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North Yuba Water District Irrigation and Domestic Water Delivery Feasibility Study

3 August 2012

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Prepared for

North Yuba Water District
8691 La Porte Road
Brownsville, California 95919

K/J Project No. 1170035*00

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Section 1: Introduction and Background

1.1 Purpose of Study

The North Yuba Water District's (District's) rights to receive one half of the South Feather Power Project's (SFPP) net power revenues provide financial opportunities to plan and construct infrastructure to support increased agricultural production in the District service area. Retirement of the SFPP construction debt in 2010 now allows for transition of the beneficial use of District water rights from a power generating flow regime to a domestic and agricultural water supply flow regime. This report describes facilities that NYWD can construct to take advantage of these opportunities.

The purposes of this study are to:

- Identify and quantify existing irrigated and potential irrigable land in the District.
- Identify soil types and respective agricultural crop types for identified irrigable land.
- Quantify total potential agricultural water demand and locations of demand.
- Estimate potential use of permitted water for potable uses within the District and quantify future potable use.
- Develop a conceptual raw water conveyance plan including reconnaissance level cost estimates.

This project investigates and identifies potential water delivery improvements for agricultural uses and possible future potable use within the District's service area.

1.2 Summary Scope of Work

The scope of work for this study consists of the following four (4) tasks:

Task 1: Project Management and Quality Assurance/Quality Control

Provide project management and quality control to result in the completion of the project within the time, budget and scope of the agreement.

Task 2: Collect and Review Available Data

- Create a Request for Information (RFI),
- Review existing studies, reports, maps, and relevant operational records that have been previously prepared for the District,
- Research documents prepared by the U.S. Department of Agriculture and Natural Resources Conservation Service (NRCS) with regard to soils data and available geographic information system (GIS) data,

- The District southern service area will be shown on an aerial photograph background and the soils data and information provided as a set of plates and an Excel data table. The soils and District boundary mapping will be used to identify existing irrigated land and potential irrigable acreage,

- Obtain Yuba County Planning Department (County) mapping showing landuse designations and existing demographic data. Demographic data will include population and projected growth through the maximum County mapping horizon,

- The District's 2005 agreement with the South Feather Water and Power Agency will be reviewed to determine limits on rates of delivery of water to the District.

Task 3: Identify Water Demands

- Identify water use types including irrigation and municipal/industrial (M&I) uses,

- Identify potential crop patterns for the irrigated and irrigable lands based on the soil properties and existing agricultural records for other Sierra foothill counties at similar elevations.

- Calculate water demand estimates based on the general crops identified with a range of corresponding water use factors applied to calculate the total existing and future water demand. The calculation will include factors for non-crop consumptive use such as frost control, salt management and water losses to provide an estimate of the water supply required.

- Estimate District wide M&I water use factors using County GIS designated coverages.

- Develop an estimate of total water use potential for the primary County land use categories.

Task 4: Conceptual Raw Water Conveyance Plan

- Develop a conceptual raw water conveyance plan based on the results of the previously completed tasks including preliminary sizing of infrastructure, a schematic drawing showing locations of improvements and reconnaissance level cost estimate.

  - Phase 1 – Irrigation/Municipal/Industrial supply system for suitable lands within the limits of the existing District infrastructure. This Phase includes recommended improvements to maximize existing infrastructure delivery capacity to meet demands serviceable from the existing raw water system.

  - Phase 2 – Irrigation/Municipal/Industrial supply system for expansion of service to suitable lands using a gravity piped water conveyance network. This Phase includes recommended improvements to provide for meeting projected demand including irrigation and potable uses using piped and canal systems.

  - Phase 3 – Irrigation/Municipal/Industrial supply system improvements expanding service using pumping to reach higher elevations.

1.3 North Yuba Water District Service Area Description

The District, previously named the Yuba County Water District, is located primarily within Yuba County with a small portion of its service area located within Butte County, as shown in Figure 1-1. The District comprises a large portion of the northern region of Yuba County, which is located within the Northern Sierra Foothills. The topography ranges from steep mountainsides with forested lands not suitable for irrigation to moderately sloped hilly valleys currently used for large lots with dry land pasture and limited irrigated pasture. There are small areas of farming consisting of local vegetable production, fruit crops and specialty crops. The irrigation potential exists in the west central, east central and southern portions of the District with land elevations ranging from about 2,100 feet to 500 feet above mean sea level.

Existing commercial agriculture in northern Yuba County includes a long history of wine production including gold mining era work in the Frenchtown area. Later development included development near Collins Lake and Oregon House in the 1930’s. Planting methods using drilled holes on steeper slopes with drip irrigation used to expand production of grapes and olives southeast of Oregon House to include Cabernet Sauvignon, Riesling and Sauvignon Blanc production at the Renaissance Vineyards straddling the lower Dobbins-Oregon House Canal. The Renaissance Vineyards reports 365 acres cultivation with a focus on 45 acres for fine wine varietals. The 2010 reported production from the Renaissance Vineyards was 3,500 cases of wine.

Portions of the northern and western edges of the District are adjacent to and partially overlap areas of the Plumas National Forest and the Tahoe National Forest. The National Forest vicinity includes islands of developed private land with rural housing. The existing development in the vicinity of the forest includes water supplies from individual wells and a public water supply operated by the District.

The rural development includes forest residential lots, small to medium size ranch lots and limited small family farm land use. There are several small communities within the District including Brownsville, Challenge, Forbestown, Rackerby, Sharon Valley, Dobbins, Frenchtown, Robinson Mills and Scott Hill. The community of Oregon House is also within the District and includes an island of properties not annexed in the District but commonly known as Oregon House. Oregon House, Frenchtown and Dobbins do not currently receive treated water from the District and rely on wells for potable use.

Other water districts near the North Yuba Water District include Camptonville Community Service District (CCSD), the Browns Valley Irrigation District (BVID) and South Feather Water and Power Agency (SFWPA). There are overlapping service areas and there are currently no known conflicting services being provided by multiple agencies to a single parcel. The District boundary is not a contiguous perimeter but includes approximately 35 island areas surrounded by the District as not all landowners opted to be included in the District at the time of formation. It is assumed that the island parcels have no water service provided by the District. Figure 1-2 shows the District and surrounding areas. Figure 1-3 shows the adopted 2010 Sphere of Influence (SOI) for the District and is consistent with the effort to improve coordination of services supported by the District and surrounding Districts/Agencies. The SOI does not include areas in the southerly portion of the District where BVID also has potential to provide water service. This southern area is shown as a potential future exclusion in Figure 1-3 and was not used to estimate the District’s reasonable and foreseeable water demands. This area is included in the total water use determination because this area is at this time in the District.

1.3.1 Conveyance System

The current District infrastructure for both the treated surface water and irrigation raw water systems are aging and in need of various levels of repairs and upgrades to maintain reliable water service to the entire District. The raw water conveyance systems include the Forbestown Ditch and the Dobbins-Oregon House Canal (DOHC). Both facilities are in poor condition and have insufficient conveyance capacity to meet existing requests for water from District rate payers. The Forbestown Ditch supplies water from the SFPP through the Woodleaf Turnout SF-14 to either the ditch turnout at Costa Creek, for agricultural water use, or the Forbestown Water Treatment Plant (FWTP) for domestic use. Also, untreated water is routed down New York Creek to Dry Creek and used for irrigation. The portion of water that is sent down the Costa Creek turnout continues down Costa Creek to Dry Creek and is diverted to the southeastern part of the District through the DOHC. Figure 1-2 depicts the District Boundary, surrounding areas, and key features within the District.

The domestic water system in the northern area of the District provides water to the communities of Brownsville, Challenge, Cummings Ranch, Forbestown, Rackerby, and Sharon Valley. Some of this water is used for agricultural purposes for small family farms in the area and for typical outdoor uses associated with residential use. The areas in the communities in the southern region of the District do not have a public water system, and rely on local groundwater wells for potable water.

1.4 Acknowledgements

We wish to acknowledge the participation of the North Yuba Water District's Staff who provided information, drawings and recommendations for completing the work to produce this report. A special thanks to Yuba County and the Natural Resources Conservation District for providing existing GIS Shape files for the project.

The following District staff and Kennedy/Jenks team supported and participated in the preparation of this work.

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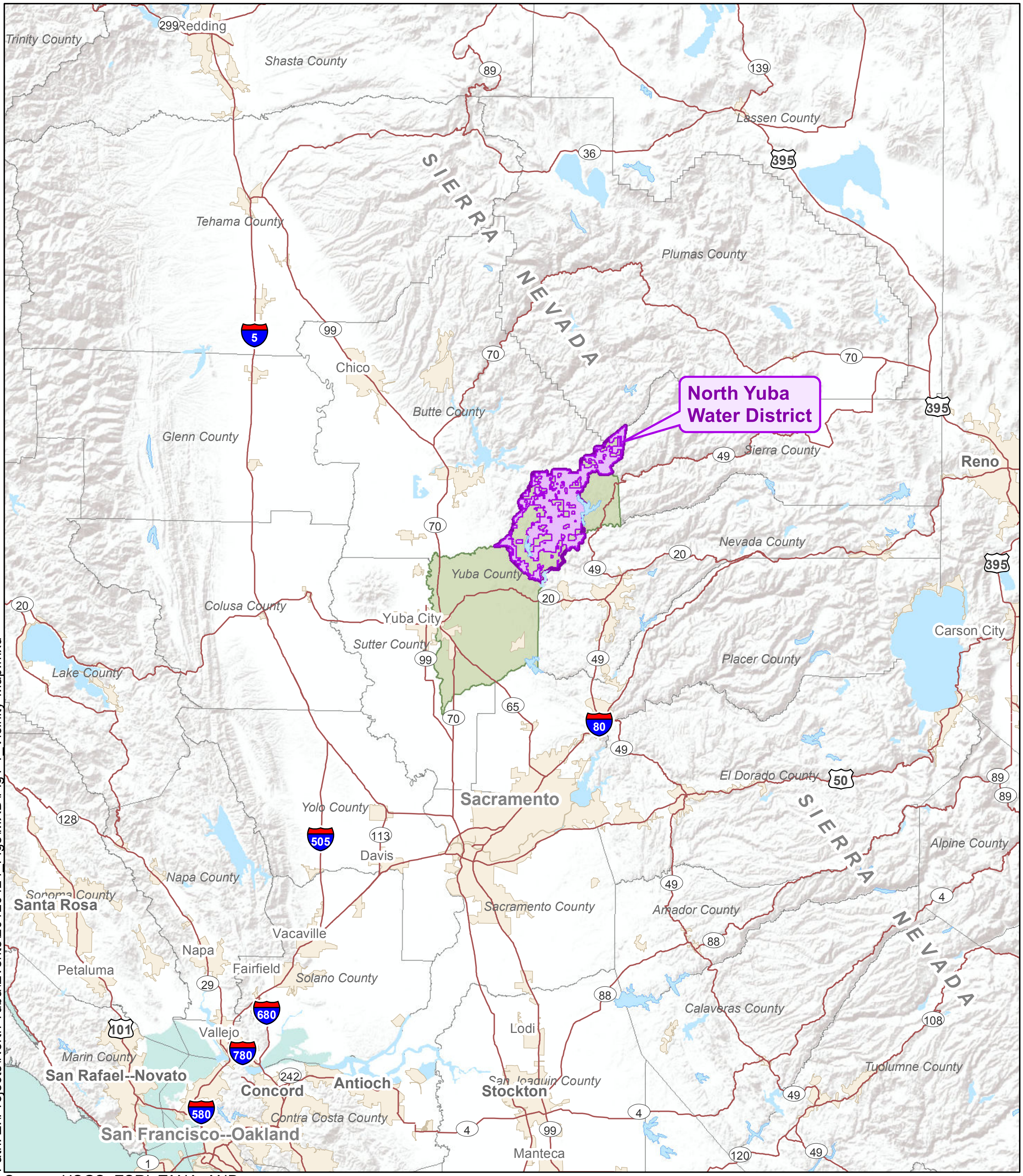

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Source: USGS, ESRI, TANA, AND

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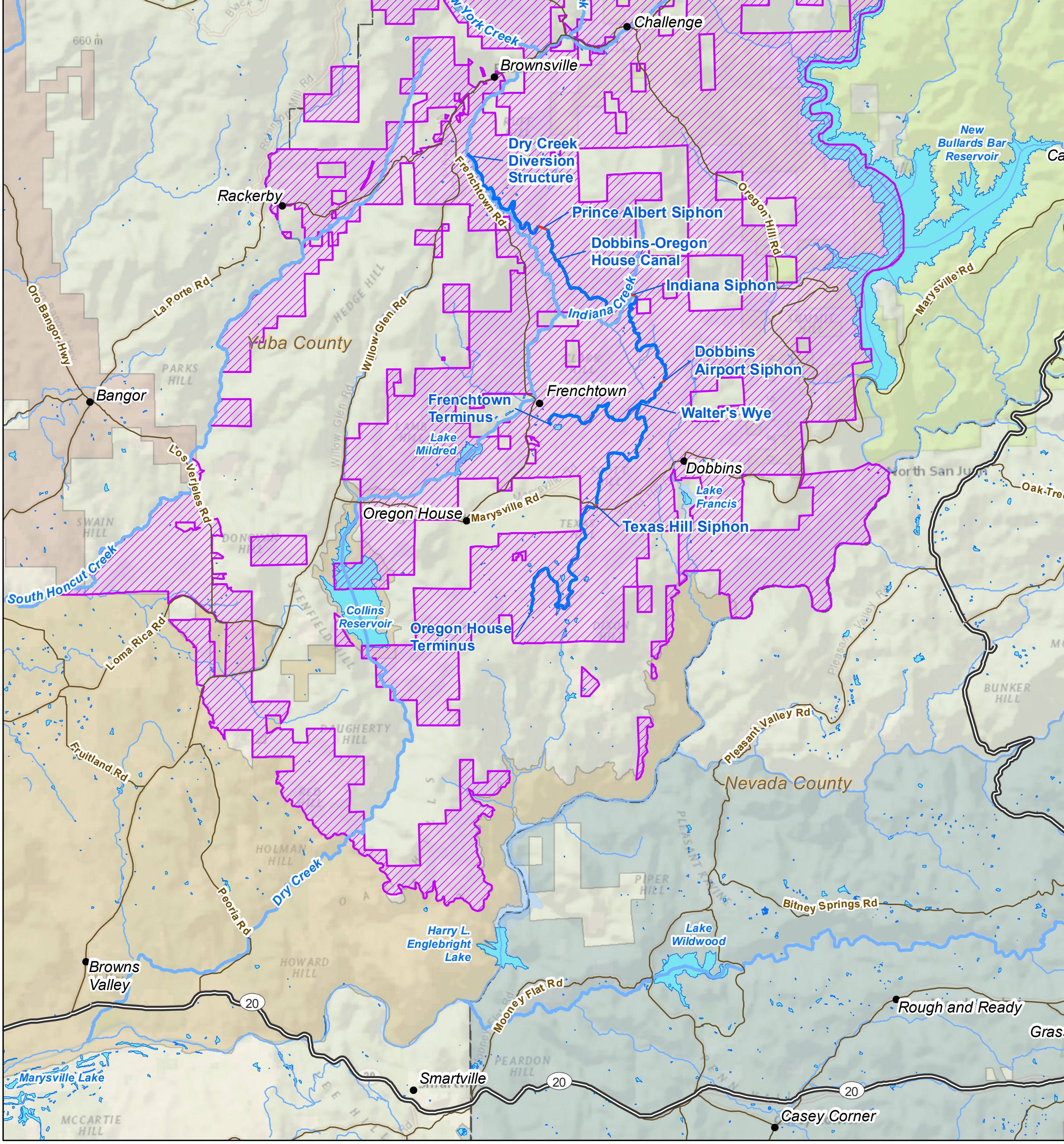
Kennedy/Jenks Consultants

