Cindy Thieman <cindy@hoodriverswcd.org> 9:09 AM (3 hours ago)

to karen.m.quigley

Dear Karen
I am helping to develop four water conservation and development proposals for the Hood River Watershed. These proposals will be submitted to Oregon Water Resources Department for their Water Supply Development grant offering. These projects will positively affect instream water levels and water availability for irrigation in the Hood River Watershed. One of our regular watershed partners is the Confederated Tribes of the Warm Springs. They are aware of all of these proposals. Could you tell me if there are any other tribes that may be affected or should be contacted about our proposals? Thank you!

Sincerely,

Cindy Thieman, Coordinator
Hood River Watershed Group
3007 Experiment Station Rd.
Hood River, OR 97031

Phone: 541-386-6063
Email: cindy@hoodriverswcd.org

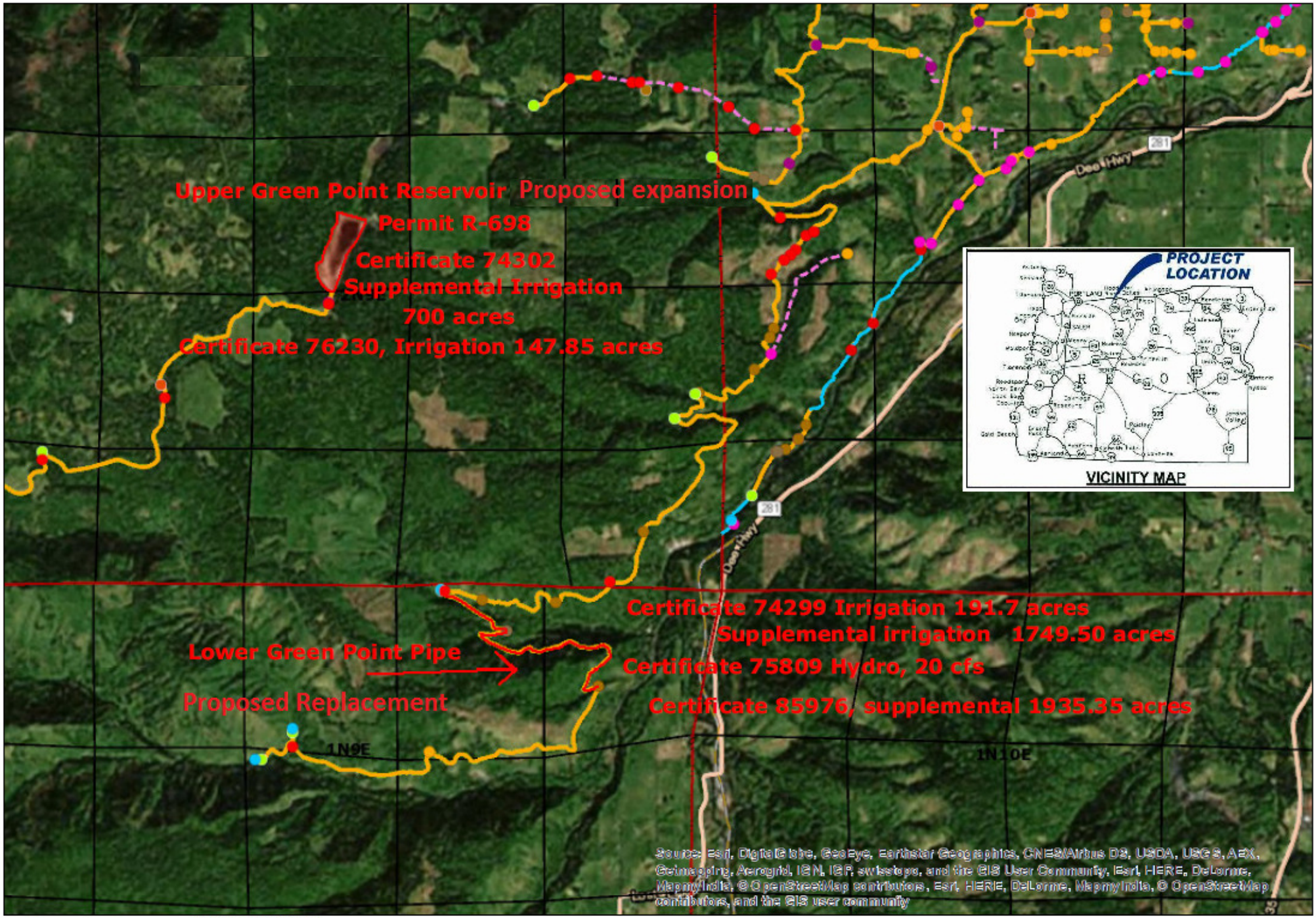
Quigley Karen M 11:45 AM (32 minutes ago)

to Cindy

Hello Cindy,
I suggest you also notify the following OR Tribes in addition to Warm Springs: Siletz and Grand Ronde. If any potential impact or proximity to Columbia River, you might consider touching base with Umatilla and the other two Columbia River treaty Tribes (for potential impact on treaty fishery resources)... Yakama and Nez Perce (ID)
Thanks,
Karen

Sent from my Verizon Wireless 4G LTE DROID

Green Point Pipe & Reservoir 2016



gisdirect

Author: Rick Brock

Organization: Farmers Irrigation District

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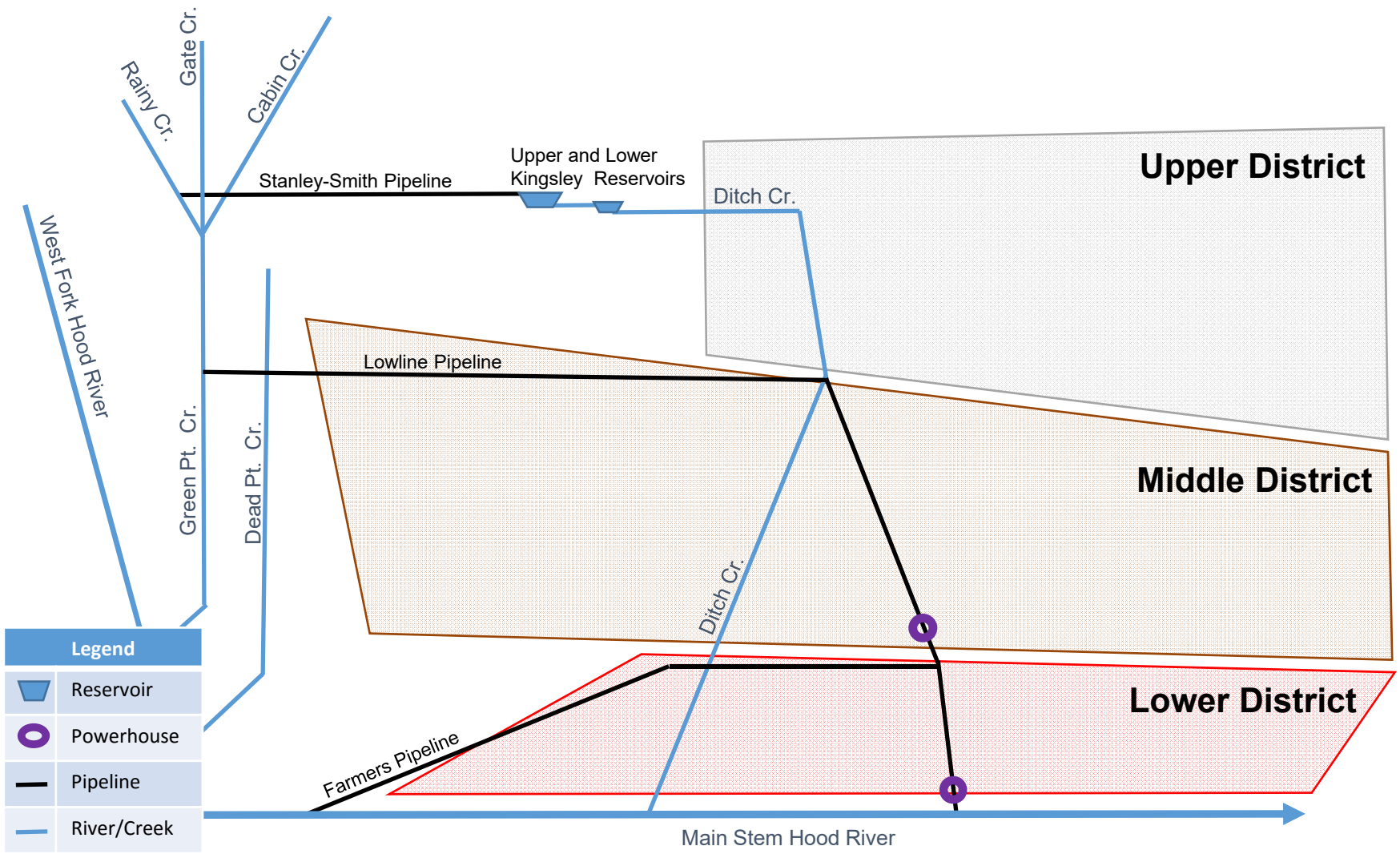
Date Created: January 19, 2016


Gate Cr.
Rainy Cr.
Cabin Cr.
Stanley-Smith Pipeline
Upper and Lower
Kingsley Reservoirs
Ditch Cr.
Upper District
West Fork Hood River
Lowline Pipeline
Green Pt. Cr.
Dead Pt. Cr.
Middle District
Ditch Cr.
Lower District
Farmers Pipeline
Main Stem Hood River
Legend
Reservoir
Powerhouse
Pipeline
River/Creek

Component #2: Cost estimate for 9' raise of Upper Kingsley Dam (501 acre-feet of additional storage)

Item	Quantity	Unit	Unit Cost	Amount	Notes
EXISTING DAM					
EMBANKMENT					
SILT FENCE	2,000	LF	$4	$8,000	
CLEARING AND GRUBBING	2	AC	$2,000	$4,000	Remove all organic material from downstream face of dam for extent of project. Clearing and grubbing outside of embankment not included due to timber sales.
REMOVAL/REPAIR OF RIGHT ABUTMENT	6,000	CY	$10	$60,000	
EXCAVATE KEY TRENCH	1,481	CY	$39	$57,778	8' wide excavation, 5' deep for length of dam.
EMBANKMENT FILL	41,191	CY	$30	$1,235,729	
BENTONITE FOR CLAY CORE	146	TON	$333	$48,701	Bentonite to be mixed in with soil for length of dam (~8' width) from key trench to top of new embankment. Includes haul (22.5 tons/truck) and spreading.
GRAVEL TOE DRAIN	3,675	CY	$77	$282,975	
GEOTEXTILE OVER TOE DRAIN	7,350	SY	$2	$14,700	
OUTLET AND SPILLWAY					
18" HDPE OUTLET PIPE	280	LF	$150	$42,000	New outlet pipe through existing dam and extending downstream of dam expansion.
18" OUTLET VALVE, GUIDES, ENCLOSURE	1	LS	$35,000	$35,000	New intake and control structure.
18" SCREENED OUTLET	1	LS	10,000	$10,000	
SPILLWAY	1	LS	$12,000	$12,000	Upstream end of existing earthen spillway to be raised 8' and rock placed for scour protection. Includes cost of materials and construction.
SITE RESTORATION					
LOOSE RIPRAP, CLASS 100	1,583	CY	$77	$121,917	2' deep riprap for new upstream dam face.
3/4 INCH - AGGREGATE BASE	208	CY	$78	$16,234	15' wide road, 4" deep.
SITE RESTORATION	1	EA	$7,500	$7,500	Seeding and planting.
NEW UPSTREAM DIKE					
EMBANKMENT					
EMBANKMENT FILL	1,614	CY	$14	$22,596	7' tall x 328' long, 2H:1V slopes, 5' top width.
MODIFY EXISTING INLET	1	LS	$7,000	$7,000	
TOTAL DIRECT COSTS:				$1,986,100	
MARKUPS					
MOBILIZATION AND STAGING	-	%	5%	$99,305	
CONTINGENCY	-	%	10%	$198,610	
Total Construction Cost:				**$2,284,000**	
OTHER PROJECT COSTS					
SOIL TESTING		LS	$10,000	$10,000	Testing for suitability of local soils, optimal moisture content, and compaction specifications.
TESTING, DESIGN AND ENGINEERING		%	5%	$114,200	Using low end of typical 5%-20% markup. Includes preliminary design through final design of all project components, specifications and contract documents.
PERMITTING	1	LS	$20,000	$20,000	Permitting costs uncertain.
CONSTRUCTION MANAGEMENT	-	%	5%	$114,200	Cost incurred through FID staff time and construction oversight engineer.
TOTAL ESTIMATED PROJECT COST:				**$2,532,000**	

Component #1: Planning-level cost estimate for replacement of North Greenpoint to Deadpoint pipe (Lowline).

Item	Quantity	Unit	Unit Cost	Amount	Notes
TESC	1	LS	$5,000	$5,000	
REMOVAL AND DISPOSAL OF 39" CMP	11,500	LF	$4	$46,000	
TRENCH EXCAVATION	11,500	LF			* for now "30" pipe inclusive of trench excavation
PIPE BEDDING	852	CY	$75	$63,889	6"of pipe bedding
30" HDPE PIPE	11500	LF	$110	$1,265,000	Includes purchase and installation.
SITE RESTORATION	5.6	AC	$5,000	$28,094	Seeding and planting.
TOTAL DIRECT COSTS:				$1,408,000	
MARKUPS					
MOBILIZATION AND STAGING	-	%	5%	$70,400	
CONTINGENCY	-	%	5%	$70,400	
Total Construction Cost:				**$1,549,000**	
OTHER PROJECT COSTS					
SURVEY		LS	$30,000		
DESIGN AND ENGINEERING		%	5%	$77,450	Using low end of typical 10%-25% markup. Includes preliminary design through final design of all project components, specifications and contract documents
PERMITTING	1	LS	$5,000	$5,000	Permitting costs uncertain.
CONSTRUCTION MANAGEMENT	-	%	5%	$77,450	Cost incurred through FID staff time and construction oversight engineer.
Total Estimated Project Cost:				**$1,709,000**	

Farmers Irrigation District
Kingsley Reservoir Expansion
Feasibility Study

June 2015

Prepared for:

Farmers Irrigation District
1895 Country Club Road
Hood River, OR 97031

Prepared by:

Niklas Christensen, PE
Watershed Professionals Network LLC
701 June Street
Hood River, OR 97031
www.watershednet.com

7. Fish Passage Requirements 28
7.1 Analysis 28
7.2 Next Steps 28
8. Impacts on Streamflow and Instream Habitat 29
8.1 Streamflow Impacts 29
8.1.1. Upper Ditch Creek 30
8.1.2. Hood River from FID Plant #2 to mouth 30
8.1.3. Greenpoint Creek, West Fork Hood River, and the Hood River 30
8.2 Habitat Impacts 31
8.2.1. Upper Ditch Creek 31
8.2.2. Hood River from FID Plant #2 to mouth 31
8.2.3. Greenpoint Creek, West Fork Hood River, and Hood River 31
8.2.3.1 Species, Lifestage, and Habitat Suitability 32
8.2.3.2 Changes to Habitat Index 35
8.3 Discussion 36
9. Property Ownership 37
10. Physical Evaluation of Storage Alternatives 39
10.1 Target Storage Volume 39
10.2 Alternatives 39
10.2.1. Alternative 1: Increase storage volume in upper reservoir without decommissioning lower reservoir 39
10.2.2. Alternative 2: Increase storage volume in upper reservoir and decommission lower reservoir 39
10.3 Stage-Storage Relationship 40
10.4 Inundated Area 41
10.5 Seismic Requirements 41
10.6 Use of Existing Infrastructure 43
10.6.1. Existing dam 43
10.6.2. Stanley-Smith pipeline 43
10.6.3. Outlet from Stanley-Smith pipeline (i.e. inlet to the reservoir) 43
10.6.4. Reservoir outlet 43
10.6.5. Spillway 44
10.6.6. Piezometers 44

Contents

1. Introduction 1

2. District Overview 3

2.1 Upper, Middle, and Lower Districts 3

2.2 Crop Types 5

2.3 Existing Storage Facilities 6

2.3.1. Upper Reservoir 6

2.3.2. Lower Reservoir 7

2.3.2.1 Structural Issues 7

3. Water Demand 10

3.1 Crop ET Demand 10

3.2 Historical Water Use 12

3.3 Expected Future Water Use 12

3.4 Discussion 13

4. Water Supply 14

4.1 Historic Water Supply 14

4.2 Future Water Supply 15

4.2.1 Climate Impacts to Snowpack and Streamflow 15

4.2.2 Water Available for Storage 16

4.2.3 Live Streamflow Available During Irrigation Season 17

4.3 Discussion 18

5. Water Conservation Potential 19

5.1 On-farm Conservation 19

5.1.1. Sprinkler Conversion 19

5.1.2. Use-Based Rate Structure 21

5.2 Installation or Replacement of Pipe 22

5.3 Converting Crop types 23

5.4 Discussion 24

6. Water Rights 25

6.1 OWRD Water Availability Calculation 25

6.2 Existing FID Diversions 26

6.3 Seasonally Varying Flow Requirement 27

11. Planning-Level Design 45
11.1 Project Elements 45
11.1.1. Embankment Fill Material 45
11.1.2. Impervious Core Material 46
12. Planning-Level Cost Estimate 48
12.1 Capital Cost 48
12.1.1. Alternative 1 48
12.1.2. Alternative 2 48
12.1.3. Cost of Other Potential Expansion Volumes 48
12.2 Annual Cost 53
12.2.1. Operations and Maintenance 53
12.2.2. Lost Hydropower Revenue 53
13. Recommendations and Next Steps 54
14. References 55
15. Appendix 57

List of Tables

Table 1. Estimate of acreage of commonly grown 6

Table 2. Crop evapotranspiration demand in inches per growing season (Source: Reclamation, 2013). 11

Table 3. Historic irrigation water use calculated by acres of each application type. 12

Table 4. Future irrigation water due to projected climate changes. 13

Table 5. Allocation of Stanley-Smith flow that goes to storage or hydropower in historic average and drought years (all values in acre-feet). 15

Table 6. Allocation of Stanley-Smith flow that goes to storage or hydropower in future average and drought years (all values in acre-feet). 17

Table 7. Sprinkler types, water use, and sample size from Hood River SWCD (2013) and Irrinet (2007) studies. 20

Table 8. Area of each sprinkler type, typical water use by sprinkler type, and total water use in area served by Kingsley reservoir system. 21

Table 9. Area of each sprinkler type, typical water use by sprinkler type, and total water use in area served by Kingsley reservoir system if 100% of patrons converted to high efficiency sprinkler systems. 21

Table 10. Summary of Farmers Irrigation District water use reduction based on Tables 7 through 9. 21

Table 11. Capital cost, annual cost, and potential water reductions available through implementing use-based rate structure. 22

Table 12. Water savings and cost of potential FID conveyance upgrade projects. 23

Table 13. Cost and effectiveness of potential water conservation. 24

Table 14. OWRD water availability calculation generated by OWRD's Water Availability Reporting System[1]. 25

Table 15. FID existing storage water right certificate for 1,003 acre-feet. 26

Table 16. FID existing water right certificate used to fill Kingsley reservoirs 26

Table 17. Presence of Steelhead lifestages by month in Greenpoint Creek and the West Fork Hood River. 32

Table 18. Presence of spring chinook lifestages by month in the West Fork Hood River. 32

Table 19. Average lowest monthly streamflow, habitat index and rate of change at the lowest monthly streamflow, and percent change in habitat for a 2.1 cfs streamflow increase in Greenpoint Creek and the West Fork Hood River for steelhead juvenile rearing. 35

Table 20. Average summer low streamflow, habitat index and rate of change at the summer low streamflow, and percent change in habitat for a 2.1 cfs streamflow increase in the West Fork Hood River spring chinook spawning and juvenile rearing. 35

Table 21. Additional storage volume available through raising the height of Upper Kingsley dam. 40
Table 22. Cost estimate for raising Upper Kingsley dam by nine feet. 49
Table 23. Cost estimate for raising Upper Kingsley dam by thirteen feet. 50
Table 24. Cost estimated for restoration activities associated with decommissioning Lower Kingsley dam. 51

List of Figures

Figure 1. Farmers Irrigation District boundary, water right point of diversions, and distribution system. 4
Figure 2. Schematic of Farmers Irrigation District's upper, middle, and lower districts. 5
Figure 3. Distribution of crop and land types in the Hood River Basin. 6
Figure 4. Average monthly upper, lower and total reservoir storage based on water year 2005-2012. 8
Figure 5. Timeseries of monthly combined reservoir storage for water year 2005-2012. 9
Figure 6. Storage Volume in Upper and Lower Greenpoint Reservoirs as a function of elevation below spill. 9
Figure 7. Average monthly precipitation and pear ET demand at Hood River OSU Extension office. 11
Figure 8. Average Hood River Basin growing season crop evapotranspiration values. 11
Figure 9. Projected climate change impacts to the Hood River Basin for 2030-2060. 13
Figure 10. Allocation of flow in the Stanley-Smith pipeline (storage or hydro) in an average year. 14
Figure 11. Average monthly snowpack (% of basin covered) under historic (1980-2010) and expected future (2030-2060) climate. 16
Figure 12. Average projected streamflow change in Greenpoint Creek (2030-2060 versus 1980-2010). 16
Figure 13. Average monthly FID irrigation demand (based on years 2005-2012) 19
Figure 14. Sprinkler types in upper and middle district. 20
Figure 15. Average monthly ET demand by crop types found in the Hood River basin. 23
Figure 16. Impacts to stream reaches from expanding Kingsley Reservoir storage volume. 29
Figure 17. Steelhead velocity habitat suitability (Normandeau, 2014). 33
Figure 18. Steelhead depth habitat suitability (Normandeau, 2014). 33
Figure 19. Spring chinook velocity habitat suitability (Normandeau, 2014). 33
Figure 20. Spring chinook depth habitat suitability (Normandeau, 2014). 33
Figure 21. Relationship between streamflow and habitat index for Steelhead on Greenpoint Creek (Normandeau, 2014). 34
Figure 22. Relationship between streamflow and habitat index for Steelhead on West Fork of the Hood River (Normandeau, 2014). 34
Figure 23. Relationship between streamflow and habitat index for spring chinook on West Fork of the Hood River (Normandeau, 2014). 34
Figure 24. Average monthly streamflow in Greenpoint Creek. 36
Figure 25. Average monthly streamflow in the West Fork of the Hood River. 36

Figure 26. Stage-storage relationship for Upper Kingsley reservoir dam height increase.....41
Figure 27. Upper Kingsley Reservoir aerial photo with elevation contours. 42
Figure 28. Cross-section of planning-level design for raising Upper Kingsley Dam. 47
Figure 29. Construction cost associated with raising Upper Kingsley reservoir between three and eleven feet. 52
Figure 30. Cost per acre-foot of storage as a function of reservoir expansion volume.....52
Figure 31. FID power generation as a function of flow at Plant #2 and Plant #3. 53

Executive Summary

Historic water shortages, coupled with projections that these shortages will occur more frequently and be more severe in the future, have caused FID to evaluate the feasibility of adding additional storage volume in their Kingsley Reservoir system. This study evaluates and concludes the following:

1. Water demand has historically exceeded supply in the upper and middle districts of FID during average and dry water years. Projected climate change is expected to increase upper district demand by 383 acre-feet per year by the 2030s to 2060s while at the same time decreasing spring streamflow by 25 percent and summer streamflow by 10 to 15 percent.
2. No significant water conservation projects exist that FID could implement that would alleviate the need for additional reservoir storage volume. FID is almost entirely piped, and the only remaining pipe project with measureable water savings is replacement of the North Greenpoint pipeline. Replacement of this pipe would cost $1,700,000 and conserve approximately 2-3 cfs. However, this pipe does not supply the upper district and therefore does not alleviate the need for expanding the reservoir storage volume.
3. FID could reliably fill up to 631 acre-feet of additional storage per year.
4. Additional storage volume should be added to the system by raising the height of the upper reservoir. The upper reservoir has a surface area roughly three times the size of the lower reservoir, hence every foot of dam raise nets three times the storage volume gain. Additionally, the upper dam has minor structural issues at the right abutment that can be relatively easily repaired concurrently with a reservoir expansion project.
5. The lower reservoir has structural deficiencies, and the opportunity exists to decommission this reservoir concurrently with expanding the upper reservoir. The lower reservoir has an existing capacity of 246 acre-feet that would be lost if decommissioned, so a comparable volume must be added to the upper reservoir in addition to the of the actual storage expansion volume (e.g., 746 acre-feet must get added to the upper reservoir for a 500 acre-foot reservoir expansion if the lower reservoir is decommissioned).
6. An eight foot raise of the upper dam would net an additional 501 acre-feet at a cost of $1,740,000, while a thirteen foot dam raise would add 760 acre-feet total at a cost of $2,480,000. Decommissioning the lower reservoir would cost an additional $280,000 for removing embankment fill and restoration related activities.
7. FID could obtain 500 acre-feet by using 2.7 cfs of an existing 5 cfs hydro diversion for three months and therefore would not need to divert additional streamflow above the presently existing diversion rates. This 2.7 cfs reduction would cost FID $32,100 per year in lost hydropower production.
8. Expanding the storage volume by 500 to 600 acre-feet would have negligible impacts on winter instream habitat. Steelhead juvenile rearing summer habitat would be improved in Greenpoint Creek (by four percent) and West Fork Hood River (by 0.3 percent) if FID used 25 percent of the additional storage volume for instream flow, while spring chinook spawning habitat would be increased in the West Fork Hood River (by 1.0 percent).
9. Oregon Water Resource Department water availability calculations show that water is available for a new storage water rights.
10. FID would need to purchase, or obtain the right to use, the property above the existing high water mark.

1. Introduction

This study evaluates the feasibility of increasing storage volume in Farmers Irrigation District's (FID) Upper and Lower Kingsley Reservoir system. The study includes economic, geotechnical, and engineering analyses of potential storage alternatives. The study also evaluates impacts to streamflow, quantifies potential water savings from future conservation projects, and investigates the potential to increase summer streamflow.

Even during normal water years, FID has difficulty providing late-summer irrigation water to patrons in its upper district. In 2015, FID was forced to declare a drought emergency and reduce water availability to patrons, and results from the recent Hood River Basin Study (Reclamation, 2014) indicate that these water shortages will be more frequent and severe in the future. Over the past 25 years, FID has converted almost all of its distribution system from open canals to pipeline, and most of its orchardists are already using high-efficiency on-farm sprinkler equipment. As such, adding storage volume to the existing reservoirs is an important option to investigate for improving current and future water availability for farmers and fish.

