Delineation of Jurisdictional Waters
for the Moon Camp Project (Tentative Tract #16136)
County of San Bernardino, California

The undersigned certify that this report is a complete and accurate account of the findings and conclusions of a jurisdictional "waters of the U.S." determination for the above-referenced project.

RBF Consulting

Richard Beck

Richard Beck
Environmental Analyst

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Project Manager

March 2002

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LIST OF EXHIBITS

APPENDIX

1.0 INTRODUCTION AND PURPOSE

This report was prepared for the County of San Bernardino in order to delineate U.S. Army Corps of Engineers' and California Department of Fish and Game's (CDFG) jurisdictional authority for unnamed drainages located within the project site known as Moon Camp-Tentative Tract #16136, a residential subdivision. The proposed project is located along the north shore of Big Bear Lake, in the community of Fawnskin, County of San Bernardino, State of California (refer to Exhibit 1, *Regional Vicinity Map,* and Exhibit 2, *Site Vicinity Map*).

1.1 Project Description

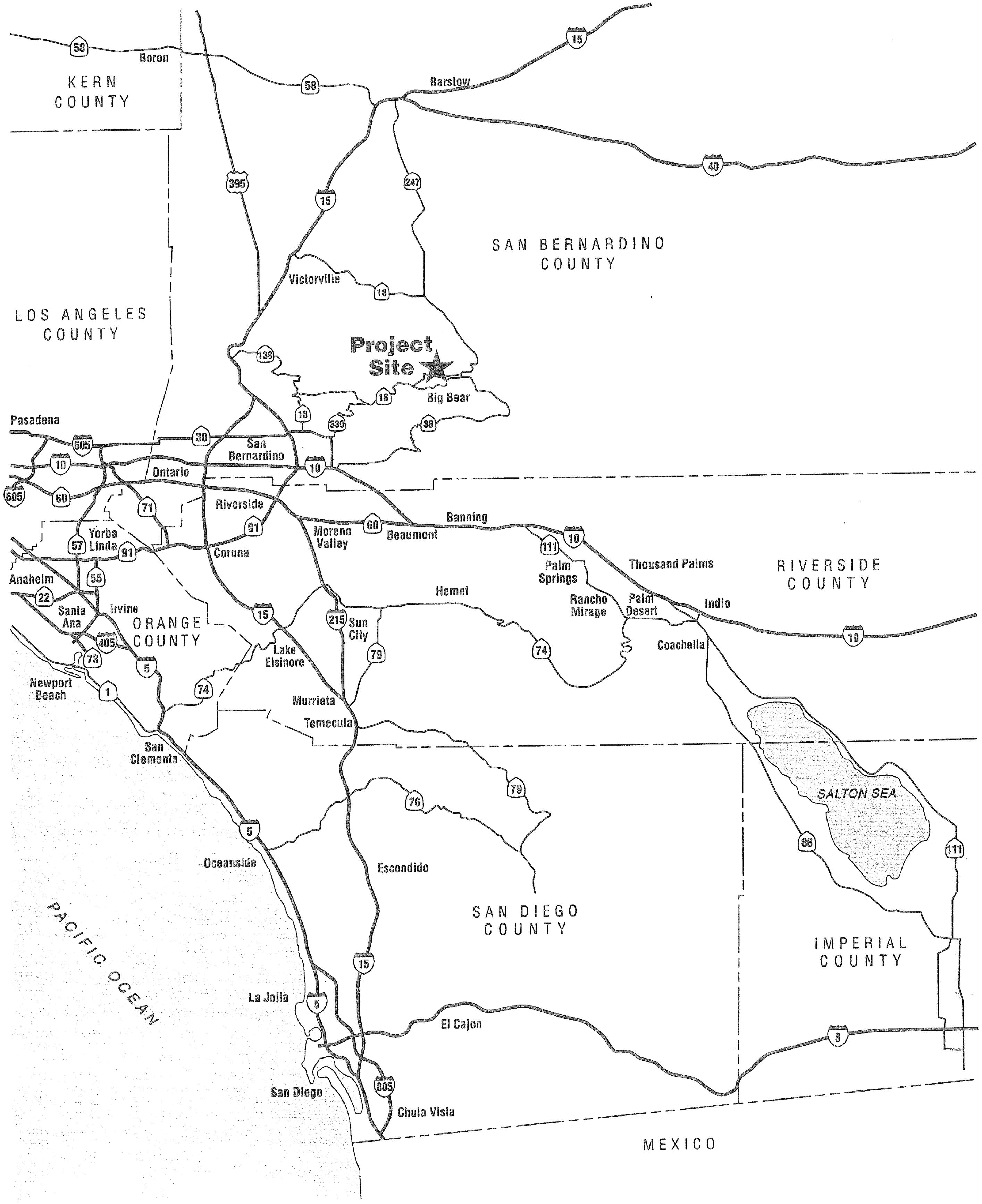
The proposed project consists of a 95-lot residential subdivision with lots ranging in size from 0.17-acres to 2.11-acres (refer to Exhibit 3, *Project Site Plan*). The project site includes 62.43-acres and is in a relatively undeveloped eastern portion of Fawnskin.

2.0 SUMMARY OF REGULATIONS

There are three key agencies that regulate activities within inland streams, wetlands and riparian areas in California. The U.S. Army Corps of Engineers (Corps) Regulatory Program regulates activities pursuant to Section 404 of the Federal Clean Water Act, and Section 10 of the Rivers and Harbors Act. The California Department of Fish and Game (CDFG) regulates activities under the Fish and Game Code Section 1600-1607, and the Regional Water Quality Control Board (RWQCB) under Section 401 of the Federal Clean Water Act and the California Porter-Cologne Act.

2.1 Army Corps of Engineers

The Corps of Engineers has regulatory authority over the discharge of dredged or fill material into the waters of the United States under Section 404 of the Clean Water Act (CWA). The term "waters of the United States" includes (1) all waters that have, are, or may be used in interstate or foreign commerce (including sightseeing or hunting), including all waters subject to the ebb and flow of the tide; (2) wetlands; (3) all waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds; the use, degradation or destruction of which could affect interstate or foreign commerce; (4) all impoundments of water mentioned above; (5) all tributaries of waters mentioned above; (6) the territorial seas; and (7) all wetlands adjacent to the waters mentioned above. Under this definition, and in the absence of wetlands, the limits of the Corps' jurisdiction in non-tidal waters extend to the ordinary high water mark (OHWM), which is defined as "...that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas."