North Yuba Water District
Irrigation Water Feasibility Study
Yuba County, California

Vicinity Map

K/J 1170035*00
April 2012

Figure 1-1



Legend

Water Districts
- Browns Valley I.D.
- Nevada I.D.
- South Feather Water & Power Agency
- North Yuba Water District

- River/Stream/Canal
- District Ditch/Canal
- Waterbody
- National Park
- State Park or Forest
- County Boundary

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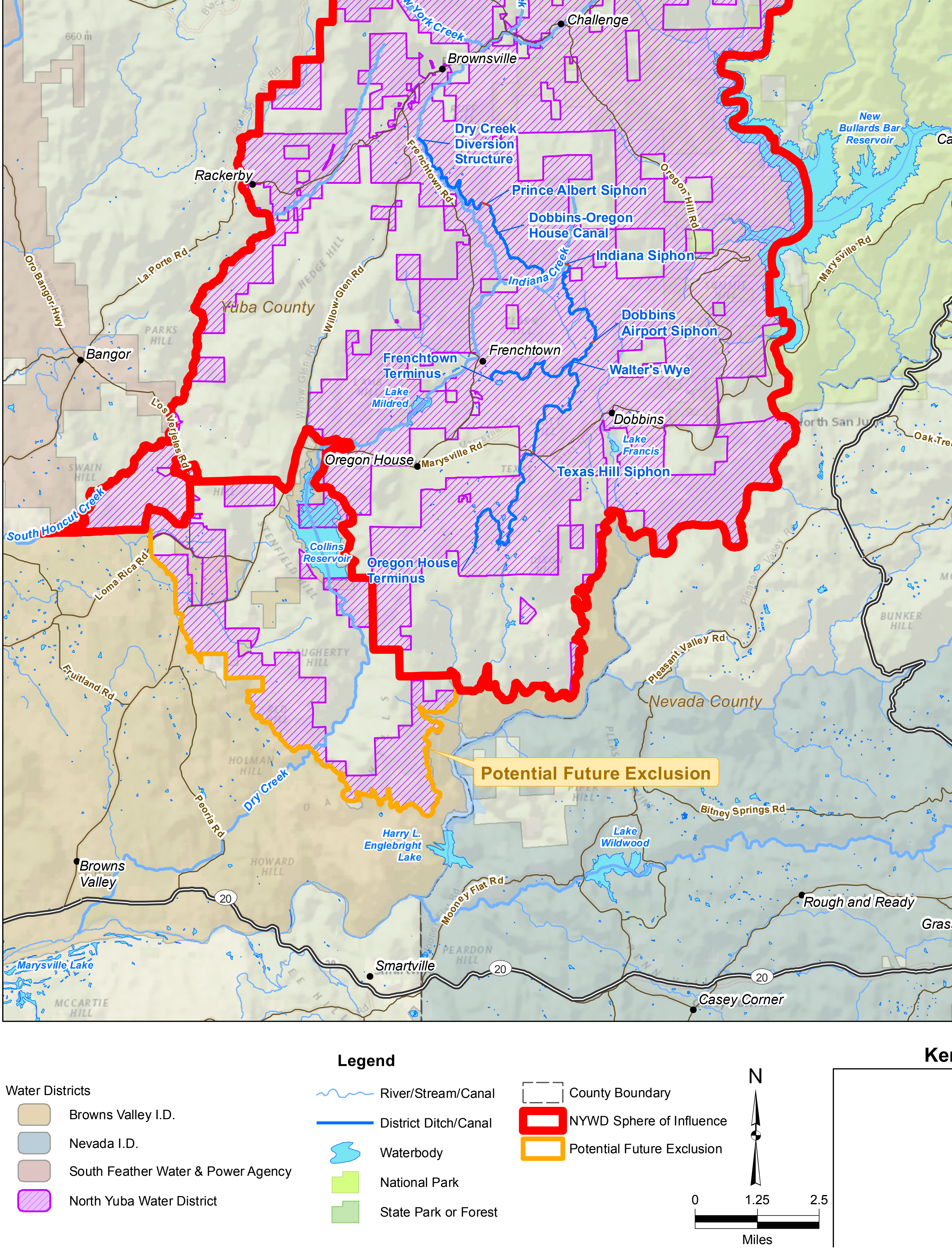
Challenge
Brownsville
Rackerby
Dry Creek
Diversion
Structure
Prince Albert Siphon
Dobbins-Oregon
House Canal
Indiana Siphon
Indiana Creek
Yuba County
Bangor
Dobbins
Airport Siphon
Frenchtown
Frenchtown
Terminus
Walter's Wye
Lake
Mildred
Dobbins
Lake
Francis
Oregon House
Marysville Rd
Texas Hill Siphon
South Honcut Creek
Collins
Reservoir
Oregon House
Terminus
Nevada County
Potential Future Exclusion
Dry Creek
Harry L.
Englebright
Lake
Lake
Wildwood
Browns
Valley
Rough and Ready
Smartville
Casey Corner
Marysville Lake
New
Bullards Bar
Reservoir
La Porte Rd
Oro Bangor Hwy
Willow Glen Rd
Frenchtown Rd
Oregon Hill Rd
Marysville Rd
Los Verjeles Rd
Loma Rica Rd
Fruitland Rd
Peoria Rd
Pleasant Valley Rd
Bitney Springs Rd
Mooney Flat Rd
20
Legend
River/Stream/Canal
District Ditch/Canal
Waterbody
National Park
State Park or Forest
County Boundary
NYWD Sphere of Influence
Potential Future Exclusion
Water Districts
Browns Valley I.D.
Nevada I.D.
South Feather Water & Power Agency
North Yuba Water District
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Section 2: Water Supply

2.1 Introduction

The District water supply being reviewed for this study is the water supply now available to the District from the SFPP. The District's rights to use this water are specified in Water Right Permits 11516 and 11518. The District has the right to convey this water through the Forbestown Ditch, starting at the SFPP's Woodleaf Penstock (SF-14) Turnout. Water received at SF-14 is conveyed through the Forbestown Ditch, with some water flowing through a turnout from the ditch to the headwaters of Costa Creek and the balance of the water flowing to a pond near the District's FWTP. Also, SFWPA may require the District to convey up to 11 cubic feet per second (cfs) of water, up to 3,720 acre-feet per year (AFY), of SFWPA water through the Forbestown Ditch. This water requested by SFWPA is used for irrigation purposes, and therefore is generally only ordered between April-October each year.

This report examines the potential for application of water diverted under Permits 11516 and 11518 to irrigable lands and expanded use for municipal potable supply within the District's service area.

2.1.1 Review of Water Rights

The water-right permits and license that the District has and that are being considered for sizing water conveyance facilities are the following (use of other District water rights is beyond the scope of this study):

- **Water Right Permits 11516 & 11518** – These permits allow for diversion and use of up to a total of 23,700 AFY of water by the District, measured at the SF-14 Turnout.

- **Water Right License 12984** – This water right license authorizes the direct diversion of water from natural Dry Creek flows at rates up to 21.4 cfs, with a maximum of 6,060 AFY during the period of April 1 to October 15 of each year. A bypass flow of 4 cfs must be maintained when water is diverted under this license.

Daily operational flow regulation of the water diverted under License 12984 is not considered in this study's sizing of the conveyance facilities.

2.2 North Yuba Water District SFPP Water Rights

An agreement executed in 2005 between the District and the SFWPA (2005 Agreement), and updated in 2010, replaced a 1959 agreement and now describes the conditions for use of the specified water and the allocation of half of the net hydroelectric power revenues from the SFPP to the District. The 2005 Agreement also provided for transfer of the Forbestown Ditch from the SFWPA to the District.

This water is delivered to the District through a turnout at the Woodleaf Penstock (SF-14), and accountings of this water are based on the volumes provided through the SF-14 turnout. The estimated water deliveries in this report include consideration of conveyance water losses between Turnout SF-14 and the places of use, to estimate the total required supply from SF-14 to meet downstream demands.

2.3 Prior Uses of Water

The District water that is conveyed to the FWTP is used primarily for domestic uses. This supply provides potable water for the communities of Brownsville, Challenge, Cummings Ranch, Forbestown, Rackerby, and Sharon Valley. These communities are located in the northwestern portion of the District. District water that bypasses the FWTP is routed through New York and Dry Creeks and then is conveyed through the existing DOHC Dry Creek diversion dam for irrigation purposes.

The Forbestown Ditch includes a turnout at Costa Creek, which diverts flows from the ditch into Costa Creek. This water then flows down Dry Creek to the Dry Creek diversion structure and then into the DOHC. This water is used for irrigation purposes in the Dobbins-Oregon House area. This area includes parcels that currently do not receive irrigation water from the District, and the owners of many of these parcels would like to receive such water. The District is currently unable to deliver additional water due to limited upstream capacity in the Forbestown Ditch and at the DOHC diversion dam and the DOHC itself.

The existing operational capacities reported by District staff are as follows:

- Forbestown Ditch – 23 cubic feet per second
- Dobbins-Oregon House Canal – 13 cubic feet per second (at the diversion structure)

The District is currently considering a project to replace part or all of the Forbestown Ditch with a pipeline. The District estimates the losses in the Forbestown Ditch are approximately thirty percent (30%). This project would reduce or eliminate these conveyance losses and increase the conveyance capacity and improve reliability for the District’s services to its customers and for the District’s obligations to convey water for SFWPA (up to 11 cfs). Section 4.1.1.1 further discusses a preliminary capacity analysis for the Forbestown Ditch.

Section 3: Existing and Potential Water Demand

3.1 Existing Water Use

Existing water use in the District includes M&I and agricultural water uses. Before 2010, District water supply normally was limited to 3,700 AFY from the SFPP system. Actual measured deliveries at SF-14 to NYWD in 2010 were 3,232 AF, with additional water supplied from natural flows in Dry Creek, for a total water usage of 4,328 AF in 2010.

Approximately 800 AFY is diverted from the Forbestown Ditch at the Forbestown Water Treatment Plant, with part of this water being used for domestic purposes and the rest being discharged to New York Creek for conveyance to the DOHC The balance of District water in the Forbestown Ditch is diverted from the ditch at the Costa Creek turnout and distributed to agricultural customers through the DOHC. In addition, the SFWPA has the right to request conveyance of up to 11 cfs (up to 3,720 AFY) of its water through the Forbestown Ditch. SFWPA flows and deliveries are measured at a weir (WD-6) near the FWTP. The District is responsible for all conveyance losses in the Forbestown Ditch.

The gross water supply needed to meet existing demands was estimated with Forbestown Ditch water losses included. The existing District uses and the District's responsibility for conveyance losses while making the SFWPA deliveries require approximately 4,770 AFY.

Historically, M&I water use in the District for domestic purposes peaked at approximately 640 AF, based on reported values for gross production at the Forbestown Water Treatment Plant (shown in Figure 3-1). Over the period from 2008-2010, this use has trended downward despite a relatively constant number of connections. This trend has been seen statewide due to increase in water conservation due to increasing water rates as well as relatively wet years. Future dry years and increases in population will likely cause an increase in water use in the future. A 2008 Municipal Service Review (MSR) for Yuba County reported overall domestic water use to be 611 gallons per capita per day (gpcd) within the District. The per-capita domestic water use within the District is likely this high due to outdoor use with large lots and agricultural irrigation using domestic water for irrigated pastures and home gardens.

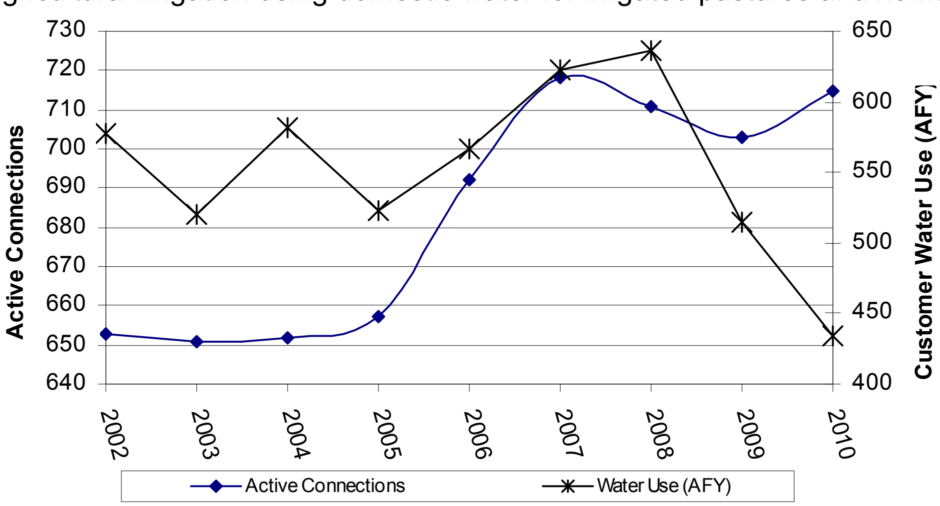


Figure 3-1: Existing Domestic Water Use within the District

1. Water Use based on reported gross product at Forbestown WTP.
2. Number of Active Connections based on average No. Active Connections each year.

Agricultural water use has historically varied significantly from year to year. Figure 3-2 shows water measurements for water used for irrigation purposes in the southern district without any allowance for conveyance losses in the Forbestown Ditch. The water measurements include the raw water turnout from the FWTP into New York Creek and water diverted through the turnout from the Forbestown Ditch to Costa Creek.

