Stormwater Planning Grant

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1.0 INTRODUCTION

In 2014, the Water Bond (Assembly Bill 1471), or Proposition 1, was passed by California voters. Proposition 1 enacted the Water Quality, Supply, and Infrastructure Improvement Act of 2014, which created a fund to allocate monetary resources to increase water supply reliability, restore and preserve fish and wildlife habitat, and develop resilient and sustainably-managed water systems to withstand future and unforeseen pressures in the coming decades. In 2015, the State Stormwater Resource Plan Guidelines were prepared to build a framework consistent with the requirements of California Water Code sections 10561-10573. The Coastal Mendocino County Stormwater Resource Plan (SWRP) utilizes the State Stormwater Resource Plan Guidelines to screen and evaluate projects based on weighted benefit criteria and quantitative analysis. The potential projects will utilize stormwater as a resource for multi-benefit projects to augment water supply, identify areas of concern, enhance water quality, reduce localized flooding, and create environmental and community benefits within the three coastal watersheds included in the SWRP.

1.1 Purpose and Scope

The Coastal Mendocino County (SWRP) encompasses three coastal watersheds in Mendocino County, California: Pudding Creek-Frontal Pacific Ocean Watershed, Noyo River Watershed, and Big River Watershed. A map of the study area boundaries is presented in Figure 1. Main Rivers and creeks are displayed in Figure 2. The purpose of the SWRP is to provide a framework for identifying and selecting potential projects that utilize stormwater as a resource for multi-benefit projects that augment water supply, identify areas of concern, enhance water quality, reduce localized flooding, and create environmental and community benefits within the three coastal watersheds.

1.2 Study Area Description

1.2.1 Pudding Creek-Frontal Pacific Ocean Watershed

Fort Bragg is a coastal town, as well as a California historical landmark, and has an estimated population of 7,289 in 2015 (USCB, 2015). Weather in Fort Bragg is mild throughout the year and the majority of the rainfall takes place between November and April. The Fort Bragg storm drain map is displayed in Figure 3 (LACO, 2017). The City of Fort Bragg sources over fifty percent of its water supply from the Noyo River, and the remainder from Newman Reservoir and the Simpson (Waterfall Gulch) diversion (City of Fort Bragg, 2013).

The Town of Mendocino is a small unincorporated California town located 9.5 miles south of Fort Bragg. According to a 2015 U.S. United States Census Bureau (USCB) estimate, the Town of Mendocino's population is 894 (United States Census Bureau, USCB, 2015). Both businesses and residents of the town of Mendocino rely on wells for water supply. Water companies in this area, also reliant on water wells, supply water to three residential subdivisions that are located east and west of Highway 1. Groundwater pumping from 2005 to 2015 has not exceeded 200 acre-feet per year. Water importation, from sources in Fort Bragg and Elk, during seasonal dry periods amounted to an estimated 11 acre-feet per year in 2015 (Town of Mendocino, 2015).

Caspar is a small coastal community located 4 miles north of Mendocino on the Pacific Ocean. In 2015, the community population was estimated to be 801 (USCB, 2015). The community is considered a disadvantaged community by the North Coast Resource Partnership and relies on groundwater for its water supply (NCRP, 2015).

1.2.1.1 *Caspar Creek Sub-Watershed*

The Caspar Creek Sub-Watershed is located 6 miles south of Fort Bragg. The two major sub-watersheds in Caspar Creek are the North Fork Caspar Creek Sub-Watershed and the South Fork Caspar Creek Sub-Watershed (Cafferata and Reid, 2013). The North Fork Caspar Creek Sub-Watershed drains 1,169 acres and the South Fork Caspar Creek Sub-Watershed drains 1,048 acres. Marine sandstone and shale underlie both watersheds (Cafferata and Reid, 2013). The soil is well drained and varies from loams and sandy loams to gravelly loams in texture (Riitiman and Thorson 2006). The average annual precipitation is 46 inches and approximately 95% of the precipitation falls between October and April (Keppeler and Brown, 1998).

Since much of the North Coast is forested, rainfall is mainly transferred to streams channels by subsurface flow (Keppeler and Brown, 1998). Rainfall interception can be affected by timber harvesting and can increase the amount of subsurface flow during storms. Elevated pore pressure during a storm as well as disruption of subsurface flow increases landslide risk (Montgomery et al. 2000).

1.2.1.2 *Pudding Creek Sub-Watershed*

Pudding Creek is located north of the Noyo River and flows into the Pacific Ocean. The sub-watershed is approximately 18 square miles and has 118.5 stream miles of potential habitat (SWRCB, 2014).

1.2.2 Noyo River Watershed

The forested coastal Noyo River watershed drains an area of 113 square miles into the Pacific Ocean. The Noyo River watershed is primarily underlain by the Franciscan Formation (WCW, 2007). Elevated marine terraces near the coast indicate that the area is experiencing uplift (WCW, 2007). The primary land use of the watershed is forest management area. Currently, the Noyo watershed is listed on the US Environmental Protection Agency 303d List due to water quality impairment from excess sedimentation, high water temperature, and non-point source pollution (Koehler, Kelson, Matthews, Kang, and Barron, 2005).

The Noyo River is approximately 34 miles long and is divided into five segments: Lake Cleone, Lower Noyo River, Middle Noyo River, South Fork River, and Upper River. The elevation of the watershed ranges from sea level to 2,850 feet.

1.2.3 Big River Watershed

The Big River Watershed drains 181 square miles and is 24 miles in length (EPA, 2001). The estuary enters the Pacific Ocean at the town of Mendocino (Downie, DeWarrd, and Dudik E., 2006). The Big

River watershed geology is composed of the Franciscan formation that contains sandstones and shales (Warrick and Wilcox, 1981). The Big River is mainly underlain by the coastal belt of the Franciscan Complex; however, the eastern portion of the watershed is underlain by the central belt, which contains more pervasively sheared and disrupted rock. According to the California Geological Survey (CGS), landslides are a common occurrence along the Big River watershed. In the middle portion of the watershed, deep-seated rockslides occur frequently. In the eastern portion of the watershed, earthflows, a downslope and viscous flow of cohesive fine-grained soil materials, are the most common type of landslides. Active debris slides are common in large tributaries and inside meanders of the Big River (CGS, 2005).

1.3 Physiography

Pudding Creek-frontal Pacific Watershed is a tributary to the Pacific Ocean and has an elevation range from average mean sea level at the mouth of the creek to 1,600 feet in the headwater areas (KRIS, n.d.). This watershed is located north of the Noyo River Watershed and consists of a distinct drainage basin. Pudding Creek is a second-order stream and has approximately 14.3 miles of blue line stream according to the USGS Fort Bragg 7.5 minute quadrangle (CAFWS, 2006). The distinct drainage basin pool depths are at least two feet in depth in first and second order streams and at least three feet in depth in third and fourth order streams. Streambeds with greater depths are favorable to salmonid populations specifically due to the presence of large woody debris (LWD). The canopy cover along the coastal streams mainly consists of coniferous trees that provide greater amounts of shade year round.

The Noyo River watershed is primarily used for timber production and very little development has occurred in the watershed in the last two decades (waterboard.gov). The watershed is a 72,323-acre coastal tributary and is surrounded by redwood and Douglas fir forest on a rugged, mountainous terrain. The Noyo River Watershed is within the California Coast Ranges. The terrain includes elevations that range from sea level at the mouth of the Noyo River to 2,850 feet at the headwaters in the eastern portion of the watershed (WCW 2007). The watershed's hydrologic unit is 113.20. The Noyo River supports an anadromous fishery including species listed as threatened under the federal Endangered Species Act: steelhead trout, Coho salmon, and Chinook salmon. Turbidity levels in the river remain elevated after the cessation of rain. Such physical attributes of the river can have adverse effects on fish populations and drinking water quality. Pool volumes have decreased due to the accumulation of fine sediment delivered by surface erosion throughout the basin (CA SWRCB n.d.).

The Big River watershed drains from east to west and covers an area of approximately 116,000 acres (181 square miles). The watershed's hydrologic unit is 113.30 (CalWater version 2.2). Vegetation in the basin is predominantly surrounded by coniferous forest, with redwoods near the coast and along the stream bottoms and Douglas-fir in the interior and along the ridges. The watershed has accessible streams that historically house Coho salmon and steelhead trout (NCRWQB, 2006).

1.4 Climate

The 2006 study, conducted by the California Fish and Wildlife Services, noted the average temperature during the fall months between 41 and 69 degrees Fahrenheit. North of Fort Bragg,

Pudding Creek's predicted annual precipitation is 40 inches. The Noyo River has moderate temperatures with an annual average of 53 degrees Fahrenheit with an average rainfall of 40 to 65 inches. The Big River watershed has a Mediterranean climate, containing characteristics of low-intensity rainfall in the winter and cool, dry summers with coastal fog. Near the western margin of the watershed near Fort Bragg, the annual precipitation is 40 inches and 51 inches at Willits, east of watershed's margin. The precipitation season in the area occurs between October and April, with the highest average monthly precipitation in January. (CAFWS 2006).

1.5 Land Use

The land use in this project area is separated into two categories, outside Fort Bragg and inside Fort Bragg. The land use outside of Fort Bragg comprises 99.99 percent of the total land area. The land outside of Fort Bragg is mostly forestland and the Jackson Demonstration State Forest, which combine to cover 84.60 percent of the total area (Table 1).

Table 1. Land Use, Outside Fort Bragg

Type of Land Use	Square Miles	Percent of Total Area
Agriculture	0.24	0.07
Coastal Commercial	0.25	0.07
Forestland	228.68	62.40
Industrial	0.17	0.05
Open Space	4.72	1.29
Public Facility	81.38	22.20
Rangeland	20.90	5.70
Residential	0.31	0.08
Remote Residential	6.20	1.69
Rural Residential	20.71	5.65
Sum	**363.58**	**99.20**

The land inside Fort Bragg has been urbanized to a large extent. The combined business and commercial districts comprise 49 percent of the land area inside Fort Bragg, with residential development representing another 35 percent (Table 2).

Table 2. Land Use, Fort Bragg

Type of Land Use	Square Miles	Percent of Total Area
Central Business District	0.079	2.72
General Commercial	0.087	2.97
Harbor District	0.004	0.13
Heavy Industrial	0.087	2.99
High Density Residential	0.096	3.30
Highway Visitor Commercial	0.239	8.19
Light Industrial	0.074	2.52
Low Density Residential	0.589	20.18
Medium Density Residential	0.106	3.63
Neighborhood Commercial	0.011	0.36
Office Commercial	0.055	1.88
Open Space	0.079	2.70

Parks and Recreation	0.143	4.90
Public Facilities and Services	0.396	13.57
Suburban Residential	0.017	0.57
Timber Resources Industrial	0.653	22.38
Very High Density Residential	0.205	7.01
Sum	**2.919**	**100.00**

1.6 Population

Pudding Creek is located northeast of Fort Bragg and flows west towards the Pacific Ocean. Communities that have direct access to the watershed include Fort Bragg, with a population of approximately 7,000, and Cleone, with a population of approximately 600.

The three largest landowners along the Noyo River Watershed are Mendocino Redwood Company (MRC), Campbell Timberland Management (CTM), and Jackson Demonstration State Forest (JDSF); together, these landowners own approximately 70 percent of the watershed.

Timber production and harvest is the primary land use along the watershed, and the area is sparsely populated. The populated areas within the Big River Basin include areas around Orrs Spring, Whiskey Spring, Cameron, and Mendocino. The unincorporated town of Mendocino has by far the largest population in the area with approximately 800 people (North Coast Region, 2006).

1.7 Previous Work (Literature Review)

1.7.1 Executive Summary

The purpose of the literature review is to document efforts to gather and review existing data appropriate to the SWRP including maps, geographic information system (GIS) data, analytic tools, related plans, permits, and stormwater management information, and identify data gaps. Compilation of GIS data is documented with the submission from LACO Associates to Mendocino County Water Agency (MCWA) for Task 3.2, dated March 31, 2017, which documented the SWRP boundary, primary watersheds, sub-watersheds, surface water resources, groundwater resources, land use, and the Fort Bragg storm drain map. Included is a description of the SWRP study area as shown in the SWRP Boundary Map in Figure 1.

1.7.2 Pudding Creek-Frontal Pacific Ocean Watershed

Fort Bragg originally used its sewer system to carry both stormwater and sanitary sewage. A separate stormwater drainage system was implemented in the late 1970s. In 1997, 7H Consulting Engineers conducted a smoke test of the main system and access lines of the sewer. The results from the smoke test found deficiencies in the main line system. Nute Engineering evaluated the smoke test in 2004 and found 227 cross-connections between the storm drains and sanitary sewer systems (City of Fort Bragg, 2004). According to the City of Fort Bragg in 2004, there was excessive inflow and infiltration into the wastewater system during storms due to shared connections between the stormwater and

sanitary sewage systems and leaks. The original stormwater distribution system consisted of clay pipes with cement or tar joints every two to three feet. Tree roots and excavation damage to stormwater distribution lines allows rainwater, groundwater, and soil to enter the sewer system. The interconnections between the stormwater and sanitary sewage could potentially cause raw sewage to be discharged into Fort Bragg's storm drain system that empties into the Noyo River, Pudding Creek, and ocean beaches (City of Fort Bragg, 2004).

In 2004, Fort Bragg received a grant from both the United States Environmental Protection Agency (EPA) Region IX and California State Water Resources Control Board to address the highest priority cross-connection sites. Treatment priorities were allocated based on a ratio of the estimated cost to remove the cross section to the volume of water flowing through the cross-connection during a storm. Priority sites 1, 2, and 3, which were selected for repair, correspond to approximately 95% of the total volume of potential cross-connection flows. A total of 57 cross-connections were proposed to be repaired that would result in a 12% reduction in peak flow and an 18% reduction in the combined inflow and intensity component. The repair would reduce the probability of raw sewage being discharged into Fort Bragg's storm drain system (City of Fort Bragg, 2004).

Winzler and Kelly Consulting Engineers updated the City of Fort Bragg's 1985 Storm Drainage Master Plan in 2004. The update provides a plan development of the city's stormwater drainage until 2012. The plan gives a detailed overview of the adequacy of the major storm drainage facilities and provides maps of the existing stormwater drainage infrastructure (City of Fort Bragg and Winzler and Kelly, 2004).

Two Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS) precipitation gauges are located in the Pudding Creek – Frontal Pacific Ocean Watershed: Caspar 1.4 ESE and Mendocino 2.7 NNE (CoCoRaHS, 2017a). Caspar 1.4 ESE started collecting daily rainfall data on April 24, 2014, and Mendocino 2.7 NNE started collecting daily rainfall data on March 9, 2016 (CoCoRaHS, 2017b). One National Climatic Data Center (NCDC) precipitation gauge is located approximately five miles north-northeast of Fort Bragg and has been collecting data since 1895 (WRCC, 2017).

1.7.2.1 *Casper Creek Sub-Watershed*

Through the collaboration of the California Department of Forestry and Fire Protection (CAL FIRE) and the Pacific Southwest Research Station (PSW), a 100-year Caspar Creek Memorandum of Understanding has been developed to continue research along the Caspar Creek until 2099 (Catterata and Reid, 2013). The research focuses on erosion, streamflow, rainfall, hydrology, suspended sediment, and subsurface hydrology.

In 1996, a sediment budget was constructed under per-treatment conditions to evaluate the sediment production from sediment sources (Napolitano, 1996). Studies conducted in the Caspar Creek Sub-Watershed have focused on sediment deposits due to logging. A report from Reid and Keppeler in 2012 suggests that clear-cut logging has increased the incidence of large landslides and has destabilized slopes adjacent to roads (Reid and Keppeler, 2012). In 2010, a study conducted in the North Fork Caspar Creek Sub-Watershed identified that sediment inputs significantly increased downstream of a logged sub-watershed, and that in-channel erosion was a major source of sediment (Reid et al., 2010). In 1989, Lisle addresses the impacts that sediment deposition and scour have on North Fork spawning redds (Lisle, 1989). The effects of timber operation on Coho, steelhead, and

pacific giant salamanders were evaluated along the North Fork of Caspar Creek (Nakamoto, 1998). In 2001, a study analyzed the changes in flow and sediment loads due to watershed scales (Lewis, Mori, Keppeler, and Ziemer, 2001). Data collected in a 2010 study found that logging resulted in an increase drainage density, widened low-order channels, and aggraded higher-order channels in the Caspar Sub-Watershed (Reid et al. 2010).

1.7.2.2 *Pudding Creek Sub-Watershed*

The central Fort Bragg sewer collection system is connected to the lift station at Pudding Creek and is pumped south of Pudding Creek. Most of the sewer force-main was installed between 1974 and 1979. In 1985, 450 feet of pipeline was replaced by the Fort Bragg Municipal Improvement District. Since 2005, there have been four breaches in the sewer force-main crossing Pudding Creek caused by rocks and roots that have created holes in the pipe wall. The force-main was scoured from the bottom of the creek by a storm event in 2006 and was re-anchored under an emergency repair contract from the Office of Emergency Services. In 2007, a Cease and Desist Order was adopted by the Regional Board for the Fort Bragg Municipal Improvement District which required upgrades and repairs of the Pudding Creek force-main. North Bay Construction was selected in 2008 to construct and repair the force-main. There have been no spills since the new force-main was constructed (SWRCB, 2014).

In 1994, Warren Mitchell conducted a habitat inventory and surveyed 62,728 feet of Pudding Creek. A study conducted by Flosi and Reynolds in 1994 found that 66% of its primary pools had favorable depths for salmonids. In a study by Robison and Beschta, it was determined that 39% of the pools in Pudding Creek were created by large woody debris (KRIS, 1994).

The canopy cover of Pudding Creek was assessed by Flosi and Reynolds, who found that the average canopy cover percentage was 89%, which is considered optimum (KRIS, 1994). In 2006, the California Department of Fish and Game (CDFG) conducted a stream inventory report of Pudding Creek and assessed habitat conditions for anadromous salmonids (CDFG, 2006).

1.7.3 Noyo River Watershed

In 2004, the Mendocino Redwood Company (MRC) conducted hydrological mass wasting, a process in which a bulk soil moves downslope, surface and fluvial erosion, and biological assessments of the Noyo River watershed (MRC, 2004). The assessment data was used to develop land management guidelines and monitoring protocols.

The Coastal Conservancy conducted several biological assessments on the Noyo River watershed between 2004 and 2005 to evaluate fish migration barriers and survival rates (West Coast Watershed, 2007). In 2004, the Coastal Conservancy created an inventory of fish passage barriers along the Noyo River and entered the data into the Fish Assessment Database (WCW, 2007).

In 2001, the California Department of Forestry and Fire Protection published a study of the South Fork Noyo River that utilized geological maps and surveys to determine the amount of sediment that was produced in pre-historic terraces, historic terraces, and active channels (William Lettis & Associates

and GMA, 2001). In 1999, Graham Matthews and Associates (GMA) conducted a sediment source analysis and a preliminary sediment budget for the Noyo River (GMA, 1999).

The California Division of Mines and Geology (CDMG) website provides an interactive map of the Noyo River watershed that displays landslide occurrence potential (CDMG, 2001). The California Water Board provides an interactive GIS tool that marks the location of groundwater projects, wells, permitted underground storage tanks, and sampling points through the use of GEOTRACKER program (SWRCB, 2015). It also provides information about land disposal sites/reports and geological information (SWRCB, 2015).

United States Geological Survey (USGS) streamflow gauge 11468500 was installed in the Noyo River near Fort Bragg in 1953 and provides discharge and temperature data (USGS, 2017).

1.7.4 Big River Watershed

Both public and private agencies have conducted studies and collected data for the Big River Basin. The California Department of Fish and Game (CDFG) has extensive Big River survey reports regarding streams, fish habitat, and large woody debris in the river (Downie et al. 2006). In 1984 and 2000, aerial photographs were used to map fluvial features in major channels within the Big River watershed that included the main-stem Big River, the South Fork Big River, the North Fork Big River, and the Dougherty Creek sub-watersheds. USGS 7.5 minute quadrangle topographic maps were used to create stream gradients along the watershed based on the 10-meter digital elevation model (DEM) (CGS, 2005).

The Department of Water Resources (DWR) determined that most of the Big River tributaries maintained flow throughout the year (Downie, DeWaard, and Dudik, 2006). The United States' Fish and Wildlife Service (USFW) measured stream flows at 20 locations in six streams and the main-stem Big River in a 1973 fishery improvement study. The data was gathered between the months of May and June in 1973 (Downie et al., 2006). Most runoff events in the Big River occur between December and March. High flows during storms are not long lasting and flow rates return to baseflow within a week of the peak flows. Synthetic peak discharges were developed by Graham Matthews and Associates (GMA) in 2001 for the South Fork Big River (GMA, 2001a). GMA created a database with 2,307 unique landslide features across the Big River Basin during a study period from 1937 to 2000. Data collected displayed a decreasing trend in the frequency of landslides since 1952. The results demonstrated a correlation between higher slide frequencies with more intense land use such as extensive timber harvest.

CGS created a map that outlines the areas of active and dormant landslides in the Big River Basin (CGS, 2005). The map indicates that most of the landslides occurred in the Inland Subbasin, and the majority of landslides were dormant. The CGS landslide potential map indicates that 50% of the Big River Basin has either high or very high landslide potential. Turbidity and suspended sediment samples were collected by GMA at 10 sites in the Big River watershed. Analyzing data form 1936 to 2000; GMA determined that change in alluvial sediment storage due to fluvial activity was minimal (GMA, 2001a).

The CDFG also conducted 20 electroshock surveys from 1983 to 1996. Young-of-year Coho salmon were found in Berry Gulch, Two Log Creek, and Chamberlain Creek during the 1980s. The highest density of Coho salmon was recorded in Berry Gulch. Both young-of-year and year-old Steelhead

age classes were recorded with the highest density of the Steelhead found in West Chamberlain Creek. Lower Gates Creek was the only location in which no Steelheads were found. The surveys during the 1990s recorded one instance of Coho salmon in Berry Gulch (NCRWQCB, 2001b).

In 1995 and 1996, the CDFG conducted habit characteristic surveys in 41% of fish bearing streams in the Big River watershed and recorded pool frequency, depth, and embeddedness (EPA, 2001). From 1994 to 1996, MRC used snorkeling and electroshock surveys to gather fish data (MRC, 1999). Coho salmon were found in 13 out of the 58 sites that were surveyed. Steelhead were recorded in 50 of the 58 sites (MRC, 1999).

From 1993 to 1996, salmonid population data was collected by Georgia-Pacific Corporation at the lower Little Fork and lower Two Log Creek in the Big River watershed. The results demonstrated that lower Little North Fork had a higher density of Coho salmon than lower Two Log Creek. Data on juvenile Coho salmon and steelhead numbers was collected by the U.S. Fish and Wildlife Service (USFWS) using electroshock surveys in ten locations along the Big River in 2001. The highest density of Steelhead was found in South Fork. Coho were observed in six of the ten locations (EPA, 2001).

United States Geological Survey (USGS) streamflow gauge 11468092 was installed in the Big River approximately 10 miles east of the town of Mendocino in 2001, and provides discharge and temperature data (USGS, 2017).

1.7.5 Data Group

Challenges to planning, implementation, and improvement of stormwater management are due to nonexistent and unstandardized data, ambiguous climate conditions, and uncertainties in spatial data analyses (DWR, 2011). Future research on sea level rise is needed to effectively improve and assess stormwater management. The lack of standardization and incomplete data of former studies has limited the ability of local communities to develop fine-scale plans for floods (NCRP, 2015).

Digital elevation models (DEM) are available along the Noyo River watershed, Big River Watershed, Caspar Creek, and Pudding Creek. Both 1/3-acre-second and 1-acre-second DEM resolutions are available for all watersheds in the study area. A DEM resolution of 1/3-acre-second is the highest seamless resolution that has a ground spacing of approximately 10 meters north/south. A 1-acre-second DEM has a lower seamless resolution with a ground spacing of approximately 30 meters north/south (USGS, 2017).

Light Detection and Ranging (LIDAR), a remote sensing method used to measure variable distances to the Earth, is available along the coastal regions in the study area. From 2009 to 2011, the Coastal Conservancy collected LIDAR and imagery data to determine sea level rise and shoreline delineation. LIDAR data is available in the western portions of the Noyo River, Big River, Caspar Creek, and Pudding Creek. Topobathy LIDAR data exists along the coastal regions of the study area. However, topobathy LIDAR information is only available along the drain areas of the Noyo River, Big River, Caspar Creek, and Pudding Creek. There is no LIDAR data available for the rest of regions in the study area (NOAA, 2017).

1.7.6 Hydrology Findings

1.7.6.1 *Pudding Creek-Frontal Pacific Ocean Watershed*

Two Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS) precipitation gauges are located in the Pudding Creek – Frontal Pacific Ocean Watershed: Caspar 1.4 ESE and Mendocino 2.7 NNE (CoCoRaHS, 2017a). Caspar 1.4 ESE started collecting daily rainfall data on April 24, 2014, and Mendocino 2.7 NNE started collecting daily rainfall data on March 9, 2016 (CoCoRaHS, 2017b). One National Climatic Data Center (NCDC) precipitation gauge), is located approximately five miles north-northeast of Fort Bragg and has been collecting data since 1895 (WRCC, 2017).

Casper Creek Sub-Watershed

The Caspar Creek Sub-Watershed is located 6 miles south of Fort Bragg. The two major sub-watersheds in Caspar Creek are the North Fork and the South Fork Caspar Creek Sub-Watershed (Cafferata and Reid, 2013). The North Fork Caspar Creek Sub-Watershed and the South Fork Caspar Creek Sub-Watershed drainage areas are 1,169 acres and 1,048 acres, respectively. The climate of the Caspar Creek Sub-Watershed is characterized by a Mediterranean climate. The average annual precipitation is 46 inches and approximately 95% of the precipitation falls between October and April (Keppeler and Brown, 1998).