MOON CAMP-TENTATIVE TRACT #16136
JURISDICTIONAL DELINEATION

Regional Vicinity

Exhibit 1

not to scale

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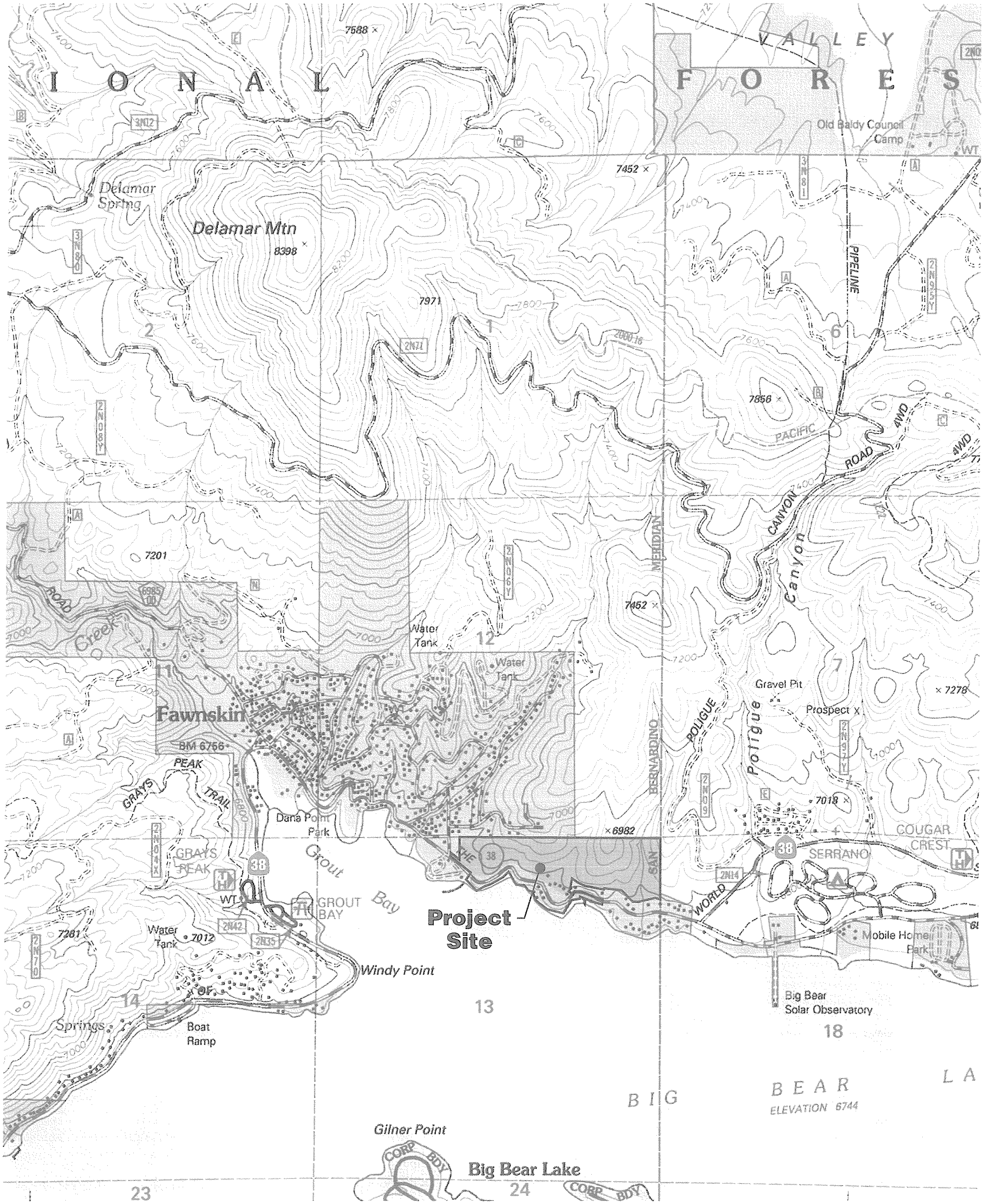
3/13/02 JN 10-101901-9314



USGS Topo, Fawnskin, Calif., 1996

MOON CAMP-TENTATIVE TRACT #16136
JURISDICTIONAL DELINEATION

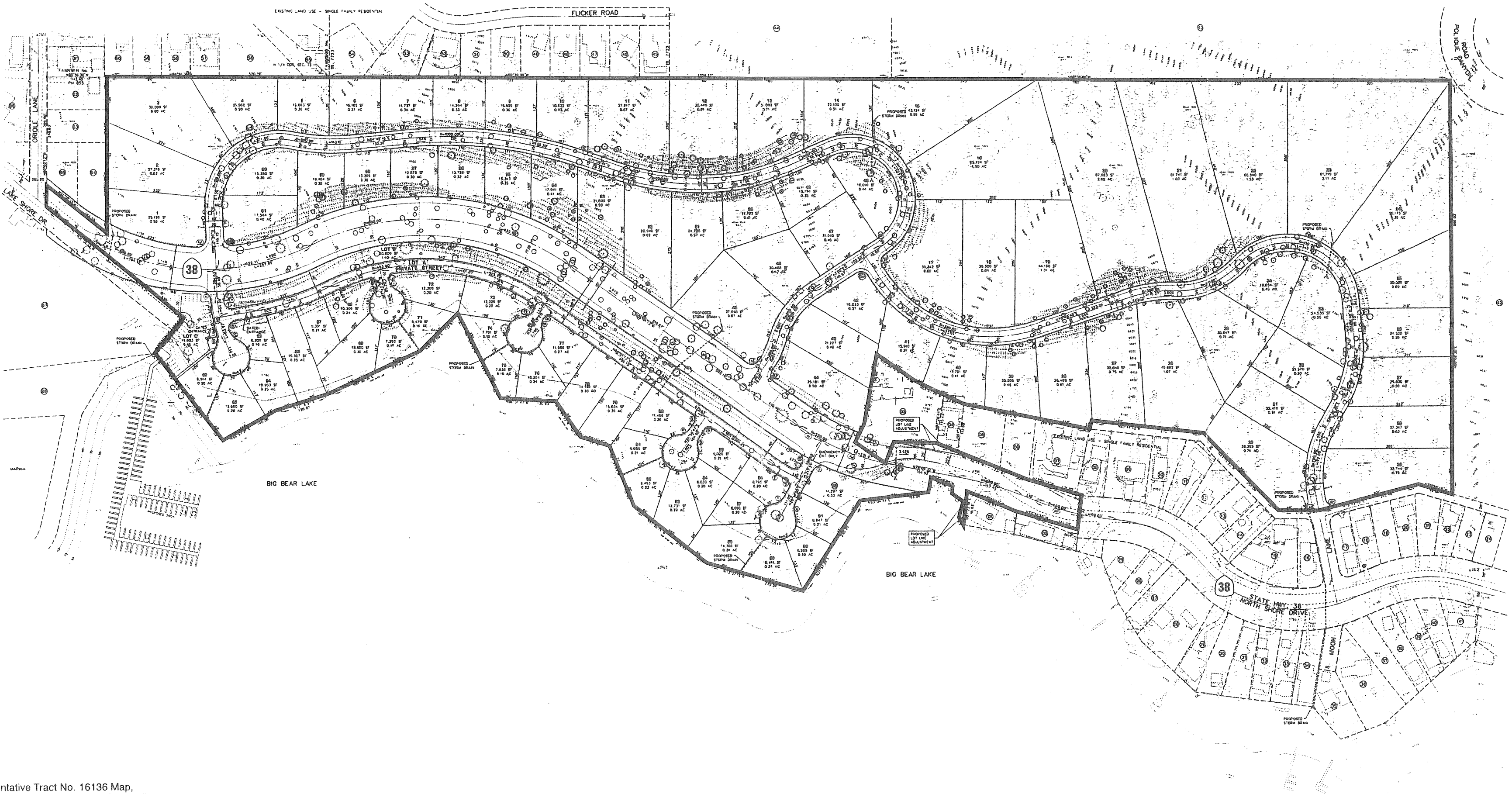
Site Vicinity

Exhibit 2

RBF CONSULTING

0 2000'

3/13/02 JN 10-101901-9314



Source: Tentative Tract No. 16136 Map,
Fawnskin, County of San Bernardino,
Hicks & Harwick, Inc., 5/21/01.