Upper Kingsley reservoir at dead pool during irrigation season 2015.

FID's main goal is to increase water resource reliability for its upper district irrigators by adding storage volume. The upper district receives water solely from the reservoir system (i.e. no other sources) and is therefore especially vulnerable to drought years. The upper district consists almost entirely of perennial orchard crops and therefore suffers extreme crop damage if unable to receive irrigation water. The second goal that may be achieved through expanding the reservoir storage volume is increased summer streamflow on Green Point Creek, the West Fork of the Hood River, and Ditch Creek. Green Point Creek and the West Fork Hood River have some of the highest native fish densities in the basin, which make them a high priority for streamflow enhancement. In addition, summer steelhead distribution is limited to the West Fork Hood River sub-basin, and this population is one of the weakest native stocks in the Hood River Basin. Increased summer flow on Ditch Creek would benefit native resident cutthroat trout.

Increasing the storage volume in the Kingsley reservoir system has been part of the irrigated agriculture planning process for over 40 years. In July 1973, the State of Oregon, in the Oak Grove Watershed Project (Appendix A), identified the potential to expand the existing Kingsley reservoir volume by up to 7,300 acre-feet. In October 1988 Hood River County signed a 20-year agreement with FID allowing it to expand up to this additional volume, but FID did not exercise its right to expand by October 2008 and the agreement lapsed (Appendix A). In addition to low water years and water resource reliability issues over the past decade, recent studies have highlighted the need for FID to actively look at this project again. The Hood River Basin Study (Reclamation, 2014) evaluated climate impacts to the basin's streamflow and water availability and recommended that FID expand the reservoir system. The Hood River County Surface Water Feasibility Study (Hood River County, 2014) concurred with this recommendation and identified the upper reservoir as the most cost effective location to increase the storage volume.

Several studies have identified structural issues with the long-term integrity of the lower reservoir, and hence a significant enough increase in volume in the upper reservoir may allow decommissioning of the lower reservoir at the same time. Due to these structural issues with the lower reservoir, this report presents two design options for increasing the storage volume:

Alternative 1: Increase storage volume in upper reservoir

Alternative 2: Increase storage volume in upper reservoir and decommission lower reservoir

This report is organized into the following sections:

1. Introduction: Purpose of report and summary of FID goals.
2. District Overview: Overview of FID, crop types, storage facilities, and issues with lower reservoir.
3. Water Demand: Evaluates crop water demand and historic and future water use.
4. Water Supply: Evaluates the ability to fill the reservoir under historic and future conditions.
5. Water Conservation Potential: Evaluates if water reliability can be achieved through water conservation measures instead of additional storage volume.
6. Water Rights: Evaluates the potential to obtain water rights for additional storage volume.
7. Fish Passage: Evaluates if expanding the reservoir would trigger fish passage requirements.
8. Impacts to Streamflow and Instream Habitat: Evaluates impacts to streamflow and habitat on Ditch Creek, Greenpoint Creek, West Fork Hood River, and the mainstem Hood River.
9. Property Ownership: Evaluates the ability to secure ownership or easement of the area inundated by reservoir expansion.
10. Physical Evaluation of Storage Alternatives: Evaluates the additional storage volume obtained through reservoir expansion, seismic considerations, and ability to utilize existing infrastructure.
11. Design and Cost Estimate: Present planning-level design and cost estimate.
12. Recommendations: Based on above sections, makes a recommendation to expand the upper reservoir volume by 760 acre-feet, decommission the lower reservoir, and details next steps required.

2. District Overview

Farmers Irrigation District is located in the northern part of Hood River County (Figure 1). It is bounded on the north by The City of Hood River and the Columbia River, on the west by the Cascade Mountain range, and on the south and east by the Hood River. District elevation ranges from 180' to 2,250' mean sea level. Total area within the district is over 12,000 acres, of which 5888.25 acres of water rights are reserved. The district currently has 1851 accounts, which typically increases by a few new accounts per year.

Historically, the district used 34 unscreened diversions. As a result of various conservation projects, however, the district now operates only nine water diversions, each of which is fully screened and fish safe. The district operates two reservoirs, Upper Kingsley and Lower Kingsley, with a combined storage capacity of 918 acre-feet (Farmers Irrigation District Water Management and Conservation Plan, 2011). These reservoirs are fed by tributaries to Green Point Creek (Gate Creek, Cabin Creek, and Rainy Creek) via the Stanley-Smith pipeline. The district's largest single diversion is off of the mainstem of the Hood River, from which it has a not-to-exceed 73 cfs water right, consisting of a 73 cfs hydropower right, 40 cfs irrigation right, and 30 cfs agricultural right. It should be stressed that the 73 cfs diversion from the Hood River serves only FID's lower district. FID's upper and middle districts are unable to receive water from the Hood River diversion due to elevation and geographic differences. The district has two hydroelectric power plants which combined generate roughly 25,000 MW-hr/yr. Due to system configuration, the district is typically unable to generate hydropower with the same water it uses for irrigation, causing monthly output to vary from roughly 3,000 MW-hr/month outside of irrigation season down to around 500 MW-hr/month during peak irrigation season.

2.1 Upper, Middle, and Lower Districts

Farmers Irrigation District is divided into three geographically distinct districts: the upper district, middle district, and the lower district (Figure 2). Each of these districts is served by unique sources of water, and, therefore, not all of FID can be lumped together in a water resource reliability study. The upper district receives water solely from the Kingsley reservoir system, the middle district receives water from Greenpoint Creek and Deadpoint Creek (via the Lowline pipeline) plus any water that may be left over from the upper district, while the lower district receives water from the Hood River (via Farmers canal). Since the lower district is "at the bottom of the hill" and has the Hood River as its water supply source, its water reliability is fairly secure. The upper district, however, receives water only from the reservoir system and is therefore extremely vulnerable to drought. Since the middle district is served from any supplemental water that may be left over from the upper district, it is also susceptible to drought but not to the same degree as the upper district.

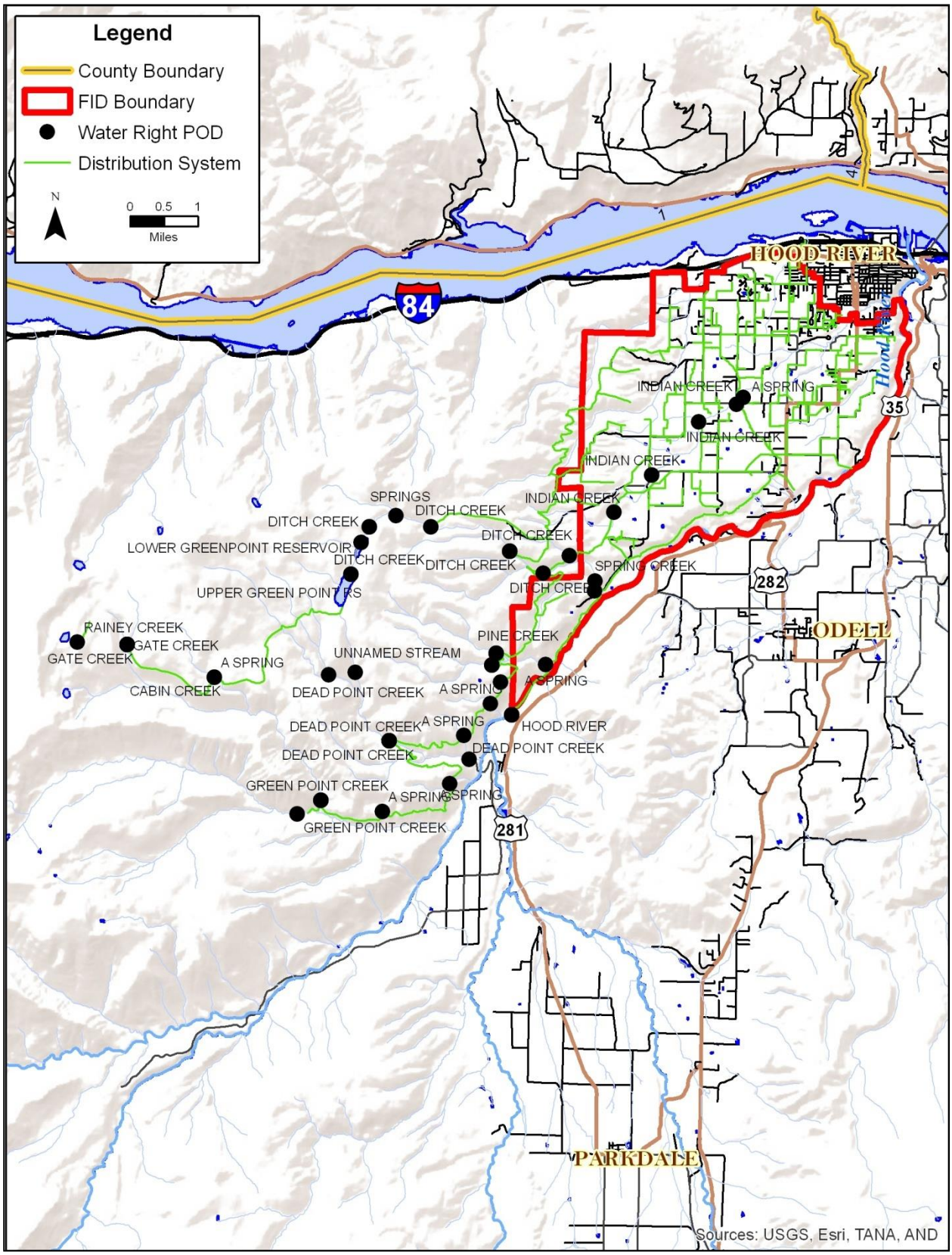


Figure 1. Farmers Irrigation District boundary, water right point of diversions, and distribution system.

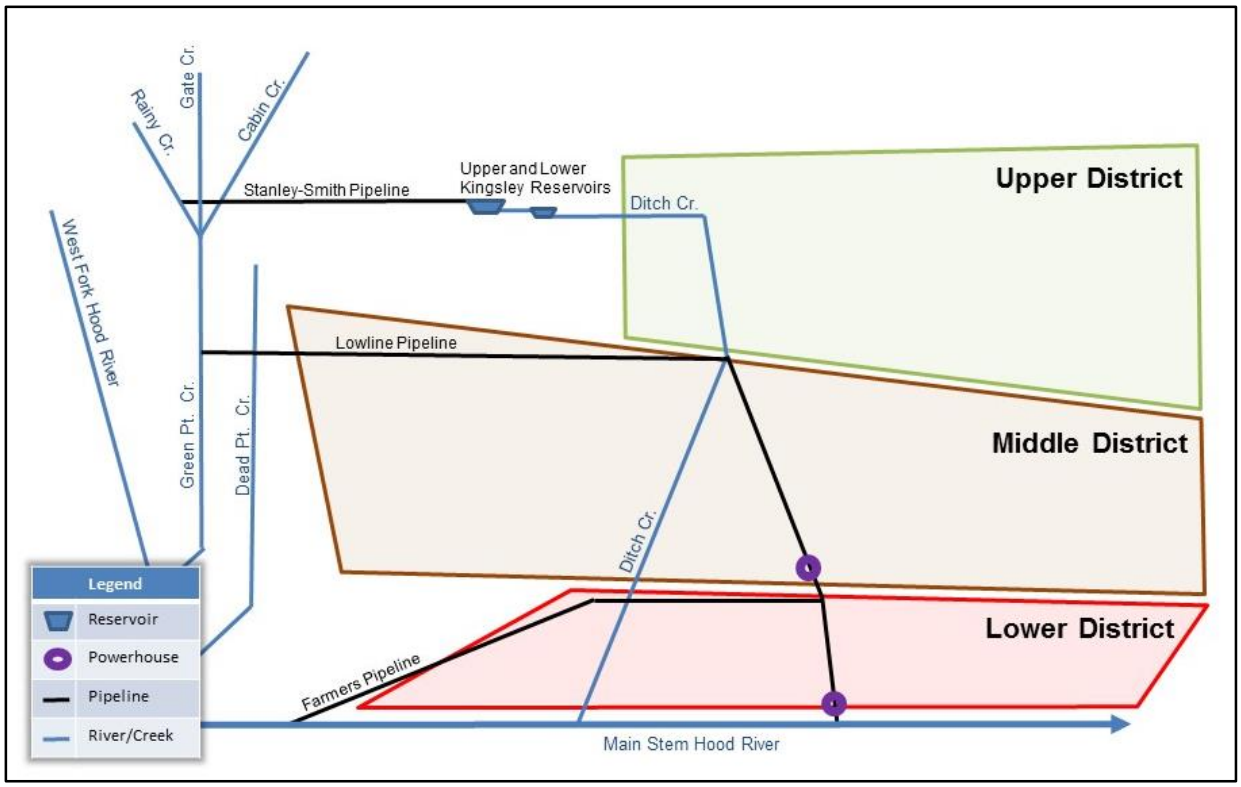


Figure 2. Schematic of Farmers Irrigation District's upper, middle, and lower districts.

2.2 Crop Types

The most recent assessment of crop types in FID (Table 1, Figure 3) is documented in FID's 2011 Water Management and Conservation Plan. This assessment is not based on an actual survey of FID acreage, but is an extrapolation of OSU Extension Service data from the whole Hood River Valley. The FID manager reviewed the initial results from OSU and added in values for "Suburban/Residential" and "Other." The table below is an average for the entire district (i.e. upper, middle, and lower districts). Unfortunately, from a water supply perspective, the upper and middle districts have a higher percent of orchard crops and less suburban/residential than the lower district. Orchard crops cannot be fallowed during dry years, and, as a result, reliable water supply to the upper and middle districts is imperative.

Table 1. Estimate of acreage of commonly grown crops and land types in the Hood River Basin.

Crop Type	Area (acres)[1]	Area (percent)[1]
Pears	2,889	49
Cherries	517	9
Apples	303	5
Blueberries / grapes	130	2
Hay / forage	410	7
Suburban / residential	1,444	25
Other	195	3
Total	5,888	100

Notes: [1] Most recent estimate from 2011 FID Water Management and Conservation Plan (FID 2011).

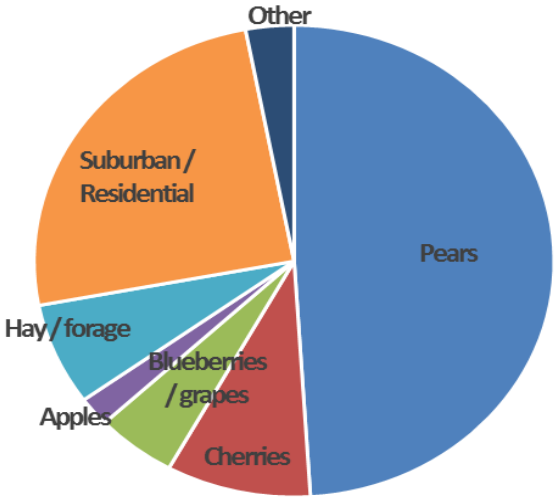


Figure 3. Distribution of crop and land types in the Hood River Basin.

2.3 Existing Storage Facilities

FID's storage reservoirs are located in series, with the lower reservoir located approximately half mile downstream from the upper reservoir. All releases from the upper reservoir enter the lower reservoir, and from a water supply perspective the reservoirs act as a single combined reservoir.

The water right for the reservoirs is contained in permit #698, priority date 11/22/1933, and is for 1,003 acre-feet (715 acre-feet in the Upper Reservoir plus 288 acre-feet in the lower reservoir). The water right for these reservoirs is for supplemental irrigation only, hence they are operated to fill in early spring and release during irrigation season (Figure 4). The reservoirs are in the Ditch Creek drainage, but inflow to the reservoir system comes from an inter-basin transfer from the Greenpoint Creek drainage via the Stanley-Smith pipeline. The reservoirs are small relative to their potential supply, and, therefore, since the construction of the Stanley Smith pipeline in 1987, they reliably fill each year (Figure 5).

2.3.1. Upper Reservoir

The upper dam was built immediately upstream of the 15-ft high Old Mill Pond Dam, which was incorporated into the downstream toe of the new construction. The Old Mill Pond Dam was built by the Stanley-Smith Lumber Company in 1926 and used by the Hood River Irrigation District in the 1930s before it was expanded into the existing dam in 1937. In its current configuration, the dam is 30 feet high, 1,010 feet long, has a crest elevation of 3166 feet, 3H:1V upstream slope, and 2H:1V downstream slope. The storage capacity at the time of construction was estimated at 715 acre-feet, and more recently (Wy' East Surveys, 2002) estimated capacity at 692 acre-feet.

2.3.2. Lower Reservoir

The Lower Dam was built in 1936 and is 35 feet high and 560 feet long. Its storage capacity was estimated at 288 acre-feet after construction, and more recently at 246 acre-feet (Wy'East 2002). Several investigations of the dam have detailed improper construction techniques when it was built in 1936 and subsequent structural issues.

2.3.2.1 Structural Issues

Section A – C below summarize results from previous investigations of the lower dam. As a result of these investigations, Anderson Perry and Associates recommended in 2003 that the dam required $700,000 of high-priority improvements if FID intends to continue long-term use of it (Anderson Perry, 2003).

A. State Engineer's Report (1937)

The State Engineer inspected the dam during construction and reported the following:

1. Cutoff trench was not constructed in accordance with plans and specifications. The sides of the trench were nearly vertical instead of 1H:1V as specified. The backfill in the trench appeared to not have been compacted and could be removed by shovel. Additionally, the actual material used for backfill consisted of decomposed rock that was "unsuitable for the water-tight portion of the dam."

2. The embankment material had a fines content (i.e. material passing No. 200 sieve) of 47.5 percent, which is finer and lighter than that used in most dam construction.

3. The total unit weight of the embankment fill material when compacted was less than 89 pounds per cubic foot which suggest placement and compaction at less than the optimal water content.

4. The void ratio of the embankment fill material was 0.493 which also suggests placement and compaction at less than the optimal water content.

B. Soil Conservation Services Investigation (1978)

The Soil Conservation Service (SCS) investigated the dam in 1978 and concluded the following (SCS, 1978):

1. Embankment material at the right abutment was very soft, and there was a spring producing roughly ten gallons per minute in the vicinity.

2. Soils between the 15 and 30 foot depth consisted of inorganic silt and sands with a fines content between 70 and 77 percent.

3. Standard Proctor compaction tests yielded maximum dry densities in the range of 85 to 88 pounds per cubic foot.

C. Hong West and Associates Investigation (1992)

Hong West and Associates made the following observations in 1992 (HWA, 1992):

1. High water content was encountered indicating fill material was improperly placed.

2. Improper placement of the soil has caused a brittle embankment that is susceptible to internal cracking due to settlement of the foundation soils under the weight of the dam.

3. The right abutment of the dam had considerable leakage.

4. The dam was poorly constructed with respect to contemporary standards, and this poor construction requires remedial work to improve the long-term integrity of the dam.

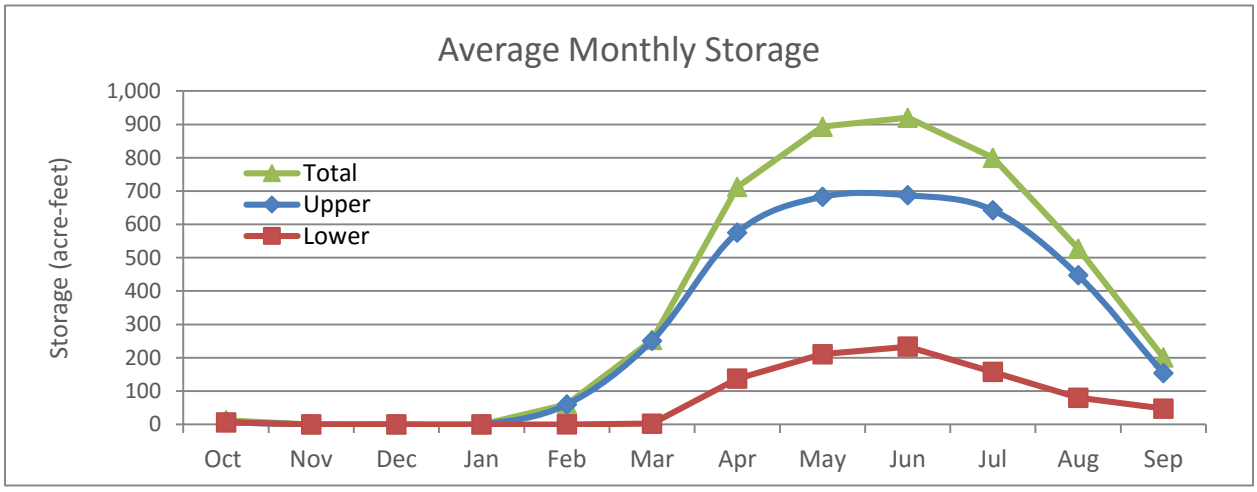


Figure 4. Average monthly upper, lower and total reservoir storage based on water year 2005-2012.

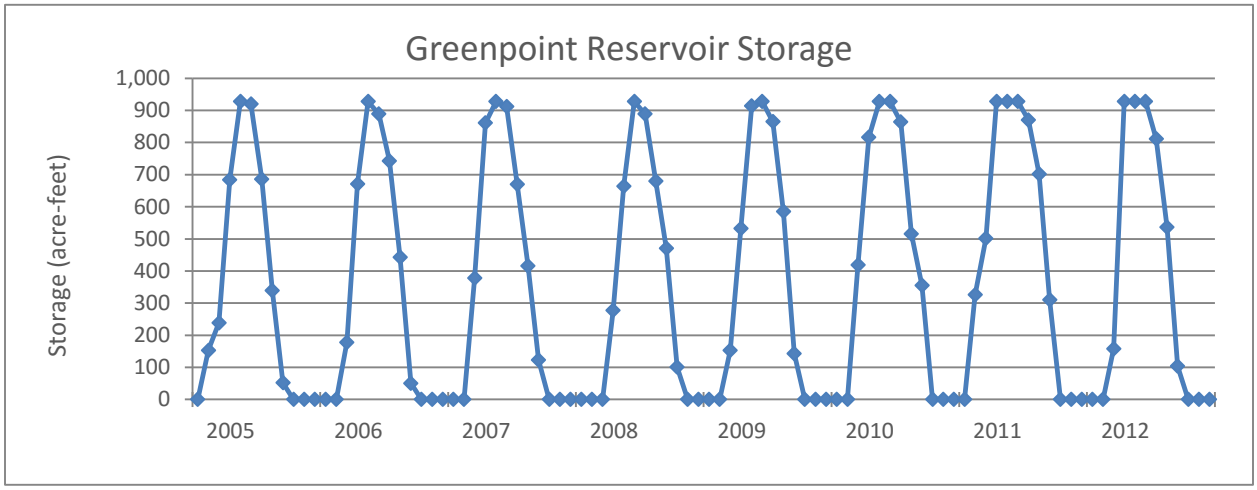


Figure 5. Timeseries of monthly combined reservoir storage for water year 2005-2012.

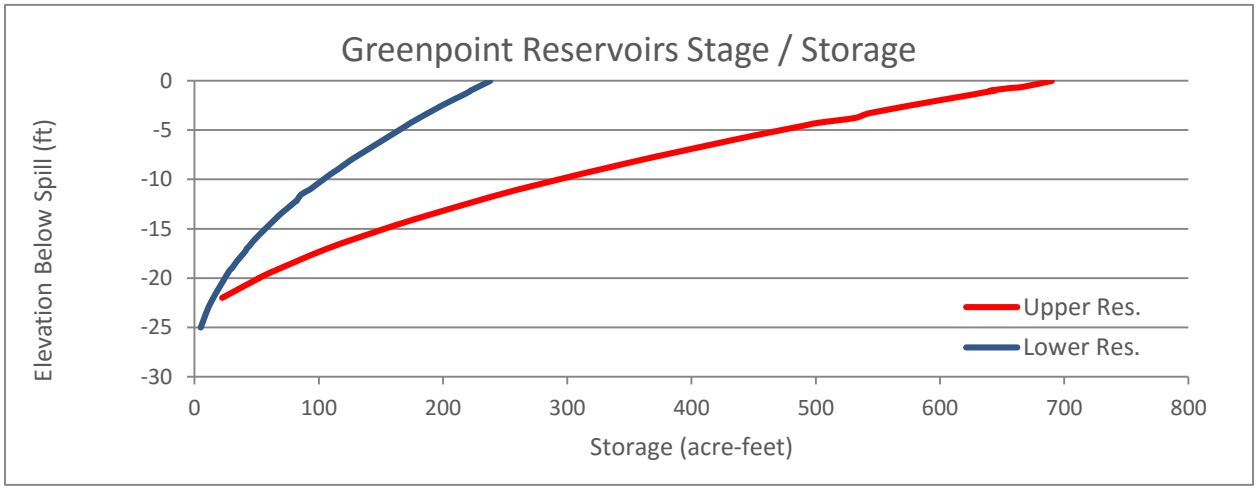


Figure 6. Storage Volume in Upper and Lower Greenpoint Reservoirs as a function of elevation below spill.

3. Water Demand

The decision on whether or not to expand the storage volume in the Kingsley Reservoir system depends on whether irrigation season water demand exceeds water availability. The section below evaluates crop evapotransporative (ET) demand, historical water use, and projected future water use. This section focuses on FID's upper district only because the upper district is solely dependent upon reservoir water and has no other source.

3.1 Crop ET Demand

The objective of irrigation water use is to satisfy crops' evapotransporative (ET) demands. As such, an irrigation system that has no overflows or canal seepage, and that applies just the correct amount of water to the crops should be able to use the same amount of water as published in the crop ET requirement tables. Reclamation's AgriMet website (Reclamation 2013) publishes crop- and location-specific ET data for major crops in the United States, of which values for Hood River are presented in Table 2 and Figure 7 and 8. These values are specific to irrigation season (i.e., full bloom through 3 to 4 weeks after harvest) and therefore can be compared directly against irrigation water use.

For pears (the most common crop type grown in Farmers Irrigation District), the growing season ET demand is 25.8 inches at the Oregon State University Extension office near the City of Hood River (Figures 7 and 8, Table 2). Currently, this demand is met by both precipitation and irrigation water supply. During April through October, Hood River receives 7.75 inches of precipitation on average, of which a majority goes to meet ET demands and the rest runs off as overland flow. Assuming an ET demand for pears of 25.8 inches (see Table 2), and assuming 70 percent of precipitation goes to meet ET demand (5.4 inches), then the remaining ET demand for pears that must be met by irrigation supply would be 20.4 inches. Although each crop type and each part of the Hood River Basin has specific ET demands, this value of 20.4 inches (1.7 feet) is a reasonable approximate goal for on-farm water use, given that pears are the most common crop in the Basin. For reference, typical irrigation water rights are 3.0 feet per year, which is almost double the AgriMet calculated ET demand.

