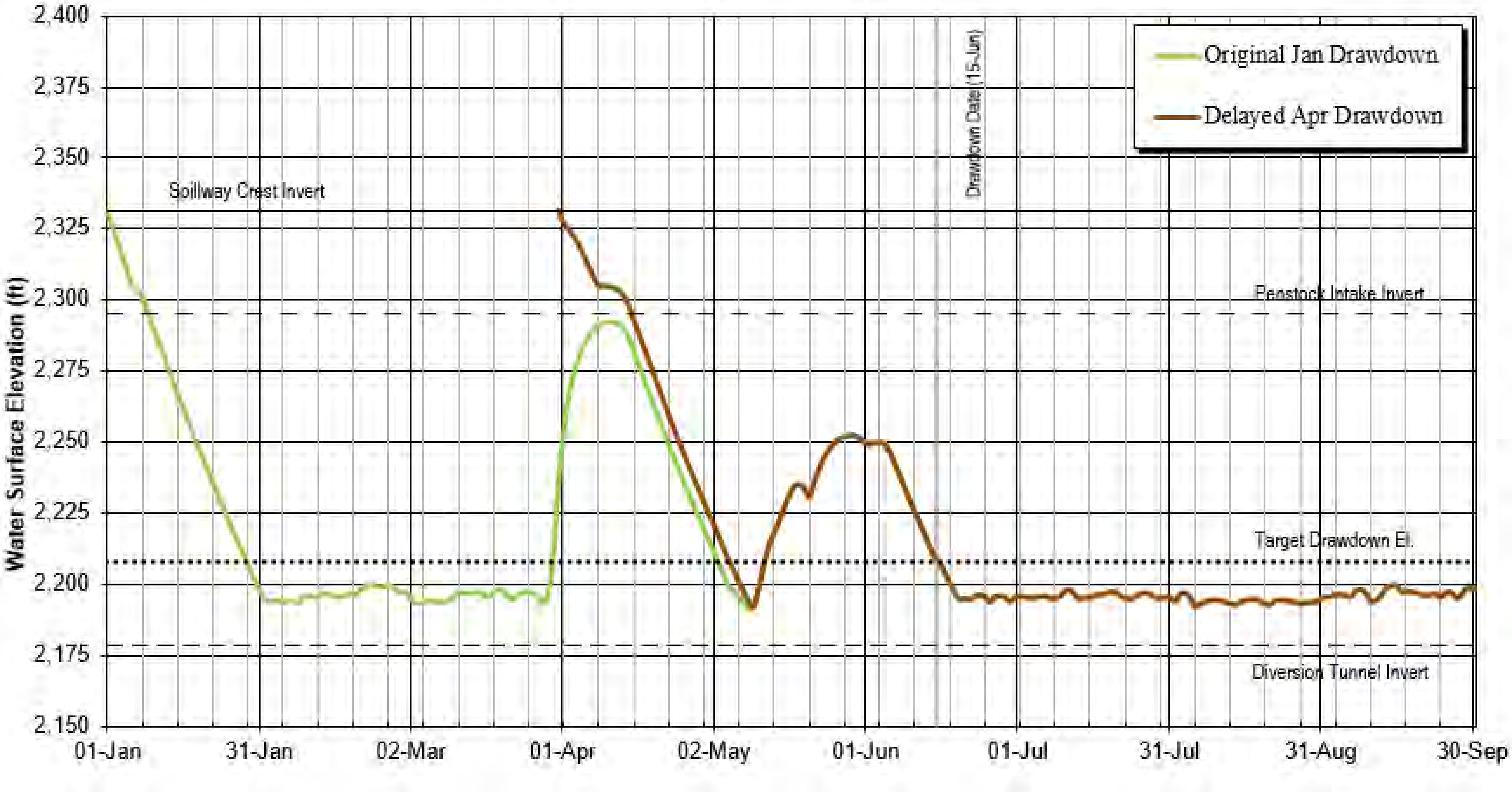
WY 1990 WSE



- Based on simulations results for 2019 BiOp flows

Iron Gate

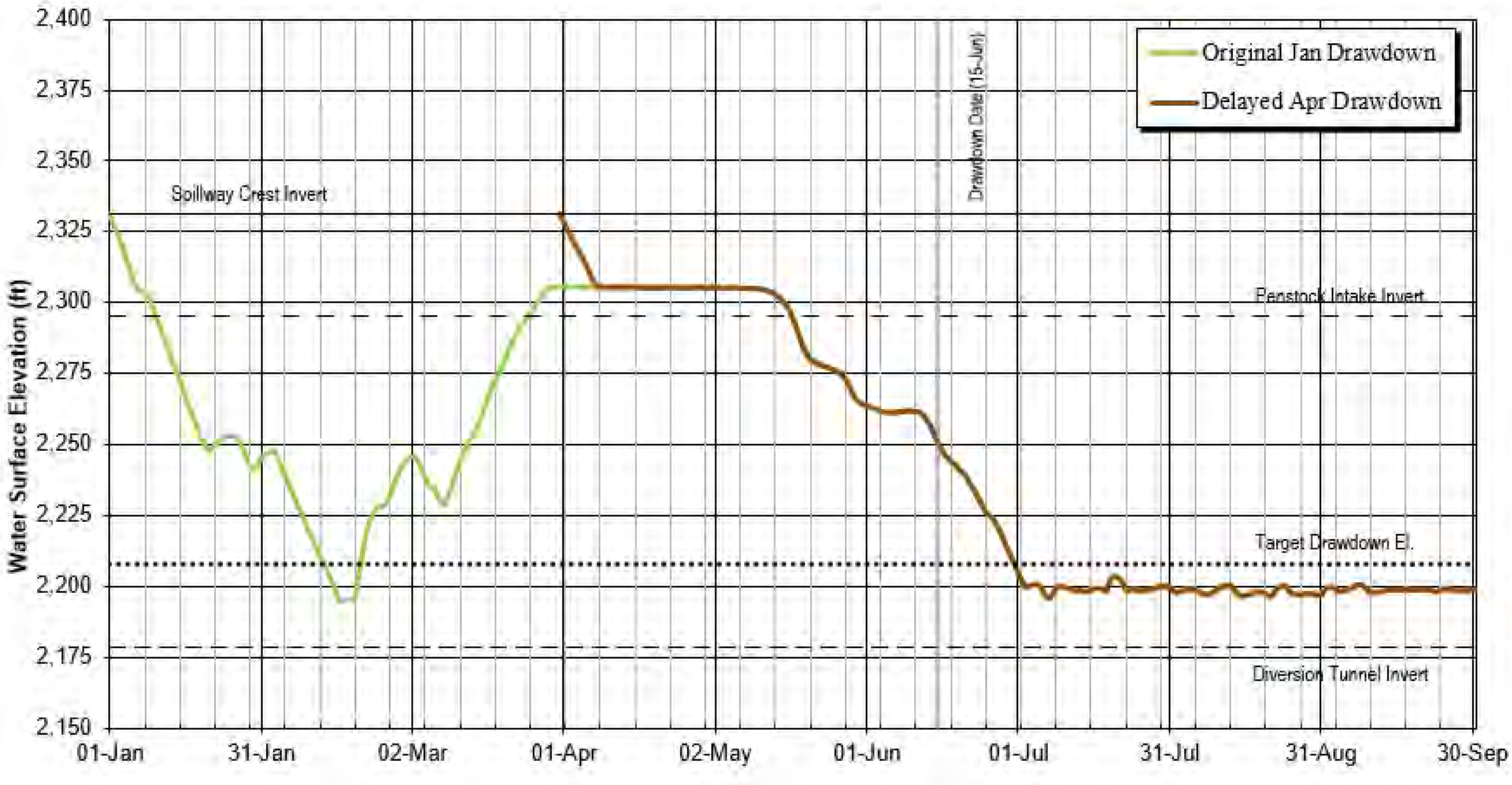
WY 2005 WSE



- Based on simulations results for 2019 BiOp flows

Iron Gate

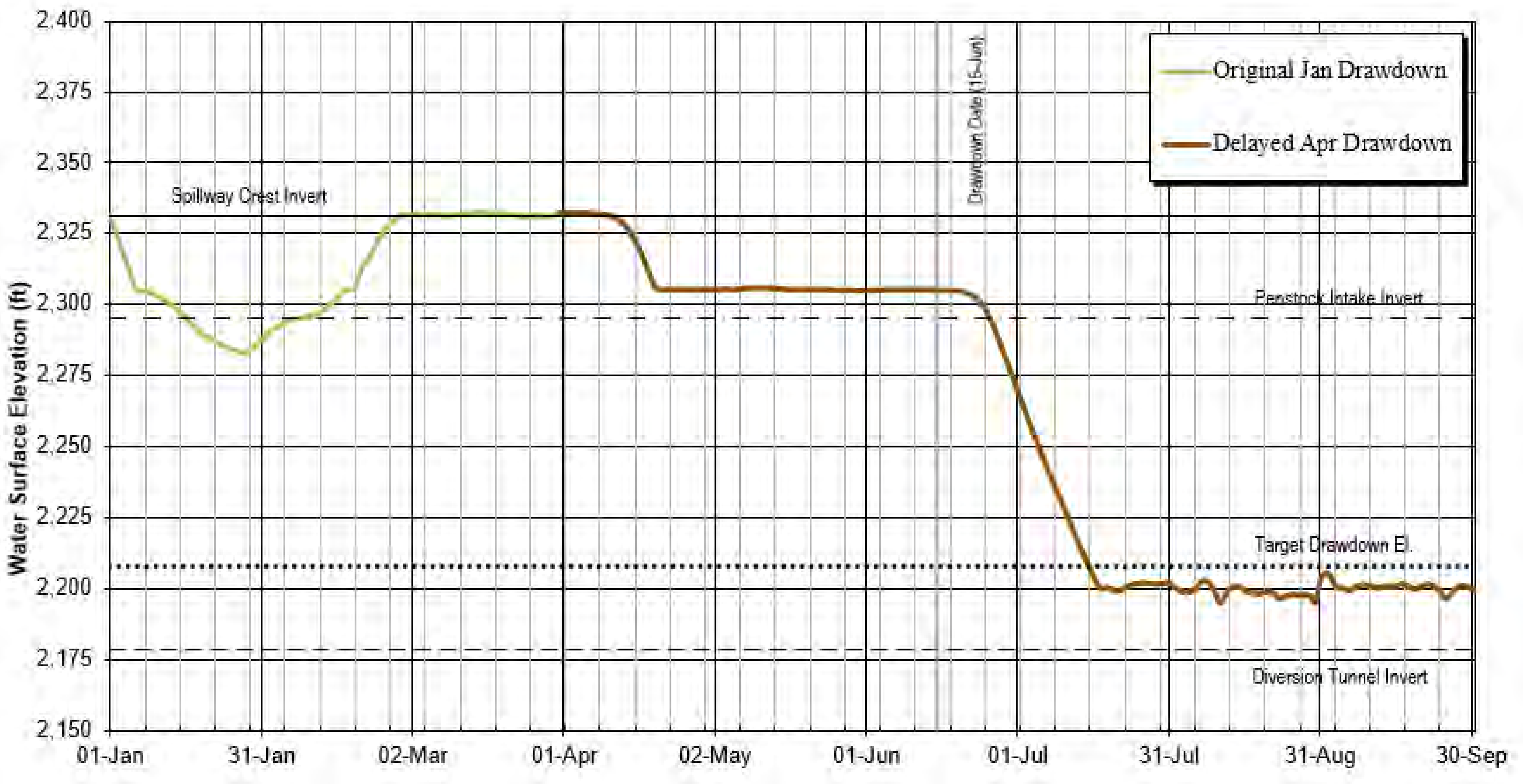
WY 2011 WSE



- Based on simulations results for 2019 BiOp flows

Iron Gate

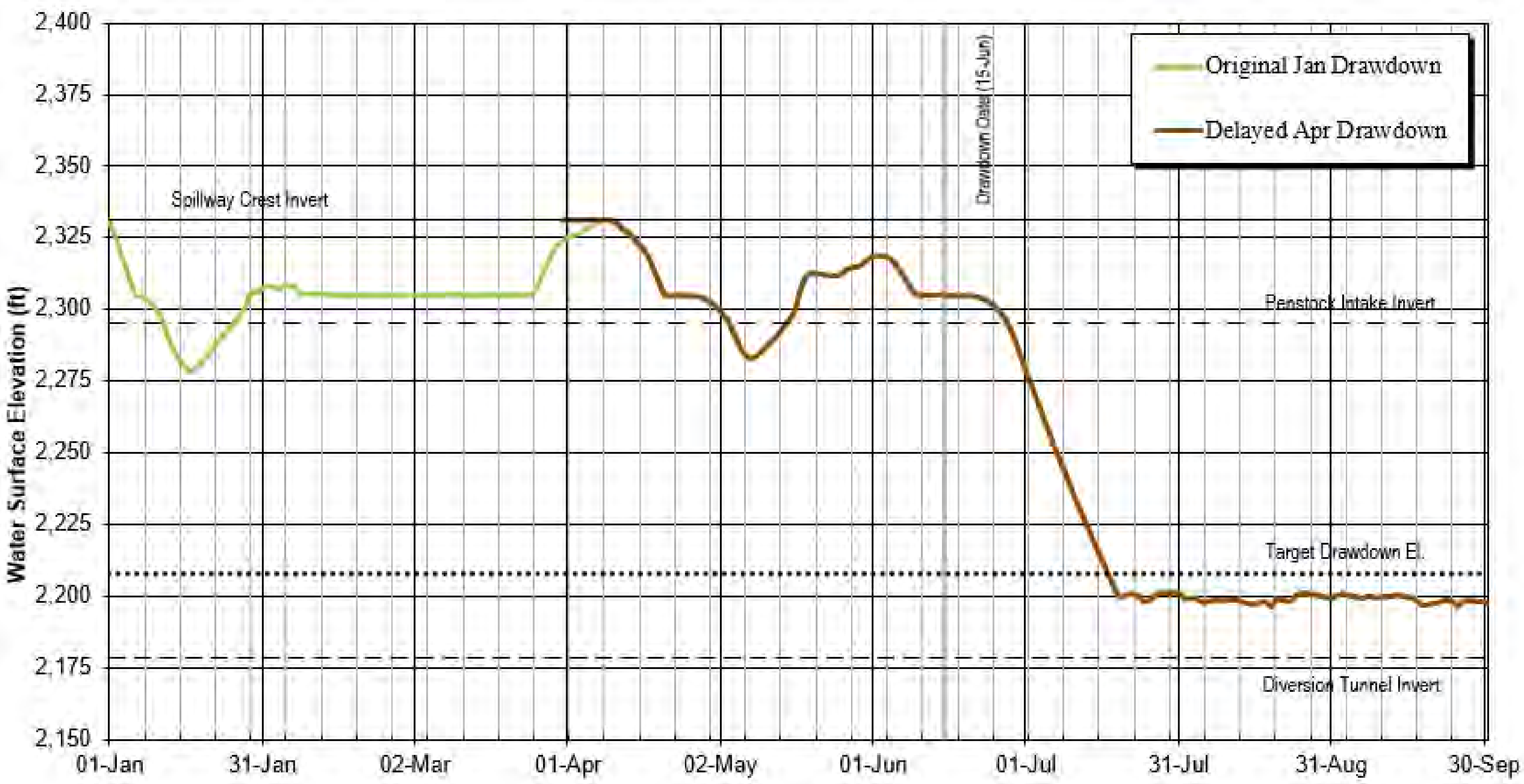
WY 1983 WSE



- Based on simulations results for 2019 BiOp flows

Iron Gate

WY 1998 WSE



- Based on simulations results for 2019 BiOp flows

APPENDIX A4

VE-1 Submittals: Iron Gate Reservoir Flood Flows and Water Levels

(Pages A4-1 to A4-2)

Knight Piésold CONSULTING

TABLE 1

KIEWIT INFRASTRUCTURE WEST CO.
KLAMATH RIVER RENEWAL PROJECT

RECOMMENDED DESIGN VALUES OF MONTHLY PEAK FLOODS

Print May/20/20 13:34:12

Location	Month	Instantaneous Peak Floods for Specified Time Period (cfs)								Average Monthly Flow (cfs)
		50% Probable Flood	20% Probable Flood	10% Probable Flood	5% Probable Flood	2% Probable Flood	1% Probable Flood	0.5% Probable Flood	0.2% Probable Flood	
Iron Gate	Jan	3,200	6,100	8,900	12,500	18,700	24,800	32,400	45,400	2,030
	Feb	3,200	6,100	9,000	12,500	18,700	24,800	32,400	45,400	2,500
	Mar	6,900	9,000	10,800	13,800	18,100	21,700	25,400	30,800	3,430
	Apr	4,800	7,300	9,400	11,800	15,300	18,000	20,900	24,800	2,950
	May	3,000	4,800	6,300	7,900	10,000	11,700	13,500	16,000	2,230
	Jun 1 - 15	2,000	3,000	3,800	4,800	6,800	8,700	11,100	15,000	1,720
	Jun 16 - 30	1,500	2,000	2,500	3,000	3,700	4,400	5,200	6,500	1,280
	Jul 1 - 15	1,200	1,400	1,700	2,100	2,800	3,400	4,300	5,600	1,050
	Jul 16 - 30	1,300	1,400	1,600	1,700	1,900	2,100	2,200	2,500	1,050
	Aug	1,300	1,400	1,600	1,700	1,900	2,100	2,200	2,500	1,040
	Sep	1,500	1,800	2,000	2,200	2,500	2,600	2,800	3,100	1,090
	Oct 1 - 15	1,600	2,100	2,600	3,100	3,900	4,600	5,400	6,600	1,120
	Oct 16 - 31	1,600	2,300	2,900	3,500	4,500	5,400	6,400	8,000	1,210
	Nov 1 - 15	1,800	2,700	3,500	4,400	5,700	7,000	8,400	10,600	1,300
	Nov 16 - 30	2,000	3,200	4,200	5,200	6,900	8,300	9,900	14,000	1,310
	Dec	2,700	5,300	7,900	11,300	17,600	24,000	32,400	47,500	1,580

M:\1\03\00640\01\A\Data\Task 0900 - 90% Design\08 - Hydrology\Flood Frequency Analysis\[Flood Frequency Analysis - Monthly.xlsm]Table - Monthly_Max_b

NOTES:

1. RECOMMENDED DESIGN VALUES ARE BASED ON THE MAXIMUM VALUES BETWEEN THE ANALYSIS COMPLETED USING THE HISTORIC USGS GAGE DATA AND THE 2019 BIOP FLOW DATA.
2. HISTORIC USGS DATA SOURCE FOR ANALYSIS: USGS STATION 11516530 "KLAMATH R BL IRON GATE DAM CA", PERIOD OF RECORD 1960 TO 2019. PERIOD OF RECORD USED IN ANALYSIS 1960 TO 2019.
3. 2019 BIOP FLOW DATA SOURCE FOR ANALYSIS: 2019 BIOLOGICAL OPINION FLOWS (AECOM, 2019) PROVIDED FOR THE PERIOD 1981 TO 2016. FLOWS WERE PROVIDED AT IRON GATE (USGS GAGE 11516530).
4. THE DATA INDICATE THAT FOR SOME MONTHS THERE IS A TRANSITION IN THE HYDROLOGY IN THE MIDDLE OF THE MONTH. MONTHS WHEN THIS OCCURS INCLUDE JUNE, JULY, OCTOBER, AND NOVEMBER. FOR ANALYSIS PURPOSES THESE MONTHS HAVE BEEN DIVIDED INTO TWO PERIODS: 1st TO 15th AND 16th TO 30th/31st OF EACH MONTH.
5. RECOMMENDED DESIGN VALUES FOR THE SECOND HALF OF JULY ARE DICTATED BY THE AUGUST PEAK MONTHLY FLOOD VALUES FOR DAM SAFETY PURPOSES.

A	20MAY'20	ISSUED WITH TRANSMITTAL VA20-01072	ELK	AS
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE 3.4

KIEWIT INFRASTRUCTURE WEST CO.
KLAMATH RIVER RENEWAL PROJECT

IRON GATE DAM
FLOOD FLOWS AND STEADY-STATE WATER SURFACE ELEVATION

Print May/20/20 13:19:31

Flow Condition		Discharge (cfs)[1]															
		Jan	Feb	Mar	Apr	May	Jun 1 - 15	Jun 16 - 30	Jul 1 - 15	Jul 16 - 31	Aug	Sep	Oct 1-15	Oct 15-31	Nov 1-15	Nov 15-30	Dec
Statistical High Water (Flood Conditions)	1% Probable Flood	24,800	24,800	21,700	18,000	11,700	8,700	4,400	3,400	2,500	2,500	2,600	4,600	5,400	7,000	8,300	24,000
	5% Probable Flood	12,500	12,500	13,800	11,800	7,900	4,800	3,000	2,200	2,200	2,200	2,200	3,100	3,500	4,400	5,200	11,300
	20% Probable Flood	6,100	6,100	9,000	7,400	4,800	3,000	2,300	1,900	1,900	1,900	1,800	2,100	2,300	2,700	3,200	5,300
	50% Probable Flood	3,200	3,200	6,900	4,800	3,000	2,200	1,800	1,600	1,600	1,600	1,500	1,600	1,600	1,600	200	2,700
Mean Monthly Flow		2,030	2,500	3,430	2,950	2,230	1,720	1,280	1,050	1,050	1,040	1,090	1,120	1,210	1,300	1,310	1,580

Flow Condition		Reservoir Water Surface Elevation (ft) - Fully Open Upper Gate (57 in.)[2]															
		Jan	Feb	Mar	Apr	May	Jun 1 - 15	Jun 16 - 30	Jul 1 - 15	Jul 16 - 31	Aug	Sep	Oct 1-15	Oct 15-31	Nov 1-15	Nov 15-30	Dec
Statistical High Water (Flood Conditions)	1% Probable Flood	2,335.5	2,335.5	2,335.1	2,334.5	2,333.2	2,332.4	2,305.4	2,290.1	2,240.4	2,240.4	2,245.1	2,305.5	2,305.9	2,331.7	2,332.3	2,335.4
	5% Probable Flood	2,333.4	2,333.4	2,333.7	2,333.2	2,332.1	2,305.6	2,265.9	2,227.7	2,227.7	2,227.7	2,227.7	2,271.7	2,296.7	2,305.4	2,305.8	2,333.1
	20% Probable Flood	2,331.0	2,331.0	2,332.5	2,332.0	2,305.6	2,265.9	2,231.7	2,216.8	2,216.8	2,216.8	2,213.6	2,223.8	2,231.7	2,250.0	2,277.6	2,305.9
	50% Probable Flood	2,277.6	2,277.6	2,331.6	2,305.6	2,265.9	2,227.7	2,213.6	2,207.8	2,207.8	2,207.8	2,205.3	2,207.8	2,207.8	2,207.8	2,190.4	2,250.0
Mean Monthly Flow		2,221.3	2,240.4	2,292.1	2,263.2	2,228.9	2,211.2	2,200.4	2,196.3	2,196.3	2,196.2	2,196.9	2,197.4	2,199.0	2,200.8	2,201.0	2,207.3

Flow Condition		Reservoir Water Surface Elevation (ft) - 9 ft Orifice[2]															
		Jan	Feb	Mar	Apr	May	Jun 1 - 15	Jun 16 - 30	Jul 1 - 15	Jul 16 - 31	Aug	Sep	Oct 1-15	Oct 15-31	Nov 1-15	Nov 15-30	Dec
Statistical High Water (Flood Conditions)	1% Probable Flood	[redacted]				2,332.9	2,332.0	2,289.7	2,249.4	2,220.8	2,220.8	2,223.5	2,298.8	2,305.3	2,318.1	2,331.7	2,335.3
	5% Probable Flood					2,331.4	2,305.0	2,235.7	2,212.8	2,212.8	2,212.8	2,212.8	2,239.0	2,252.9	2,289.7	2,305.2	2,332.8
	20% Probable Flood					2,305.0	2,235.7	2,215.4	2,205.7	2,205.7	2,205.7	2,203.5	2,210.4	2,215.4	2,226.5	2,242.4	2,305.3
	50% Probable Flood					2,235.7	2,212.8	2,203.5	2,199.4	2,199.4	2,199.4	2,197.5	2,199.4	2,199.4	2,199.4	2,180.9	2,226.5
Mean Monthly Flow						2,213.6	2,201.8	2,193.6	2,190.0	2,190.0	2,189.8	2,190.6	2,191.0	2,192.4	2,193.9	2,194.1	2,199.0

M:\1\03\00640\01\A\Data\Task 0800 - GMP Project Submittal and Supporting Cost Estimates\10 - Alt Drawdown Assessment\Task 801.0050 VE Extended Drawdown\FloodWSE Elevations\1_SteadyStateAnalysis\[4_IronGate WSEs.xlsm]Table_IGD_Gate

NOTES:

1. SOURCE: TABLE 1 VA20-01072. SOME RECOMMENDED DESIGN VALUES FOR JULY ARE DICTATED BY THE AUGUST PEAK MONTHLY FLOOD VALES FOR DAM SAFETY PURPOSES.
2. WATER SURFACE ELEVATION CALCULATED USING RATING CURVE PRESENTED ON FIGURE 2.4 VA20-00897 ASSUMING STEADY-STATE CONDITIONS.
3. SHADED VALUES REPRESENT WATER SURFACE ELEVATIONS WITH SPILLWAY FLOW (SPILLWAY INVERT AT 2331.3 ft).
4. THE WATER ELEVATION IN THIS TABLE DO NOT INCLUDE THE RECOMMENDED 3ft FREEBOARD.
5. FOR DAM DECONSTRUCTION, RESERVOIR WATER SURFACE ELEVATIONS SHOULD BE BASED ON 1% PROBABLE FLOOD UNTIL ELEVATION 2224 ft. (AUG). [CREST OF HISTORIC COFFERDAM IS AT ELEVATION 2008 ft]. BELOW THIS ELEVATION, RESERVOIR WATER SURFACE ELEVATION SHOULD BE BASED ON THE 5% PROBABLE FLOOD UNTIL THE CONTROLLED COFFERDAM BREACH IS PREPARED AND IMPLEMENTED.

B	20MAY'20	ISSUED WITH TRANSMITTAL VA20-01072	AS	NB
REV	DATE	DESCRIPTION	PREP'D	RVW'D

APPENDIX A5

VE-1 Submittals: Iron Gate Dam Removal Staging Sketches

(Pages A5-1 to A5-4)

Iron Gate Dam – Staging Sketches

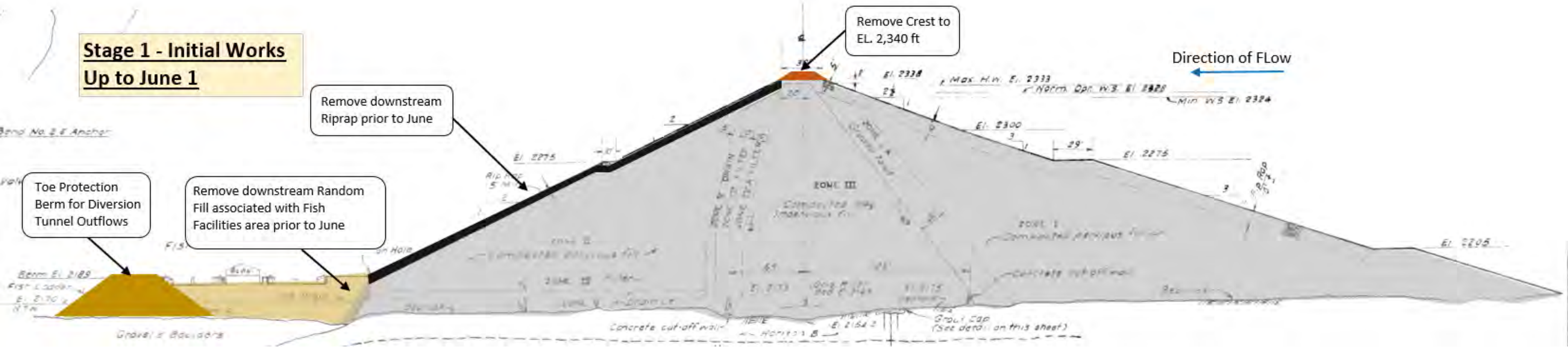


Figure 1: Stage 1 Dam Removal

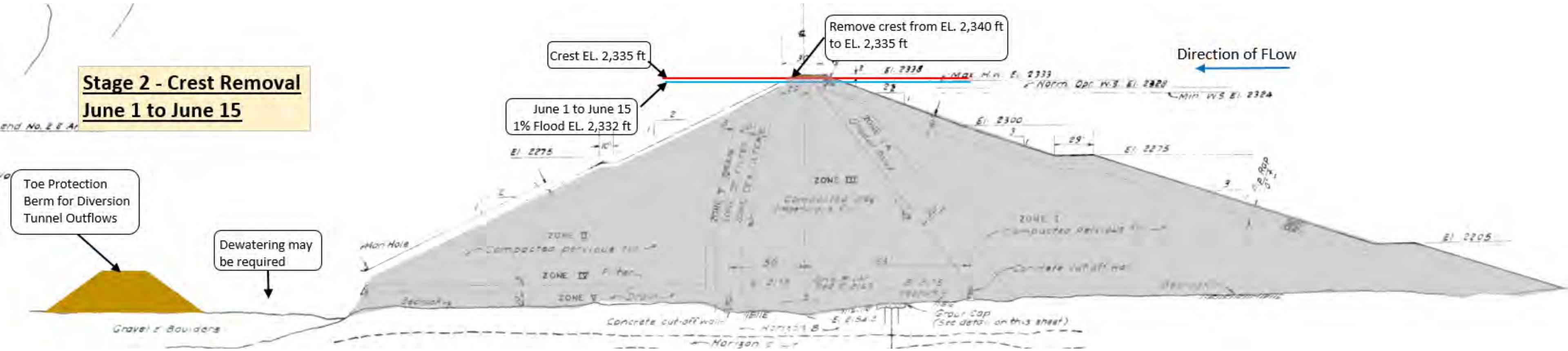


Figure 2: Stage 2 Dam Removal

Iron Gate Dam – Staging Sketches

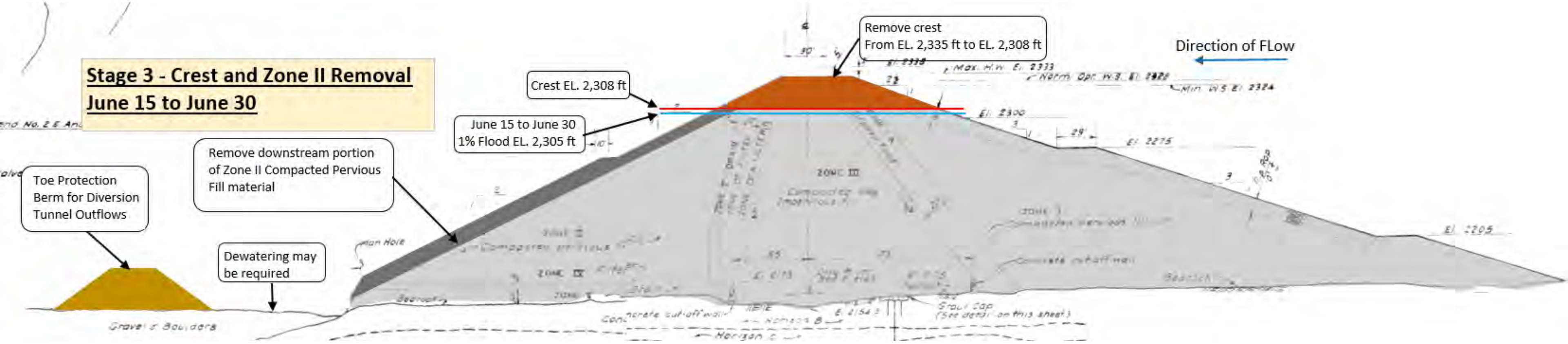


Figure 3: Stage 3 Dam Removal

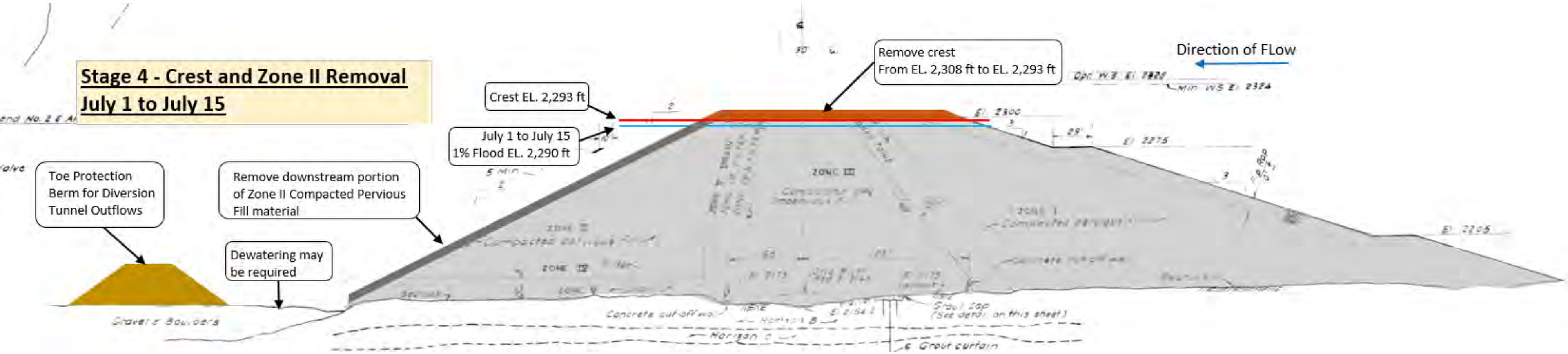


Figure 4: Stage 4 Dam Removal

Iron Gate Dam – Staging Sketches

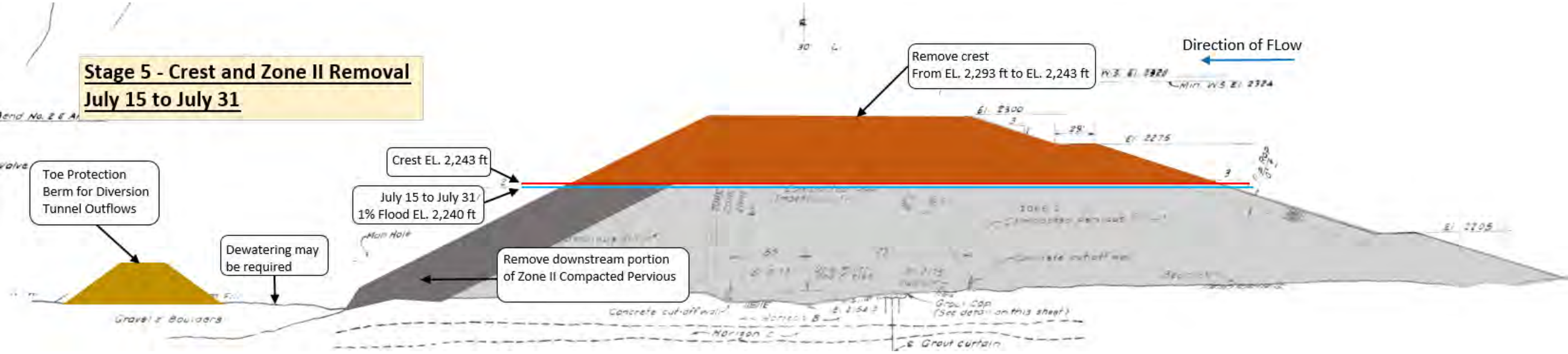


Figure 5: Stage 5 Dam Removal

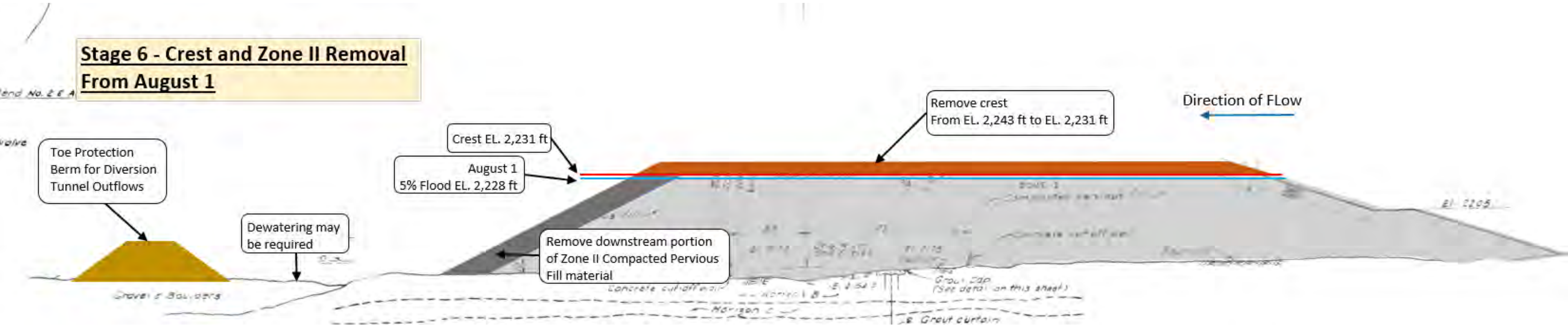


Figure 6: Stage 6 Dam Removal

Iron Gate Dam – Staging Sketches

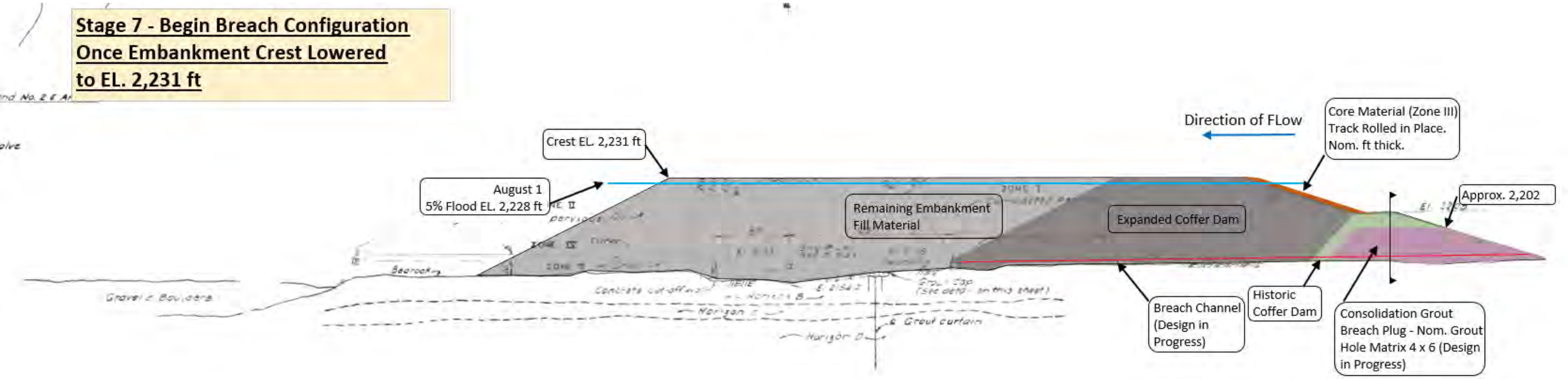


Figure 7: Stage 7 Dam Removal

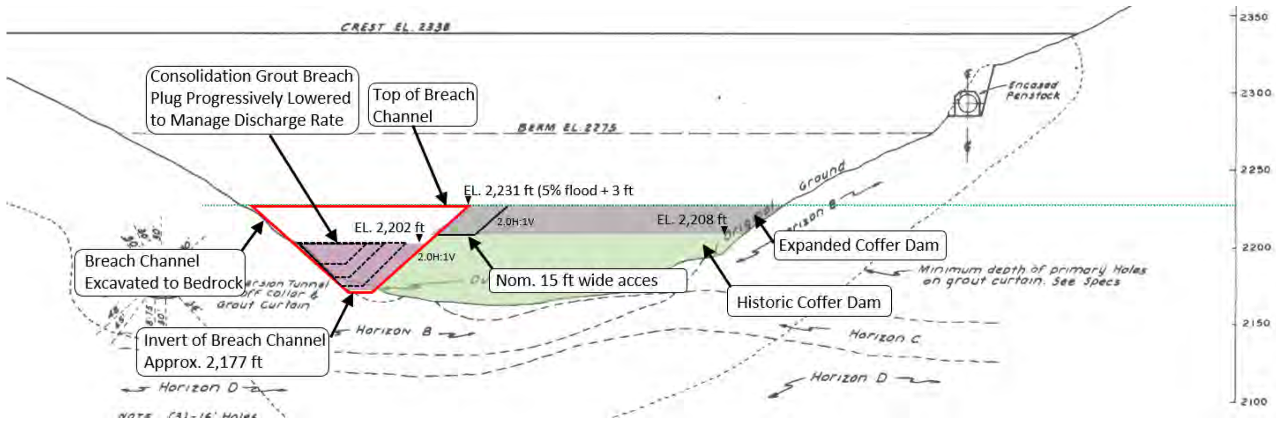


Figure 8: Indicative Breach Cross Section

Knight Piésold CONSULTING

APPENDIX B

VE-2: River Channel Design – J.C. Boyle and Iron Gate

Appendix B1	VE-2 Submittals: Summary Presentation
Appendix B2	VE-2 Submittals: JC Boyle Progress Prints
Appendix B3	VE-2 Submittals: Iron Gate Progress Prints

APPENDIX B1

VE-2 Submittals: Summary Presentation

(Pages B1-1 to B1-14)

JC Boyle and Iron Gate VE-2

Volitional Channel Task Force Meeting

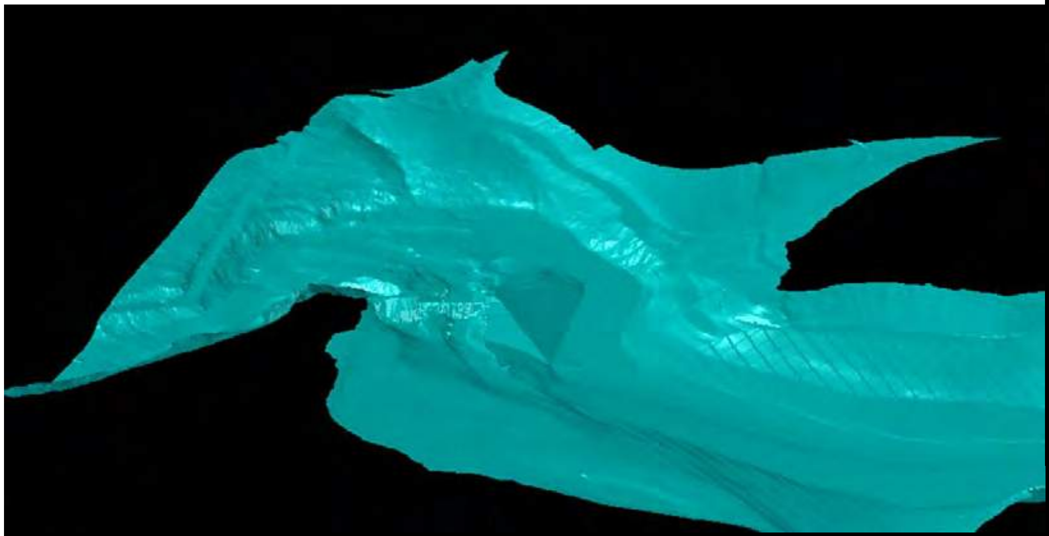
Dam. Unwatered foundation.
7/25/57

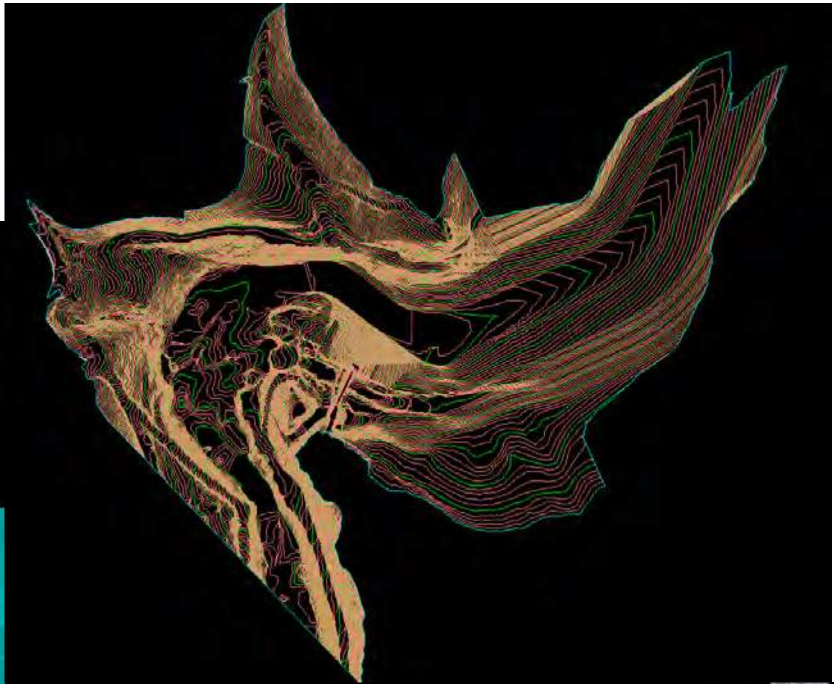
Action Items

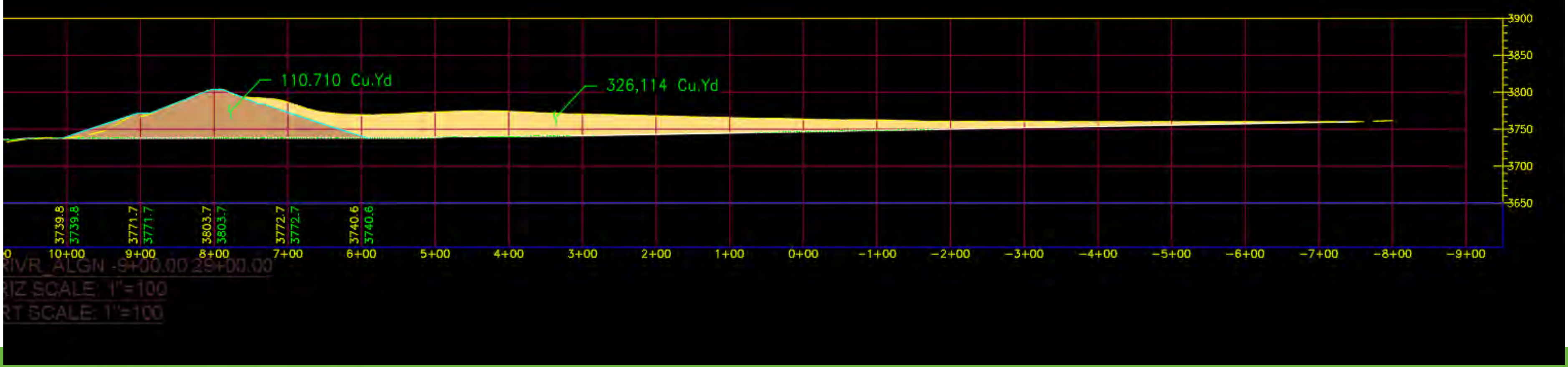
J.C. Boyle	Date
~~Develop J.C. Boyle XML channel and terrain~~	~~April 30~~
~~Confirm model is appropriate for Yurok flow modelling~~	~~May 1~~
~~Run HEC-RAS 2D to determine bank velocities~~	~~May 4~~
~~Design Erosion Protection/Bedding~~	~~May 4~~
~~Develop Progress Prints for Review~~	~~May 5~~
~~Present Detailed Material Takeoffs and Submit Progress Prints~~	~~May 6~~
Iron Gate	
~~Develop Iron Gate XML channel and terrain~~	~~April 30~~
~~Confirm model is appropriate for Yurok flow modelling~~	~~May 7~~
~~Run HEC-RAS 2D to determine bank velocities~~	~~May 7~~
~~Design Erosion Protection/Bedding~~	~~May 7~~
~~Develop Progress Prints for Review~~	~~May 8~~
~~Present Detailed Material Takeoffs and Submit Progress Prints~~	~~May 11~~

Channel Alignment

JC Boyle



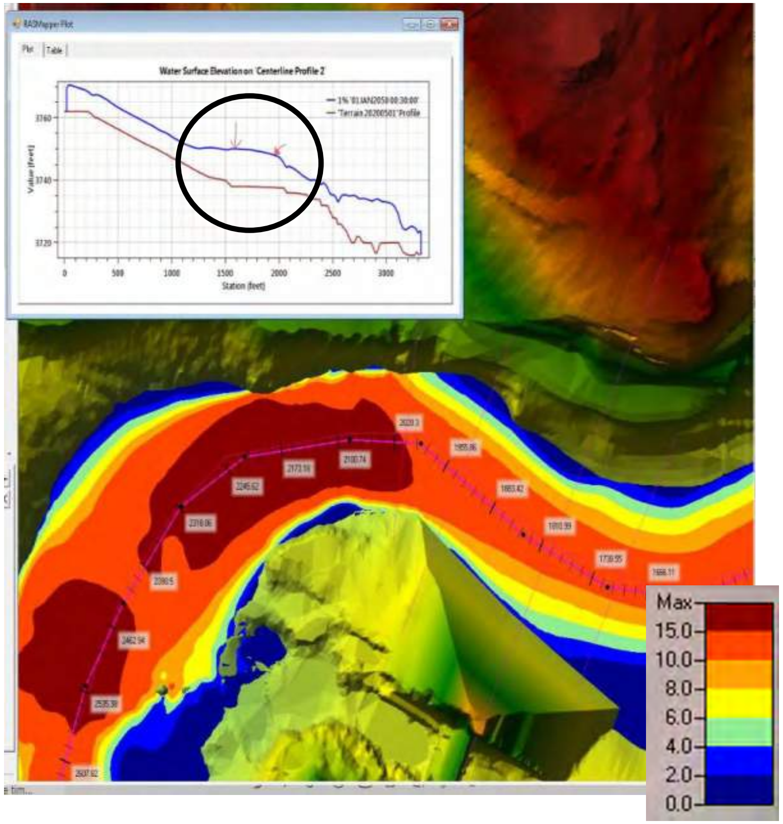




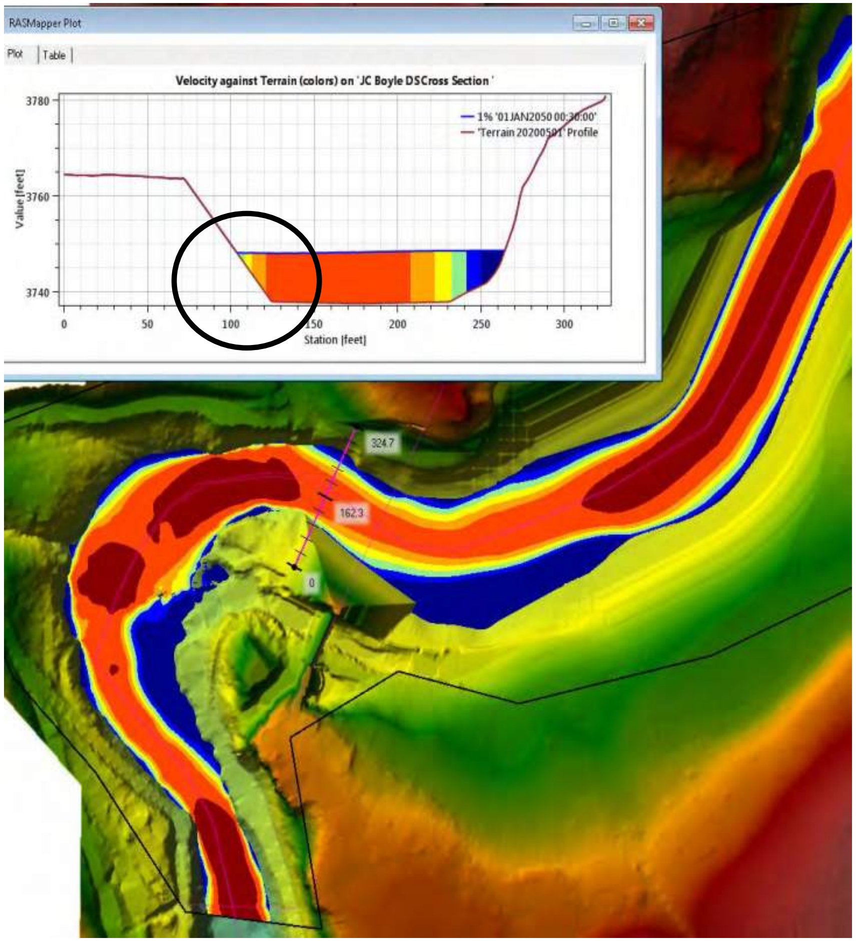
Hydraulic Modelling

JC Boyle

Terrain and WSE Profile (1% Probable Flood)



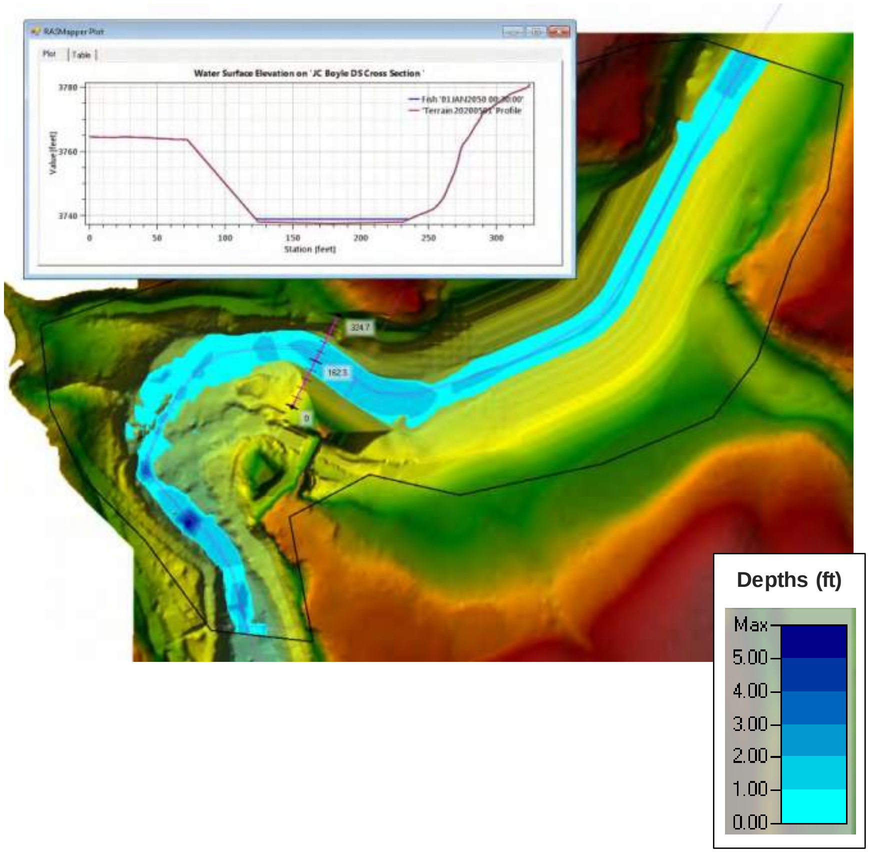
Velocity at 1% Probable Flood (14,200 cfs)



