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Executive Summary

Hopkins Producers ID Watershed/Water Storage Project, Level I Study

Professional Services No. 05SC0293251

Prepared for:

**Wyoming Water Development Commission
Cheyenne, Wyoming**

Prepared by:

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October 2008

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1. INTRODUCTION

1.1 General

This executive summary briefly presents the findings of the Hopkins Producers Irrigation District Watershed/Water Storage Project, Level I Study. This study describes the French Creek and upper North Fork of Clear Creek watersheds and develops conceptual designs and cost estimates for the addition of storage reservoirs to the watersheds. Figure 1.1 shows a map of the region highlighting the watersheds and irrigated lands in the area.

1.2 Project Description

This study assessed, described, and mapped the watershed. The sponsor indicated interest in analyzing and developing surface water within the watershed for irrigation use. This study took an in depth look at the watershed for potential multiuse water storage facilities to supply water and benefit various users including the Hopkins Producers Irrigation District, other irrigators in the watersheds, the City of Buffalo, and other benefits including recreation, environmental, and fishery. The consultant team took a big picture approach to the study to identify potential multipurpose projects that could potentially draw support and funding from multiple sources.

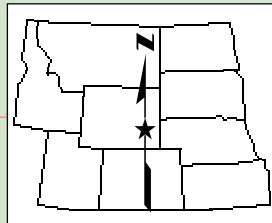
2. OVERVIEW

2.1 General

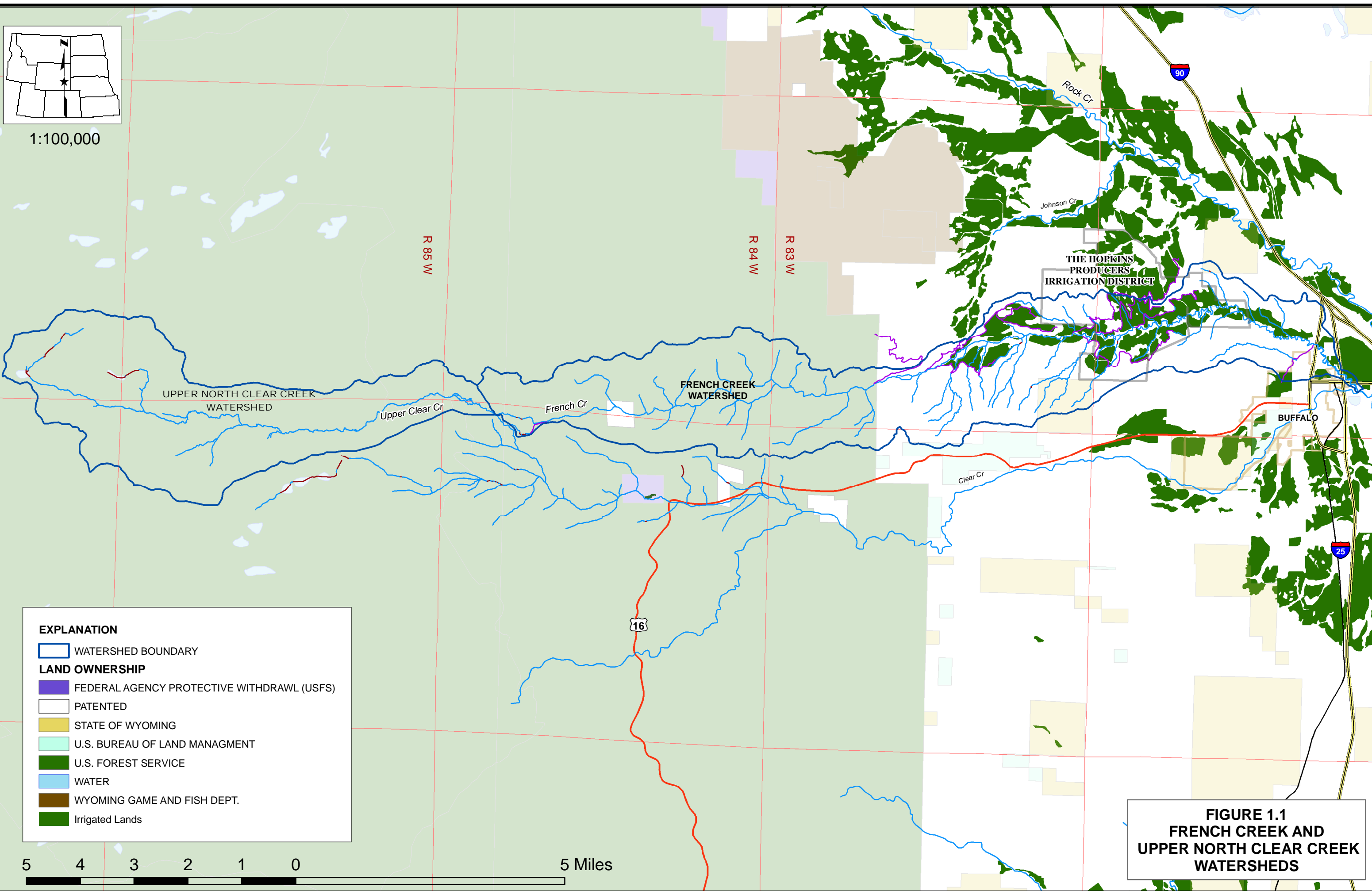
The HPID currently has no storage in the basin and relies solely on direct flow irrigation. The diversion flow rate varies with irrigation demand and available flow in the creek, however, under normal conditions (one cfs per 70 acres) HPID typically diverts 30 cfs.

2.2 Problem Identification










French Creek with its relatively low elevation drainage area typically has good flow in May and June during the early runoff season, but the low elevation snow pack melts out early and flows drop in July and August. The North Fork of Clear Creek draws from a high elevation drainage area and flows are typically sustained through the runoff season. These flows transferred from the North Fork of Clear Creek to French Creek sustain the irrigators on French Creek while in priority. The transfer is reduced by regulation on Clear Creek typically in mid-June during dry years and mid-July during normal years. The irrigators on French Creek typically experience late season irrigation water supply shortages. These shortages usually occur in August and September when flows in French Creek drop and regulation shuts down the transfer from the North Fork of Clear Creek. It would be beneficial to the irrigation district to release water from storage during this time. Several potential reservoirs are presented in this study to solve these water shortage problems.



