MOODY FLATS QUARRY PROJECT

HYDROLOGY AND WATER QUALITY

DECEMBER | 2009

REVISED FEBRUARY 2011

Lead Agency

Shasta County, Department of Resource Management – Planning Division

Applicant/Operator

Moody Flats Quarry, LLC

BENCHMARK RESOURCES

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Shasta County, Department of Resource Management – Planning Division
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Applicant/Operator

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HYDROLOGY AND WATER QUALITY

This section addresses potential impacts on hydrology and water quality associated with the Project. Topics include impacts on flooding, surface water drainage, groundwater flow, groundwater supply, water quality, and water balance.

1.0 METHODOLOGY AND TERMINOLOGY

The hydrology and water-quality conditions of Moody Flats Quarry (Project) were assessed through review of existing reports, aerial photos, and field observations. Field reconnaissance observations and site assessments of the Project site were conducted in 2008 and 2009 to assess the existing hydrologic conditions and develop a field testing program. Previous corehole data collected by 3M (along with U.S. Geological Survey reports), university research, data from the California Department of Water Resources, and other publicly-available documents were reviewed and evaluated as part of this assessment. Four monitoring wells were installed in 2009. Water levels were measured in the wells to identify the groundwater depths. Groundwater and surface water samples were collected and analyzed to assess the water quality in the Project site. Field data collection activities are described in *Field Investigation Report, Hydrology Analysis, 3M Redding Hard Rock Aggregate Quarry, Shasta County, California* (see Appendix K). Evaluation of the hydrologic conditions related to the Project is provided in the *Hydrology and Water-Quality Analysis of the Proposed 3M Moody Flats Quarry Use Permit and Reclamation Plan, Shasta County, California* (see Appendix L).

This section includes a discussion of the general site conditions including topography and meteorology, surface-water occurrence and volumes, surface water quality, groundwater occurrence, and groundwater quality. As part of the assessment presented in this section, anticipated changes to these baseline conditions as a result of the Project were identified and, where possible, quantified. Potential impacts to hydrology and water quality were evaluated based on the CEQA significance criteria.

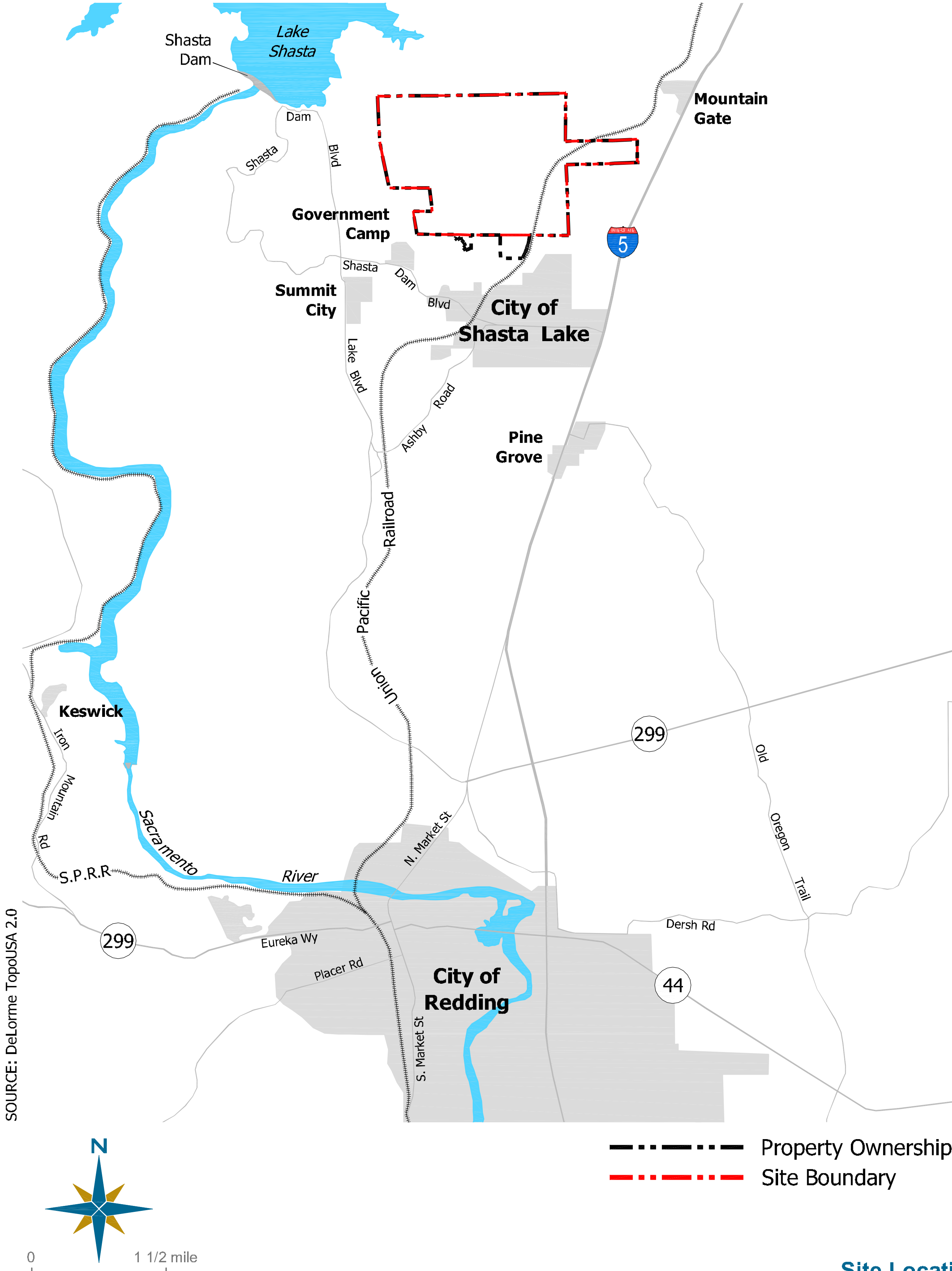
2.0 EXISTING CONDITIONS

The Project site is located in western Shasta County, California, about 1 mile west of Interstate 5, north of the City of Shasta Lake, and 9 miles north of the City of Redding (see HYDRO-Figure 1, Site Location). The Project site is located on land historically utilized as open space, as shown in HYDRO-Figure 2, Existing Conditions Aerial Photograph. The elevation of the Project site ranges from approximately 800 feet to 2,000 feet above mean sea level (msl). The site encompasses approximately 1,900 acres dominated by Montane Hardwood-Conifer and Montane Hardwood vegetative habitats.

2.1 Climate and Precipitation

General meteorological data for the Project site are presented in Table 1, Temperature and Meteorological Data. The average high temperature ranges from 53°F in January and December to 95°F in July. The average low temperature ranges from 39°F in January to 68°F in July. The seasonal temperature variations, however, can be much larger. For example, the record high temperature is 115°F (in 1981), whereas the record low temperature is 7°F (in 1985). The average annual precipitation in the Project vicinity is approximately 64 inches per year (www.weather.com, WRCC 2007), which includes approximately 4.5 inches of snowfall equivalent water depth. The 24-hour 100-year storm has a magnitude of approximately 11.4 inches (City of Redding 2006).

Precipitation that reaches the ground surface is subject to several processes. Some of the precipitation will be intercepted by vegetation before reaching the ground. Rainfall that reaches the ground surface, and snowmelt, may percolate into the soil, run off the surface and contribute to stream flow, or evaporate. Based on studies conducted for the area (City of Redding 2006; Waananen and Crippen 1977), approximately 60 percent of the precipitation that falls on bedrock areas will become surface runoff, whereas approximately 50 percent of the surface runoff that falls on forested areas will become runoff. The relatively high runoff from the forested areas is most likely a result of the topographic slopes, the lack of a well-developed soil, and the presence of the bedrock at shallow depths, minimizing the amount of water that can percolate to greater depths.