Based on the values above, the crop water demand for FID area that is served by the reservoir is 2,040 acre feet/year. This is equal to 1,200 acres multiplied by the average irrigation demand of 1.7 feet/year.

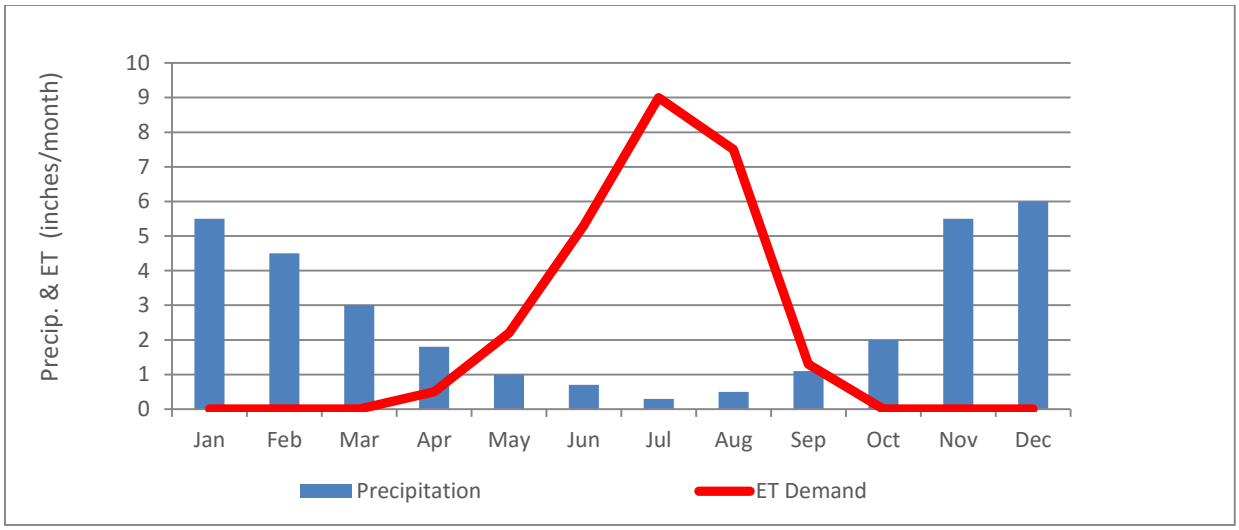
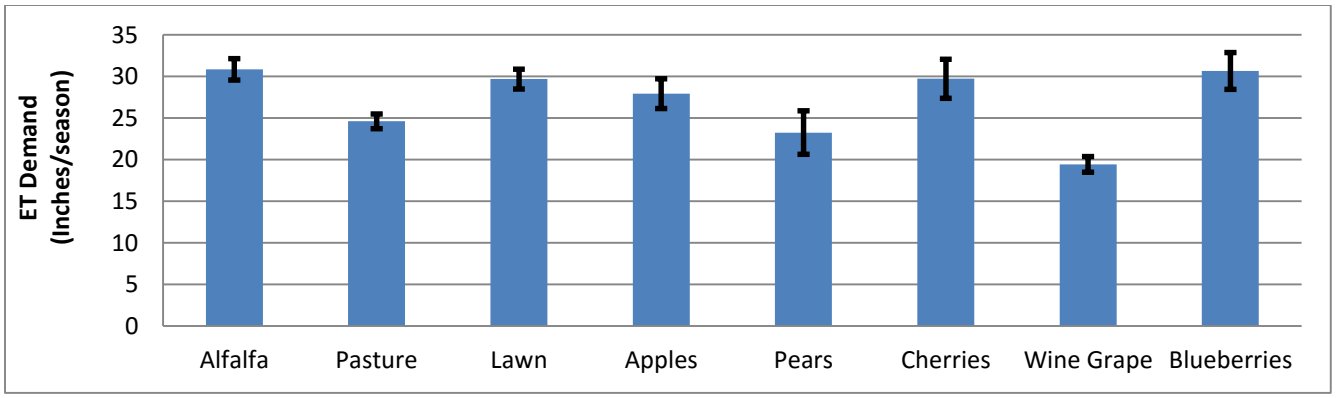


Figure 7. Average monthly precipitation and pear ET demand at Hood River OSU Extension office.

Table 2. Crop evapotranspiration demand in inches per growing season (Source: Reclamation, 2013).

	Dee Flats[1]	Hood River[2]	Pine Grove[3]	Parkdale[4]	Average
Alfalfa	29.9	32.5	30.3	30.7	30.9
Pasture	24	25.8	24.2	24.4	24.6
Lawn	28.8	31.2	29.2	29.5	29.7
Apples	26.7	30.2	26.6	28.2	27.9
Pears	20.6	25.8	22.3	24.3	23.3
Cherries	28.5	32.7	28	29.7	29.7
Wine Grapes	n/a	20.7	18.8	18.8	19.4
Blueberries	29.2	33.6	29.5	30.3	30.7

[1] Dee Flat station is located on the north end of the flat, [2] Hood River station is at the OSU Extension Office, [3] Pine Grove station is just south of the Pine Grove Grange Hall, [4] Parkdale station is near Old Parkdale Rd and Woodworth Rd.



Note: Error bars show range from Dee Flats, Parkdale, Hood River, and Pine Grove AgriMet stations.

Figure 8. Average Hood River Basin growing season crop evapotranspiration values.

3.2 Historical Water Use

Although FID has multiple water use measurement throughout the district, measurements do not existing that allow partitioning out water use for the area served exclusively from the reservoir. As such, water use for this area is estimated below based on the total area served solely by the reservoirs and the application methods (i.e. sprinkler types) within that area (Table 3).

FID water use specialist (Rick Brock, personal communications, October 10, 2015) estimated the 'reservoir supply' area consists of 200 acres of handlines, 700 acres of micro sprinklers, 15 acres of drip, 45 acres of low efficiency residential, and 240 acres of high efficiency residential. Based on these acreages and typical water use by application type (see Section 5 for further discussion on typical water use by application type), this area uses approximately 2,300 acre-feet of water per irrigation season.

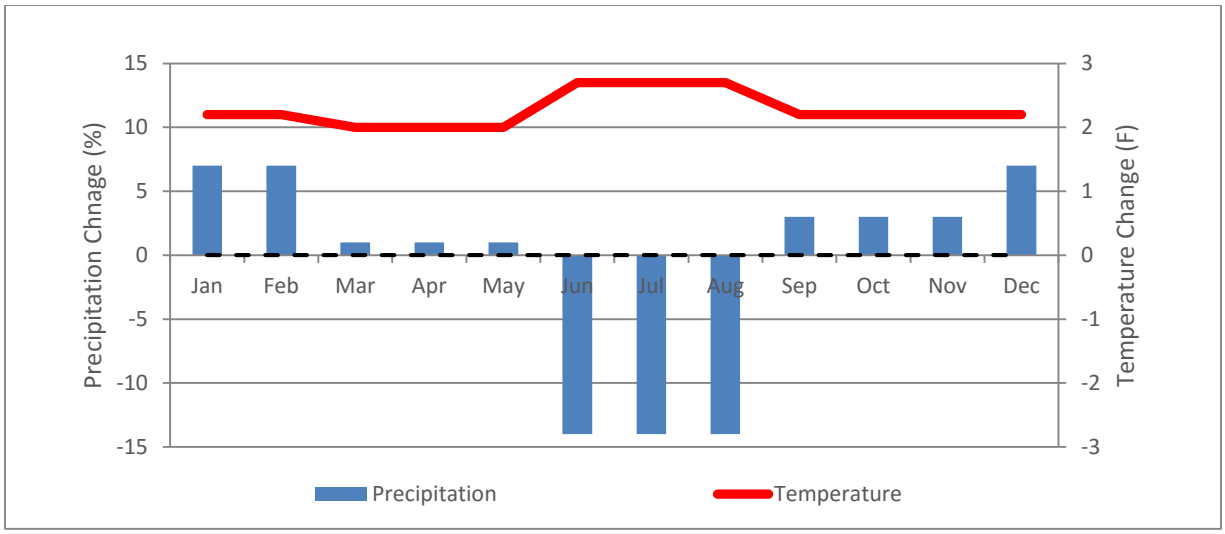
Table 3. Historic irrigation water use calculated by acres of each application type.

Application Type	Water Use (feet/yr)	Area (acres)	Water Use (acre-ft/yr)
Hand line / impact	2.39	200	478
Rotator / micro	1.7	700	1,190
Drip	1.4	15	21
Residential – low efficiency	3	45	135
Residential – high efficiency	2	240	480
Total	n/a	1,200	2,304

3.3 Expected Future Water Use

Crop ET demand is a function of air temperature, with warmer temperatures causing greater demand. A recent study by Oregon State University (OSU, 2010) calculated that crop ET demand will increase by 10 percent for every 1.8 °F increase in temperature. The Hood River Basin Study projected that the median temperature increases for the period 2030-2059 during July through September would be 2.7 °F (Figure 9), resulting in a 15 percent (2.7 °F ÷ 1.8 °F x 10 percent) increase in irrigation demand.

Additionally, crop ET demand is met by precipitation, and the Hood River Basin Study projected a 14 percent decrease in July through September precipitation which results in .077 inch less of precipitation going to meet ET demand (7.75" x 14 percent x 70 percent effectiveness = 0.77 inch). This 0.77 inch is equal to a four percent increase in demand, which plus the 15 percent increase in demand from temperature increase results in a total increase in demand of 19 percent, or an increase of 383 acre-feet of demand in FID's upper and middle district (Table 4).



Notes: Changes are for 2030-2060 relative to 1980-2010, Source Reclamation 2013

Figure 9. Projected climate change impacts to the Hood River Basin for 2030-2060.

Table 4. Future irrigation water due to projected climate changes.

Climate impacts to ET and irrigation demand	ET and Irrigation Demand (acre-feet/yr)
Increased in ET demand from 2.7 °F increase in temperature (2030-2060 median projection)	306
Increased in irrigation demand from 0.77" decrease in precipitation (2030-2060 median projection)	77
Total increase in irrigation demand	383

3.4 Discussion

FID's historic water demand has been met in average and better water years, while low water years typically see water shortages. In 2015, for example, FID declared a drought emergency on July 5 and put patrons on rotation. Even under the rotation system where water was available only 50% of the time, the upper district water supply ran out one month before the end of irrigation season. The FID manager estimates that without the drought declaration and rotations that the water supply would have expired approximately two and a half month before the end of irrigation season (Jer Camarata, FID manager, personal communications, October 20th 2015).

FID's difficulty in meeting water demands reliably under historical climate will be exacerbated in the future. Crop ET demand will increase by 19 percent over the next few decades, and, since FID already operates an efficient system (both conveyance and on-farm), this additional demand will need to be met with additional supply.

4. Water Supply

The water supply volume available at the Kingsley Reservoir system is evaluated below for average and drought years in historical and projected future climates. FID has indicated that it would fill any new storage volume by using water that is currently used for hydropower as opposed to diverting new live streamflow.

4.1 Historic Water Supply

Kingsley reservoir storage volume is small relative to its contributing area, and, therefore, it has filled reliably every year since the Stanley Smith Canal was replaced by continuous pipe in 1987 (see Figures 5 and 6 for typical monthly volumes). Although non-stored water is routed through Kingsley Reservoir to downstream hydropower production all winter, FID does not begin filling the reservoir until January or February. Figure 10 below shows the flow in the Stanley-Smith pipeline that gets allocated to storage (blue line) and the amount of the Stanley-Smith flow that gets passed through the reservoir and is used to generate hydropower (black dashed line). The volume of water that goes to storage is equal to the total storage volume of the reservoirs (938 acre-feet), while the volume that goes to hydropower is equal to an additional 1,187 acre-feet (Table 5), for a total of 2,133 acre-feet.

Unfortunately, flow data prior to 2011 (to determine what a historical low inflow year would be) do not exist for the Stanley-Smith pipeline. Greenpoint Snow Telemetry Station (SNOTEL) data, however exist back to 1981. From the SNOTEL record, water year 2005 had the lowest annual precipitation on record, and was 63% of average. If 2005 were used to represent an extreme drought, and all months are scaled by 63% (hydro months above 5 cfs are not scaled since it's the water right, not available flow, that constrained those months) the inflow to storage would have been 596 acre-feet, the inflow to hydro would have been 973 acre-feet, for a total water availability of 1,569 acre-feet.

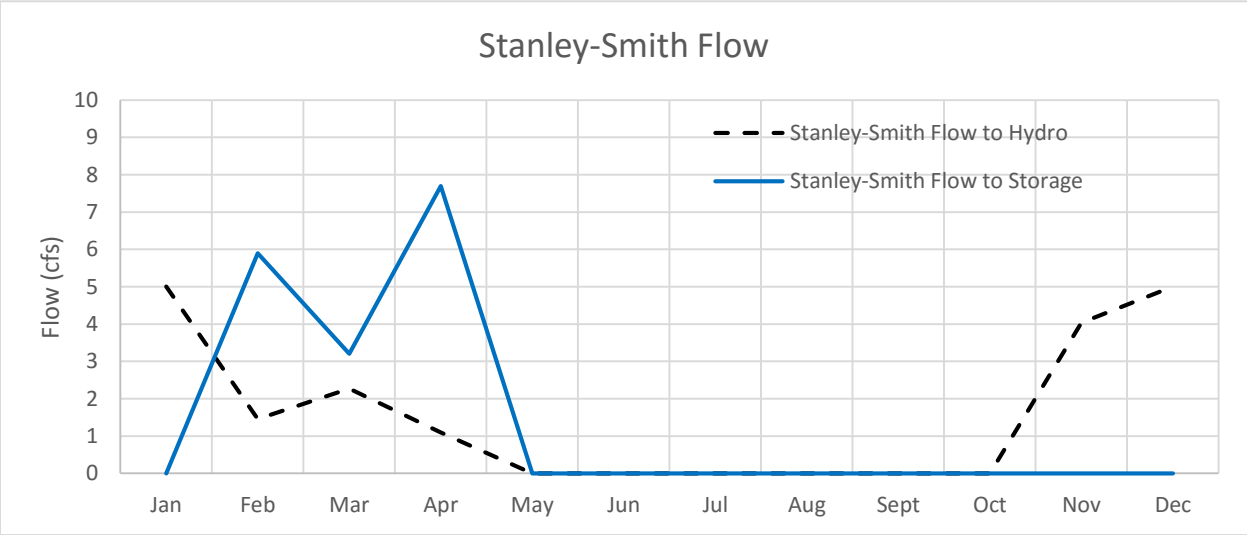


Figure 10. Allocation of flow in the Stanley-Smith pipeline (storage or hydro) in an average year.

Table 5. Allocation of Stanley-Smith flow that goes to storage or hydropower in historic average and drought years (all values in acre-feet).

Stanley-Smith Allocation (Acre-feet)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Sum	**Combined**
Average Year	To Storage	0	312	188	438	0	0	0	0	0	0	0	0	938	**2,133**
	To Hydro	305	101	145	85	0	0	0	0	0	0	246	305	1,187	
Drought Year	To Storage	0	199	120	277	0	0	0	0	0	0	0	0	596	**1,569**
	To Hydro	305	64	91	54	0	0	0	0	0	0	155	305	973	

4.2 Future Water Supply

The amount of water available for irrigation supply in the future depends on future temperature and precipitation. The recent Hood River Basin Study (Reclamation, 2014) evaluated projected climate and its impact to future streamflow. Both of these items are discussed further below along with their implications for the amount of water available for storage in the Kingsley Reservoir system. Additional discussion is presented for the amount of live streamflow available during irrigation season.

4.2.1 Climate Impacts to Snowpack and Streamflow

The Hood River Basin Study evaluated projected changes to temperature, precipitation, snowpack, and streamflow for the period from 2030 to 2060 (temperature and precipitation results presented in Figure 9 in Section 3.3.). Precipitation is expected to remain relatively unchanged over the year, but warmer wintertime temperatures will cause more precipitation to fall as rain, resulting in lower snowpack than historical levels (Figure 11). The increase in wintertime rain will cause higher wintertime streamflow, while the decreased snowpack will result in lower spring and summer streamflow.

The Hood River Basin Study did not evaluate climate impacts specifically to the point of diversions for the Stanley-Smith pipeline but did evaluate impacts further downstream on Greenpoint Creek. Since the PODs are tributaries to Greenpoint Creek, the Greenpoint Creek evaluation is used here as a surrogate for impacts at the actual PODs. Based on the temperature and precipitation projections presented in Section 3.3, Greenpoint Creek is expected to see 5-28% increases in winter streamflow, 25% decreases in spring streamflow, and approximately 10% decrease in summer streamflow (Figure 12).

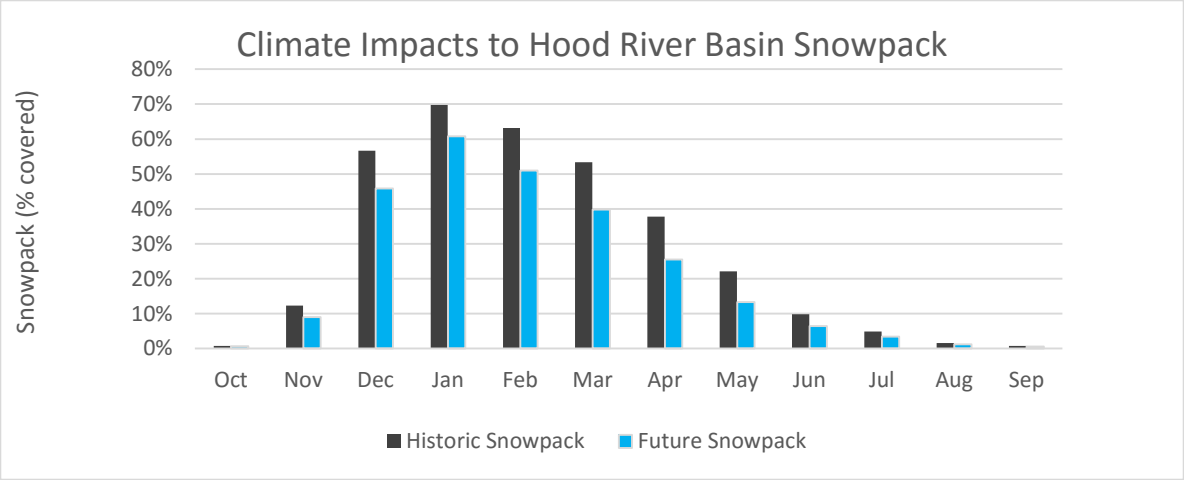


Figure 11. Average monthly snowpack (% of basin covered) under historic (1980-2010) and expected future (2030-2060) climate.

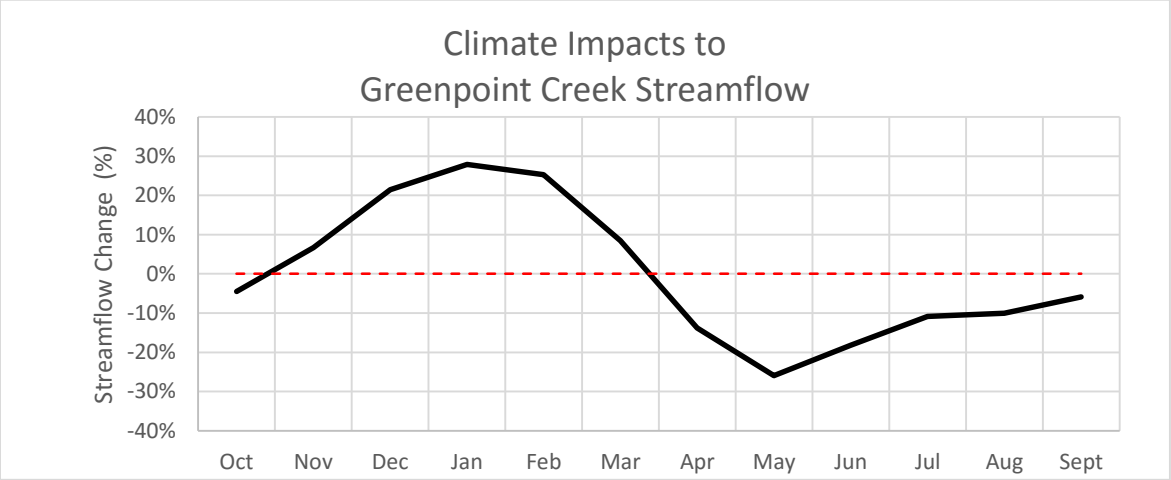


Figure 12. Average projected streamflow change in Greenpoint Creek (2030-2060 versus 1980-2010).

4.2.2 Water Available for Storage

The amount of water available for storage in the future can be estimated by multiplying the historical water availability against projected percent changes in streamflow (Table 6). Based on this methodology, in an average future water year, 2,361 acre-feet of water is available for storage, while in a drought year 1,769 acre-feet are available.

Table 6. Allocation of Stanley-Smith flow that goes to storage or hydropower in future average and drought years (all values in acre-feet).

Stanley-Smith Allocation (Acre-feet)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Sum	**Combined**
Percent Change		+ 28%	+ 25%	+ 9%	- 14%	- 26%	- 18%	- 11%	- 10%	- 6%	- 4%	+ 7%	+ 21%	n/a	n/a
Average Year	To Storage	0	396	206	379	0	0	0	0	0	0	0	0	981	2,361
	To Hydro	390	126	157	73	0	0	0	0	0	0	263	371	1,380	
Drought Year	To Storage	0	249	130	239	0	0	0	0	0	0	0	0	618	1,769
	To Hydro	390	80	99	46	0	0	0	0	0	0	166	371	1,151	

4.2.3 Live Streamflow Available During Irrigation Season

A detailed analysis is not presented here since limited streamflow measurements are available at FID's actual PODs, but it must be stressed that projected climate change will decrease streamflow during irrigation season. The streamflow changes shown in Figure 12 are representative of streamflow impacts expected in the rest of the Hood River Basin as well (Reclamation, 2014). As discussed above, the increase in winter streamflow is a result of a greater amount of precipitation falling as rain rather than snow in the wintertime. The decrease in summer streamflow is primarily due to the decrease in snowpack and subsequent snowmelt, but a small portion of the decrease is also attributable to overall increased evapotranspiration (ET) in the Hood Basin.

One cannot extrapolate directly from percent changes shown in Figure 12 and conclude that the FID water supply will be impacted by the same percentages. Live streamflow exceeds FID's water rights at most locations, and reductions in streamflow would not necessarily mean that the full FID water right is no longer available. Nonetheless, so as to protect its constituents, FID must plan for decreased live streamflow during irrigation season, and, where possible, take advantage of increased winter streamflows to offset the decreased summer flows.

4.3 Discussion

Tables 5 and 6 show that approximately 2,133 to 2,361 acre-feet are available for storage in normal water years, while 1,569 to 1,769 acre-feet are available in extreme drought years. FID's existing reservoir storage volume is 938 acre-feet, which means the additional storage volume available to fill a reservoir expansion is a minimum of 631 acre-feet (minimum future supply of 1,569 acre-feet minus existing volume of 938 acre-feet equals 631 acre-feet). Since streamflow during irrigation season is expected to decrease in the future, FID should size a new reservoir expansion as closely to the minimum available 631 acre-feet as possible.

5. Water Conservation Potential

The irrigation season in Hood River County is from April 15 through September 30. At the peak of irrigation season, FID district-wide delivers approximately 65 cfs to its patrons (Figure 13). Irrigation demand can potentially be reduced through three primary pathways: 1) reducing on-farm use through conversion to more efficient sprinklers and the use of soil moisture sensors, 2) replacing open canals with pipe to reduce seepage and overflows, and 3) converting to lower water use crops. Other districts that are not essentially fully enclosed in pipe like FID also have the potential to implement operational changes to reduce overflows. FID, however, has already eliminated all overflows in its system.

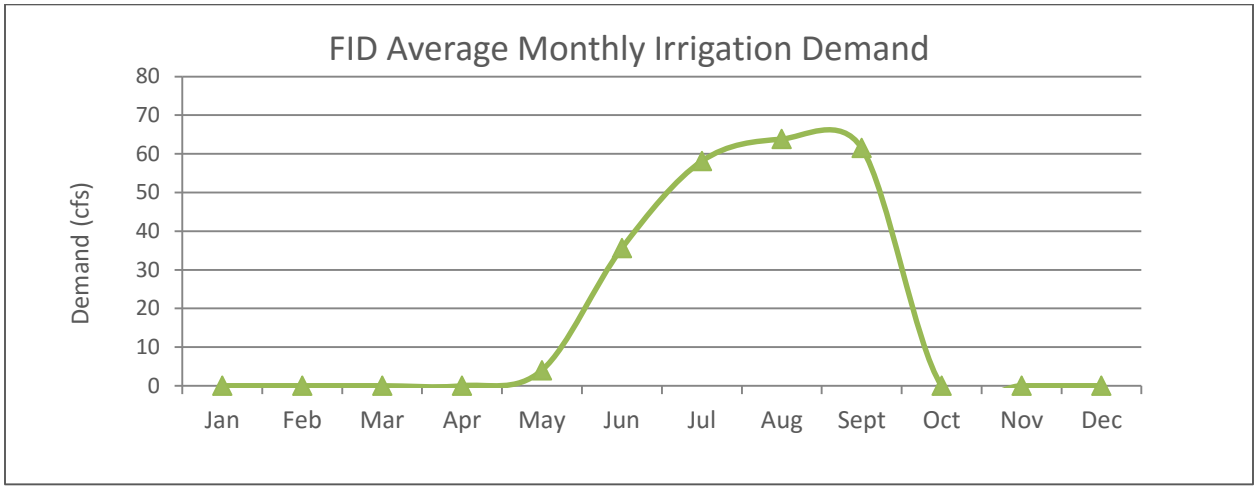


Figure 13. Average monthly FID irrigation demand (based on years 2005-2012)

5.1 On-farm Conservation

On-farm water conservation, through converting sprinkles to more efficient technology, has the potential to reduce overall water use. FID, however, has limited ability to enforce sprinkler conversion amongst its patrons and may thus require a shift to a use-based rate structure if it wanted a 100% conversion to more efficient sprinklers.