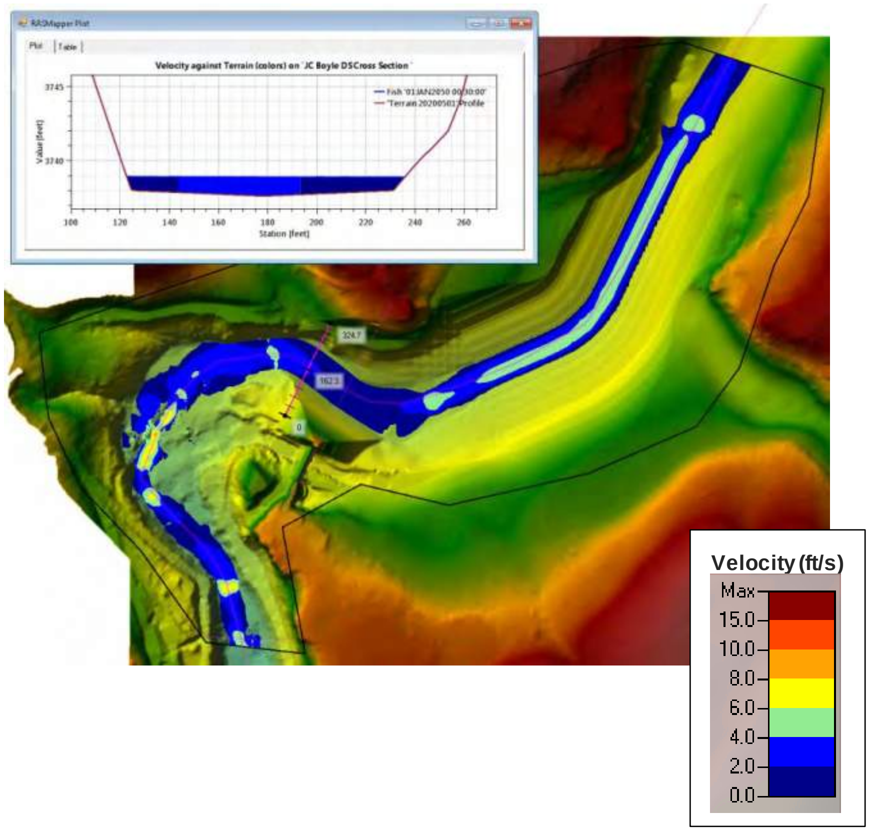
Hydraulic Modelling

JC Boyle

Fish Passage Low Flow (230 cfs) Depth

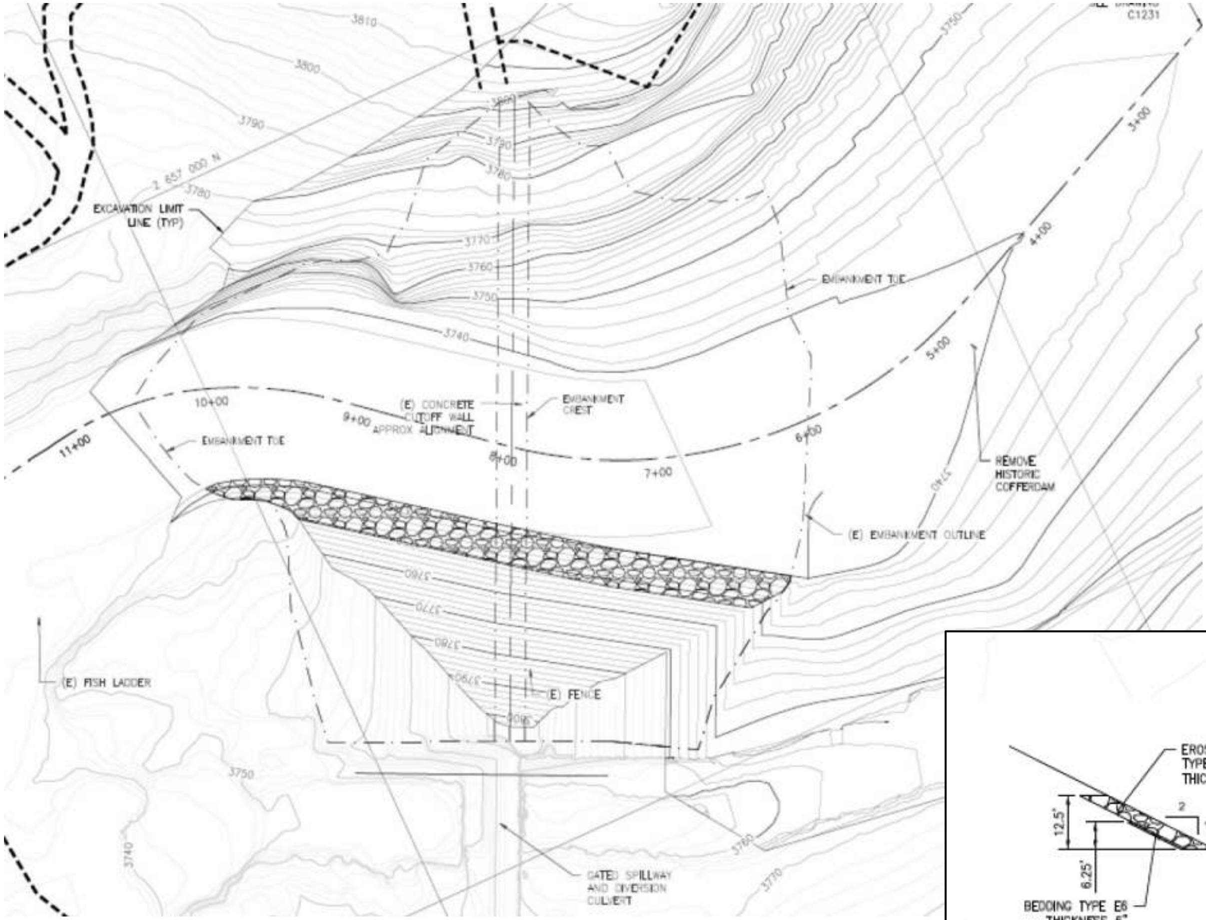


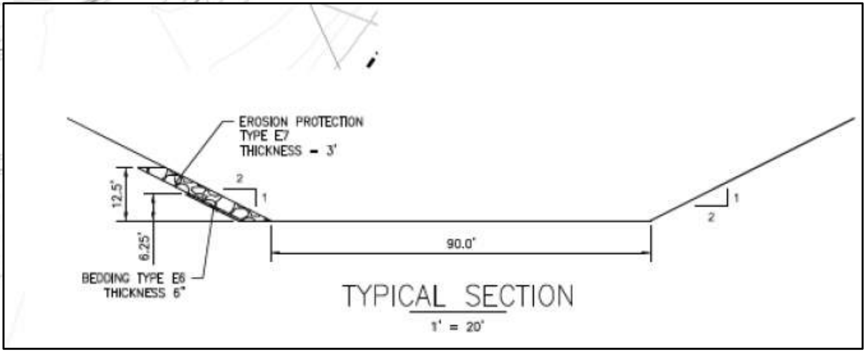
Fish Passage Low Flow (230 cfs) Velocity



Progress Prints

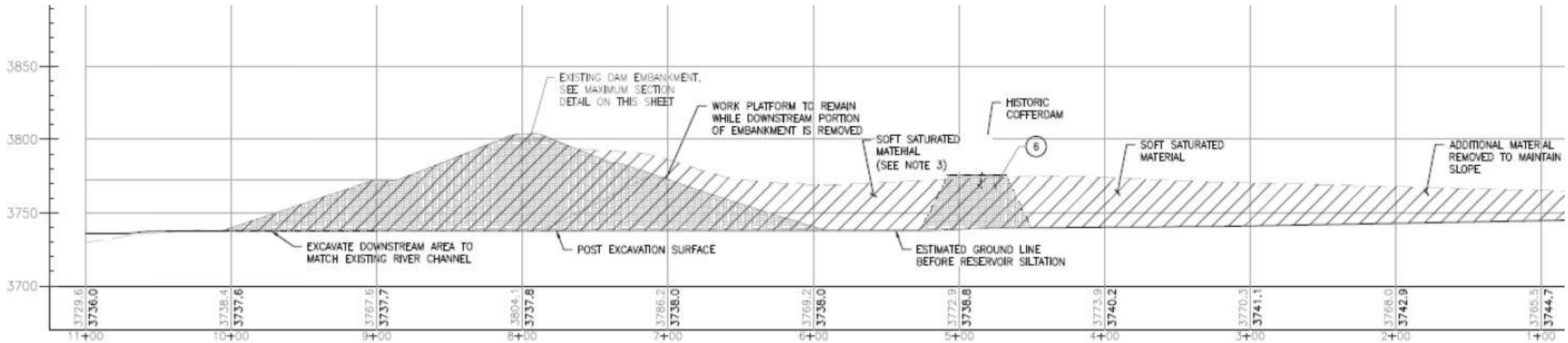
JC Boyle

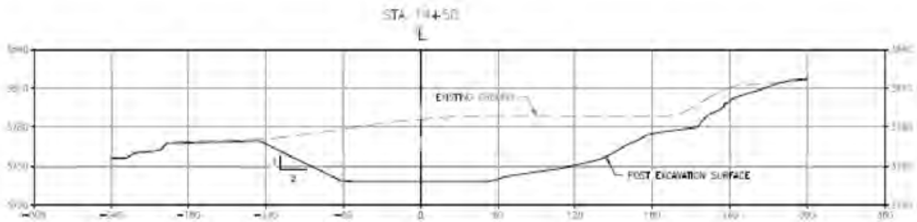


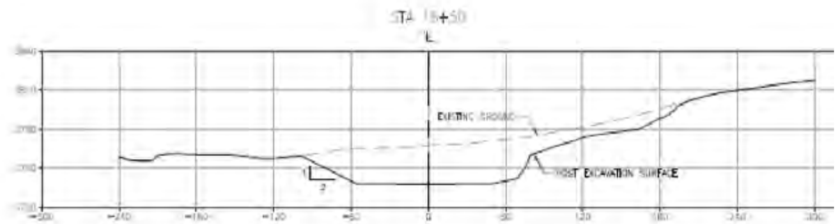


Progress Prints

JC Boyle







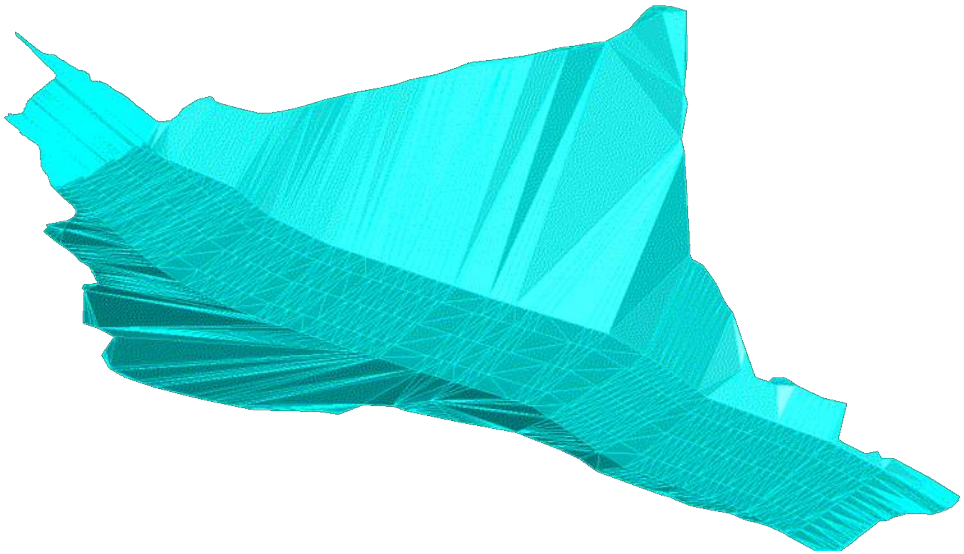
Summary Information

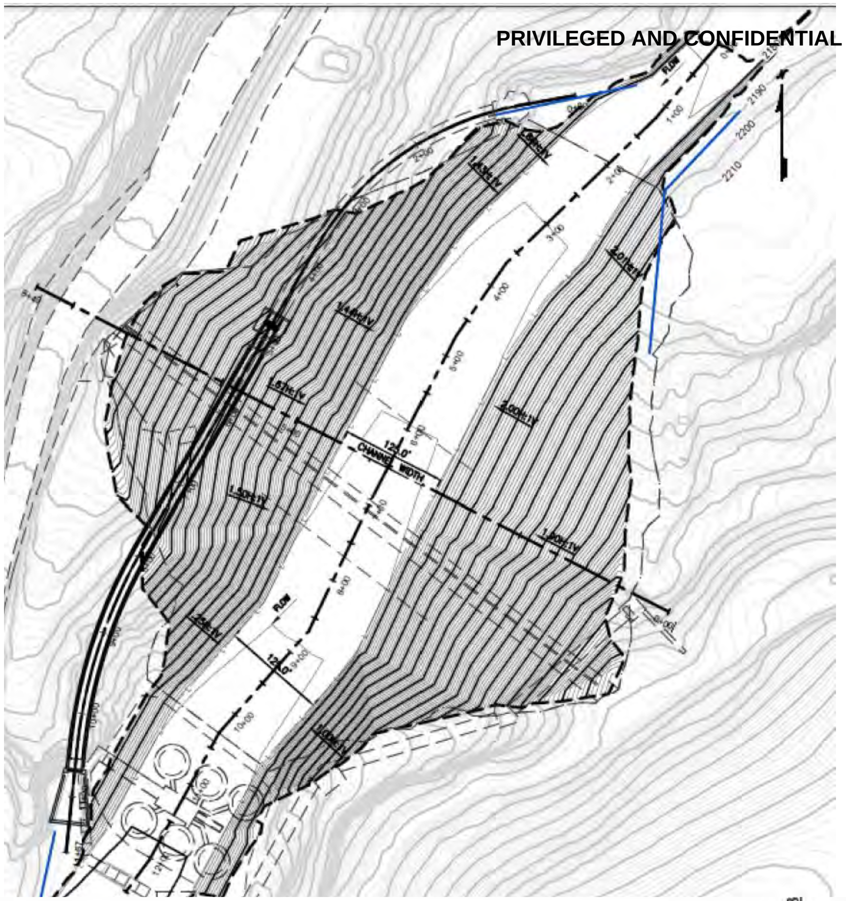
JC Boyle

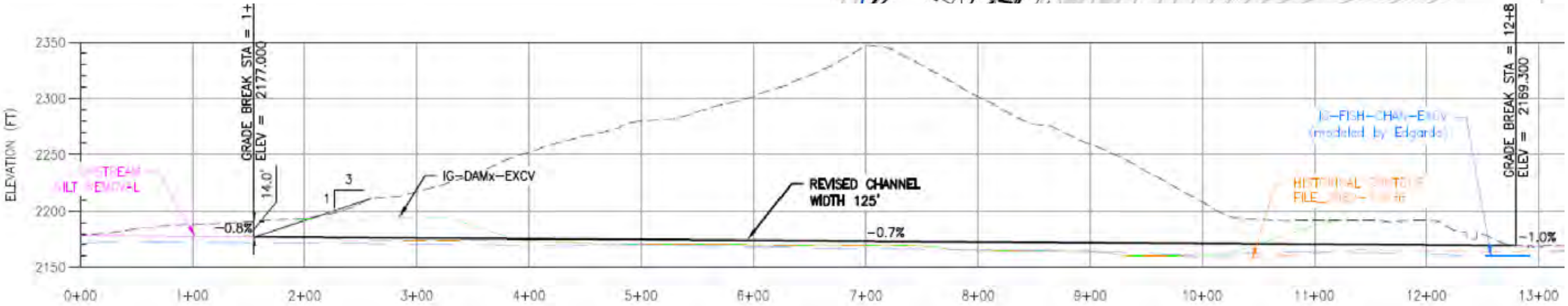
	60% Design	VE Results
Excavation Volume	91,000 yd^3	111,000 yd^3
E7 Volume	10,800 yd^3	1,250 yd^3
E8/E6 Volume	2,800 yd^3	200 yd^3
Channel Slope	2%	1%
2 yr flow elevation	5.0 ft	8.3 ft
5 yr flow elevation	6.5 ft	9.3 ft
100 yr flow elevation	10.0 ft	12.25 ft
E7 D_{50} (min)	2.5 ft	$Lower_{0.5}$ 1.0 ft $Upper_{0.5}$ 0.5 ft

Channel Alignment

Iron Gate





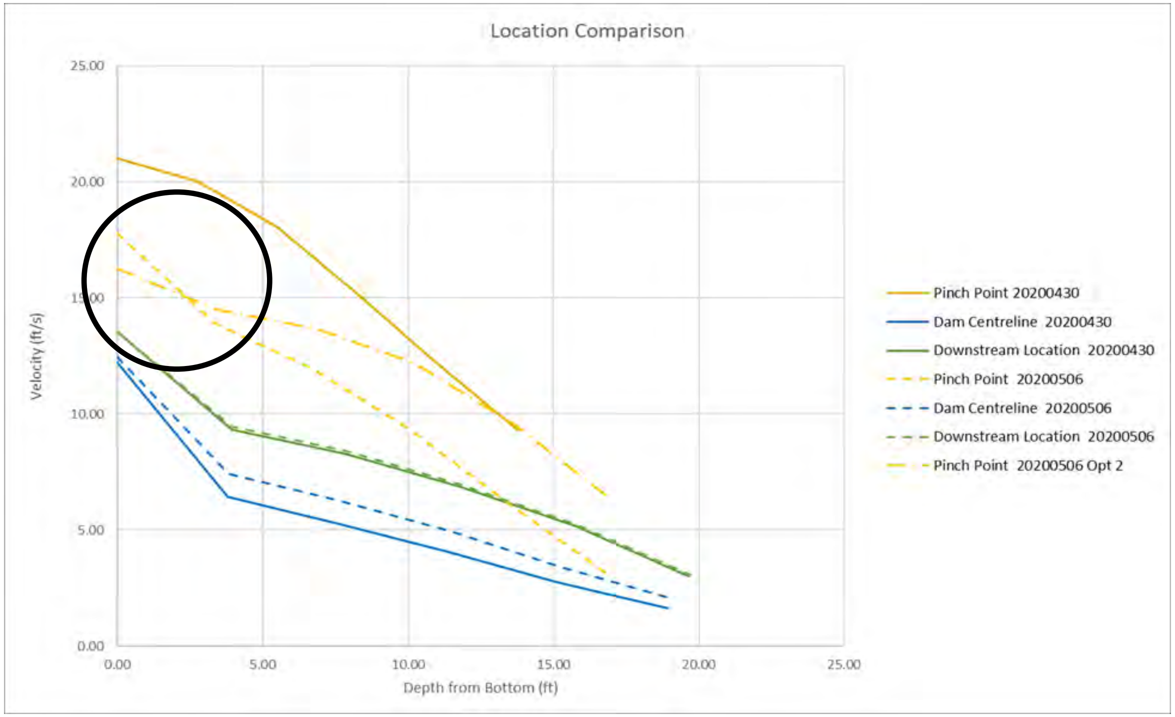


Hydraulic Modelling

Iron Gate

Pinch Point 20200506 = Option 1 – 1% Flow

Pinch Point 20200506 Opt 2 = Option 2 – 1% Flow



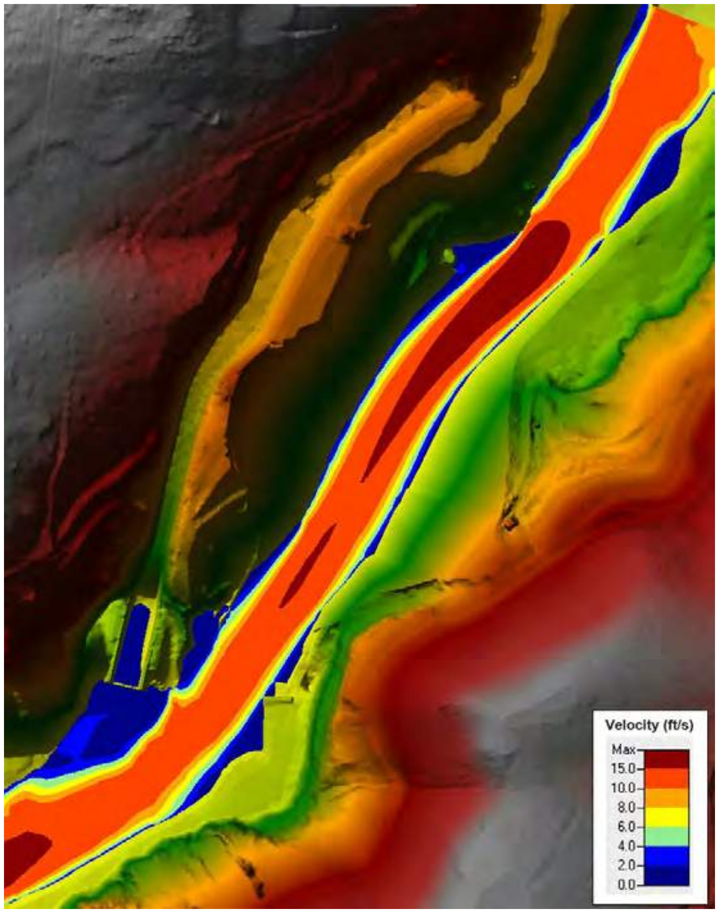
Option 1 Chosen – bank velocity from 0-3 ft from bottom is slightly higher, but velocities dissipate rapidly up the right bank slope above appro x. 5ft

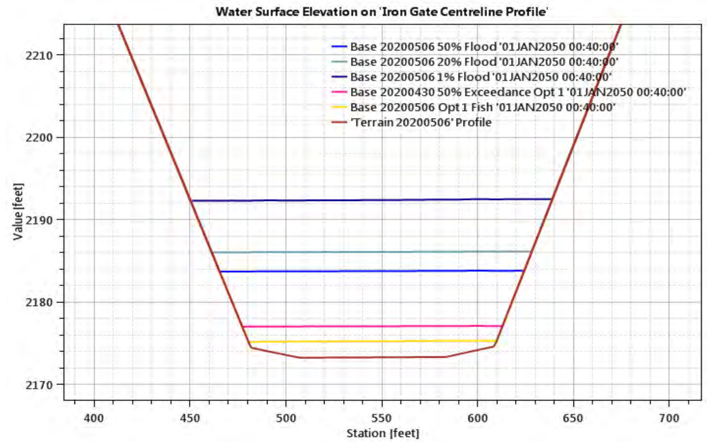
Hydraulic Modelling

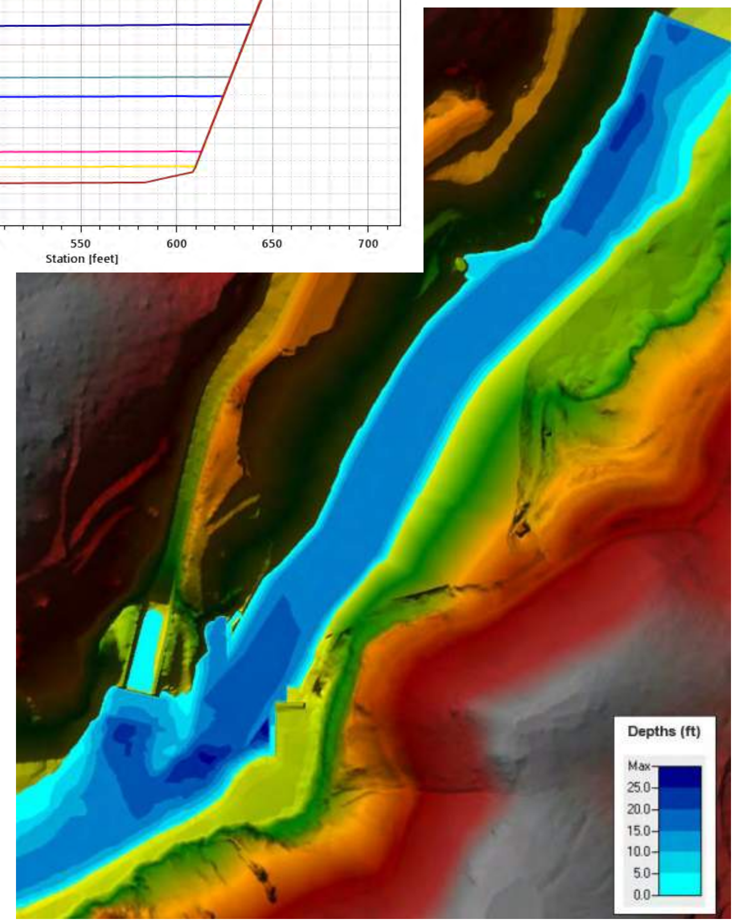
WSE Section and 1% Probable Flood Depth

Iron Gate

Velocity at 1% Probable Flood (33,700 cfs)



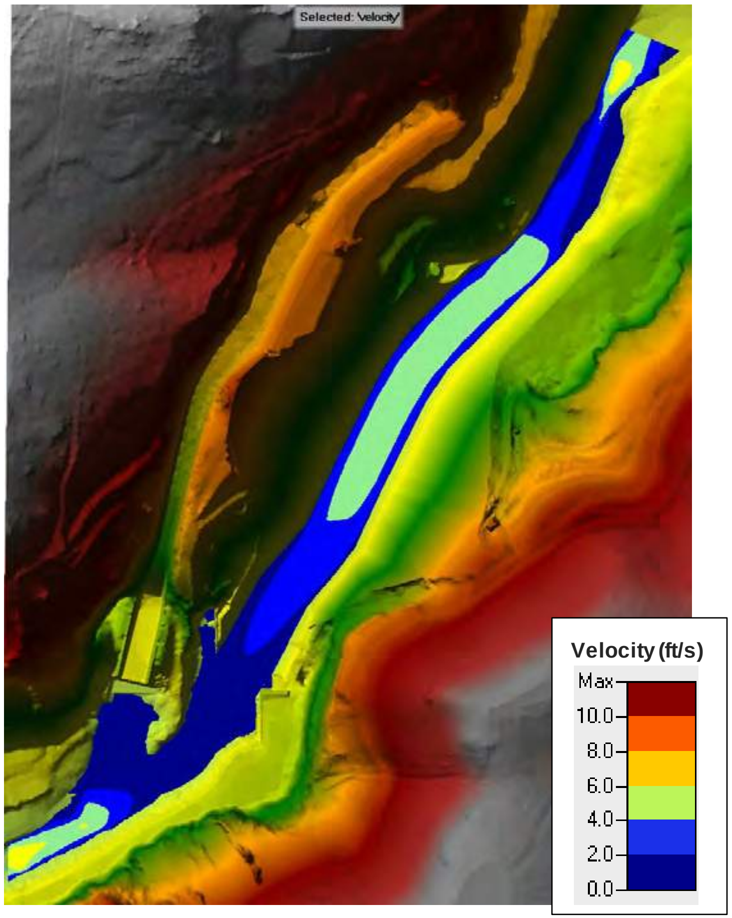




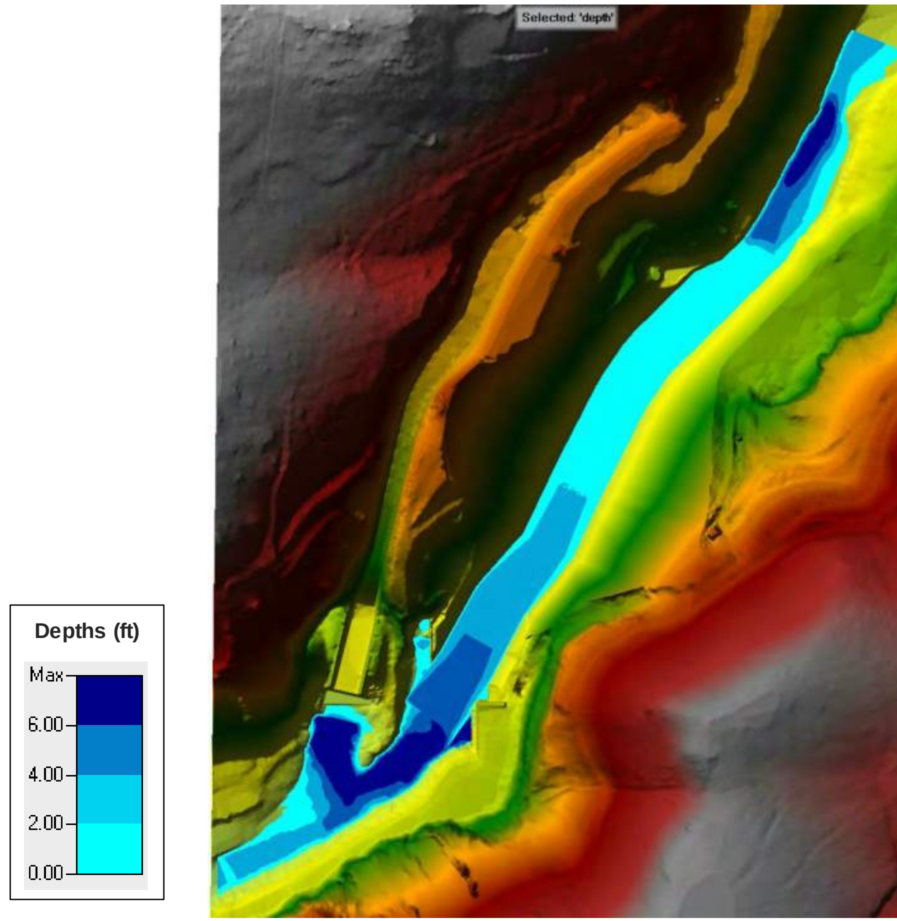
Hydraulic Modelling

Iron Gate

Fish Passage Low Flow (900 cfs) Velocity



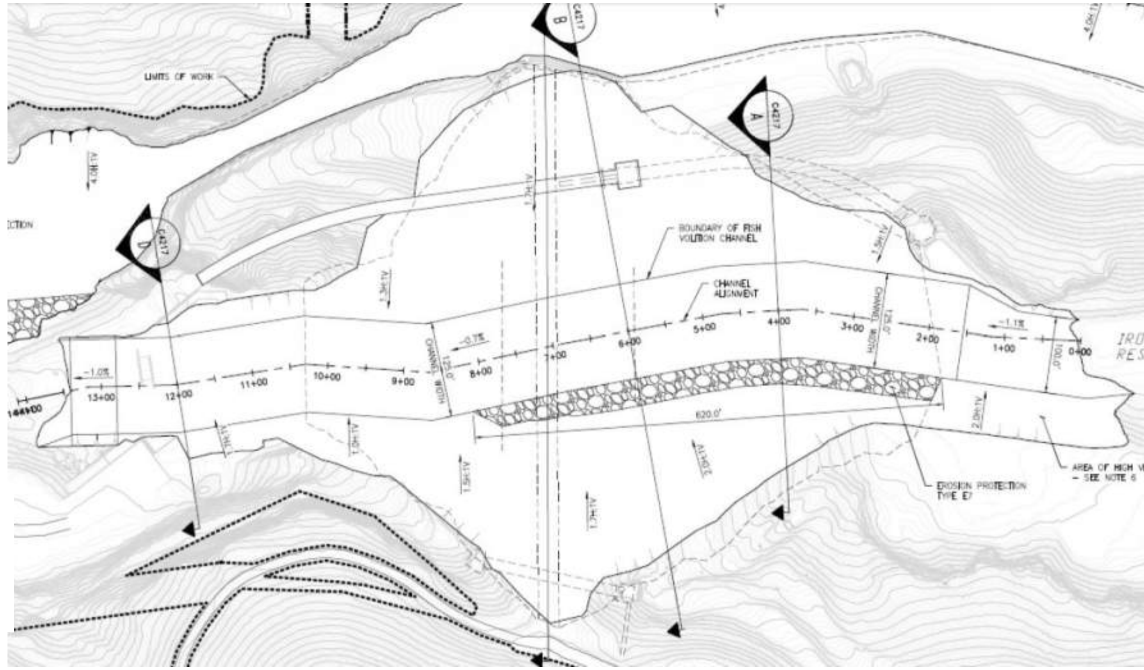
Fish Passage Low Flow (900 cfs) Depth



Progress Prints

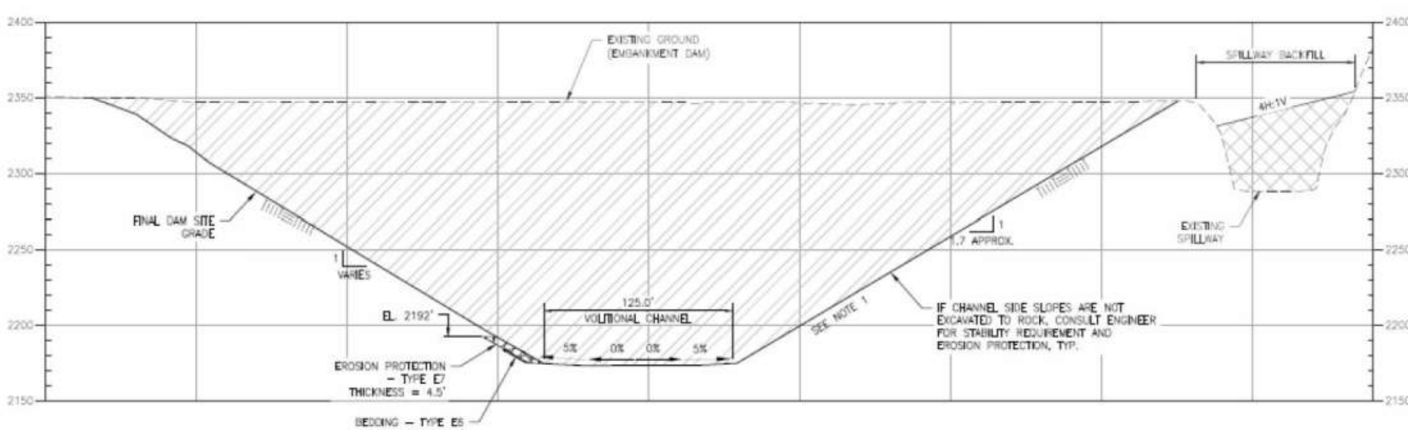
Iron Gate

MATERIAL TYPE	D_{50} LOWER	D_{50} UPPER	VOLUME
EROSION PROTECTION – TYPE E7	2.0 ft	1.0 ft	4900 yd^3
BEDDING – TYPE E6	–	–	500 yd^3



1. ALL CUT SLOPES STEEPER THAN 2H:1V ARE ASSUMED TO BE IN AN AREA WHERE EXCAVATION WILL BE BEDROCK.
2. ESTIMATED VOLUMES:

- EMBANKMENT CUT = 935,000 CU. YD.
- SPILLWAY FILL = 192,612 CU. YD.



Summary Information

Iron Gate

	60% Design	VE Results
Excavation Volume	914,000 yd^3	935,000 yd^3
E7 Volume	6,500 yd^3	4,900 yd^3
E8/E6 Volume	1,700 yd^3	1,500 yd^3
Channel Slope	1 %	0.7 %
2 yr flow elevation	9.0 ft	10 ft
5 yr flow elevation	12.5 ft	12 ft
100 yr flow elevation	20 ft	17 ft
E7 D_{50} (min)	2.0 ft	$Lower_{0.5}$ 2.0 ft $Upper_{0.5}$ 1.0 ft

Knight Piésold CONSULTING

APPENDIX B2

VE-2 Submittals: JC Boyle Progress Prints

(Pages B2-1 to B2-3)

ATTACHMENT A

100% FINAL Design ReportAppendix LMay28(Part1)

Pages 21-28 and 80-94

REDACTED: Pages 21-28 and 80-94 of 100% FINAL Design ReportAppendix LMay28(Part1) consist in their entirety of information about the location, character, or ownership of historic resources that, if disclosed, may cause a significant invasion of privacy; cause a risk of harm to the historic resource; or impede the use of a traditional religious site by practitioners. These pages are labeled as "Privileged" in accordance with 18 C.F.R. § 388.112, 18 C.F.R. § 388.107 and 36 C.F.R. § 800.11(c).

APPENDIX D

Use of Onsite Materials

Appendix D1 VE-4 Submittals: Borrow Sources Site Investigation Report (Draft)

APPENDIX D1

VE-4 Submittals: Borrow Sources Site Investigation Report (Draft)

(Pages D1-1 to D1-141)

Knight Piésold CONSULTING

May 21, 2020

Knight Piésold
KRRP Project Office
4650 Business Center Drive
Fairfield, California
USA, 94534
www.knightpiesold.com

Mr. Nick Drury
Kiewit Infrastructure West Co.
4650 Business Center Drive
Fairfield, California
USA, 94534

Dear Nick,

RE: Klamath River Renewal Project – Summary of Onsite Borrow Source Site Investigation – DRAFT Rev A

1.0 INTRODUCTION

The Klamath River Renewal Project (KRRP) is undergoing a Value Engineering (VE) Phase prior to moving progressive design forward to the 90% design milestone. As part of the VE phase Knight Piésold (KP) has completed an onsite assessment of potential borrow sources at each of the four dam sites. The proposed borrow sources were outlined in KP Work Plan 'VA20-00737'. This borrow source VE focused to identify possible erosion protection, riverbed material and some granular fill onsite borrow sources, and was limited to surficial investigations with no subsurface excavations. The purpose of this letter is to summarize the site investigation findings including an approximate material classification at each site, and provide an estimated potential borrow source volume. WORK PERFORMED

The site investigation was completed by two KP representatives between May 5 and May 8, 2020. Each of the evaluated borrow areas was visually assessed for material type and particle size. To supplement the visual and hand field particle size measurements, photogrammetry analysis was used to assist in the classification the material gradation within the borrow sources. Photographs were taken with 10-inch scale-balls placed on accessible talus and rock piles and were sent to Split Engineering for analysis. Finer grained soils sent for photogrammetry analysis were photographed with a ruler or tape measure as a scale. Relative hardness (strength) of the potential erosion protection materials encountered were obtained using a Schmidt rebound hammer. Erosion protection material samples were obtained at each potential borrow site in 5-gallon buckets. Samples of granular fill were obtained at each potential site in 1-gallon plastic bags. These samples were taken to the KP laboratory for additional testing.

Steep slopes, large void filled boulder fields and loose surface ground prohibited safe access in some potential site borrow areas. In these cases, an attempt was made to capture the general area with photographs and visually classify the material.

A summary of the sample inventory is presented in Appendix A - Table A.1. The samples have been sent to KP's geotechnical laboratory in Denver, Colorado for the following tests and the results will be provided a finalized version of this letter: It is not expected that the lab testing results will change the borrow locations or quantities available from these locations. The lab test results will be reported in the final letter version.

- Point Load – ASTM D5731
- L.A. Abrasion – ASTM C535
- Micro-Deval – ASTM D6928

Knight Piésold CONSULTING

- Magnesium Sulphate Soundness – ASTM C88
- Specific Gravity and Absorption – ASTM D6473
- Modified Acid Base Accounting (ABA)
- Synthetic Precipitate Leaching Procedure (SPLP) – EPA 1312
- Particle Size Analysis (PSA) – ASTM D6913

Field Schmidt rebound hammer test values are summarized and presented in Appendix A - Table A.2. A summary of the approximate coordinates that bound each of the borrow sources investigated is included in Table A.3. A catalog of borrow assessment site visit photographs are presented in Appendix B.

2.0 POTENTIAL BORROW SOURCES FOR EROSION PROTECTION AND GRANULAR FILL

The following sections describe each of the assessed potential borrow sites. The boundaries of the potential borrow sources are denoted for each project location and borrow area on the respective area Figures below. The sites are classified as either a potential source for 'Erosion Protection Material' or 'Granular Fill'. Some borrow site locations are subdivided where the available material type and particle size differs significantly. Due to smaller gradations of clean rock found at some potential erosion protection borrow sites, and similarities between smaller particle size erosion protection, and desired riverbed and bedding, the riverbed and bedding materials were considered when assessing the erosion protection sites.

2.1 IRON GATE WORKER'S ACCOMMODATION AREA

The Iron Gate Worker's Accommodation borrow site is located on the right bank of the Klamath River approximately 1,000 ft downstream the Iron Gate dam. The material on the cut face to the north of the workers accommodation was the primary focus of the investigation, as shown in Figure 2.1, and comprised a potential granular fill potential source, with some limited erosion protection material present adjacent to a rock outcrop.

Granular fill potential source

- Observed gradation of the two Sub-Areas identified:
    - o Sub-area 1: ~10% 2-ft minus material, ~35% 1-ft minus material, ~30% 6-inch minus material, ~20% sand, <5% minus No. 200 (plastic fines), approximately 590 yd² based on aerial imaging.
    - o Sub-area 2: Rock outcrop and limited talus present. Not a significant source of erosion protection material by volume. Basalt, moderately weathered, angular, strong to very strong, breaks with moderate to hard strikes with rock hammer, Schmidt Hammer strength values ranging from 12 to 41 ksi with no apparent sulfide mineralization.
- Approximately 2 ft of finer material exists on the lower 10 ft of exposed slope face of both Sub-Areas. A Split-NET gradation analysis of this material is presented in Appendix C - Figure C1. Results indicated a D_{85} = 1.4", D_{50} = 0.31" and D_{15} = 0.03".
- Granular Fill sample IGW-GF1 was obtained for sieve analysis and soil classification.
- Erosion Protection sample IGWA-EP1 was obtained for durability properties testing.
- Road surfacing material generally 1.5 inch minus consisting of silty gravel with sand.
    - o Approximate surface area and thickness of 1,100 yd², 0.1 ft, respectively.

Based on the results of the field assessment, there is potential for Sub-Area 1 to be processed to produce granular fill. The hillside would have to be mined further into the slope to generate larger quantities. There

Knight Piésold CONSULTING

does not appear to be any surficial infrastructure or property boundary impediments to accomplishing this. This area is not considered an adequate source of erosion protection material.

Figure 2.1 Iron Gate Worker's Accommodation Potential Borrow Source

2.2 IRON GATE LAKEVIEW ROAD

The Iron Gate Lakeview Road borrow site is located adjacent to Lakeview Road, approximately 1,100 ft east of Daggett Bridge as shown in Figure 2.2. The material primarily comprised smaller class erosion protection, or possibly bedding material.

Erosion protection potential source

- Basalt, slightly weathered, angular, very strong, difficult to break with rock hammer, Schmidt hammer strength values ranging from 31 to 55 ksi with no apparent sulfide mineralization.
- Very little organics are apparent, almost zero vegetation is in area.
- Observed Gradation: <1% 4-foot minus material, ~10% 2-ft minus, ~25% 1-ft minus, ~40% 6-inch minus, ~25% 3-inch minus.
- Three Split-NET gradation analyses were completed and are presented in Appendix C - Figures C.2, C.3, and C.4. Results indicated a D_{85} = 13.7", D_{50} = 7.1" and D_{15} = 1.2"; a D_{85} = 8.5", D_{50} = 3.25" and D_{15} = 0.46"; and D_{85} = 21.3", D_{50} = 4.1" and D_{15} = 0.1".
- Granular Fill sample LV-GF1 was obtained for sieve analysis and soil classification.
- Erosion Protection sample IGLV-1 was obtained for durability properties testing.
- Borrow source surface area approximately 825 yd² based on aerial imaging.
- Assume excavation invert will be limited to the adjacent ditch line of road to avoid allowing water to pool.

Based on the results of the field assessment, the assessed area is appropriate for smaller size erosion protection or bedding material. The dashed area located to the east of the main borrow source may be suitable for use as granular fill, however a gradation of the material is difficult to estimate from a visual assessment without trenching or probing.

Figure 2.2 Iron Gate Lakeview Road Potential Borrow Source

2.3 IRON GATE DAM DOWNSTREAM FACE

The Iron Gate Dam Downstream Face has existing Erosion Protection placed from the dam crest to the fish hatchery at the dam toe. The dam face was sub-divided into three separate sub-areas based on the apparent surface erosion protection particle size, as shown on Figure 2.3.

Erosion protection potential source

- Basalt is slightly weathered, angular, very strong, and difficult to break with rock hammer; Schmidt hammer strength values range from 44 to 49 ksi with no apparent sulfide mineralization.
- Observed gradation of the three sub-areas assessed on the downstream face:
    - Sub-area 1: D_{50} = ~28”, D_{85} = 40”, approximately 2,980 yd² based on aerial imaging. Split-NET gradation analysis was completed and is presented in C.5. Results indicated a D_{85} = 36”, D_{50} = 18” and D_{15} = 3.4”.
    - Sub-area 2: D_{50} = ~20”, approximately 1,950 yd² based on aerial imaging. Split-NET gradation analysis was completed and is presented in C.6. Results indicated a D_{85} = 26”, D_{50} = 12” and D_{15} = 1.4”, which were smaller than the observed average gradation.
    - Sub-area 3: D_{50} = ~9”, D_{85} = 12”, D_{15} = 3” approximately 5,900 yd² based on aerial imaging. Split-NET gradation analysis was completed and is presented in C.7. Results indicated a D_{85} = 10”, D_{50} = 3.5” and D_{15} = 0.4”, which are smaller than the field observed average gradation.
- Erosion Protection sample IGDDS-1 was obtained for durability properties testing across lower half of embankment surface.
- The downstream dam face has a minimum erosion protection thickness of 5 ft, as per historic as-built drawing 5407-A-111.

The observed material quality and durability within all 3 sub-areas of the downstream shell are similar, however the material size varies across each sub-area. Sub-area 1 had the largest material, followed by Sub-areas 2, then Sub-area 3. Based field assessment results, this site can be used as a source for Erosion Protection of varying sizes.

Figure 2.3 Iron Gate Downstream Dam Face

2.4 COPCO NO. 1 ACCESS ROAD

The Copco No. 1 Access Road potential borrow source is located along the existing Copco No. 1 right bank access road and along the proposed future road alignment shown on drawing C2510. The access road construction will produce a surplus material, of which some is expected to be used as source of erosion protection or granular fill. This investigation, however, was limited to surface observations and was unable to ascertain the gradation and material type of the proposed bulk excavation. Two areas that had visible erosion protection material on surface were investigated, as shown on Figure 2.4.

Erosion protection potential source

- Fine-grained basalt, some vesicular, angular, lightly weathered, very strong, breaks with hard strikes from rock hammer, Schmidt hammer strength values ranging from 23 to 41 ksi with no apparent sulfide mineralization.
- Observed gradation of two Sub-areas assessed on the Copco No. 1 Access Road:
    - Sub-area 1: D_{50} = ~15", <10% 3-inch minus material, approximately 365 yd² based on aerial imaging.
    - Sub-area 2: Not considered an adequate source. Localized erosion protection material available.

- Two Split-NET gradation analyses were completed in Sub-area 1 and are presented in Appendix C - Figures C.8, and C.9. Results indicated a D_{85} = 18”, D_{50} = 9” and D_{15} = 1.6”, and a D_{85} = 15”, D_{50} = 7” and D_{15} = 1.8”, respectively, which are smaller than the field observed average gradation.
- Erosion Protection sample CRBR-1 obtained for durability properties testing in Sub-area 1

Figure 2.4 Copco No. 1 Access Road Potential Borrow Source

Based on the results of the investigation, Sub-area 1 may be an acceptable source of small size Erosion Protection, Riverbed, or Bedding Material. The surface material at Sub-area 2 does not have adequate coverage of large sized rocks to be a reliable borrow source.

2.5 COPCO NO. 1 VILLAGE

Copco No. 1 Village potential borrow source is located the north of the Copco No. 1 Dam Right Abutment and lies adjacent to an existing historic borrow source, as shown in Figure 2.5. The material was assessed as a potential source of granular fill.

Granular fill potential source

- USCS, SC, 1 to ½” minus, clayey sand with gravel. Two Split-NET gradation analyses were completed and are presented in Figures C.10, and C.11 in Appendix C. Results indicated a D_{85} = 0.9”, D_{50} = 0.2” and D_{15} = 0.03”, and a D_{85} = 0.6”, D_{50} = 0.2” and D_{15} = 0.03”, respectively.
- Granular Fill sample C1V-1 obtained for sieve analysis and soil classification.
- Approximately 2,070 yd² based on aerial imaging.

Area may be possible source for finer grained granular fill.

Figure 2.5 Copco No. 1 Village Potential Borrow Source

2.6 COPCO NO. 2 DOWNSTREAM RIGHT BANK

The Copco No. 2 downstream right bank potential borrow source is a talus slope located approximately 250 ft downstream of the Copco No. 2 diversion dam, as shown on Figure 2.6. The talus comprises erosion protection material.

Erosion protection potential source

- Fine-grained basalt, some vesicular, angular, slightly weathered, very strong, difficult to break with rock hammer, Schmidt hammer strength values ranging from 30 to 52 ksi with no apparent sulfide mineralization.
- Observed gradation: D_{50} value ~ 48 inches, 20% 7-ft minus, 20% 5-ft minus ft, 50% 4-ft minus, 10% 1-ft minus.
    - o In the areas denoted by the orange boundaries in Figure 2.6, the D_{50} was observed to be smaller, approximately 32” to 36”.
- Two Split-NET gradation analyses were completed and are presented in Appendix C - Figures C.12, and C.13. Results indicated a D_{85} = 46”, D_{50} = 32” and D_{15} = 14”, and a D_{85} = 44”, D_{50} = 28” and D_{15} = 5”, respectively. The results of the analysis are suspected to be smaller than the field observed gradations due to the inability to place both scaling balls in the photograph to account for depth of field.
- Erosion Protection sample C2DSR-1 obtained for durability properties testing.
- No Granular Fill samples obtained at this site.
- Approximately 3,000 yd² based on aerial imaging.

The material found within the right bank talus pile is among the largest onsite sized boulders available and is appropriate for the large erosion protection sizes specified at the Copco No. 1 and No. 2 locations.

Figure 2.6 Copco No. 2 Downstream Right Bank Potential Borrow Source

2.7 COPCO NO. 2 DOWNSTREAM LEFT BANK

The Copco No. 2 downstream left bank potential borrow source is a talus slope located approximately 300 ft downstream of the Copco No. 2 diversion dam, as shown on Figure 2.7. The talus comprises erosion protection material.

Erosion protection potential source

- Fine-grained basalt, some vesicular, angular, slightly weathered, very strong, difficult to break with rock hammer, Schmidt hammer strength values ranging from 29 to 46 ksi with no apparent sulfide mineralization.
- Observed Gradation: D_{50} = 40”, general material is 6-ft minus.
- Two Split-NET gradation analyses were completed and are presented in Appendix C -Figure C.14 and C.15. Results indicated a D_{85} = 44”, D_{50} = 28”, and D_{15} = 15”, and a D_{85} = 60”, D_{50} = 33”, and D_{15} = 7.5”, respectively. The two photographs are of the same area but at different setback distances. Figure C.15 photograph was taken further back and the results were closer to the field observed gradation.
- Erosion Protection sample C2LB-1 was obtained for durability properties testing.
- No Granular Fill samples was obtained at this site.
- Approximately 1,940 square yards based on aerial imaging.

The material found within the talus pile on the left bank is among the largest sized boulders available onsite and is appropriate for the large erosion protection classes specified at the Copco No. 2 location.

Figure 2.7 Copco No. 2 Downstream Left Bank Potential Borrow Source

2.8 COPCO NO. 2 WOOD-STAVE PENSTOCK

The Copco No. 2 Wood-Stave Penstock is located to the south of the Wood-Stave Penstock and Tunnel 2 Inlet Portal along the Copco No. 2 Water Conveyance system. The area has possibly been previously used as borrow source or material storage site. The area was divided into three distinct materials, as shown in Figure 2.8.

Granular fill potential source

- Three distinct materials, working west to east:
  - Sub-area 1: USCS, GC, 3-inch minus brown, clayey gravel with sand, occasional cobbles, approximately 990 yd² based on aerial imaging. A Split-NET gradation analysis was completed and is presented in C.16. Results indicated a D_{85} = 1.25", D_{50} = 0.2" and D_{15} = 0.01".
  - Sub-area 2: USCS, GP, grey sandy gravel, approximately 230 yd² based on aerial imaging.
  - Sub-area 3: USCS, GP, 6-inch minus, 75-80% passing 3-inch screen, 50% > 1.5 inches, 20% passing 1-inch screen, approximately 240 yd² based on aerial imaging. A Split-NET gradation analysis of Sub-Area 3 is presented in Appendix C – Figure C.17. Results indicate a D_{85} = 3.5", D_{50} = 1.2" and D_{15} = 0.14".
- Granular Fill samples C2WP-1, C2WP-2 AND C2WP-3 was obtained for sieve analysis and soil classification.
- The coarse material in Sub-area 2 and 3, as shown in Figure 2.9, appear to be remnants of processed material that was stockpiled in this area. Without further excavation into the slope the confirmed depth of this coarse material was limited to 2 ft.

Figure 2.8 Copco No. 2 Wood-Stave Penstock Potential Borrow Source

Figure 2.9 Wood-Stave Penstock Sub-Area 3 Coarse Granular Fill

Knight Piésold CONSULTING

2.9 J.C. BOYLE DOWNSTREAM OF DAM

The area directly downstream of the J.C. Boyle was assessed for possible sources of erosion protection material. Five distinct sub-areas were investigated, as shown in Figure 2.10.

Erosion protection potential source

- Coarse-grained basalt, some vesicular, angular, lightly weathered, very strong, difficult to break with most specimens requiring multiple blows from rock hammer, Schmidt hammer strength values ranging from 21 to 49 ksi with no apparent sulfide mineralization.
- Observed gradations for the five Sub-areas assessed downstream of the J.C. Boyle dam:
  - Sub-area 1: D_{50} = ~9", D_{max} = ~3 ft, ~35% passing 6" screen, ~20% waste, approximately 850 yd². Two Split-NET gradation analyses were completed and are presented in Appendix C - Figure C.18 and C.19. Results indicated a D_{85} = 12", D_{50} = 2.4" and D_{15} = 0.03", and a D_{85} = 26", D_{50} = 8.4" and D_{15} = 0.03", respectively.
  - Sub-area 2: D_{50} = 24", approximately 250 yd². A Split-NET gradation analysis was completed and is presented in Figure C.20, in Appendix C. Results indicated a D_{85} = 33", D_{50} = 19" and D_{15} = 4".
  - Sub-area 3: not a significant source of material.
  - Sub-area 4: not a significant source, localized piles of approximately D_{50} = 36" material (see Figure 2.11).
  - Sub-area 5: D_{50} = 24", D_{max} = 48", approximately 2,020 yd² based on aerial imaging.
- Erosion Protection sample JCBEP-1 obtained for durability properties testing.
- No Granular Fill samples obtained at this site.
  The downstream dam face (Sub-area 1) has a minimum erosion protection thickness of 2 ft, as per historic as-built drawing AA 78084.

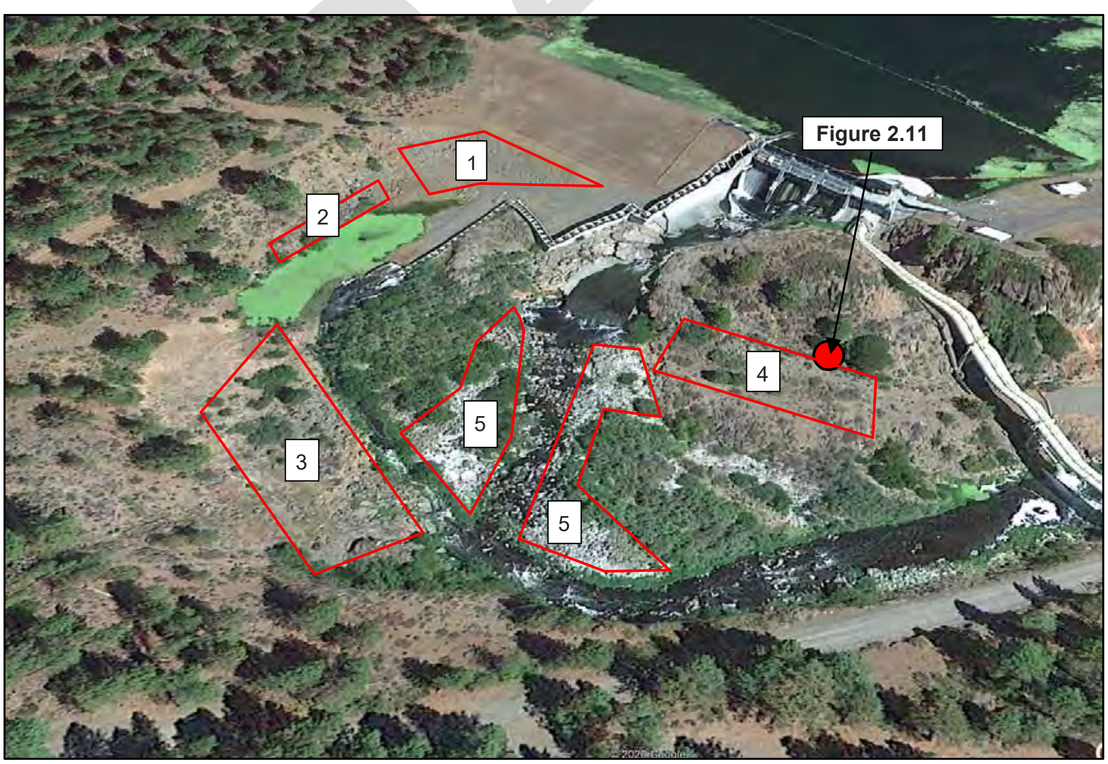


Figure 2.10 J.C. Boyle Downstream of Dam Potential Borrow Source

Figure 2.11 Sub-area 4 Downstream, Left Slope coarse particles are scattered and bedded

2.10 J.C. BOYLE FOREBAY

The granular surfacing material at the J.C. Boyle Forebay access road and parking area was identified as a possible granular fill source for the access road realignment. The areas shown in Figure 2.12 were assessed.