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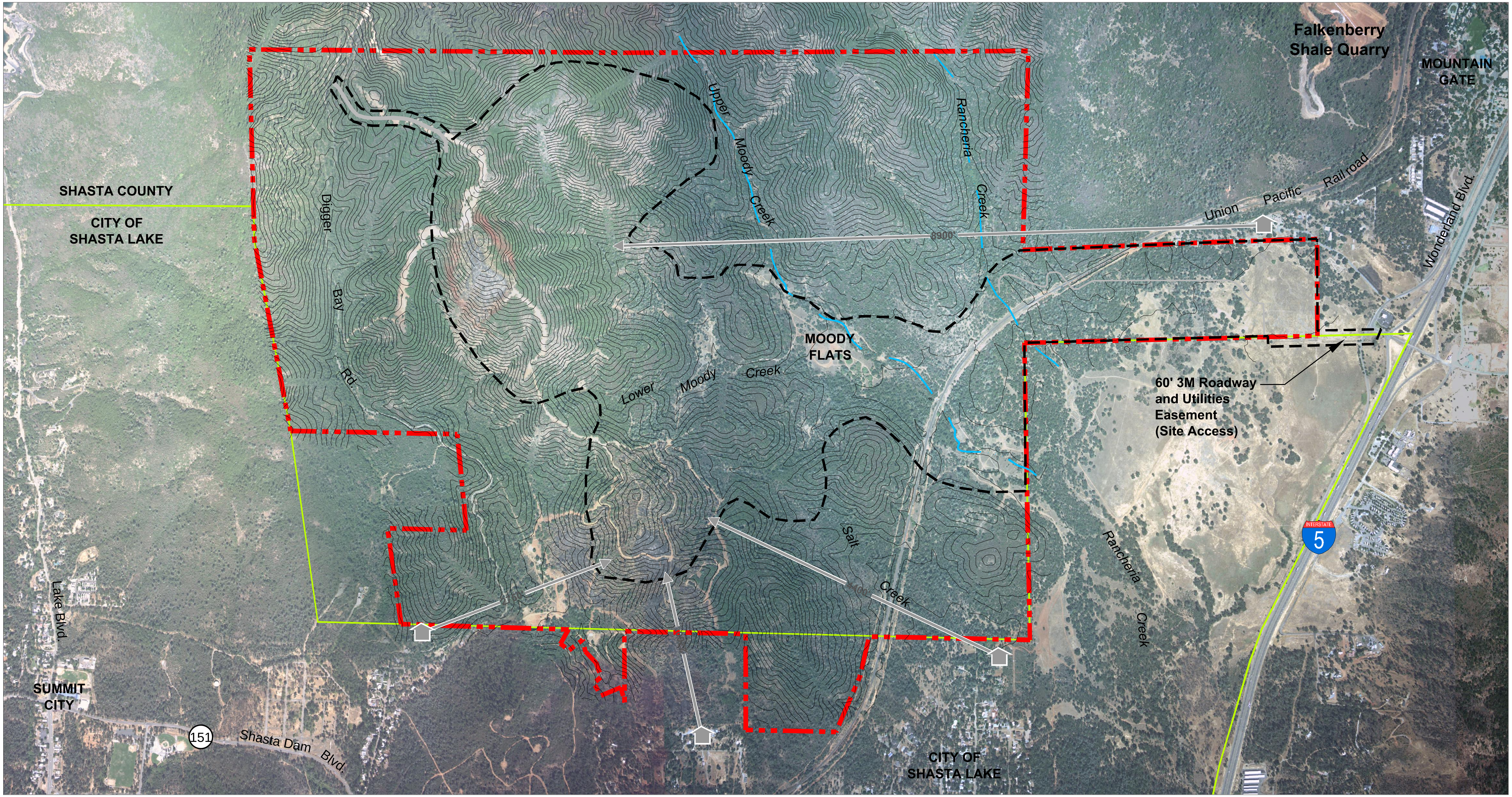
Site Location

MOODY FLATS QUARRY

HYDRO - Figure 1



AERIAL PHOTOGRAPH SOURCE: Pace Civil, Inc. (08-2006)

	Property Ownership	± 1900 acres
	Site Boundary	± 1810 acres
	Limits of Surface Disturbance	± 760 acres
	City of Shasta Lake Boundary	
	Residence	

N

0 1/4 mile

SCALE: 1" = 1/4 mile

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Existing Conditions Aerial Photograph

MOODY FLATS QUARRY

HYDRO - Figure 2

TABLE 1
TEMPERATURE AND METEOROLOGICAL DATA

Parameter	January	July
Average High Temperature	53	95
Average Low Temperature	39	68
Mean Temperature	46	81
Record High Temperature	75(1968)	115(1981)
Record Low Temperature	7(1985)	50(1997)
Average Annual Precipitation	64	
Pan Evaporation	64	
Lake Evaporation	45	
Evapotranspiration	51	

Notes:
1. Temperature in degrees Fahrenheit; and
2. Rainfall and evaporation rates in inches.

Sources:
Weather.com; WRCC (2007); Department of Water Resources (1975, 1979)

Evaporative loss of water is estimated through several parameters. The pan evaporation rate is the rate at which water will evaporate from a standard (Class A) pan used for making such a measurement. The measured pan evaporation rate is used to approximate other water-loss terms such as the lake evaporation rate and the evapotranspiration rate. The lake evaporation rate is the rate at which water evaporates from surface-water bodies, such as lakes or ponds, and is typically less than the pan evaporation rate. In the Project site, the lake evaporation rate is assumed to be approximately 0.7 times the pan evaporation rate (Department of Water Resources 1975, 1986). The evapotranspiration rate is the amount of rainfall and applied water (e.g. for irrigation or dust control) that is lost to both surface evaporation and transpiration from plant surfaces. In the Project site, the evapotranspiration rate is assumed to be approximately 0.8 times the pan evaporation rate (Department of Water Resources 1975, 1986). The average pan evaporation rate for the Project site is approximately 64 inches.

2.2 Surface Water Hydrology

2.2.1 Regional Surface Water Hydrology

The Project site is located at the north edge of the Sacramento Valley within the foothills of the Cascade Range. The most significant surface-water feature in the area is Shasta Lake. Shasta Lake is a reservoir created by the construction of Shasta Dam, which was completed in 1945. The lake has a surface area of 29,740 acres and a total capacity of approximately 4,552,000 acre-feet (AF). Shasta Dam has a crest elevation of 1,077.5 ft msl and a spillway elevation of 1,067 ft msl. Water levels fluctuate seasonally within the lake. Within the past five years, the peak water elevation occurred in June 2006 at 1,064 ft msl, and the low water elevation in the lake occurred in October 2008 at 909 ft msl. Shasta Lake has a watershed area of 6,665 square miles, or about 4,265,600 acres (www.cdec.water.ca.gov)

The property is within 3 watersheds including Shasta Lake, Moody Creek, and Salt Creek with over 90 percent of proposed surface disturbance within the Moody Creek watershed (see HYDRO-Figure 3, Existing Surface Water Drainage). The remaining 10 percent is within the Salt Creek watershed. No surface disturbance will occur within the Shasta Lake watershed.