5.1.1. <u>Sprinkler Conversion</u>

Older, traditional irrigation systems typically consist of handlines (moved by hand) or wheel lines (the actual line sits on wheels) with impact sprinklers on them, while newer, upgraded systems typically consist of micro or rotator sprinklers with poly-tubes. The newer systems use considerably less water than the older impact-sprinkler systems; therefore, converting any acreage under the older systems to the newer ones would result in reducing overall water use. Quantifying the actual amount of water that can be conserved is dependent on annual water use of each type of sprinkler, the amount of acreage using each type of sprinkler, and how much acreage is converted to more efficient systems. Each of these three variables is discussed further below.

Two recent studies have documented water use by each application method specifically in Hood River County. The Hood River Soil and Water Conservation District (SWCD) measured water use on 32 farms from 2010 to 2013 as part of the Hood River Irrigation Upgrade Flow Meter Monitoring study (Hood River SWCD, 2013). This study monitored a single hand line to establish a baseline and found that hand line use was 3.64 feet per year, while water use on the upgraded systems averaged 1.55 feet per year. A separate study performed by Irrinet and FID from 2006 to 2007 monitored water use on 10 irrigation systems (Irrinet, 2007). This study monitored older systems before and after upgrading and, therefore, has 10 water use measurements for conventional systems and 10 water use measurements for upgraded systems. Results from the SWCD and Irrinet studies (Table 7) were averaged based on sample size and are used to calculate the potential reduction in on-farm use.

Table 7. Sprinkler types, water use, and sample size from Hood River SWCD (2013) and Irrinet (2007) studies.

Sprinkler System		Sample Size		Notes
Type	Efficiency (ft/yr)	SWCD Study	Irrinet Study	
Wheel line / Impact	3	0	0	Set at full water right based on feedback from irrigation district managers.
Hand line / Solid set impact	2.39	1	10	One estimate of 3.64 feet from SWCD and 10 estimates averaging 2.25 feet from Irrinet study.
Rotator / Micro	1.7	32/10	10	Based on combination of Irrinet study, SWCD study, and AgriMet crop use.
Drip	1.4	0	1	Based on one system from Irrinet study.

The district area served solely by the reservoir consists on 200 acres of impact sprinklers, 700 acres of micro sprinklers, 15 acres of drip irrigation, 240 acres of high efficiency residential, and 45 acres of low efficiency residential (Figure 14). Based on the studies presented in Table 7, these acreages of sprinkler types result in the use of 2,304 acre-feet of water per irrigation season (Table 8). Converting all low efficiency sprinklers to higher efficiency sprinklers would result in an annual water use of 2,121 acre-feet (Table 9). Based on $1,500/acre to convert orchard land and $1,500 per half acre suburban conversion, this water savings of 183 ac-ft/year would cost approximately $435,000 dollars.

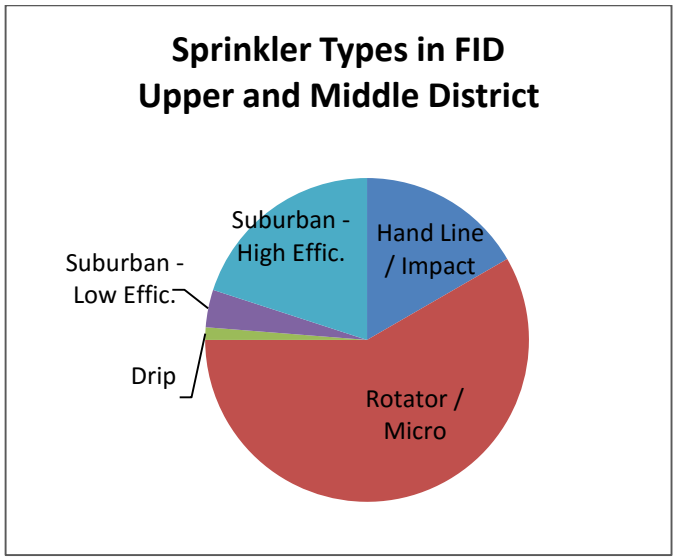


Figure 14. Sprinkler types in upper and middle district.

Table 8. Area of each sprinkler type, typical water use by sprinkler type, and total water use in area served by Kingsley reservoir system.

Sprinkler Type (Existing)	Area (acres)	Water Use (feet/year)	Total Water Use (acre-feet/year)
Hand Line / Impact	200	2.39	478
Rotator / Micro	700	1.7	1,190
Drip	15	1.4	21
Suburban - Low Efficiency	45	3	135
Suburban - High Efficiency	240	2	480
Total	1,200	n/a	2,304

Table 9. Area of each sprinkler type, typical water use by sprinkler type, and total water use in area served by Kingsley reservoir system if 100% of patrons converted to high efficiency sprinkler systems.

Sprinkler Type (Conservation Scenario)	Area (acres)	Water Use (feet/year)	Total Water Use (acre-feet/year)
Hand Line / Impact	0	2.39	0
Rotator / Micro	900	1.7	1,530
Drip	15	1.4	21
Suburban - Low Efficiency	0	3	0
Suburban - High Efficiency	285	2	570
Total	1,200	n/a	2,121

Table 10. Summary of Farmers Irrigation District water use reduction based on Tables 7 through 9.

Total Acreage	1,200 acres	
Converted Acres	245 acres	
Existing Use	2,304 ac-ft/yr	Calculated as existing use based on Table 8.
Projected Use	2,121 ac-ft/yr	Calculated as projected use based on Table 9.
Water Savings (ac-ft/yr)	183 ac-ft/yr	Based on reduction between existing and projected use
Cost ($)	$435,000	Based on $1,500/acre from Irrinet (2007) study for orchard, $1,500 per residential for 0.5 acre micro system.
Cost per Acre-Foot	$2,380	

5.1.2. Use-Based Rate Structure

Implementing a use-based rate structure may be required to achieve a 100% conversion of patrons to more efficient sprinkler technology. For example, FID currently operates a sprinkler exchange program and works with farmers to install micro-sprinkler systems, soil moisture sensors, and other sustainable on-farm practices, but some growers, nevertheless, continue to use older, less efficient technologies.

Since a use-based rate structure would require knowing the exact water use of each customer, this would require the installation of one flow meter per customer, replacing worn meters, and reading meters at least once per year. The cost of a flow meter is dependent on the diameter of pipe. At the time of this writing, a flow meter for ¾-inch pipe costs approximately $300; for a 2-inch pipe, the cost is

approximately $1,000. Because of the high sediment load in the Hood River, it is likely that meters would need to be replaced roughly every 5 years. Although meters could be read only at the end of each season, customers would probably feel more comfortable with meters also being read at the start of each season.

Estimated costs to implement a use-based rate program are based on: 1) an average cost of $450 per flow meter, 2) $50 to install each meter, 3) replacing one-fifth of the meters each year, and 4) $25 to read each meter twice a year. The costs shown in Table 11 are specific to implementing a use-based rate structure. To achieve the water reduction values shown in Table 10, all acreage must also be using micro sprinklers with soil moisture sensors so would be additive to the costs presented in Table 10.

Table 11. Capital cost, annual cost, and potential water reductions available through implementing use-based rate structure.

District	Accounts	Costs			Reduction in Water Use
		Capital[1]	Annual Meter Replacement[2]	Semi-Annual Meter Reading[3]	
FID	200	$100,000	$20,000	$10,000	N/A[4] N/A[4]

[1] Capital costs based on an average cost of $450 per meter and $50 to install.

[2] Annual meter replacement equal to cost of replacing 1/5 of all meters.

[3] Semi-annual meter reading estimated at $25/meter.

[4]Actal water use reduction is realized through 100% conversion to upgraded sprinkler systems (Section 3.2)

5.2 Installation or Replacement of Pipe

Farmers Irrigation District has converted open conveyance canals to pipe and, by 2015, had converted over 99 percent of its system to pipe. One canal remains with two open sections that may be converted, plus one previously piped section that is due for replacement due to leakage (Table 12).

2.8 miles of Farmers Canal remains to be piped as funds allow. However, this canal conveys water from the Hood River to the lower district and does not impact upper and middle district water supply. Additionally, FID has already piped the sections of Farmers Canal that provide significant water savings, and it is believed that only 1 cfs is lost to seepage over the remaining length (Jerry Bryan, FID, personal communications, October 10, 2015).

FID's one leaky pipe is the North Greenpoint pipeline, which FID plans to replace or rehabilitate as funds allow. This pipeline is an above-ground, 39" diameter corrugated galvanized pipe which is over 30 years old and has been subject to considerable wear. Replacement of this pipe is expected to cost $1,700,000 and would eliminate approximately 2 cfs of losses, however, this pipe supplies water to FID's middle district and therefore replacement of it does not have the ability to increase upper district water supply.

Table 12. Water savings and cost of potential FID conveyance upgrade projects.

Canal / Pipe	Length (feet)	Diam. (inch)	Flow (cfs)	Water Savings (cfs)	Cost ($M)	Comments
Farmers Canal – Schedule B	6,170’	2 x 48”	73	~1	$2.5	Lower district only, does not impact upper or middle district.
Farmers Canal – Schedule F	7,250’	2 x 48”	73	~1	$2.7	Lower district only, does not impact upper or middle district.
North Greenpoint to Deadpoint Pipe	11,500’	30”[1]	20	2	$1.5	Project has been prioritized for future construction.

Notes: [1]Existing pipe 39” spiral bound, will be replaced by 30” HDPE

5.3 Converting Crop types

In theory, converting crops that have a relatively high water demand to other types with lower demand might provide significant water savings. However, no choice is more central to farming economics than crop choice, and it is unlikely that any incentive based program to convert crops is going to result in significant changes in crop type or water savings.

Pears are the dominant crop in the Hood River basin. Recent trends have seen some replacement of pears with cherries, blueberries, and, to a limited extent, wine grapes, and encouraging further conversion to cherries or blueberries would not benefit water conservation, as these crops have generally as high or higher water use than pears (Figure 15). Conversion from pears to wine grapes is the most likely crop conversion that could yield a water savings, but the economics of wine grapes can be tenuous at best. Accordingly, since it’s unlikely any wide-scale crop conversion program could be reasonably implemented, no projections are made within this report.

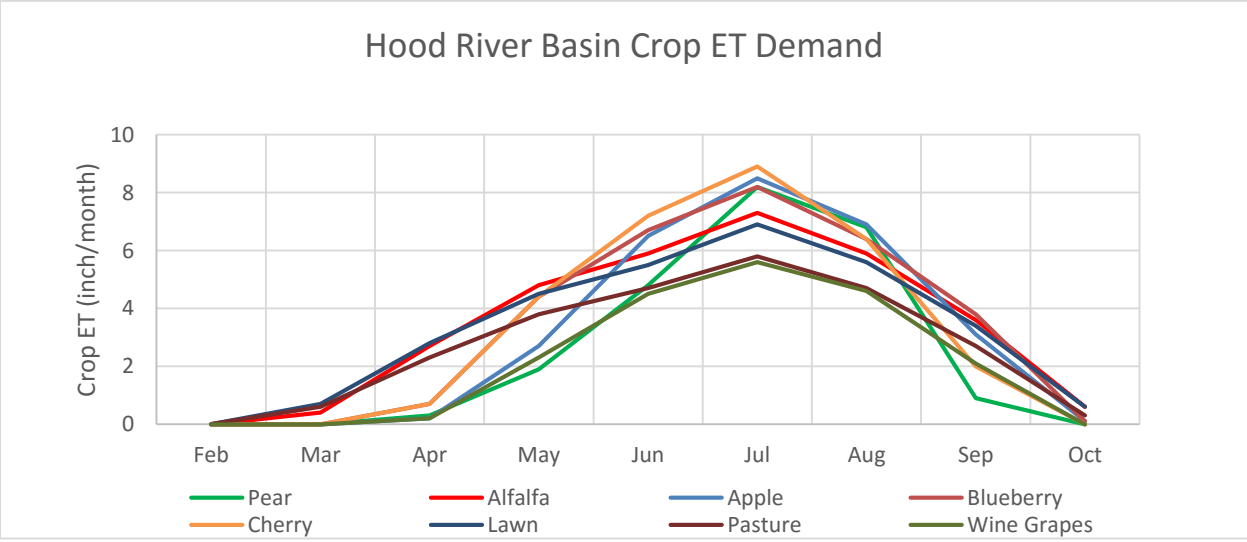


Figure 15. Average monthly ET demand by crop types found in the Hood River basin.

5.4 Discussion

Table 13 below summarizes the effectiveness of water conservation measures that FID may implement. The most effective measure is on-farm conversion to more efficient sprinklers, which would save 183 ac-ft/yr in the area served by the reservoir. The sprinkler conversion itself would cost $435,000 but may also require conversion to a use-based rate structure for an additional $100,000. Replacing the North Greenpoint pipeline would save approximately 2 cfs during irrigation season and cost $1,700,000. Although converting to lower water use crops would reduce overall water use, as discussed previously in this document, it is unlikely that any formal program would be effective due to unfavorable market forces, which are the main driver of crop selection.

Table 13. Cost and effectiveness of potential water conservation.

Water Conservation Type		Water Savings (ac-ft)	Cost ($)	Cost per Water Saving ($/ac-ft/yr)
On-Farm	Sprinkler conversion	183	435,000	$2,380[1]
	Use-based rate structure	N/A[2]	$100,000 capital $30,000 annual	N/A[2]
	Combined	183	$535,000 capital $30,000 annual	$2,923
Pipe Upgrades	Farmers – Sched B	240[3]	$2,500,000	$10,417[3]
	Farmers – Sched F	240[3]	$2,700,000	$11,250[3]
	N. Greenpoint	480[3]	$1,700,000	$3,541[3]
Crop Conversion		No water savings; difficult to implement.		

Notes: [1] *Implementation may not be achieved without use-based rate structure or subsidies.*
[2] *Water savings come from sprinkler conversion, and use-based rate structure encourages that conversion*
[3] *Water savings does not impact upper district supply*

6. Water Rights

FID will need to obtain a water right from the Oregon Department of Water Resources if it wants to expand its existing reservoir, as well as a transfer of Place of Use if it moves storage volume from the lower reservoir to the upper reservoir. Analysis as to whether or not a new water right can be obtained is typically performed by the OWRD Water Availability Reporting System (WARS), but the fact that FID is not seeking to increase its overall diversion rate may help streamline the application process. As discussed earlier, FID is looking to forgo some of its hydropower diversion in the wintertime and put that water into storage instead. Of FID's 5 cfs hydropower diversion from Rainy, Gate, and Cabin Creek, FID seeks to use 2.7 cfs of this rate in the months of December, January, and February to fill the reservoir (for a total volume of 500 acre-feet). It would continue to divert 5 cfs from those sources and pass the remaining 2.3 cfs to downstream hydropower. As is, FID currently keeps the outlet from the reservoir open so as to flow the full 5 cfs through the reservoir, whereas in the future FID would close the valve to allow only a 2.3 cfs release for hydropower, using the remaining 2.7 cfs for storage.

6.1 OWRD Water Availability Calculation

OWRD evaluates new applications for storage based on a 50% exceedance standard. This means that, based on WARS, water is available for new appropriations at the proposed diversion 50% of the time. Results from the OWRD calculation are presented below and show that 42,300 acre-feet/year are available in the Greenpoint subbasin between November and May (Table 14). Additionally, Table 14 shows that downstream basins also have water availability in all months from November through May. Although the water available for new appropriation may be further limited during the water rights application process, FID would only be applying for approximately one to two percent of the available storage volume and therefore it is believed the application for new storage volume would be approved.

Table 14. OWRD water availability calculation generated by OWRD's Water Availability Reporting System[1].

All units cfs	Greenpoint Creek	West Fork Hood River	Hood River - RM 0.75	Hood River - at mouth	Maximum Available
Jan	93	389	331	831	93
Feb	109	426	328	828	109
Mar	106	396	272	772	106
Apr	122	371	306	806	122
May	122	319	249	749	122
Jun	61	93	0	463	0
Jul	22	32	0	208	0
Aug	12	0	0	70	0
Sep	13	0	0	93	0
Oct	28	29	0	227	0
Nov	65	186	154	654	65
Dec	87	361	298-	798	87
Ac-ft/yr	50,500	155,000	116,000	391,000	42,300

Notes: [1] http://apps.wrd.state.or.us/apps/wars/wars_display_wa_tables/search_for_WAB.aspx

6.2 Existing FID Diversions

Although the OWRD water availability calculation in Section 6.1 already shows that water is available for a new storage permit, some consideration should be given to the interaction of a new storage right with FID's existing use. FID's existing water rights associated with the Kingsley Reservoir system are presented below in Tables 15 and 16. The storage permit is for 715 acre-feet of storage in Upper Kingsley reservoir, 288 acre-feet of storage in Lower Kingsley reservoir, and is for supplemental irrigation only.

Since FID is not seeking to increase its diversion rate, there are no decreases in streamflow at the source stream (all tributaries to Greenpoint Creek) during filling of the additional storage volume. Putting water into storage instead of conveying it to hydropower will impact Ditch Creek between the reservoir outlet and the forebay for Plant #3 and from the tailrace of Plant #2 to the mouth of the Hood River. The impact would be a 2.7 decrease in these two reaches in the winter and approximately one cfs increases in the summertime.

As discussed further in Section 8, the Oregon Department of Fish and Wildlife regional biologist saw no fish habitat impacts from these hydrologic changes. Since the water used to fill the reservoir is from an inter-basin transfer, removing water from the Ditch Creek drainage (by putting it into storage versus conveying it for hydropower) is closer to natural conditions. On the mainstem Hood River, a 2.7 cfs decrease in winter flow is less than a two percent change (2.7 cfs ÷ 1,500 cfs average flow) during a period that is not limited for streamflow. During the summer period, however, the Hood River is often limited for streamflow, and any increase in streamflow provides additional wetted area and habitat.

Table 15. FID existing storage water right certificate for 1,003 acre-feet.

Certificate	48819
Permit R-698	R-698
Source	Gate Creek
Priority Date	11/22/1933
Use	Irrigation Storage: 715.0 acre-feet in Upper Green Point Reservoir and 288.0 acre-feet in Lower Green Point Reservoir for a total of 1003.0 acre-feet.
Duty	N/A

Table 16. FID existing water right certificate used to fill Kingsley reservoirs

Certificate	74302
Permit	S-12362
Source	North Fork Greenpoint Creek, Upper Greenpoint Reservoir, Lower Greenpoint Reservoir.
Priority Date	11/22/1933
Use	Supplemental irrigation of 700 acres. Rate 8.75 cfs.
Duty	Not to exceed 3 acre-feet per acre irrigated, per year (2,100 acre-feet/yr).

6.3 Seasonally Varying Flow Requirement

Although not pertinent to the physical feasibility of expanding the storage volume in the Kingsley reservoir system, OWRD has a Seasonally Varying Flow (SVF) requirement if it funds a reservoir expansion project. The SVF requirement is in draft at this time (to be finalized in January 2016), but it will likely require that the maximum diversion of streamflow for a storage project funded by OWRD not exceed 15% of live flow at the point of diversion. This is not a requirement for obtaining a new storage water right but will be a requirement for OWRD financial assistance with a project.

It is unclear whether or not an expansion of FID's storage volume would meet the SVF requirement. FID already diverts a significant portion (i.e. above the 15% SVF threshold) at the point of diversions so using this water for storage technically does not meet the SVF requirement. However, this water is already being diverted, so construction of new storage volume would not actually impact the source streams.

It is unfortunate that the SVF rules are in draft at this time and that no clarity is available. FID has consulted with the OWRD Water Supply Development Coordinator (Jon Unger, personal communications, November 10, 2015) and was told that although the department is unable to provide clarity at this time, the SVF determination is made on all successful recipients of OWRD State funding (e.g., Senate Bill 839 funding). As such, Mr. Unger encouraged FID to apply for the SB 839 funding so as to allow OWRD to make the official SVF determination.

7. Fish Passage Requirements

Since August 2001, fundamental changes to a dam on waters in which fish are present trigger fish passage requirements. These passage requirements can be met through: 1) construction of approved fish passage, 2) obtaining a waiver through constructing mitigation, or 3) obtaining an exemption from providing passage.

7.1 Analysis

Because no river channel exists upstream of Upper Kingsley dam and fish passage would provide no appreciable benefit to fish, it is believed that FID would be able to receive a waiver or exemption from being required to provide fish passage. Obtaining a waiver may be an easier option for FID as it does not require proof that no fish are present. A waiver does require mitigation (an exemption does not), however, FID has already identified restoration of the lower reservoir site and increased Greenpoint streamflows as project goals, and hence sufficient mitigation will likely already be part of the project. ODFW's district fish biologist (Rod French) visited the reservoir site and agrees that obtaining a waivers should not pose any challenges.

7.2 Next Steps

An application for a waiver or an exemption must be submitted to ODFW. Once an application is submitted to ODFW, an approval decision will typically take from 2-3 months, though this may vary depending on the complexity of the situation and ODFW workload. The exemption process entails the following steps (with typical ODFW time-frame in parenthesis):

1. The owner/operator of the artificial obstruction submits a signed and completed Application to the ODFW Fish Passage Coordinator (form available at: (http://www.dfw.state.or.us/fish/passage/).

2. ODFW completes a written Benefit Analysis (3 weeks).

3. ODFW develops a Draft Agreement which is then forwarded to the owner/operator for review, comment, and preliminary approval (1 week).

4. ODFW develops a Public Notice soliciting comments regarding the waiver or exemption request. This will remain in effect for 3 weeks after distribution (4 weeks).

5. After the public comment period, an approval decision will be made by the ODFW Fish Passage Coordinator or the Oregon Fish and Wildlife Commission (approximately 4 weeks).

6. If the exemption is approved, a letter will be sent from ODFW to the owner/operator indicating the decision outcome (1 week).

8. Impacts on Streamflow and Instream Habitat

Potential new impacts to streamflow are likely minimal since FID will not divert additional streamflow to fill any additional storage volume. Nonetheless, these impacts, along with their corresponding impacts to aquatic habitat, are discussed below.

8.1 Streamflow Impacts

As discussed elsewhere in this report, FID will not increase diversions to obtain new streamflow for storage expansion, but will instead use a portion of its current hydropower diversion to fill any new volume. FID currently diverts 5 cfs from Rainy, Gate, and Cabin Creeks (all tributaries to Greenpoint Creek) in the winter for hydropower. FID will continue to divert the same 5 cfs from these sources but will put approximately 2.7 cfs (depending on final additional storage volume) into storage and convey the remaining 2.3 cfs to hydropower. Although the impacts will be small, this practice will cause slight decreases in the streamflow in Ditch Creek and the mainstem Hood River during the fill period and a corresponding slight increases in the same waters during irrigation season. Greenpoint Creek will experience no change during the winter (since the streamflow is already taken for hydropower production), but will likely experience small (~1 cfs) increases during irrigation season. These impacts are shown on Figure 16 and discussed further below.

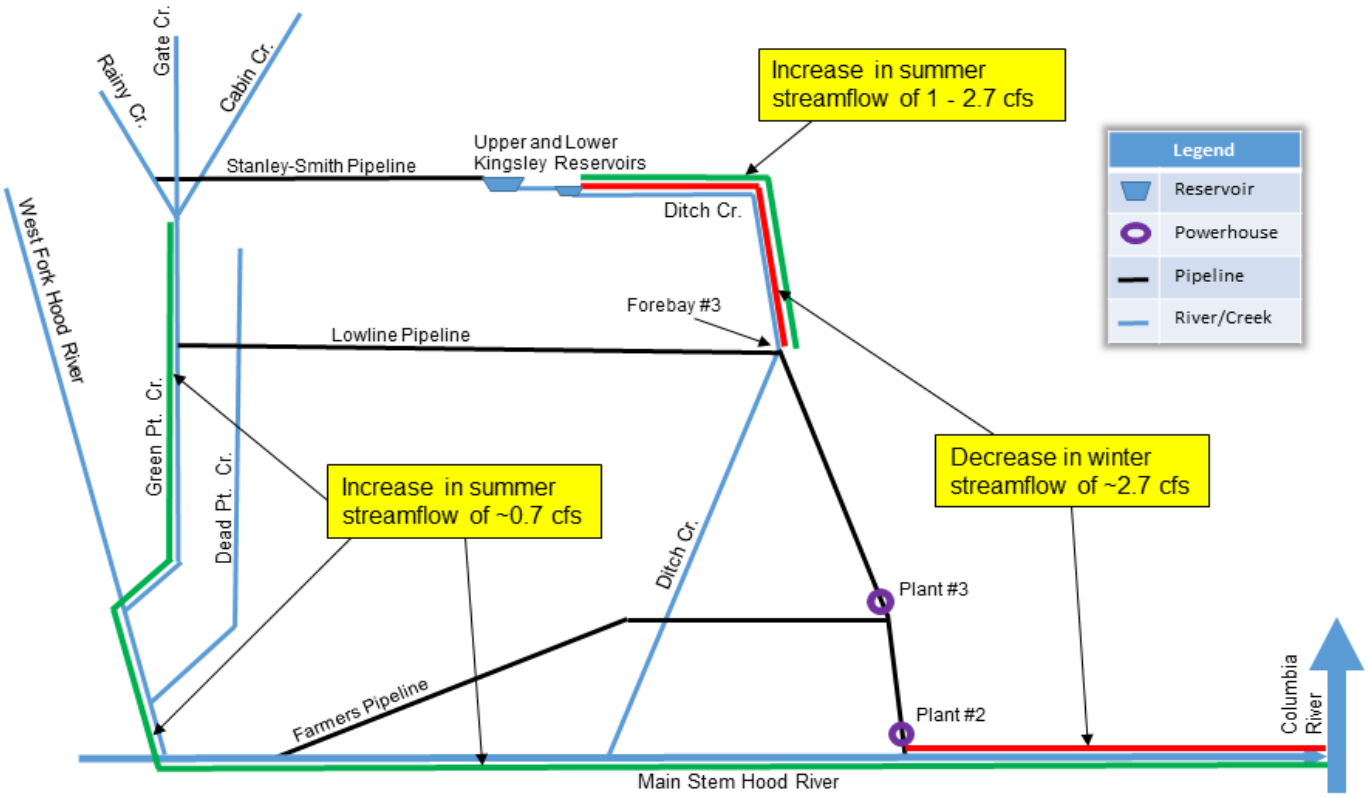


Figure 16. Impacts to stream reaches from expanding Kingsley Reservoir storage volume.