Potential granular fill source

- Road course and parking lot generally 1-inch nominal with trace cobbles and boulders, zero to low plasticity, silty sand, and gravel, black in color when moistened. A Split-NET gradation analysis was completed and is presented in Appendix C - Figure C.21. Results indicated a D_{85} = 0.75”, D_{50} = 0.2” and D_{15} = 0.02”.
- Approximately 0.2 ft in depth within gravel surfacing.
- Material adjacent to road covered areas, gravel with sand, 10-20% cobbles, low to medium plasticity, likely oxidized native material, reddish brown in color when moistened. Material with similar properties exists in access roads below road surfacing gravel (See Figure 2.13).
- Road surfacing area is approximately 2,800 square yards based on aerial imaging, however due to limited thickness of the pavement, there is limited salvageable road coarse material.
- No samples were obtained in this area.

Knight Piésold CONSULTING

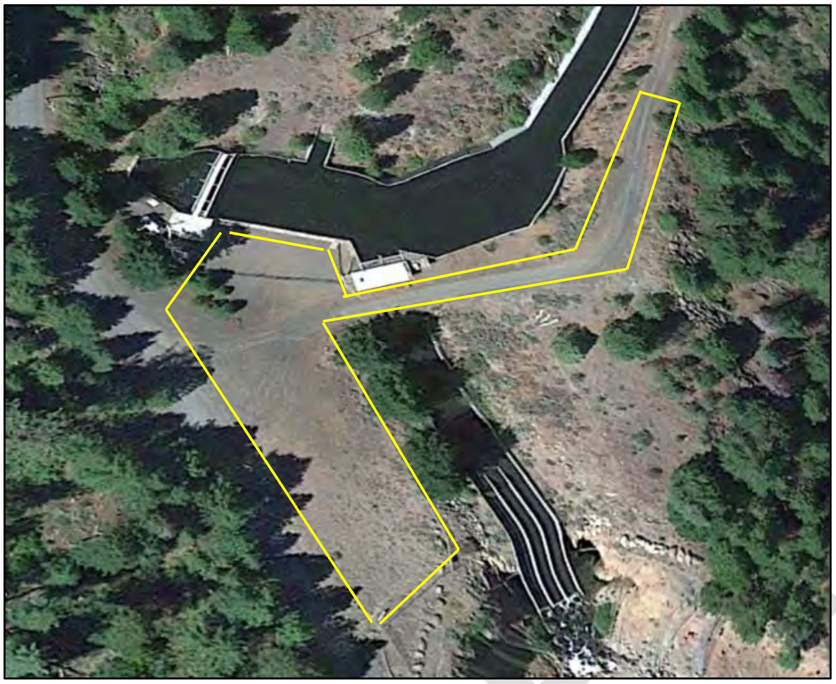


Figure 2.12 J.C. Boyle Forebay Potential Borrow Source

Figure 2.13 Evidence of little to no gravel surfacing along access roads. Coarse fraction in subgrade include cobble to boulder sized particles

2.11 J.C. BOYLE POWERHOUSE

The material adjacent to the J.C. Boyle Powerhouse and Penstocks was assessed to determine if any significant volume of areas of possible granular fill or erosion protection materials were present. The area was sub-divided based on material type, as shown in Figure 2.14.

Knight Piésold CONSULTING

Potential granular fill source

- Sub-area 1: Variable material, typically clayey sand and gravel to clayey gravel with sand, 1-foot minus with boulders and cobbles. Localized concentrated cobble to boulder sized particles present on surface adjacent to road (see JCB Powerhouse Photo 11 in Appendix B). Localized pile was analyzed using Split-NET, as shown in Appendix C - Figure C.22. Results indicated a D_{85} = 14”, D_{50} = 8.” and D_{15} = 1.5”.
- Sub-area 2: Road surfacing gravel nominal size nominal 1-inch; grey sandy gravel; 0.05 to 0.1 ft. in thickness, approximately 3,700 yd², however due to limited thickness of the pavement, there is limited salvageable road coarse material. A Split-NET analysis was complete on the road material, as shown in Appendix C – Figure C.23, however the large cobbles in the top of created unrepresentative results.

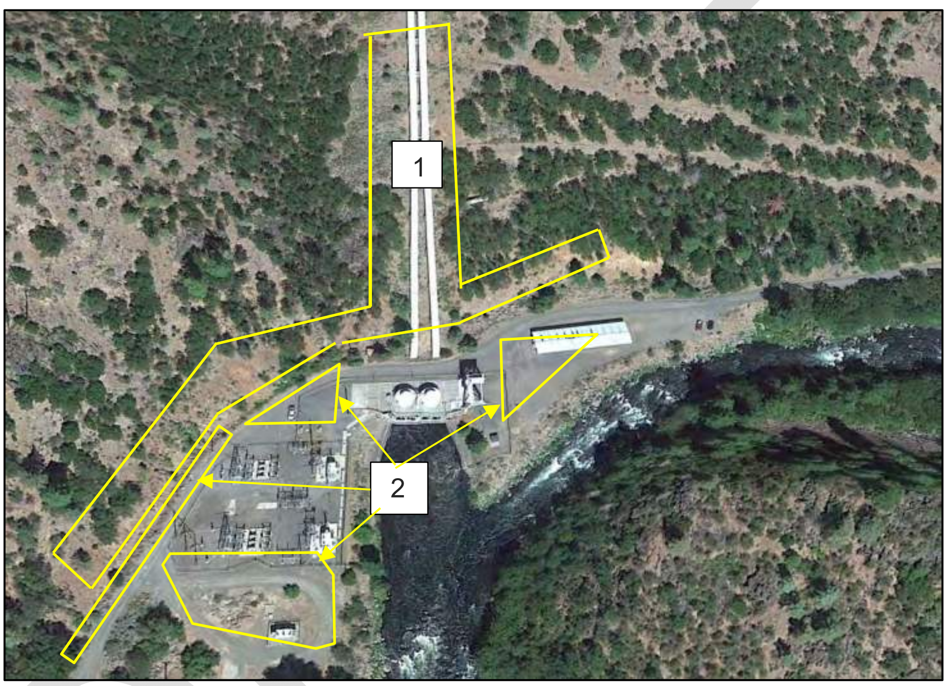


Figure 2.14 J.C. Boyle Powerhouse

Figure 2.15 J.C Boyle Powerhouse Road Surfacing Material

Knight Piésold CONSULTING

3.0 CONCLUSIONS

3.1 EROSION PROTECTION, RIVERBED AND BEDDING MATERIAL

A summary of the potential erosion protection, riverbed, and bedding material identified onsite at the investigated potential borrow sources is included below in Table 3.1. The table includes an approximate gradation of the material, surficial area of the source and an assumed depth of material. The following assumptions were used to determine the depth of each of the sources:

- Iron Gate Downstream Face: Historic construction drawings (5407-A-111).
- Iron Gate Lakeview Road: Assumed invert excavation limit equal to ditch adjacent to road.
- Copco No. 1 Access Road: Visual assessment.
- Copco No. 2 Downstream Right Bank: Visual assessment.
- Copco No. 2 Downstream Left Bank: Visual assessment.
- J.C. Boyle Downstream Dam Sub-area 1: Historic construction drawings (AA 78084) and historic photographs.
- J.C. Boyle Downstream Dam Sub-areas 2 and 5: Visual Assessment.

The outstanding laboratory testing for the erosion protection material is not expected to alter the volumes provided below.

The approximate gradations in Table 3.1 were selected based on the observed and field measured particle sizes. Split-NET results were considered when selecting a representative gradation, however, were in general found to produce smaller gradations than what was observed in the field, and therefore the results were not taken verbatim.

Knight Piésold CONSULTING

Table 3.1 Identified Erosion Protection Borrow Sources Summary

Borrow Source	Approximate Gradation	Surface Area (yd^2)[1]	Assumed Depth (yd)	Expected Volume (CY)
Iron Gate Dam Downstream Face Sub-area 1 Figure 2.3	D_{50} = 28" D_{85} = 40"	2,980	1.67	4,400 – 4,800
Iron Gate Dam Downstream Face Sub-area 2 Figure 2.3	D_{50} = 20"	1,950	1.67	2,900 – 3,200
Iron Gate Dam Downstream Face Sub-area 3 Figure 2.3	D_{15} = 3" D_{50} = 9" D_{85} = 12"	5,900	1.67	9,000 – 9,800
Iron Gate Lakeview Road Figure 2.2	D_{15} = 1" D_{50} = 6" D_{85} = 14"	825	2 – 4	1,600 – 3,200
Copco No. 1 Access Road Sub-area 1 Figure 2.4	D_{15} = 3" D_{50} = 15" D_{85} = 28"	365	0.5 – 2	200 – 700
Copco No. 2 Downstream Right Bank Figure 2.6	D_{15} = 36" D_{50} = 48" D_{85} = 72"	3,000	2 – 5	9,000 – 18,000[2]
Copco No. 2 Downstream Left Bank Figure 2.7	D_{15} = 12" D_{50} = 40" D_{85} = 60"	1,940	1 – 3	2,000 – 6,000[2]
J.C. Boyle Downstream of Dam Sub-area 1 Figure 2.10	D_{15} = 1" D_{50} = 9" D_{85} = 20"	850	0.5 – 2	500 – 1,500
J.C. Boyle Downstream of Dam Sub-area 2 Figure 2.10	D_{15} = 8" D_{50} = 24" D_{85} = 36	250	0.5 – 1.5	150 - 400
J.C. Boyle Downstream of Dam Sub-area 5 Figure 2.10	D_{50} = 24"	2,020	0.5 – 1.5	1,000 – 1,500

NOTES:

1. SURFACE AREAS CALCULATED THROUGH GOOGLE EARTH PROJECTIONS
2. TO ACHIEVE THE UPPER VOLUME ESTIMATIONS OF CERTAIN SIZE MATERIAL THE CONTRACTOR MAY NEED TO EXCAVATE FURTHER DOWNSTREAM INTO ADJACENT TALUS PILES.

Table 3.2 presents a summary of the required erosion protection, riverbed and bedding material volumes required at each of the dam sites. All bedding material may require some site processing to achieve the proper gradation. Some of the smaller class erosion protection may require site processing. The 'Adequate Source Volume' commentary considers the source material gradation, the required gradation of fill, and the lower bound volumes to conclude if there is adequate borrow material volumes present to fulfill the design volume requirements.

Table 3.2 Erosion Protection Requirements by Dam Site

Material Type	Design D_{50} (in)	Neat Line Required Volume (CY)	Anticipated Borrow Source	Adequate Source Volume
J.C. Boyle				
Erosion Protection - E7	D_{50} = 12	625	JCB Downstream Dam Sub-Area 2 JCB Downstream Dam Sub-Area 5	Yes
Erosion Protection - E7	D_{50} = 6	625	JCB Downstream Dam Sub-Area 1 JCB Downstream Dam Sub-Area 5	Yes
Bedding – E6		100	JCB Downstream Dam Sub-Area 1 with site processing	Yes
Copco No. 1				
Erosion Protection – E7	D_{50} = 60	1,190	Copco No. 2 Downstream Right Bank	Yes[1]
Copco No. 2				
Riverbed Material – E7		5,670	Copco No. 2 Downstream Right Bank Copco 1 Access Road Sub-Area 1	Yes[1]
Erosion Protection – E7	D_{50} = 21	1,620	Copco No. 2 Downstream Right Bank Copco No. 2 Downstream Left Bank	Yes[1]
Erosion Protection – E7	D_{50} = 42	1,660	Copco No. 2 Downstream Left Bank	Yes[1]
Iron Gate				
Erosion Protection – E7	D_{50} = 12	2,450	IG DS Dam Face Sub-Area 2 IG DS Dam Face Sub-Area 3	Yes
Erosion Protection – E7	D_{50} = 24	2,450	IG DS Dam Face Sub-Area 1	Yes
Bedding – E6		500	Iron Gate Lake View Road IG DS Dam Face Sub-Area 3 with site processing	Yes

NOTES

1. PENDING EXPANSION OF WORK LIMITS FROM 60% DESIGN.

3.2 GRANULAR FILL

Commentary on the possible granular fill material types that may be able to be processed from the identified borrow sources will be provided once the particle size analyses are complete.

3.3 SCOPE OF REPORTING AND FUTURE WORK

The scope of this site investigation was to determine if there were surficial borrow sources close to the dam sites that could produce the material required for the project, primarily the erosion protection material. The site investigation was not intended to fully quantify the potential borrow areas and this summary does not address subsurface in situ material. Ground disturbance was limited to collection of free and loose material at the surface either by hand. Topographical data was not collected other than obtaining GPS coordinates while sampling. The estimates provided are based on visual observations, aerial imaging and historic drawings and photographs, and the accuracy of the presented gradations and volumes must reflect these limitations. KP recommends that narrow and focused investigations be conducted within the actual potential borrow sources Kiewit is proposing to use. This will increase confidence for volumes and gradations available at each site. KP has not assessed the feasibility of each site beyond establishing the material type

Knight Piésold CONSULTING

and approximate gradation. Borrow source access, cultural resources and slope stability concerns were not considered in this analysis.

4.0 CLOSURE

We trust the information contained herein meets your needs at this time. Please contact any of the undersigned if you have any questions or comments.

Yours truly,
Knight Piésold

Prepared: Brad Hill   Prepared: Samuel Bush

Reviewed: Cory Vos   Reviewed: Norman Bishop

Approval that this document adheres to the Knight Piésold Quality System: CN

Attachments:

Appendix A	Report Tables
Appendix B	Site Photographs
Appendix C	Split-NET Analysis Results

References:

Google Earth, 2020. Imagery taken from Google Earth Pro, https://earth.google.com.

Copy To: Erik Esparza, Gary Jara

APPENDIX A

Report Tables

(Tables A.1 to A.3)

Knight Piésold CONSULTING

TABLE A.1

KIEWIT INFRASTRUCTURE WEST CO.
KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SAMPLE SUMMARY

Print May/21/20 8:38:38

Location	Sample ID	Sample Potential		Sample Type	No. of Pieces	Approx. Weight, lbs	PLT Samples	Notes
		Erosion	Granular					
J.C. Boyle								
Downstream of Dam	JCBEP-1	x		EP	4	230	3	Sampled from Sub-Area 2
Powerhouse Area	JCBP-GF1		x	SD	2	12	-	Sampled from Sub-Area 1
Powerhouse Area	JCBP-GF2		x	LD	1	40	-	Sampled from Sub-Area 2
Copco No. 1								
Access Road	CRBR-1	x		EP	4	230	3	Sampled from Sub-Area 1
Copco Village	C1V-1		x	SD	3	20		
Copco No. 2								
Downstream Right Bank	C2DSR-1	x		EP	4	230	3	
Downstream Left Bank	C2LB-1	x		EP	4	230	3	
Wood-Stave Pennstock	C2WP-1		x	SD	3	20	-	Brown overburden Sampled from Sub-Area 1
Wood-Stave Pennstock	C2WP-2		x	LD	1	40	-	Grey 1 inch minus Sampled from Sub-Area 2
Wood-Stave Pennstock	C2WP-3		x	LD	1	40	-	Brown 3 inch minus Sampled from Sub-Area 3
Iron Gate								
Dam Downstream Face	IGDDS-1	X		EP	4	230	3	Sampled from Sub-Areas 1 and 2
Lakeview Road	LV-GF1		x	LD	1	40	-	Sampled from east (dashed) area
Lakeview Road	IGLV-1	x		EP	4	230	3	Sampled from west area
Worker's Accommodation Area	IGW-GF1		x	LD	1	40	-	Sampled from Sub-Area 1
Worker's Accommodation Area	IGWA-EP1	x		EP	4	230	3	Sampled from Sub-Area 2
TOTAL:					41	1862	21	

\\KPL\VA-Prj$\1\03\00640\01\A\Correspondence\7_Letter\2020\VA20-01037 - VE Onsite Borrow Source SI\Appendix A\[On Site Material Investigation Tables.xlsx]Table A1

NOTES:

SD: BAG SAMPLE

A	21MAY'20	ISSUED WITH LETTER VA20-01037	TB	CAV
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE A.2

KIEWIT INFRASTRUCTURE WEST CO.
KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SCHMIDT HAMMER SUMMARY

Print May/21/20 8:38:38

Location	Schmidt Hammer Readings (R)			Average R	UCS (Mpa)	UCS (ksi)	Notes
J.C. Boyle							
Downstream of Dam	52	52	56	53	237	34	Readings taken on boulders in field
	58	58	56	57	301	44	Readings taken on boulders in field
	58	58	60	59	339	49	Readings taken on boulders in field
	48	52	50	50	198	29	Readings taken on PLT sample JCB-1
	50	54	52	52	223	32	Readings taken on PLT sample JCB-2
	46	45	45	45	147	21	Readings taken on PLT sample JCB-3
Copco No. 1							
Right Bank Road-Upper Road (Sub-Area 1)	45	46	46	46	156	23	Readings taken on boulders in field
	50	53	52	52	223	32	Readings taken on boulders in field
	55	60	52	56	283	41	Readings taken on boulders in field
	54	56	50	53	237	34	Readings taken on PLT sample CRBR-1
	50	52	60	54	251	36	Readings taken on PLT sample CRBR-2
	52	52	50	51	210	30	Readings taken on PLT sample CRBR-3
Copco No. 2							
Right Bank Downstream	49	50	54	51	210	30	Readings taken on boulders in field
	54	54	60	56	203	41	Readings taken on boulders in field
	50	52	54	52	223	32	Readings taken on boulders in field
	52	51	56	53	237	34	Readings taken on PLT sample C2DSR-1
	52	51	54	52	223	32	Readings taken on PLT sample C2DSR-2
	60	58	61	60	359	52	Readings taken on PLT sample C2DSR-3
Left Bank Downstream	48	48	55	50	198	29	Readings taken on boulders in field
	52	54	48	51	210	30	Readings taken on boulders in field
	48	54	50	51	210	30	Readings taken on boulders in field
	55	60	58	58	319	46	Readings taken on PLT sample C2LB-1
	48	52	50	50	198	29	Readings taken on PLT sample C2LB-2
	48	50	56	51	210	30	Readings taken on PLT sample C2LB-3
Iron Gate							
Downstream Face	59	55	57	57	301	44	Readings taken on boulders in field
	55	58	61	58	319	46	Readings taken on boulders in field
	61	60	57	59	339	49	Readings taken on boulders in field
	62	58	66	62	405	59	Readings taken on PLT sample IGDDS-1. Strength is too high, will discount until results from PLT are provided
	62	66	66	65	484	70	Readings taken on PLT sample IGDDS-2. Strength is too high, will discount until results from PLT are provided
	62	68	68	66	514	75	Readings taken on PLT sample IGDDS-3. Strength is too high, will discount until results from PLT are provided
Lakeview Road	52	51	50	51	210	30	Readings taken on boulders in field
	56	59	58	57	301	44	Readings taken on boulders in field
	59	61	54	57	301	44	Readings taken on boulders in field
	58	56	54	56	283	41	Readings taken on PLT sample IGLV-1
	52	58	55	55	267	39	Readings taken on PLT sample IGLV-2
	57	61	66	61	382	55	Readings taken on PLT sample IGLV-3
Workers Accommodation Area	54	58	56	56	283	41	Readings taken on boulders in field
	44	46	41	43	138	19	Readings taken on boulders in field
	40	40	41	40	116	16	Readings taken on boulders in field
	41	43	46	43	130	19	Readings taken on PLT sample IGW-1
	33	34	32	36	86	12	Readings taken on PLT sample IGW-2
	53	53	50	52	223	32	Readings taken on PLT sample IGW-3

\\KPL\VA-Prj$\1\03\00640\01\A\Correspondence\7_Letter\2020\VA20-01037 - VE Onsite Borrow Source SI\Appendix A\[On Site Material Investigation Tables.xlsx]Table A2

NOTES:

1. UCS VALUES CALCULATED USING THE FOLLOWING EQUATION: $10e^{(0.0597R)}$
2. ROCK ASSUMED TO HAVE A UNIT WEIGHT OF 184.8 lbs/ft^3 (2.96 g/cm^3)

A	21MAY'20	ISSUED WITH LETTER VA20-01037	TB	CAV
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE A.3

KIEWIT INFRASTRUCTURE WEST CO.
KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
APPROXIMATE LOCATIONS OF POTENTIAL BORROW SOURCES

Print May/21/20 8:38:38

KRRP Site	Borrow Source Location	Approximate Coordinates[1]	
		Easting (m)[3]	Northing (m)[3]
J.C. Boyle	Downstream of Dam	578,560	4,663,768
		578,479	4,663,895
	Powerhouse Area	576,909	4,660,758
		576,735	4,660,551
	Forebay Area	577,477	4,661,017
		577,615	4,660,968
Copco No. 1	Right Bank Access Road	554,895	4,647,654
		554,969	4,647,702
	Copco No. 1 Village	554,951	4,647,886
		554,970	4,647,839
Copco No. 2	Downstream Right Bank	554,587	4,647,744
		554,647	4,647,714
	Downstream Left Bank	554,602	4,647,642
		554,540	4,647,595
	Wood-Stave Penstock	553,628	4,647,420
		553,622	4,647,446
Iron Gate	Dam Downstream Face	546,702	4,642,682
		546,690	4,642,644
	Lakeview Road	546,511	4,642,152
		546,649	4,642,174
	Workers Accommodation Area	546,391	4,642,438
		546,458	4,642,453

\\KPL\VA-Prj$\1\03\00640\01\A\Correspondence\7_Letter\2020\VA20-01037 - VE Onsite Borrow Source SI\Appendix A\[On Site Material Investigation Tables.xlsx]Table A3

NOTES:

1. COORDINATES TAKEN FROM GOOGLE EARTH BASED ON BORROW SOURCE LOCATION FIGURES PRESENTED IN VA20-00737.

2. UTM ZONE 10 T

A	24APR'20	ISSUED FOR INFORMATION	GOJ	CAV
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

APPENDIX B

Site Photographs

(Pages B-1 to B-94)

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 1.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing north.	

Photo No. 2.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing north.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 3.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing north.	

Photo No. 4.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing southeast.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 5.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing northeast.	

Photo No. 6.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 7.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing east.	

Photo No. 8.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

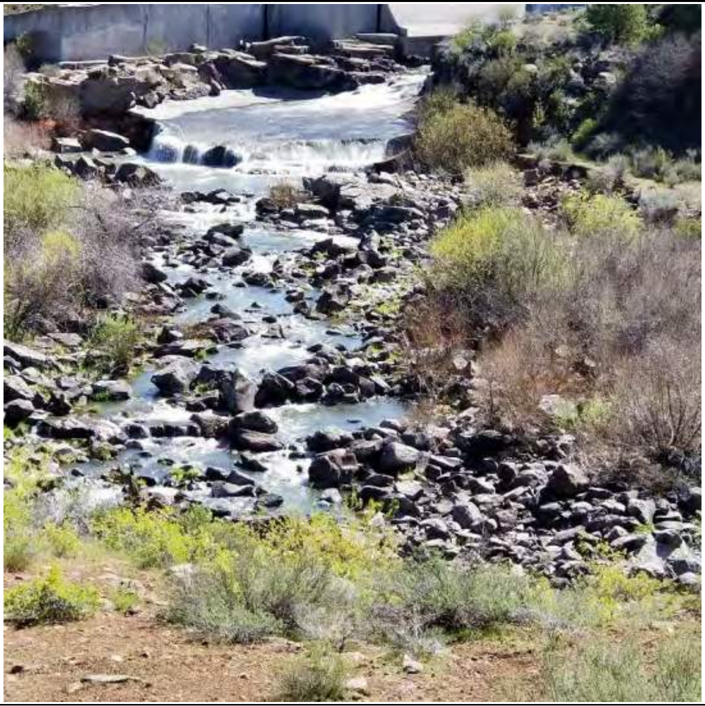
Photo No. 9.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing east.	

Photo No. 10.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, spillway, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 11.

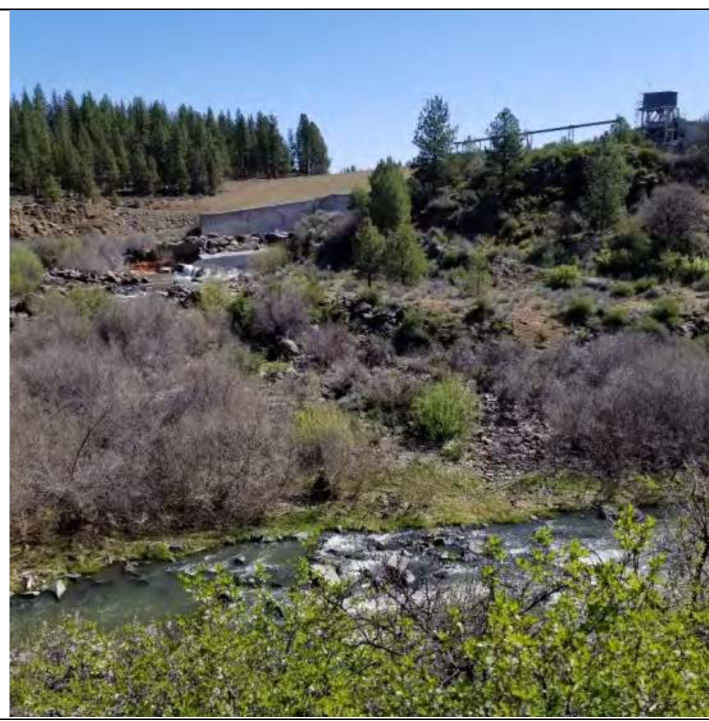
Date: May 6, 2020

Description:
J.C. Boyle Dam – Downstream, spillway, photo facing east.

Photo No. 12.

Date: May 6, 2020

Description:
J.C. Boyle Dam – Downstream, spillway, photo facing east.



Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

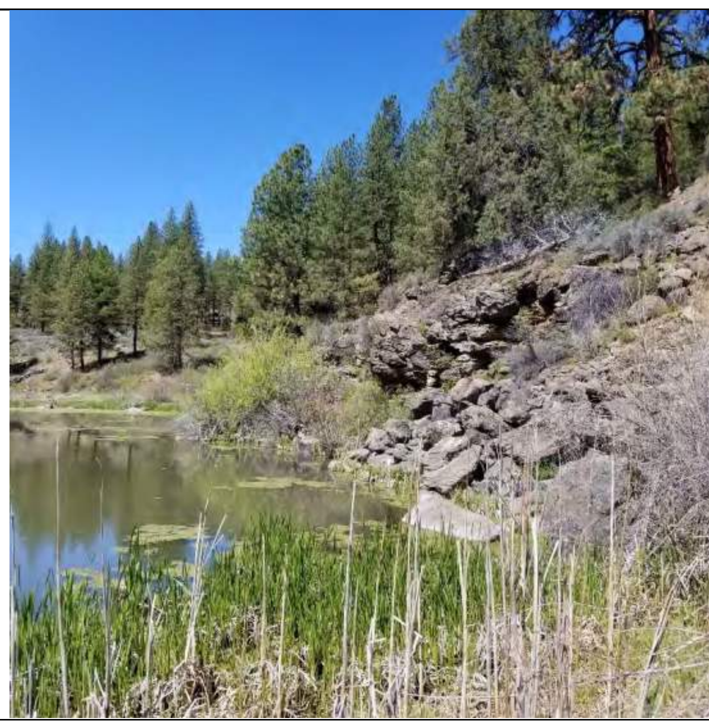
Photo No. 13.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing east.	

Photo No. 14.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo of workplan figure.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 15.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing south.	

Photo No. 16.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing west.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 17.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing west.	

Photo No. 18.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 19.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing north.	

Photo No. 20.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 21.

Date: May 6, 2020

Description:
J.C. Boyle Dam – Downstream, photo facing north.

Photo No. 22.

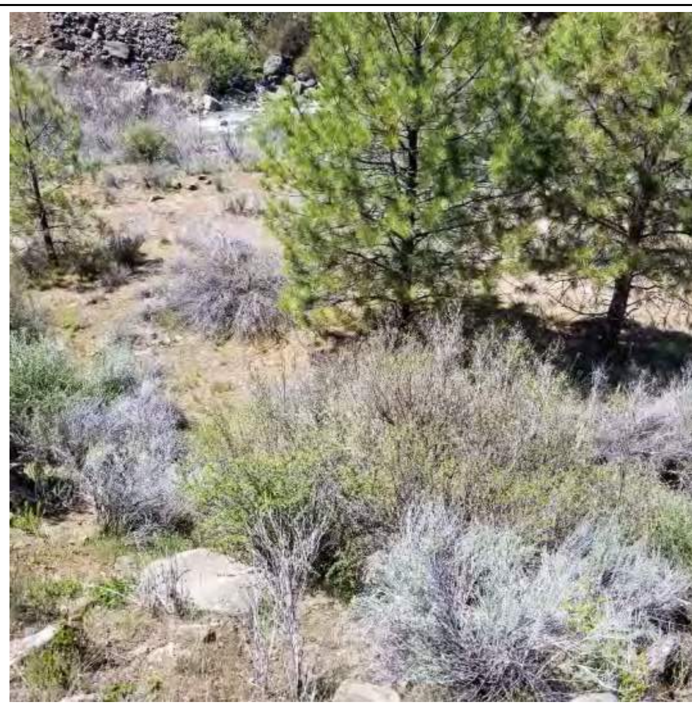
Date: May 6, 2020

Description:
J.C. Boyle Dam – Downstream, photo facing east.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 23.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing east.	

Photo No. 24.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 25.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream.	

Photo No. 26.	
Date: May 6, 2020	
Description: J.C. Boyle Dam – Downstream, photo facing north.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE DAM-DOWNSTREAM

Photo No. 27. **Date:** May 6, 2020 **Description:** J.C. Boyle Dam – Downstream, tape measure for scale.	

Photo No. 28. **Date:** May 6, 2020 **Description:** J.C. Boyle Dam – Downstream, photo facing north.	

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 1. **Date:** May 6, 2020 **Description:** J.C. Boyle Bridge, photo facing west.	

Photo No. 2. **Date:** May 6, 2020 **Description:** J.C. Boyle Bridge, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

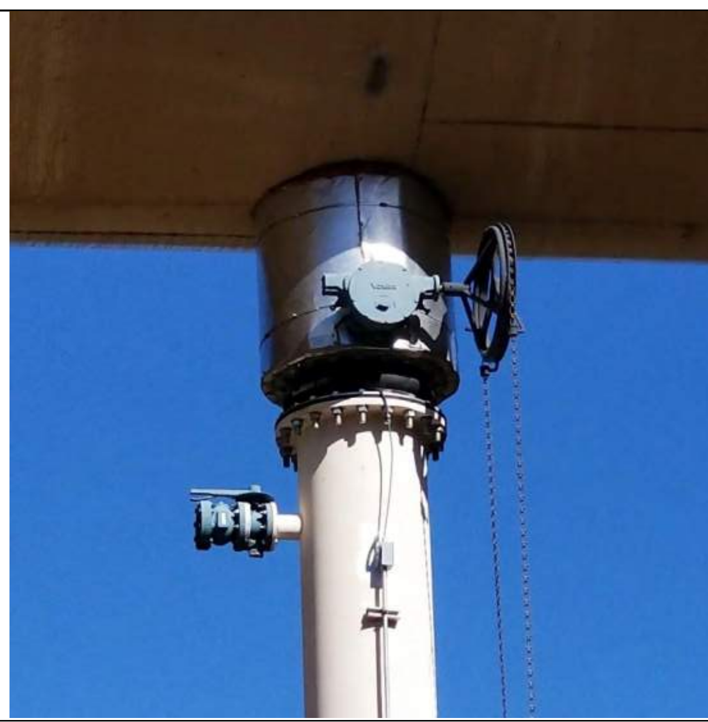
Photo No. 3.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Photo No. 4.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing north.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 5.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing norhtwest.	

Photo No. 6.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 7.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northeast.	

Photo No. 8.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 9.

Date: May 6, 2020

Description:
J.C. Boyle Bridge, photo facing south.

Photo No. 10.

Date: May 6, 2020

Description:

J.C. Boyle Bridge, photo facing north.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 11.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, old timber abutment.	

Photo No. 12.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing west.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 13.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing west.	

Photo No. 14.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 15.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Photo No. 16.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 17.

Date: May 6, 2020

Description:
J.C. Boyle Bridge, photo facing northwest.

Photo No. 18.

Date: May 6, 2020

Description:
J.C. Boyle Bridge, photo facing northwest.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

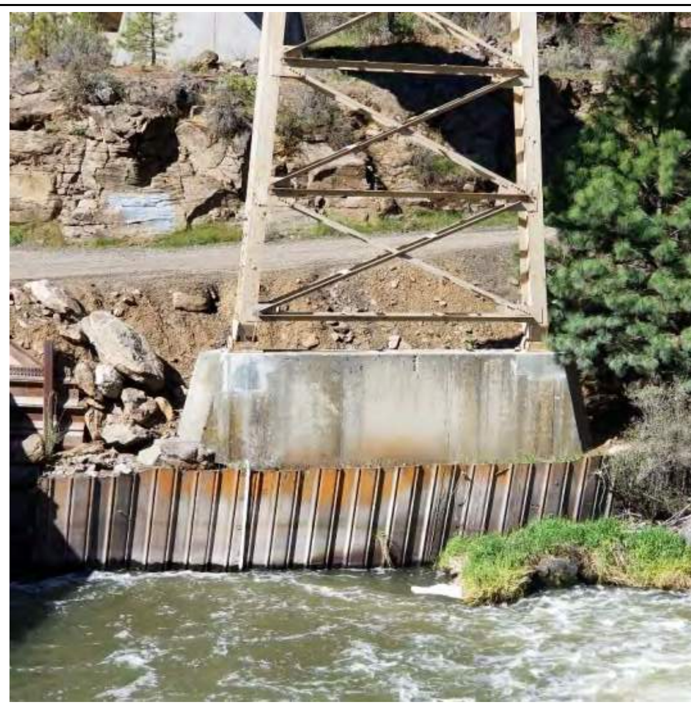
Photo No. 19.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Photo No. 20.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 21.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing west.	

Photo No. 22.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing west.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 23.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge.	

Photo No. 24.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing southwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 25.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing southwest.	

Photo No. 26.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing southwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 27.

Date: May 6, 2020

Description:
J.C. Boyle Bridge, photo facing west.

Photo No. 28.

Date: May 6, 2020

Description:
J.C. Boyle Bridge, photo facing west.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 29.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northeast.	

Photo No. 30.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northeast.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 31.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, old timber abutment.	

Photo No. 32.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northeast.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

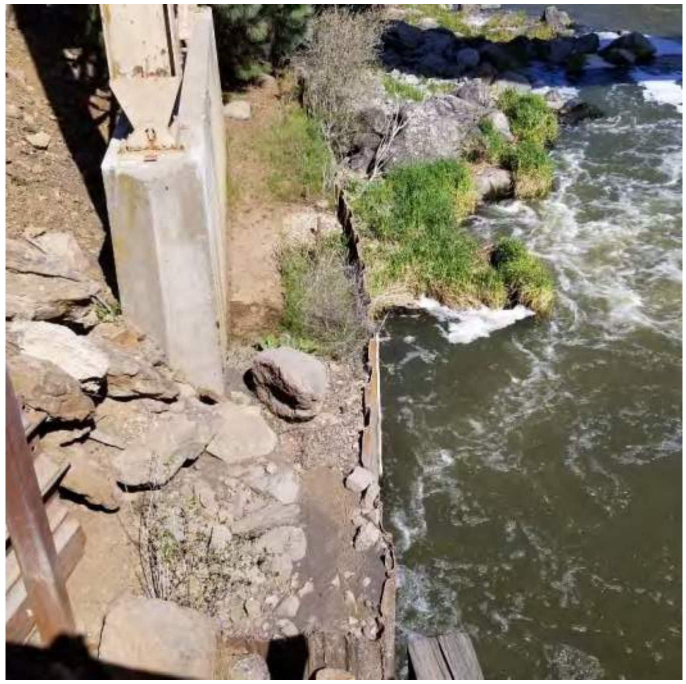
Photo No. 33.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Photo No. 34.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE BRIDGE

Photo No. 35.	
Date: May 6, 2020	
Description: J.C. Boyle Bridge, photo facing northwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 1.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, photo facing east.	

Photo No. 2.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, photo facing southwest.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 3.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, photo facing northeast.	

Photo No. 4.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 5. **Date:** May 6, 2020 **Description:** J.C. Boyle Powerhouse, photo facing west.	

Photo No. 6. **Date:** May 6, 2020 **Description:** J.C. Boyle Powerhouse, photo facing east.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 7.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, photo facing west.

Photo No. 8.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, road wearing course, tape measure for scale.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 9.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, berm at side of road, tape measure for scale.

Photo No. 10.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, slope north of road, tape measure for scale.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 11.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, toe of slope north of road.	

Photo No. 12.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, toe of slope north of road, photo facing west.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

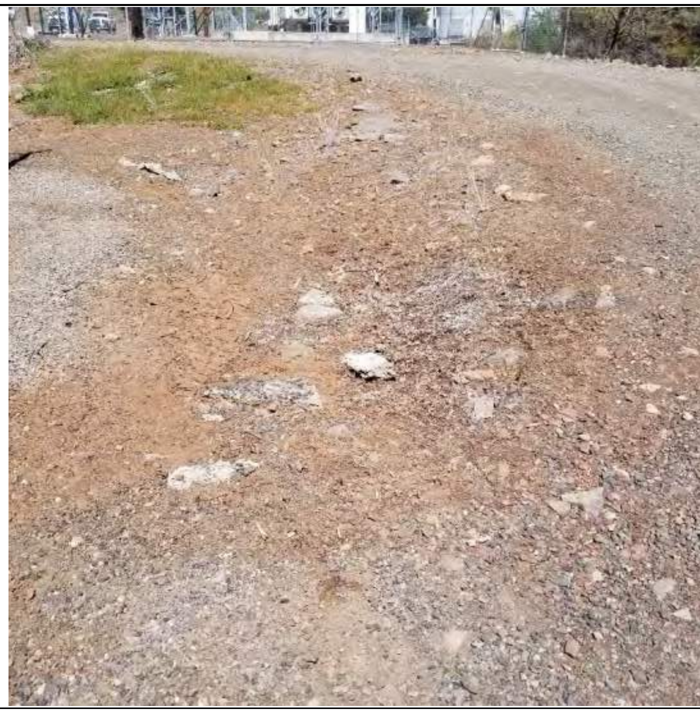
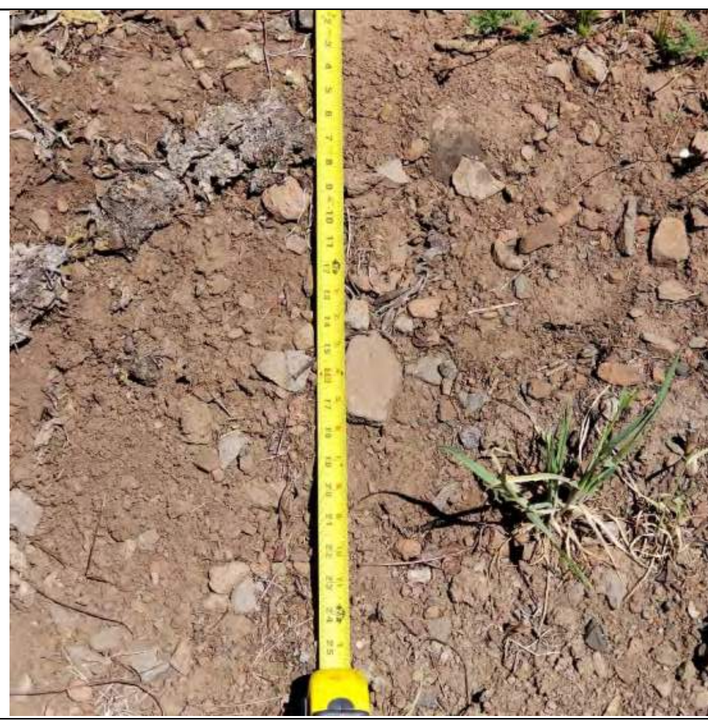
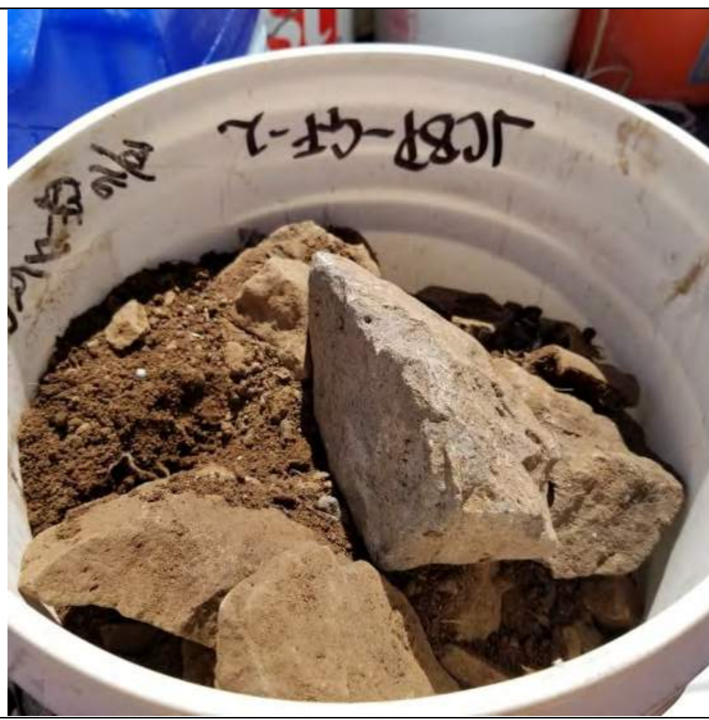
Photo No. 13. **Date:** May 6, 2020 **Description:** J.C. Boyle Powerhouse, parking area.	

Photo No. 14. **Date:** May 6, 2020 **Description:** J.C. Boyle Powerhouse, parking area.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 15.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, photo facing northeast.	

Photo No. 16.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, sample of berm north of road.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 17.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, sample of road wearing course.

Photo No. 18.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, photo facing east.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 19.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, slope north of road.	

Photo No. 20.	
Date: May 6, 2020	
Description: J.C. Boyle Powerhouse, photo facing northeast.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
J.C. BOYLE POWERHOUSE

Photo No. 21.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, photo facing northeast.

Photo No. 22.

Date: May 6, 2020

Description:
J.C. Boyle Powerhouse, photo facing east.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 RIGHT BANK ROAD

Photo No. 1.	
Date: May 5, 2020	
Description: Copco 1 Right Bank road – Zone 1	

Photo No. 2.	
Date: May 5, 2020	
Description: Copco 1 Right Bank road – Zone 1	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 RIGHT BANK ROAD

Photo No. 3.

Date: May 5, 2020

Description:

Copco 1 Right Bank road

Photo No. 4.

Date: May 5, 2020

Description:

Copco 1 Right Bank road

ATTACHMENT A

100% FINAL Design ReportAppendix LMay28(Part2)

Pages 113-115, 136-137, 141, 150, 152-53, 163-65

REDACTED: Pages 113-115, 136-137, 141, 150, 152-53, 163-65 of 100% FINAL Design ReportAppendix LMay28(Part2) consist in their entirety of information about the location, character, or ownership of historic resources that, if disclosed, may cause a significant invasion of privacy; cause a risk of harm to the historic resource; or impede the use of a traditional religious site by practitioners. These pages are labeled as "Privileged" in accordance with 18 C.F.R. § 388.112, 18 C.F.R. § 388.107 and 36 C.F.R. § 800.11(c).

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
COPCO 1 RIGHT BANK ROAD

Photo No. 5.	
Date: May 5, 2020	
Description: Copco 1 Right Bank road – Zone 2	

Photo No. 6.	
Date: May 5, 2020	
Description: Copco 1 Right Bank road – Zone 2	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 RIGHT BANK ROAD

Photo No. 7. **Date:** May 5, 2020 **Description:** Copco 1 Right Bank road – Zone 2	
Photo No. 8. **Date:** May 5, 2020 **Description:** Copco 1 Right Bank road – Zone 2, toe of slope	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 RIGHT BANK ROAD

Photo No. 9.	
Date: May 5, 2020	
Description: Copco 1 Right Bank road	

Photo No. 10.	
Date: May 5, 2020	
Description: Copco 1 Right Bank road	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 RIGHT BANK ROAD

Photo No. 11. **Date:** May 5, 2020 **Description:** Copco 1 Right Bank road – Schmidt hammer testing	

Photo No. 12. **Date:** May 5, 2020 **Description:** Copco 1 Right Bank road – Point Load Testing (PLT) samples	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 VILLAGE

Photo No. 1.	
Date: May 5, 2020	
Description: Copco 1 Village facing NE	

Photo No. 2.	
Date: May 5, 2020	
Description: Copco 1 Village	

Knight Piésold
CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 1 VILLAGE

Photo No. 3.

Date: May 5, 2020

Description:

Copco 1 Village

Photo No. 4.

Date: May 5, 2020

Description:

Copco 1 Village – mid slope

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS RIGHT BANK

Photo No. 1.

Date: May 5, 2020

Description:

Copco 2, Right Bank Downstream

Photo No. 2.

Date: May 5, 2020

Description:

Copco 2, Right Bank Downstream

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS RIGHT BANK

Photo No. 3.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream	

Photo No. 4.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream	

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS RIGHT BANK

Photo No. 5.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream	

Photo No. 6.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream – facing WNW	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS RIGHT BANK

Photo No. 7.

Date: May 5, 2020

Description:

Copco 2, Right Bank Downstream

Photo No. 8.

Date: May 5, 2020

Description:

Copco 2, Right Bank Downstream – PLT sample 1

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS RIGHT BANK

Photo No. 9.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream **– PLT sample 2**	

Photo No. 10.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream – PLT sample 3	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS RIGHT BANK

Photo No. 11.	
Date: May 5, 2020	
Description: Copco 2, Right Bank Downstream – All 3 PLT samples	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS LEFT BANK

Photo No. 1.

Date: May 5, 2020

Description:

Copco 2, Left Bank Downstream – PLT sample 1

Photo No. 2.

Date: May 5, 2020

Description:

Copco 2, Left Bank Downstream – PLT sample 2

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 DS LEFT BANK

Photo No. 3.	
Date: May 5, 2020	
Description: Copco 2, Left Bank Downstream – PLT sample 3	

Photo No. 4.	
Date: May 5, 2020	
Description: Copco 2, Left Bank Downstream – PLT samples 1-3	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 1.	
Date: May 5, 2020	
Description: Copco 2 wood-stave Penstock – Zone 1	

Photo No. 2.	
Date: May 5, 2020	
Description: Copco 2 wood-stave Penstock – Zone 2	

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 3.

Date: May 5, 2020

Description:

Copco 2 wood-stave Penstock – Zone 3

Photo No. 4.

Date: May 7, 2020

Description:

Copco 2 wood-stave Penstock - Overview

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 5. **Date:** May 7, 2020 **Description:** Copco 2 wood-stave Penstock	

Photo No. 6. **Date:** May 5, 2020 **Description:** Copco 2 wood-stave Penstock – Zone 2	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 7.	
Date: May 7, 2020	
Description: Copco 2 wood-stave Penstock	

Photo No. 8.	
Date: May 7, 2020	
Description: Copco 2 wood-stave Penstock – above Zone 1 looking west	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 9.	
Date: May 7, 2020	
Description: Copco 2 wood-stave Penstock	

Photo No. 10.	
Date: May 7, 2020	
Description: Copco 2 wood-stave Penstock - panorama	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No.

Date: May 7, 2020

Description:

Copco 2 wood-stave Penstock

Photo No. 11.

Date: May 7, 2020

Description:

Copco 2 wood-stave Penstock – facing east

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

<table>
<tr><td>Photo No. 12.</td><td rowspan="3">1</td></tr>
<tr><td>Date: May 7, 2020</td></tr>
<tr><td>Description:

Copco 2 wood-stave Penstock – facing west across upper part of Zone 1</td></tr>
</table>

<table>
<tr><td>Photo No. 13.</td><td rowspan="3"></td></tr>
<tr><td>Date: May 7, 2020</td></tr>
<tr><td>Description:

Copco 2 wood-stave Penstock</td></tr>
</table>

Knight Piésold
CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 14.	
Date: May 7, 2020	
Description: Copco 2 wood-stave Penstock	

Photo No. 15.	
Date: May 7, 2020	
Description: Copco 2 wood-stave Penstock	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
COPCO 2 WOOD-STAVE PENSTOCK

Photo No. 16.

Date: May 7, 2020

Description:

Copco 2 wood-stave Penstock - panorama

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

Photo No. 1.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – center of embankment	

Photo No. 2.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

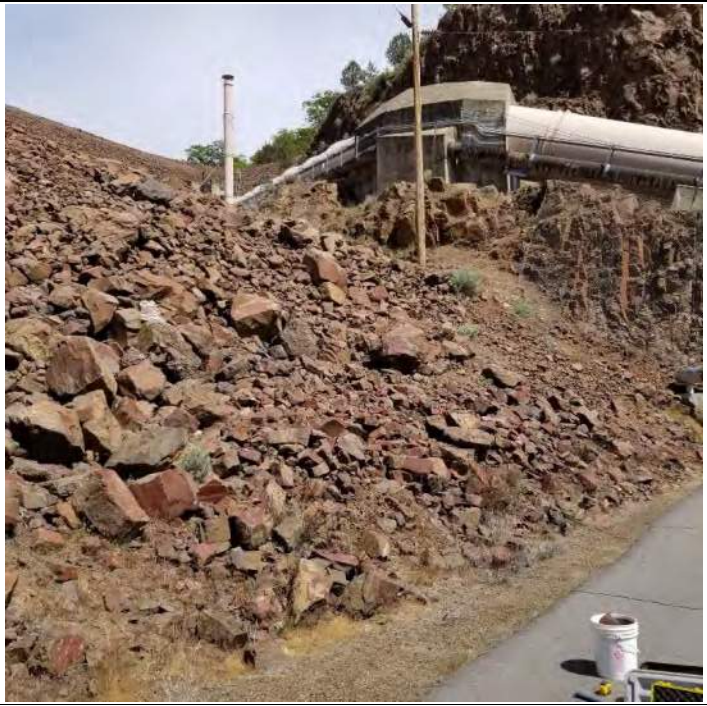
Photo No. 3.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – facing upstream ENE	

Photo No. 4.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – west groin area	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

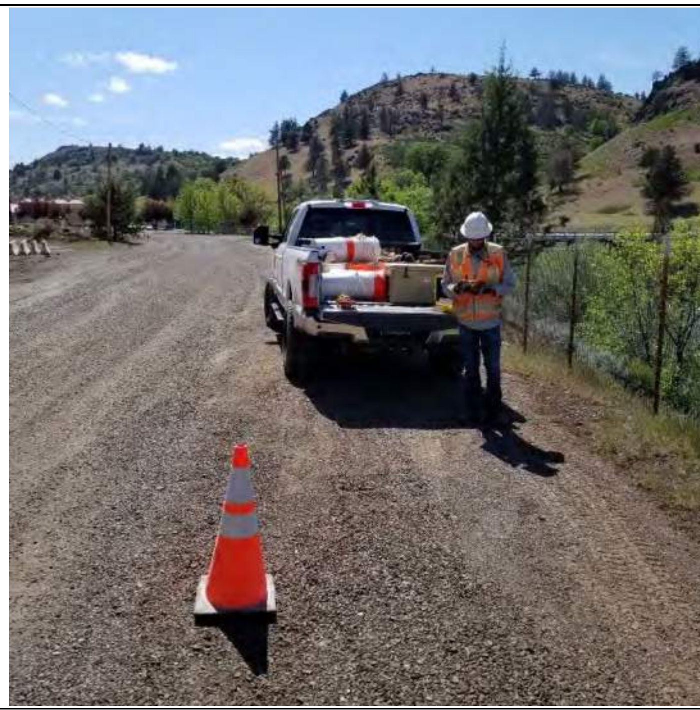
Photo No. 5.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – entrance road access	

Photo No. 6.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – facing north onto embankment downstream face	

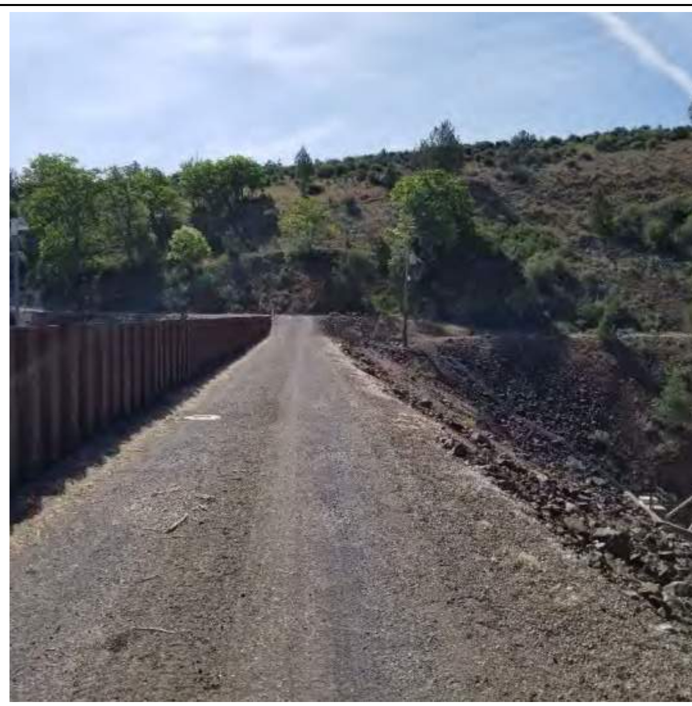
Photo No. 7.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – PLT sample	

Photo No. 8.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – PLT sample	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

Photo No. 9.	
Date: May 4, 2020	
Description: Iron Gate DS Dam Shell – PLT sample	

Photo No. 10.	
Date: May 7, 2020	
Description: Iron Gate DS Dam Shell – along crest facing east	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

Photo No. 11.

Date: May 7, 2020

Description:

Iron Gate DS Dam Shell

Photo No. 12.

Date: May 7, 2020

Description:

Iron Gate DS Dam Shell

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

Photo No. 13.	
Date: May 7, 2020	
Description: Iron Gate DS Dam Shell – facing downstream	

Photo No. 14.	
Date: May 7, 2020	
Description: Iron Gate DS Dam Shell – Embankment crest looking west	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

Photo No. 15.

Date: May 7, 2020

Description:

Iron Gate DS Dam Shell – facing west along crest

Photo No. 16.

Date: May 7, 2020

Description:

Iron Gate DS Dam Shell

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE DS DAM SHELL

Photo No. 17.	
Date: May 7, 2020	
Description: Iron Gate DS Dam Shell – Zone 3, facing east	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE-LAKEVIEW ROAD

Photo No. 1.	
Date: May 4, 2020	
Description: Iron Gate – Lakeview Road PLT sample.	

Photo No. 2.	
Date: May 4, 2020	
Description: Iron Gate – Lakeview Road PLT sample.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE-LAKEVIEW ROAD

Photo No. 3. **Date:** May 4, 2020 **Description:** Iron Gate – Lakeview Road PLT sample.	

