Water Conservation

Appendix 1

Water Conservation Measures

For the

South Fork Trinity River

Watershed

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INTRODUCTION

The South Fork Trinity River watershed is approximately 932 square miles (596,480 acres). It is the longest undammed river remaining in California.

Purpose

The "South Fork Trinity River Supplemental Watershed Assessment" is a gap analysis Watershed Assessment for the South Fork Trinity River (SFTR) watershed completed by the Watershed Research and Training Center (WRTC) for the Fisheries Restoration Grant Program (FRGP).

The assessment focuses on major information gaps which were chosen utilizing specific tasks outlined in the Southern Oregon Northern California Coast (SONCC) Coho Recovery Plan (NOAA 2014). The recovery plan is a science based plan designed as a road map for the recovery of coho salmon populations. It is a guidance document for conservation groups and agencies that specifies assessments, coordination efforts, implementation measures that benefit coho salmon.

The WRTC utilized its unique knowledge of the SFTR watershed to choose the most pertinent and imperative tasks from the SONCC to focus on. This report focuses on water conservation measures.

How to Use this Report

The central document of the South Fork Trinity River Supplemental Watershed Assessment outlines the overall goals, overview of the watershed, past studies, and the summaries of major findings from each individual sub-topic assessment.

This larger Watershed Assessment project has been broken into multiple documents based upon individual sub-topics for ease of use and sharing. Each individual sub-topic assessment is written up with the complete suite of analyses and data in an appendix to the larger Watershed Assessment. This report is the Water Conservation Measuressub-topic (Appendix 1). A summary of findings for each sub-topic can be found in the main body of the Watershed Assessment.

The following is the overall Watershed Assessment outline:

- Watershed Assessment – Main Body
- Appendix 1: Water Conservation Measures – This Document
- Appendix 2: Stream Temperature Analysis
- Appendix 3: Riparian Vegetation Assessment and Plan
- Appendix 4: Fish Passage at Stream Diversion Assessment
- Appendix 5: Fish Passage at Stream Mouth Assessment

We intend that this assessment will be used to identify and prioritize a suite of projects in the South Fork Trinity River Watershed that are essential to the recovery of its fisheries and overall watershed health.

WATER CONSERVATION MEASURES ANALYSIS

SONCC Recommended Action Items

The SONCC plan lists multiple actions or measures necessary for the recovery of the species. One of the primary stressors of coho salmon identified in the SONCC assessment is reduced stream flows thus one of the primary recommended "Action Items" is to "Improve flow timing or volume"(SONCC-SFTR.3.1.8). The steps to "improve flow timing or volume" that we focus on in this Water Conservation section (Appendix 1) are the following:

Table 1: SONCC Action Item Steps to Improve Flow Timing or Volume.The following items we selected from Chapter 40 of the SONCC assessment.

SONCC section	Action Item
SONCC-SFTR.3.1.42.1	Increase storage capacity or delivery capability for Ewing Reservoir
SONCC-SFTR.3.1.10.1	Assess agricultural lands and develop a plan for improving water delivery systems
SONCC-SFTR.3.1.10.2	Improve water delivery systems, guided by the assessment
SONCC-SFTR.3.1.7.1	Assess the utility of water storage tanks for private agricultural and domestic water uses during periods of low flow
SONCC-SFTR.3.1.7.2	Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow
SONCC-SFTR.3.1.47.1	Identify and cease unauthorized water diversions
SONCC-SFTR.3.1.48.1	Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation
SONCC-SFTR.3.1.3.1	Develop an educational program about water conservation programs and instream leasing programs

Overview

Fish need water, this is clear, however there is much complexity in the earth's water cycle and in our human interactions with natural systems. Humans need water too, for a variety of uses, and this water use and diversion from streams can have huge implications for fish populations. These water uses need not be mutually exclusive; with some foresight, planning, and determination it is possible for humans and fish to coexist in a sustainable manner.

The SFTR watershed has a Mediterranean climate that has plentiful precipitation in winter months and nearly no rainfall in summer months. Average stream discharge of the SFTR near Hyampom ranges from 500 to 5,000 cfs in winter and spring months (Figure 1).

The supply of water in the Hayfork Valley in dry years is not sufficient for current users and to meet beneficial use under the public trust doctrine. This water supply problem has led to legal challenges between water users in the area, studies of water availability, and to designation of the area by Trinity County as a Critical Water Resource Overlay Zone (Patrick Truman & Associates et al 1996).

Decreasing the amount of water diverted during the summer months by promoting off-channel storage during high winter flows is imperative to recovery of this coho salmon population (NMFS2012).If the

human population of the SFTR watershed undertake the water conservation measures outlined in this section it would result in the majority of withdrawals being conducted in late spring when water is plentiful and store it for use in the summer months when water is scarce. If all collective water withdrawals in the SFTR watershed (regulated, agriculture, domestic, unregulated and marijuana) were combined, we estimate the maximum rate of diversion to be approximately 138cfs (seeTable 5 in the Methods and Results sectionfor detail). This 138cfs diverted is not perceptible when compared to the large 500-5,000 cfs stream flows available in the SFTR during December-May.

This chapter explores a wide variety of management actions that have the potential to leave more water in streams for fish in the specific times when it is needed most including: off-channel water storage, forbearance, changes in timing and type of diversion, improving water delivery, water transactions and much more. These measures would reduce the negative impacts of our human water consumption on aquatic ecology in the study area.

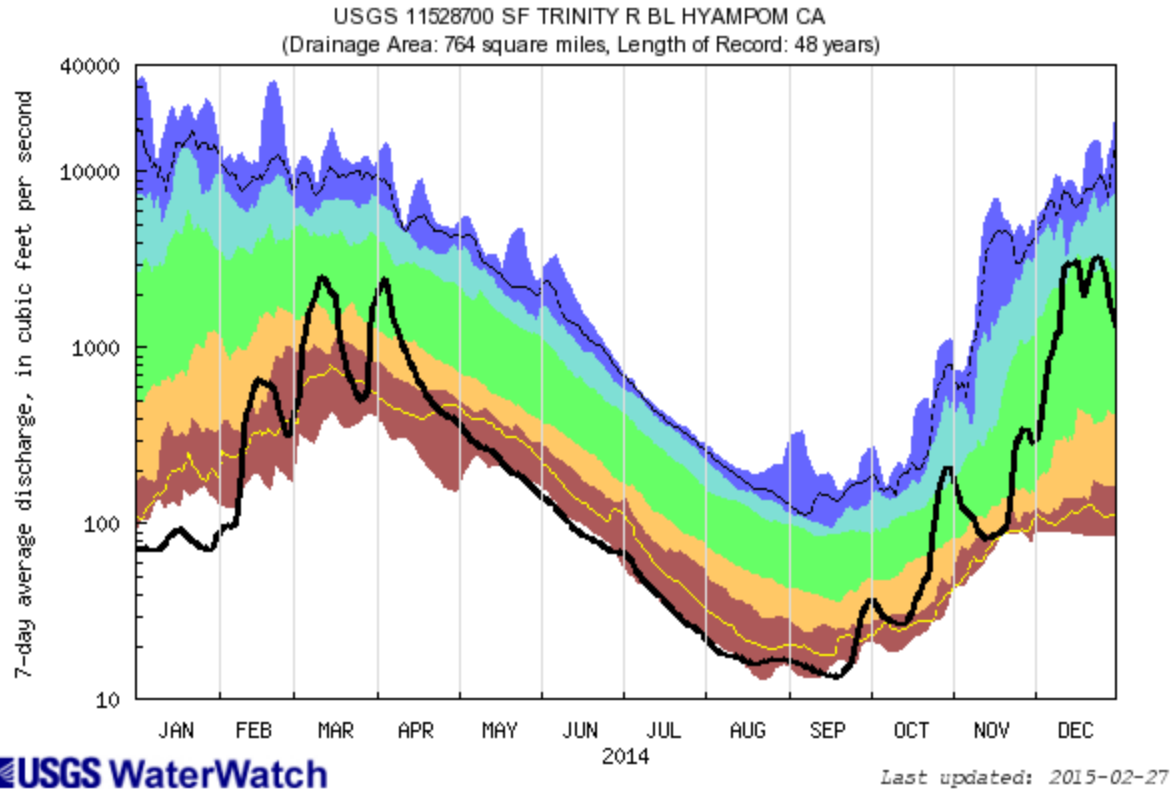

Figure 1: USGS Streamflow duration hydrograph for the South Fork Trinity River in 2014.The Duration Hydrograph is a graphical presentation of recent daily streamflow (discharge) observed at an individual USGS streamgage (the black line), plotted over the long-term statistics of streamflow for each day of the year at that station. The statistics include the maximum discharge recorded during the period of record for each day of the year (top of the dark blue area); the 90th percentile flow for each day (top of the light blue area); the interquartile range (the green area bounded by the 75th percentile on top and 25th percentile on the bottom); the 10th percentile flow for each day (the bottom of the orange area); and the minimum discharge recorded for each day (bottom of dark brown area).While this report is focused on fisheries, the drought of 2014 and 2015 made it apparent that there is not enough water in streams of the SFTR during summertime drought to accommodate the needs of fish or the current population in the basin. As streams dried up in those summers, dozens (possibly

hundreds) of homes were without water and many did not have backup domestic water systems such as storage tanks to accommodate water transported to their homes. This lack of water for domestic use may become a basic human rights issue if droughts and over withdrawal of water continues to occur in this basin, drastically reducing accessible, affordable and safe water for personal and domestic use.

Analysis Methods

The WRTC has conducted a combination of Geographic Information Systems (GIS) based analysis and physical streamflow measurements in an attempt to quantify the amount of water currently diverted from streams in the SFTR Watershed for anthropogenic use. In order to determine overall anthropogenic water use within the watershed we needed to quantify metrics such as population, types of agricultural production and water use rates, acres in agricultural production, legal water diversions, and estimates of unregulated (illegal) water diversions.

Geographic Information Systems Methods

A water use and need analysis was conducted looking at a variety of issues across all scales in an attempt to analyze the current water use, analyze it in a spatial and temporal setting, and use that information to determine locations that would benefit most from minimizing the impacts of human water use and suggest appropriate methods to potentially increase the volume of water that remains in the streams. The following is a summary of the assessment methodology, assumptions, data acquisition and values used to calculate anthropogenic water use. Much of the following description of GIS Analysis Methods is technical GIS terminology that will help other future GIS technicians review and replicate the process that we developed. Unless otherwise noted, all GIS work was conducted with Esri ArcMap 10.3 and associated programs.

We primarily used hydrologic unit codes (HUC) to delineate the SFTR into subwatersheds not just for ease of data interpretation, but also because they often best fit practical boundaries such as neighborhoods or roads (Figure 2). We attempted the analysis at multiple scales and eventually chose the US Forest Service Shasta-Trinity National Forest's HUC 7 subwatershed (average size is 7,186 acres) as the unit size for subwatersheds of the SFTR because it best represented a functional size for this analysis. For example, the Barker Creek HUC 7 subwatershed is the correct size that represents the community that lives in the Barker Creek watershed as well as representing Barker Creek itself which is a stream with high intrinsic potential for coho salmon habitat.

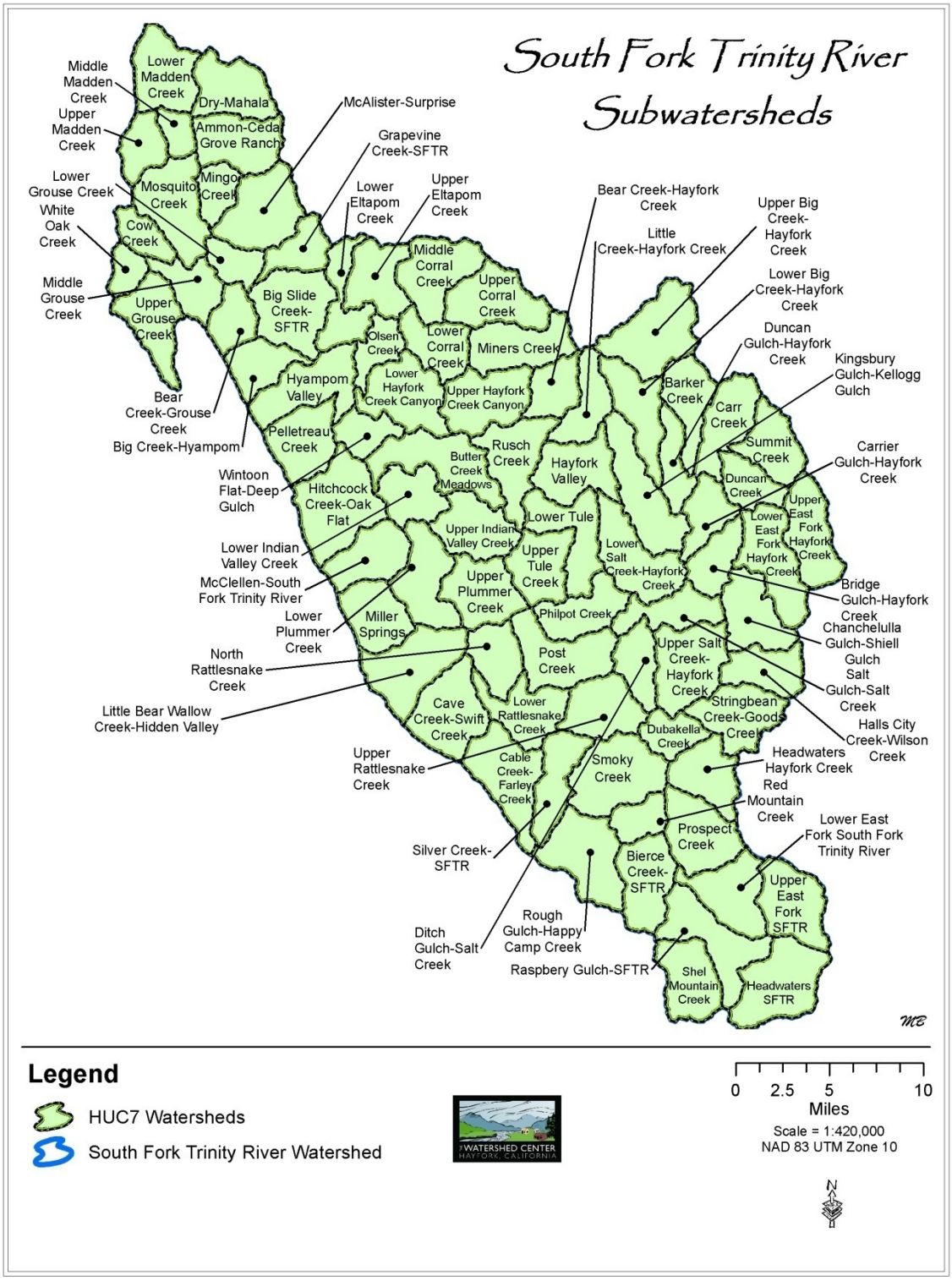

Figure 2: Hydrologic Unit Code (HUC) size 7 subwatersheds of the SFTRwatershed.

Population Data

Two techniques were used to determine the human population size and/or population percentage per subwatershed. The population percentage is the percent of the total population in the SFTR watershed that reside within each subwatershed. The census is the official method but our local knowledge led us to believe that it is somewhat unreliable in rural areas, in particular for trying to determine peak anthropogenic water use (total population in mid-summer). Therefore, we supplemented the census data with a GIS exercise using "residential structures" dataset that we could use as a proxy for residential homes and thus population size. This residential structure based data was derived from pre-existing GIS data of mapped structures (created from aerial photo interpretation) developed for a separate project by the Trinity County RCD and WRTC.

Residential StructureBased Population Estimate Method

For the purposes of this study "residential structures" are defined as houses, mobile homes, yurts,and any other structure that offers human lodging over summer months; it does not include barns, sheds or greenhouses.To determine the number and location of residential structures we followed the following methods. Initially all parcels bearing the residence(s) code(s) were processed using the ArcMapFeature to Point tool. This generated a single point for each residence recorded in the "Land Use" attribute within Trinity County's parcel data. County wide, the private parcels were analyzed for houses that existed on parcels with correct land use code (i.e. CXX1 = residential land use zoning with a single residence, 6XC2 = agricultural zoned parcel with two residences, etc.).Aerial interpretation and spatial refinement was completed using the 2014 National Agriculture Imagery Program (NAIP) imagery, plus Trinity and Humboldt County parcel and Public Land Survey System (PLSS) data, while blocking out federal lands.If the land use code seemed correct (appropriate), each point was moved from the center of the parcel to the correct residence location. If the land use code was not correct (i.e. a parcel was identified as rural residential but there were no roads or structures) further analysis was conducted. Driveways and lawns help with differentiating barns and sheds from residences. In the case where a property was coded for multiple residences, multiple points were generated to reflect that. Commercial buildings, offices and government structures were generated in a similar way (using land use codes), and then the data set was further refined using local knowledge of these structures. Following digitization, important attribute data was populated, such as structure type (residential, commercial, government, etc.), to enhance query functionality of the dataset. Once all structures were determined, the "structure based population" was estimated with the assumption of the 2010 (Census) California average household size of 2.9 persons per structure. We then performed selection sets of the population within each HUC 7 subwatershed to summarize the population within each HUC 7 subwatershed. For the most part the population totals for the structure based analysis were similar to the census analysis. The most conservative (largest) estimate of population was "structure based" and this was used for water use analysis. Because the local water district (Trinity County Waterworks District #1) does not take water from streams during summer months (see Description of the Existing Waterworks District System in Discussion section below), the population that lives within the district's boundary has been excluded from the majority of this assessment.

Diversions

Regulated (permitted) Diversion

Water diversion data was provided in tabular format by the California State Water Resources Control Board's (SWRCB) Division of Water Rights; the primary agency tasked with monitoring and controlling water rights/diversions. The data contained the primary water right information and states the official diversion rates for each permitted diversion. This data was obtained from SWRCB in 2014 and since then, new regulated diversions have been allocated and are not reflected in this analysis. Furthermore, for some unknown reason a few long time diversions are not in this State dataset (even some of the very largest ones), and therefore were not included in this assessment because diversion rates were not known.

NRCS (1994)estimated that only 13% of water diverted from Hayfork Creek and its tributaries (in the Critical Water Resource area) have recognized permits while most water users operated under riparian rights for which no statement of diversion and use has been filed. It is likely that the number of unregistered water diversions has only increased in recent times.

The water diversion data's spatial coordinates were transformed into points and projected into GIS as a shapefile. Diversion ratesprovided in the data were converted into cubic feet per second (cfs). The location and diverted cfs rate were then used to calculate subwatershed diversion totals using anArcMap Select by Location query within HUC 7 unit boundaries. It should be noted that the recognized (regulated) diversion rates (cfs) are probably larger than actual diversion rates since they are documented as maximum diversion rates and the majority of the time (especially peak diversion times during June, July and August) there simply isnot even that amount of water available in the stream.

