SECTION 3.0

Numerical Model Construction

The GSWIM design is the result of translating the GSWI conceptual model (described in the Task 2A Report (CH2M HILL-HGL, 2006b) into a form that is suitable for numerical modeling. The following steps were associated with the GSWIM design:

1. Establishing study area boundaries (i.e., model domain) and developing a numerical grid
2. Spatially distributing the land surface parameter values
3. Spatially distributing the interception storage and ET parameter values
4. Spatially distributing the subsurface hydraulic parameter values
5. Establishing initial conditions for flow
6. Spatially distributing the transport parameter values and initial conditions for chloride
7. Selecting a time discretization (i.e., stress period durations) appropriate for evaluating the field problem and fulfilling the modeling objectives
8. Establishing boundary conditions for flow and chloride (i.e., water budget and solute loading terms through time)

The following subsections describe results of these eight design steps.

3.1 Model Domain

In the real world, space is continuous, but a numerical model must use discrete space to represent the hydrologic system. The simplest way to discretize space is to subdivide the study area into many subregions (i.e., grid-blocks) of the same size. However, it is typically advantageous to use relatively small grid-blocks in key areas of the modeling domain where more resolution in the numerical solution is desired, but having small grid-blocks across the entire modeling domain can lead to very long simulation run times. Using larger grid-blocks in areas of the modeling domain that are located away from the main areas of interest, and that are less critical to the evaluation of the overall field problem, is a typical grid-building strategy, especially when the model domain represents a large geographic area. This strategy seeks to maximize the resolution of the numerical solution in areas of interest within the modeling domain while minimizing model run times. Following is discussion of the aerial and vertical characteristics of GSWIM's numerical grid, which is illustrated on Figure 3-1.

3.1.1 Domain Boundaries

The following subsections describe the basis for the locations and geometry of the GSWIM numerical boundary.

3.1.1.1 Western Boundary

At the GSWI TWG and Modeling Subcommittee meetings held during the first and second quarters of 2006, it was agreed that the most downstream location at which GSWIM calibration will be focused will coincide with the Piru-Fillmore Subbasin boundary (as designated by USGS) in Reach 4 of the SCR. Figure 3-2 shows the western limit of the calibration area (at the subbasin boundary) and the western boundary of GSWIM. The Piru-Fillmore Groundwater Subbasin boundary is located in an area of significant groundwater pumpage by local irrigators and from Fillmore Fish Hatchery operations. To simulate responses of groundwater levels to this nearby pumping in GSWIM and to minimize numerical model boundary effects at this location, the western numerical boundary of GSWIM was located farther downstream at the A Street bridge, which also marks the end of Reach 4 of the SCR.

3.1.1.2 Northern Boundary

A portion of the SCR watershed located north of Reaches 4, 5, 6, and 7 contains such features as surface-water reservoirs. The larger reservoirs include Bouquet Reservoir, Pyramid Lake, and Castaic Lake and Lagoon in Los Angeles County, and Lake Piru in Ventura County. These surface-water bodies accumulate water that drains from a large portion of the SCR watershed and, in some cases, serve as terminal reservoirs for the State Water Project (SWP). A detailed understanding of the hydrology in areas tributary to these reservoirs is not considered necessary for the GSWI Study because the timing, magnitude, and quality of water downstream of these reservoirs is controlled and measured. Therefore, to further refine the GSWIM domain, the areas upstream of Bouquet Reservoir, Pyramid Lake, Castaic Lake and Lagoon, and Lake Piru were not considered for the GSWI Study area; this is consistent with the approach taken by Systech Engineering (2002a and 2002b) during development of the Watershed Analysis Risk Management Framework (WARMF) model. Release and spill data from these reservoirs were used to account for streamflow and chloride entering the modeling domain at the respective locations.

3.1.1.3 Eastern Boundary

Reach 6 of the Upper SCR begins at the west pier of Bouquet Canyon Road in Los Angeles County, near the Saugus WRP. Selection of an eastern boundary for the GSWI study area considered the upstream distance and extent of the drainage area east of Reach 6, up to the headwaters of the Upper SCR, and the locations of stream gages in the Upper SCR upstream of Reach 6. The portion of the SCR watershed located east of the Lang community in Los Angeles County, where a USGS stream gage exists in the Upper SCR, was not considered for the GSWI study area. An eastern boundary that corresponds to the location of the Lang stream gage and also coincides with the beginning of Reach 7 is consistent with previous modeling of the region conducted by CH2M HILL (2004a, 2004b, and 2005). Streamflow data recorded at the Lang stream gage were used to account for streamflow and chloride entering the modeling domain from the Acton Subbasin of the SCR watershed, which is located east of this stream gage.

3.1.1.4 Southern Boundary

The southern boundary of GSWIM was extended to the southern boundary of the SCR watershed.

3.1.2 Areal Characteristics of Model Grid

A grid that mathematically represents a 418-square-mile area was developed with 271 columns and 111 rows. The grid's areal extent is illustrated on Figure 3-1. The domain boundaries, as shown on Figure 3-1, represent natural hydrologic divides around an area located downstream of three local surface-water reservoirs (Bouquet Reservoir, Castaic Lake and Lagoon, and Lake Piru).

This grid is orthogonal and curvilinear, which means that it is topologically a uniform Cartesian grid, but is geometrically warped in space. This grid type was chosen because of the ability to warp the grid along nonlinear features of interest, such as the domain boundaries and the SCR. Furthermore, use of a curvilinear grid facilitates assignment of smaller cell spacings (i.e., finer discretization) within areas of the domain representing the groundwater subbasins and along the SCR. Grid resolution varies in the x-direction from 50 to 3,000 feet and in the y-direction from 50 to 11,000 feet, as shown on Figures 3-3 and 3-4, respectively.

With orthogonal curvilinear grids, care must be given to avoid excessively warping the grid to conform to features of interest, because a high degree of warping (i.e., sharper angles between grid-blocks) can lead to unacceptable errors in the numerical solution. The orthogonality, defined as the cosine of the angles between adjacent grid-block intersections, provides a measure of how closely the grid-block intersections of a curvilinear grid resemble those of a rectilinear grid (i.e., where the intersection angles occur at 90 degrees). Given that the orthogonality of a rectilinear grid equals zero (i.e., cosine[90]=0), it is desirable with curvilinear grids to have grid-block intersections meet at angles that are close to 90 degrees (i.e., orthogonality close to zero). Figure 3-5 shows the orthogonality of GSWIM's grid, with values generally less than 0.05 (i.e., within 3 degrees of right angle intersections) in areas of interest, which is considered acceptable for the purposes of the GSWI Study.

The surface regime was discretized using an OLF grid and CHF grid and the subsurface regime was discretized using and extension of the OLF grid with depth. Following is discussion of the OLF and CHF grid characteristics.

3.1.2.1 Overland Flow Grid

The OLF grid is two-dimensional and represents the land surface within the domain (see Figure 3-1). The OLF grid domain overlies the first layer of the subsurface grid domain and contains 22,307 OLF nodes, which coincide areally with the subsurface grid nodes. The subsurface grid below the OLF grid was made inactive in regions where the groundwater basins or the Alluvium do not exist. A layer of active subsurface grid nodes was initially used to represent the topsoil above bedrock in these areas; however, results from preliminary sensitivity simulations indicated that this layer of nodes did not contribute much subsurface flow to the groundwater subbasins, and that the simulations were insensitive to its hydraulic conductivity and vertical leakance. In bedrock areas, this layer of nodes essentially "held water" in the subsurface regime for ET (analogous to a bucket that fills with rainfall before overflowing). Assignment of rill storage can conceptually provide the same functionality where subsurface layers are not present and decrease model run times. In the context of GSWIM, rill storage represents the capacity for depressions and undulations in the land surface to hold back runoff until the storage height (i.e., depression storage) is exceeded. Thus, the rill storage height was selected to represent the combined storage in rills and topsoil in bedrock areas of the domain (i.e., the subsurface grid layer was removed in the bedrock areas). In these bedrock areas, the rill height was calibrated to provide appropriate ET and streamflow characteristics throughout the domain.

3.1.2.2 Channel Flow Grid

The CHF grid (also shown on Figure 3-1) consists of a network of interconnected one-dimensional channel segments, which were delineated via flow accumulation calculations along the surface topography using the ArcHydro software add-on with ESRI® ArcGIS™ Version 9.1[1]. The CHF segment lengths vary between 170 and 440 feet, with most of the segments being approximately 300 feet long. The CHF grid contains 6,176 segments.

3.1.3 Vertical Characteristics of Model Grid

GSWIM's grid is stacked into multiple layers to provide a three-dimensional representation of the surface and subsurface system. Nine subsurface layers consisting of 59,320 active subsurface nodes were used to discretize the subsurface. The top three layers represent the saturated and unsaturated portions of the Alluvium overlying the East, Piru, and Eastern Fillmore Subbasins. The exception to this is where Alluvium is absent within the East Subbasin; here, Model Layers 1 through 3 represent an upper portion of the Saugus Formation. Model Layers 4 through 9 were used to discretize the Saugus Formation in the East Subbasin, whereas Model Layers 4 and 5 were used to discretize the San Pedro Formation in the Piru and Eastern Fillmore Subbasins. Grid-blocks that generally lie outside the areas representing the groundwater subbasins were made inactive, so that the proper three-dimensional geometry of the groundwater subbasins was delineated with depth by the actively modeled grid system. Figure 3-6 shows schematic cross-sectional views of the model grid along Row 69 and Column 187, depicting the shapes of the groundwater subbasins (Figure 3-6 is not to scale and is vertically exaggerated). Table 3-1 lists the number of active model grid nodes within each model layer.

Model Layers 1 (the topmost subsurface layer) and 2 have thicknesses of 1 and 5 feet, respectively. The thickness of Model Layer 3 is variable, occupying the remaining thickness of the Alluvium. The bottom elevation of Model Layer 3 represents the base of the Alluvium and top of the Saugus Formation in the East Subbasin and San Pedro Formation in the Piru Subbasin (see Figure 3-7). The total Alluvium thickness (sum of Model Layers 1 through 3) is based on the Alluvium thicknesses from the following two models:

- Groundwater flow model of a large portion of Ventura County, initially developed by the USGS (USGS, 2003) and then further developed by United Water Conservation District (UWCD). This model was developed using Modflow.
- Groundwater flow model of the East Subbasin, developed by CH2M HILL for the Upper Basin Water Purveyors[2] (CH2M HILL, 2004a, 2005b). This model was developed using MicroFEM.

