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Supply Creek Watershed Cumulative Impact Assessment

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Project: Supply Creek Watershed Cumulative Impact Assessment

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List of Acronyms

BFI	Baseflow index
BPTC	Best Practicable Treatment or Controls
CDFW	California Department of Fish and Wildlife
CMMLUO	Commercial Medical Marijuana Land Use Ordinance
CUP	Conditional Use Permit
DWR	California Department of Water Resources
eWRIMS	electronic Water Rights Information Management System
HVIR	Hoopa Valley Indian Reservation
HVT	Hoopa Valley Tribe
MG	million gallons
NLCD	National Land Cover Database
NRCS	Natural Resources Conservation Service
POD	Point of diversion
SDU	Statement of Diversion and Use
SGM	Sustainable Groundwater Management
SSURGO	Soil Survey Geographic Database
SWRCB	State Water Resources Control Board
TGAEC	Thomas Gast & Associates Environmental Consultants

1. Summary

Water diversions associated with cannabis cultivation can pose a threat to overall water budget in North Coast streams and it is critical to assess the cumulative watershed impact in areas with high densities of cultivation occurring. Supply Creek, tributary to Trinity River and Klamath River, flows through the Hoopa Valley Indian Reservation and provides critical fisheries habitat to salmonids. The headwaters of Supply Creek lie outside the Reservation and have a high density of cannabis cultivation seeking Conditional Use Permits from Humboldt County. This report expands upon the watershed assessment conducted by HMC Engineering, Inc in 2020. In order to assess the overall impact to the Supply Creek, this report summarizes the cumulative water demand by proposed operations and assesses potential impacts to water quantity and quality in Supply Creek.

Twelve active Conditional Use Permit (CUP) applications for commercial cannabis cultivation in the Supply Creek watershed were evaluated in the following report. Water demand, water source, and storage were assessed to determine the cumulative impact on water availability in Supply Creek. In addition, Site Assessments and Site Management Plans associated with each CUP application were reviewed to determine the greatest threats to water quality, and best management practices were recommended as mitigation measures.

The total annual water demand by cultivators is approximately 3.5 million gallons (MG), significantly lower than the original estimate of 36 million gallons. This water demand represents a small portion of the annual surface water budget. Even during the summer low-flow period, daily water demands by cultivators represent less than 1% of the average daily streamflow in Supply Creek. The majority of cultivators depend on groundwater as their primary water source, with only four applicants diverting surface water for irrigation. Continuous groundwater pumping during the summer season has potential to influence baseflows in Supply Creek in the long-term, but it is difficult to determine the extent of impact without further analyses. Based on review of site visits and soil characteristics in the Supply Creek watershed, the greatest threat to water quality is posed by sediment delivery from unmaintained roads and stream crossings.

To further assess the impacts of cultivation activities, it would be beneficial to monitor groundwater levels and streamflow in Supply Creek during the period of peak extraction. It would also be beneficial to request annual site visit reports and water meter readings to ensure that cultivation sites are being maintained in a way that conserves water and reduces sediment delivery to the waters of Supply Creek.

2. Introduction

2.1 Watershed Description

The Supply Creek watershed is 16 square miles in Humboldt County near Hoopa, California. The watershed drains to Trinity River and Klamath River and is classified as a Class I/Class II stream. Approximately 70% of the watershed falls within the Hoopa Valley Indian Reservation (HVIR). Reservation residents rely on Supply Creek for municipal and agricultural water, as well as for groundwater resources, recreation, and providing cold-water habitat to migrating and spawning fish, including species of concern such as Chinook and coho salmon and steelhead.

The mean annual precipitation input to the Supply Creek watershed is 114 inches in the form of rain and snow (30-year normal; PRISM, 2022). Typical of a Mediterranean climate, the watershed receives majority of its precipitation between the months of October – April, with little inputs occurring during the summer season. The primary land cover in the watershed is forested (89%), followed by scrub/shrub cover class (7%) and 3% developed (NLCD, 2019).

2.2 Study Background

Land use in the headwaters of Supply Creek, upstream of HVIR, is dominated by cannabis cultivation. Cultivators have submitted Conditional Use Permit (CUP) applications for commercial cannabis cultivation in accordance with Humboldt County's Commercial Medical Marijuana Land Use Ordinance (CMMLUO). HVIR residents have expressed concerns regarding the high density of cultivation activities affecting the water quality and quantity in Supply Creek.

In 2020, HMC Engineering, Inc. conducted a hydrologic assessment to determine the cumulative impacts of the cultivation activities on Supply Creek per Humboldt County's request. The report identified rainwater catchment as the primary water source for irrigation, overestimated the irrigation demand, and assessed the impacts relative to the annual yield in Supply Creek.

The 2020 report indicated rainwater catchment as the primary water source, but analysis of aerial imagery indicated there is not enough infrastructure and storage in place to capture rainwater and meet the irrigation demands. To thoroughly assess the impact to the Supply Creek watershed, it is important to first identify where water is being sourced from. If surface water diversions are taking place, the impact to streamflow in Supply Creek needs to be evaluated during the summer season, when irrigation demand is highest and stream flow is lowest.

This report, therefore, expands upon the initial hydrologic assessment with the following objectives:

1. Identify the cumulative water demand by cannabis cultivators using an appropriate water demand rate
2. Identify water sources that will be used for irrigation and, if applicable, the cumulative impact to summer streamflow in Supply Creek
3. Identify potential water quality impacts with associated cultivation practices
4. Recommend best management practices and propose a monitoring plan

3. Methods

3.1 Data Collection and Sources

Upon request, the Humboldt County Planning and Building Department ("Humboldt County") provided all active CUP applications for cannabis cultivation in the Supply Creek watershed ("applications"). All applications were received by TGAEC staff on January 10, 2022. Most applications included supporting documents such as: Cultivation and Operations Plan, Site Map, Site Management Plan, and/or Water Resource Protection Plan. These supporting documents were frequently prepared by consulting groups and site visit dates listed on these reports ranged from 2016 to 2021. Oftentimes, different estimates of water use, operation size, and operation plans were reported based on the year that the report was prepared. It was also common to encounter plans and anticipated completion dates listed in these reports, with no follow-up to indicate that the proposed plans were successfully implemented.

In addition to applications provided by Humboldt County, Statements of Water Diversion and Use (SDU) were accessed through the electronic Water Rights Information Management System (eWRIMS). This database is developed by the State Water Resources Control Board (SWRCB) to provide and track information regarding water rights throughout California. Applicants with registered points of surface water diversion, or those diverting water under Riparian Rights, are required to submit an SDU on an annual basis. The most up-to-date records were downloaded from eWRIMS for all parcels with pending CUP applications. The following assessment uses a combination of information presented in CUP applications provided by Humboldt County and annual SDU reports. The most up-to-date estimates were used in analysis and any discrepancies were noted.