1:100,000



EXPLANATION

-  WATERSHED BOUNDARY
- LAND OWNERSHIP**
-  FEDERAL AGENCY PROTECTIVE WITHDRAWAL (USFS)
-  PATENTED
-  STATE OF WYOMING
-  U.S. BUREAU OF LAND MANAGMENT
-  U.S. FOREST SERVICE
-  WATER
-  WYOMING GAME AND FISH DEPT.
-  Irrigated Lands

5 4 3 2 1 0

5 Miles

**FIGURE 1.1
FRENCH CREEK AND
UPPER NORTH CLEAR CREEK
WATERSHEDS**

3. WATERSHED DESCRIPTION

The French Creek and upper North Fork of Clear Creek watersheds were assessed, described and mapped. Land uses in the lower French Creek watershed include rural development, irrigated land for pasture, grass hay, and alfalfa production, and grazing. Land uses in the upper French Creek watershed include grazing, logging, and recreation. Land uses in the upper North Fork of Clear Creek watershed include grazing, logging, and recreation. Existing data was compiled and used to map ground water and oil and gas wells, surface and subsurface geology, soils, major plant communities and land cover, level IV ecoregions, and climate data.

3.1 Channel Structure/Morphology

All of French Creek and the reaches of North Clear Creek above the Four Lakes and French Creek Ditch diversion were examined in a desktop level stream morphology effort. The watershed was analyzed from a water development perspective. The approach was to identify current issues and opportunities and how the stream morphology would affect and be affected by the development of a reservoir facility in the watershed.

French Creek has been influenced by the introduction and development of irrigation. The additional flows transferred into the French Creek basin from the North Fork of Clear creek have influenced the stream structure. The additional flow has widened and straightened the stream causing bank erosion and downcutting in areas. These transfers have occurred since 1884. Given the length of time since the transfers first began influencing the stream morphology, the stream has likely stabilized in most reaches. Additional transfers as presented in this study would likely cause additional erosion and instability in some reaches of the stream.

3.2 Water Quality

French Creek is a Class 2AB stream and upper North Fork of Clear Creek is a Class 1 stream.

Currently, French Creek and the North Fork of Clear Creek are not on the Wyoming Department of Environmental Quality Section 303(d) list. Assessment by DEQ indicated French Creek is impacted by flow augmentation, however, it is meeting the aquatic life uses. A watershed plan was completed by the Lake DeSmet Conservation District to improve water quality in the French Creek watershed. There are currently no active National Pollution Discharge Elimination System permits in the French Creek or upper North Fork of Clear Creek watersheds.

3.3 Big Game Habitat & Sensitive Species

Big game habitat classifications in the French Creek watershed and observations of sensitive species within a township buffer of the potential reservoir sites in the French Creek watershed are shown in the final report.

4. HYDROLOGY

4.1. Introduction

Watershed hydrology was developed for the French Creek, upper North Fork of Clear Creek and upper South Rock Creek drainages in effort to determine water availability for storage in the proposed reservoir facilities. Stream discharge for wet, normal, and dry year scenarios was developed.

There are no streamflow gauging stations in the French Creek drainage, therefore estimated streamflows were based on streamflow records at hydrologically similar gaging station locations. The final report describes the approaches and techniques for developing streamflow data in the study area.

4.2 Water Availability

A meeting held March 17, 2008 with the Board of Control, Water Division II in Sheridan, WY resulted in anecdotal information on water availability in the study area. In general, French Creek and South Rock Creek are not prolific sources of additional water. There could be some water available for storage in French Creek in April and May before irrigation starts. South Rock Creek is usually regulated around June 1st. Some water could be available in April and early May. There is additional water available in the North Fork of Clear Creek early in the runoff season. Snow and ice in the Four Lakes and French Creek Ditch Diversion preclude delivery of early runoff water to French Creek. If a method of delivery was installed, additional water could be delivered to French Creek for storage. The final report contains a complete description of the methodologies used in determining water availability. The lack of streamflow gauging stations in the French Creek and upper North Fork of Clear Creek drainages induces uncertainty into the water availability determination; therefore a range of water availability is given for dry, normal, and wet years as shown in Table 4.1. The analysis presented is an approximation of water availability.

Table 4.1 - Water Availability (Acre-Feet per year)

Yield (AF)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6 (South Rock Creek)	Site 7	Site 8	North Clear Creek
Dry Year	200-450	200-400	200-400	100-250	100-200	300-550	300-550	100-250	500-900
Normal Year	900-1250	900-1200	900-1200	300-700	300-600	1000-1600	1000-1600	300-700	2800-3500
Wet Year	1100-1450	1100-1400	1100-1400	400-800	400-700	1100-1850	1100-1850	400-800	3500-4300

4.3 Needs

Anecdotally, the Hopkins Producers ID indicated a need in dry years for 13cfs for 45 days. This computes to 1160 AF of water. The Powder/Tongue River Basin Water Plan indicates shortages during dry, normal, and wet year hydrologic conditions. The basin plan indicates shortages on French Creek at 1200, 430, and 200 AF for dry, normal, and wet years respectively. The basin plan indicates shortages on Johnson Creek at 4839, 3003, 2217 AF for dry, normal, and wet years respectively. The basin plan indicates shortages on Clear Creek above Buffalo at 4839, 3003, 2217 AF for dry, normal, and wet years respectively. Estimates of need should be further defined with additional stream flow gauging. With additional stream flow gauging, modeling

can further the refinement of shortages estimates. Storage on French Creek could supply water to supplement these needs. Site #1 could help supplement the needs of irrigators on French Creek and the Hopkins Producers Irrigation District. Sites #2,3,4,5, and 8 could help supplement the needs of not only the irrigators on French Creek but also needs in the greater Clear Creek watershed.

4.4 Future Stream Gauging

To advance a potential reservoir site in the French Creek basin, stream flow data would need to be collected and refinements would need to be made to the reservoir hydrology. Stream flow gages on the North Fork of Clear Creek near the Four Lakes and French Creek diversion and on French Creek at the Forest Service boundary would be two logical locations for further study of water availability and needs.

5. NORTH FORK OF CLEAR CREEK DIVERSION REHABILITATION

5.1 Introduction

The existing Four Lakes and French Creek Ditch Diversion diverts water by gravity from the North Fork of Clear Creek to French Creek. This system diverts an average of 7773 AF per year with historic maximum of 12,409 AF and minimum of 2088 AF. The average first diversion is June 7 with historic extremes of May 7 to July 13. The system has an approximate capacity of 75 cfs. The average shut off date is September 23 with historic extremes of August 1 to September 30.