No Alluvium thickness data were available for the region between the East and Piru Subbasins (i.e., Blue Cut area near the county line). Thus, depth to bedrock was estimated in

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[1] http://www.esri.com/software/arcgis/index.html.

[2] The Upper Basin Water Purveyors consist of Los Angeles County Waterworks District #36 (LACWWD#36), Newhall County Water District (NCWD), Santa Clarita Water Division of CLWA (SCWD), and Valencia Water Company (VWC).

this area using data resulting from Task 1B exploratory drilling and geophysical surveys. Figure 3-8a shows the estimated Alluvium bottom elevation in the Blue Cut area. Figure 3-8b shows cross sections through this area, which illustrate that the modeled bottom elevations for the Alluvium are representative of the geophysical interpretations.

During model construction, it was noted that a layer of Alluvium exists (according to available well depth data) beneath Piru Creek outside of the Piru Subbasin, as defined by the USGS. For modeling purposes, a 70-foot thick layer of Alluvium was numerically extended up Piru Canyon to the Santa Felicia Dam in accordance with the Alluvium boundary, as shown on the geologic map on Figure 3-9. This was done to include groundwater wells along Piru Creek that were not represented in the UWCD model. Specifically, Wells V-0009, V-0014, V-0015, and V-0026 have depths of 70, 40, 60, and 47 feet, respectively, suggesting that the Alluvium is at least 70 feet thick under portions of Piru Creek. Figures 3-10 through 3-15 depict the bottom elevations of the model layers representing the Saugus and San Pedro Formations. The thicknesses of these Saugus and San Pedro Formation layers are based on data from the UWCD and Upper Basin Water Purveyors' models. Figures 3-16 through 3-22 show the simulated thicknesses of Model Layers 3 through 9. Model layer elevations and thicknesses from the calibrated version of GSWIM are illustrated on Figures 3-7, 3-8, and Figures 3-10 through 3-22.

3.2 Land Surface Parameters

The following subsections describe the land surface parameterization of the OLF and CHF domains. The land surface parameters in GSWIM were initially assigned using available field and land use data, as well as data from a flow and transport model of the SCR Watershed. The SCR Watershed model was developed by Systech Engineering (Systech Engineering, 2002a, 2002b) using WARMF model code. Some of these land surface parameter values were modified during the calibration process. Values and figures presented in this section reflect calibrated results.

3.2.1 Overland Flow Domain

Parameters of the OLF domain include the land surface elevation; parameters related to land cover (e.g., pavement, vegetation, structures, and water bodies), which change through time; and rill height.

3.2.1.1 Land Surface Elevation

Digital Elevation Model (DEM) data obtained from the National Elevation Dataset[3] form the basis for land surface elevations of GSWIM. The 30-meter DEM data are the best available for land surface elevation covering the study domain, given the large extent of the GSWI study area. These land surface elevations were assigned to the OLF grid and the top of the first subsurface model layer that underlies the OLF grid. Elevation data were processed using ESRI® ArcGIS™ Version 9.1 software to fill numerical imperfections (local sinks) prior to being interpolated onto each grid-block. Figure 3-23 shows the modeled land surface elevation. Land surface elevations in the GSWI Study area range from approximately 5,200 feet above mean sea level (ft msl) near Bouquet Reservoir to approximately

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[3] http://ned.usgs.gov/.

420 ft msl at the downstream end of Reach 4, at the A Street bridge in Fillmore. Drops in elevation along the chloride TMDL reaches of the Upper SCR average about 35 to 40 feet per mile (ft/mi) in Reach 6 and about 30 ft/mi in Reach 5, according to the DEM data.

3.2.1.2 Parameters Related to Land Cover

Parameters related to the land cover were classified according to LUC designations established during conceptual model development (see Figures 3-5 through 3-15 in the Task 2A Report [CH2M HILL-HGL, 2006b] for land use maps). Land cover parameters in GSWIM include the Manning friction coefficient (Manning-n), vertical leakance, obstruction height, canopy interception storage, and rill height. Table 3-2 lists the calibrated values of these parameters.

Manning Friction Coefficient. Manning-n values were obtained from *Open Channel Hydraulics* (Chow, 1959) and calculated for commercial/industrial and residential LUCs using land cover assumptions shown in Table 3-3.

Vertical Leakance. Vertical leakance values for the OLF domain were classified by LUC as shown in Table 3-2. Vertical leakance values for the commercial/industrial and residential LUCs were computed using land cover assumptions shown in Table 3-3 and the following pavement assumptions:

- Vertical leakance equals 10^{-7} days^{-1} for 100 percent pavement cover.
- Vertical leakance equals 10^{-3} days^{-1} for 10 percent pavement cover.

Vertical leakance values for commercial/industrial and residential LUCs shown in Table 3-2 were computed via linear interpolation of the log of the vertical leakance and percent-paved assumption (percent-paved values are shown in Table 3-3).

Obstruction Height. Obstruction heights in GSWIM are used to constrain the reduction of water storage capacity on the land surface resulting from the presence of structures or vegetation on the land surface (analogous to porosity, in which flow must go around the obstructions). Obstruction height values for the OLF domain were also classified by LUC as shown in Table 3-2. Obstruction height values for the commercial/industrial and residential LUCs were computed using land cover assumptions shown in Table 3-3 and the following pavement assumptions:

- Obstruction height equals 0.001 foot for 100 percent pavement cover.
- Obstruction height equals 0.500 foot for 10 percent pavement cover.

Obstruction height values for commercial/industrial and residential LUCs shown in Table 3-2 were computed via linear interpolation of the obstruction height and percent-paved assumption (percent-paved values are shown in Table 3-3).

Obstruction height values for unpaved LUCs, including golf courses and improved pasture (0.200 foot), crop-related LUCs (0.700 foot), and nonirrigated LUCs (0.500 foot), were derived as part of the calibration process.

Canopy Interception Storage. Some precipitation and irrigation water that is applied in the GSWI Study area is intercepted by vegetation or structures, as opposed to falling directly onto the land surface. GSWIM accounts for the intercepted precipitation and applied water through use of a canopy interception storage (Cint) term. Table 3-2 also shows the calibrated Cint values, which are discussed with the ET parameters in Section 3.3.

Grid-block Computation. Grid-block parameter values associated with LUCs were evaluated for the OLF domain internally by GSWIM in an area-weighted fashion through time (see Figure 3-4 and Table 3-2 in the Task 2A Report [CH2M HILL-HGL, 2006b]). Area-weighted averaging was performed on the obstruction height values and on the log of the Manning-n and vertical leakance values.

LUC coverages were input to GSWIM for CYs 1980, 1990, 1993, 1997, 2000, 2001, 2002, 2004, and 2005 (see Figures 3-5 through 3-15 in the Task 2A Report [CH2M HILL-HGL, 2006b] for land use maps). The LUC fractions within each grid-block were then computed for these years using a Python[4] script developed by CH2M HILL for use in ESRI® ArcGIS™ Version 9.1, which intersected the LUC polygons with the model grid-block polygons. These LUC fractions were then input to GSWIM, which internally interpolated between CYs 1980, 1990, 1993, 1997, 2000, 2001, 2002, 2004, and 2005 to give the LUC fraction for each grid-block, for each simulation year.

3.2.1.3 Rill Height

The rill height is also a hydrologic property required for the OLF domain. The rill height represents storage in topsoil in portions of the domain located outside the Alluvium or groundwater subbasins (where subsurface model layers are absent). The calibrated rill height in this portion of the domain is 3.5 feet near Hopper Creek and 4 feet elsewhere. In areas where the Alluvium or groundwater subbasins exist, the calibrated rill height is 0.1 foot.

3.2.2 Channel Flow Domain

DEM data that were used to parameterize the land surface elevations in the OLF domain were also input to the ArcHydro model[5] of ESRI® ArcGIS™ Version 9.1 to delineate stream locations (see Figure 3-24) for the CHF domain. The stream locations were input to GSWIM as polylines, whereby rectangular segments and reaches were defined along the stream polylines. Parameters of the CHF domain include streambank elevation, channel bottom elevation, channel width, Manning-n, rill height, obstruction height, and vertical leakance for each channel segment.

3.2.2.1 Streambank Elevation

The streambank elevation for a CHF segment is defined by the elevation at the middle of the CHF segment, according to the land surface distribution shown on Figure 3-23. All other CHF parameter values depend on whether the physical stream reach, represented by a given CHF segment, is unlined, lined, or bermed. CHF segments were input as unlined, lined, bermed, or some combination thereof, according to visual evaluation of the stream channels using Google Earth™[6]. Figure 3-24 shows the unlined, lined, and bermed

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[4] http://www.python.org/.

[5] http://support.esri.com/index.cfm?fa=downloads.dataModels.filteredGateway&dmid=15.

[6] http://earth.google.com/.

segments of the CHF domain, which did not change throughout the model simulation periods.

3.2.2.2 Unlined Stream Channels

As illustrated on Figure 3-24, most of the stream channels in the GSWI Study area, and, therefore, within the CHF domain, were simulated as unlined channels. The following parameter values were assigned to the CHF segments representing unlined stream channels:

- Channel bottom elevation was set at 2 feet below the streambank elevation.
- Channel width was set at 40 feet throughout most of the domain to account for the features of the stream channel that are smaller than the width of an OLF grid-block. However, the Pole and Hopper Creek channels were calibrated with widths of 60 feet, and those of Mint and Upper Bouquet Creeks were calibrated with widths of 10 feet.
- Manning-n was set at 0.130 (value suggested in *Open Channel Hydraulics* [Chow, 1959] for earthen channels).
- Rill and obstruction heights were set at 0.20 and 0.500 foot, respectively.
- Vertical leakance was computed as the vertical hydraulic conductivity (Kv) of Model Layer 1 divided by half the thickness of Model Layer 1 (which represents the vertical distance between the CHF segment and the subsurface node in Model Layer 1), and varies between 0.100 and 3.000 days^{-1}.

3.2.2.3 Lined and Bermed Stream Channels

According to visual approximations, some reaches of Bouquet Canyon through the City of Santa Clarita are assumed to be lined and bermed or just bermed, as follows:

- Bouquet Canyon is lined from where it crosses Newhall Ranch Road to where it intersects Bouquet Canyon Road near Garza Drive. A bermed portion of Bouquet Canyon is located near Hob Drive, near the edge of the City of Santa Clarita.
- Haskell Canyon is bermed from its intersection with Bouquet Canyon to the edge of the City of Santa Clarita, north of Copper Hill Drive.
- Pole Creek is lined through the City of Fillmore as well as bermed from where it enters the SCR, north up to 4th Street.