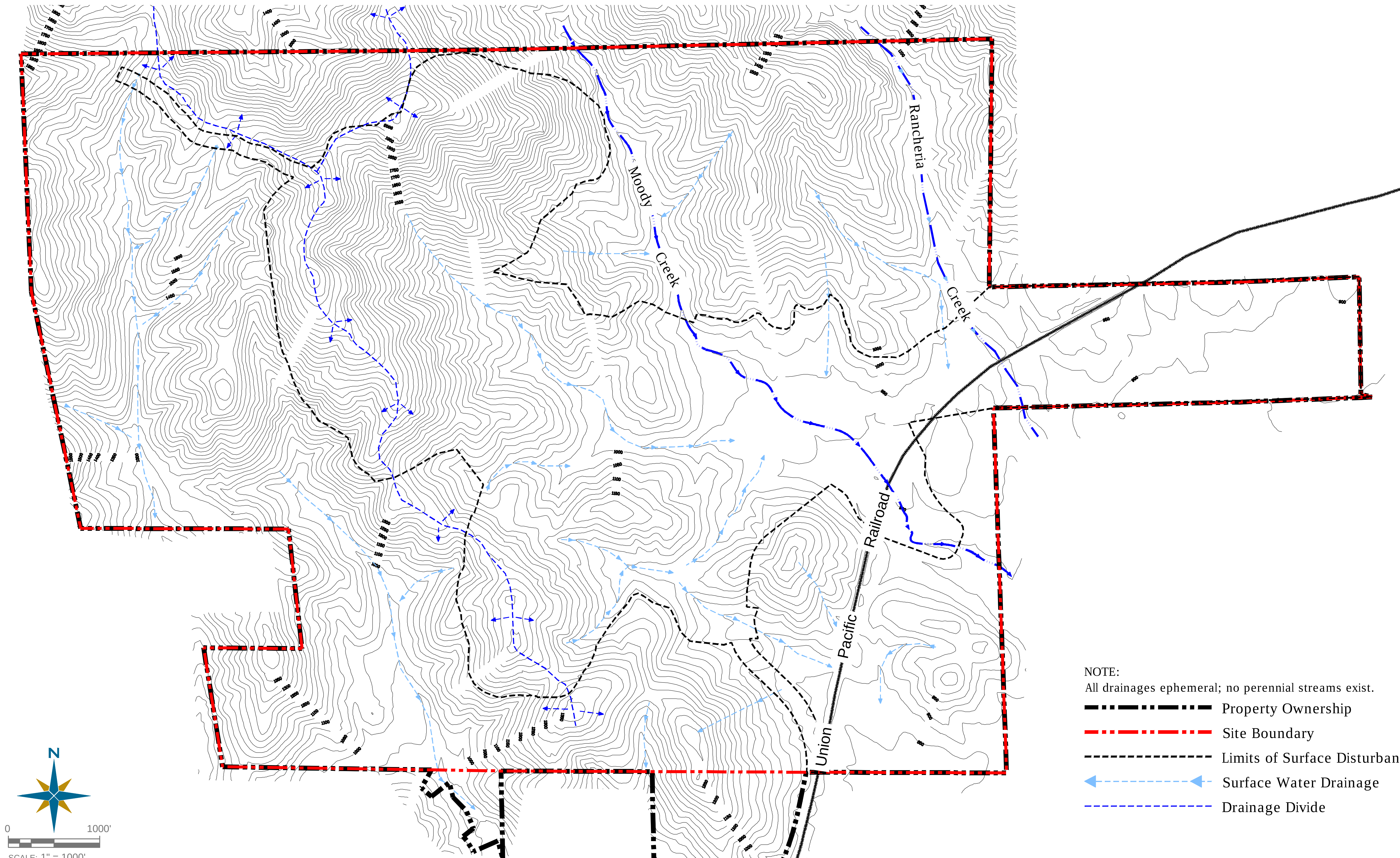
Three intermittent streams are located within the Property including Moody Creek, Rancheria Creek, and Salt Creek. Salt Creek is a tributary of Churn Creek. The remaining areas to be disturbed by the Project are within the Moody Creek watershed. Moody Creek is a tributary of Stillwater Creek. Both Churn Creek and Stillwater Creek join the Sacramento River at Anderson, approximately eight miles south of Redding. There are no perennial streams within the Project boundary.

2.2.2 Project Site Surface Water Hydrology

Surface Water Quantity

The streams and surface drainages on the site are ephemeral. There are no perennial streams within the Project boundary. Runoff occurs primarily in the winter and spring months and after major storm events. Based on the information presented in Section 2.1, Climate and Precipitation, the average annual runoff from the entire approximately 1,900-acre property is approximately 5,000 AF.

The average runoff from the approximately 430 acres that would be disturbed by the Project is approximately 1,200 acre-feet per year (AF/yr). For the South Pit, the average annual runoff is approximately 170 AF/yr. Of this total runoff, approximately 53 AF/yr drains into Salt Creek, while the remaining 117 AF/yr drains into Moody Creek. For the North pit, the average annual runoff is approximately 635 AF/yr. Of this total runoff, approximately 130 AF/yr drains into Salt Creek and the remaining 505 AF/yr drains into Moody Creek. The



TOPOGRAPHY SOURCE: Pace Civil, Inc. (08-2006)
CONTOUR INTERVAL: 25'-0"

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Existing Surface Water Drainage

MOODY FLATS QUARRY

HYDRO - Figure 3

remaining balance of annual runoff, approximately 395 AF/yr, comes from the overburden fill area, primary processing plant, secondary and ancillary processing plant and load out area, and rail spur/siding area.

Surface Water Quality

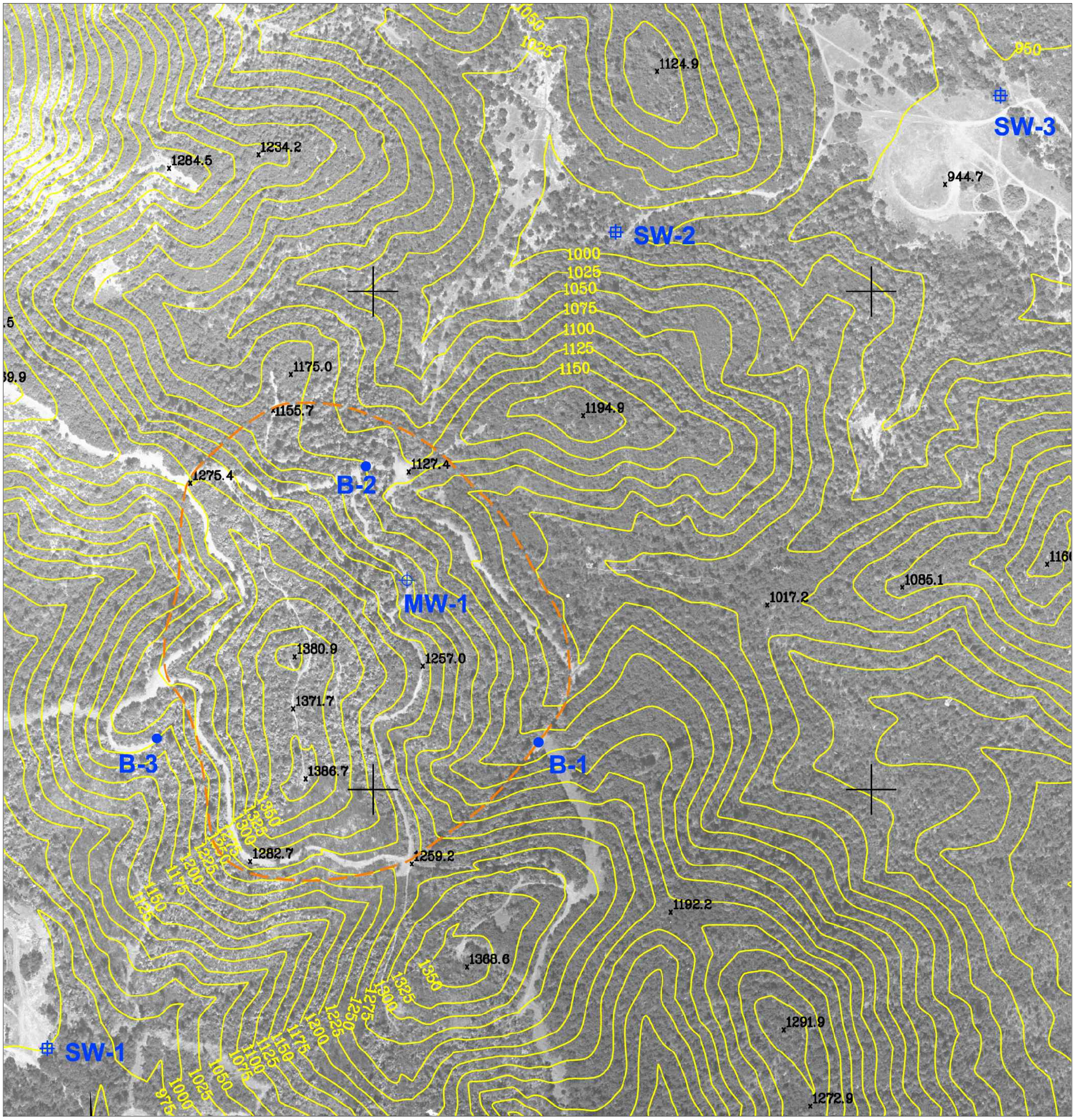
Surface-water sampling was conducted at the site in March 2009 to identify baseline water-quality conditions (EMKO Environmental, Inc., 2009; Brown & Caldwell, 2009). Surface-water samples were collected from three locations within the Project site, as shown on HYDRO-Figure 4, Sampling Locations. Sample locations include:

- SW-1, collected from the unnamed tributary to Salt Creek that drains the west sides of the North and South Pits;
- SW-2, collected from the unnamed tributary to Moody Creek that drains the north and northeast sides of the South Pit and the southeast side of the North Pit; and
- SW-3, collected from Moody Creek upstream of the confluence with the unnamed tributary from which sample SW-2 was collected, which drains the east side of the North Pit area.

A duplicate sample was also collected at the SW-1 location for quality assurance/quality control (QA/QC) purposes. The water samples were collected from actively flowing surface streams.