3.2 Reviewed CUP Applications

In the 2020 Supply Creek Surface Water Supply Study by HMC Engineering, 14 parcels with proposed cultivation were reviewed (Attachment 1). Since 2020, one application (parcel APN# 522-032-004, CUP# 12353) was determined to be draining into the Three Creeks watershed to the southeast and was therefore not included in this assessment (Attachment 2). Another CUP application was withdrawn from consideration (parcel APN# 522-013-009). All active applications within Supply Creek watershed as of January, 2023 are summarized in Table 1 and Figure 1.

Table 1: Parcels with active Conditional Use Permit (CUP) Applications with Humboldt County for in the Supply Creek Watershed as of January 2023.

Parcel APN	**CUP Application Number**	**Farm Name**
522-023-001	11607	707 Cultivation Co
522-024-001	12460	Mojo Mountain / New Earth Farms
522-024-002	11978	Evergreen Family Farm
522-025-003	11980	Evergreen Family Farm
522-033-010	12848	4 Ponds, LLC
522-025-006	10558	Kush Creek Organics
522-032-011	13160	Three Creeks Holdings
522-021-009	11291	Emerald Mountain Coast
522-021-010	11491	Stay Humboldt
522-026-007	11167	Aloha Top Shelf
522-022-015	11525	High Art
522-024-004	12750	RGI Organics

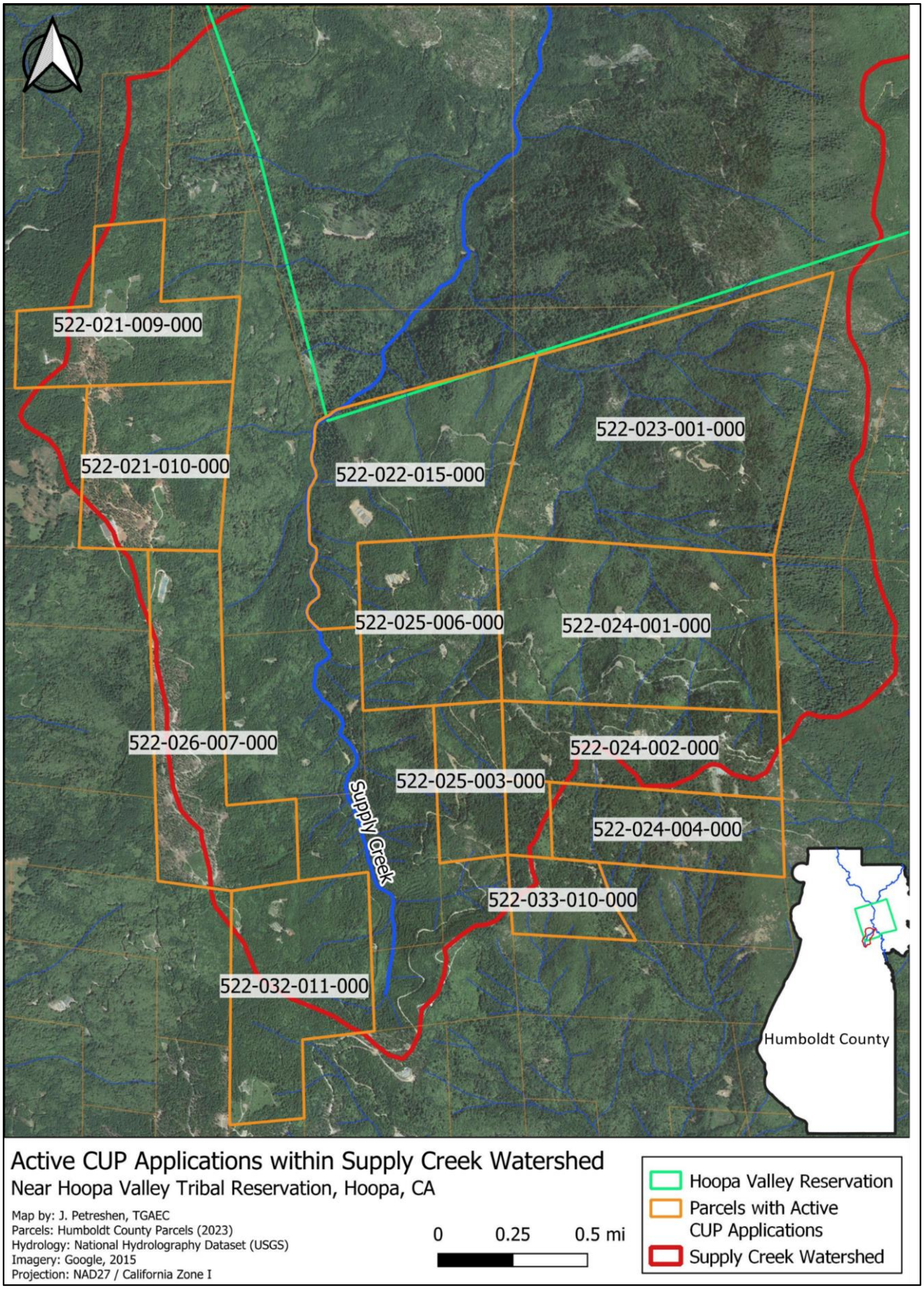

Figure 1: Parcels with active CUP applications within Supply Creek watershed near Hoopa Valley Reservation

3.3 Total Annual Water Use

Total annual water use at each cultivation operation were typically estimated by the applicant. Site management plans and reports associated with CUP applications were generally compiled over several years; therefore, some applicants reported changes in their water use, water source, and/or total cultivation areas. In addition to these changes, majority of applicants were not using water meters to track their water use. Instead, total water use was estimated and frequently presented as a range of values.

In the following analysis, all applications were reviewed and the most recent estimates of water demand were used. However, if two documents from the same year reported differing estimates of water use, the higher of the two estimates was used to ensure a conservative approach. In some cases, applicants reported water use estimates which included domestic supply and fire suppression needs. In this situation, TGAEC only used estimates of water use for cannabis irrigation, and disregarded the portion of water that was allocated for domestic and fire suppression.

3.4 Water Demand Estimates

Following the 2020 Surface Water Supply Study, there was some confusion regarding water demand by cannabis plants. There were significantly different estimates provided by the 2020 report and by Humboldt County, leading to uncertainty regarding how much water each operation demands from the Supply Creek watershed. Due to the relatively recent legalization of cannabis, documentation and literature on the water demand by plants is sparse. TGAEC reviewed all existing literature on water demand by cannabis plants, and compared these to the estimates provided by Humboldt County and HMC Engineering.