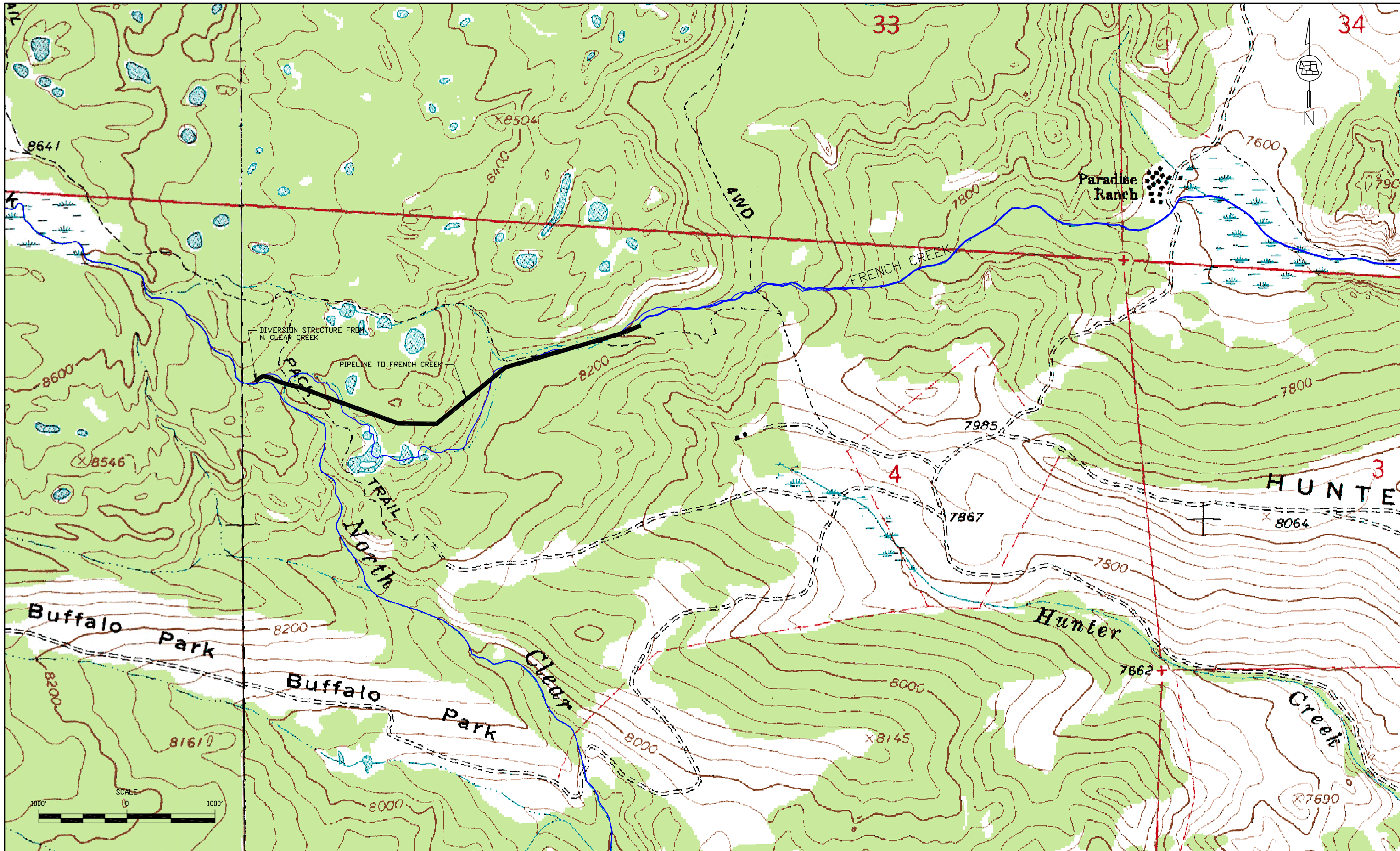
The diversion system consists of the head gate with two steel gates, a parshall measurement flume, and an approximately 5000 foot long ditch to French Creek.

Preliminary hydrology has indicated the availability of additional water from the North Fork of Clear Creek. This water could be transferred and stored in a reservoir facility on French Creek. This system, to capture additional water, would require modification to the existing facilities including a water right enlargement. Preliminary design and cost estimates of these modifications have been developed.

5.2 Preliminary Design

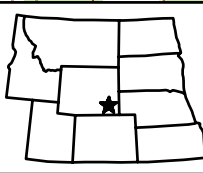
A concrete diversion structure, new headgate, wasteway, and flow measurement device could be constructed as shown on Figures 5.1. Snow and ice keeps the existing ditch inoperable until early May when a minimum flow is diverted to clear the ditch. A pipeline from the diversion to French Creek is proposed to allow early diversions if water is available. The system capacity would be increased to take advantage of larger available flows in normal and wet years. The diversion would discharge to a 36" pipeline to convey approximately 140 cfs 5000 feet to the French Creek drainage. A stream gauge should be installed on North Clear Creek near the diversion to keep record of flows.

5.3 French Creek Channel Erosion Control / Rehabilitation



FILE NAME: SITE 3
 OPERATOR: DWW
 PROJECT NO.: 522-WY
 TASK NO.: 001-263
 DATE: 07/08
 LOCATION: BUFFALO, WY
 PROJECT: HOPKINS STORAGE
 SEND TO: VICTOR E. ANDERSON
 PHONE: (307) 634-7848

REV	DESCRIPTION OF REVISION	BY	DATE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
	PRELIMINARY DESIGN	DWW	07/08
	DESCRIPTION OF REVISION	BY	DATE



STATES WEST WATER RESOURCES CORPORATION
 1804 E. 15th STREET
 CHEYENNE, WYOMING 82001
 (307) 634-7848
 FAX: (307) 634-7851

WARNING
 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE

DESIGNED	DWW
DRAWN	DWW
CHECKED	VEA
PEER REVIEWED	VEA
PROJECT MANAGER	VEA
DATE	07/08

HOPKINS PRODUCERS ID STORAGE PROJECT
FIGURE 5.1
NORTH CLEAR CREEK DIVERSION
SITE PLAN

REVISION	
1	
PROJECT	522-WY
DRAWING	

The French Creek channel has demonstrated erosion problems currently due to the introduced flows from the North Fork of Clear Creek. With increased flows, the erosion issues would be increased. In addition, stream losses at a potential storage facility would require mitigation. It is proposed to rehabilitate and protect the French Creek channel from the North Fork diversions to the reservoir site. Boulder drop structures could be used to reduce channel slope, provide stream bed grade control, and create a pool for enhancement of aquatic habitat. Where bank stabilization is required, structural protection may be best suited along the toe of the slopes while bioengineering protection may be more appropriate along the upper slopes of the bank. Long-term stability is often facilitated by the integration and placement of both structural and bioengineered stability measures.