The surface-water chemistry data are presented in Table 2, Water Chemistry Data. The surface water samples had relatively low dissolved solids levels, with total dissolved solids (TDS) levels ranging from 65 milligrams per liter (mg/L) in the sample from the tributary to Moody Creek (SW-2), to 75 mg/L in the sample from the tributary to Salt Creek (SW-3), to 130 mg/L in the sample from Moody Creek (SW-1 and its duplicate). The pH levels were neutral, ranging from 6.99 to 7.65. The only metal reported above its analytical detection limit in the surface-water samples was barium. Barium was reported at a concentration of 22 micrograms per liter (ug/L) in sample SW-3, collected from Moody Creek.

HYDRO-Figure 5, Stiff Diagrams for Surface Water Samples, and HYDRO-Figure 6, Piper Diagram for Water Samples, present a Stiff Plot and Piper Diagram, respectively, of the water chemistry from the surface water samples. The Stiff



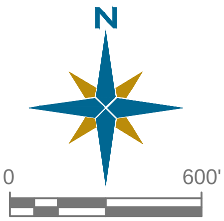
SOURCE: EMKO Enviromental (2009)

Surface Water Sampling Location

Monitoring well Location

Boring Location

Proposed South Pit Boundary

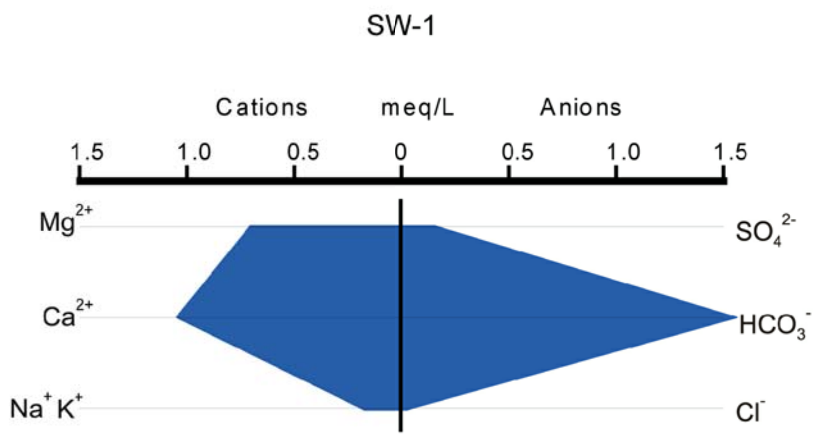


BENCHMARK RESOURCES

Sampling Locations

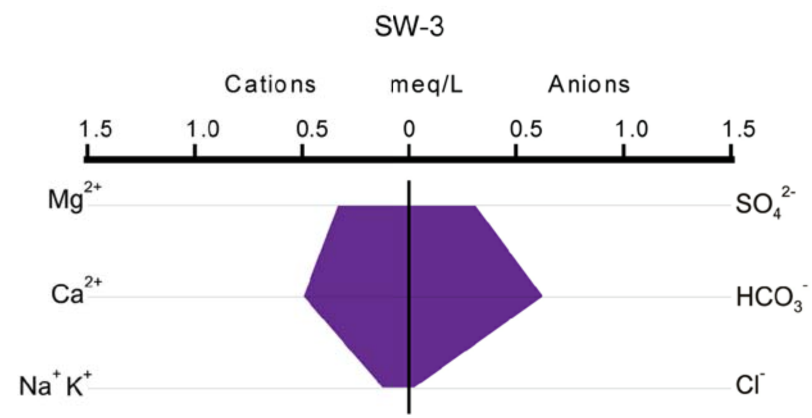
MOODY FLATS QUARRY

HYDRO - Figure 4



Legend

Ca^{2+}	Calcium
Mg^{2+}	Magnesium
Na^{+}	Sodium
K^{+}	Potassium
Cl^{-}	Chloride
SO_4^{2-}	Sulfate
HCO_3^{-}	Bicarbonate
NO_3^{-}	Nitrate
meq/L	milliequivalents per liter



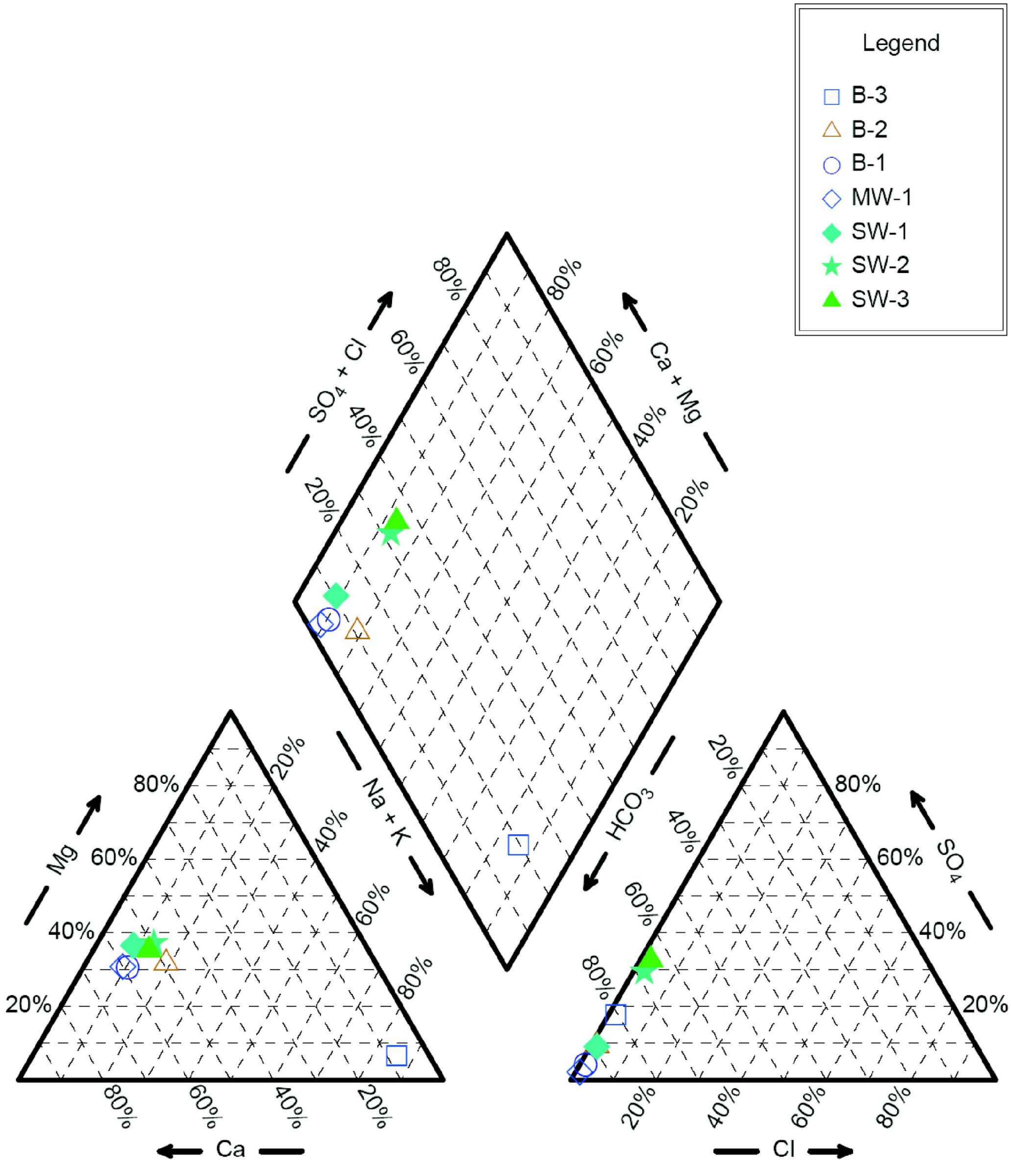
SOURCE: EMKO Enviromental (2009)

Stiff Diagrams for Surface Water Samples

MOODY FLATS QUARRY

BENCHMARK RESOURCES

HYDRO - Figure 5



SOURCE: EMKO Enviromental (2009)

Plots indicate that the surface water is a calcium-bicarbonate water type at all three sample locations. The Piper Diagram indicates that all three surface water samples are very similar, with only minor differences in the ratios of bicarbonate, chloride, and sulfate.