Un-regulated Diversion

When no active diversion was found in the Division of Water Rights database we attempted to estimate peak anthropogenic water use by using the following metrics:

For indoor domestic use estimation, each domestic structure was estimated at 2.9 persons (2010 U.S.Census average household estimate), multiplied by 108 gallons per day (gpd; Maupin et. al. 2014) which equals 313 gpd per domestic structure. All estimates were converted to cfs for ease of comparison. It should be noted that this estimate does not account for outdoor domestic use such as home gardens and landscapingwhich could potentially make the overall domestic household estimate significantly underestimated.

In hot climates such as the SFTR, outdoor domestic water use is likely greater than indoor domestic use (Asarian 2015). Sanctuary Forest (2008) estimated outdoor domestic household water use in the upper Mattole watershed to be 675 gpd. While the 313 gpd estimate is nearly half of that which Sanctuary Forest estimated, many people in the SFTR watershed are accustomed to little available water and thus do not have gardens or landscaping. Furthermore, the overall contribution from domestic sources in the overall assessment pales when compared to agricultural, ranching, and marijuana diversions. If time allowed, we would have liked to map irrigated area for each residence to get a much more accurate depiction of domestic use but this did not happen.

Marijuana agricultural water use estimation was conducted per California Department of Fish and Wildlife (CDFW) methods (Bauer 2015). An estimated count of individual marijuana plants per watershed was determined through a combination of aerial photography from Esri online databases and Google Earth high resolution NAIP imagery from 2011 and 2014. An 8 gallons/day/plant irrigation requirement was assumed over the common outdoor growing period of June 1-October 31 (169 days) (anonymous pers.comm., 2012). The 8 gpd per plant is a deviation from CDFW (2015) methodology but better suits climate conditions in the SFTR watershed and the number was confirmed by anonymous personal communication with local marijuana farmers. We believe that the 8 gpd is still an underestimate of the amount used by the typical farmer.The number of plants per subwatershed was multiplied by 8 gpd per plant, and converted to cfs within the growing season.

Streamflow (discharge) Data

The only permanent and currently functioning stream discharge (flow) gage within the entire 980 square miles of the SFTR watershed is the US Geologic Survey (USGS) 11528700 site on the South Fork Trinity River below Hyampom. This gage has consistently measured discharge from 1965 to present and offers real time instantaneous data online. Several other stream gage sites have existed over time but none have lasted more than 10 years in any particular location.

Other pertinent past streamflow monitoring efforts are: USGS gage 11528100 on the SFTR in Forest Glen, USGS gage 11528400 on Hayfork Creek near Hayfork, Graham Matthews and Associates at five sites during 2002 (GMA 1996), and the Big Creek at two sites during 2007-2008 (WRTC 2009).

In collaboration with the Trinity County Resource Conservation District (TCRCD) the WRTC conducted stream discharge measurements at a variety of sites within the SFTR watershed at varying time intervals from (June through November) in 2014, to a lesser degree in 2015 and again in early 2016. The full suite of streamflow data is available upon request but a subset of data is listed in Table 2 and Table 3 respectively. Discharge was measured with a Marsh-McBirney electronic flow meter utilizing a modified USGS Midsection Method (Turnipseed & Sauer 2010). The main modification to the USGS method was that field crews used typically 11 transect verticals rather than 20-30 because low flow conditions warranted the time and cost savings of using less verticals.

In April of 2016 the Regional Water Quality Control Board conducted a suite of stream discharge measurements in the SFTR watershed (Table 2) utilizing the “Standard Operating Procedure for Discharge Measurements in Wadeable Streams in California” (CDFW-IFP-002 2013) stream discharge measurement method.

These April 2016 measurements were taken during a moderately average water year at a slightly below average inter-annual discharge rate at the USGS gage 11528700 site. These measurements were taken with the objective of determining the average streamflow conditions in a wide variety of streams before the cumulative impacts of diversions begin to occur (May-September). Conversely, Table 3 is representative of extreme low streamflow conditions as they were taken during the lowest measurements ever recorded at the USGS gage 11528700 site (Table 3).

Table 2. Stream discharge measured on April 2016.Sites listed in table are expected to be monitored bi-monthly through 2016 and possibly beyond. Gray shaded boxes are comparable locations to 2014 data in Table 3.

Stream Site	Date	Flow (cfs)
Big Creek at County Bridge 324 (upstream site)	4/21/2016	25.8
Big Creek near Highway 3 Bridge (downstream site)	4/21/2016	23.7
EF Hayfork Creek upstream of Hayfork Creek	4/21/2016	18.7
Salt Creek near 31N38 (upstream site)	4/21/2016	31.8
Salt Creek below Tule Creek Road (downstream site)	4/21/2016	29.5
Tule Creek at Tule Creek Road Bridge	4/21/2016	12.4
Hayfork Creek near Wildwood	4/21/2016	19.2
Hayfork Creek at Shiell Gulch Campground	4/21/2016	43.2
Hayfork Creek downstream of East Fork Hayfork Creek	4/21/2016	62.0
Hayfork Creek at OakStreet Bridge	4/21/2016	114.2
Hayfork Creek downstream of Hayfork Valley	4/21/2016	176.7
Post Creek upstream of Rattlesnake Creek near 30N59	4/21/2016	5.5
Rattlesnake Creek upstream of Post Creek at Highway 36	4/21/2016	15.5

Table 3. Stream discharge measured on September 9 and 18th, 2014. This table contains an example of discharge measurements for streams within the SFTR region. Gray shaded boxes are comparable locations to 2016 data in Table 2.

Stream Site	Date	Flow (cfs)	Notes
Big Creek at County Bridge 324 (upstream site)	9/9/2014	1.14	Measureable flow.
Big Creek near Highway 3 Bridge (downstream site)	9/9/2014	0.36	Measureable flow.
Tule Creek at County Bridge	9/9/2014	n/a	**No discernable above ground flow. Few scattered pools visible.**
Salt Creek near USFS Campground (upstream site)	9/9/2014	0.10	Measureable flow.
Rattlesnake Creek near Highway 36	9/9/2014	0.08	Measureable flow.
South Fork Trinity near Forest Glen	9/9/2014	7.03	Measureable flow.
Corral Creek	9/18/2014	1.45	Measureable flow.
Hayfork Creek downstream of Hayfork Valley	9/18/2014	n/a	**No discernable above ground flow. Few scattered pools visible.**
Hayfork Creek near Hyampom	9/18/2014	4.84	Measureable flow.

The Trinity County Drought Impacts map (Figure 3) articulates several narratives. First, that current stream discharge volumes are not sustainable during droughts of this scale and provisions will need to be made for the futureif climate change predictions are correct; otherwise streams will continue to run dry. Climate prediction models suggests the Klamath-Siskiyou region, of which contains the SFTR watershed, will be receiving more variable precipitation, higher temperatures, and less snowpack in the future (Barr et al. 2010). Second, the September map shows the impact of diversions on streams, as most streams near population centers are dry or nearly dry. For example, Hayfork Creek has little discharge before entering the town of Hayfork, is dry through town where the greatest population density occurs, and then streamflow increases as it leaves the valley and flows through the unpopulated

designated “roadless” area. By the time Hayfork Creek reached Hyampom, its discharge had increased all the way back up to 7cfs. There may be small variations in localized hydrology that contribute to this but it is most certainly correlated with the fact that hundreds of diversions exist in the Hayfork Valley, while there are less than 10 in the subwatersheds below the valley. It should be noted that this map may have some small errors and some segments were created with local knowledge/observations, not physical streamflow data, especially with accounts of dry streams.

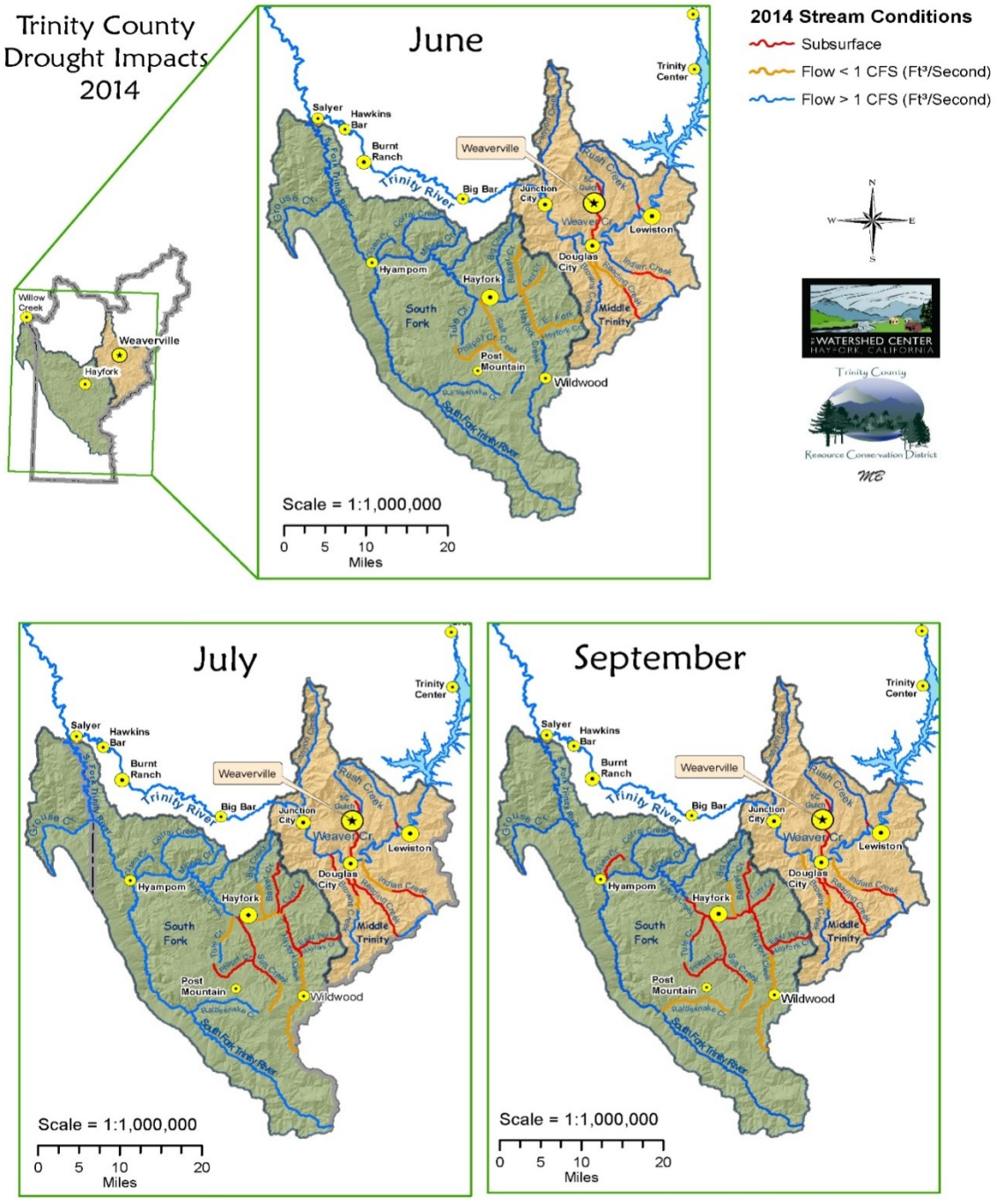

Figure 3: Streamflow conditions during the summer of 2014,one of the greatest droughts on record. Trinity County drought impacts map of 2014. The watershed shaded in green is the SFTR while the tan subwatershed are tributaries in the mainstem Trinity River. Map created by TCRCD, 5C, and WRTC from 2014 stream discharge data and visual observations.

RESULTS

Population Density

The greatest human population densities by HUC 7 subwatersheds arein the Post Creek, HyampomValley, Hayfork Valley andKingsbury Gulch-Kellogg Gulch subwatersheds (Table 4, Figure 4). The majority of the population of the community of Hayfork liveswithin current Waterworks District boundarieswhich covers part of the Hayfork Valley and Kingsbury Gulch-Kellogg Gulch HUC 7 watersheds. The majority of this population gets their water from the Waterworks District andthus have been excluded from this assessment. It should be noted that there still are some riparian diversionswithin the Waterworks District boundaries, however there are many fewer diversions from the stream inside than areas outside and there was not a feasible manner of extracting those diversions. Post Creek, the subwatershed with the highest density of people, is a subdivision with nearly 1,200small (mostly 2 acre) lots, which obtains most of its domestic water from individual private wells and nearby streams. Hyampom Valley domestic water supply comes from private seep or ground water wells, instream pumps, tributary stream diversions, and one water district (Valley-view Water System).

Major population centers and their associated HUC 7 watersheds:

- Hayfork outside of the Waterworks District boundary (residential structure based population is 1,490): Kingsburry Gulch-Kellog Gulch, Hayfork Valley, Lower Salt Creek-Hayfork Creek, and a few more subwatersheds (13 in total).
- Post Mountain aka the Trinity Pines (residential structure based population is 403): Post Creek and Philpot Creek subwatersheds.
- Hyampom (residential structure based census population is 440): Hyampom Valley, Lower Hayfork Creek Canyon, Olsen Creek, Pelletreau Creek, and Wintoon Flat-Deep Gulch subwatersheds.
- Wildwood (residential structure based population is 159): Hall City Creek-Wilson Creek, Stringbean Creek-Goods Creek subwatersheds.

The priority subwatersheds based strictly on density are shown in order of magnitude in Table 4 and Figure 4.

Table 4. Human population estimates and size of subwatersheds.Only subwatersheds with 1% or greater of overall SFTR watershed population are presented in table.

HUC 7 Name	Population (people)	Subwatershed area (acres)	% of Total SFTR Population
Post Creek	374	9416	12.17
Kingsbury Gulch-Kellogg Gulch	287	9830	9.34
Hyampom Valley	249	9175	8.11
Hayfork Valley	232	8087	7.55
Lower Salt Creek-Hayfork Creek	177	9395	5.75
Carr Creek	168	7195	5.47
Lower Hayfork Creek Canyon	162	9077	5.27
Duncan Gulch-Hayfork Creek	131	4443	4.25
Dry-Mahala	116	7533	3.77
Barker Creek	113	6522	3.68
Duncan Creek	113	4603	3.68
Lower Tule Creek	96	8094	3.12
Halls City Creek-Wilson Creek	81	5877	2.64
Stringbean Creek-Goods Creek	78	7970	2.55
Lower Madden Creek	61	8063	1.98
Summit Creek	52	6304	1.70
Wintoon Flat-Deep Gulch	46	4225	1.51
Salt Gulch-Salt Creek	44	5911	1.42
Lower Big Creek-Hayfork Creek	32	7133	1.04
Ammon-Cedar Grove Ranch	32	8058	1.04

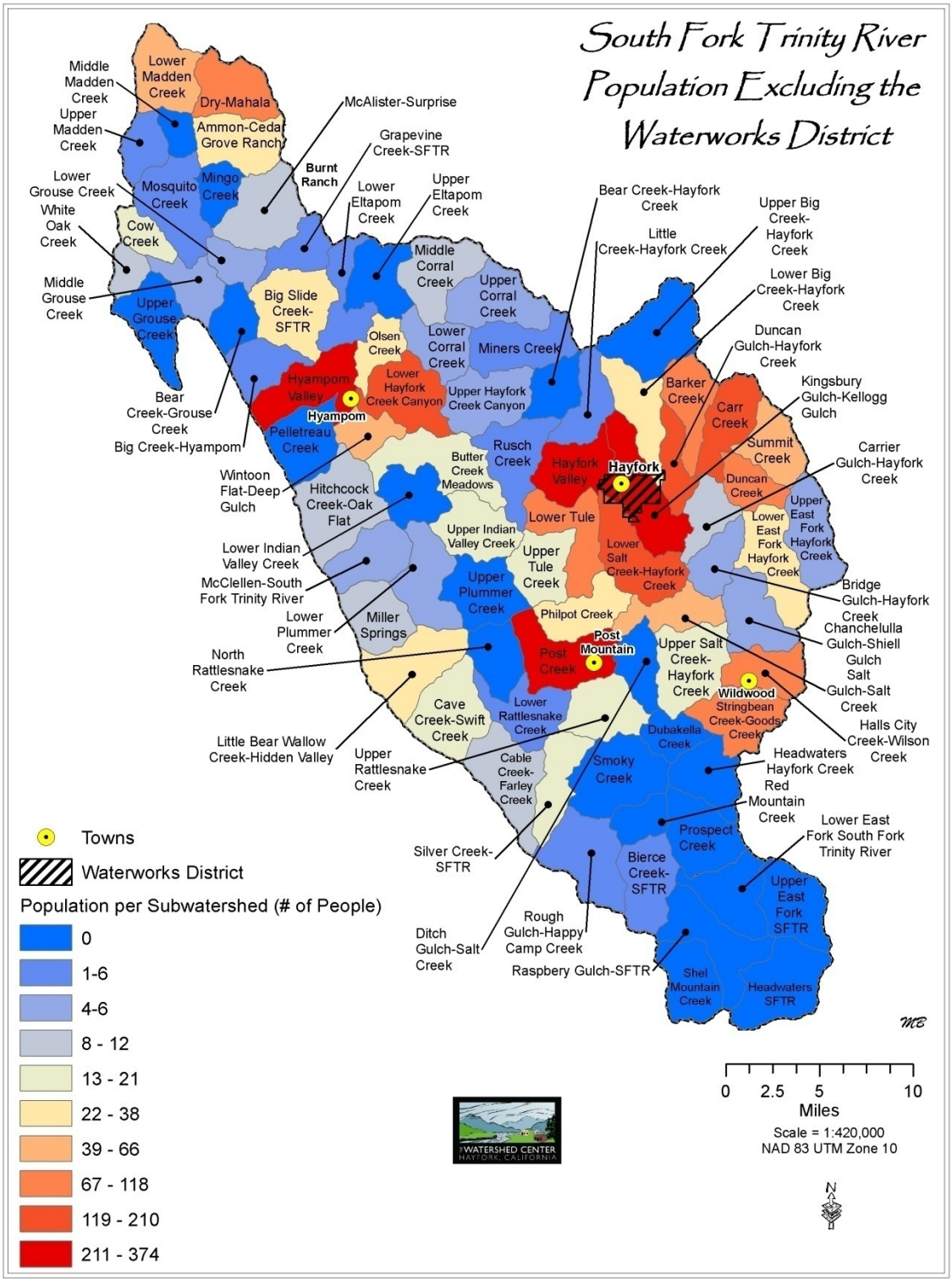

Figure 4: Human population estimates within each HUC 7 subwatershed of the SFTR.Population in numbers of people.

Anthropogenic Water Use

The estimated total of all combined water use per HUC 7 subwatershed within the SFTR watershed is presented in Figure 5, Figure 6 and Table 5.

It should be noted that the “regulated” diversion information is based on water rights data and this diversion data is probably overestimated, especially on the largestdiversions. The largest water rights holders are not typically able to divert their full allotted amount of water because there simply isnot that much water in the streams in the summer months. For example, the official diversion rate recorded at SWRCB for a particular ranching diversion in the Lower Big Creek-Hayfork Creek subwatershed is 25 cfs, but a streamflow discharge monitoring effort in June of 2007 showed a maximum diversion rate of 7.2 cfs. Other examples of certain overestimated regulated diversions include Lower Hayfork Creek Canyon and Barker Creek both of which state they take more water than these streams typically discharge. Therefore, it is likely that Figure 6 shows an overestimate of overall anthropogenic water use.