5.4 Cost Estimates

A preliminary construction cost estimate was developed for the North Fork of Clear Creek water supply to French Creek. The estimated construction cost for the system is approximately \$2.4 million.

6. WATER STORAGE SITE EVALUATION

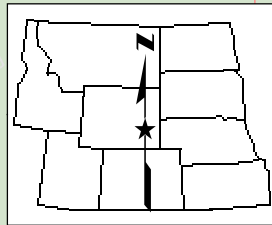
Potential reservoir sites were identified and evaluated in the French Creek, upper North Clear Creek, and South Rock Creek watersheds. Sites were identified based on their ability to serve the needs of the Hopkins Producers ID and other needs in the watershed. Sites were identified in both on and off channel locations at topographically optimal locations, in locations where water is available for storage, and in locations where environmental impacts could be minimized and environmental improvements could be made. A range of sites were developed. Multiuse projects that promote not only agriculture but also recreation, environmental, and municipal benefits were explored. Sites No. 1 and 2 are single purpose sites that could serve irrigation benefits to the Hopkins Producers ID and other irrigators on lower French Creek. All other sites identified are considered multipurpose projects serving multiple benefits to a range of users.

Eight reservoir sites were identified and evaluated in this reconnaissance level study and are discussed in the final report. The identified sites are shown on Figure 6.1. Tables 6.1 and 6.2 display information about each potential reservoir site. Sites No. 1, 3, and 8 are more favorable and are discussed briefly below. All sites are discussed in detail in the final report.

6.1 SITE NO. 1 PRELIMINARY ANALYSIS

6.1.1 Introduction

Site No. 1 is an off-channel site located approximately three miles east of the Forest Service boundary and approximately one-half mile north of French Creek in Section 23, Township 51 North, Range 83 West as shown on Figure 6.2. The site is located on private property. The reservoir would be supplied utilizing an enlarged Moeller Ditch. Water would be delivered from the reservoir to the Hopkins ditch by a pipeline. The site could store a maximum of approximately 1000AF. Three alternatively sized reservoirs were analyzed and preliminary designs and cost estimates were developed.



1:50,000

R 84 W

R 83 W

6

7

French Cr

5

4

8

3

2

Upper Clear Cr

Clear Cr

EXPLANATION

- WATERSHED BOUNDARY
- LAND OWNERSHIP**
- FEDERAL AGENCY PROTECTIVE WITHDRAWAL (USFS)
- PATENTED
- STATE OF WYOMING
- U.S. BUREAU OF LAND MANAGMENT
- U.S. FOREST SERVICE
- WATER
- WYOMING GAME AND FISH DEPT.
- Irrigated Lands

16

2.5 Miles

2.5 1.25 0

**FIGURE 6.1
POTENTIAL
RESERVOIR SITES**

Table 6.1 - Potential Reservoir Storage Sites Matrix

Site Name	1	2	3 RCC	3 Earth	4
Location	Off Channel	Off Channel	On Channel French Ck	On Channel French Ck	On Channel French Ck
Legal Description	23, T51N, R83W	34, T51N, R83W	32, T51N, R83W	32, T51N, R83W	36, T51N, R84W
Size (AF)	230, 500, 965	4000	3500, 6000	3000, 5500, 7500, 10000	3200+
Average Annual Yield	230, 465, 850	2500	2230, 3630	1950, 3350, 4000, 4000	-
Irrigated Acres Supplied	HPID, lower Clear Ck	HPID, lower Clear Ck	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek
Uses	Ag Irrigation	Ag Irrigation	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation
Dam Type	Earth Embankment	-	RCC	Earth Embankment	RCC or Earth Embank
Borrow Material Availability	available onsite	-	available onsite	Rock avail, fine grain unknown	Rock avail, fine grain unknown
Dam Height	60-100	160	170, 210	190, 230, 250, 280	120
Crest Elevation	5358, 5378, 5400	5800	6200, 6240	6200, 6240, 6260, 6290	7200
Crest Length	700	1250	880, 1000	880, 1000, 1100, 1240	740
Crest Width	30	-	20	48, 56, 60, 66	-
Embankment Volume (CY)	175k, 300k, 475k		300k, 470k	2200k, 3500k, 4500k, 5700k	-
Design Flood	-	PMF	PMF	PMF	PMF
Peak Flood Flow (cfs)	-	8000	14150	14150	9100
Flood Volume (AF)	-	550	3050	3050	1650
Drainage Area (sq-mi)	0.1	1.2	11.9	11.9	6.2
Mean Basin Elevation		6172	7571	7571	7901
Reservoir Supply	Rehabed Moeller No. 3 ditch, French Creek	4000' supply canal, French Creek	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div
Outlet Works	control gate on upstream face	-	Multilevel intake	Multilevel inclined intake	-
Spillways	Earth	-	Section in dam	Excavate around left abutment	-
Land Ownership	Private	Private	Forest Service	Forest Service	Forest Service
Cultural/Archaeological impacts	est. minimal	est. minimal	Mining site, historic road	Mining site, historic road	est. minimal
Wetlands impacts (ac)	~0.7	est. minimal	<0.5	<0.5	<1.0
Riparian impacts	none	some	some	some	some
Endangered Species	none	none	none	none	none
Threatened Species	occur in area	occur in area	occur in area	occur in area	occur in area
Big Game impacts	none	elk crucial winter range	elk crucial winter range	elk crucial winter range	elk crucial winter range
Project Cost (\$)	3.1M, 4.6M, 6.8M	-	51.7M, 68.3M	44.2M, 59.5M, 71.6M, 86.9M	-
Cost/AF (\$/AF)	13.5k, 9.2k, 6.9k	-	14.8k, 11.4k	14.7k, 10.8k, 9.6k, 8.7k	-
Cost/AF Yield (\$/AF Yield)	13.5k, 9.9k, 8k	-	23.2k, 18.8k	22.7k, 17.8k, 17.9k, 21.7k	-