A report from Reid and Keppeler in 2012 suggests that clear-cut logging has increased the incidence of large landslides and has destabilized slopes adjacent to roads (Reid and Keppeler, 2012). In 2010, a study conducted in the North Fork Caspar Creek Sub-Watershed identified that sediment inputs significantly increased downstream of a logged sub-watershed, and that in-channel erosion was a major source of sediment. It was also found that logging increased drainage density, widened low-order channels, and aggraded higher-order channels in the Caspar Creek Sub-Watershed (Reid et al., 2010). In 1989, Lisle addressed the impacts of sediment deposition and scour on North Fork spawning redds (Lisle, 1989). In 2001, a study analyzed the changes in flow and sediment loads due to watershed scales (Lewis, Mori, Keppeler, and Ziemer, 2001).

Through the collaboration of the California Department of Forestry and Fire Protection (CAL FIRE) and the Pacific Southwest Research Station (PSW), a 100-year Caspar Creek Memorandum of Understanding has been developed to continue research along the Caspar Creek until 2099 (Catterata and Reid, 2013). The research focuses on erosion, streamflow, rainfall, hydrology, suspended sediment, and subsurface hydrology.

Pacific Creek Sub-Watershed

Pudding Creek is located north of the Noyo River and flows into the Pacific Ocean at Pudding Creek Beach. The lagoon area at Pudding Creek Beach can be characterized as an enclosed lagoon during the dry weather season because of the formation of a berm that impacts water circulation, limiting tidal influence in the lagoon. The sub-watershed is approximately 18 square miles and has 118.5 stream miles of potential habitat (SWRCB, 2014).

While water quality standards of the beach showed low concentrations of bacteria, higher bacteriological concentrations, not regulated by water quality standards, have been found, which appear to be associated with warm water and wildlife found in the lagoon in a study done by SWRCM in 2014.

Pudding Creek is historically known to produce Coho salmon. In 1994, Warren Mitchell conducted a habitat inventory and surveyed 62,728 feet of Pudding Creek. A study conducted by Flosi and Reynolds in 1994 found that 66% of its primary pools had favorable depths for salmonids. In a study by Robison and Beschta, it was determined that 39% of the pools in the Pudding Creek were created by large woody debris (KRIS, 1994). The canopy cover of Pudding Creek was assessed by Flosi and Reynolds and found that the average canopy cover percentage was 89%, which is considered optimum (KRIS, 1994). In 2006, the California Department of Fish and Game (CDFG) conducted a stream inventory report of Pudding Creek and assessed habitat conditions for anadromous salmonids (CDFG, 2006).

1.7.6.2 *Noyo River Watershed*

The forested coastal Noyo River watershed drains an area of 113 square miles into the Pacific Ocean. The primary land use of the watershed is forest management. Currently, the Noyo watershed is listed on the US Environmental Protection Agency 303d List due to water quality impairment from excess sedimentation, high water temperature, and non-point source pollution (Koehler, Kelson, Matthews, Kang, and Barron, 2005).

The Noyo River is approximately 34 miles long and is divided into five segments: Lake Cleone, Lower Noyo River, Middle Noyo River, South Fork River, and Upper River. The elevation of the watershed ranges from sea level to 2,850 feet. United States Geological Survey (USGS) streamflow gauge 11468500 was installed in the Noyo River near Fort Bragg in 1953 and provides discharge and temperature data (USGS, 2017).

The climate of the Noyo River Watershed has moderate temperatures with an annual average of 53 degrees Fahrenheit and an average annual rainfall of 40 to 65 inches (NCRWQB, 2005).

1.7.6.3 *Big River Watershed*

The Big River Watershed drains 181 square miles and is 24 miles in length (EPA, 2001). The estuary enters the Pacific Ocean at the town of Mendocino (Downie, DeWarrd, and Dudik E., 2006). According to the California Geological Survey (CGS), landslides are a common occurrence along the Big River watershed.

United States Geological Survey (USGS) streamflow gauge 11468092 was installed in the Big River approximately 10 miles east of the town of Mendocino in 2001, and provides discharge and temperature data (USGS, 2017).

The Big River Watershed has a Mediterranean climate characterized by a pattern of low-intensity rainfall in the winters and cool, dry summers with coastal fog. The mean annual precipitation varies from 38 inches in Fort Bragg near the western margin of the watershed to 50 inches in Willits to the east. Higher elevations receive in excess of 65 inches annually, while mean annual rainfall for the full watershed is 56 inches (EPA, 2001).

1.7.7 Hydrologeologic Findings

Marine sandstone and shale underlie the Caspar-Creek Sub-Watershed (Cafferata and Reid, 2013). The soil is well drained and varies from loams and sandy loams to gravelly loams in texture (Riitiman and Thorson 2006). The Noyo River watershed is primarily underlain by the Franciscan Formation (WCW, 2007). Elevated marine terraces near the coast indicate that the area is experiencing uplift (WCW, 2007). The Big River watershed geology is composed of the Franciscan formation that contains sandstones and shales (Warrick and Wilcox, 1981). The Big River is mainly underlain by the coastal belt of the Franciscan Complex; however, the eastern portion of the watershed is underlain by the central belt, which contains more pervasively sheared and disrupted rock.

In a groundwater study conducted by the California Department of Water Resources (DWR) for the town of Mendocino in 1989, five major underlying rock formations were identified to be within the northern Coast Range geomorphic province. While the bulk of the rocks are a part of the Franciscan Complex, other formations include the Gualala Block, marine terrace deposits, alluvium deposits, and beach and dune deposits (DWR, 1989). Topography in the area is dominated by northwest-trending high ridges and narrow valleys shaped by the San Andreas Fault that crosses the southern boundary of Mendocino County. The San Andreas Fault is a 25-million-year-old, right-lateral strike-slip fault separating Jurassic to Cretaceous Franciscan rocks in the east from Cretaceous and Tertiary Gualala Block rocks in the west. The San Andreas is accompanied by the Maacama Fault, also a right-lateral strike-slip fault, which cuts through the Ukiah, Willits, Little Lake, and Laytonville Valleys.

The Franciscan Complex is made up of three structural belts: the Eastern Belt, the Central Belt, and the Coastal Belt (Blake, 2002). Eastern Belt rocks tend to be the most metamorphosed, while Coastal Belt rocks tend to be the least. The Coast Range geomorphic province contains rocks primarily from the Coastal Belt, but also from the Central Belt. Coastal Belt rocks are the youngest in the Franciscan Complex dating from Late Cretaceous to Late Eocene. This formation is composed of greywacke, sandstone, and shale. Sandstone is poorly sorted, medium-grained, and angular. These rocks have experience relatively little deformation but are deeply weathered (DWR, 1989).

The Gualala Block consists of 20,000 feet of marine sediments that are Upper Cretaceous to Miocene in age. Rocks within this formation consist of shale, sandstone, conglomerate, and basalt. They have been recently deformed through faulting and folding by the San Andreas Fault. In the study done by DWR, the Gualala Block is divided into four sub-formations: the Gualala Series, the Galloway and Schooner Gulch Formation, the Monterey Formation, and the Iverson Belt (DWR, 1989).

Both the Franciscan Complex and the Gualala Block are considered to be nonwater-bearing formations, meaning that except for locally and where the rocks are highly jointed or fractured, they do not absorb, transmit, or yield water readily (DWR, 1958).

Marine terrace deposits lie along the Northern California coastline, 50 miles long (Rockport to Point Arena) and up to five miles inland (NCHR, 2004). These discontinuous uplifted marine sedimentary deposits range from 1 to 140 feet thick, and are thickest in Fort Bragg. These rocks are Pleistocene in age and have been uplifted above sea level over the past 0.5 million years. Marine terrace deposits are composed of semi-consolidated clay, silt, sand, and gravel. Sand ranges from fine- to coarse-grained, clean, and well sorted to sand with a silty matrix that is poorly sorted. Gravel is fine- to medium-grained lag gravel, representing gravels deposited by ancient rivers. Permeability ranges from high in the sand and gravel to very low in the silt and clay (DWR, 1958).

Alluvium deposits are composed of stream channel and associated stream terrace deposits of clay, silt, sand, and gravel derived from the erosion of nearby bedrock and adjacent marine terrace deposits. Beach and dune deposits are located next to the ocean, composed of clean, well-sorted sands with minor amounts of well-rounded pebbles (DWR, 1989).

In 2004, the North Coast Hydrologic Region (NCHR) found the marine terrace deposits to be the primary water-bearing formation in the area. The deposits cap bedrock, making it an unconfined aquifer in which groundwater is in direct contact with the atmosphere through the open pore space of the overlying soil (NCHR, 2004). Marine terrace aquifers reach maximum storage by mid-January under normal rainfall. Wells in the region produce 1 to 75 gallons per minute, on average producing 14 gallons per minute.

The groundwater study conducted by DWR in 1989, established a monthly groundwater level monitoring program that provided data from 185 wells within their study area between Rockport and Gualala. Data from 507 "Water Well Drillers' Reports" were used to estimate aquifer characteristics and determine depth to bedrock. The study divided the area into five subunits, seen in Table 3.

Table 3: Groundwater aquifer characteristics for five subunits (Westport, Fort Bragg, Albion, Elk, Point Arena)

Subunit		Aquifer Area (ac)	Storage Capacity (ac-ft)	Percent Change in Storage Spring to Fall
Westport	Qt	1,470	2,910	34
Westport	Qal	1,000	6,000	1 to 8
Fort Bragg	Qt	20,000	80,800	17
Albion	Qt	10,100	26,800	18
Elk	Qt	2,840	2,270	80
Elk	Qal	215	1,290	8
Point Arena	Qt	5,930	18,400	37
Point Arena	Qal	3,830	13,800	8
Study Area Total	Qt	40,340	131,180	18 to 80
Study Area Total	Qal	5,050	21,090	1 to 8

Qt = Marine terrace aquifers
Qal = Alluvial aquifers

In May 1962, 15 wells in Fort Bragg indicated well water to be a sodium bicarbonate-chloride type water of good mineral quality with sporadic amounts of ferrous iron and sulfates. There was found to be no seawater intrusion although localized occurrences in wells drilled below sea level near Point Arena have been noted (NCHR). Mendocino County Division of Environmental Health provided NCHR with chemical analyses data of well water showing iron concentrations as high as 20 to 40 milligrams per liter in some wells. High iron content occurs in water from deep bedrock wells, as well as from shallow terrace deposit wells. The presence of hydrogen sulfide in some wells from the Fort Bragg area to the Point Arena area was reported by coastal residents but was found to be an isolated problem.

Most marine deposits lie well above sea level, making them insusceptible to seawater intrusion. In May and August 1980, two wells experiencing seawater intrusion were analyzed by USGS and found to have moderate to high electrical conductivity, chloride content of 120 and 3000 milligrams per liter (DWR, 1989). These wells were found to be drilled below sea level and within close proximity to the ocean.

2.0 WATERSHED IDENTIFICATION

2.1 Watershed and Sub-Watersheds

The Coastal Mendocino County Stormwater Resource Plan includes three HUC-10 Watersheds. The southernmost is the Big River Watershed which covers 181 square miles and is the largest of the three Watersheds. North of the Big River Watershed resides the Noyo River Watershed, which covers 113 square miles. The Noyo covers the northeastern half of the SWRP boundary from Clair Mill to the coast, splitting the last and smallest watershed, the Pudding Creek-Frontal Pacific Ocean Watershed. The Pudding Creek-Frontal Watershed borders the Pacific Ocean and covers 72 square miles. In total the SWRP area covers 367 square miles.

The Big River Watershed contains four sub-watersheds: the North Fork Big River Watershed, the South Fork Big River Watershed, the Upper Big River Watershed, and the Lower Big River Watershed. These sub-watersheds are roughly the same size, being 44, 55, 33, and 50 square miles respectively. The North Fork covers the northernmost section of the Big River Watershed while the South Fork covers the southern and southeastern section of the Watershed. The Upper Sub-Watershed covers the eastern side of the Watershed, leaving the Lower Sub-Watershed to cover the western extent.

The Noyo River Watershed contains four sub-watersheds: the Lower Noyo River Watershed, the South Fork Noyo River Watershed, the Upper Noyo River Watershed, and the North Fork Noyo River Watershed. The largest of the sub-watersheds, the Lower Noyo Watershed, is located in the northwestern section of the watershed and covers 34 square miles. The Lower Noyo is also notably long, stretching over 13 miles, and is fed by each of the other three sub-watersheds before emptying into the Noyo Bay in Fort Bragg. The other three Noyo River Watersheds are: the Upper Noyo, the North Fork, and the South Fork. The Upper Noyo sits on top of the Big River Watershed and covers 27 square miles. The North Fork is the smallest of the sub-watersheds, covering 25 square miles, and feeds the Lower Noyo. The South Fork watershed covers 27 square miles and resides underneath the Lower Noyo. It is completely separated from the North Fork and the Upper Noyo.

The Pudding Creek-Frontal Pacific Ocean Watershed contains three sub-watersheds: the Virgin Creek-Frontal Pacific Ocean Watershed, the Pudding Creek Watershed, and the Hare Creek-Frontal Pacific Ocean Watershed. The Hare Creek-Frontal Pacific Ocean Watershed is the largest of the sub-watersheds, ranging over 40 square miles. The Hare Creek-Frontal Pacific Ocean Watershed covers the southernmost area of the Pudding Creek-Frontal Pacific Ocean Watershed and is split by the Noyo River Watershed, leaving a small sliver of area in Fort Bragg while the rest is south of the Noyo River. The next largest sub-watershed is the Pudding Creek Watershed, which covers 17 square miles. It is an abnormal shape with two long arms, one stretching east on top of the Noyo River Watershed, while the other stretches west and splits the Virgin Creek-Frontal Pacific Ocean Watershed before out letting into the Pacific Ocean in the northern part of Fort Bragg. The last and smallest sub-watershed is

the Virgin Creek-Frontal Pacific Ocean Watershed which only covers 15 square miles. As previously mentioned, the Virgin Creek-Frontal Pacific Ocean Watershed is split by the Pudding Creek Watershed. The southern area only covers the small area in Fort Bragg that is north of the Noyo River and south of Pudding Creek. The northern section of the Virgin Creek-Frontal Pacific Ocean Watershed ranges from the western border of the Noyo River Watershed to the Pacific Ocean.

2.2 Land Use and Open Space

The Pudding Creek Watershed enters the Pacific Ocean at Pudding Creek Beach, located south of MacKerricher State Park. This site is used for recreational purposes and is supported and protected by sandy beaches along the lagoon. Pudding Creek Watershed is surrounded by private property and is adjacent to undeveloped forest area (WCW 2007). The creek forms around the northern perimeter of Fort Bragg's residential area and is the source of water for the former industrial Georgia Pacific Mill Site (FBMID No. 1, n.d.).

The three major landowners of the Noyo River watershed are Hawthorne Timber Company (HTC), Mendocino Redwood Company (MRC), and Jackson Demonstration State Forest (JDSF). Approximately 78% of the Noyo Watershed is zoned Inland Forest Land or Inland Timber Preserve, such industrial zoning still remains the primary land use even with timber representing a diminished share of the region's local economy.. The timber harvest practice has caused several impacts to the watershed, including evapotranspiration through vegetation removal, increasing surface runoff, and the removal of instream woody debris. Such alterations have resulted in the 303(d) listing of the Noyo River for sediments (NCRWQCB, 2005). Road development and maintenance have caused an excessive amount of sedimentation in the Noyo River watershed and soil surface compaction that can interfere with soil permeability. Sub-watersheds i.e. Little North Fork Noyo and Lower South Fork Noyo have high road density that can cause disruption and barriers to the forest ecosystem by altering wildlife populations and aquatic and terrestrial migration. Additional impacts to the soil originate from the Sierra Railroad, which operates the Skunk Train, transverse along the Noyo River watershed. Other minor land uses in the basin include ranching and recreation (Waterboard, n.d.). The mouth of the Noyo River is dominated by a marine and fish processing facility that supports the local fishery industry, making it one of the major fishing fleets between Bodega Bay and Eureka.

The North Coast Watershed Assessment Program (NCWAP) divided the Big River Basin into three subbasins (Coastal, Middle, and Inland). The Coastal basin contains the entire downstream confluence of the Peterson Gulch which travels from the Noyo RIver basin to the Pacific Ocean. Much of the land in the subbasin is owned and managed by the Department of Parks and Recreation (DPR). The Middle subbasin is located above Peterson Gulch and is mostly owned by timber harvesting companies such as the Mendocino Redwood Company (MRC) and Hawthorne Timber Company (HTC). The Inland subbasin includes North and South Fork Big River and is primarily owned by the MRC, Strategic Timber Trust and the Jackson State Demonstration Forest (JDSF) and is managed for timber production and recreation. There are a large number of smaller, privately owned parcels near the western borders and the small hamlet of Orr Springs lies near the headwaters of the South Fork Big River (Downie et al., 2006a).

2.3 Public Agency Boundaries

North and south of Pudding Creek beach, is the California Coastal National Monument owned by the Bureau of Land Management (BLM). The water agencies surrounding the mouth of Pudding Creek before it enters into the Pacific is the City of Fort Bragg (agency unit 919). The Regional Water Control Board boundaries include the mouth of Pudding Creek and travels east of Highway 1 approximately 0.14 miles.

A large percentage of the Noyo River watershed is publicly owned. Approximately 19% of the basin is owned by the State of California and managed by the California Department of Forestry and Fire Protection (CDF) as a demonstration forest (EPA Region IX, 1999). The Environmental Protection Agency (EPA) draft total maximum daily load (TMDL) report in 1999 involved the Regional Water Board for insight regarding the watershed.

The 2006 Big River Basin Assessment is a project developed by the North Coast Watershed Assessment Program (NCWAP). From the program's establishment by the California Legislature, the agencies issued the role of management include the California Resources Agency and the California Environmental Agency. Participatory resources agency departments include the department of Fish and Game (CDFG), forestry and Fire Protection (CDF), Conservation/California Geologic Survey (DOC/CGS), and Water Resources (DWR) in conjunction with the North Coast Regional Water Quality Control Board (NCRWQCB), and the State Water Resources Control Board (Downie et al., 2006b).

2.4 Surface and Groundwater Resources

The western portion of the Noyo River watershed and Pudding Creek watershed has been classified as "very low" priority under the California Statewide Groundwater Elevation Monitoring (CASGEM) groundwater basin prioritization. The CASGEM Groundwater basin prioritization map of the northern region does not include the coastal area of Mendocino County (CA DWR, 2014). Therefore, when utilizing the Department of Water Resources collected and analyzed groundwater data findings in the California's Groundwater Bulletin 118, no data is available for Big River's groundwater level trends, storage, budget, and quality (CA DWR, 2004).

2.5 Water Quality Priorities

Following the 2006 raw wastewater spill into the Pudding Creek Beach, Fort Bragg's Department of Environmental Health (DEH) water quality samples north and south of the lagoon area displayed low concentrations of bacteria in ocean water near the mouth of Pudding Creek. However, the bacteria in the lagoon water exceeded water quality standards due to the warm water found in the lagoon.

The Noyo River watershed has been placed on the 303(d) list of the Clean Water Act, due to the water body's inability to support all beneficial uses or meet water quality objectives and describing the pollutants that limit its use or prevent attainment of its water quality objectives. The Noyo Rivers' water quality problems are related to sedimentation and the impact it has on the cold water fishery industry. Sediment delivery into the Noyo River has generally increased since 1933 and has contributed to the decline of the salmonid population within the watershed. The EPA's 1999 Noyo

River Total Maximum Daily Load for Sediments Report has concluded that the rate of sediments entering into the watershed is associated with the railroad, harvest areas, roads, and skid trails.

3.0 WATER QUALITY COMPLIANCE

3.1 Activities Contributing to Polluted Runoff

The majority of potential pollutant sources throughout the Big River, Noyo River, and Pudding Creek Frontal Pacific Ocean watersheds are sediment related. Together, these activities contribute to polluted runoff and/or impair the beneficial use of stormwater and dry weather runoff. Table 4 contains a summary of potential pollutant sources and the associated pollutants.

Table 4: Summary of potential pollutant sources

Water Body	Potential Pollutant Source	Pollutant
Big River	Abandoned and unimproved roads	Sediment
	Legacy logging	Sediment
	Livestock entering waterbodies	Nitrogen, Phosphorous, Ammonia, and microbes
	Aging septic systems	Nitrogen, Phosphorous, Ammonia, and microbes
	Rock quarry	Sedimentation
	Landfill	Trash, waste, leachate
	Historic lumber mills	Hydrocarbons
	Underground fuel storage tanks	Hydrocarbons
	Fuel Spill	Hydrocarbons
Noyo River	Legacy logging	Sediment
	Abandoned and unimproved roads	Sediment

3.1.1 Big River

Section 303(d) of the federal Clean Water Act mandates State Governments to identify water bodies that do not meet water quality standards. The Big River watershed is listed on the 303(d) List due to impairment and/or threat of impairment to water quality by sediment and temperature. On December 20, 2001, the United States Environmental Protection Agency (EPA) established the Big River Total Maximum Daily Load (TMDL) for Sediment. A TMDL is used to attain and maintain water quality standards for the designated impaired water body. Implementation of a temperature TMDL is still in development.

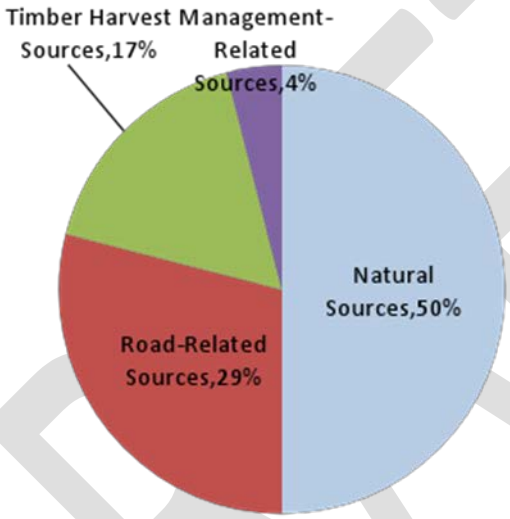
3.1.1.1 *Sediment*

High levels of slope erosion and excessive sediment loading in the Big River can be partially attributed to legacy logging and abandoned/unimproved roads along the Big River watershed. As of 2016, 86 percent of the basin has experienced one or more timber harvests (CWPAP, 2016).

In the 2001 TMDL Report, the EPA explains that Native California Coho populations have declined by 80 to 90 percent from their populations in the 1940's. Salmonid populations are affected by a number of factors, however excessive quantities of sediment or changes in sediment grain-size distribution adversely affect salmonid development and habitat (EPA, 2001).

The TMDL for the Big River was determined to be 393 tons per square mile per year. Non-point sources related to landslides, road surface erosion, and skid-trail surface erosion are allocated 78 tons per square mile per year and background sources are expected to generate the remaining 315 tons per square mile per year. Background sources include soil creep, fluvial erosion, and landslides due to non-management sources (EPA, 2001). The following diagram is based on the EPA calculations of the proportion of sediment delivered by source, based on sediment delivery dates from 1933 to 1957.

Exhibit 1. Sediment delivery rates pie chart (adapted from NCRWQCB, 2008)



As roads are considered to be the largest non-natural contributor to sedimentation, efforts to reduce sediment from roads are anticipated to be highly effective in reducing overall sediment to meet the TMDL. A greater reduction is expected to come from road-related surface erosion (87 percent), rather than from road-related landslides (77 percent) due to the difficulty in controlling landslides (EPA, 2001). Approximately 1 percent of sediment erosion is attributed to skid trails, so lesser reductions are needed. While sediment from skid trails will remain insignificant, sedimentation from roads is expected to reduce from 29 to 8 percent of the current sediment load. Landsliding in timber harvest and grassland areas is currently contributing 15 percent and 4 percent, respectively, to the total sediment load. Using the best conservation and land management measures, the overall sediment load contribution from timber harvest and grassland areas are expected to be reduced in half, to 7 percent and 2 percent, respectively (EPA, 2001).

3.1.2 Noyo River

The Noyo River Watershed is listed on the 303(d) List due to impairment and/or threat of impairment to water quality by sedimentation.

3.1.2.1 *Sediment*

Legacy logging and road building have been identified as contributors to sedimentation and sediment discharge. The majority of the roads are unsurfaced and seasonal which increases surface erosion potential (EPA, 1999).

On December 16, 1999, the EPA established the Noyo River Total Maximum Daily Load (TMDL) for Sediment at 470 tons per square mile per year. Background sedimentation sources include landslides, surface erosion, and stream bank erosion. These background sources are expected to generate 300 tons per square mile per year and the remaining 100 tons per square mile per year are expected to be generated from land use activities. These values were determined by the sediment loading rate from 1933 to 1957 based on the assumption that sustainable populations of salmonids were present during that time period.

Sediment load allocations of related mass wasting, surface erosion, and stream bank erosion are 91 tons per square mile per year, 75 tons per square mile per year, and 200 tons per square mile per year, respectively. The combined load allocation for harvest areas, skid trails, and railroads has been estimated to be 32 tons per square mile per year. Road related sediment sources such as surface erosion, mass wasting, and fluvial erosion have been allocated a total of 68 tons per square mile per year.

3.1.2.2 *Other Pollutants*

Additional pollutants have been recorded in the watershed, including a case in 1992 in which wood treatment with diesel, pentachlorophenol, tetrachlorophenol, and dioxins contaminated the surface water. The Skunk Train, which runs on 40 miles of track along the Noyo River, has creosote and metals that are of concern to the water body. Furthermore, continued herbicide use on forestlands and frequent oil spills in the Noyo Harbor have been recorded (NCRWQCB, 2005).