4. Water Demand for Cannabis Cultivation

4.1 Water Demand in Literature

The 2020 report by HMC Engineering conducted initial investigations into the impacts of cultivation water demand on the greater Supply Creek watershed. In this report, the water demand rate for cannabis plants was estimated to be 0.5 gal/sq ft/day. In June 2020, Humboldt County delivered the final report to HVT along with a cover letter in which they stated that the water demand rate used in the report is an overestimation. Humboldt County indicated that a more appropriate water demand estimate is 0.055 gal/sq ft/day (Attachment 3).

Although literature on water demand by cannabis plants is sparse, studies have indicated water demand rates between 0.04 – 0.22 gal/sq ft/day (Table 2). This estimate range is broad, as there is variation in demand based on both the type of grow operation (i.e., outdoor, greenhouse, mixed light) and the month during which demand was estimated. The highest estimated water demand is typically during the months of August and September; therefore, these months were chosen for comparison in Table 2 to provide a conservative estimate of water demand.

Table 2: Estimates of water demand by cannabis plants based on grow type and month of water demand.

Source	Water Demand Estimate (gal/sq ft/day)	Grow Type	Month
Wilson et al., 2019	0.22	Outdoor	August
	0.17	Outdoor	September
	0.18	Greenhouse	August
	0.22	Greenhouse	September
Dillis et al., 2020	0.07	Mixed Light	August
	0.04	Outdoor	August
2020 Supply Creek Surface Water Supply Study (HMC Engineering, Inc.)	0.5		
Humboldt County	0.055		

4.2 Reported Water Usage by Cultivators in Supply Creek Watershed

Estimates of cultivation area and water use reported in CUP applications and/or eWRIMS SDU were used by TGAEC to calculate water demand by each operation (Table 3). Based on these reports, water demand by cultivators ranged between 0.02 and 0.09 gal/sq ft/day. These estimates are similar to those provided by Humboldt County and Dillis et al., (2020). As Humboldt County stated in their cover letter (Attachment 3), the water demand rate of 0.50 gal/sq ft/day used in the 2020 HMC Engineering report was an overestimate.

Table 3: CUP estimated annual water use, cultivation area, and calculated water demand for CUP applicants in the Supply Creek watershed. Water demand was calculated assuming a 180-day growing season.

CUP Applicant ID/Farm Name	Estimated Annual Water Use (gal)	Total Cultivation Area (sq. ft)	Water Demand (gal/sq. ft/day)
11291 Emerald Mountain Coast	180,500	30,100[1]	0.03
11491 Stay Humboldt	642,000	50,050	0.07
11525 High Art	199,000	20,180	0.06
11607 707 Cultivation Co	700,000	43,560[2]	0.09
11978 Evergreen Family Farm	250,000	21,688	0.06
11980 Evergreen Family Farm	53,000	10,000	0.03
12460 Mojo Mountain / New Earth Farms	525,000	35,025	0.08
12848 4 Ponds, LLC	164,000	10,000[1]	0.09
13160 Three Creeks Holdings	174,000	20,000	0.05
10558 Kush Creek Organics	72,000	14,540	0.03
11167 Aloha Top Shelf, LLC	525,000	34,500	0.08
12750 RGI Farms	64,200	15,475	0.02

[1] – Value copied from 2020 HMC Engineering report because unable to find other estimates

[2] – Actual value may be lower that this, reports mentioned sites expected to be decommissioned

A summary of water demand by each operation, estimated using different rates, is presented in Table 4. The 2020 report indicated that the cultivation operations in Supply Creek would demand 35.9 MG per year using their rate of 0.5 gal/sq ft/day. However, based on the water demand rate provided by Humboldt County (0.055 gal/ft2/day), the total annual demand for a 180-day growing period would be 3.75 MG. This is similar to the total water demand that was reported by individual applicants, summing to 3.54 MG. A 180-day growing period was assumed for each estimate to be conservative; generally, growing seasons range between 150-180 days.

Table 4: Comparison of annual water demand given rates used in the 2020 HMC report, provided by Humboldt County, and using reported annual totals summarized from CUP applications.

Applicant ID / Farm Name		**Annual Water Demand (MG)**		
		HMC Report, 2020	*Humboldt County*	*Reported by Applicants (CUP Applications, eWRIMS Reports)*
	Water Demand Rate (gal / ft^2/day)	*0.5*	*0.055*	*-*
	Growing Period Length (days)	*180*	*180*	*180*
11291 Emerald Mountain Coast		2.7	0.30	0.18
11491 Stay Humboldt		4.5	0.50	0.64
11525 High Art		1.9	0.20	0.20
11607 707 Cultivation Co		5.5	0.61	0.70
11978 Evergreen Family Farm		3.2	0.36	0.25
11980 Evergreen Family Farm		0.9	0.10	0.05
12460 Mojo Mountain / New Earth Farms		3.9	0.43	0.53
12848 4 Ponds, LLC		0.9	0.10	0.16
13160 Three Creeks Holdings		3.9	0.43	0.17
10558 Kush Creek Organics		1.3	0.14	0.07
11167 Aloha Top Shelf, LLC		3.9	0.43	0.53
12750 RGI Organics		N/A[1]	0.15	0.06
TOTAL		**32.6**[2]	**3.75**	**3.54**

[1]Application was not evaluated in the 2020 HMC Engineering, Inc. report

[2]Total value excludes CUP applications that have been dropped since the 2020 HMC Engineering, Inc. report

5. Water Sources for Cannabis Cultivation in Supply Creek Watershed

The 2020 HMC Engineering report listed rainwater catchment as the primary water source for cultivation. However, review of CUP applications and public water rights records indicated that most cannabis cultivators in the Supply Creek watershed rely on groundwater. A small portion of applicants claim to use surface water diversion and rainwater catchment to supplement their water needs (Table 5). All twelve applicants indicated that groundwater is their primary existing, or proposed, water source. Three applicants indicated the use of surface water diversions for irrigation purposes. Two applicants have a rainwater catchment system established, and two additional applicants proposed to incorporate rainwater catchment into their operations plan.

Table 5: Summary of water sources claimed by applicants. X indicates that the water source is present and/or being used for irrigation purposes. P indicates that the water source is proposed to be used for irrigation in the future.

CUP ID/Farm Name	Groundwater Well	Surface Water Diversions	Rainwater Catchment
11291 Emerald Mountain Coast	X		P
11491 Stay Humboldt	X		P
11525 High Art	X		
11607 707 Cultivation Co	X	X	
11978 Evergreen Family Farm	X	X	X
11980 Evergreen Family Farm			
12460 Mojo Mountain / New Earth Farms	X		X
12848 4 Ponds, LLC	X		
13160 Three Creeks Holdings	X		
10558 Kush Creek Organics	P[1]	X	
12750 RGI Farms	X		
11167 Aloha Top Shelf, LLC	X		

[1] Proposed for installation in Fall of 2021, but no follow-up documents have yet confirmed this

5.1 Groundwater as Primary Water Supply

Groundwater is the most commonly used water source by cultivators in California's North Coast region (Dillis et al., 2019). Generally, cultivators directly apply extracted groundwater rather than storing it for a later use, indicating that the highest rates of groundwater extraction occur during the summer growing season. This preference for groundwater is potentially driven by the reliability of groundwater and exemption from compliance with regulatory agencies, which require forbearance from surface water diversions during the summer season. Groundwater wells that are deemed disconnected from surface waters currently do not have regulatory guidelines for extraction seasons or volumes.