RBF
CONSULTING

0 250'

3/13/02 JN 10-101901-9314

MOON CAMP-TENTATIVE TRACT #16136
JURISDICTIONAL DELINEATION

Project Site Plan

Exhibit 3

Wetlands, a subset of jurisdictional waters, are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". The Corps has developed a methodology for determining the boundaries of jurisdictional wetlands that is published in the document known as the *1987 Manual*. The methodology set forth in the manual is based on the following **three** indicators that are normally present in wetlands: (1) hydrology providing permanent or periodic inundation by groundwater or surface water, (2) hydric soils, and (3) hydrophytic vegetation. In order to be considered a wetland, an area must exhibit at least minimal hydric characteristics within these three parameters.

2.2 Regional Water Quality Control Board

The Regional Water Quality Control Board (RWQCB) is the primary agency responsible for protecting water quality in California. The RWQCB regulates discharges to surface waters under the federal Clean Water Act and the California Porter-Cologne Water Quality Control Act. The RWQCB's jurisdiction extends to all waters of the State and to all waters of the United States, including wetlands.

The Clean Water Act Section 401 gives the RWQCB the authority to regulate through 401 Certification any proposed federally-permitted activity which may affect water quality. Among such activities are discharges of dredged or fill material permitted by the Corps under Clean Water Act Section 404. Certification must be based on a finding that the proposed discharge will comply with water quality standards.

2.3 California Department of Fish and Game

The State of California regulates activities in rivers, streams, and lakes pursuant to Sections 1600-1607 of the California Fish and Game Code. These sections discuss the process by which an individual, government agency, or public utility must notify the Department of Fish and Game prior to any activity that would "substantially divert or obstruct the natural flow or substantially change the bed, channel or bank of any river, stream or lake..." Following such notification, the Department must inform the individual, agency, or utility of the existence of any fish and wildlife resource that may be substantially adversely affected by the activity. The Department must also include a proposal for measures to protect fish and wildlife resources. This proposal is called a "Streambed Alteration Agreement" (1601 Agreement for public agencies and utilities, and a 1603 Agreement for private party activities).

Jurisdictional limits of the CDFG are not as clearly defined by regulation as those of the Corps. While they closely resemble the limits described by Corps regulations, they exclude isolated wetlands (those not associated with a stream, river, or lake, such as isolated vernal pools) and include riparian habitat supported by a river, stream, or lake regardless of the presence or absence of hydric soils and saturated soil conditions. Generally, CDFG takes jurisdiction to the bank of the stream or to the outer limit of the adjacent riparian vegetation, whichever is greater.

2.4 Activities Requiring Permits

Any development proposal that involves impacting the drainages, streams, or wetlands on the site through filling, stockpiling, conversion to a storm drain, channelization, bank stabilization, road or utility line crossings, or any other modification would require permits from the Corps, the RWQCB, and the CDFG before any development could commence on the project site. Both permanent and temporary impacts are regulated and would trigger the need for permits. Processing of the 401 and 1603 can occur concurrently with the Corps permit process and can utilize the same information and analysis. The Corps will not issue its authorization until the RWQCB completes the Section 401 Water Quality Certification. Applications to both the RWQCB and the CDFG requires submittal of a valid California Environmental Quality Act (CEQA) document along with the application.

3.0 METHODOLOGY

Prior to visiting the site, RBF conducted a review of USGS topographic maps (Quadrangle *Fawnskin, California*, dated 1996) and aerial photographs to identify areas that *may* fall under any agency's jurisdiction. Corps jurisdictional wetlands are delineated using the methods outlined in the Corps of Engineers *Wetland Delineation Manual* (1987) based on hydrologic and edaphic features of the site, and on the vegetation composition of the site. Non-wetland waters of the U.S. are delineated based on the limits of the OHWM as determined by erosion, the deposition of vegetation or debris, and changes in the vegetation. CDFG jurisdiction is defined to the bank of the stream/channels or to the limit of the adjacent riparian vegetation.

Analysis presented in this document consists of field surveys and verification of current conditions conducted on March 15, 2002. While in the field, jurisdictional areas were recorded onto a base map at an approximate scale of 1"=300' using visible landmarks. Conditions during field work were generally good and it is assumed that conditions encountered at the time of field investigations represented a "normal" rainfall year.

3.1 Vegetation

Cover of vegetation is estimated and are ranked according to their dominance. Species that contribute to a cumulative total of 50% of the total dominant coverage, plus any species that comprise at least 20% (also known as the "50/20 rule") of the total dominant coverage are recorded a wetland data sheet. Wetland indicator status is assigned to each species using *The List of Plant Species that Occur in Wetlands* (FWS, 1996). If greater than 50% of the dominant species from all strata were Obligate, Facultative-wetland, or Facultative species, the criteria for wetland vegetation was considered to be met. Plant indicator status categories are described below:

- **Obligate Wetland (OBL):** Plants that occur almost always (estimated >99 percent) in wetlands under natural conditions, but which may also occur rarely (estimated <1 percent) in non-wetlands.

- **Facultative Wetland (FACW):** Plants that occur usually (estimated >67 to 99 percent) in wetlands, but also occur (estimated 1 to 33 percent) in non-wetlands.
- **Facultative (FAC):** Plants with similar likelihood (estimated 33 to 67 percent) of occurring in both wetlands and non-wetlands.
- **Facultative Upland (FACU):** Plants that occur sometimes (estimated 1 to <33 percent) in wetlands, but occur more often (estimated >67 to 99 percent) in non-wetlands.
- **Obligate Upland (UPL):** Plants that occur rarely (estimated 1 percent) in wetlands, but occur almost always (estimated >99 percent) in non-wetlands under natural conditions.

3.2 Soils

The presence of hydric soils are initially investigated by comparing the mapped soil series for the site to the county list of hydric soils. Soil characteristics are verified by digging soil pits along each transect to a depth of at least 18 inches. At each soil pit, the soil texture and color are recorded by comparison with standard plates within a *Munsell Soil Chart* (1994). Any indicators of hydric soils, such as redoximorphic features, buried organic matter, organic streaking, reduced soil conditions, gleyed or low-chroma soils, or sulfuric odor are also recorded. It should also be noted that the limits of wetland hydrology indicators are used as a guide for locating soil pits. If any hydric soil features are located, progressive pits are dug moving laterally away from the active channel until hydric features are no longer present within the top 18 inches of the soil profile.

3.3 Hydrology

If wetland vegetation criteria is met, the presence of wetland hydrology is evaluated at each transect by recording the extent of observed surface flows, depth of inundation, depth to saturated soils, and depth to free water in the soil test pits. In addition, indicators of wetland or riverine hydrology are recorded including Ordinary High Water Marks (OHWM), drift lines, rack ,debris, and sediment deposits. The lateral extent of the hydrology indicators are used as a guide for locating soil pits for evaluation of hydric soils and jurisdictional areas. In portions of the stream where the flow is divided by multiple channels with intermediate sand bars, the entire area between the channels is considered within the OHWM and the wetland hydrology indicator is considered met for the entire area.