Photo No. 4. **Date:** May 4, 2020 **Description:** Iron Gate – Lakeview Road Erosion Protection samples.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 1.

Date: May 4, 2020

Description:
Iron Gate Workers Accommodation Area, facing north.

Photo No. 2.

Date: May 4, 2020

Description:
Iron Gate Workers Accommodation Area, facing east.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 3.

Date: May 4, 2020

Description:
Iron Gate Workers Accommodation Area, material at toe of slope.

Photo No. 4.

Date: May 4, 2020

Description:
Iron Gate Workers Accommodation Area erosion protection samples.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 5.	
Date: May 4, 2020	
Description: Iron Gate Workers Accommodation Area, obtaining Schmidt Hammer reading.	

Photo No. 6.	
Date: May 4, 2020	
Description: Iron Gate Workers Accommodation Area PLT sample.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 7.	
Date: May 4, 2020	
Description:	

Photo No. 8.	
Date: May 4, 2020	
Description: Iron Gate Workers Accommodation Area PLT sample.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 9.	
Date: May 4, 2020	
Description: Iron Gate Workers Accommodation Area PLT sample.	

Photo No. 10.	
Date: May 7, 2020	
Description: Iron Gate Workers Accommodation Area, road wearing course.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

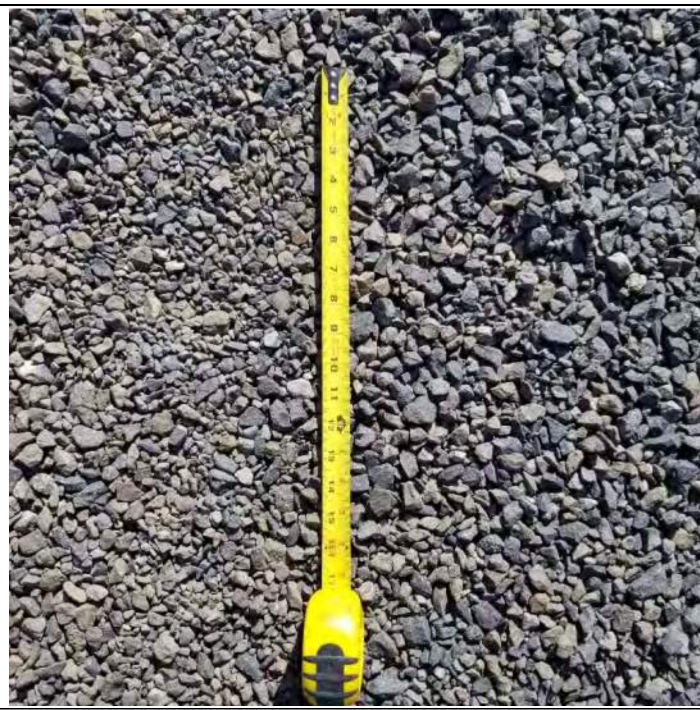
Photo No. 11.	
Date: May 7, 2020	
Description: Iron Gate Workers Accommodation Area, road wearing course.	

Photo No. 12.	
Date: May 7, 2020	
Description: Iron Gate Workers Accommodation Area, face of slope.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 13.

Date: May 7, 2020

Description:
Iron Gate Workers Accommodation Area, facing north.

Photo No. 14.

Date: May 7, 2020

Description:
Iron Gate Workers Accommodation Area, facing north.

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 15.

Date: May 7, 2020

Description:
Iron Gate Workers Accommodation Area, face of slope.

Photo No. 16.

Date: May 7, 2020

Description:
Iron Gate Workers Accommodation Area, facing east.

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
IRON GATE WORKERS ACCOMMODATION AREA

Photo No. 17. **Date:** May 7, 2020 **Description:** Iron Gate Workers Accommodation Area, facing west.	

Photo No. 18. **Date:** May 7, 2020 **Description:** Iron Gate Workers Accommodation Area, face of slope.	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
FOREBAY

Photo No. 1.

Date: May 6, 2020

Description:

Forebay road surface at entrance

Photo No. 2.

Date: May 6, 2020

Description:

Forebay road surface at entrance

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
FOREBAY

Photo No. 3.	
Date: May 6, 2020	
Description: Forebay road surface	

Photo No. 4.	
Date: May 6, 2020	
Description: Forebay entrance	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
FOREBAY

Photo No. 5.

Date: May 6, 2020

Description:

Forebay road surface

Photo No. 6.

Date: May 6, 2020

Description:

Forebay area

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
FOREBAY

Photo No. 7.	
Date: May 7, 2020	
Description: Forebay road surface	

Photo No. 8.	
Date: May 6, 2020	
Description: Forebay road surface	

Knight Piésold CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
FOREBAY

Photo No. 9. **Date:** May 6, 2020 **Description:** Forebay road surface – Dmax view	

Photo No. 10. **Date:** May 6, 2020 **Description:** Forebay road surface	

Knight Piésold
CONSULTING

PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
FOREBAY

Photo No. 11.

Date: May 6, 2020

Description:

Forebay road surface – Northern portion of site access road

Photo No. 12.

Date: May 6, 2020

Description:

Forebay road surface – exposed native soils on right side of photo

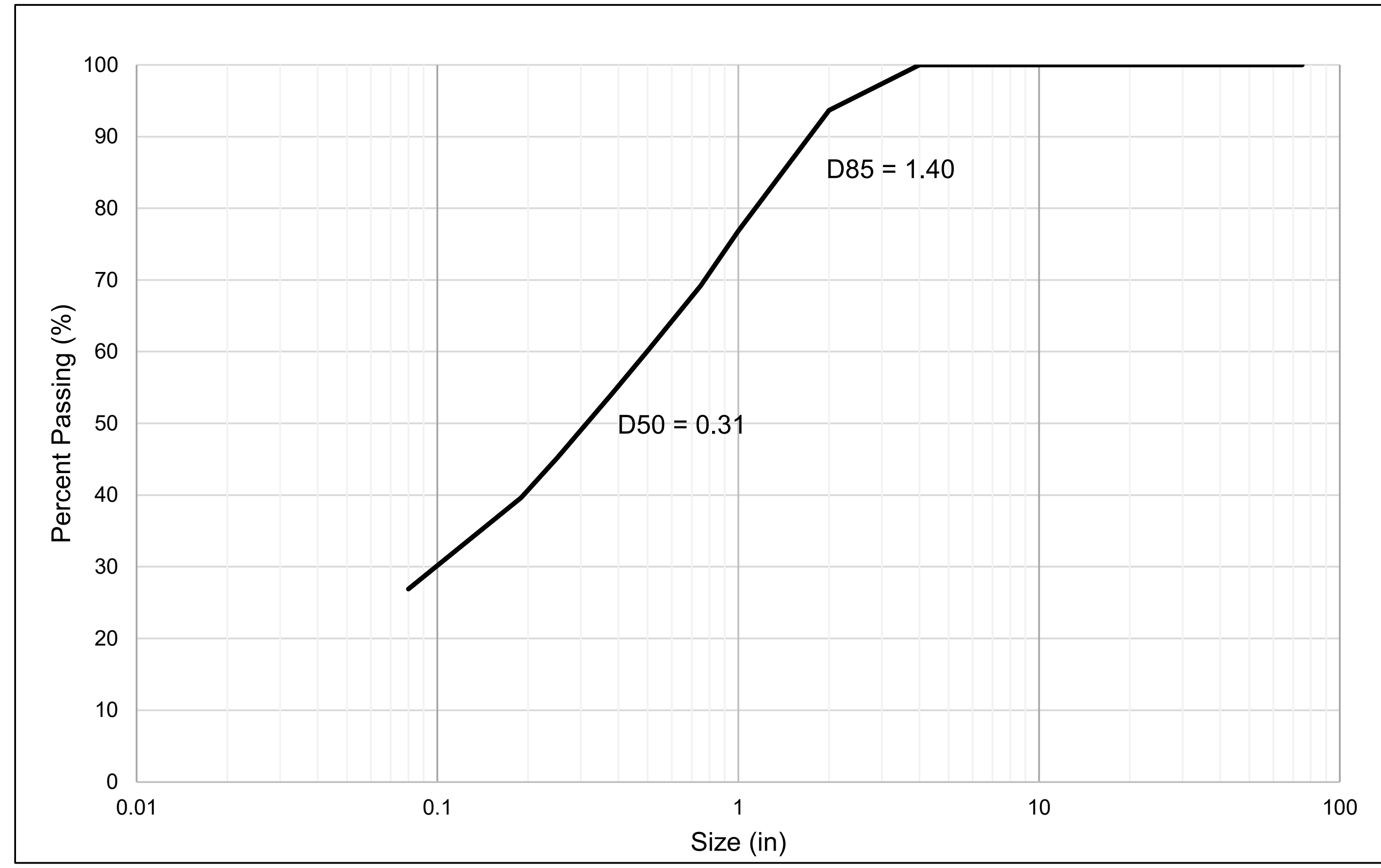
APPENDIX C

Split-NET Analysis Results

(Figures C.1 to C.23)

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	100.00
6	100.00
4	100.00
2	93.67
1	76.83
0.75	69.19
0.5	60.10
0.38	54.11
0.25	45.18
0.19	39.64
0.08	26.91

% Passing	Size[in]
F10	0.01
F20	0.04
F30	0.10
F40	0.19
F50	0.31
F60	0.50
F70	0.77
F80	1.13
F90	1.67
Topsize (99.95%)	3.41



NOTES:
1. TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE WORKERS ACCOMMODATION

Knight Piésold CONSULTING

P/A NO. VA103-640/1

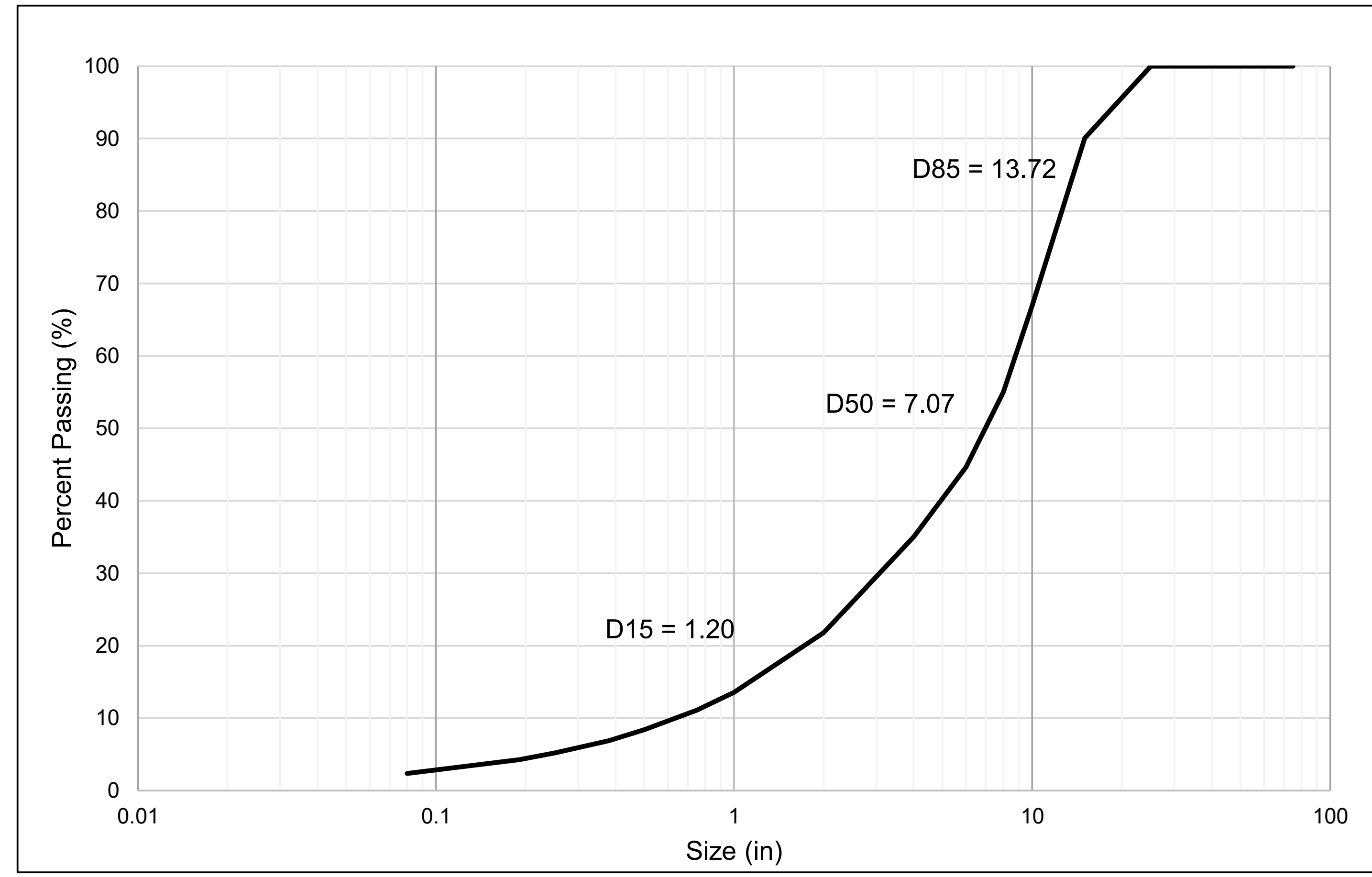
REF. NO. VA20-01037

FIGURE C.1

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	90.06
10	66.92
8	55.01
6	44.65
4	35.04
2	21.81
1	13.56
0.75	11.12
0.5	8.41
0.38	6.90
0.25	5.21
0.19	4.26
0.08	2.34

% Passing	Size[in]
F10	0.64
F20	1.76
F30	3.19
F40	4.95
F50	7.07
F60	8.84
F70	10.53
F80	12.46
F90	14.98
Topsize (99.95%)	22.57



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE LAKEVIEW ROAD - 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

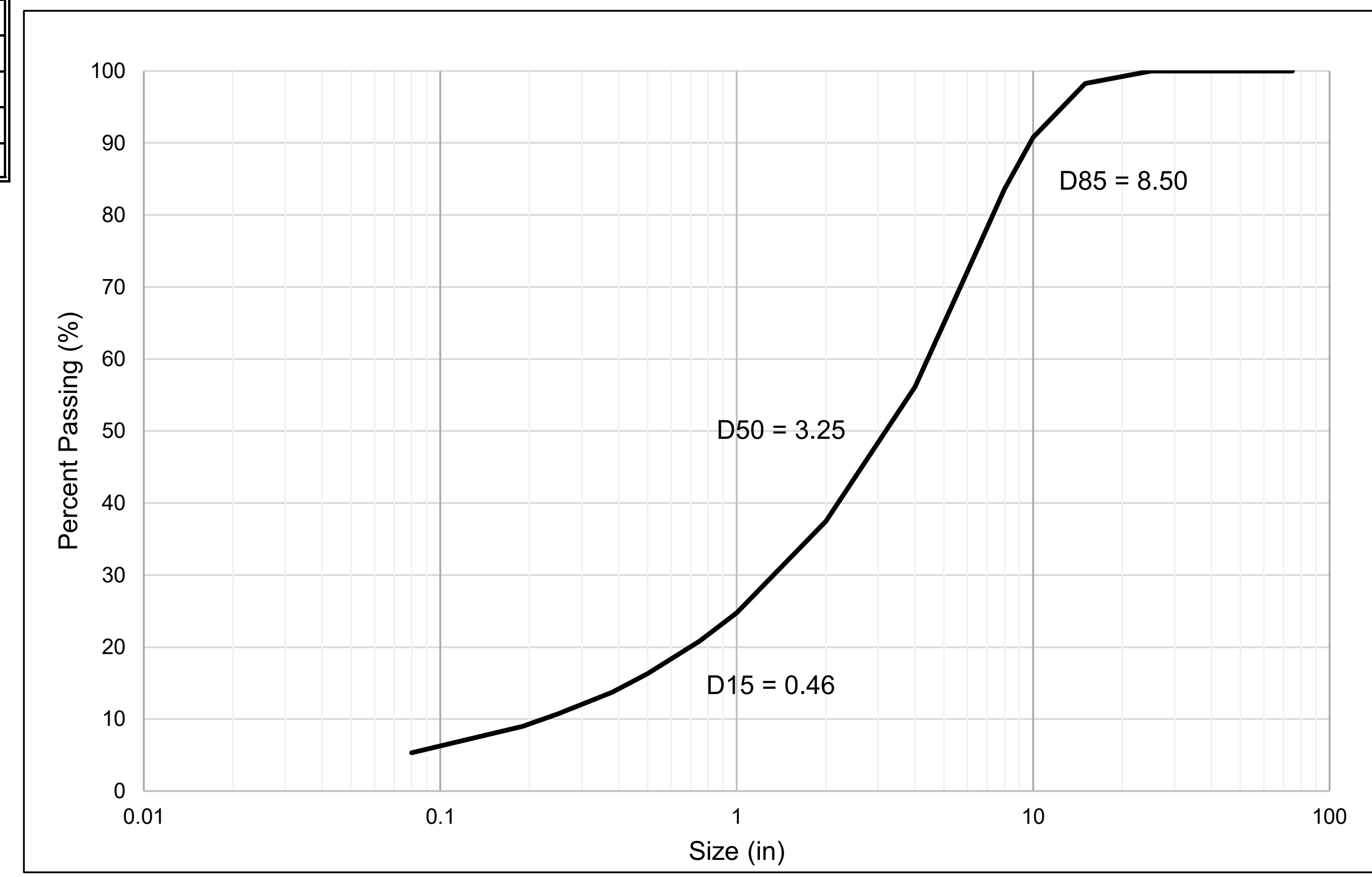
REF. NO. VA20-01037

FIGURE C.2

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	98.25
10	90.77
8	83.61
6	72.16
4	56.15
2	37.46
1	24.75
0.75	20.83
0.5	16.32
0.38	13.72
0.25	10.74
0.19	9.01
0.08	5.33

% Passing	Size[in]
F10	0.22
F20	0.70
F30	1.38
F40	2.23
F50	3.25
F60	4.45
F70	5.70
F80	7.26
F90	9.73
Topsize (99.95%)	19.06



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE LAKEVIEW ROAD - 2

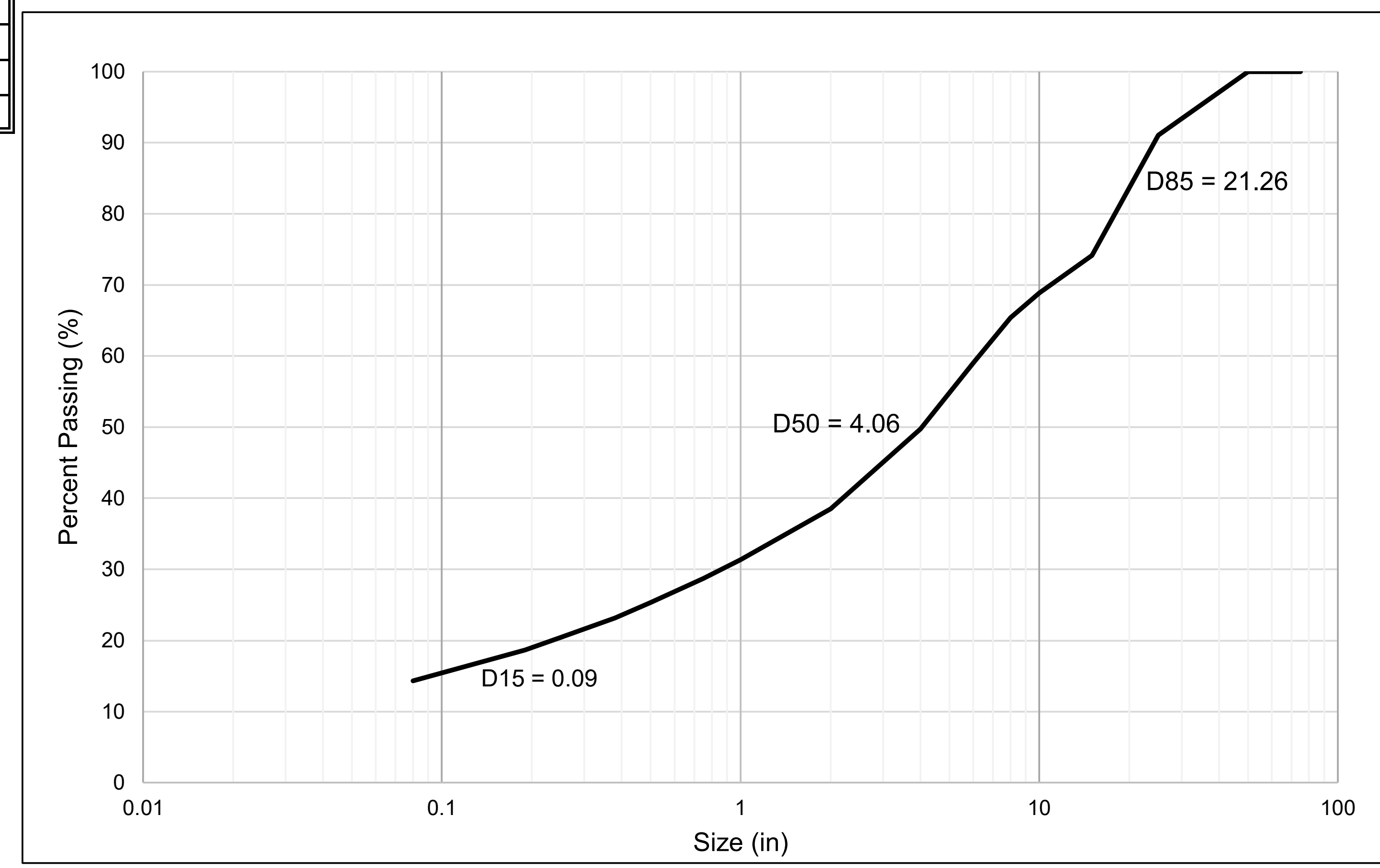
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.3 | REV A

Size[in]	% Passing
75	100.00
50	100.00
25	91.05
15	74.14
10	68.87
8	65.37
6	58.99
4	49.71
2	38.49
1	31.36
0.75	28.71
0.5	25.34
0.38	23.19
0.25	20.45
0.19	18.70
0.08	14.33

% Passing	Size[in]
F10	0.02
F15	0.09
F20	0.23
F30	0.87
F40	2.24
F50	4.06
F60	6.25
F70	10.92
F80	18.59
F85	21.26
F90	24.22
Topsize (99.95%)	32.75



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE LAKEVIEW ROAD - 3

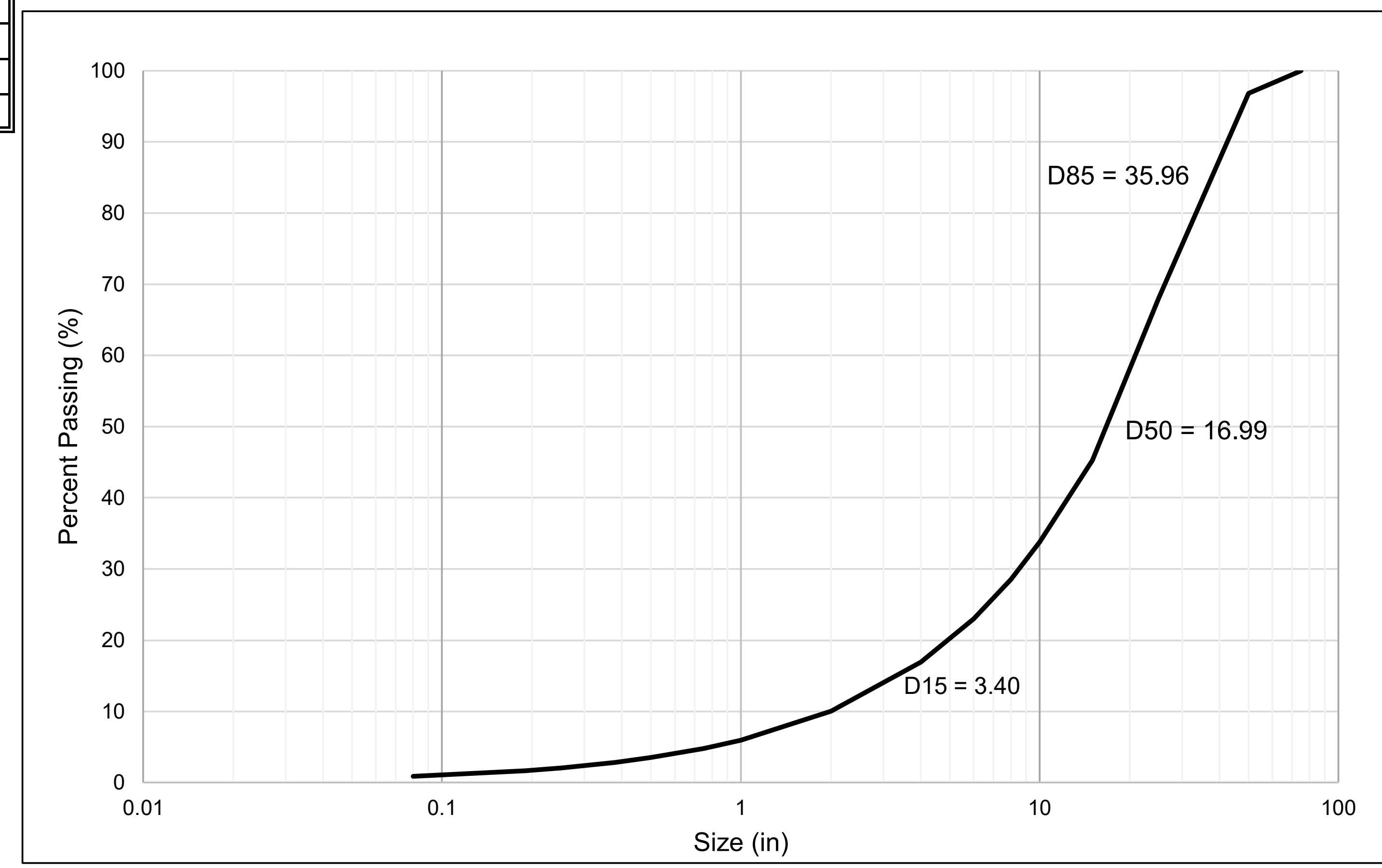
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.4 | REV A

Size[in]	% Passing
75	100.00
50	96.80
25	68.09
15	45.28
10	33.75
8	28.54
6	23.00
4	16.95
2	10.06
1	5.97
0.75	4.80
0.5	3.54
0.38	2.84
0.25	2.09
0.19	1.68
0.08	0.87

% Passing	Size[in]
F10	1.98
F15	3.40
F20	4.98
F30	8.55
F40	12.63
F50	16.99
F60	21.20
F70	25.99
F80	32.05
F85	35.96
F90	40.61
Topsize (99.95%)	65.36



NOTES:
1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE DAM DOWNSTRAM FACE SUB-AREA 1

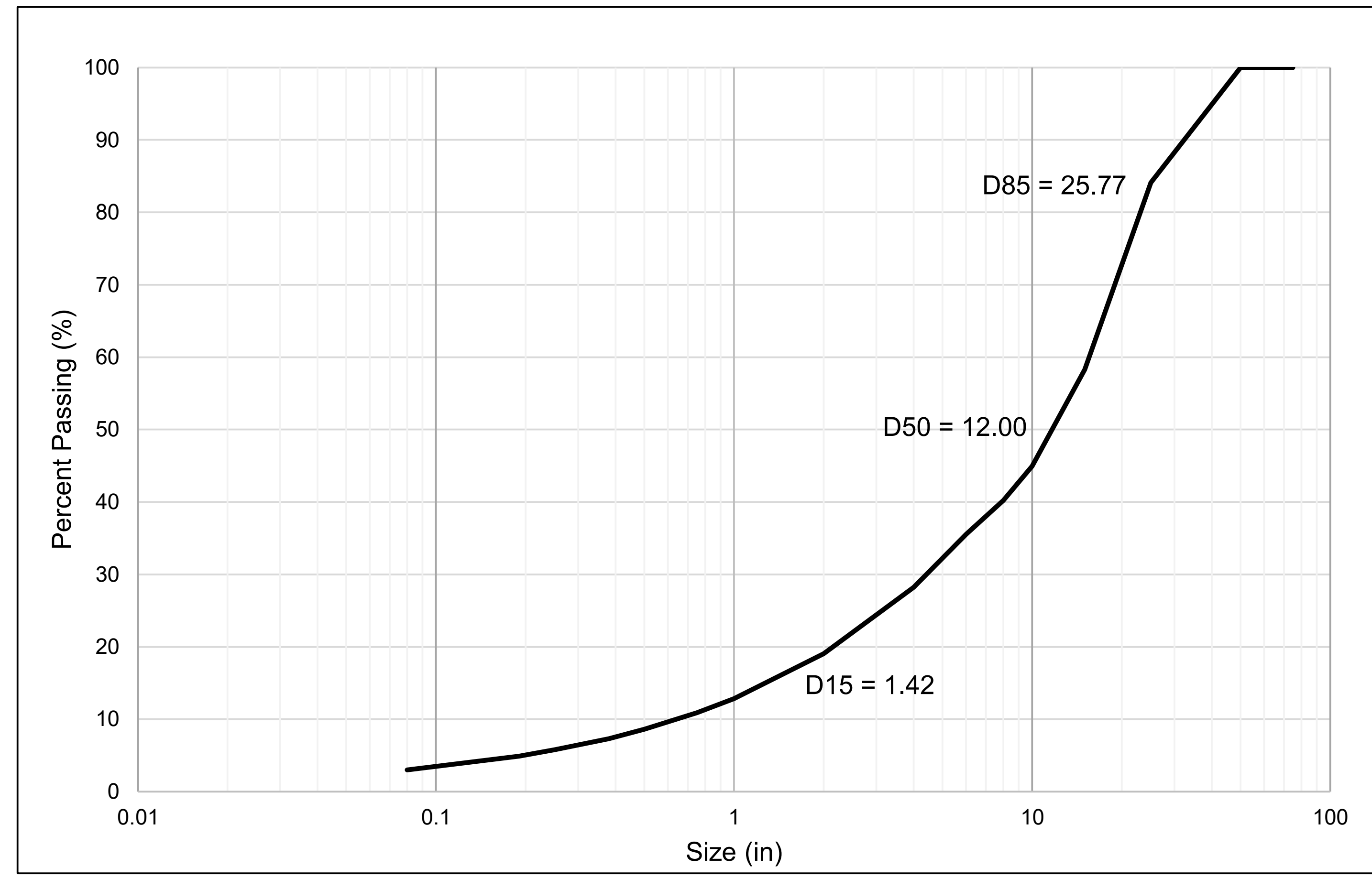
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.5 | REV A

Size[in]	% Passing
75	100.00
50	100.00
25	84.10
15	58.29
10	44.94
8	40.21
6	35.51
4	28.23
2	19.05
1	12.84
0.75	10.89
0.5	8.64
0.38	7.32
0.25	5.80
0.19	4.91
0.08	2.98

% Passing	Size[in]
F10	0.65
F20	2.18
F30	4.45
F40	7.91
F50	12.00
F60	15.63
F70	19.24
F80	23.14
F90	28.39
Topsize (99.95%)	44.87



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE DAM DOWNSTREAM FACE - SUB-AREA 2

Knight Piésold CONSULTING

P/A NO. VA103-640/1

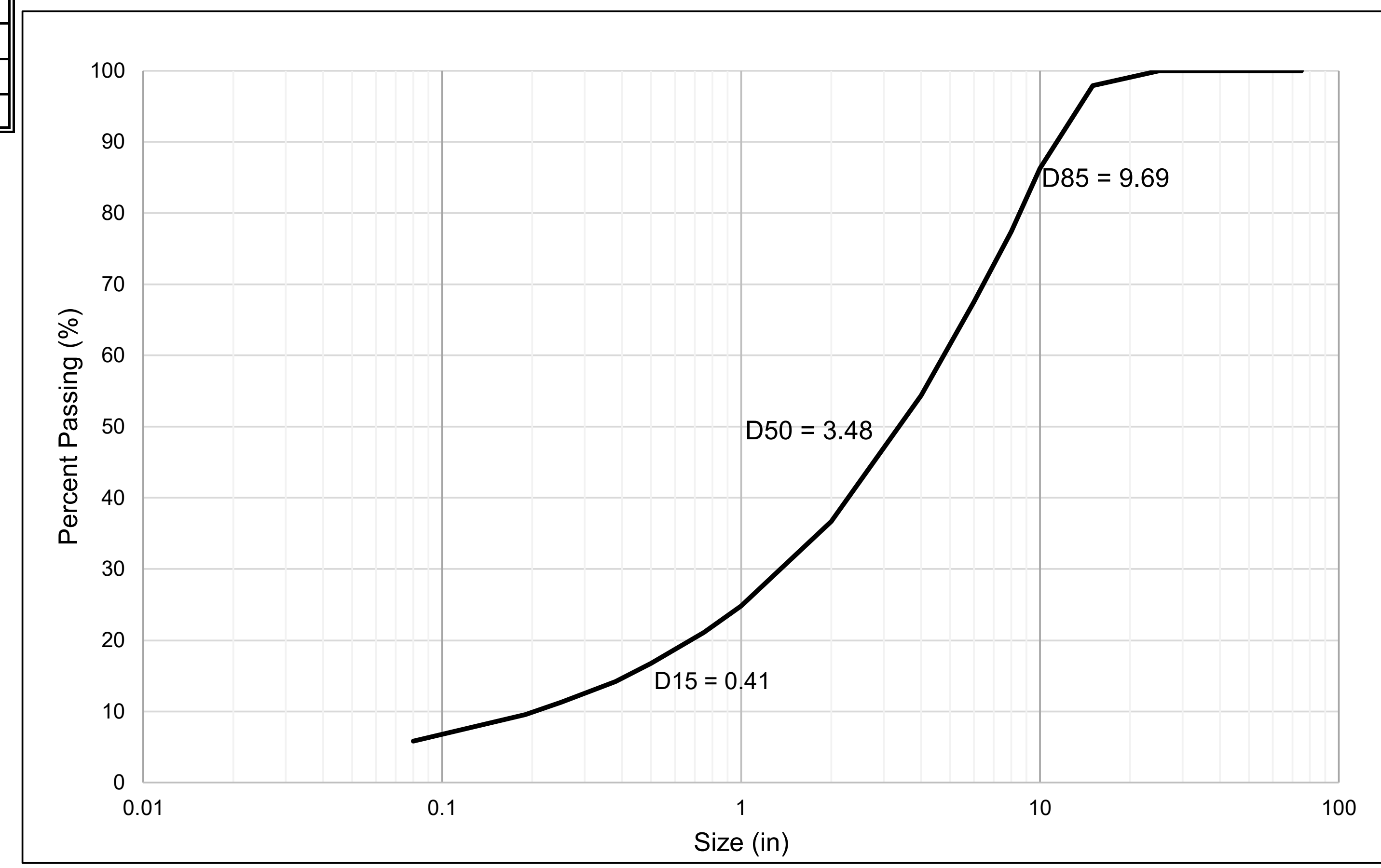
REF. NO. VA20-01037

FIGURE C.6

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	97.89
10	86.27
8	77.39
6	67.51
4	54.36
2	36.69
1	24.82
0.75	21.09
0.5	16.76
0.38	14.23
0.25	11.30
0.19	9.57
0.08	5.84

% Passing	Size[in]
F10	0.20
F15	0.41
F20	0.68
F30	1.40
F40	2.34
F50	3.48
F60	4.78
F70	6.48
F80	8.57
F85	9.69
F90	11.05
Topsize (99.95%)	18.66



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
IRON GATE DAM DOWNSTREAM FACE SUB-AREA 3

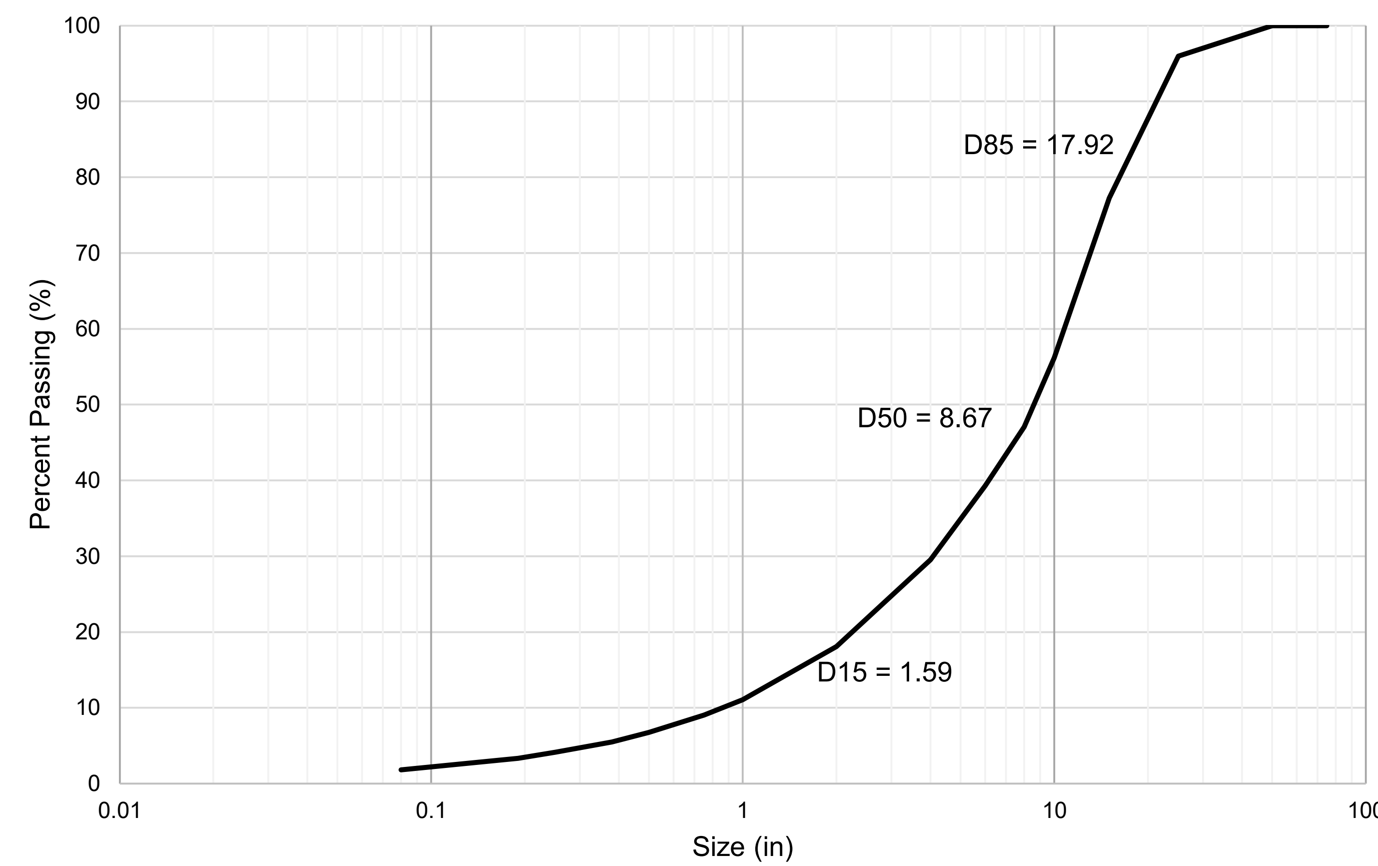
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.7 | REV A

Size[in]	% Passing
75	100.00
50	100.00
25	95.98
15	77.28
10	56.17
8	47.08
6	39.30
4	29.52
2	18.09
1	11.07
0.75	9.03
0.5	6.77
0.38	5.51
0.25	4.13
0.19	3.35
0.08	1.80

% Passing	Size[in]
F10	0.87
F20	2.31
F30	4.09
F40	6.15
F50	8.67
F60	10.82
F70	13.09
F80	15.81
F90	20.02
Topsize (99.95%)	34.58



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 1 ACCESS ROAD - 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

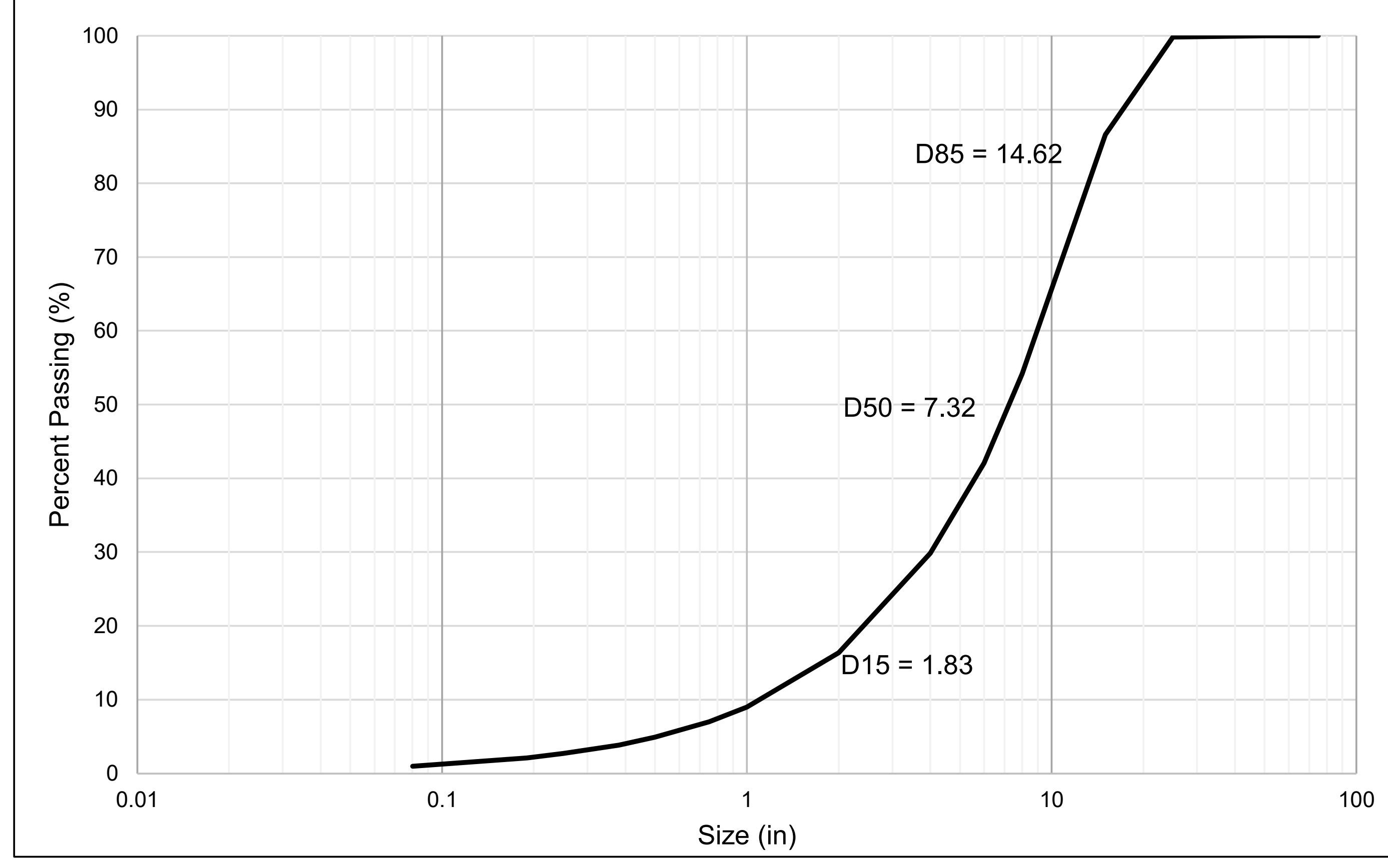
REF. NO. VA20-01037

FIGURE C.8

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	99.82
15	86.61
10	65.63
8	54.14
6	42.07
4	29.83
2	16.40
1	9.01
0.75	7.02
0.5	4.94
0.38	3.85
0.25	2.71
0.19	2.11
0.08	0.99

% Passing	Size[in]
F10	1.13
F20	2.52
F30	4.03
F40	5.62
F50	7.32
F60	9.00
F70	10.82
F80	13.07
F90	16.16
Topsize (99.95%)	25.37



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO.1 ACCESS ROAD - 2

Knight Piésold CONSULTING

P/A NO. VA103-640/1

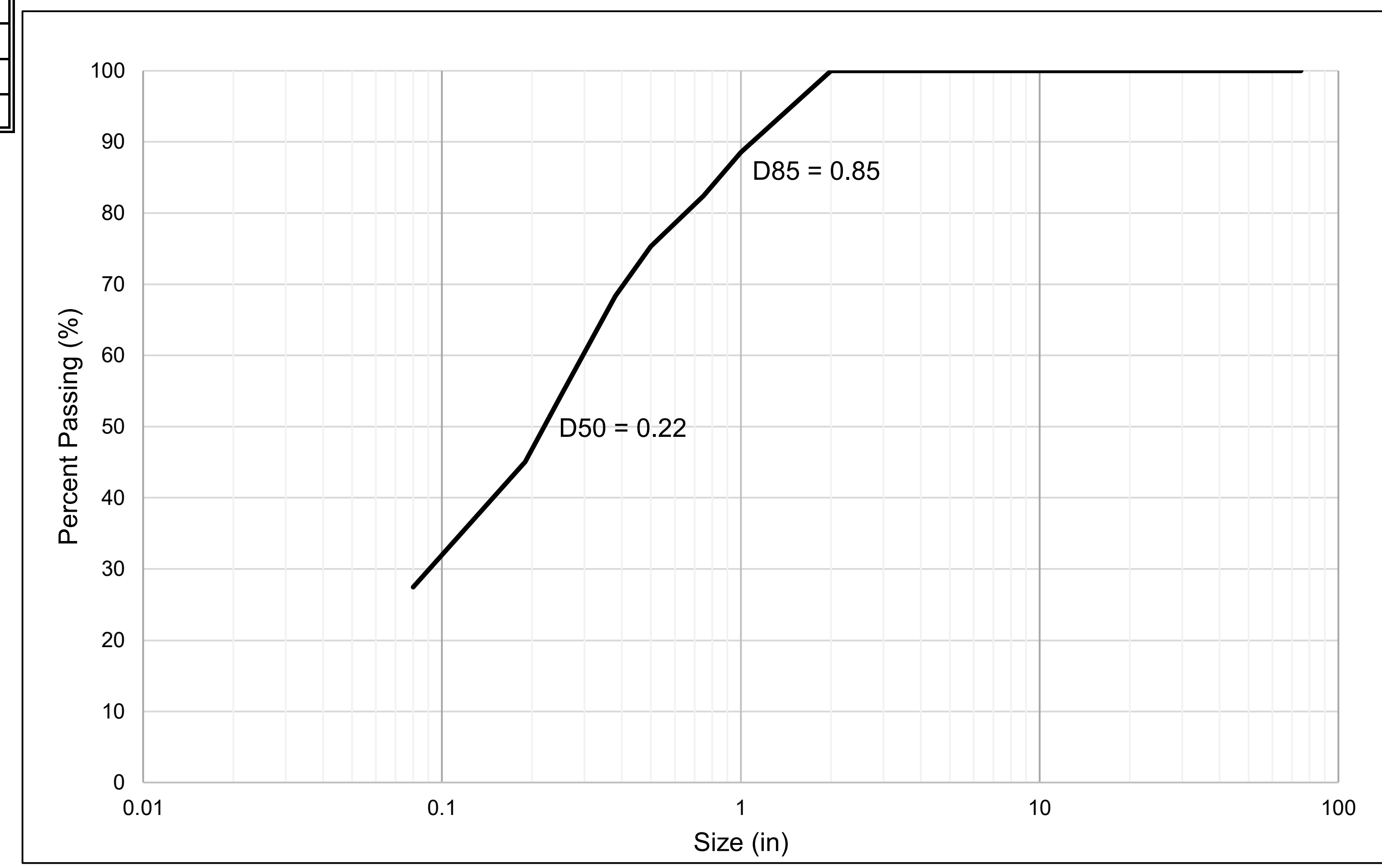
REF. NO. VA20-01037

FIGURE C.9

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	100.00
6	100.00
4	100.00
2	99.98
1	88.54
0.75	82.42
0.5	75.30
0.38	68.34
0.25	54.36
0.19	45.06
0.08	27.46

% Passing	Size[in]
F10	0.01
F15	0.03
F20	0.05
F30	0.09
F40	0.15
F50	0.22
F60	0.29
F70	0.40
F80	0.65
F85	0.85
F90	1.07
Topsize (99.95%)	1.98



NOTES:

1. STANDARD TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 1 VILLAGE - 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

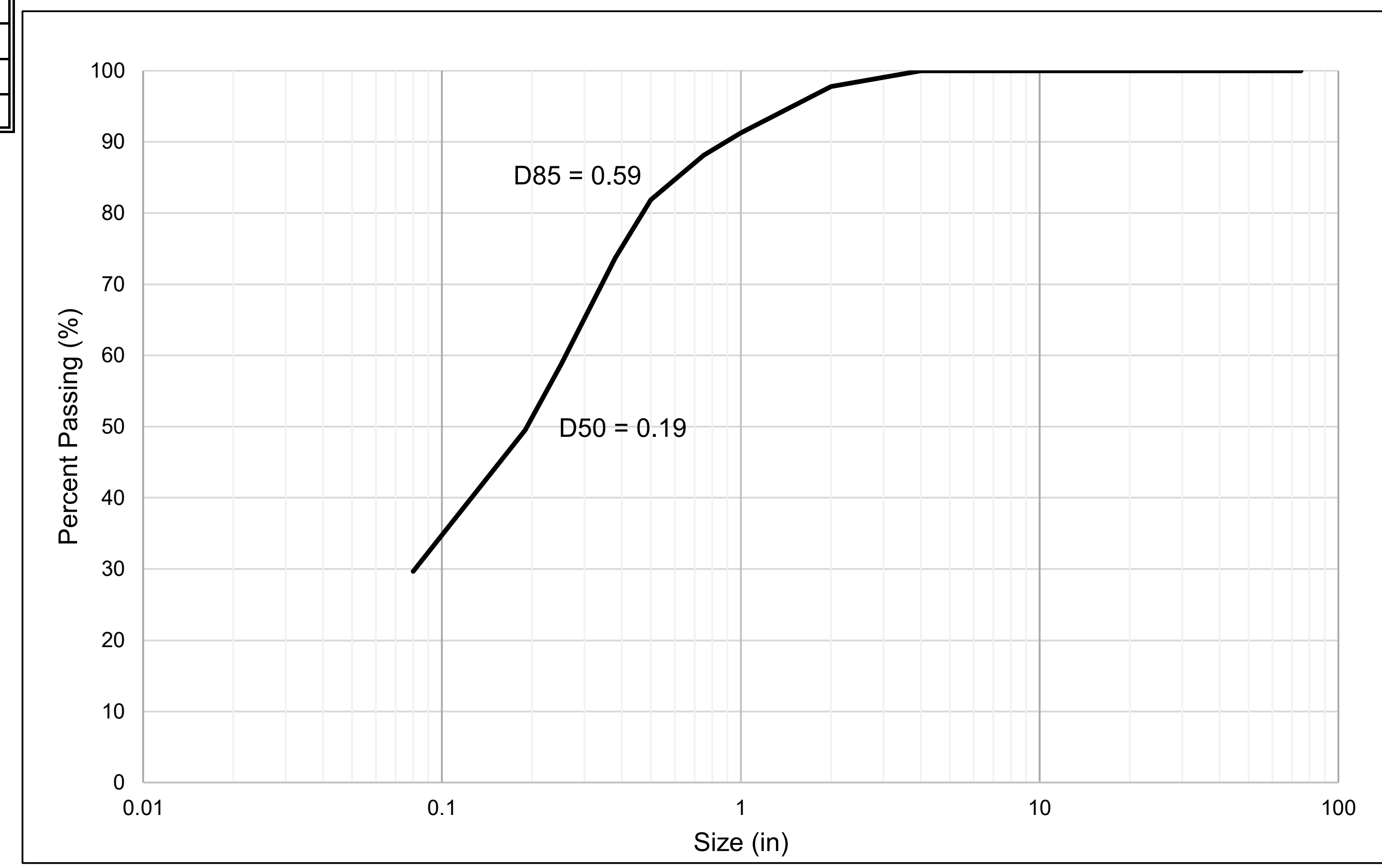
REF. NO. VA20-01037

FIGURE C.10

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	100.00
6	100.00
4	100.00
2	97.78
1	91.28
0.75	88.12
0.5	81.84
0.38	73.71
0.25	58.69
0.19	49.50
0.08	29.65

% Passing	Size[in]
F10	0.01
F15	0.03
F20	0.04
F30	0.08
F40	0.13
F50	0.19
F60	0.26
F70	0.34
F80	0.46
F85	0.59
F90	0.88
Topsize (99.95%)	2.64



NOTES:

1. STANDARD TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 1 VILLAGE - 2

Knight Piésold CONSULTING

P/A NO. VA103-640/1

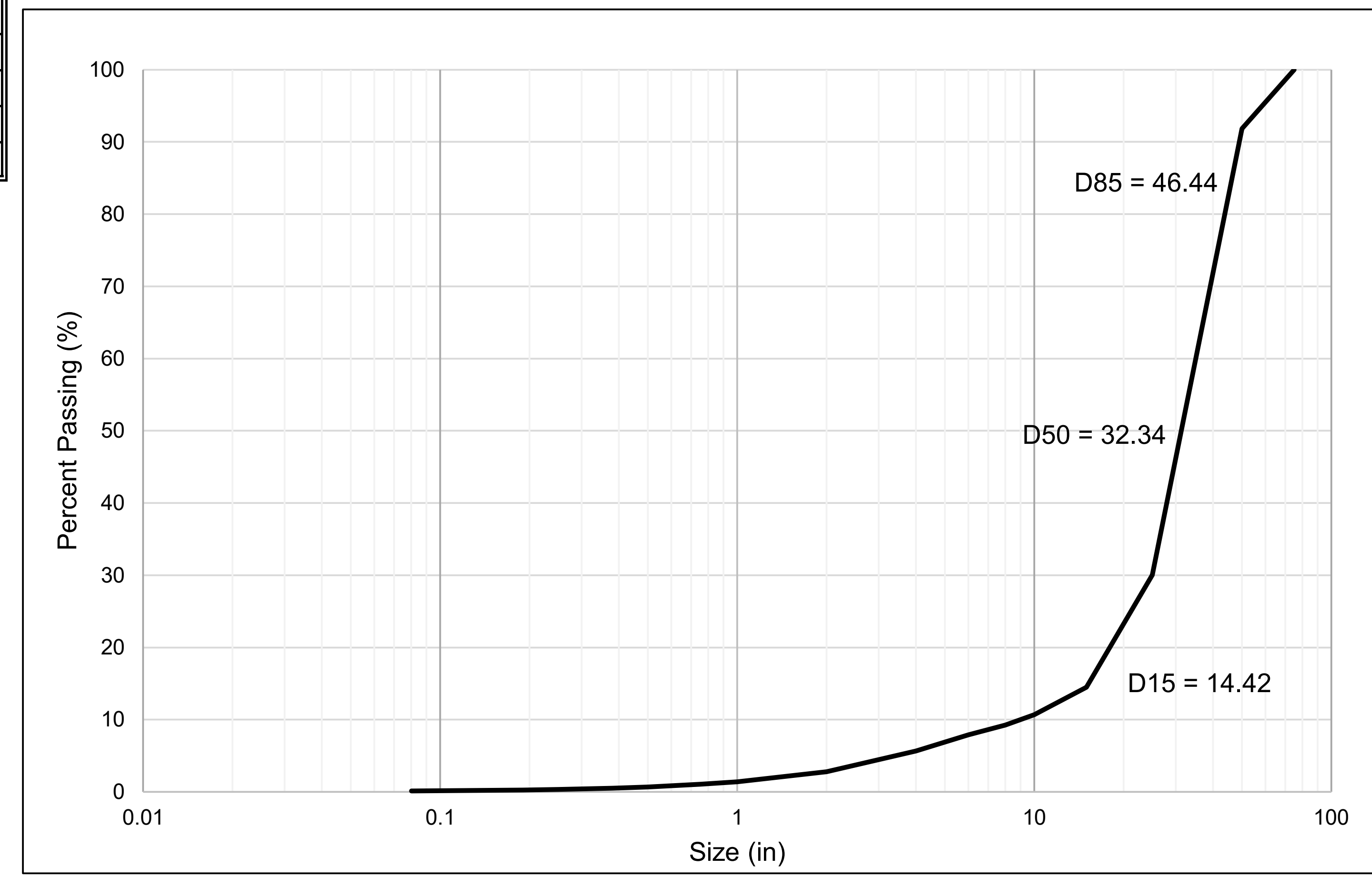
REF. NO. VA20-01037

FIGURE C.11

REV A

Size[in]	% Passing
75	100.00
50	91.83
25	30.04
15	14.50
10	10.67
8	9.27
6	7.92
4	5.67
2	2.80
1	1.39
0.75	1.04
0.5	0.69
0.38	0.51
0.25	0.34
0.19	0.25
0.08	0.10