The influence of groundwater extraction on streamflow is difficult to determine. Cultivator's preference for groundwater may either be beneficial, or just as harmful, to streamflow (Dillis et al., 2019). The extent of influence depends on whether groundwater wells are hydrologically connected to nearby streams – which is difficult to quantify but oftentimes determined based on groundwater well depth and distance to streams. Generally, wells that are shallow, close to streams, and in regions with highly conductive soils have a greater risk of depleting groundwater inputs to streams. In the headwaters of streams, groundwater makes a significant contribution to sustaining summer streamflow as subsurface water drains from the landscape (Dillis et al., 2019).

Characteristics and location of existing wells were found for 7 of the 12 active CUP applications. In addition to information presented in CUP applications, TGAEC also reviewed public well-completion reports for indication of well depth (DWR, 2022). This review indicated that most cultivators in Supply Creek watershed rely on wells that are between 130 – 260 feet in depth, with an average depth of 203 feet (n = 7). Most wells are located more than 150 feet from the nearest watercourses, which are typically Class III streams. However, one applicant (CUP# 12460) claims the use of one groundwater well within 60 feet of a Class II watercourse. This applicant's CUP application indicates the groundwater well is permitted by the Humboldt County Division of Environmental Health (permit # 11/12-0971). The application also states that this groundwater well is assumed to be disconnected from surface waters, but there was no indication of total well depth. Further discussion of groundwater extraction and impacts to Supply Creek are in Section 7.1 below.

5.2 Surface Water Diversions

Existing registration numbers, months of diversion, and volumes of water diverted were compiled from annual Statements of Diversion and Use (SDU) accessed through the SWRCB eWRIMS database (Attachment 4). SDU reports are required for anyone diverting water under riparian water rights. Under riparian rights, diverted water is only allowed to be stored for up to 30 days; therefore, SDU reports reflect water that is diverted and either directly applied, or used within 30 days. SDU reports are generally submitted by property owners and volumes of water diversions are estimated to their best ability.

Of the twelve active CUP applications in Supply Creek watershed, there are four registered points of diversions (PODs) distributed across four parcels. Two of these PODs are also identified as a Cannabis Registration with the SWRCB. Annual SDU reports were reviewed and summarized in Table 6. Due to incomplete and/or inconsistent reporting, total diversion volumes were estimated only from complete years. Diversions generally begins around April and last through the summer or fall. Based on the evaluated SDU reports, annual diversion volumes range from 0.06 MG to 0.56 MG per applicant. The maximum total volume diverted by these applicants is 0.92 MG per year. It is important to note that these annual reports had a lot of variation and these were roughly estimated by each applicant; a more precise and consistent report of water diversion would be required to conduct a thorough analysis of impact.

Table 6: Registered surface water diversions for existing CUP applicants. Information is sourced from annual SDU reports. Existing registration numbers beginning with “H” indicate a Cannabis Registration and “S” indicate a Statement of Diversion and Use where water was diverted under riparian right.

CUP ID / Farm Name	**Existing Registrations**	**Storage Capacity (gal)**	**Reported Months of Diversion**	**Total Volume Diverted (MG)**	**SDU Reports Used**
11607 / 707 Cultivation Co	H504869 S027566 S027565	80,000	Nov. – Mar., Apr. - Nov	0.20 – 0.29	2016, 2019
11978 & 11980 / Evergreen Family Farm	S026775	26,600	Apr. – Dec., Apr. – Jul.	0.20 – 0.56	2016, 2017
10558 / Kush Creek Organics	H506356 S025410	52,500	Mar – Jul., May – Nov.	0.06 – 0.07	2016, 2018, 2021

5.3 Surface Water Diversions as Percentage of Water Budget

Annual diversion volumes reported in SDU reports were also evaluated on a monthly timescale to determine the effects of diversion during the summer low-flow period. Monthly diversions were summed and summarized in Table 7. Based on information within available reports, the highest volume of diversion occurs in November, followed by June and July. Table 7 also summarizes the mean monthly discharge in Supply Creek, recorded at the USGS Station #115300200 between 1981-1987. Surface water diversions presented as a portion of the mean monthly discharge indicate that, even during in the months with high demand and low streamflow, diversions represent less than 0.1% of the water available in Supply Creek.

Table 7: Monthly summary of surface water diversions reported by CUP applicants in SDU statements

Month	Total Water Diverted[1]	Monthly Percentage of Annual Diversions	Average Demand Rate (MG/day)	Mean Monthly Discharge in Supply Creek[2]		Monthly Demand as Portion of Mean Discharge
	MG	%	MG/day	cfs	MG/day	%
January	0.040	4.5	0.0013	98.0	63.36	0.002
February	0.080	9.0	0.0029	213.5	137.97	0.002
March	0.072	8.2	0.0023	139.4	90.08	0.003
April	0.011	1.2	0.0004	97.8	63.21	0.001
May	0.059	6.7	0.0019	41.5	26.84	0.007
June	0.092	10.3	0.0031	17.8	11.53	0.027
July	0.092	10.3	0.0030	10.0	6.48	0.046
August	0.084	9.5	0.0027	6.5	4.17	0.065
September	0.084	9.5	0.0028	8.9	5.73	0.049
October	0.084	9.5	0.0027	13.1	8.48	0.032
November	0.129	14.6	0.0043	100.4	64.89	0.007
December	0.059	6.7	0.0019	176.1	113.78	0.002

[1]Water diversion estimates presented here are sourced from three statements of diversion and use: S025410, H504869, S026775. Due to incomplete reports, only estimates from the years of 2016, 2019, or an average of 2016 and 2019, are used in this analysis.
[2]Taken from USGS gage station #115300200, averaged between the years of 1981-1987

5.4 Storage Capacity

Applicants that depend on surface water as their primary irrigation source must have enough storage infrastructure in place in order to comply with streamflow forbearance requirements during the summer season. Table 8 summarizes the existing and proposed storage relative to each applicant's total water demand. Applicants currently have enough storage to support between 1.5 – 73% of their annual water demand. Most existing storage infrastructure consists of HDPE tanks, some of which are equipped to capture rainwater. One parcel has a water bladder (CUP# 10558) and another has ponds that are used for water storage (CUP# 11978 and 11980). To increase their storage capacities, some proposed operations are planning to expand by building ponds, purchasing more HDPE tanks, and/or installing groundwater wells.