Figure 5 shows the population density of each subwatershed with the total anthropogenic water diversion rates overlaid on top in circles. This enables us to look at these subwatersheds spatially and determine appropriate tools for water conservation. For example, the Lower Big Creek subwatershed has relatively low population density but some of the highest diversion rates so water conservation needs to focus specifically on diversions. Conversely, the Post Creek subwatershed has high population density and high water diversion rates and thus requires a different water conservation tool.

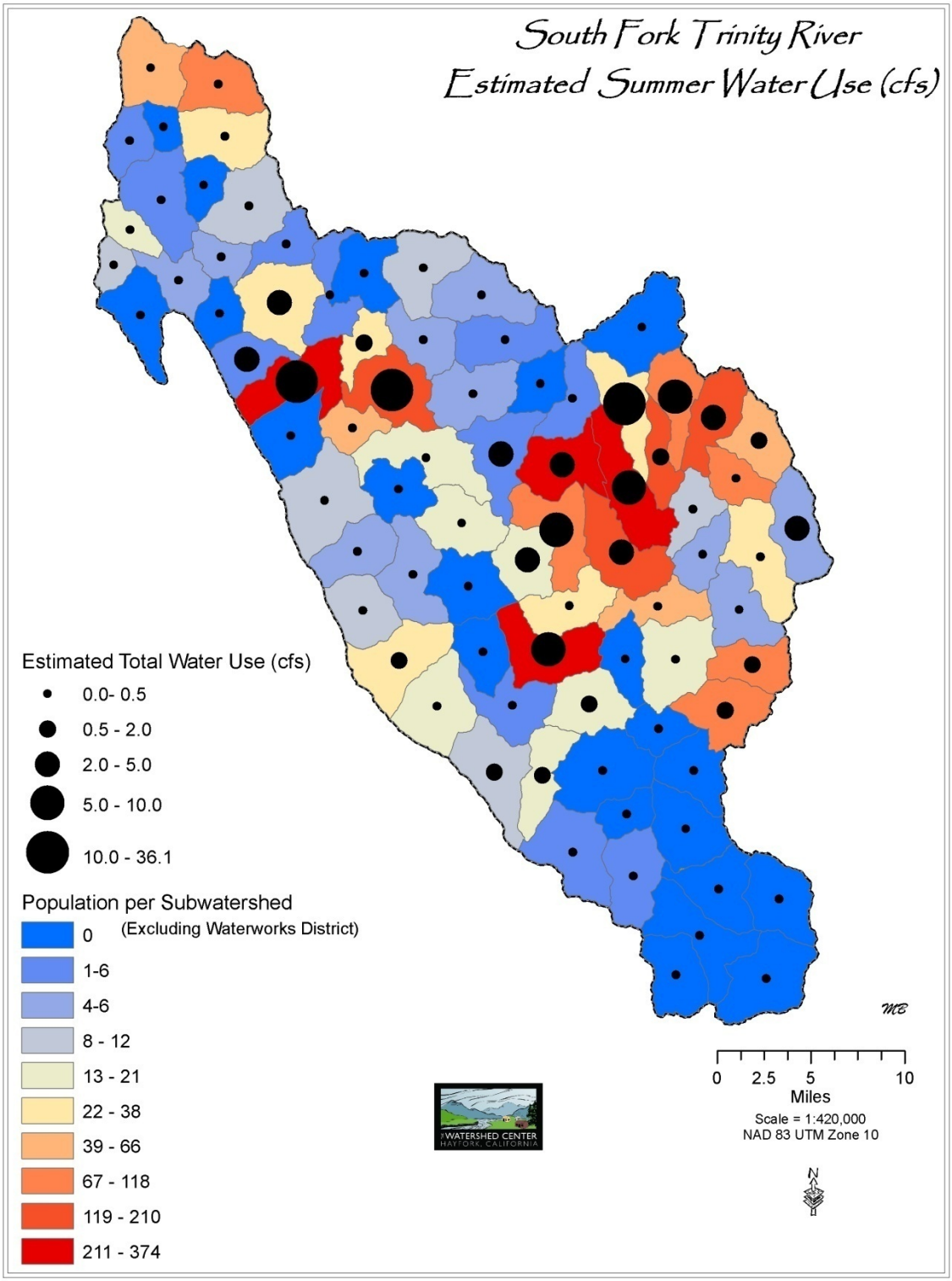

Figure 5. Estimated water use per subwatershedshown by the size of the dots overlain on the quantity of people per subwatershed based on data in Table 5. While the regulated diversions are large, they are by their very nature more regulated (by CDFW staff) and thus are required to leave a minimum amount of water left

in streams for aquatic life. Unregulated diversions on the other hand tend to be “the tragedy of the commons” situation where each landowner is trying to take enough water for themselves and often do not consider leaving water in the stream below the diversion site for downstream diverters or fish. These unregulated diversions may be small in terms of individual diversion flow rates, however, cumulatively these appear to be a significant portion of the overall take and in recent years may have contributed to streams going entirely dry. Interestingly, the total anthropogenic water use in theGIS analysis (Figure 5) results match closely with the “Trinity County Drought Impacts” map (Figure 3) produced with streamflow monitoring data.

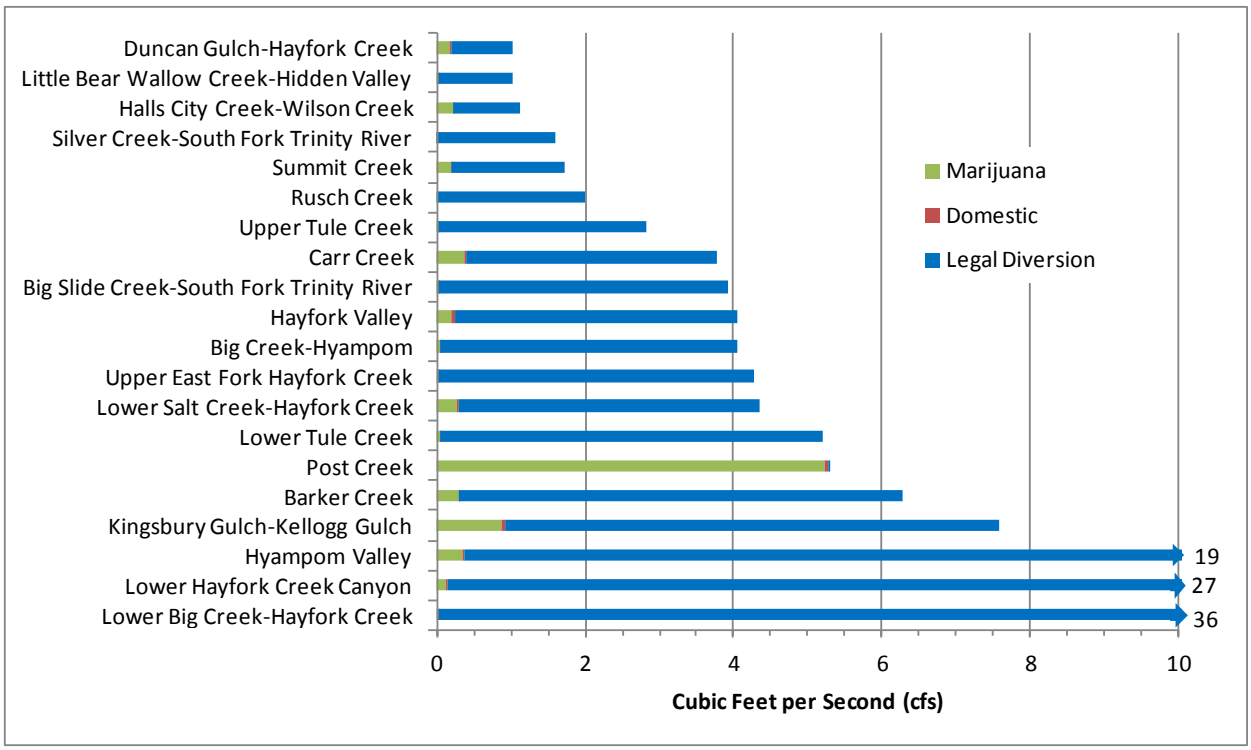

Figure 6: Total water use per subwatershed based on all potential anthropogenic diversion rates.Only subwatersheds with diversions greater than 0.1 cfs are included in this table.Figure 6 shows the extent to which the regulated diversions (if taking the full allocated diversion rate) overwhelm the rest of the diversions in terms of sheer volume of water. The subwatersheds with the greatest legal diversion rates are: Lower Big Creek-Hayfork Creek, Lower Hayfork Creek Canyon, Hyampom Valley, Kingsbury Gulch-Kellogg Gulch, Barker Creek, and Lower Tule Creek. It should be noted that at least one major diversion is missing from this analysis; the Chanchelulla Gulch-Shiell Gulch subwatershed has a diversion that is not listed in the SWRCB data set which would make it one of the major water use subwatersheds in the SFTR.However, because this diversion is not listed in the SWRCB data set we did not know what diversion rate to use in this analysis and therefore excluded it.

Table 5: Total Anthropogenic Water Use (cfs) within the SFTR Watershed.Domestic is estimated by residential structure population count. Marijuana is estimated by plant count from aerial photography. Legal diversion is from SWRCB data. This table contains only the HUC 7 subwatershed with greater than 1% of the total SFTR watershed population and it does not include all of the cumulative diversions. The sum of all (cumulative) maximum anthropogenic water diverted in the SFTR is 138 cfs (see Appendix 1A).

Sub-Watershed	Total Estimated Antropogenic Water Use	Domestic	Marijuana	Legal Diversion
Ammon-Cedar Grove Ranch	0.024	0.005	0.018	0.000
Salt Gulch-Salt Creek	0.031	0.007	0.018	0.006
Lower Madden Creek	0.093	0.010	0.083	0.000
Wintoon Flat-Deep Gulch	0.096	0.008	0.028	0.060
Dry-Mahala	0.267	0.019	0.248	0.000
Duncan Creek	0.416	0.019	0.303	0.094
Stringbean Creek-Goods Creek	0.532	0.013	0.073	0.446
Duncan Gulch-Hayfork Creek	1.015	0.022	0.183	0.810
Halls City Creek-Wilson Creek	1.116	0.014	0.211	0.892
Summit Creek	1.714	0.009	0.193	1.513
Carr Creek	3.779	0.028	0.367	3.384
Hayfork Valley	4.040	0.039	0.202	3.800
Lower Salt Creek-Hayfork Creek	4.356	0.030	0.266	4.061
Lower Tule Creek	5.215	0.016	0.037	5.162
Post Creek	5.279	0.063	5.216	0.001
Barker Creek	6.282	0.019	0.284	5.979
Kingsbury Gulch-Kellogg Gulch	7.578	0.048	0.880	6.650
Hyampom Valley	19.563	0.042	0.339	19.182
Lower Hayfork Creek Canyon	27.032	0.027	0.128	26.876
Lower Big Creek-Hayfork Creek	36.102	0.005	0.028	36.069

Therefore, based on this analysis (when we exclude legal permitted diversions but include unregulated diversions for agriculture and domestic uses), the subwatersheds that have the greatest unregulated anthropogenic water use are Post Creek and Kingsbury Gulch-Kellogg Gulch closely followed by a number of other subwatersheds (Figure 7 and Table 6). Trinity Pines subdivision, located in Post Creek, has a reputation for marijuana growing and majority of the 1,200 lots are approximately 2 acres and the residents obtain their water from individual wells. It should be noted that the data used to collect this information is from 2012 and there have been large increases in water use and unregulated diversions across most of the private land in the SFTR. Furthermore, no attempt was made to quantify illicit marijuana growsites*on public lands,* some of which are diverting huge amounts of water. For example, an illicit growsitewas removed from the Salt Creek watershed in 2015 and reclamation teams estimated the diversions for this marijuana growsiteto be 200,000 gallons per day (0.31 cfs) for a total diversion of 30.4 million gallons of water a season. There are dozens of these illicit marijuana growsites across the SFTR watershed and their cumulative diversions likely significantly reduce streamflow.

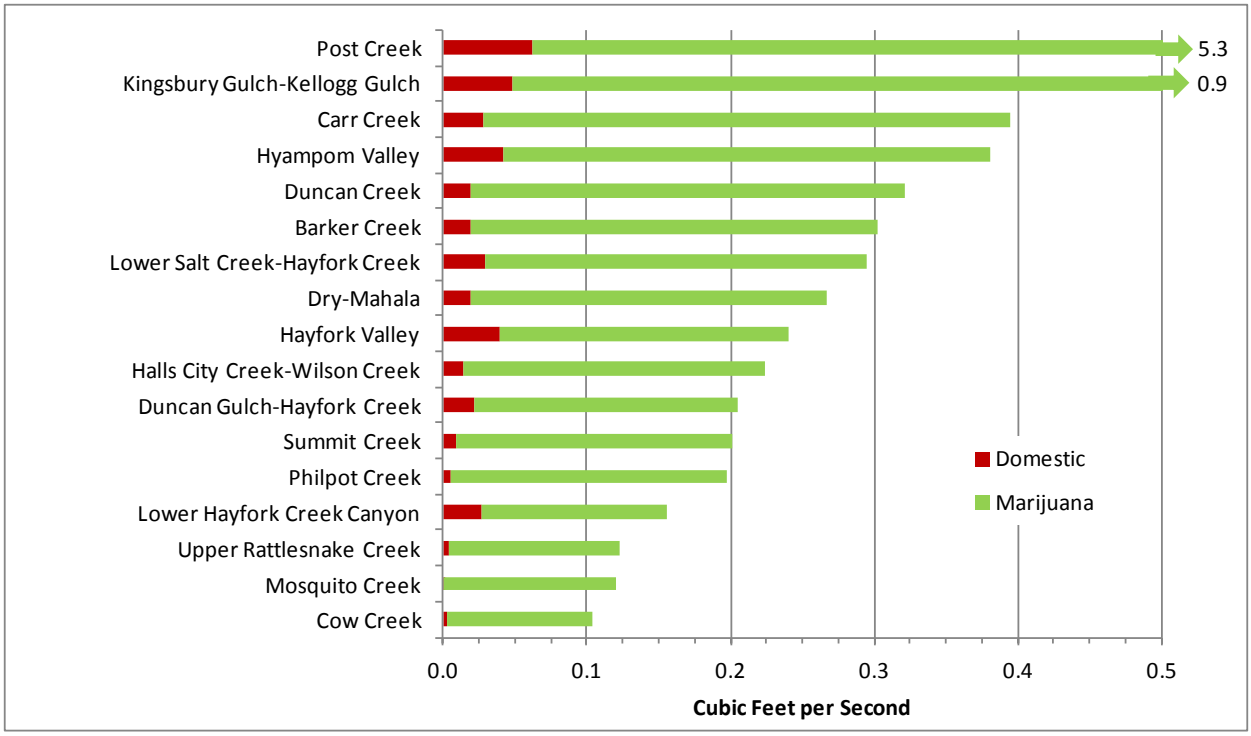

Figure 7. Estimated anthropogenic water use not including legal diversions. Only subwatersheds with overall water use >0.1 cfs are shown.

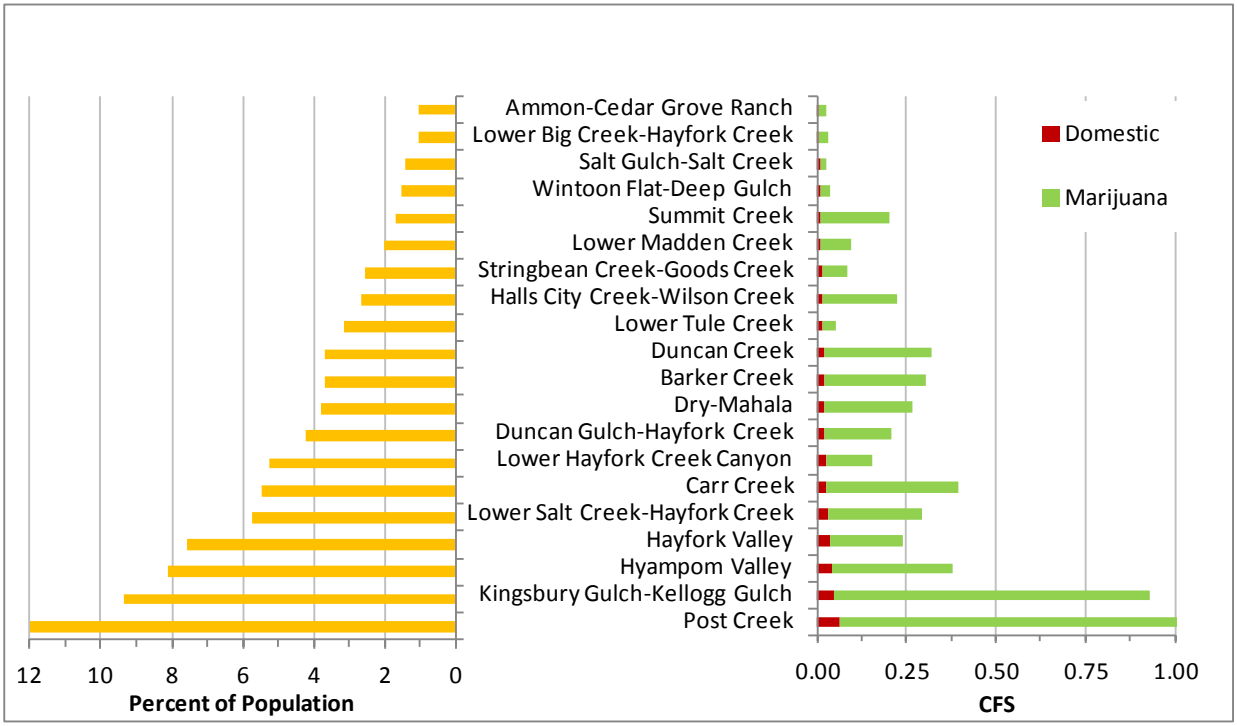

Figure 8. Percent of SFTR population compared to volume of domestic and marijuana water use estimates.

Table 6. Domestic and Marijuana estimated water use for 12 most populated subwatersheds.