% Passing	Size[in]
F10	9.03
F20	19.81
F30	24.98
F40	28.85
F50	32.34
F60	35.88
F70	39.68
F80	44.02
F90	48.86
Topsize (99.95%)	58.83



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING
3. DUE TO THE LARGE PARTICLE SIZES OF THE ROCKS, BOTH SCALING BALLS COULD NOT BE SHOWN IN THE PHOTOGRAPHS SENT FOR ANALYSIS. THE RESULTING ANALYSIS IS THEREFORE EXPECTED TO PRODUCE AN ARTIFICIALLY SMALLER PARTICLE SIZE CURVE DUE TO AN INABILITY TO DETERMINE THE DEPTH OF FIELD.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 2 DOWNSTREAM RIGHT BANK - 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

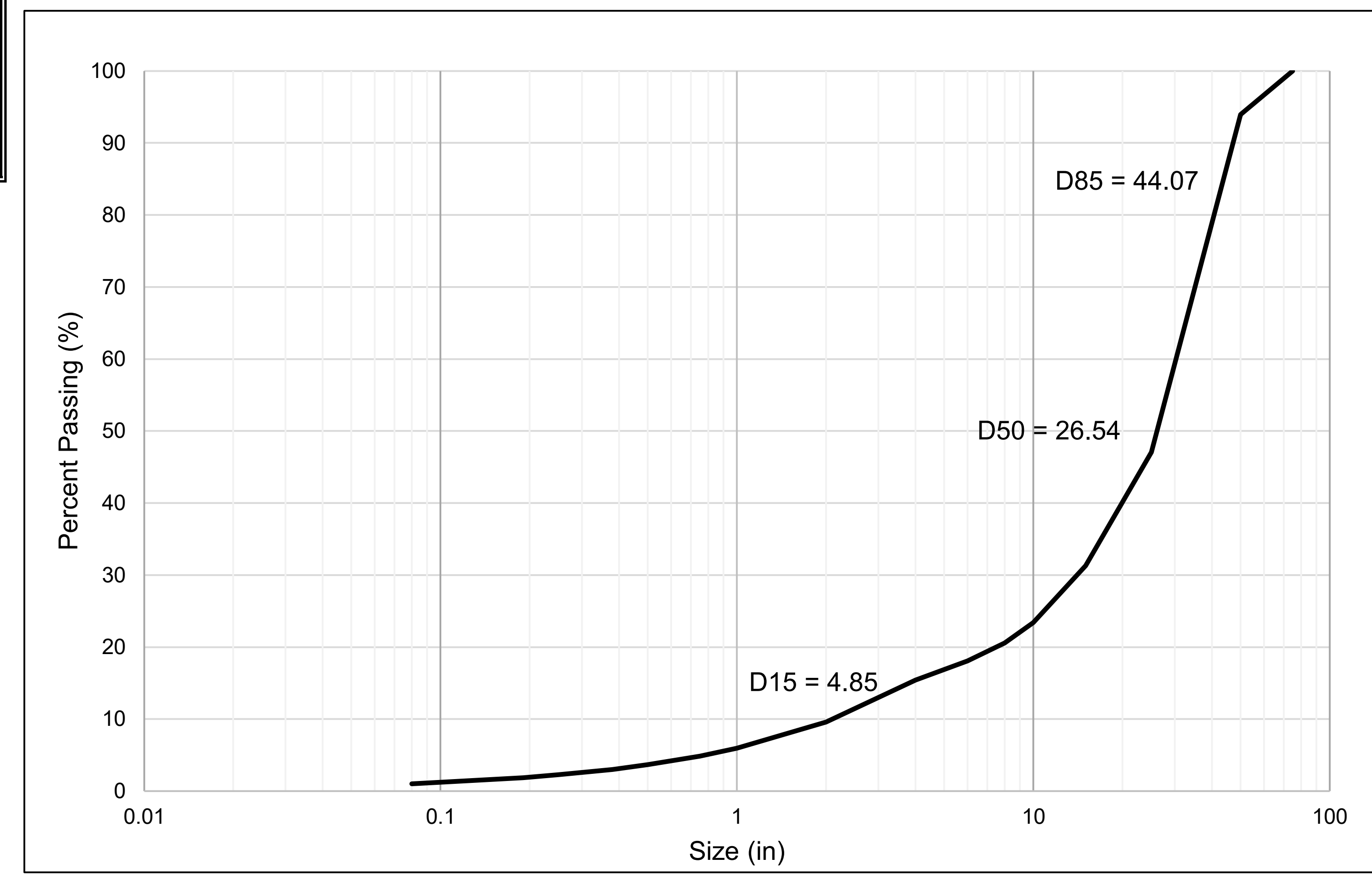
REF. NO. VA20-01037

FIGURE C.12

REV A

Size[in]	% Passing
75	100.00
50	93.97
25	47.08
15	31.32
10	23.41
8	20.57
6	18.09
4	15.44
2	9.59
1	5.95
0.75	4.88
0.5	3.68
0.38	3.02
0.25	2.28
0.19	1.86
0.08	1.02

% Passing	Size[in]
F10	2.13
F20	7.57
F30	14.17
F40	20.86
F50	26.54
F60	31.36
F70	35.74
F80	40.92
F90	47.21
Topsize (99.95%)	54.73



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING
3. DUE TO THE LARGE PARTICLE SIZES OF THE ROCKS, BOTH SCALING BALLS COULD NOT BE SHOWN IN THE PHOTOGRAPHS SENT FOR ANALYSIS. THE RESULTING ANALYSIS IS THEREFORE EXPECTED TO PRODUCE AN ARTIFICIALLY SMALLER PARTICLE SIZE CURVE DUE TO AN INABILITY TO DETERMINE THE DEPTH OF FIELD.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 2 DOWNSTREAM RIGHT BANK - 2

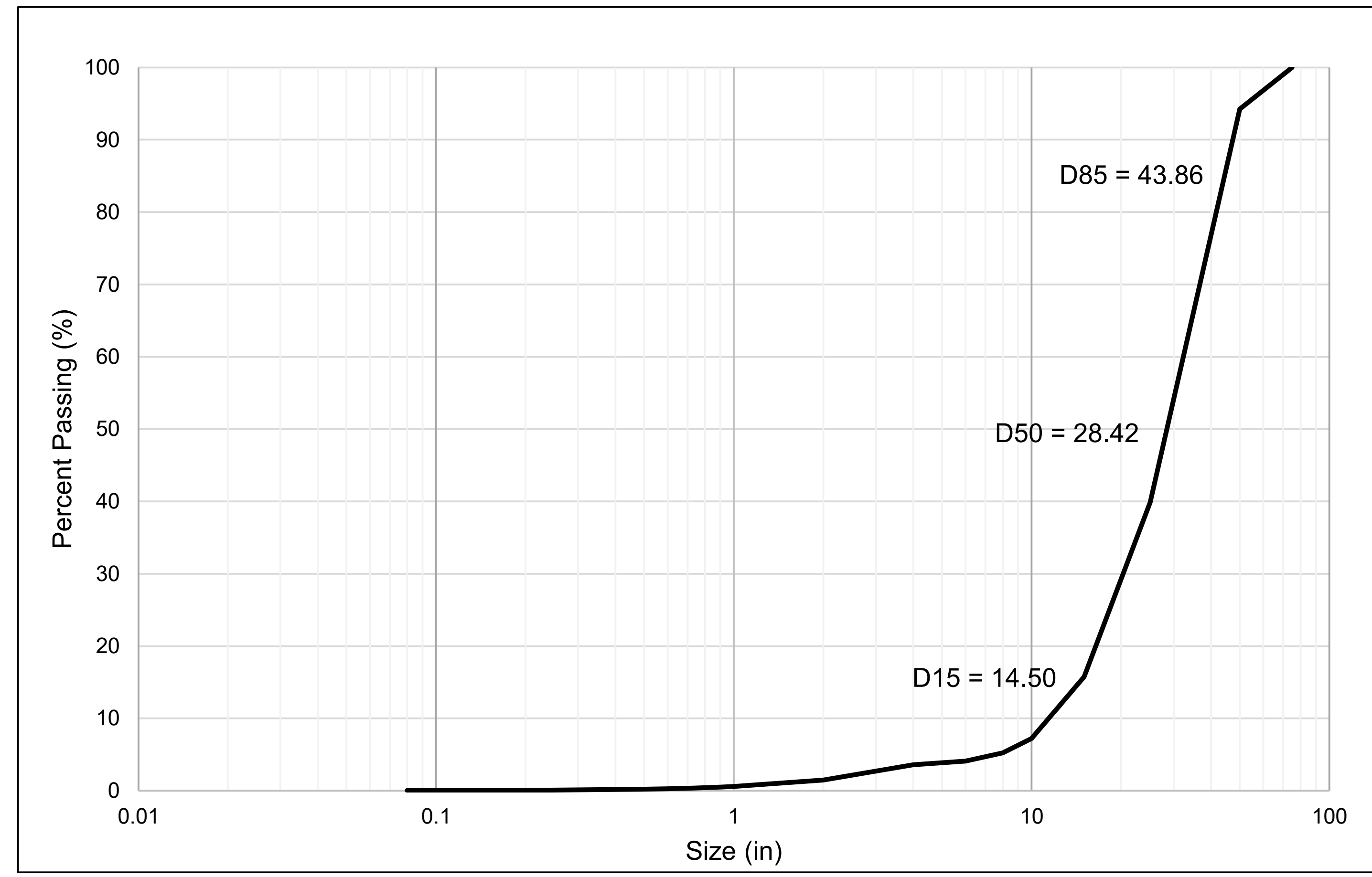
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.13 | REV A

Size[in]	% Passing
75	100.00
50	94.25
25	39.87
15	15.75
10	7.22
8	5.23
6	4.12
4	3.58
2	1.46
1	0.58
0.75	0.40
0.5	0.23
0.38	0.16
0.25	0.09
0.19	0.06
0.08	0.02

% Passing	Size[in]
F10	11.96
F20	17.03
F30	21.27
F40	25.05
F50	28.42
F60	32.15
F70	36.23
F80	40.90
F90	46.82
Topsize (99.95%)	59.07



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 2 DOWNSTREAM LEFT BANK

Knight Piésold CONSULTING

P/A NO. VA103-640/1

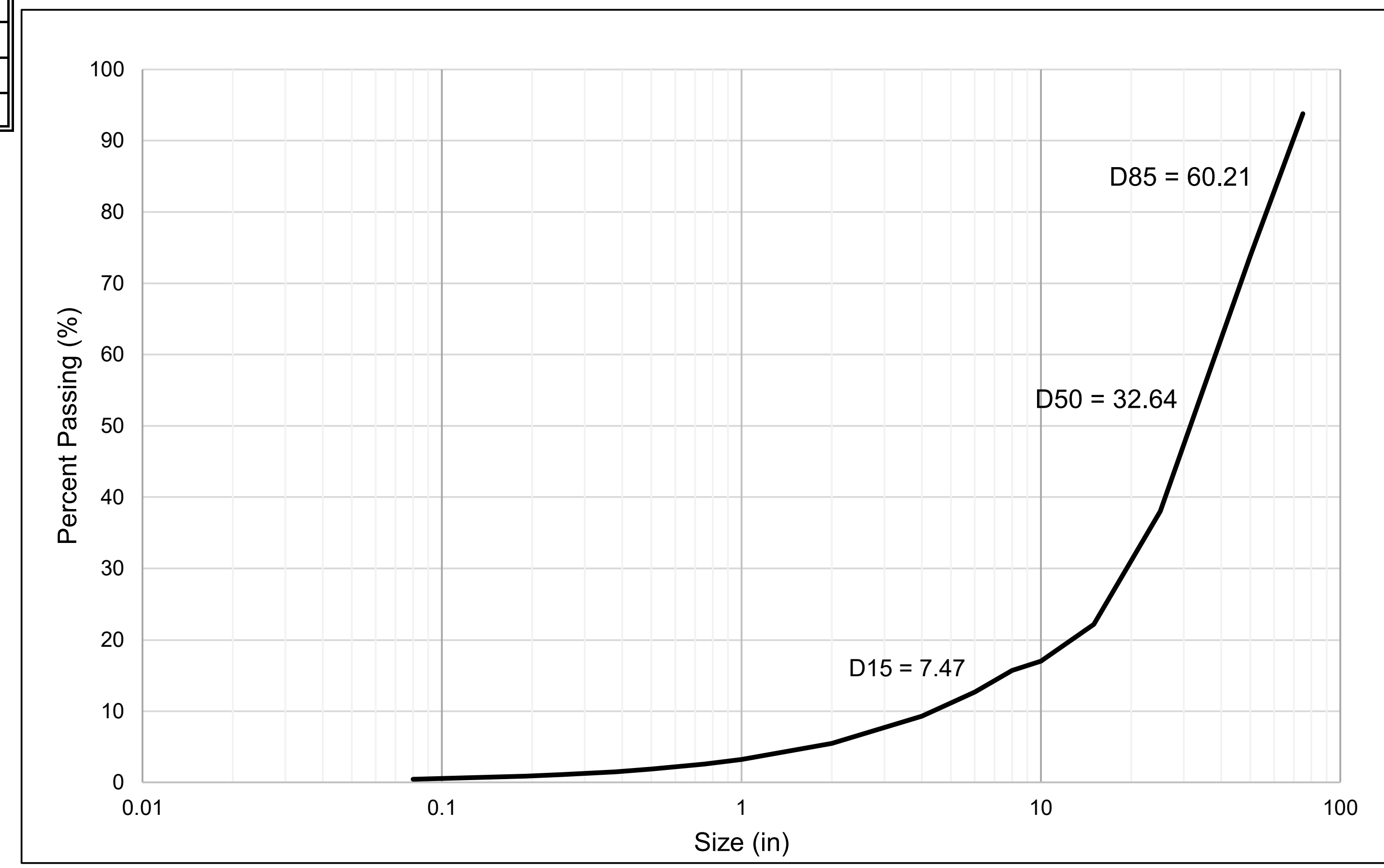
REF. NO. VA20-01037

FIGURE C.14

REV A

Size[in]	% Passing
75	93.79
50	73.82
25	38.04
15	22.20
10	17.01
8	15.71
6	12.68
4	9.31
2	5.48
1	3.23
0.75	2.59
0.5	1.90
0.38	1.52
0.25	1.11
0.19	0.89
0.08	0.46

% Passing	Size[in]
F10	4.39
F15	7.47
F20	13.16
F30	20.16
F40	26.16
F50	32.64
F60	39.26
F70	46.84
F80	55.48
F85	60.21
F90	67.31
Topsize (99.95%)	89.88



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 2 DOWNSTREAM LEFT BANK - 2

Knight Piésold CONSULTING

P/A NO. VA103-640/1

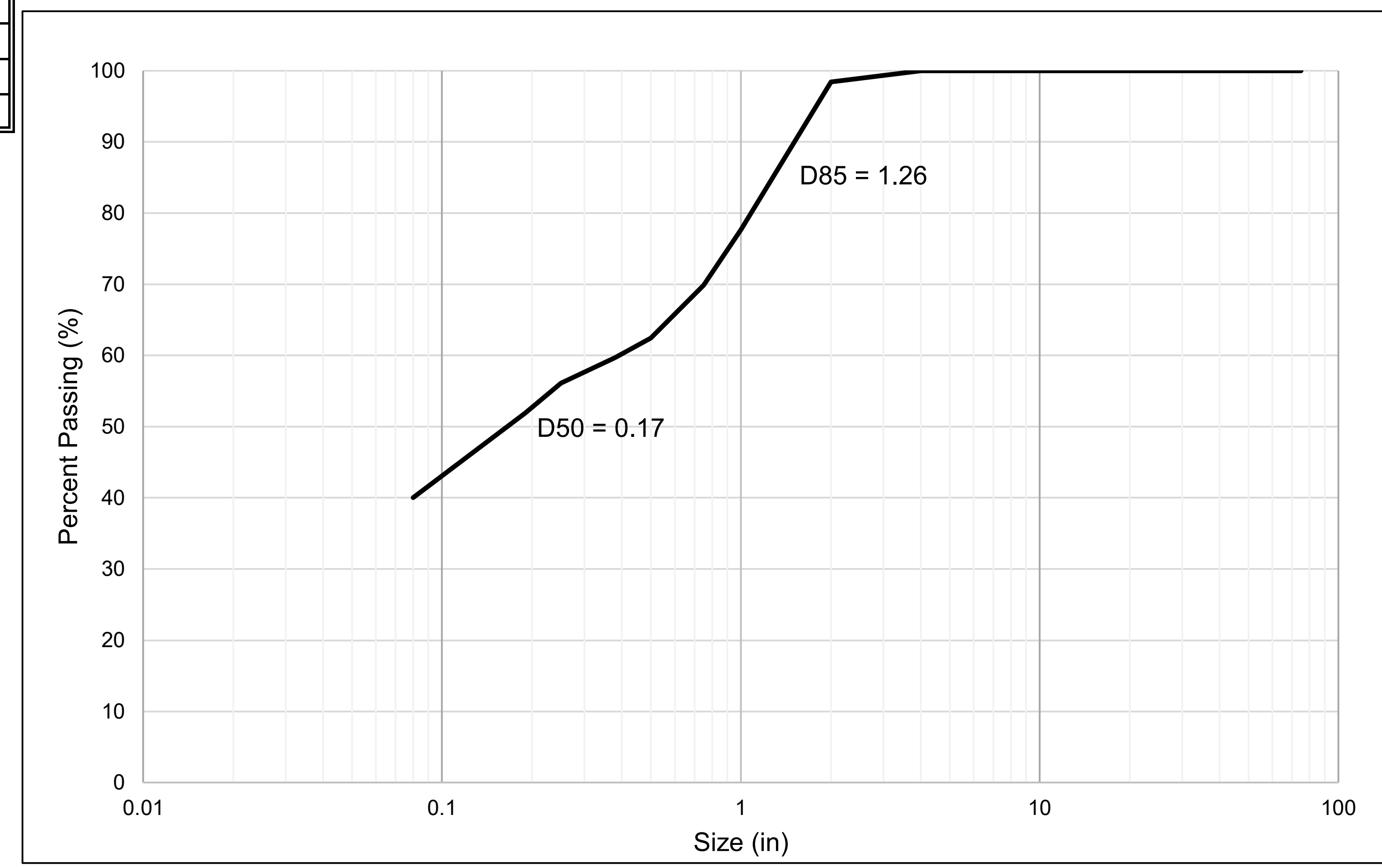
REF. NO. VA20-01037

FIGURE C.15

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	100.00
6	100.00
4	100.00
2	98.41
1	77.66
0.75	69.83
0.5	62.42
0.38	59.72
0.25	56.11
0.19	51.90
0.08	40.02

% Passing	Size[in]
F10	0.00
F15	0.01
F20	0.01
F30	0.03
F40	0.08
F50	0.17
F60	0.39
F70	0.76
F80	1.08
F85	1.26
F90	1.48
Topsize (99.95%)	2.18



NOTES:

1. STANDARD TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 2 WOOD-STAVE PENSTOCK SUB-AREA 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

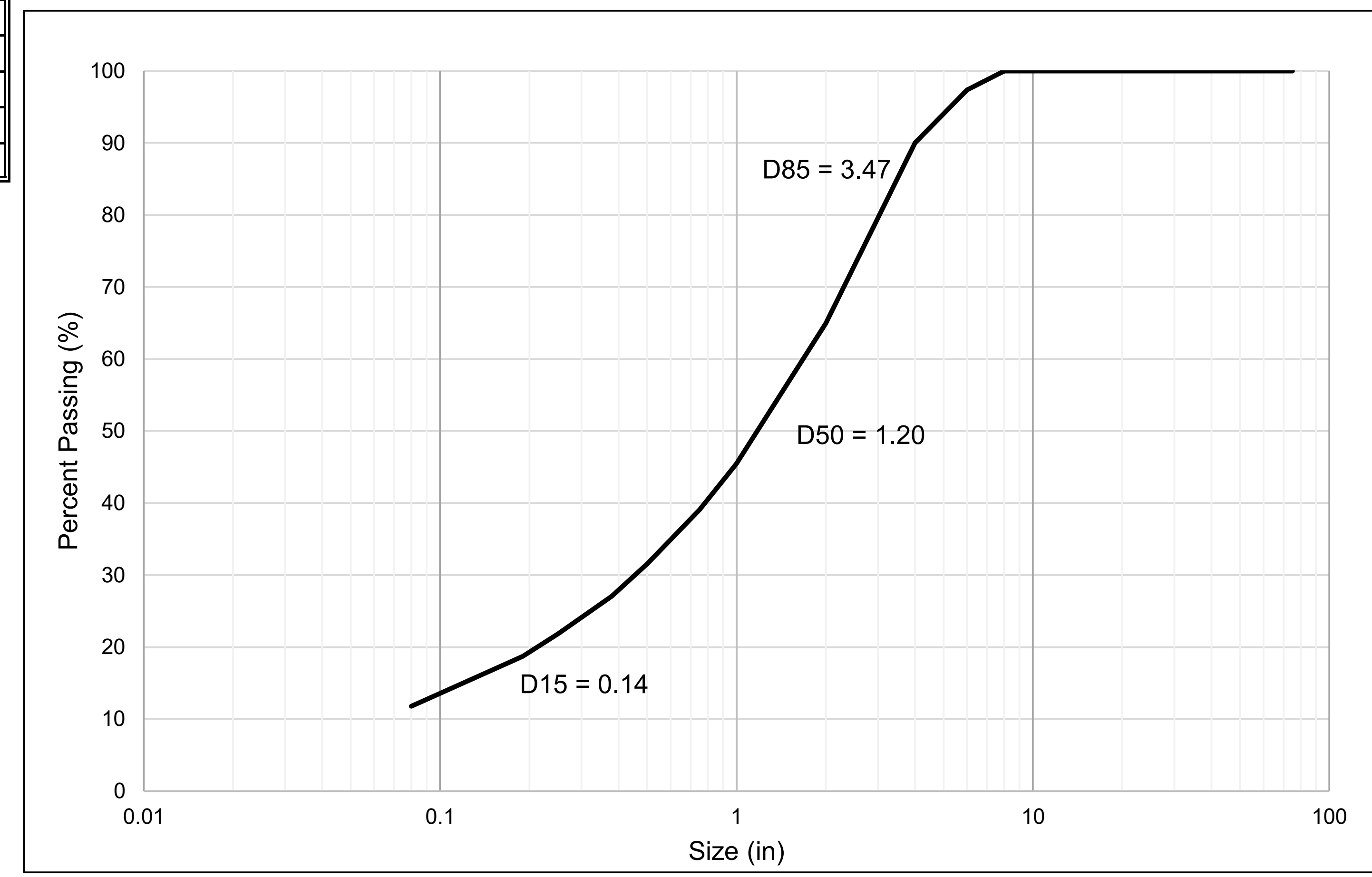
REF. NO. VA20-01037

FIGURE C.16

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	100.00
6	97.36
4	90.02
2	64.97
1	45.46
0.75	39.07
0.5	31.54
0.38	27.08
0.25	21.83
0.19	18.71
0.08	11.80

% Passing	Size[in]
F10	0.06
F20	0.21
F30	0.45
F40	0.78
F50	1.20
F60	1.73
F70	2.29
F80	2.94
F90	4.00
Topsize (99.95%)	7.53



NOTES:
1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
COPCO NO. 2 WOOD-STAVE PENSTOCK SUB-AREA 3

Knight Piésold CONSULTING

P/A NO. VA103-640/1

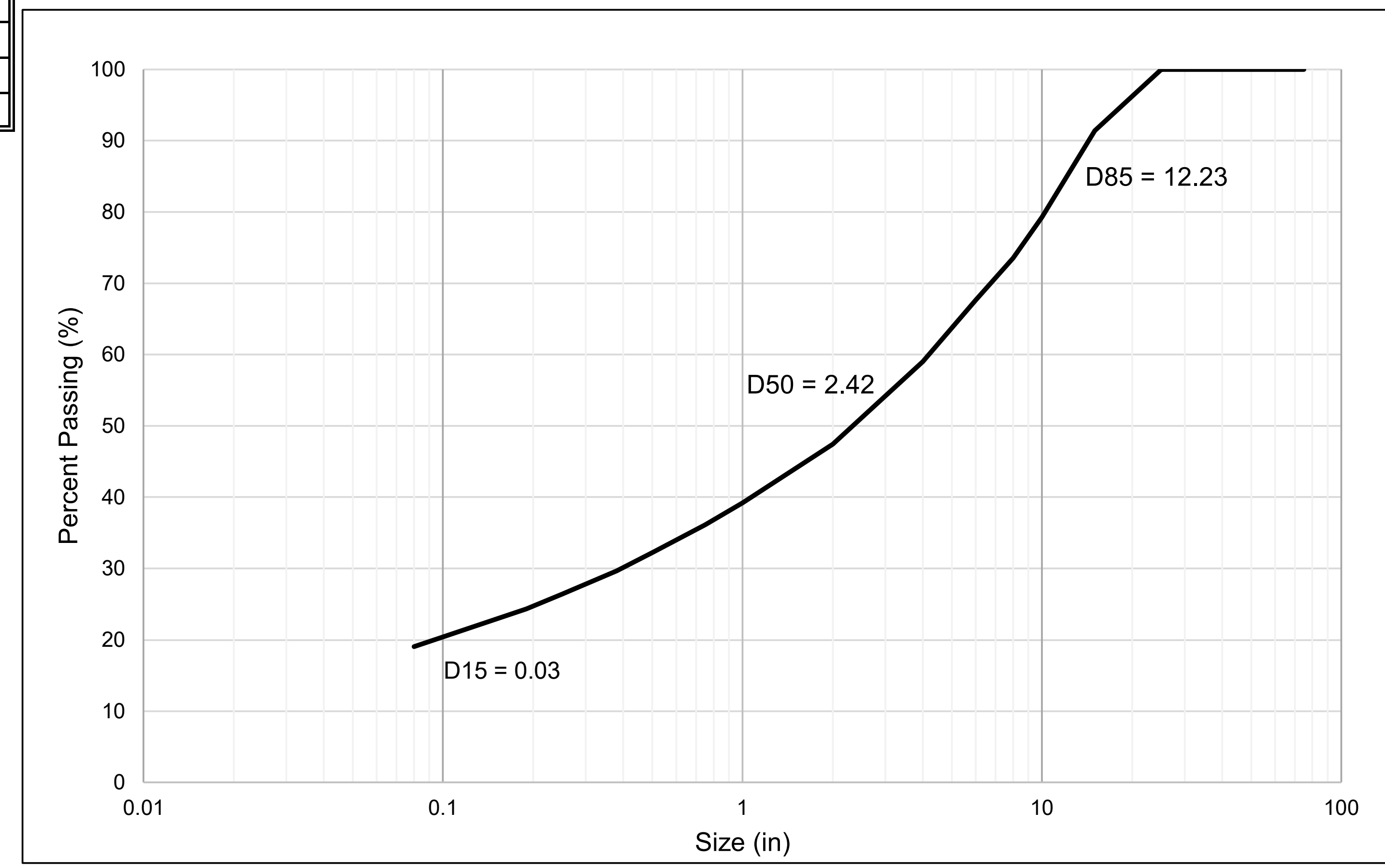
REF. NO. VA20-01037

FIGURE C.17

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	91.41
10	79.27
8	73.52
6	67.62
4	59.01
2	47.41
1	39.20
0.75	36.13
0.5	32.21
0.38	29.67
0.25	26.44
0.19	24.34
0.08	19.05

% Passing	Size[in]
F10	0.01
F15	0.03
F20	0.09
F30	0.39
F40	1.07
F50	2.42
F60	4.20
F70	6.78
F80	10.27
F85	12.23
F90	14.32
Topsize (99.95%)	21.76



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
J.C. BOYLE DOWNSTREAM DAM - SUB-AREA 1 - 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

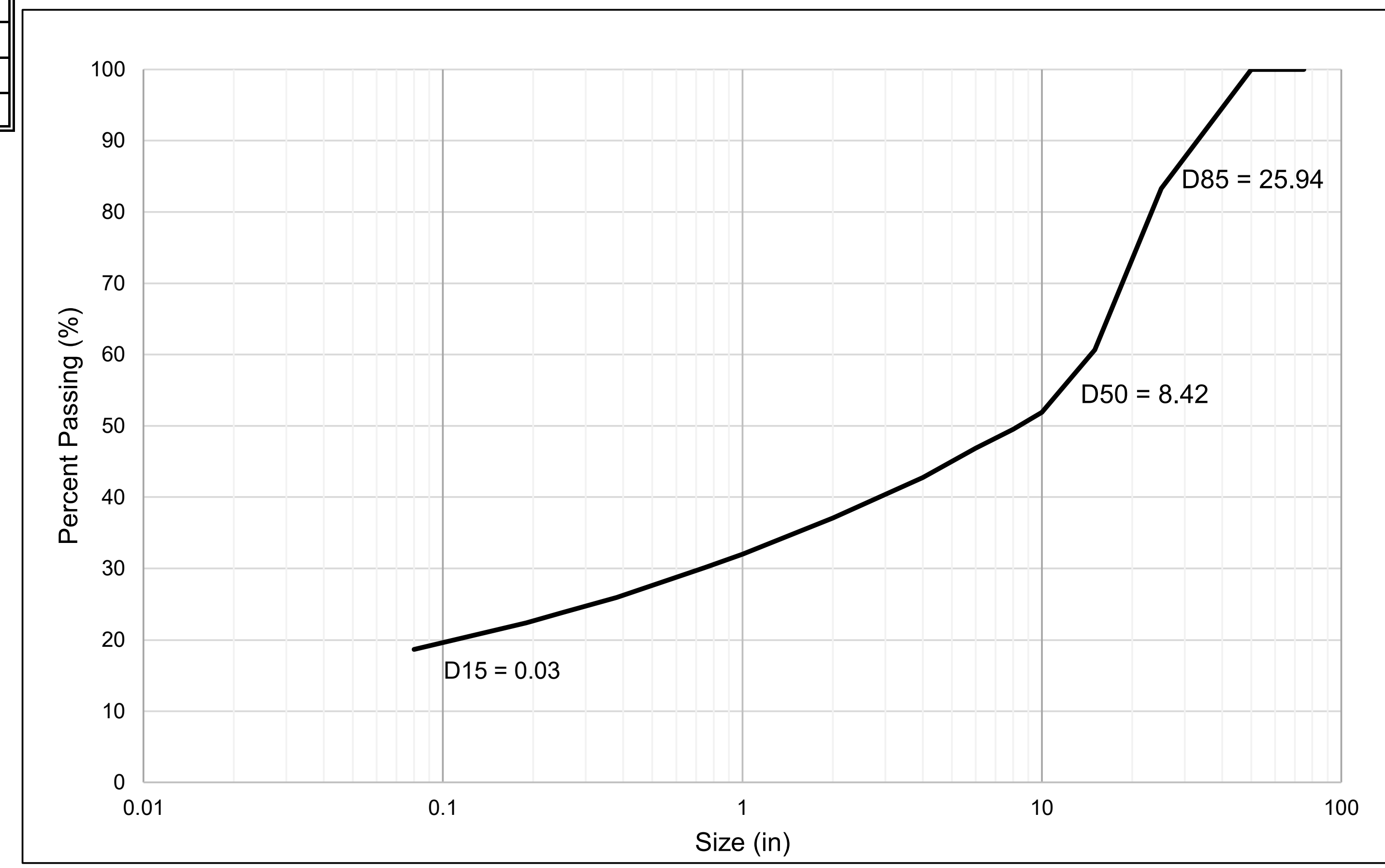
REF. NO. VA20-01037

FIGURE C.18

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	83.27
15	60.67
10	51.91
8	49.51
6	46.88
4	42.74
2	37.07
1	32.01
0.75	30.11
0.5	27.62
0.38	25.98
0.25	23.83
0.19	22.41
0.08	18.67

% Passing	Size[in]
F10	0.01
F15	0.03
F20	0.11
F30	0.74
F40	2.92
F50	8.42
F60	14.68
F70	19.03
F80	23.40
F85	25.94
F90	29.26
Topsize (99.95%)	41.86



NOTES:
1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
J.C. BOYLE DOWNSTREAM DAM - SUB-AREA 1 - 2

Knight Piésold CONSULTING

P/A NO. VA103-640/1

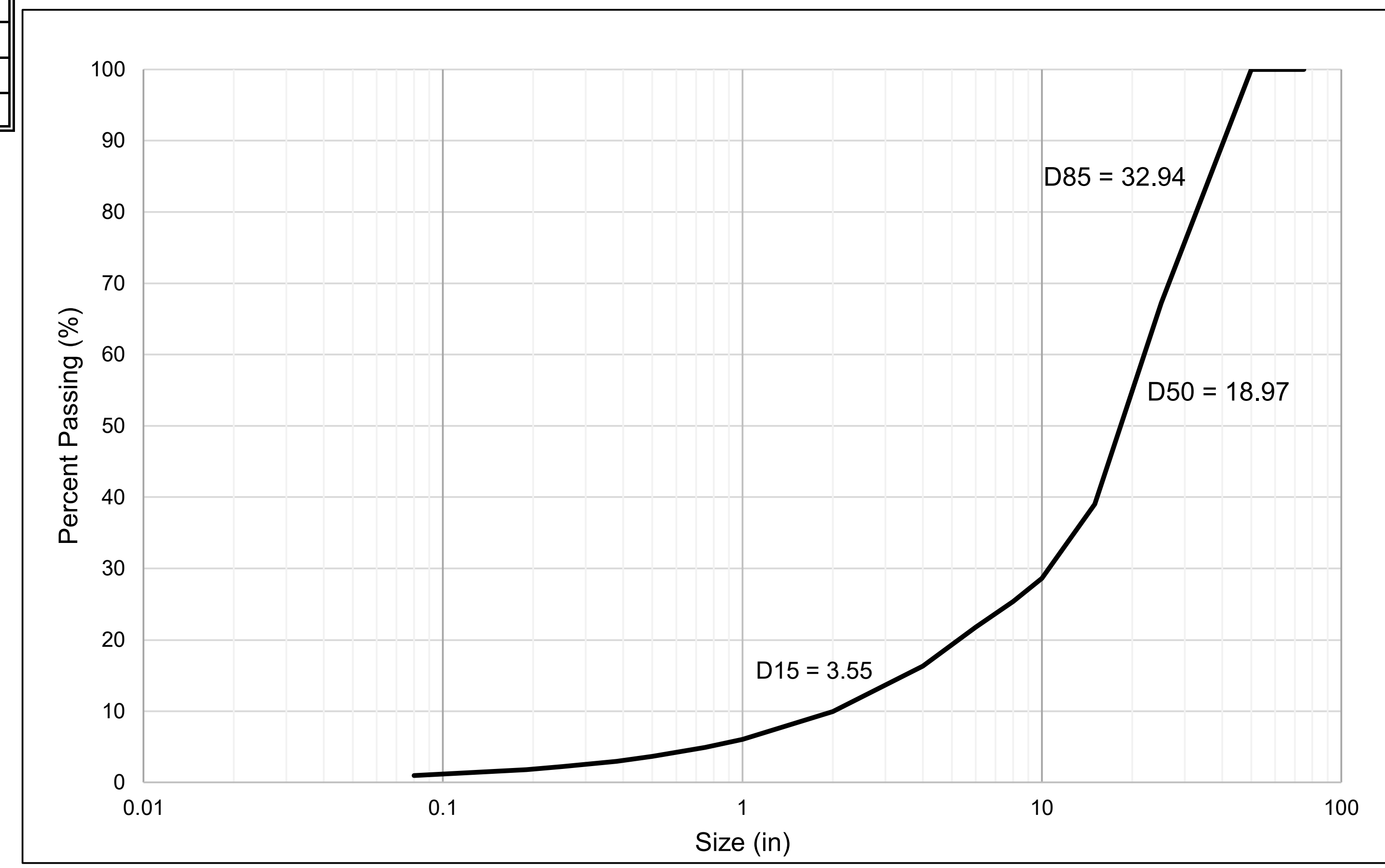
REF. NO. VA20-01037

FIGURE C.19

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	67.26
15	39.01
10	28.62
8	25.42
6	21.81
4	16.33
2	9.95
1	6.06
0.75	4.93
0.5	3.68
0.38	2.99
0.25	2.23
0.19	1.81
0.08	0.97

% Passing	Size[in]
F10	2.01
F15	3.55
F20	5.31
F30	10.78
F40	15.40
F50	18.97
F60	22.40
F70	26.04
F80	30.29
F85	32.94
F90	36.04
Topsize (99.95%)	48.90



NOTES:

1. SCALE BALL SIZE = 10"
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
J.C. BOYLE DOWNSTREAM DAM - SUB-AREA 2

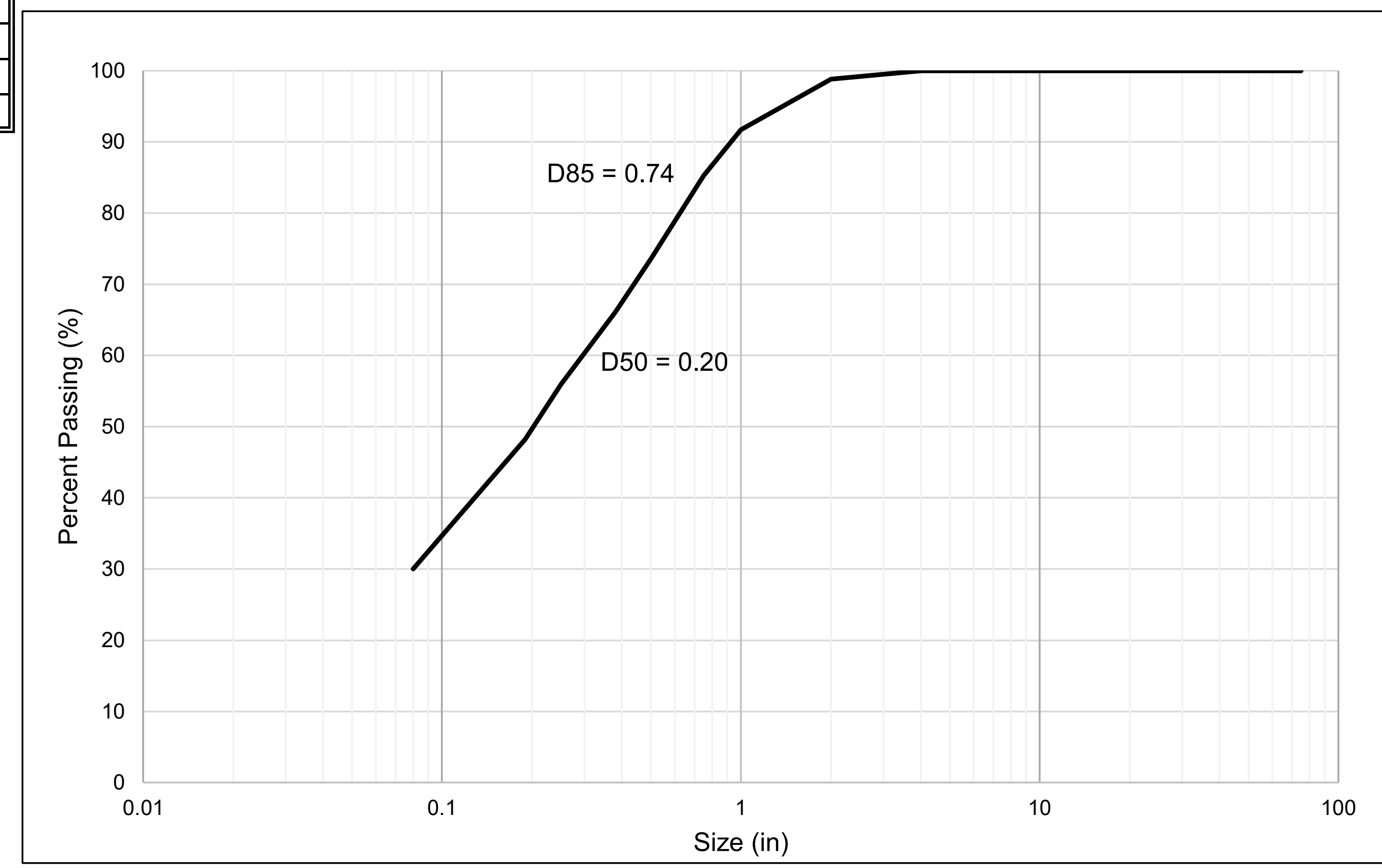
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.20 REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	100.00
6	100.00
4	100.00
2	98.83
1	91.72
0.75	85.23
0.5	73.52
0.38	66.08
0.25	55.91
0.19	48.19
0.08	30.01

% Passing	Size[in]
F10	0.01
F15	0.02
F20	0.04
F30	0.08
F40	0.13
F50	0.20
F60	0.29
F70	0.44
F80	0.62
F85	0.74
F90	0.91
Topsize (99.95%)	2.29



NOTES:

1. STANDARD TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
J.C. BOYLE FOREBAY - 1

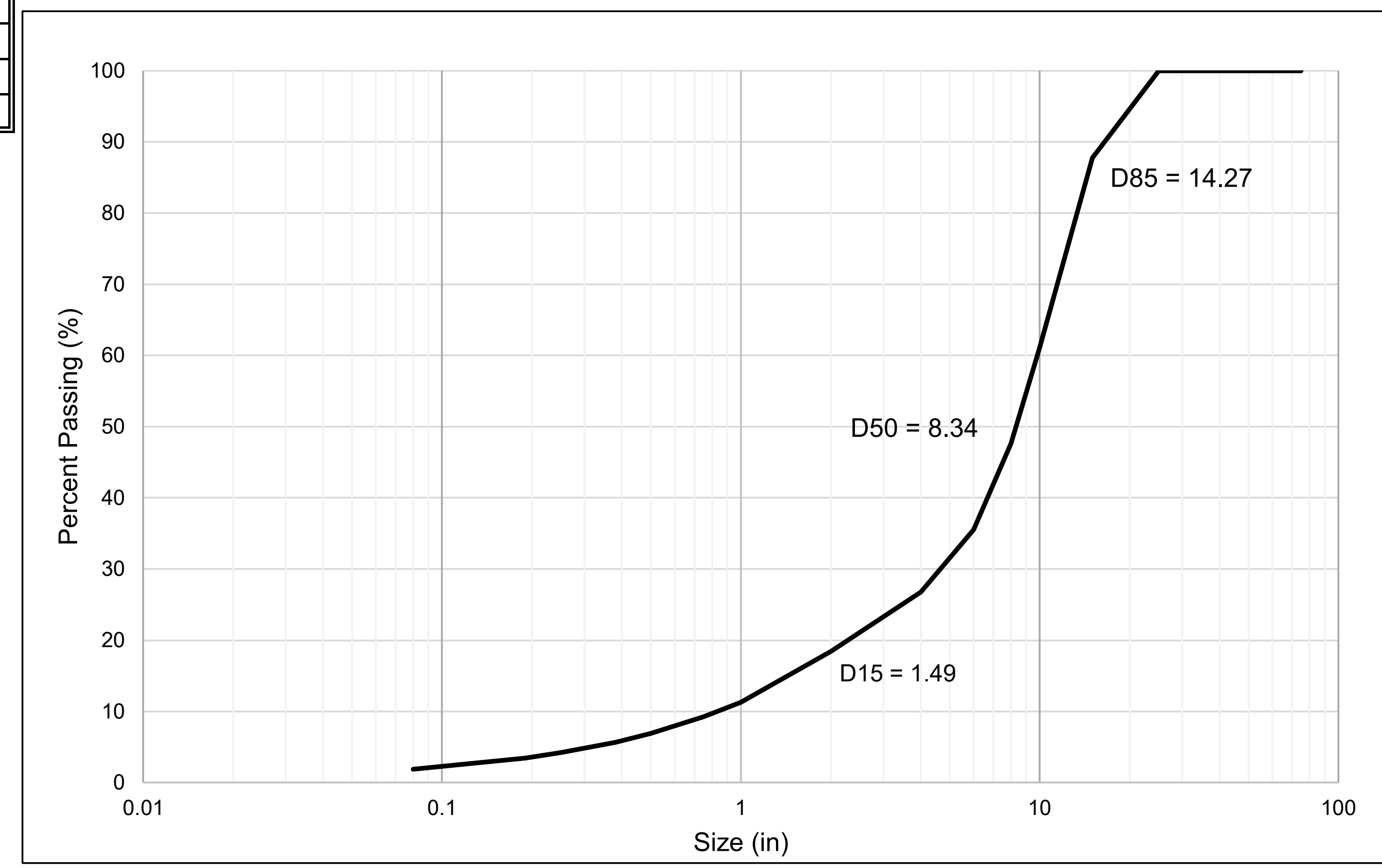
Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.21 | REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	87.77
10	61.07
8	47.62
6	35.50
4	26.74
2	18.44
1	11.32
0.75	9.25
0.5	6.94
0.38	5.67
0.25	4.25
0.19	3.46
0.08	1.87

% Passing	Size[in]
F10	0.84
F15	1.49
F20	2.25
F30	4.82
F40	6.83
F50	8.34
F60	9.84
F70	11.37
F80	13.17
F85	14.27
F90	15.61
Topsize (99.95%)	19.28



NOTES:

1. STANDARD TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
J.C. BOYLE POWEROUSE SUB-AREA 1

Knight Piésold CONSULTING

P/A NO. VA103-640/1

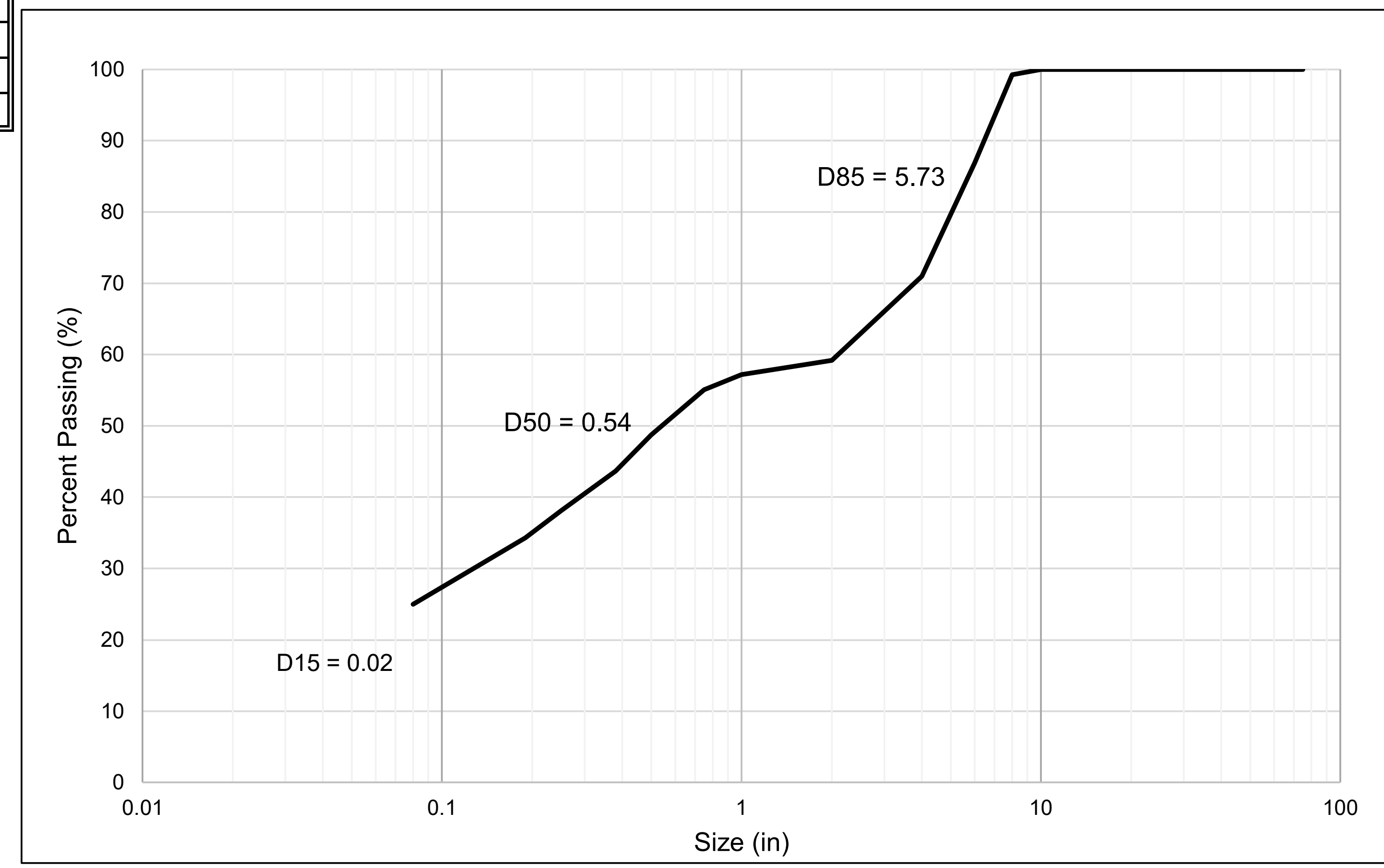
REF. NO. VA20-01037

FIGURE C.22

REV A

Size[in]	% Passing
75	100.00
50	100.00
25	100.00
15	100.00
10	100.00
8	99.26
6	86.90
4	70.98
2	59.18
1	57.19
0.75	55.04
0.5	48.72
0.38	43.64
0.25	38.11
0.19	34.29
0.08	25.01

% Passing	Size[in]
F10	0.01
F15	0.02
F20	0.04
F30	0.13
F40	0.29
F50	0.54
F60	2.23
F70	3.89
F80	5.03
F85	5.73
F90	6.45
Topsize (99.95%)	8.14



NOTES:

1. STANDARD TAPE MEASURE FOR SCALE
2. ANALYSIS CONDUCTED BY SPLIT ENGINEERING

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	21MAY'20	ISSUED WITH LETTER	TB	CAV

KIEWIT INFRASTRUCTURE WEST CO.

KLAMATH RIVER RENEWAL PROJECT

ONSITE BORROW SOURCE SITE INVESTIGATION
SPILT-NET PARTICLE SIZE ANALYSIS RESULTS
J.C. BOYLE POWERHOUSE SUB-AREA 2

Knight Piésold CONSULTING

P/A NO. VA103-640/1 | REF. NO. VA20-01037

FIGURE C.23 | REV A

Knight Piésold CONSULTING

APPENDIX E

VE-5: Fall, Camp, and Scotch Creek Crossing Concepts

Knight Piésold CONSULTING

APPENDIX E1

VE-5 Submittals: Fall Creek Field Assessment Memo

(Pages E1-1 to E1-24)

MEMO

To:	James O'Reilly, PEng	Date: 2020.05.13	
From:	Joey Howard, PE	NHC Ref. No.	2004947
Re:	Field Assessment of Fall Creek Crossings at Daggett Road and Substation Access Road		

1 INTRODUCTION

As part of the Value Engineering (VE) process for the Klamath River Renewal Project (KRRP), Knight Piesold (KP) and Kiewit are identifying the need for fish passage improvements at two existing Fall Creek crossings located downstream from the planned fish hatchery site. The two crossings consist of a culvert at Daggett Road and a bridge at the PacifiCorp Substation Access Road. The Definite Plan (KRRC, 2018) identified the Daggett Road Culvert crossing as a barrier to fish and recommended replacing it with a bridge. The Definite Plan did not identify the need for improvements to the existing Substation Access Road bridge crossing. At the request of the Project Team, Northwest Hydraulic Consultants Inc. (NHC) fish passage engineer, Joey Howard, carried out a morphologic field assessment of the stream conditions at the Daggett Road Culvert crossing, at the Substation Access Road bridge crossing, and the reach between the two crossings - Daggett Road Crossing and at the Substation Access Bridge Crossing. The field assessment and recommendations for fish passage improvements at the two crossings are presented in this memo.

2 BACKGROUND DATA

NHC reviewed the following information as part of the site investigation and barrier assessment:

- Project LiDAR and bathymetry data obtained in 2018 (GMA and Quantum Spatial);
- Field surveys near the Daggett Road and Substation Access Road Crossings conducted in 2019;
- Iron Gate Reservoir stage data (2016.12.31 to 2019.01.01);
- Fall Creek streamflow data (1933.10.1 to 1959.9.30 and 2003.05.01 to 2005.09.30); and,
- Aerial photographs (1955, 2019)

3 SITE INSPECTION

NHC conducted an inspection of the crossing and stream conditions from the reservoir to approximately 150 feet upstream of the Substation Access Road on April 22, 2020. The purpose of the investigation was to assess passage conditions at the Daggett Road Culvert and Substation Access Road and channel morphology between the crossings and identify potential fish passage solutions where needed.

The fish passage assessment included identification of geomorphic channel units, quantification of substrate size, and measurements of drop heights and wetted and active channel widths.

Figure 1 shows the reach that was investigated, extending from the reservoir to about 150 feet upstream of the Substation Access Road, a distance of about 2150 feet. There are no significant tributaries to Fall Creek within this reach. USGS Gage No. 11512000, Fall Creek at Copco, is located about 1,000 feet upstream of the Daggett Road crossing. The peak flow of record between 1933 and 1959 was 875 cfs, which occurred on December 22, 1956. The second highest flow of 392 cfs occurred on January 7, 1948. Flow duration analyses provided by Klamath River Renewal Corporation (KRRC) indicate 85 cfs is equaled or exceeded 1 percent of the time during the period returning spawning fish are expected. Flows equal or exceed about 27 cfs 95 percent of the time . Figure 2 shows calculated mean daily flow duration quantiles calculated by month. NHC anticipates that these flows should capture the range of fish passage design flows for a crossing in this reach of Fall Creek.

Iron Gate Reservoir stage influences channel morphology downstream of Daggett Road Culvert (Image 1). The stage is managed by PacifiCorp. NHC calculated stage duration for the period between January through March. Stage records between 2016.12.31 to 2019.01.01 were used in the analysis. The stage duration curve is shown in Figure 3.

Review of field surveyed topographic data shows the average slope from downstream of Daggett Road crossing to upstream of the Substation Access Road crossing is about 0.028 ft/ft. NHC observed local slopes within instream geomorphic units near 8 percent (0.08 ft/ft) within this reach. LiDAR and bathymetric data suggest the average stream slope between the Daggett Road crossing and the post dam confluence elevation with the Klamath River will range from about 0.03 to 0.05 ft/ft. Aerial images are provided of the confluence in 2019 (Figure 4) and in 1955 (Figure 5), prior to dam construction.