It is especially critical for CUP applicants relying on surface water diversions to have adequate storage. These applicants, CUP numbers 11607, 11978/11980, and 10558, have enough storage capacity to meet 22.5%, 12.5%, and 73% of their total water demand, respectively. CUP applicant #10558 is proposing to build a water storage pond which would cover their water needs. The other applicants are assumed to rely on groundwater to supplement their water needs.

Because groundwater has been identified as the primary water source for cultivators, there is less reliance on water storage infrastructure to support water demand, as would be the case for operations relying entirely on surface water diversions. However, this is under the assumption that their groundwater wells are able to provide enough water through the entire growing season. With recent drought conditions, many residents along the North Coast report their groundwater wells drying and/or not producing enough to meet their demands. Based on the capacity of proposed storage infrastructure by the CUP applicants, it is likely they are also experiencing drying wells and are attempting to shift their reliance on capturing rainwater and surface water and storing it for the growing season.

Table 8: Summary of water demand, existing storage, proposed storage, and the percentage of storage as function of total demand.

		Existing		**Proposed**		
Applicant ID/Farm Name/Parcel APN	**Annual Water Use (gal)**	**Storage (gal)**	**Demand Available by Storage (%)**	**Additional Proposed Storage (gal)**	**Proposed Storage Type**	**Demand Available by Existing + Proposed Storage (%)**
11291 Emerald Mountain Coast	180,500	45,000	24.9	500,000	Pond, hard plastic tanks	302
11491 Stay Humboldt	642,000	15,000	2.3	400,000	Rainwater catchment pond	64.6
11525 High Art	199,000	5,600	2.8	60,900	Hard plastic tanks	33.4
11607 707 Cultivation Co	700,000	157,750	22.5			
11978 Evergreen Family Farm	250,000	38,000[1]	12.5			
11980 Evergreen Family Farm	53,000					
12460 Mojo Mountain / New Earth Farms	525,000	19,000	3.6	5,000	Rainwater catchment tanks	4.6
12848 4 Ponds, LLC	164,000	21,000	12.8			
13160 Three Creeks Holdings	174,000	5,000[1]	2.9			
10558 Kush Creek Organics	72,000	52,500	72.9	550,000	Pond, groundwater well	836.8
11167 Aloha Top Shelf, LLC	525,000	8,000[2]	1.5			
12750 RGI Farms	64,200	8,500	13.2	23,500	Hard plastic tanks	49.8

[1]This estimate reflects volume of water used for irrigating cannabis only, and does not include water stored for domestic and fire suppression use

[2]This estimate is unclear whether it includes domestic and/or fire suppression in addition to irrigation demand

5.5 Water Conservation Measures

During the review of CUP applications, water conservation measures were commonly observed and/or planned for future operations. The most common conservation methods practiced were the use of drip irrigation and heavy mulching of top soils. Drip-irrigation generally reduces the risk of over-watering and the potential of nutrient-rich runoff. Similarly, mulching of top soils reduces the amount of water lost to the atmosphere by evaporation – helping soils retain moisture and reducing the need for excessive watering.

In addition to water conservation practices, almost all applicants indicated plans to improve water infrastructure to become more water-conscious. Installing float valves and water meters is one measure that was commonly presented as a plan for the future of operations, which is intended to help operators better track their water usage over the growing season.

6. Water Quality

With the proposed CUP applications for cultivation occurring in the headwaters of Supply Creek, there are concerns of impacts to downstream water quality if pesticides, fertilizers, and other pollutants are delivered to the stream channel. The potential for pollution by surface runoff and leaching were evaluated based on Supply Creek soils information accessed by the Natural Resources Conservation Service SSURGO database (NRCS, 2022).

The headwaters of Supply Creek are primarily composed of soils in Hydrologic Group C (Table 9). Soils in this group are characterized as having a slow infiltration rate when thoroughly wet, either due to the fine texture of soils or a layer within the soil profile which impedes the movement of water downward. This characteristic of soils indicates a high chance of runoff, which increases the likelihood of sediment, fertilizers, and other amendments reaching the stream. However, this high runoff potential is only observed when soils are thoroughly wet, which is typically not the case during the summer growing season. If cultivation waste and amendments are not properly secured and stored before the onset of winter rains, runoff during storm events is capable of transporting these materials to Supply Creek. Similarly, it is critical that all roads and active erosional features are stabilized before the winter season to reduce excessive sediment delivery to the stream.

Table 9: Summary of hydrologic soil groups within Supply Creek watershed

Hydrologic Soil Group	Portion of the Watershed (%)	Description
A	1.6	High infiltration rate, low runoff potential when thoroughly wet
B	14.5	Moderate infiltration rate when thoroughly wet
C	64.5	Slow infiltration rate when thoroughly wet, high runoff potential
D	17.7	Very slow infiltration rate, high runoff potential
A/D	1.6	Hydrologic Group A (high infiltration) for drained areas, and Group D (very slow infiltration) for undrained areas

The potential for pesticide leaching was also evaluated using NRCS SSURGO database. A rating provided by SSURGO describes the potential for soils in the Supply Creek watershed to transmit pesticides through the soil and contaminate groundwater. This is determined by examining soil properties based on their natural conditions (e.g., not considering land use), and considers the depth to water table, saturated hydraulic conductivity, and underlying fractured bedrock. Majority of the Supply Creek watershed (~95%) was ranked as "not limited" – indicating that soils in the watershed have very low potential to leach pesticides into groundwater (Table 10).

Table 10: Leaching potential of soils within the Supply Creek watershed

Soils Rating	Portion of the Watershed (%)	Description
Not Limited	94.6	Soils have a low leaching potential
Somewhat Limited	2.9	Moderate leaching potential, some leaching is expected
Very Limited	2.5	Leaching potential is high

Most CUP applications submitted to Humboldt County included a Site Management Plan. Part of this plan involves site visits and reports which summarize the farm's compliance with Best Practicable Treatment or Controls (BPTC's) listed in Attachment A, Section 2 of the SWRCB Order 2019-0001-DWQ ("Order"; SWRCB, 2019). TGAEC staff reviewed each applicant's Site Management Plan to determine the greatest threats to water quality; the most frequently observed threats are summarized in the following sections.

6.1 Stream Crossing and Road Maintenance

Inadequate maintenance of stream crossings and road drainage features were the most commonly observed threats to water quality of Supply Creek. Some cultivators are occupying parcels that have historically been used for timber operations. This includes a large network of roads, some of which are no longer being used. Most unused roads have been decommissioned and pose little threat to the waters of Supply Creek. Roads that are still actively used, however, were frequently noted as exhibiting poor drainage and maintenance. During site visits, rilling and rutting was observed which can transport sediment to streams.