3.1.3 Casper Creek

In a report by Rice et al. in 1979, erosion rates demonstrated that logging activities in the South Fork Caspar Creek produced 27,185 cubic yard per square mile in excess erosion (Rice et al, 1979). Erosion and sedimentation rates were determined in units of cubic yards of erosion/sediment per square mile of land disturbed. Sediment delivery ratios were calculated as the sedimentation rate over the erosion rate. A sediment delivery ratio of 0.183 was determined for logging-related erosion and 0.224 for combined road construction and logging related erosion, along the South Fork Caspar Creek. (Rice et al., 1979)

Sedimentation data indicates that Pre-Forest Practices Act Logging in the South Fork Caspar Creek significantly increased erosion and sediment delivery compared to post-Forest Practices Act logging in the North Fork Caspar Creek. Even with Post-Forest Practices Act logging along North Fork Caspar Creek, management activities were responsible for 92 percent of the total erosion measured in that area. Excess sediment loads associated with Post-Forest Practices Act are correlated with an increase in storm flow volumes along Caspar Creek (NCRWQCB, 2001).

3.1.4 Pudding Creek

The main stem of Pudding Creek is listed on the 303(d) List with a TMDL required status for water temperature based on flow alteration and removal of riparian vegetation (SWRCB, 2010). The maximum weekly maximum temperature is 16°C. No other water quality impairments are listed on the 303(d) List.

3.2 Strategies to Address Pollutant Runoff and Sources

3.2.1 State of California

In 1972, the Environmental Protection Agency (EPA) established the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES permit authorizes State Governments to regulate water pollution by monitoring point sources that discharge pollutants into U.S. water bodies (EPA, 2017). Stormwater from industrial sites, construction sites, and municipal stormwater systems are monitored by the NPDES permit program (SWRCB, 2017). To regulate and reduce stormwater pollutant discharge, the California State and Regional Water Boards implemented the Municipal Separate Storm Sewer System (MS4) Permits, California Department of Transportation Phase I MS4 Permit, the Statewide Construction Storm Water General Permit, and the Industrial Storm Water General Permit (SWRCB, 2017).

Stormwater entering municipal systems is regulated by requiring sewer system operators to comply with the MS4 permits. The MS4 permits are divided into two phases. Phase I MS4 permits apply to municipalities that serve over 100,000 people and are issued by the Regional Water Boards. The State Water Board issues Phase II MS4 permits to small municipalities that serve less than 100,000 people, and to non-traditional small operations such as hospitals. The Phase II Small MS4 General Permit in Mendocino County applies to the unincorporated areas of the County that have a high population (over 10,000 people) and high population density (at least 1,000 residents per square mile), affecting properties in the vicinity of Fort Bragg, but not within the city limits. The City of Fort Bragg has an additional Phase II MS4 permit that covers the entire incorporated area of the City. The California Department of Transportation Phase I MS4 permit was established to regulate stormwater discharge from the California Department of Transportation (Caltrans); which is the largest stormwater discharger in California. All state highways, including Highways 1 and 20 that pass through the study area, must comply with this permit. The Construction General Permit (CGP) regulates stormwater from construction sites that disturb more than one acre of soil. The CGP requires dischargers (construction sites) to implement best management practices (BMP)'s during and after construction to reduce sediment and pollutants from the site's discharge. Non-compliance with the CGP can result in a Cleanup and Abatement Order, issued by the NCRWQCB. To comply with the Industrial General Permit (IGP), industrial companies in the study area, such as manufacturing facilities, wastewater treatment plants, recycling facilities, rock quarries, and landfills, must implement BMPs to reduce pollutants from stormwater. The IGP also requires owners to develop and monitor a Storm Water Pollution Prevention Plan (SWPPP) to meet the specified pollutant levels outlined in the IGP (SWRCB, 2017).

3.2.2 County of Mendocino

Current County of Mendocino regulatory framework and regulations assist in the effort to reduce water quality impairments that currently exist within Mendocino County. While the NCRWQCB is responsible for regulating County of Mendocino through the Phase II Small MS4 General Permit in the urban areas of Mendocino County, the County of Mendocino must ensure projects and activities within the permit area (refer to MS4 map in Attachments) and covered by the permit are in compliance. In order to do this, the County has incorporated requirements into its permitting and entitlement programs. In addition to the use of a stormwater hotline that residents may call to report stormwater pollution in their area, the County of Mendocino has prepared a Low Impact Development Standards Manual to help facilitate compliance with the requirements of the MS4 Permit. The LID Standards Manual provides guidance for the implementation of stormwater quality control measures in new development and redevelopment projects in unincorporated areas of the County with the intention of improving water quality and mitigating potential water quality impacts from stormwater and non-stormwater discharges (Mendocino County, 2017). The County of Mendocino Coastal Zoning Code places additional standards on development within the coastal zone, so as to ensure that proposed developments that environmentally sensitive habitat areas (including areas of surface or subsurface drainage) will be protected from adverse impacts (County of Mendocino, 2017). The County of Mendocino has also adopted and continues to utilize the Coastal Groundwater Development Guidelines, initially established in 1989. These guidelines apply to the development of new or expanded groundwater supplies in the coastal areas of the County, and intend to assure that development is in accordance with the limitations of the local water supply (County of Mendocino, 1989).

Major efforts are being made by the North Coast Stormwater Coalition (NCSC), which works in collaboration with the County of Mendocino, to reduce stormwater pollution and protect local waterways through community outreach (NCSC, 2017). Much like the County, the NCSC has implemented a stormwater complaint hotline that residents call to report stormwater pollution in their area. A stormwater survey is also still active, inviting community members to participate so that the NCSC can gauge the public's knowledge of issues including urban runoff and other harmful discharges into local waterways. Additionally, there is currently a line of stormwater education posters available for print and download on the NCSC's website (NCSC, 2017). The City of Fort Bragg will be holding a stormwater education booth at the Fort Bragg Farmers Market in Summer 2017, as well as participating in a 5th Grade Stormwater Teaching/Education Session in the Fall of 2017.

3.2.3 Regional Efforts

3.2.3.1 *Five Counties Salmonoid Conservation Program (5C)*

In 1997, the Coho salmon was listed as a federally threatened species. In response, the Five Counties Salmonid Conservation Program (5C) was formed by Del Norte, Humboldt, Mendocino, Siskiyou, and Trinity Counties (Final Report, 2010). The goal of the Five Counties Salmonid Conservation Program (5C Program) is to seek opportunities to contribute to the long-term recovery of salmon and steelhead in Northern California. In addition, the 5C Program develops and implements education outreach efforts to the public. These efforts include community events, urban stream programs, and other venues to present conservation strategies (5C Program, 2017). The 5C Program has also created a Stormwater Management Handbook, providing an outline to best management practices for

managing stormwater so that it has minimal impacts on watershed health and salmon populations. The handbook is available to view and download on the program's website (5C Program, 2017). In collaboration with partners, the 5C effort has coordinated work on fish passage improvements, sediment reduction, habitat enhancement, and water quality improvement projects.

Utilizing a grant received from the California Department of Fish and Game, from 1998 to 2000, the 5C Program conducted an inventory of stream crossings and evaluate salmonid crossing ability in streams in Mendocino County. During this process, one 10.8-foot-diameter culvert was modified on Johnson Creek, in the southern component of the Big River Watershed (Five Counties Salmonid Conservation Program, 2006). The Mendocino County Department of Transportation worked with the California Department of Water Resources and the California Coastal Conservancy on an additional culvert retrofit project for salmonid passage on Digger Creek. The culvert restoration project took place south of the Noyo River in Fort Bragg. The 12-foot-wide 4-foot-tall culvert replaced a 6-foot-wide 4-foot tall culvert and was designed to convey the 100 year peak flow (Five Counties Salmonid Conservation Program, 2003).

3.2.3.2 *Big River Watershed*

In 2008, the NCRWQCB identified tasks designed to minimize the sediment TMDL in the Big River. Tasks include working with key stakeholders to conduct outreach and education regarding excess sediment in the watershed, funding sediment control projects through non-point source and watershed protection grants, identifying sources that produce the most egregious excess sediment, and developing and implementing waste discharge requirements (NCRWQCB, 2008). The NCRWQCB created project plans to execute the tasks described in the 2008 Study, but the necessary human and monetary resources have not yet been allocated to the projects through grant funding.

The NCRWQCB also plans to work with the Conservation Fund, Jackson Demonstration State Forest, and Coastal Ridges to enforce compliance with the measures to control excess sedimentation of surface waterways. The organizations will contact landowners, inform them of their responsibilities to control excess sediment, and develop time schedules and strategies to control excess sediment. The NCRWQCB plans to develop a conditional waiver of waste discharge requirements for Mendocino Headlands State Park in the Big River unit. The wavier will be brought before the Regional Water Board for review and will be adopted if approved. The Mendocino Redwood Company and the Regional Water Board will collaborate on developing the Habitat Conservation Plan and Natural Community Conservation Plan (HCP/NCCP). After the completion of the HCP/NCCP, the NCRWQCB plans to develop an ownership-wide waste discharge requirement for Mendocino Redwood Company that will address excess sediment after eight months of the signing of the HCP/NCCP. The NCRWQCB is collaborating with the County of Mendocino to further address sediment discharge from County roads by developing waste discharge requirements (WDRs). To meet the Big River TMDL, the NCRWQCB plans to develop WDRs for the Comptche-Ukiah Road, and work with Caltrans to prioritize, control, and monitor excess sediment along Highway 20 (NCRWQCB, 2008).

3.2.3.3 *Noyo River Watershed*

In 2008, the North Coast Regional Water Quality Control Board implemented a work plan that lists tasks and actions that the NCRWQCB plans to execute to reduce excess sediment in the Noyo River. The Noyo River tasks include working with key stakeholders to conduct outreach and education that

promotes excess sediment control, funding excess sediment control projects, identifying high priority areas that have the most egregious excess sediment sources, and developing and enforcing waste discharge requirements (NCRWQCB, 2008).

The NCRWQCB plans to work with the Irmulco Road Association, a group of residential landowners that use the Irmulco Road, to discuss excess sediment inventory, control, planning, and monitoring efforts. An effort will be made by the NCRWQCB to work with the City of Fort Bragg and County of Mendocino to improve stormwater management of rural residential water discharges (NCRWQCB, 2008).

To ensure compliance with the measures of control excess sediment prohibition, the NCRWQCB intends to collaborate with Jackson Demonstration State Forest, Barnum, Sierra Railroad, and Soper Wheeler. Through mutual efforts, landowners will understand their responsibility to control excess sediment and will coordinate a schedule to implement excess sediment control strategies. To address both water quality concerns and excess sediment, the NCRWQCB plans to develop ownership-wide waste discharge requirements for Mendocino Redwood Company and Campbell Timber Management/Hawthorne Timber Company. With collaboration from County of Mendocino, the NCRWQCB intends to develop waste discharge requirements for county roads to reduce excess sediment. Order No. R1-2013-0004 from the NCRWQCB covers activities including road maintenance, culvert maintenance, and soil disposal, and provides waste discharge requirements (NCRWQCB, 2013).

From 2006 to 2015, the California Conservation Corps installed 632 pieces of large woody debris at 351 sites spanning 12.16 stream miles throughout the Noyo River watershed. These large woody debris help create and maintain deep pools, trap cool water and provide optimal spawning and rearing habitat for salmonid species. Funding is now in place for installing an additional 327 pieces over 3.77 stream miles (NCRWQCB, 2015). CAL FIRE has improved five miles of road surface, replaced/upgraded eight stream crossings, and removed two fish passage barriers In Jackson Demonstration State Forest. Over four miles of road, an additional eight stream crossings are proposed for replacement (NCRWQCB, 2015). Private timber companies have upgraded and/or hydrologically disconnected abandoned and decommissioned roads which were historically sources of excess sediment (NCRWQCB, 2015).

3.2.4 SWRP Strategies to Reduce Sediment

State, County, and City governments have regulated development and roadway maintenance operations in order to meet TMDL requirements as described previously in this Plan. Additional regulation is not warranted, but outreach and education efforts can provide a means to further reduce sedimentation of waterways.

Proper Roadway Reclamation and Maintenance Workshops led by the SWRP TAC are proposed to educate contractors and equipment operators regarding sustainable practices for roadway maintenance and reclamation. The County of Mendocino can provide a sub-page on the SWRP Website for Outreach and Education to provide relevant information, promote, and schedule Proper Roadway Reclamation and Maintenance Workshops.

During the workshops, local professionals can describe methods of roadway development to limit concentration of stormwater flow and discuss what methods have proven useful and what issues arise from varying strategies. The Handbook for Forest, Ranch & Rural Roads, prepared by Pacific Watershed Associates, will be referenced to develop discussion points and provide recommendations for roadway maintenance and reclamation including rolling dips, out-sloping, and reduction of concentrated flow (Pacific Watershed, 2015). Incentives will include food, refreshments, and a SWRP Training Certification for contractors and equipment operators who attend. This outreach effort is not a SWRP project, due to the requirement that SWRP projects require a minimum of $250,000 for a grant, but can be included as an outreach program within the existing SWRP grant budget.

3.3 Identify, Monitoring, and Date Requirements to Support SWRP Implementation

Sediment Total Maximum Daily Load (TMDL) is the primary water quality concern for the Coastal Mendocino County SWRP study area. In-stream and watershed water quality indicators associated with sediment should be monitored to evaluate the progress toward meeting TMDL standards. In-stream indicators' target values are associated with sediment-related conditions that support salmonids and directly measure stream health. Watershed indicators assess future water quality degradation and indirectly measure stream health. Thus, watershed indicators can be used to address areas that are at a greater risk for degradation. In-stream indicators reflect years of change within the watershed while watershed indicators indicate current conditions.

In 2001, the Environmental Protection Agency established in-stream and watershed indicator target values to measure TMDL for sediment in the Big and Noyo Rivers. In-stream indicators included sediment substrate, riffle embeddedness, residual pool volume, thalweg profile, pool/riffle distribution and depth of pools, turbidity, aquatic insect production, and large woody debris. Watershed indicators include diversion potential and stream crossing failure potential, hydrologic connectivity of roads, annual road inspection and correction, road location, surfacing, sidecast fill, and activities in unstable areas. Sidecast fill is excavated soil that is placed alongside the excavation site.

3.3.1 Substrate Composition

To monitor sediment substrate composition, an annual sample is recommended during a period of low flow at riffle heads that have potential spawning reaches. Based on adequate spawning conditions for the Big River, the target goal is to have 14 percent of fines less than or equal to 0.85 millimeters and 30% of fines that are less than 6.4 millimeters (EPA, 2001). For the Noyo River, the aim is to achieve an average of 14 percent of fines that are less than 0.85 millimeters (EPA, 1999). A reduction in water flow through salmon redds, or spawning nests, can occur if excess fine sediment is present and can affect oxygen levels. Hatching fry are likely to be smothered when finer sediment deposits are present (EPA, 2001).

3.3.2 Riffle Embeddedness

Fine sediment surrounding gravel packs should be measured by riffle embeddedness. Riffle locations that are heavily embedded make spawning difficult because adult fish cannot use their tail to lift

unembedded gravels to develop necessary spawning habitat for redds (EPA, 2001). The Big River's target goal of less than or equal to 25 percent was set by the EPA based on an 1998 report from Flosi et al. that suggests that 25 percent or less of embedded sediment is preferred during spawning (EPA, 2001). The goal for the Noyo River is to increase the percentage of riffle areas that are less than 25 percent embedded (EPA, 1999). Riffle embeddedness should be approximated during low-flow periods where there are potential spawning reaches.

3.3.3 Residual Pool Volume

Mobile bedload sediment can be measured by determining the fraction volume of fine sediment that is present in a pool (Lisle and Hilton, 1992). The measurement is an indicator of pool habitat conditions. Pools filled with less fine sediment offer better food sources, protection, and resting locations. The Big River has established a goal of less than 0.21 for Franciscan fine sediment or less than 0.10 for fine sediment other than Franciscan for the Big River (EPA, 2001). An average fraction volume of 0.27 was set for the Noyo River (EPA, 1999). Monitoring should occur during low-flow periods (Lisle and Hilton, 1992).

3.3.4 Thalweg Profile

Thalweg profile is an indicator of habitat variety and complexity. High variability in the thalweg profile reflects conditions that support pool and riffle formations that can be utilized by fish for spawning. Thalweg profile indicators incorporate streambed elevations that can be used to assess sediment transportation and determine if the stream is experiencing an increase in elevation or degradation. Profiles should be measured and evaluated every 5 to 10 years during low flow periods after large storm seasons.

3.3.5 Pool Distribution and Depth

Pool distribution and depth are important for providing shelter and food for fish and is another. Based on a 1998 report, the EPA aims to increase pool frequency that is greater than 40 percent of the length of the river to establish good salmonid habitat (EPA, 2001). For the Noyo River, the goal is to obtain at least three feet in depth in third- and high-order streams for 40 percent of the habitat length (EPA, 1999). Primary pool depths that are greater than 2 feet are considered 1st and 2nd order streams and a depth greater than 3 feet are classified as 3rd and 4th order streams (EPA, 2001). Measuring and evaluation should occur every 5 to 10 years during a low-flow period after a large storm (EPA, 2001). The number of primary pools and the depth and length of pools should be recorded and evaluated.

3.3.6 Turbidity

Turbidity is an indicator of overall water quality and feeding ability of fish. High levels of turbidity reduce fish vision that affects feeding and growth. Long periods of elevated turbidity clog fish gills and suffocate salmonids. Higher turbidity levels indicate elevated concentrations of inorganic and organic material in the water. For the Big River, suspended sediment is highly correlated with turbidity levels (GMA 2001). The EPA has set a target goal of reducing turbidity until it is less than 20 percent above the naturally occurring background levels for both Big River and Noyo River (EPA, 1999, 2001).

A common method to measure turbidity is through a turbidity meter that uses a light scatter technique, which measures the light that passes through the water and is not obstructed by particles (Fondriest Environmental Inc., 2014). Turbidity should be measured during the winter when there are storm flows and data collected should include duration and magnitude of turbidity levels (EPA, 2001). To determine the contribution that management activities have on turbidity, it should be measured upstream and downstream from the activity (EPA, 2001).

3.3.7 Aquatic Insect Production

The EPA's objective to enhance aquatic insect production in the Big River is measured by Ephemeroptera, Plecoptera, and Trichoptera (EPT) trends, which are indicator species for insect habitat condition health (EPA, 2001). Water quality affects benthic macroinvertebrates and excess fine sediment negatively impacts populations (EPA, 2001). EPA recommends calculating the EPT index, percent dominant taxa, and richness index for determine the health of aquatic insect production. The EPT Index indicates the number of species divided by the total number of taxa found in EPT orders. Organisms within the EPT orders are associated with high water quality and their populations respond rapidly to both degrading and improving conditions (BJornn et al., 1997). The percent dominant taxa indicates the distribution of the ecosystem. The indicator is calculated by locating the most abundant taxa, measuring the number of organisms, and dividing it by the total number of organisms in the sample (EPA, 2001). The richness index indicates the number of taxa in a sample. A high diversity in the taxa collected typically indicates higher water quality.

3.3.8 Large Woody Debris

Large Woody Debris (LWD) is an indicator of habitat availability (EPA, 2001). An increase in LWD distribution will aid in attaining the Big River and Noyo River TMDL (EPA, 1999, 2001). LWD form pools and provide shelter for fish and influence the movement of sediment (EPA, 2001). LWD data should include the volume and number of the pieces that are the appropriate size for salmonid populations. Data should be recorded during periods of low-flow (EPA, 2001).

3.3.9 Stream Crossing Failure and Diversion Potential

The Environmental Protection Agency has set a target to reduce stream crossing failure and diversion potential in a 100-year storm to less than or equal to 1 percent for both the Noyo and Big River (EPA, 1999, 2001). Stream failures are often associated with plugged, undersized, or poorly placed culverts. The sediment volume that is discharged to the river due to crossing failures typically includes sediment from road fill and debris that has scoured channel and stream banks. Installing road ditches and omitting out-sloping roads and inboard ditches can eliminate the potential of sediment delivery into the river. There is a high risk of sediment delivery due to stream crossing failures or diversion potential in streams of the Big River (EPA, 2001).

3.3.10 Hydrologic Connectivity of Roads

A road that directly drains to a stream is considered a hydrologically connected road and increases the frequency, intensity, and magnitude of flood flows and suspended sediment. A goal of reducing

the length of hydrologic connected roads to less than or equal to 1 percent of the total length of road within the watershed has been established to reduce sediment load in the Noyo and Big River (EPA, 2001).

3.3.11 Road Inspection and Correction

An annual road inspection and correction of 100 percent of roads is recommended by the EPA to reduce sediment load. Road networks that have not experienced excessive road related sedimentation have been properly maintained, inspected, decommissioned, or have not hydraulically altered the natural stream. Typical annual inspections can be completed with a windshield survey, or observations that take place in a moving vehicle. Roads at a higher risk for sediment delivery should be addressed before the beginning of winter conditions (EPA, 2001).

3.3.12 Surfacing, Sidecast Fill, and Road Location

Road location, sidecast fill, and surfacing are indicators of roads that are at a high risk for sediment delivery. To reduce sediment input, the EPA has set a goal of increasing out-sloped or hand-surfaced roads and reducing the length of roads near streams (EPA, 2001).

3.3.13 Activity in Unstable Areas

Due to a high risk in landslides, activity in unstable areas including inner gorges, steep slopes, and headwall swales should be avoided unless a Certified Engineering Geologist assesses the area and determines that the activity will not result in an increase in sediment delivery. Reducing activity from unstable areas will minimize sediment delivery related to management activities. Decreasing clear-cut areas, road densities, and skid trail densities will reduce the amount of disturbed areas (EPA, 2001).

4.0 ORGANIZATION, COORDINATION, AND COLLABORATION

This Stakeholder Outreach, Education, and Engagement Plan is provided to address Section 5.1 of the Coastal Mendocino County Stormwater Resource Plan (SWRP) Scope Agreement, signed April 27, 2017, between the State Water Resources Control Board (SWRCB) and the Mendocino County Water Agency (MCWA) (SWRCB, 2017). The scope of work presented in Section 5.1 includes:

- 5.1- Facilitate the organization, coordination, and collaboration among stakeholders and provide opportunities for general public participation and education throughout development of the SWRP.
    - 5.1.1 – Prepare a stakeholder outreach, education, and engagement plan and submit to the Grant Manager for review and approval.
    - 5.1.2 - Conduct a minimum of two (2) stakeholder meetings and one (1) public outreach meeting for interested stakeholders over the course of development of the SWRP. At a minimum, one of the outreach meetings shall be conducted prior to Item 4.5 and include a request for stakeholders to propose multi-benefit storm water management projects.

- 5.1.3 – Develop a website for outreach pertaining to the SWRP development and submit the website link and any updates to the Grant Manager.

The objective of the SWRP is to identify multi-benefit projects that utilize stormwater as a resource, address activities contributing to polluted runoff, characterize the watersheds and planning boundaries within the SWRP area, and host Stakeholder and Technical Advisory Committee (TAC) meetings for public outreach and education purposes.

4.1 SWRP Organization Structure

4.1.1 Program Intent

In 2014, Proposition 1 was passed by California voters. Proposition 1 created a fund to allocate monetary resources to increase water supply reliability, restore and preserve fish and wildlife habitat, and develop resilient and sustainably managed water systems to withstand future and unforeseen pressures in the coming decades. In 2015, the State Stormwater Resource Plan Guidelines were prepared to build a framework consistent with the requirements of California Water Code sections 10561-10573. The Coastal Mendocino County Stormwater Resource Plan (SWRP) utilizes the State Stormwater Resource Plan Guidelines to screen and evaluate projects based on weighted benefit criteria and quantitative analysis. The potential projects will utilize stormwater as a resource for multi-benefit projects to augment water supply, identify areas of concern, enhance water quality, reduce localized flooding, and create environmental and community benefits within the three coastal watersheds included in the SWRP.

The intent of the Mendocino County Stakeholder Outreach, Education, and Engagement Plan (hereinafter, Plan) is to comply with California Water Code (CWC) § 10562, subd. (b)(4) that specifies "a stormwater resource plan shall: ...provide for community participation in plan development and implementation" (Water Code, 2009). This Plan has been developed to encourage volunteerism, public comment and input on policy, and activism in the community to develop and potentially implement projects that comply with the SWRP requirements.

4.1.2 Purpose of this Strategy

The purpose of this Strategy is to develop a public participation and involvement program to meet the requirements of (CWC) § 10562, subd. (b)(4). This Strategy identifies a range of methods, goals, and tasks the County is using or will consider using to incorporate public involvement in the development and implementation of SWRP projects.

4.1.3 SWRP Project Boundaries

The Coastal Mendocino County Stormwater Resource Plan encompasses three coastal watersheds in Mendocino County, Northern California: Pudding Creek-Frontal Pacific Ocean Watershed, Noyo River Watershed, and Big River Watershed. Furthermore, these three watersheds are broken down into 11 sub-watersheds for further accuracy when developing projects that are important to localized communities.

4.2 Coordination between SWRP Organization, TAC, Stakeholders, and SWRCB (Public Involvement and Participation Methods)

The County has chosen various public involvement and participation methods to facilitate and encourage citizen involvement in SWRP efforts. Methods include the informal and volunteering approach, those requiring a higher level of organization and funding, and mandated opportunities for public involvement (U.S. EPA, 2013). The County's informal and volunteer method includes an existing focus group and stakeholder meetings, as well as roundtable ad-hoc meetings with select stakeholders (i.e. focus groups). The County's involvement with the Integrated Regional Water Management Plan (IRWMP) is an example of a highly-organized and well-funded way to get the public involved in SWRP related projects. Mandated opportunities for public involvement include the public meetings required by Mendocino County Board of Supervisors, along with public hearing requirements.