8.1.1. Upper Ditch Creek

Upper Ditch Creek is the creek between the reservoir outlet and the forebay to Plant #3. It will be impacted in the following way:

Winter: Ditch Creek streamflow will be decreased by 2.7 cfs in December, January, and February

Irrigation Season: The initial part of Ditch Creek (above any irrigation turnouts) will see a 2.7 cfs streamflow increase in July, August, and September. This streamflow increase will become smaller over the course of Ditch Creek as water gets turned out to irrigation.

8.1.2. Hood River from FID Plant #2 to mouth

This section of the Hood River will be impacted in the following way:

Winter: This section will see a 2.7 cfs reduction in streamflow in December, January, and February.

Irrigation Season: This section will see an approximate 1 cfs increase in streamflow during irrigation season.

8.1.3. Greenpoint Creek, West Fork Hood River, and the Hood River

Greenpoint Creek, the West Fork Hood River, and the mainstem Hood River (from the West Fork confluence to the mouth) will be impacted in the following way:

Winter: There will be no additional diversion and therefore no changes to Greenpoint Creek or the West Fork Hood River streamflow during the winter. The mainstem Hood River will see decreased streamflow below FID Plant #2 as discussed in Section 8.1.2.

Irrigation Season: FID's expanded reservoir storage volume will allow it to divert approximately 125 acre-feet less of live streamflow during irrigation season (125 acre-feet is equal to 25% of new storage volume if FID expanded the reservoir by 500 acre-feet). This decreased diversion would increase streamflow from the Stanley-Smith PODs to the mouth of the Hood River by roughly 2 cfs for one month, or 0.67 cfs for three months.

8.2 Habitat Impacts

Habitat impacts are presented below for the same reaches analyzed in the preceding section.

8.2.1. Upper Ditch Creek

The changes to Upper Ditch Creek streamflow have negligible impacts to fish habitat. Although upper Ditch Creek will see a 2.7 cfs decrease during December, January, and February, this streamflow decrease moves Ditch Creek closer to its natural hydrology (since the flow in the Stanley-Smith pipeline is an inter-basin transfer). As mentioned in Section 6, the Oregon Department of Fish and Wildlife regional biologist was consulted on this change and saw no negative fish habitat impacts.

8.2.2. Hood River from FID Plant #2 to mouth

This reach will see a 2.7 cfs decrease in December, January, and February. This 2.7 cfs decrease is less than a two percent change (2.7 cfs ÷ 1,500 cfs average flow) during a period that is not limited for streamflow (the instream water right for this reach during this period is between 170 cfs and 270 cfs, while preferred instream flows are between 270 and 325 cfs). And although there are periods in the winter that do see critically low streamflow in this reach, these periods are usually caused by lack of precipitation coupled with very cold air temperatures, which in turn cause streamflow at the point of diversions to dry up, and, hence, a reservoir expansion would not impact streamflow when streamflows are at this level.

8.2.3. Greenpoint Creek, West Fork Hood River, and Hood River

The West Fork Hood River and mainstem Hood River experience streamflow below their respective instream water rights during the summer, while Greenpoint Creek experiences flow very close to an FID/ODFW minimum flow agreement. As such, any increases in streamflow have positive impacts to habitat availability.

Analysis is presented below if FID were to target a 125 acre-foot release to supplement streamflow during a one month period of low flow. This 125 acre-feet is equal to a 2.1 cfs release (or reduction in live streamflow diversion) for 30 days. Alternatively, FID could target the 125 acre-foot release for a three month period, which would result in elevating streamflow by 0.7 cfs. The analysis presented below focuses on Greenpoint Creek and the West Fork Hood River since both water bodies had recent instream studies that can be leveraged (Normandeau, 2014). Although not a forgone conclusion due to the intricacies of the relationships between streamflow and habitat, it is a reasonable assumption that the habitat impacts in the Hood River due to streamflow increase will be less pronounced than impacts to Greenpoint and the West Fork Hood River since the overall percent change in streamflow will be less.

8.2.3.1 Species, Lifestage, and Habitat Suitability

The ODFW regional biologist identified Steelhead spawning and juvenile rearing as a critical species and lifestages that inhabits both Greenpoint Creek and the West Fork Hood River (Table 17), and spring chinook as an additional critical lifestage in the West Fork Hood River (Table 18). The habitat suitability for Steelhead is shown in Figure 17 (velocity suitability) and Figure 18 (depth suitability), and the habitat suitability for spring chinook is shown in Figure 19 (velocity suitability) and Figure 20 (depth suitability). The derived relationships between streamflow and habitat amount is shown in Figures 21 through 23.

Although velocity and depth suitability is shown below for Steelhead spawning, this lifestage occurs outside of the period in which streamflow will be impacted (lifestage occurs in late winter while streamflow impacts will be during irrigation season) and hence there are no habitat impacts to the Steelhead spawning lifestage. Nonetheless, these values are shown below for informational purposes only.

Table 17. Presence of Steelhead lifestages by month in Greenpoint Creek and the West Fork Hood River.

Steelhead Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning												
Juvenile Rearing												

Not present Present, not critical Present, critical

Table 18. Presence of spring chinook lifestages by month in the West Fork Hood River.

Spring Chinook Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning												
Juvenile Rearing												

Not present Present, not critical Present, critical

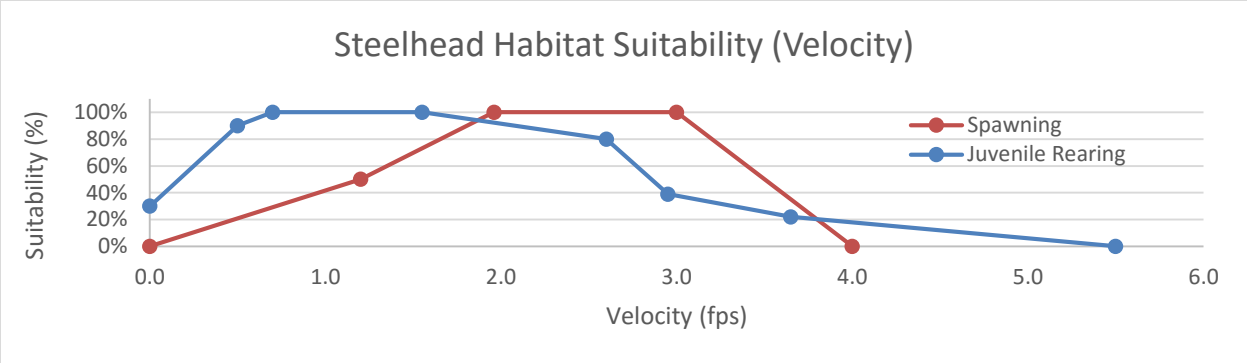


Figure 17. Steelhead velocity habitat suitability (Normandeau, 2014).

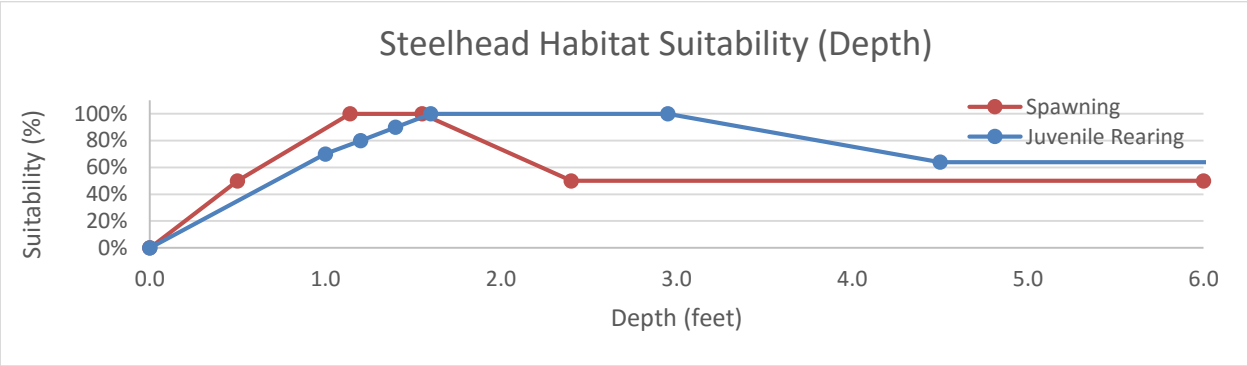


Figure 18. Steelhead depth habitat suitability (Normandeau, 2014).

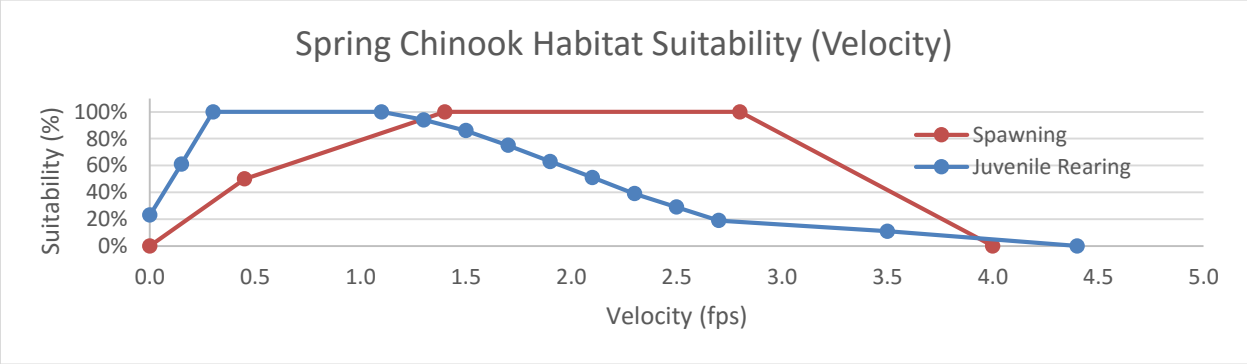


Figure 19. Spring chinook velocity habitat suitability (Normandeau, 2014).

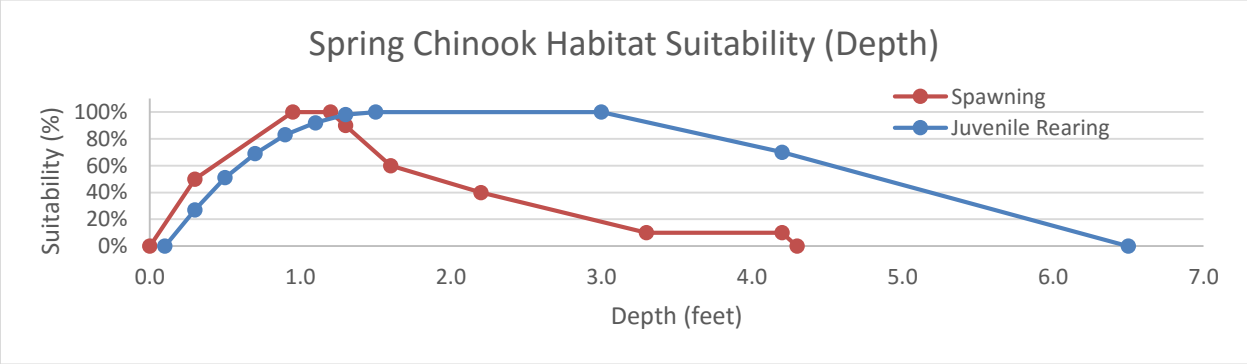


Figure 20. Spring chinook depth habitat suitability (Normandeau, 2014).

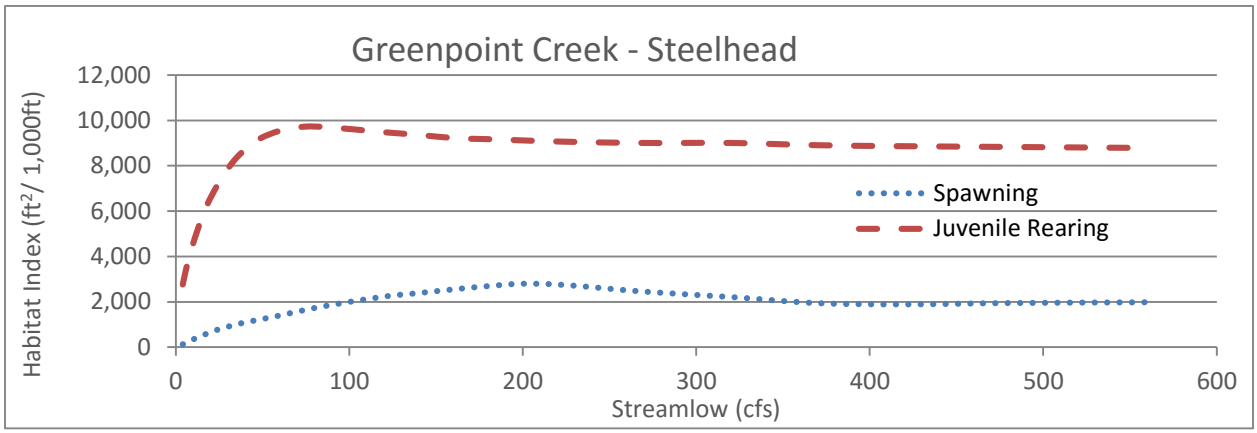


Figure 21. Relationship between streamflow and habitat index for Steelhead on Greenpoint Creek (Normandeau, 2014).

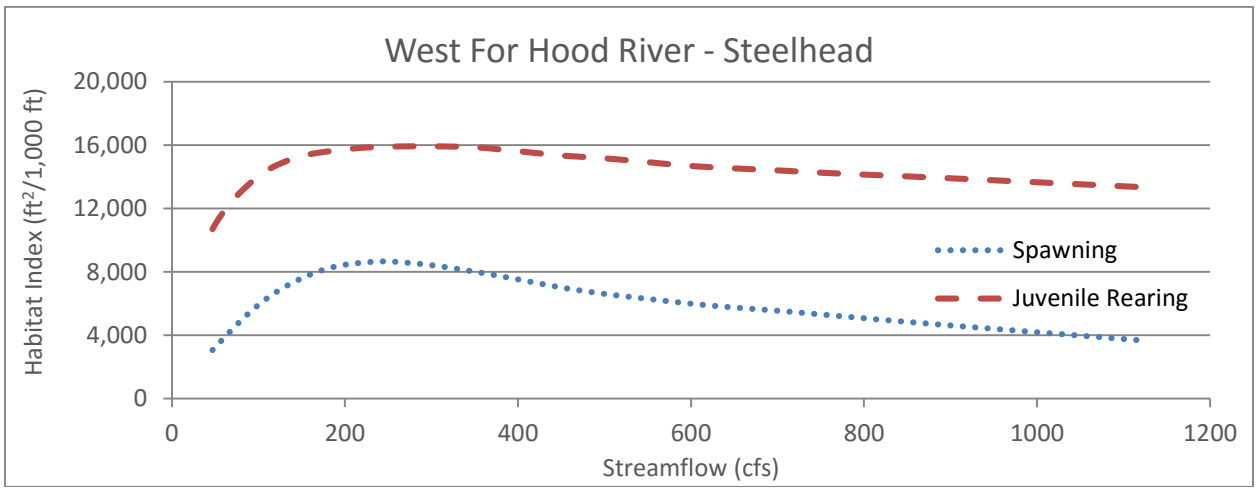


Figure 22. Relationship between streamflow and habitat index for Steelhead on West Fork of the Hood River (Normandeau, 2014).

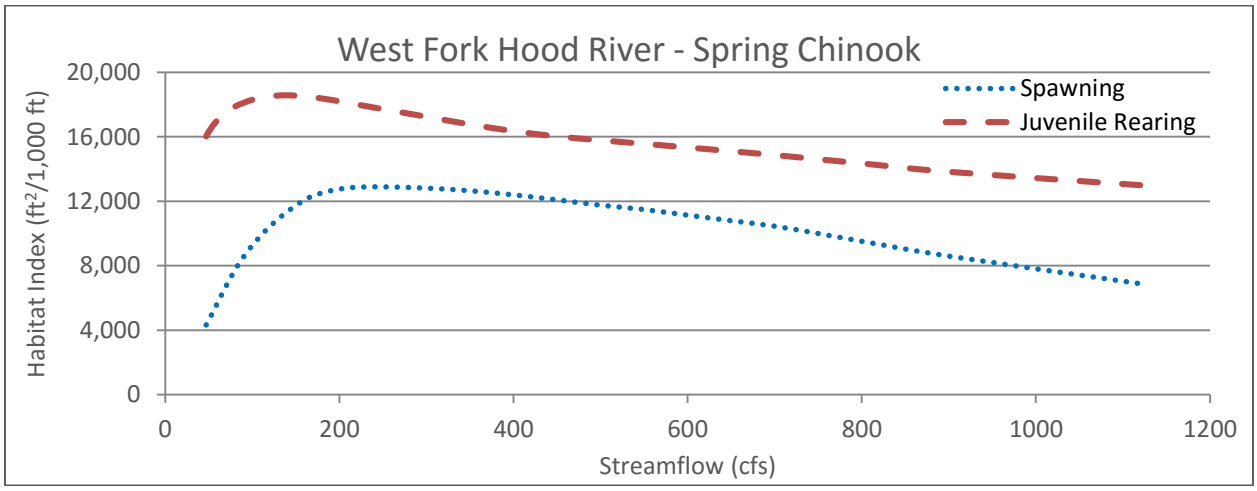


Figure 23. Relationship between streamflow and habitat index for spring chinook on West Fork of the Hood River (Normandeau, 2014).

8.2.3.2 Changes to Habitat Index

The changes to habitat index discussed below are based on a 2.1 cfs reduction in diversion during the lowest streamflow month of the year. Average monthly low flows in Greenpoint Creek are approximately 20 cfs (Figure 24) while average low flows in the West Fork Hood River are 130 cfs (Figure 25.

For Steelhead juvenile rearing in Greenpoint, 20 cfs corresponds to a Habitat Index of 6,553 ft^2/1,000 feet (Table 19, Figure 21). The slope of the juvenile rearing habitat index curve at this streamflow is 146 ft^2/1,000 feet/cfs, hence a 2.1 cfs increase in streamflow results in an additional 307 ft^2/1,000 feet of habitat. The 307 additional ft^2/1,000 feet represents a 4.7 percent increase in habitat (307 ft^2/1,000 feet ÷ 6553 ft^2/1,000 feet = 4.7 percent).

For Steelhead juvenile rearing in the West Fork, average monthly low flows of 130 cfs corresponds to a Habitat Index of 14,919 ft^2/1,000 feet (Table 19, Figure 22). The slope of the juvenile rearing habitat index curve at this streamflow is 22.8 ft^2/1,000 feet/cfs, hence a 2.1 cfs increase in streamflow results in an additional 47.9 ft^2/1,000 feet of habitat. The 47.9 additional ft^2/1,000 feet represents a 0.3 percent increase in habitat (47.9 ft^2/1,000 feet ÷ 14,919 ft^2/1,000 feet = 0.3 percent).

For spring chinook in the West Fork, average monthly low flows of 130 cfs corresponds to a Habitat Index of 10,874 ft^2/1,000 feet (Table 20, Figure 23). The slope of the juvenile rearing habitat index curve at this streamflow is 46.7 ft^2/1,000 feet/cfs, hence a 2.1 cfs increase in streamflow results in an additional 98.0 ft^2/1,000 feet of habitat. The 98.0 additional ft^2/1,000 feet represents a 1.0 percent increase in habitat (98.0 ft^2/1,000 feet ÷ 10,874 ft^2/1,000 feet = 1.0 percent). As shown in Table 20, changes to spring chinook juvenile rearing habitat due to a 2.1 cfs change in streamflow around 130 cfs are negligible (i.e. 0.05 percent).

Table 19. Average lowest monthly streamflow, habitat index and rate of change at the lowest monthly streamflow, and percent change in habitat for a 2.1 cfs streamflow increase in Greenpoint Creek and the West Fork Hood River for steelhead juvenile rearing.

Reach	Avg. Monthly Low Streamflow (cfs)	Steelhead Juvenile Rearing Habitat Index		
		At Low Flow (ft^2/1,000 ft)	Change per cfs Change (ft^2/1,000 ft/cfs)	**Percent Change (percent)**
Greenpoint Creek	20	6,553	146	**4.7**
West Fork Hood River	130	14,919	22.8	**0.3**

Table 20. Average summer low streamflow, habitat index and rate of change at the summer low streamflow, and percent change in habitat for a 2.1 cfs streamflow increase in the West Fork Hood River spring chinook spawning and juvenile rearing.

Lifestage	Summer Low Streamflow (cfs)	Spring Chinook Habitat Index		
		At Low Flow (ft^2/1,000 ft)	Change per cfs Change (ft^2/1,000 ft/cfs)	**Percent Change (percent)**
Spawning	130	10,874	46.7	**1.0**
Juvenile Rearing	130	18,540	3.2	**0.05**

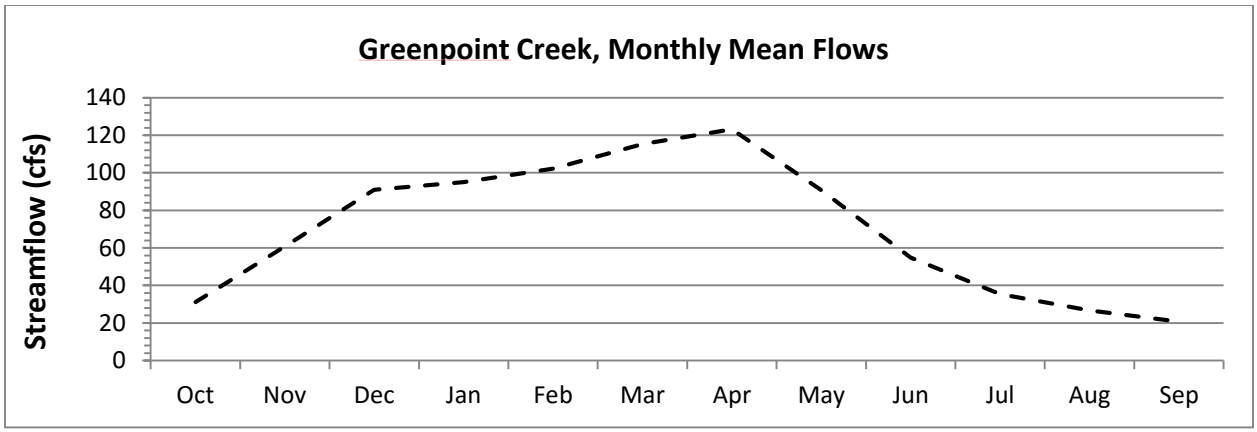


Figure 24. Average monthly streamflow in Greenpoint Creek.

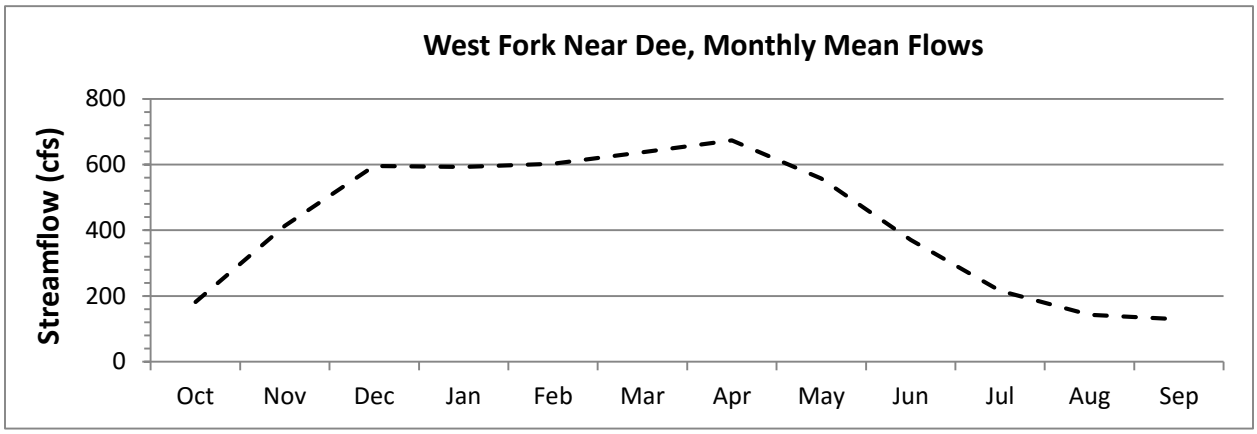


Figure 25. Average monthly streamflow in the West Fork of the Hood River.

8.3 Discussion

Although there would be some changes to streamflow and habitat from a reservoir expansion project, they are quite limited since FID would not be seeking a new diversion to fill the storage volume. The greatest change to streamflow would occur during the winter months (a 2.7 cfs decrease), but this change would move Ditch Creek back to a more natural state (by reducing the inter-basin transfer water volume) and be largely negligible in the mainstem Hood River. Increases to streamflow and habitat would occur during the summer months if FID were to allocate 25% of the storage volume to instream flow. This could be released (or an existing diversion reduced by) 2.1 cfs for one month or 0.67 cfs for three months. In a smaller creek like Greenpoint, a 2.1 cfs increase in the summer is approximately a 10 percent increase in streamflow which would have a measurable increase in habitat (4 percent per recent instream study), but, moving downstream, the percent increase in flow becomes less as the overall flow volume increases, causing the corresponding habitat to increase less significantly as well.

9. Property Ownership

FID owns the land up to the current high water mark, and Hood River County owns the land above the high water mark. FID would either need to obtain an easement from the County or obtain the property outright so as to expand the storage volume.

FID met with the Hood River County Planning Director (John Roberts) and Hood River County Forester (Doug Thiesies) on November 17th, 2015. These individuals indicated there were no 'red flags' that could not be overcome, recommended that a land-swap would be much easier for FID to pursue (versus a land sale or easement), and identified the following steps for FID to be able to proceed with the reservoir expansion project:

1. FID determine if they want to pursue Option A (expand the upper reservoir by 500 acre-feet without decommissioning the lower reservoir) or Option B (expand the upper reservoir by 760 acre-feet and decommission the lower reservoir). If FID were to pursue Option A, it must identify a comparably valued property to swap with the County. IF FID pursues Option B, it could use the lower reservoir property to swap with the County.

2. FID to submit an outline of the project to Hood River County to obtain approval of the concept and an indication that the County is willing to move forward with the concept which would include land use approval and either a lease or land trade.

3. Hood River County Forestry, Parks, and Planning Departments to review outline of project and make recommendations to the Board of Commissioners.

4. Hood River County Board of Commissioners make a decision on support for the project concept and authorize department heads to pursue the appropriate measures to move the project forward including land use and land ownership options.