NHC performed a cursory assessment of Fall Creek channel morphology within the project area using RiverStyles (Fryirs, K.A. and Brierley, G.J. 2013) conventions for characterizing the valley and geomorphic instream units. Select RiverStyles terms are provided in Attachment A. Fall Creek within the project reach ranges from confined to confined with occasional floodplain pockets. Columnar Basalt flows confine the east side of the creek. The slides and rock falls appear to occur relatively frequently and are most likely to occur in the winter as a result of freeze and thaw of water (pers. Com Jim Fitzgerald). Image 2 shows the confined valley and rock slide scar. Large colluvium boulders from these slides largely control the planform and channel slope. Copco Road was cut into the west valley slope. A highly-confined sub-reach forms a gorge midway between the crossings. In this area, side cast material from Copco Road construction and colluvium from rock slides and falls from the basalt flow on the east valley slope largely confine the creek to the west. Small areas form floodplain pockets on either side of the creek through the reach. Wetted channel widths range from 5 feet wide to about 18 feet wide.

Instream geomorphic units include riffles, runs, rapids, step-pools and a cascade. Downstream of the Daggett Road crossing, reservoir water levels influence creek morphology. Bed material from the culvert outlet to about 200 feet downstream ranges from sands to gravels with some cobbles and boulders. The banks are primarily silt and clay with dense root networks. A high water table supports riparian and wetland vegetation that stabilize the banks.

The Daggett Road Culvert slopes at about 4.3 percent (0.043 ft/ft). Flows within the culvert are supercritical and the outlet is perched. During low flows, the hydraulic drop at the culvert outlet is about 18 inches. This drop likely increases during higher flows. These hydraulic/geometric factors could create conditions that are likely to be a complete barrier to juvenile and adult salmonids. Channel conditions near the culvert are shown in Image 3 through Image 7. The active channel width ranges from about 15 to 25 feet near the crossing (Image 8).

The creek becomes confined upstream of Daggett Road as the natural valley slopes converge constricting the channel. Valley bottom confinement increases as road construction further encroaches on the stream corridor. Several wood jams exist within this reach (Image 9). The creek morphology consists of a cascade (Image 10 and Image 11) and a series of step pools (Image 12 and Image 13). Channel widths are highly constrained in this reach (Image 14). However, isolated floodplain pockets consisting of dense vegetation growing on talus and debris exist. These channel units are relatively stable. Adjustment likely only occurs during extreme flood flows or during moderate to high flows shortly after rock slides or boulder detachment from the basalt flow. Bed material ranges from boulder, to cobbles with some gravel.

The creek slope appears to lessen upstream of the gorge from the USGS gage to upstream of the Substation Access Road Bridge (Image 16 and Image 17). Upstream of the USGS gage, the active channel bifurcates forming two channels separated by a vegetated island. Debris jams span both channels near the island head (Image 18). The two channels converge into one, about 100 feet downstream of the bridge. The wetted channel width ranged from 15 to 18 feet and the active channel width appeared to range from about 18 to 22 feet (Image 19, Image 20, and Image 21). The wetted channel width beneath the bridge is about 15 feet and the active channel width is about 20 feet (Image 22). On the east side (river left), an alder tree downstream of the bridge and a cluster of trees upstream of the bridge influence the hydraulics through the bridge. The left channel bank beneath the bridge is comprised of erosion resistant clay. Rock slope protection and tree roots stabilize the right bank beneath the bridge (Image 23). Review of the bank material and vegetation along the banks did not suggest that measurable incision or bank erosion near the bridge has occurred over the last several decades. Active channel widths upstream of the bridge range from about 18 feet to about 25 feet.

4 CONCLUSIONS

Morphologic and hydraulic conditions were assessed to characterize passage conditions created by the Daggett Road Culvert and Substation Access Road Bridge Crossings and identify fish passage solutions as needed.

Hydraulic conditions between the existing reservoir up through the gorge require fish to swim through swift and turbulent flow conditions and leap self formed steps in excess of 18 inches. These conditions are within the capability of adult salmonid swimming capabilities but may present barriers to juvenile salmonids. Periodic rock falls or slides may create complete barriers to both juvenile and adult salmonids and may require inspection and debris movement to ensure passage.

The Daggett Road Culvert is a complete barrier to adult and juvenile salmonids. NHC recommends replacing the Daggett Road Culvert using stream simulation or hydraulic design approach to meet fish passage objectives. A stream simulation approach would likely include a 20 to 25-foot-wide clear span bridge, or sunken multiplate culvert. A hydraulic design approach includes a box culvert with a 15-foot span and 10-foot rise. The box culvert would have 3.5 to 4 feet of engineered streambed material inside the crossing. Additional work is necessary to identify likely channel adjustment that may occur following reservoir drawdown. The channel invert is likely to be 1 to 3.5 feet lower than the existing culvert inlet and outlet and about 4 feet lower than the existing creek bed immediately upstream of the culvert. KP fish biologist, Jean Baldridge, provided the following information for consideration as part of the hydraulic design for a crossing at Daggett Road.

> "One of the factors investigated for coho salmon, navigating passage through culverts, was the costs of sustained and burst swimming speeds. Puckett and Dill (1984) found that the metabolic rate experience by juvenile coho salmon during burst swimming was high, but the number of bursts that a fish would implemented kept their metabolic costs relatively low, allowing juvenile to use busting speed without experiencing excessive metabolic costs. They found that 14 consecutive bursts increased the metabolic rate by only 30% for the first hour. This allows the fish to recover while still being very active aerobically as they navigate the culvert. This indicates that juvenile coho salmon would be able to move both upstream and downstream through the Daggett Road Box Culvert.
>
> Coho salmon routinely move upstream in tributaries seeking improved habitat, cooler water temperatures or increased food resources (Boulton et all 2002; Kahler et al. 2001). To accommodate this characteristic, the box culvert proposed for the Daggett Road Crossing on Fall Creek is designed to accommodate upstream passage of juvenile coho salmon. Studies have found that juvenile salmon can swim upstream through culverts with mean velocities higher than their swimming performance (Johnson et al 2012, Powers et al 1997). Juvenile salmonids accomplish this by using the low velocity and low turbulence region that forms in the lee of the culvert. Most studies found that larger juveniles (139 mm fork length) were more successful in navigating upstream movement in culverts that smaller juveniles (55 ml Fork length)."

NHC's initial design of a 15-foot span reinforced concrete box culvert at Daggett Road meets hydraulic design criteria for adult salmonids and will have flow characteristics that are within juvenile coho salmon's swimming abilities.

NHC believes the Substation Access Bridge currently provides acceptable fish passage conditions. The energetic cost to pass through the bridge is significantly less than passage through the gorge and is similar to the self-formed riffles within the project area. NHC does not believe any action is required at the Substation Access Bridge to change hydraulic conditions for fish passage.

5 CITATIONS

Boulton S. M. J. Moss, J. Southard, G. Williams, C. DeBois, and N. Evans. 2002. Juvenile Coho salmon movement study. Washington State Transportation Center Research Report WA-RD 539.1. University of Washington, Seattle.

Fryirs, K.A. and Brierley, G.J. 2013. Geomorphic Analysis of River Systems: An Approach to Reading the Landscape. Wiley-Blackwell, Hoboken.

Johnson, Gary E. Walter H Pearson, Susan Southard, Robert Mueller. 2012. Upstream movement of juvenile coho salmon in relation to environmental conditions in a culvert test box. Trans. Of American Fisheries Society 141:6, 1520-1531.

Kahler, T. H., P. Roni, and T. P Quinn. 2001. Summer movement and growth of juvenile anadromous salmonids in small western Washington streams. Canadian Journal of Fisheries and Aquatic Science 58: 1947-1956.

Klamath River Renewal Corporation. Definite Plan for the Lower Klamath Project. June 2018

Powers, P.D., K. Bates, T. Burns, B Gowen, and R. Whitney 1997. Culvert hydraulics related to upstream juvenile passage, WA Dept Fish and Wildlife, Lands and Restoration Services Program. Olympia WA.

Puckett, K. & Dill, Larry. 2011. Cost of Sustained and Burst Swimming to Juvenile Coho Salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences. 41. 1546-1551. 10.1139/f84-192.

6 EXHIBITS

Figure 1. Study Reach

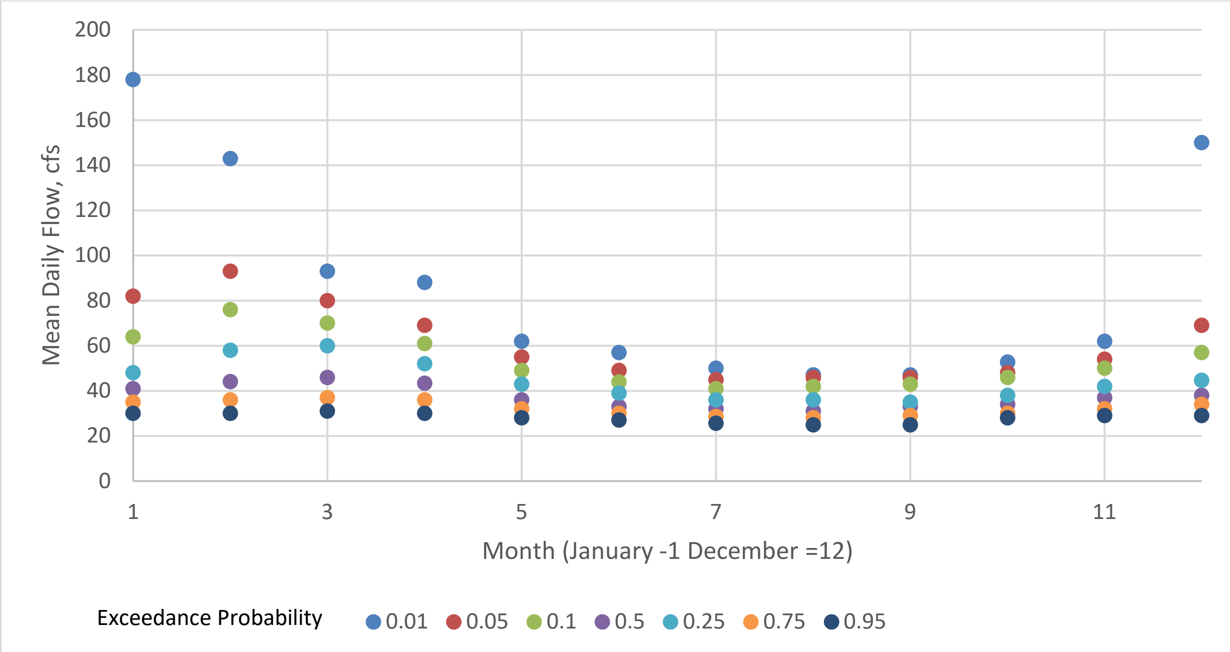


Figure 2. Mean Daily Flow Duration Quantiles for Fall Creek Calculated by Month

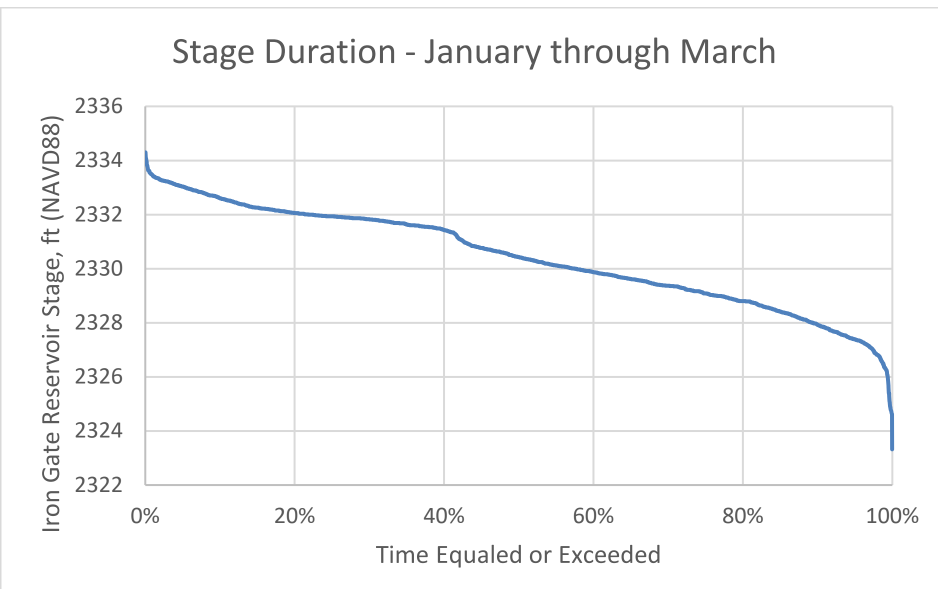


Figure 3. Iron Gate Reservoir Stage Duration Curve

Figure 4. Google Earth Imagery, Date 2019.08.23

Figure 5. 1955 Pre-Iron Gate Dam

Image 1. Reservoir tailwater control

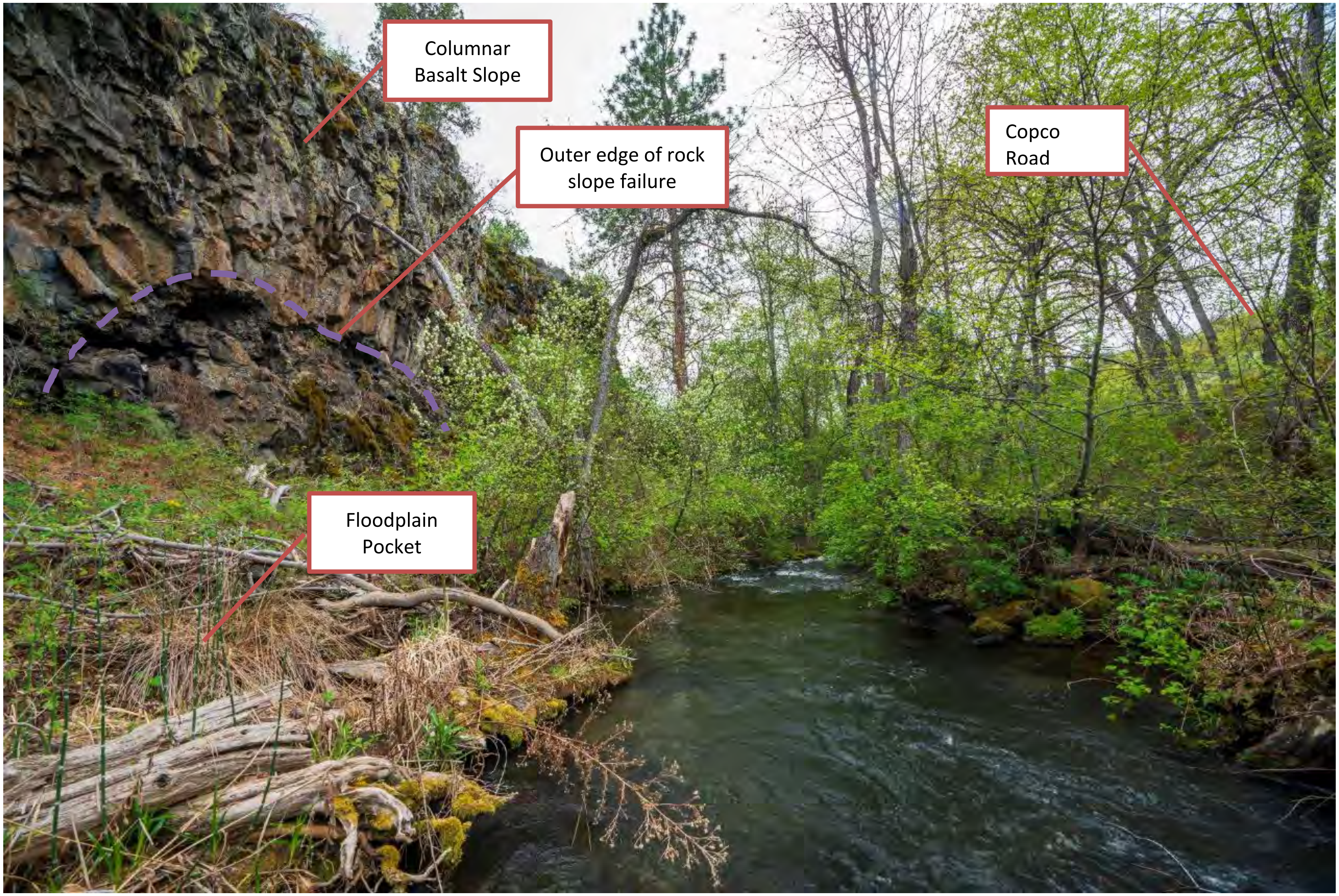


Image 2. Confined valley with floodplain pocket

Image 3. Looking downstream of Daggett Culvert

Image 4. Looking upstream at Daggett Culvert outlet

Image 5. Looking upstream at Daggett Road Culvert

Image 6. Daggett Road Culvert Inlet

Image 7. View of Daggett Road Culvert Inlet

Image 8. Channel Upstream of Daggett Road (Wetted channel about 14 ft wide; Active channel about 18 ft wide)

Image 9. Self-formed Wood Jam

Image 10. Cascade along the gorge reach between Daggett and the Substation Access Road

Image 11. Looking Downstream along Cascade

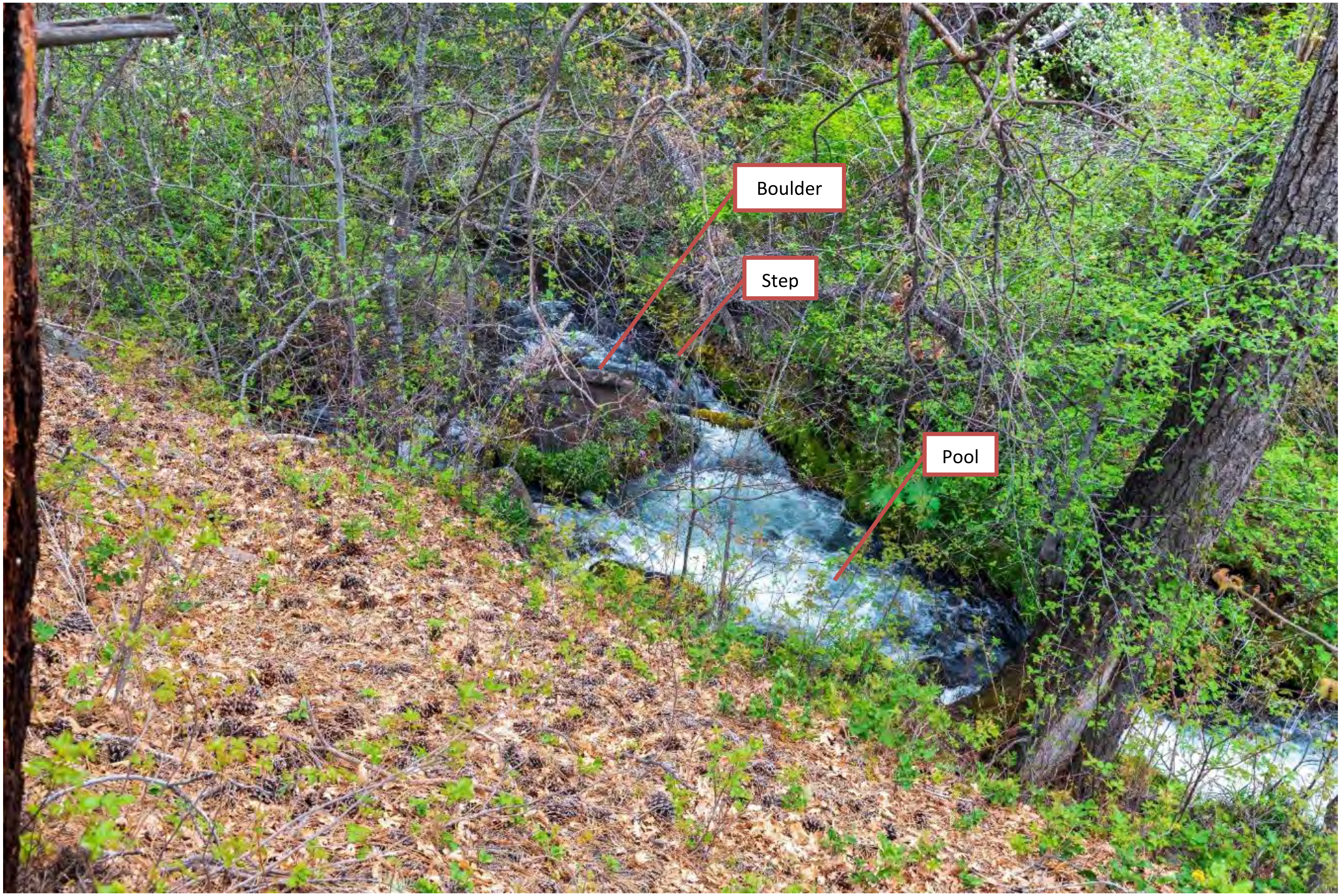


Image 12. Step-pool Unit in Gorge Sub-reach

Image 13. Step-Pool in Gorge Sub-reach

Image 14. Example of Narrow Wetted Channel Width in Gorge Sub-reach

Image 15. Low flow channel width of 5 ft.

nhc
northwest hydraulic consultants

Image 16. Riffle near gage location looking upstream

Image 17. Riffle near gage location looking downstream

nhc
northwest hydraulic consultants

Image 18. Island upstream of stream gage.

Image 19. Channel Downstream of Substation Access Road Bridge

Image 20. Channel Measurement near Downstream End of Substation Access Road Bridge

Image 21. Measurement Location about 30 ft downstream of Substation Access Road Bridge

Image 22. Measurement Section Beneath Substation Access Road Bridge

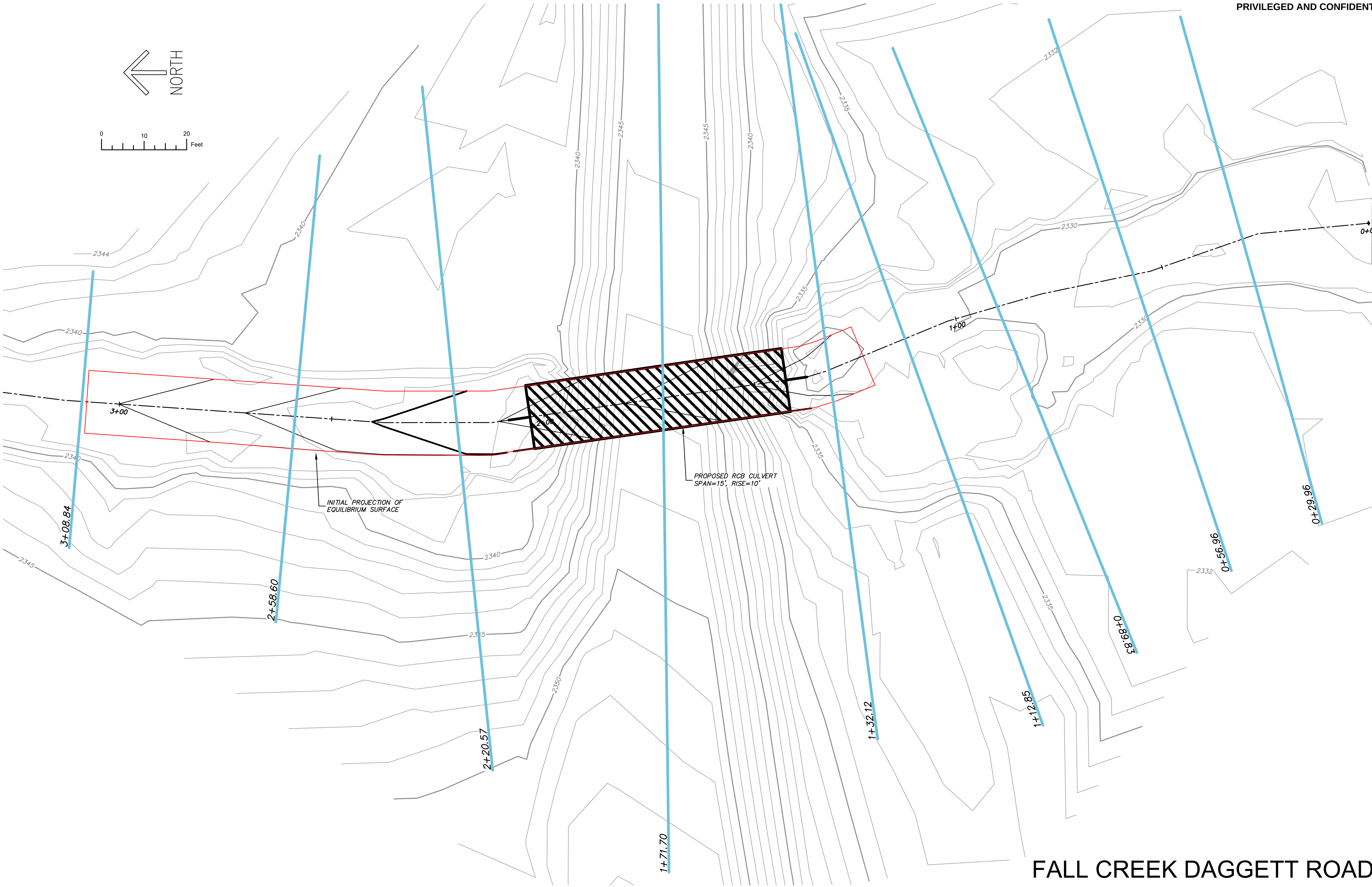
Image 23. Channel below Substation Access Road bridge

Knight Piésold CONSULTING

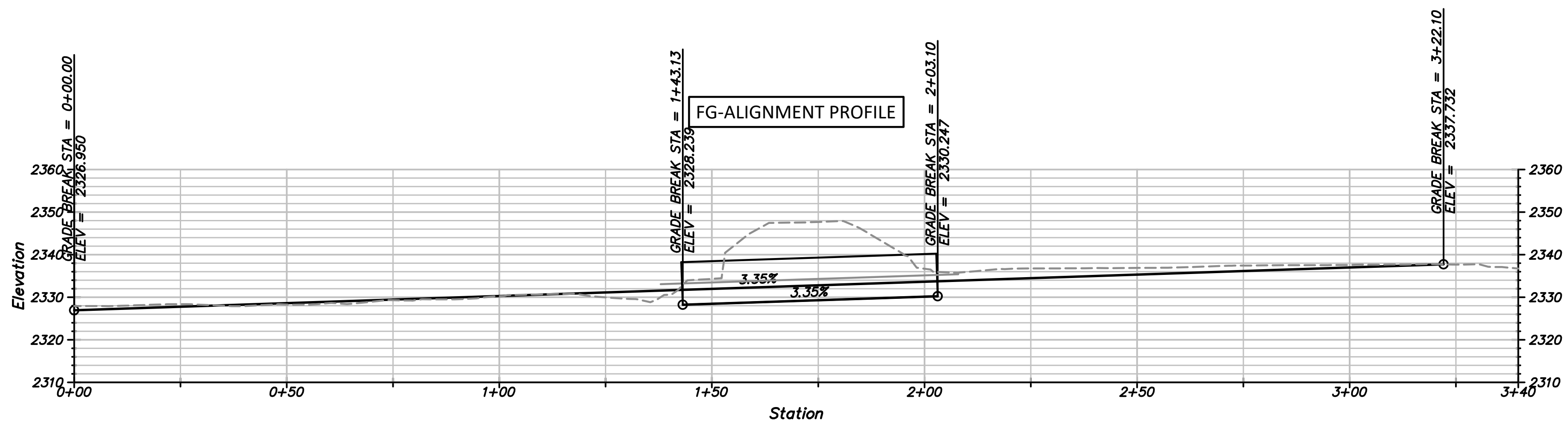
APPENDIX E2

VE-5 Submittals: Fall Creek at Daggett Road – Box Culvert Concept Sketches

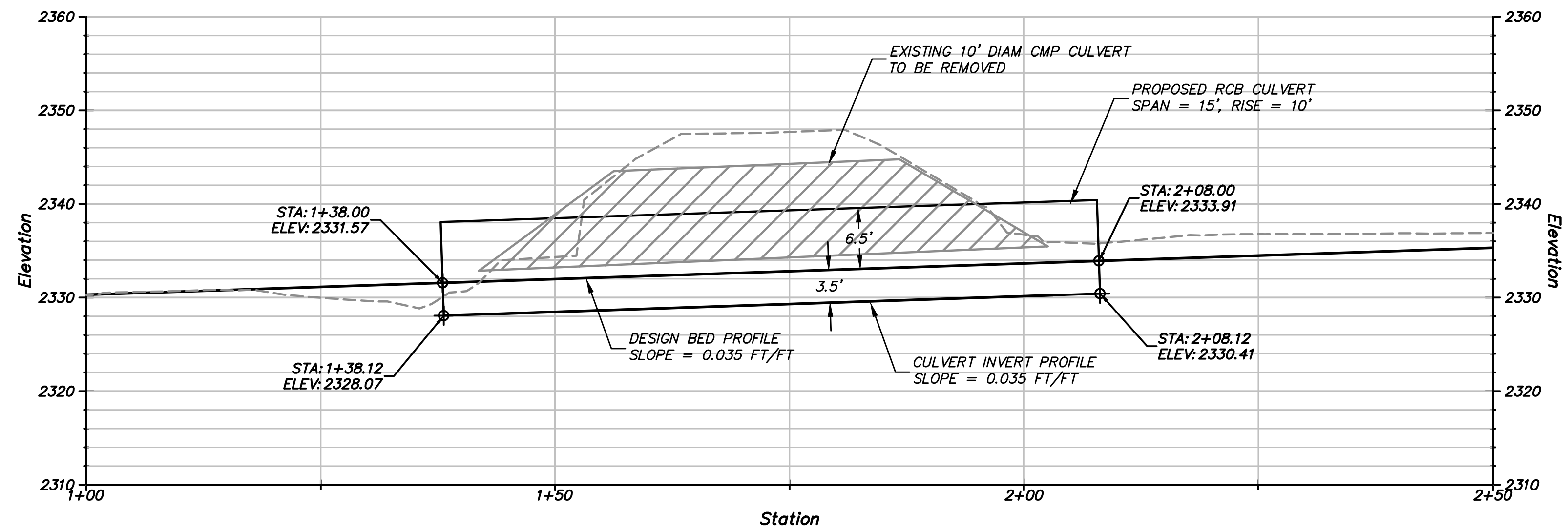
(Pages E2-1 to E2-2)



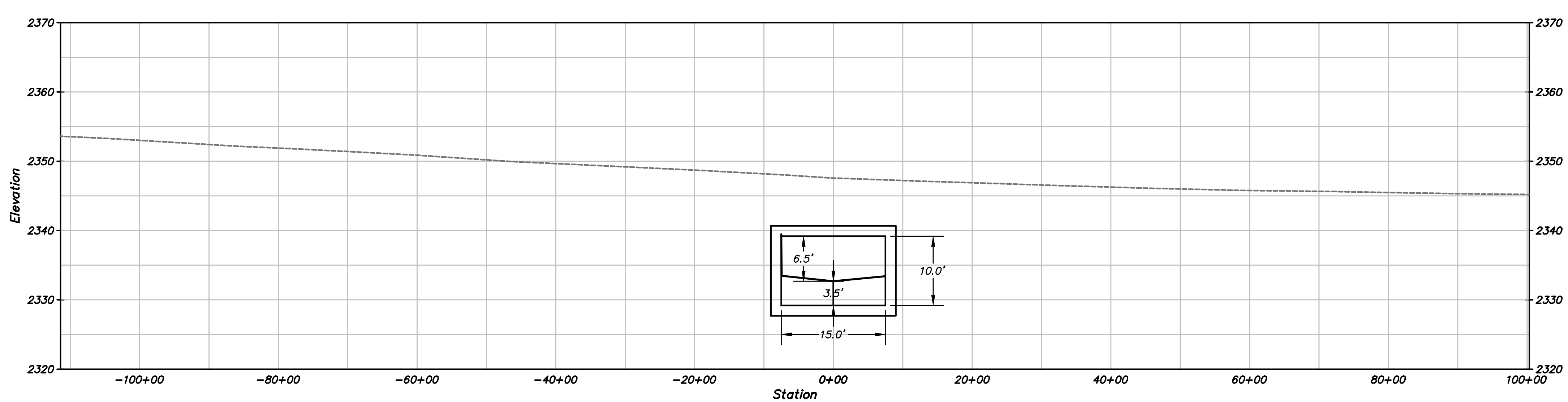
FALL CREEK DAGGETT ROAD



FG-ALIGNMENT PROFILE



STA. 1+71.70



FALL CREEK DAGGETT ROAD

Knight Piésold CONSULTING

APPENDIX E3

VE-5 Submittals: Camp and Scotch Creek – Box Culvert Discussion Points

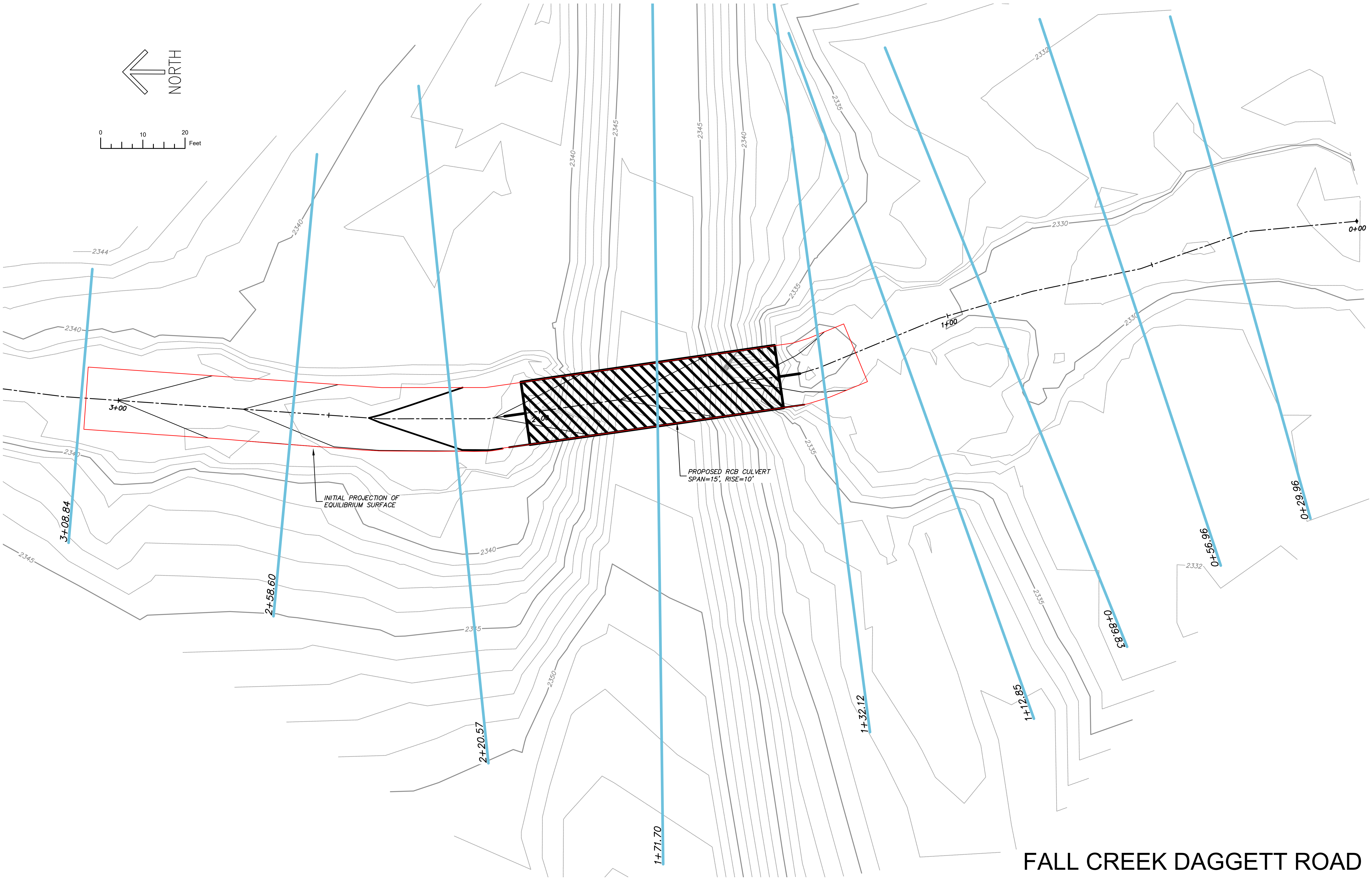
(Pages E3-1 to E3-7)

Camp/Scotch Creek Crossing Discussion Points

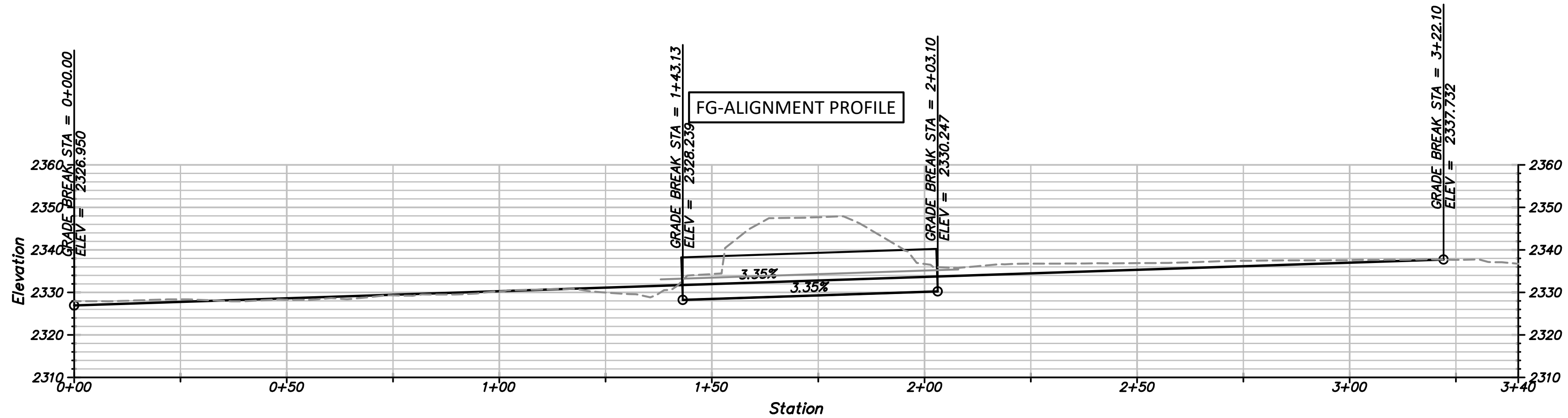
Joey Howard (NHC) - 2020 05 13

Employ hydraulic design approach with embedded culverts to minimize project costs.

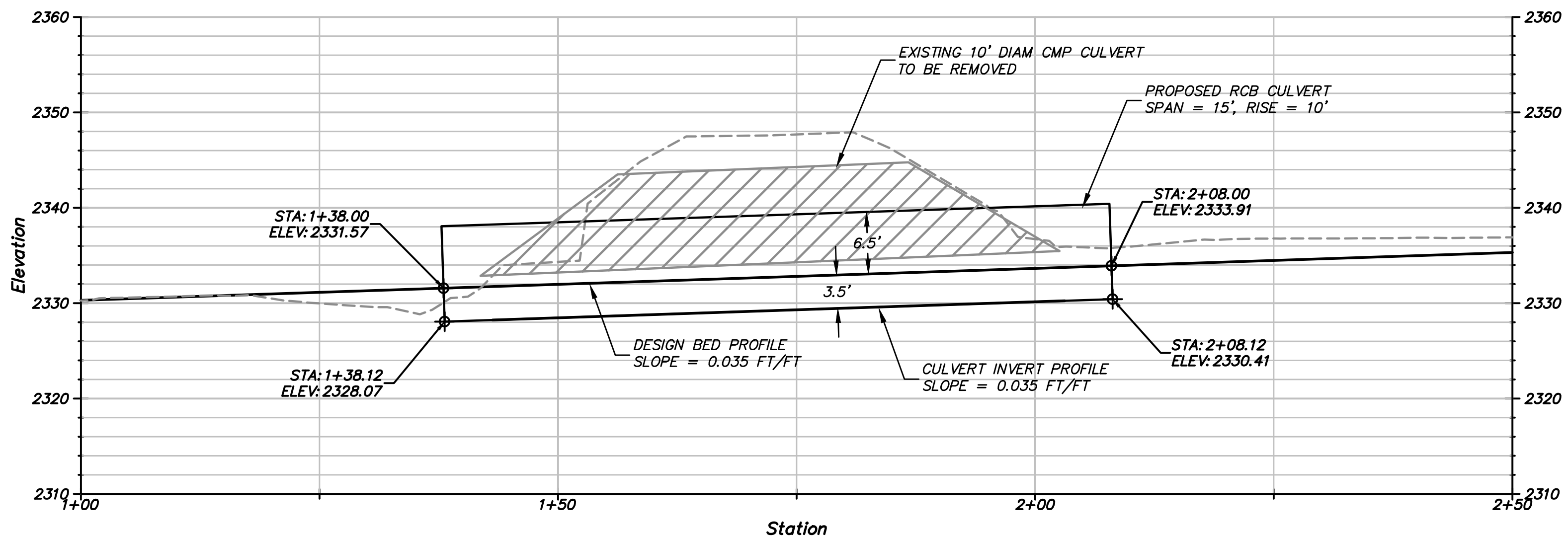
- Proposed culvert widths are 15 feet and will be similar to active channel widths upstream of the crossings.
- Bed slopes within the crossing will be similar to self-formed slopes up and downstream of the crossings following dam removal.
- Crossings will pass the 1 percent exceedance flow (100-year flow) with a headwater depth less than the culvert rise as required by NOAA (2019)
- Crossings will have a minimum of 20 percent of the crossing embedded with engineered streambed gravels and will be designed using techniques similar to the stream simulation approach.
- Design flows calculated as a fraction of the 2-year peak flow are estimated to have an adult high design flow of 60 cfs and a juvenile high design flow of 12 cfs.
- At adult high fish passage design flow, velocities will be less than 6 fps and will meet adult velocity criteria
- Average velocities in culverts will be 2 fps or less, but are unlikely to be 1 fps or less and will likely require a variance. Velocities are unlikely to exceed juvenile coho salmon's swimming ability. Bell (1986) lists sustained speeds (aerobic effort 'used for long periods of travel at low speeds') from 0.5 to 2.1 fps. Swimming abilities have been related to body length and are known to increase with increased body length. Critical swim speeds for steelhead (O. mykiss), which are the stronger salmonid swimmers, have been measured to be about 7.5
- body lengths per second. The crossing will be constructed with significant roughness features similar to Image 1 through Image 6. These features will create a complex
- heterogeneous flow field with spatial diversity in velocity. Boulders will provide rest areas for juvenile fishes.
- Scotch and Camp Creeks are intermittent streams and near the crossing locations are not sources of cold water during the summer months. Upstream passage is likely valuable for adult spawners and possibly for juveniles seeking rearing habitat before stream flows are no longer sufficient to provide passage.



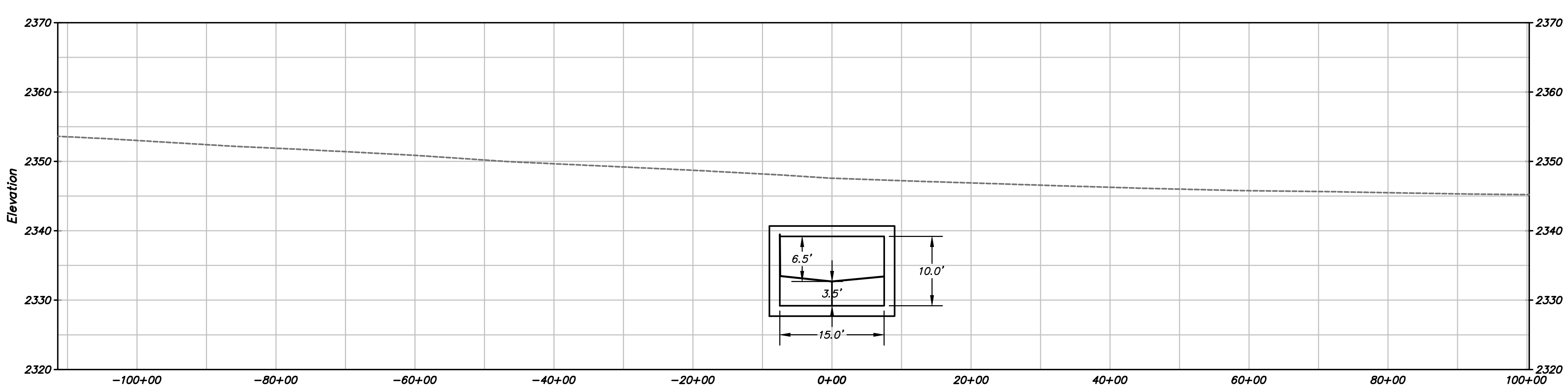
FALL CREEK DAGGETT ROAD



FG-ALIGNMENT PROFILE



STA. 1+71.70



FALL CREEK DAGGETT ROAD

Image 1. Elder Creek Multi-plate sunken culvert 21 ft span, 13 ft rise

Image 2. Elder Creek Multi-plate sunken culvert 21 ft span, 13 ft rise

Image 3. Elder Creek Multi-plate sunken culvert (span 21 ft, rise 13 ft)

Image 4. Corrolitos Creek Sunken Box Culvert

Image 5. Howard Creek Tributary sunken culvert (span 12 ft, 8 ft rise)

Image 6Howard Creek Tributary sunken culvert (span 12 ft, 8 ft rise)

Knight Piésold CONSULTING

APPENDIX F

VE-6: Alternate Access in Lieu of Lakeview/Daggett Bridges

Appendix F1 VE-6 Submittals: Alternate Access Routes Maps
Appendix F2 VE-6 Submittals: Alternate Access Route Information Transmittal

Knight Piésold CONSULTING

APPENDIX F1

VE-6 Submittals: Alternate Access Routes Maps

(Pages F1-1 to F1-3)

APPENDIX F2

VE-6 Submittals: Alternate Access Route Information Transmittal

(Pages F2-1 to F2-4)

Knight Piésold CONSULTING

TRANSMITTAL

Preliminary Services

Date:	May 1, 2020	**File No.:**	VA103-00640/01-A.01
		Cont. No.:	VA20-00915
To:	Kiewit Infrastructure West Co. (California) 4650 Business Center Drive Fairfield, California USA, 94534		
Attention:	Mr. Erik Esparza		

Document Items

Item No.	Description		
1.	1 Copy of Each – PDF Files VE Alternate Route Assessment – 2020 04 30 - Fall Creek - Temp Support Concept - Notes and Screenshots.pdf VE Alternate Route Assessment – KRRP_ KP_Alt_Access_Routes_Bridges Rating Table_2020 04 30.pdf		
2.	1 Copy of Each – MP4 Files 20200423_091319 Private Land to PP Land Alt1.mp4 20200423_091815 Private Land to PP Land Alt2.mp4 20200423_092302 PP Land to Daggett Bridge.mp4 20200423_120110 Bogus Ck Bridge.mp4 20200423_124219 Willow Ck Bridge.mp4 20200423_134223 Klamathon Bridge.mp4 20200423_142814 Shasta River Bridge H3.mp4		
3.	1 Copy of Each – JPEG Files		
	20200423_091142.jpg	20200424_094552.jpg	20200424_130940.jpg
	20200423_091218.jpg	20200424_094554.jpg	20200424_131042.jpg
	20200423_091515.jpg	20200424_095230.jpg	20200424_131233.jpg
	20200423_091519.jpg	20200424_095249.jpg	20200424_131236.jpg
	20200423_093218.jpg	20200424_095905.jpg	20200424_131744.jpg
	20200423_093246.jpg	20200424_100047.jpg	20200424_131921.jpg
	20200423_100617.jpg	20200424_100319.jpg	20200424_131959.jpg
	20200423_100634.jpg	20200424_101053.jpg	20200424_132001.jpg

Knight Piésold Ltd. | Suite 1400 - 750 West Pender Street | Vancouver, British Columbia | Canada, V6C 2T8
T +1 604 685 0543 | E vancouver@knightpiesold.com | www.knightpiesold.com

Item No.	Description		
	20200423_100638.jpg	20200424_101155.jpg	20200424_132231.jpg
	20200423_100653.jpg	20200424_101622.jpg	20200424_132338.jpg
	20200423_100720.jpg	20200424_101638.jpg	20200424_132548.jpg
	20200423_100726.jpg	20200424_101643.jpg	20200424_132605.jpg
	20200423_101250.jpg	20200424_101733.jpg	20200424_132733.jpg
	20200423_101255.jpg	20200424_102400.jpg	20200424_133022.jpg
	20200423_101540.jpg	20200424_102552.jpg	20200424_133038.jpg
	20200423_102522.jpg	20200424_102555.jpg	20200424_133131.jpg
	20200423_103840.jpg	20200424_102558.jpg	20200424_133533.jpg
	20200423_103845.jpg	20200424_102612.jpg	20200424_133559.jpg
	20200423_104217.jpg	20200424_103111.jpg	20200424_133600.jpg
	20200423_104221.jpg	20200424_103318.jpg	20200424_133934.jpg
	20200423_104454.jpg	20200424_103726.jpg	20200424_133937.jpg
	20200423_104458.jpg	20200424_103750.jpg	20200424_134614.jpg
	20200423_104502.jpg	20200424_103901.jpg	20200424_134654.jpg
	20200423_104712.jpg	20200424_104335.jpg	20200424_135018.jpg
	20200423_104717.jpg	20200424_104339.jpg	20200424_135020.jpg
	20200423_105114.jpg	20200424_104456.jpg	20200424_135032.jpg
	20200423_105118.jpg	20200424_104525.jpg	20200424_135714.jpg
	20200423_105337.jpg	20200424_104607.jpg	20200424_135716.jpg
	20200423_105341.jpg	20200424_104855.jpg	20200424_135739.jpg
	20200423_105352.jpg	20200424_104916.jpg	20200424_140229.jpg
	20200423_105357.jpg	20200424_104927.jpg	20200424_140230.jpg
	20200423_105551.jpg	20200424_104952.jpg	20200424_140405(0).jpg
	20200423_105740.jpg	20200424_105115.jpg	20200424_140405.jpg
	20200423_112123.jpg	20200424_105414.jpg	20200424_144338.jpg
	20200423_112128.jpg	20200424_105503.jpg	IMG_0458.JPG
	20200423_113832.jpg	20200424_105617.jpg	IMG_0460.JPG
	20200423_113844.jpg	20200424_105639.jpg	IMG_0462.JPG
	20200423_113850.jpg	20200424_110514.jpg	IMG_0464.JPG
	20200423_113855.jpg	20200424_110517.jpg	IMG_0466.JPG
	20200423_115805.jpg	20200424_110519.jpg	IMG_0468.JPG
	20200423_115811.jpg	20200424_110652.jpg	IMG_0470.JPG
	20200423_120059.jpg	20200424_110721.jpg	IMG_0472.JPG
	20200423_120106.jpg	20200424_111044.jpg	IMG_0474.JPG
	20200423_120210.jpg	20200424_111131.jpg	IMG_0476.JPG
	20200423_120435.jpg	20200424_111455.jpg	IMG_0478.JPG
	20200423_120441.jpg	20200424_111527.jpg	IMG_0480.JPG
	20200423_120528.jpg	20200424_111911.jpg	IMG_0482.JPG
	20200423_120535.jpg	20200424_111933.jpg	IMG_0484.JPG
	20200423_120542.jpg	20200424_112258.jpg	IMG_0486.JPG
	20200423_120644.jpg	20200424_112329.jpg	IMG_0488.JPG
	20200423_121156.jpg	20200424_112636.jpg	IMG_0490.JPG
	20200423_121206.jpg	20200424_112700.jpg	IMG_0492.JPG

Knight Piésold CONSULTING

Item No.	Description		
	20200423_124102.jpg	20200424_112800.jpg	IMG_0494.JPG
	20200423_124206.jpg	20200424_113055.jpg	IMG_0496.JPG
	20200423_124212.jpg	20200424_113142.jpg	IMG_0498.JPG
	20200423_124352.jpg	20200424_113151.jpg	IMG_0500.JPG
	20200423_124356.jpg	20200424_113600.jpg	IMG_0502.JPG
	20200423_124400.jpg	20200424_113601.jpg	IMG_0504.JPG
	20200423_125103.jpg	20200424_113602.jpg	IMG_0506.JPG
	20200423_125107.jpg	20200424_113652.jpg	IMG_0508.JPG
	20200423_125118.jpg	20200424_114045.jpg	IMG_0510.JPG
	20200423_125120.jpg	20200424_114057.jpg	IMG_0512.JPG
	20200423_125315.jpg	20200424_114423.jpg	IMG_0514.JPG
	20200423_125343.jpg	20200424_114425.jpg	IMG_0516.JPG
	20200423_125355.jpg	20200424_114428.jpg	IMG_0518.JPG
	20200423_125400.jpg	20200424_114521.jpg	IMG_0520.JPG
	20200423_125426.jpg	20200424_114522.jpg	IMG_0522.JPG
	20200423_125432.jpg	20200424_114656.jpg	IMG_0524.JPG
	20200423_125447.jpg	20200424_114659.jpg	IMG_0526.JPG
	20200423_125935.jpg	20200424_114701.jpg	IMG_0528.JPG
	20200423_125954.jpg	20200424_114753.jpg	IMG_0530.JPG
	20200423_131405.jpg	20200424_115244.jpg	IMG_0532.JPG
	20200423_132216.jpg	20200424_115247.jpg	IMG_0534.JPG
	20200423_133153.jpg	20200424_115336.jpg	IMG_1813.JPG
	20200423_133432.jpg	20200424_115400.jpg	IMG_1814.JPG
	20200423_133941.jpg	20200424_115852.jpg	IMG_1815.JPG
	20200423_134239.jpg	20200424_115958.jpg	IMG_1816.JPG
	20200423_141703.jpg	20200424_115959.jpg	IMG_1817.JPG
	20200423_141818.jpg	20200424_120329.jpg	IMG_1818.JPG
	20200423_141936.jpg	20200424_120427.jpg	IMG_1819.JPG
	20200423_142026.jpg	20200424_120803.jpg	IMG_1820.JPG
	20200423_142038.jpg	20200424_120827.jpg	IMG_1821.JPG
	20200423_142751.jpg	20200424_121124.jpg	IMG_1822.JPG
	20200423_142927.jpg	20200424_121150.jpg	IMG_1823.JPG
	20200423_142952.jpg	20200424_121442.jpg	IMG_1824.JPG
	20200424_085428.jpg	20200424_121445.jpg	IMG_1825.JPG
	20200424_085518.jpg	20200424_121519.jpg	IMG_1826.JPG
	20200424_085651.jpg	20200424_121524.jpg	IMG_1827.JPG
	20200424_085702.jpg	20200424_121603.jpg	IMG_1828.JPG
	20200424_090146.jpg	20200424_122119.jpg	IMG_1829.JPG
	20200424_090155.jpg	20200424_122218.jpg	IMG_1830.JPG
	20200424_090207.jpg	20200424_122221.jpg	IMG_1831.JPG
	20200424_090719.jpg	20200424_122254.jpg	IMG_1832.JPG
	20200424_090744.jpg	20200424_122525.jpg	IMG_1834.JPG
	20200424_090912.jpg	20200424_122528.jpg	IMG_1835.JPG
	20200424_091059.jpg	20200424_122637.jpg	IMG_1836.JPG

Knight Piésold CONSULTING

Item No.	Description		
	20200424_091103.jpg	20200424_123918.jpg	IMG_1837.JPG
	20200424_091144.jpg	20200424_124102.jpg	IMG_1838.JPG
	20200424_091426.jpg	20200424_124439.jpg	IMG_1839.JPG
	20200424_091818.jpg	20200424_124442.jpg	IMG_1840.JPG
	20200424_092149.jpg	20200424_124514.jpg	IMG_1842.JPG
	20200424_092430.jpg	20200424_124917.jpg	IMG_1843.JPG
	20200424_092453.jpg	20200424_124938.jpg	IMG_1844.JPG
	20200424_093018.jpg	20200424_124959.jpg	IMG_1845.JPG
	20200424_093215.jpg	20200424_125814.jpg	IMG_1846.JPG
	20200424_093510.jpg	20200424_125817.jpg	IMG_1847.JPG
	20200424_093610.jpg	20200424_125849.jpg	IMG_1848.JPG
	20200424_093636.jpg	20200424_130235.jpg	IMG_1849.JPG
	20200424_093736.jpg	20200424_130237.jpg	IMG_1850.JPG
	20200424_093935.jpg	20200424_130249.jpg	IMG_1851.JPG
	20200424_094330.jpg	20200424_130323.jpg	IMG_1852.JPG
	20200424_094424.jpg	20200424_130847.jpg	IMG_1853.JPG