This section provides a summary of potential public participation and involvement methods the County has available and can use at its discretion to incorporate public involvement in the development and implementation of the SWRP.

4.2.1 Public Participation and Involvement Method

4.2.1.1 *Technical Advisory Committee*

A Technical Advisory Committee (TAC) is a small group of 5 to 10 citizen volunteers recruited by County staff to provide staff with pro-bono professional-level expertise and feedback. Volunteer TAC members typically include citizens who are licensed professionals and contractors, project designers, property managers, and affected Industry representatives. As this is a volunteer group of professionals, the County works to create TAC agendas that can be completed in one-hour or less.

The TAC formed in response to the SWRP comprises representatives from the following organizations:

- Mendocino County Water Agency,
- Mendocino County Resource Conservation District (MCRCD)
- City of Fort Bragg Public Works Department
- Mendocino County Department of Transportation
- Mendocino County Environmental Health Division
- Ridge to River
- LACO Associates
- North Coast Regional Water Quality Control Board
- The State Water Resources Control Board
- Department of Fish and Wildlife

The TAC will be most useful for assisting County staff and consultants with the direction of the SWRP; ranking benefits to meet watershed-specific needs; and the identification, prioritization, and selection of multiple-benefit SWRP projects. The TAC's roles and responsibilities are:

- Suggest projects for evaluation.
- Assist in stakeholder outreach and review the Stakeholder Engagement Plan and project website.
- Provide any available data to support identification and analysis of potential projects.
- Screen proposed projects to ensure projects will meet the goals of the SWRP.
- Establish the watershed's priorities for various benefit types.
- Assign benefits to each project evaluated.
- Provide feedback for quantifying benefits and review memoranda documenting the evaluation process and methods.
- Rank and prioritize the projects for future implementation.
- Review and comment on draft SWRP documents.

The TAC Kickoff meeting occurred on July 12, 2017. The purpose of the meeting was to introduce the TAC members (see Table 5) and discuss the purpose and goals of both the committee and those of the SWRP, and identify priorities for benefit categories, primary benefits, and secondary benefits. TAC Meeting 2 occurred on August 9, 2017.. During TAC Meeting 2, the TAC discussed several topics with the focus of making the SWRP more easily understood and applied for, such as public meetings, Project Proposal Form updates and revisions, clarifications for the Technical Memorandum, revisions to be made to the Benefit Matrix, and revisions for public meetings and related material (flyers). TAC Meeting 3 is scheduled for November 16, 2017, and TAC Meeting 4 will take place in late February or early March of 2018.

Table 5: Coastal Mendocino SWRP Technical Advisory Committee Members

Name	Organization	Title
Sarah Dukett	Mendocino County Water Agency	Administrative Analyst II
Alex Straessle	Mendocino County Department of Transportation	Engineering and Technical Assistant
Trey Strickland	Mendocino County Environmental Health Division	Environmental Health manager
Chantell O'Neal	City of Fort Bragg – Public Works Department	Engineering Technician
Patty Madigan	Mendocino County Resource Conservation District	Conservation Programs Director
Colleen Hunt	North Coast Regional Water Quality Control Board	Environmental Scientist
Teri Jo Barber	Ridge to River Environmental	Hydrologist
Daniel Harrington	California Department of Fish and Wildlife	Environmental Scientist
Brian Wallace	LACO Associates	Assistant Engineer II
Chris Watt	LACO Associates	GeoEnvironmental Services Director
Ravinder Jawanda	State Water Resources Control Board	Grant Manager

4.2.1.2 *Stakeholder Meeting/Stakeholder Workshop*

The purpose of a Stakeholder Meeting is to provide a public forum at the County departmental level for presenting program updates to and exchanging important information with affected parties, including residents, business owners, environmental organizations, and in some cases, the media. This type of information exchange can be conducted as a formal meeting or as a more informal

"workshop". A Stakeholder Meeting would cover a wide-range of project topics, while a Stakeholder Workshop would focus on a single topic, such as a workshop on project prioritization.

There are many opportunities for public involvement and participation during the planning, promotion, and presentation of a Stakeholder Meeting. The County could consider inviting citizens, business owners, and organizations to help plan and organize the event. Sponsorships and marketing opportunities by businesses and organizations to garner public-attention and attract attendance are ways to help promote the event. Citizens could also serve on a panel to present a specific topic at a stakeholder meeting or workshop.

The first Stakeholder Meeting has been scheduled for October 2017 to present and seek input, while utilizing input by the TAC on SWRP project ranking, project prioritization, and evaluation criteria. The second of these meetings will take place in January 2018, at which meeting the draft SWRP will be presented.

4.2.1.3 *Stewardship*

The County of Mendocino currently participates in two regional watershed planning efforts that benefit the watersheds this SWRP is focused on: the North Coast Stormwater Coalition (NCSC) and the North Coast Integrated Regional Water Management Plan (NCIRWMP). The County is a member of the NCSC, which consists of stormwater management staff from the participating cities and counties on the North Coast of California, as well as local, state, and federal agency representatives; non-profit organizations; tribes; the California State and Regional Water Boards; consultants; engineers; graduate students; and interested community members (NCSC, 2017).

The North Coast Integrated Regional Water Management Plan (NCIRWMP) is an innovative, stakeholder-driven collaboration among local government, watershed groups, tribes, and interested partners in the North Coast region of California. The NCIRWMP integrates long-term planning and high-quality project implementation in an adaptive management framework that fosters coordination and communication among the region's diverse stakeholders. The focus areas of the NCIRWMP include restoring salmonid populations, enhancing the beneficial uses of water, promoting energy independence, reducing greenhouse gas emissions, addressing climate change, supporting local autonomy and intra-regional cooperation, and enhancing public health and economic vitality in the region's economically disadvantaged communities. The County of Mendocino became signatory to the initial Memorandum of Mutual Understandings in 2005 and signed the most recent version in 2011. The County of Mendocino adopted Phase I and II of the NCIRWMP in 2005 and 2007, respectively.

The County's participation in regional watershed planning efforts provides multiple opportunities for the County's SWRP to obtain public involvement and participation from residents, business owners, and organizations at the regional level. Meetings typically involve updates and guest speakers, and the public is invited to participate in the discussion. Regional watershed planning groups also provide a venue to share past successes and lessons learned, and contribute to a collective education and the discussion of potentially beneficial projects to further benefit local watersheds.

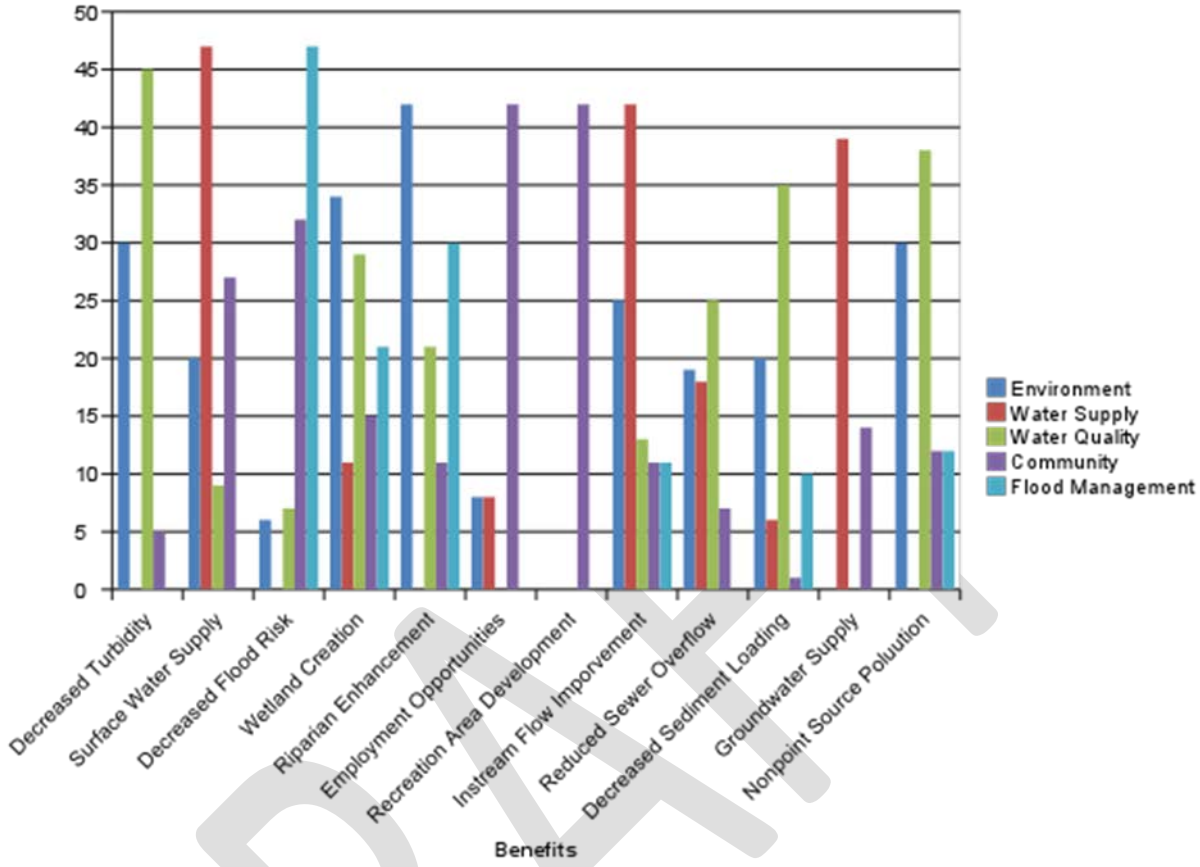
4.2.1.4 *Public Meeting*

Public meetings allow citizens the opportunity to discuss various viewpoints and provide input. For the purposes of this strategy, there are two types of public meetings: formal and informal. Compliance with applicable state, tribal, and local public noticing requirements is required to govern open meetings for local government bodies, such as, for example, local government compliance with the Ralph M. Brown Act (Government Code Section 54950 et. seq.).

On August 17, 2017, the first public meeting for the SWRP was held in Fort Bragg. In attendance from the SWRP Technical Advisory Committee were Christopher Watt, CEG, CHG from LACO Associates; Sarah Dukett, Administrative Analyst from Mendocino County Water Agency; Chantell O' Neal, Engineering Technician for the City of Fort Bragg; Teri J. Barber from Ridge to River; and Trey Strickland, Mendocino County Health Specialist. Ten people from the public were in attendance representing various organizations and local businesses. Multiple Benefit worksheets were handed out and the meeting began with introductions. Christopher Watt led a presentation of the SWRP's background and intent, and an explanation of the Multiple Benefit worksheet including examples of multiple-benefit projects. It was announced that a fillable PDF document would be created and available online for those unable to attend the meeting. Following the SWRP presentation, Teri J. Barber led a presentation of Low Impact Development (LID) projects completed in Fort Bragg. A Q&A session, led by Sarah Dukett and Christopher Watt, followed the presentations, which focused primarily on the Multiple Benefit worksheet. The worksheet asked the participants to place twelve benefits into five major categories included on the application submission form: (1) environment, (2) water supply, (3) water quality, (4) community, and (5) flood management. The goal was to gain community input in assisting the TAC to further refine the multiple benefits associated with each category as required by the SWRP guidelines. Results from this meeting are in Appendix A.

In total, four completed worksheets were collected and their results graphed (see Exhibit 2). Decreased Flood Risk in the Flood Management category and Surface Water Supply in the Water Supply category scored highest, with several categories receiving a zero benefit ranking.

Exhibit 2. Benefit ranging by category



4.2.1.5 *Citizen Participation during Public Meeting*

Formal public meetings include a formal presentation and may include a panel, such as the Board of Supervisors or a Standing or Ad-Hoc Committee of the Board of Supervisors, to receive public comments. Citizens have the opportunity to submit written and/or verbal comments and questions to the panel or speaker. Citizens may also be invited to be part of the formal presentation, as the keynote or guest-speaker, to provide testimony and expertise about certain subjects. During local rulemaking, such as the adoption of an ordinance, the County is required to conduct specific public noticing and hold a public hearing specific to the action. County legal counsel shall be consulted for legal advice prior to the planning of formal public meetings and public hearings focused on the SWRP. Based on staff availability, a public meeting including the City of Fort Bragg is proposed.

Informal public meetings could take the form of an "open-house" during which County staff and volunteers would be available to receive input and questions in a one-on-one discussion with citizens. These would not include a formal presentation or a panel to receive public comments. Informal public meetings may involve a "charrette" format to bring together multiple stakeholders to provide feedback and develop ideas and solutions in a joint-ownership format.

4.2.1.6 *Survey and Assessment*

Survey and assessment techniques are useful for receiving feedback from citizens on specific topics or continuously over the lifespan of a program. The use of free online survey websites and comment 'customer-service' cards available to the public are examples of survey and assessment tools for researching and/or measuring citizen and stakeholder thoughts, opinions, and feelings (Shaughnessy, Zechmeister, & Jeanne, 2017). Survey and customer-service cards are appropriate for exit polling, where the target audience would be, for example, citizens who participated in a stakeholder meeting or workshop.

4.3 Goals

The goal of this Stakeholder Outreach, Education, and Engagement Plan is to establish a framework of advisable public outreach steps the County can utilize.

1. Consider development of a citizen advisory group (either a stand-alone group or utilize an existing group or process). The advisory group may consist of a balanced representation of all affected parties, including residents, business owners, and environmental organizations in the SWRP watershed area.
2. Create opportunities for citizens to participate in the implementation of Best Management Practices (BMPs) and Project ideas/submission through promoting community activities (e.g. stream/beach/lake clean-ups, volunteer opportunities, and educational activities).
3. Ensure the public can easily find information about the status and implementation of SWRP.
4. Actively engage in the North Coast Resource Partnership (NCRP); North Coast Rivers Watershed Management Area (NCRWMA), a group dedicated to public outreach and watershed health that includes Big River, Pudding Creek, and the Noyo River Watersheds.

The goals above are further detailed in the following sections.

4.3.1 Goal 1: Develop Public Involvement

The adoption and processes used to gain funding from California Proposition 1 is relatively new. To aid in the development of a strategy during this ongoing process, County staff have developed a simple Project Submission Form online to identify possible projects to serve local watersheds. Appropriate County staff will complete a review on each project submission and make contact with potential applicants such as public agencies, nonprofit organizations, public utilities, and mutual water companies to further strengthen the citizen-to-County methods of communication. Contact is made either through a phone call, or by a Stakeholder Outreach Letter (Appendix, C), to either let the agency know their projects are eligible or if not, to come to the Stakeholder Outreach meeting to further analyze and clarify their projects benefits and goals. In line with strengthening the citizen-to-County communication, a table of eligible stakeholders was created outlining business/agency names, their mailing addresses, and their phone numbers to create an organized reference sheet to better reach out to the community (Appendix D). The table is utilized to contact agencies that are eligible to participate either through contributing projects to the SWRP or by attending the Stakeholder Outreach meeting and invite them to provide projects for further analysis in the SWRP.

Task: Project Submission Form

An example of a completed project submission form is attached in Appendix B. The purpose of the submission form is to outline specific project details such as location, sponsors, and benefits both primary and secondary. Contact information is requested in order to respond to project submissions in regards to seeking more information or moving forward with the project.

Task: Continue to use existing group and processes to obtain citizen involvement and participation

The County is using several existing processes as well as groups to obtain citizen involvement and participation. Opportunities for citizen participation are widespread such as with the Russian River Watershed Association, North Coast Stormwater Coalition, and the North Coast Integrated Regional Water Management Plan. The County is currently benefiting from citizen input at focus groups and stakeholder workshops (see Section 2.1 [Public Participation and Involvement Methods]). The County also has a contract with the Mendocino County Resource Conservation District (MCRD) to provide tabling at events with stormwater information, stormwater education efforts at schools, and river clean ups.

The County will continue to build upon the use of existing groups and processes to obtain citizen involvement and participation. Use of existing groups and processes is thought to be cost effective because it reduces duplication of effort. Some circumstances may warrant the formation of a new group or process, such as forming a Technical Advisory Committee to work on a specific task (e.g. review of proposed projects under a specific sub-watershed with special requirements).

4.3.2 Goal 2: Create Opportunities for Citizens to Participate

Task: Create opportunities for citizens to participate in the implementation of BMPs through sponsoring activities (e.g. stream/beach/lake clean-ups, storm drain stenciling, volunteer monitoring, and education activities)

As a Member Agency of the Russian River Watershed Association, the County contributes financially to sponsoring activities of the Association. The County is also a member in the North Coast Stormwater Coalition and The North Coast Integrated Regional Water Management Plan (NCIRWMP).

Membership in these organizations create numerous opportunities for citizens to participate in the implementation of various BMPs, such as Creek Week, Regional Safe Medicine Program, Urban Creek Care, Creek Signage, LID Manuals, Car Wash Kits, Pet Waste Signs, and other monitoring and educational activities.

Active participation on this task by County staff means receiving and allocating these resources from the regional watershed organizations to citizens. County staff will develop an annual work plan to incorporate elements of the annual work plans for each of the three above-mentioned regional providers.

4.3.3 Goal 3: Provide Stormwater Program Information to the Community

Task: Ensure the public can easily find information about the County's Stormwater Program

The County website will be the primary location and clearing house regarding the SWRP and the office locations will be the primary source for hard-copy information. Hard copies of these

informational resources will also be available at public events, such as stakeholder meetings and workshops.

4.3.4 Goal 4: Participate in Watershed Planning

Task: Actively engage in the [County's] IRWMP (Integrated Regional Watershed Management Program) or other watershed-level planning effort

Since approximately 2005, the County has been actively involved in the NCIRWMP and its planning, policy, and grant programs. Beginning in 2015, Proposition 1 (passed 2014) planned to invest $285 million in projects of statewide importance over a 10-year period, with 70 percent of those funds allocated to Coastal Wetlands and Anadromous Salmonid habitat which make up large portions of watersheds being focused on by the SWRP (CDFW, 2017). Mendocino County watersheds have benefitted from approximately $8,000,000 in watershed-funded projects, with more on the horizon. The NCIRWMP program was created through state bond proceeds and provides funding for watershed projects in Mendocino County and six other counties in Northern California. The North Coast Resource Partnership (NCRP), a collaborative group under the NCIRWMP, works on water and energy management challenges to reduce conflicts; integrate federal, state, regional, and local priorities; and utilize a multi-beneficial approach to identify and seek funding for the highest priority project needs throughout the region. The NCRP Policy Review Panel consists of two Board of Supervisors' appointees and alternates from each of the seven counties and three Tribal representatives and alternates selected by the North Coast tribes according to the "Tribal Representation Process", as defined in the North Coast IRWMP Memorandum of Mutual Understandings. This governing and decision-making group provides direction and oversight for the NCIRWMP process. The NCIRWMP Policy Review Panel is committed to transparency and inclusion, supporting input from stakeholders from throughout the region, as well as information sharing via the website and workshops.

4.4 Action Plan and Responsibilities

The County will identify the methods to be employed, responsible person/entity (project sponsor), attendance/participation, and reporting mechanism for each project conducted under SWRP.

The County Public Works Department staff will keep records on project submission numbers and approvals, as well all public outreach initiatives created and supported by the County and summarize this information at the end of each year. The summary will address the relationship between the public involvement and participation program element activities and the County's SWRP outcomes to further measure the effectiveness of its public involvement methods.

5.0 QUANTITATIVE METHODS

Quantitative methods described in this Section are used to evaluate changes in the benefit metrics over time. Simulation models and empirical relationships are proposed to prioritize multiple-benefit projects. Model selection is described in Section 4.0 of this Plan. Model applications to primary and secondary benefits are illustrated in Appendix 2.

5.1 Hydrologic Simulation Model Methodology

GSFLOW is a coupled Groundwater and Surface-water FLOW model that utilizes the USGS Precipitation-Runoff Modeling System (PRMS) and the USGS Modular Groundwater Flow Model (MODFLOW and MODFLOW-NWT). GSFLOW simulates coupled groundwater and surface-water flow in one or more watersheds by simultaneously simulating flow across the land surface, within subsurface saturated and unsaturated materials, and within streams and lakes. Climate data consisting of measured or estimated precipitation, air temperature, and solar radiation, as well as groundwater stresses (such as withdrawals) and boundary conditions are the driving factors for a GSFLOW simulation. GSFLOW operates on a daily time step. In addition to the MODFLOW variable-length stress period used to specify changes in stress or boundary conditions, GSFLOW uses internal daily stress periods for adding recharge to the water table and calculating flows to streams and lakes. GSFLOW can be used to evaluate the effects of such factors as land-use change, climate variability, and groundwater withdrawals on surface and subsurface flow for watersheds that range from a few square kilometers to several thousand square kilometers, and for time periods that range from months to several decades (Markstrom, 2008).

HEC-HMS is a widely used numerical model that includes a large set of methods to simulate watershed, channel, and water-control structure behavior predicting flow, stage, and timing. The HEC-HMS simulation methods represent watershed precipitation and evaporation, runoff volume, direct runoff including overland flow and interflow, base flow, and channel flow (Ford, 2008). HEC-HMS simulates surface runoff response of a river basin to precipitation, computing the streamflow hydrographs at desired locations in the river basin. Its capabilities also include a linear-distributed runoff transformation that can be applied with gridded rainfall data. An interconnected system of hydrologic and hydraulic components representing the basin must be introduced by the user (Azagra, 1999). The HEC-HMS model is limited because it cannot model branching or looping stream networks. It also cannot model backwater in a stream network.

5.2 Hydraulic Simulation Models

Hydraulic models can be coupled with Geographic Information Systems (GIS) to demonstrate channel geometry and hydraulic conditions for river and stream reaches. The effectiveness and accuracy of hydrologic simulation models is dependent on the quality of digital elevation models (DEMs) that can be obtained for the study area. Although 10-meter DEM is available for the majority of the SWRP boundary, hydraulic model results will not be sufficient. Hydraulic modeling will be most effective where one-foot LIDAR DEM data is available.

One-dimensional or two-dimensional models with steady- and unsteady-state assumptions are used to simulate high flows. Two dimensional models use terrain as a continuous surface, where one-dimensional models only consider the river and floodplain geometry at discrete locations along the length of length of the channel. Two-dimensional models can more accurately describe lateral interaction of between the main channel and the floodplain, whereas in one-dimensional models the flow is assumed to only move in the longitudinal direction (Alzahrani, 2017).

HEC-RAS (Hydrologic Engineering Center River Analysis System), developed by the United States Army Corps of Engineers in 1995 is a one-dimensional unsteady, open channel, hydraulics program. The HEC-RAS program solves the mass conservation and momentum conservation equations with an

implicit linearized system of equations using Preissman's second order box scheme (Fleenor, 2003). The required parameters for HEC-RAS include topographic data in the form of a series of cross-sections, a friction parameter in the form of Mannin's "n" values across each cross-section, and flow data including flow rates, flow change locations, and boundary conditions (Look, 2008). Early versions of HEC-RAS had the capability to calculate water surface profiles for steady-state gradually varied flow in channels, however it is unusual for natural channel flow to be steady or constant, as it decreases in the summer and increases in the winter (Alzahrani, 2017).

Limitations in steady-flow simulation include assumptions that flow is steady, flow is gradually varied, flow is one-dimensional, and river channels have small slopes (Look, 2008). The system can handle a full network of channels, a dendritic system, or a single river reach. HEC-RAS also uses grid cells, two-dimensional flow cells, or computational grid cells containing elevation and roughness data to create two-dimensional unsteady models. It uses a sub-grid bathymetry approach in which each grid cell is composed of multiple GIS cells (Alzahrani, 2017).

The original MIKE SHE model became operational in 1982 under the name Systeme Hydrologique European (SHE). It is an integrated, deterministic, fully distributed watershed, physically-based model. MIKE SHE can describe the flow within the land-based portion of the hydrological cycle including evapotranspiration, interception, overland flow, channel flow, unsaturated zone, saturated zone and river/aquifer exchange (Zhang, 2008). MIKE 11, was developed from the MIKE SHE model for water resources by the Danish Hydraulic Institute of Water and Environment. Like HEC-RAS, it is also a one-dimensional unsteady, open channel hydraulics program. The MIKE 11 scheme is setup to solve any form of the Saint Venant equations, kinematic, diffusive or dynamic (Fleenor, 2003). It can be used for detailed analysis, design, management, and the operation of both simple and complex river/channel systems. MIKE 11 simulates flow, water quality, and sediment transport in estuaries, rivers, irrigation channels and other bodies of water.

In an evaluation of numerical models the HEC-RAS and DHI-MIKE done by Fleenor in 2003, the results from a floodplain zone were compared with the two hydraulic models, showing an insignificant difference between the results calculated.

Sewer flow programs, like SewerCAD and SSOAP, are used by engineering firms to design, analyze, and plan wastewater collection systems. They address important questions such as sewer capacity and pipe size and depth by providing hydraulic modeling tools for scenarios unique to a municipality's needs. Automated designs generated by these programs can recommend the most cost-effective plans while meeting design restrictions.

5.3 Transport Simulation Models

AQUATOX predicts the fate of various pollutants, such as nutrients and organic chemicals, and their effects on the ecosystem, including fish, invertebrates, and aquatic plants. This model is a valuable tool for ecologists, biologists, water quality modelers, and anyone involved in performing ecological risk assessments for aquatic ecosystems.

Hydrus is a suite of Windows-based modeling software that can be used for analysis of water flow, heat and solute transport in variably saturated porous media. Hydrus uses linear finite element

methods to solve flow and transport partial differential equations. Hydrus uses linear finite elements to numerically solve Richard's equation for saturated-unsaturated water flow and Fickian-based advection dispersion equations for both heat and solute transport. HYDRUS models may be used to analyze water and solute movement in unsaturated, partially saturated, or fully saturated homogeneous of layered media.

HEC-RAS computes energy transport based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction, contraction, and expansion. Heat transfer from the surface water can be calculated from both the expansion and contraction of the water from temperature changes and the heat loss due to friction from those energy losses.