5. Hood River County Planning, Parks, and Forestry Departments work with FID to develop project parameters and details. Land ownership or lease options as well as timber harvest and park relocation to be determined and detailed as follows:

6. If a lease is pursued, the County and FID will determine appropriate terms and legal language. The timeline would be dependent upon many factors but could be completed in 90 to 120 days.

7. If a land swap is pursued, confirmation that the fair-market value of land being swapped from FID to the County is of equal value of the land being swapped from the County to FID. Any difference in value to be made up in cash. Once the values have been determined and the details have been clarified, the land swap would be presented to the Board of Commissioners for approval. Once approval is obtained, the land swap process could be completed in 120 to 180 days.

8. FID and HRC Parks Department to determine details regarding relocation of the County Park, including the access road, power access, toilet relocation, and water source.

9. FID and HRC Forestry to determine responsible party and schedule for timber harvest at the location of the upper reservoir expansion.

The feasibility of the reservoir expansion project depends in part on the ability to obtain outside funding to help offset the project cost. If FID were to apply for Oregon Water Resources Department Senate Bill 839 funding, it must include with its application "*evidence that landowners are aware of and agree to the proposal*". As such, FID has initiated step 2 above, and the Hood River County Commissioners are scheduled to make a recommendation on whether to pursue a land swap at their December 21st Board meeting.

10. Physical Evaluation of Storage Alternatives

Whether or not it is feasible to expand the storage volume in Upper Kingsley Reservoir depends on the stage/storage relationship, inundated area, seismic considerations, and the ability to use (reuse) existing infrastructure. Additionally, since the incremental cost of reservoir expansion decreases with additional height, increasing storage volume in the upper reservoir potentially provides the opportunity to decommission the lower reservoir as part of the upper reservoir expansion project.

10.1 Target Storage Volume

Based on water supply and water demand calculations presented in earlier sections of this report, it is believed that FID should target a reservoir volume increase of approximately 500 acre-feet. FID water use specialist (Rick Brock, personal communications, November 12, 2015) states that the upper district needed an additional 180 acre-feet during the drought of 2015 ("a few cfs for 30 days"). This demand, plus the expected 383 acre-foot per year demand increase from climate change is equal to a total of 563 acre-feet per year. Complete conversion of FID's upper district patrons to micro sprinklers would reduce existing demand by 245 acre-feet per year, resulting in a total required new storage of 318 acre-feet. Expanding a total of 500 acre-feet would allow FID to meet these demands, plus have some buffer to decreased summertime streamflows.

10.2 Alternatives

FID can achieve the 500 acre-foot storage volume increase by either expanding the upper reservoir by 500 acre-feet, or by expanding the upper reservoir by approximately 750 acre-feet and decommissioning the lower reservoir at the same time. Both alternatives are discussed further below.

10.2.1. Alternative 1: Increase storage volume in upper reservoir without decommissioning lower reservoir

This alternative is the most economical way to increase overall storage volume as it requires only the 500 acre-foot increase in the upper reservoir, and does not require any work (i.e. cost) associated with the lower reservoir. As shown below in Section 10.3, a nine foot dam height increase with an associated nine foot increase in maximum water surface elevation would add an additional 501 acre-feet of storage to the reservoir.

10.2.2. Alternative 2: Increase storage volume in upper reservoir and decommission lower reservoir

This alternative involves increasing the storage volume in the upper reservoir by approximately 750 acre-feet. The 750 acre-feet consists of the 500 acre-foot overall volume expansion, plus an additional 250 acre-feet to offset the storage volume lost by decommissioning the lower reservoir. Although Alternative 2 is more expensive than Alternative 1, it addresses concerns about the integrity of the rower reservoir by removing it from the system.

10.3 Stage-Storage Relationship

The additional storage volume that may be obtained by raising the height of the upper reservoir dam is shown below in Table 21 and Figure 26.

Table 21. Additional storage volume available through raising the height of Upper Kingsley dam.

	Elevation[1] (ft)	Additional Storage[1,2] (ft)	Surface Area (ac)	Incremental Volume (ac-ft)	New Volume[2] (ac-ft)	North Dam Length (ft)	South Dam Height (ft)	South Dam Length (ft)
	3,166		49	-	-	1,013	-	-
	3,167	1	50	50	50	1,013	-	-
existing	3,168	2	52	51	101	1,013	-	-
1	3,169	3	53	53	153	1,013	-	-
2	3,170	4	55	54	207	1,013	-	-
3	3,171	5	57	56	263	1,056	1	100
4	3,172	6	58	57	321	1,080	2	177
5	3,173	7	60	59	380	1,104	3	192
6	3,174	8	61	60	440	1,114	4	208
7	3,175	9	62	61	501	1,125	5	237
8	3,176	10	63	63	564	1,134	6	284
9[3]	3,177	11	65	64	628	1,144	7	328
10	3,178	12	66	65	693	1,163	8	355
11	3,179	13	67	66	760	1,185	9	374
12	3,180	14	68	68	827	1,203	10	448
13[4]	3,181	15	69	69	896	1,217	11	505
14	3,182	16	70	70	967	1,228	12	542

Notes: [1]Existing dam height is 3,168 feet with a maximum water surface elevation of 3,166 feet.
[2] Additional storage volume maintains two feet of freeboard.
[3] Section 10.2.1 identifies a nine foot dam raise as a potential target volume for Alternative 1.
[4] Section 10.2.2 identifies a 13 foot dam raise as a potential target volume for Alternative 2.

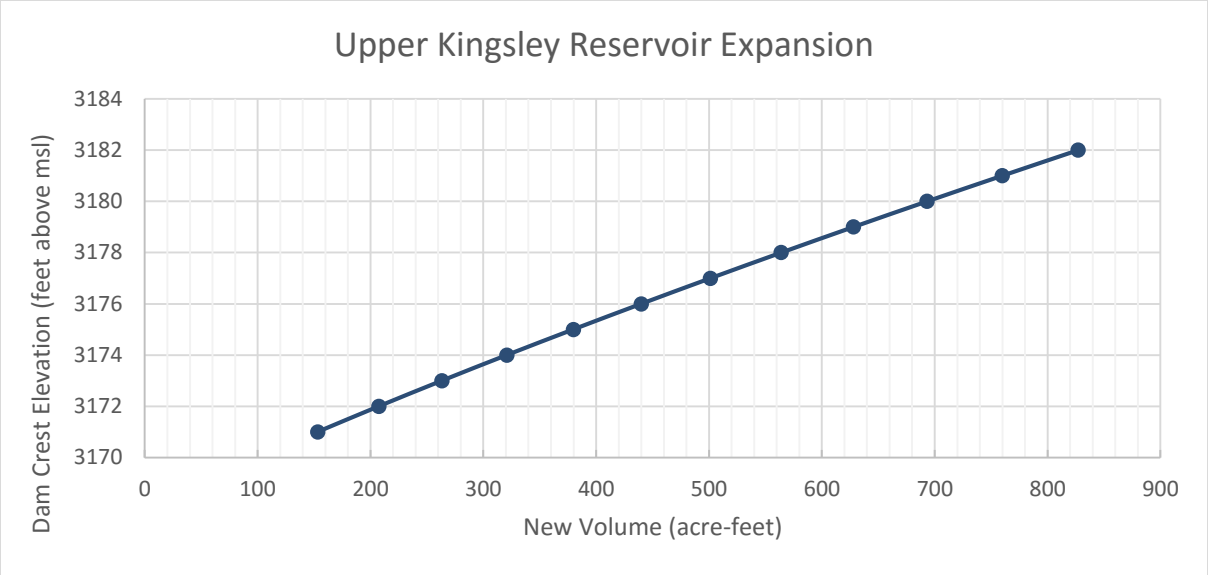


Figure 26. Stage-storage relationship for Upper Kingsley reservoir dam height increase.

10.4 Inundated Area

Raising the elevation of the dam would cause new land to be inundated that has not been inundated in the past (Figure 27). The current maximum water surface elevation of the reservoir is 3166 feet (dark green line), which inundates 49 acres, and raising the maximum water surface elevation to 3175 feet (yellow line, 500 acre-foot expansion) would inundate an additional 13 acres, and raising the water surface elevation to 3179 feet (orange line, 760 acre-foot expansion) would inundate a total additional area of 18 acres. The higher water surface elevations would extend 50-80 feet further on the east, 130-150 feet further on the south, and between 20 feet and 130 feet further on the west side depending on alternative, location and slope.

10.5 Seismic Requirements

A stability analysis of the existing dam was performed by HWA Geosciences in 1996 (HWA, 1996). The analysis indicated that the existing structure has a 1.5 factor of safety under static conditions, and a 1.1 factor of safety on a seismic ground acceleration of 0.15 g. If FID decides to move forward with expanding the existing dam, it would be required to bring the newly enhanced dam up to current standards of a 1.5 safety factor on a 0.25 g seismic event. A preliminary analysis of the design detailed in Section Appendix B indicates the newly expanded structure would meet this requirement, but further analysis should be performed as part of the final design process.

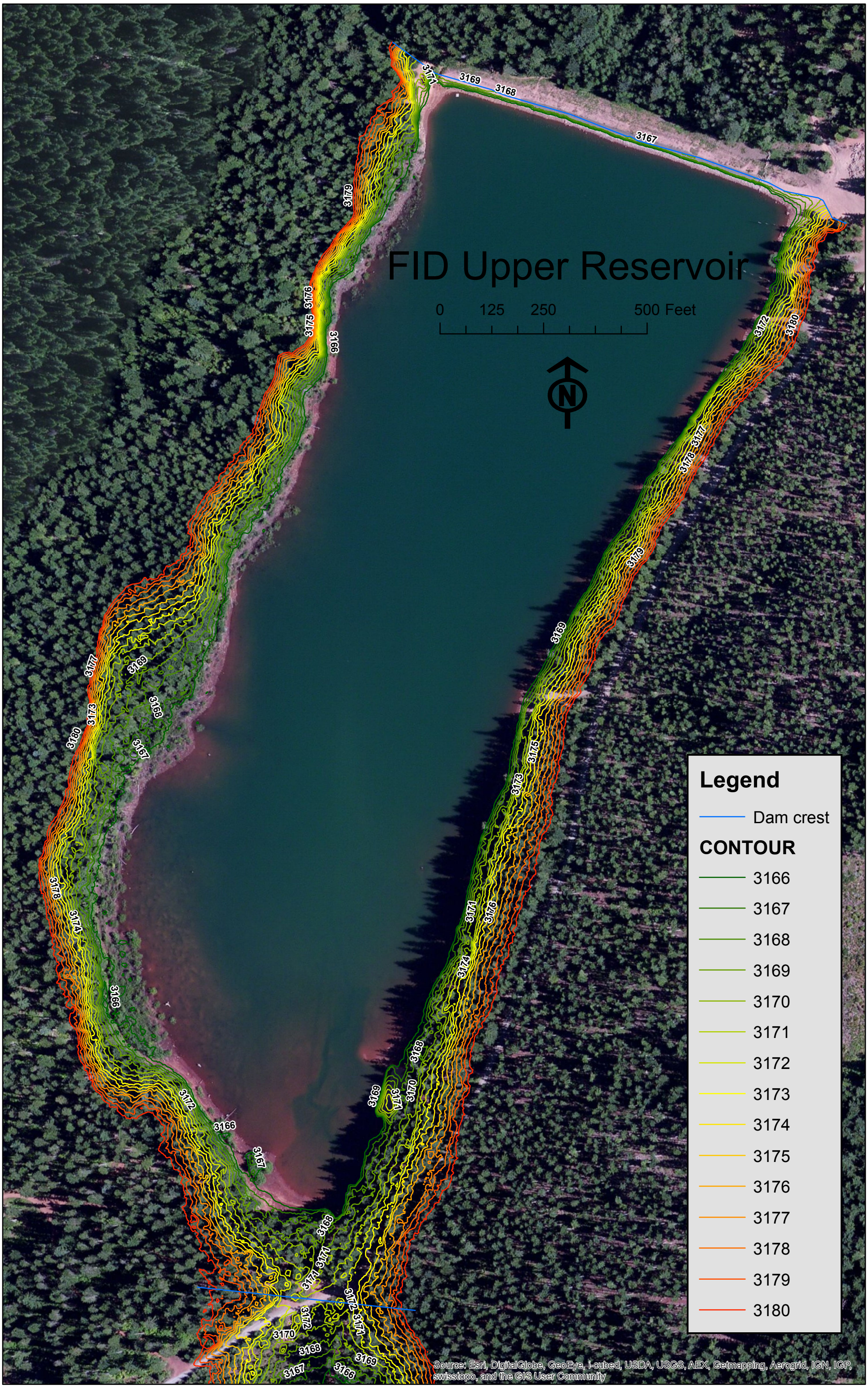


Figure 27. Upper Kingsley Reservoir aerial photo with elevation contours.

10.6 Use of Existing Infrastructure

Provided all contemporary dam safety and operational standards are met, existing reservoir related infrastructure may be utilized to the maximum extent feasible to minimize overall project costs. Major components of the existing reservoir and their ability to be incorporated into the expanded reservoir are discussed below. The ability to use the existing components is applicable to both Alternative 1 and Alternative 2.

10.6.1. Existing dam

According to HWA Geosciences, the existing earthen fill dam of the Upper Kingsley reservoir may be safely incorporated into the reservoir expansion with the following modifications:

1. A trench shall be excavated 6 feet deep by 5 feet wide into the top of the dam for full length of dam. This trench will "key" the new material into the existing dam.

2. The right abutment of the dam shall be over excavated to remove any unconsolidated or leaky material. This right abutment has shown leakage throughout the years and the reservoir expansion provides an opportunity to rehabilitate this area.

10.6.2. Stanley-Smith pipeline

The Stanley-Smith pipeline can be used as is except that approximately the last 150 feet of the pipeline will need to be removed (or abandoned) to accommodate moving the reservoir inlet structure to the southern dike wall. The inlet to the Stanley-Smith pipeline at Gate Creek is at elevation 3,404 feet, which is 238 feet above the existing full reservoir water surface elevation. Raising the water surface elevation by nine feet will reduce the static head from 238 feet to 229 feet, which will not measurably impact the conveyance capacity of the pipeline.

10.6.3. Outlet from Stanley-Smith pipeline (i.e. inlet to the reservoir)

Although the concrete outlet structure from the Stanley-Smith pipeline into the reservoir could conceivably remain in its existing location, it would be preferable to relocate it to near the new southern dike. The existing concrete structure could be reused (i.e. not abandoned in place) along with the associated weir and flow measuring equipment.

10.6.4. Reservoir outlet

The existing reservoir outlet pipe is reverse-grade and has been a source of significant maintenance and therefore should be replaced as a part of a reservoir expansion project. A new reservoir outlet should include a new pipe through the dam, outlet screen on the upstream side, and valve, crankshaft, and controls on the downstream side.

10.6.5. Spillway

The existing spillway will need to be raised to accommodate the any additional dam height and width, and the spillway will have to be improved to existing Oregon State dam safety standards for irrigation dams. The slope of the new spillway would be adjusted so as to remain roughly equivalent to the existing slope, so channel design and scour protection can be based on current conditions in the field. It should be noted here that the natural contributing drainage area to the reservoir is only 0.5 square miles and that the spillway should be designed to accommodate the maximum flow from this area plus the maximum flow conveyance from the Stanley-Smith pipeline. Specifically, the spillway does not need to be designed to convey any flow from the Gate, Cabin, and Rainy Creek drainages in excess of the maximum capacity of the Stanley-Smith pipeline.

10.6.6. Piezometers

The existing dam has four piezometers installed through the core of the dam that should be retained in their existing location during a dam expansion. These piezometers monitor groundwater elevations as piezometric head within the dam and are important for monitoring the integrity of the dam. Depending on the length of the cables on the piezometers, raising the dam will likely require either extending these cable or installing new pressure transducers with longer cables. The stilling well (pipe) housing the pressure transducers will also need to be extended to the top elevation of the new dam.

11. Planning-Level Design

Planning-level design considerations and cross-section are presented below. This planning-level design applies to both Alternative 1 and 2: the main difference between the two alternatives is just the greater amount of fill volume required for the second alternative, and the ability to reuse material from the associated removal of the lower dam. If FID were to move forward with the reservoir expansion project, it should perform soil testing at an early stage to further identify which soils are appropriate for dam construction. Although considerably more expensive than raising the height of the existing dam, dependent on the absence of any historical site downstream, FID may wish to evaluate moving the whole dam further downstream.

11.1 Project Elements

Increasing the storage volume in Upper Kingsley Reservoir should be accomplished by placing new fill on top of and downstream of the existing dam as shown in Figure 28. The expanded dam would be nine (Alternative 1) or thirteen (Alternative 2) feet taller, have a 3H:1V upstream face, 12-foot wide crest, and 2H:1V downstream face. Additionally, Alternative 1 would require a seven-foot tall dike while Alternative 2 would require an eleven foot tall dike at the southern end of the reservoir. Major project elements required as part of this expansion are as follows:

- Implement a temporary erosion and sediment control plan (TESC)
- Clear and grub organic material from project boundaries
- Excavating key trench into top of existing dam
- Excavate right abutment to remove or habilitate unconsolidated material
- Place embankment fill on top and downstream of existing dam to raise dam by nine or thirteen feet. Use soil mixed with bentonite for core of dam extending into key trench
- Place gravel for toe drain
- Place geotextile over gravel toe drain
- Replace outlet pipe and control structure
- Extend piezometer tubes and cabling, and outlet valve control to top of raised dam.
- Construct new seven or eleven foot tall dike at southern end of reservoir
- Construct new Stanley-Smith pipeline outlet and flow measurement facility near dike
- Construct new outlet facility and control valve

11.1.1. <u>Embankment Fill Material</u>

The fill material used for the dam should be of the following Unified Soil Classification System (USCS) types; high or low plasticity clay (CH or CL), high or low plasticity silt (MH or ML), clayey gravel (GC) or clayey sand (SC). The fill material represents the single greatest cost item of the overall dam construction, and therefore local material should be used to the maximum extent feasible to reduce overall project costs. The existing dam is constructed from material that was sourced approximately 500 feet to the east of dam from where additional material may be able to be obtained again (add note after

talk to County/Forestry). Additionally, the material from the reservoir bottom (the area beneath the pool) has been visually reviewed by HWA Geosciences and determined to be acceptable for general fill for the dam expansion. Testing of both these materials would be required during final design to ensure adequate soil properties. Construction of the dam expansion would occur outside of irrigation season, which is typically wet at the project location. As such, either cement or lime (or a combination of the two) would likely be required to be mixed with the fill material before placement to ensure correct moisture content.

11.1.2. Impervious Core Material

The dam should be constructed with an impervious core to reduce seepage through the dam and aid in dam stability. The core should be keyed into the top of the existing dam five feet deep by eight feet wide, and then carried eight feet wide to the top of the dam for its entire length. This core can be constructed by mixing bentonite with the same materials specified above (CH, CL, MH, ML, GC, or SC). Alternatively, the core can be comprised of either clay or silt (i.e. no gravel or sand material) and thus not require mixing with Bentonite. Again, soil testing should be conducted if FID plans to move forward with expanding the reservoir.

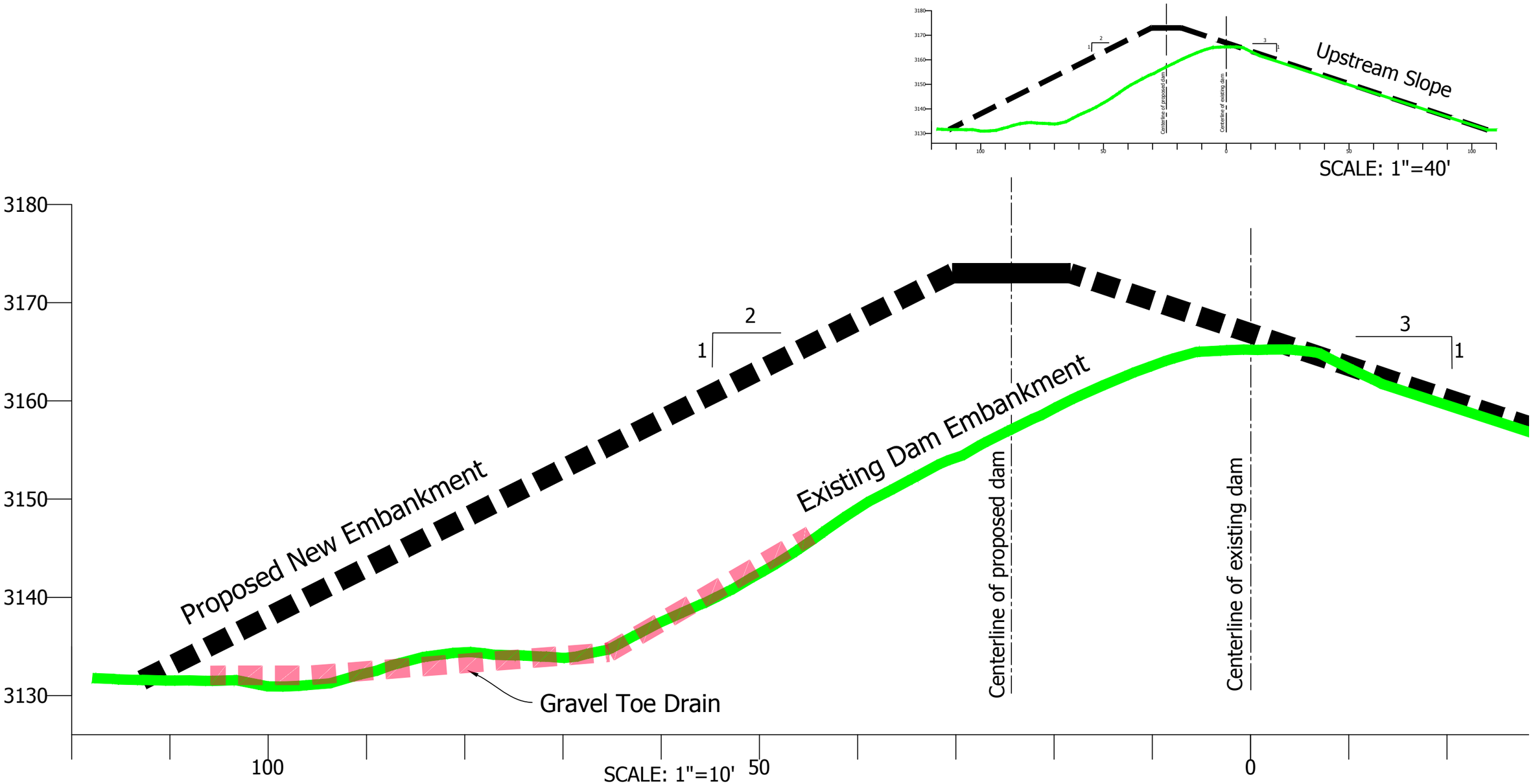


Figure 28. Cross-section of planning-level design for raising Upper Kingsley Dam.

HWA GeoSciences Inc.	Geotechnical Review Kingsley Dam Raising Preliminary Feasibility Study Hood River, Oregon	Cross-Section through the middle of dam	DRAWN BY EFK CHECK BY RB DATE: 06.01.15	FIGURE # PROJECT # 2015-032-21

S:\2015 PROJECTS\2015-032-21 KINGSLEY DAM RAISING PRELIMINARY FEASIBILITY STUDY\CAD 2015-032\HWA 2015-032 XSEC.DWG <Layout1 (2)> Plotted: 6/4/2015 5:49 PM

12. Planning-Level Cost Estimate

Cost estimates are presented below for the one-time capital cost of constructing the facility and the annual operating cost that FID would incur due to operating the expanded reservoir.

12.1 Capital Cost

Line items for Alternative 1 and 2 are similar, except that Alternative 2 has additional embankment fill volumes and the additional cost of removing and re-vegetating the lower reservoir.

12.1.1. Alternative 1

The capital cost for raising the elevation of Upper Kingsley Reservoir by nine feet is $1,740,000 (Table 22). This cost estimate is inclusive of all project costs. It includes sourcing, hauling and placing material, as well as soil testing, engineering, contract documents, and construction oversight. The cost estimate is based on sourcing embankment fill material from either the reservoir bottom (beneath the pool area) or from the source site of the original dam material. Project cost would increase if fill material must be sourced from further away. Using the clayey material from the reservoir pool area might eliminate the need to source and place bentonite in the dam core, which would reduce project cost by approximately $45,000. Costs for tree removal from the new area to be inundated are not included as that area will likely be harvested by Hood River County before any land exchange.

12.1.2. Alternative 2

The capital cost for raising the elevation of Upper Kingsley Reservoir by thirteen feet is $2,480,000 (Table 23) and the cost of decommissioning the lower reservoir is $280,000 (Table 24) for a total project cost of $2,720,000. These costs assume the projects occur concurrently, with the cost of removing the embankment material from the lower reservoir captured in the cost of expanding the upper reservoir since the fill material for the upper reservoir would be derived from the decommissioned lower reservoir. The cost for non-excavation related activities associated with decommissioning the lower reservoir are taken from a 2002 United States Forest Service (USFS) Report titled "Lower Greenpoint Reservoir and Ditch Creek Restoration Analysis" (USFS, 2002) plus a 20 percent markup to cover cost increases since publication of the report.

12.1.3. Cost of Other Potential Expansion Volumes

Figure 29 and 30 show the cost of reservoir expansion by one foot increments between a three foot and fourteen foot dam raise. As expected, due to initial costs incurred before the actual construction commences, the cost per acre-foot decreases with the larger storage volume (Figure 30).

Table 22. Cost estimate for raising Upper Kingsley dam by nine feet.