The following parameter values were assigned to the CHF segments representing lined and bermed stream channels:

- Channel bottom elevation was set at 12 feet below the streambank elevation.
- Channel width was set at 100 feet along lined and bermed segments of Bouquet Canyon, 80 feet along bermed portions of Haskell Canyon, and 60 feet along lined portions of Pole Creek.
- Manning-n was set at 0.013 (value suggested in *Open Channel Hydraulics* [Chow, 1959] for lined channels) for lined portions of Bouquet Canyon and Pole Creek, and at 0.065 for bermed portions of Bouquet Canyon and Haskell Canyon.

- Rill heights were set at 0.01 and 0.10 foot for lined and bermed portions of stream channels, respectively.
- Obstruction heights were set at 0.001 foot for lined portions of Bouquet Canyon and Pole Creek and at 0.250 foot for bermed portions of Bouquet Canyon and Haskell Canyon.
- Vertical leakance was set at 0.001 day^{-1} for lined portions of Bouquet Canyon and Pole Creek and at 0.005 day^{-1} for bermed portions of Bouquet Canyon and Haskell Canyon.

Table 3-4 summarizes the property values for lined, bermed, and unlined sections of the CHF segments.

3.3 Interception Storage and Evapotranspiration Parameters

3.3.1 Interception Storage Parameters

Interception of rainfall is conceptualized as discussed in Section 2.1.4 of the Task 2A Report (CH2M HILL-HGL, 2006b). The Cint and LAI are parameters that are required to quantify precipitation interception, and are assigned according to LUCs. The LAI is a dimensionless parameter that represents the leaf cover over a unit area of land surface and varies temporally. Both Cint and LAI values were obtained from the WARMF model (Systech Engineering, 2002a and 2002b). Tables 3-2 and 3-5 show Cint and LAI values used in GSWIM.

3.3.2 Evapotranspiration Parameters

Parameters that affect the simulated rate of ET include the LAI, crop coefficient, root-zone distribution function (RDF), field capacity, and wilting point in the unsaturated soil. LAI parameterization is described in Section 3.3.1. Crop coefficient values shown in Table 3-6 were assigned to LUCs. Values assigned to the commercial and residential LUCs were computed using the land cover assumption percentages shown in Table 3-3. Grid-block values of crop coefficient, Cint and LAI were evaluated for the OLF domain by the model in an area-weighted fashion, similar to the other parameters of the OLF domain described in Section 3.2.1.

The RDF, field capacity, and wilting point were assigned by Hydrologic Soil Group (HSG) code (see Table 3-7). The RDF is a dimensionless parameter that represents the density of roots within a model layer. The RDF along a column of grid-blocks sums to a value of unity in GSWIM. Field capacity and wilting point values were initially obtained from the WARMF model, but it was discovered that these were incompatible with the van Genuchten moisture retention parameters for the soils. Hence, the wilting point and field capacity were established at the moisture content, where the pressure heads in the soil are at 25 and 5 feet of suction, respectively. These parameter values were assigned to the HSG distributions shown on Figure 3-25 to provide areally distributed moisture content values over the model domain.

ET from unconfined Model Layer 3 was computed as a function of depth, with maximum ET occurring at the top of the grid-block and minimum ET occurring at an extinction depth 3 feet below the top of the grid-block (subject to the RDF within Model Layer 3).

Unsaturated Model Layers 1 and 2 are 1 and 5 feet thick, respectively, providing the extinction depth for groundwater ET at 8 feet below land surface.

3.4 Subsurface Hydraulic Parameters

The hydraulic parameters in GSWIM were initially assigned using available and relevant field data and data from the UWCD and Upper Basin Water Purveyors' models. Subsurface hydraulic properties required by GSWIM include the horizontal hydraulic conductivity (Kh) and specific storage for each groundwater model layer, vertical leakance between model layers, and either the specific yield (for Model Layer 3) or the porosity (for all other model layers) and unsaturated moisture properties (for Model Layers 1 and 2, where the variably saturated flow formulation is used).

3.4.1 Horizontal Hydraulic Conductivity and Specific Storage

The calibrated distribution of Kh for Model Layers 1 through 3 is illustrated on Figure 3-26, and the calibrated distributions of Kh for Model Layers 4 through 9 are illustrated on Figures 3-27 through 3-32. The calibrated values of Kh are within the ranges reported in *2001 Update Report: Hydrogeologic Conditions in the Alluvial and Saugus Formation Aquifer Systems* (Richard C. Slade and Associates, LLC [RCS], 2002) and *Newhall Ranch Updated Water Resources Impact Evaluation, Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development and Calibration*, and *Calibration Update of the Regional Groundwater Flow Model, Santa Clarita, California* (CH2M HILL, 2002, 2004a, and 2005b) and are reasonable for the types of lithologies that are present in the GSWI Study area. A specific storage value of 10^{-4} feet^{-1} was assigned in all model layers to represent the compressible storage of the water and aquifer matrix.

3.4.2 Vertical Leakance

Vertical leakance values were assigned for the bottom of each model layer in GSWIM (e.g., the vertical leakance of Model Layer 1 limits the vertical groundwater flow that is simulated between Model Layers 1 and 2). The vertical leakance between Model Layers 1 through 3 was internally computed as the harmonic mean of the vertical leakances of the individual layers in GSWIM. For these model layers, the vertical leakance of each layer was assigned as the Kv value divided by half the grid-block thickness. The Kv values were used to compute the layer-specific vertical leakances of Model Layers 1 through 3 (where Model Layer 1 represents the topsoil layer beneath the OLF domain). The Kv values for Model Layers 1 through 3 were obtained from the WARMF model for various soil types, as shown in Table 3-8. These Kv values were assigned throughout the GSWIM domain according to the HSG distributions shown on Figure 3-25. GSWIM internally computes the harmonic mean of the vertical leakances between model layers for use with the governing flow equations for each grid-block location.

The vertical leakance values for Model Layers 3 through 8 were initially obtained from the UWCD and Upper Basin Water Purveyors' models. These vertical leakances represent the combined vertical leakance effect of the aquifers (i.e., model layers) and aquitards (i.e., interfaces between model layers). Thus, the vertical leakance values of Model Layers 3 through 8 represent the net vertical leakance between these model layers and their respective underlying layers, including the effects of intermediate aquitard units. Figures 3-33 through 3-38 show the calibrated vertical leakance values for Model Layers 3 through 8. Because the bottom of Model Layer 9 is a no-flow boundary, no vertical leakance value was assigned to this layer.

3.4.3 Specific Yield, Porosity, and Unsaturated Moisture Parameters

The specific yield values for Model Layer 3 (which is treated as unconfined) were initially obtained from the UWCD and Upper Basin Water Purveyors' models. The calibrated specific yield values for Model Layer 3 are illustrated on Figure 3-39.

The calibrated porosity and unsaturated moisture property values for Model Layers 1 and 2 are a function of the various HSGs, as shown in Table 3-9. These values were assigned to the discretized HSG distributions shown on Figure 3-25. The calibrated values are within the ranges reported in *2001 Update Report: Hydrogeologic Conditions in the Alluvial and Saugus Formation Aquifer Systems* (RCS, 2002) and *Newhall Ranch Updated Water Resources Impact Evaluation, Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development,* and *Calibration Update of the Regional Groundwater Flow Model, Santa Clarita, California* (CH2M HILL, 2002, 2004a, and 2005b) and are reasonable for the types of lithologies that are present in the GSWI Study area.

3.5 Initial Flow Conditions

The establishment of GSWIM as a predictive model necessitates establishment of initial conditions in the hydrologic system from which to simulate hydrologic conditions in a forward-in-time manner. Initial conditions, in this context, refer to the initial distribution of groundwater elevations, streamflow locations, and solute concentrations throughout the modeling domain that are representative of January 1975 (the beginning of the calibration period).

Initial flow conditions for the calibration simulations were established in a "charge-up" simulation conducted prior to starting the transient calibration simulation. This involved simulating 1975 surface and subsurface flow conditions in a steady-state manner, and then qualitatively comparing the steady-state solution with conditions observed in the mid-1970s (e.g., groundwater levels and streamflow locations versus Dry Gap locations). Interception storage was disregarded for the steady-state simulation to allow rainfall and ET to directly interact with the domain. The transport of chloride was also disregarded for the steady-state flow simulation. Local recharge values were adjusted within zones to give a good initial head match. The steady-state flow condition was then used for simulating transient conditions from CYs 1975 through 2005. Section 4.1.1 further describes the steady-state flow simulation.

3.6 Transport Parameters

3.6.1 Chloride Transport Properties

As previously described, GSWIM was built to quantify potential cause-and-effect relationships between chloride loading from WRP discharges and the resulting responses of the hydrologic system under a variety of future hydrology, land use, and water use assumptions for CYs 2007 through 2030. Thus, values for transport parameters, including the decay coefficient, adsorption coefficient, horizontal longitudinal and transverse dispersivities, and vertical longitudinal and transverse dispersivities, in addition to specific yield and porosity, are also required inputs to GSWIM. The calibrated chloride transport parameter values are listed in Table 3-10.

3.6.2 Initial Chloride Conditions

The curvilinear grid used to simulate surface and subsurface flow was also used to simulate surface and subsurface chloride transport. Chloride transport was simulated under the assumption that chloride in the GSWI Study area is conservative (i.e., there is no sorption or decay of chloride). Initial subsurface chloride concentrations used for calibration are shown on Figures 3-40 through 3-46. These chloride concentrations were obtained by examining and areally distributing chloride concentration data available from 1970 through 1978 and then modifying the distribution as part of the calibration process to improve the match between simulated and measured chloride concentrations (see Section 4.0 for a detailed discussion of the model calibration process and results).

3.7 Model Time Discretization

Time is continuous in the physical system, but a numerical model must use transient parameter values that describe the field problem at discrete time intervals. The durations of the time intervals were carefully selected for GSWIM in an attempt to input transient parameter values that represent time-continuous hydrologic processes and allow the model solution to be output at a time scale appropriate for the field problem being evaluated.

Transient parameter values were discretized using monthly stress periods for the WSS variables, including groundwater pumping and imported water (see Section 3.8.6 for more details on WSS functionality). Monthly stress-period durations were selected according to the availability of measured groundwater-level and chloride concentration data, and achieving sufficient resolution in model output. Data for the remaining boundary conditions were input as daily values (e.g., daily precipitation, daily reservoir releases and spills, and daily WRP discharges). Adaptive time stepping was employed when conducting the calibration simulations using both the monthly stress-period data and daily input data.