The Revised Universal Soil Loss Equation version 2 (RUSLE2) provides sediment transport modeling capabilities. This program is currently used throughout the engineering community to provide analysis for road development, tree removal, and agricultural development. It includes a scientific library of soil types, ground hazards (hill slides, fault lines,) and accounts for sediment characteristics, residue, and resurfacing changes. RUSLE2 primary usage is to predict rill and inter-rill erosion by rainfall and runoff analysis. Hydrologic cycles, and watershed hydrology can be quantified using Penn State Integrated Hydrologic Modeling System (PIHM) coupled with Sundials nonlinear and differential/algebraic equation library enhancement. This model can be used to calculate a total average of sediment in cubic feet per square mile. Calibration utilizes regression modeling in order to estimate the changes in sediment yield of a specific area. Each equation consists of two independent variables, the estimated sediment discharge (either suspended sediment or debris basin accumulations) and the mean discharge of the upper 25 percent of flow volume. A second regression model is used to calculate the annual debris basin accumulation.

5.4 Empirical Methods

Stormwater discharge from catchment areas is calculated using the Rational Method presented by the SCWA FCDC (SCWA, 2017), (Equation 1):

$$Q = CIA \quad \text{(Equation 1)}$$

Where

Q = stormwater flow rate (cubic feet per second)
C = runoff coefficient (from Plate B-1 in the SCWA FCDC Appendix, based upon ultimate development)
I = intensity of rainfall (inches per hour)
A = tributary watershed area (acres)

Rational Method assumptions include:

- The Rational Method is appropriate for catchment areas less than 200 acres.
- Time of concentration is less than peak rainfall intensity duration.
- Runoff is proportional to precipitation intensity.
- Uniform distribution of rainfall during storm duration.
- Minimum duration of rainfall is 10 minutes.
- Depression storage is filled prior to Rational Method calculations.
- Frequency of discharge is equal to frequency of rainfall.

Open channel flow problems can be quantified using Manning's Equation (Equation 2):

$$Q = A\frac{1.49}{n}R_h^{0.67}S_o^{0.5} \quad \text{(Equation 2)}$$

Where

Q = stormwater flow rate in (cubic feet per second)
A = channel cross-sectional area (square feet)
n = Manning's roughness coefficient
Rh = hydraulic radius (feet)
SO = maximum longitudinal channel slope (in/in)

The design utilizes a triangular channels, trapezoidal channels, and rectangular channels that have hydraulic radius and area described in Table 6.

Table 6. Manning's equation calculations for hydraulic radius and area

Channel Geometry	*Equation*	*Name*
Trapezoidal Channel Area	Rh=(b+zy)yb+2y1+z2	Equation 3
Trapezoidal Channel Hydraulic Radius	A=(b+zy)y	Equation 4
Triangular Channel Area	Rh=zyzz2+1	Equation 5
Triangular Channel Hydraulic Radius	A=zy2	Equation 6

Where b = channel bottom width (feet)
z = horizontal component of the channel slope versus 1 foot vertical
y = depth of the channel (feet)

Manning's Equation assumptions include (Mehaute, 1976):

- Uniform flow conditions.
- Energy grade line slope, water surface slope, and channel bottom slope are equal.
- Flow in channels is driven by gravity.
- Sheer stress at channel boundary is constant.

5.5 Selected Quantification Methods

Based on our understanding of the various hydrologic mathematical models and the specific benefit criteria of importance in the SWRP area, GIS and HEC-RAS were selected to be the most economically and technically effective quantitative methods for the SWRP. GIS and HEC-RAS will be used to quantify the various benefits and benefit categories that were chosen at the TAC Kickoff Meeting on July 13, 2017. The HEC-RAS Software allows users to perform sediment transport computations, water temperature modeling, one-dimensional steady flow, and one- and two-dimensional unsteady flow calculations. While the HEC-RAS program is limited to only accurately modeling seven of the benefits on its own, it can be coupled with GIS to depict several others. GIS allows users to represent spatial and geographic data that can be stored, analyzed, and managed through a wide variety of user-friendly tools. HEC-RAS has the ability to import geometric data from the GIS system to represent river system schematics and cross-sectional data. The Rational Method and Manning's Equation, described previously in Section 3.0, are also expected to be utilized in the SWRP project prioritization process.

6.0 IDENTIFICATION AND PRIORITIZATION OF PROJECTS

6.1 Company Ranch Road Project

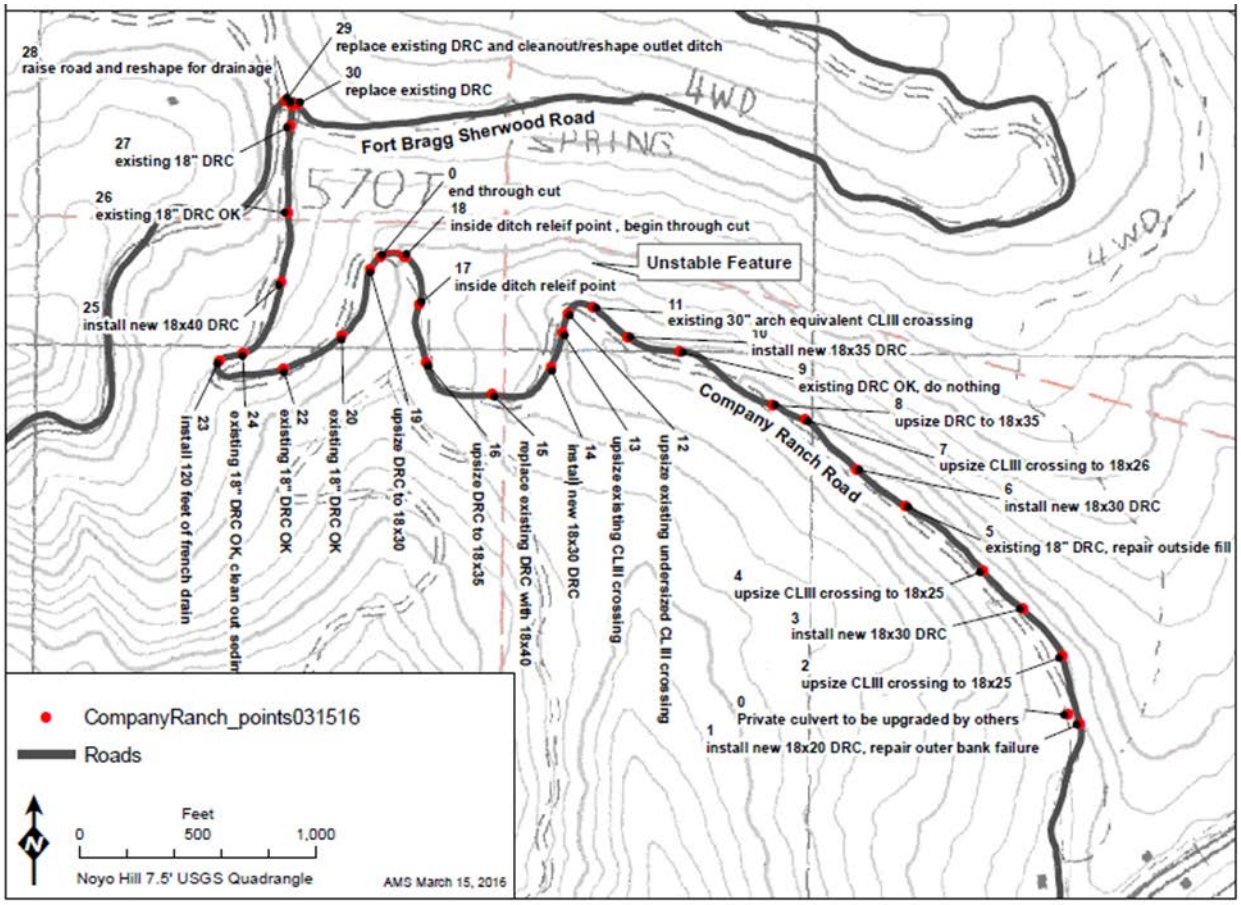
Agency/Entity: Mendocino County Department of Transportation

6.1.1 Project Description

The Company Ranch Road Project (CRRP) is located on Company Ranch Road (County Road #419A) in the Noyo River Watershed in western Mendocino County. The proposed project encompasses all 1.4 miles of Company Ranch Road with two sites on Fort Bragg Sherwood Road that are considered pertinent to addressing sediment delivery from Company Ranch Road. The project seeks to prevent sediment from entering the Noyo River basin through the use of sediment reduction treatments on Company Ranch Road. The Direct Inventory of Road Treatments (DIRT) indicates up to 2,150 cubic yards of sediment may be prevented from entering the Noyo River over a 10-year period through Pacific Watershed Associates' (PWA) accepted treatment prescription protocols modified for use on county roads. Proposed treatment, shown in Exhibit 3, includes: installing six new ditch relief culverts; upsizing five stream crossing culverts; replacement of six ditch relief culverts; and other sediment reduction treatments such as out-sloping, rolling grade breaks, removal of outside berm, repair of erosion areas, and rock surfacing.

The Noyo River watershed supports an anadromous fishery and is listed on the 303(d) impaired water bodies by the State of California because of water quality deficiencies related to sedimentation. Sediment loading in the watershed is caused by logging, overgrazing, and road building. Fish in the fishery include the steelhead trout, Coho salmon, and Chinook salmon, which are all classified as endangered species under the federal Endangered Species Act. The watershed provides habitat for migration, spawning, reproduction, and early fish development.

Exhibit 3. Proposed Treatment of Company Ranch Road



6.1.2 *Project Prioritization*

Projects are assigned a score as a method to prioritize SWRP projects. The score is generated from a technical score, a TAC score, and assigned bonus points. The technical score is calculated from the weights given for the project's benefits. The TAC score is calculated from scores assigned by TAC for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Bonus points are also given by TAC on a scale of 1 to 10.

6.1.2.1 *Technical Score*

Weights for Calculating a Technical Score

A technical score is generated from weight values assigned to the project's benefits. The project's benefits and assigned weight values are summarized in Table 7 below. Weight values for the benefits are assigned using benefit metric weighting criteria.

Table 7. Summary of benefit weights relevant to the Company Ranch Road project

Benefit Category	Weight	Benefit Type	Benefit	Weight	Reasoning
Environmental	3	Primary	In-Stream Flow Improvements	3	Reducing sediment loading to the stream channel will allow it to regain its natural morphology. Culverts will help to increase flow during the dry season while decreasing flow during storm events.
			Riparian Enhancement	2	Decreasing sediment loading will reduce turbidity which will benefit riparian habitat.
		Secondary	Improvement of Fish and Wildlife Habitat	3	Anadromous fish like the Coho salmon and steelhead trout depend on gravel beds for spawning and step pool channels for development. When sediment load is too high it causes degradation of these habitats.
			The Reestablishment of Natural Hydrographs	3	The natural hydrograph will be reestablished as reaches of the stream channel respond to decreased sediment loading and regain natural channel morphologies.
Water Quality	3	Primary	Nonpoint Source Reduction	3	Decreasing turbidity and sediment loading will benefit nonpoint source reduction.
			Decreased Turbidity	1	The proposed treatments of Company Ranch Road will decrease turbidity because an estimated 2,150 cubic yards of sediment would be prevented from entering the Noyo River over a 10-year period.
			Decreased Sediment Loading	2	Sediment loading would decrease because the proposed treatments of Company Ranch Road

					would prevent an estimated 2,150 cubic yards of sediment from entering the Noyo River over a 10-year period.
Community	2	Primary	Employment Opportunities	1	Employment opportunities will be created for the construction of the proposed treatment of Company Ranch Road.
Flood Management	1	Primary	Reduce Stormwater Runoff Rate & Volume	2	The Installation of six new ditch relief culverts, upsizing five stream crossing culverts, replacing six ditch relief culverts and other sediment reduction treatments such as out-sloping, rolling grade breaks, removal of outside berm, repair of erosion areas, and rock surfacing will reduce stormwater runoff rate and volume.
		Secondary	Decreased Flood Risk	1	Reducing runoff rate and volume from the proposed treatments will help to decrease flood risk.

Metric Value Comparison

The metric comparison value is used to differentiate between similar projects. The Company Ranch Road project is comparable to the State Park Legacy Logging Road Rehabilitation project, so it receives a metric comparison value calculated as the ratio between the cost benefits of the two projects. The cost benefit for the Company Ranch Road project is estimated as $221 per cubic yard of sediment saved. The cost benefit of the State Park Legacy Logging Road Rehabilitation project is $70 per cubic yard of sediment saved. The average cost per sediment savings for the similar projects is calculated to be $145.50. The metric comparison value is then calculated to be 0.65. This metric comparison value is used for the benefits of nonpoint source reduction, decreased turbidity, and decreased sediment loading.

Calculating the Technical Score

The technical score is calculated from the weight of the benefit category, the weight of the primary benefit, and the weight of the secondary benefit. The technical score can be calculated as follows:

Technical Score = (iWCi[2jWPj+kWSk]

Where WCi = the weight of benefit category i
WPj = the weight of primary benefit j
WSk = the weight of secondary benefit k

Technical Score = 3[2(3+2)+(3+3)] + 3[2(3+1+2)(0.65)] + 2[2(1)] + 1[2(2)+1] = 80.3

The technical score is calculated to be 80.3.

6.1.2.2 *TAC Score*

Weights for Generation a TAC Score

The TAC score is generated from weight values assigned by TAC to account for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Table 8 is provided for TAC's assigned weight values on a 1 to 10 scale.

Table 8. TAC Scores for Company Ranch Road Project

Description	Score (1-10)
Environmental Benefit	8.2
Technical Feasibility	8.7
Economic Feasibility	5.8
Community and Partner Involvement	5.3
Shovel Readiness	5.7
CEQA Preparation	4.2
Match Funding	6.3
Bonus Points	5.2

Environmental Benefit

The proposed treatments of Company Ranch Road could prevent 2,150 cubic yards of sediment from entering the Noyo River over a 10-year period. Reducing sediment load into Noyo River will provide multiple environmental benefits, but the primary benefit is it will help to preserve and restore habitat for the anadromous fish populations including the steelhead trout, Coho salmon, and Chinook salmon, which are all classified as endangered species under the federal Endangered Species Act. Anadromous fish like the Coho salmon and steelhead trout depend on gravel beds for

spawning and step pool channels for development, and when sediment load is too high it causes degradation of these habitats.

Technical Feasibility

The project plan, design, and activities are clearly identified. The objectives, approach, and scope of work are clearly identified and technically sound. The project has been discussed with the Sponsor, the Department of Transportation. Funding is most likely to be matched by the Five Counties Salmonid Conservation Program (5C Program). The project would likely be completed on schedule, regardless of if there be any reasonable constraints such as unfavorable weather conditions, planting seasons, and operational conditions.

Economic Feasibility

Local area stakeholder support for the project is demonstrated. The project has been discussed with the Sponsor and match funding is highly likely through the 5C Program. The 5C Program has provided a planning grant to the Department of Transportation to develop the project and provide necessary studies and permits to prepare for an Implementation Grant. The construction costs to treat Company Ranch Road is estimated between $450,000 and $500,000. Based on averages from 2013 and 2014 contract culvert costs, the cost of 19 culverts and related work is estimated at $171,800. Reshaping and rock resurfacing is estimated at $267,200 considering the delivered material cost, labor cost, and equipment cost. The total estimated cost is estimated at $483,000 considering the contract documents and construction administration costs, and using a 10-percent rule of thumb. The project would also result in decreased maintenance costs of the road from the storm proofing treatments and will improve the habitat for anadromous fish which also benefits a cold-water fishery on the Noyo River.

Community and Partner Involvement

The treatment of Company Ranch Road will provide multiple benefits that include improved road conditions for the local residents and public; decreased maintenance costs; and enhanced protection of beneficial uses that relate to anadromous fish populations which inhabit the Noyo River. The 5C Program is committed to reducing erosion, improving water quality, and restoring anadromous habitat in Northern California through the development and implementation of conservation standards. The 5C Program was formed in 1997, by the Board of Supervisors of Del Norte, Humboldt, Trinity, Siskiyou and Mendocino Counties, in response to the Coho salmon being listed under the Endangered Species Act. The 5C Program has done a comprehensive deliverable sediment source analysis for county roads based off the Pacific Watershed Associates' road inventory and prescription protocols modified for county roads. From the road erosion inventories, the 5C Program has goals to identify sites that supply sediment to waterways along county roads and facilities; to assure economic, biological, management, and physical effectiveness by prioritizing implementation treatments; and to identify sites where spoils from construction and maintenance projects can be stored as a preventative measure of sediment delivery into watercourses.

Shovel Readiness

The project proposal does not indicated if it is shovel ready, but the project is technically sound and has a thorough site plan and cost estimate.

CEQA Preparation

CEQA exemption status is unknown.

Match Funding
The proposal states that match funding will be identified, likely through the 5C program.

Bonus Points
Bonus points are assigned by TAC on a scale of 1 to 10 based on the committee's support for the project.

6.2 City of Fort Bragg – Trash Capture

Agency/Entity: City of Fort Bragg

6.2.1 Project Description

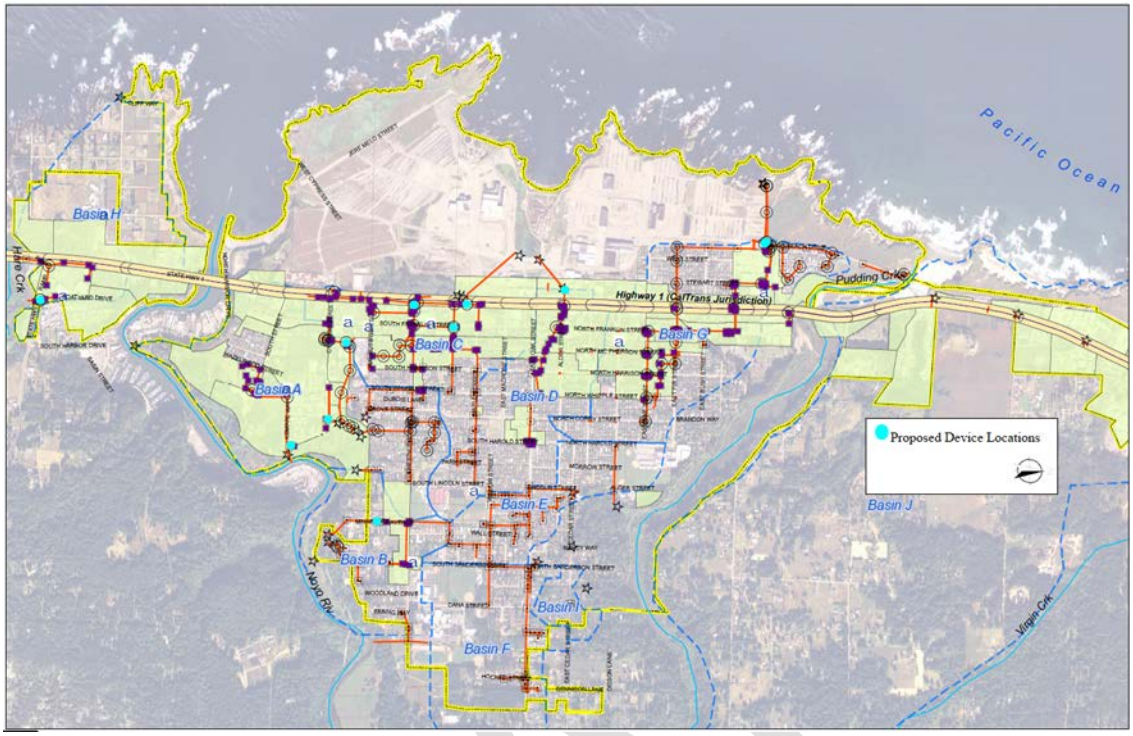
The City of Fort Bragg Trash Capture project is located throughout the City of Fort Bragg. The proposed project identifies key nodal points in the storm drain system to install state-certified trash capture devices, as part of implementation of Track 1 in the statewide Trash Provisions. The City of Fort Bragg is designated as a Phase II MS4, which is regulated through the statewide general permit received (Water Code Section 13383 Order) with the new regulations, including the Trash Provisions. The Order requires the City of Fort Bragg to capture 100 percent of trash runoff from priority land use areas, by achieving 10 percent compliance per year over 10 years. The Order establishes the priority land use areas as: residential lots with at least 10 developed lots per acre, industrial land uses, commercial land uses, and public transportation stations, with substituted land use areas approved on a case-by-case basis. There are approximately 583 acres of priority land use areas with the city limits.

The two options available for full-capture of the trash load include 149 catch basin insert devices or 12 high-flow capacity devices. The high-flow capacity trash capture devices chosen for the project are grate-style, rather than net-style, and are included in the technologies approved by the State Water Resources Control Board (CA-SWRCB 2017). Through cost comparisons, the high-flow capacity devices were chosen; however, the City of Fort Bragg has determined that six high-flow capacity technology devices will be installed as a pilot study, before determining if the remaining six devices will be installed and finding funding for their installation. The proposed pilot study will also include additional development of a public outreach education program. Maintenance in this pilot study will be conducted twice a year, before the spring and fall rains, and additionally as necessary.

6.2.1.1 *Project Area*

The City of Fort Bragg has been divided into 10 drainage basin (A to J), each of which is served by a separate storm drain system (Exhibit 4). Trash collectors are generally located along Main Street and Glass Beach.

Exhibit 4. Map of drainage basin and proposed trash capture device locations



The drainage basins vary greatly between each other, so they are described below in regards to the drainage area and the applicability of trash capture devices for each storm drain system (Table 9).

Table 9. Ten drainage basins with respective drainage areas (acres), priority land uses, and descriptions of runoff and the applicability of installing trash capture devices

Drainage Basin	Drainage Area (acres)	Priority Land Use[1]	Description
A	205	C, R	Runoff generally flows toward a logging road, into an open natural channel, and ends up in the Noyo River. **Three** locations have been identified for placement of trash capture devices.
B	100	R	Runoff generally flows toward the Noyo River directly down steep slopes. **One** location has been identified for placement of a trash capture device.
C	130	R, C	Runoff moves across Main Street to the Georgia-Pacific log pond[2]. **Three** locations have been identified for placement of trash capture devices.
D	104		Runoff is carried in a single pipeline down the center of the drainage area (aka Alder Creek). Cross drains prevent standing water at intersections by conveying gutter flow downstream. **One** location has been identified for placement of a trash capture device.

E	76	--	Runoff drains toward an old duck pond near Alder, discharges to an open channel in Johnson Park, and then flows into Pudding Creek. **No** locations are identified for the installation of trash capture devices.
F	144	R	Runoff is directed toward Pudding Creek. **No** locations are identified for the installation of trash capture devices.
G	174	R, C, I	Runoff meets from two main branches of the existing drainage system at Glass Beach, which then discharges into the Pacific Ocean. **Three** locations have been identified for placement of trash capture devices.
H	142	R, C	The existing drainage system is primarily Caltrans and private lines, so the applicability of the state mandate is currently undetermined. **One** location has been identified for placement of a trash capture device.
I	17	R	**No** locations are identified for the installation of trash capture devices.
J	983	R, C, I, rural	A majority of drainage area is outside of city limits, but the runoff is all directed toward the city storm drain system. The existing system consists of ditches and culverts with no built infrastructure to support installation of trash capture devices. **No** locations are identified for the installation of trash capture devices.

1] C - commercial, R - residential, I - industrial
[2] The Georgia Pacific log pond is approximately 10 acres, with 30 percent of the City's stormwater, from a 233-acre area (Basins C and D), discharged into the pond on its path to the Pacific Ocean. The log pond has become a wetland of its own accord, containing several aquatic plant species and potentially providing treatment to the stormwater before its end destination.

6.2.1.2 *Project Cost*

The two types of trash capture devices approved by the state are: (1) a catch basin insert at every drain inlet of an identified priority land use area, and (2) a high flow capacity or in-line device installed at specified manhole locations. The catch basin insert method would require installation at the 149 identified priority land use drainage inlets, while the high-flow capacity device would require installation of 12 devices. The lifetime of the project has been estimated as the 10 years, used to determine the total annual operation and maintenance costs for the project. The accuracy of this lifetime depends on the adherence to maintenance of the trash capture devices. The maintenance costs account for physical maintenance of the devices, as well as, public outreach and education to decrease the trash loading rates into the stormwater system.

The estimated unit cost for each of the catch basin insert devices is $1,250, with annual maintenance of $500 per device per year, while the unit cost for each of the high-flow capacity devices is $25,000, with annual maintenance of $1,800 per device per year (Table 10). The cost of full capture over 10 years results in $840,000 for a system with the catch basin insert devices and $516,000 for a system with the high-flow capacity devices. The City of Fort Bragg decided on the high-flow capacity devices to achieve 100 percent trash capture, and plans to implement 6 of the 12 devices in the 2018/2019 fiscal year. The estimated cost to install and maintain the **first six** devices is **$258,000**.

Table 10. Unit capital and maintenance costs for the two trash capture device options

Device	Capital Cost ($/device)	Maintenance Cost ($/device/year)
Catch Basin Insert	1,250	500
High-flow Capacity	25,000	1,800

Additional budget is necessary to account for: the development of a public outreach education program; the additional waste management needed to dispose of the trash captured by the devices; and a study and corresponding report on the effectiveness of the trash capture devices and the public outreach program. The current public outreach program includes visiting schools twice a year, with additional outreach opportunities at the local farmers market. Roughly $10,000 should be set aside for a report to evaluate the effectiveness of the pilot study in terms of the trash capture devices, public outreach, and maintenance. The report will document the installation of the six trash capture devices, describe the ability of the devices to fully capture the trash load, identify the quantity of trash collected, and quantify the environmental benefits from the trash capture system implementation. This report will also be part of an attempt to obtain grant funding for the remaining six high-flow capacity trash capture devices to complete the trash capture system.