Remarks

Remarks	The photos and videos of the road inspection have been uploaded to the TFMM SharePoint at - https://portal.kiewit.com/:f:/r/teams/bw20032424/DBOps/TFMM/TFMM%20Attachments/Daggett_Lakeview%20VE-005/Alternate%20Route%20Assessment%20-%20Photos%20and%20Video%20-%202020%2004%2030?csf=1&web=1&e=xFfWeN

Prepared: Tyler Scheffel

Reviewed: For: Craig Nistor

/jo

Knight Piésold CONSULTING

APPENDIX G

VE-7: Early Start Options

Appendix G1	VE-7 Information: Early Works Schedule (Kiewit)
Appendix G2	VE-7 Submittals: Summary Presentation
Appendix G3	VE-7 Submittals: JC Boyle Forebay Progress Prints
Appendix G4	VE-7 Submittals: JC Boyle Summary Presentation
Appendix G5	VE-7 Submittals: JC Boyle Downstream Tunnel Progress Prints

Knight Piésold CONSULTING

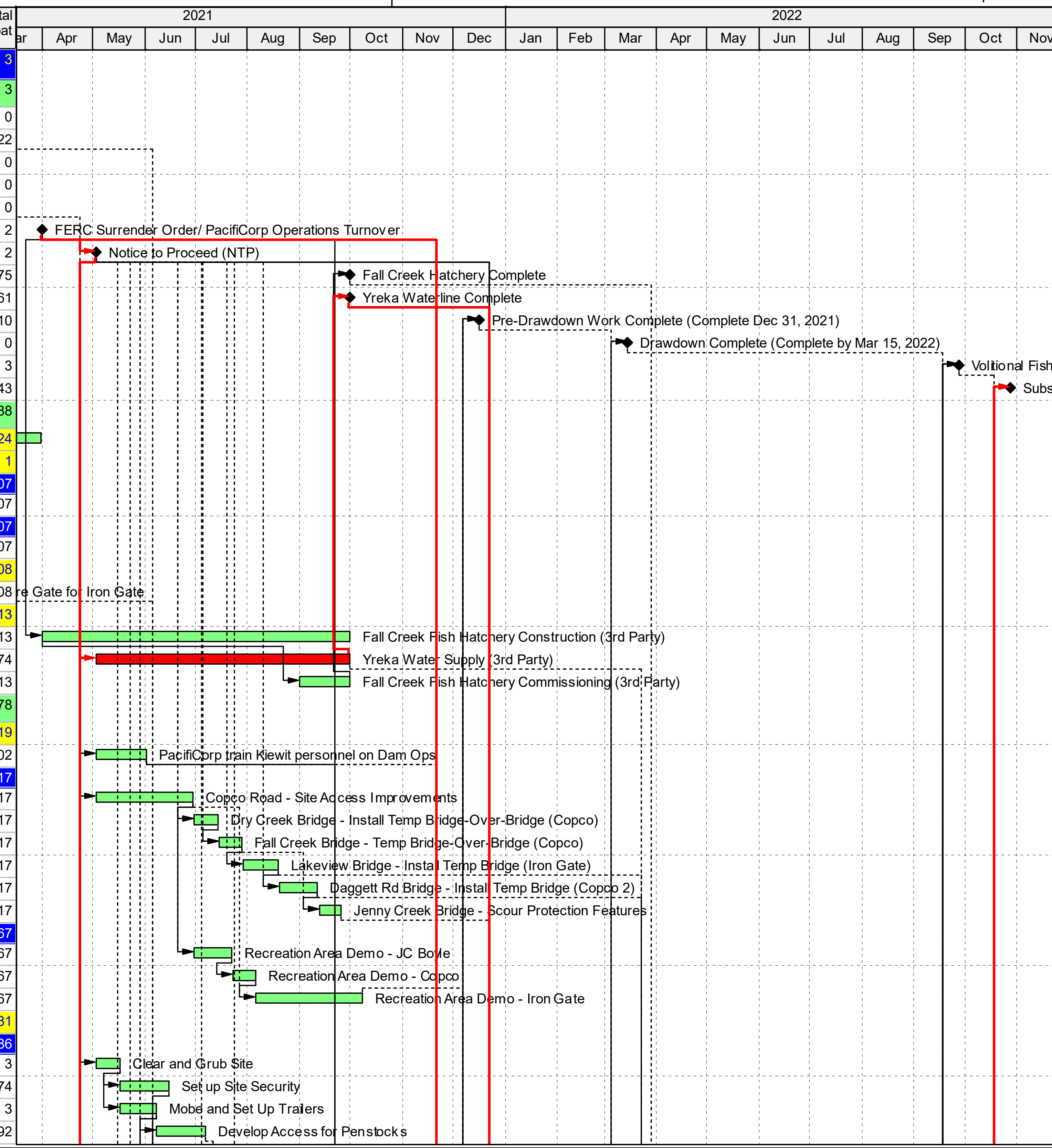
APPENDIX G1

VE-7 Information: Early Works Schedule (Kiewit)

(Pages G1-1 to G1-7)

KRRP - Early Work Schedule | 13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
KRRP - Early Work Schedule		356	30-Aug-19 A	28-Oct-22	3
MILESTONES		356	24-Feb-20	28-Oct-22	3
GEN0011	FERC GMP	0	24-Feb-20*		0
GEN0060	Inspection of Existing Gate at Iron Gate	0	02-Mar-20*		22
GEN0003	LNTP - Iron Gate Dam - Gate Procurement	0	01-Apr-20*		0
GEN0030	2020 Permit/LNTP for Geotech/Dredging at Copco 1	0	15-Jun-20*		0
GEN0001	GMP Amended - Executed	0	01-Oct-20*		0
GEN0040	FERC Surrender Order/ PacifiCorp Operations Turnover	0	01-Apr-21		2
GEN0002	Notice to Proceed (NTP)	0	03-May-21		2
GEN0019	Fall Creek Hatchery Complete	0		30-Sep-21	175
GEN0018	Yreka Waterline Complete	0		30-Sep-21	61
GEN0006	Pre-Drawdown Work Complete (Complete Dec 31, 2021)	0		16-Dec-21*	10
GEN3000	Drawdown Complete (Complete by Mar 15, 2022)	0		14-Mar-22*	0
GEN0020	Volitional Fish Passage (Complete by Oct 1, 2022)	0		27-Sep-22*	3
GEN0008	Substantial Completion - Dam Removal Work (Complete by Dec 31, 2022)	0		28-Oct-22*	43
PRE-CONSTRUCTION		155	30-Aug-19 A	30-Sep-21	88
Permitting		396	30-Aug-19 A	31-Mar-21	24
Submittals		0	01-Apr-20	28-May-20	1
Prep and Submit		20	01-Apr-20	29-Apr-20	107
PS0003	P/S Shop Drawings Gate for Iron Gate	20	01-Apr-20	29-Apr-20	107
Review and Approve		20	30-Apr-20	28-May-20	107
RA0003	R/A Shop Drawings Gate for Iron Gate	20	30-Apr-20	28-May-20	107
Procurement		180	29-May-20	15-Feb-21	108
PRC003	Procure Gate for Iron Gate	180	29-May-20	15-Feb-21	108
3rd Party Work		153	01-Apr-21	30-Sep-21	213
PW1104	Fall Creek Fish Hatchery Construction (3rd Party)	153	01-Apr-21	30-Sep-21	213
PW1010	Yreka Water Supply (3rd Party)	127	03-May-21	30-Sep-21	74
PW1114	Fall Creek Fish Hatchery Commissioning (3rd Party)	25	01-Sep-21	30-Sep-21	213
PRE-DRAWDOWN YEAR		153	03-May-21	30-Dec-21	178
Project Wide		134	03-May-21	08-Oct-21	19
PW1194	PacifiCorp train Kiewit personnel on Dam Ops	25	03-May-21	01-Jun-21	102
Roads and Bridges		123	03-May-21	25-Sep-21	17
PW0044	Copco Road - Site Access Improvements	49	03-May-21	29-Jun-21	17
PW1001	Dry Creek Bridge - Install Temp Bridge-Over-Bridge (Copco)	12	30-Jun-21	14-Jul-21	17
PW1002	Fall Creek Bridge - Temp Bridge-Over-Bridge (Copco)	12	15-Jul-21	28-Jul-21	17
PW1003	Lakeview Bridge - Install Temp Bridge (Iron Gate)	19	29-Jul-21	19-Aug-21	17
PW1004	Daggett Rd Bridge - Install Temp Bridge (Copco 2)	19	20-Aug-21	11-Sep-21	17
PW1084	Jenny Creek Bridge - Scour Protection Features	12	13-Sep-21	25-Sep-21	17
Demo Recreation Sites		85	30-Jun-21	08-Oct-21	67
PW1008	Recreation Area Demo - JC Boyle	19	30-Jun-21	22-Jul-21	67
PW1020	Recreation Area Demo - Copco	12	23-Jul-21	05-Aug-21	67
PW1030	Recreation Area Demo - Iron Gate	54	06-Aug-21	08-Oct-21	67
JC Boyle		150	03-May-21	28-Oct-21	181
Access/ Site Work		60	03-May-21	14-Jul-21	186
JCB0057	Clear and Grub Site	12	03-May-21	17-May-21	3
JCB1060	Set up Site Security	24	17-May-21	15-Jun-21	174
JCB0056	Mobe and Set Up Trailers	18	17-May-21	08-Jun-21	3
JCB1070	Develop Access for Penstocks	24	08-Jun-21	07-Jul-21	192



Actual Work | Milestone
Remaining Work
Critical Remaining Work

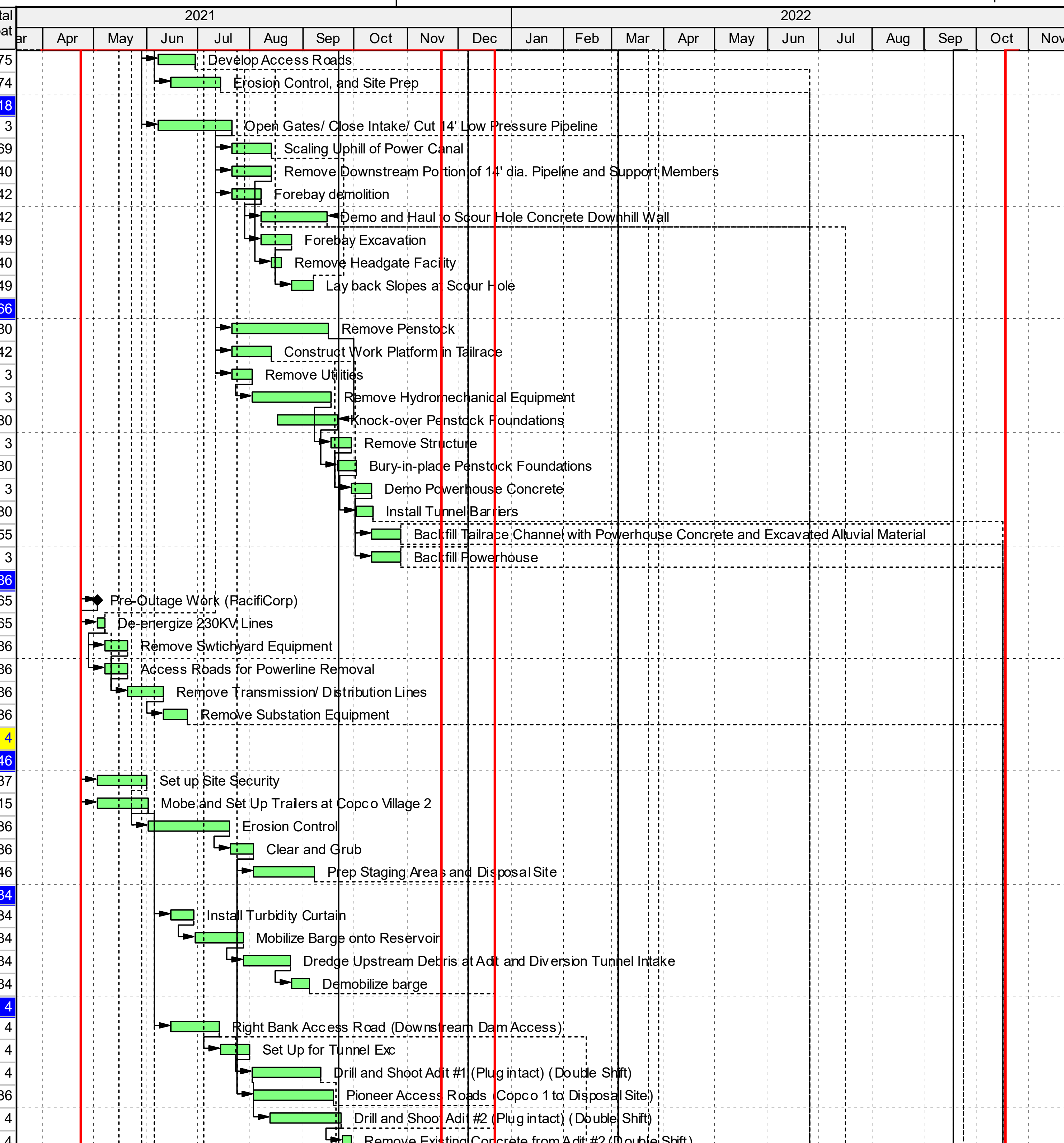
EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 1 of 7

TASK filter: All Activities

KRRP - Early Work Schedule

13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
JCB0052	Develop Access Roads	18	08-Jun-21	29-Jun-21	175
JCB0051	Erosion Control, and Site Prep	24	15-Jun-21	14-Jul-21	174
Power Canal Removal		83	08-Jun-21	15-Sep-21	218
JCB1220	Open Gates/ Close Intake/ Cut 14' Low Pressure Pipeline	36	08-Jun-21	21-Jul-21	3
JCB1090	Scaling Uphill of Power Canal	20	21-Jul-21	13-Aug-21	169
JCB0024	Remove Downstream Portion of 14' dia. Pipeline and Support Members	20	21-Jul-21	13-Aug-21	240
JCB0029	Forebay demolition	15	21-Jul-21	07-Aug-21	142
JCB0027	Demo and Haul to Scour Hole Concrete Downhill Wall	32	07-Aug-21	15-Sep-21	142
JCB1010	Forebay Excavation	15	07-Aug-21	25-Aug-21	149
JCB0026	Remove Headgate Facility	5	13-Aug-21	19-Aug-21	240
JCB0040	Lay back Slopes at Scour Hole	10	25-Aug-21	07-Sep-21	149
Powerhouse and Penstock Removal		84	21-Jul-21	28-Oct-21	166
JCB0022	Remove Penstock	48	21-Jul-21	16-Sep-21	180
JCB0034	Construct Work Platform in Tailrace	20	21-Jul-21	13-Aug-21	42
JCB0043	Remove Utilities	10	21-Jul-21	02-Aug-21	3
JCB0044	Remove Hydromechanical Equipment	39	02-Aug-21	17-Sep-21	3
JCB0023	Knock-over Penstock Foundations	29	17-Aug-21	21-Sep-21	180
JCB1020	Remove Structure	10	17-Sep-21	29-Sep-21	3
JCB0032	Bury-in-place Penstock Foundations	10	21-Sep-21	02-Oct-21	180
JCB0041	Demo Powerhouse Concrete	10	29-Sep-21	11-Oct-21	3
JCB0033	Install Tunnel Barriers	8	02-Oct-21	12-Oct-21	180
JCB0038	Backfill Tailrace Channel with Powerhouse Concrete and Excavated Alluvial Material	15	11-Oct-21	28-Oct-21	155
JCB0025	Backfill Powerhouse	15	11-Oct-21	28-Oct-21	3
Transmission/Distribution		45	03-May-21	25-Jun-21	286
JCB1110	Pre-Outage Work (PacifiCorp)	0		03-May-21*	65
JCB1040	De-energize 230KV Lines	4	03-May-21	07-May-21	65
JCB0036	Remove Swtichyard Equipment	12	07-May-21	21-May-21	286
JCB0100	Access Roads for Powerline Removal	12	07-May-21	21-May-21	286
JCB0042	Remove Transmission/ Distribution Lines	17	21-May-21	11-Jun-21	286
JCB0045	Remove Substation Equipment	12	11-Jun-21	25-Jun-21	286
Copco 1		149	03-May-21	26-Oct-21	4
Site Prep		107	03-May-21	07-Sep-21	46
CO10290	Set up Site Security	24	03-May-21	01-Jun-21	37
CO10062	Mobe and Set Up Trailers at Copco Village 2	25	03-May-21	01-Jun-21	15
CO10040	Erosion Control	40	02-Jun-21	19-Jul-21	36
CO10041	Clear and Grub	12	20-Jul-21	02-Aug-21	36
CO10031	Prep Staging Areas and Disposal Site	30	03-Aug-21	07-Sep-21	46
Upstream Work		70	15-Jun-21	04-Sep-21	34
CO10030	Install Turbidity Curtain	12	15-Jun-21	28-Jun-21	34
CO10010	Mobilize Barge onto Reservoir	24	29-Jun-21	27-Jul-21	34
CO10210	Dredge Upstream Debris at Adit and Diversion Tunnel Intake	24	28-Jul-21	24-Aug-21	34
CO10052	Demobilize barge	10	25-Aug-21	04-Sep-21	34
Downstream Work		113	15-Jun-21	26-Oct-21	4
CO10034	Right Bank Access Road (Downstream Dam Access)	24	15-Jun-21	13-Jul-21	4
CO10380	Set Up for Tunnel Exc	16	14-Jul-21	31-Jul-21	4
CO10071	Drill and Shoot Adit #1 (Plug intact) (Double Shift)	35	02-Aug-21	11-Sep-21	4
CO10021	Pioneer Access Roads (Copco 1 to Disposal Site)	40	03-Aug-21	18-Sep-21	36
CO10702	Drill and Shoot Adit #2 (Plug intact) (Double Shift)	35	12-Aug-21	23-Sep-21	4
CO10350	Remove Existing Concrete from Adit #2 (Double Shift)	5	24-Sep-21	29-Sep-21	4



Actual Work ◆ ◆ Milestone
Remaining Work
Critical Remaining Work

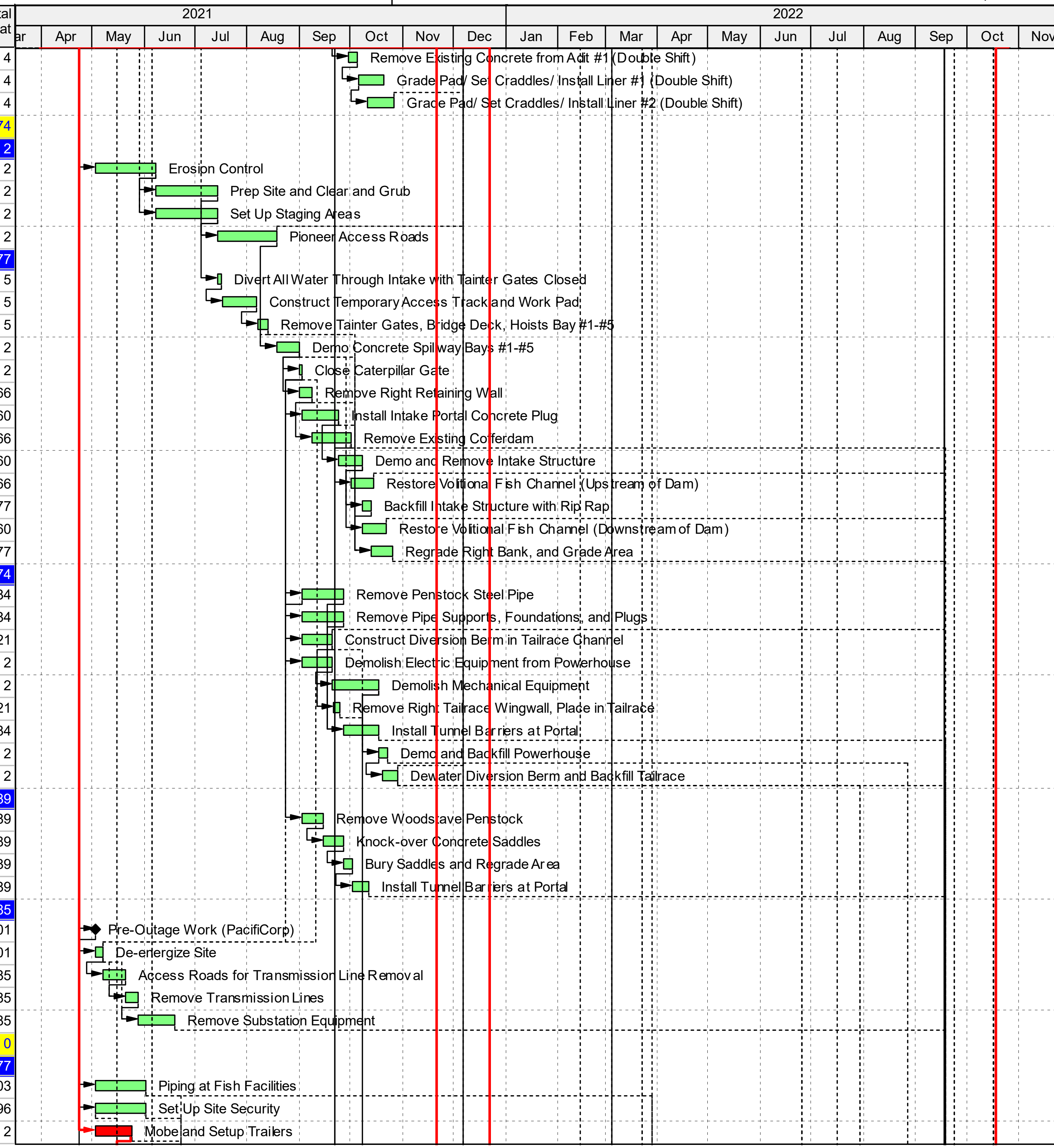
EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 2 of 7

TASK filter: All Activities

KRRP - Early Work Schedule

13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
CO10340	Remove Existing Concrete from Adit #1 (Double Shift)	5	30-Sep-21	05-Oct-21	4
CO10360	Grade Pad/ Set Cradles/ Install Liner #1 (Double Shift)	13	06-Oct-21	20-Oct-21	4
CO10370	Grade Pad/ Set Cradles/ Install Liner #2 (Double Shift)	13	11-Oct-21	26-Oct-21	4
Copco 2		151	03-May-21	29-Oct-21	174
Access/Site Work		90	03-May-21	18-Aug-21	2
CO20011	Erosion Control	30	03-May-21	08-Jun-21	2
CO20013	Prep Site and Clear and Grub	30	08-Jun-21	14-Jul-21	2
CO20012	Set Up Staging Areas	30	08-Jun-21	14-Jul-21	2
CO20014	Pioneer Access Roads	30	14-Jul-21	18-Aug-21	2
Dam Removal		88	14-Jul-21	26-Oct-21	177
CO2001	Divert All Water Through Intake with Tainter Gates Closed	3	14-Jul-21	16-Jul-21	5
CO2003	Construct Temporary Access Track and Work Pad	18	17-Jul-21	06-Aug-21	5
CO2007	Remove Tainter Gates, Bridge Deck, Hoists Bay #1-#5	6	07-Aug-21	13-Aug-21	5
CO2011	Demo Concrete Spillway Bays #1-#5	12	18-Aug-21	01-Sep-21	2
CO20401	Close Caterpillar Gate	1	01-Sep-21	02-Sep-21	2
CO2008	Remove Right Retaining Wall	5	01-Sep-21	08-Sep-21	166
CO2004	Install Intake Portal Concrete Plug	18	02-Sep-21	24-Sep-21	160
CO2026	Remove Existing Cofferdam	20	08-Sep-21	01-Oct-21	166
CO20411	Demo and Remove Intake Structure	12	24-Sep-21	08-Oct-21	160
CO20381	Restore Volitional Fish Channel (Upstream of Dam)	12	01-Oct-21	15-Oct-21	166
CO2002	Backfill Intake Structure with Rip Rap	4	08-Oct-21	13-Oct-21	177
CO20391	Restore Volitional Fish Channel (Downstream of Dam)	12	08-Oct-21	22-Oct-21	160
CO2013	Regrade Right Bank, and Grade Area	11	13-Oct-21	26-Oct-21	177
Powerhouse and Penstock Removal		48	02-Sep-21	29-Oct-21	174
CO20190	Remove Penstock Steel Pipe	20	02-Sep-21	27-Sep-21	184
CO20110	Remove Pipe Supports, Foundations, and Plugs	20	02-Sep-21	27-Sep-21	184
CO20112	Construct Diversion Berm in Tailrace Channel	15	02-Sep-21	20-Sep-21	21
CO20051	Demolish Electric Equipment from Powerhouse	14	02-Sep-21	20-Sep-21	2
CO20053	Demolish Mechanical Equipment	24	20-Sep-21	18-Oct-21	2
CO20010	Remove Right Tailrace Wingwall, Place in Tailrace	4	21-Sep-21	24-Sep-21	21
CO20111	Install Tunnel Barriers at Portal	18	27-Sep-21	18-Oct-21	184
CO20113	Demo and Backfill Powerhouse	5	18-Oct-21	23-Oct-21	2
CO20114	Dewater Diversion Berm and Backfill Tailrace	8	20-Oct-21	29-Oct-21	2
Wood Stave Penstock Removal		33	02-Sep-21	12-Oct-21	189
CO2014	Remove Woodstave Penstock	10	02-Sep-21	15-Sep-21	189
CO2016	Knock-over Concrete Saddles	10	15-Sep-21	27-Sep-21	189
CO2017	Bury Saddles and Regrade Area	5	27-Sep-21	02-Oct-21	189
CO2018	Install Tunnel Barriers at Portal	8	02-Oct-21	12-Oct-21	189
Transmission/Distribution		40	03-May-21	19-Jun-21	285
CO20330	Pre-Outage Work (PacifiCorp)	0		03-May-21	101
CO20280	De-energize Site	4	03-May-21	07-May-21	101
CO20230	Access Roads for Transmission Line Removal	12	07-May-21	21-May-21	285
CO20052	Remove Transmission Lines	6	21-May-21	28-May-21	285
CO20054	Remove Substation Equipment	18	28-May-21	19-Jun-21	285
Iron Gate		153	03-May-21	30-Dec-21	0
Access/ Site Work		63	03-May-21	16-Jul-21	77
IG2140	Piping at Fish Facilities	25	03-May-21	01-Jun-21	103
IG2130	Set Up Site Security	25	03-May-21	01-Jun-21	96
IG0067	Mobe and Setup Trailers	19	03-May-21	24-May-21	2



Actual Work
Remaining Work
Critical Remaining Work
Milestone

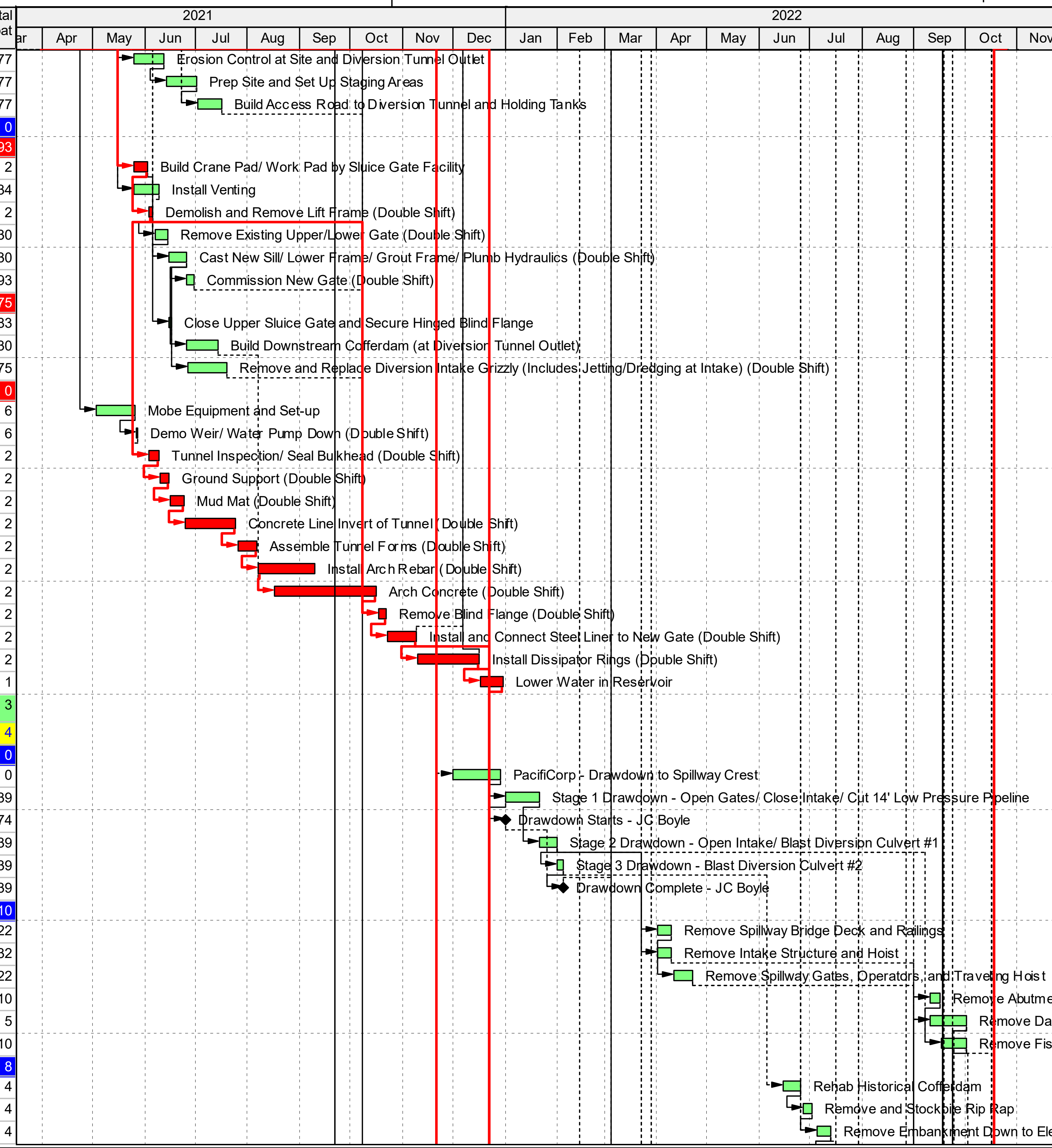
EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 3 of 7

TASK filter: All Activities

KRRP - Early Work Schedule

13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
IG0064	Erosion Control at Site and Diversion Tunnel Outlet	16	25-May-21	12-Jun-21	77
IG0065	Prep Site and Set Up Staging Areas	16	14-Jun-21	01-Jul-21	77
IG0051	Build Access Road to Diversion Tunnel and Holding Tanks	12	02-Jul-21	16-Jul-21	77
Pre-Drawdown Modifications		153	03-May-21	30-Dec-21	0
Gate Replacement		31	25-May-21	30-Jun-21	93
IG0100	Build Crane Pad/ Work Pad by Sluice Gate Facility	7	25-May-21	02-Jun-21	2
IG3180	Install Venting	13	25-May-21	09-Jun-21	34
IG0015	Demolish and Remove Lift Frame (Double Shift)	3	03-Jun-21	05-Jun-21	2
IG3010	Remove Existing Upper/Lower Gate (Double Shift)	7	07-Jun-21	14-Jun-21	30
IG3020	Cast New Sill/ Lower Frame/ Grout Frame/ Plumb Hydraulics (Double Shift)	10	15-Jun-21	25-Jun-21	30
IG3030	Commission New Gate (Double Shift)	4	26-Jun-21	30-Jun-21	93
Diversion Intake Structure		29	15-Jun-21	19-Jul-21	75
IG0001	Close Upper Sluice Gate and Secure Hinged Blind Flange	2	15-Jun-21	16-Jun-21	83
IG3240	Build Downstream Cofferdam (at Diversion Tunnel Outlet)	15	26-Jun-21	14-Jul-21	30
IG0011	Remove and Replace Diversion Intake Grizzly (Includes Jetting/Dredging at Intake) (	19	26-Jun-21	19-Jul-21	75
Tunnel Linning		153	03-May-21	30-Dec-21	0
IG3050	Mobe Equipment and Set-up	21	03-May-21	26-May-21	6
IG3060	Demo Weir/ Water Pump Down (Double Shift)	1	27-May-21	27-May-21	6
IG3070	Tunnel Inspection/ Seal Bulkhead (Double Shift)	6	03-Jun-21	09-Jun-21	2
IG3080	Ground Support (Double Shift)	5	10-Jun-21	15-Jun-21	2
IG3090	Mud Mat (Double Shift)	8	16-Jun-21	24-Jun-21	2
IG3100	Concrete Line Invert of Tunnel (Double Shift)	25	25-Jun-21	24-Jul-21	2
IG3110	Assemble Tunnel Forms (Double Shift)	11	26-Jul-21	06-Aug-21	2
IG3120	Install Arch Rebar (Double Shift)	28	07-Aug-21	09-Sep-21	2
IG3130	Arch Concrete (Double Shift)	51	17-Aug-21	16-Oct-21	2
IG0013	Remove Blind Flange (Double Shift)	5	18-Oct-21	22-Oct-21	2
IG0028	Install and Connect Steel Liner to New Gate (Double Shift)	15	23-Oct-21	09-Nov-21	2
IG3140	Install Dissipator Rings (Double Shift)	30	10-Nov-21	16-Dec-21	2
IG3250	Lower Water in Reservoir	4	17-Dec-21	30-Dec-21	1
DRAWDOWN YEAR		201	01-Oct-21	28-Oct-22	3
JC Boyle		174	01-Dec-21	26-Oct-22	4
Drawdown		0	01-Dec-21	04-Feb-22	0
JCB1180	PacifiCorp - Drawdown to Spillway Crest	20	01-Dec-21*	29-Dec-21	0
JCB0001	Stage 1 Drawdown - Open Gates/ Close Intake/ Cut 14' Low Pressure Pipeline	21	01-Jan-22	21-Jan-22	39
JCB0082	Drawdown Starts - JC Boyle	0	01-Jan-22		74
JCB0017	Stage 2 Drawdown - Open Intake/ Blast Diversion Culvert #1	10	21-Jan-22	31-Jan-22	39
JCB0019	Stage 3 Drawdown - Blast Diversion Culvert #2	4	31-Jan-22	04-Feb-22	39
JCB1050	Drawdown Complete - JC Boyle	0		04-Feb-22	39
Dam/Intake/Spillway Removal		154	01-Apr-22	01-Oct-22	10
JCB0014	Remove Spillway Bridge Deck and Railings	8	01-Apr-22	09-Apr-22	122
JCB0012	Remove Intake Structure and Hoist	8	01-Apr-22	09-Apr-22	132
JCB0015	Remove Spillway Gates, Operators, and Traveling Hoist	10	11-Apr-22	22-Apr-22	122
JCB0004	Remove Abutment Left Wall	6	10-Sep-22	16-Sep-22	10
JCB0061	Remove Dam Spillway	19	10-Sep-22	01-Oct-22	5
JCB0005	Remove Fish Ladder	13	17-Sep-22	01-Oct-22	10
Embankment Removal		83	15-Jun-22	21-Sep-22	8
JCB0003	Rehab Historical Cofferdam	10	15-Jun-22*	25-Jun-22	4
JCB0006	Remove and Stockpile Rip Rap	6	27-Jun-22	02-Jul-22	4
JCB0020	Remove Embankment Down to Elev 3785.2	8	05-Jul-22	13-Jul-22	4



Actual Work
Remaining Work
Critical Remaining Work
Milestone

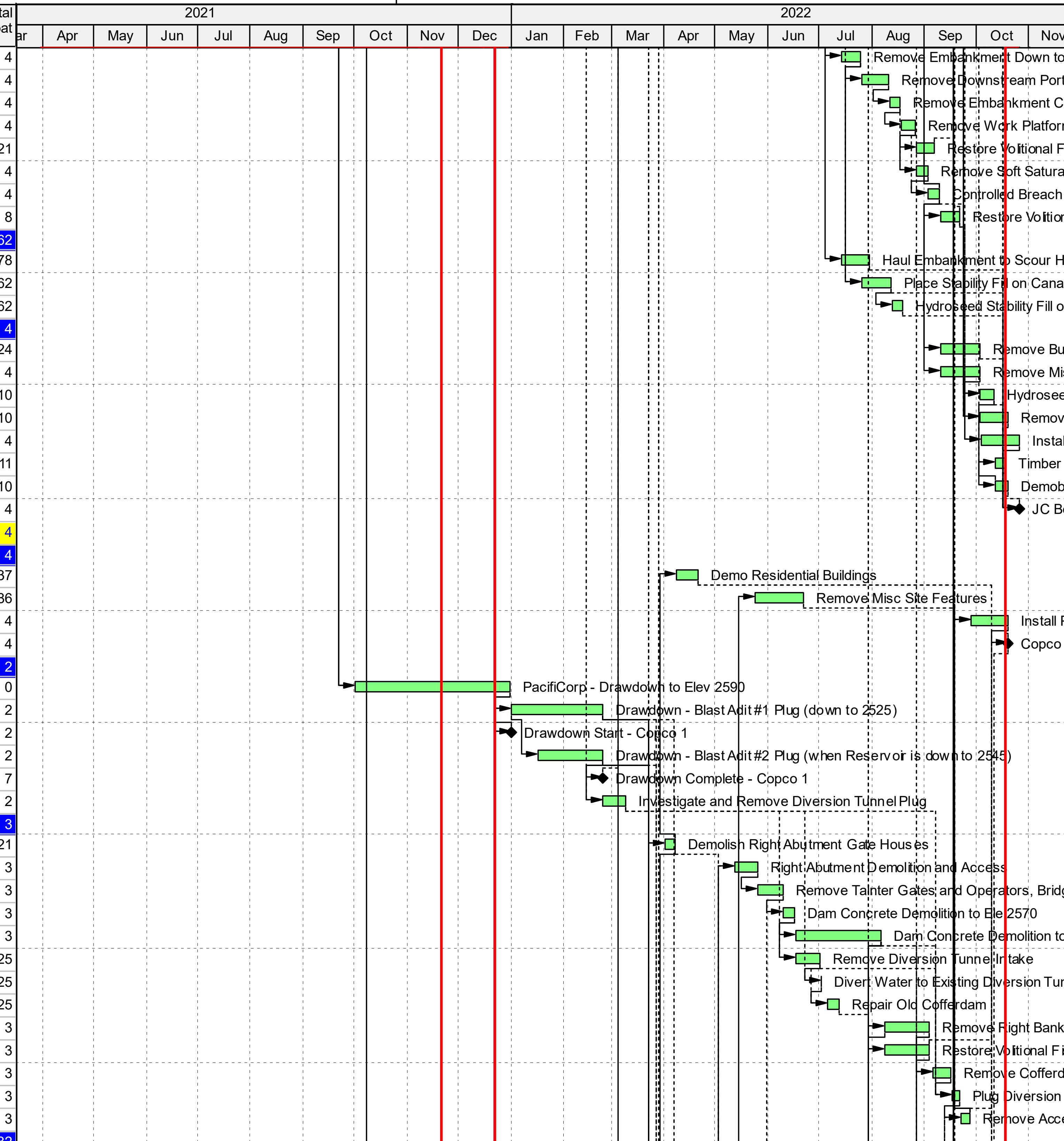
EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 4 of 7

TASK filter: All Activities

KRRP - Early Work Schedule

13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
JCB1120	Remove Embankment Down to Elev 3775.7	10	14-Jul-22	25-Jul-22	4
JCB1130	Remove Downstream Portion of Embankment down to Bedrock Elev 3740.7	14	26-Jul-22	10-Aug-22	4
JCB0007	Remove Embankment Cut Off Wall	6	11-Aug-22	17-Aug-22	4
JCB1170	Remove Work Platform down to Bedrock	8	18-Aug-22	26-Aug-22	4
JCB1000	Restore Volitional Fish Passage (Downstream of Historic Cofferdam)	8	27-Aug-22	06-Sep-22	21
JCB1140	Remove Soft Saturated Material	6	27-Aug-22	02-Sep-22	4
JCB0009	Controlled Breach of Historic Cofferdam (down to 3740.7)	5	03-Sep-22	09-Sep-22	4
JCB1150	Restore Volitional Fish Passage (Upstream of Embamkment)	10	10-Sep-22	21-Sep-22	8
Power Canal		**31**	**14-Jul-22**	**18-Aug-22**	**62**
JCB0031	Haul Embankment to Scour Hole (3' rock cover)	15	14-Jul-22	30-Jul-22	78
JCB0028	Place Stability Fill on Canal	16	26-Jul-22	12-Aug-22	62
JCB1100	Hydroseed Stability Fill on Canal	5	13-Aug-22	18-Aug-22	62
Site Work		**40**	**10-Sep-22**	**26-Oct-22**	**4**
JCB1200	Remove Buildings and Storage Sheds at Dam	20	10-Sep-22	03-Oct-22	24
JCB1190	Remove Misc Site Features	20	10-Sep-22	03-Oct-22	4
JCB0058	Hydroseed Disposal Sites	7	03-Oct-22	11-Oct-22	10
JCB1030	Remove Warehouse and Buildings	15	03-Oct-22	19-Oct-22	10
JCB1210	Install Permanent BMPs	20	04-Oct-22	26-Oct-22	4
JCB0013	Timber Bridge Removal	6	12-Oct-22	18-Oct-22	11
JCB0059	Demobilize	7	12-Oct-22	19-Oct-22	10
JCB0081	JC Boyle Complete	0		26-Oct-22	4
Copco 1		**194**	**01-Oct-21**	**19-Oct-22**	**4**
Access/Site Work		**162**	**08-Apr-22**	**19-Oct-22**	**4**
CO10032	Demo Residential Buildings	10	08-Apr-22	20-Apr-22	137
CO11000	Remove Misc Site Features	24	24-May-22	21-Jun-22	86
CO11020	Install Permanent BMPs	18	28-Sep-22	19-Oct-22	4
CO10064	Copco 1 Complete	0		19-Oct-22	4
Drawdown		**55**	**01-Oct-21**	**09-Mar-22**	**2**
CO10018	PacifiCorp - Drawdown to Elev 2590	31	01-Oct-21*	31-Dec-21	0
CO10003	Drawdown - Blast Adit #1 Plug (down to 2525)	19	01-Jan-22	23-Feb-22	2
CO10063	Drawdown Start - Copco 1	0	01-Jan-22		2
CO10073	Drawdown - Blast Adit #2 Plug (when Reservoir is down to 2545)	14	17-Jan-22	23-Feb-22	2
CO10260	Drawdown Complete - Copco 1	0	24-Feb-22		7
CO10240	Investigate and Remove Diversion Tunnel Plug	5	24-Feb-22	09-Mar-22	2
Dam Removal		**149**	**01-Apr-22**	**27-Sep-22**	**3**
CO10005	Demolish Right Abutment Gate Houses	6	01-Apr-22	07-Apr-22	21
CO10004	Right Abutment Demolition and Access	12	12-May-22	25-May-22	3
CO10002	Remove Tainter Gates and Operators, Bridge Deck and Piers	12	26-May-22	09-Jun-22	3
CO10250	Dam Concrete Demolition to Ele 2570	6	10-Jun-22	16-Jun-22	3
CO10300	Dam Concrete Demolition to Elev 2472	42	17-Jun-22	06-Aug-22	3
CO10072	Remove Diversion Tunnel Intake	13	17-Jun-22	01-Jul-22	25
CO10331	Divert Water to Existing Diversion Tunnel	1	02-Jul-22	02-Jul-22	25
CO10400	Repair Old Cofferdam	6	06-Jul-22	12-Jul-22	25
CO10341	Remove Right Bank Material (Upstream of Dam)	24	08-Aug-22	03-Sep-22	3
CO10371	Restore Volitional Fish Passage Channel (Downstream of Historical Cofferdam)	24	08-Aug-22	03-Sep-22	3
CO10351	Remove Cofferdam and Historical Construction	10	06-Sep-22	16-Sep-22	3
CO10019	Plug Diversion Tunnel with Rip Rap (Downstream)	4	17-Sep-22	21-Sep-22	3
CO10017	Remove Access Road and Temp Bridge Crossing (Downstream)	5	22-Sep-22	27-Sep-22	3
Powerhouse and Penstock Removal		**136**	**06-Apr-22**	**16-Sep-22**	**32**



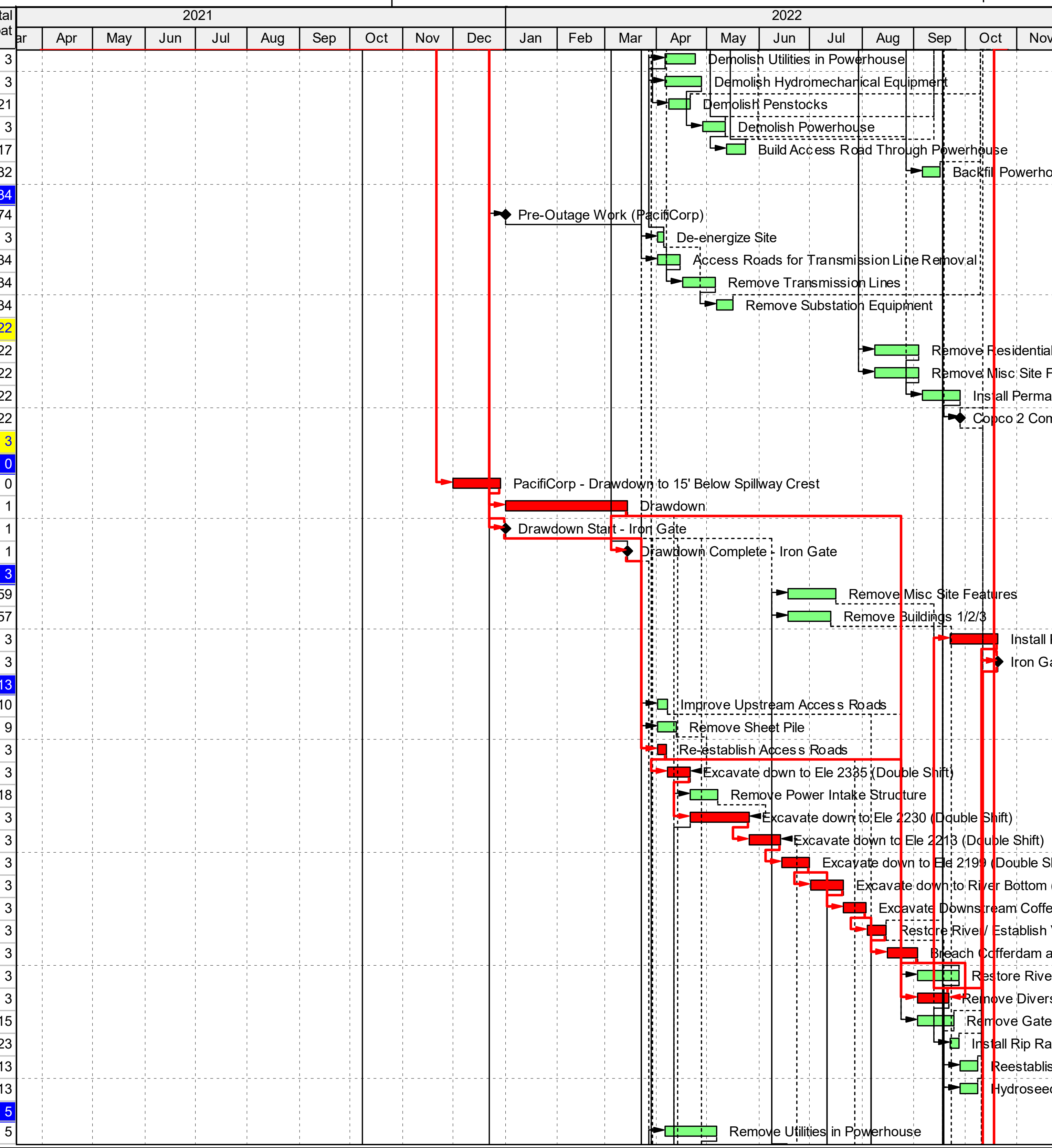
Actual Work
Remaining Work
Critical Remaining Work
Milestone

EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 5 of 7

TASK filter: All Activities

KRRP - Early Work Schedule | 13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
CO10051	Demolish Utilities in Powerhouse	15	06-Apr-22	23-Apr-22	3
CO10053	Demolish Hydromechanical Equipment	18	06-Apr-22	27-Apr-22	3
CO10006	Demolish Penstocks	10	08-Apr-22	20-Apr-22	21
CO10007	Demolish Powerhouse	12	28-Apr-22	11-May-22	3
CO10390	Build Access Road Through Powerhouse	10	12-May-22	23-May-22	17
CO10022	Backfill Powerhouse	10	06-Sep-22	16-Sep-22	32
Transmission/Distribution		38	01-Jan-22	16-May-22	134
CO10225	Pre-Outage Work (PacifiCorp)	0		01-Jan-22	74
CO10270	De-energize Site	4	01-Apr-22	05-Apr-22	3
CO10220	Access Roads for Transmission Line Removal	12	01-Apr-22	14-Apr-22	134
CO10054	Remove Transmission Lines	17	16-Apr-22	05-May-22	134
CO10055	Remove Substation Equipment	9	06-May-22	16-May-22	134
Copco 2		44	08-Aug-22	28-Sep-22	22
CO20431	Remove Residential Buildings	24	08-Aug-22	03-Sep-22	22
CO20421	Remove Misc Site Features	24	08-Aug-22	03-Sep-22	22
CO20441	Install Permanent BMPs	20	06-Sep-22	28-Sep-22	22
CO2081	Copco 2 Complete	0		28-Sep-22	22
Iron Gate		169	01-Dec-21	20-Oct-22	3
Drawdown		0	01-Dec-21	14-Mar-22	0
IG2000	PacifiCorp - Drawdown to 15' Below Spillway Crest	20	01-Dec-21*	29-Dec-21	0
IG0003	Drawdown	73	01-Jan-22	14-Mar-22	1
IG0040	Drawdown Start - Iron Gate	0	01-Jan-22		1
IG2110	Drawdown Complete - Iron Gate	0		14-Mar-22	1
Access/Site Work		104	18-Jun-22	20-Oct-22	3
IG1000	Remove Misc Site Features	24	18-Jun-22	16-Jul-22	59
IG0050	Remove Buildings 1/2/3	20	18-Jun-22	13-Jul-22	57
IG1020	Install Permanent BMPs	24	22-Sep-22	20-Oct-22	3
IG0070	Iron Gate Complete	0		20-Oct-22	3
Embankment Removal		159	01-Apr-22	08-Oct-22	13
IG2150	Improve Upstream Access Roads	6	01-Apr-22	07-Apr-22	110
IG0021	Remove Sheet Pile	10	01-Apr-22	12-Apr-22	9
IG0033	Re-establish Access Roads	5	01-Apr-22	06-Apr-22	3
IG0022	Excavate down to Ele 2335 (Double Shift)	11	07-Apr-22	20-Apr-22	3
IG3230	Remove Power Intake Structure	15	21-Apr-22	07-May-22	18
IG0024	Excavate down to Ele 2230 (Double Shift)	30	21-Apr-22	25-May-22	3
IG0025	Excavate down to Ele 2213 (Double Shift)	15	26-May-22	13-Jun-22	3
IG3190	Excavate down to Ele 2199 (Double Shift)	15	14-Jun-22	30-Jun-22	3
IG3220	Excavate down to River Bottom (Double Shift)	15	01-Jul-22	20-Jul-22	3
IG0027	Excavate Downstream Cofferdam (Double Shift)	12	21-Jul-22	03-Aug-22	3
IG3150	Restore River/ Establish Volitional Fish Passage (Downstream of Upstream Cofferda	10	04-Aug-22	15-Aug-22	3
IG0029	Breach Cofferdam at Iron Gate	16	16-Aug-22	02-Sep-22	3
IG3210	Restore River/ Establish Volitional Fish Passage (Upstream of Cofferdam)	20	03-Sep-22	27-Sep-22	3
IG0004	Remove Diversion Tunnel Intake Structure	15	03-Sep-22	21-Sep-22	3
IG0020	Remove Gate and Operator, Structure	18	03-Sep-22	24-Sep-22	15
IG0080	Install Rip Rap at Diversion Tunnel Intake Structure	5	22-Sep-22	27-Sep-22	23
IG3160	Reestablish Site	10	28-Sep-22	08-Oct-22	13
IG3200	Hydroseed Disposal Sites	10	28-Sep-22	08-Oct-22	13
Powerhouse/ Penstock/ Fish Facility Removal		143	06-Apr-22	24-Sep-22	5
IG0061	Remove Utilities in Powerhouse	26	06-Apr-22	06-May-22	5



Actual Work | Remaining Work | Critical Remaining Work | ◆ Milestone

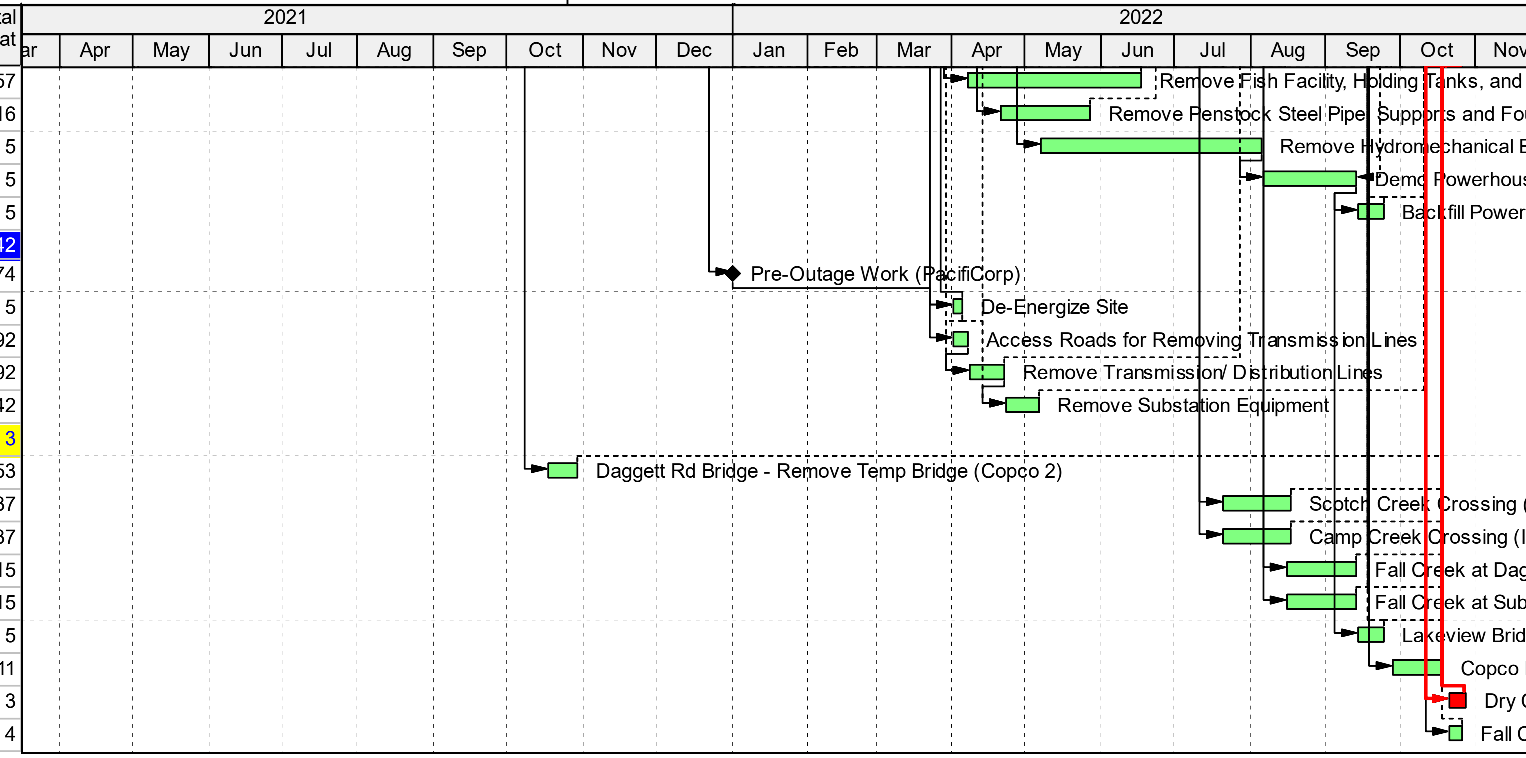
EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 6 of 7