4.0 SITE CONDITIONS

The 62.43-acre site (designated RL-40, Rural Living, by the County of San Bernardino) gently slopes from south to north. Elevations range from 6,747 at the lakefront, to a high of 6,960 at the northeast boundary. Total relief is therefore 483 feet and slopes range from five percent to 40 percent. The site is vegetated in Jeffrey Pine forest and pebble plain habitat occurs in scattered patches in the western portion of the property. Dirt roads and trails traverse the property; access to the project site is provided via Highway 38 (refer to Exhibit 4, *Project Site Aerial Photo* and Exhibit 5, *Site Photographs*).

4.1 Vegetation

Vegetation within the drainages of the project site consisted of upland habitat, dominated by jeffery pines.

4.2 Soils

Soils within the drainages were documented to be silty-sand (large grain). Soil samples taken on-site were generally dry and lacked characteristics of hydric soils (i.e., odor, streaking, mottling).

4.3 Hydrology

No flow within the on-site drainages was observed during the March 15, 2002 field visit. However, evidence of an OHWM was observed within the drainages, primarily indicated by sediment deposits.

5.0 FINDINGS

5.1 Waters of the U.S. (Wetland) Determination

The Corps and the EPA jointly define wetlands as: *Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas* (33 CFR §328.3(b)). Wetlands have the following general diagnostic environmental characteristics:

Vegetation: The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions. Hydrophitic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, reproduce, and/or persist in anaerobic soil conditions.

Soil: Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions.

Hydrology: The area is inundated either permanently or periodically at mean water depths $\leq$6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.

RBF CONSULTING

0 500'

3/13/02 JN 10-101901-9314

MOON CAMP-TENTATIVE TRACT #16136
JURISDICTIONAL DELINEATION

Project Site Aerial Photo

Exhibit 4

View looking at sediment deposits within the main eastern drainage.

Typical view of on-site drainage and surrounding vegetation.

MOON CAMP-TENTATIVE TRACT #16136
JURISDICTIONAL DELINEATION

Site Photographs

Exhibit 5

As previously noted, in order to be considered a wetland, an area must exhibit **all three** of the wetland parameters identified above per the evaluation criteria in the Wetland Delineation Manual. Based on the results of the field investigations, it was determined that not all three parameters were present within the drainages (hydric soils nor riparian vegetation were present). As a result, RBF identified no Corps wetlands on the proposed project site.

5.2 Waters of the U.S. (Non-Wetland) Determination

The unnamed drainages within the proposed project site exhibited evidence of flow (i.e., sediment/silt deposition) sufficient to document the Ordinary High Water Mark (i.e., channel bed and bank lines), thus meeting the criteria for jurisdictional waters. Refer to Exhibit 5, *Site Photographs*, for representative photos of the jurisdictional drainages. Also, refer to Exhibit 6, *Jurisdictional Map*, for an illustration of jurisdictional boundaries.

Based on the results of the field observations and data collection, RBF identified 0.15-acre of Corps jurisdictional "waters of the U.S." within the 62.43-acre proposed project site. The drainages are ephemeral. Utilizing the most current development plans, it was also determined that roadway improvements would impact 0.04-acre of Corps jurisdiction.

5.3 California Department of Fish and Game (1603) Jurisdiction

Based on the results of the field observations and data collection, RBF identified 0.15 -acre of CDFG jurisdictional waters. Utilizing the most current development plans, it was also determined that roadway improvements would impact 0.04-acre of CDFG jurisdiction (refer to Exhibit 6, *Jurisdictional Map)*.

6.0 OVERVIEW OF REGULATORY APPROVAL PROCESS

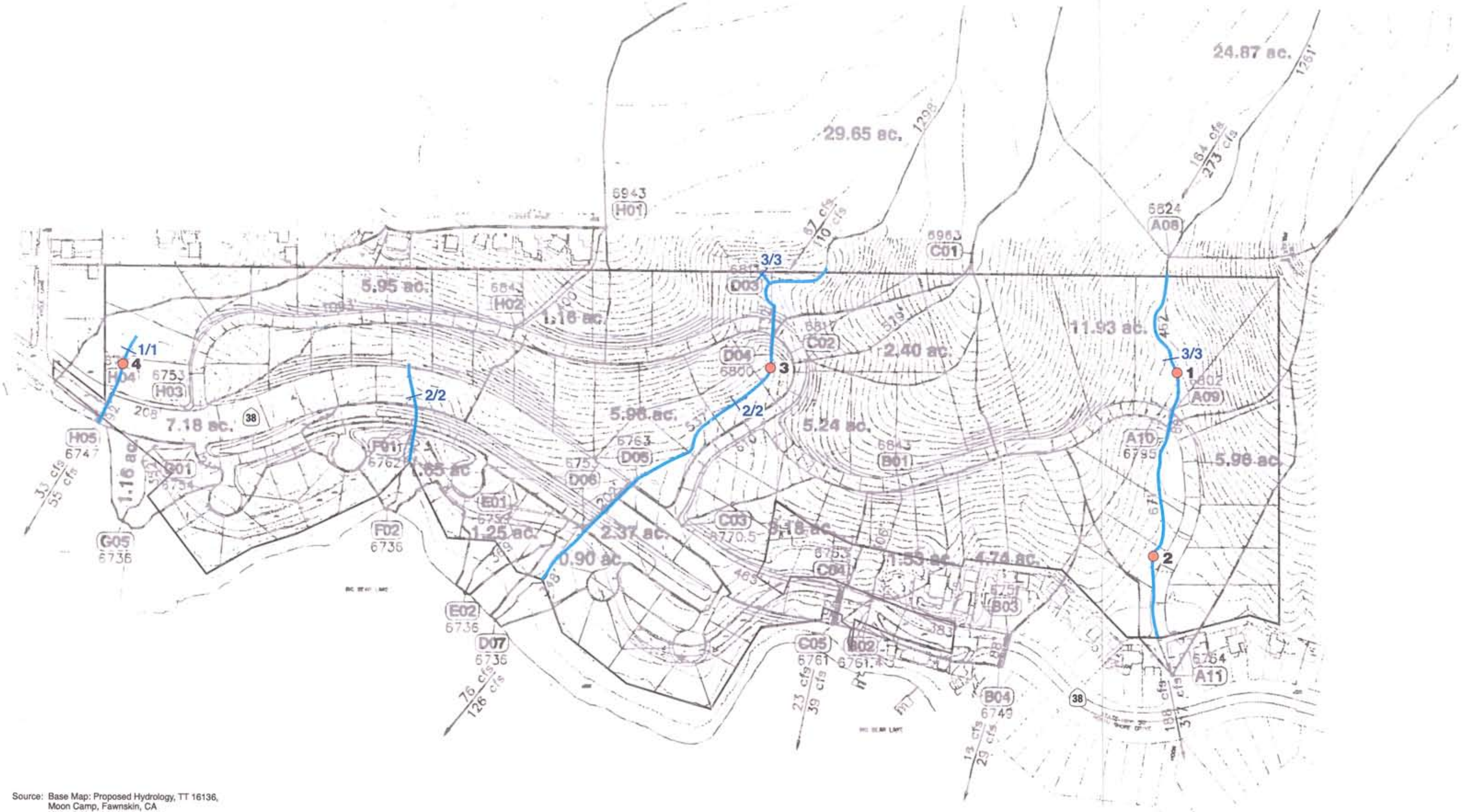
The following is a summary of the various permits, agreements, and certifications required before construction activities take place within the above mentioned jurisdictional areas.