Sub-Watershed	People	Domestic (cfs)	Marijuana (cfs)
Post Creek	374	0.063	5.216
Kingsbury Gulch-Kellogg Gulch	287	0.048	0.880
Hyampom Valley	249	0.042	0.339
Hayfork Valley	232	0.039	0.202
Lower Salt Creek-Hayfork Creek	177	0.030	0.266
Carr Creek	168	0.028	0.367
Lower Hayfork Creek Canyon	162	0.027	0.128
Duncan Gulch-Hayfork Creek	131	0.022	0.183
Dry-Mahala	116	0.019	0.248
Barker Creek	113	0.019	0.284
Duncan Creek	113	0.019	0.303
Lower Tule Creek	96	0.016	0.037

Climate Change

While the full impacts of changes in climate are not well known, primarily due to a lack of data collection, one major change has been obvious: the amount of snowpack accumulated in winter has changed dramatically in recent times. This could be a short climate cycle, however if it does become the new normal precipitation type then it could have drastic implications. Streams at lower elevations, such as the South Fork Trinity River, are more susceptible to decreases in base flow caused by decreases in April 1 snow water equivalent (reflecting timing and amount of snowmelt). Here, local-scale human induced changes associated with water and land use could have a greater effect on stream flow and water temperature than in higher-elevation streams experiencing the same continental-scale warming (Van Kirk and Naman 2008). Snowpack in lower elevations, especially in maritime mountain snowpack areas is the most sensitive to increases in temperature (Sproles 2013). The Pacific Northwest exhibits a diversity of responses to climate change, where transitional (intermediate elevation) watersheds experience the greatest seasonal shifts in runoff in response to cool season warming (Vano 2015). The California Cooperative Snow Survey program does not operate any surveys in the SFTR watershed so there is no data to analyze, however historical references, personal observations, and personal communications with longtime residents indicate that much less precipitation falls as snow and more falls as rain today than did so in recorded history. To illustrate the point we conducted the following mapping exercise: if the snow line rises 1,000 feet in elevation (educated estimate for illustrative purposes) we would see a substantial reduction in area within the SFTR watershed receiving snowpack and related slow release of runoff into stream systems.

Figure 9 illustrates the dramatic difference in snowpack from 61% to 26%, a 35% reduction in slow release of water over spring and summer months. The quantity of snow varies from year to year but if this trend continues it will likely lead to dramatic changes in streamflow and associated stream temperature increases that will be a detriment to salmonid populations.

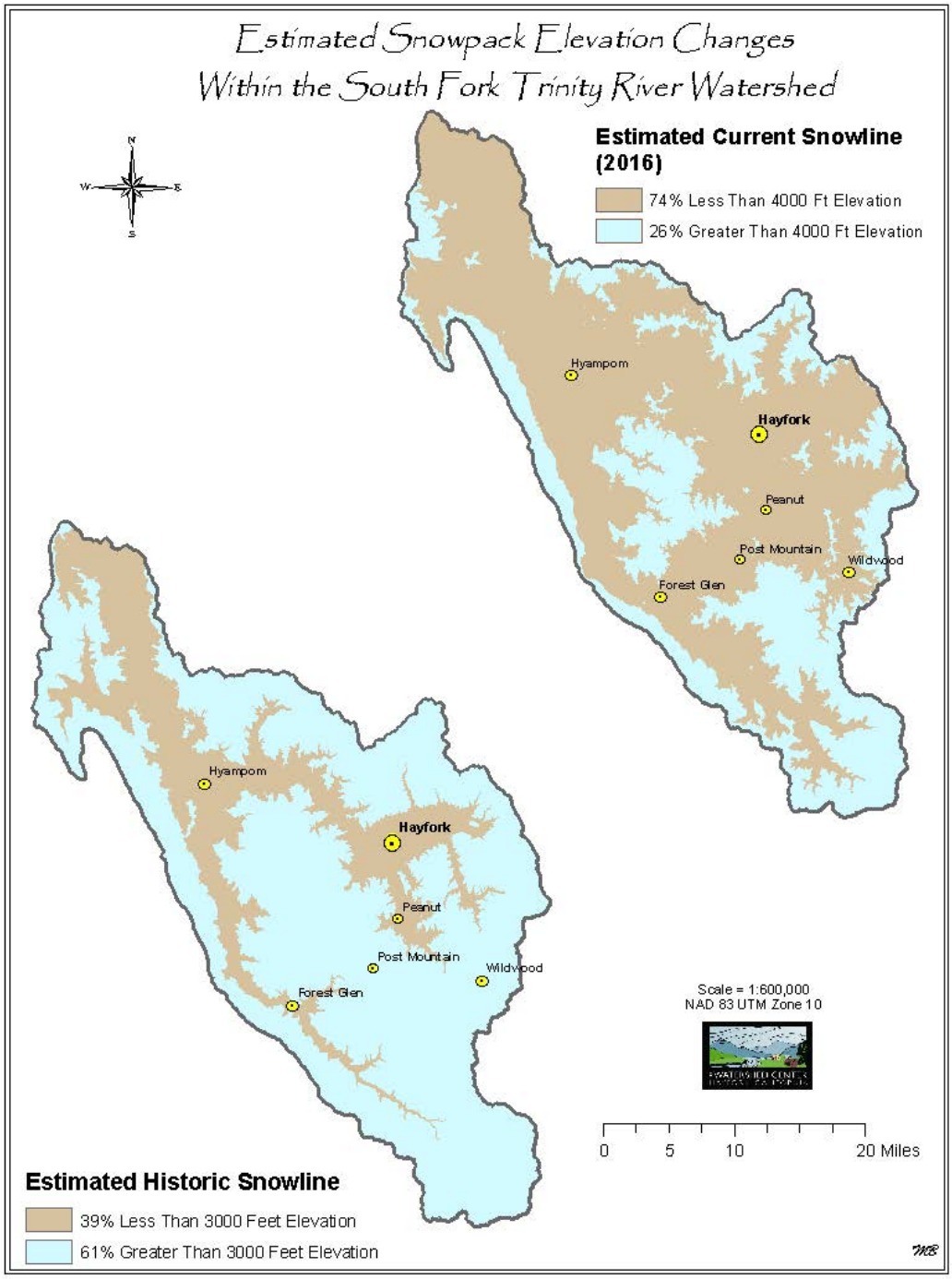

Figure 9: Estimated Changes in Snowpack between Historic and Current Conditions.

DISCUSSION

Increase Storage Capacity or Delivery Capability for Ewing Reservoir.

SONCC-SFTR.3.1.42.1 In order to make water available for use during low summer flow periods, it will be important to increase water storage and increase and improve water delivery from Ewing Reservoir.

There are a variety of ways in which to increase public community water supplies while increasing available instream summer flows. Most methods include increasing either the storage or delivery capacity of the Trinity County Waterworks District #1 (Waterworks District):

- Increasing the storage capacity of Ewing Reservoir
- Utilizing untreated and/or reclaimed water
- Expansion of Waterworks District boundaries
- Creation of altogether new water districts

In this report "water district" is a term used to describe a regulated water utility such as a mutual water company, water association, water agency, or irrigation district.

It should be noted that any recommendations on Waterworks District boundary expansion are derived from the WRTC watershed analysis and are not advocated for or against by the district board or staff.

Description of the Existing Waterworks District System

Trinity County Waterworks District No. 1 was formed in 1952 for purpose of operating and maintaining a municipal water system (DWR 1964). The Waterworks District operates and maintains the community water system, which serves approximately 2,450 persons. Water is supplied by diverting flows from Big Creek and other smaller tributaries to Ewing Reservoir, which can store 820 acre feet of water (SHN 2004). Ewing Reservoir is located in the Ewing Gulch watershed, a non-fish bearing intermittent stream.

The Waterworks District is currently allowed to divert water from Big Creek beginning November 1 through June 30 each year; diversion usually starts in November if conditions permit. The maximum allowable diversion is 14 cubic feet per second (cfs), provided minimum flows (15 cfs) are set aside for fish and downstream irrigation demands in Big Creek. The Waterworks District diverts their allotted portion into the reservoir usually up until June 30, or before if the minimum flows in Big Creek decrease below 15 cfs. At this point, Ewing Reservoir is normally filled to a maximum elevation of 2,430 feet, which is equal to 820 acre feet of storage. During the months of June through Novemberthe water supply is a closed system, meaning that for these four months water is not being diverted from Big Creek. During this time, the community of Hayfork only has access to the water stored in the reservoir, which is 168 million gallons or peak daily flow of 1.8 million gallons per day (SHN 2004). Dam operations and regulations require a certain amount of water to remain in the reservoir (Hair 2016)

Therefore, the existing Waterworks District's water source and storage system is a very good system for fisheries and a large scale example of forbearance, because it takes and stores all of its 900 acre feet of water in winter and spring when streams have plentiful water and does not take a drop in mid-summer

when the streams are vulnerable to take. See the Establish an Instream Flow Transaction (Forbearance) Program section for more information.

A significant limitation to the Waterworks District's ability to increase delivery capacity of their system is the capacity of each individual segment of infrastructure. For example, the Dam Outlet can produce 14.4 million gallons per day, while the pump plant can produce 1.9 million gallons per day. The bottleneck is actually in the water treatment plant which can only produce 1.2 million gallons of potable water per day, therefore this is the limiting factor for water production in the entire system. This is in reference to treated potable water and fortunately there is a new irrigation line system that increases overallcapacity by offering untreated water to large irrigators. This is discussed further in the "Using Untreated and/or Reclaimed Water" section below.

The water treatment facility consists of a regulation reservoir with a storage capacity of one million gallons, a clarifier with a capacity of 0.60 MGD, and a filter with a capacity of 1.2 MGD. With a clarifier capacity of only 0.6 MGD, much of the water needed during peak times bypass the clarifier entirely and the filter can only handle 1.2 million gallons per day, which runs at 90% capacity during peak demand times (summer months). The water treatment facility appears to be a limiting factor in supplying additional water to the community (SHN 2004). To our best knowledge the system is the same as described in the 2004 SHN report.

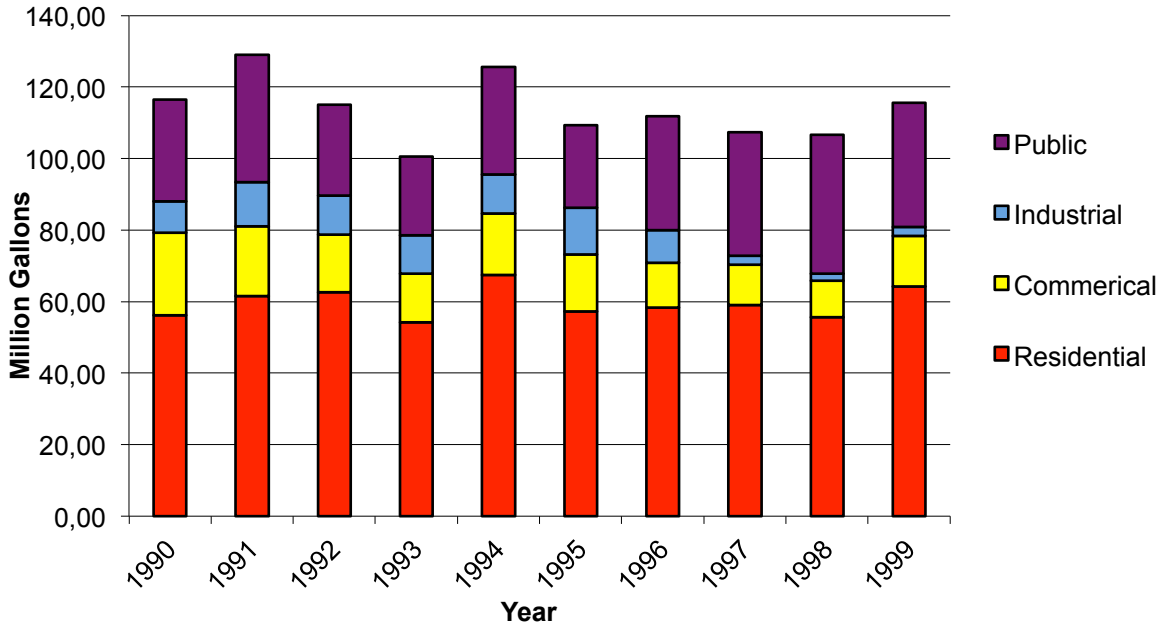

Figure 10: Total water sold by the Waterworks District in years 1990-1999. Figure replicated from SHN Engineers and Geologists (SHN 2004).The Waterworks District has a different accounting system than what was used in the 1990s and is no longer able to track differences in public, industrial, commercial or residential users therefore it was not possible to track these changes over time.

We were trying to determine the changes in water use over time within the Waterworks District but could not aquire to comparable datasets. The significant difference between Figure 10 and Figure 11 derives from a combination of changes that make accounting difficult; the old accounting system monitored water sales and the new system monitors water production, the new untreated water system, the new backwater recycling system, and a change in software used for billing.

The Waterworks District is confident that the numbers from 2012 to 2015 are very accurate and that their overall use/production in that time is in sharp decline due to increases in rates and Statewide Drought Policies.

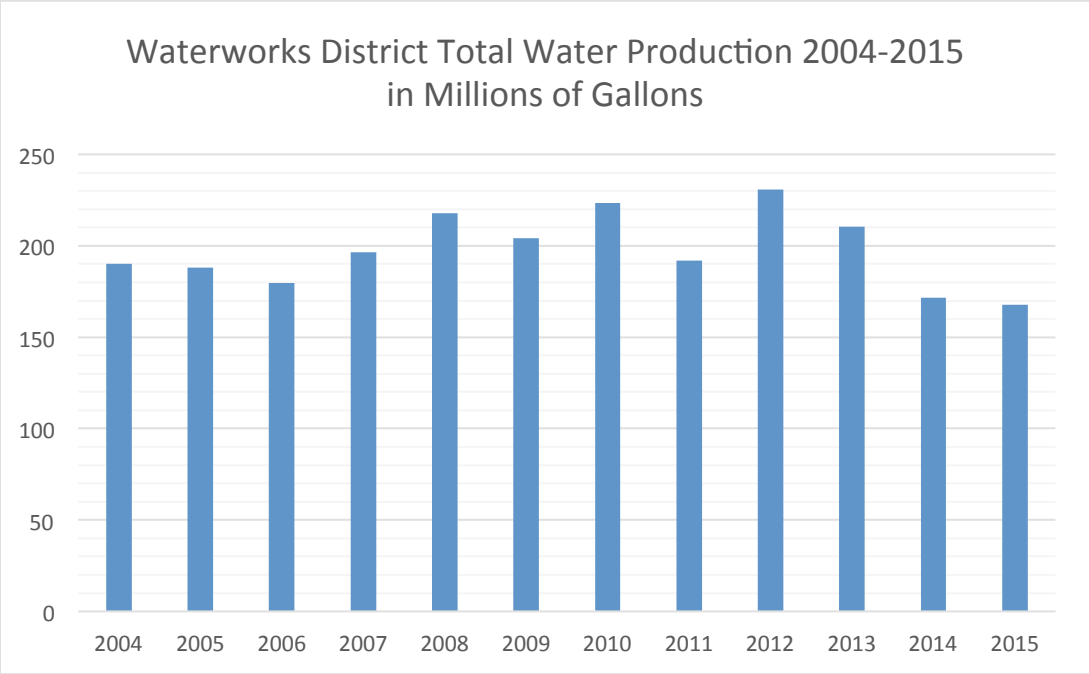

Figure 11: Total water production by the Trinity County Waterworks District #1including all water that passes through the treatment facility. Production is measured at the meter at the Waterworks District treatment facility. Total production includes water sold at the plant by to water tenders but does not include raw water sold to major public irrigation systems (C. Hair pers. comm. 2016).

Increasing the Storage Capacity of Ewing Reservoir

One concept to increase water availability for the community yet keep water in the streams is to increase the capacity of Ewing Reservoir. Increasing the height of the dam would significantly increase storage capacity, allowing more water to be used during high demand (peak summer) months. The Department of Water Resources (DWR) who conducted feasibility assessments for the original Ewing Project had anticipated the future needs of the Waterworks District system: The Ewing Project would meet the estimated water requirements of the district for about 30 years. At that time, the most economical source of additional water would probably be an enlargement of Ewing Reservoir. Accordingly, it was decided that the design of Ewing Dam should be suitable for eventual enlargement. The dam was designed to accommodate an increase in height of about 12 feet, which would provide a yield in excess of the estimated water demands for the year 2020 (DWR 1965).

A feasibility study for increasing the storage capacity of the Hayfork Community Water System was completed by SHN Consulting Engineers & Geologists, Inc. in 2004. The *conceptual* engineering plan was to increase the height of the dam by 12 feet after 30 years, or when growth in Hayfork required additional impoundment.

Raising the reservoir by 12 feet would increase the reservoir surface area from 41 acres to 65 acres, triple the water holding capacity of the reservoir and even allow for increased recreation on the reservoir lake (Hair, Pers. Comm. 2015).

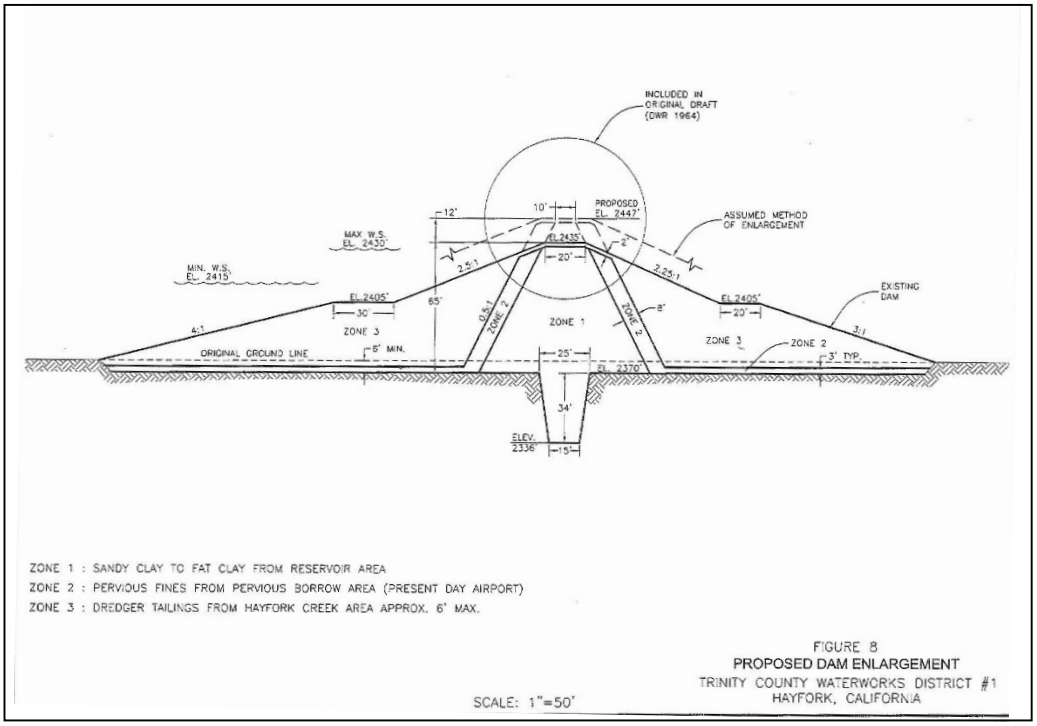

Figure 12: Engineering design from SHN Consulting Engineers & Geologists demonstrating that Ewing Dam was designed for an eventual 12-foot enlargement.

There is some consternation about the feasibility of raising the dam height. The SHN Engineers cites a number of reasons why "Ewing reservoir is currently capable of providing more than enough water storage for Hayfork's current and future demands and an enlargement of the dam appears to be unwarranted at this time" (SHN 2004). According to SHN, increasing the dam height may not be cost effective and would not solve the current problem of peak demand issues which are primarily related to treatment capacity. The last feasibility study was conducted by DWR in 1964 and would need to be updated to present costs and needs. Population growth and municipal demand predictions by DWR were overestimated nearly two fold from actual 1997 water use. However, industrial water use has declined significantly in the late 1990's from 13 million gallons to 2 million gallons per year (SHN 2004). The DWR and SHN studies had not taken into account the increase of marijuana related agriculture that has occurred since 2008. If any significant industrial water use returns to the community of Hayfork it could easily tip the balance and lead to increased water demand beyond the current ability of the reservoir.

