EXISTING AND PROPOSED SURFACE WATER QUALITY
Mill Creek Wetlands Recreation and Restoration Demonstration Project[1]

Prepared by Geosyntec Consultants
December 9, 2008

1 INTRODUCTION

The Mill Creek Wetlands Recreation and Restoration Demonstration Project (Project) proposes to create recreational and habitat opportunities while treating stormwater runoff from the Cucamonga Creek watershed. The multiple goals of the Project will be met by the creation of a series of hydraulically connected basins that incorporate wetland and riparian areas, recreational trails and educational kiosks, and water treatment components.

The purpose of this memorandum is to discuss the water treatment aspects and potential water quality benefits of the Project. The Project proposes to treat portions of both dry and wet weather flows in Cucamonga Channel that otherwise would continue flowing down to the Santa Ana River and Pacific Ocean untreated for stormwater pollutants such as bacteria and nutrients. The Project will achieve water quality treatment by diverting flows from Cucamonga Channel, routing diverted flows through a series of cascading ponds which combine constructed wetland and extended detention basin treatment features, and discharging treated flows back to Mill Creek, 0.67 mile downstream of the diversion location on Cucamonga Channel.

The Project illustrates the leveraged benefit of regional treatment facilities. The Project will have the capacity to hold and treat 160 acre-feet of water at any given time and will provide treatment of 10%-18% of all wet-weather runoff from the Cucamonga Channel watershed. In contrast, a single-function water quality project of the same size in an upstream tributary could, for example, mitigate impacts from a 7 square mile development and treat approximately 70% of wet weather runoff, resulting in an effective capture volume of approximately 7% of the total wet-weather runoff from the watershed. The Project as designed provides some flood control benefits, the extent of which varies with the magnitude of the flood flow rates in Cucamonga Channel.

[1] Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use." (Gov. Code 7550, 40 CFR 31.20)

The Project thus not only provides multiple benefits; it also increases effective volume treated by 40% to 160%, showing a significant increase in return on investment. (see Geosyntec 2008 for more detailed discussion of treatment volumes).

2 PROJECT SETTING/SITE DESCRIPTION

2.1 Project Location

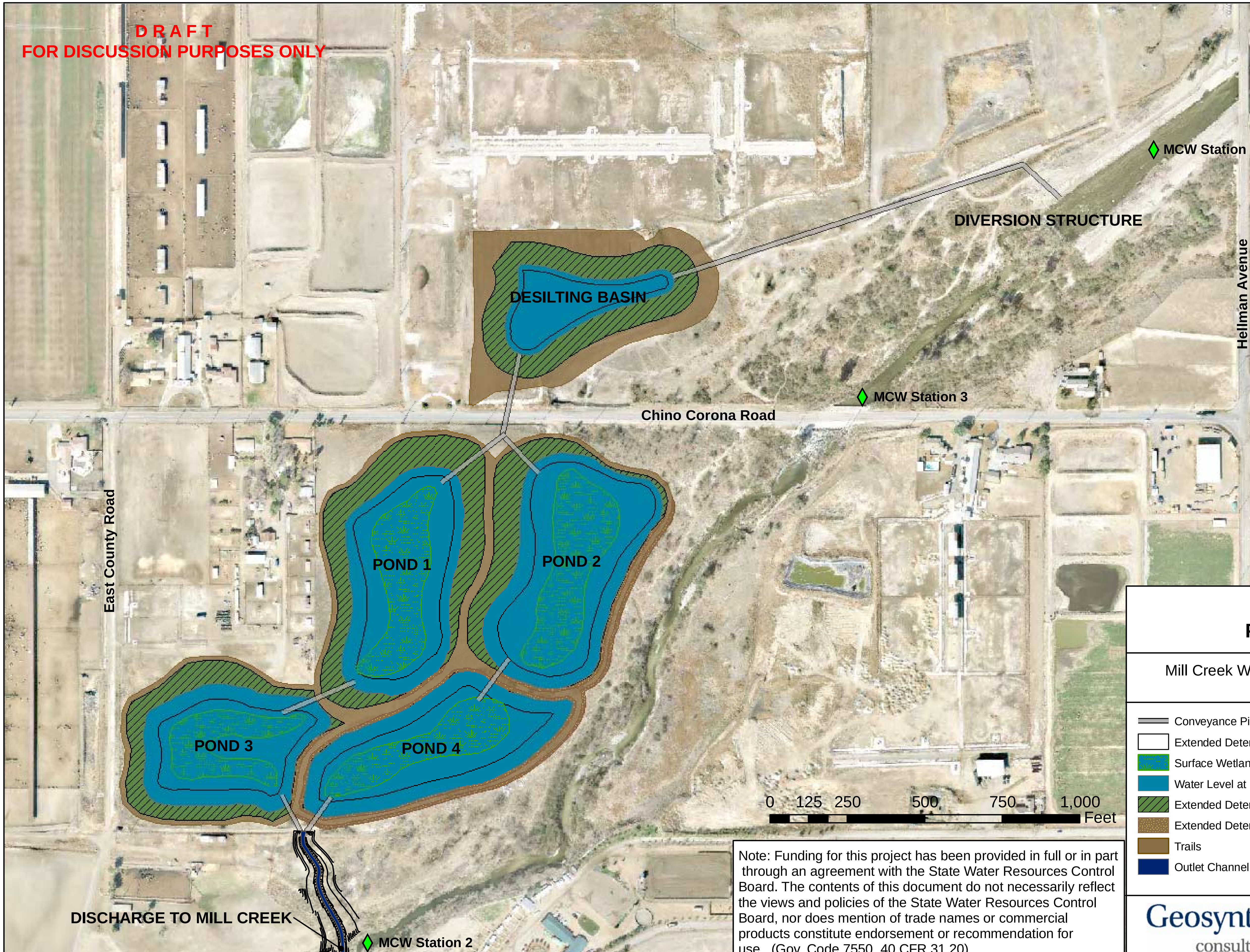
The Project is located in the City of Chino in San Bernardino County along Mill Creek/Cucamonga Channel upstream of the Prado Dam in the Santa Ana River Basin. The Project can roughly be delimited by Cucamonga Channel/Mill Creek to the southeast, Comet Road to the west and the Cucamonga Creek crossing of Hellman Avenue to the north. Figure 1 shows the location of the Project site and approximate Project limits.

The Project is adjacent to Cucamonga Channel near its terminus and transition to Mill Creek. The Project site is located on the northwest floodplain of the channel through this transition reach. The floodplain and Project site is bisected by Chino Corona Road, which runs in the east-west direction, and crosses the channel over a series of 10 culverts. Site slopes are generally mild from north to south, with somewhat steeper slopes in the creek corridor. Because the Project site is within the floodplain, it is subject to inundation under flood conditions when flows in the adjacent channel overtop the channel banks. The connection between the channel and floodplain varies along the length of the Project and therefore the Project site is inundated under varying conditions in different places.

2.2 Tributary Watershed

Cucamonga Channel, at its terminus, drains a watershed of approximately 76.7 mi^2. This watershed area incorporates the tributary areas of Deer Creek, Old Deer Creek and West Cucamonga Creek as well. The watershed is comprised of both low gradient urbanized valley areas as well as steeper mountain tributaries. The majority of the mountainous tributary area drains to more defined channels in the valley through debris basins. There are approximately ten debris basins which filter debris from mountain flows prior to discharge into the valley channels.

The mountainous areas are predominantly undeveloped open space with low imperviousness. The valley portion of the watershed, in contrast, is well developed and comprised of a mixture of industrial, commercial, agricultural and residential land uses. Historically, the valley portion of watershed consisted of predominantly agricultural and diary land uses. Today, the agricultural and dairy farms are being replaced by residential developments. The watershed, as a whole, is approximately 25% impervious based on land use data from 2005 (SCAG, 2005).