Site visit reports frequently noted that the existing culverts at road-stream crossings were undersized and not able to pass a 100-year flood event. Many culverts were also noted as being installed improperly – either not aligned correctly or set to the appropriate grade – causing surface erosion and/or clogging. Clogged culverts prevent aquatic organisms from passing upstream, and flow that would originally pass through the culvert is bypassed, causing erosion and sediment delivery into the watercourses.

6.2 Location of Cultivation Activities

The SWRCB Order requires all cultivation areas and activities to be outside a 50-ft, 100-ft, and 200-ft buffer of Class I, Class II, and Class III watercourses, respectively. Most applicants are well outside this buffer zone. However, there were several site assessment reports which indicated that cultivation areas, soil piles, fuel cans, and/or water pumps were located within these riparian zones.

Some Site Management Plans reported the presence of legacy cultivation areas and/or onstream impoundments that have been abandoned. These abandoned sites were recommended for remediation, including actions such as removing all abandoned cultivation materials, installing erosion control measures, removing instream impoundments and recontour the stream bed to match the natural channel, with permission from CDFW. TGAEC has not received a follow-up site visit report that indicates whether these corrective actions have been implemented or not.

Generally, cultivation areas are located on previously graded and cleared areas that have been used for timber operations. These areas are typically located on stable slopes (e.g., <15% grade), and those that are on unstable slopes (i.e., 50% grade) have been decommissioned. During a site visit in 2021, one site which had cultivation activities on unstable slopes; these applicants developed plans to decommission the area and relocate to a more stable location to reduce erosion and sediment delivery to Supply Creek.

6.3 Use and Storage of Soil, Fertilizers, and Soil Amendments

Based on information provided in Site Management Reports, all operations either did not use pesticides and herbicides, or used them according to manufacturer's instruction. When possible, cultivators also indicated the use of natural fertilizers and soil amendments, (e.g., compost tea) rather than chemical fertilizers. The application of pesticides, herbicides, and/or fertilizer was frequently reported as being half of the amount recommended by manufacturers. Reducing the amount that is applied, coupled with proper storage, and adequate distance from adjacent streams, indicates a low threat level to water quality in the Supply Creek.

For this category, the most commonly reported violation of SWRCB Order was improper storage of soils, fertilizers, and other soil amendments. As outlined in the Order, all soils and amendments need to be stored in a secondary container and be under some sort of shelter or cover. If this is not followed, it increases the potential for mobilization and/or leaching of nutrients if they are not covered during the wet periods of the year.

6.4 Waste Management

The most commonly reported method of dealing with refuse and domestic waste are outhouses and pit toilets. However, per recommendations in the Site Management Plan, operators plan to either purchase and maintain portable toilets, or permit an on-site wastewater treatment system. Plant waste related to cultivation activities was observed to be burned on-site at some operations, where the burn pile was located adjacent to a previously failed landing fill slope. This location was deemed unsuitable because of the potential of delivering sediment and debris into surface waters given another future slope failure.

6.5 Water Storage

Per the SWRCB Order, all off-stream water storage containers (e.g., ponds, water tanks, bladders) cannot be not located in the riparian buffer zone or next to equipment that generates heat. In addition, reservoirs and ponds used to store water for cultivation purposes are required to be "designed or approved by a qualified professional in compliance with Division of Safety of Dams (DSOD), county, and/or city requirements." In reviewing the Site Management Plans, most operators were within compliance. One operation (CUP# 11978), however, had an on-stream storage pond that showed signs of instability during a site visit in 2017. The pond's embankment was reported as having the potential of catastrophic undermining of the spillway culvert, and it was recommended that the pond be inspected by a licensed professional for an adequate outflow design and embankment stability. In a follow up site visit in 2020, it was noted that this unstable pond had been decommissioned.

7. Watershed Impacts

It was previously suspected that surface water diversions from Supply Creek were the primary water source for cultivators. Based on registered diversions and CUP applications, diversions make up a very small portion of the surface water budget, even during the summer low flow period (section 5). The majority of the annual water demand by cultivators is sourced from groundwater wells. Although the total water demand is a small component of the summer streamflow, it is possible for streamflow in the headwaters of Supply Creek to be depleted by excessive groundwater pumping.

7.1 Groundwater as Primary Water Source

A 2010 publication by The Nature Conservancy evaluating groundwater dependence of California streams classified the Supply Creek watershed as an ecosystem with "low" level of dependence on groundwater (Figure 2; Howard and Merrifield, 2010). Groundwater dependence was determined using three datasets: distribution of springs and seeps, wetlands, and a calculation of baseflow index. The baseflow index (BFI) is defined as the ratio of baseflow to total flow in a stream. Supply Creek was reported as having approximately 48% of the total annual discharge dependent on groundwater (BFI = 0.48). Based on the National Hydrography

Dataset, there were no identified springs or seeps, and only 1% of the total watershed consisted of groundwater-dependent wetlands. The overall groundwater dependence index, which qualifies Supply Creek as having “low dependence,” considers all three factors. However, based on the baseflow index alone, Supply Creek relies on groundwater for a significant portion of its summer streamflow.