Drainage and Stormwater Management

A Stormwater, Erosion Control, and Drainage Plan (see Appendix D) has been prepared based on the *Shasta County Development Standards, Chapter 2, Section F - Drainage* (reprinted December 1997) and the California State Water Resources Control Board (SWRCB) *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Appendix D: Sediment Basin Sizing*[1].

HYDRO-Figure 7, Site Stormwater Plan Concept Map presents a process-flow diagram for Project storm water management. HYDRO-Figure 8, Stormwater Feasibility Map, shows the approximate layout of the proposed storm water system features at the site. In addition, flow arrows indicate the direction of runoff to each of the main collection features. The exact location of detention features, drainage channels, diversions, and culverts will be determined after any mitigation measures and permit conditions have been identified. The feasibility map, however, demonstrates that there is adequate space within the Project layout for the storm water control system and that adequate grades and flow directions can be maintained.

Storm water runoff in the North and South Pit watersheds will be retained within the pits' water storage sumps. As appropriate and necessary to facilitate mining, retained water within the storage sumps may be pumped out between storms or after the wet season. Runoff from the overburden, processing, loadout, and access areas will be directed to a series of surge basins and rate control basins to reduce peak flows and provide initial settling of sediment particles.

The surge and rate control basins discharge to a series of Water Quality Control Ponds to improve storm water quality prior to discharge. The Water Quality Control Ponds discharge to a Vegetated Sheet Drain to provide an additional margin of safety in removing sediment and improving storm water quality. Flows through the Vegetated Sheet Drain eventually enter Moody Creek at the eastern edge of the Project site.

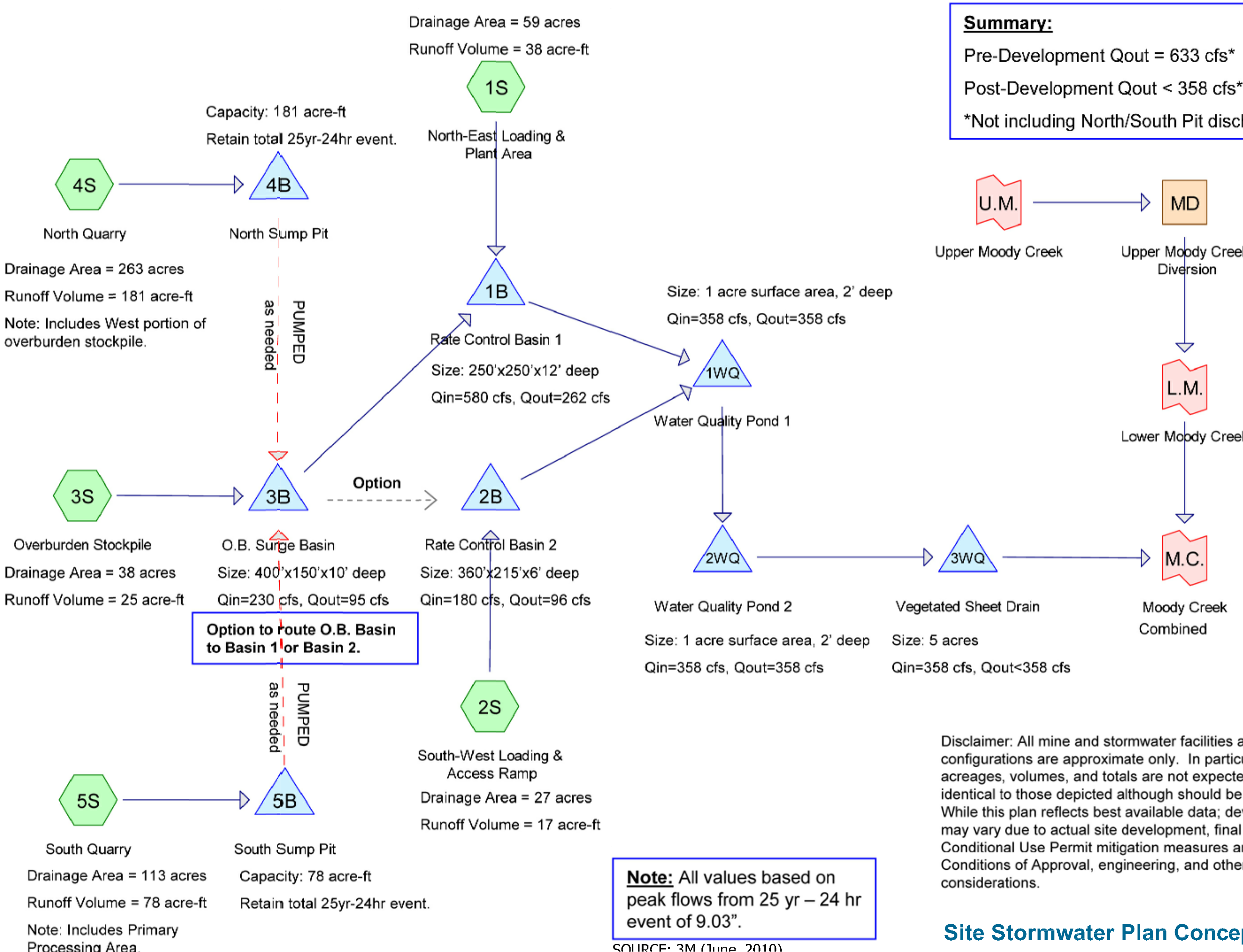
[1] www.waterboards.ca.gov/water_issues/programs/stormwater/docs/constpermits/draft/draftconst_att_d_sed_basin.pdf

Summary:

Pre-Development Qout = 633 cfs*

Post-Development Qout < 358 cfs*

*Not including North/South Pit discharge



Note: All values based on peak flows from 25 yr – 24 hr event of 9.03".

SOURCE: 3M (June, 2010)

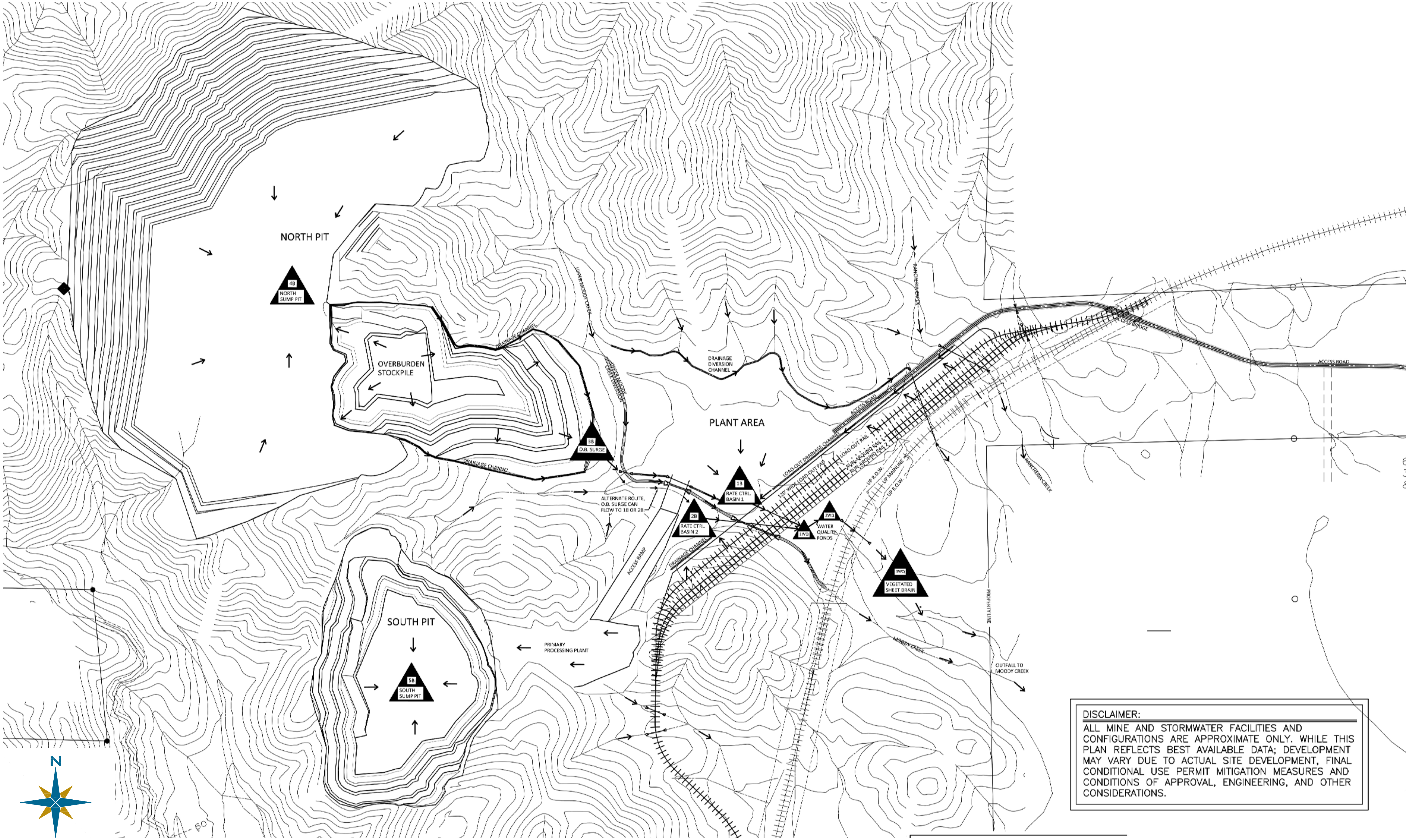
Disclaimer: All mine and stormwater facilities and configurations are approximate only. In particular, acreages, volumes, and totals are not expected to be identical to those depicted although should be similar. While this plan reflects best available data; development may vary due to actual site development, final Conditional Use Permit mitigation measures and Conditions of Approval, engineering, and other considerations.