California is in a long term drought (past 4 years) and in 2014 Ewing Reservoir had been drawn down to a level that prompted the Waterworks District to issue a statement to its customers to drastically reduce water use. Water conservation measures put in place in 2015 did reduce peak water use from 1.2 million gallons per day (2004 data, Hair 2016) to 0.8 million gallons per day. However, even with conservation measures in place, Ewing Reservoir may not have enough storage capacity to fully accommodate the present community population or future growth during drought peak water use.

During the 2014-2015 drought, the outlying community of Hayfork outside of the Waterworks District boundary largely ran out of available surface water thus turned to the Waterworks District for their water needs, however current state laws dissuade the use of District water outside of its boundaries because it would be called an out of basin transfer. The actual effect of the Waterworks District being unable to give water to the outlining Hayfork community is that people illegally diverted water directly from streams and water trucks were diverting water from streams further and further into salmonid refugia areas. A multitude of water tender drafting sites were noted throughout the basin, and some were used very heavily. For example, in 2014 marijuana growers from Post Mountain were caught diverting water from Browns Creek near Deerlick Springs some 30 miles away. These water tender trucks do not typically use fish screens and can access very remote areas which are often the last cold water refugia areas for salmonids. Essentially, it would be much better for salmonid populations of the SFTR if all of these water tender trucks were to purchase water from the Waterworks District (even if it is an out of basin transfer) because they then would leave water in the streams.

The largest hurdle to raising Ewing Dam is that the Division of Dam Safety has determined that Hayfork High School is in the direct line of overflow should the dam breach (Hair, pers. Comm. 2015). An unofficial precursory investigationby the Division of Dams determined the new dam size would increase the inundation of the High School from 5’ of water to 10-15’ of water (Hair, pers. Comm 2016). While it is obvious that we do not condone any project that puts the community or children in danger, it is likely that engineering solutionsareconceivable for this inundation problem (such as levees). A full, official investigation is needed to determine the factual inundation path and to assess potential solutions.

While the cost of increasing Ewing Reservoir capacity would surely be too much to bear for the small community of Hayfork and the Waterworks District, it should be noted that increasing the storage capacity would be more of a fisheries restoration project than a water supply project. WRTC is considering the project because of its potential positive impact for fisheries and therefore may be eligible for grant funding such as the new California State Proposition 1 bonds.

Using Untreated and/or Reclaimed Water

Another method of increasing serviceable area while increasing the capacity of the Waterworks District to provide water is to utilize reclaimed wastewater and/or untreated surface water. For most agricultural producers purchasing treated water from the Waterworks District would be far too expensiveand unnecessary so no agricultural producers use water from the district. If there are ways to make untreated and/or reclaimed water available for agriculture it could potentially further reduce demand on treated water and increase overall Waterworks District system efficiency thus benefiting salmonids of Hayfork Creek.

Untreated Water

In 2010, the Waterworks District completed a project funded by the North Coast Resource Partnership (NCRP) to utilize untreated water for irrigation on municipal properties in Hayfork.

While virtually all of the District's customers use water for irrigation, the users classified as Other Public Authorities are the primary users of treated water for irrigation. Other Public Authorities (OPA) are those public entities such as schools, parks, cemeteries and fairgrounds (SHN 2004). Looking further at this irrigation water (21.81 MGY), most is used in the summer months when total demand and daily peak demand is highest. If the District could provide this irrigation water as untreated (bypassing the treatment plant), it appears that the District could reduce treatment of 16.59 million gallons of water between June and September alone. This equates to an average August reduction in treatment of 4.02 million gallons (SHN 2004).

Before the project the Waterworks District wasted between 50,000 to 100,000 gallons per day (gpd) by backwashing the filtering system. The NCRP project recovered this backwash water and provided it for the major irrigation users:Fairgrounds, Hayfork High School, Hayfork Elementary School, and the Cemetery (Hair, Pers.Comm. 2016).

Furthermore, a separate tie-in to the District's raw water source was constructed in 2009 to feed unfiltered (raw) water from the holding pond to the new recycled pipeline to augment the recycled water supply. This project has resulted in the four major OPA irrigators using previously wasted water (50,000-100,000 gpd) and also removed these four largest irrigators from using treated Waterworks District water which made more water available for the community for public, industrial, commercial, and residential uses (SHN 2004).

The "Reservoir Road Pipeline" raw water use project connected the pipe immediately downstream of the regulation reservoir, but prior to any treatment elements, to several public water irrigators. The pipeline was be routed down Reservoir Road, across Highway 3, and on to the top four public irrigators (peak) including the fairgrounds (177,000 GPD), the high school (70,000 GPD), the cemetery (31,000 GPD) and the elementary school (19,000 GPD) (SHN 2004).

Table 7. Hayfork public facilities irrigation usage.Table adapted from SHN 2004.

User Group	Average Base Flow (Gallons/Month)	Maximum Peak Monthly Flow(Gallons/Month)	Maximum Peak Daily Flow(Gallons/Day)	Percent Irrigation Use	Total Percent District Use
Fair Grounds	560,003	5,296,416	176,547	54.95%	14.71%
Football Field	104,321	2,111,828	70,394	21.91%	5.87%
Cemetery	2,539	941,523	31,384	9.77%	2.62%
High School	40,684	579,760	19,325	6.02%	1.61%
Elementary School	165,333	531,387	17,713	5.51%	1.48%
Park	7,690	95,370	3,179	0.99%	0.26%
Continuation School	5,582	46,398	1,547	0.48%	0.13%
School Office	3,246	25,671	856	0.27%	0.07%
Bus Barn	2,279	9,455	315	0.10%	0.03%
Total	**891,677**	**9,637,808**	**321,260**	**100.00%**	**26.77%**

There is potential for future expansion of this untreated “raw water” line that was built in 2009 including industrial sites, agricultural sites, and a few unforeseen uses like wildfires. Further utilizing the raw water for irrigation purposes helps the Waterworks District meet peak summer water demands, and thus removing those irrigators from pulling water from the streams when in their most fragile state. The Waterworks District has not yet moved to allow its water to be used for agricultural activities since their charter states their primary purpose is to provide potable water, so while the untreated water project was necessary to make more water available for district customers, it is not yet decided whether the district will continue to offer more untreated water than is currently available.

Industrial uses of raw water: There are several old lumber mill sites in the vicinity of the Waterworks District that could potentially use cheaper untreated water for their purposes if the need arises. Currently a firewood processing plant is operating at one of the industrial properties and there is interest in annexing the property into the Waterworks District so that they can utilize district water.

Agricultural uses of raw water: Several agricultural opportunities near the Waterworks District exist including several private parcels and a couple of public parcels zoned for agriculture. Economic evaluation of this option has not occurred though it is likely that high value crops would need to be produced to validate the cost of the water.

Other Uses of Raw Water: Interestingly, the Waterworks District provided a large proportion of water used to fight wildfires on National Forest and CALFIRE protection area lands in recent decades. In particular, the 2015 wildfires burned more than 200,000 acres within the SFTR watershed and the Waterworks District provided approximately 10 million gallons of water for firefighting the Stafford and Forks Complex wildfires during 2013 and 2015 respectively. This water was extremely important during the severe historic drought of 2015 because firefighters were drafting massive quantities of water from nearly dry streams before the District provided water. Several streams were nearly dewatered before the untreated water from the Waterworks District became available (and mandatory) to be used for firefighting.

Reclaimed Wastewater

Using reclaimed wastewater for irrigation or industrialuses can be a viable alternative to the use of treated drinking water for irrigation or industrial uses. By providing some of the larger irrigation users in Hayfork with reclaimed wastewater, unused treated water could be used for economic development.

California laws and codes related to the use of recycled and reclaimed water states the “use of potable domestic water for non-potable uses, including, but not limited to, cemeteries, golf courses, parks, highway landscaped areas, and industrial and irrigation uses, is a waste or an unreasonable use of the water” if recycled water is reasonably available. The use of recycled water instead of use of potable domestic water, may be considered a reasonable beneficial use of water. The recycled water must be of adequate quality for the designated use, be supplied at a reasonable cost to the user, the use of water must not be detrimental to public health, nor degrade downstream water quality. The use of recycled water must also not adversely affect downstream water rights nor negatively affect plant, fish and wildlife.

The current Waterworks District’s wastewater treatment facility consists of an oxidation/marsh system, providing primary and secondary treatment to the District's wastewater (SHN 2004). The Waterworks District sewage treatment plant’s water output depends on the amount of rain per year and to what extent the plant is running to capacity. Currently the plant is running at 25% of capacity and is thus producing approximately0.1 million gallons per day (0.15cfs).

Table 8: Examples of “limited human contact”.

Primary Treatment: Sedimentation	**Secondary Treatment:** Biological Oxidation, Disinfection	**Tertiary / Advanced Treatment:** Chemical Coagulation, Filtration, Disinfection
No uses recommended at this level	Surface irrigation of orchards and vineyards Non-food crop irrigation Dairy cattle and stock fodder irrigation Restricted landscape impoundments Groundwater recharge of non-potable aquifer** Wetlands, wildlife habitat, stream augmentation** Industrial cooling processes** Non-structural firefighting	Landscape and golf course irrigation Toilet flushing Vehicle washing Food crop irrigation Unrestricted recreational impoundment Industrial water that may contact persons. Structural firefighting

** These uses require review by State Waterboards on an individual case basis (CDPH 2001).

Table 9: Potential uses of Waterworks District’s reclaimed wastewaterincluding necessary system upgrades and associated costs. *SHN estimated cost for additional treatment to meet the government requirements during 2004.

Human Contact Allowed	**Type of Use Allowed**	**Cost of upgrade for new filtration equipment***
Full human contact	Use at fairgrounds or high school	Chlorine contact chamber, sand filter, clear well, and building: $344,500 to $450,000
Limited human contact	Use at cemetery	Chlorine contact chamber: $188,500
Non-human contact	Use for “fodder, fiber, and seed”	No additional treatment required: $65,000

Use of wastewater in landscaping (residential and community) would require installation of an irrigation network of piping that would not contaminate the drinking water supply nor be accidentally consumed by public.

Examples of potential non-human contact include: compost creation, enhancing wetlands and/or riparian wildlife habitat, stream augmentation, recharging “non-potable” groundwater aquifers, surface irrigation of orchards and vineyards, non-food crop irrigation, and industrial cooling processes such as a biomass power plant.

On the west side of Hayfork is a developing industrial and business park called Hayfork Community Enterprise. The land was once a lumber mill and some of the old buildings still remain. Presently, there is a small wood products facility in operation and plenty of room for development of other industries. Conveniently, this area is situated across Salt Creek from the Hayfork community wastewater treatment plant which could provide non-potable water for industrial and landscaping uses in an area with extremely limited water supply.

Other uses for the recycled water include irrigation of nearby agricultural land for grass and alfalfa production and potentially groundwater recharge or wetland augmentation of nearby Salt and Hayfork Creeks. However, to provide this water for irrigation use, the District would be required to provide advanced treatment as specified by state regulatory agencies (Table 8)(SHN 2004).

Increase Delivery Capacity through District Boundary Expansion

Currently, the Waterworks District is not actively seeking any increase in boundary expansion. It is not the Waterworks District's intent or policy to look at anything other than the boundaries of the current District. *Note: Any recommendations on Waterworks District boundary expansion are derived from the WRTC watershed analysis and are not advocated for or against by the district board or staff.

They are willing to look at areas if requested to do so by the residents of a particular area and if small expansions could economically and practically fit with the existing system. Currently the small expansions being assessed by the Waterworks District are all located along the mainstem of Hayfork Creek including: Brady Road, Morgan Hill Road (furthest extents), the Kingsbury area (a few parcels left excluded), Riverview Road and the Hayfork Community Enterprise area.

The Waterworks District is willing and able to increase delivery capacity into specific neighborhoods *if*residents are interested in utilizing the District's water, however there are many obstacles to expanding the Waterworks District. The biggest obstacle is that most people do not want to pay for water from any district while they are able to get water from streams, springs, or wells for much cheaper or free. Concurrently, when residents do not use district supplied water, the water districts do not collect enough money from rate payers to cover their costly infrastructure. Further consternation occurs with the fact that water districts are "Special Districts" and thus boundary changes need to be conducted through a formal annexation process by Local Agency Formation Commission (LAFCo) which is complicated and time consuming.

Another, more unexpected setback for Waterworks District expansion came in the attempt to expand the district boundary to the Kingsbury area. Some residents had approached the Waterworks District about providing water to the area, however, many residents in the neighborhooddidnot want to join the Waterworks District because they would then be regulated by a Trinity County shooting ordinance which prohibits recreational shooting of guns on your property. The result was political turmoil and public anger about something entirely outside of water issues. This exemplifies the small nuances that make changes difficult to achieve in rural towns.The issue was dealt with by zoning variance and the Waterworks District was able to expand, however it made the process difficult, time consuming, and politically loaded instead of simple and straightforward.

On the other hand, the drought of 2012-2015 did impact water users in regard to the potential for water district expansion. Numerous properties (probably hundreds) ran out of water entirely when streams, springs or wells ran dry. Numerous tributariesand Hayfork Creek went subsurface, a previously unrecorded event by most accounts. Many people had to resort to purchasing water from water tender vendors who are often unregulated to supply domestic water which may not be certified potable. Therefore, the drought did cause some folks to inquire about other options for acquiring domestic

water; many of whom were interested in paying for their water through a district if it guaranteed them supply. Guaranteed water supply, certified potable water, and decreased environmental footprint are several of the reasons to make the switch to water district systems, and are much more attractive during major droughts. Many neighborhoods are much more interested in public water than they were previously.

From a practical perspective there are several areas that are too small to show up in this HUC 7 analysis but are still very worthy for potential future expansions of the existing Waterworks District. The most practical areas to expand the Waterworks District boundary are the parcels of land directly adjacent to the existing system along major roads. Based on adjacency and estimated water usage per subwatershed (Figure 4 and Figure 6) potential areas for the HayforkWaterworks District expansion are shown in Figure 13Figure 13: Potential Waterworks District expansion areas or altogether new water districts.:

- Properties along Hyampom Road to the west and north.
- Cedar Gulch, Brady Road and North Vista Lane
- Drinkwater Gulch and Doctor Lane
- Tule Creek and McAlexander Roads
- Big Creek Road, Duncan Gulch, and East Hayforkalong the Highway 3 corridor.

These potential areas for Waterworks District expansion are simply conceptual areas with water conservation in mind based on proximity to the existing water district and private lands. Further analysis would be required to determine economic and physical feasibility, public interest, off channel storage site location and more.

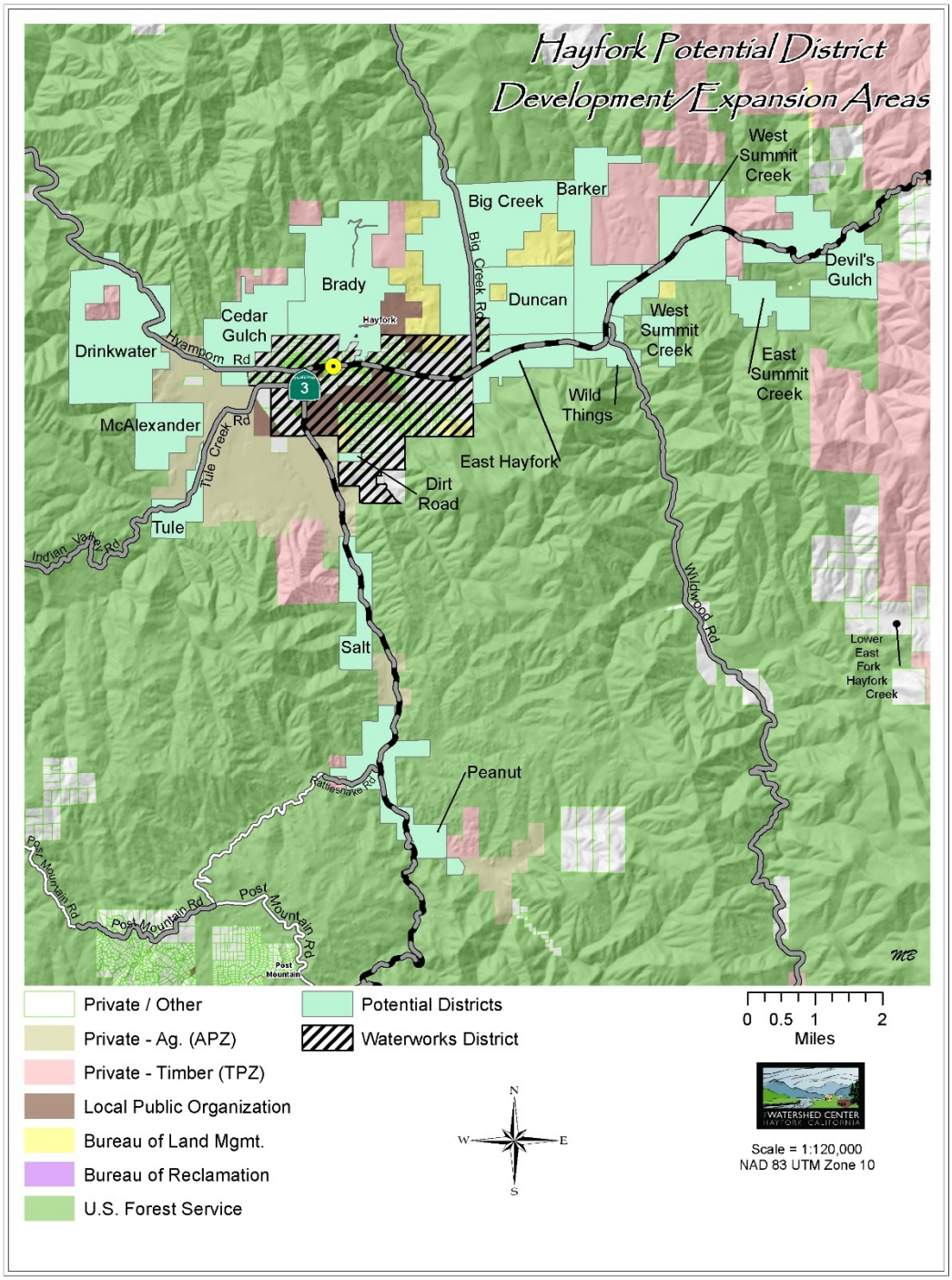

Figure 13: Potential Waterworks District expansion areas or altogether new water districts.

Increasing Delivery Capacity by Creating Altogether New Water Districts

If several communities decided to join together to form new water districts it could help with water conservation within the SFTR watershed. The water diversions in these areas would be better regulated, the water would be safer for residents to use, and if off channel storage is utilized water could be left in streams for anadromous fish. Currently two small water districts exist within the SFTR watershed. The

Peanut Water System provides potable water to residents of Peanut, located south of Hayfork on Highway 3. The Valley View Water System, west of Hyampom, services some residents along the Lower South Fork Road.