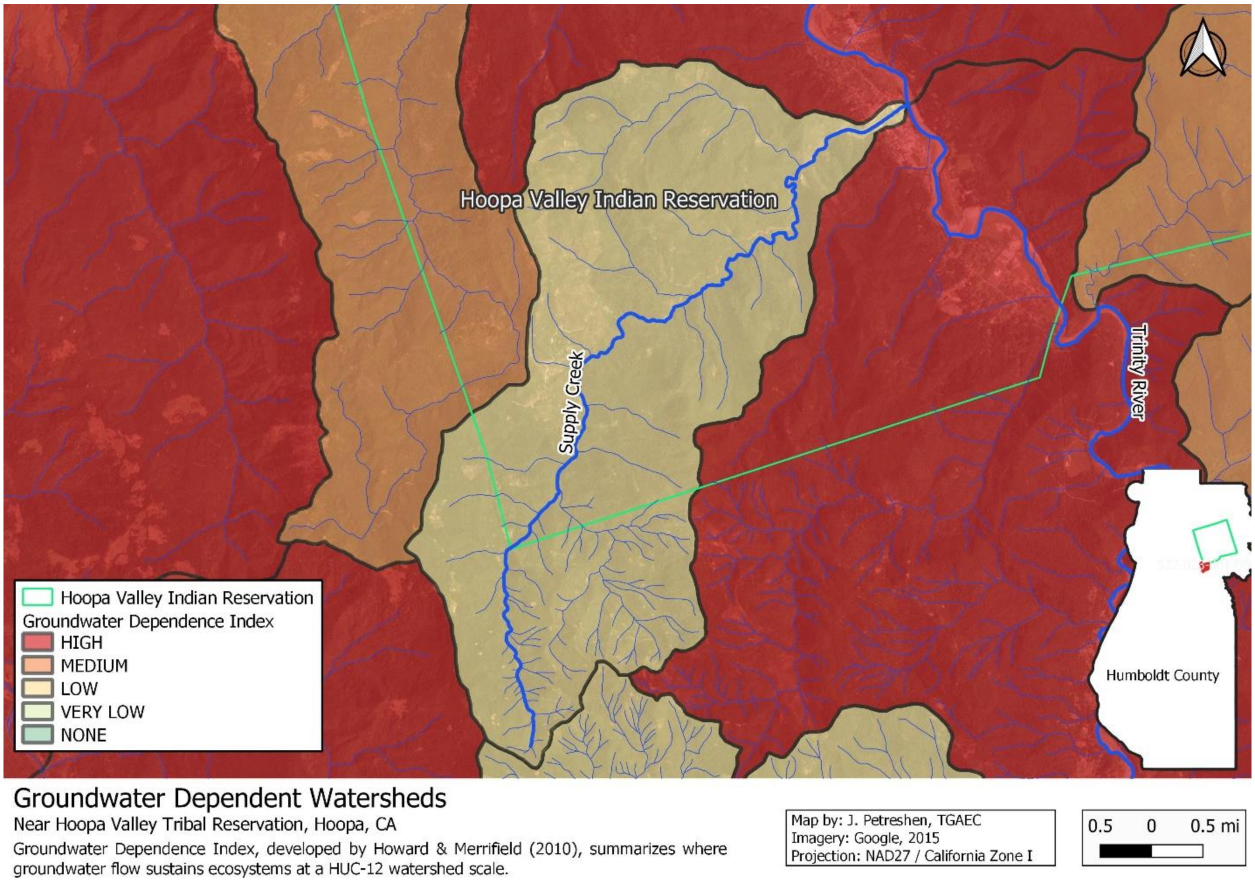

Figure 2: Groundwater dependence in and around Supply Creek watershed, as determined by Howard & Merrifield, 2010.

A study examining the impacts of groundwater pumping on summer streamflow in the Navarro River watershed, Mendocino County, found a relationship between streamflow depletion and cannabis production (Zipper et al., 2019). Streamflow depletion was most evident in the late summer season when groundwater maintains baseflows. There was a 1-month lag response in streamflow following peak pumping, with the greatest streamflow depletion occurring in September. The overall impact of pumping on streamflow was best predicted by the annual water use, distance to stream, and soil transmissivity between the well and stream. Short-term streamflow depletion was best predicted by the distance between the well and stream, but long-term impacts were most impacted by the annual water use.

The degree of impact to streamflow was also dependent on climatic conditions; for example, groundwater pumping during “drought” conditions had a greater impact than during “wet” years

(Zipper et al., 2019). This study also found an increase in flow depletion caused by wells within 1.2 km of a stream, suggesting this may be a critical threshold for maintaining streamflow in portions of the watershed with high habitat potential.

Overall, most of the existing groundwater wells used by CUP applicants in Supply Creek follow the riparian setbacks required by SWRCB (Section 5.1). Based on their depth and distance from the stream, it is unlikely that the groundwater wells are directly pulling from surface water. However, literature indicates that groundwater wells outside the SWRCB setback can still deplete streamflow (Zipper et al., 2019). Continuous pumping taking place in a concentrated area can cause the groundwater table to lower over time. Groundwater basins recharge on a longer time-scale (e.g., months – years), and if groundwater pumping exceeds the rate of groundwater recharge (which may be impacted by consecutive droughts), streamflow may be affected. Therefore, the pumping by cultivators may not affect streamflow on a seasonal scale, but the long-term effects on Supply Creek streamflow requires further investigation.

7.2 Impacts to Water Quality

Based on review of commonly observed SWRCB General Order violations (section 6), sediment poses the greatest threat to water quality in Supply Creek. Erosion caused by improper drainage features, road-stream crossings, and inadequate road maintenance have the highest likelihood of contributing sediment. Sediment pollution poses a significant threat to fishes of all life stages. Although there is often no direct death caused by sediment, indirect effects include damage to gills, changes to the physio-chemical environment caused by reduced light penetration, reduced invertebrate populations, reduced feeding ability, and reduced oxygen levels in redds (Cordone and Kelley, 1961).

Nutrient and pesticide contamination is unlikely because majority of applicants observed the recommended setbacks and showed appropriate storage of soil amendments. In addition, the likelihood of contamination via runoff or infiltration is unlikely based on soil characteristics within the watershed and time of active operations (e.g., during summer dry season).

8. Best Management Practices

As mentioned in section 6, CUP applicants are required to comply with SWRCB's Best Practicable Treatment or Controls (BPTC's) listed in Attachment A, Section 2 of the Order 2019-0001-DWQ (SWRCB, 2019). These BPTC's outline the most effective practices and measures applicants can take to protect natural resources and should be used as the primary guidance for applicants within the Supply Creek watershed. Based on observed conditions described in Site Management Plans, TGAEC has highlighted the following best management practices aimed at improving water conservation and water quality in Supply Creek.

8.1 Develop a Water Budget

- Applicants should develop a water budget to ensure that the on-site water storage containers are sufficient for cultivation needs during the low flow period (May 15th – October 31st).
- Applicants should install flow meters on water diversion infrastructure, including in-stream diversions, spring diversions, and groundwater wells, to accurately document water use over the growing season.
    - Hoopa Valley Tribe may request that cultivators take monthly photos of water meters to track and report their water use.

8.2 Practice Water Conservation

- Request applicants without registered water rights to sign an agreement with the Hoopa Valley Tribe ensuring they will not withdraw water from Supply Creek and/or adjacent tributaries or springs.
- Almost all applicants already have drip-irrigation systems in place, and any applicants without these in place should get them installed; irrigation should take place in the early mornings and late afternoons.
- Recommend mulching the soil surface in pots and planting beds to minimize evaporation. In addition, applicants can mix compost and mulch fertilizer into soils to increase its water holding capacity.
- Recommend the establishment of rainwater catchment systems to reduce the amount of water extracted from groundwater and/or surface water during the dry season.

8.3 Minimize Impacts to Water Quality

- Request applicants to plant a cover crop and/or properly secure soil piles before the onset of winter conditions to reduce the amount of soil and nutrients picked up by runoff.
- Applicants should monitor the weather forecast and refrain from applying any agricultural chemicals within 48 hours of a predicted rainfall event of 0.25 inches or more if the probability is more than 50%.
- Applicants should install straw waddles, berms, or infiltration ditches along the downslope perimeter of each cultivation site to ensure any generated runoff doesn't reach streams.
- Soil amendments, potting soils, and fertilizers should be stored in a water-tight building or a covered area; it is possible for these items to also be stored safely outdoors, but they must be fully tarped, in a stable location, with no potential of reaching surface waters.
- Applicants should dispose of spent growth medium at an authorized landfill or other appropriate disposal site; cultivators may also reuse spent growth medium by incorporating it into garden beds or spreading it on a stable surface and revegetating with native plants.