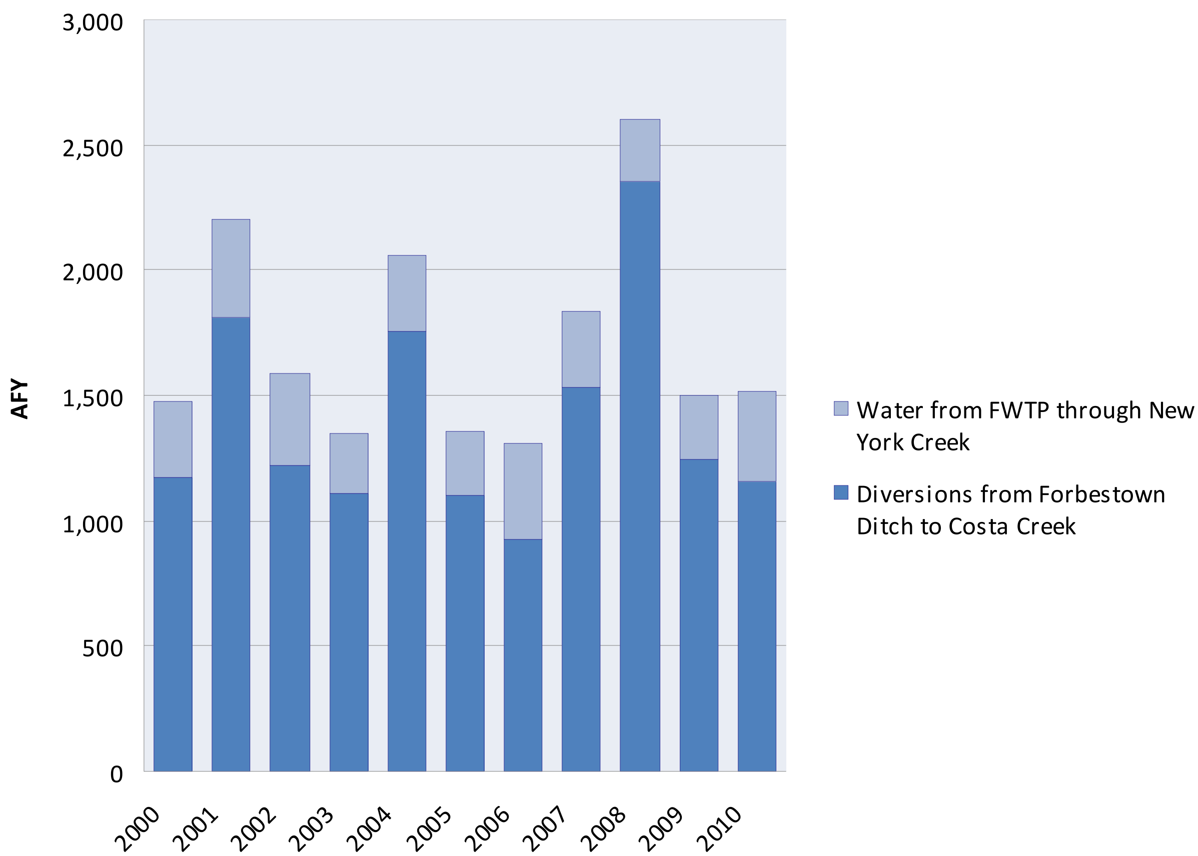


Figure 3-2: Existing Irrigation Water Use within the District

Source: Deliveries, Capacity, and Water Losses in the Dobbins/Oregon House Canal (DOH canal)

3.2 Water Demand Projections of Prior Studies

Before this study, five water use studies were made for the District's service area. The prior work estimated the available suitable lands for irrigation and associated water supply needs. The results of these studies produced varying water demand projections based on different assumptions for irrigable acreages within the District and differing water demand factors. Table 3-1 provides a summary of the estimated total water use resulting from these prior studies.

- CA Department of Water Resources (DWR) Study – Determined that there are 19,875 acres of irrigable land and that 80 percent (15,900 acres) was expected to be developed in the future. Of this acreage, 12,750 acres of land in the District would be used in the future to produce clover and pasture grass, with a 4 AF/acre water duty factor.

- St. Maurice-Helmkemp-Musser Study – Determined that there are 22,600 acres of irrigable land and 68 percent (15,400 acres) was estimated to be fully developed. Of the 15,400 acres, 11,900 acres of land in the District would be used in the future for improved pasture with a water duty of 3.7 AF/acre.
- CH2M Hill Study – Determined that 11,000 acres in the District would be used in the future for agricultural purposes with a water duty of 2.5 AF/acre.
- Bookman-Edmonston Study (1990) – Determined that there would be a demand for approximately 3,960 acres irrigated pasture and 820 acres irrigated trees with water duty factors of 5.5 and 4.1 AF/acre respectively.
- Bookman-Edmonston Study (2000) – Determined the water use prediction for the year 2040 by first determining the irrigable land and then sorting these based on parcel size. If the parcel size was less than 2.5 acres, it was assumed that it was not well suited for irrigation and thus only 25% of the gross acreage would be irrigated. If the parcel size was greater than 2.5 acres, it was assumed the parcel was better suited for irrigation, and thus 75% of these acreages were assumed to be irrigated. The water duty was assumed to be 4.6 AF/acre. Additionally, service in the DOHC was assumed to have a water conveyance loss of 15 percent (decreased from the current level of 40 to 60 percent due to assumed upgrades).

Table 3-1: Previous Water Demand Projections

Report Prepared By	Year	Irrigation Potential (AFY)	Domestic & Commercial Potential (AFY)	Water Demand Potential Total (AFY)
DWR Advisory Board, County of Yuba	1957	59,000	2,600	61,600
St. Maurice-Helmkemp-Musser	1962	53,700	4,930	58,630
CH2M Hill	1976	24,200	800	25,000
Bookman-Edmonston Engineering, Inc.	1990	25,100	3,850	28,950
Bookman-Edmonston Engineering, Inc. (unpublished)	2000	21,837	3,950	25,767

Source: Water Demands and Conveyance Requirements, Yuba County Water District

It is clear from the previous studies conducted for the area that there can be varying estimates as to how much of the District area will be used for residential, commercial, or agricultural purposes. For this study, the foreseeable future land uses were assumed to be similar to the existing uses. All prior studies concluded that the most probable use of the farmland within the District is for small family farms with irrigated pasture; however, the assigned water duty for irrigated pasture ranged from 2.5 to 5.5 acre-feet/acre/year (AF/AY).

DWR Bulletin 113-4 Table 1 provides an estimated applied water use for pasture land in Yuba County as 5.0 AF/AY. This value is consistent with other foothill west slope counties. The values range from a low applied water rate of 3.3 AF/AY in Siskiyou County to a high applied water rate of 6.6 AF/AY in Glenn and Colusa Counties. The average of the sixteen west slope central California counties from Bulletin 113-4 is 5.65 AF/AY. This study uses 5.0 AF/AY for the irrigated pasture water duty.

All prior reports estimate that potential water use would exceed the total amount of water available under Permits 11516 and 11518. The total water available under Permits 11516 and 11518 is 23,700 AFY. The prior studies estimated the potential water demand to range from 25,000 AF to 61,600 AF annually with a minimum water duty of 2.5 AF/AY. The 2.5 AF/AY water use was described in the CH2M Hill report as a water use for a combined residential small farm application.

Based on the prior work and review of current development patterns in the District, it was assumed for this study that not all land within any given parcel will be used for irrigated pasture. In addition, it was assumed that not all parcels will be developed with an irrigation demand. Water demand estimates for the District assumed half the irrigable land will ultimately use water and that a 5.0 AF/AY water duty, based on the DWR Bulletin 113-4 for irrigated pasture, will be used.

3.3 Irrigable Acreage Descriptions

The evaluation of the potential water demand within the District focused primarily on the availability of irrigable acreage and the suitability for various crop types. Prior studies and published data were used to quantify the current estimates of lands suitable for agricultural production using GIS tools and judgment as to the feasibility of marginal lands being put to significant irrigated use.

In general, the evaluation quickly identified that the highest value soil types suitable for irrigation are limited to irrigated pasture. The shallow soils, rocky soils and slopes in excess of thirty percent (30%) further limit the widespread potential for production type agriculture. This finding is consistent with prior studies, which concluded that small family ranches and food production would be the most likely form of development in the District.

The following describes the evaluation for estimating the available lands and associated potential water demand created by the future development of those lands as irrigated pasture and domestic farming.

3.3.1 Irrigable Acreage Analysis Description

Our study updated the estimated available land suitable for irrigation using GIS and published reports as well as engineering judgment regarding feasibility of conveying water to all areas with potential demand. The process started with a District wide assessment followed by a refined determination of those areas most likely to support development of irrigated acreage. The following steps describe the process:

- Identify all lands within the District designated as Farmland or Other land (based on the Farmland Mapping and Monitoring Program GIS Database).
- Import GIS data layers for soil conservation survey and overlay District Farmland.
- Refine soil conservation GIS analysis to indentify the land capability class (provided by the soil survey of Yuba County conducted by the NRCS) for areas of Farmland.
- Calculate gross area of the Land Capability Classes 1 through 4 that are identified as irrigable.

- Review geographic areas, topographic factors, existing water conveyance facilities, and identify regions within the District and document the gross irrigable acreage within each region.
- Prioritize regions based on proximate to existing water conveyance, suitability for flood irrigation based on slope, and existing development.
- Calculate an initial estimate of potential water use based on a water duty identified in prior reports. The water duty used for this initial estimate was 5.0 AF/AY, with assumed 50% development of irrigable acreage.

3.3.2 District Land Use

Zoning data for the District area was obtained from Yuba County. Yuba County requires that its zoning data be in accordance with the land use data dictated in the General Plan. Figure 3-3 shows the zones that are present within the District. Most areas (approximately 65,700 acres) within the District are zoned as A/RR0.5-40. This designation stands for Agricultural/Rural Residential, with varying parcel sizes corresponding to the number in the designation. This designation has a broad allowance of land use including growing and harvesting any agricultural crop or product, livestock and fowl farming, and game preserves.

Other zoning allocations within the District include 15,700 acres of Public Facilities (PF), Resource Conservation (RC) Recreational Zone (RZ), and Timberland Preserve Zone (TPZ), with the majority of the acreage designated TPZ.

3.3.3 Agricultural Land Use Types

Agricultural Land Use Data was taken from the Farmland Mapping and Monitoring Program (FMMP) GIS Database and overlaid onto the District Boundary. The FMMP produces maps of agricultural land that is rated according to soil quality and irrigation status as well as consideration of land use information. This database has four (4) main agricultural land use allocations within the District as shown in Table 3-2. They are as follows:

Prime Farmland: Irrigated land with the best combination of physical and chemical features able to sustain long term production of agricultural crops. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date.

Farmland of Statewide Importance: Irrigated land similar to Prime Farmland that has a good combination of physical and chemical characteristics for the production of agricultural crops. This land has minor shortcomings, such as greater slopes or less ability to store soil moisture than Prime Farmland. Land must have been sued for production of irrigated crops at some time during the four years prior to the mapping date.

Unique Farmland: Lesser quality soils used for the production of the state’s leading agricultural crops. This land is usually irrigated, but may include non-irrigate orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.

Grazing Land: Land on which the existing vegetation is suited to the grazing of livestock. This category is used only in California and was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities.

Table 3-2: Agricultural Land Use Types within the District

Landuse Type	Acres
Unique Farmland	317
Prime Farmland	105
Farmland of Statewide Importance	31
Grazing Land	24,611
Total	25,064

3.3.4 Soil Type Mapping

The FMMP gives overall recommended allocations for large areas within the District, with a majority of the land allocated as grazing land. Due to the fact that grazing land can be irrigated or non-irrigated, more specific soils data was necessary to determine the capacity for irrigation of grazing land within the District. Soils data for Yuba County was obtained from NRCS.

3.3.4.1 Soil Map Units

The NRCS soil survey for Yuba County identifies "soil map units" for the entire County. Each one of these units has a description of key soil types, slope, landuse, natural vegetation, a soil type classification of 1-8 and other key information regarding that unit. Based on these descriptions, key information for the soil map units within the District have been summarized below. Soil map units with the same key information, but differing slopes were grouped together. For a full detailed description of each soil map unit for the entire County as well as detailed plates that contain soil type within the District, see Appendix A.

Argovar silt loam (0-5%) – The native vegetation for this unit is mainly carex and sedges. This unit is used for livestock grazing and wildlife habitat. Where this unit is used for grazing, it is limited by wetness.

Auburn-Sobrante complex (3-15%) – The native vegetation for this unit is mainly blue oak and scattered Digger pine with an understory of annual grasses and forbs. This unit is used mainly for woodland and livestock grazing. It is also used for homesite development, wildlife habitat, and irrigated pasture. Few limitations affect livestock grazing on this unit. If this unit is used for irrigated pasture, the main management concern is soil depth.

Auburn-Sobrante complex (15-30%) – The native vegetation for this unit is mainly blue oak and scattered Digger pine with an understory of annual grasses and forbs. This unit is used mainly for woodland and livestock grazing. It is also used for homesite development and wildlife habitat. Few limitations affect livestock grazing on this unit.

Auburn-Sobrante complex, gravelly (3-15%) – The native vegetation for this unit is mainly blue oak, interior live oak, and Digger pine with an understory of brush, annual grasses and forbs. This unit is used for woodland and livestock grazing. It also is used for homesite development and wildlife habitat. Where this unit is used for grazing, it is limited by a tendency to produce woody species.

Auburn-Sobrante complex, gravelly (15-30%) – The native vegetation for this unit is mainly blue oak, interior live oak, and Digger pine with an understory of brush, annual grasses and forbs. This unit is used for woodland and livestock grazing. It also is used for homesite development and wildlife habitat. Where this unit is used for grazing, it is limited by a tendency to produce woody species.

Auburn-Sobrante, rock outcrop complex (8-15%) – The native vegetation for this unit is mainly blue oak, interior live oak, and Digger pine with an understory of brush, annual grasses and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, wildlife habitat, and irrigated pasture. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. This unit is suited to irrigated hay and pasture, although hay is not commonly grown.

Auburn-Timbuctoo-Argonaut complex (3-15%) – The native vegetation for this unit is mainly blue oak, interior live oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited to a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concerns are very slow permeability and limited soil depth.

Boomer gravelly loam (8-15%) – The native vegetation for this unit is mainly ponderosa pine and California black oak with an understory of brush, annual grasses, and forbs. This unit is used for timber production, livestock grazing, homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. This unit is suited to irrigated pasture.

Boomer gravelly loam (15-30%) – The native vegetation for this unit is mainly ponderosa pine and California black oak with an understory of brush, annual grasses, and forbs. This unit is used for timber production, livestock grazing, homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. This unit is suited to irrigated pasture.

Flanly sandy loam (3-8%) – The native vegetation for this unit is mainly interior live oak, blue oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concern is limited soil depth.