3.8 Boundary Conditions

Boundary conditions are mathematical statements (i.e., rules) that specify water elevation, water flux, solute concentration, and/or solute flux at particular locations within the model domain, which can vary in time. The following five types of boundary conditions were used with GSWIM:

1. **Specified-head –** Water elevation is specified.
2. **Specified-flux –** Water flux is specified.
3. **Head-dependent flux –** Given head values, a water flux is internally computed across the boundary using an appropriate governing flow equation.

4. **No-flow –** Water can flow parallel to the boundary but not across it.
5. **Inflow solute concentration –** Solute concentration is assigned at inflow boundaries to simulate solute loading to the model domain. Assigning concentrations to outflow boundary conditions is not necessary because solute outflow is computed as part of the numerical solution.

Related to the boundary conditions is an internal routing system module, known in GSWIM as a WSS. The WSS includes mathematical statements (i.e., rules) that specify linkages between the water and solute conditions at source and destination locations, which can vary through time (see Section 3.8.6 for more details on WSS functionality). This linkage allows GSWIM to internally route water and solute between selected boundary conditions (e.g., allows for water uses, such as groundwater pumping, to be linked with end uses, such as irrigation – linking the fate of both water and chloride). Table 3-11 summarizes the boundary conditions selected for GSWIM.

3.8.1 Specified-head Boundaries

The western stream outflow boundary of the CHF domain is assigned as a zero-depth gradient (i.e., specified-head) boundary condition along the SCR and Pole Creek. The western subsurface outflow boundary is assigned as a specified-head boundary, whereby the head value is set at 10 feet below the bottom elevation of the SCR at the boundary location. This head value is assigned to all western subsurface outflow boundary nodes so that simulated outflow is horizontal from the groundwater domain.

3.8.2 Specified-flux Boundaries

3.8.2.1 Precipitation

Precipitation data conceptualization and processing were described in detail in Sections 2.1.1 through 2.1.3 of the Task 2A Report (CH2M HILL-HGL, 2006b). Figures 2-6 and 2-8 of that report show the temporally continuous daily rainfall data that were initially used throughout the domain and the areal distribution of this rainfall via precipitation zones created around each of the gages. During model calibration, it was found that, at a few stream gages and for some periods, the simulated streamflows did not match the measured streamflows. To minimize the differences between simulated and measured streamflow data, the precipitation input data were critically reviewed. The reliability of precipitation data for some of the rain gages was deemed questionable because of inconsistent measured streamflow and precipitation records for neighboring monitoring locations over portions of the calibration period. For example, some of the simulated streamflow results indicated no streamflow during wet periods and streamflow during dry periods. Upon further scrutiny of the input precipitation data, several discrepancies were discovered between neighboring rain gages. Upon this discovery, staff at the County of Los Angeles Department of Public Works (LADPW) were contacted to discuss the discrepancies. It was determined that LADPW personnel were still finalizing the review of precipitation data for rain gages in the watershed. Specifically, the GSWI Modeling Team was informed that short-term (e.g., hourly) precipitation data, which were used to estimate daily precipitation rates for periods prior to CY 2000, were questionable (Willardson, 2007, pers. comm.).

After the discussions with the LADPW, the GSWI Modeling Team prepared a set of subwatershed sensitivity analyses, whereby the questionable precipitation data for selected gages were replaced with the precipitation data from the neighboring gages. The sensitivity analyses helped refine the precipitation data series that resulted in reasonable matches between the simulated and measured streamflows. Table 3-12 summarizes the affected precipitation datasets and Figure 3-47 illustrates the revised precipitation zones that resulted from these precipitation analyses and the calibration process.

3.8.2.2 Inflow at Lang

Daily stream inflows were computed for Lang using a regression technique described in Section 5.5.2 of the Task 2A Report (CH2M HILL-HGL, 2006b). Table 3-13 lists the monthly rates for stream inflow at Lang.

The subsurface inflow at Lang was computed as a linear function of the computed daily stream inflows at Lang so that the annual subsurface inflow averaged approximately 2,000 acre-feet per year (acre-ft/yr). A subsurface inflow rate of 2,000 acre-ft/yr from the Acton Subbasin at Lang is consistent with the range of annual underflow rates reported by the California Department of Water Resources (DWR) in the 2003 Bulletin 118 Update[7] and *Assessment of Hydrogeologic Conditions within Alluvial and Stream Terrace Deposits, Action Area, Los Angeles County* (Slade, 1990). Table 3-14 lists the monthly subsurface inflow rates at Lang.

3.8.2.3 Reservoir Releases and Spills

Daily spills and releases from Bouquet Reservoir, Castaic Lagoon, and Lake Piru were compiled and input to GSWIM as described in Section 5.0 of the Task 2A Report (CH2M HILL-HGL, 2006b). Tables 3-15 through 3-18 list the monthly releases and spills from Bouquet Reservoir, Castaic Lagoon, and Lake Piru.

3.8.2.4 Dam Underflow

Underflow beneath Castaic Dam was estimated as described in Section 6.3.2 of the Task 2A Report (CH2M HILL-HGL, 2006b) and provided as a daily average of 202,885 cubic feet per day (ft^3/day). Underflow from Bouquet Reservoir and Lake Piru was not simulated in accordance with the UWCD and Upper Basin Water Purveyors’ models.

3.8.2.5 Septic System Discharge

Septic system discharges are a small component of the overall water budget in the GSWI Study area. Table 3-19 shows the simulated septic system discharge and associated chloride concentrations. WARMF model data quantifying the population served by septic systems in subareas of the watershed (Systech Engineering, 2002a, 2002b) were multiplied by an estimated water usage of 113 gallons per capita, per day, to give the total gallons per day discharged by septic systems. This value was then distributed evenly to each of the subarea GSWIM grid-blocks. The septic system discharge rates were kept constant throughout the simulations.

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[7] http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/4-5.pdf.

3.8.2.6 Industrial Point-source Discharges

The locations of WRPs, the Piru WWTP, and other industrial point-source dischargers are shown on Figure 3-48. Daily discharges from the Saugus and Valencia WRPs and the Piru WWTP were input to GSWIM as described in Sections 5.2 and 6.3.1 of the Task 2A Report (CH2M HILL-HGL, 2006b). Tables 3-20 and 3-21 list the monthly discharge rates associated with the surface and subsurface point-source dischargers, respectively. Surface point-source discharges were assigned to the CHF surface and subsurface point-source discharges were assigned to the OLF surface. The discharge locations provided for Texaco Trading and Transportation, Keysor Century Corporation, and City of Santa Clarita did not lie on streams (or very close to the streams); therefore, these were assigned to the nearest stream segment in GSWIM.

3.8.3 Head-dependent Flux Boundaries

The monthly time series of reference ET (ETo) for Piru #101 Station was obtained as discussed in Section 2.2 of the Task 2A Report (CH2M HILL-HGL, 2006b). Simulated ET in the model domain is governed by availability of moisture at the surface and topsoil layer and groundwater elevations in relation to the RDF and evaporation distribution function. Thus, ET of shallow groundwater is a head-dependent flux process.

3.8.4 No-flow Boundaries

Lateral boundaries of the OLF domain that do not coincide with specified-flux boundaries (e.g., reservoir releases and spills) were simulated as no-flow boundaries because these locations represent watershed divides. Aquifer bottom boundaries of Model Layer 9 in the East Subbasin and Model Layer 5 in the Piru and Eastern Fillmore Subbasins are also simulated as no-flow boundaries, as are the lateral boundaries of the active subsurface grid-blocks. Therefore, it is inherently assumed that flow into or out of the bedrock is negligible.

3.8.5 Inflow Solute Concentration Boundaries

Inflow chloride boundary conditions were assigned along with all water inflow boundary conditions. The chloride concentration values of incoming water were input to GSWIM, which then internally used the product of the chloride and water inflow rates to provide the mass flux of chloride entering the model domain. Chloride exits the outflow boundaries via advection only (i.e., the process of ET does not remove chloride in GSWIM). Tables 3-22 through 3-29 list the monthly chloride concentrations associated with the inflow solute concentration boundary conditions. Water distributed by CLWA contains the chloride concentration of Castaic Lake plus 4 mg/L that result from the water treatment process. Chloride concentrations in recycled water are the same as those in the Valencia WRP effluent for the calibration period.

As discussed in the Task 2A Report (CH2M HILL-HGL, 2006b), chloride concentration data are not available for Bouquet Reservoir. Initially, the GSWI TWG collaboratively agreed to move forward with the assumption that chloride concentrations in Bouquet Reservoir are consistent with those in Castaic Lake. During calibration, it was discovered that simulated groundwater chloride concentrations at the SCWD-Clark well were strongly influenced by the simulated chloride concentrations in Bouquet Reservoir. Thus, the GSWI Modeling

Team opted to use the groundwater chloride concentrations at the SCWD-Clark well to develop a dataset for chloride concentrations in Bouquet Reservoir.

As described in Section 8.1.1.4 of the Task 2A Report, a constant chloride concentration of 43.4 mg/L was assigned to groundwater inflow at Lang.

3.8.6 Water Supply Systems

A WSS in GSWIM tracks imported and pumped groundwater that it receives and distributes that water onto the OLF surface as applied water in its service area after accounting for indoor uses. The applied water distribution within a service area is related to the water demands established for each LUC in that service area.

3.8.6.1 Imported Water and Groundwater Pumping

The sources of potable water in the GSWI Study area include imported water and locally pumped groundwater. The Upper Basin Water Purveyors supply water to users of the Santa Clarita Valley and surrounding communities. In GSWIM, each Upper Basin Water Purveyor's service area is conceptualized as a WSS. Each Upper Basin Water Purveyor uses both imported water purchased from CLWA and locally pumped groundwater. The monthly imports by CLWA were scaled by the annual distribution of imported water among the Upper Basin Water Purveyors to compute the monthly imported water flux values for each Upper Basin Water Purveyor. Other groundwater pumping includes the following:

- Newhall Land and Farming Company (NLF), which distributes water for outdoor use within its parcels
- Wayside Honor Rancho (WHR) wells, which distribute water to WHR (including the Pitchess Detention Center) for indoor use and further supply water to LACWWD#36
- Robinson Ranch (RR) well, which irrigates a golf course north of the well
- Wells located in Ventura County that are used for domestic and irrigation purposes

The Ventura County wells in GSWIM are associated with the land parcels that contain them, as well as adjacent irrigated land parcels for which no groundwater wells were identified. Each parcel and associated groundwater well defines the service area for each well or group of wells.