Item	Quantity	Unit	Unit Cost	Amount	Notes
EXISTING DAM					
EMBANKMENT					
SILT FENCE	2,000	LF	$4	$8,000	
CLEARING AND GRUBBING	2	AC	$2,000	$4,000	Remove organic material from face of dam for extent of project.
REMOVAL/REPAIR RIGHT ABUTMENT	6,000	CY	$8	$48,000	
EXCAVATE KEY TRENCH	1,481	CY	$39	$57,778	8' wide excavation, 5' deep for length of dam.
EMBANKMENT FILL	41,191	CY	$14	$556,078	
BENTONITE FOR CLAY CORE	146	TON	$333	$48,701	Bentonite mixed with soil for length of dam from key trench to top of new embankment. Includes haul (22.5 tons/truck) and spreading.
GRAVEL TOE DRAIN	3,675	CY	$77	$282,975	
GEOTEXTILE OVER TOE DRAIN	7,350	SY	$2	$14,700	
OUTLET AND SPILLWAY					
18" HDPE OUTLET PIPE	280	LF	$200	$56,000	New outlet pipe through existing dam and extending downstream of dam expansion.
18" OUTLET VALVE, GUIDES, ENCLOSURE	1	LS	$35,000	$35,000	New outlet, valve, and controls.
18" SCREENED OUTLET	1	LS	10,000	$10,000	
SPILLWAY	1	LS	$8,000	$8,000	Upstream end of existing earthen spillway to be raised 8' and rock placed for scour protection. Includes cost of materials and construction.
SITE RESTORATION					
LOOSE RIPRAP, CLASS 100	1,583	CY	$77	$121,917	2' deep riprap for new upstream dam face.
3/4 INCH - AGGREGATE BASE	208	CY	$78	$16,234	15' wide road, 4" deep.
SITE RESTORATION	1.125	EA	$5,000	$5,625	Seeding and planting.
NEW UPSTREAM DIKE					
EMBANKMENT					
EMBANKMENT FILL	1,614	CY	$14	$22,596	7' tall x 328' long, 2H:1V slopes, 5' top width.
MODIFY EXISTING INLET	1	LS	$7,000	$7,000	
TOTAL DIRECT COSTS:				**$1,302,600**	
MARKUPS					
MOBILIZATION AND STAGING	-	%	5%	$65,130	
CONTINGENCY	-	%	10%	$130,260	
TOTAL CONSTRUCTION COSTS:				$1,498,000	
OTHER PROJECT COSTS					
SOIL TESTING	1	LS	$10,000	$10,000	Testing for suitability of local soils, optimal moisture content, and compaction specifications.
TESTING, DESIGN AND ENGINEERING	-	%	10%	$149,800	Includes preliminary design through final design of all project components, specifications and contract documents
PERMITTING	1	LS	$20,000	$20,000	Permitting costs uncertain.
CONSTRUCTION MANAGEMENT	-	%	5%	$74,900	Cost incurred through FID staff time and construction oversight engineer.
TOTAL PROJECT COSTS:				**$1,740,000**	

Table 23. Cost estimate for raising Upper Kingsley dam by thirteen feet.

Item	Quantity	Unit	Unit Cost	Amount	Notes
EXISTING DAM					
EMBANKMENT					
SILT FENCE	2,000	LF	$4	$8,000	
CLEARING AND GRUBBING	2	AC	$2,000	$4,000	Remove organic material from face of dam for extent of project.
REMOVAL/REPAIR RIGHT ABUTMENT	6,000	CY	$8	$48,000	
EXCAVATE KEY TRENCH	1,481	CY	$39	$57,778	8' wide excavation, 5' deep for length of dam.
EMBANKMENT FILL	66,739	CY	$14	$900,976	
BENTONITE FOR CLAY CORE	211	TON	$333	$70,346	Bentonite mixed with soil for length of dam from key trench to top of new embankment. Includes haul (22.5 tons/truck) and spreading.
GRAVEL TOE DRAIN	4,467	CY	$77	$343,958	
GEOTEXTILE OVER TOE DRAIN	8,934	SY	$2	$17,868	
OUTLET AND SPILLWAY					
18" HDPE OUTLET PIPE	320	LF	$100	$64,000	New outlet pipe through existing dam and extending downstream of dam expansion.
18" OUTLET VALVE, GUIDES, ENCLOSURE	1	LS	$35,000	$35,000	New outlet, valve, and controls.
18" SCREENED OUTLET	1	LS	10,000	$10,000	
SPILLWAY	1	LS	$8,000	$8,000	Upstream end of existing earthen spillway to be raised 8' and rock placed for scour protection. Includes cost of materials and construction.
SITE RESTORATION					
LOOSE RIPRAP, CLASS 100	2,287	CY	$77	$176,102	2' deep riprap for new upstream dam face.
3/4 INCH - AGGREGATE BASE	301	CY	$78	$23,449	15' wide road, 4" deep.
SITE RESTORATION	1.625	EA	$5,000	$8,125	Seeding and planting.
NEW UPSTREAM DIKE					
EMBANKMENT					
EMBANKMENT FILL	5,553	CY	$14	$77,739	11' tall x 505' long, 2H:1V slopes, 5' top width.
MODIFY EXISTING INLET	1	LS	$7,000	$7,000	
TOTAL DIRECT COSTS:				$1,860,300	
MARKUPS					
MOBILIZATION AND STAGING	-	%	5%	$93,015	
CONTINGENCY	-	%	10%	$186,030	
TOTAL CONSTRUCTION COSTS:				$2,103,000	
OTHER PROJECT COSTS					
SOIL TESTING	1	LS	$10,000	$10,000	Testing for suitability of local soils, optimal moisture content, and compaction specifications.
TESTING, DESIGN AND ENGINEERING	-	%	10%	$213,900	Includes preliminary design through final design of all project components, specifications and contract documents
PERMITTING	1	LS	$20,000	$20,000	Permitting costs uncertain.
CONSTRUCTION MANAGEMENT	-	%	5%	$106,950	Cost incurred through FID staff time and construction oversight engineer.
TOTAL PROJECT COSTS:				**$2,480,000**	

Table 24. Cost estimated for restoration activities associated with decommissioning Lower Kingsley dam.

Item	Quantity	Unit	Unit Cost	Cost	Notes
Logging	20	Acres	$1,200	$24,000	Obtaining logs from the Lake Branch watershed for large woody debris placement for channel restoration.
Large Wood Haul	20	Truck loads	$480	$9,600	Self-Loading Log Truck
Log Skidding	30	Hours	$90	$2,700	Rubber Tire Skidder
Upland Wood Placement	30	Hours	$180	$5,400	Excavator
Gravel Delivery	14	Load	$480	$6,720	Dump Truck
Channel and Riparian Restoration	150	Hours	$180	$27,000	Excavator
	20	Hours	$120	$2,400	Dump Truck
Road Upgrade	12	Hours	$120	$1,440	Dump Truck
	20	Hours	$150	$3,000	D8 Dozer
Road Closure (berms)	40	Hours	$180	$7,200	Excavator
	3	Hours	$120	$360	Dump Truck
Road & Quarry Obliteration	40	Hours	$180	$7,200	Excavator
Conifer Reforestation	15	Acre	$180	$2,700	Planting Crew
Seed, Mulch, and Fertilizer Slash Spreading	20	Crew Days	$600	$12,000	Planting Crew
Compost Mulch Application (3" depth)	10	Acre	$9,600	$96,000	Planting Crew
TOTAL DIRECT COST:				$207,720	
MARKUPS					
MOBILIZATION AND STAGING	-	%	0%	-	Mobilization covered on Table 23.
CONTINGENCY	-	%	10%	20,772	
TOTAL CONSTRUCTION COST:				228,492	
OTHER PROJECT COSTS					
DESIGN	1	LS	$25,000	25,000	Includes channel design and contract documents
PERMITTING	1	LS	$5,000	5,000	Permitting costs uncertain.
CONSTRUCTION MANAGEMENT	70	Person Days	$350	24,500	Cost incurred through FID staff time and construction oversight engineer.
TOTAL PROJECT COST:				**280,000**	

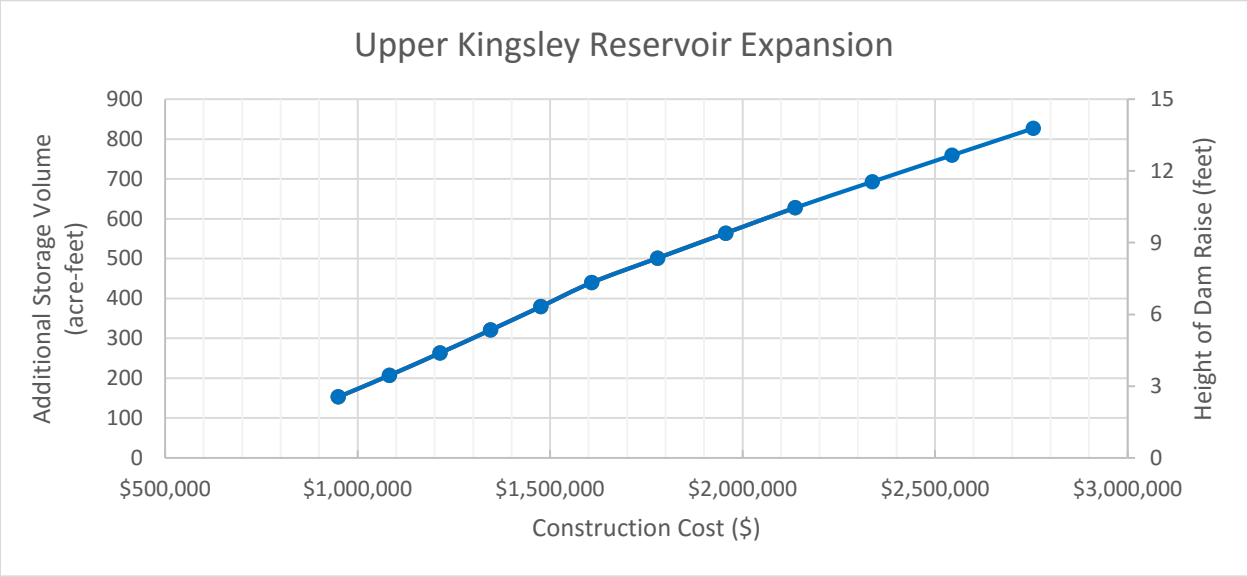


Figure 29. Construction cost associated with raising Upper Kingsley reservoir between three and eleven feet.

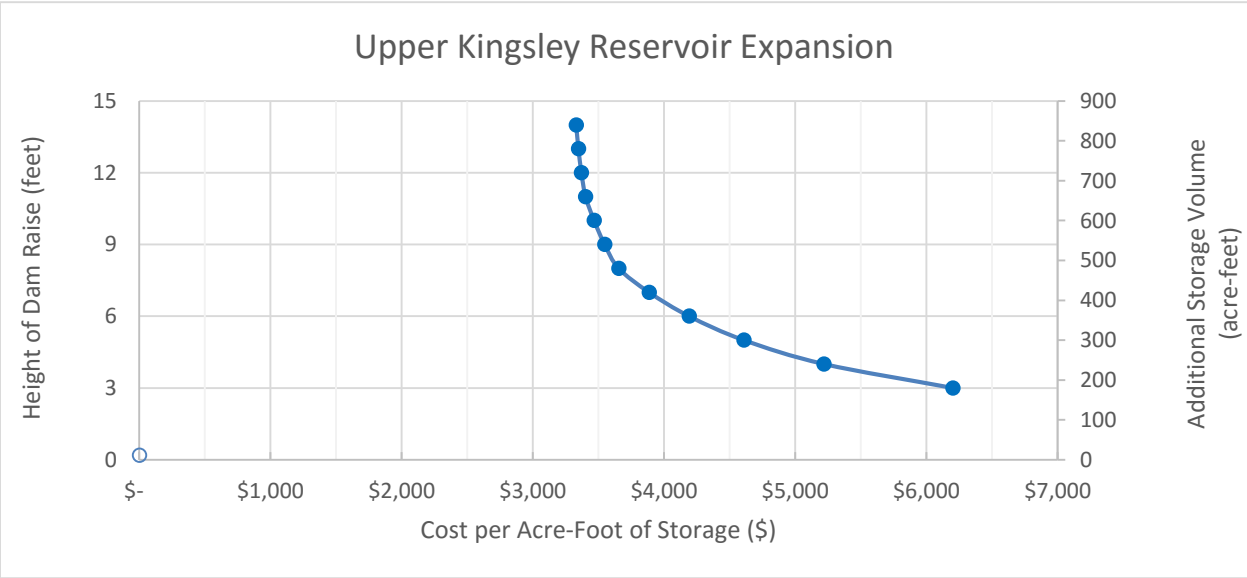


Figure 30. Cost per acre-foot of storage as a function of reservoir expansion volume

12.2 Annual Cost

FID's annual cost for operating the expanded reservoir can be divided into the following two categories: 1) increased operations and maintenance cost compared to operating the existing reservoir system, and 2) decreased revenue from storing water as opposed to conveying it for hydropower production.

12.2.1. Operations and Maintenance

No additional operations and maintenance cost would be incurred above FID's current costs.

12.2.2. Lost Hydropower Revenue

FID's lost hydropower revenue would be approximately $32,100 per year. This is based on FID's historic generation (Figure 31), a power purchase price of $0.07 per kW-hr, and forgoing 2.7 cfs of generation for three months, and calculated as follows:

➔ *2.7 cfs x (37,734 + 18,912) kW-hr/month/cfs x 3 months/year x $0.07/kW-hr = $32,118 per year*

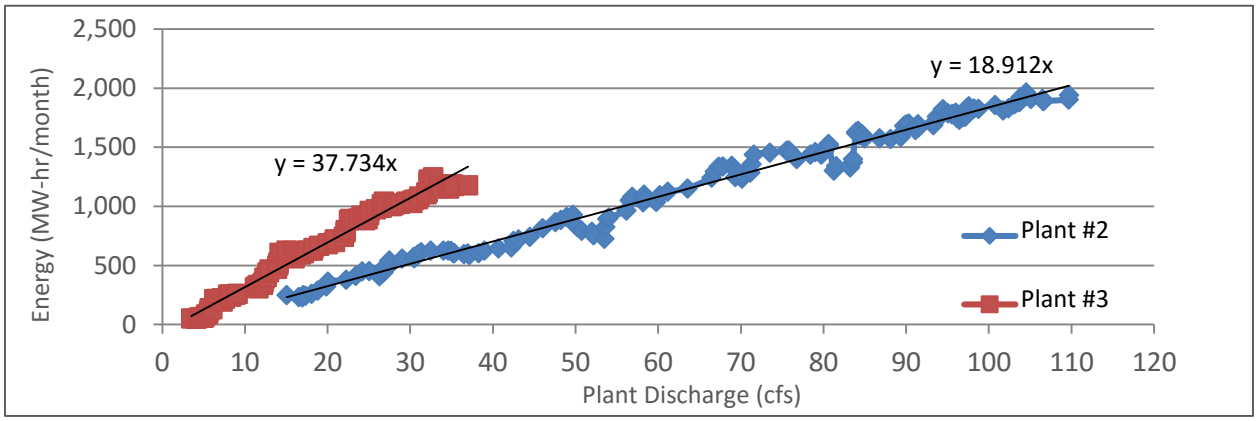


Figure 31. FID power generation as a function of flow at Plant #2 and Plant #3.

13. Recommendations and Next Steps

Based on the analysis presented in this report, it is recommended that FID expand the storage volume in its reservoir system by up to 631 acre-feet. Due to structural issues with the lower reservoir, coupled with the upper reservoir's larger surface area, expanding the storage volume should be done at the upper reservoir.

Additionally, the reservoirs have seen very few changes since the 1930s when they were built, and expanding the overall storage volume provides FID an opportunity to bring the entire system up to contemporary standards by concurrently decommissioning the lower reservoir. The lower reservoir has had several structural deficiencies identified, and decommissioning along with channel restoration through the lower reservoir footprint have been prioritized for several decades by natural resource agencies.

Ultimately, FID will need to evaluate the district's financial resources (including the ability to obtain outside funding) along with its tolerance to risk of drought and potential lower dam failure so as to determine if and how it wishes to increase its storage volume. Due to the fixed costs incurred irrespective of project size (e.g., soil testing, engineering, and mobilization), the first 200 acre-feet of storage ($1,100,000) costs approximately the same per acre foot as the next 423 acre-feet ($2,100,000 for a total of 630 acre-feet), and, therefore, if FID elects to move forward with reservoir expansion, it should do so in a single large project as opposed to several smaller projects.

The following steps should be taken if FID decides to expand the reservoir storage volume:

1. Apply to OWRD for a storage water right.
2. Determine if FID has the financial resources to decommission the lower reservoir concurrently with expanding the upper reservoir volume.
3. Start formal process with Hood River County to obtain land (or easement) to expand reservoir volume.
4. Perform soil testing to finalize the design process.
5. Seek outside resource to help fund the project. The OWRD Senate Bill 839 funding is specifically designed to help districts such as FID implement water reliability projects. Applications for the next round of SB 839 funding are due on January 15, 2016. If FID is interested in SB 839 funding, FID should complete the "Application Guidance" section in the SB 839 application and meet with an OWRD representative to discuss the project. FID should also seek formal guidance on OWRD's Seasonally Varying Flow requirement as part of the initial application review.

14. References

Anderson Perry and Associates 2003	Evaluation of Greenpoint Reservoirs, April 2003. Performed by Anderson Perry and Associates for Farmers Irrigation District.
FID 2011	Water Management and Conservation Plan. Prepared by Farmers Irrigation District. January 2011.
Hood River County 2014	Hood River Basin Surface Water Storage Feasibility Assessment. June 2014. Written by Hood River County and funded through the Oregon Water Resources Department. Available at: http://www.co.hood-river.or.us/
Hood River SWCD 2013	Hood River Irrigation Upgrade Flow Meter Monitoring: Final Monitoring Report. Hood River Soil and Water Conservation District. January 2013.
HWA Geoscience 1992	Preliminary Geotechnical Investigation of Upper and Lower Greenpoint Dams, Hood River, Oregon. January 31, 1992. Prepared by Hong West and Associates for Farmers Irrigation District.
HWA GeoSciences 2002	Stability Evaluation of the Existing Dam Structure, Upper Green Point Reservoir Project, Hood River, Oregon. October 18, 2002. Prepared by Hong West and Associates for Farmers Irrigation District.
HWA GeoSciences 2015	Geotechnical Review Kingsley Dam Raising Preliminary Feasibility Study, Prepared by HWA GeoSciences for Watershed Professionals Network. March 2015.
Irrinet 2007	Farmers Irrigation District Impact Sprinkler Conversion Project. Irrinet LLC. November 2007.
Normandau Associates 2014	Hood River Instream Flow Study, Prepared for Hood River County June 2012, Normandeau Associates Inc.
Oregon State University Extension 2010	2010 Oregon County and State Agricultural Estimates. Special Report 790-10. February 2011.

Reclamation 2012	Bureau of Reclamation. 2012. Hood River Basin Study Surface Water Storage Feasibility Assessment. U.S. Department of the Interior, Bureau of Reclamation, Pacific Northwest Regional Office, Boise, Idaho. June 2012.
Reclamation 2013	AgriMet, the Pacific Northwest Cooperative Agricultural Weather Network. United States Department of the Interior, Bureau of Reclamation. Accessed (July 10, 2013). http://www.usbr.gov/pn/agrimet/
Reclamation 2014	Bureau of Reclamation. 2014. Hood River Basin Study Final Report. U.S. Department of the Interior, Bureau of Reclamation, Pacific Northwest Regional Office, Boise, Idaho. February 2014.
Soil Conservation Services 1979	Geologic Report: Oak Grove Watershed, Greenpoint Dam and Reservoir Site. Soil Conservation Service, U.S. Department of Agriculture, Portland, Oregon, January 1979.
USFS 2002	United States Forest Service. 2002 Lower Greenpoint Reservoir and Ditch Creek Restoration Analysis. USFS, 2002
WPN 2013a	Christensen, N. and E. Salminen. 2013. Hood River Basin Water Use Assessment. Prepared for Hood River County. June 2013. Available at http://www.co.hood-river.or.us/vertical/sites/%7B4BB5BFDA-3709-449E-9B16-B62A0A0DD6E4%7D/uploads/Hood_River_Basin_Water_Use_Assessment.pdf
WPN 2013b	Watershed Professionals Network LLC. 2013. Hood River Basin Water Conservation Assessment. Prepared for Hood River County. August 2013. Available at http://www.co.hood-river.or.us/vertical/sites/%7B4BB5BFDA-3709-449E-9B16-B62A0A0DD6E4%7D/uploads/Hood_River_Basin_Water_Conservation_Assessment.pdf
Wy' East 2002	Survey of Upper and Lower Kingsley Reservoir System, report dated June 26, 2002. Performed by Wy' East Surveyors.

15. Appendix

Appendix A 1988 Agreement between Hood River County and Farmers Irrigation District for expansion of the Kingsley Reservoir System.

Appendix B HWA Geo Sciences Geotechnical Review Kingsley Dam Raising Preliminary Feasibility Study, Prepared by HWA GeoSciences for Watershed Professionals Network. March 2015.

Water Availability Analysis

GREEN POINT CR > W FK HOOD R - AT MOUTH
HOOD BASIN

Water Availability as of 10/20/2015

Watershed ID #: 30410506 (Map)

Exceedance Level: 50%

Date: 10/20/2015

Time: 1:31 PM

Dow nload Data

Water Availability

Select any Watershed for Details

Watershed ID #	Stream Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sto
192	HOOD R> COLUMBIA R- AT MOUTH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
30410575	HOOD R> COLUMBIA R- AT RM 0.75	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes
72076	W FK HOOD R> HOOD R- AT MOUTH	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes
30410506	**GREEN POINT CR> W FK HOOD R- AT MOUTH**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**

Limiting Watersheds

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

Month	Limiting Watershed ID #	Stream Name	Water Available?	Net Water Available
JAN	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	93.40
FEB	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	109.00
MAR	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	106.00
APR	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	122.00
MAY	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	122.00
JUN	30410575	HOOD R > COLUMBIA R - AT RM 0.75	No	-36.90
JUL	30410575	HOOD R > COLUMBIA R - AT RM 0.75	No	-292.00
AUG	30410575	HOOD R > COLUMBIA R - AT RM 0.75	No	-430.00
SEP	30410575	HOOD R > COLUMBIA R - AT RM 0.75	No	-407.00
OCT	30410575	HOOD R > COLUMBIA R - AT RM 0.75	No	-273.00
NOV	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	64.70
DEC	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	87.40
ANN	30410506	GREEN POINT CR > W FK HOOD R - AT MOUTH	Yes	42,300.00

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

Month	Natural Stream Flow	Consumptive Uses and Storages	Expected Stream Flow	Reserved Stream Flow	Instream Flow Requirement	Net Water Available
JAN	1,260.00	72.60	1,190.00	186.00	170.00	831.00
FEB	1,380.00	75.30	1,300.00	206.00	270.00	828.00
MAR	1,300.00	74.30	1,230.00	184.00	270.00	772.00
APR	1,320.00	122.00	1,200.00	122.00	270.00	806.00
MAY	1,310.00	195.00	1,120.00	117.00	250.00	749.00
JUN	1,040.00	240.00	800.00	86.60	250.00	463.00
JUL	739.00	281.00	458.00	0.00	250.00	208.00
AUG	559.00	239.00	320.00	0.00	250.00	70.40
SEP	511.00	168.00	343.00	0.00	250.00	93.30
OCT	517.00	69.90	447.00	0.00	220.00	227.00
NOV	870.00	70.10	800.00	45.50	100.00	654.00
DEC	1,160.00	71.40	1,090.00	120.00	170.00	798.00
ANN	721,000.00	102,000.00	619,000.00	64,000.00	164,000.00	391,000.00

Detailed Report of Consumptive Uses and Storage

Consumptive Uses and Storages in Cubic Feet per Second

Month	Storage	Irrigation	Municipal	Industrial	Commercial	Domestic	Agricultural	Other	Total
JAN	0.21	0.00	37.10	2.96	0.23	2.16	29.40	0.64	72.60
FEB	0.25	0.00	39.80	2.96	0.23	2.16	29.40	0.64	75.30
MAR	0.23	0.00	38.80	2.96	0.23	2.16	29.40	0.64	74.30
APR	0.16	48.80	38.30	2.96	0.06	2.16	29.40	0.64	122.00
MAY	0.12	114.00	45.20	2.96	0.06	2.16	29.40	0.64	195.00
JUN	0.09	157.00	48.10	2.96	0.06	2.16	29.40	0.64	240.00
JUL	0.06	205.00	40.30	2.96	0.06	2.16	29.40	0.64	281.00
AUG	0.05	167.00	36.50	2.96	0.06	2.16	29.40	0.64	239.00
SEP	0.04	96.80	35.60	2.96	0.06	2.16	29.40	0.64	168.00
OCT	0.05	0.15	34.50	2.96	0.06	2.16	29.40	0.64	69.90
NOV	0.11	0.00	34.90	2.96	0.06	2.16	29.40	0.64	70.10
DEC	0.18	0.00	36.10	2.96	0.06	2.16	29.40	0.64	71.40

Detailed Report of Reservations for Storage and Consumptive Uses

Reserved Streamflow in Cubic Feet per Second

Application #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RN80401A	39.50	43.00	36.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.60
RN80402A	130.00	136.00	122.00	106.00	117.00	86.60	0.00	0.00	0.00	0.00	45.50	88.80
RN80403A	16.20	26.90	25.70	15.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**185.70**	**205.90**	**183.70**	**121.58**	**117.00**	**86.60**	**0.00**	**0.00**	**0.00**	**0.00**	**45.50**	**120.40**

Detailed Report of Instream Flow Requirements

Instream Flow Requirements in Cubic Feet per Second

Application #	Status	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MF191A	CERTIFICATE	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
MF192A	CERTIFICATE	170.00	270.00	270.00	270.00	170.00	170.00	130.00	100.00	100.00	100.00	100.00	170.00
IS83969A	CERTIFICATE	0.00	0.00	0.00	0.00	250.00	250.00	250.00	250.00	250.00	220.00	0.00	0.00
Maximum		**170.00**	**270.00**	**270.00**	**270.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**220.00**	**100.00**	**170.00**

Detailed Reports for Watershed ID #30410575

HOOD R > COLUMBIA R - AT RM 0.75
HOOD BASIN

Water Availability as of 10/20/2015

Watershed ID #: 30410575 (Map)

Exceedance Level: 50%

Date: 10/20/2015

Time: 1:31 PM

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

Month	Natural Stream Flow	Consumptive Uses and Storages	Expected Stream Flow	Reserved Stream Flow	Instream Flow Requirement	Net Water Available
JAN	1,260.00	573.00	687.00	186.00	170.00	331.00
FEB	1,380.00	575.00	805.00	206.00	270.00	328.00
MAR	1,300.00	574.00	726.00	184.00	270.00	272.00
APR	1,320.00	622.00	698.00	122.00	270.00	306.00
MAY	1,310.00	695.00	615.00	117.00	250.00	249.00
JUN	1,040.00	740.00	300.00	86.60	250.00	-36.90
JUL	739.00	781.00	-42.00	0.00	250.00	-292.00
AUG	559.00	739.00	-180.00	0.00	250.00	-430.00
SEP	511.00	668.00	-157.00	0.00	250.00	-407.00
OCT	517.00	570.00	-52.90	0.00	220.00	-273.00