Flanly sandy loam (8-15%) – The native vegetation for this unit is mainly interior live oak, blue oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concern is limited soil depth.

Flanly-Orose-Verjeles complex (3-8%) – The native vegetation for this soil type is mainly interior live oak, blue oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used for woodland, livestock grazing, homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concerns are the very slow permeability of the Verjeles soil and limited soil depth.

Flanly-Orose-Verjeles complex (8-15%) – The native vegetation for this unit is mainly interior live oak, blue oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used for woodland, livestock grazing, homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concerns are the very slow permeability of the Verjeles soil and limited soil depth.

Fluvaquents (0-1%) – The native vegetation for this unit is mainly willows, alder, and blackberry with sedges and rushes in the wetter areas. These soils are located on floodplains. This unit is classified as nonirrigated.

Holland sandy loam (30-50%) –The native vegetation for this unit is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. This unit is used mainly for timber production. It also is a watershed. This unit is classified as nonirrigated.

Holland-Hoda-Hotaw complex (2-30%) – The native vegetation for this unit is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. This unit is located on mountains. This unit is classified as nonirrigated.

Hotaw sandy loam (15-30%) – The native vegetation for this unit is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. This unit is located on mountains. This unit is classified as nonirrigated.

Hotaw-Chawanakee-Holland complex (8-30%) – The native vegetation for this unit is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. This unit is located on mountains. This unit is classified as nonirrigated.

Mariposa gravelly loam (8-30%) – The native vegetation for this unit is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. This unit is used mainly for timber production.

Mildred cobbly loam (3-15%) – The native vegetation for this unit is mainly interior live oak, MacNab cypress, and scattered California black oak and ponderosa pine with a dense understory of brush. This unit is used for homesite development and wildlife habitat.

Orose sandy loam (8-15%) – The native vegetation for this unit is mainly interior live oak, blue oak, and Digger pine with an understory of brush, annual grasses, and forbs. This unit is used for woodland, livestock grazing, homesite development, and wildlife habitat. Where this unit is used for grazing, it is limited by a tendency to produce woody species.

Perkins loam (0-2%) – This well drained soil is on stream terraces. The vegetation in uncultivated areas is mainly annual grasses and forbs. Most areas of this unit are used for rangeland or for wildlife habitat. A few areas are used for irrigated crops, dryland grain crops, or urban development. This unit is suited to rangeland. This unit is suited to irrigated and nonirrigated crops.

Ricecross loam (0-2%) – The native vegetation for this unit is mainly annual grasses and valley oaks. This unit is used for rangeland, irrigated pasture, homesite development, and wildlife habitat. This unit is suited for rangeland. This unit is suited for irrigated pasture.

Sites loam (3-15%) – The native vegetation for this soil type is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. Most areas of this unit are used for timber production. A few areas are used for livestock grazing or homesite development. Where this soil type is used for grazing, the main management concern is a dense cover of brush.

Sites gravelly loam (15-30%) – The native vegetation for this unit is mainly mixed conifers and hardwoods with an understory of brush, grasses, and forbs. This unit is used primarily for timber production. This unit is classified as nonirrigated.

Sobrante gravelly loam (3-15%) – The native vegetation for this unit is mainly blue oak, interior live oak, and Digger pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concern is limited soil depth.

Sobrante gravelly loam (15-30%) – The native vegetation for this unit is mainly blue oak, interior live oak, and Digger pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for livestock grazing, it is limited by a tendency to produce woody species. If this unit is used for irrigated pasture, the main management concern is limited soil depth.

Sobrante-Timbuctoo complex (8-15%) – The native vegetation for this unit is mainly blue oak, interior live oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for grazing, it is limited by a tendency to produce woody species. If it is used for irrigated pasture, the main management concern is limited soil depth.

Sobrante-Timbuctoo complex (15-30%) – The native vegetation for this unit is mainly blue oak, interior live oak, Digger pine, and scattered ponderosa pine with an understory of brush, annual grasses, and forbs. This unit is used mainly for woodland and livestock grazing. It also is used for homesite development, irrigated pasture, and wildlife habitat. Where this unit is used for grazing, it is limited by a tendency to produce woody species. If it is used for irrigated pasture, the main management concern is limited soil depth.

Surnoff loam (8-15%) – The native vegetation for this unit is mainly ponderosa pine, incense cedar, and California black oak with a dense understory of brush. Most areas of this unit are used for timber production, a few areas are used for livestock grazing or homesite development. Where this unit is used for livestock grazing, the main management concern is a dense cover of brush.

Surnoff loam (15-30%) – The native vegetation for this unit is mainly ponderosa pine, incense cedar, and California black oak with a dense understory of brush. Most areas of this unit are used for timber production, a few areas are used for livestock grazing or homesite development. Where this unit is used for livestock grazing, the main management concern is a dense cover of brush.

Surnuf cobbly loam (8-30%) – The native vegetation for this unit is mainly ponderosa pine, incense cedar, and California black oak with a dense understory of brush. Most areas of this unit are used for timber production. A few areas are used for livestock grazing or homesite development. Where this unit is used for livestock grazing, the main management concern is a dense cover of brush.

The soil map units described by the NRCS were correlated with the farmland landuse data obtained from the Farmland Mapping and Monitoring Program. Table 3-3 contains the map soil units for the irrigable farmland (Land Capability Class of 1-4) within the District.

Table 3-3: Irrigable Farmland within the District

Type of Farmland	Map Soil Unit	Acres	Land Capability Class
Grazing Land	Perkins loam, 0 to 2 percent slopes	42.0	1
Grazing Land	Ricecross loam, 0 to 2 percent slopes	346.0	1
Grazing Land	Sites loam, 3 to 8 percent slopes	456.7	2
Grazing Land	Argovar silt loam, 0 to 5 percent slopes	23.5	3
Grazing Land	Boomer gravelly loam, 8 to 15 percent slopes	132.5	3
Grazing Land	Flanly sandy loam, 3 to 8 percent slopes	729.0	3
Grazing Land	Sites loam, 8 to 15 percent slopes	395.1	3
Grazing Land	Sobrante gravelly loam, 3 to 8 percent slopes	408.5	3
Grazing Land	Sobrante gravelly loam, 8 to 15 percent slopes	1,097.6	3
Grazing Land	Sobrante-Timbuctoo complex, 8 to 15 percent slopes	107.6	3
Grazing Land	Surnuf loam, 8 to 15 percent slopes	570.7	3
Grazing Land	Auburn-Sobrante complex, 15 to 30 percent slopes	348.5	4
Grazing Land	Auburn-Sobrante complex, 3 to 8 percent slopes	23.1	4
Grazing Land	Auburn-Sobrante complex, 8 to 15 percent slopes	41.2	4
Grazing Land	Auburn-Sobrante complex, gravelly, 15 to 30 percent slopes	858.5	4
Grazing Land	Auburn-Sobrante complex, gravelly, 3 to 8 percent slopes	731.5	4
Grazing Land	Auburn-Sobrante complex, gravelly, 8 to 15 percent slopes	1,932.2	4
Grazing Land	Auburn-Sobrante-Rock outcrop complex, 8 to 15 percent slopes	0.6	4
Grazing Land	Auburn-Timbuctoo-Argonaut complex, 3 to 8 percent slopes	0.3	4
Grazing Land	Auburn-Timbuctoo-Argonaut complex, 8 to 15 percent slopes	215.3	4

Type of Farmland	Map Soil Unit	Acres	Land Capability Class
Grazing Land	Boomer gravelly loam, 15 to 30 percent slopes	436.6	4
Grazing Land	Flanly sandy loam, 8 to 15 percent slopes	2,114.9	4
Grazing Land	Flanly-Orose-Verjeles complex, 3 to 8 percent slopes	1,159.4	4
Grazing Land	Flanly-Orose-Verjeles complex, 8 to 15 percent slopes	676.0	4
Grazing Land	Holland-Hoda-Hotaw complex, 2 to 30 percent slopes	96.8	4
Grazing Land	Mariposa gravelly loam, 15 to 30 percent slopes	32.2	4
Grazing Land	Mariposa gravelly loam, 8 to 15 percent slopes	149.7	4
Grazing Land	Orose sandy loam, 8 to 15 percent slopes	189.6	4
Grazing Land	Sobrante gravelly loam, 15 to 30 percent slopes	1,092.3	4
Grazing Land	Sobrante-Timbuctoo complex, 15 to 30 percent slopes	1,047.4	4
Grazing Land	Surnuf cobbly loam, 15 to 30 percent slopes	1,183.5	4
Grazing Land	Surnuf cobbly loam, 8 to 15 percent slopes	660.9	4
Grazing Land	Surnuf loam, 15 to 30 percent slopes	648.8	4
Farmland of Statewide Importance	Flanly sandy loam, 3 to 8 percent slopes	4.7	3
Farmland of Statewide Importance	Sobrante gravelly loam, 8 to 15 percent slopes	26.2	3
Prime Farmland	Perkins loam, 0 to 2 percent slopes	1.6	1
Prime Farmland	Boomer gravelly loam, 8 to 15 percent slopes	103.7	3
Prime Farmland	Boomer gravelly loam, 15 to 30 percent slopes	0.1	4
Unique Farmland	Boomer gravelly loam, 8 to 15 percent slopes	0.5	3
Unique Farmland	Sobrante gravelly loam, 8 to 15 percent slopes	0.2	3
Unique Farmland	Auburn-Sobrante complex, gravelly, 3 to 8 percent slopes	37.2	4
Unique Farmland	Boomer gravelly loam, 15 to 30 percent slopes	246.9	4
Unique Farmland	Sobrante gravelly loam, 15 to 30 percent slopes	0.0	4
Unique Farmland	Surnuf loam, 15 to 30 percent slopes	29.5	4
Total		18,399.1	

3.3.4.2 Land Capability Class

The District contains approximately 453 acres of farmland zoned as Farmland of Statewide Importance, Prime Farmland or Unique Farmland and 24,611 Acres of Farmland zoned as Grazing Land. NRCS has different land capability classifications that show, generally, the suitability of soils for most kinds of field crops. Below are the descriptions of the different soil type classifications allocated by the NRCS.

Class 1: Soils have few limitations that restrict their use.

Class 2: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3: Soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4: Soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5: Soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland or wildlife habitat.

Class 6: Soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7: Soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8: Soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

GIS Shapefiles were obtained through NRCS and the different irrigable soil type classifications were mapped for the District. For this study, it was assumed that land capability Classes of 1-4 are likely to become irrigated, whereas soils of Class 5-8 are not. These classes located within the District's Farmland and Grazing Land are depicted in Figure 3-4.

3.3.5 Irrigable Acreage Results

The Yuba County General Plan designates the District land use as foothill agriculture, timber production, and public land use. The primary land uses in the General Plan also identifies farmland of statewide importance, unique farmland, and prime farmland, used for growing olives and grapes as well as large areas of grazing land. The area of farmland of statewide importance includes the historic grape growing areas near Oregon House currently producing 3,500 cases of wine per year. Ranching operations with "on ranch" sales of locally raised beef have been approved by the County expanding the potential for use of irrigated pasture to increase beef production.

3.3.5.1 Total Irrigable Acreage – Sub Areas within the District

According to this analysis, the District contains 18,399 acres of irrigable land; however, portions of this land may not be areas where future irrigation through District irrigation systems is reasonable and foreseeable. To analyze potential future water demand within the District, the District was broken down into sub areas, as shown in Figure 3-1 (some acreages were not included in any of the sub areas). Table 3-4 presents the results of the evaluation and the corresponding water use estimates (based on 5.0 AF/AY, with 50% development) for each sub area.

Table 3-4: Irrigable Acreage and Estimated Water Demand for Sub Areas

Sub Area Description	Priority	Irrigable Acreage (Acres)	Estimated Water Demand (AFY) [1]
Southern District – South Honcut Creek East to Yuba River Canyon	3	5,210	13,025
Western Central District – Upper Honcut Creek and Rackerby	2	2,093	5,232
Central District – Dry Creek Drainage, Frenchtown Road and Collins Reservoir	4	5,119	12,798
East Central District – Dobbins-Oregon House	1	5,763	14,408
Total		18,185	45,463

1. Assumes zero conveyance losses.

The prioritized sub areas were reviewed for feasibility to deliver and to use water as follows:

- Southern District – South Honcut Creek East to Yuba River Canyon –This region is in the lowermost region of the District. It would be impractical to provide water to this area through the current DOHC. Additionally, 3,613 of the irrigable acres within this area correspond to the area of potential future exclusion. This area will likely either be provided water by BVID or local wells in the future.

- Western Central District – Upper Honcut Creek and Rackerby – This region is located in the western portion of the District and has a much smaller area of irrigable land than the other three areas. Providing water through the current DOHC to this area would not be possible, although an expansion of the FWTP and its delivery system could possibly provide water to this area for some agricultural purposes and increased domestic consumption in the future.

- Central District – Dry Creek Drainage, Frenchtown Road, and Collins Reservoir – This region is located along Dry Creek and adjacent to the upper DOHC. The vicinity of Dry Creek that could be served water from the DOHC is narrow and moderately wooded with mature pines and oak trees. Portions of the Central District region are served by the potable water system. Future agricultural demands in this area could be met through diversion of water from the existing Dry Creek Diversion Dam. This water could be diverted across the creek through a gravity pipeline and run alongside Frenchtown Road to agricultural acreages along the northern portion of the sub area.

- East Central District – Dobbins-Oregon House – This region is the most likely area to be able to increase irrigation lands, and growth in this area would be consistent with the existing developed parcels. The area has wide valleys of rolling hills with irrigable soils and mixed outcrops of shallow soils and rock hills. The area has the benefit of the existing DOHC which currently has limited hydraulic capacity but has significant potential to increase availability of water to the region.

As shown in Table 3-4, the reconnaissance level estimate of potential water demand assumed a water duty of 5.0 AF/AY, with 50% development, resulting in a maximum potential at total buildout of approximately 45,500 AF, without any allowance for conveyance losses.

Because the amounts of water supplied to the District under Permits 11516 and 11518 are measured at SF-14, conveyance losses within the existing and improved systems need to be considered when estimating the gross diversion volumes required at SF-14. This includes the additional water necessary to convey the net consumptive supply needs as well as conveyance losses associated with the conveyance of the SFWPA water (11 cfs, 3,720 AFY). The estimated water supply required to meet the demands listed in Table 3-4 could range from 59,000 to 66,000 AF, without any reduction in water losses in the Forbestown Ditch. These requirements could be even higher depending on improvements to conveyance systems subsequent to the Forbestown Ditch, including the DOHC and FWTP delivery systems as well as additional future infrastructure built by the District. Improvements to the District raw water canal system, resulting in significant reduction in water losses, will be required to meet the identified demands in Table 3-4.