Table 6.2 - Potential Reservoir Storage Sites Matrix

Site Name	5 RCC	5 Rockfill	6	7	8 RCC	8 Earth
Location	On Channel French Ck	On Channel French Ck	On Channel South Rock Ck	Off Channel	On Channel French Ck	On Channel French Ck
Legal Description	34&35, T51N, R84W	34&35, T51N, R84W			36, T51N, R84W	36, T51N, R84W
Size (AF)	2500, 5000, 7500	2500, 5000	4900	9700	2500, 6000, 7500, 10000	2500, 5500, 7500
Average Annual Yield	1620, 3020, 3500	1620, 3020	-	-	1630, 3590, 3590, 3590	1630, 3310, 3590
Irrigated Acres Supplied	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek	-	-	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek	HPID, French Ck, Clear Ck, Johnson Ck, lower Rock Creek
Uses	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation	Ag Irri., Municipal, Environmental, Recreation
Dam Type	RCC	Earth Embankment	Earth Embankment, RCC?	Earth Embankment	RCC	Earth Embankment
Borrow Material Availability	available onsite	Rock avail, fine grain unknown	Rock avail, fine grain unknown	Rock avail, fine grain unknown	available onsite	Rock avail, fine grain unknown
Dam Height	120, 155, 180	120, 155, 180	80	60-120	180, 210	200, 230
Crest Elevation	7480, 7515, 7540	7480, 7515	8880	8520	7080, 7110, 7125, 7155	7080, 7110, 7130
Crest Length	580, 720, 830	580, 720	550-900	6300	700, 800	700, 800
Crest Width	20	-	26	34	20	50, 56
Embankment Volume (CY)	140k, 250k, 350k	450k, 750k	-	-	110k, 350k, 450k, 620k	900k, 2400k, 3400k
Design Flood	PMF	PMF	PMF	-	PMF	PMF
Peak Flood Flow (cfs)	8050	8050	7950	-	9500	9500
Flood Volume (AF)	1350	1350	1400	-	1800	1800
Drainage Area (sq-mi)	5.0	5.0	7.1	-	6.2	6.2
Mean Basin Elevation	7982	7982	10066	-	7901	7901
Reservoir Supply	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div	South Rock Ck	South Rock Ck & N. Clear Creek	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div	N. Clear Creek & French Ck enlarge and pipe 4 Lakes div
Outlet Works	Multilevel intake	Multilevel inclined intake	-	-	Multilevel intake	Multilevel inclined intake
Spillways	Section in dam	-	-	-	Section in dam	Excavate around left abutment
Land Ownership	Forest Service	Forest Service	Forest Service	Forest Service	Forest Service	Forest Service
Cultural/Archaeological impacts	est. minimal	est. minimal	est. minimal	est. minimal	French Creek cow camp	French Creek cow camp
Wetlands impacts (ac)	1.03 fens, >2.0 total	1.03 fens, >2.0 total	significant ~98	0.75-1.25	<1.0	<1.0
Riparian impacts	some	some	some	some	some	some
Endangered Species	none	none	none	none	none	none
Threatened Species	occur in area	occur in area	occur in area	occur in area	occur in area	occur in area
Big Game impacts	elk crucial winter range	elk crucial winter range	none	none	elk crucial winter range	elk crucial winter range
Project Cost (\$)	33.5M, 49.6M, 58.2M	35.6M, 43.7M	-	-	32.1M, 55.2M, 65.4M, 82.0M	21.9M, 39.9M, 52.4M
Cost/AF (\$/AF)	13.4k, 9.9k, 7.8k	14.2k, 8.7k	-	-	12.8k, 9.2k, 8.7k, 8.2k	8.8k, 7.3k, 7.0k
Cost/AF Yield (\$/AF Yield)	20.7k, 16.4k, 16.6k	22.0k, 14.5k	-	-	19.7k, 15.4k, 18.2k, 22.8k	13.4k, 12k, 14.6k

This alternative site would be a single-purpose reservoir with the reservoir yield being utilized for supplementary irrigation water for the Hopkins Irrigation District. The analysis of the reservoir alternatives is discussed in detail in the final report.

6.1.2 Reservoir Alternative Size Comparison

The three alternative size reservoirs analyzed for Site 1 are compared in Table 6.3. As indicated, the 985 AF reservoir has a lower unit cost per acre-foot of storage. The comparison of the unit cost per acre-foot of yield indicates that the 500 to 985 AF reservoirs have the lower unit cost. This site would be most economically developed at the larger size alternatives

Dam Type	Total Capacity	Est. Cost	Storage Unit Cost	Est. Yield	Unit Cost Yield
	AF	\$Mil	\$/AF	AF/Yr	\$/AF Yield
Earth	230	\$3.1	\$13,478	230	\$13,478
Earth	500	\$4.6	\$9,200	465	\$9,892
Earth	985	\$6.8	\$6,904	850	\$8,000

6.1.3 Project Financing

Assuming a 67% WWDC grant and 33% loan at 4% for 50 years, the annual repayment would be as follows:

Table 6.4 - Site No. 1 Annual Repayment

Dam Type	Total Capacity	Est. Cost	Annual Repayment
	AF	\$Mil	\$/Yr
Earth	230	\$3.1	\$48,149
Earth	500	\$4.6	\$71,446
Earth	985	\$6.8	\$105,616