6.1 Army Corps of Engineers

The Corps regulates discharges of dredged fill materials into "waters of the United States" under Section 404 of the Clean Water Act (CWA). Since improvements associated with the proposed project will result in the discharge of material within the jurisdiction of the Corps, a 404 permit will be required.

6.2 California Department of Fish and Game

As noted above, the drainage within the proposed project area meets the CDFG's definition as streambed and thus would be regulated by them. An agreement from the Department must be obtained. The CDFG agreement will require a $1,390.50 fee and approximately 45 days processing time. CEQA Compliance is necessary in order for the Agreement to be issued.



Source: Base Map: Proposed Hydrology, TT 16136,
Moon Camp, Fawnskin, CA
Hicks & Harwick, Inc., 4/12/01.

ACOE/CDFG Jurisdictional Boundaries

● Soil Test Pit

RBF CONSULTING

0 250'

3/25/02 JN 10-101901-9314

MOON CAMP-TENTATIVE TRACT #16136
JURISDICTIONAL DELINEATION

Jurisdictional Map

Exhibit 6

6.3 Regional Water Quality Control Board

The RWQCB requires that a CEQA compliance certification be obtained before starting this process. Processing time should not exceed 60 days following submission of a complete application (determination of what constitutes a complete application is made by the Regional Water Quality Control Board). Additionally, the RWQCB requires that water quality concerns related to urban storm water runoff be addressed. Any 401 Certification application submitted to the RWQCB should incorporate the use of Best Management Practices (BMPs) for the treatment of pollutants carried by storm water runoff in order to be considered a complete application. For the 404 permit to be approved, a 401 water certification will be required. A $1,000 fee is required as part of the application submittal.

7.0 REFERENCES

Army Corps of Engineers (ACOE) Wetland Delineation Manual, 1987.

Munsell Soil Color Charts, 1994.

National List of Vascular Plant Species that Occur in Wetlands, U.S. Fish and Wildlife Service, 1996.

Site Visit, conducted on March 15, 2002.

USGS Topographic Map, Fawnskin, California, Quadrangle, 1996.

APPENDICES

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Moon Camp
Applicant/Owner: ______
Investigator: R. Beck / T. Smith

Date: 3/15/02
County: S.B.
State: CA

Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes No
Is the area a potential Problem Area? Yes [✓ No]
(If needed, explain on reverse.)

Community ID: —
Transect ID: —
Plot ID: 1

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Jeffery Pine	Tree	—	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). ______

Remarks:
upland habitat / dry

HYDROLOGY

___ Recorded Data (Describe in Remarks):
  ___ Stream, Lake, or Tide Gauge
  ___ Aerial Photographs
  ___ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: — (in.)
Depth to Free Water in Pit: — (in.)
Depth to Saturated Soil: — (in.)

Wetland Hydrology Indicators:
Primary Indicators:
  ___ Inundated
  ___ Saturated in Upper 12 Inches
  ___ Water Marks
  ___ Drift Lines
  X Sediment Deposits
  ___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
  ___ Oxidized Root Channels in Upper 12 Inches
  ___ Water-Stained Leaves
  ___ Local Soil Survey Data
  ___ FAC-Neutral Test
  ___ Other (Explain in Remarks)

Remarks:
No flow present. Sediment, rock obsened ; small banks. Pine needleground cover.

SOILS

Map Unit Name (Series and Phase): ____________________

Drainage Class: ____________

Field Observations Confirm Mapped Type? Yes No

Taxonomy (Subgroup): ____________________

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
8"	A	—	—	—	Silty-Sand

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: No indicators present. Sandy, with large grain size.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes [✓ No] (Circle)
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? Yes [✓ No]

(Circle)
Is this Sampling Point Within a Wetland? Yes [✓ No]

Remarks: NON-WETland.

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Moon Camp
Applicant/Owner:
Investigator: R. Beck / T. Smith

Date: 8/15/02
County: SB
State: CA

Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem Area? Yes [✓ No]
(If needed, explain on reverse.)

Community ID: –
Transect ID: –
Plot ID: 3

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Jeffery Pine	Tree	–	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks: open areas, upland habitat / dry.

HYDROLOGY

___ Recorded Data (Describe in Remarks):
  ___ Stream, Lake, or Tide Gauge
  ___ Aerial Photographs
  ___ Other
☒ No Recorded Data Available

Field Observations:

Depth of Surface Water: — (in.)

Depth to Free Water in Pit: — (in.)

Depth to Saturated Soil: — (in.)

Wetland Hydrology Indicators:
Primary Indicators:
  ___ Inundated
  ___ Saturated in Upper 12 Inches
  ___ Water Marks
  ___ Drift Lines
  ☒ Sediment Deposits
  ___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
  ___ Oxidized Root Channels in Upper 12 Inches
  ___ Water-Stained Leaves
  ___ Local Soil Survey Data
  ___ FAC-Neutral Test
  ___ Other (Explain in Remarks)

Remarks: No flow present. Sediment, larger rocks observed, rocks on small banks. "Y" in northern drainge.

SOILS

Map Unit Name
(Series and Phase): ______________________
Drainage Class: ______
Field Observations
Confirm Mapped Type? Yes No
Taxonomy (Subgroup): ______________________

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
8"	A	—	—	—	Silty-SAND/SAND

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: No indicators present.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes [✓ No] (Circle)
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? Yes [✓ No]

(Circle)
Is this Sampling Point Within a Wetland? Yes [✓ No]

Remarks: Non-Wetland.

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: MooN CAP
Applicant/Owner:
Investigator: R. BECK / T. SMITH

Date: 3/15/02
County: S.B.
State: CA

Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem Area? Yes [✓ No]
(If needed, explain on reverse.)

Community ID: —
Transect ID: —
Plot ID: 2

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Jeffery Pine	Tree	—	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks: upland habitat / dry

HYDROLOGY

☐ Recorded Data (Describe in Remarks):
- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☑ No Recorded Data Available

Field Observations:

Depth of Surface Water: — (in.)

Depth to Free Water in Pit: — (in.)

Depth to Saturated Soil: — (in.)

Wetland Hydrology Indicators:
- Primary Indicators:
  - ☐ Inundated
  - ☐ Saturated in Upper 12 Inches
  - ☐ Water Marks
  - ☐ Drift Lines
  - ☒ Sediment Deposits
  - ☐ Drainage Patterns in Wetlands
- Secondary Indicators (2 or more required):
  - ☐ Oxidized Root Channels in Upper 12 Inches
  - ☐ Water-Stained Leaves
  - ☐ Local Soil Survey Data
  - ☐ FAC-Neutral Test
  - ☐ Other (Explain in Remarks)

Remarks: No flow present. Sediment rock observed. Small banks, Pine Needle 'ground cover.