In addition to conservation through improvements to District infrastructure, improved irrigation practices and possible conversion to alternative crops that use less water may effect future demands for water within the District. Possible projects discussed later in this report focus on the DOHC system as the infrastructure most likely to be economically feasible to improve and expand beneficial use of the District's water resources.

3.3.5.2 Total Irrigable Acreage – Sphere of Influence

The analysis conducted for the District boundaries using GIS was also conducted for the Sphere of Influence (SOI) to determine potential change in acreage within the District should parcels be annexed into the District boundaries in the future and should parcels within the southern portion of the District be excluded from the District. Table 3-5 shows the District and SOI irrigable acreages. This shows a net increase in irrigable acreages of approximately 66 percent if all land within the SOI is annexed into the District boundaries.

Although the SOI describes the areas of potential future District jurisdiction, this is not the current District Boundary; therefore, Table 3-5 is shown for information only and the SOI area was not used in this study to estimate water demands for this report. The area of potential exclusion was considered as unlikely to require potential future water District service, assuming likely exclusion of this area in the future.

Table 3-5: Irrigable Acreage Comparison

Area	Irrigable Acres
Sphere of influence	**30,480**
District boundary	**18,399**
District boundary less potential area of exclusion	**14,505**

3.3.6 Existing Infrastructure and Water Use Patterns

The regions with the highest likelihood of additional use of surface water under Permits 11516 and 11518 will rely on the expansion of the FWTP and improvements to the DOHC. The expansion of the FWTP is beyond the scope of this evaluation and was assumed to be limited to an increase from approximately 800 AFY to 900-1000 AFY. This increase was based on analysis of the number of parcels within the Western Central District sub area and a water use of 611 gpcd (Yuba County MSR), with an assumed number of persons per parcel.

Dobbins-Oregon House Canal: The DOHC contains approximately 17 miles of hillside canal and four piped inverted siphons. The DOHC conveys water from a check dam diversion structure to the two separate terminus points where the District goal is to manage the flows for near zero return flows leaving the canal. The District has estimated the capacity of the canal reaches as shown in Table 3-6.

Table 3-6: Dobbins-Oregon House Canal – Estimated Capacity

Description	Estimated Capacity (CFS)
Dry Creek Diversion Dam and Inlet Gate	13
Canal Segment Upstream of Walter's Wye (9.1 Miles)	53.5
Prince Albert Siphon	42.5
Indiana Siphon	36.9
Dobbins Airport Siphon	37.0
Canal Segment to Frenchtown Terminus	46.5
Canal Segment to Oregon House Terminus	46.5
Texas Hill Siphon	36.0

Figure 4-1 shows the locations of these facilities.

The District described the existing Dobbins-Oregon House Canal as having reaches where weed removal and annual maintenance has resulted in reduced bank height and reduced freeboard, and reaches where flows are slow, contributing to the high water losses of the system. Water losses are estimated by the District at about 60% during the peak delivery period. The current limiting element of the DOHC is the diversion structure. Improvements to the diversion capacity combined with canal bank restoration, siphon cleaning and headwall modifications could increase the DOHC capacity from 36 to 42.5 cfs.

The historic water use records for the District were reviewed to develop the monthly water use pattern for existing customers. This water use pattern was then used to estimate peak flows to deliver the entire 23,700 AFY available under Permits 11516 and 11518 (minus domestic system demands). The following describes the review of District records and findings regarding the water use pattern.

Existing irrigation supply to the DOHC is derived from two sources: (1) natural Dry Creek Flows and (2) SF-14 water delivered through a turnout from the Forbestown Ditch to Costa Creek and from FWTP releases to New York Creek. Water use records for Dry Creek are available for the years 2004-2006 and were used to create peak monthly factors for seasonal irrigation demands based on the composite flows from the two sources.

All three years reviewed showed a constant spring and fall water use pattern and two of the three years had a significant peak in July and August. The year 2004 data did not include the high peak for those months. Additional evaluation is necessary to determine a firm delivery pattern before proceeding with a design of any new facilities. For the purposes of this study, the 2004 lesser peak flow curve was used as a basis for estimating the maximum month peak factor.

The monthly flows in AF and cfs are shown in Table 3-7. The monthly supply assumptions were based on two cases as follows:

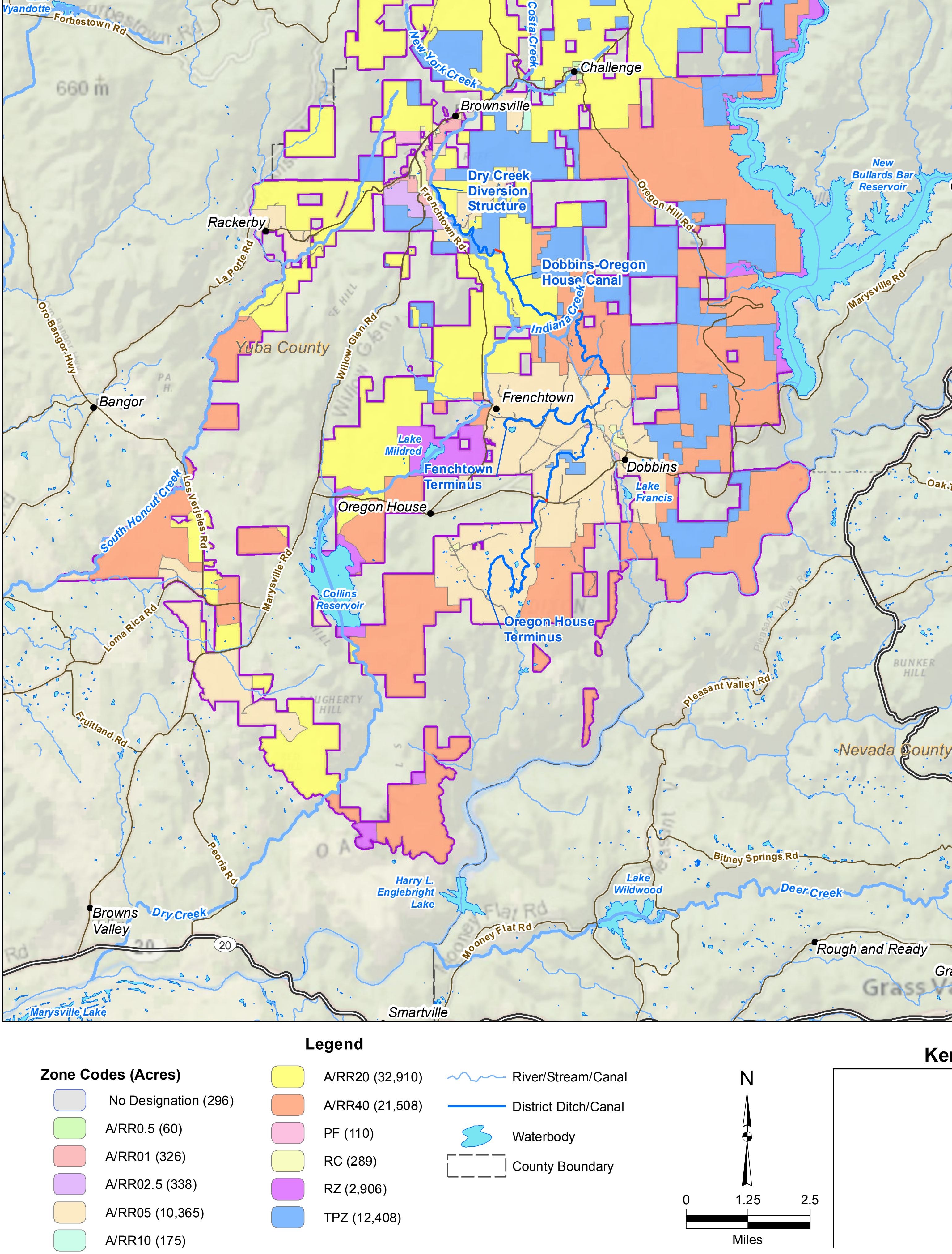
- **Case 1 Existing Conditions** – Water use is approximately 3,700 AF with 800 AF diverted to the FWTP. The maximum month in this case requires an estimated 8 cfs diversion to the DOHC to meet existing demands and no improvements are required to meet this demand condition. The estimated water required at SF-14 to meet all existing demands, including the conveyance losses for the SFWPA 3,720 AFY is 4,770 AFY.

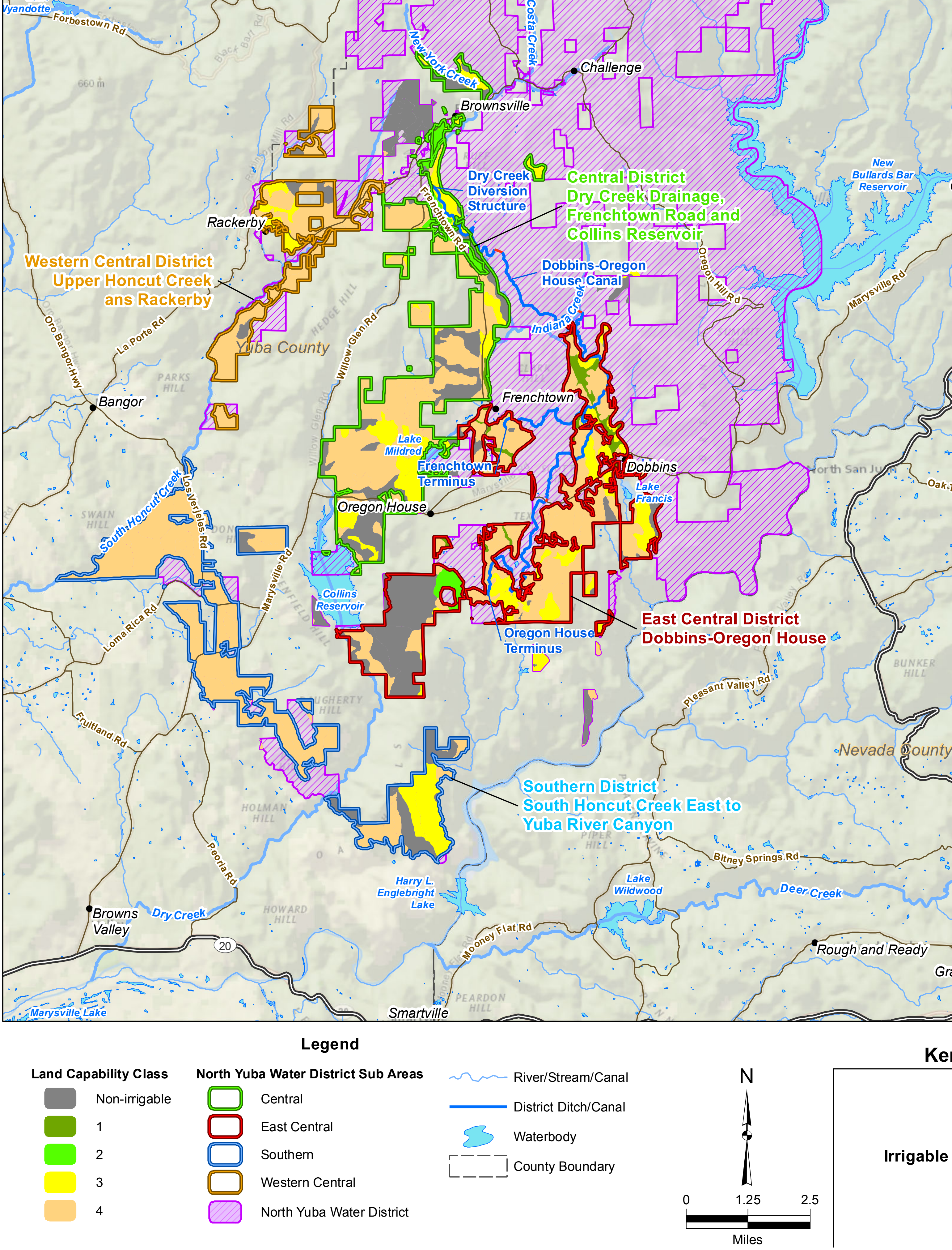
- **Case 2 Full Use of Water Available Under Permits 11516 and 11518** – Full allocation will be approximately 22,700 AF for irrigation and 1,000 AF for diversion to the FWTP and use in the District's domestic system. Increased conservation through improvements to the DOHC and the FWTP could allow for future expansion of water deliveries to the Honcut/Rackerby and the Dry Creek Drainage sub areas. System improvements to reduce water losses will increase the acreage that can be supplied from the 23,700 AF of available water.

The water demands within the District at full buildout have been estimated to be 45,463 AFY. Development of alternatives to meet the full buildout water demand conditions (that is, over 23,700 AFY) is beyond the scope of this study.

Table 3-7: Irrigation Schedule for Case 1, and 2

Month	Monthly Peaking Factor	Case 1 (AF)	Case 1 (cfs)	Case 2 (AF)	Case 2 (cfs)
April	0.60	248	4	1,944	33
May	1.20	499	8	3,906	66
June	1.21	501	8	3,923	66
July	1.21	501	8	3,920	66
August	1.19	495	8	3,872	65
September	1.09	450	8	3,525	59
October	0.50	206	3	1,609	27
Average		414		3,243	
Total		**2,900**		22,700	


Forbestown Rd
660 m
New York Creek
Costa Creek
Challenge
Brownsville
Dry Creek
Diversion
Structure
Frenchtown Rd
Oregon Hill Rd
New
Bullards Bar
Reservoir
Rackerby
La Porte Rd
Dobbins-Oregon
House Canal
Indiana Creek
Marysville Rd
Oro Bangor Hwy
Yuba County
Willow Glen Rd
Bangor
Frenchtown
Lake
Mildred
Fenchtown
Terminus
Dobbins
Lake
Francis
Oak
Oregon House
South Honcut Creek
Los Verjeles Rd
Marysville Rd
Collins
Reservoir
Oregon House
Terminus
Loma Rica Rd
Pleasant Valley Rd
Fruitland Rd
Nevada County
Peoria Rd
Bitney Springs Rd
Harry L.
Englebright
Lake
Lake
Wildwood
Deer Creek
Browns
Valley
Dry Creek
20
Mooney Flat Rd
Rough and Ready
Marysville Lake
Smartville
Legend
Zone Codes (Acres)
No Designation (296)
A/RR0.5 (60)
A/RR01 (326)
A/RR02.5 (338)
A/RR05 (10,365)
A/RR10 (175)
A/RR20 (32,910)
A/RR40 (21,508)
PF (110)
RC (289)
RZ (2,906)
TPZ (12,408)
River/Stream/Canal
District Ditch/Canal
Waterbody
County Boundary
N
0
1.25
2.5
Miles



Central District
Dry Creek Drainage,
Frenchtown Road and
Collins Reservoir
Western Central District
Upper Honcut Creek
ans Rackerby
East Central District
Dobbins-Oregon House
Southern District
South Honcut Creek East to
Yuba River Canyon
Dry Creek
Diversion
Structure
Dobbins-Oregon
House Canal
Frenchtown
Terminus
Oregon House
Terminus
Challenge
Brownsville
Rackerby
Bangor
Frenchtown
Dobbins
Oregon House
Browns
Valley
Smartville
Rough and Ready
Yuba County
Nevada County
New York Creek
Costa Creek
Indiana Creek
South Honcut Creek
Dry Creek
Deer Creek
New
Bullards Bar
Reservoir
Collins
Reservoir
Lake
Mildred
Lake
Francis
Harry L.
Englebright
Lake
Lake
Wildwood
Marysville Lake
Forbestown Rd
La Porte Rd
Oro Bangor Hwy
Willow Glen Rd
Frenchtown Rd
Oregon Hill Rd
Marysville Rd
Los Verjeles Rd
Loma Rica Rd
Fruitland Rd
Peoria Rd
Pleasant Valley Rd
Bitney Springs Rd
Mooney Flat Rd
20
Legend
Land Capability Class
Non-irrigable
1
2
3
4
North Yuba Water District Sub Areas
Central
East Central
Southern
Western Central
North Yuba Water District
River/Stream/Canal
District Ditch/Canal
Waterbody
County Boundary
N
0
1.25
2.5
Miles
Irrigable

Section 4: Conceptual Raw Water Conveyance Plan

4.1 Conceptual Raw Water Conveyance Plan

The District provides raw water for irrigation and treatment for the potable water supply to the District's customers. Water treatment for potable use occurs at the Forbestown Water Treatment Plant. Water conveyed into the southern part of the District is exclusively used for irrigation. This section of the report discusses the existing canals and natural channels used to convey water through the District.