Figure 3-49 shows the pumping locations of the Upper Basin Water Purveyors and their service area boundaries, along with other WSS wells and their service area boundaries. Service areas can overlap, as seen by NLF boundaries overlapping portions of VWC. Figure 3-50 shows the Warring Water Service wells and the agricultural land parcels of Ventura County. Groundwater pumping data are available for further review upon request.

3.8.6.2 Indoor and Outdoor Water Use

Imported and pumped groundwater received by a WSS are distributed onto the OLF surface, depending on the LUC distributions through time within its service area, after accounting for indoor use. Indoor use rates were set to 0 ft^3/day for all WSSs except those containing wells for which a portion of potable supply is routed to a WRP or WWTP as a result of indoor water use (i.e., municipal and industrial wells). For calibration, this water was numerically treated as an outflow from the WSS, but was returned to the domain as inflow at locations of the domain that represent WRP or WWTP points of discharge. For the Upper Basin Water Purveyors, the fraction of indoor use was computed as the total effluent flow from the Saugus and Valencia WRPs divided by the total potable water supply (locally pumped groundwater plus imported water). Annual indoor use fractions are shown in Table 3-30 for reference. Monthly fractions were applied to the potable water supply and the computed volume of water was numerically removed from the total supply to the Upper Basin Water Purveyors. The remaining supply was applied to the OLF domain in the respective service areas (i.e., as outdoor use).

Indoor use fractions and related flows were similarly computed for the Warring Water Service wells in relation to Piru WWTP (see Table 3-30). The indoor use fractions were applied to the potable water supply and the computed volume of water was numerically removed from the total supply of the Warring Water Service wells, with the remaining supply applied to the OLF domain in the respective parcel (i.e., as outdoor use).

Water was returned to the OLF domain according to the LUC distributions within each WSS at any given time, and the outdoor duty factor for each LUC (DF_{LUC}). The duty factor is the applied water demand per unit area of a LUC. The DF_{LUC} value was first multiplied by the area of each LUC within each WSS service area boundary ($A_{LUC,WSS}$) at any given time, to give the volumetric water need per day ($VN_{LUC,WSS}$) by each LUC for that WSS at that time, as follows:

$$VN_{LUC,WSS} = DF_{LUC} \times A_{LUC,WSS} \qquad (3\text{-}1)$$

The total volumetric water need ($VN_{TOT,WSS}$) of the WSS was calculated as the sum of VN_{LUC} over all LUCs of the WSS:

$$VN_{TOT,WSS} = \sum \left(VN_{LUC,WSS}\right) \qquad (3\text{-}2)$$

The total supply of a WSS (i.e., local groundwater and imported water) was distributed to the irrigated LUCs according to the ratio of the daily volumetric need of the LUC within the WSS to the total daily volumetric need for the WSS:

$$Q_{LUC,WSS} = S_{WSS} \times \frac{VN_{LUC,WSS}}{VN_{TOT,WSS}} \qquad (3\text{-}3)$$

Where:

$Q_{LUC,WSS}$ = the total supply to a LUC in a WSS

S_{WSS} = the remaining supply of the WSS after accounting for indoor water use (i.e., outdoor supply)

The $Q_{LUC,WSS}$ was further distributed to the OLF grid-blocks (Q_{grid}) according to the following equation:

$$Q_{grid} = \sum \sum \left(Q_{LUC,WSS} \times FTOT_{LUC,GRID,WSS}\right) \text{ over all LUCs and WSSs} \qquad (3\text{-}4)$$

Where:

$FTOT_{LUC,GRID,WSS}$ = the fraction of the total irrigated LUCs at any given time, which are located within grid-blocks of the WSSs combined

The DF_{LUC} was estimated for the LUCs of the GSWIM from applied water requirements as follows. The monthly ETo values over the simulation period (Table 3-31) were first multiplied by the monthly crop coefficients (Kc) for each LUC (Table 3-6) to give a vegetation water demand for that LUC for each month over the calibration period. These values were next divided by an irrigation efficiency (E) to provide the total applied water demand for the LUC. The assumed irrigation efficiencies were 0.90 for LUCs irrigated by drip irrigation (e.g., strawberries, peppers, and nursery crops), 0.80 for LUCs irrigated by sprinklers (e.g., nursery crops, citrus with no ground cover, immature citrus, avocadoes, small vegetables, and grass) and zero for unirrigated lands. Additional assumptions for irrigation efficiency are as follows:

- The average of drip and sprinkler irrigation efficiency values was computed for use with nursery crops (both methods of irrigation are used in the GSWI Study area).
- The average of small vegetables and peppers was computed for the “Truck Crops” LUC.
- The average of citrus with no ground cover, immature citrus, and avocado was computed for the “Citrus and Avocado” LUC.

For residential and commercial land use types, the unpaved area fractions, as listed in Table 3-3, were further used for scaling as follows:

$$DF_{LUC} = \frac{ET_O \times Kc}{E\left(1 - F_{paved}\right)} \tag{3-5}$$

Where:

F_{paved} = the fraction of paved area for residential and commercial LUCs

The total applied water demand for each LUC was finally averaged for each month over all years, to provide a monthly DF_{LUC}. Table 3-32 lists the DF_{LUC} values by LUC.

The area of each LUC within a WSS service area boundary at any given time ($A_{LUC,WSS}$) was computed by summing the respective LUC areas over all grid-blocks within the WSS:

$$A_{LUC,WSS} = \sum A_{LUC,grid} \tag{3-6}$$

The area of an LUC within a grid-block ($A_{LUC,grid}$) was computed as the LUC fraction of the grid-block at that time ($F_{LUC,grid}$) multiplied by the grid-block area (A_{grid}):

$$A_{LUC,grid} = A_{grid} \times F_{LUC,grid} \tag{3-7}$$

The fraction of the LUC for each WSS that lies within every grid-block at any given time ($FTOT_{LUC,grid,WSS}$) is computed as follows for each WSS:

$$FTOT_{LUC,grid,WSS} = \frac{A_{LUC,grid}}{A_{LUC,WSS}} \tag{3-8}$$

3.8.6.3 Diversions

Diversions also function as WSSs in GSWIM in that they extract water from one location and distribute the water for outdoor use at other locations within the domain. There are four diversions within the domain that divert surface water for irrigation: Camulos, Isola, Piru Mutual, and Piru Spreading Grounds. Figure 3-51 shows the sources and destination locations of the diversions. Tables 3-33 through 3-36 list the monthly diversion rates for reference. Constant values for these fluxes reflect the sparsity of data and result from the methodology of filling data gaps, as discussed in Section 5.4.2 of the Task 2A Report (CH2M HILL-HGL, 2006b).

3.8.6.4 Recycled Water

Water recycling in the GSWI Study area began in CY 2003. The application of recycled water is simulated via a WSS, which has input of water from the Valencia WRP effluent and applies that water to Westridge Golf Course within the WSS (see Figure 3-52). Table 3-37 lists the monthly recycled water rates for the calibration period.

TABLE 3-1
Summary of Active GSWIM Grid Nodes
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Model Layer	Number of Active Nodes
CHF	6,176
OLF	22,307
Groundwater Model Layer 1	10,246
Groundwater Model Layer 2	10,246
Groundwater Model Layer 3	10,246
Groundwater Model Layer 4	8,234
Groundwater Model Layer 5	7,564
Groundwater Model Layer 6	3,661
Groundwater Model Layer 7	3,323
Groundwater Model Layer 8	3,011
Groundwater Model Layer 9	2,789
Total	87,803

TABLE 3-2
Calibrated Land Cover Parameter Values by Land Use Code
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

LUC Description	Manning-n[a]	Vertical Leakance (days^{-1})	Obstruction Height (feet)	Cint (feet)
Native Vegetation	0.070	NA	0.500	3.28E-03
Riparian Vegetation	0.070	NA	0.500	4.92E-04
Barren	0.013	NA	0.500	4.92E-04
Vacant	0.013	NA	0.500	4.92E-04
Water	0.030	NA	0.500	4.92E-04
Improved Pasture	0.030	NA	0.200	4.92E-04
Strawberries	0.035	NA	0.700	3.28E-03
Nursery Crops	0.035	NA	0.700	3.28E-03
Truck Crops	0.035	NA	0.700	3.28E-03
Citrus and Avocado	0.150	NA	0.700	3.28E-03
Golf Course	0.030	NA	0.200	4.92E-04
Urban Commercial/Industrial	0.022	1.67E-05	0.278	3.28E-03
Rural Commercial/Industrial	0.027	2.15E-04	0.417	3.28E-03
Urban High-density Residential	0.020	5.15E-06	0.215	3.28E-03
Urban Low-density Residential	0.029	6.80E-04	0.479	3.28E-03
Rural High-density Residential	0.025	8.20E-05	0.364	3.28E-03
Rural Low-density Residential	0.029	6.80E-04	0.479	3.28E-03

[a] Source: Chow, 1959.

Note:

NA = not applicable; vertical leakance values for these land uses are based on the topsoil only, because there is no land cover

TABLE 3-3
Calibrated Manning Friction Coefficient Values for Residential and Commercial Land Use Codes Based on Land Cover Assumptions
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

LUC Description	Definition	Manning-n[a]	Land Cover Assumptions
Urban Commercial/Industrial	Partially irrigated commercial/industrial areas serviced by sewerage systems, such as WWTPs or WRPs. Includes offices, hotels, institutions, schools, businesses, parks, facilities, warehouses, mills, airports, installations, and refineries.	0.013	50.0 percent paved
		0.030	37.5 percent lawn
		0.035	12.5 percent nursery crop
		0.022 (resulting)	100.0 percent total
Rural Commercial/Industrial	Partially irrigated commercial/industrial areas not serviced by sewerage systems (i.e., that use septic tanks). Includes offices, hotels, institutions, schools, businesses, parks, facilities, warehouses, mills, airports, installations, and refineries.	0.013	25.0 percent paved
		0.030	56.3 percent lawn
		0.035	18.7 percent nursery crop
		0.027 (resulting)	100.0 percent total
Urban High-density Residential	Partially irrigated residential areas with multiple units per acre serviced by sewerage systems, such as WWTPs or WRPs.	0.013	61.5 percent paved
		0.030	28.9 percent lawn
		0.035	9.6 percent nursery crop
		0.020 (resulting)	100.0 percent total
Urban Low-density Residential	Partially irrigated residential areas with few units per acre serviced by sewerage systems, such as WWTPs or WRPs.	0.013	13.8 percent paved
		0.030	64.7 percent lawn
		0.035	21.5 percent nursery crop
		0.029 (resulting)	100.0 percent total
Rural High-density Residential	Partially irrigated residential areas with multiple units per acre not serviced by sewerage systems (i.e., that use septic tanks).	0.013	34.4 percent paved
		0.030	49.2 percent lawn
		0.035	16.4 percent nursery crop
		0.025 (resulting)	100.0 percent total
Rural Low-density Residential	Partially irrigated residential areas with few units per acre not serviced by sewerage systems (i.e., that use septic tanks).	0.013	13.8 percent paved
		0.030	64.7 percent lawn
		0.035	21.5 percent nursery crop
		0.029 (resulting)	100.0 percent total

[a] Source: Chow, 1959.