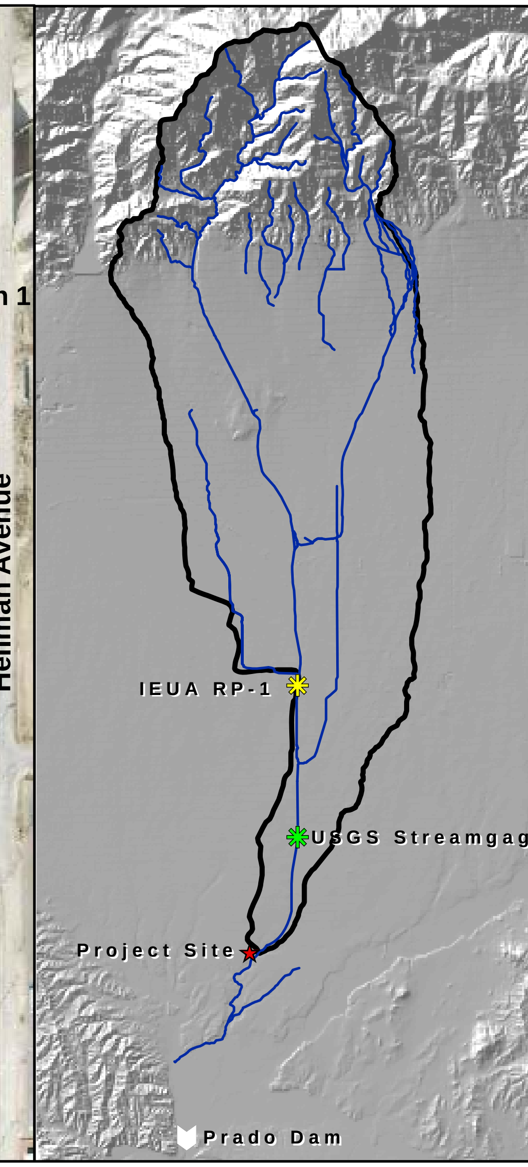


FIGURE 1
Project Location

Mill Creek Wetands Recreation and Restoration Demonstration Project

Note: Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. (Gov. Code 7550, 40 CFR 31.20)

Geosyntec consultants

Date: 11/13/2008

Project No: LA0183

2.3 Cucamonga Channel

Cucamonga Channel is a concrete flood control channel that was constructed in the 1970's by the United States Army Corps of Engineers (USACE). The upstream end of the concrete channel coincides with the outlet of the Cucamonga Creek Debris Basin in the foothills of the San Bernardino Mountains. At its terminus downstream of Hellman Avenue and upstream of Chino Corona Road, the concrete flood control channel transitions to a grouted rip-rap channel and then finally discharges to Mill Creek. At this point, Cucamonga Channel is a trapezoidal channel with a bottom width of 138 ft and a design depth of 21 ft.

2.4 Mill Creek

Mill Creek is not a concrete flood control channel but is comprised rather of natural soils and vegetation. The current connection of Mill Creek with Cucamonga Channel however, is not necessarily natural. As recent as 1928, Mill Creek terminated prior to connection with Cucamonga Creek.

During dry weather flows in Cucamonga Channel generally vary between 30 and 60 cfs, primarily consisting of effluent from the Inland Empire Utilities Agency (IEUA) RP-1 water reclamation plant that discharges to the channel upstream of the diversion. Cucamonga Channel also receives dry weather flows from activities in the tributary watershed associated with dairy farming, agriculture, residential communities, industrial and commercial activities, and potentially, groundwater sources.

During wet weather, the channel conveys stormwater runoff from the entire 76.7 mi^2 watershed, with peak flows observed as high as 17,300 (USGS, October 2004) in 20 years of stream gage data (USGS), a 100-year flow event of 32,000 cfs and Probable Maximum flowrates of 52,000 cfs (USACE, 1973). Under the 100-year and Probable Maximum Flood events, Mill Creek overtops its channel banks along the entire reach adjacent to the Project and inundates portions of the floodplain and Project site.

The 10 culverts which convey flows in Mill Creek under Chino Corona Road have modified the hydrologic regime within the vicinity of the Project. As sized, the culverts only effectively convey low flows and result in backwater effects up Mill Creek and Cucamonga Channel under medium to high flow conditions. Under high flow conditions, the culvert crossing acts as an Arizona Crossing and flows overtop the road and are conveyed back into the channel on the downstream end of the culverts. Chino Corona Road, because it is higher than the adjacent floodplain, acts as a partial dam on the floodplain and prevents flood waters up to a certain water surface elevation from draining downstream along the floodplain. These conditions have facilitated overtopping of the channel banks and sediment deposition in the reach immediately

upstream of the culverts. Thus, the distinction between the channel and floodplain in this reach is not well defined and backwater effects result in the inundation of portions of the Project site more frequently than would result if the Chino Corona Road crossing could effectively convey all flows.

Downstream of the culverts, the Mill Creek channel is degraded, likely as a result of the impacts of the culverts on sediment transport processes within the reach, as well as hydrologic source loading impacts from upstream drainage areas. Because of the backwater effects and reduced velocities upstream of the culverts, sediments in suspension may be deposited under a range of flows upstream of the culverts. The flows through the culverts, therefore, may lose a portion of their sediment load and are discharged to the downstream reach deficient in sediment. To account for sediment losses upstream, flows downstream of the culverts erode the channel bed and banks. The channel, in this reach, is therefore deeply incised with steep channel banks. Because of this channel geometry, the channel has lost its natural connection with the floodplain and the frequency of floodplain inundation in this reach is less than that upstream of the Chino Corona Road culverts.

2.5 Prado Dam

Prado Dam is approximately 5 miles downstream of the Project location. Prado Dam was constructed for flood control purposes in 1941. The Project location is within the area that could potentially be inundated by water retained behind the dam at its capacity. The spillway on the dam is set at 543 ft MSL, however the crest of the embankments have been set at 566 ft MSL. The Project site ranges in elevation between 519 ft MSL and 563 ft MSL and therefore, the entire site would be inundated if the dam were filled to capacity.

3 EXISTING WATER QUALITY

Mill Creek and Cucamonga Creek are continuations of the same surface-water stream system. Cucamonga Creek is named for the upstream concrete lined portions of the stream, and Mill Creek refers in the unlined natural reaches within the Prado basin. The transition point is where the concrete channel ends near the crossing at Hellman Road.

The water quality in Cucamonga Creek and Mill Creek is degraded due to runoff from existing communities, agricultural operations, and dairies, as well as discharges from the Inland Empire Utilities Agency (IEUA) water reclamation facilities. Figures 1 and 2 show the approximate locations of water quality and flow monitoring stations on Cucamonga Creek and Mill Creeks.

3.1 Dry and Wet Weather Flows

Flows in Cucamonga Creek and Mill Creek are divided into two flow regimes with different water quality characteristics. Dry weather flows occur in the absence of rainfall and include discharges from groundwater and springs, runoff from agricultural areas and dairies, discharges from the IEUA water reclamation plant, and runoff from urban related activities such as landscape irrigation, car washing, and swimming pool discharges. Wet weather flows are runoff from storm events. Wet weather flows can occur throughout the year, but mainly occur in the rainy wet season from November to April. Dry weather flows occur throughout the year and are the predominant flow regime.

Average daily flow in Cucamonga Creek is monitored by the US Geological Survey (USGS) at station 11073495 near Mira Loma (see Figure 1). IEUA also monitors its discharges of tertiary treated effluent to Cucamonga Channel at RP-1 about 2-3 miles upstream from the UGSG monitoring station (Figure 1). Table 1 compares the average monthly discharge in Cucamonga Creek with the effluent discharges from IEUA during 2004 to 2006, and also shows the monthly precipitation.

3.1.1 Dry Weather

During dry weather conditions the average monthly flow in Cucamonga Creek during 2004 to 2006 ranged from about 30 to 60 cfs, as measured at the USGS flow gauge (Table 1). The average monthly dry weather flow during this period was about 50 cfs, however more recent average dry weather flows in 2006 were smaller than in 2004. Lower average flows in 2006 may reflect smaller base flows or smaller urban contributions due to low precipitation, and/or a change in IEUA operation.