8.4 Maintain Roads and Stream Crossings

- Applicants should ensure that all road-stream crossings are able to pass a 100-year peak streamflow and associated debris flow; all culverts should be installed at the natural channel grade to avoid erosion and allow for aquatic organism passage.
- Applicants should regularly inspect culverts before onset of winter precipitation, and after precipitation events to determine if maintenance or cleaning is required. Inspect outflow of culverts to make sure erosion is not undermining the culvert.
- Untreated road-stream crossings require the installation of rolling dips or water bars to reduce delivery of fine sediment to watercourses.
- Quad and low-use roads should be winterized by installing water bars before the onset of winter rainy season (or November 1st) and these roads should not be used until after March 15th.
- Some cultivators and applicants are occupying parcels which were historically used for timber harvesting and have an extensive network of unused logging roads. These unused roads should be decommissioned and seeded with native grass species; it is expected that natural revegetation by Douglas fir, Tan Oak, and Madrone will follow.

8.5 Winterization Measures

At the end of each growing season and/or before the onset of winter rains, applicants should ensure the following tasks are complete:

- Soils in trenches are covered with a cover crop; soil in smart pots and soil bags can be piled and covered with a tarp and surrounded by straw waddle.
- Any bare soil (on fill slopes, landings, access paths, etc.) should be maintained with erosion control measures. For example, this may include covering bare soil with straw 2-3" thick or vegetated to prevent discharge of sediment to surface waters.
- Do not operate heavy equipment of any kind at the cultivation site during the winter period, unless authorized for emergency repairs contained in an enforcement order issued by the State Water Board, Regional Water Board, or other agency with jurisdiction.

9. Monitoring Plan

Monitoring the short and long-term responses in groundwater and streamflow following peak irrigation months can provide insight into the impacts of cannabis cultivation in the Supply Creek watershed. Acquiring more accurate water use data would also support a more thorough assessment of cultivation impacts to the watershed.

9.1 Groundwater Monitoring

Without long-term data, it is difficult to determine whether groundwater extraction has a direct or indirect impact on streamflow. To determine the impacts, it would be beneficial to monitor both groundwater levels and streamflow continuously for at least several years to capture the effects of pumping during different hydrologic years (e.g., wet years vs. droughts). This can be done by monitoring groundwater levels in existing wells on the HVIR. Equipping the existing groundwater wells with pressure transducer data loggers allows for continuous data collection without frequent site visits. In addition, if an agreement is established between HVT and the CUP applicants, it may be requested that cultivators share their water meter data or groundwater levels with HVT for further analysis of impacts.

A more thorough evaluation of groundwater impacts can be done by installing a series of groundwater wells or nested wells. Groundwater wells of similar depths installed at varying distances downstream of active cultivation zones can provide insight into the changes in groundwater levels in response to pumping. Because majority of the groundwater wells used by cultivators in Supply Creek are deep, it may be beneficial to install nested groundwater wells for monitoring. Nested wells consist of two or more casings of different depths within the same borehole. This design allows monitoring of water levels in groundwater at varying depths (e.g., shallow groundwater basins, deep groundwater storage). Nested wells such as these can help HVT determine whether cultivators are pulling groundwater from a shallow, unconfined aquifer (which supports summer streamflow), or a deeper, confined aquifer which is disconnected from the stream.

9.2 Streamflow Monitoring

In order to assess the impacts of groundwater extraction and/or surface water diversions on the streamflow in Supply Creek, it is recommended to continuously maintain a stream gage, especially during the summer season. If an existing, active stream gage exists on Supply Creek, it should receive regular maintenance and calibration. For the purposes of monitoring impacts, it is recommended that the stream gage record data at an hourly or smaller timestep during the active diversion season. With these data, it may be possible to identify depletion in streamflow caused by diversions or groundwater extractions.

9.3 Request Water Use Reporting

The analysis conducted in this report uses water use volumes that were roughly estimated by CUP applicants. To ensure these reported estimates are accurate, HVT may request that all water use reporting be shared for further analysis. Daily and/or monthly reports of water extracted from surface waters and groundwater will better inform the cumulative impacts to Supply Creek.

9.4 Water Quality Monitoring

Monitoring water quality during winter peak-flow events can provide insight into potential contamination occurring in Supply Creek. Collecting grab samples around peaks in streamflow can indicate the amount of sediment being delivered to the stream. Additionally, these grab samples can be tested for nutrients and pesticides to confirm that cultivators are properly securing their soil amendments and pesticides before the onset of winter precipitation.

9.5 Establish Partnerships

Establishing a collaborative relationship with regulatory agencies may benefit multiple parties and secure funding for monitoring and addressing impacts to Supply Creek. Cultivators are required to follow guidelines outlined by SWRCB and California Department of Fish and Wildlife (CDFW) to minimize their impacts to the environment and aquatic life. As part of the permitting process, CDFW conducts site visits to cultivation sites in order to assess each farm's water sources and management practices to ensure all guidelines are being followed.

The SWRCB and CDFW have identified Supply Creek as a "Cannabis Priority Watershed." These watersheds are identified as ones which support critical habitat for terrestrial or aquatic species and are experiencing increased risk of environmental impacts due to cannabis cultivation activities. Preliminary consultation with CDFW staff indicated that they are especially interested in studying the effects of groundwater pumping on streamflow in Supply Creek. Establishing a partnership or collaborative study to evaluate these impacts may benefit both HVT and CDFW.

9.5.1 Funding Opportunities

Because Supply Creek is identified as a "Cannabis Priority Watershed," proposed projects would receive priority for funding through CDFW's Cannabis Restoration Grant Program. Grant funding under this program is awarded to public agencies, nonprofit organizations, or California Native American tribes, which would qualify the HVT for this funding source. In addition to funding by CDFW, monitoring and assessment of groundwater extraction in Supply Creek watershed could also be funded by Department of Water Resources (DWR) grant programs such as the Sustainable Groundwater Management (SGM) Grant Program.

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List of Attachments

- Attachment 1_2020_HMC-Engineering_Supply Creek Surface Water Supply Study.pdf
- Attachment 2_CUP12353_RE_Topography_08.24.21.pdf
- Attachment 3_HumboldtCo_to_HVT_CoverLetter_06-24-2020.pdf
- Attachment 4_eWRIMS_Water Right Records
- Attachment 5_CUP Applications from Humboldt County
- Attachment 6_Supply Creek_TGAEC Analysis.xlsx