Site Stormwater Plan Concept Map

MOODY FLATS QUARRY

BENCHMARK RESOURCES

HYDRO - Figure 7



NOT TO SCALE

SOURCE: 3M (June, 2010)

Stormwater Feasibility Map

MOODY FLATS QUARRY

BENCHMARK RESOURCES

HYDRO - Figure 8

TABLE 2
WATER CHEMISTRY DATA

	Surface Water				Groundwater					Basin Plan Limits
	SW-1 3/30/2009	*SW-1 Dup 3/30/2009*	*SW-2 3/30/2009*	*SW-3 3/30/2009*	*B-1 5/27/2009*	*B-1 Dup 5/27/2009*	*B-2 5/27/2009*	*B-3 5/27/2009*	*MW-1 5/27/2009*	
FIELD PARAMETERS										
Temperature (°C)	14.24	NA	14.62	12.9	17.8	NA	18.7	22.5	18.6	-
Conductivity (uS/cm)	149	NA	200	145	210	NA	650	573.8	351	-
pH (pH units)	7.65	NA	7	6.99	8.14	NA	7.74	8.29	6.19	-
Oxidation Reduction Potential (mV)	69	NA	95	100	-42	NA	4	-30	40	-
GENERAL MINERALS										
Alkalinity, Bicarbonate as $CACO_3$ (mg/L)	96	97	38	38	120	110	350	420	190	-
Alkalinity, Carbonate as $CACO_3$ (mg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-
Alkalinity, Hydroxide as $CACO_3$ (mg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-
Alkalinity, Total as $CACO_3$ (mg/L)	95	97	38	38	120	110	350	420	190	-
Ammonia as Nitrogen, Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	-
Bromide (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
Chloride (mg/L)	1.0	1.0	0.82	0.83	1.1	1.1	3.4	5.4	1.2	-
Electrical Conductivity (μmhos/cm)	200	200	100	110	230	230	710	910	370	230
Fluoride (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.18	<0.10	-
Hardness as $CACO_3$ (mg/L)	88	87	40	42	100	100	310	43	180	-
Nitrate as N (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Nitrate as N (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
Sulfate (mg/L)	7.6	7.6	13	15	4.1	4.1	29	73	3.3	-

	Surface Water				Groundwater					Basin Plan Limits
	SW-1 3/30/2009	SW-1 Dup 3/30/2009	SW-2 3/30/2009	SW-3 3/30/2009	B-1 5/27/2009	B-1 Dup 5/27/2009	B-2 5/27/2009	B-3 5/27/2009	MW-1 5/27/2009	
Total Dissolved Solids (mg/L)	130	130	65	75	140	140	440	700	210	-
Calcium (µg/L)	21,000	21,000	9,000	9,900	28,000	30,000	77,000	15,000	48,000	-
Magnesium (µg/L)	8,300	8,500	4,100	4,100	8,800	9,100	30,000	7,700	15,000	-
Sodium (µg/L)	3,900	3,900	2,800	2,900	5,700	5,800	34,000	190,000	8,500	-
Potassium (µg/L)	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	1,900	<1,000	-
Aluminum (µg/L)	<50	<50	<50	<50	<50	<50	<50	<50	<50	-
Antimony (µg/L)	<6.0	<6.0	<6.0	<6.0	<5.0	<5.0	<5.0	8.1	<5.0	-
Arsenic (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.2	<5.0	10
Barium (µg/L)	<20	<20	<20	22	<20	<20	38	<20	<20	100
Beryllium (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-
Cadmium (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10	<10	0.14
Chromium (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Chromium, Hex (µg/L)	-	-	-	-	-	-	-	-	-	-
Cobalt (µg/L)	<20	<20	<20	<20	<20	<20	<20	<20	<20	-
Copper (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10	<10	24
Iron (µg/L)	<100	<100	<100	<100	<100	<100	150	<100	<100	300
Lead (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-
Manganese (µg/L)	<20	<20	<20	<20	31	26	150	25	81	50
Mercury (µg/L)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
Molybdenum (µg/L)	<20	<20	<20	<20	<20	<20	<20	35	<20	-
Nickel (µg/L)	<20	<20	<20	<20	<20	<20	<20	<20	<20	-
Selenium (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-
Silver (µg/L)	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Thallium (µg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-
Vanadium (µg/L)	<20	<20	<20	<20	<5.0	<5.0	<5.0	7.0	<5.0	-
Zinc (µg/L)	<20	<20	<20	<20	<20	<20	<20	<20	<20	61

Notes: °C = Degrees Celsius; uS/cm = Microseimens per centimeter; mV = millivolts; µg/L = micrograms per liter; mg/L = milligrams per liter; µmhos/cm = micromhos per centimeter.

The storm water control system also acts to attenuate flood flows. Therefore, the proposed development of the property will not result in the potential for increased flooding downstream of the property, it will reduce flooding.

Stiff plots and Piper diagrams are graphical tools used to present the general mineral chemistry of water samples, based on the variations in the anions (negatively-charged atoms) and cations (positively-charged atoms) that make up the total dissolved solids in the water. Stiff plots and Piper diagrams are standard methods for interpretation of the chemical characteristics of water (Hem, 1989).

2.3 Groundwater Hydrology

2.3.1 Regional Groundwater Hydrology

The Project location is underlain by a hard, dense bedrock unit referred to as the Bass Mountain Diabase. The bedrock is commonly referred to as a "greenstone" and consists of a metamorphosed basaltic-andesitic lava flow unit. Bedrock units within the Project vicinity general produce very little water, typically only a few gallons per minute, which is sufficient for domestic use. There are a few industrial and municipal supply wells in the area that have encountered highly fractured bedrock zones and produce larger quantities of groundwater. For example, Mountain Gate Community Services District has two wells located approximately 2 miles northeast of the Project in the Spring Branch Creek watershed that combined produce approximately 350 AF/yr of groundwater (220 gpm average) (Lawrence & Associates 1992). The wells are located in a highly folded, faulted, and fractured area within the Kennett Formation. The Kennett Formation consists of shale, chert, and sandstone within the Spring Branch Creek watershed and is much more fractured than the Bass Mountain Diabase in most areas.

2.3.2 Project Site Groundwater Hydrology

Groundwater Levels and Quantity

To assess groundwater conditions at the Project site, the Applicant had four boreholes drilled in the area of the South Pit during the first week of May 2009 (Brown & Caldwell, 2009). The borehole locations are shown on Figure 4. Borehole completion details are provided in Table 3, Well Completion and Water Level Data. Three of these boreholes were located near the perimeter of the South Pit and were drilled to a depth of 50 ft below ground surface (bgs). The fourth borehole was drilled to a depth of 100 ft bgs and was located within the South Pit footprint.