Monthly discharges from the IEUA treatment plant to Cucamonga Creek during dry weather conditions in 2004-2006 was in the range of about 17-28 cfs, with an average of about 23 cfs. During this period the IEUA discharges comprised slightly less than half of the dry flows in Cucamonga Channel. The remainder of the dry weather flow is from various urban and agricultural sources in the tributary drainage area. Consequently, the water quality of dry weather flows in Cucamonga and Mill Creek is influenced by both tributary runoff from urban areas and IEUA discharges.

3.1.2 Wet Weather

During wet weather conditions, average monthly discharge in the Cucamonga Creek increases roughly in relation to precipitation totals (Table 1), and peak discharges in Cucamonga Creek increase substantially, typically up to 5,000 cfs and sometimes exceeding 10,000 cfs during large storms. The vast majority of wet weather flows is from tributary runoff. Thus, water quality of

Table 1: Comparison of Average Monthly Discharges and Monthly Precipitation

	2004				2005				2006			
	Precip (in) [1]	USGS (cfs) [2]	RP-1 (cfs) [3]	Diff (cfs) [4]	Precip (in) [1]	USGS (cfs) [2]	RP-1 (cfs) [3]	Diff (cfs) [4]	Precip (in) [1]	USGS (cfs) [2]	RP-1 (cfs) [3]	Diff (cfs) [4]
January	0.4	63.9	36.8	27.1	5.49	441.9	29.9	412	0.02	67.9	25.9	42
February	4.26	184.8	31	153.8	5.76	350.3	24.4	325.9	1.64	103.2	25.2	78
March	0.73	58.9	28.4	30.5	0.03	117.4	22.5	94.9	0	113.2	27.6	85.6
April	0.57	68.2	27.1	41.1	0.78	86.5	21	65.5	2.36	114.3	26.5	87.8
May	0	51.1	28.4	22.7	0.4	62.4	25.6	36.8	0	60.5	25.7	34.8
June	0	55.1	26.8	28.3	0	50.1	24.6	25.5	0	50.1	22.6	27.5
July	0	53.4	25.4	28	0	49.2	25.9	23.3	0.1	41.9	19.8	22.1
August	0	50.5	24.9	25.6	0.9	48	22.4	25.6	0	33	16.7	16.3
September	0	49.4	25.4	24	0	50.5	23.5	27	0	42.5	18.1	24.4
October	5.28	222.7	29	193.7	1.34	69.1	25.4	43.7	0	48.2	25.1	23.1
November	0.95	68.7	27.1	41.6	0	45.8	23.9	21.9	0	39.7	23.1	16.6
December	1.42	112.8	28.7	84.1	0.1	53.9	25	28.9	0.6	57.6	20.3	37.3
Total Precip & Average flow	13.6	86.6	28.3	58.4	14.8	118.8	24.5	94.3	4.7	64.3	23.1	41.3

1/ Monthly precipitation recorded at the Riverside Fire Station No 3, ~12 miles from the Project site.
2/ Average monthly discharge at the USGS station on Cucamonga Channel near Mire Loma
3/ Average monthly discharge from RP-1 to Cucamonga Channel at discharge location 002.
4/ Indicates tributary contributions - Average monthly flow at the USGS station minus average monthly discharge from RP-1.

wet weather flows in Cucamonga Creek and Mill Creek is predominantly influenced by urban runoff.

3.2 Basin Plan and Beneficial Uses

The Santa Ana Regional Water Quality Control Board (SARWQCB) has adopted and periodically amends the 1995 Water Quality Control Plan for the Santa Ana River Basin (Basin Plan updated February 2008 – Resolution 94-1) which establishes beneficial uses and water quality objectives for surface and groundwater bodies. Table 2 shows the designated beneficial uses of Cucamonga and Mill Creeks.

On January 22, 2004 the SARWQCB adopted a Basin Plan Amendment (Resolution No. R8-2004-0001) to revise the boundaries of groundwater basins, to revise TDS and nitrogen objectives for groundwater, and to adopt new management strategies for TDS and nitrogen in groundwater and surface waters. This amendment establishes the Prado Basin Management Zone (PBMZ) which encompasses the flood plain behind the Prado Dam. This is a unique management area because of the strong interaction of surface and groundwater. As described in the Basin Plan amendment, the PBMZ is generally defined as a surface water feature within the Prado Basin. It is defined by the 566-foot elevation above mean sea level along the Santa Ana

Table 2: Beneficial Uses of Cucamonga and Mill Creeks

Coastal Feature	MUN	GWR	REC1	REC2	WARM	LWRM	WILD	RARE
Cucamonga Creek, Reach 1 - Confluence with Mill Creek to 23rd St. in Upland	+	X	X	X		X	X	
Mill Creek (Prado Area)	+		X	X	X		X	X
Prado Basin Management Zone (PBMZ)	+		X	X	X		X	X

X = Existing or Potential Beneficial Use; + Exempted Beneficial Use

MUN Municipal and domestic supply for community, military, or individual water supply systems including, but not limited to, drinking water supply.

GWR Groundwater recharge water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

REC-1 Water contact recreational activities involving body contact with water, where ingestion is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

REC-2 Water contact recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beach combing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

WARM Habitat uses of water that support warm water ecosystems including but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

LWRM Limited warm freshwater habitat waters support warm water ecosystems which are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows which result in extreme temperature, pH, and/or dissolved oxygen conditions. Naturally reproducing finfish populations are not expected to occur in LWRM waters.

WILD Water uses that support wildlife and terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife,(e-g., mammals, buds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

RARE Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

River and the four tributaries to the Santa Ana River in the Prado Basin (Chino Creek, Temescal Creek, Mill Creek and Cucamonga Creek). The beneficial uses of the PBMZ include all of the beneficial uses previously designated for the surface waters identified above. Thus, the beneficial uses for Mill Creek are now subsumed under designated beneficial uses for the PBMZ (see Table 2).

3.3 TMDLs and 303(d) Listings

When designated beneficial uses of a particular receiving water body are being compromised by water quality, Section 303(d) of the Clean Water Act requires identifying and listing that water

body as “impaired”. Mill Creek is included on the 2006 Section 303(d) list of impaired water bodies, which is the most recent listing. Mill Creek is listed as impaired by nutrients and Total Suspended Solids (TSS). The potential sources are identified as agriculture and dairies for nutrients, and dairies for TSS. There are no listings for Cucamonga Creek.

Once a water body has been deemed impaired, a Total Maximum Daily Load (TMDL) must be developed for the impairing pollutant(s). The SARWQCB has adopted a Basin Plan amendment (Resolution No. R8-2005-0001) to incorporate indicator bacteria TMDLs for Mill Creek and Reach 1 of Cucamonga Creek, which extends from the confluence with Mill Creek to 23rd St in the City of Upland. Because there is now a TMDL for bacteria, it is no longer listed on the 303(d) list of impairments. The TMDLs are based on meeting REC-1 standards for both dry and wet weather flows.

Concentration-based wasteload allocations are designated for sources from urban runoff, confined lot feeding areas, agricultural runoff, and natural sources. The fecal coliform wasteload allocation for all sources and flow regimes is the log mean of 180 organisms/100 mL based on five or more samples per 30 day period, and not more than 10% of the samples to exceed 360 organisms/100 mL for any 30–day period. The TMDL resolution includes an implementation plan with an initial focus on monitoring and source identification.

The TMDL targets are only applicable in the receiving waters of Mill Creek and Cucamonga Creek, and are not applicable to end of pipe discharges. The Municipal NPDES Permittees (San Bernardino County Flood Control District and co-permittees) are responsible for implementing policies that will achieve TMDL compliance. The Mill Creek Wetlands Project will help to reduce bacteria and TSS levels in Mill Creek by providing treatment for a portion of the flows that are diverted to the wetland basins. Section 4 discusses the expected contributions to both bacteria and TSS load reduction.