SOILS

Map Unit Name
(Series and Phase): ____________________ Drainage Class: __________
Field Observations
Taxonomy (Subgroup): ____________________ Confirm Mapped Type? Yes No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
8"	A	—	—	—	Silty-Sand

Hydric Soil Indicators:

☐ Histosol
☐ Histic Epipedon
☐ Sulfidic Odor
☐ Aquic Moisture Regime
☐ Reducing Conditions
☐ Gleyed or Low-Chroma Colors

☐ Concretions
☐ High Organic Content in Surface Layer in Sandy Soils
☐ Organic Streaking in Sandy Soils
☐ Listed on Local Hydric Soils List
☐ Listed on National Hydric Soils List
☐ Other (Explain in Remarks)

Remarks:
No indicators present.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes [✓ No] (Circle)
Wetland Hydrology Present? [✓ Yes] No
Hydric Soils Present? Yes [✓ No]

(Circle)
Is this Sampling Point Within a Wetland? Yes [✓ No]

Remarks:
Non-wetland.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Moon Camp
Applicant/Owner: ______
Investigator: R. Beck / T. Smith

Date: 3/15/02
County: SB
State: CA

Do Normal Circumstances exist on the site? [✓ Yes] No
Is the site significantly disturbed (Atypical Situation)? Yes [✓ No]
Is the area a potential Problem Area? Yes [✓ No]
(If needed, explain on reverse.)

Community ID: —
Transect ID: —
Plot ID: 4

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Jeffery Pine	Tree	—	9.		
2. Upland Shrubs	Shrub	—	10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). ______

Remarks: upland habitat

HYDROLOGY

___ Recorded Data (Describe in Remarks):
  ___ Stream, Lake, or Tide Gauge
  ___ Aerial Photographs
  ___ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: — (in.)

Depth to Free Water in Pit: — (in.)

Depth to Saturated Soil: — (in.)

Wetland Hydrology Indicators:
Primary Indicators:
  ___ Inundated
  ___ Saturated in Upper 12 Inches
  ___ Water Marks
  ___ Drift Lines
  X Sediment Deposits
  ___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
  ___ Oxidized Root Channels in Upper 12 Inches
  ___ Water-Stained Leaves
  ___ Local Soil Survey Data
  ___ FAC-Neutral Test
  ___ Other (Explain in Remarks)

Remarks: Appeared to bed fed by outfall to the north.

SOILS

Map Unit Name
(Series and Phase): ____________________ Drainage Class: __________

Field Observations

Taxonomy (Subgroup): ____________________ Confirm Mapped Type? Yes No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
8'	A	—	—	—	Silty-Sand.

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:
No indicators present.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes [✓ No] (Circle)

Wetland Hydrology Present? [✓ Yes] No

Hydric Soils Present? Yes [✓ No]

(Circle)

Is this Sampling Point Within a Wetland? [✓ Yes] No

Remarks:
Non-Wetland.

15.11 Geohydrologic Evaluation

Focused Geohydrologic Evaluation of the Maximum Perennial Yield of the North Shore and Grout Creek Hydrologic Subunit Tributary Subareas

Prepared for: City of Big Bear Lake Department of Water and Power

December 2, 2003

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FOCUSED GEOHYDROLOGIC EVALUATION OF MAXIMUM PERENNIAL YIELD FOR THE NORTH SHORE AND GROUT CREEK HYDROLOGIC SUBUNITS

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FOCUSED GEOHYDROLOGIC EVALUATION OF MAXIMUM PERENNIAL YIELD FOR THE NORTH SHORE AND GROUT CREEK HYDROLOGIC SUBUNITS

1.0 EXECUTIVE SUMMARY

The Big Bear Lake Watershed, located in the San Bernardino Mountains of western San Bernardino County, California has previously been divided into seven hydrologic subunits based on surface water drainage divides. Two of the hydrologic subunits, the North Shore and Grout Creek Subunits, extend across most of the northern portion of Big Bear Lake. Although these subunits can be categorized as independent surface drainage catchments, their large size and/or elongated east-west extent warrants further subdivision to distinguish available ground water resources in the eastern portion from available ground water resources in the western portion. This report presents a focused geohydrologic evaluation of the maximum perennial yield of the North Shore and Grout Creek subunits that includes dividing each subunit into smaller tributary subareas.

Maximum perennial yield was evaluated in the context of the total average annual ground water recharge within the North Shore and Grout Creek subunits. Ground water recharge is the total amount of water that reaches the aquifer (i.e. ground water reservoir) through natural processes, such as deep percolation of precipitation falling on the land surface and infiltration beneath flowing stream channels. In the development of ground water resources for municipal supply, however, not all of the natural recharge that any given aquifer receives on an average annual basis can be developed.

Maximum perennial yield is distinguished from average annual ground water recharge through the following definition:

> *The maximum quantity of ground water perennially available if all possible methods and sources are developed for recharging the basin. This quantity depends on the amount of water economically, legally, and politically available to the organization or agency managing the basin (Todd, 1980).*

By definition, the maximum perennial yield is some portion (i.e. subset) of the total amount of ground water recharge that the aquifers receive from precipitation on an average annual basis. Not all of the water that reaches the aquifer can be developed for beneficial use because either it is not economically feasible, or there is no legal right to the water, or political constraints prevent or inhibit development.

Average annual ground water recharge estimates were assigned to smaller tributary subareas, which were determined from surface drainage divides within the larger hydrologic subunits. The North Shore Subunit was subdivided into six tributary subareas (A through F) and the Grout Creek Subunit was subdivided into four tributary subareas (A through D). The boundaries of the tributary subareas represent surface water drainage divides, which, for most of the tributary subareas also represent ground water flow divides. Exceptions include the margins of Big Bear Lake and in the southeast portion of the North Shore Subunit, where the ground water within one subarea/subunit can be in hydraulic communication with adjacent subareas/subunits.

Average annual ground water recharge was estimated for each tributary subarea using a watershed hydrologic model and by estimating ground water underflow (conducted for the alluvial portion of the Grout Creek Subunit only). When possible, measured data was used as input for the analysis of ground water recharge. Measured data included:

- Long-term precipitation records from weather stations within the Big Bear Lake watershed,
- Evapotranspiration data from evaporation pans and weather stations within the watershed,
- Ground water levels, and
- Ground water production.

However, most of the input parameters that are required for a detailed evaluation of the average annual ground water recharge had to be estimated or assumed from data collected outside the Grout Creek and North Shore subunits or outside the Big Bear Lake Watershed due to lack of measured data in the area. Although the assumed values are published and are from reliable sources (i.e. the U.S. Environmental Protection Agency, United States Geological Survey, etc.), they are not specific to the area of interest. Numerous additional monitoring features can be developed to collect the data necessary to refine the ground water recharge estimates. However, priority should be given to the construction of monitoring wells and the development of a reliable ground water level baseline for the tributary subareas.