TABLE 3
WELL COMPLETION AND WATER LEVEL DATA

	B-1 5/27/2009	B-2 5/27/2009	B-3 5/27/2009	MW-1 5/26/2009
Total Depth (ft)	49.80	49.95	49.90	99.70
Conductor Interval (ft msl)	1,115-1,095	1,150-1,130	1,200-1,180	1,200-1,180
Open Interval (ft msl)	1,095-1,065	1,130-1,100	1,180-1,150	1,180-1,100
Screen Length (ft)	20	20	20	20
Depth to Water (ft)	17.95	48.03	48.82	22.86
Height of Water in Well (ft)	31.85	1.92	1.08	76.84
Estimated Surface Elevation (ft msl)	1,115	1,150	1,200	1,200
Estimated Water Surface Elevation (ft msl)	1,097.05	1,101.97	1,151.18	1,177.14
Notes	~1 gpm recharge rate	Water is likely condensate	Water is likely condensate	<1 gpm recharge rate

Notes: ft = feet; ft msl = feet above mean sea level; gpm = gallons per minute.

During drilling, groundwater was observed only in borehole B-1. Water production was estimated to average 1 to 2 gallons per minute during drilling. Borehole B-1 is located near the southeast edge of the proposed South Pit, adjacent to a small drainage that is tributary to Moody Creek. Water was not observed during drilling in any of the other boreholes. After completion, water was observed in all four boreholes. In B-1, almost 32 feet of water accumulated within the well casing. At MW-1, located within the quarry footprint, almost 77 feet of water accumulated within the well casing. At B-2 and B-3, located near the north and west edges of the South Pit, less than 2 feet of water accumulated in the well casings. The water production information from drilling, and purge rates (Brown & Caldwell 2009) indicate that the fractured greenstone bedrock contains very limited quantities of groundwater in the quarry pit areas.

The depth to groundwater in the boreholes ranged from approximately 18 feet to 49 feet bgs. In general, the groundwater surface tends to mimic the topography, as indicated in Table 3. The highest water-surface elevations are at B-3 and MW-1, located along the west side and central parts of the South Pit. The lowest water-surface elevation was recorded at B-1, near the southeastern edge of the proposed South Pit and adjacent to a tributary of Moody Creek.

As shown on Figure 3, the limits of both the South Pit and the North Pit encompass small topographic peaks that sit along a north-south trending ridge that separates the Salt Creek and Moody Creek watersheds. These topographic peaks are the highest points within the Project site, and there are no other contiguous areas at a higher elevation. Since the groundwater surface within the fractured bedrock tends to mimic the ground surface, the groundwater in the area of the North Pit and South Pit is sourced from local recharge within the limits of the pits, since there are no other upslope watershed areas adjacent to the proposed pit locations.

Groundwater Quality

Groundwater sampling was conducted at the site in May 2009 to identify baseline water-quality conditions (EMKO Environmental, Inc. 2009; Brown & Caldwell 2009). Groundwater samples were collected from all four boreholes drilled at the South Pit area. A duplicate sample was also collected from B-1 for QA/QC purposes. The groundwater chemistry data are presented in Table 2. Several metals were detected in the groundwater samples. Antimony, arsenic, molybdenum, and vanadium were detected at relatively low concentrations in the sample from B-3. Barium and iron were detected at relatively low concentrations in the sample from B-2. Manganese was detected in the samples collected from all four boreholes. Table 2 also shows the water-quality limits for metals identified in the Water Quality Control Plan for the Sacramento River Basin (the "Basin Plan"), prepared by the Central Valley Regional Water Quality Control Board (1998). The detected metals concentrations were below the Basin Plan limits except for the manganese levels in the samples from B-2 and MW-1.

The groundwater samples had moderate dissolved solids levels, with total dissolved solids (TDS) levels ranging from 140 mg/L in the sample from B-1, to 210 mg/L in the sample from MW-1, to 440 mg/L in the sample from B-2, to 700 mg/L in the sample from B-3. The pH levels ranged from slightly acidic in MW-1 (pH of 6.19), to neutral in B-2 (pH of 7.74), to slightly alkaline in B-1 and B-3 (pH of 8.14 and 8.29, respectively). Figures 5 and 6 present a Stiff Plot and Piper Diagram, respectively, of the water chemistry from the groundwater samples. The Stiff Plots and Piper Diagram indicate that the groundwater type varies somewhat within the Project site. The groundwater at B-1, B-2, and MW-1 is a calcium-bicarbonate water type, while at B-3, the groundwater is a sodium-bicarbonate water type.

2.4 Floodplains

The Project site is not within a mapped FEMA flood hazard area. Downstream of the Project site, however, the floodplains of Moody Creek and Salt Creek are Special Flood Hazard Areas within the City of Shasta Lake.

3.0 PROJECT WATER DEMAND

A comparison of the consumptive water use for hardrock aggregate quarries in northern California that have recently been permitted or are in the process of being permitted was prepared to estimate the water needs for the Moody Flats Quarry. Table 4, Consumptive Water Use for Hardrock Quarries in Northern California, shows this comparison. Based on this assessment, the average net water use of hardrock quarries in northern California for processing, dust control, and other project needs averages 130 AF/yr per million tons of production. Therefore, at an initial production rate of 500,000 tons per year, the Project will require approximately 65 AF/yr. At a production rate of 2,000,000 tons per year, the consumptive water use will be approximately 260 AF/yr. In terms of pumping rates, this represents a range of approximately 60 gallons per minute (gpm), 24 hours per day for 250 operating days per year to produce 65 AF, to pumping at 235 gpm, 24 hours per day for 250 operating days per year to produce 260 AF/yr.

TABLE 4
CONSUMPTIVE WATER USE FOR HARDROCK QUARRIES IN NORTHERN CALIFORNIA

Site Name	County	AF/yr	MM tons/yr	AF/MM t/yr
Handley Ranch	Monterey	300	2	150
Madera Ranch	Madera	55	0.9	61
DeSilva Gates Quarry	Sacramento	365	3	122
Teichert Quarry	Sacramento	1,055	7	151
Walltown Quarry	Sacramento	1,200	6	200
Jesse Morrow Mountain	Fresno	194.4	2	97
Average	**-**	**-**	**-**	**130**

4.0 REGULATORY SETTING

4.1 Federal

4.1.1 Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.)

The Federal Water Pollution Control Act, commonly known as the CWA, established the basic structure for regulating discharges of pollutants into the waters of the United States. This gave U.S. EPA the authority to implement pollution control programs such as setting water quality standards and criteria for contaminants in surface waters. The CWA does not deal directly with groundwater or with water quantity issues. Section 208 requires the use of BMPs to control releases of pollutants in stormwater at construction sites. Section 303(d) requires that all activities be evaluated for their effect on impaired water bodies and that the states prepare plans for improving the quality of these water bodies. Section 401 requires the federal government to obtain certification from the state that a project is consistent with state water quality standards. Section 402(p)(3)(B)(iii) authorizes the National Pollutant Discharge Elimination System (NPDES) permit program to control water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Section 404 authorizes the USACE to regulate projects that will discharge dredge or fill materials into Waters of the U.S.

Construction projects and many industrial facilities must obtain NPDES permits to control the release of industrial chemicals in stormwater runoff. Stormwater discharges are generated by runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall events. Stormwater discharges often contain pollutants in quantities that could adversely affect water quality. The primary method to control stormwater discharges is through the use of BMPs.

4.1.2 Federal Safe Drinking Water Act of 1974

First enacted in 1974 and substantively amended in 1986 and 1996, the Federal Safe Drinking Water Act authorizes the U.S. EPA to set national health-based standards for drinking water to protect against both naturally occurring and manmade contaminants that may be found in drinking water.

4.2 State

4.2.1 State Water Resources Control Board (SWRCB)

SWRCB has jurisdiction over water quality for both surface water and groundwater in California. SWRCB Resolution 68-16, commonly referred to as the non-degradation policy, requires maintenance of the existing water quality within a specific surface-water or groundwater system. SWRCB Order No. 2003-0003-DWQ addresses the discharge of "low-threat" waters from activities such as construction dewatering. The Applicant and/or the Operator will also be required to file a Notice of Intent (NOI) for stormwater discharges, and prepare a storm water pollution prevention plan (SWPPP), which describes best management practices (BMPs) to prevent discharge of pollutants, including sediment, in storm water.