3.4 Water Quality Monitoring of IEUA Reclamation Plant Effluent

IEUA conducts regular water quality monitoring of tertiary treated discharges to Cucamonga Creek. The main water quality constituents of concern in effluent discharges are nutrients, primarily nitrate, and total dissolved solids (TDS). Elevated levels of nutrients in IEUA discharges can contribute to algae growth in downstream flows, and elevated levels of nitrate and TDS are a concern for aquifer replenishment in downstream spreading basins. Effluent concentrations of TSS, Biological Oxygen Demand (BOD), indicator bacteria, metals, and organic compounds are typically low or not detected. Table 3 shows average annual concentrations in IEUA effluent for selected constituents.

Table 3: Average Annual Concentration of Selected Constituents in IEUA Discharges to Cucamonga Creek

	TDS mg/L	TSS mg/L	NH_3-N mg/L	NO_2-N mg/L	NO_3-N mg/L	TIN mg/L
2004	485	1.7	0.2	0.02	9.2	9.4
2005	483	1.7	0.5	0.06	6.7	7.2
2006	455	1.3	0.2	0.07	7.9	8.0

On April 15, 2004, the SARWQCB adopted order number R8-2005-0033 that includes effluent quality requirements from all of the IEUA treatment plants. The combined effluent quality should not exceed 550 mg/l TDS and 8 mg/L total inorganic nitrogen (TIN) on a 12-month, running average basis. Data in Table 3 indicate the TDS and TIN objectives were met in 2005 and 2006. TDS and inorganic nitrogen (primarily nitrate) are the main water quality parameters of concern in IEUA discharges. Nitrate in particular is a concern due the 303(d) listing in Mill Creek.

3.5 San Bernardino County Water Quality Monitoring

The San Bernardino County Stormwater Program (SBC) has conducted water quality monitoring of dry and wet weather flows in Cucamonga Creek at two locations (Figure 2). SBC Station 2 is upstream of RP-1 just south of the 60 Freeway. Tributary land use is primarily urban (commercial, industrial and residential) and some open space. SBC Station 3 is located at Hellman Ave near the San Bernardino/Riverside County Line, and is downstream from RP-1 and the USGS station. Tributary land uses include those at SBC Station2, but additionally include agricultural and open space areas.

Water quality monitoring data are reported in the 2000 and 2006 Report of Waste Discharge (ROWD) submitted to the Regional Water Quality Control Board. The 2000 report differentiates between dry and wet weather monitoring data (Table 4). During dry weather flows, water quality at the upstream station (SBC Station 2) is typical of urban dry weather runoff, while water quality at the downstream station (SBC Station 3) reflects contributions of nitrate and TDS from IEUA discharges. The water quality of wet weather flows is affected by elevated levels of TSS, metals, and Chemical Oxygen Demand (COD) at both the upstream and downstream stations, typical of urban stormwater runoff (SBCSWP, 2006).

The 2006 ROWD provides more recent water quality data, but only includes wet weather monitoring (Table 5). The 2006 ROWD concluded that water quality of wet weather flows has not changed considerably over the past decade, based on comparison of median values from the 1994-1999 and the 2000-2006 monitoring periods.

Figure 2: Flow and Water Quality Monitoring Stations – Prado Dam Tributaries

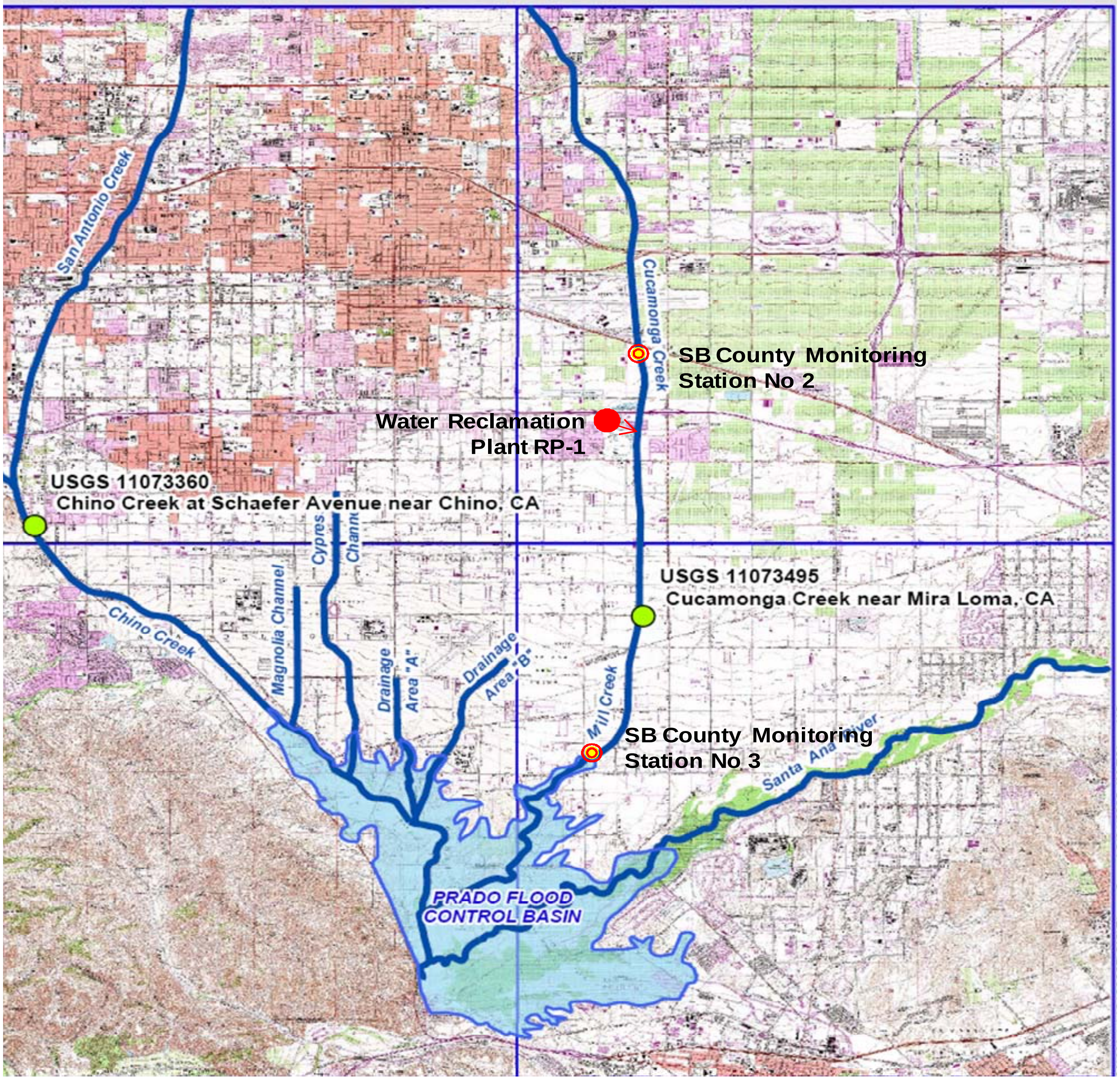


Table 4: San Bernardino County Water Quality Monitoring Data, 1994-1999

Constituent	Dry Weather Flow		Wet Weather Flow	
	SBC Station 2 - Cucamonga Creek near 60 Fwy (Ave of ~ 8 samples)	**SBC Station 3 - Cucamonga Creek near Hellman Ave** (Ave of ~ 8 samples)	**SBC Station 2 - Cucamonga Creek near 60 Fwy** (Ave of ~23 samples)	**SBC Station 3 - Cucamonga Creek near Hellman Ave** (Ave of ~23 samples)
TSS (mg/L)	38	37	278	262
TDS (mg/L)	366	578	117	298
COD (mg/L)	89	68	174	229
Nitrate (mg-N/L)	0.4	16.3	2.1	6.7
Nitrite (mg-N/L)	-	0.5	0.2	0.1
Ammonia (mg-N/L)	0.3	0.6	1.5	2.5
Total Nitrogen (mg-N/L)	3.3	20.4	9.0	15.3
Total Phosphorus (mg-P/L)	0.34	1.33	0.83	1.79
Total Copper (ug/L)	30	-	50	40
Total Lead (ug/L)			20	20
Total Zinc (ug/L)	40	40	260	240