6.2.2 *Project Prioritization*

Projects are assigned a score as a method to prioritize SWRP projects. The score is generated from a technical score, a TAC score, and assigned bonus points. The technical score is calculated from the weights given for the project's benefits. The TAC score is calculated from scores assigned by TAC for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Bonus points are also given by TAC on a scale of 1 to 10.

6.2.2.1 *Technical Score*

Weights for Calculating a Technical Score

A technical score is generated from weight values assigned to the project's benefits. The project's benefits and assigned weight values are summarized in Table 11 below. Weight values for the benefits are assigned using benefit metric weighting criteria.

Table 11. Summary of benefit weights relevant to the City of Fort Bragg Trash Capture Project

Benefit Category	Category Weight	Benefit Type	Benefit	Benefit Weight	Reasoning
Environmental	3	Primary	Trash Capture	3	The proposed trash capture devices are situated to capture 100 percent of the trash pollution in the city's storm sewer system.
		Secondary	Fish & Wildlife Habitat Protection and Improvement	3	Existing habitat is improved by the removal of physical dangers of trash in waterways, and removal of by-products that could be released through degradation of trash.
Water Quality	3	Primary	Nonpoint Source Reduction	3	Trash is accumulated from throughout the city, making it a nonpoint source pollutant.
			Increased Filtration or Treatment of Runoff	2	Trash capture devices filter out debris from stormwater runoff.
Community	2	Primary	Employment Opportunities	1	The trash capture devices require operation and maintenance.
		Secondary	Public Education	2	Development of an outreach program to promote trash reduction and trash loading into stormwater runoff pathways.
			Youth Education Programs	1	Development of an outreach program, which includes outreach to youth, to promote trash reduction and trash loading into stormwater runoff pathways.

Metric Value Comparison

The metric comparison value is used to differentiate between similar projects. The City of Fort Bragg Trash Capture project is not comparable to the other projects presented, so it receives a metric comparison value of 1.

Calculating the Technical Score

The technical score is calculated from the weight of the benefit category, the weight of the primary benefit, and the weight of the secondary benefit. The technical score can be calculated as follows:

Technical Score = (iWCi[2jWPj+kWSk]

Where WCi = the weight of benefit category i
WPj = the weight of primary benefit j
WSk = the weight of secondary benefit k

Technical Score = 3[(2(3)+3] + 3[2(3)+2] + 2[2(1) +(2+1)] = 129

The technical score is calculated to be 129.

6.2.2.2 *TAC Score*

Weights for Generating TAC Score

The TAC score is generated from weight values assigned by TAC to account for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Table 12 is provided for TAC's assigned weight values on a 1 to 10 scale.

Table 12. TAC scores for the City of Fort Bragg Trash Capture project

Description	Score (1-10)
Environmental Benefit	8.0
Technical Feasibility	8.5
Economic Feasibility	7.3
Community and Partner Involvement	6.0
Shovel Readiness	9.0
CEQA Preparation	9.0
Match Funding	8.5
Bonus Points	6.2

Environmental Benefit

The removal of trash from the waterways will improve habitat conditions and will directly reduce trash discharge into the ocean. There are no target species the project is rehabilitating, as defined in this qualitative measure, but there are endangered species of Coho salmon and steelhead trout. The waterways surrounding this area also discharge to a marine wildlife sanctuary.

Technical Feasibility
The project can be completed on schedule and is shovel ready. Reviewers are able to understand and evaluate the technical merits of the project, including the project plans, designs, and the activities identified. The objectives, approach, and scope of work are clearly identified and technically sound. The project is both practicable and appropriate for the location of the proposed project. The installation and maintenance of the trash capture devices is relatively involved. Compared to the other alternative, with 149 drainage inlet trash capture devices, the 12 high-flow full capture devices are less accessible.

Economic Feasibility
A cost analysis has been completed for the project that estimates unit costs of small devices, unit costs of large devices, and maintenance costs. The installation of 12 full-capture devices is less costly than the installation of the 149 drainage inlet devices. The smaller drainage inlet devices also require more time for maintenance because of the quantity of devices to clean more frequently. The City of Fort Bragg is recognized as the Sponsor and match funding is identified.

Community and Partner Involvement
Local area stakeholder support for the project was not clearly demonstrated, but the agency recognized to sponsor the project and match funding have been identified.

Shovel Readiness
The City of Fort Bragg decided on the high-flow capacity devices to achieve 100 percent trash capture, and plans to implement six of the twelve devices in the 2018/2019 fiscal year.

CEQA Preparation
A CEQA categorical exemption has been filed.

Match Funding
The City of Fort Bragg is recognized as the Sponsor and match funding is identified.

Bonus Points
Bonus points are assigned by TAC on a scale of 1 to 10 based on the committee's support for the project.

6.3 City of Fort Bragg – Wastewater Treatment Plant Stormwater Upgrades

Agency/Entity: City of Fort Bragg/Fort Bragg Municipal District No. 1

6.3.1 Project Description

A stormwater capture and treatment system has been proposed to be located at the Municipal District Waste Water Treatment Plant (WWTP). The WWTP has an area of 5.8 acres and is located along the coast in Fort Bragg. Approximately 7,000 residents in Fort Bragg are serviced by the WWTP. The site is bounded by the Pacific Ocean to the west and the rest of the site's perimeter is enclosed by fencing. Runoff from storm events is collected in a stormwater drainage system that includes 8-inch to 18-inch storm drain conduits, 15 catch basins, French drains, and two 18-inch storm drains that discharge into the ocean. If the WWTP eliminates its stormwater discharges to the ocean outfalls, it will

lower the city's regulatory requirements found in the State Water Board Order 97-03-DWQ, NPDES General Permit No. CAS000001 for ocean outfalls.

The current WWTP system (Exhibit 5) is at risk for failure due to the site's bowl-shaped topography. Plant components could potentially be inundated with stormwater because there are stormwater ponds at the center of the site's facilities and there is no way to prevent the inflow of untreated wastewater. Construction of the stormwater capture and treatment system (Exhibit 6) would involve a new interconnecting gravity storm drain system throughout the entire site. The gravity storm drain system is constructed from connecting pipelines that feed the site's stormwater to the lowest point on the site. Treatment prior to outfall would involve pressurizing the return flow to the front end of the WWTP using a stormwater pump station, a rectangular wet well, and a force main at the connection point. The designed project would have the capacity to capture, store, and treat runoff generated by a 100-year storm event. An excess approximation of 0.03 MG rainfall for the new system was generated.

The City of Fort Bragg WWTP stormwater upgrade project would provide more reliable wastewater treatment for the 7,000 Fort Bragg residents it serves. The current wastewater treatment plant drains all stormwater that falls onto the treatment plant parcel out through a standard storm drain system without treatment. The upgrade is designed to catch stormwater flow and direct it through the system for treatment before ocean outfall. Engineering was performed and an environmental review has been completed. The cost of the storm drain treatment network is estimated at $560,000. The project has an estimated lifetime of 30 years. The stormwater collection system requires annual cleaning and pumps need to be maintained based upon the manufacturer's recommendations.

Exhibit 5. City of Fort Bragg's current WWTP system

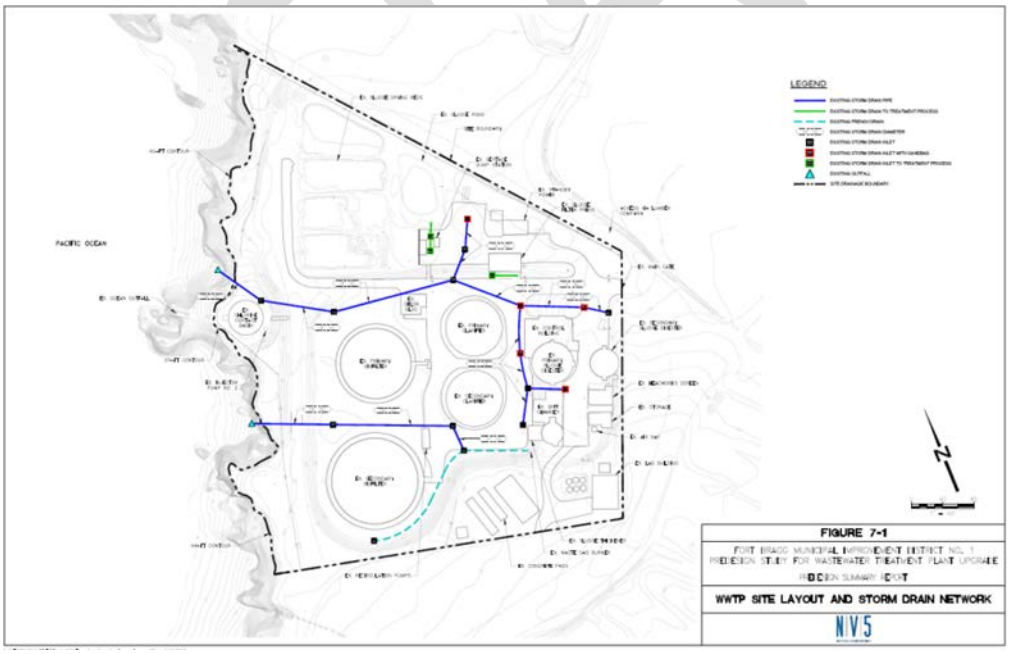
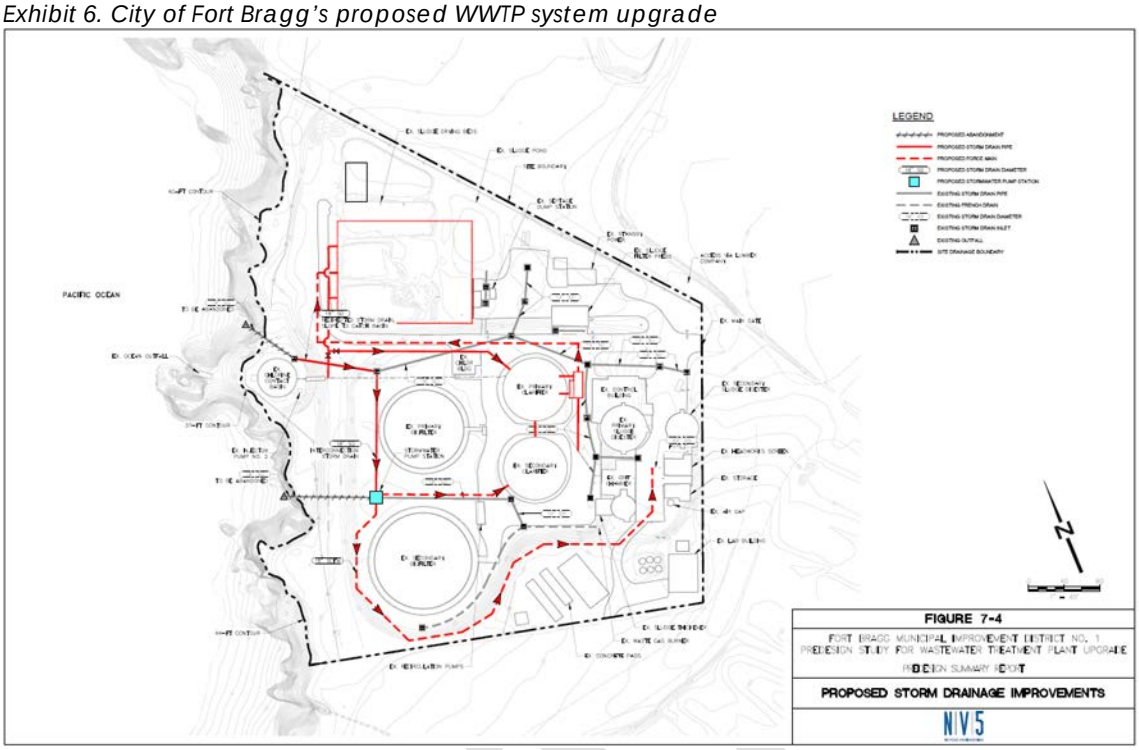


Exhibit 6. City of Fort Bragg's proposed WWTP system upgrade



6.3.1.1 *Pre Design Summary*

In a pre-design summary report the Wastewater Treatment Plant Upgrade Project was designed based off of calculations of peak runoff for a design storm. Design storms are based off recurrence intervals and storm durations. For a 100-year, 24-hour storm event, a design rainfall intensity was estimated to be 3.10 inches an hour. There are five different types of drainage areas included in the analysis including the hardscape area, the building area, open top hydraulic structures, closed top hydraulic structures, and the undeveloped area. To determine the peak runoff for the WWTP, first the different drainage types have to be evaluated for their different rates of runoff. The Rational Method, a method which weights different drainage areas using runoff coefficients was applied to get a total weighted runoff area. The total drainage area of the site was estimated to be 5.67 acres, but the total weighted runoff area, estimated using the runoff coefficients, was calculated to be 1.95 acres. To determine peak runoff the total weighted runoff area (1.95 acres) was multiplied by the design storm intensity (3.10 inches per hour). The peak runoff, based off of a 100-year, 24-hour storm was estimated to be 2,730 gallons per minute.

The design criteria to convey on-site runoff to the front of the WWTP consists of an interconnecting gravity storm drain, a triplex submersible stormwater pump station with a rectangular wet well, and a 450-foot force main. Two locations were evaluated for the stormwater pump station which are centrally located and at the lowest elevations possible. Location 1 is an existing catch basin northwest of the primary biofilter, and location 2 is an existing catch basin northwest of the secondary biofilter. Although the first location was closer to the depth to the lowest storm drain invert elevation, location 2 was the preferred location because existing utilities are avoided by routing the connecting force main to the front of the WWTP at the southern section of the site.

The design for the new system is based off of recommended improvements from the calculation of peak runoff for a 100-year, 24-hour storm. An 18-inch force main was selected for conveying stormwater from the stormwater pump station to the WWTP. The new system eliminates ocean outfalls and will have the capacity to pump all of the calculated peak runoff for a 100-year, 24-hour storm event. By rerouting the stormwater, estimations were made to evaluate the new design criteria impacts on peak hourly flow (PHF), maximum daily flow (MDF), biochemical oxygen demand 5 day (BOD_5), and total suspended sediment (TSS) concentrations. The analysis found that PHF and MDF increase incrementally while BOD_5 and TSS concentrations are diluted.

6.3.2 Project Prioritization

Projects are assigned a score as a method to prioritize SWRP projects. The score is generated from a technical score, a TAC score, and assigned bonus points. The technical score is calculated from the weights given for the project's benefits. The TAC score is calculated from scores assigned by TAC for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Bonus points are also given by TAC on a scale of 1 to 10.

6.3.2.1 *Technical Score*

Weights for Calculating a Technical Score

A technical score is generated from weight values assigned to the project's benefits. The project's benefits and assigned weight values are summarized in Table 13 below. Weight values for the benefits are assigned using benefit metric weighting criteria.

Table 13. Summary of benefit weights relevant to the City of Fort Bragg WWTP Stormwater Upgrades

Benefit Category	Weight	Benefit Type	Benefit	Weight	Reasoning
Water Quality	3	Primary	Nonpoint Source Reduction	3	Increased filtration and treatment of runoff would benefit nonpoint source reduction. The current the WWTP drains all stormwater that falls onto the treatment plant parcel out through a standard storm drain system without treatment. The upgrade is designed to catch stormwater flow and direct it through the system for treatment before outfall. Eliminating stormwater discharges to the ocean outfalls ensures compliance with the State Water Board Order and NPDES Permit.
			Decreased Sediment Loading	3	Increased filtration and treatment of runoff would decrease sediment loading.

			Increased Filtration and Treatment of Runoff	2	The new system would capture and treat all the stormwater that is currently released as untreated to the ocean outfall and therefore eliminate all stormwater discharges to ocean outfalls. The system would provide more reliable water treatment for water quality because the proposed drainage network will prevent stormwater from infiltrating into the chlorination system and gaseous chlorination tank storage area.
			Decreased Turbidity	1	Increased filtration and treatment of runoff would decrease turbidity. An evaluation of the new design criteria's impacts on biochemical oxygen demand 5 day (BOB_5) and total suspended sediment (TSS) concentrations found BOD_5 and TSS concentrations would be diluted.
Community	2	Primary	Employment Opportunities	1	Employment opportunities would be created for the construction and maintenance of the new system. Construction will require a new interconnecting gravity storm drain system throughout the entire site. The gravity storm drain system is constructed from connecting pipelines that feed the site's stormwater to the lowest point on the site. The system would require annual cleaning and pump maintenance based on the manufacturer's recommendations.
Flood Management	1	Primary	Reduce Stormwater Runoff Rate & Volume	2	The designed project would have the capacity to capture, store, and treat runoff generated by a 100-year storm event. An evaluation of the new design criteria's impacts on the system's peak hourly flow (PHF), maximum daily flow (MDF) found that PHF and MDF would increase incrementally.
		Secondary	Reduced Sewer Outflow	1	The designed project would have the capacity to capture runoff generated by a 100-year storm event. Storm events can lead to increased flows in sewer systems even if the system is not integrated with a stormwater system.

					Stormwater may enter a sewer system through inherent cracks and contribute to additional flow. If a sewer system does not have the capacity for the additional stormwater, failures may occur.
			Decreased Flood Risk	1	The designed project would have the capacity to capture runoff generated by a 100-year storm event. By reducing flood risk, critical components of the wastewater treatment system such as the control system, the pumping gallery, primary and secondary clarifiers and the trickling filters would be protected from flooding.

Metric Value Comparison

The metric comparison value is used to differentiate between similar projects. The City of Fort Bragg WWTP Stormwater Upgrades project is not comparable to the other projects presented, so it receives a metric comparison value of 1.

Calculating the Technical Score

The technical score is calculated from the weight of the benefit category, the weight of the primary benefit and the weight of the secondary benefit. The technical score can be calculated as follows:

Technical Score = (iWCi[2jWPj+kWSk]

where WCi = the weight of benefit category i
WPj = the weight of primary benefit j
WSk = the weight of secondary benefit k

Technical Score = 3[2(3+3+2+1)] + 2[2(1)] + 1[2(2)+(1+1)] = 64

The technical score is calculated to be 64.

6.3.2.2 *TAC Score*

Weights for Generating a TAC Score

The TAC score is generated from weight values assigned by TAC to account for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Table 14 is provided for TAC's assigned weight values on a 1 to 10 scale.

Table 14. TAC scores for City of Fort Bragg's WWTP Stormwater Upgrades

Description	Score (1-10)
Environmental Benefit	5.5
Technical Feasibility	7.0
Economic Feasibility	6.3
Community and Partner Involvement	4.5
Shovel Readiness	7.3
CEQA Preparation	7.7
Match Funding	7.7
Bonus Points	4.5

Environmental Benefit
Decreased turbidity would have a positive impact on the marine environment located in the proximity of ocean outfalls, but the project does not address the recovery or restoration of a target species, its age-class, and its location.

Technical Feasibility
Engineering for the project has been performed by Nolte Associates, Inc. (NV5), so the technical merits of the project are easily understood and the objectives, approach, and scope of work are identifiable and technically sound. The location of the project is practical and appropriate. The project can be completed on schedule as it is already shovel ready and ready to bid in spring 2018.

Economic Feasibility
The agency recognized to sponsor the project is the City of Fort Bragg, Fort Bragg Municipal District No.1, and match funding has been identified. The City of Fort Bragg has approximated an $84,000-match for this project, which is approximately 15 percent of the requested grant funding. This should be a qualifying amount because the City of Fort Bragg is considered a disadvantaged community. Additional funding sources would also contribute because the stormwater handling system rehabilitation is one piece of a much larger full overhaul on the WWTP, which is a $15.5M dollar project. A cost analysis for the project has been completed and the project cost for the new storm drain treatment network has been estimated at $560K. The project lifetime has been estimated at 30 years. The project would benefit the 7,000 residents in Fort Bragg that the wastewater facility serves as well as visitors by providing more reliable wastewater treatment. Maintenance costs for the stormwater collection system are expected to be minimal and the system would require annual cleaning and pump maintenance based upon the manufacturer's recommendations.

Community and Partner Involvement
The local area stakeholder support for the project was not clearly demonstrated, but the agency recognized to sponsor the project and match funding have been identified.

Shovel Readiness
The project can be completed on schedule, as it is shovel ready and ready to bid in spring 2018.

CEQA Preparation
An environmental impact report (EIR) has been completed in accordance with CEQA.

Match Funding
Match funding has been identified and the project has been discussed with the Sponsor.

Bonus Points
Bonus points are assigned by TAC on a scale of 1 to 10 based on the committee's support for the project.

6.4 DOT – County Facilities Project – LID Retrofit

Agency/Entity: Ukiah Unified School District

6.4.1 Project Description

Low Impact Development (LID) Retrofits have been proposed for the Mendocino Department of Transportation (DOT) County Facilities located within Fort Bragg. The DOT facilities indicated are the Avila Center, the Planning & Building Services building, the county DOT yard, and the county library. The LID retrofits include rain gardens, infiltration trenches, and drought tolerant landscaping (Table 12). LID improvements have been indicated to benefit in-stream flow improvement, re-establishment of natural hydrographs, re-establishing groundwater supply, water conservation, and employment opportunities.

Table 15. LID retrofits with their benefits listed (City of Santa Rosa 2017; Humboldt County 2016)

LID	Description	Benefits
Rain Garden	Bioretention areas with infiltration and filtration into soil and vegetation that provides natural physical, biological, and chemical treatment of stormwater.	• Designed to achieve volume capture and treatment requirements • Enhances water quality naturally • Aesthetically pleasing • Habitat for birds and pollinators • Can reduce heat accumulation from impervious areas
Infiltration Trench	Long, narrow gravel-filled trench that intercepts stormwater before reaching impervious (paved) areas and allows for infiltration into the soil.	• Designed to achieve volume capture • Can be used on sloped sites • Simple to install
Drought Tolerant Landscaping	Landscaping with native plants that can withstand periods of drought associated within the local climate.	• Designed to achieve volume capture • Vegetates previously impervious areas • Simple installation and does not require irrigation

The Avila Center located at 790 S. Franklin Street, is a Health & Human Services Agency Social Services facility. The Avila Center includes 1.5 acres of impervious area where the ability to infiltrate stormwater is lacking. Rain gardens and an infiltration trench with a valley gutter within the paved area are indicated to address these shortcomings. The volume of stormwater captured is estimated

at 4.6 acre feet per year. The total cost to retrofit the 1.5 acres of impervious area is estimated to be $80,000.

The Planning & Building Services facility located at 120 W. Fir Street, is a satellite government and administration facility of the Ukiah office. The facility includes a paved drive around design and typical turf grass lawn curbside; these features contribute to low infiltration and high stormwater runoff. An infiltration trench with valley gutter within the paved area, as well as removing and replacing existing turf with drought tolerant landscaping is proposed. The volume of stormwater captured is estimated at 1.2 acre feet per year. The total cost of this installation would be $50,000 to address the 0.4 acres of impervious area.

The County DOT Yard located at 120 E. Bush Street is a county roads maintenance crew operations base which serves the county with six other yards located throughout Mendocino County. The yard includes metal buildings to house maintenance equipment as well as a paved open maneuvering space, this space contributes to low infiltration and high stormwater runoff. An infiltration trench with valley gutter in front of the truck bays is indicated to address these shortcomings. The volume of stormwater captured is estimated at 0.6 acre feet per year. The total cost of this installation would be $80,000 to address the 0.2 acres of impervious area.

The County Library located at 499 E. Laurel Street is a branch of the larger Mendocino County Library system based out of Ukiah. A paved alley runs along the north side of the library's gabled roof, which contributes to the low infiltration and high stormwater runoff. An infiltration trench with valley gutter within this area is indicated to address these shortcomings. The volume of stormwater captured is estimated at 0.30 acre feet per year. The total cost of this installation would be $40,000 to retrofit the 0.1 acres of impervious area.

6.4.2 Project Prioritization

Projects are assigned a score as a method to prioritize SWRP projects. The score is generated from a technical score, a TAC score, and assigned bonus points. The technical score is calculated from the weights given for the project's benefits. The TAC score is calculated from scores assigned by TAC for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Bonus points are also given by TAC on a scale of 1 to 10.

6.4.2.1 *Technical Score*

Weights for Calculating a Technical Score

A technical score is generated from weight values assigned to the project's benefits. The project's benefits and assigned weight values are summarized in Table 16 below. Weight values for the benefits are assigned using benefit metric weighting criteria.

Table 16. Summary of benefit weights relevant to the DOT – County Facilities Project – LID Retrofits

Benefit Category	Weight	Benefit Type	Benefit	Weight	Reasoning
Environmental	3	Primary	In-Stream Flow Improvement	3	Constructing rain gardens, constructing infiltration trenches with valley gutters and removing and replacing turf with drought tolerant landscaping will help to decrease flow during storm events and increase flow during the dry season.
		Secondary	Reestablishment of Natural Hydrographs	3	Impervious areas disrupt the equilibrium between the movement of water and the movement of sediment that exists in streams and rivers, management of stormwater will help to replicate an area's natural hydrology and watershed processes.
Water Supply	3	Primary	Groundwater Supply	3	Infiltration trenches with valley gutters, rain gardens and removing and replacing existing turf with drought tolerant landscaping will increase infiltration and therefore increase groundwater supply.
		Secondary	Water Conservation	3	The LID retrofits are estimated to capture 6.7 acre-feet of stormwater per year.
Water Quality	3	Primary	Increased Filtration or Treatment of Runoff	2	Stormwater runoff is given a second chance to infiltrate into the ground where it is treated by landscape vegetation and soils. LID retrofits will help to capture rainwater before it comes into contact with contaminants.
Community	2	Primary	Employment Opportunities	1	Construction of the project will create employment opportunities. Construction of the LID retrofits includes infiltration trenches with valley gutters, rain gardens, and removing and replacing existing turf with drought tolerant landscaping.