The results of the ground water recharge analysis for the North Shore Subunit are as follows:

Summary of Ground Water Recharge Results
North Shore Tributary Subareas

Tributary Subarea	Area [acres]	Annual Precipitation [inches]	Average Annual Ground Water Recharge - Low Estimate [acre-ft/yr]	Average Annual Ground Water Recharge - High Estimate [acre-ft/yr]	Average of Ground Water Recharge Estimate Range [acre-ft/yr]
A	247	27.87	14	44	29
B	720	25.45	36	110	73
C	828	23.01	37	107	72
D	558	21.45	22	63	43
E	392	20.01	15	39	27
F	814	18.27	23	66	44

Based on the analyses presented in this report, the following have been concluded regarding the maximum perennial yield of the North Shore Hydrologic Subunit:

- The North Shore Hydrologic Subunit can be conveniently subdivided into six tributary subareas (A through F) based on surface water drainage divides;

- The revised range of average annual ground water recharge for the North Shore Hydrologic Subunit as a whole is approximately 150 to 430 acre-ft/yr with a midpoint of approximately 290 acre-ft/yr.

- The midpoint of the estimated range of average annual ground water recharge (290 acre-ft/yr) is considered a good estimate of maximum perennial yield for the North Shore Hydrologic Subunit, given the available data. The midpoint of the range is approximately 4.5 percent of precipitation for the subunit which is within the range of accepted recharge estimates for other ground water basins in southern California (3 to 7 percent; Metropolitan Water District of Southern California (MWD), 1999; Daniel B. Stevens, 1996).

- The revised perennial yield of **290 acre-ft/yr** is slightly higher than the previous perennial yield value of 260 acre-ft/yr from the GEOSCIENCE, 2001 report, primarily as a result of the use of an updated EPA input parameter list for the watershed model and the consideration of the bedrock aquifer as a viable source of ground water supply;

- The maximum perennial yield for individual tributary subareas within the North Shore Subunit range from 27 acre-ft/yr (Subarea E) to 73 acre-ft/yr (Subarea B); and

- Additional ground water monitoring and geohydrologic data collection are required in each individual subarea to manage the ground water resources in the area as it is developed in the future.

The results of the ground water recharge analysis for the Grout Creek Subunit are as follows:

Summary of Ground Water Recharge Results
Grout Creek Tributary Subareas

Tributary Subarea	Area (acres)	Annual Precipitation (inches)	Average Annual Ground Water Recharge - Low Estimate (acre-ft/yr)	Average Annual Ground Water Recharge - High Estimate (acre-ft/yr)	Average of Ground Water Recharge Estimate Range (acre-ft/yr)
A	1,074	33.44	74	249	161
B	850	29.01	50	160	105
C	1,668	29.93	104	331	217
D	592	26.74	32	99	66

For the Grout Creek Hydrologic Subunit, the following is concluded:

- The Grout Creek Hydrologic Subunit can be conveniently subdivided into four tributary subareas (A through D) based on surface water drainage divides;

- The revised range of average annual recharge for the Grout Creek Hydrologic Subunit as a whole (Tributary Subareas A through D) is approximately 260 to 840 acre-ft/yr with a midpoint of approximately 550 acre-ft/yr. However, ground water resources in Subareas A and B of the Grout Creek Subunit are not currently practical to develop because they are remote and are located on land under the jurisdiction of the USFS;

- Due to the cost and political limitations associated with ground water development in Subareas A and B, it is currently recommended to use the sum of the midpoint recharge estimates for tributary Subareas C and D as the maximum perennial yield for the Grout Creek Subunit. This results in a maximum perennial yield for the Grout Creek Subunit of **283 acre-ft/yr**;

- The revised perennial yield is higher than the previous perennial yield value of

200 acre-ft/yr from the GEOSCIENCE, 2001 report, primarily as a result of the use of an updated EPA input parameter list for the watershed model and the consideration of the bedrock aquifer as a viable source of ground water supply;

- The maximum perennial yield for individual tributary subareas within the Grout Creek Subunit range from 66 acre-ft/yr (Subarea D) to 217 acre-ft/yr (Subarea C).

Given the possible range of recharge for the North Shore and Grout Creek Hydrologic Subunits, and correspondingly the range of recharge for the individual tributary subareas within each subunit, it is recommended that development planning for tributary subareas be initially based on the maximum perennial yield estimates described above. However, as ground water production is initiated in each tributary subarea, it will be very important to monitor ground water levels in dedicated non-pumping monitoring wells located in each tributary subarea from which ground water is extracted.

The ground water recharge analysis is based on long-term precipitation records. However, short-term periods (5 to 10 years) of relatively low precipitation have been observed throughout the period of record. These short-term periods of low precipitation are anticipated to have a significant impact on the ground water levels in the North Shore and Grout Creek Hydrologic Subunits because the storage capacity of the ground water reservoir is relatively small. For this reason, future ground water production, and development, in each tributary subunit should rely more on established ground water level thresholds than the perennial yield estimates.

2.0 INTRODUCTION

2.1 Background

The Big Bear Lake Watershed, located in the San Bernardino Mountains of western San Bernardino County, California (see Figure 1), has previously been divided into seven hydrologic subunits based on surface water drainage divides (Glenn A. Brown & Associates, 1974; GEOSCIENCE, 2001). These hydrologic subunits include: Gray's Landing, Mill Creek, Village, Rathbone, Division, North Shore and Grout Creek. The North Shore Hydrologic Subunit extends across most of the northern portion of Big Bear Lake (see Figure 2). Although the subunit can be categorized as one surface drainage catchment, its elongated east-west extent warrants further subdivision to distinguish available ground water resources in the eastern portion from available ground water resources in the western portion. Likewise, the large size of the Grout Creek Subunit, also located on the northern side of Big Bear Lake, also warranted further subdivision.

As a follow-up study to the most recent Maximum Perennial Yield analysis for the Big Bear Lake area (GEOSCIENCE, 2001), GEOSCIENCE conducted a focused evaluation of the maximum perennial yield of the North Shore and Grout Creek Hydrologic Subunits. The evaluation involved dividing the larger subunits into multiple tributary subareas and assigning perennial yield values to each of the subareas.

2.2 Purpose and Scope

The purpose of this report is to summarize the methodology, analysis, and findings of a focused evaluation of maximum perennial yield for the North Shore and Grout Creek Hydrologic Subunits of the Big Bear Lake Watershed. The scope of this evaluation included:

1. Updating the existing geohydrologic database for these hydrologic subunits,
2. Dividing the North Shore and Grout Creek Hydrologic Subunits into multiple tributary subareas,
3. Evaluating the maximum perennial yield of each tributary subareas using independent methods, and
4. Preparing this report of findings from the analysis.

The geohydrologic database was updated with well production and ground water level data from the Big Bear Lake Department of Water and Power (BBDWP) and precipitation data from the San Bernardino County Flood Control District. In addition, the following reports were consulted for the analysis and in the preparation of this report:

- Re-evaluation of the Maximum Perennial Yield Big Bear Lake Watershed and a Portion of Baldwin Lake, GEOSCIENCE, 2001.

- Geohydrological Investigation of the Moon Camp Area, Big Bear Valley, California, GEOSCIENCE, 2001.

- Estimating Hydrology and Hydraulic Parameters for HSPF, United States Environmental Protection Agency, 2000.