Source: 2000 Report of Waste Discharge, prepared by CDM

Table 5: San Bernardino County Wet Weather Water Quality Monitoring Data

Constituent	SBC Station 2 Cucamonga Creek near 60 Fwy		SBC Station 3 Cucamonga Creek near Hellman Ave	
	Median of 1994-1999 Monitoring Data	**Median of 2000-2006 Monitoring Data**	**Median of 1994-1999 Monitoring Data**	**Median of 2000-2006 Monitoring Data**
TSS (mg/L)	205	285	200	200
TDS (mg/L)	80	70	249	165
COD (mg/L)	130	190	100	130
Nitrate (mg-N/L)	1.2	0.97	4.4	2.75
Ammonia (mg-N/L)		1.35		0.9
Total Phosphorus (mg-P/L)	0.66	0.61	1	1.3
Total Copper (ug/L)	30	30	20	23
Total Lead (ug/L)	10	10	10	8
Total Zinc (ug/L)	200	180	150	150
Total coliform (MPN/100 mL)		65,000		80,000
Fecal coliform (MPN/100 mL)		12,000		8,000

Source: 2006 Report of Waste Discharge, prepared by CDM

3.6 Mill Creek Wetlands Baseline Monitoring

Baseline water quality monitoring in Cucamonga Creek and Mill Creek has been initiated for the proposed Project. To date, two sampling rounds of dry weather flows have been conducted at locations shown in Figure 1. Results are summarized in Table 6. In addition to the results in Table 6, samples were also analyzed for organophosphate pesticides. No pesticides were present above a reporting limit of 4 ug/L.

Table 6: Mill Creek Wetlands, Baseline Monitoring

Constituent	Dry Weather Flow Monitoring (5/29/08)		Dry Weather Flow Monitoring (8/21/08, except as noted)		
	MCW - Station 1	MCW - Station 2	MCW - Station 1	MCW - Station 2	MCW - Station 3
TSS (mg/L)	15	5	10	6	7
TDS (mg/L)	380	360	420	540	460
Oil & Grease (mg/L)	ND < 4.9	ND < 5.3	ND < 4.7	ND < 4.7	ND < 5.0
Nitrate (mg-N/L)	1.7	3.9	2.1	6.6	3.2
Nitrite (mg-N/L)	ND < 0.1	ND < 0.1	0.1	0.23	0.15
Ammonia (mg-N/L)	ND < 0.1	ND < 0.1	0.17	0.40	0.34
Kjeldahl Nitrogen (TKN) (mg-N/L)	1.6	1.0	1.9	2.1	2.0
Total Nitrogen[1] (mg-N/L)	3.3	4.9	4.1	8.93	5.35
Dissolved Phosphorus (mg-P/L)	0.077	0.11	0.11	0.29	0.19
Total Phosphorus (mg-P/L)	0.1	0.13	0.17	0.35	0.26
Total Copper (ug/L)	ND < 10	ND < 10	ND < 10	ND < 10	ND < 10
Total Lead (ug/L)	ND < 10	ND < 10	ND < 10	ND < 10	ND < 10
Total Zinc (ug/L)	13	56	16	33	21
Fecal Coliform (MPN/100mL)	10	ND < 1000	800 (6/19/08)	1000 (6/19/08)	900 (6/19/08)

ND = below method reporting limit
1/ TN calculated as the sum of TKN, nitrate, and nitrite-nitrogen

The baseline data are limited in number, but are consistent with expected characteristics of dry weather water quality. The data exhibit elevated levels of TDS and nutrients, are low in organics and metals, and the bacteria data are variable showing both compliance and exceedance of the 30-day water quality objective. The nitrogen levels are consistently highest at the downstream station. The limited baseline data suggest improvements in dry weather water quality in comparison to 1994-1999 levels (Table 3), particularly for nitrate and phosphorus. Possible explanations are reduced flows and/or reduced levels of nitrogen compounds in IEUA discharges in compliance with Basin Plan amendments of water quality objectives, and/or reduced contributions from agricultural areas and dairies.

Regional Studies

The USGS has recently published several reports on regional water quality in the Santa Ana River Basin including summary results from the National Water Quality Assessment (NWQA) Program (Berlitz et al., 2004) and associated reports. Pertinent findings include the following:

- Nitrate and TDS levels are higher in tributary streams that receive treatment plant discharges. Water quality data for Cucamonga Creek are consistent with this finding.

- A wide variety of organic compounds and pesticides were consistently detected in surface waters in urban areas, but generally at low levels. Pesticides were detected more frequently after storm events. Wet weather water quality data for Cucamonga Creek show elevated levels of COD, which is an indirect indicator of organic compounds.

- Elevated levels of indicator bacteria are present in storm runoff, particularly from urban areas, and in areas draining agricultural, and dairy farms. Extremely high concentrations of indicator bacteria have been measured in wet weather flows in Cucamonga Creek and Mill Creek. It was found that highest concentrations occur in areas with urban and agriculture land uses, similar to areas in the lower reaches of the Cucamonga Creek watershed. Available water quality monitoring data for dry and wet weather flows in Cucamonga Creek are consistent with this finding, indicating high fecal coliform concentrations in excess of the water quality objective.

4 POST-PROJECT WATER QUALITY

The proposed Project will provide water quality treatment, and will improve water quality, for a portion of the dry and wet weather flows in Cucamonga Creek. The proposed facilities are constructed water quality treatment wetlands integrated into stormwater detention basins. These are proven treatment technologies that will reduce the loadings of pollutants in dry and wet weather runoff from existing urban and agricultural land uses throughout the tributary watershed. The anticipated treatment effectiveness for the Mill Creek Wetlands Project was assessed qualitatively for selected water quality pollutants in dry and wet weather flows. The following describes the water quality pollutants that were selected for evaluation and the results of the qualitative assessment of treatment performance.

4.1 Water Quality Pollutants Selection for Performance Assessment

Water quality pollutants were selected for qualitative treatment performance assessment based on consideration of water quality data and reports, existing TMDLs and 303(d) listings, and general characteristics of urban runoff. Different pollutants are selected for dry and wet weather

flows to address the differences in water quality characteristics and treatment mechanisms for each of these flow regimes.

4.1.1 Water Quality Pollutants for Dry Weather Flow Treatment Assessment

- The water quality of dry weather flows is influenced by runoff from tributary urban and agricultural areas, base flows, and IEUA discharges. Treatment of dry weather flows occurs in the constructed wetlands by a variety of mechanisms including sedimentation, filtration, transformation, sorption, and uptake. Dry weather flow treatment is a primary water quality design feature of the proposed project. The following describes the pollutants that were selected for dry weather treatment assessment and the rationale for their selection.
- ***Pathogen indicators (coliform bacteria)***: Due to the difficulty and cost of directly measuring the presence of human pathogens, coliform bacteria are used as an indicator organism of human pathogens. Elevated levels of pathogen indicators in receiving waters are typically caused by the transport of domestic animal, wildlife, or human fecal wastes from the watershed. Coliform bacteria are selected for treatment assessment of dry weather flows because they are a TMDL constituent in dry weather flows of Cucamonga Creek and Mill Creek, and because urban and agricultural runoff is a primary source of elevated levels of coliform bacteria.