TABLE 3-4
Calibrated Hydraulic Parameters for Unlined, Lined, and Bermed CHF Segments
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Parameter	Unlined	Lined	Bermed
Channel Bottom Elevation	Streambank Elevation minus 2	Streambank Elevation minus 12	Streambank Elevation minus 12
Channel Width (feet)	10 (Mint Creek) 10 (Upper Bouquet Creek) 60 (Hopper Creek) 60 (Pole Creek) 40 (Elsewhere)	100 (Bouquet Creek) 60 (Hopper Creek) 60 (Pole Creek)	80 to 100
Manning-n	0.130	0.013	0.065
Rill Height (feet)	0.20	0.01	0.10
Obstruction Height (feet)	0.500	0.001	0.250
Vertical Leakance (days^{-1})	0.100 to 3.000	0.001	0.005

TABLE 3-5
Calibrated Leaf Area Index Parameter Values by Land Use Code and Month
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

LUC Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Native Vegetation	1.00	1.00	1.00	2.00	2.00	3.00	4.00	4.00	3.00	2.00	1.00	1.00
Riparian Vegetation	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Barren	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vacant	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Water	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Improved Pasture	0.50	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.50
Strawberries	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Nursery Crops	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Truck Crops	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Citrus and Avocado	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Golf Course	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Urban Commercial/Industrial	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Rural Commercial/Industrial	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Urban High-density Residential	0.01	0.01	0.01	0.20	0.40	1.00	1.60	1.80	1.80	0.40	0.01	0.01
Urban Low-density Residential	0.01	0.01	0.01	0.20	0.40	1.00	1.60	1.80	1.80	0.40	0.01	0.01
Rural High-density Residential	0.01	0.01	0.01	0.20	0.40	1.00	1.60	1.80	1.80	0.40	0.01	0.01
Rural Low-density Residential	0.01	0.01	0.01	0.20	0.40	1.00	1.60	1.80	1.80	0.40	0.01	0.01

TABLE 3-6
Calibrated Crop Coefficient Parameter Values by Land Use Code and Month
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

LUC Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Native Vegetation	1.10	0.60	0.60	0.77	0.92	0.93	0.92	0.94	0.91	0.78	0.68	0.85
Riparian Vegetation	1.10	0.60	0.60	0.77	0.92	0.93	0.92	0.94	0.91	0.78	0.68	0.85
Barren	1.10	0.60	0.60	0.77	0.92	0.93	0.92	0.94	0.91	0.78	0.68	0.85
Vacant	1.10	0.60	0.60	0.77	0.92	0.93	0.92	0.94	0.91	0.78	0.68	0.85
Water	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Improved Pasture[a]	1.10	0.60	0.60	0.77	0.92	0.93	0.92	0.94	0.91	0.78	0.68	0.85
Strawberries[a]	1.10	0.36	0.39	0.24	0.35	0.89	0.90	0.37	0.05	0.19	0.46	0.86
Nursery Crops[a]	1.08	0.36	0.30	0.45	0.80	0.85	0.85	0.86	0.82	0.64	0.44	0.86
Truck Crops[a]	1.11	0.51	0.64	0.89	0.43	0.52	0.42	0.16	0.20	0.42	0.74	0.97
Citrus and Avocado[a]	1.10	0.64	0.54	0.58	0.67	0.68	0.66	0.69	0.68	0.72	0.68	0.99
Golf Course[a]	1.10	0.60	0.60	0.77	0.92	0.93	0.92	0.94	0.91	0.78	0.68	0.85
Urban Commercial/Industrial	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Rural Commercial/Industrial	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Urban High-density Residential	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Urban Low-density Residential	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Rural High-density Residential	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Rural Low-density Residential	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10

[a] Computed according to *California Crop and Soil Evapotr8anspiration* (Irrigation Training and Research Center [ITRC] (2003) and tables located at http://www.itrc.org/etdata/waterbal.htm.

TABLE 3-7
Calibrated Evapotranspiration Parameter Values by Hydrologic Soil Group
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Parameter	HSG-A	HSG-B	HSG-C	HSG-D
Water Suction at Field Capacity	5 feet	5 feet	5 feet	5 feet
Field Capacity Moisture Content (Saturation)	0.105 (0.255)	0.211 (0.492)	0.200 (0.514)	0.298 (0.662)
Water Suction at Wilting Point	25 feet	25 feet	25 feet	25 feet
Wilting Point Moisture Content (Saturation)	0.074 (0.181)	0.133 (0.310)	0.147 (0.377)	0.192 (0.428)
Root Zone Distribution: Model Layer 1	0.75	0.75	0.68	0.68
Root Zone Distribution: Model Layer 2	0.15	0.20	0.22	0.22
Root Zone Distribution: Model Layer 3	0.10	0.05	0.10	0.10

TABLE 3-8
Calibrated Classification of Vertical Hydraulic Conductivity to Hydrologic Soil Group in Model Layers 1 though 3
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Model Layer	HSG-A	HSG-B	HSG-C	HSG-D
1	1.271	1.443	0.775	0.269
2	2.625	2.625	2.603	2.600
3	1.837	1.837	1.083	1.083

Note:
Units are feet per day.

TABLE 3-9
Calibrated Unsaturated Moisture Property Values by Hydrologic Soil Group
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

HSG	Soil Classification System Texture Classification	van Genuchten Alpha Parameter[a,b] (feet^{-1})	van Genuchten Beta Parameter[a,b]	van Genuchten Residual Saturation[a,b]	Total Porosity[a,b]
A	Sandy loam	2.25	1.89	0.158	0.41 or 0.45
B	Loam	1.08	1.56	0.181	0.43
C	Sandy clay loam	1.77	1.48	0.256	0.39
D	Silt loam	0.6	1.41	0.149	0.45

[a] Mean values from “Characterizing the Uncertainty of Pesticide Movement in Agriculture Soils” (Carsel et al., 1988).

[b] Source: van Genuchten, 1976.

TABLE 3-10
Calibrated Chloride Transport Parameter Values
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Parameter	Value
Decay Coefficient	0
Adsorption Coefficient	0
Horizontal Longitudinal Dispersivity	100 feet
Horizontal Transverse Dispersivity	10 feet
Vertical Longitudinal Dispersivity	10 feet
Vertical Transverse Dispersivity	1 foot
Porosity for Model Layers 1 and 2	0.39 to 0.45[a]
Specific Yield for Model Layer 3	0.06 to 0.32[b]
Porosity for Model Layers 4 through 9	0.1

[a] See Table 3-9 and Figure 3-25 for spatial distribution of porosity.

[b] See Figure 3-39 for spatial distribution of specific yield.

TABLE 3-11
Summary of Boundary Conditions Used in Calibration Simulation
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Hydrologic Process	Specified-head Boundary	Specified-flux Boundary	Head-dependent Flux Boundary	Inflow Solute Concentration Boundary
Stream Inflow at Lang Stream Gage		X		X
Groundwater Inflow at Lang Stream Gage		X		X
Dam Underflow		X		X
Precipitation		X		X
ET			X	
Applied Water		X[b]		X[b,c]
Industrial Point-source Discharges		X		X
Reservoir Releases and Spills		X		X
Imported Water		X[b]		X[b,c]
Groundwater Pumping		X[b]		X[b,c]
Surface-water Diversions		X[b]		X[b,c]
Discharges to Septic Systems		X		X
Stream Outflow at A Street Bridge	X[a]			
Groundwater Outflow at A Street Bridge	X			

[a] More specifically, a zero-depth gradient boundary condition.

[b] Included in a WSS.

[c] Concentrations computed internally by GSWIM as part of the numerical solution.

Note:

No-flow boundaries were simulated at lateral boundaries of surface and active subsurface grid-blocks and below the bottom-most model layer.

TABLE 3-12
Summary of Revisions to Precipitation Data during Calibration
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Modified Precipitation Zone	Precipitation Zone Data Used
South Fork Area		
1991	32c, 1262, 200, 1040, 1012b, 446, al301	al301
1992	32c, 1262, 200, 1040, 1012b, 446, al301	446
1993	32c, 1262, 200, 1040, 1012b, 446, al301	al301
1994 through 1999	32c, 1262, 200, 1040, 1012b, 446, al301	446
2000	32c, 1262, 200, 1040, 1012b, 446, al301	1262
2001	32c, 1262, 200, 1040, 1012b, 446, al301	446
Hopper Creek Area		
1975 through 2005	Eastern portion of 224a	94c
1975 through 2005	Western portion of 36a and 160	94c
Bouquet Canyon Area		
1975 through 2005	1104c	Zone representing 1104c was revised; precipitation data for 1104c were revised as 80 percent of precipitation values from 125b
Mint Canyon Area		
1975 through 2005	1005b	Zone representing 1005b was revised; average of al402 and 1005b used
1983	1005b	125b
1993	1005b	125b