Based on estimated anthropogenic water use andhuman population numbers large enough to support a district in a contiguous geographic area (Figure 5), WRTC has identified multiple communities that may be suitable for development of a community water system (Figure 13 and Table 10).

Table 10: Potential New Water Districts by community/road, HUC 7 watershed, and anthropogenic water use.Anthropogenic water use includes estimated Domestic and Marijuana uses and does not include legal diversions.

Community	HUC 7 Subwatershed	Population	Anthropogenic Water Use (cfs)
Hyampom	Hyampom Valley, Olsen Creek and Lower Hayfork Creek Canyon subwatersheds	440	0.541
Trinity Pines (Post Mountain)	Post Creek, and Upper Rattlesnake Creek subwatersheds	394	5.398
Highway 3 North (Peanut)	Barker Creek, Carr Creek, Summit Creek, Duncan Creek, and Duncan Gulch-Hayfork Creek subwatersheds	577	1.679
Highway 3 South and 13 Dips Road	Lower Salt Creek-Hayfork, Philpot, and Salt Gulch Creek subwatersheds	250	0.519
Wildwood	Stringbean-Goods and Halls City-Wilson Creek subwatersheds	159	0.311
McAlexander and Tule Creek Roads	Upper and Lower Tule Creek subwatersheds	110	0.064

Hyampom Valley

The mainstem SFTR runs through Hyampom and even the driest years such as 2014 had 14 cfs at the USGS gage at its lowest point. While care needs to be taken to ensure that specific diversion points are well screened and do not entirely dewater areas, along with other diversion best management practices, the mainstem SFTR can probably provide for the community of Hyampom without endangering salmonids. Hyampom does have some of the highest intrinsic potential for coho salmon and there are certain refugia areas that should be avoided. Furthermore, any off channel storage in Hyampom should be looked at closely by a professional geologist, especially anything on the west side of the river, due to geologic instability.

Trinity Pines

The Trinity Pines (Post Creek HUC 7 subwatershed) is using an estimated 5 cfs in marijuana related agriculture during the summer month (June to September). The actual streamflow measured in Post Creek on April 2016 was 5.5 cfs. While the majority of landowners are utilizing wells for their water withdrawals, this cumulative action is either taking water at a rate faster than it can be replenished or at the minimum taking the majority of water from the stream. Post Creek is a tributary to Rattlesnake

Creek which, while it isnot known as a major coho stream, is possibly the best spring chinook rearing tributary in the entire SFTR watershed (Dean 1996). The water use in this subwatershed seems unsustainable and while it is unclear what type of system might be used to reduce impact to aquatic life, it seems fairly apparent that a change needs to be made.

Wildwood

Wildwood has relatively low human population numbers and density but it is a community that has a well consolidated population in a contiguous valley. It is an area where a small water district would be practical.

Other

The dispersed communities in the Barker Valley Road, Highway 3 North and Summit Creek Road, and Highway 3 South and 13 Dips Road all have excellent potential for future new water districts. Each has viable sites for off channel ponds similar (though smaller) to Ewing Reservoir, consolidated human populations, and higher population densities.

Assess Agricultural Lands and Develop a Plan for Improving Water Delivery Systems

SONCC-SFTR.3.1.10.1 and SONCC-SFTR.3.1.10.2: Assess agricultural lands and develop a plan for improving water delivery systems and Improve water delivery systems, guided by the assessment.

The subwatersheds with the greatest potential for improvement of irrigation and agricultural water use to improve instream flow are: Lower Big Creek-Hayfork Creek, Hyampom Valley, Chanchelulla Gulch-Shiell Gulch, Lower Hayfork Creek Canyon, Lower Tule Creek, Lower Salt Creek-Hayfork Creek, Upper East Fork Hayfork Creek, Barker Creek, Carr Creek, Rusch Creek, and Big Creek-Hyampom (Figure 5 and Figure 6). This does not include marijuana related agriculture. These subwatersheds have the largest legal water diversions in the SFTR watershed.

We have looked into working with several landowners on off channel storage and delivery improvements. Unfortunately, a number of factors have made this segment of the analysis less successful than anticipated.

Firstly, at the time of writing the FRGP grant proposal the WRTC had been in discussions with Jonathan George the District Conservationist (DC) for the Natural Resources Conservation Service (NRCS) and Ryen Rourke the ranching and irrigation technician for NRCS. However, by the time the grant was awarded DC Johnathan George had moved on to a new job and was replaced by a new DC Heidi Harris. Technician Ryen Rourke soon left too, but was not replaced. We did develop a relationship with DC Harris and she has been extremely helpful in discussing ideas and potential solutions for water conservation however there have been some major changes out of her control that have further hampered this assessment. DC Harris had taken over management at NRCS in a time of great transition in Trinity County, the demographics of farms and agriculture has changed dramatically since DC George's time. The number of marijuana grows on private lands has spiked dramatically and because NRCS is a federal agency they are unable to assist any landowner engaging in this federally illegal

activity. This has resulted in less landowners that are qualified to receive assistance from NRCS to work with in Trinity County and subsequently less staff needed to work at NRCS.

Secondly, NRCS rightfully has very strict privacy clauses for the landowners that they do work with and are not able to share any information unless specifically designated by the landowner. The historic drought of 2014 and 2015 created a situation with a lot of conflict between water users and a major drop in water rights owners' interest in discussing their diversions or irrigation systems. The new diversions around marijuana growing have increased the conflict and uncertainty around water rights and diversions. Many agricultural producers, both new and longtime landowners, have been reluctant to discuss diversions in this uncertain and controversial time.

Thirdly, DC Harris inherited a series of irrigation improvement projects that had not been very successful for one reason or another and have led to less producers wanting or being able to engage on irrigation efficiency projects.

Regardless of all of these difficulties, the bottom line is that we were not able to accomplish as much as we had hoped on this particular FRGP task. Improving irrigation transmission and efficiency on the agricultural lands of the SFTR watershed is extremely important in conserving water. The WRTC will continue to work with NRCS and directly with private landowners into the future to improve water efficiency on multiple ranches within the SFTR watershed. The amount of time required to conduct this type of sensitive outreach was beyond the projected scope of this current FRGP project.

Water Storage Tanks for Private Domestic and Agricultural Use

The primary focus of this Water Conservation Measures watershed assessment task has been to assess watersheds in the SFTR to determine areas of maximum potential reduction of water diversions during summer and fall months focusing on where water storage would have the most potential to help keep water in the streams for coho salmon. Though it would be a different solution to the same general problem, this watershed assessment task is addressed more thoroughly in theIncrease Delivery Capacity through District Boundary Expansionsection of this document. The subwatersheds identified as higher human population density and water use (Figure 5) but that will not be feasibly annexed into the Waterworks District nor feasibly helped to create a new water district with off channel storage should be heavily promoted for water storage tank programs. Essentially, the more people we can help to utilize storage tanks, the better. Storage tanks not only help provide the streams with buffering of diversion impacts, but they also offer many practical benefits to landowners.

The secondary focus was to develop several programs to expand the use of private domestic water storage tanks including outreach, education, grant applications, water storage regulation research, and discussions with landowners.

We have conducted education workshops on storage tanks and provided multipleevents to educate marijuana cultivators on water conservation and storage tanks, more information on WRTC outreach work can be found in the "Water Conservation Outreach and Education Programs" section of this document. Marijuana cultivation is a serious problem in many areas, such as the Rattlesnake Creek

watershed and likely has significant impact on the hydrologic function of tributary streams during critical low-flow periods in the summer and fall (NMFS 2012).

We have also addressed this task by collaborating with the Five Counties Salmonid Conservation Program (5C) on a water tank program. We have been awarded a grant to produce a pilot project that will provide incentives and assist citizens in selective watersheds (i.e. Lower East Fork Hayfork Creek and subwatershed groups in the Forest Glen and Hidden Valley areas) with water tank installation, permitting, and technical assistance that can help keep water in streams to benefit coho salmon. This project is described in more detail in the Five Counties' "Trickle Fill" Forbearance section of this document.

The tertiary focus was to assess where water tank storage systems will be insufficient in volume for providing the necessary storage needs of agriculture. The ideas was to gauge water resource demand as well as the studying the potential utility of Ewing Reservoir type storage in other areas like Salt Creek, Barker Creek, or Hyampom and then work on developing basic feasibility studies for those off-channel water storage options. This is described further in the Off-Channel Pond Storage and Forbearance section of this document.

In the end, essentially the more landowners that begin to utilize water storage tanks for private agricultural and domestic water uses during periods of low flow, the better condition streams will be in regardless of which watershed.

Establish an Instream Flow Transaction (Forbearance) Program

SONCC-SFTR 3.1.7.2 Establish a forbearance program using water storage tanks to decrease diversion during periods of low flow. Monitor forbearance compliance and flow.

Forbearance refers to the practice of using stored water from an above-ground tank during the low flow season, as opposed to diverting water directly from a river or tributary.

A forbearance agreement is a contractual arrangement between an organization and a water right holder that typically specifies the terms under which a water diversion will be managed for instream use. Forbearance agreements can take several forms, including a water lease agreement – which could be a short-term document between the organization as lease holder and the water right holder – or a covenant that runs with the land and is recorded on the deed to the property with the County's records office (Figure 14, SWIFT 2016). A wonderful new guide has been created to help water right holders – and those assisting them – understand their options for keeping water instream in California : "*A Practitioner's Guide To Instream Flow Transactions in California, Small Watershed Instream Flow Transfers (SWIFT) Working Group, March 2016"* (SWIFT 2016).

Ultimately we hope to have sufficient water in stream during the driest months of the year in order to help salmonids survive these critical periods. In order to do this a suite of instream flow transaction techniques (including forbearance)may be able to deliver reductions in the amount of water taken from anadromous streams during low flow periods. There are numerous mechanisms which can be utilized to

make water available for instream flows and we believe that the utilization of a combination of forbearance techniques may be the most appropriate and effective for the SFTR watershed. For example, “Trickle Fill” systems may be beneficial in the East Fork Hayfork Creek watershed, while “Temporary Water Transaction” might be a better fit for Big Creek.

Table 11. Types of Instream Flow Transaction programs including permits required by SWRCB, CDFW, and CEQA and a benefit and drawback for each.

Type	Cost	Benefits	Drawbacks
1707 instream dedication (i.e. Letton Ranch)	$$$	Dedicates water to stream (in perpetuity or seasonal). Protects landowner’s water rights and provides flexibility to add water instream and protect it and/or continue to use it. Few annual costs.	Expensive and difficult to shepherd through the legal process. Requires moderate continuing oversight.
Tanks and Forbearance (i.e. Sanctuary Forest)	$$$	Keeps water in streams during essential summer months. Develops useful storage infrastructure.	Requires continuing regulatory oversight and streamflow monitoring. Annual costs. Needs very specific watershed circumstances to succeed.
Trickle Fill Systems (i.e. 5C program)	$$	Inexpensive, simple to set up and maintain. Small short and long term benefits. Moderate annual costs.	Does not dedicate water as with other forbearance. Only minimizes impact of withdrawal.
Short-term water acquisition (i.e. Scott River Water Trust)	$$$	Puts water in streams when needed. Large short term benefits.	Requires annual reassessment and detailed monitoring. Annual costs. Difficult to find funding.
Coordinated voluntary contributions	$	Keeps water in streams during essential weeks.	Substantial coordination necessary. Needs a reason to voluntarily contribute.

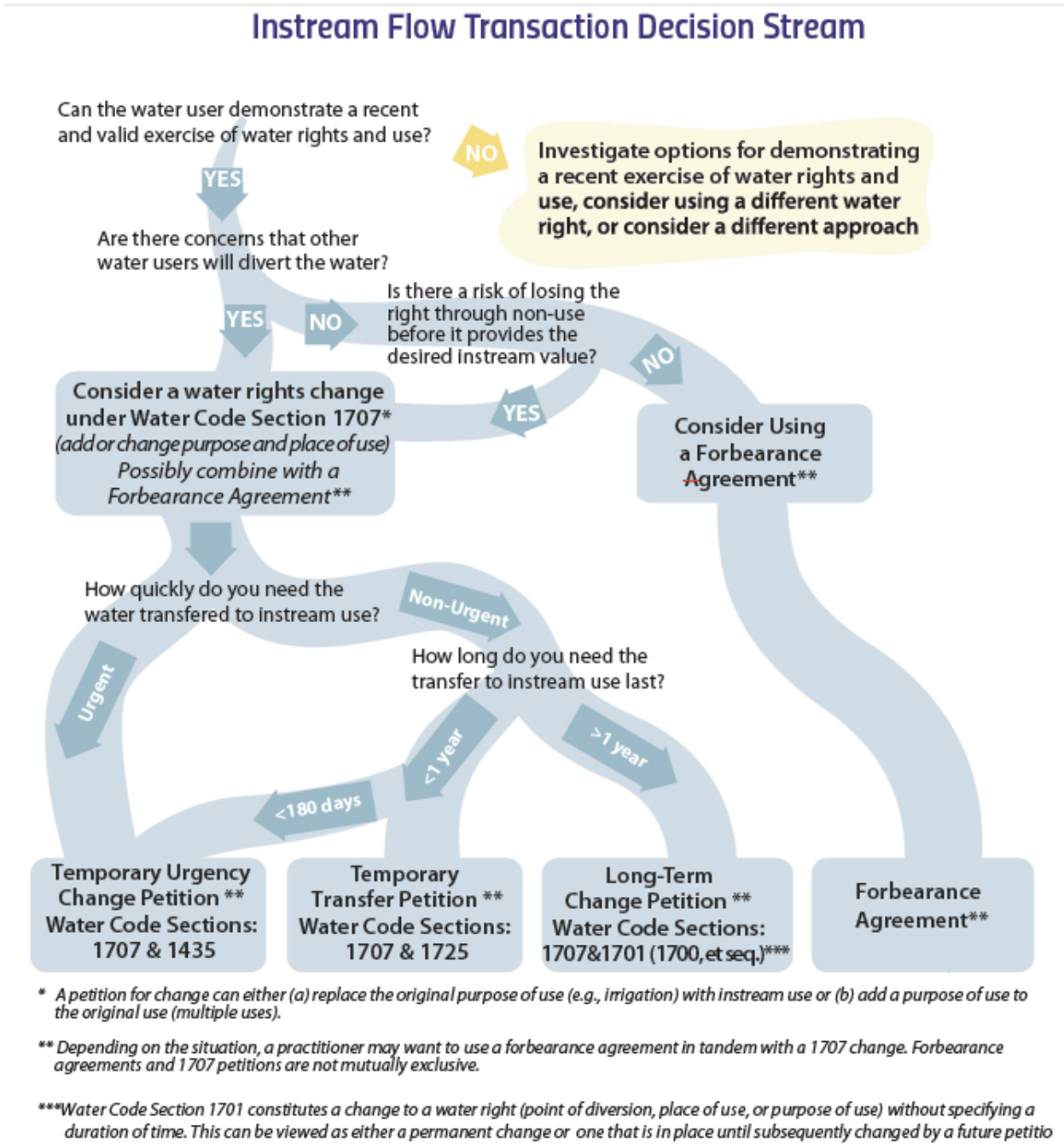

Figure 14. Flow chart for determining type of forbearance agreement(SWIFT 2016).

1707 Instream Water Right Dedication

The longest term technique to keep water in streams is the idea of dedicating existing water rights for instream beneficial uses. Section 1707 was added to the California Water Code by the state legislature in 1991. This section of water code enables the State Water Board to approve petitions to change existing water rights for the purposes of preserving or enhancing wetlands, protecting fish and wildlife, and

recreation. According to the State Water Board's website, over the past two decades, the State Water Board has processed fewer than 40 petitions for 1707 transfers (SWIFT 2016).

A great example of this can be found nearby on the mainstem Trinity River. The owner of Indian Creek Ranch (and former County Judge) improved water use efficiency on their property and subsequently dedicated his remaining water right for instream uses. In the beginning it started off as a practical matter, the ranch's old diversion and irrigation systems were a headache and expensive due to ditch/dam maintenance and difficult permitting. Indian Creek Ranch found out about the 1707 permit from Trinity County RCD staff and began to investigate with great cooperation from CDFW. The process of filing the 1707 permit was a very long slow process that required a lot of patience and perseverance working with multiple agencies because it was one of the first 1707 permits in the State of California. In the end it took 5 years to complete and Indian Creek Ranch gave up the original water right and original diversion point in return two new diversion points (one for irrigation and one for domestic use) and a new appropriative right. The new system was more than adequate to supply ranch, domestic and farm needs and was easier and cheaper to maintain. In the end, it was just the right thing to do and resulted in as much as an estimated 5 cfs more water in the stream than before.

This technique might be very beneficial to overall streamflow in the SFTR if even a few major diverters decide that is beneficial for them to utilize this mechanism. State governments have improved the process substantially and regional partners. The Nature Conservancy (TNC) has substantial experience shepherding the 1707 and other water right transfers through the legal process on the Shasta River. In the Shasta River example, the TNC filed 1707 petitions on two major ranch diversions so that, during critical times for fish, the consumed portion of the water rights will move past downstream users to benefit salmon and steelhead in the Shasta River 30 miles downstream (SWIFT 2016).

Another prospective option for 1707 dedication petitions within the SFTR watershed are the Shasta-Trinity National Forest (STNF) and Six Rivers National Forest (SRNF) water rights. The STNF and SRNF currently maintain dedicated water rights on nearly one hundred sites that are not used. If it were decided that the USFS could dedicated these water rights it would result in a total of 97,792 gallons per day or 0.15 cfs being dedicated to the SFTR.

A potential drawback of forbearance agreements is that they do not protect against forfeiture. An appropriative water right could be forfeited due to non-use if the water is left instream for more than five consecutive years. For this reason, long-term or continuous forbearance agreements are most commonly used for projects involving riparian rights (SWIFT 2016)**.**

Off-Channel Pond Storage and Forbearance

A good example of utilizing forbearance and off channel pond storage to keep irrigation for agricultural farms while providing dry season flows is the Pine Gulch Creek project. The goal of the project was to change the timing of water diversion for three of the largest farms along the creek in order to improve conditions for juvenile salmon and steelhead survival during the low flow season. To store wet season water, a series of five ponds is being constructed with a combined capacity of 52.6 acre-feet (SWIFT 2016).

We have had discussions with landowners and it seems that this option is a popular one, especially with the ranching and farming communities though the details about forbearance are unclear at this point. For example, a major landowner on Salt Creek developed plans for an off channel pond that would be sufficient to irrigate a large portion of their pastures. The site was surveyed and engineering was designed for the dam (though this is likely insufficient for today's engineering standards).Their original intent was to build the pond as supplemental water for irrigation because Salt Creek does not provide the water necessary to irrigate their full property. The landowner uses 15 acre feet in spring irrigations and 20 acre feet in summer irrigations. Assuming one spring irrigation and three summer irrigations for two harvests of orchard grass hay mixture, the landowner would need at least 75 acre feet of water just for irrigation for one year. A detailed analysis of water use timing and stream discharge would be required to determine storage needs and diversion scheduling. Like the Pine Gulch Creek project, the landowner would fill the pond during high flow, use the riparian water to irrigate until June 1, and then irrigate from a pond for the remaining year, until December 30. Depending on the size of the pond, this could provide the farm with as much irrigated pasture as in past non-drought years and be guaranteed water. This type of water diversion and storage would not be effective at reserving water in the stream for fisheries without a forbearance agreement. A forbearance agreement could be drafted to allow drafting from Salt Creek during high water years and exclusive forbearance during drought years.