6.1.4 Summary

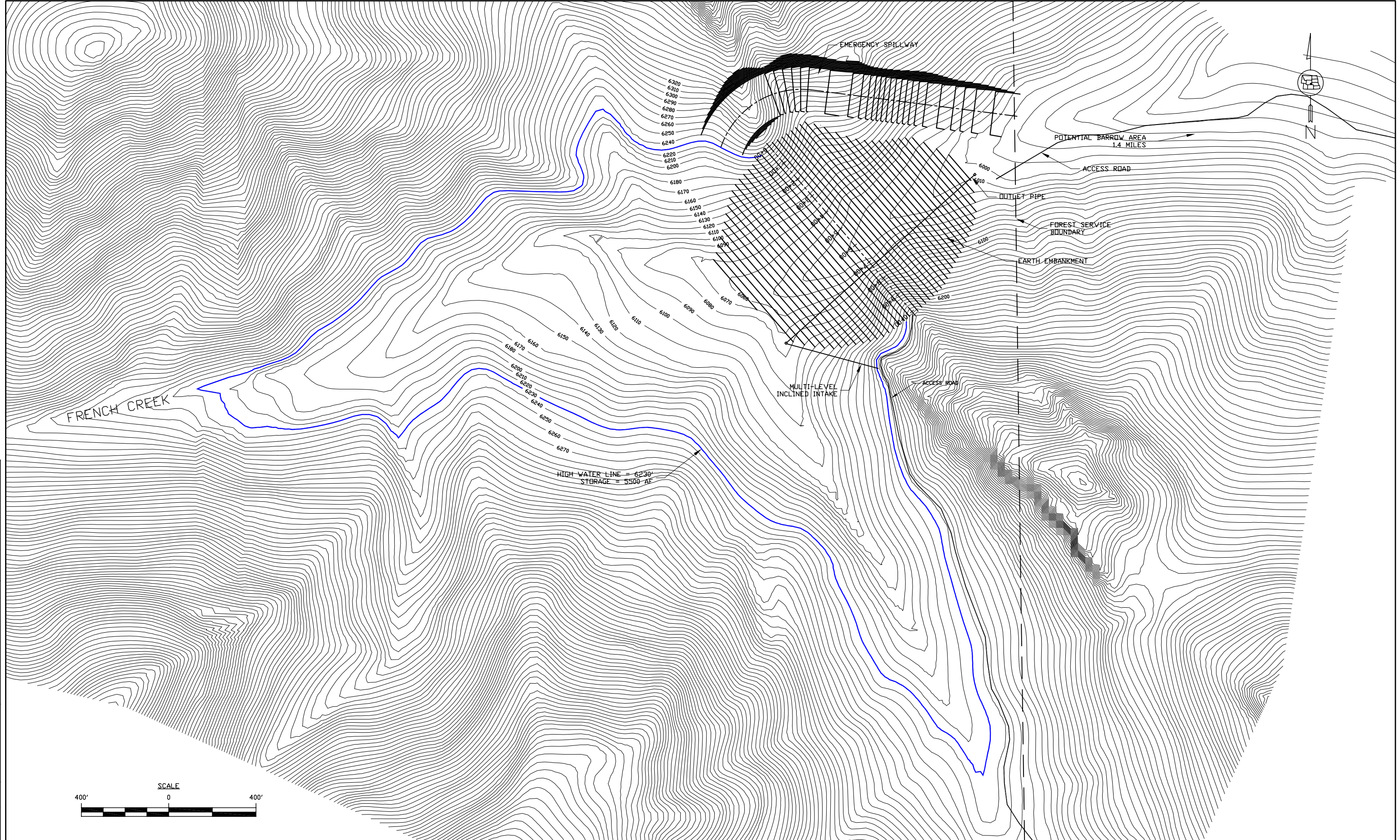
Site No. 1 would be a single purpose facility to supply supplemental irrigation water to the Hopkins Producers ID. Site No. 1 is located off channel on private land. The reservoir could be supplied by improving the existing Moeller ditch. Site No. 1 is most efficient based on the water availability and project cost in the 500-985 AF range. With the anticipated availability of fine grain material, an earth embankment at this location would be the most economical dam. The cultural resources in the vicinity are likely minimal. Wetland impacts at this site are minimal but will likely require mitigation. The design flood at this site is minimal. Access to the site requires improvement of an existing private road. This site is recommended for further study if single purpose alternatives are pursued.

6.2 SITE NO. 3 PRELIMINARY ANALYSIS

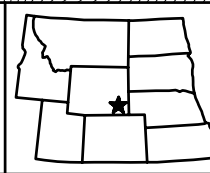
6.2.1 Introduction

Site No. 3 is located on French Creek on US Forest Service property approximately 700 feet above the boundary as shown on Figure 6.3. Site No. 3 is located in Section 32, Township 51 North, Range 83 West. The reservoir would be supplied by flows from the North Fork of Clear

FILE NAME: SITE_3
 SCALE: 1"=300'
 OPERATOR: DWW
 DATE: 07/08
 PROJECT NO: 522-WY
 TASK NO: 001-263
 LOCATION: BUFFALO, WY
 PROJECT: HOPKINS STORAGE
 SEND TO: VICTOR E. ANDERSON
 PHONE: (307) 634-7848



REV	DESCRIPTION OF REVISION	BY	DATE
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	PRELIMINARY DESIGN	DWW	07/08
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PROJECT MANAGER	VEA
DATE	07/08

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**FIGURE 6.3
 SITE 3 EARTH EMBANKMENT
 SITE PLAN - 5500AF**

REVISION	PROJECT
△	522-WY
	DRAWING

Creek and French Creek. 3000, 5500, 7500, and 10,000 ac-ft reservoirs were analyzed and preliminary designs and cost estimates were developed.

This site could be a multiple-use reservoir. The reservoir yield could be utilized in the French Creek, Johnson Creek, lower Rock Creek, and Clear Creek drainages for irrigation supplementary flows, municipal purposes, environmental uses, and recreation. Benefits to the Hopkins Producers ID and other downstream irrigators could be achieved with additional late season water. This water could be transferred to Clear Creek to be utilized for future municipal needs of the City of Buffalo and additional hydropower generation, supplemental irrigation water, and instream flows through Buffalo, and could delay regulation on the Clear Creek drainage. A minimum pool could be maintained in the reservoir to promote recreation and a fishery. Stream fishing improvements on French Creek could also be realized with the project. The analysis of the reservoir alternatives is discussed in detail in the final report.

6.2.2 Reservoir Alternative Size Comparison

The reservoir size alternatives analyzed for Site 3 are compared in Table 6.5. As indicated, the 10,000 AF earth reservoir has the lower unit cost per acre-foot of storage. The comparison of the unit cost per acre-foot of yield indicates that the 5500-7500 AF reservoir size range has the lowest unit cost. This site would be most economically developed at the 5500-7500 AF size range alternative.