- ***Nutrients (nitrate, ammonia, phosphorus)***: Nutrients are inorganic forms of nitrogen (nitrate, nitrite, and ammonia) and phosphorous. Nutrients are biostimulatory substances that can cause accelerated growth of algae growth in Cucamonga and Mill Creek. Eutrophication due to excessive nutrient input can lead to changes in algae, benthic, and fish communities. High levels of nitrate are also a concern for aquifer replenishment in downstream recharge basins and can potentially impair groundwater beneficial uses. Nutrients are selected for treatment assessment of dry weather flows because they are a 303(d) constituent in Mill Creek, and because runoff from agricultural and urban land uses and IEUA discharges are primary sources of nutrients in dry weather flows.

- ***Salinity (total dissolved solids (TDS))***: TDS is a measure of the dissolved anions and cations in water. TDS is primarily made up of inorganic salts, and the most common constituents include calcium, sodium, potassium, phosphate, nitrate, and chloride. TDS is difficult to treat, requiring advanced methods such as reverse osmosis. High TDS concentrations can impair groundwater beneficial uses for potable water supply. Locally, groundwater desalter projects using reverse osmosis treatment have been implemented to reduce TDS levels in groundwater, and TDS effluent limits are in place on IEUA discharges. In the Prado Basin there is a strong interaction between surface and groundwater flows, and therefore high TDS concentrations in surface flows can

potentially impact downstream groundwater beneficial uses. Sources of TDS in surface flows are runoff from agricultural and dairy areas, and IEUA discharges. TDS is selected for treatment assessment of dry weather flows due to potential impacts to groundwater beneficial uses and elevated concentrations present in dry weather flows.

Other pollutants that are commonly associated with urban runoff such as TSS, organic compounds, metals, and trash and debris were not selected for dry weather treatment assessment. These pollutants are typically present at low levels in dry weather flows, as is supported by local monitoring data. Any TSS, organics, metals, and gross solids that are present in dry weather flows would receive some treatment in the wetlands.

4.1.1 Water Quality Pollutants for Wet Weather Flow Treatment Assessment

The water quality of wet weather flows is mainly influenced by runoff from urban and agricultural areas. Treatment of wet flows will primarily occur by extended detention and gravitational settling in the wetland basins. Wetland vegetation will also provide some treatment by filtration and sorption. The following describes the pollutants that were selected for wet weather treatment assessment and the rationale for their selection.

- ***Sediment (TSS).*** Excessive erosion, transport, and deposition of sediment in surface waters are a significant form of pollution resulting in major water quality problems. Sediment imbalances impair waters' designated uses, and can impair aquatic habitat by reducing beneficial habitat structure in stream channels, and impairing food sources. Sediments also transport other pollutants such as metals and organic compounds that tend to adsorb to sediment particles. TSS is selected for treatment assessment of wet weather flows because TSS is a principle stormwater pollutant of concern for runoff from urban, construction site, and agricultural areas, and because sediment is a 303(d) pollutant in Mill Creek.

- ***Pathogen indicators (coliform bacteria).*** Very high levels of coliform bacteria are commonly detected in wet weather flows in Cucamonga and Mill Creek Coliform bacteria are selected for treatment assessment of wet weather flows because they are a TMDL constituent in wet weather flows of Cucamonga Creek and Mill Creek, and because urban and agricultural runoff is the primary source of elevated levels of bacteria.

- ***Trace Metals (Copper, Lead, and Zinc)*:** Urban stormwater runoff can be a significant source of metals. Copper, lead, and zinc are the most prevalent metals in urban runoff. Other trace metals, such as cadmium, chromium, and mercury, are typically not detected in urban runoff or are detected at very low levels found in urban runoff. The primary sources of trace metals in stormwater are typically commercially available metals used in vehicles, buildings, and infrastructure. Metals are also found in fuels, adhesives, paints,

and other coatings. Metals are of concern because of the potential for toxic effects on aquatic life and impairment of beneficial uses. Trace metals (copper, lead, zinc) are selected for treatment assessment of wet weather flows because they are a common pollutant of urban stormwater runoff, and because they are present at elevated concentrations in wet flows in Cucamonga Creek.

- ***Nutrients (nitrate, ammonia, phosphorus)***: Concentrations of nitrogen compounds in Cucamonga Creek are typically lower in wet weather flows than in dry weather flows, but loadings are higher due to the much high flows. Total phosphorus concentration and loads typically increase in wet weather flows due to their association with particulates. Nutrients are selected for treatment assessment of wet weather flows because they are a 303(d) constituent in Mill Creek, and because runoff from agricultural and urban land uses are sources of nutrients in wet weather flows.

- ***Organic Compounds (Oil and Grease, PAHs, Pesticides, COD)***: USGS studies have found the presence of a wide variety of organic compounds in wet weather flows in Cucamonga Creek, typically at low levels. The SBC Stormwater Program has used COD as an indicator of organic compounds, and has found high levels of COD in wet weather flows in Cucamonga Creek. Organic compounds can potentially impair aquatic habitat and the beneficial uses of the streams. Some organic compounds can bioaccumulate in aquatic organisms from contaminated water, sediments, and food and are toxic to aquatic life at low concentrations. Also, some organic compounds can persist in sediments for long periods of time and result in potentially significant impacts on the diversity and abundance of benthic communities. Organic compounds are selected for treatment assessment of wet weather flows because they are a common pollutant of urban stormwater runoff.

- ***Trash and Debris***: Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic debris (such as leaves, grass cuttings, and food waste) are general waste products on the landscape that can be entrained in urban runoff. Trash and debris may have a significant impact on the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand in a water body and thereby lower its water quality. Also, in areas where stagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide. Trash and Debris compounds are selected for treatment assessment of wet weather flows because they are a common pollutant of urban stormwater runoff.

4.2 Treatment of Dry Weather Flows

Dry weather flows are the prevailing flow regime in Cucamonga Creek throughout the year. Minimum sustained dry weather flows based on USGS flow data from 2004-2006 are about 35 cfs, with average flows greater than 40 cfs. The Project will divert between 2.5-5 cfs of the dry weather flows from Cucamonga Creek to constructed water quality wetlands, with the design criteria being maintenance of minimum downstream flows to Mill Creek (Geosyntec 2008). The actual dry weather diversion rate will be refined through monitoring and adaptive management of Mill Creek's ecological needs and the levels of water quality treatment. The design diversion rate is based on providing a 3 to 6 day retention time in the wetlands for effective nitrate reduction in the wetlands. Wetlands with both longer and shorter residence times have been effective at reducing nitrate loads and therefore the treatment performance of the wetlands will be monitored and adaptively managed to optimize treatment potential. This may result in residence times that are shorter or longer than the target 3 – 6 days. Water quality objectives and ecological concerns in the creek will both be considered throughout the adaptive management process.

Constructed wetlands are a proven effective approach for treating a variety of pollutants. Numerous examples of the successful use of constructed wetlands are available in the literature (Kadlec and Knight 1996, USEPA, 2000). Local examples of the use constructed wetlands for water quality treatment include the following:

- The Orange County Water District operates the 465-acre water quality treatment wetlands behind the Prado Dam, primarily for removal of nitrogen from river flows (OCWD, 2003).

- The 24-acre Hemet/San Jacinto Multipurpose Demonstration wetlands are used to treat ammonia-dominated secondary municipal effluent (Smith et al. 2000).

- Lewis Homes has recently constructed water quality treatment wetlands in the Kimball and Bickmore basins as part of their Preserve Development Project in Chino, California. The wetlands provide treatment for runoff from on-site residential development, and existing offsite areas development areas.

- IEUA recently opened a 22-acre Chino Creek Wetlands & Educational Park in Chino. The wetlands provide water quality treatment of dry and wet weather flows, habitat functions, and recreational and educations benefits.

- The 55-acre constructed wetlands in the San Joaquin Marsh in Irvine are used to remove nitrate from flows into Upper Newport Bay (IRWD, 2003). Based on the success of this wetland, the Irvine Ranch Water District is constructing and maintain an extensive

network of constructed wetlands to treat urban runoff and help meet discharge limits in the San Diego Creek watershed (IRWD, 2003).