4.1.1 Existing Facilities

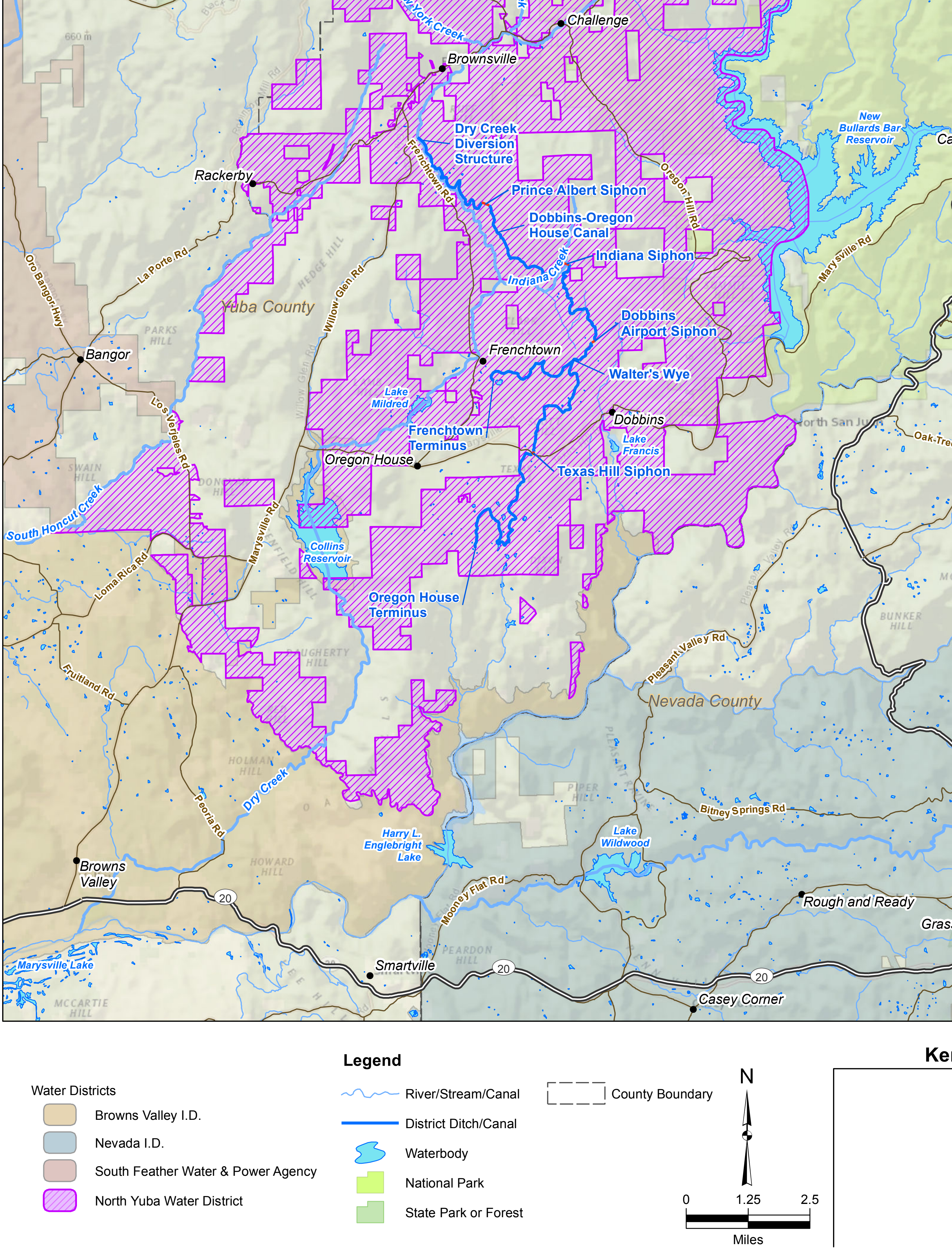
The primary facilities providing for movement of water through the District are the Forbestown Ditch in the north and the Dobbins-Oregon House Canal in the central and southern portion of the district. Figure 4-1 depicts these facilities.

4.1.1.1 Forbestown Ditch

The Forbestown Ditch is a 10-mile long unlined canal that conveys all of the District's water supply that is delivered under the SFWPA agreement. This facility was originally constructed in the 1860's and has been in service since that time. The Ditch historically was operated by the SFWPA and, under the 2005 Agreement, was conveyed to the District in 2011.

The Forbestown Ditch maintenance was minimal over the last 20 years and many sections are severely overgrown and subject to tree falls and other storm related impacts to reliability. SFWPA and the District have completed significant clean up and renewal of access for maintenance since 2005. However, the ditch capacity remains inadequate and the ditch has significant water losses. The District has preliminary plans to replace the ditch with a pipeline to improve service reliability and realize significant water savings through reduced water losses. Conversion of this ditch to a pipeline would do the following:

- Reduce or eliminate water losses in the ditch (current water losses are between 30 to 40 percent of the water delivered)
- Improve reliability of flow to the District water treatment plant
- Improve quality of the water delivered to the District
- Increase capacity to meet existing future demands
- Improve safety of the facilities



Challenge
Brownsville
New York Creek
Dry Creek Diversion Structure
Rackerby
Prince Albert Siphon
Dobbins-Oregon House Canal
Indiana Siphon
Indiana Creek
New Bullards Bar Reservoir
Oregon Hill Rd
Frenchtown Rd
La Porte Rd
Oro Bangor Hwy
Yuba County
Willow Glen Rd
Mary'sville Rd
Dobbins Airport Siphon
Bangor
Frenchtown
Walter's Wye
Lake Mildred
Dobbins
Lake Francis
Frenchtown Terminus
Oregon House
Texas Hill Siphon
Los Verjeles Rd
South Honcut Creek
Marysville Rd
Collins Reservoir
Loma Rica Rd
Oregon House Terminus
Pleasant Valley Rd
Fruitland Rd
Nevada County
Dry Creek
Peoria Rd
Bitney Springs Rd
Harry L. Englebright Lake
Lake Wildwood
Browns Valley
Mooney Flat Rd
Rough and Ready
Marysville Lake
Smartville
Casey Corner
20
Legend
Water Districts
Browns Valley I.D.
Nevada I.D.
South Feather Water & Power Agency
North Yuba Water District
River/Stream/Canal
District Ditch/Canal
Waterbody
National Park
State Park or Forest
County Boundary
N
0
1.25
2.5
Miles

The District had a preliminary design prepared to assess the feasibility of the pipeline and potential alignments. The pipeline preliminary design anticipated the use of a 36-inch diameter pipeline with a maximum flow rate of 44 cubic feet per second (cfs). Thirty three (33) cfs will be for District use and 11 cfs will be used for conveyance for SFWPA. (Forbestown Ditch Improvements Feasibility Study). The canal segment upstream of the Costa Creek turnout may require a larger pipe, and plans for deliveries through the Costa Creek could reduce the pipe size between the turnout and the FWTP. Final sizing and design for the Forbestown pipeline will need to address the District's ultimate water delivery plans. Additional considerations may include the affordability of a pipeline large enough to convey the entire 23,700 AFY available under Permits 11516 and 11518. For this reason, future water demand was considered for both an improved Forbestown Ditch and a pipeline replacing the current Forbestown Ditch.

The current and potential water use demand schedule shown in Figure 4-2 is based on the historical 2007 District water use data. The model curve in Figure 4-2 assumes a linear increase in water use for each month extrapolated for a 23,700 AF maximum water use.

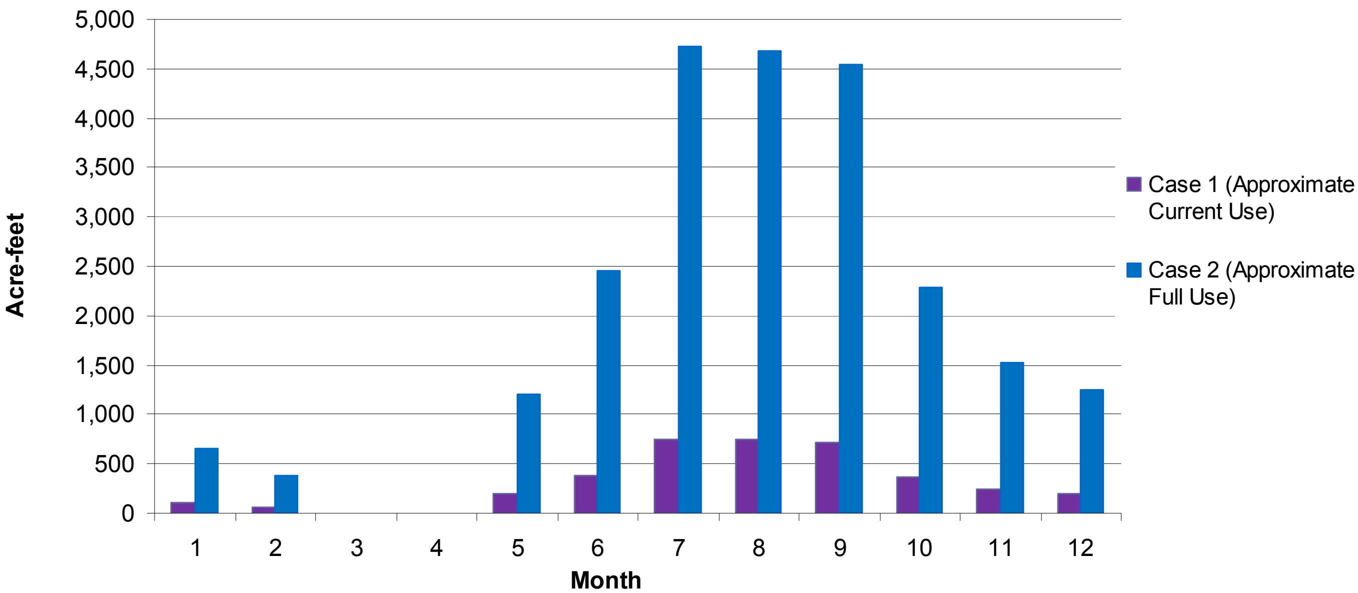


Figure 4-2: NYWD Water Use Schedule Forbestown Ditch (Acre-feet)

Figure 4-2 was used to create Figure 4-3, which depicts the predicted water demands in cfs for the District under Case 2. The contract between the District and SFWPA requires the District to provide 11 cfs of conveyance capacity to SFWPA upon request. Thus, Figure 4-3 includes a linear 11 cfs delivery to SFWPA.

Current peak Forbestown Ditch flow is approximately 24 cfs. Full use of the 23,700 AFY available under Permits 11516 and 11518 would require a peak conveyance capacity of approximately 90 cfs. The Forbestown Ditch will need to be enlarged or piped to provide this increased conveyance capacity. A canal or pipe with sufficient flow capacity for approximately 90 cfs would be needed for Case 2.

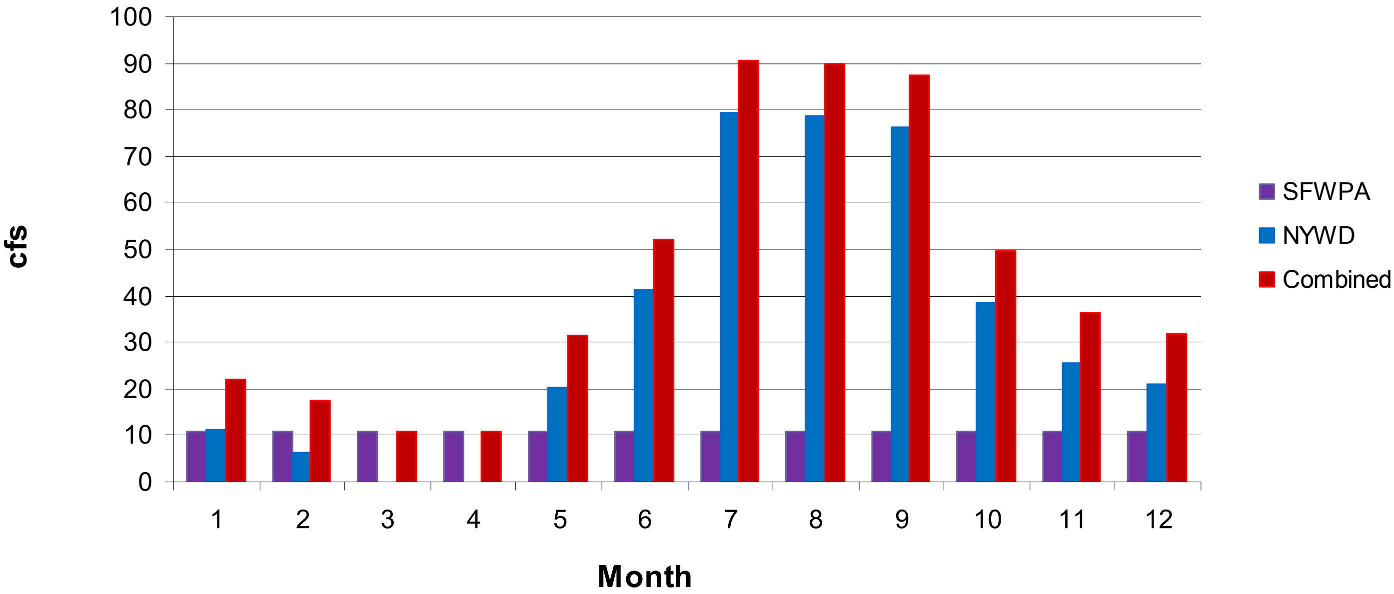


Figure 4-3: NYWD/SFWPA Case 2 Water Use Schedule Forbestown Ditch (cfs)

4.1.1.2 Dobbins-Oregon House Canal

The eastern portion of the District's agricultural water demands is supplied by the DOHC. Water is diverted into the DOHC through the Dry Creek Diversion from three (3) sources:

1. Water diverted from the Forbestown Ditch at the Costa Creek turnout

2. Water from the Forbestown treatment plant, routed through New York Creek and then Dry Creek

3. Natural flows in Dry Creek diverted under License 12984

Water from the Forbestown Ditch is released to the Costa Creek Turnout into Costa Creek. This water flows down Costa and Dry Creek to the DOHC. Additionally, water from the Forbestown treatment plant can be released to New York Creek. This water then flows to Dry Creek and is diverted at the Dry Creek Diversion. As discussed above, the conveyance capacity from the Forbestown Ditch turnout to Costa Creek will need to be approximately 66 cfs to allow for use of the full 23,700 AFY, assuming 1,000 AFY are used by the FWTP for domestic uses in the future and 22,700 AFY are used for irrigated agriculture.