Dam Type	Total Capacity	Est. Cost	Storage Unit Cost	Active Capacity	Est. Yield	Unit Cost Yield
	AF	\$Mil	\$/AF	AF	AF/Yr	\$/AF Yield
RCC	3,500	\$51.7	\$14,761	2450	2230	\$23,167
RCC	6,000	\$68.3	\$11,384	4200	3630	\$18,817
Earth	3,000	\$44.2	\$14,740	2100	1950	\$22,677
Earth	5,500	\$59.5	\$10,820	3850	3350	\$17,763
Earth	7,500	\$71.6	\$9,553	5250	4000	\$17,912
Earth	10,000	\$86.9	\$8,690	7000	4000	\$21,725

6.2.3 Project Financing

Assuming a 67% WWDC grant and 33% loan at 4% for 50 years, the annual repayment would be as follows:

Dam Type	Total Capacity	Est. Cost	Annual Repayment
	AF	\$Mil	\$/Yr
RCC	3500	\$51.7	\$802,400
RCC	6000	\$68.3	\$1,060,913
Earth	3000	\$44.2	\$686,829
Earth	5500	\$59.5	\$924,258
Earth	7500	\$71.6	\$1,112,820
Earth	10000	\$86.9	\$1,349,712

6.2.4 Summary

Site No. 3 would be a multipurpose facility located on the Bighorn National Forest. Site No. 3 is most efficient based on the water availability and project cost in the 5500-7500 AF range. With the anticipated availability of fine grain material, an earth embankment at this location would be the most economical dam. The cultural resources in the vicinity are likely not fatal flaws but may require mitigation. Wetland impacts at this site are minimal but will likely require mitigation. Riparian impacts are present at this site and will likely require mitigation. This site is within crucial winter range for elk which will likely require mitigation. The design flood at this site is relatively large requiring a relatively substantial spillway. Access to the site requires improvement of an existing Forest Service road and improvement of a private road. The reservoir is sited on the Bighorn National Forest which will require a special use permit and will likely be more difficult to permit. This site is recommended for further study if any alternatives are pursued.

6.3 SITE NO. 8 PRELIMINARY ANALYSIS

6.3.1 Introduction

Site No. 8 is located on French Creek on US Forest Service property as shown on Figure 6.4. Site No. 8 is located in Section 36, Township 51 North, Range 84 West. The reservoir would be supplied by flows from the North Fork of Clear Creek and French Creek. 2500, 5500, 7500 and 10,000 ac-ft reservoirs were analyzed and preliminary designs and cost estimates were developed.

This site could be a multiple-use reservoir. The reservoir yield could be utilized in the French Creek, Johnson Creek, lower Rock Creek, and Clear Creek drainages for irrigation supplementary flows, municipal purposes, environmental uses, and recreation. Benefits to the Hopkins Producers ID and other downstream irrigators could be achieved with additional late season water. This water could be transferred to Clear Creek to be utilized for future municipal needs of the City of Buffalo and additional hydropower generation, supplemental irrigation water, and instream flows through Buffalo, and could delay regulation on the Clear Creek drainage. A minimum pool could be maintained in the reservoir to promote recreation and a fishery. Stream fishing improvements on French Creek could also be realized with the project. The analysis of the reservoir alternatives is discussed in detail in the final report.

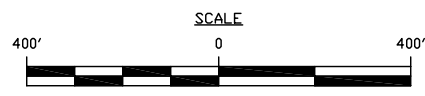
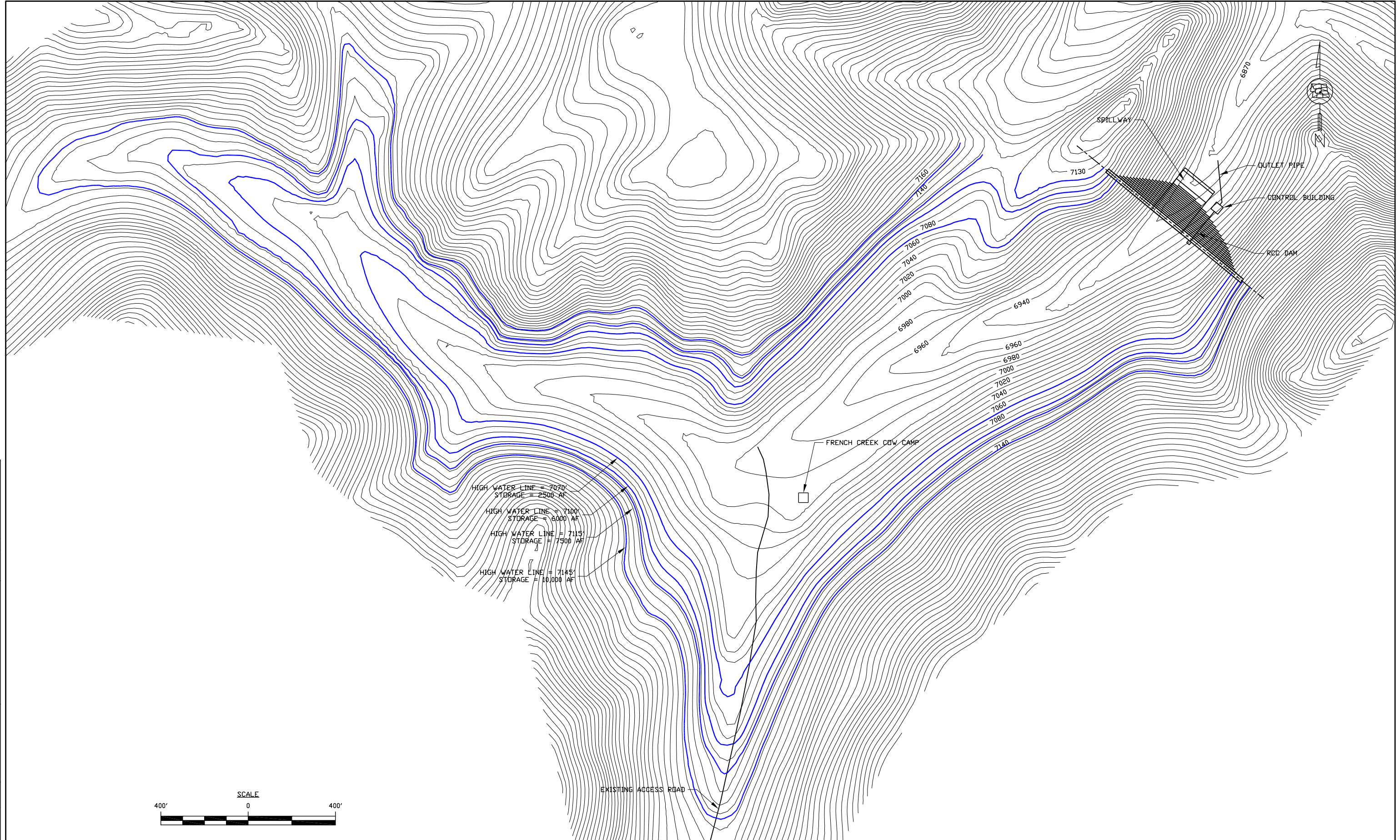
6.3.2 Cultural Impacts

The French Creek Cow Camp is located within the inundation area of Site 8. This site is a recorded historical site (48JO3778) and is suggested that the site be considered eligible for nomination to the National Register of Historic Places. This historical site is a potential fatal flaw and will likely require mitigation.