The pollutant removal mechanisms and effectiveness are different for individual pollutants. The following describes the expected water quality benefits for dry weather flows.

Nitrogen. Nitrogen compounds in dry weather flows of Cucamonga Creek are mainly in the form of nitrate. Densely vegetated wetlands are very effective at removing nitrate, primarily through microbially facilitated denitrification processes, and to a lesser extent by uptake into wetland vegetation. Nitrate removal will depend on temperature, residence time, and local conditions. Literature and local information suggests a mature densely vegetated and properly functioning wetland with a 3-6 day residence time design will effectively treat the majority of influent nitrate. Based on monitoring data from constructed wetlands in the Southern California, it is expected that the wetlands would remove the vast majority of nitrate loadings that are diverted from Cucamonga Creek. Nitrate treatment is the primary water quality benefit of the wetlands for dry weather flows in downstream receiving waters.

Concentrations of ammonia in Cucamonga Creek are variable but are typically low in dry weather. Treatment of ammonia occurs in the aerated open water areas of the wetlands through volatilization and microbially facilitated transformation to nitrate. Treatment performance for ammonia will be dictated by local conditions, but due to the generally low levels in Cucamonga Creek, the wetlands are not expected to significantly affect ammonia levels in the receiving waters.

Phosphorus. Phosphorus is often associated with particulates, which are typically low in dry weather flows. Particulate bound phosphorus is subject to removal in the wetlands by sedimentation and filtration processes, and soluble phosphorus may be removed by sorption to wetland sediments and uptake by plants. It is also possible that wetland sediments can be a source of phosphorus through desorption, though this source would be expected to diminish over time (EPA, 2000). Treatment performance for phosphorus in the Mill Creek wetlands will be dictated by local conditions, including the concentration and form of phosphorus in influent flows, and local wetland conditions. Monitoring data from San Joaquin Marsh and Bickmore Basin suggest that treatment performance may be inconsistent, but overall the wetlands should provide a small amount of removal of phosphorus.

TDS. Because TDS is mainly comprised of dissolved inorganic salts which are not subject to removal in the wetlands, the TDS levels are not expected to substantially change in the wetlands. Evaporation losses in the wetlands could result in a minor increases are TDS levels.

Pathogen Indicators. Bacteria treatment in wetlands primarily occurs by sedimentation of fine particles which is promoted in wetlands through filtering and hydraulic slowing by wetland

vegetation and extended retention (EPA, 2000; Davies and Bavor, 2000). Other removal processes that occur are predation, UV degradation, natural die-off. The wetlands themselves can also be a source of indicator bacteria from birds and other wildlife. Many studies have shown moderate to good removals of coliform bacteria in surface wetlands, but case studies with negative removals have also been reported (EPA, 2000, Gerba et al, 1999). Treatment performance for bacteria in the Mill Creek wetlands is difficult to forecast; however, literature information, wetland studies in the San Diego Creek watershed, and information from the San Joaquin Marsh suggest that good removals of coliform bacteria are achievable in the Mill Creek wetlands. Actual treatment performance will depend on influent concentrations and local conditions.

4.3 Treatment of Wet Weather Flows

The Mill Creek wetlands will treat wet weather flows in Cucamonga Creek primarily by detention and gravitational settling of pollutants. The Project will divert up to a maximum of between 249and 269cfs from the channel to the wetland basins, or approximately 10% - 18% percent of the average annual wet weather runoff. Diverted flows will first pass through a sedimentation forebay that is designed to remove sediments, gross solids and coarse particulates. Storm flows will then drain to the wetland basins where they will be detained in the stormwater quality pool above the normal low flow water level in the wetlands. The basins are designed with a maximum inundation depth of 9 feet, and a maximum drain time of 48 hours.

The anticipated treatment performance of the Mill Creek wetlands, described below, is based on monitoring data available from the International BMP monitoring database, including an analysis of the expanded database performed in 2004 (Strecker et al., 2004).

Summary performance data for detention basins and constructed wetlands from the BMP database are shown in Table 7. Wetlands, which include permanent pools and vegetation, generally show better median effluent quality, and better removal for most constituents, including some removal for dissolved constituents. Thus, the Mill Creek wetland basins, which include permanent pools and wetland vegetation, should provide more effective treatment for wet weather flows than dry extended basin alone. The following describes the expected water quality benefits for selected wet weather pollutants.

Table 7: Median and Range of Average Influent & Effluent Event Mean Concentrations of BMPs from the BMP Database

Constituent	Sample Location	Detention Pond (n=25)[1]	Wetland Basin (n=19)[1]
Total Suspended Solids (mg/L)	Influent	72.65 (41.70-103.59)	37.76 (18.10-53.39)
	Effluent	31.04 (16.07-46.01)	17.77 (9.26-26.29)
Total Phosphorus (mg/L)	Influent	0.19 (0.17-0.22)	0.27 (0.11-0.43)
	Effluent	0.19 (0.12-0.27)	0.14 (0.04-0.24)
Dissolved Phosphorus (mg/L)	Influent	0.09 (0.06-0.13)	0.10 (0.04-0.22)
	Effluent	0.12 (0.07-0.18)	0.17 (0.03-0.31)
Total Nitrogen (mg/L)	Influent	1.25 (0.83-1.66)	2.12 (1.58-2.66)
	Effluent	2.72 (1.81-3.63)	1.15 (0.82-1.62)
TKN (mg/L)	Influent	1.45 (0.97-1.94)	1.15 (0.81-1.48)
	Effluent	1.89 (1.58-2.19)	1.05 (0.82-1.34)
Nitrate-Nitrogen (mg/L)	Influent	0.70 (0.35-1.05)	0.22 (0.01-0.47)
	Effluent	0.58 (0.25-0.91)	0.13 (0.07-0.26)
Total Lead (µg/L)	Influent	25.01 (12.06-37.95)	4.62 (1.43-11.89)
	Effluent	15.77 (4.67-26.87)	3.26 (2.31-4.22)
Dissolved Lead (µg/L)	Influent	1.25 (0.33-2.17)	0.50 (0.33-0.67)
	Effluent	2.06 (0.93-3.19)	0.87 (0.85-0.89)
Total Zinc (µg/L)	Influent	111.56 (51.50-171.63)	47.07 (24.47-90.51)
	Effluent	60.20 (20.70-99.70)	30.71 (12.80-66.69)
Dissolved Zinc (µg/L)	Influent	26.11 (5.20-75.10)	xx
	Effluent	25.84 (10.75-40.93)	xx
Total Copper (µg/L)	Influent	20.14 (8.41-31.79)	5.65 (2.67-38.61)
	Effluent	12.10 (5.41-18.80)	4.23 (0.62-7.83)
Dissolved Copper (µg/L)	Influent	6.66 (0.73-12.59)	xx
	Effluent	7.37 (3.28-11.45)	xx

Sediments (TSS). Sediments are a primary constituent targeted for removal.The Mill Creek wetland basins are expected to provide effective treatment of sediments through gravitational settling. Coarser particulates will be effectively removed in the sediment forebay, and finer grained particulates will be subject to removal in the extended detention basins by gravitational settling and by filtration through the wetland vegetation.

Nutrients (Nitrogen, Phosphorus). The wetland basins are expected to provide limited to small amounts of treatment for nutrients in wet weather flows, based on literature information and summary performance monitoring data from the BMP database (Table 7). Because sedimentation is a primary treatment mechanism of wet weather flows, treatment is expected to be most effective for nutrients that are associated with particulates (TP, organic nitrogen – TKN). Lower removal effectiveness is expected for the soluble nutrients (nitrate, ammonia, dissolved phosphorus).

Metals (Copper, Lead, Zinc). Because metals are associated with particulates, the wetlands are expected to provide good reductions of total metal concentrations in wet weather flows, as supported by data from the BMP database (Table 7).