The District may divert natural flows from Dry Creek under License 12984 with maximum diversion of 21.4 cfs with an annual limit of 6,060 AFY, with a required 4 cfs bypass flow. Consideration of facilities to develop a reliable annual diversion of 21.4 cfs from natural flows of Dry Creek was not part of this evaluation and is not included in the estimated facility sizing.

The existing conveyance capacity of the DOHC is limited by the diversion structure to 13 cfs and the water losses are estimated by the District to be approximately 60 percent. Improvements to increase capacity and reduce water losses are required to provide for the full use of water for Case 2.

4.2 Improvement Plan

This section describes three proposed projects of conceptual improvements to develop the conveyance capacity needed to put the full 23,700 AFY to beneficial use within the District. These improvements center around the DOHC.

- Project 1 – Maximize Service Using Existing Facilities With Improvements and a New Piped Gravity System in the Frenchtown Road area
- Project 2 – Expand Services Using Piped Gravity System to Replace the DOHC
- Project 3 – Expand DOHC Service Using Pumped Deliveries

These three projects all center around the DOHC. The DOHC receives water from deliveries sent through the Forbestown Ditch. The existing Forbestown Ditch is at capacity and unable to provide for additional flows without improvements. The District is considering further work on its proposed project to construct a pipeline from the SF-14 point of diversion on the Woodleaf Penstock that will provide capacity for increased conveyances to and releases at the Costa Creek turnout and the Forbestown Water Treatment Plant.

The District could choose to instead increase the capacity of the current ditch to provide water deliveries within the District. For the purposes of this study, both options are discussed. It is assumed that 15-25% water losses would occur between SF-14 and the Costa Creek Turnout with the expanded ditch.

4.2.1 Project 1 – Maximize Service Using Existing Facilities

Project 1A – Maximize Service through Ditch Improvements

The existing capacity of the DOHC is reported as 13 cfs at the Dry Creek Diversion. The existing DOHC is predominantly unlined and the District has estimated a 60 percent water loss factor in the canal. The physical canal capacity is approximately 35 cfs and is limited by canal freeboard. There are four (4) existing siphons that range in estimated flow capacity from 36 to 42.5 cfs.

The plans for the improvements described below were developed for projects that would increase the canal capacity to 55 cfs and reduce the water loss through infiltration in the canal to approximately 30 percent. In canal peak irrigation season, flows of 55 cfs would supply the irrigation needs of approximately 5,320 acres of pasture. The estimated total water required includes the 30 percent water losses that are estimated would occur following canal lining. The Project 1 improvements would require approximately 19,000 AF of gross supply, with a net delivery of 13,300 AF (assuming the post improvement 30 percent water loss factor).

If the District chooses to increase the capacity of the Forbestown Ditch through an expanded ditch, an estimated water loss of 15-25% would result in a total District water demand at SF-14 of 22,350-25,330 AF (accounting for use at the FWTP and losses attributed to delivery of SFWPA water, as shown in Table 4-1, for Project 1A). The District would not be able to supply sufficient water to irrigate the entire 5,320 acres with SF-14 water alone, but could potentially supplement that supply with water diverted under Water Right License 12984 when natural flows within Dry Creek are available to supplement the remaining water demand. If the District instead decides to pipe the Forbestown Ditch (FD) (shown as Project 1B in Table 4-1), this would result in 19,000 AF of water demand at SF-14. This would allow an additional 3,700 AF of water to be allocated in other portions of the District, such as areas within the Central District sub area (which is discussed below).

Table 4-1: Estimated Water Use at SF-14, Project 1

	Area Served	Irrigable Acres	Potential Water Use (AF)	DOHC Capacity (AF)	DOHC Water Loss (%)	Water Loss in FD (%)	Actual Delivery (AF)	Demand at SF-14 (AF)
Project 1A	DOHC	5,763	14,408	19,000	30%	15-25%	13,300	22,350-25,330
Project 1A	FWTP	N/A	1,000	N/A	N/A	30%	1,429	1,429
Project 1A	SFWPA	N/A	3,720	N/A	N/A	30%	1,594	1,594
Total								**25,373-28,353**
Project 1B	DOHC	5,763	14,408	19,000	30%	0%	13,300	19,000
Project 1B	FWTP	N/A	1,000	N/A	N/A	0%	1,000	1,000
Project 1B	SFWPA	N/A	3,720	N/A	N/A	0%	0	0
Project 1B	Central District	2,000	3,700	N/A	N/A	0%	3,700	3,700
Total								**23,700**

Project 1A-1 – DOHC Diversion Structure Improvements

This project includes the removal of the existing two concrete dikes in Dry Creek and reconstruction with an increase impoundment depth. The increase depth will be less than three feet, and will result in a structure that remains below the limits established for jurisdictional oversight by the California Division of Safety of Dams. The conceptual plan includes a fixed crest elevation and a bypass from the canal diversion structure for the mandatory 4 cfs bypass flow. The bypass flow is required during periods when the natural inflow to the diversion is equal to or exceeds 4 cfs.

The diversion structure will be a concrete headwall with manually cleaned sloping thrash rack. The diversion will have a manually operated downward opening weir gate and metering station for control of the DOHC diversion. The work assumed reshaping the initial 250 feet of canal and the creation of an all weather turnaround for maintenance vehicles.

The recommended design diversion capacity is 100 cfs, which would be sufficient for full use of water under Case 2 and some use of available natural flows from Dry Creek.

Project 1A -2 – DOHC Canal Restoration

This project includes the removal of canal accumulations including sediments, plant growth and reshaping approximately 20 percent of the canal length to restore the canal cross section and minimum freeboard. This work includes limited regrading of the access road and inlet improvements to the existing siphons.

The recommended design capacity for the restoration is 55 cfs.

Project 1A-3 – DOHC Canal Lining

This project includes the identification and lining of those segments of the canal with the highest water losses. It is assumed that 30 percent of the canal invert will be lined and 60 percent of the canal side walls will be lined and that these actions will result in a reduction in water losses to 30 percent of the diversion. It is assumed that these improvements will not result in any increase in capacity.

Project 1A-4 – Siphon Replacement

This project includes replacing the Prince Albert Siphon, the Indiana Siphon and the Dobbins Airport Siphon with new siphons with capacities of 55 cfs. These actions will result in sufficient capacity for the District to be able to provide irrigation supplies to the areas that can be served by the DOHC. Future improvements to extend the service area would require a piped or pumped system.

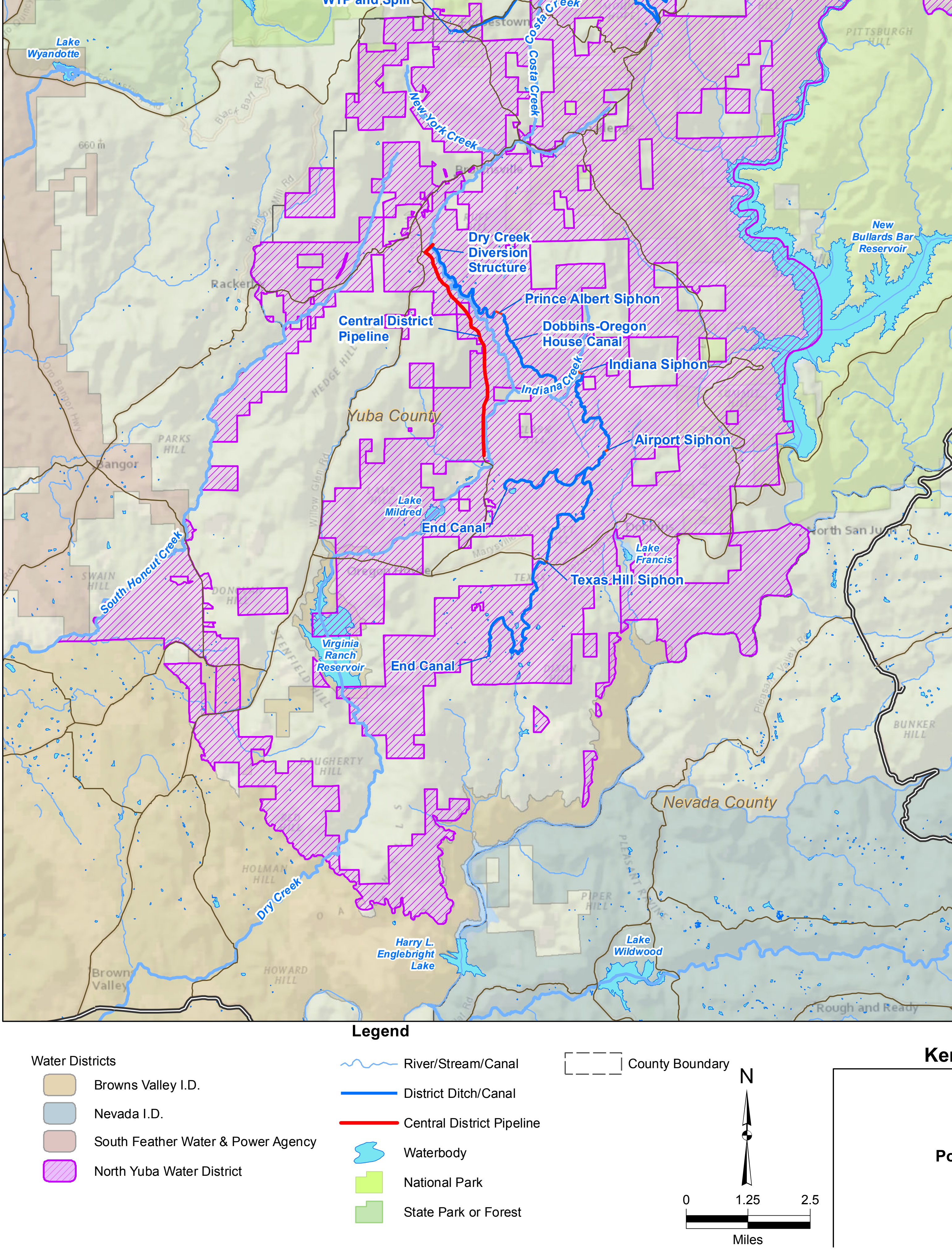
Project 1B – Expand Service Using Piped Gravity System to Central District Sub Area

Project 1B would provide a pipeline to replace the Forbestown Ditch, this replacement would result in an increase in water conservation such that the District's total demand for water at SF-14 would be 20,000 AFY for the DOHC and FWTP, which would free up 3,700 AFY of water under Water Permits 11516 and 11518 for use in other parts of the District.

There are 2,000 acres of irrigable land in the northern portion of the Central District Sub Area. Of this land, approximately 75% could be served by a gravity system that receives water from the Dry Creek Diversion across the creek and into the Central District Sub Area. This gravity driven pipeline could potentially be run along Frenchtown Road and La Porte Road to acreages within this area, as shown in Figure 4-4. As discussed in the preceding paragraph, after the Forbestown Pipeline and the DOHC improvements are completed, approximately 3,700 AFY of additional water would be available to serve irrigation demands in this area.

Project 1B includes the following elements:

- DOHC Turnout at diversion dam
- 6,800 feet of 18-inch pipeline including a crossing of Dry Creek and 1,300 feet requiring new right of way.
- 7,000 feet of 12-inch pipeline ending with a discharge to return to Dry Creek or South Honcut Creek. This pipeline is assumed to be in the pavement.
- 24,000 feet of 16-inch pipeline ending with a discharge to Dry Creek near Frenchtown.
- 25 Turnouts Assumed
- 8 Laterals Assumed


WTP and Spill
Lake Wyandotte
Costa Creek
New York Creek
Dry Creek Diversion Structure
Prince Albert Siphon
Central District Pipeline
Dobbins-Oregon House Canal
Indiana Siphon
Indiana Creek
Yuba County
Airport Siphon
New Bullards Bar Reservoir
Lake Mildred
End Canal
Lake Francis
Texas Hill Siphon
South Honcut Creek
Virginia Ranch Reservoir
End Canal
Nevada County
Dry Creek
Harry L. Englebright Lake
Lake Wildwood
Legend
Water Districts
Browns Valley I.D.
Nevada I.D.
South Feather Water & Power Agency
North Yuba Water District
River/Stream/Canal
District Ditch/Canal
Central District Pipeline
Waterbody
National Park
State Park or Forest
County Boundary
N
0
1.25
2.5
Miles

4.2.2 Project 2 – Expand Service in DOHC Area Using Piped Gravity System

Project 2 reflects additional improvements needed to expand DOHC conveyance capacity to support future demands. Project 2 includes replacing the DOHC with a piped system. This would allow for delivery of the full acreage that can be served by the DOHC.