- An Interactive Database of HSPF Model Parameters, Version 1.0, United States Environmental Protection Agency, 1999.

- Geohydrology of Big Bear Lake and Baldwin Lake Drainage Areas, Glenn A. Brown & Associates, 1974.

3.0 METHODOLOGY

Maximum perennial yield is defined as:

> *The maximum quantity of ground water perennially available if all possible methods and sources are developed for recharging the basin. This quantity depends on the amount of water economically, legally, and politically available to the organization or agency managing the basin (Todd, 1980).*

By definition, the maximum perennial yield is some portion (i.e. subset) of the total amount of ground water recharge that the aquifers receive from precipitation on an average annual basis. Not all of the water that reaches the ground water aquifer can be developed for beneficial use because either it is not economically feasible, or there is no legal right to the water, or political constraints prevent or inhibit development.

Estimating the average annual ground water recharge involves relating geohydrologic and ground water basin operational factors in a quantitative form. It requires a detailed understanding of the basin's inflow terms (including all precipitation, infiltration, and other recharge), and outflow terms (including ground water extraction, evapotranspiration, and losses to the surface and/or adjacent ground water reservoirs). When possible, inflow and outflow terms are obtained from measured data, such as:

- Long-term precipitation records from weather stations within the Big Bear Lake watershed,
- Evapotranspiration data from evaporation pans and weather stations within the watershed,
- Ground water levels, and
- Ground water production.

However, most of the factors that affect the inflow and outflow terms that are required for a detailed evaluation of the ground water recharge have to be estimated or assumed from data collected outside the Grout Creek and North Shore subunits or outside the Big Bear Lake Watershed. Although the values are published and are from reliable sources (i.e. the U.S. Environmental Protection Agency, United States Geological Survey, etc.), they are not specific to the area of interest.

The lack of measured hydrologic data in the Grout Creek and North Shore Hydrologic subunits and corresponding assumptions necessary to estimate average annual ground water recharge (from which the maximum perennial yield can be evaluated) results in a relatively wide range of possible ground water recharge values for any given hydrologic subunit or tributary subarea. As more hydrologic information is collected, the range in ground water recharge estimates will narrow. Hydrologic data that, if measured in the Grout Creek and North Shore areas, would have the greatest impact on the ground water recharge/perennial yield estimates for the subunits and tributary subareas (and the Big Bear Lake Watershed as a whole) would include:

- Ground water monitoring wells in each of the tributary subareas,
- Additional information from private wells in each of the tributary subareas,
- Stream flow discharge (as would be measured from stream gages) for the major tributaries in the Grout Creek and North Shore subunits;
- Additional weather stations in the Grout Creek and North Shore subunits that would be equipped with instrumentation to measure:
  - Precipitation (including snow accumulation),
  - Ambient air temperature,
  - Vertical and horizontal wind speed and direction,
  - Relative humidity,

  - Barometric pressure,
  - Water vapor density,
  - Solar radiation,
  - Soil temperature,
  - Soil heat flux, and
  - Soil moisture content;

- Evaporation pans at each weather station location; and

- Pumping tests in selected wells to obtain aquifer parameters.

It should be noted that surface water infiltration testing currently being conducted in the Big Bear Valley as part of the Big Bear Area Regional Wastewater Agency Groundwater Replenishment Study will also provide valuable information on the recharge characteristics of the sediments between the land surface and ground water table.

Where possible, multiple methods were utilized to estimate the average annual ground water recharge of the various tributary subareas of the North Shore and Grout Creek Hydrologic Subunits. The methods considered were:

- Ground Water Underflow Calculation - Darcian Flow
- Watershed Model

The methods employed for the analysis are described in more detail in the following subsections.

3.1 Delineation of Tributary Subareas

Prior to conducting the maximum perennial yield analysis, the North Shore and Grout Creek Hydrologic Subunits were subdivided into multiple tributary subareas (see Figure 2). Tributary subareas represent smaller surface water drainage subbasins within the larger hydrologic subunit. Thus, the boundaries of the subareas represent surface water drainage divides. For most of the hydrologic subunits, it is assumed that the surface water drainage divides also represent ground water flow divides, particularly in areas where bedrock is exposed at the ground surface. However, in areas of the North Shore and Grout Creek subunits where the surface water drainage boundaries transect unconsolidated alluvium, which occurs on the lower slopes and in the southeast portion of the North Shore Subunit, the drainage divides do not necessarily represent ground water flow divides. In these areas, the ground water within one subarea/subunit can be in hydraulic communication with adjacent subareas/subunits.

The North Shore Subunit was subdivided into six tributary subareas (A through E) and the Grout Creek Subunit was subdivided into four tributary subareas (A through D). The subareas were determined through hydrological analysis of a digital elevation model using a Geographic Information System (GIS). Tributary subareas in the North Shore Subunit range in area from 247 to 828 acres with a total subunit area of 3,559 acres. Tributary subareas in the Grout Creek Subunit range in area from 592 to 1,668 acres with a total subunit area of 4,184 acres.

3.2 Ground Water Underflow Calculation – Darcian Flow

The Underflow Method (Roscoe-Moss, 1990) provides an estimate of ground water recharge moving through permeable formations (i.e. aquifers) within the watershed. This method is based on Darcy's Law and was determined only for the alluvial aquifers with available data. In this case, only Grout Creek has enough available information to perform an estimate of ground water underflow.

The underflow calculation utilized average transmissivity, aquifer width, and hydraulic gradient to solve Darcy's Law through the use of a flow net. Transmissivity values for the underflow calculations were obtained from pumping tests and lithologic data of wells within and/or immediately adjacent to each respective flow net. Hydraulic gradient and aquifer width were obtained from a ground water level contour map.

It should be noted that the underflow calculation only accounts for outflow in the alluvial aquifer and does not account for outflow through the bedrock in the subunit. It is assumed that some outflow occurs within the bedrock aquifer, which explains why the underflow estimate for the Grout Creek Subunit is lower than the ground water recharge estimate from the watershed model (described below). Previous perennial yield estimates (GEOSCIENCE, 2001) have been based on the assumption that production of water from the bedrock aquifer is not as economically feasible as production of water from the alluvial aquifer.

3.3 Watershed Model

Another method used to estimate the average annual ground water recharge was through the use of a watershed model. The watershed model is a computer tool that assists in solving the water balance, or hydrologic budget, for each tributary subarea. The water balance takes into account all of the quantifiable hydrologic variables that affect the water resources of the catchment. These variables include daily precipitation, surface water infiltration, surface water runoff, evapotranspiration, and deep percolation (see Figure 3). The deep percolation term given by the watershed model is considered an estimate of the average annual ground water recharge.

The model code used for the Big Bear Lake Watershed model was the Hydrological Simulation Program Fortran (HSPF; EPA, 1997). This program uses measured precipitation and potential evapotranspiration[1] (PET) to estimate surface water runoff, actual evapotranspiration[2] (ET), and

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[1] The amount of water that would be lost to the atmosphere through evaporation and uptake by plants (transpiration) under a given climatic condition if there were unlimited soil moisture.

[2] The amount of water that would be lost to the atmosphere through evaporation and uptake by plants (transpiration) under a given climatic and soil moisture condition.