NOV	870.00	570.00	300.00	45.50	100.00	154.00
DEC	1,160.00	571.00	589.00	120.00	170.00	298.00
ANN	721,000.00	464,000.00	283,000.00	64,000.00	164,000.00	116,000.00

Detailed Report of Consumptive Uses and Storage

Consumptive Uses and Storages in Cubic Feet per Second

Month	Storage	Irrigation	Municipal	Industrial	Commercial	Domestic	Agricultural	Other	Total
JAN	0.18	0.00	37.10	2.96	0.23	2.16	29.40	501.00	573.00
FEB	0.22	0.00	39.80	2.96	0.23	2.16	29.40	501.00	575.00
MAR	0.20	0.00	38.80	2.96	0.23	2.16	29.40	501.00	574.00
APR	0.16	48.80	38.30	2.96	0.06	2.16	29.40	501.00	622.00
MAY	0.12	114.00	45.20	2.96	0.06	2.16	29.40	501.00	695.00
JUN	0.09	157.00	48.10	2.96	0.06	2.16	29.40	501.00	740.00
JUL	0.06	205.00	40.30	2.96	0.06	2.16	29.40	501.00	781.00
AUG	0.05	167.00	36.50	2.96	0.06	2.16	29.40	501.00	739.00
SEP	0.04	96.80	35.60	2.96	0.06	2.16	29.40	501.00	668.00
OCT	0.04	0.15	34.50	2.96	0.06	2.16	29.40	501.00	570.00
NOV	0.09	0.00	34.90	2.96	0.06	2.16	29.40	501.00	570.00
DEC	0.15	0.00	36.10	2.96	0.06	2.16	29.40	501.00	571.00

Detailed Report of Reservations for Storage and Consumptive Uses

Reserved Streamflow in Cubic Feet per Second

Application #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RN80401A	39.50	43.00	36.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.60
RN80402A	130.00	136.00	122.00	106.00	117.00	86.60	0.00	0.00	0.00	0.00	45.50	88.80

RN80403A	16.20	26.90	25.70	15.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**185.70**	**205.90**	**183.70**	**121.58**	**117.00**	**86.60**	**0.00**	**0.00**	**0.00**	**0.00**	**45.50**	**120.40**

Detailed Report of Instream Flow Requirements

Instream Flow Requirements in Cubic Feet per Second

Application #	Status	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MF191B	CERTIFICATE	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
MF192B	CERTIFICATE	170.00	270.00	270.00	270.00	170.00	170.00	130.00	100.00	100.00	100.00	100.00	170.00
IS83969B	CERTIFICATE	0.00	0.00	0.00	0.00	250.00	250.00	250.00	250.00	250.00	220.00	0.00	0.00
Maximum		**170.00**	**270.00**	**270.00**	**270.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**220.00**	**100.00**	**170.00**

Detailed Reports for Watershed ID #72076

W FK HOOD R > HOOD R - AT MOUTH
HOOD BASIN

Water Availability as of 10/20/2015

Watershed ID #: 72076 (Map)

Exceedance Level: 50%

Date: 10/20/2015

Time: 1:31 PM

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

Month	Natural Stream Flow	Consumptive Uses and Storages	Expected Stream Flow	Reserved Stream Flow	Instream Flow Requirement	Net Water Available
JAN	603.00	24.50	579.00	39.50	150.00	389.00
FEB	643.00	24.50	619.00	43.00	150.00	426.00
MAR	608.00	25.80	582.00	36.00	150.00	396.00
APR	665.00	38.50	626.00	0.18	255.00	371.00
MAY	621.00	46.90	574.00	0.00	255.00	319.00
JUN	401.00	53.20	348.00	0.00	255.00	92.80
JUL	244.00	62.10	182.00	0.00	150.00	31.90
AUG	184.00	54.10	130.00	0.00	180.00	-50.10
SEP	177.00	44.30	133.00	0.00	176.00	-43.30
OCT	197.00	31.10	166.00	0.00	195.00	-29.10

NOV	465.00	24.50	441.00	0.00	255.00	186.00
DEC	597.00	24.50	573.00	31.60	180.00	361.00
ANN	325,000.00	27,500.00	298,000.00	9,000.00	142,000.00	155,000.00

Detailed Report of Consumptive Uses and Storage

Consumptive Uses and Storages in Cubic Feet per Second

Month	Storage	Irrigation	Municipal	Industrial	Commercial	Domestic	Agricultural	Other	Total
JAN	0.00	0.00	22.50	0.00	0.00	0.01	1.45	0.50	24.50
FEB	0.00	0.00	22.50	0.00	0.00	0.01	1.45	0.50	24.50
MAR	0.00	1.33	22.50	0.00	0.00	0.01	1.45	0.50	25.80
APR	0.00	14.10	22.50	0.00	0.00	0.01	1.45	0.50	38.50
MAY	0.00	22.50	22.50	0.00	0.00	0.01	1.45	0.50	46.90
JUN	0.00	28.80	22.50	0.00	0.00	0.01	1.45	0.50	53.20
JUL	0.00	37.60	22.50	0.00	0.00	0.01	1.45	0.50	62.10
AUG	0.00	29.70	22.50	0.00	0.00	0.01	1.45	0.50	54.10
SEP	0.00	19.80	22.50	0.00	0.00	0.01	1.45	0.50	44.30
OCT	0.00	6.65	22.50	0.00	0.00	0.01	1.45	0.50	31.10
NOV	0.00	0.00	22.50	0.00	0.00	0.01	1.45	0.50	24.50
DEC	0.00	0.00	22.50	0.00	0.00	0.01	1.45	0.50	24.50

Detailed Report of Reservations for Storage and Consumptive Uses

Reserved Streamflow in Cubic Feet per Second

Application #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RN80401A	39.50	43.00	36.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.60

	Total	39.50	43.00	36.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.60

Detailed Report of Instream Flow Requirements

Instream Flow Requirements in Cubic Feet per Second

Application #	Status	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MF196A	CERTIFICATE	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
IS72076A	CERTIFICATE	150.00	150.00	150.00	255.00	255.00	255.00	150.00	180.00	176.00	195.00	255.00	180.00
Maximum		150.00	150.00	150.00	255.00	255.00	255.00	150.00	180.00	176.00	195.00	255.00	180.00

Detailed Reports for Watershed ID #30410506

GREEN POINT CR > W FK HOOD R - AT MOUTH
HOOD BASIN

Water Availability as of 10/20/2015

Watershed ID #: 30410506 (Map)

Exceedance Level: 50%

Date: 10/20/2015

Time: 1:31 PM

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

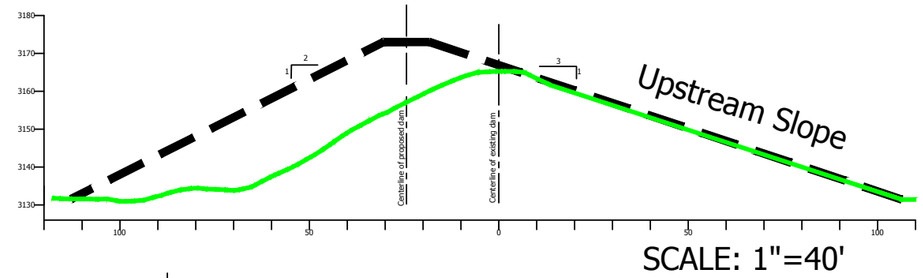
Month	Natural Stream Flow	Consumptive Uses and Storages	Expected Stream Flow	Reserved Stream Flow	Instream Flow Requirement	Net Water Available
JAN	93.90	0.51	93.40	0.00	0.00	93.40
FEB	110.00	0.51	109.00	0.00	0.00	109.00
MAR	107.00	0.71	106.00	0.00	0.00	106.00
APR	124.00	2.40	122.00	0.00	0.00	122.00
MAY	125.00	3.39	122.00	0.00	0.00	122.00
JUN	64.70	4.13	60.60	0.00	0.00	60.60
JUL	26.80	5.25	21.60	0.00	0.00	21.60
AUG	16.50	4.22	12.30	0.00	0.00	12.30
SEP	16.20	3.06	13.10	0.00	0.00	13.10
OCT	29.00	1.51	27.50	0.00	0.00	27.50

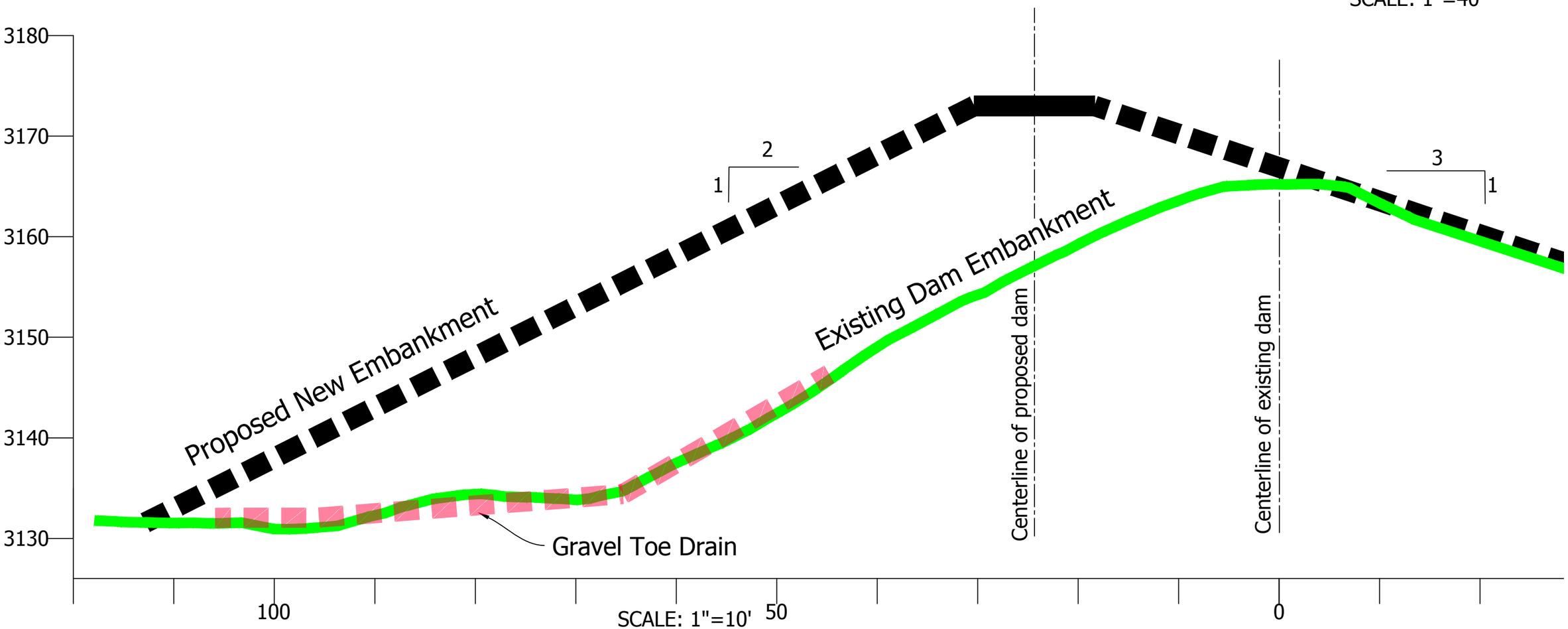
NOV	65.20	0.51	64.70	0.00	0.00	64.70
DEC	87.90	0.51	87.40	0.00	0.00	87.40
ANN	52,100.00	1,620.00	50,500.00	0.00	0.00	50,500.00

Detailed Report of Consumptive Uses and Storage

Consumptive Uses and Storages in Cubic Feet per Second

Month	Storage	Irrigation	Municipal	Industrial	Commercial	Domestic	Agricultural	Other	Total
JAN	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.51
FEB	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.51
MAR	0.00	0.20	0.00	0.00	0.00	0.00	0.51	0.00	0.71
APR	0.00	1.89	0.00	0.00	0.00	0.00	0.51	0.00	2.40
MAY	0.00	2.88	0.00	0.00	0.00	0.00	0.51	0.00	3.39
JUN	0.00	3.62	0.00	0.00	0.00	0.00	0.51	0.00	4.13
JUL	0.00	4.74	0.00	0.00	0.00	0.00	0.51	0.00	5.25
AUG	0.00	3.71	0.00	0.00	0.00	0.00	0.51	0.00	4.22
SEP	0.00	2.55	0.00	0.00	0.00	0.00	0.51	0.00	3.06
OCT	0.00	1.00	0.00	0.00	0.00	0.00	0.51	0.00	1.51
NOV	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.51
DEC	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.51





HWA GEOSCIENCES INC.

Geotechnical Review
Kingsley Dam Raising
Preliminary Feasibility Study
Hood River, Oregon

Cross-Section through the middle of dam

DRAWN BY EFK	FIGURE #
CHECK BY RB	PROJECT # 2015-032-21
DATE: 06.01.15	

S:\2015 PROJECTS\2015-032-21 KINGSLEY DAM RAISING PRELIMINARY FEASIBILITY STUDY\CAD 2015-032\HWA 2015-032 XSEC.DWG <Layout1 (2)> Plotted: 6/4/2015 5:49 PM

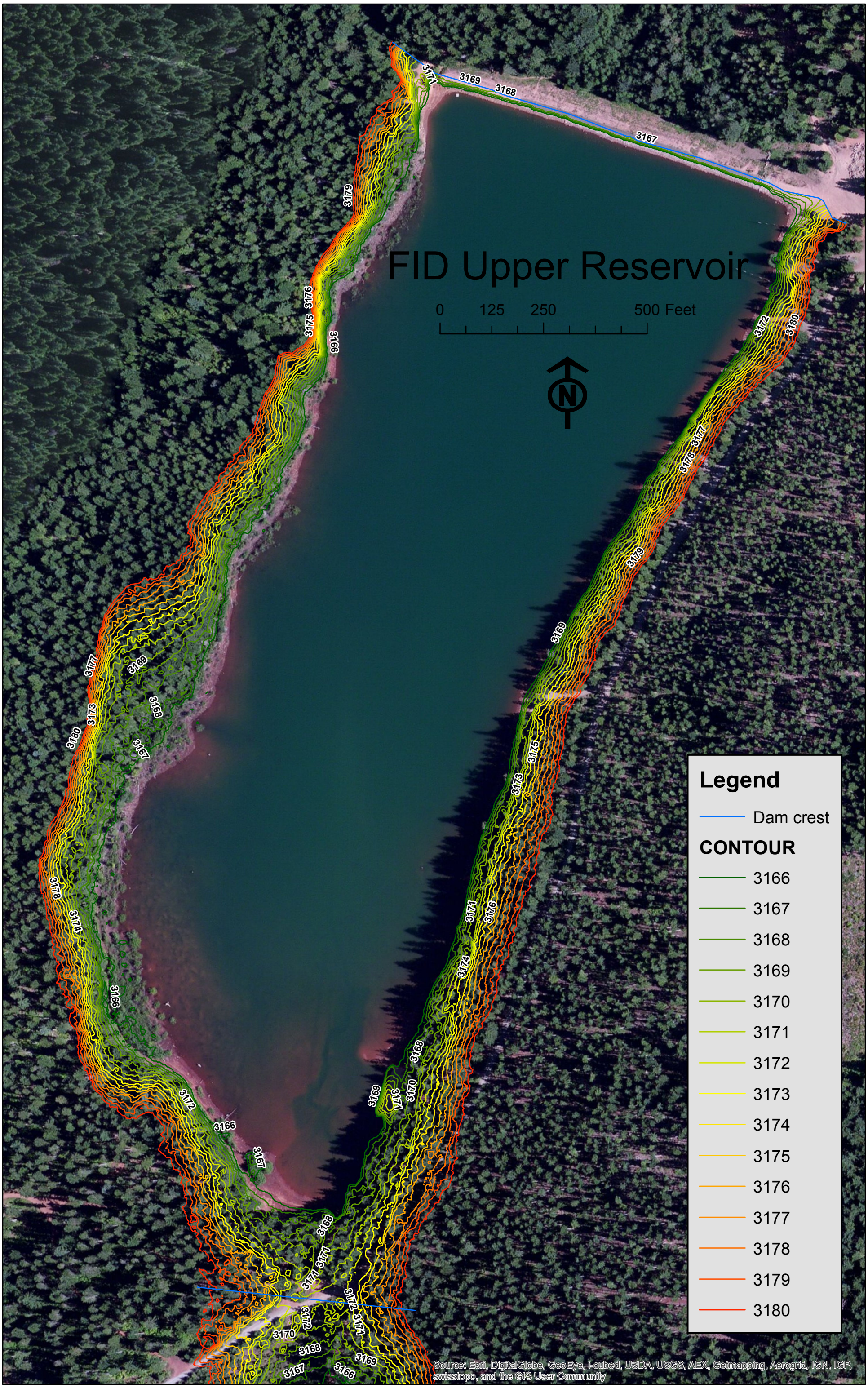


Figure 24. Upper Kingsley Reservoir aerial photo with elevation contours.

Low Line Pipeline

HOOD RIVER COUNTY BOARD OF COMMISSIONERS

DAVID MERIWETHER, COUNTY ADMINISTRATOR
601 State Street • Hood River, OR 97031 • (541) 386-3970 • FAX (541) 386-9392

BOARD OF COMMISSIONERS
RON RIVERS - CHAIR
KAREN JOPLIN - DISTRICT NO. 1
MAUI MEYER - DISTRICT NO. 2
BOB BENTON - DISTRICT NO. 3
LES PERKINS - DISTRICT NO. 4

January 15, 2016

Oregon Water Resources Department
Attention: Jonathan Unger
725 Summer St. NE, Suite A
Salem, OR 97301

Re. ***Water Supply Development Account Grant Applications***- Coe Branch Pipeline & On-farm Irrigation Upgrade Project, Dee Irrigation Water Conservation & Delivery Project, Highline Canal Pipeline Project, and Kingsley Reservoir Expansion and Green Point Pipeline Project

Dear Mr. Unger:

The Hood River Board of County Commissioners strongly supports the grant proposals being submitted for water conservation and development by the Middle Fork Irrigation District (MFID), Dee Irrigation District (DID), East Fork Irrigation District (EFID), and Farmers Irrigation District (FID). These projects are the result of several years of basin-wide assessment and planning that culminated in several documents, including the MFID Fish Management Plan (2010), Hood River Basin Study (2015), and the Hood River Water Conservation Strategy (2015). All of these proposals will ultimately lead to increased water conservation instream and greater water resource reliability for the Basin's agricultural producers. With one-third of County incomes and over $100 million in annual gross sales coming from agriculture, it is critical that we find long-term solutions to provide reliable water into the future. The Board also recognizes the importance of improving instream flows to support threatened native fish populations, tribal fishing rights, and recreation.

The Coe Branch Pipeline and On-farm Irrigation Project will direct water diverted at Coe Branch to MFID's existing settling pond before being delivered to patrons. MFID's settling pond removes a significant amount of sediment, which will encourage and enable more of its patrons to use high efficiency irrigation equipment. The pipeline project will be complemented by 200 acres of on-farm irrigation upgrades in the MFID, which will save an estimated 1 cfs.

The Dee Irrigation Water Conservation and Delivery Project and the Highline Canal Pipeline Project (EFID) will replace open canals and old, unpressurized pipes with pressurized delivery pipelines. Collectively, this will eliminate canal seepage loss and eight end spills, and save almost 3 cfs. Eight DID patrons will upgrade their on-farm irrigation equipment, which will conserve an additional 0.7 cfs.

The Kingsley Reservoir Expansion and Green Point Pipeline projects will increase water storage and conservation in the Farmers Irrigation District. The expansion of Kingsley Reservoir by 500 acre-feet will allow FID to store enough water to reliably meet the needs of their growers as well as the operational

flexibility to leave more water in-stream during critical times of the year. The project will also allow FID to make sorely needed dam safety improvements for greater resiliency and reliability. The reservoir expansion will require extensive coordination with Hood River County in order to acquire the land necessary for the expansion. FID is currently working with Hood River County Forestry, Planning, and Parks Departments to determine the best path forward. The Green Point Pipeline Project will replace approximately 11,500 feet of aging and damaged steel pipeline that is currently leaking in multiple locations. This project will conserve roughly 2.5 to 3 cfs which will allow FID to reduce their diversion rate from North Green Point Creek while improving water resource reliability for the growers within FID.

The Hood River Basin has a very long history of collaboratively working to address potentially conflicting water use demands for fish, farms, and people. Water plays a central role in the cultural, economic, and social history and values of Hood River County. Finding ways to allow for equitable use of our valuable water resources is essential to the continued success of the communities within Hood River County. The proposed projects are critical for continuing to support environmental, agricultural, and community investments already made, and will perpetuate and enhance our collaborative, progressive, basin-wide approach to solving water resource issues and concerns.

Sincerely,
Hood River County
Board of Commissioners

Ron Rivers, Chair

THE CONFEDERATED TRIBES OF THE WARM SPRINGS RESERVATION OF OREGON

DEPARTMENT OF NATURAL RESOURCES
Hood River Production Program
6030 Dee Hwy. Parkdale, Oregon
Phone (541) 352-3548
Fax (541) 352-9365

January 11, 2016

Oregon Water Resources Department
Attn. Jon Unger
725 Summer St. NE, Suite A
Salem, OR 97031

RE: Letter of Support for Farmers Irrigation District Reservoir Expansion & Pipeline Project

The Hood River Watershed Group has requested the Confederated Tribes of Warm Springs support the Kingsley Reservoir Expansion and Lowline Pipeline Project. The project as described in the attached **Preliminary 16 Questions/Answers for SB 839 Grant dated December 18, 2015** will result in the opportunity to return up to 3 cfs of flow to Green Point Creek.

The CTWS supports projects that result in protected instream flows that restore basin fisheries. This project and the three others submitted by the basin irrigation districts as part of the 2016 SB 839 Grant Application should benefit Hood River basin fisheries.

Sincerely,

CHRIS BRUN
Hood River Production Program

Hood River Watershed Group

3007 Experiment Station Dr., Hood River, OR 97031 • www.hoodriverswcd.org

January 18, 2016

Oregon Water Resources Department
Attention: Jonathan Unger
725 Summer St. NE, Suite A
Salem, OR 97301

Re. ***Water Supply Development Account Grant Applications***- Coe Branch Pipeline & On-farm Irrigation Efficiency Project, Dee Irrigation Water Conservation & Delivery Project, Highline Lateral Pipeline Project, and Farmers Irrigation District Reservoir Expansion and Pipeline Project

Dear Mr. Unger:

The Hood River Watershed Group (HRWG) strongly supports the grant proposals being submitted for water conservation and development by the Middle Fork Irrigation District (MFID), Dee Irrigation District, East Fork Irrigation District (EFID), and Farmers Irrigation District (FID). The HRWG's purpose is to sustain and improve the Hood River Watershed through education, cooperation and stewardship. All of these projects will ultimately lead to increased water conservation instream to support threatened native fish populations, while providing greater water resource reliability for the Basin's agricultural producers, tribal fisherman, and recreationalists.

These projects are the result of several years of basin-wide planning that culminated in several documents, including the MFID Fish Management Plan (2010), Hood River Basin Study (2015), EFID System Improvement Plan (2015), FID Storage Expansion Study (2015), and the Hood River Water Conservation Strategy (2016, pending). The two most important project types identified in the Water Conservation Strategy were conveyance system improvements and on-farm irrigation efficiency projects, both for their significant overall impact and cost effectiveness. Storage expansion projects also provide an excellent opportunity to increase irrigation water reliability. Collectively, all remaining conveyance system improvements, on-farm irrigation upgrades, and expansion of existing storage have the potential to increase streamflows by an estimated 57 cfs. Our objective is to increase instream flow by *at least* 57 cfs at the mouth of the Hood River within the next 20 years. To attain this, watershed partners need to implement large-scale projects every year. The suite of projects being proposed in the Hood River Basin represent our first collective effort to pursue this critical objective.

Fish populations, the local economy, and social equity are inextricably linked in the Hood River Basin. From an ecological standpoint, if instream flows are insufficient, Hood River salmon and steelhead will not recover to self-sustaining levels. From an economic standpoint, a certain amount of water is required to sustain existing agricultural production. Furthermore, from a cultural and societal perspective, healthy fish runs benefit local tribes, tourism, and recreation, as well as heading off costly conflicts over water allocations. We strongly urge you to fund all of these broadly supported, highly effective projects that will keep fish and people on a positive, synergistic trajectory.

Sincerely,

Cindy Thieman
Hood River Watershed Group Coordinator

Oregon
Kate Brown, Governor

Department of Fish and Wildlife
The Dalles District Office
3701 West 13th Street
The Dalles OR 97058
541-296-4628
(fax) 541-298-4993

January 14, 2016

Jon Unger
Oregon Water Resources Department
Water Resources Grant Administrator
725 Summer St. NE, Suite A
Salem, OR 97301

Re: Support for Farmers Irrigation District Reservoir Expansion and Pipeline Project

Dear Mr. Unger:

The purpose of this letter is to provide the Oregon Department of Fish and Wildlife's (ODFW) support for the Farmers Irrigation District's (FID) Irrigation Water Conservation and Development Project. This project proposes increasing the capacity of Upper Kingsley Reservoir, decommissioning Lower Kingsley Reservoir, and replacing the Lowline Pipeline. This project is proposed to address water shortages in FID, and collectively increase instream flow in Green Point Creek, and the West Fork Hood River. In addition, this project has the potential to improve water quality by lowering stream temperatures, and reducing sedimentation.

The West Fork of the Hood River provides critical habitat for steelhead, Chinook salmon, and coho salmon, which are listed as a threatened species under the Endangered Species Act. The West Fork Hood River also provides habitat for other gamefish such as cutthroat trout. Diminished streamflow has been identified as a key limiting factor in the recovery of ESA fish throughout the Hood River Basin. Irrigation withdrawls for agriculture have been identified as the main contributing factor to summer low flows. Through the implementation of this proposed project, the FID has estimated approximately 1.5 (cfs) would be saved instream in Green Point Creek.

Implementation of this project has potential to provide substantial benefits to fisheries resources in Green Point Creek and the West Fork Hood River. This project represents the culmination of many years of FID's infrastructure and conservation efforts in the basin. The ODFW supports this proposal, and urges the Oregon Water Resources to consider this project for grant funding. If have you have further questions concerning ODFW's support for this project feel free to contact me at (541) 296-4628.

Sincerely,

Rod A. French
Mid-Columbia District Fish Biologist