The replacement of the DOHC with a piped system would reduce conveyance losses to near zero and would provide for improved water quality and pressure downstream of the point of diversion on Dry Creek. The design considerations for a piped system require a balance between a minimum velocity to maintain suspension of sediment and debris and a maximum velocity to avoid excessive head loss due to friction. The reconnaissance sizing assumed the following flows and pipe diameters:

Table 4-2: Pipe Sizing Criteria

Canal Segment	Minimum Diversion Rate (cfs)	Maximum Diversion Rate (cfs)	Pipe Diameter (in)
Dry Creek to Airport Siphon	25	42	36
French Town Branch	8	13	20
Dobbins-Oregon House Branch	17	30	30

The pipeline alignment was assumed to be within the existing canal alignment pending a more detailed evaluation of right of way costs, savings due to reduced pipe length and hydraulic feasibility. For this report it was assumed that the existing canal could be taken out of service during construction and the pipeline built over a period of two construction seasons. The excavation of the existing canal invert to a depth of three feet was assumed to allow for a full pipe and the pipe was assumed to be partially covered. The re-grading of the down slope bank and access road would accommodate sheet flow of precipitation with periodic culverts and minor channel improvements.

As shown in Table 4-9, the total estimated cost for Project 2 is $34,211,000.

4.2.3 Project 3 – Expand Service Using Pumped Deliveries

Significant tracts of irrigable land suitable for District water service using a pumped irrigation system do not appear to exist and there is not an identified Project 3 alternative to support water deliveries to significant additional land. Existing irrigable lands exist within the areas serviceable by gravity flows. It is assumed that development by individual property owners of the pumping facilities that would be necessary to provide irrigation flows to those properties would be the responsibility of the property owners. A Project 3 – Expanded Service Using Pumped Deliveries set of alternatives was not developed as part of this study.

4.3 Cost Estimates

The cost estimates for Project 1 and 2 are preliminary quantities and are based on conservative estimates of existing conditions obtained from historical documents from the District as well as engineering judgment. No survey was available for the project areas included in Projects 1 and 2.

4.3.1 Basis of Costs

The feasibility cost estimates for Projects 1 and 2 were prepared using prior construction bids, current materials pricing, and engineering judgment. The costs are opinions of probable cost and reflect a conceptual level of accuracy. The estimates include a 25 percent allowance for contingency for unforeseen conditions, 15 percent for engineering, administrative and legal costs and 10 percent for environmental review.

4.3.2 Cost Estimates

Conceptual level cost estimates for Project 1 and 2 were created based on the descriptions in section 4.2.1.

4.3.2.1 Project 1 Cost Estimates

Table 4-3 contains the summary for all portions of Project 1, which includes improvement to the DOHC diversion structure to increase capacity of the diversion, restoration of the canal to improve the capacity throughout the canal, and improvement of the canal by lining portions of it to decrease water loss within the canal. Tables 4-3 to 4-5 contain more detailed cost estimates for each sub-project of Project 1.

Table 4-3: Project 1 Conceptual Level Cost Estimate Summary

Project	Project Element		Total Cost
1A-1	Diversion Structure Improvements	$	508,000
1A-2	Canal Restoration	$	2,106,000
1A-3	Canal Lining	$	2,687,000
1A-4	Siphon Replacement	$	1,477,000
1B	Piped Gravity System to Central District Sub Area	$	7,731,000.00
	Estimated Cost	$	14,509,000.00

Project 1A-1 – DOHC Diversion Structure Improvements

Table 4-4 contains the elements for Project 1A-1 of Project 1. Project 1A-1 includes improvements to the DOHC diversion structure to increase capacity through the removal of the existing two concrete dikes and reconstruction with an increased impoundment depth. Total costs for each element are described below with a 25% allowance for contingency, 15% for engineering, administration and legal, and 10% for environmental review.

Table 4-4: Project 1A-1 Conceptual Level Cost Estimate

Project Element		Total Cost
Mobilization		$ 15,500
Clear/Grub		$ 5,000
Demolition		$ 45,000
Canal Improvement		$ 45,000
Control Structure and Headwall		$ 80,000
Dam and Spill Structure		$ 106,210
Site Grading		$ 8,150
Site Restoration		$ 7,500
Site Security		$ 12,000
Subtotal		$ 324,360
Taxes	7.25%	$ 13,678
Subtotal		$ 338,038
Contingencies	25%	$ 84,510
Subtotal		$ 422,548
Engineering, Admin, and Legal	15%	$ 50,706
Subtotal		$ 473,254
Environmental Review	10%	$ 33,804
Subtotal		$ 507,058
	Rounded to:	**$ 508,000.00**

Project 1A-2 – DOHC Canal Restoration

Table 4-5 contains the elements for Project 1A-2 of Project 1. Project 1A-2 includes restoration of the canal through removal of canal accumulations including sediments, plant growth and restoration of the original canal cross section and freeboard. Total costs for each element are described below with a 25% allowance for contingency, 15% for engineering, administration and legal, and 10% for environmental review.

Table 4-5: Project 1A-2 Conceptual Level Cost Estimate

Project Element		Total Cost
Mobilization		$ 66,000
Clear/Grub		$ 35,000
Total Ditch Excavation (5' Width)		$ 356,040
Total Ditch Excavation (4' Width)		$ 276,120
Total Ditch Excavation (3' Width)		$ 93,100
Access Road		$ 410,000
Siphons		$ 16,000
Services		$ 37,500
Gates		$ 20,000
Fencing		$ 55,000
Spill Structures		$ 15,000
Subtotal		$ 1,379,760
Taxes	7.25%	$ 23,635
Subtotal		$ 1,403,395
Contingencies	25%	$ 350,849
Subtotal		$ 1,754,244
Engineering, Admin, and Legal	15%	$ 210,510
Subtotal		$ 1,964,754
Environmental Review	10%	$ 140,340
Subtotal		$ 2,105,094
	Rounded to:	**$ 2,106,000.00**

Project 1A-3 – DOHC Canal Lining

Table 4-6 contains the elements for Project 1A-3 of Project 1. Project 1A-3 includes identification and lining of those segments of the canal with the highest water loss. Total costs for each element are described below with a 25% allowance for contingency, 15% for engineering, administration and legal, and 10% for environmental review.

Table 4-6: Project 1A-3 Conceptual Level Cost Estimate

Project Element		Total Cost
Mobilization		84,074
Canal Preparation - 5 foot wide		12,400
Shotcrete - invert plus wall 5 foot		447,640
Shotcrete - walls only -5 foot		329,840
Canal Preparation - 4 foot wide		8,496
Shotcrete - invert plus wall 4 foot		363,204
Shotcrete - walls only -4 foot		282,492
Canal Preparation - 3 foot wide		2,394
Shotcrete - invert plus wall 3 foot		128,877
Shotcrete - walls only -3 foot		106,134
Subtotal		1,765,551
Taxes	7.25%	25,309
Subtotal		1,790,860
Contingencies	25%	447,716
Subtotal		2,238,576
Engineering, Admin, and Legal	15%	268,630
Subtotal		2,507,206
Environmental Review	10%	179,087
Subtotal		2,686,293
	Rounded to:	**$ 2,687,000.00**

Project 1A-4 – Siphon Replacement

Table 4-7 contains the elements for Project 1A-4 of Project 1. Project 1A-4 includes identification and lining of those segments of the canal with the highest water loss. Total costs for each element are described below with a 25% allowance for contingency, 15% for engineering, administration and legal, and 10% for environmental review.

Table 4-7: Project 1A-4 Conceptual Level Cost Estimate

Project Element		Total Cost
Mobilization		$ 54,711
Prince Albert Siphon (900 feet)		$ 292,000
Indiana Siphon (550 feet)		$ 178,000
Dobbins Airport (1200 feet)		$ 390,000
Subtotal		$ 858,600
Taxes	7.25%	$ 62,249
Subtotal		$ 920,849
Contingencies	25%	$ 230,212
Subtotal		$ 1,151,061
Engineering, Admin, and Legal	15%	$ 172,659
Subtotal		$ 1,323,720
Environmental Review	10%	$ 132,372
Subtotal		$ 1,456,092
	Rounded to:	**$ 1,456,000.00**

Project 1B - Expand Service Using Piped Gravity System to Central District Sub Area

Table 4-8 contains the elements for Project 1B of Project 1. Project 1B includes a piped gravity system to provide water to the Central District Sub Area. Total costs for each element are described below with a 25% allowance for contingency, 15% for engineering, administration and legal, and 10% for environmental review.

Table 4-8: Project 1B Conceptual Level Cost Estimate

Project Element		Total Cost
Mobilization		$ 238,513
Canal Turnout Improvement for 18" Pipe		$ 12,200.00
18-inch Pipe in Canal Embankment		$ 495,000
18-inch Pipe Crossing Dry Creek		$ 90,000
18-inch Pipe Cross Country		$ 128,700
12-inch Pipe		$ 679,000
12-inch Pipe Discharge		$ 7,500
16-inch Pipe in Pavement		$ 2,952,000
16-inch Pipe Discharge		$ 12,200
Turnouts		$ 55,000
Laterals		$ 320,000
Land for 18-inch Cross Country		$ 18,652
Subtotal		$ 5,008,765
Taxes	7.25%	$ 144,585
Subtotal		$ 5,153,350
Contingencies	25%	$ 1,288,338
Subtotal		$ 6,441,688
Engineering, Surveying, Geotech, ROW, Admin, and Legal	15%	$ 773,003
Subtotal		$ 7,214,691
Environmental Review	10%	$ 515,335
Subtotal		$ 7,730,026
	Rounded to:	**$ 7,731,000.00**

4.3.2.2 Project 2 Cost Estimate

Table 4-9 contains the elements for Project 2. Project 2 includes replacement of the canal with a piped system along the alignment of the existing canal. Total costs for each element are described below with a 25% allowance for contingency, 15% for engineering, administration and legal, and 10% for environmental review.

Table 4-9: Project 2 Conceptual Level Cost Estimate

Project Element		Total Cost
Mobilization		$ 995,000
Clear/Grub		$ 35,000
Excavation - Pipe		$ 752,400
Grading Berm		$ 720,000
Backfill Pipe		$ 407,000
Access Road		$ 410,000
Spoil -Rock		$ 300,960
Pipe Installation (36" dia.)		$ 8,404,200
Pipe Installation (30" dia.)		$ 6,018,000
Pipe Installation (20" dia.)		$ 1,729,000
Valves		$ 30,000
Appurtenances		$ 300,000
Services		$ 375,000
Siphons-Demo		$ 70,000
Siphon -New		$ 74,000
Spill Structures		$ 180,000
Gates		$ 20,000
Fencing		$ 55,000
Signage		$ 7,700
Subtotal		$ 20,883,260
Taxes	7.25%	$ 751,985
Subtotal		$ 21,635,245
Contingencies	25%	$ 5,408,812
Subtotal		$ 27,044,057
Engineering, Admin, and Legal	15%	$ 4,056,609
Subtotal		$ 31,100,666
Environmental Review	10%	$ 3,110,067
Subtotal		$ 34,210,733
Estimated Cost		$ 34,211,000
	Rounded to:	**$ 34,211,000.00**

Section 5: Findings and Recommendations

5.1 Findings

The potential irrigation demands of lands within the areas serviceable within the District substantially exceed the 23,700 AFY of water available to the District under Permits 11516 and 11518. Annexations of properties within the SOI currently existing as islands in the DOHC vicinity could increase these demands but were not part of this evaluation.

There are additional lands in the western and southern district that could be developed using expanded deliveries of treated water from the Forbestown Water Treatment Plant to 5 to 40 acre ranch properties and horse pastures. New facilities for such expanded deliveries were not part of this evaluation.

Existing commercial agriculture in the District includes a vineyard and winery, cultivation of olives and small vegetable crop farms for local consumption. Ultimate build-out of the District may include expanded cultivation of specific crops and development of ranch properties with irrigated pasture.

The following specific findings were developed during the study described in this report:

- NRCS estimated irrigable acreages in Land Capability Classes 1, 2, 3, and 4 to be 389, 457, 3,600, and 13,953 acres, respectively within the District. The estimated irrigable land within the District is approximately 18,399 acres.

- Not all land within the District will develop and an assumption that no more than half the irrigable land will receive water was used to estimate potential water demands.

- The NRCS suitability for crop production identifies irrigated pasture as the likely use of the land. DWR Bulletin 113-4 identifies a typical water duty of 5.0 AF/AY for irrigated pasture in Yuba County. Combined with the assumption that 50% of the land will develop full water use demands, the required water supply is approximately 45,500 AFY.

- If 100% of the irrigable farmland within the District were developed, the water supply required would be approximately 90,900 ac-ft/yr, based on a 5.0 AF/AY water duty for irrigated pasture.

- Dobbins-Oregon House area has existing irrigation demand and infrastructure. This demand includes demands for ranching, small farms and at least one commercial winery. There are significant tracts of irrigable land that do not currently receive water and can be developed if water supplies become available. This area includes 5,763 acres of irrigable land with a potential demand of approximately 14,408 AFY of applied water. This estimate does not include conveyance losses.

- The most likely area for development of new water demands within the District is in the Dobbins and Oregon House area along the DOHC.

- The amounts of District water at SF-14 that will be available to and needed by the DOHC will depend on water losses in the Forbestown Ditch and DOHC, but are estimated to be

19,000 AFY, assuming a pipeline to replace the Forbestown Ditch, a DOHC capacity of 55 cfs, and a 30% DOHC conveyance loss.

- The total right to divert natural Dry Creek flows to the DOHC is 6,060 AFY. This right can be used to supplement the water the District receives from Turnout SF-14 during wet years.
- The conveyance losses in the DOHC currently are on the order of 60%. It is assumed that improvements to the DOHC can decrease conveyance losses to 30%.
- Improvements to the DOHC will allow for expanded use of water through conservation and could result in meeting the full developable potential of the Dobbins-Oregon House region.
- With the construction of the proposed pipeline to replace the Forbestown Ditch, the proposed improvements to the DOHC described above and the proposed piped gravity system along Frenchtown Road to provide irrigation water to the Central District Sub Area, the following allocation of the 23,700 AFY available to the District under water-right Permits 11516 and 11518 at SF-14 would occur: (a) 1,000 AFY for the domestic system served by the FWTP; (b) 19,000 AFY for the DOHC service area; and (c) 3,700 AFY for the service area of the proposed piped gravity system along Frenchtown Road.

5.2 Recommendations

The District currently is considering replacing the Forbestown Ditch with a pipeline. Alternatively, the District may decide to expand and improve this ditch. Either of these projects would expand conveyance capacity and reduce conveyance losses. As discussed in this report, the following recommendations describe recommended steps to improve the DOHC system and develop a piped gravity system along Frenchtown Road:

1. Evaluate the Dry Creek Diversion structure and canal headworks and determine what actions are needed to increase its capacity.
2. Proceed with initial engineering, environmental, geotechnical and surveying to determine the existing capacities of the various reaches of the DOHC and the feasibility of reducing conveyance losses through lining some reaches of the canal. After these improvements are made, the minimum conveyance capacity should be 42 cfs.
3. Proceed with initial engineering, environmental, geotechnical and surveying for the proposed piped gravity system along Frenchtown Road to provide irrigation water to customers in the Central District Sub Area.

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