Metric Value Comparison

The metric comparison value is used to differentiate between similar projects. The DOT County Facilities LID Retrofits project is not comparable to the other projects presented, so it receives a metric comparison value of 1.

Calculating the Technical Score

The technical score is calculated from the weight of the benefit category, the weight of the primary benefit, and the weight of the secondary benefit. The technical score can be calculated as follows:

Technical Score = (iWCi[2jWPj+kWSk]

where WCi = the weight of benefit category i
WPj = the weight of primary benefit j
WSk = the weight of secondary benefit k

Technical Score = Technical Score = 3[2(3)+(3)]+3[2(3)+(3)]+3[2(2)]+2[2(1)] = 70

The technical score is calculated to be 70.

6.4.2.2 *TAC Score*

Weights for Generating a TAC Score

The TAC score is generated from weight values assigned by TAC to account for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Table 17 is provided for TAC's assigned weight values on a 1 to 10 scale.

Table 17. TAC scores for DOT – County Facilities Project – LID Retrofits

Description	Score (1-10)
Environmental Benefit	7.5
Technical Feasibility	8.0
Economic Feasibility	7.8
Community and Partner Involvement	6.2
Shovel Readiness	5.7
CEQA Preparation	5.5
Match Funding	6.2
Bonus Points	5.3

Environmental Benefit

This project will benefit the environment through in-stream flow improvement and the reestablishment of natural hydrographs. Constructing rain gardens, constructing infiltration trenches with valley gutters, and removing and replacing turf with drought-tolerant landscaping will help to decrease flow during storm events and increase flow during the dry season. Impervious areas disrupt the equilibrium between the movement of water and the movement of sediment that exists in streams and rivers,

management of stormwater will help to replicate an area's natural hydrology and watershed processes. The project does not address the recovery or restoration of a target species.

Technical Feasibility
The project plans, designs, and activities identified are easily understood, but a sitemap is not provided. The objectives, approach, and scope of work are clearly identified and technically sound. The project is both practicable and appropriate for the locations of the proposed project. The project would involve four different locations. The project does not have enough information to determine if it could be completed on schedule, should there be any reasonable constraints such as unfavorable weather conditions, planting seasons, and operational conditions. Because there are four different locations there are many different factors to consider that could influence the schedule.

Economic Feasibility
The project is cost effective and the project budget identifies unit costs, hourly rates, and line items. Administrative overhead costs do not exceed a total of 20 percent of the total budget. Although it is not mentioned in the proposed project, a $643,000 grant was received from the State's Water Resources Control Board for demonstrating beneficial effects of LIDs on urban receiving waters. A current public works project that involves LID retrofits in Fort Bragg is the Green Alley Project which the City of Fort Bragg and the California Water Resources Control Board are partners on.

Community and Partner Involvement
Not enough information was provided to determine the local area stakeholder support.

Shovel Readiness
The project proposal does not indicate if it is shovel ready, but is most likely not because no site plans are provided for the four different locations.

CEQA Preparation
The CEQA preparation stage is unknown.

Match Funding
Match funding for the project is unknown.

Bonus Points
Bonus points are assigned by TAC on a scale of 1 to 10 based on the committee's support for the project.

6.5 Georgia-Pacific Mill Wetland Project

Agency/Entity: Noyo Headlands Urban Design Group (NHUDG)

6.5.1 Project Description

The goal of the proposed Georgia-Pacific Mill Wetland Project (GPMWP) is to reclaim stormwater and other natural water features that are buried in an underground stormwater drainage network at the Georgia-Pacific mill site, which is located on the coast of Fort Bragg. The current underground stormwater network, once intended for industrial purposes at the active mill site, is aged, undersized, rusted, and has crushed metal culverts which intercept and reroute stormwater. The current underground water network was created 30 to 40 years ago and has been recorded to leak a

significant amount of water (Birchard, 2014). Because the system is no longer applicable for industrial purposes, it is proposed to repurpose the stormwater drainage network. By daylighting the network, it can be linked to historic wetland features to benefit native plants and animals and provide urban green space.

The Georgia-Pacific Mill site was closed in 2002 and is currently under remediation. It is in a brownfields reclamation phase regulated by the California Department of Toxic Substance Control. The City of Fort Bragg is working on rezoning the parcel to plan for future development at the mill site. The planning processes have not considered subsurface waterways, but the City Council and the community are pushing to daylight Alder and Maple Creek in a channel which flows to the ocean. Although Georgia-Pacific (GP) wants to sell the property as one parcel, community interests in the past have made GP consider multiple parcels. The community is exceptionally interested in the designation of wetlands in the California coastal zone. Other interested community members include the local Pomo Indians, who would be invited for involvement as core members in the planning process to protect their ancestral grounds and resources. The process could include a coastal intertidal estuary which would come into contact with the sea. Arcadis - GP Consultants recommended an alternative path in a Remedial Action Plan (RAP), which has completed a Public Comment Period and is currently under review by DTSC. The alternative path is to occupy a meandering stream north of the millpond that crosses a beach berm and flows to a sandy beach at Soldiers Bay. The plan would create new coastal access to the sandy beach for the public.

The project would require a study evaluating existing drainage pathways for the redevelopment. Previous research has been completed to better understand old streams and wetlands, but a main concern is the risks associated with infrastructure and buried pollutants. The former GP millpond is still polluted with heavy metals and dioxin from the site's industrial brownfields. Homes and businesses have been built above Alder Creek and Maple Creek which are intercepted by the underground stormwater drainage network located on the Eastern side of Fort Bragg. Alder Creek and Maple Creek return to the subsurface after crossing Highway One and daylight approximately a mile downstream. The Creeks are routed into the old GP millpond which stores water behind an old dam which discharges into the ocean. From a 233-acre area, approximately 30 percent of the City's stormwater is discharged into the GP millpond.

It is proposed to reroute the watercourses around the millpond which is polluted by heavy metals and dioxins. By rerouting the watercourse around the millpond, it would provide a healthier habitat for visiting birds, amphibians, and terrestrial life; provide the public with more urban green space; and reduce the risk of hazards associated with the aging dam at the millpond. The site remediation would apply Low Impact Development (LID) stormwater methods for managing runoff of new developments at the mill site. Site remediation would provide revegetation of riparian corridors which serve as natural carbon sinks. Runoff from parking lots would be managed with bioswales, rain gardens, or other bioretention improvements.

Planning goals for the project include: using Sandborne Maps and longtime residents to identify natural waterways of the past; locating historic wetlands and identifying their uses through consultation with Tribal Representatives; mapping infrastructures for determining flow paths; identifying and mapping the underground stormwater drainage network and its water sources; creating a new flow path plan for Alder and Maple Creeks which includes wetlands; and to evaluate the levels of toxicity of the soil through soil sampling. The project would involve not only recognizing

the watercourse flow paths and wetlands but also 100-foot open space buffer zones to facilitate zoning for City Planning. The stormwater management plan would implement a watershed approach to the zoning, building and planning around the proposed watercourse.

6.5.2 Project Prioritization

Projects are assigned a score as a method to prioritize SWRP projects. The score is generated from a technical score, a TAC score, and assigned bonus points. The technical score is calculated from the weights given for the project's benefits. The TAC score is calculated from scores assigned by TAC for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Bonus points are also given by TAC on a scale of 1 to 10.

6.5.2.1 *Technical Score*

Weights for Calculating a Technical Score

A technical score is generated from weight values assigned to the project's benefits. The project's benefits and assigned weight values are summarized in Table 18 below. Weight values for the benefits are assigned using benefit metric weighting criteria.

Table 18. Summary of benefit weights relevant to the Georgia-Pacific Mill Wetland project.

Benefit Category	Weight	Benefit Type	Benefit	Weight	Reasoning
Environmental	3	Primary	Instream Flow Improvement	3	Daylighting Alder and Maple Creeks would create a more natural reach for the creeks and therefore improve instream flow. The Creeks are presently buried in pipes below the eastern area of Fort Bragg, and daylight approximately a mile downstream of Highway One into GP's millpond where the flow is stored by an old dam before draining to the beach below. For the proposed project the creeks would no longer discharge into the millpond and would instead be distributed in a naturalized path. The naturalized path would distribute the water to the environment and increase flow during dry seasons. By distributing water in a naturalized path to the environment, flow would also be less concentrated during storm events.
			Wetland Creation	3	The daylighted creeks would form and estuary at Soldiers Bay, creating wetlands. The creation of new wetlands could increase the local population of migratory birds. Creating new wetlands could also impact local climate conditions and increase the native plant and animal populations.
			Riparian Enhancement	2	Daylighting the creeks and revegetating the surrounding area would enhance the riparian environment. The new vegetation would shade the streams in

					the summer which would decrease evaporation. The creeks and surrounding vegetation would serve as wildlife corridors which can benefit wildlife including fish populations like the anadromous salmonids.
		Secondary	Improvement of Fish & Wildlife Habitat	3	Creating new wetlands and enhancing the riparian environment would improve the fish and wildlife habitat for marine, freshwater, and terrestrial life. The Noyo Center, just south of the site, would provide protection through their marine research.
			Re-establishment of the Natural Hydrographs	3	The creation of naturalized flow would help to reestablish natural hydrographs as the rate of flow for the creeks to return to a natural setting.
			Creation of New Open Spaces and Wildlife Corridors	2	Daylighting the creeks, creating wetlands and coastal trails would provide new open spaces and wildlife corridors. The wetlands and coastal trails would serve as new open spaces for the environment and the health of the community.
			Reduced Energy Use/Greenhouse Gas Emission/Provide Carbon Sink	1	The newly revegetated land would serve as a natural carbon sink, reducing pollution.
Water Quality	3	Primary	Nonpoint source reduction	3	There would be nonpoint source pollution control because the concentration of TSS would decrease from the suspended sediment being repurposed as point bars.
Community	2	Primary	Employment opportunities	1	New employment opportunities would be created in construction, environmental, engineering and geological practices. The designing of the watercourse, revegetation and creation of wetlands will require environmental, engineering and geological practices. There will need to be a thorough investigation and evaluation of historic and current drainage pathways. The underground pathways will need to be mapped. A watercourse will need to be designed which takes infrastructures and pollutants into account. The process of daylighting the creeks and redevelopment at the mill site will require construction. The project intends to apply low impact development stormwater techniques like bioswales and rain gardens for new developments at the mill site. To upkeep the new riparian and wetland environments, maintenance of the new vegetation will be required. Redevelopments of the mill site will also create opportunities for new businesses.
			Recreational Area Development	1	The new recreational area that is envisioned would provide a location for the public to hike on new walking trails and it would provide new access to the sandy beaches below. It would give the community a place to observe native

					plants and wildlife in the area.
		Secondary	Public education	2	The Noyo Center envisions making the coastline into a place for scientific research, hands on education, and natural resource stewardship. Coastal access would provide a new gateway to oceanographic features with significant ecosystem productivity zones of upwelling, the large Mendocino Eddy, the river ocean interface, and two underwater canyons. It will also provide access to different marine substrates including rocky benches, surge channels, and sand and cobble beaches.
			Youth Education Programs	1	The Noyo Center envisions making the coastline into a place for scientific research, hands on education, and natural resource stewardship. Restoring the site will provide a place of scientific explorations for citizens and children.
Flood Management	1	Primary	Reduce Stormwater Runoff Rate & Volume	2	Riparian enhancement and wetland creation would allow heavy precipitation to infiltrate into soil, reducing stormwater runoff rates and volumes. LID techniques would be applied to manage stormwater and decrease flood risk for redevelopments.
		Secondary	Reduced sanitary sewer overflows	1	Riparian enhancement and wetland creation would allow heavy precipitation to infiltrate into soil, reducing runoff rate and/or volume, providing flood protection and therefore reducing sanitary sewer overflows. Green infrastructure will increase infiltration and manage stormwater.
			Decreased Flood Risk	1	Riparian enhancement and wetland creation would allow heavy precipitation to infiltrate into soil, providing flood protection. Water would no longer be routed to the millpond and be held behind an aging dam. LID techniques would be applied to manage stormwater and decrease flood risk for redevelopments.

Metric Value Comparison

The metric comparison value is used to differentiate between similar projects. The Georgia-Pacific Mill Wetland project is not comparable to the other projects presented, so it receives a metric comparison value of 1.

Calculating the Technical Score

The technical score is calculated from the weight of the benefit category, the weight of the primary benefit, and the weight of the secondary benefit. The technical score can be calculated as follows:

Technical Score = (iWCi[2jWPj+kWSk]

where WCi = the weight of benefit category i
WPj = the weight of primary benefit j
WSk = the weight of secondary benefit k

Technical Score = 3[2(3+3+2)+(3+3+2+1)] + 3[2(3)]+2[2(1+1)+(2+1)]+1[2(2)+(1+1)] = 113

The technical score is calculated to be 113.

6.5.2.2 *TAC Score*

Weights for Generating a TAC Score

The TAC score is generated from weight values assigned by TAC to account for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Table 19 is provided for TAC's assigned weight values on a 1 to 10 scale.

Table 19. TAC Scores for the Georgia-Pacific Mill Wetland project

Description	Score (1-10)
Environmental Benefit	9.4
Technical Feasibility	7.1
Economic Feasibility	4.4
Community and Partner Involvement	8.1
Shovel Readiness	3.3
CEQA Preparation	5.3
Match Funding	4.6
Bonus Points	7.1

Environmental Benefit

New habitat would be created for native plants and wildlife through riparian enhancement and wetland creation. Migratory birds and native animals that are exposed to toxins in the GP millpond would be able to inhabit the new wetlands, which would decrease their exposure to toxins and therefore improve their health and development.

Technical Feasibility

There is still a lot of work that needs to be done to implement this project. The designing of the watercourse, revegetation, and creation of wetlands will require environmental, engineering, and geological practices. There will need to be a thorough investigation and evaluation of historic and current drainage pathways. The underground pathways will need to be mapped. A watercourse will

need to be designed which takes infrastructures and pollutants into account. The process of daylighting the creeks and redevelopment at the mill site will require construction. Arcadis proposed alternative pathways for the streams through occupying a meandering path north of the millpond that connects to Soldiers Bay. Metrics are provided and estimate the distance that would be daylighted, the area needed for a 100-foot buffer area of revegetation around the creeks, and the amount of impervious area that would need to be removed. Although the City of Fort Bragg, the Noyo Center, and members of the community are in support of daylighting Maple and Alder Creeks, the planning processes have ignores subsurface waterways.

Economic Feasibility
The project cost is $250,000 on the proposal, but no cost analysis was provided to support this estimate and it is likely to cost more considering the amount of research, engineering, construction, monitoring, and maintenance the project would require. According to the Noyo Center, the City of Fort Bragg has a $1.36M grant from the State Coastal Conservancy, a $4.8M grant from the Statewide Park Program, and a $348K grant from Caltrans to fund the Fort Bragg Coastal Trail and Restoration project. The Fort Bragg Coastal Trail and Restoration project involves a new 8-foot wide trail which extends over a mile of restored coastal land, but GP still owns over 300 acres. GP has been delaying clean-up of their property and is marketing the land for around $50M. GP's property is considered a brownfields site so Brownfields Grants may be available through the EPA's Brownfields Program.

Community and Partner Involvement
Many people are interested and involved in this project including the Noyo Headlands Urban Design Group, local tribes, community members, and the City of Fort Bragg. As the former GP Mill Site redevelopment began, public and municipal efforts toward diversifying and revitalizing the economy and community of Fort Bragg sparked initiative to develop the Noyo Center for Marine Science, with property just south of the GP Mill Site. It plans to develop its property to include a Marine Research Center, a Discovery Center, an exhibition space, and a campus. The Noyo Center has goals to:

- Advance marine research and education of the Mendocino Coast.
- Provide a place of scientific explorations for citizens and children.
- Place a blue whale skeleton on exhibit.
- Benefit the research and management of natural resources through assisting in the collaboration between scientists, public agencies, and private business.
- Provide support for restoring and protecting coastal and marine ecosystems.
- Increasing tourism to Fort Bragg and the surrounding coast.
- Increase the diversity of economic development in Fort Bragg and Mendocino County.
- Promote the investigation of climate variability.
- Promote education of improved resiliency.

Within 250 miles of the Northern California Coast, the Noyo Center will be the only year-round marine research and education center.

Shovel Readiness
Project is not shovel ready.

CEQA Preparation
The project is exempt from CEQA.

Match Funding
Match funding for the project has been identified and the project has been discussed with the Sponsor.

Bonus Points
Bonus points are assigned by TAC on a scale of 1 to 10 based on the committee's support for the project.

6.6 State Park Legacy Logging Road Rehabilitation

Agency/Entity: Sonoma-Mendocino State Parks

6.6.1 Project Description

The State Park Legacy Logging Road Rehabilitation projects include decommissioning old logging roads by removing culverts and associated road fill. The projects are designed to reduce the erosion and transport of sediment into waterways in the Big River watershed of Mendocino Headlands State Park. The Road Segments Inventory in Appendix B of the Engineering Geologic Resource Assessment Addendum determines there to be 8.41 miles of high priority road in the Big River Unit of Mendocino Headlands State Park (CA Geologic Survey 2008). In Appendix C, the Watercourse Crossing Inventory identified 102 high priority culverts. An inventory of sub-watersheds within the Big River watershed have been prioritized and ranked based on their potential for erosion and sediment transport into surrounding waterways. Information for the priority of sub-watersheds has been requested from the client, but has not yet been received. From the inventory, the highest priority sub-watershed that has not yet received grant funding will be adopted as the main component of this project.

6.6.1.1 *Project Area*

The State Park Legacy Logging Road Rehabilitation project area is made up of 7,334 acres near the town of Mendocino, California. The area is surrounded by Mendocino Woodlands to the northeast, Jackson State Demonstration Forest to the north, Russian Gulch State Park to the northwest, Mendocino Headlands State Park to the west, Van Damme State Park to the south, and private residential and industrial timber lands in various locations. The lower portion of the Big River watershed is within the area, along with small portions of the Albion and Little River watersheds. Between 1852 and 2002, the Big River watershed was heavily managed for commercial timber harvesting. As a result of management, there are extensive road networks and in-stream dams. In 2002 the Mendocino Land Trust purchased the Big River property from Campbell-Hawthorne Timber Company and transferred ownership to the California Department of Parks and Recreation (DPR) (*Big River Preliminary Plan: Resource Assessment and Recommendations, April 2005.)* The primary goal of the property acquisition was to preserve the Big River estuary, to protect its fish and wildlife resources, to support late seral forest characteristics, and to provide public access consistent with the protection and enhancement of natural resources. The Big River Project Area is now part of Mendocino Headlands State Park. (CRP 2005)

The project area includes one of California's most expansive and significant estuaries. Elevations range from sea level throughout the estuary to about 1,000 feet. The three watersheds with portions

lying inside the project area (Big River, Albion River, Little River) drain down steep terrain. The small tributaries are characterized by narrow, deeply incised canyons with minimal floodplain. The lower main channel of the Big River is a broad, flat valley with a developed floodplain.

Streamside landslides are a major source of sediment to the rivers. Altered drainage pathways due to roads are a major cause of the instability resulting in landslides. Inventories of the roads and hillslope conditions, developed by California Geological Survey (CGS), indicate that sediment yield comes from three main sources: (1) failure of roads, (2) erosion near or because of stream crossings, and (3) road surface and ditch erosion (CGS 2008).

The Big River project area includes saline wetlands, freshwater wetlands, riparian, coastal scrub, coastal dunes and strand, redwood forest, northern mixed evergreen forest, Bishop pine forest, and pygmy cypress type forest. These habitats provide for over 450 species of plants, including several rare or endangered species. The Big River watershed also provides for anadromous and resident salmonid populations, including endangered species of Coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*). Several special status mammals, including northern red-legged frog (*Rana aurora aurora*), Vaux's Swift (Chaetura vauxi), Marbled Murrelet (Brachyramphus marmoratus), and Northern Spotted Owl (Stix occidentalis), inhabit the project area.

Due to the listing of Coho salmon as an endangered species on both the Federal and California Endangered Species Act lists, the Five Counties Salmonid Conservation Program (5C) was formed, which includes Del Norte, Humboldt, Trinity, Siskiyou, and Mendocino Counties. The 5C's primary objectives are to reduce sediment erosion into waterways, improve water quality, and restore anadromous habitat in Northern California. The 5C created the DIRT database (Direct Inventory of Road Treatments) as a sediment source evaluation of county roads based on the Pacific Watershed Associates (PWA) standard road erosion inventory and treatment prescription protocols modified for use on county roads. The DIRT database holds information on: location along county roads and facilities that are contributing sediment to waterways; prioritization of implementation treatments to assure economic, biological, management, and physical effectiveness of reducing erosion; and location of sites where excess material generated from construction and maintenance projects can be stored with minimal potential of sediment delivery into waterways. There are 207 spoils sites identified in Mendocino County, with capacity to hold 98,701 cubic yards of material (TCPD n.d.).

The projects propose the following actions be taken to perform high priority remediation work (*Big River Preliminary Plan: Resource Assessment and Recommendations, April 2005)*.

- Consider removing or modifying roads from floodplains in order to enable geomorphic processes, to allow for creation and maintenance of side channels, to promote floodplain habitat for anadromous fish that utilize floodplain resources, and to protect sensitive wetland habitat. The extent of the floodplain should include an aquatic-terrestrial ecotone buffer.
- Minimize or modify the number of roads on steep, unstable slopes.
- Minimize or modify the number of roads that cross dormant landslides.
- Avoid re-activation of dormant slides, debris slides or other mass movement features on steep slopes where future slides are most likely to occur.
- Minimize, modify, or reroute roads that cross inner gorges.
- Rehabilitate unstable cut and fill slopes on roads close to stream channels within the 300-foot buffer.

- Re-surface dirt roads that will be maintained for public safety, future restoration effort access, and public access to minimize surface erosion, especially where road gradient is steep. Prioritize re-surfacing based on steepness, as well as impacts to known sensitive resources (e.g., aquatic habitats).
- Reroute drainage to keep water from running down the road surface or from destabilizing road fill material on sites found in regular surveys of road condition.
- Outslope roads that currently have inboard ditches; create rolling dips to disperse runoff.
- Continue to maintain culverts annually prior to the rainy season and during the rainy season in order to keep sediment and wood from plugging the culvert. Ongoing erosion control activities by DPR include culvert clearing and maintenance, and ditch and road surface improvements (R. Pasquinelli, DPR, pers. comm. 2004).
- Modify, remove, or replace culverts.
- Utilize assessment recommendations provided by CGS for determining priorities for culvert replacement or removal. Priority for culvert replacement should be based on consequences to ecological or other resources rather than solely to culvert capacity.

Roads and culverts within the State Park are prioritized, high to low, in the 2008 inventories on road segments and watercourse crossings (CGS 2008). The highest priority road segments and watercourse crossings are included in Table 20. Based on values from previous projects, it is estimated that sediment savings will be around 2,700 cubic yards of sediment savings into the streams per mile of road treated, based on sediment savings for previous road decommissioning and trail conversion projects (T. Fuller, pers.comm. 2017).

Table 20. High priority road segments and watercourse crossings in the Big River Unit of Mendocino Headlands State Park (CGS, 2008)

Road Number	High Priority Road Segment Length (miles)	No. of High Priority Watercourse Crossings
F1.0	0.26	5
L4.0	0.54	1
L4.2	0.31	0
M10.0	0.45	2
M10.1	0.15	0
L2.0	0.18	5
L2.1	0.63 (moderate)	4
L2.3	0.33	2
C1.0	0.65	1
M13.0	0.53	0
M4.0	0.09	1
L5.0	0.48	0
L20.0	0.49	0
S6.0	0.44; 0.08 (mod)	4; 3 (mod)
S5.0	0.33; 0.6 (mod)	3; 1 (mod)
S7.0	0.04; 0.2 (mod)	3; 1 (mod)
M3.0	0.39 (mod); 0.51 (low)	2
M3.1	0.19 (mod)	0
M7.0	0	7

M7.2	0.05 (mod)	2
M7.4	0.01; 0.05 (mod)	6; 1 (mod)
M7.5	0.17 (mod)	1
M7.6	0	3

6.6.1.2 *Project Cost*

The State Park Legacy Logging Road Rehabilitation project's estimated cost is roughly $160,000 per mile based on the average of two projects that have been recently completed by the DPR (T. Fuller; pers. comm. 2017). The cost estimated will vary greatly with the length of road that would be treated, volume of roadfill to be moved, number of culverts per road, and costs per unit length of road decommissioning and culvert removal, for any of the potential projects.

6.6.2 Project Prioritization

Projects are assigned a score as a method to prioritize SWRP projects. The score is generated from a technical score, a TAC score, and assigned bonus points. The technical score is calculated from the weights given for the project's benefits. The TAC score is calculated from scores assigned by TAC for the environmental benefit, technical feasibility, economic feasibility, community and partner involvement, organization qualifications, shovel readiness, CEQA preparation, and match funding. Bonus points are also given by TAC on a scale of 1 to 10.

6.6.2.1 *Technical Score*

Weights for Calculating a Technical Score

A technical score is generated from weight values assigned to the project's benefits. The project's benefits and assigned weight values are summarized in Table 21 below. Weight values for the benefits are assigned using benefit metric weighting criteria.