TABLE 3-13

Monthly Cumulative Streamflow at Lang

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	53	90	228	181	104	31	15	3	0	0	0	0	704
1976	0	111	63	39	33	12	0	0	1	0	0	0	259
1977	28	7	28	19	60	5	0	0	0	47	491	926	1,610
1978	1,491	12,363	4,153	965	391	159	49	105	148	279	426	884	21,412
1979	1,083	1,429	1,121	748	182	123	12	0	27	90	120	558	5,492
1980	1,310	7,446	1,213	568	218	78	6	0	0	0	36	48	10,924
1981	157	416	528	388	154	81	20	3	5	159	218	444	2,571
1982	465	836	718	573	151	109	16	38	75	364	530	838	4,712
1983	967	16,566	5,593	1,251	472	227	306	375	438	248	382	304	27,129
1984	246	65	68	25	4	4	0	9	17	102	647	830	2,018
1985	686	271	234	94	37	26	4	20	59	257	314	418	2,419
1986	604	929	810	484	186	80	29	23	35	113	169	259	3,723
1987	267	311	222	180	100	71	22	19	289	519	637	556	3,192
1988	553	431	449	393	278	94	74	35	12	74	94	77	2,566
1989	15	273	345	286	57	57	6	63	102	94	34	18	1,350
1990	5	0	0	9	12	10	11	14	10	29	38	147	286
1991	297	955	1,028	766	175	163	38	20	49	73	276	547	4,386
1992	573	645	562	474	132	98	17	5	108	144	498	1,446	4,700
1993	14,704	5,335	1,194	530	239	110	54	10	64	118	228	1,016	23,601
1994	1,483	13,753	1,431	1,119	431	236	81	15	43	103	193	176	19,062
1995	110	31	19	2	0	0	0	0	0	0	27	189	378
1996	666	896	730	314	151	46	7	0	0	85	252	502	3,649
1997	505	345	140	85	33	5	4	50	66	239	566	808	2,846
1998	18,991	8,543	3,838	963	667	347	81	91	70	146	199	311	34,248
1999	249	217	230	250	200	107	80	46	52	54	31	80	1,595
2000	302	458	511	333	214	57	55	41	68	71	65	255	2,430
2001	800	1,058	858	417	219	67	27	9	34	152	267	315	4,223
2002	235	46	0	0	0	0	0	0	0	0	0	0	281
2003	0	404	226	349	109	0	0	0	0	0	0	0	1,087
2004	0	30	0	0	0	0	0	0	0	25	0	1,513	1,569
2005	13,750	11,074	6,300	2,426	1,484	738	334	122	78	384	328	0	37,018

Note:

Units are acre-feet.

TABLE 3-14
Monthly Cumulative Groundwater Inflow at Lang
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total**
1975	15	25	63	50	29	9	4	1	0	0	0	0	195
1976	0	31	17	11	9	3	0	0	0	0	0	0	72
1977	8	2	8	5	17	1	0	0	0	13	136	256	446
1978	413	3,423	1,150	267	108	44	14	29	41	77	118	245	5,929
1979	300	396	310	207	50	34	3	0	7	25	33	154	1,521
1980	363	2,062	336	157	60	22	2	0	0	0	10	13	3,025
1981	43	115	146	107	43	22	5	1	1	44	60	123	712
1982	129	231	199	159	42	30	4	11	21	101	147	232	1,305
1983	268	4,587	1,549	346	131	63	85	104	121	69	106	84	7,512
1984	68	18	19	7	1	1	0	2	5	28	179	230	559
1985	190	75	65	26	10	7	1	6	16	71	87	116	670
1986	167	257	224	134	51	22	8	6	10	31	47	72	1,031
1987	74	86	61	50	28	20	6	5	80	144	176	154	884
1988	153	119	124	109	77	26	21	10	3	21	26	21	710
1989	4	76	95	79	16	16	2	17	28	26	9	5	374
1990	1	0	0	2	3	3	3	4	3	8	11	41	79
1991	82	264	285	212	48	45	11	6	14	20	76	152	1,214
1992	159	179	156	131	36	27	5	1	30	40	138	400	1,302
1993	4,072	1,477	331	147	66	30	15	3	18	33	63	281	6,535
1994	411	3,808	396	310	119	65	22	4	12	28	53	49	5,278
1995	30	9	5	0	0	0	0	0	0	0	7	52	105
1996	184	248	202	87	42	13	2	0	0	24	70	139	1,010
1997	140	96	39	23	9	1	1	14	18	66	157	224	788
1998	5,259	2,365	1,063	267	185	96	22	25	19	40	55	86	9,483
1999	69	60	64	69	55	30	22	13	14	15	9	22	442
2000	84	127	141	92	59	16	15	11	19	20	18	71	673
2001	222	293	238	115	61	18	8	3	9	42	74	87	1,169
2002	65	13	0	0	0	0	0	0	0	0	0	0	78
2003	0	112	62	97	30	0	0	0	0	0	0	0	301
2004	0	8	0	0	0	0	0	0	0	7	0	419	434
2005	3,807	3,066	1,744	672	411	204	92	34	22	106	91	0	10,250

Notes:

Units are acre-feet.

Values were computed via a linear relationship with stream inflow at Lang, so that the average groundwater inflow at Lang over the calibration period equals approximately 2,000 acre-ft/yr.

TABLE 3-15
Monthly Release Volumes from Bouquet Reservoir
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	2	2	0	60	61	135	275	306	289	218	44	0	1,392
1976	0	0	0	29	30	29	58	90	342	213	58	4	853
1977	0	0	0	0	30	179	117	143	183	61	59	18	790
1978	0	0	0	69	613	591	609	609	583	613	243	63	3,993
1979	62	55	62	296	307	297	308	309	297	63	60	62	2,178
1980	61	38	24	296	310	298	298	370	357	63	60	62	2,237
1981	62	56	61	403	516	300	309	308	298	55	69	63	2,500
1982	64	60	66	292	311	298	309	309	299	58	61	65	2,193
1983	64	58	64	205	337	327	333	332	300	70	68	65	2,222
1984	61	59	63	298	311	300	308	308	301	63	60	61	2,192
1985	61	56	62	298	310	299	310	309	308	65	63	67	2,209
1986	64	57	63	299	308	301	310	310	304	71	64	63	2,214
1987	67	62	71	301	311	298	312	309	302	65	63	64	2,226
1988	65	58	63	304	318	305	311	311	303	62	62	63	2,225
1989	65	59	62	299	314	302	310	312	300	98	64	63	2,248
1990	69	58	65	305	313	299	311	314	299	67	66	65	2,232
1991	66	59	69	304	315	305	311	313	305	71	64	67	2,248
1992	65	61	65	296	307	298	305	302	290	59	60	61	2,170
1993	60	57	60	290	306	292	312	308	302	63	60	63	2,174
1994	57	57	59	272	308	294	306	299	297	94	61	64	2,169
1995	60	54	60	295	306	298	306	309	297	69	59	62	2,176
1996	64	57	63	298	307	300	306	307	298	61	59	1	2,121
1997	61	55	65	297	307	297	307	305	297	81	61	63	2,197
1998	63	57	63	128	308	297	305	306	299	244	58	60	2,188
1999	62	56	61	294	308	297	306	306	295	68	61	62	2,176
2000	62	58	71	283	307	299	308	306	295	67	57	60	2,173
2001	61	57	65	293	319	288	307	306	296	64	61	63	2,180
2002	62	56	63	295	308	297	307	307	254	59	58	61	2,128
2003	59	55	65	297	307	297	307	307	293	61	59	61	2,170
2004	61	57	61	285	307	297	307	307	297	65	174	236	2,456
2005	21	26	1	54	64	60	111	122	119	95	62	62	797

Note:
Units are acre-feet.

TABLE 3-16

Monthly Release Volumes from Castaic Lagoon to Castaic Creek

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	1,335	4,493	10,410	5,793	491	0	3,300	0	4,648	30,470
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	1,998	1,692	2,686	3,767	1,243	2,822	408	55	20	0	0	0	14,691
1981	0	949	2,685	506	66	0	0	0	0	0	0	0	4,205
1982	0	0	1,892	4,102	1,732	0	0	0	0	0	0	242	7,968
1983	178	0	53,377	6,803	2,452	0	0	199	0	0	235	4,026	67,270
1984	1,781	987	1,743	1,957	360	105	0	0	0	0	0	0	6,933
1985	0	0	0	0	0	0	0	0	0	0	0	428	428
1986	1,203	283	35	1,090	184	0	0	0	0	0	0	0	2,795
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	365	544	809	341	900	0	0	0	0	0	0	0	2,960
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	65	65
1992	0	11,996	580	3,052	667	127	24	0	0	0	0	0	16,446
1993	0	139	13,307	3,031	1,901	635	341	337	774	0	0	341	20,806
1994	210	53	7	2,979	93	0	0	0	0	0	0	0	3,342
1995	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611
1996	0	0	0	4,961	671	0	0	0	0	0	0	0	5,632
1997	0	0	8,701	873	0	0	0	0	0	0	0	310	9,885
1998	1,186	19,545	10,747	4,566	7,561	186	1,370	436	464	302	652	926	47,942
1999	612	691	0	3,187	1,191	149	0	0	0	0	0	0	5,830
2000	0	660	855	0	2,087	3,484	0	0	0	0	0	0	7,086
2001	0	389	1,218	867	222	0	0	0	0	0	0	0	2,696
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	2,286	418	315	0	0	0	0	0	0	3,019
2004	0	59	1,004	0	0	0	0	0	0	0	0	60	1,122
2005	32,392	37,514	12,994	3,614	2,891	90	1,657	32	0	0	0	0	91,184

Note:
Units are acre-feet.