Unique solutions like this might have multiple benefits: first, providing water to fish; second, storage of sufficient water for farmers with pre-existing water rights and thus leave enough water for other uses in the summer months thus avoid litigation and eventual adjudication. Issues one rancherraised regarding implementing pond storage is the limits on stream withdraw that may be imposed during the early summer months should a forbearance agreement be required, if the diversion conflicts with his existing water right, and the cost of permitting and construction of the pond.

Permits for off stream pond storage for small irrigation use is limited to storage capacity of 20 acre feet per year. Since this would be an agricultural use, the permitting process could more complex and time consuming due to storing more than 20 acre feet and the legal requirements of a forbearance agreement. An instream beneficial use assessment must be filed which includes description of the project, description and assessment of the area and resources the project will impact including wildlife, botanical, and fisheries resources, soil and geology resources, and other pertinent resources, an analysis of proposed flow regime, and a list of the assumptions and methodologies used in the analysis. For most individuals, this task is time consuming and costly as they may need to hire contractors to obtain the environmental information and engineering.

Permits for pond water storage may be easier to obtain within the Hayfork Creek drainage than along the SFTR corridor due to Wild and Scenic River designation of the SFTR. Water projects will not be approved within Wild and Scenic corridors due to the impacts the project will have on extraordinary scenic, recreational, fishery, or wildlife values of any such designated river. An exception would be the development of a community water source, however the permit process will be more time consuming and costly due to protections provided under the Wild and Scenic River designation.

Sanctuary Forest's "Tanks and Forbearance" Program

The Sanctuary Forest's "Forbearance" program is currently located in the headwaters of the Mattole River watershed. Sanctuary Forest's program focuses on tanks and forbearance which helps landowners get the water storage capacity they need in order to give up pumping from the river during the critical dry season – and keeps the water in streams flowing when the river needs it most (Sanctuary Forest 2014b).

An example of this program is the Whitethorn School Tank Storage for Dry Season Flows project. A combination of 1707 dedication, tank storage forbearance agreement to lessen the impact of the school's impact on the Mattole River during dry season. This involved constructing tanks near the school to store 80,000 gallons of water that are filled during the sinter to supply the school with water in the summer and fall (SWIFT 2016).Water rights and streamflow protections included changing the schools existing appropriative water right to allow for storage and execution of a legally binding forbearance agreement requiring the school to cease all diversions when flows drop below 0.7 cfs as measured at site MS6 in the Mattole Headwaters mainstem.

We spoke at length with Tasha McKee – Director of Sanctuary Forest – several times during 2014-2015 about the feasibility of replicating the model program. Unfortunately, we have concluded that the Sanctuary Forest program is not practical for the WRTC to administer in the SFTR watershed *on the whole* for the following reasons:

1. The infrastructure for the program is extremely costly. Each storage tank system (25,000-50,000 gallons) for each home is $40,000 to $100,000. A Sanctuary Forest "tanks and forbearance" type program within the SFTR watershed would require thousands of tanks to be purchased which is currently economically unfeasible. For example, if we were to purchase tanks for each home in the Lower Salt Creek subwatershed we would need to spend $1,770,000 in this subwatershed alone (177 homes x $100,000 per tank); and this is a conservative estimate of the total number of homes.
2. The regulatory components of the program are costly, time intensive, and require continuing funding. Regulatory oversight needs to include streamflow monitoring, water use monitoring/budgeting in each home, and compliance monitoring to regulate each systems water use. Finding enduring funding for this level of regulatory oversight is unsustainable for a non-profit organization like the WRTC.
3. The streamflow monitoring required for this particular program is currently untenable. The WRTC does conduct sporadic streamflow monitoring on the SFTR and its tributaries but this is often unfunded and other work is often prioritized, therefore it would be a major limiting factor for any type of forbearance program. If agencies decide to monitor more locations in the SFTR than just one single USGS station in Hyampom, then this situation could become more reasonable.
4. Overall, currently the large investment for a tanks and forbearance program would be wasted in the Hayfork Valley because there are far too many diverters and no adjudication. Any investment in the program would not have impact on streamflow since the water saved through the forbearance of one landowner would just be diverted by another user located downstream.

Still, Sanctuary Forest's "Tanks and Forbearance" program could effectively be utilized within the SFTR in several key subwatersheds with low human population density (for exampleless than 50 people per

subwatershed) and contains residents who have a culture of stewardship. Subwatersheds such as this could also be more affordable if landowners paid a significant share of the cost. This type of forbearance, while expensive, could be used in particularly critically sensitive reaches of the SFTR for salmonids. The SFTR has high temperatures for salmonids and key springs and tributaries along its mainstem provide essential cold water refugia habitats. Keeping this water in the streams so it can provide cold water may be worth the high cost of the program

Key subwatersheds matching this criteria for this Tanks and Forbearance program in the SFTR are: Lower and Upper East Fork Hayfork Creek, Olsen Creek, Lower Corral Creek, Wintoon Flat-Deep Gulch, Butter Creek Meadows, Hitchcock Creek-Oak Flat, McClellen-SFTR, Miller Springs, Lower Plummer Creek, Little Bear Wallow Creek-Hidden Valley, Cave Creek-Swift Creek, Lower Rattlesnake Creek,Cable Creek-Farley Creek, Silver Creek, Rough Gulch-Happy Camp Creek, and Bierce Creek-SFTR. Subwatersheds that are appropriate for this type of project are presented in the Five Counties' "Trickle Fill" Forbearance section of this document.

Five Counties' "Trickle Fill" Forbearance

A simpler and less expensive system for minimizing impacts to streams from water withdrawals is the Five Counties Salmonid Conservation Program's (5C) "Trickle Fill System" (Figure 15). This system essentially is designed to minimize the effect of high flow pumps on small streams. The system diverts water from a stream via gravity feed pipe at a very small rate (0.05cfs) and deposits that into tanks. The tanks can then have standard pumping systems with high powered, high volume pumps without drawing down streams to the same extent.

The 5C, the Trinity County RCD, and the WRTC have partnered and acquired a grant from the California Department of Water Resources to apply several model "Trickle Fill System" projects within the Trinity River Basin from 2016-2020. Assistance will be provided by the Director of Sanctuary Forest, the Salmonid Restoration Federation, and CDFW Water Rights and Lake and Streambed Alteration program staff.

The type of water storage proposed here will require all landowners be in compliance with their water right filings and apply for a Small Domestic Use Appropriation Registration (SDU). With rare exception, CDFW requires a Lake & Streambed Alteration Agreement (LSA) that includes provisions that prohibit diverting water during the dry season and these LSA provisions, which are incorporated into the SDU registration, would bind landowners to forgo dry season diversions (forbearance). The timing and length of the dry season restrictions would be determined based on the size of the diversion and other specifics of each location, but with these provisions in place, landowners would forgo diverting water during the dry season, minimizing impacts on instream habitat and wildlife during the most critical periods. The 5C, WRTC and partner staff will conduct a home water audit, complete design, implement infrastructure improvements, provide education on proper day to day maintenance of systems, monitor system conditions and function, and confirm dry season diversion restrictions.

Several areas have been discussed as focal subwatersheds for this 5C Trickle Fill project. For example, there are approximately 105 remote homes along the mainstem SFTR upstream of Hyampom. This is an

extremely low human population density, however these homes dotake water from essential streams and springs. In key areas these springs and streams contribute cold water to key salmonid thermal refugia areas such as cold spring seeps and deep cold water pools. These small cold springs and streams are absolutely essential for adult spring chinook holding pools and juvenile thermal refugia along the mainstem SFTR. Therefore, even though the water diversions are small, reducing or moderating this take could still have major benefits for salmonids by augmenting these cold water sources. Conversely, subwatersheds such as Salt Creek and Kingsburry Gulch each have hundreds of structures and associated diversions thus this type of program will be less effective program in these areas.

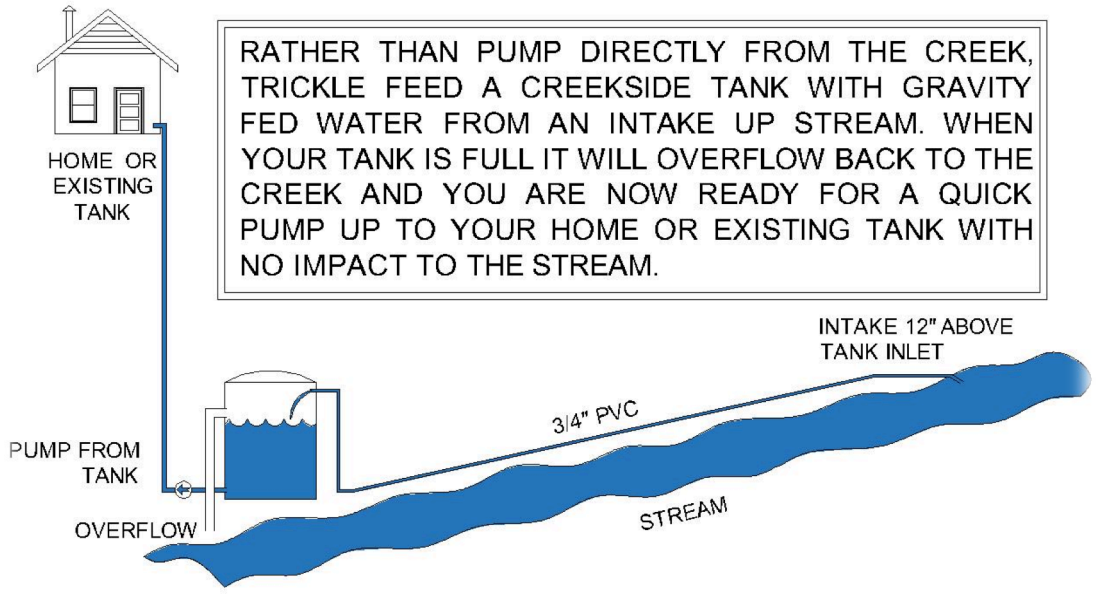

Figure 15: The Five Counties Salmonid Conservation Program's "Trickle Tank" design.

The key subwatersheds with lowest population density and highest intrinsic potential that would be most effective for the "Tanks and Forbearance" and the "Trickle Fill" type of programs are located along the middle and upper South Fork Trinity River. Corral Creek, East Fork Hayfork Creek, and Upper Hayfork Creek areas are also suitable for these types of programs as they have low population densities and the water that remains in the creeks could provide refugia for young salmonids.

Table 12. Subwatersheds identified for potential Trickle-Fill or Tanks and Forbearance programs.

Area name	Subwatershed	Population	Potential water savings (cfs)
Mainstem Upper SFTR	Bierce Creek-SFTR, Rough Gulch-Happy Camp Creek, Silver Creek, Cable Creek, Lower Rattlesnake Creek, Cave Creek-Swift Creek	53	2.63
Mainstem Middle SFTR	Little Bear Wallow Creek-Hidden Valley, Miller Springs, Lower Plummer Creek, McClellen-SFTR, Hitchcock Cr-Oak Flat	53	0.467
St John's Road	Wintoon Flat-Deep Gulch, Butter Creek Meadows	63	0.429
Corral Creek	Lower Corral Creek, Middle Corral Creek, Upper Corral Creek	24	0.332
Mainstem Hayfork Cr near Wildwood	Chanchelulla Gulch-Shiell Gulch, Bridge Gulch-Hayfork Creek	12	0.039
East Fork Hayfork Creek	Lower and Upper EF Hayfork Creek	35	4.32

Temporary Water Transactions

A Temporary Water Transaction is a forbearance agreement in which the water right holder may be financially compensated by a water trust, conservation organization, or agency for entering into a forbearance agreement. For example, a water user may be paid to forgo use of their water and leave that water instream – either temporarily or permanently (SWIFT 2016). Such transactions have the benefit of being able to be performed quite quickly and thus can be very dynamic tools to utilize inatypical circumstances such as major droughts.

The Scott River Water Trust and The Nature Conservancy are organizations working within the larger Klamath River Watershed who have expertise and experience implementing water transactions in the State of California. For example, the Scott River Water Trust's primary mission is "To lease surface water in Scott Valley as a means of improving instream flows for salmon and steelhead by paying fair compensation to water right holders for the temporary instream use of all or part of their water use."

In order to achieve the targeted instream benefits Water Transactions need to involve the largest individual permitted (regulated) water diversions. Temporary Water Transactions have the ability to increase necessary instream flows but only in streams where cumulative withdrawals are not significant. In some cases where large regulated diversions exist with Water Transaction potential but also significant cumulative withdrawals other projects or actions will be required to yield the flows needed to achieve targeted instream benefits will be required. For example, Salt Creek has a few major diversions with potential for Water Transaction use, however it is also a stream with large human population density and thus major cumulative withdrawal problems and is thus not a good fit for the use of Water Transactions.

Within the SFTR watershed, the largest diversions in terms of quantity of water diverted are typically are the only diversions on the stream because these diversions are so large, there are few other diverters able to take water(there simply isnot enough water left in the stream).Streams that have the fewest number of diversions and low human population density, but have large amounts of water diverted have the greatest potential for water savings via temporary water transaction forbearance. Streams within the study area that meet these criteria (>1 cfs) include: Lower Big Creek-Hayfork Creek, Hyampom Valley, Chanchelulla Gulch-Shiell Gulch, Lower Hayfork Creek Canyon, Lower Tule Creek, Lower Salt Creek-Hayfork Creek, Upper East Fork Hayfork Creek, Barker Creek, Carr Creek, Rusch Creek, and Big Creek-Hyampom. Using the SWRCB's "statement of water diversion and use" data, the amount of water that could potentially be purchased in temporary water transactions (of just the 15 largest diversions) of the SFTR is nearly 100 cfs. Remember, that these statement of water diversions are often greatly overestimated, however it does illustrate the huge benefit that could be achieved utilizing this tool.

A few factors that still need to be determined for feasibility and worth of Temporary Water Transactions in the SFTR watershed are:

- The SFTR is very data poor when it comes to salmonid populations. This lack of data makes it difficult to determine if a particular Water Transaction project alone yield the flows needed to achieve the targeted instream benefits. More information on salmonid spawning and rearing relative to diversions, distance that the purchased water will provide cold and oxygenated water downstream, etc. We need to know more about when, where, how much and what quality our water needs are to determine the most appropriate and effective Water Transaction.
- A significant potential drawback to pursuing a forbearance agreement alone – without a water right change – is that the water is not protected from diversion by other water right holders (SWIFT 2016). For the majority of diversions in the SFTR watershed it is very likely that any water acquired by a forbearance agreement alone would be used by other diverters downstream.

The WRTC only recently learned of the Temporary Water Transaction forbearance tool. Unfortunately we have been unable to consolidate all of the necessary information necessary and have felt unprepared to have this discussion with water users in the SFTR watershed. We plan to continue to learn more about these programs and then develop partnerships with other agencies and landowners to provide progress towards keeping water in streams for instream benefits in the future.

Water Conservation Outreach and Education Programs

SONCC-SFTR.3.1.7.2, SONCC-SFTR.3.1.7.3 and SONCC-SFTR.3.1.3.1 "Develop an educational program about water conservation programs and instream leasing programs." (SONCC 2012)

Outreach and education produced by the WRTC from 2013-2016

Trinity Lands and Communities Column

The Trinity Journal, the local Trinity County newspaper, is distributed once a week, it has a circulation of over 6,400 throughout the Trinity County area, and is available on-line. Piper McDaniel, WRTC Communication and outreach coordinator, has authored multiple articles for publication in the Trinity Journal for a column titled "Trinity Lands and Communities" during 2014-2015. Water conservation methods were targeted at the home owner up to small farmers with a combination of information, human connection, and references to further reading. Articles published that have direct connection to water conservation issues include:

- Local Game Theory. How Hayfork's water is, but doesnot need to be, a zero sum game
- Cannabis Compliance Program. State Water Board Program
- Xeriscaping will Conserve Water Indefinitely
- Ways to get ahead with your water use: Water Conservation
- 2015: the year of the Salmon

Water Conservation Newspaper Insert

In 2015, the WRTC joined with the Trinity County Resource Conservation District and 5Counties Salmonid Conservation Program, and the Weaverville Community Sewer District to produce a ten-page newspaper insert titled "Water Conservation during the 2015 drought" that was printed and distributed by the local newspaper, the Trinity Journal. A newspaper insert is a standalone newspaper that could be left at coffee shops, garden centers, gas stations and so on. In this insert, information was conveyed in simplified language so nearly every person could understand what can be daunting scientific jargon. At the end of the insert, the Weaverville Community Sewer District listed and described some in home water conservation tips. Sub-topics within the insert included:

- How you water supply works
- What is a Watershed?
- The Water Cycle: is complex but below is an outline of the key points of the water cycle
- Current drought conditions in Trinity County
- Snowpack
- Cumulative impacts of human use and drought
- What you can do to help
- Building water resilience as a community
- Water conservation tips for kitchens, bathrooms, laundry, and outdoor uses.

Websites and Blogs

- The Trinity County Water Conservation Website was created by the 5C, TCRCD and WRTC and is hosted on the 5C webpage. http://5counties.org/waterconservation.htm The web page highlights various conservation measures for the homeowner and the small farmer
- The TCRCD and WRTC created a Facebook page called Trinity County Drought. https://www.facebook.com/TrinityCountyDrought
- WRTC Website Blog: "The Wellspring" has hosted numerous blog posts on water conservation. http://www.thewatershedcenter.com/?page_id=1214

Regulatory Summary Document

The WRTC initiated development of guide that is a synthesis of regulations that small agricultural farmers may need. It was intended to give landowners the tools needed to get involved and connect with agencies so that they are compliant and following all appropriate state and federal guidelines. The guide includes information from the California Department of Fish and Wildlife, California Department of Water Resources, State Water Resources Control Board, CAL FIRE, and Trinity County. This document is pending review by the above mentioned agencies.

Conservation Almanac Publication

The WRTC has co-authored several articles for the TCRCD's publication, the Conservation Almanac. Articles have included subjects like: "Beavers provide many human and environmental benefits", "Illicit Grow-site Impacts", "Runoff: Slow it, spread it Sink It", "Water Conservation Best Practices" and more.

Workshops and events produced by the WRTC from 2013-2016

Growing Green

The WRTC has developed and hosted Growing Green Workshops for the local community including Hayfork (2013-2015) and Post Mountain (2016 and 2015). Attendance at the workshops has ranged from 50-75 people over the three years. These workshops have brought in presenters from the local community and regulatory agencies covering a wide range of topics, most of which are directly related to water conservation, water quality, and fisheries. Presenters have included California Department of Fish and Wildlife, North Coast Regional Water Quality Control Board, CAL FIRE, Emerald Growers Association (now California Growers Association), Pacific Watershed Associates,the WRTC, and other local experts such as apermaculturalist, a farmer and a soil biologist. The WRTC presented on water conservation, drought, and fisheries within the South Fork Trinity River watershed. The Growing Green Workshops are a grassroots effort to reach out to a component of the local populous that would not otherwise have access to or knowledge of the issues surrounding the cultivation of cannabis. Of note, the latest Growing Green Workshop in Post Mountain had members from the local Hmong community who were able to participate through the presence of a translator (sponsored by NCRWQCB). The Hmong community is a significant portion of the cannabis growing community and has not been able to be reached up until now.