Table 21. Summary of benefit weights relevant to the State Parks Logging Road Rehabilitation Project

Benefit Category	Category Weight	Benefit Type	Benefit	Benefit Weight	Reasoning
Environmental	3	Primary	In-Stream Flow Improvement	3	Reducing sediment load will allow for unimpaired channel morphologies to form, which will benefit in-stream flow improvements.
			Riparian Enhancement	2	Decreasing sediment loading will help to reduce turbidity, which will benefit riparian enhancement and improve fish and wildlife habitat.
		Secondary	Fish & Wildlife Habitat Protection and Improvement	3	Decreasing sediment loading will help to reduce turbidity, which will benefit riparian enhancement and improve fish and wildlife habitat.
			Re-establishment of Natural Hydrographs	3	Another benefit of decreasing sediment load is the re-establishment of natural hydrographs because the dynamics between the hillslope and the channel will be restored to a more natural balance.
Water Supply	3	Primary	Surface Water Supply	3	Surface water supply will benefit from reduction in sediment loading, so that

					the amount of water for utilization will increase.
Water Quality	3	Primary	Nonpoint Source Reduction	3	Improving the water quality through reduction in sediment loading will also benefit nonpoint source reduction.
			Decreased Turbidity	1	Reducing sediment load will decrease turbidity.
			Decreased Sediment Loading	2	Reduction in sediment load.
Community	2	Primary	Employment Opportunities	1	Employment opportunities will be created for the construction of the proposed treatment of legacy logging roads within Mendocino Headlands State Park in the Big River watershed.
Flood Management	1	Primary	Reduce Stormwater Runoff Rate & Volume	2	Restoring natural hillslopes and reducing the concentration of flows will reduce stormwater runoff rates, and will also decrease flood risk.
		Secondary	Decreased Flood Risk	1	Restoring natural hillslopes and reducing the concentration of flows will reduce stormwater runoff rates, and will also decrease flood risk. Stopping the concentration of flows along roadways will reduce the peak runoff rates by distributing the water that reaches a waterway over a longer period of time.

Metric Value Comparison

The metric comparison value is used to differentiate between similar projects. The State Park Legacy Logging Road Rehabilitation project is comparable to the Company Ranch Road project, so it receives a metric comparison value calculated as the ratio between the cost benefits of the two projects.

The cost benefit of the State Park Legacy Logging Road Rehabilitation project is $70 per cubic yard of sediment saved. The cost benefit for the Company Ranch Road project is estimated as $221 per cubic yard of sediment saved. The average cost per sediment savings for the similar projects is calculated to be $145.50. The metric comparison value is then calculated to be 2.07. This metric comparison value is used for the benefits of nonpoint source reduction, decreased turbidity, and decreased sediment loading.

Calculating the Technical Score

The technical score is calculated from the weight of the benefit category, the weight of the primary benefit, and the weight of the secondary benefit. The technical score can be calculated as follows:

Technical Score = (iWCi[2jWPj+kWSk]

where WCi = the weight of benefit category i
WPj = the weight of primary benefit j
WSk = the weight of secondary benefit k

Technical Score = 3[2(3+2)+(3+3)] + 3[2(3)] + 3[2(3+1+2)(2.07)] + 2[2(1)] + 1[2(2)+1] = 149.52

The technical score is calculated to be 149.52.

Table 22. TAC scores for the State Park Legacy Logging Road Rehabilitation project

Description	Score (1-10)
Environmental Benefit	9.3
Technical Feasibility	8.3
Economic Feasibility	7.3
Community and Partner Involvement	7.4
Shovel Readiness	5.3
CEQA Preparation	6.9
Match Funding	7.3
Bonus Points	6.1

Environmental Benefit
The project objective is to reduce sediment loading in the river, which will improve conditions for salmonids and other aquatic species. The reduction in the sediment load will improve water quality parameters, including decreasing total suspended solids and turbidity, and increasing dissolved oxygen. All improvements to the water quality parameters will provide salmonids and other aquatic life with new or improved habitat.

Technical Feasibility
Road rehabilitation projects have been previously done within the Mendocino Headlands State Park.

Economic Feasibility
The project cost is roughly $250,000, but this estimate is likely to change depending on the project site chosen, based on the remaining road portions needing rehabilitation that have not received funding yet. The cost associated with rehabilitating a 2-mile segment of road and removing culverts had an associated cost estimate of $150,000, so this project in particular would likely be extended to including greater lengths of road to achieve the $250,000 minimum.

Community and Partner Involvement
Local area stakeholder support for the project was not demonstrated, but the agency recognized to sponsor the project and match funding have been identified. The agency recognized to sponsor the project is Sonoma-Mendocino State Parks.

Shovel Readiness
The project is not shovel ready because one project in particular has yet to be decided on. There are various road segments ready for rehabilitation; the limiting factor is finding funding for the projects.

CEQA Preparation
The project is not exempt from CEQA. There is a negative declaration application in progress.

Match Funding
Match funding has been identified and the project has been discussed with a Sponsor.

Bonus Points
Bonus points are assigned by TAC on a scale of 1 to 10 based on the committee's support for the project.

7.0 PROJECT PRIORITIZATION AND RANKING

The project prioritization after calculating the technical score and receiving TAC scores is summarized in Table 19. The TAC scores were averaged from the individual TAC scores submitted by the TAC members. The project scores are majorly influenced by the technical scores with substantial influence from the TAC scores. It is recommended that the projects be prioritized for implementation based on the ranking provided in Table 23.

Table 23. Ranking and scores for projects

Ranking	Project	Total Score
1	State Parks – Legacy Logging Road Rehabilitation	207.4
2	City of Fort Bragg – Trash Capture	191.5
3	NHUDG – Georgia-Pacific Mill Wetland	162.4
4	DOT – Company Ranch Road	129.6
5	DOT – County Facilities LID	122.2
6	City of Fort Bragg – WWTP Stormwater Upgrades	114.5

The two highest scoring projects are the State Parks Legacy Logging Road Rehabilitation and the City of Fort Bragg Trash Capture. The two projects had the highest technical scores, determined from the benefits of the project, and also received the highest overall TAC scores. For TAC scoring, the State Parks Legacy Logging Road project's highest scores were in: Environmental Benefit, Technical Feasibility, and Community and Partner Involvement. The City of Fort Bragg Trash Capture project's highest TAC scores were in: Shovel Readiness, CEQA Preparation, Technical Feasibility, and Environmental Benefit.

The three lowest scoring projects are the DOT Company Ranch Road, DOT County LID Facilities, and the City of Fort Bragg WWTP Stormwater Upgrades. The bottom three scoring projects had the lowest three technical scores, and approximately the same overall TAC score. The difference between the bottom three scores has a total range of 15.1.

The gap between the three highest scoring and three lowest scoring projects is 32.8. The NHUDG Georgia-Pacific Mill Wetland project is in between the two highest scoring and three lowest scoring projects, with a total score of 162.4. The difference in scores for the Georgia-Pacific Mill Wetland project to get up to the two highest scoring is 29.1 and to drop down to the three lowest scoring projects is 32.8, which is a sizable gap in both cases.

8.0 IMPLEMENTATION STRATEGY AND SCHEDULE

8.1 Introduction

This technical memorandum presents the Stormwater Resource Plan (SWRP) implementation strategy including the following components:

- Stakeholder Involvement;
- Performance Measures;
- Decision Support Tools;
- Monitoring and Data Requirements;
- Adaptive Management Approach;
- Achievement of Multiple Benefits; and
- Implementation Strategies and Project Tracking.

8.2 Implementation Strategies

8.2.1 Stakeholder Involvement

Stakeholders are individuals and communities who will benefit from SWRP implementation, policies, and operations. Stakeholders include the public, special interest groups, non-governmental organizations (NGOs), academic institutions, utilities, local jurisdictions, and regulatory agencies. Representatives from disadvantaged communities (DACs) are considered priority stakeholders. Stakeholder involvement requires providing a method for identifying public concerns and values, developing a consensus among affected parties, providing and disseminating information, and producing efficient and effective solutions through an open, inclusive process. Regular interaction with stakeholders is required for the SWRP to meet scope agreements, ensure that proposed projects are in accordance with stakeholder interests, and provide a sense of public ownership and support for proposed projects. Regular interaction includes communication, consistent consultation, and coordination between programs, as well as building interest, involvement, and momentum by engaging stakeholders. Communication should implement both one-way methods (providing information and education) and two-way methods (providing information and education as well as provide a method for the public to respond with ideas and comments) (Table 24).

Table 24. Outreach and communication methods

Outreach Method	Communications	
	One-way	Two-way
Website		✓
Emails		✓
Newsletters	✓	
Public Meetings		✓
Presentations		✓
Summits		✓
Partnerships		✓

Building a process designed to foster stakeholder participation is key, but before stakeholders became involved, their level of interest and existing public opinion about the SWRP were measured. Stakeholder outreach included an educational component. Letters were mailed to Stakeholders prior to the October Stakeholder meeting, and phone calls were made on behalf of the Mendocino County Water Agency.

SWRP strategies will have greater ownership and support from the community when members of the community are responsible for implementing the strategies. Implementation must include a forum where stakeholders can view projects submitted, while monitoring their status and ranking, ensuring that all stakeholders are given an opportunity to actively participate in the SWRP process. The October Stakeholder meeting provided the necessary forum to educate stakeholders, discuss submitted SWRP projects, and enable stakeholders to provide feedback with regard to project performance.

8.2.2 Performance Measures

Tracking and measuring projects for their effectiveness and ensuring they meet the benefit criteria provided in the SWRP guidelines is an important component of the grant requirements. Generating data that measures outcomes and results of projects is an essential component of performance measures. Measurable criteria specification is the first step in this process. The SWRP is designed to encourage watershed-based approaches to stormwater management, including stream flow enhancement, recharge of groundwater aquifers, fresh water supply, water supply augmentation, minimization of erosion, and removal of hydromodification systems (SWCRB, 2015). California Water Code 79747 authorizes $200,000 for grants for multi benefit stormwater projects including stormwater capture, reuse, green building, and stormwater treatment facilities (State of California, 2014).

Requirements for measuring project success include on-going monitoring of desired outcomes. Metrics for the various benefit areas and projects should adhere to a pre-set level of performance, achieving their multi-benefit goals, thereby assuring stakeholders the project is consistent with SWRP goals and objectives. Necessary data, technical analysis, and metrics should include evaluation of the expected and actual outcomes of a project. With each review and update the objectives will be analyzed to assess the extent to which their proposed benefits are being achieved.

8.2.3 Decision Support Tools

In order for the Plan to achieve its goals, it must develop appropriate decision support tools and the data necessary to use these tools. Decision support tools refer to a wide range of computer based tools developed to support decision analysis and communicate knowledge to a broader audience; i.e., stakeholders. Such tools generally consist of a database and should have an interface that can be easily accessible by the general public, serving as vehicles for analysis, communication, forecasting, and experimentation. Models embedded in an applicable decision support tool can serve as a means for jointly finding an agreement about issues and strategies for solving them. A number of decision support tools exist and can be divided into several categories; scenario simulation and modeling systems, expert systems, GIS application and databases, and visualization (Welp, Decision Support Tools). A decision support tool that can be easily interpreted by stakeholders is essential, and implementation and on-going use of such a tool may require using an outside

organization equipped to manage the Plan's data and/or train county staff for inputting it. An example of a stormwater decision support tool is E²STORMED (Exhibit 7).

Exhibit 7. E²STORMED Decision Support Tool

E²STORMED allows the user to define different drainage system scenarios and see the advantages and disadvantages of each scenario, including energy efficiency and environmental criteria in urban stormwater management decisions (Project E²STORMED, 2017).

The Marine Pollution Studies laboratory at Moss Landing Marine Labs (MPSL-MLML) offers a service through their Data Navigator tool. This tool allows users to view water quality data in a number of ways, and includes graphs, maps, tables, and statistical tools. MPSL-MLML also offers support in collecting data necessary to use this decision support tool.

Other types of decision support tools include:

- BASINS (Better Assessment Science integrating Point & Non-point Sources)
    - This tool creates climate change scenarios for input into EPA watershed models, allowing users to change scenarios on streamflow and water quality in different watershed locations (EPA, 1998).
- Benchmark Dose Modeling Software (BMDS)
    - This modeling software can be used in conjunction with dose-response data from toxicological studies to derive hazardous pollutants associate with a defined response level (EPA, 2016).
- EPANET-MSX (multi-species extension)
    - This tool is used to model any system of multiple, interacting chemical species in a water distribution system, allowing users to track the fate and transportation of the chemicals through the system (EPA, 2011).
- Storm Water Management Model (SWMM)
    - This tool is used to determine how stormwater runoff and sanitary sewer flows can be effectively managed within urban drainage systems. It offers suggestions for structural controls, non-structural BMPs, and low-impact development practices to reduce runoff (EPA, 2017).
- VELMA
    - This eco-hydrological model is used to identify BMPs for ecosystems. Visualization tools are provided to help users assess how alternative decisions impact the sustainability of vital ecosystems (EPA, 2017).
- National Stormwater Calculator

  - This tool is used to determine stormwater runoff based on soil conditions, land cover, historical rainfall records, and a variety of land uses. Users can try different types of models to see potential runoff changes based on land use (EPA, 2017).
- International Stormwater Best Management Practices Database

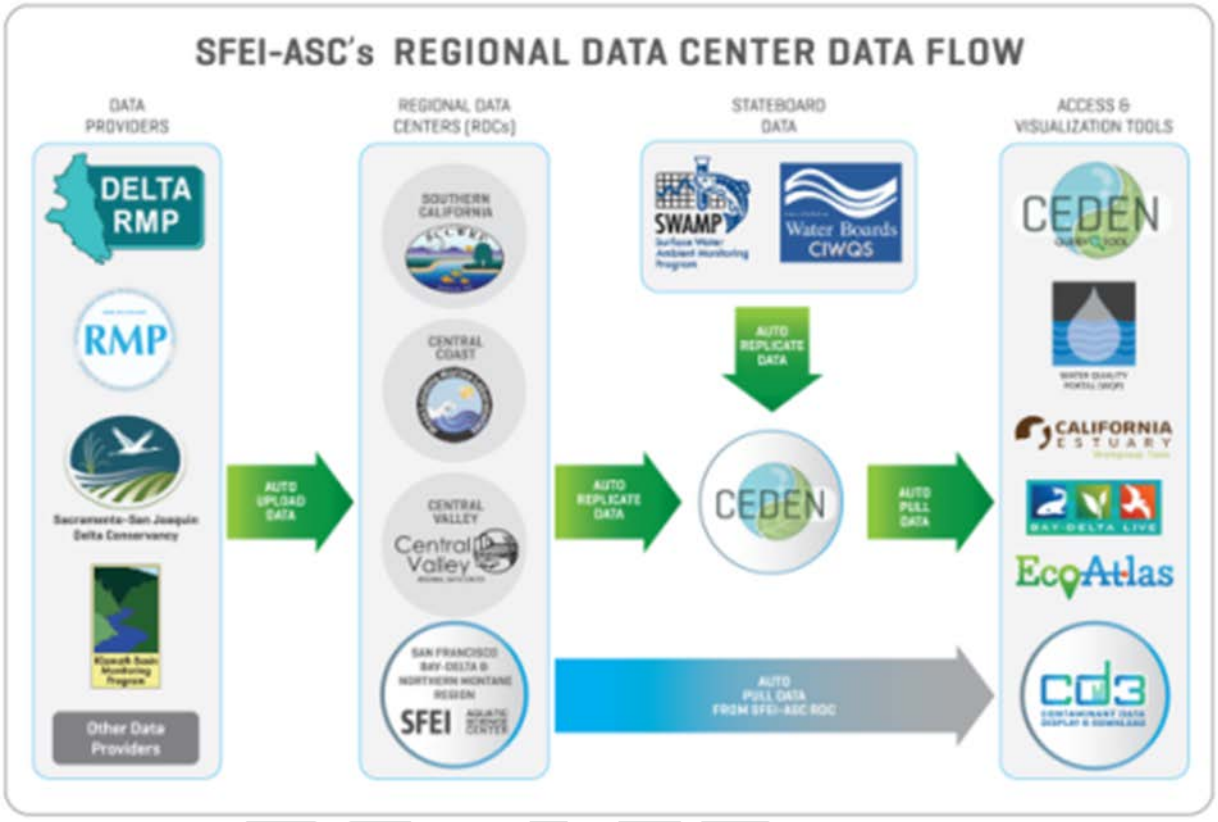
This database of stormwater reduction ideas allows users to find performance information on stormwater BMPs cross listed with other environmental, geographic, and demographic information (International Stormwater BMP Database, 2017).

8.2.4 Monitoring and Date Requirement

Requirements for monitoring and collecting data include online data entry and retrieval tools which record field collections, house data reports, and have the capability of uploading to a central location where data can be shared. Outside consultants brought on for this purpose should offer proper data entry training, webinars, direct entry of field data, review and revision of draft data, third party data verification and validation, project-specific data reporting and analysis, and data storage functionality and services. Additional requirements might include calculation of metrics and indices such as the California Stream Condition Index (CSCI) and the Index of Biological Integrity (IBI) for bio-assessment data, customized training of field and lab personnel, and verification, validation, interpretations, and troubleshooting of project data (see Appendices 1 – 4).

Successful management of data includes making it available to stakeholders via online management tools such as California Environmental Data Exchange Network (CEDEN). CEDEN offers a central location where the county can share information about SWRP projects with its stakeholders. SWRP monitoring requirements will be reported by the individual projects, based on their metrics and monitoring plan. It is the responsibility of the project's team to ensure monitoring is being directed and reported in accordance with the grant agreement so the quantification of the metrics used for determining the success of the project are met. In addition to providing support with decision support tools, MPSL-MLML offers online data entry and retrieval tools that allow users to record field collections, report data using standard or custom-build queries, and upload of data to CEDEN (SWRP guidelines suggest data be stored in a centralized local, region, or statewide water quality data collection systems such as CEDEN, SWAMP, or Groundwater Ambient Mentoring and Assessment Program). The San Francisco Estuary Institute (SFEI) also offers data management and direct uploads to CEDEN (Exhibit 8).

Exhibit 8. SFEI's Data Center Data Flow

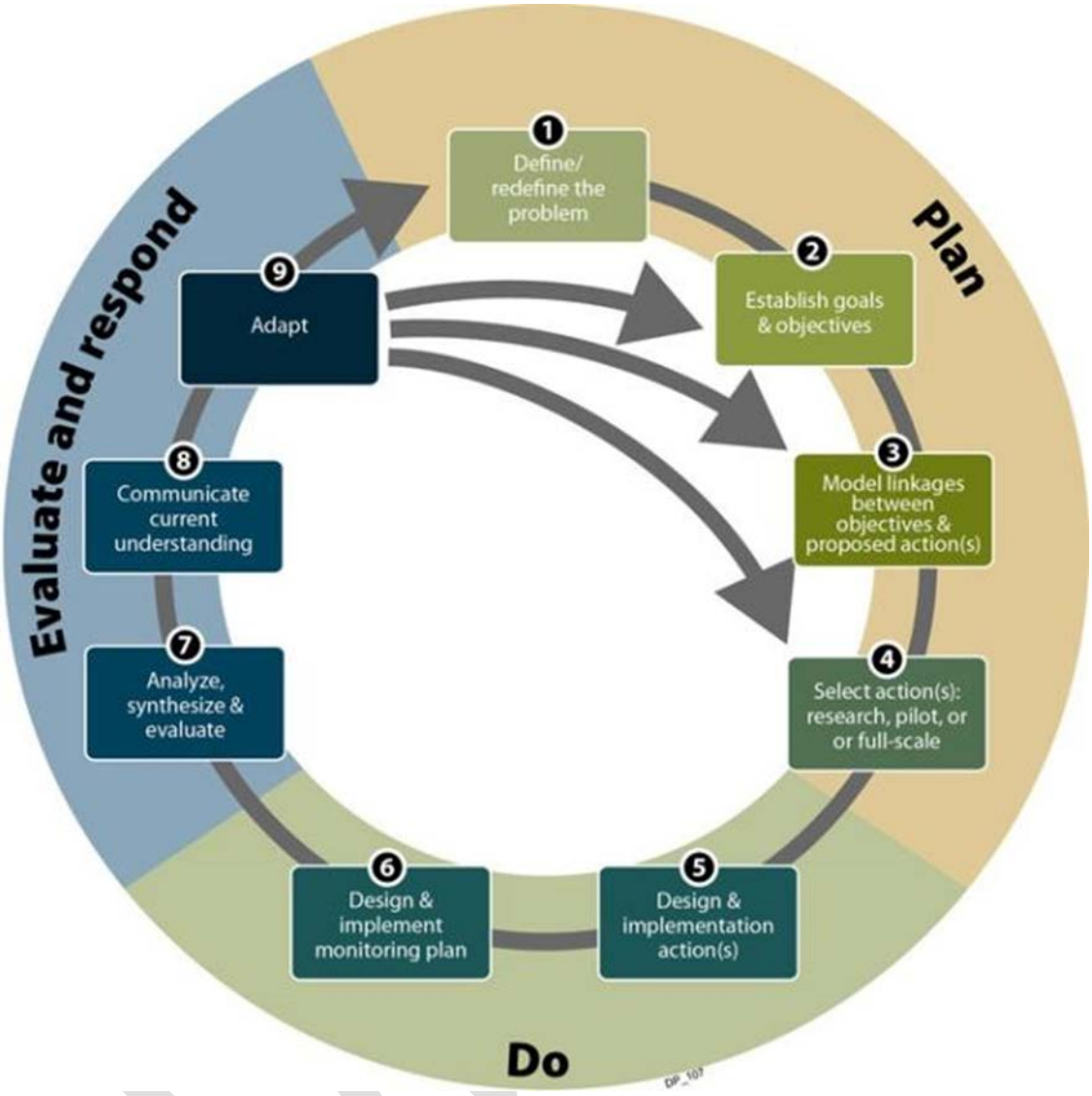


Both SFEI and MPSL-MLML offer training on data entry, processing, and reporting in CEDEN formats.

8.2.5 *Adaptive Management Approach*

Adaptive Management is a systematic approach for improving resource management by learning from management outcomes – "a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives" (Exhibit 9).

Exhibit 9. Adaptive management (CADFW 2017)



Once the Plan is in operation it will be considered a living document with clear procedures for updating it, tracking plan performance, and evaluating future projects. Adaptation to the Plan may include:

- Re-characterization of water quality priorities
- Source assessment re-evaluation
- Effectiveness assessment of projects
- Updated metrics
- Quantitative analysis
- Adding or removing projects
- Identification of completed projects

The adaptive management approach will be used to revise monitoring strategies (in order to meet project needs as they change), and to make recommendations for future projects. Careful monitoring of these outcomes advances the understanding of a project and helps adjust policies or operations. This involves exploring alternative ways to meet objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring them to learn about the impacts of management actions, and then using the results to update data and adjust management actions. The SWRP is structured in a manner that it is an ongoing, adaptive program that allows stakeholders to recognize, strategize, and implement all projects. As the SWRP progresses it should reflect the most current understanding of the watershed and present approaches to any changing circumstances. Adaptive management is useful when there is substantial uncertainty regarding the most appropriate strategy for managing natural resources. A structured approach to decision making is key to adaptive management.

8.2.6 Plan Implementation

A SWRP Project List will be created and maintained online through the Mendocino County SWRP website. It might include a listing of the projects, checklists for projects being developed, and a ranking of projects for further development. The website shall continue to accept and rank projects until November 15 2017. The Project List might be frequently updated as new projects are submitted, and existing projects updated with additional information as it becomes available. Using project-specific monitoring and measurable objectives, the Mendocino County Water Agency will adjust project operations and plan implementation to ensure that the Plan goals and objective are being met. Using the adaptive management methods, the Mendocino County Water Agency will be able to learn from project monitoring efforts and utilize collected information, particularly as new data is made available. With this data, the County can decide to either modify Plan objectives; the outcome of those objectives; the use of resource management strategies; or the project review process. These decisions will dictate implementation and prioritization of future projects.

8.2.7 Achievement of Multiple Benefits

As required by California Water Code Section 10562(e) and the SWRP Guidelines, the SWRP must utilize "measureable factors to identify, quantify, and prioritize potential stormwater and dry weather runoff capture projects." SWRP projects might be identified and prioritized online using a "scoring" system integrated into the Mendocino County website which ranks projects based on their multi-benefit achievements, with projects achieving the most multi-benefits ranking highest. The approach for assessing multiple benefits might consist of two parts: quantification of multiple benefits to determine a multi-benefit index for each identified project and prioritization of all identified projects based on the multi-benefit index and other factors. Stakeholders submitting projects should be encouraged to develop submissions that include multiple benefits. Project submissions might then be scored using an easy to understand system available to all stakeholders, who can then compare projects and their multi-benefit achievements online using agreed upon metrics.

8.2.8 Project Tracking

The implementation strategy for the SWRP might allow for continual project updates through additions and modifications to the Project List. Projects might be required to complete a checklist

that satisfies multi-benefit status in order to be considered. Once included on the list, project sponsors will be able to update information on their projects in anticipation for the next stage of the SWRP and will demonstrate their strategies to meet the goals they have set. Sponsor schedules and timelines for implementing their project should include short-term and long-term goals as well as identify mechanisms and schedules they will use to ensure their goals are met. These goals should be quantifiable and measureable.

9.0 EDUCATION, OUTREACH, AND PUBLIC PARTICIPATION

9.1 Outreach Website

The County of Mendocino will develop a SWRP Website to describe:

- The purpose and scope of the SWRP.
- Benefit categories, primary benefits, and secondary benefits.
- Project prioritization and ranking process.
- Quantitative Methods used to prioritize projects.

The website will also provide a portal for stakeholders and the public to submit projects for the SWRP, and provide feedback regarding the ranking of benefit categories, primary benefits, and secondary benefits. Project submissions will utilize google docs to better facilitate ease of use and allow applicants the space to aptly describe their projects including the location, estimated costs, benefits, and additional project sponsor information. The project submission form as available on the website is included in Appendix B.

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This outline is based on the requirements set forth in the Planning Grant for the Storm Water Resource Plan (Agreement No: D1612603) in Section 4.2 of the Project-Specific Scope of Work.

FIGURES

APPENDIX 1

Appendix 1 Title