Pathogen indicators (coliform bacteria). There are limited performance data for bacteria in the BMP database. The California BMP Manual grades detention basins as providing a medium level of treatment performance for bacteria, and grades wet ponds and wetlands as providing a high level of treatment performance. The Center for Watershed Protection (2000) maintains a National Pollutant Removal Performance Database that shows bacteria removal performance of about 78 percent for dry extended detention basins. The primary removal mechanism for bacteria in the Mill Creek wetland basin is sedimentation, but processes of UV degradation and die-off would also occur in the basins. Thus, literature data suggests the Mill Creek wetland basins will provide good to significant reductions in the bacteria concentrations; however, given the very high influent concentrations measured in Cucamonga Creek, the effluent concentrations from the wetlands basins are not expected to consistently meet the very low water quality objectives for bacteria.

Organic Compounds. There are limited performance data for organic compounds in the BMP database. Treatment performance for organics is compound specific; however, many organic compounds have low solubility and tend to adsorb to particulates. These compounds are subject to treatment by sedimentation processes occurring in the basins. The Mill Creek wetlands basins should therefore provide moderate to good removals of many organic compounds.

Trash & Debris. Trash & debris are effectively trapped and removed in the forebay and wetland basins, providing a high level of removal. The accumulated sediments and trash and debris that

are trapped in the forebay and wetland basins will be removed during routine maintenance operations.

5 CONSTRUCTION-RELATED IMPACTS

The potential impacts of construction activities, construction materials, and non-stormwater runoff on water quality during the construction phase focus primarily on sediment (TSS and turbidity) and certain non-sediment related pollutants. Construction-related activities that are primarily responsible for sediment releases are related to exposing soils to potential mobilization by rainfall/runoff, truck traffic, and wind. Such activities include grading of the site, and trenching and excavation. Environmental factors that affect erosion include topographic, soil, and rainfall characteristics.

Non sediment-related pollutants that are also of concern during construction include construction materials; chemicals, liquid products, and petroleum products used in construction or the maintenance of heavy equipment; and concrete-related pollutants.

Construction impacts from the Project will be minimized through compliance with the Construction General Permit. This permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP), which must include erosion and sediment control BMPs that will meet or exceed measures required by the Construction General Permit, as well as BMPs that control the other potential construction-related pollutants. Erosion control BMPs are designed to prevent erosion, whereas sediment controls are designed to trap sediment once it has been mobilized. A SWPPP will be developed as required by, and in compliance with, the Construction General Permit and the County of San Bernardino Standard Conditions. The SARWQCB has inspection and enforcement authority for the General Permit. The General Permit requires the SWPPP to include a menu of BMPs to be selected and implemented based on the phase of construction and the weather conditions to effectively control erosion and sediment to the BAT/BCT.

Based on the above considerations, the impact of construction-related runoff from the Project is considered less than significant.

6 SUMMARY AND CONCLUSIONS

The Project is intended to provide a net benefit to creek water quality, and with the optimization of the hydrologic and hydraulic systems, the Project is expected to provide treatment of volumes that could not be attained with conventional siting practices (Geosyntec 2008).

Water quality in dry and wet weather flows in Cucamonga Creek and Mill Creek is degraded by pollutants from urban and agricultural runoff and IEUA discharges. The proposed Project will provide water quality treatment for a portion of the dry and wet weather flows in Cucamonga Creek using constructed water quality treatment wetlands that are integrated into stormwater extended detention basins. These treatment technologies are well established, commonly used, and proven methods. There are several successful examples of constructed water quality treatment wetlands within the Prado Basin.

Anticipated reduction in loadings of pollutants by the proposed Mill Creek Wetlands in dry and wet weather runoff are based on available literature information and data from local constructed wetlands. Treatment of dry weather flows will occur in the constructed wetlands and will mainly target nitrate and bacteria, which are designated impairing pollutants in Mill Creek. Water quality and treatment performance monitoring will be conducted to support adaptive management of the wetlands. Treatment of wet weather flows will occur by flow through a sedimentation forebay, and by extended detention in the wetland basins. This approach will effectively capture trash and debris, and reduce concentrations of sediments and pollutants that are associated with sediments including phosphorus, trace metals, and organic compounds. In addition, literature data indicates basins that include wet pools and vegetation, like the proposed Mill Creek wetlands, will provide better treatment of wet weather flows than traditional dry basins. The proposed Project is anticipated to provide improvement to dry and wet weather surface water quality in Mill Creek.

7 LIMITATIONS

The information presented in this document is conceptual and intended to describe the water quality benefits of the Project and to present information that can be used for environmental clearance efforts. The bases for conclusions presented herein are the design concept (as of the date of publication). This document is not intended to address the Project should there be significant design changes. In addition, the conclusions presented herein are based on publicly available hydrologic, water quality, and BMP performance data. Geosyntec did not independently validate or conduct a quality assurance review of this data for this project. Should new data become available, the analyses presented herein may change.

No warranty, expressed or implied, is made regarding the professional opinions expressed in this report. Geosyntec is not liable for any use of the information contained in this report by persons other than for the stated project purpose.

8 REFERENCES

Davies, C.M. and H.J. Bavor, 2000. The fate of stormwater-associated bacteria in constructed wetland and water pollution control pond systems, J of Applied Microbiology, 8, 349-360.

Geosyntec 2008. Conceptual Hydrologic and Hydraulic Project Design and Function: Mill Creek Recreation and Restoration Demonstration Project (Draft). November 26, 2008.

Gerba, C.P., J.A Thurston, J.A. Falabi, P.M. Watt, M.M. Karpiscak, 1999. Optimization of artificial wetland design for removal of indicator microorganisms and pathogenic protozoa,40(4-5), 363-368.

IRWD, March 2003. San Diego Creek Watershed Natural Treatment System Draft Master Plan, Irvine Ranch Water District.

Kadlec, R.H. and R.L. Knight, 1996. Treatment Wetlands – Theory and Implementation, CRC Lewis Publishers.

Belitz, K., Hamlin, S.N., Burton, C.A., Kent, R., Fay, R.G., and Johnson, T. 2004. Water Quality in the Santa Ana Basin California, 1999-2001. Circular 1238, U.S. Geological Survey.

OCWD, 2003. Prado Wetland Overview, Orange County Water District, online at http://www.ocwd.com/_html/prado.htm, visited July, 2003.

Reilly, J.F., A.J. Horne, C.D. Miller 2000. Nitrate removal from a drinking water supply with large free-surface constructed wetlands prior to groundwater recharge, Ecological Engineering, 14, 33-47.

San Bernardino County, October 2006. County of San Bernardino, Santa Ana Basin Area, Report of Waste Discharge, Application for Renewal of the Municipal NPDES Stormwater Permit No. CAS618036; 2007 – 2012, prepared by CDM.

San Bernardino County, September 2000. County of San Bernardino, Santa Ana Basin Area, Report of Waste Discharge, Application for Renewal of the Municipal NPDES Stormwater Permit, 2001-2006, prepared by CDM.

Strecker, E.W., Quigley, M.M., Urbonas, B., and Jones, J., 2004. Analyses of the Expanded EPA/ASCE International BMP Database and Potential Implications for BMP Design, In: Proceedings of the World Water and Environmental Congress 2004, June 27 - July 1, 2004, Salt

Lake City, UT. Edited by Sehlke, G., Hayes, D.F. and Stevens, D.K., ISBN 0-7844-0737-1, ASCE, Reston, VA.

Smith, L.K., J.J. Sartoris, J.S. Thullen, D.C. Anderson. 2000. Investigation of denitrification rates in an ammonia-dominated constructed wastewater-treatment wetland, Wetlands, 20(4), 684-696.

State Water Resources Control Board, February 2008, Santa Ana River Basin Water Quality Control Plan, Resolution 94-1.

USEPA, September 2000. Manual, Constructed Wetlands Treatment of Municipal Wastewaters, EPA/625/R-99/010.