4.2.2 Regional Water Quality Control Board (RWQCB)

The Central Valley (Region 5) office of the RWQCB guides and regulates water quality in streams and aquifers of the area of Shasta County (County) within the Sacramento River watershed through designation of beneficial uses, establishment of water quality objectives, administration of the National Pollutant Discharge Elimination System (NPDES) permit program for storm water and construction site runoff, and Section 401 water quality certification where development results in fill of jurisdictional wetlands or waters of the U.S. under Section 404 of the Clean Water Act. RWQCB and SWRCB act to protect and enhance water quality, both through their designation as the lead agencies in implementing the Section 319 nonpoint source program of the federal Clean Water Act, and from the state's primary water-pollution control legislation, the Porter-Cologne Act. The RWQCB also oversees and regulates operation and closure of facilities that discharge waste to land, including mine tailings, under Title 27 of the California Code of Regulations (CCR). The provisions of Title 27, Division 2, Article 1, Subchapter 1, Chapter 7, Subdivision 1 (Section 22470), regulate the discharge of mining waste. The standards set by the RWQCB do not override or relieve an owner of compliance with other orders, laws, regulations, or other requirements of other approval, regulatory or enforcement agencies, such as DTSC, local health entities, water and air quality control boards, local land use authorities, fire authorities, and other agencies.

For projects that will include discharge of waste to land, the Applicant is required to submit a Report of Waste Discharge (RoWD) to RWQCB. RWQCB staff use the information in the RoWD to determine whether the project requires a Waste Discharge

Requirements permit (WDRs). WDRs specify the types and amounts of waste that may be discharged, and include monitoring and reporting provisions.

4.2.3 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) was enacted to establish a regulatory program to protect water quality and beneficial uses of all waters of the state of California. It created the SWRCB and RWQCB to plan, implement, manage, and enforce water quality protection and management. The RWQCB is empowered by the Porter-Cologne Water Quality Control Act to require compliance with State and local water quality standards.

4.3 Local

The County General Plan contains the following water supply and water quality goals, policies, and programs:

W-9: Institute effective measures to protect groundwater quality from potential adverse effects of increased pumping or potential sources of contamination.

W-a: Sedimentation and erosion from proposed developments shall be minimized through grading and hillside development ordinances and other similar safeguards as adopted and implemented by the County.

W-b: Septic systems, waste disposal sites, and other sources of hazardous or polluting materials shall be designed to prevent contamination to streams, creeks, rivers, reservoirs, or groundwater basins in accordance with standards and water resource management plans adopted by the County.

W-c: All proposed land divisions and developments in Shasta County shall have an adequate water supply of a quantity and a quality for the planned uses. Project proponents shall submit sufficient data and reports, when requested, which demonstrate that potential adverse impacts on the existing water users will not be significant. The reports for land divisions shall be submitted to the County for review and acceptance prior to a completeness determination of a tentative map. This policy will not apply to developments in special districts which have committed and documented, in writing, the ability to provide the needed water supply.

5.0 THRESHOLDS OF SIGNIFICANCE

A hydrology or water quality impact would be considered significant if it would result in any of the following, adapted from the CEQA Guidelines, Appendix G:

- Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater water quality;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems, cause flooding on- and off-site, or provide substantial additional sources of polluted runoff;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- Inundation by seiche, tsunami, or mudflow.

6.0 ENVIRONMENTAL IMPACTS, MITIGATION MEASURES, AND SIGNIFICANCE DETERMINATIONS

Impact HYDRO-1: Violate Water Quality Standards or Waste Discharge Requirements

Prior to commencing operations, the Applicant will need to submit a RoWD to the Regional Water Quality Control Board to determine whether WDRs will be required for the Project. Typical operations that may require a WDR include discharge of process water and the use of settling ponds. As discussed above, process water will be retained on-site. Settling ponds will be used to reclaim and recycle process wash water. Any tailings that accumulate in the settling ponds will have the same geologic composition as the bedrock that will be mined to produce aggregate. Therefore, the process water will have water chemistry similar to that of the surface runoff and groundwater at the site. As discussed above, except for the concentrations of manganese in two groundwater samples, the water samples collected for this evaluation meet the Regional Water Quality Control Board Basin Plan limits, which are typically used for WDR water-quality standards.

The Applicant will also need to submit an NOI to discharge stormwater to the State Water Resources Control Board, and prepare Construction and Industrial SWPPPs, as appropriate. Best management practices will be used to control stormwater runoff from the process area, overburden storage site, plant site, and stockpile and loadout area, and prevent the discharge of pollutants, including sediment, from the Project facilities.

Compliance with the WDRs and SWPPP will maintain water quality at the Project site and prevent any violations of water quality standards.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact HYDRO-2: Substantially Effect Groundwater Supplies as a Result of Withdrawals or Recharge Interference

There are no known groundwater supply wells located within the Bass Mountain Diabase bedrock formation within the vicinity of the proposed Project. Groundwater production for domestic and municipal supply use occurs in adjacent watersheds and from different geologic formations. The Project will not affect these watersheds and will not involve the mining of these other geologic formations.

As discussed above, the groundwater surface tends to mimic the topography, but is located approximately 18 ft bgs to 49 ft bgs. The fractured bedrock contains very little groundwater, with maximum production rates of only 1 to 2 gallons per minute (1 to 2 gpm) observed. Since the mine pit locations are on small peaks located along a topographic ridge, the pits form their own watersheds and will not intercept groundwater that has percolated into the subsurface from outside the pit boundaries. Therefore, the quarry pits will not affect groundwater supplies outside of the pit boundaries or at depths below the pit floors.

The mine pits will not interfere with or reduce recharge. During mining, all rain that falls within the pit will be retained within the pit. Part of the water retained within the pit will recharge groundwater through fractures in the bedrock. After mining is completed, reclamation will re-establish the natural surface drainage patterns in the area. The flat quarry floors, however, will enhance recharge locally.

The final elevation of the North Pit will be above the high-water level in Shasta Lake. The final elevation of the South Pit, however, will be below the high-water level in Shasta Lake. The lake, however, is nearly 2 miles from the South Pit. In addition, another dense, massive geologic unit, the Copley Greenstone, is located between the South Pit and Shasta Lake. The Copley Greenstone is not highly fractured and does not transmit large quantities of groundwater. Therefore, there is no indication that the proposed Project could cause water to flow from Shasta Lake or any other groundwater basin to the South Pit.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact HYDRO-3: Substantial Alteration of Drainage Patterns Resulting in Substantial Erosion or Siltation

The Project will alter the drainage patterns at the two quarry pit locations, the plant site, the processing area, and the overburden storage area. During mining, rain that falls on the disturbed quarry areas will be retained within the quarry pits for use as process water or dust control water. There will be no discharge of water from the quarry pits, and thus no potential for erosion or siltation, from the quarries. After the quarries have been reclaimed, surface runoff will occur within the same watersheds and natural drainage courses as it did prior to mining. The drainage pattern will not be altered substantially, and no streams or rivers will be altered by the quarry pits.

The processing area and overburden storage area will involve the filling of small drainages with waste rock and overburden. Major stream courses or rivers will not be altered. Drainage controls and stormwater best management practices will be constructed in these areas to prevent erosion or siltation.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact HYDRO-4: Increased Runoff Which Would Exceed the Capacity of Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

As outlined in Section 2.2.2 above, a site-specific stormwater, erosion control, and drainage plan has been prepared for the Project (see Appendix D). The plan has been prepared to control and remove sediment from stormwater such that stormwater runoff would not exceed the capacity of the drainage system and result in additional sources of off-site runoff. As outlined in that plan, the amount of surface runoff during mining will be reduced because rain within the quarry areas will be retained through the creation of sumps of sufficient capacity to retain stormwater runoff of the current surface disturbance. After the pits are reclaimed and revegetated, the rate and amount of runoff would be the same as that which occurred prior to mining.

Runoff from the primary processing area, overburden fill area, secondary and ancillary processing and loadout area, and rail spur/siding will be controlled in accordance with the plan provided in Appendix D, providing for a series of stormwater diversions and basins to control and remove sediment through the use of best management practices, as defined in the SWPPP. After reclamation, runoff will occur through existing drainage channels and stream courses. Runoff will not exceed that which currently occurs through the same drainage courses.

Therefore, the Project will not increase surface runoff and will not result in any flooding.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact HYDRO-5: Flooding

The Project will not involve the construction of any housing or the placement of any structures within a 100-year flood hazard area that could impede or redirect flood flows. Dams, levees, or other structures to retain water will not be constructed as part of the Project.

The Project will not result in any flooding.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required

Impact HYDRO-6: Inundation by Seiche, Tsunami, or Mudflow

The Project site is not immediately adjacent to any large surface water bodies. Therefore, the Project is not subject to inundation by seiche or tsunami. The Project site is underlain by bedrock with minimal soil cover. Therefore, the Project is not subject to inundation by a mudflow.

Level of Significance Before Mitigation: Less than Significant

Mitigation Measures: None Required