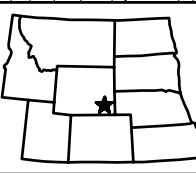
6.3.3 Reservoir Alternative Size Comparison

The reservoir size alternatives analyzed for Site 8 are compared in Table 6.7. As indicated, the 10,000 AF earth reservoir has the lower unit cost per acre-foot of storage. The comparison of the unit cost per acre-foot of yield indicates that the 5500-7500 AF reservoir size range has the

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 SEND TO: VICTOR E. ANDERSON PHONE: (307) 634-7848



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DATE	07/08

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FIGURE 6.4
SITE 8 RCC
SITE PLAN - 6000AF

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PROJECT	522-WY
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lowest unit cost. This site would be most economically developed at the 5500-7500 AF size range alternative.

Table 6.7 - Site No. 8 Alternatives Comparison

Dam Type	Total Capacity AF	Est. Cost \$Mil	Storage Unit Cost \$/AF	Active Capacity AF	Est. Yield AF/Yr	Unit Cost Yield \$/AF Yield
RCC	2500	\$32.1	\$12,840	1750	1630	\$19,693
RCC	6000	\$55.2	\$9,195	4200	3590	\$15,367
RCC	7500	\$65.4	\$8,720	5250	3590	\$18,217
RCC	10000	\$82.0	\$8,200	7000	3590	\$22,841
Earth	2500	\$21.9	\$8,760	1750	1630	\$13,436
Earth	5500	\$39.9	\$7,257	3850	3310	\$12,058
Earth	7500	\$52.4	\$6,987	5250	3590	\$14,596

6.3.4 Project Financing

Assuming a 67% WWDC grant and 33% loan at 4% for 50 years, the annual repayment would be as follows:

Table 6.8 - Site No. 8 Annual Repayment

Dam Type	Total Capacity AF	Est. Cost \$Mil	Annual Repayment \$/Yr
RCC	2500	\$32.1	\$498,570
RCC	6000	\$55.2	\$856,872
RCC	7500	\$65.4	\$1,015,778
RCC	10000	\$82.0	\$1,273,606
Earth	2500	\$21.9	\$340,146
Earth	5500	\$39.9	\$619,915
Earth	7500	\$52.4	\$813,865

6.3.5 Summary

Site No. 8 would be a multipurpose facility located on the Bighorn National Forest. Site No. 8 is most efficient based on the water availability and project cost in the 5500-7500 AF range. Both RCC and earth embankment were analyzed. With the anticipated lack of fine grain material availability, an RCC embankment at this location is likely the most economical dam. The French Creek Cow Camp cultural resource is potentially a fatal flaw. Mitigation of this structure will likely be required. Wetland impacts at this site are minimal but will likely require mitigation. Riparian impacts are present at this site and will likely require mitigation. This site is within crucial winter range for elk which will likely require mitigation. The design flood at this site is relatively large requiring a relatively substantial spillway. Access to the site requires improvement of an existing Forest Service road. The reservoir is sited on the Bighorn National Forest which will require a special use permit and will likely be more difficult to permit. This site is recommended for further study if any alternatives are pursued.

6.4 FRENCH CREEK TO CLEAR CREEK PIPELINE

6.4.1 Introduction

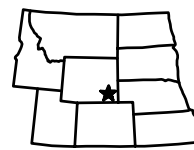
Storage water from Sites No. 3, 4, 5, and 8 could be diverted from French Creek to Clear Creek as shown on Figures 6.5. A diversion structure could be constructed below the Bighorn National Forest boundary and water diverted by gravity to Clear Creek. This water could be utilized for future municipal needs of the City of Buffalo, supplemental irrigation water, and instream flows



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 FILE NAME: 522-WY
 PROJ. TASK: CONCEPT DESIGN
 LOC: BUFFALO, WY
 SEND TO: JENNIFER RUSSELL
 PHONE: (307) 634-7848

REV	DESCRIPTION OF REVISION	BY	DATE

JMR	06/17/08
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PROJECT MANAGER	VEA
DATE	JUNE 2008

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FIGURE 6.5
 FRENCH CREEK TO CLEAR CREEK
 PIPELINE - PLAN VIEW

REVISION	PROJECT
	522-WY

through Buffalo, and could delay regulation on the Clear Creek drainage. Senior water right demands below the City of Buffalo typically call for regulation of most other water rights in the basin. Storage water could be utilized to satisfy these rights and allow water usage throughout the basin for a longer time period for the more junior water rights.

6.4.2 Preliminary Design

A diversion structure, headgate, and flow measurement device could be constructed below the Bighorn National Forest boundary. This installation could discharge to a PVC pipeline approximately 32,250 feet in length that would discharge to Clear Creek. Water could also be delivered to the Buffalo Water Treatment Plant. There is potential for hydropower production with the head available and flow rate. A 24-inch pipeline could deliver approximately 40cfs.

6.4.3 Cost Estimates

A preliminary cost estimate was developed for the French Creek to Clear Creek Pipeline system. The estimated cost for the 24-inch pipeline to deliver 40cfs is approximately \$6.0 million.

7.1 SUMMARY

This Level I Study conducted for the Hopkins Producers Irrigation District under the direction and funding of the Wyoming Water Development Commission develops reconnaissance level studies, designs and cost estimates of reservoir and rehabilitation projects in the French Creek and upper North Fork of Clear Creek watersheds.

Based on the preliminary hydrologic analysis of the watersheds, there appears to be some water available for storage in a potential reservoir facility. In order to further study reservoir feasibility, stream flow gauging data needs to be gathered and evaluated to better understand the basin hydrology and water availability. The water availability estimates made in this report are based on assumptions and correlations with gage data from other basins. Additionally, estimates of need should be further defined with additional stream flow gauging. With additional stream flow gauging, modeling can further the refinement of shortages estimates.

The cost estimates of potential reservoir facilities developed in this study were based on the reconnaissance level geotechnical information developed. Sub-surface exploration and laboratory testing is required to further assess the feasibility of a reservoir facility project and to better define cost estimates.

7.2 RECOMMENDATIONS

If further study is requested, the following projects are recommended for further study of technical and economic feasibility:

- Potential Reservoir Site 1
- Potential Reservoir Site 3
- Potential Reservoir Site 8
- North Fork of Clear Creek Diversion Rehabilitation
- French Creek to Clear Creek Pipeline