The Salmon Gathering

The Salmon Gathering event (2012-2015), organized by the WRTC, is an annual educational event hosted in Hyampom. The event is focused on viewing spawning fall-run chinook salmon but also offers the opportunity to present to the community on topics such as watershed health, water conservation measures, the effects of aggregate impacts on water quantity and quality,coho and chinook salmon life history and genetics. The event has been attended by approximately 30-50 people each year. This event has brought in presenters from TCRCD, Salmon River Restoration Council, UC-Davis, the Yurok Tribe, the Karuk Tribe, the Hoopa Tribe and the USFS.

Hayfork Community Wetland

The WRTC has hosted numerous community and school field trips to a wetland enhancement project in Hayfork. Attendees learn about the watershed, the water cycle, natural water storage influence on water quality and temperature, aquatic ecology, water conservation and more.

Other Water Conservation Workshops

- Mother's Day Gardener Celebration: the WRTC hosted a water conservation booth with the 5C's water conservation demonstration trailer.
- Young Family Ranch Water Conservation Workshop in collaboration with the TCRCD, 5C, NRCS, and Trinity River Restoration Program.
- Trivia Nights in Hyampom and Hayfork.

DATA GAPS

Through the process of assessing the SFTR watershed water use, multiple data gaps were identified.

Ewing Reservoir was built to accommodate an increase in the dam height of 12 additional feet. To pursue increasing the storage capacity of the reservoir a feasibility study and safety analysis would need to be conducted, however the cost to perform these studies is exorbitant and beyond the fiscal capacity of the local waterworks. This limitation continues to impede serious contemplation of increasing the storage capacity of Ewing Reservoir.

The WRTC only recently learned of the Temporary Water Transaction forbearance tool. Unfortunately we have been unable to consolidate all of the necessary information necessary and have felt unprepared to have this discussion with water users in the SFTR watershed. We plan to continue to learn more about these programs and then develop partnerships with other agencies and landowners to provide progress towards keeping water in streams for instream benefits in the future.

A data gap identified during the study that would have been very beneficial in assessing water consumption is streamflow measurements. The only continuous discharge data is from a USGS gauge in Hyampom on the SFTR. The WRTC in coordination with the SWRCB has initiated a discharge monitoring program in 2016 on select streams to better assess the impacts of water diversions on flow.

SUMMARY OF FINDINGS

Guided by the SONCC assessment for the South Fork Trinity River, the WRTC has performed preliminary analysis towards fulfillment of action items to improve the timing and volume of flow within SFTR subwatersheds (Table 1).

The 2014 and 2015 droughts have resulted in numerous tributaries to the SFTR running dry in July-September, many of which are associated with human water withdrawals (Figure 3). To assess the impact of anthropogenic water diversions on streams in the SFTR watershed, the WRTC estimated the quantities of water diverted for domestic and marijuana uses and added these values to the legal diversions recorded at the SWRCB. Along with population data, these results were used to determine what type of water conservation measure would be applicable per subwatershed.

Population: Major population centers and their associated HUC 7 watersheds

- Hayfork: Kingsburry Gulch-Kellog Gulch, Hayfork Valley, Lower Salt Creek-Hayfork Creek, and portions of other nearby subwatersheds.
- Post Mountain (Trinity Pines): Post Creek and Philpot Creek subwatersheds.
- Hyampom: Hyampom Valley, Lower Hayfork Creek Canyon, Olsen Creek, Pelletreau Creek, and Wintoon Flat-Deep Gulch subwatersheds.
- Wildwood: Hall City Creek-Wilson Creek, Stringbean Creek-Goods Creek subwatersheds.

Diversion Types: The greatest diverter of water is the legal diversions, withdrawing 137 cfs of water throughout the SFTR watershed (Figure 6). The legal diversions typically are associated with agricultural uses such as irrigating pasture lands, irrigating crops (vineyards, orchards) and watering livestock. Not included in this estimate is the water diverted for the Hayfork Community Waterworks District. Marijuana gardens on private land were estimated at using 10 cfs throughout the SFTR watersheds. This estimate is most likely an underestimate as greenhouses and clandestine growing operations were not included in the calculations. Domestic water use estimates had the lowest rates of use at 0.5 cfs. This estimate does not include personal vegetable gardens or landscaping.

Diversions by Subwatershed: Subwatersheds (HUC 7) with the greatest amounts of water diverted (>4 cfs) includes Lower Big Creek-Hayfork Creek, Lower Hayfork Creek Canyon, Hyampom Valley, Kingsbury Gulch-Kellogg Gulch, Barker Creek, Lower Tule Creek, Upper East Fork Creek, Lower Salt Creek-Hayfork Creek, and Big Creek- Hyampom (Figure 7). Subwatersheds with the greatest marijuana related diversions (> 0.2 cfs) include Post Creek, Kingsbury Gulch-Kellogg Gulch, Carr Creek, Hyampom Valley, Duncan Creek, Barker Creek, Lower Salt Creek-Hayfork Creek, Dry-Mahala, Halls City Creek-Wilson Creek, and Hayfork Valley. Post Creek marijuana growers obtain their water from wells or truck delivery, thus the impact of marijuana cultivation related water diversions is spread throughout other subwatersheds, depending on where legally or illegally the water is obtained.

Conclusions and Recommendations

There are many ways to conserve water or make more water available to streams for salmonids.

Illegal Diversion Enforcement: Unregulated stream diversions are a significant portion of the overall water use and cumulatively appear to be a major issue in reduced streamflows, increasing stream temperatures, and associated water quality problems.

The rural and remote nature of this watershed leads to a reduced regulatory oversight compared to most other watersheds in California. It would be productive if agencies charged with enforcing the various laws and regulations associated with water diversions and water use had more of a presence.

Increase storage or delivery capability of the Waterworks District: The Trinity County Waterworks District #1 (Waterworks District) utilizes an off channel reservoir and diverts water from Big Creek from November through February. Therefore, the existing Waterworks District's water source and storage system is a very good system for fisheries and a large scale example of forbearance, because it takes and stores all of its 900 acre feet of water in winter and spring when streams have plentiful water and does not take a drop in mid-summer when the streams are vulnerable to take.

It should be noted that any recommendations on Waterworks District boundary expansion are derived from the WRTC watershed analysis and are not advocated for or against by the district board or staff.

Increase Storage Capacity of Ewing Reservoir: The SONCC coho recovery plan recommended increasing the storage capacity or delivery capability for Ewing Reservoir. The Ewing Dam was designed to accommodate an increase in height of about 12 feet (DWR 1965, Figure 12). Raising the reservoir by 12 feet would increase the reservoir surface area from 41 acres to 65 acres, triple the water holding capacity of the reservoir and even allow for increased recreation on the reservoir lake (Hair, Pers. Comm. 2015). While the cost of increasing Ewing Reservoir capacity would surely be too much to bear for the small community of Hayfork and the Waterworks District, it should be noted that increasing the storage capacity would be more of a fisheries restoration project than a water supply project. We believe that this project is worth looking into the full project because of its huge potential positive impact for fisheries.

Utilizing Untreated and/or Reclaimed Water: If there are ways to make untreated and/or reclaimed water available for agriculture it could potentially further reduce demand on treated water and increase overall Waterworks District system efficiency thus benefiting salmonids of Hayfork Creek. A new untreated (raw) water line was created that has made large amounts of raw water available for irrigation purposes which makes more treated water available for Waterworks District users. There is potential for future expansion of untreated "raw water" from the new source line that was built in 2009 including industrial sites, agricultural sites, and a few unforeseen uses like wildfires. Further utilizing the raw water for irrigation purposes helps the Waterworks District meet peak summer water demands, and thus removing those irrigators from pulling water from the streams; effectively leaving more water in stream for salmonids.

Reclaimed wastewater can currently be utilized for compost creation, enhancing wetlands and/or riparian wildlife habitat, stream augmentation, recharging "non-potable" groundwater aquifers, surface irrigation of orchards and vineyards, non-food crop irrigation, and industrial cooling processes such as a biomass power plant. Currently the plant is running at 25% of capacity and is thus producing

approximately 0.5 million gallons per day (0.9 CFS). Utilizing this water would allow for increases in industrial, irrigation use without taking water from streams.

Increasing Waterworks District Delivery Capacity through District Boundary Expansion: Expanding the delivery capacity of the Waterworks District to nearby neighborhoods would also benefit fisheries as it may eliminate illegal diversion from nearby creeks. From a practical perspective there are several areas that are too small to show up in this HUC 7 analysis but are still very worthy for potential future expansions of the existing Waterworks District. The most practical areas to expand the Waterworks District boundary are the parcels of land directly adjacent to the existing system along major roads. Based on adjacency and estimated water usage per subwatershed, the priority areas for Waterworks District expansion are shown in Figure 13 and summarized below:

- Properties along Hyampom Road to the west and north.
- Brady Road and North Vista Lane
- Drinkwater Gulch and Doctor Lane
- Tule Creek and McAlexander Roads
- The Highway 3 corridor: Cedar Gulch Road, Big Creek Road, and Summit Creek Road.

The authors of this report believe that the Waterworks District should be allowed to provide the community that lives outside of the district boundaries with water because the actual result in the Waterworks District refusing to give water to outlying Hayfork Community is people illegally diverting water directly from streams which is a much worse negative impact.

Increasing Waterworks District Delivery Capacity by Creating Altogether New Water Districts: For those neighborhoods well outside of the Waterworks District boundaries, development of community based local water districts can be an option. The subwatersheds that may benefit from the development of new local water districts (if utilizing off channel storage and forbearance systems) for current and/or future populations are listed inTable 10.

Improve Water Delivery Systems on Agricultural Lands: Agriculture is the greatest user of water in the SFTR watershed and improvements in irrigation efficiency and water delivery could greatly benefit flow and fisheries in the tributaries. The SONCC recommended assessment of agricultural lands and improvements to water delivery systems. Numerous difficulties resulted in this task not being fully accomplished, however, NRCS is still happy to develop solutions to use water more efficiently and improve and sustain our working lands. The WRTC will continue to work with NRCS and directly with private landowners into the future to improve water efficiency on multiple ranches.

Improve Water Storage for Private Domestic and Agricultural Use: The SONCC recommended assessing the utility of water storage tanks for private agriculture and domestic water uses during periods of low flow along with establishing a forbearance program. Essentially, the more people we can help to utilize storage tanks, the better. Storage tanks not only help provide the streams with buffering of diversion impacts, but they also offer many practical benefits to landowners. We have conducted education workshops on storage tanks and provided multiple events to educate marijuana cultivators on water conservation and storage tanks and we will continue to develop several programs to expand the use of

private domestic water storage tanks including outreach, education, grant applications, water storage regulation research, and discussions with landowners.

Establish a Forbearance Program: Forbearance refers to the practice of using stored water from an above-ground tank during the low flow season, as opposed to diverting water directly from a river or tributary.

1707 Instream Water Right Dedication:1707 instream dedications are a type of instream flow transaction involves dedicating existing water rights for instream use such as enhancement of fisheries habitat and stream flow. It protects landowner's water rights and provides flexibility to add water instream and protect it and/or continue to use it. As a standalone technique, a 1707 instream dedication may not work in the SFTR area due to cumulative effects, however in combination with other instream flow transaction techniques it could be extremely effective. Partial dedications may be an option for some of the larger diverters.

Off-channel Pond Storage: The WRTC is presently exploring larger agricultural off-channel pond storage locations and changes in agricultural practices (water use efficiency) for water conservation with several local ranchers.

In collaboration with the Five Counties Salmonid Conservation Program (5C) the WRTC has been awarded a grant to produce a pilot project that will provide incentives and assist citizens in selective watersheds (i.e. Lower East Fork Hayfork Creek and subwatershed groups in the Forest Glen and Hidden Valley areas) with water tank installation, permitting, and technical assistance that can help keep water in streams to benefit coho salmon.

Sanctuary Forest's "Tanks and Forbearance" Program: The WRTC looked into the Sanctuary Forest's Tanks and Forbearance program for guidance and reference. Unfortunately, the WRTC have concluded that the Sanctuary Forest program is not practical for the WRTC to administer in the SFTR watershed *on the whole* because it is too expensive, requires too much regulatory oversight and monitoring, and there are too many diverters in the SFTR watershed (Hayfork Valley in particular) to be feasible and economical. Still, Sanctuary Forest's "Tanks and Forbearance" program could effectively be utilized within the SFTR in several key subwatersheds because areas with low human population density (less than 50 people per subwatershed) have the potential to maximize the investment and because all of that water saved would stay in the creek. In order to function correctly this program requires a 1707 (see above).

Five Counties' "Trickle Fill" Instream Water Transaction Program: A simpler and less expensive system than Sanctuary Forest's Tanks and Forbearance program for minimizing impacts to streams from water withdrawals is the 5 Counties Salmonid Conservation Program's (5C) "Trickle Fill System". This system essentially is designed to minimize the effect of high flow pumps on small streams. The WRTC and 5C have obtained a grant to implement these types of systems within subwatersheds of the SFTR and the Trinity River.

Temporary Water Transactions: While 1707 dedications are a more permanent impact on a diverter's water use, a Temporary Water Transaction is a forbearance agreement in which the water right holder may be financially compensated by a water trust, conservation organization, or agency for entering into a forbearance agreement. Streams that have the fewest number of diversions and low human population density, but have large amounts of water diverted have the greatest potential for water savings via temporary Water transaction forbearance. Subwatersheds with the greatest agricultural diversions (>1 cfs) include: Lower Big Creek-Hayfork Creek, Hyampom Valley, Chanchelulla Gulch-ShiellGulch, Lower Hayfork Creek Canyon, Lower Tule Creek, Lower Salt Creek-Hayfork Creek, Upper East Fork Hayfork Creek, Barker Creek, Carr Creek, Rusch Creek, and Big Creek-Hyampom.

The SONCC recommended developing educational programs about water conservation and instream leasing. The WRTC is active in developing and implementing community outreach programs directly presenting water conservation measures and options for domestic, marijuana, and agricultural uses. These efforts have resulted in local growers contacting WRTC and other organizations to learn about and implement water conservation measures. While the numbers of participants is slowly increasing, it is hoped that the cumulative impacts from excessive diversions to the stream are reduced.

Table 13. Subwatersheds suitable for forbearance, storage tanks, and trickle-fill systems.

Area name	Subwatershed	Population	Potential water savings (cfs)
Mainstem Upper SFTR	Bierce Creek-SFTR, Rough Gulch-Happy Camp Creek, Silver Creek, Cable Creek, Lower Rattlesnake Creek, Cave Creek-Swift Creek	53	2.63
Mainstem Middle SFTR	Little Bear Wallow Creek-Hidden Valley, Miller Springs, Lower Plummer Creek, McClellen-SFTR, Hitchcock Cr-Oak Flat	53	0.467
St John's Road	Wintoon Flat-Deep Gulch, Butter Creek Meadows	63	0.429
Corral Creek	Lower Corral Creek, Middle Corral Creek, Upper Corral Creek	24	0.332
Mainstem Hayfork Cr near Wildwood	Chanchelulla Gulch-Shiell Gulch, Bridge Gulch-Hayfork Creek	12	0.039
East Fork Hayfork Creek	Lower and Upper EF Hayfork Creek	35	4.32

All subwatersheds would be improved by utilizing the following techniques:

- Unauthorized (illegal) Water Diversion Enforcement
- Utilize Water Storage Tanks for Private Domestic and Agriculture
- Improve Agricultural Water Delivery Systems (efficiency)

- Instream Water Right Dedication
- Tanks and Forbearance (including Five Counties' Trickle Fill Forbearance)

The following techniques could be particularly useful in specific watersheds (Table 14):

- Develop New Water District
- Develop Off Channel Pond Storage for Agriculture
- Temporary Water Transaction
- Waterworks District Boundary Expansion

Table 14. Prioritization of Water Conservation Techniques

Subwatershed	Priority 1	Priority 2	Priority 3	Priority 4
Salt Creek (Lower Salt Creek-Hayfork Creek, Gulch-Salt Creek, and Upper Salt Creek-Hayfork Creek)	Develop New Water District	Develop Off-Channel Pond Storage for Agriculture	Waterworks District Boundary Expansion	Improve Agricultural Water Delivery Systems (efficiency)
Big Creek (Lower Big Creek-Hayfork Creek and Upper Big Creek-Hayfork Creek)	Instream Water Right Dedication	Temporary Water Transaction	Unauthorized (illegal) Water Diversion Enforcement	Improve Agricultural Water Delivery Systems (efficiency)
Tule Creek (Lower Tule and Upper Tule)	Instream Water Right Dedication	Develop off channel storage for ranches	Temporary Water Transaction	Improve Agricultural Water Delivery Systems (efficiency)
East Fork Hayfork Creek (Upper East Fork Hayfork and Lower East Fork Hayfork creeks)	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	Temporary Water Transaction	
Barker Creek	Develop New Water District	Develop Off Channel Pond Storage for Agriculture	Unauthorized (illegal) Water Diversion Enforcement	
Carr Creek (Carr Creek, Duncan Creek, and Summit Creek)	Develop New Water District	Develop Off Channel Pond Storage for Agriculture	Unauthorized (illegal) Water Diversion Enforcement	

Subwatershed	Priority 1	Priority 2	Priority 3	Priority 4
Hyampom Valley (Lower Hayfork Creek Canyon, Hyampom Valley and Wintoon Flat-Deep Gulch)	Develop New Water District	Develop Off Channel Pond Storage for Agriculture	Unauthorized (illegal) Water Diversion Enforcement	Improve Agricultural Water Delivery Systems (efficiency)
Olsen Creek	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	Tanks and Forbearance	Develop New Water District
Hayfork Valley (Hayfork Valley, Kingsbury Gulch-Kellogg Gulch, and Lower Salt Creek-Hayfork Creek)	Waterworks District Boundary Expansion	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	
Rattlesnake Creek (Post Creek, Upper Rattlesnake Creek)	Develop New Water District	Unauthorized (illegal) Water Diversion Enforcement	Utilize Water Storage Tanks for Private Domestic and Agriculture	
Butter Creek (Butter Creek Meadows and Upper Indian Valley Creek)	Tanks and Forbearance	Develop Off Channel Pond Storage for Agriculture	Utilize Water Storage Tanks for Private Domestic and Agriculture	
Chanchelula Gulch-Shiel Gulch	Instream Water Right Dedication	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	
Hayfork Creek near Wildwood (Stringbean Creek-Good Creek and Halls City Creek-Wilson Creek)	Instream Water Right Dedication	Temporary Water Transaction	Unauthorized (illegal) Water Diversion Enforcement	Improve Agricultural Water Delivery Systems (efficiency)

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