TASK filter: All Activities

KRRP - Early Work Schedule

13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
IG0007	Remove Fish Facility, Holding Tanks, and Mechanical	60	07-Apr-22	17-Jun-22	57
IG0031	Remove Penstock Steel Pipe, Supports and Foundations	32	21-Apr-22	27-May-22	16
IG0062	Remove Hydromechanical Equipment	75	07-May-22	05-Aug-22	5
IG0032	Demo Powerhouse	32	06-Aug-22	13-Sep-22	5
IG0036	Backfill Powerhouse	10	14-Sep-22	24-Sep-22	5
Transmission/Distribution		30	01-Jan-22	06-May-22	142
IG3000	Pre-Outage Work (PacifiCorp)	0		01-Jan-22	74
IG2120	De-Energize Site	4	01-Apr-22	05-Apr-22	5
IG0210	Access Roads for Removing Transmission Lines	6	01-Apr-22	07-Apr-22	92
IG0054	Remove Transmission/ Distribution Lines	12	08-Apr-22	22-Apr-22	92
IG0063	Remove Substation Equipment	12	23-Apr-22	06-May-22	142
Project Wide		187	18-Oct-21	28-Oct-22	3
PW1051	Daggett Rd Bridge - Remove Temp Bridge (Copco 2)	11	18-Oct-21	30-Oct-21	153
PW0042	Scotch Creek Crossing (Iron Gate)	24	21-Jul-22	17-Aug-22	37
PW1074	Camp Creek Crossing (Iron Gate)	24	21-Jul-22	17-Aug-22	37
PW1174	Fall Creek at Daggett Rd	24	16-Aug-22	13-Sep-22	15
PW1184	Fall Creek at Substation Rd	24	16-Aug-22	13-Sep-22	15
PW1052	Lakeview Bridge - Remove Temp Bridge (Iron Gate)	10	14-Sep-22	24-Sep-22	5
PW1064	Copco Rd Roadway and Culvert Rehab	18	28-Sep-22	18-Oct-22	11
PW1054	Dry Creek Bridge - Remove Temp Bridge-Over-Bridge (Copco)	6	21-Oct-22	28-Oct-22	3
PW1053	Fall Creek Bridge - Remove Temp Bridge-Over-Bridge (Copco)	5	21-Oct-22	26-Oct-22	4



Actual Work
Remaining Work
Critical Remaining Work
◆ Milestone

EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 7 of 7

TASK filter: All Activities

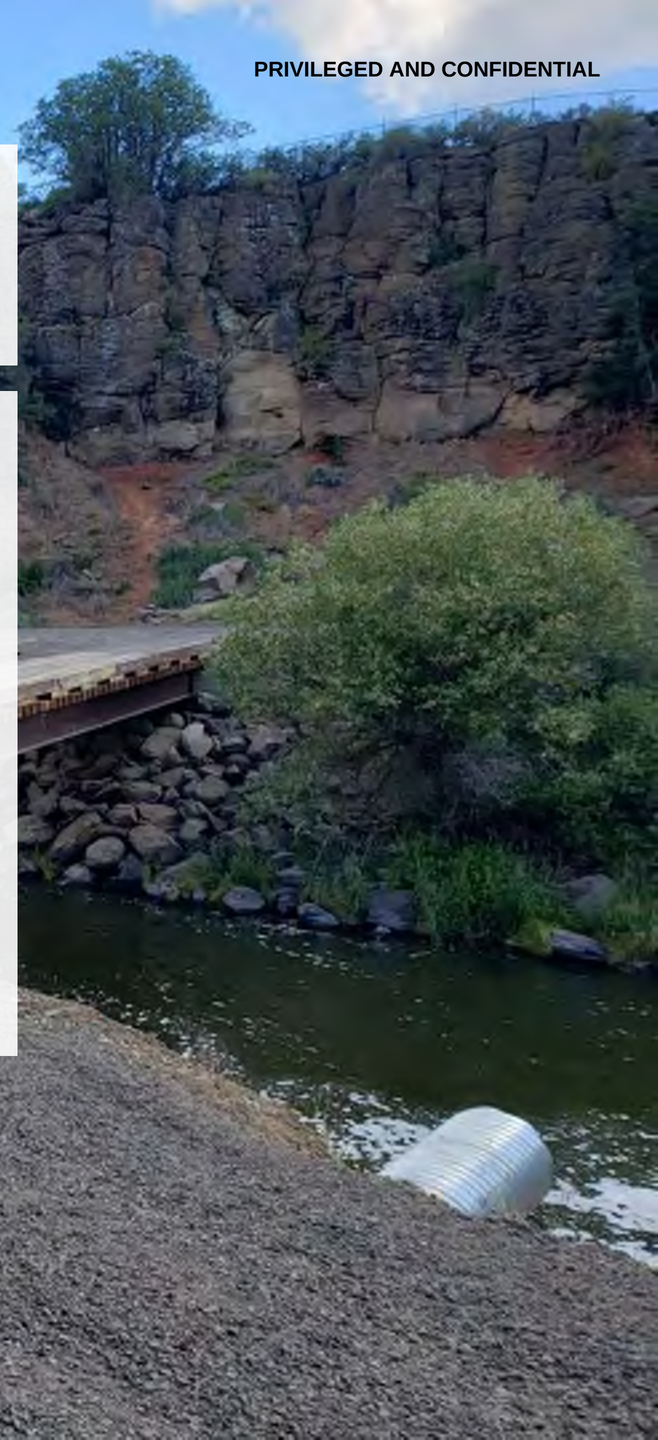
APPENDIX G2

VE-7 Submittals: Summary Presentation

(Pages G2-1 to G2-20)

Klamath River Renewal Project
VE Early Start – May 19, 2020

Outline



Tasks:

1. Early Works Implementation Schedule
2. J.C. Boyle Timber Bridge – Scour Assessment for Cut Pipeline
3. ~~J.C. Boyle Scour Hole – Temporary Stability for Partial Fill~~
4. J.C. Boyle Tunnel Forebay – Minimize Concrete Removal
5. Copco No. 1 – Construct Dam Access through Powerhouse
6. Copco No. 2 – Early Removal of Dam and Cofferdam
7. Tunnel Closures – Eliminate Use of Bat Doors

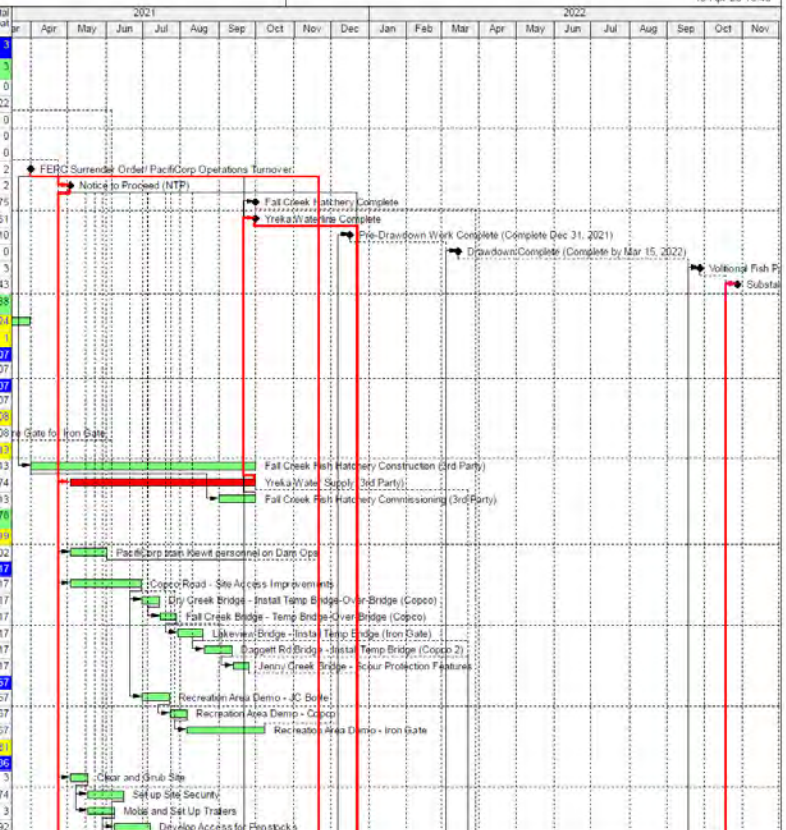
1) Early Works Implementation Schedule

KP has reviewed: no comments (May 12 TFM)

KRRP - Early Work Schedule

13-Apr-20 16:40

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float
KRRP - Early Work Schedule		356	30-Aug-19 A	28-Oct-22	3
MILESTONES		356	24-Feb-20	28-Oct-22	3
GEN0011	FERC GMP	0	24-Feb-20*		0
GEN0060	Inspection of Existing Gate at Iron Gate	0	02-Mar-20*		22
GEN0003	LNTP - Iron Gate Dam - Gate Procurement	0	01-Apr-20*		0
GEN0030	2020 Permit/LNTP for Geotech/Dredging at Copco 1	0	15-Jun-20*		0
GEN0001	GMP Amended - Executed	0	01-Oct-20*		0
GEN0040	FERC Surrender Order/ PacifiCorp Operations Turnover	0	01-Apr-21		2
GEN0002	Notice to Proceed (NTP)	0	03-May-21		2
GEN0019	Fall Creek Hatchery Complete	0		30-Sep-21	175
GEN0018	Yreka Waterline Complete	0		30-Sep-21	61
GEN0006	Pre-Drawdown Work Complete (Complete Dec 31, 2021)	0		16-Dec-21*	10
GEN3000	Drawdown Complete (Complete by Mar 15, 2022)	0		14-Mar-22*	0
GEN0020	Volitional Fish Passage (Complete by Oct 1, 2022)	0		27-Sep-22*	3
GEN0008	Substantial Completion - Dam Removal Work (Complete by Dec 31, 2022)	0		28-Oct-22*	43
PRE-CONSTRUCTION		155	30-Aug-19 A	30-Sep-21	88
Permitting		396	30-Aug-19 A	31-Mar-21	24
Submittals		0	01-Apr-20	28-May-20	1
Prep and Submit		20	01-Apr-20	29-Apr-20	107
PS0003	P/S Shop Drawings Gate for Iron Gate	20	01-Apr-20	29-Apr-20	107
Review and Approve		20	30-Apr-20	28-May-20	107
RA0003	R/A Shop Drawings Gate for Iron Gate	20	30-Apr-20	28-May-20	107
Procurement		180	29-May-20	15-Feb-21	108
PRC003	Procure Gate for Iron Gate	180	29-May-20	15-Feb-21	108
3rd Party Work		153	01-Apr-21	30-Sep-21	213
PW1104	Fall Creek Fish Hatchery Construction (3rd Party)	153	01-Apr-21	30-Sep-21	213
PW1010	Yreka Water Supply (3rd Party)	127	03-May-21	30-Sep-21	74
PW1114	Fall Creek Fish Hatchery Commissioning (3rd Party)	25	01-Sep-21	30-Sep-21	213
PRE-DRAWDOWN YEAR		153	03-May-21	30-Dec-21	178
Project Wide		134	03-May-21	08-Oct-21	19
PW1194	PacifiCorp train Kiewit personnel on Dam Ops	25	03-May-21	01-Jun-21	102
Roads and Bridges		123	03-May-21	25-Sep-21	17
PW0044	Copco Road - Site Access Improvements	49	03-May-21	29-Jun-21	17
PW1001	Dry Creek Bridge - Install Temp Bridge-Over-Bridge (Copco)	12	30-Jun-21	14-Jul-21	17
PW1002	Fall Creek Bridge - Temp Bridge-Over-Bridge (Copco)	12	15-Jul-21	28-Jul-21	17
PW1003	Lakeview Bridge - Install Temp Bridge (Iron Gate)	19	29-Jul-21	19-Aug-21	17
PW1004	Daggett Rd Bridge - Install Temp Bridge (Copco 2)	19	20-Aug-21	11-Sep-21	17
PW1084	Jenny Creek Bridge - Scour Protection Features	12	13-Sep-21	25-Sep-21	17
Demo Recreation Sites		85	30-Jun-21	08-Oct-21	67
PW1008	Recreation Area Demo - JC Boyle	19	30-Jun-21	22-Jul-21	67
PW1020	Recreation Area Demo - Copco	12	23-Jul-21	05-Aug-21	67
PW1030	Recreation Area Demo - Iron Gate	54	06-Aug-21	08-Oct-21	67
JC Boyle		150	03-May-21	28-Oct-21	181
Access/ Site Work		60	03-May-21	14-Jul-21	186
JCB0057	Clear and Grub Site	12	03-May-21	17-May-21	3
JCB1060	Set up Site Security	24	17-May-21	15-Jun-21	174
JCB0056	Mobe and Set Up Trailers	18	17-May-21	08-Jun-21	3
JCB1070	Develop Access for Penstocks	24	08-Jun-21	07-Jul-21	192



Actual Work
Remaining Work
Critical Remaining Work
◆ Milestone

EARLY WORK SCHEDULE
KLAMATH - PROJECT IMPLEMENATION WORK SCHEDULE
Page 1 of 7

TASK filter: All Activities

© Oracle Corporation

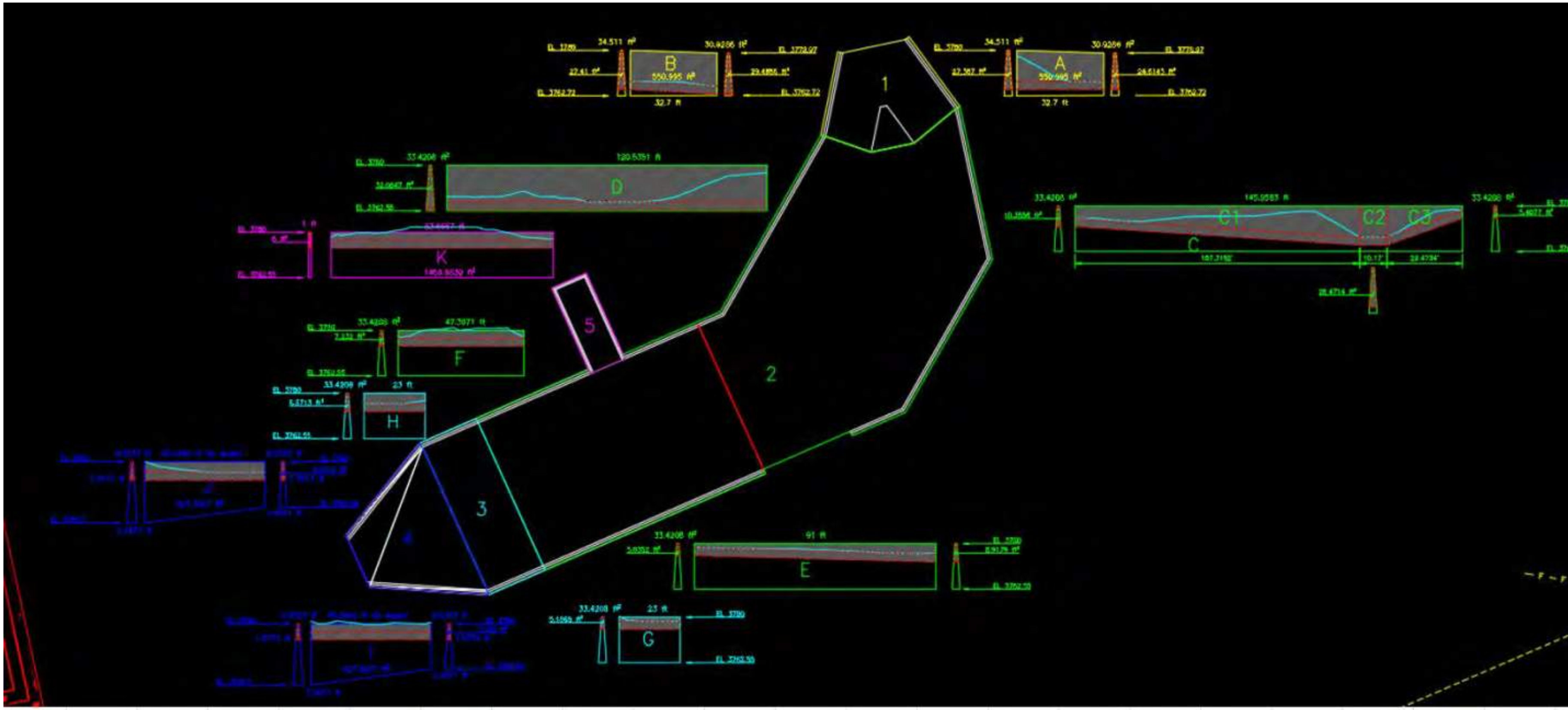
2) J.C. Boyle Timber Bridge – Scour Assessment

2) J.C. Boyle Timber Bridge – Scour Assessment

2) J.C. Boyle Timber Bridge – Scour Assessment

4) J.C. Boyle Forebay – Minimize Concrete Removal

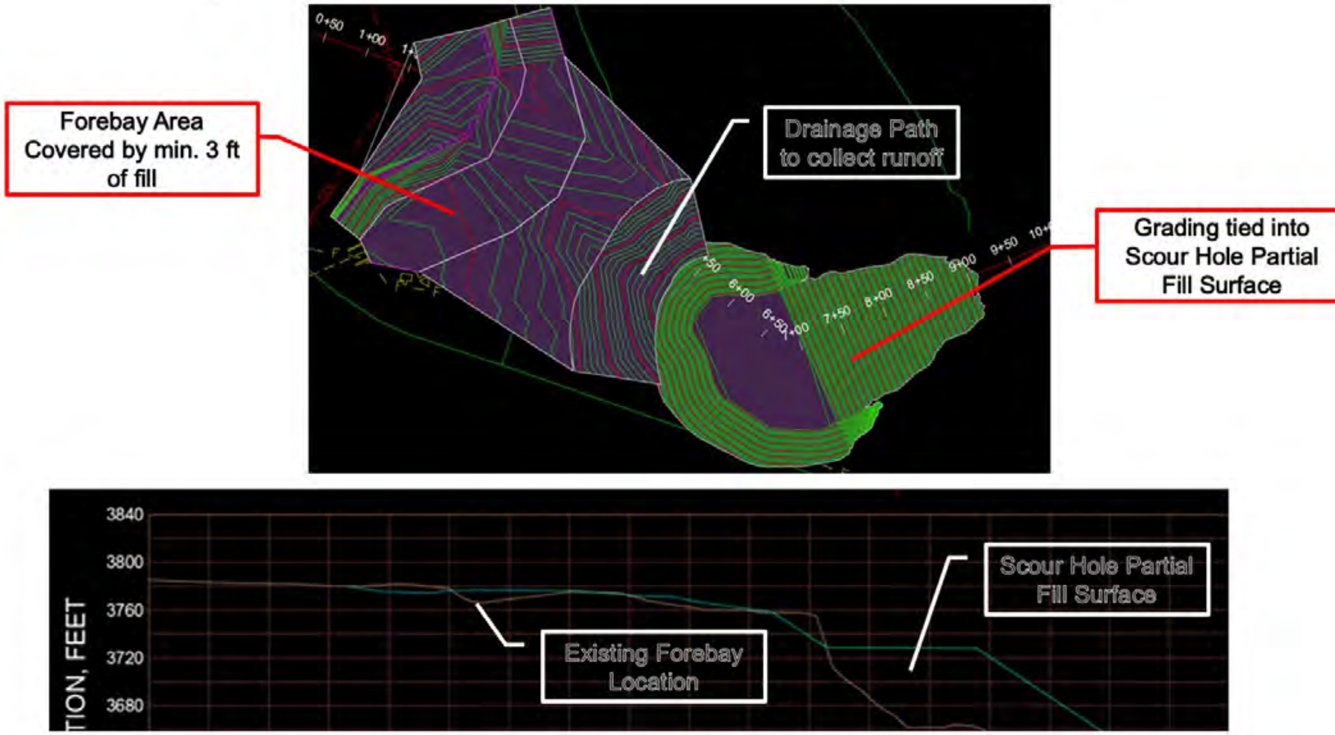
Forebay Grading – Partial Concrete Material Takeoffs



- VE Partial Removal - About 2/3 of concrete volume buried in place
- Top 1/3 of concrete (approx.) removed and placed in scour hole

4) J.C. Boyle Forebay – Minimize Concrete Removal

Forebay Grading – Grading Plan and Sections



Summary Info	60% Design	VE Results
▪ Forebay Grading		
▪ Concrete Removal Volume	2,450 yd^3	~800 yd^3
▪ Forebay Grading (cut/fill)	22,700 yd^3	7,200 yd^3

5) Copco No. 1 – Access through Powerhouse

Summary of Required Powerhouse Modifications:

- Powerhouse end wall modifications
- Cable tray and pipe support modifications
- Removal of miscellaneous electrical boxes
- Modification of two turbine/generator unit panels

5) Copco No. 1 – Access through Powerhouse

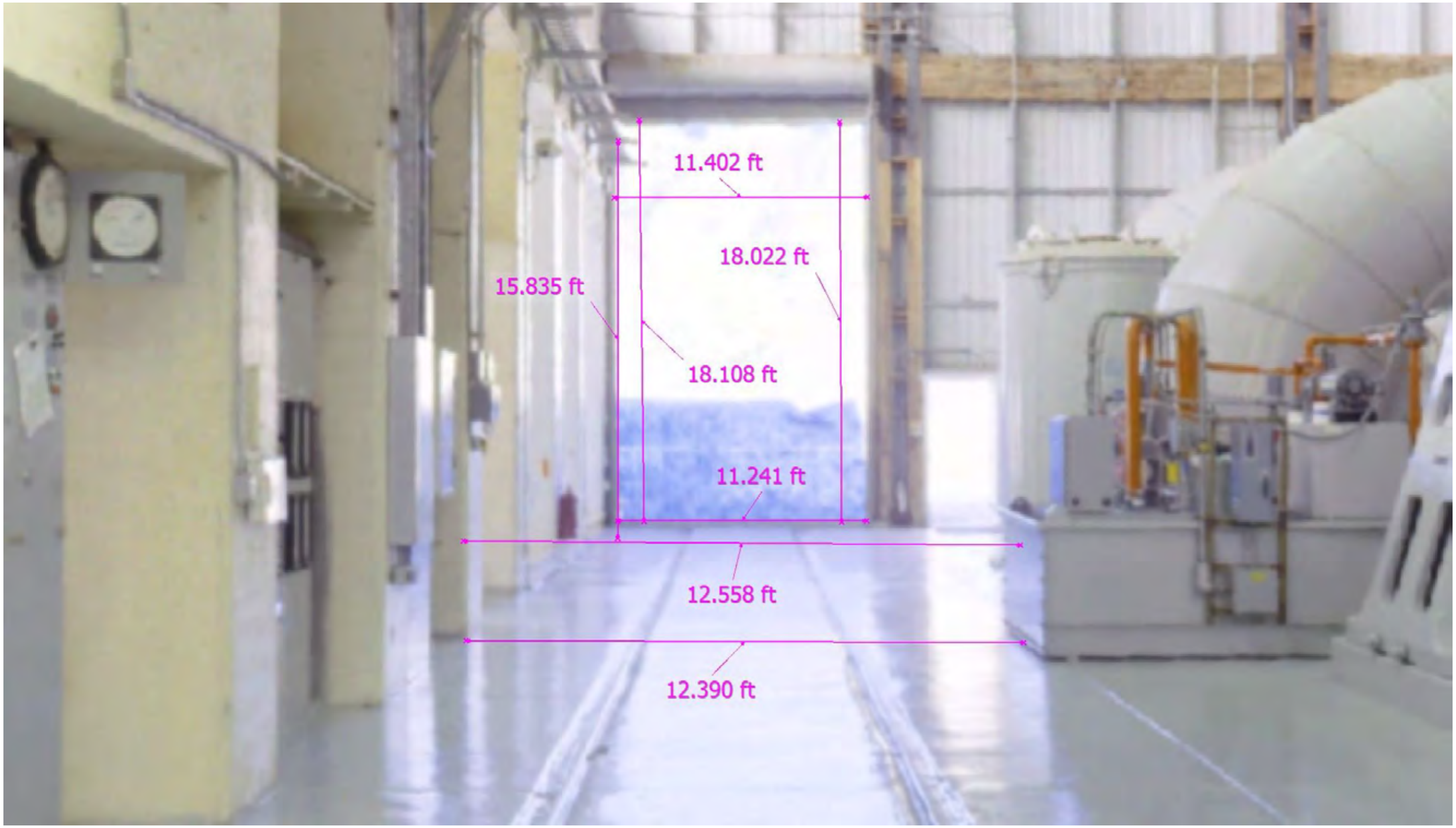


Figure 1: West Wall Entrance, Units 3&4 HPU to Column 4, and Overhead Cable Tray Measurements

5) Copco No. 1 – Access through Powerhouse

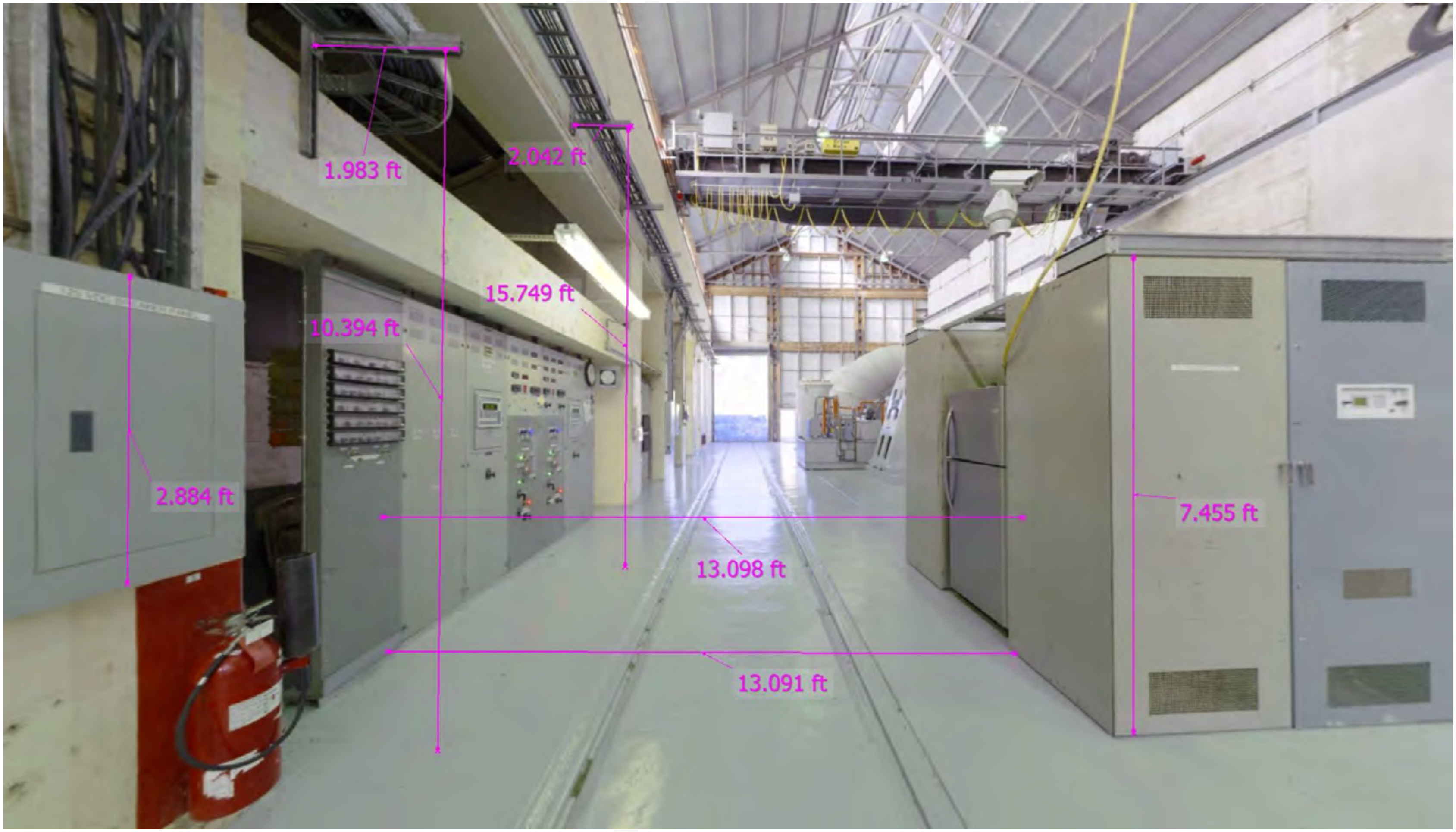


Figure 2. Cable Tray Upper and Lower Measurements, Column 7 to Exciter and Digital Excitation Control System Cabinets

5) Copco No. 1 – Access through Powerhouse

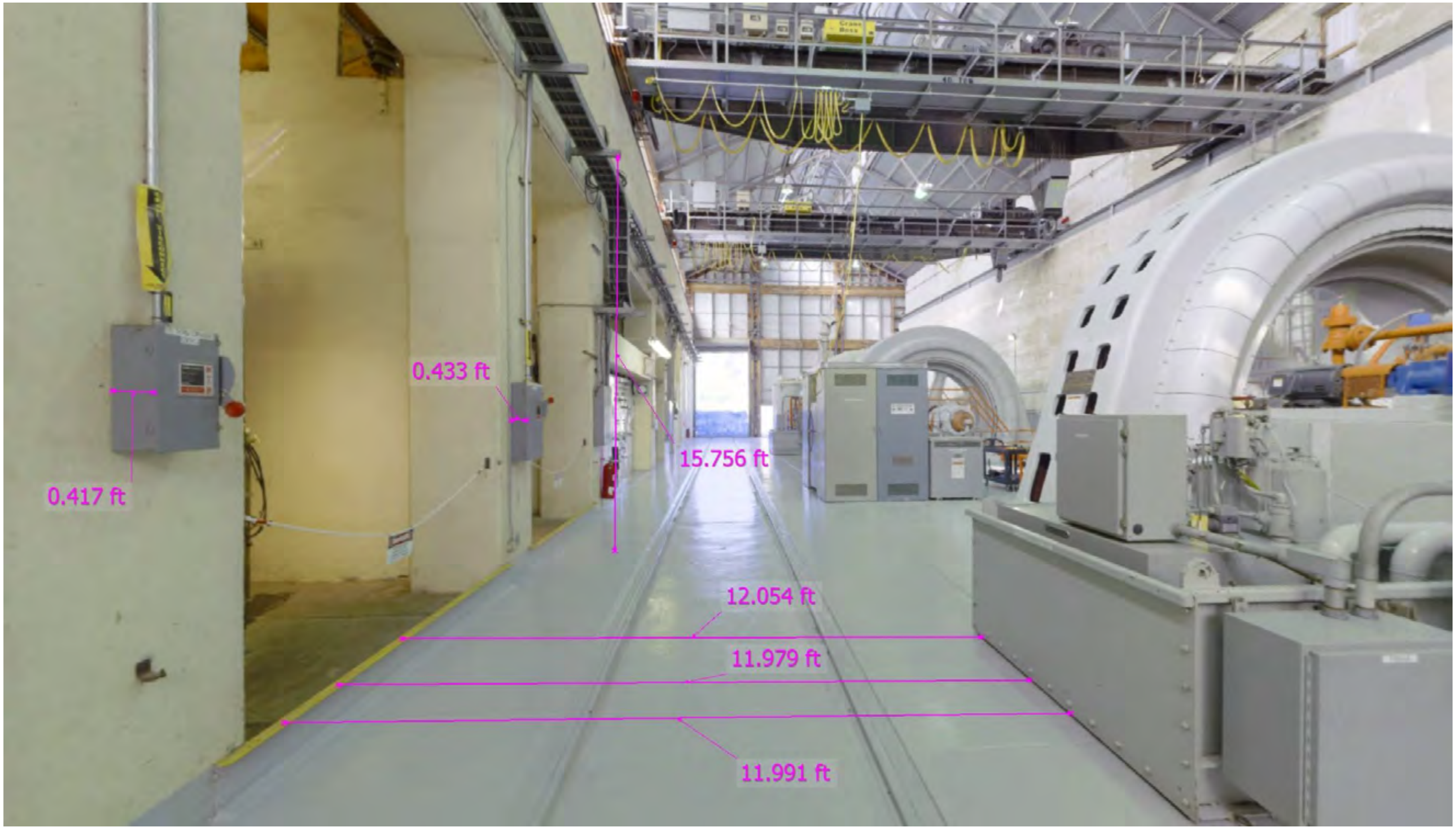


Figure 3: Electrical Switch Box Measurements, Width of corridor between columns 8 & 9 to HPU of Units 1 & 2.

5) Copco No. 1 – Access through Powerhouse

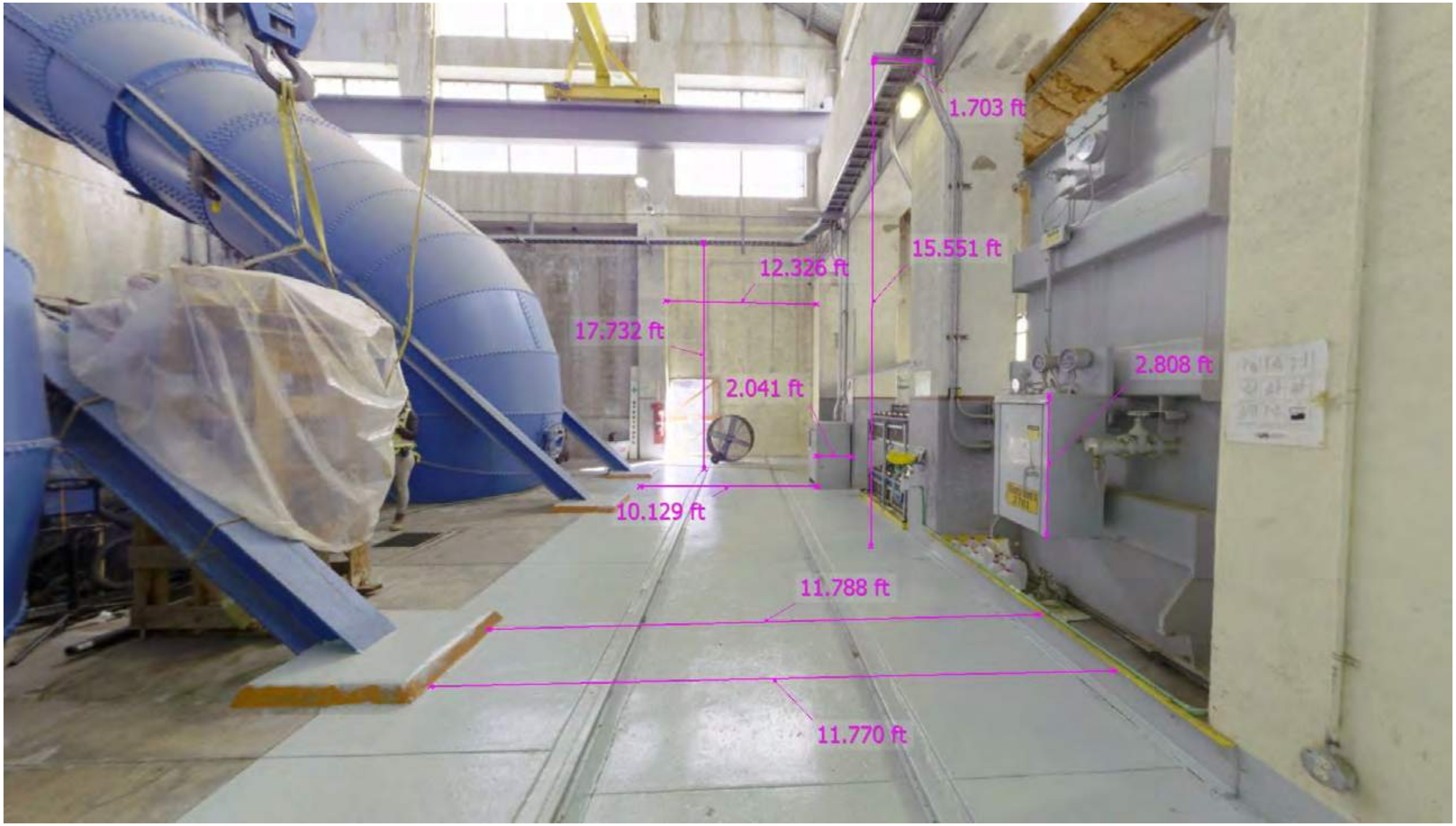


Figure 4: Width of corridor between concrete pedestal to point between columns 10 & 11. Cable Tray Height measurement and support measurement. Corridor width between pedestal and electrical box (Column 12). Electrical Box Width (Column 12). East Wall potential opening measurement

6) Copco No. 2 – Early Dam and Cofferdam Removal

Scope of Analysis:

- Estimate the duration of flow cessation that can be achieved at Copco No. 1 dam to facilitate early removal of Copco No. 2 dam and historical cofferdam during the pre-drawdown period.

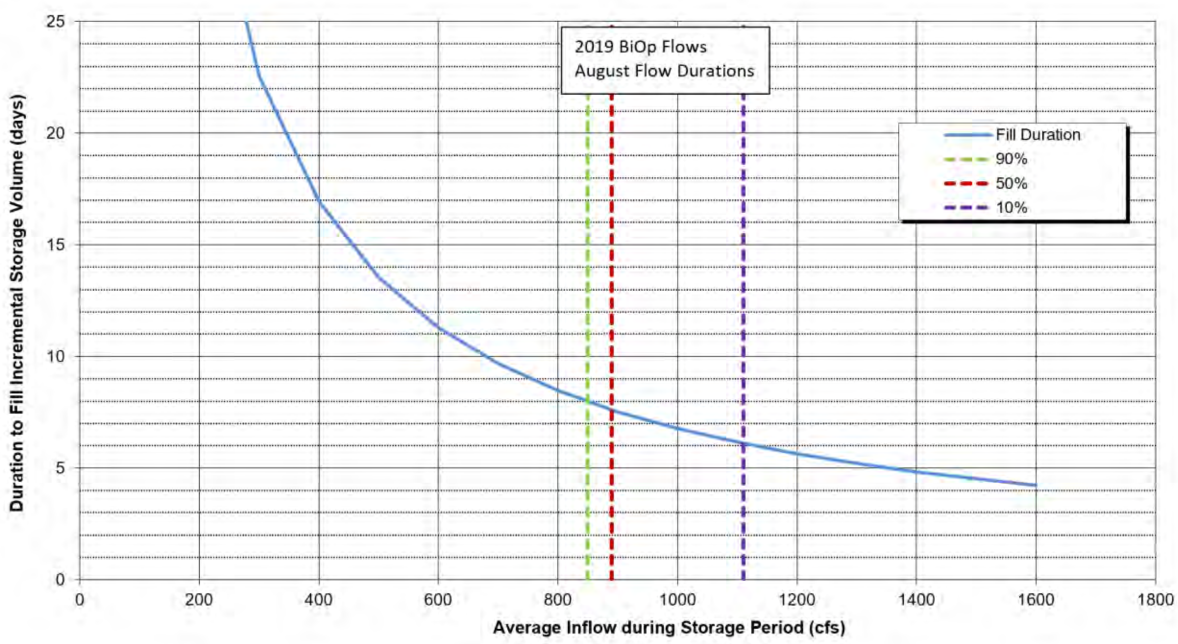
- Inflows to be temporarily stored within the operating range of Copco No. 1 reservoir (Copco Lake)

- Reservoir operating range (based on currently available information):
  - Maximum – normal operating level: 2606 ft.
  - Minimum – minimum operating level: 2592 ft.

6) Copco No. 2 – Early Dam and Cofferdam Removal

Results:

- The chart below shows the duration to fill up from minimum to normal operating level based on average inflow condition during the fill period
- Daily flow duration percentiles for August are shown for context
- Example: At median (50%) August inflow, duration to fill is 7.5 days



7) Tunnel Closures

Print May/15/20 16:57:26

Facility	Tunnel	Tunnel Diameter (ft)	Access	Portal Description	VE Tunnel Closure/Plug	Design Drawings
J.C. Boyle	Conveyance Tunnel to Penstock					C1004, C1331, C1350, C1351, C1352
	Inlet	16	County road access	Reinforced concrete tunnel portal at canal forebay	Soil/Rock/Concrete Rubble Fill	
	Outlet	16	Temporary road access	Reinforced concrete portal with steel surge tank and bifurcation to two steel penstocks	Soil/Rock/Concrete Rubble Fill	
Copco No. 1	Diversion Tunnel					C2100 series
	Inlet	16	No road access	Reinforced concrete inlet on left abutment upstream of dam	Soil/Rock Fill with Slope Protection	
	Outlet	16	No road access	Rock outlet portal on left abutment downstream of the dam	Soil/Rock Fill with Slope Protection	
Copco No. 1	Penstock No. 3 Tunnel					C2257, C2350
	Inlet	14	Dam Deck	Intake 03 (two identical intake structures)	Soil/Rock Fill	
	Outlet	14	Site Road Access	Penstock #3 structure	Soil/Rock Fill with Slope Protection	
Copco No. 2	Tunnel 1					C3200 and C3300 Series
	Inlet	16	Potential road access	Reinforced concrete tunnel intake structure	Reinforced concrete plug with soil/rockfill with rip-rap protection	C3252
	Outlet	15.6	Road access	Reinforced concrete penstock portal	Soil/Rock Fill	
Copco No. 2	Tunnel 2		Road access	Woodstave penstock portal		C3300 Series
	Inlet	15.6	Site road access	Reinforced concrete penstock portal	Soil/Rock Fill	
	Outlet	13.5	No road access	Two identical reinforced concrete outlets to steel penstocks (one for each penstock)	Soil/Rock Fill	
Copco No. 2	Tunnel 2 Surge Vent Outlet	5	No road access	Concrete Ring	Carbon Steel Cover	C3330, C3331, C3340
Copco No. 2	Emergency Spillway Outlet	Approx. 16	No road access	Exposed Rough Rock Cut	Carbon steel barrier	C3002, C3330, C3360
Iron Gate	Diversion Tunnel (Horseshoe)			Intake at Iron Gate reservoir		C4100 series
	Inlet	Approx. 17	Access by cofferdam crest	Reinforced concrete Inlet Structure	Soil/Rock Fill	C4175
	Outlet	Approx. 17	New access construction road	Concrete outlet downstream of dam	Soil/Rock Fill with Slope Protection	Similar to C4175
Iron Gate	Diversion tunnel vertical shaft	6 x 16 (Rectangular)	Access via dam crest road	Reinforced concrete shaft structure	Reinforced concrete Cap with Soil/Rock cover	C4170, C4171

\\knightpiesold.local\VA-Prj$\1\03\00640\01\A\Correspondence\1_Transmittal\2020\VA20-01052 - Tunnel Closures\[Tunnel Closures Overview.xlsx]Table

Knight Piésold CONSULTING

APPENDIX G3

VE-7 Submittals: JC Boyle Forebay Progress Prints

(Pages G3-1 to G3-2)

APPENDIX G4

VE-7 Submittals: JC Boyle Summary Presentation

(Pages G4-1 to G4-7)

J.C. Boyle Facility VE-7
Forebay Grading and Tunnel Barricade

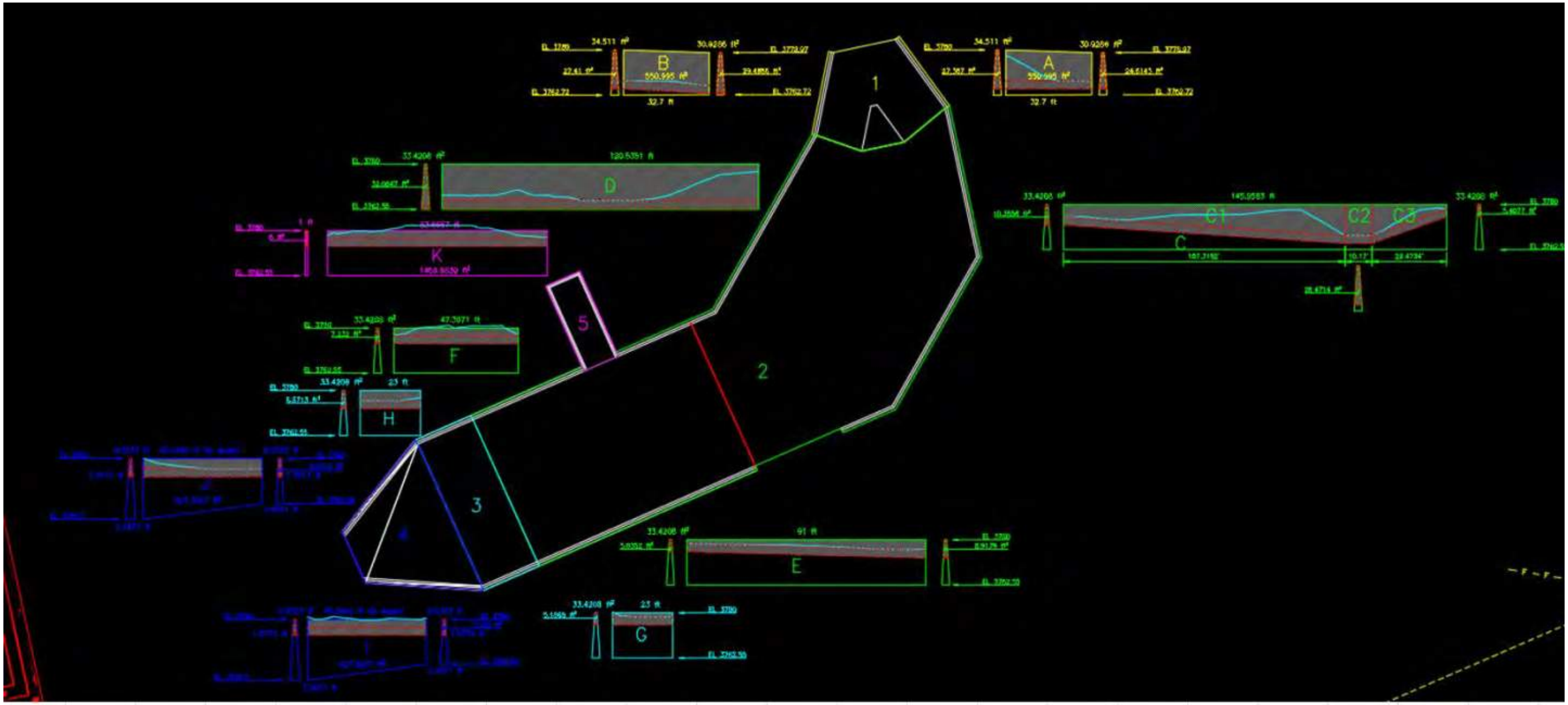
Action Items

Forebay Grading	Date
Perform Partial Concrete Material Takeoffs	May 13
Develop Grading Plan for 3' cover	May 15
Tie into Partial Scour Hole Fill	May 20
Develop Progress Prints for Review	May 21

D/S Tunnel Barricade	
Design Tunnel Infill	May 14
Perform Material Takeoffs	May 14
Develop Progress Prints for Review	May 15

Forebay Grading

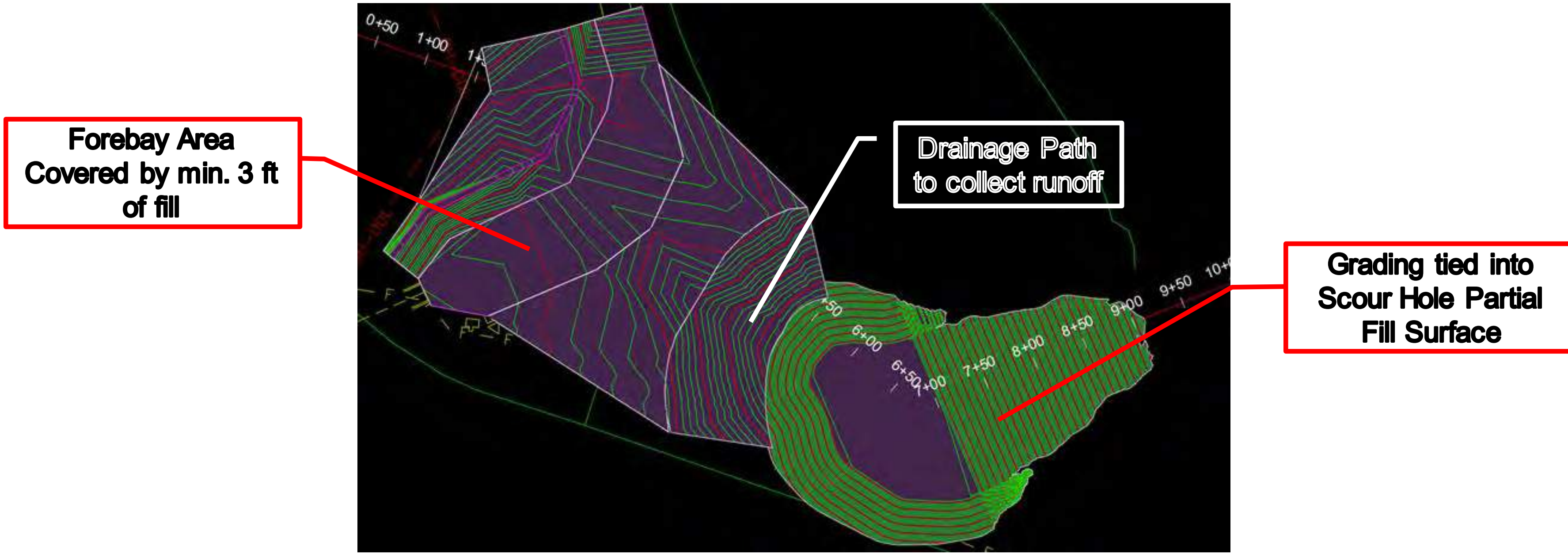
Partial Concrete Material Takeoffs



- VE Partial Removal - About 2/3 of concrete volume buried in place
- Top 1/3 of concrete (approx.) removed and placed in scour hole

Forebay Grading

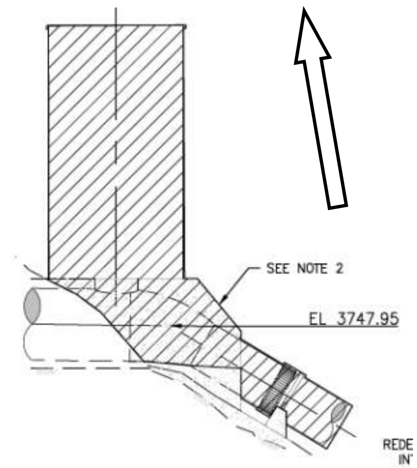
Grading Plan and Sections



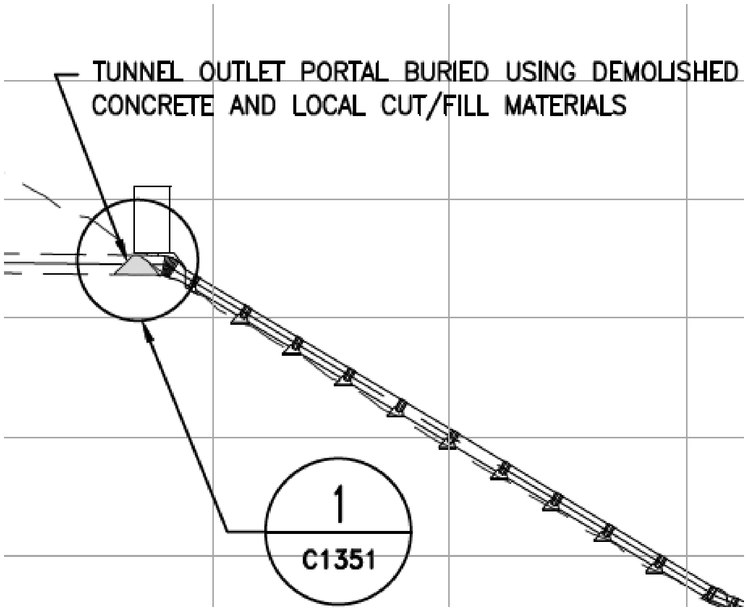
D/S Tunnel Barricade

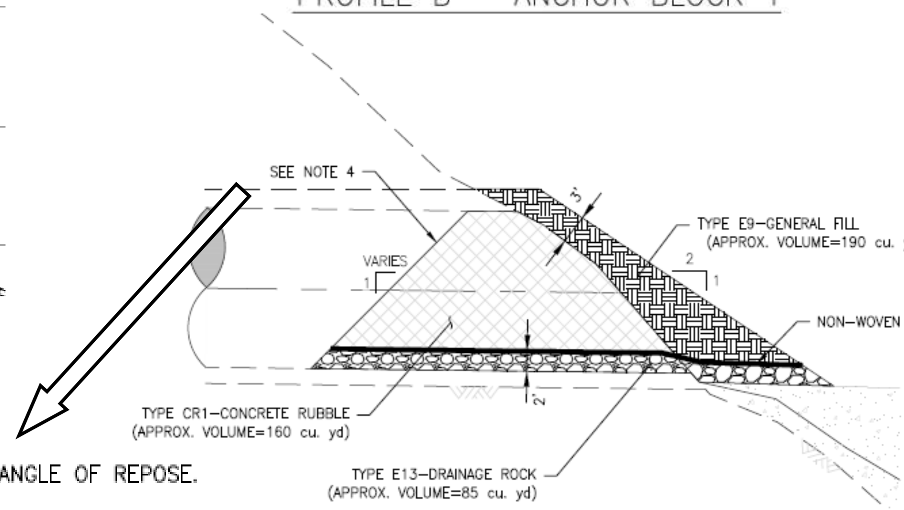
Design

2. REMOVE CONCRETE STRUCTURES TO SPRING LINE OF THE PENSTOCK AND BURY USING LOCALLY AVAILABLE SOIL MATERIAL MEETING THE TYPE E9 GENERAL FILL MATERIAL SPECIFICATIONS.



PROFILE B – ANCHOR BLOCK 1





4. CONCRETE RUBBLE PLACED IN TUNNEL AT ANGLE OF REPOSE.

1
C1350
DETAIL
1" = 10'

JCB Forebay Grading and Tunnel Barricade

Summary Info	60% Design	VE Results
Forebay Grading		
Concrete Removal Volume	2,450 yd^3	~800 yd^3
Forebay Grading (cut/fill)	22,700 yd^3	8,200 yd^3
D/S Tunnel Barricade Type	Steel Barrier	Concrete Backfilled @ angle of repose with 3' Soil Cover
CR1 Fill Volume	0 yd^3	160 yd^3
E9 Cover Volume (additional)	0 yd^3	190 yd^3
Drain Rock	0 yd^3	85 yd^3
Drawing References	C1350 Rev D, C1351 Rev D, C1352 Rev B	C1350 Progress Print, C1351 Progress Print

JCB Forebay Grading and Tunnel Barricade

Next Steps

Forebay Grading	Completion Date
~~Produce progress prints C1334 and C1335~~	~~May 21~~
~~Produce xml surface~~	~~May 21~~
~~D/S Tunnel Barricade Redesign – Complete~~	~~May 16~~

Knight Piésold CONSULTING

APPENDIX G5

VE-7 Submittals: JC Boyle Downstream Tunnel Progress Prints

(Pages G5-1 to G5-3)