TABLE 3-17
Monthly Release Volumes from Lake Piru
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	158	233	268	880	2,247	1,962	11,366	1,703	528	592	494	435	20,866
1976	387	110	136	443	2,117	2,124	463	420	417	5,131	399	403	12,551
1977	269	193	277	316	329	338	398	318	470	478	445	241	4,072
1978	0	601	1,352	6	4,104	11,041	7,887	7,506	3,785	12,697	6,421	3,834	59,233
1979	145	129	1,840	189	293	4,420	5,439	15,440	17,523	6,929	601	547	53,496
1980	170	1,878	4,332	6,496	5,068	3,590	3,517	16,069	12,489	9,522	2,460	1,048	66,638
1981	2,426	448	513	636	946	1,978	8,379	11,107	13,479	4,844	714	358	45,827
1982	263	253	288	282	334	331	411	19,781	6,983	377	354	366	30,023
1983	276	3	10	5	0	89	252	307	3,051	4,671	4,519	3,182	16,365
1984	3,473	7,060	6,931	3,366	2,670	5,370	11,136	10,741	11,941	3,350	562	334	66,933
1985	76	148	217	284	379	429	362	444	16,257	2,249	306	318	21,470
1986	315	279	285	245	272	818	16,670	296	287	256	278	287	20,290
1987	314	267	273	303	314	14,357	11,318	3,567	667	425	288	242	32,335
1988	268	373	375	419	13,796	5,981	763	609	519	496	507	305	24,411
1989	276	205	372	629	6,285	334	420	363	338	385	397	398	10,403
1990	364	311	475	1,055	375	409	416	382	288	294	327	288	4,984
1991	180	170	2,416	239	5,299	3,099	292	242	257	20,400	5,248	382	38,225
1992	441	1,239	3,471	5,099	5,897	2,161	360	394	7,074	27,400	19,237	3,129	75,902
1993	1,706	5,290	5,901	5,847	5,125	4,400	2,053	6,350	13,364	17,376	9,640	2,025	79,078
1994	5,328	552	551	282	324	1,136	256	4,468	11,221	9,581	6,204	5,506	45,411
1995	3,252	5,778	8,109	5,756	5,576	3,682	8,631	13,274	12,860	13,582	8,452	607	89,558
1996	225	162	303	284	312	315	277	813	7,516	8,099	3,198	698	22,203
1997	529	301	326	305	326	335	1,136	11,743	10,275	11,477	1,515	358	38,626
1998	366	7,708	8,567	5,864	6,213	5,155	1,313	1,312	7,300	12,927	10,809	8,451	75,985
1999	1,399	278	320	305	298	336	323	347	11,431	9,813	545	298	25,693
2000	279	277	338	279	262	312	380	386	20,126	21,133	8,105	450	52,327
2001	492	415	1,951	4,521	748	2,787	1,355	300	22,470	21,415	6,421	459	63,335
2002	413	379	588	589	589	643	578	338	20,159	776	256	261	25,568
2003	337	293	342	331	333	321	355	314	20,796	8,494	458	275	32,651
2004	307	329	287	296	308	290	272	233	229	12,931	333	343	16,159
2005	700	2,414	18,894	8,050	9,896	4,705	8,311	3,530	14,201	6,833	316	414	78,264

Note:
Units are acre-feet.

TABLE 3-18
Monthly Spill Volumes from Lake Piru
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	36,945	16,324	5,531	0	0	0	0	0	0	0	58,800
1979	0	0	0	16,444	7,672	797	0	0	0	0	0	0	24,912
1980	0	19,413	31,789	0	0	0	0	0	0	0	0	0	51,202
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	837	0	0	0	0	837
1984	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	769	1,455	0	0	0	0	0	0	0	0	2,224
1993	0	29,895	17,471	6,715	2,100	0	0	0	0	0	0	0	56,180
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	624	7,126	0	0	0	0	0	0	0	0	0	7,750
1996	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	28,445	6,070	10,789	2,495	0	0	0	0	0	0	0	47,798
1999	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	790	0	0	0	0	0	0	0	790
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	25,600	70,660	10,809	1,662	0	0	0	0	0	0	0	0	108,732

Note:
Units are acre-feet.

TABLE 3-19
Simulated Chloride Concentrations in Septic System Discharge
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

Subarea	Discharge (mgd)	Chloride Concentration (mg/L)
SCR Reach 4	0.147	154.40
SCR Reach 5	0.243	151.87
SCR Reach 6	0.206	115.50
SCR Reach 7	0.371	134.81

Note:
mgd = million gallons per day

TABLE 3-20
Annual Flow from Surface Industrial Point-source Discharges
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	City of Santa Clarita	Keysor Century Corporation	Saugus WRP	Six Flags Magic Mountain, Inc.	Texaco Trading and Transportation, Inc.	Valencia WRP	Val Verde County Park Swimming Pool
1975	0.00	106.41	3,630.83	111.65	52.41	1,905.47	0.56
1976	0.00	106.70	3,435.66	111.96	52.56	2,646.99	0.56
1977	0.00	106.41	3,294.42	111.65	52.41	2,724.77	0.56
1978	0.00	106.41	4,137.58	111.65	52.41	2,838.38	0.56
1979	0.00	106.41	4,402.51	111.65	52.41	2,974.30	0.56
1980	0.00	106.70	4,533.79	111.96	52.56	2,862.26	0.56
1981	0.00	106.41	4,944.12	111.65	52.41	3,003.82	0.56
1982	0.00	106.41	5,194.96	111.65	52.41	3,249.60	0.56
1983	0.00	106.41	5,987.56	111.65	52.41	3,432.71	0.56
1984	0.00	106.70	5,798.65	111.96	52.56	3,718.39	0.56
1985	0.00	106.41	5,611.02	111.65	52.41	4,005.16	0.56
1986	0.00	106.41	6,019.92	111.65	52.41	4,800.71	0.56
1987	0.00	106.41	5,263.02	111.65	52.41	6,580.60	0.56
1988	0.00	106.70	5,278.75	111.96	52.56	7,050.80	0.56
1989	0.00	106.41	5,467.38	111.65	52.41	8,093.03	0.42
1990	0.00	106.41	5,716.97	111.65	52.41	8,288.86	0.11
1991	99.93	106.41	5,848.58	111.65	52.41	8,273.95	0.11
1992	100.21	106.70	5,913.48	111.96	52.56	9,746.14	0.11
1993	128.91	106.41	7,073.71	111.65	50.69	10,133.97	0.11
1994	107.53	106.41	7,815.70	111.65	18.38	9,203.86	0.11
1995	86.14	106.41	7,600.44	111.65	81.07	10,223.31	0.11
1996	64.93	106.70	6,355.85	111.96	90.13	10,425.43	0.11
1997	43.37	106.41	5,909.92	111.65	52.48	9,865.42	0.11
1998	21.98	106.41	6,164.73	111.65	43.11	11,526.95	0.11
1999	53.96	106.41	6,290.53	111.65	46.29	11,692.52	0.11
2000	54.11	106.70	6,138.55	111.96	40.30	12,529.28	0.11
2001	53.96	106.41	6,347.15	111.71	41.73	12,568.70	0.11
2002	53.96	106.41	6,312.29	86.24	42.49	13,835.96	0.00
2003	53.96	0.00	4,594.15	86.24	42.49	15,602.80	0.00
2004	40.08	0.00	4,520.76	86.47	42.61	15,675.84	0.00
2005	89.94	0.00	4,691.91	86.24	42.49	18,130.22	0.00

Note:
Units are acre-feet.

TABLE 3-21

Annual Flow from Subsurface Industrial Point-source Discharges

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	College of the Canyon	Mobile Oil Newhall Station	Mobile SS#11	Mobile SS#18	Piru WWTP	Truck and RV Sales	Veterans of Foreign Wars	H.R. Textron Valencia Facility	Trans Technology Corp.
1975	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1976	1.1	168.5	6.7	0.1	77.3	0.2	0.2	5.1	235.9
1977	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1978	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1979	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1980	1.1	168.5	6.7	0.1	77.3	0.2	0.2	5.1	235.9
1981	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1982	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1983	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1984	1.1	168.5	6.7	0.1	77.3	0.2	0.2	5.1	235.9
1985	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1986	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.0	235.2
1987	1.1	168.0	6.7	0.1	77.3	0.2	0.2	5.1	235.2
1988	1.1	168.5	6.7	0.1	98.5	0.2	0.2	5.0	235.9
1989	1.1	168.0	6.7	0.1	113.2	0.2	0.2	5.0	235.2
1990	1.1	168.0	6.7	0.1	122.8	0.2	0.2	5.0	235.2
1991	1.1	168.0	6.7	0.1	119.0	0.2	0.2	5.1	235.2
1992	1.1	168.5	6.7	0.1	137.1	0.2	0.2	5.0	235.9
1993	1.1	168.0	6.7	0.1	131.5	0.2	0.2	5.0	235.2
1994	1.1	168.0	6.7	0.1	134.1	0.2	0.2	5.0	235.2
1995	1.1	168.0	6.7	0.1	172.1	0.2	0.2	5.1	235.2
1996	1.1	168.5	6.7	0.1	171.4	0.2	0.2	5.0	235.9
1997	1.1	168.0	6.7	0.1	140.1	0.2	0.2	5.0	235.2
1998	1.1	168.0	6.7	0.1	117.7	0.2	0.2	5.0	235.2
1999	1.1	168.0	6.7	0.1	127.3	0.2	0.2	5.1	235.2
2000	0.8	168.5	6.7	0.1	146.8	0.2	0.2	5.0	235.9
2001	0.0	168.0	6.7	0.1	184.7	0.2	0.2	5.0	235.2
2002	0.0	168.0	6.7	0.1	254.4	0.2	0.2	5.0	235.2
2003	0.0	168.0	6.7	0.1	254.1	0.2	0.2	5.1	235.2
2004	0.0	168.5	6.7	0.1	252.2	0.2	0.2	5.0	235.9
2005	0.0	168.0	6.7	0.1	255.1	0.2	0.2	5.0	235.2

Note:

Units are acre-feet.

TABLE 3-22

Monthly Average Wet Deposition Chloride Concentrations

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1976	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1977	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1978	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1979	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1980	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1981	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1982	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
1983	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.06	0.11	0.10	0.07	0.41
1984	1.50	1.10	0.24	0.24	0.28	0.85	0.18	0.26	0.33	0.19	0.13	0.10	0.45
1985	0.13	0.21	0.32	0.38	0.35	0.85	0.56	0.41	0.60	0.39	0.05	0.15	0.37
1986	0.02	0.24	0.12	0.31	0.57	0.85	0.54	0.51	0.23	0.62	0.02	0.18	0.35
1987	0.05	0.23	0.19	0.20	0.14	0.85	0.31	0.41	0.47	0.06	0.11	0.08	0.26
1988	0.12	0.37	0.69	0.08	0.62	0.92	0.54	0.45	0.39	0.18	0.14	0.20	0.39
1989	0.10	0.04	0.19	0.28	0.38	0.85	0.54	0.41	0.11	0.13	0.28	0.27	0.30
1990	0.28	0.14	0.45	0.27	0.10	0.34	0.54	0.41	0.49	0.21	0.14	0.36	0.31
1991	0.03	0.17	0.09	0.31	0.52	0.18	0.54	0.41	0.52	0.10	0.18	0.16	0.27
1992	0.08	0.08	0.18	1.57	0.13	0.85	0.07	0.41	0.21	0.09	0.26	0.07	0.33
1993	0.22	0.19	0.05	1.57	0.11	0.42	0.54	0.41	0.41	0.21	0.07	0.13	0.36
1994	0.25	0.03	0.11	0.17	0.07	0.85	0.54	0.41	0.14	0.21	0.18	0.22	0.26
1995	0.04	0.02	0.06	0.19	0.12	0.85	0.54	0.41	0.41	0.32	0.18	0.21	0.28
1996	0.18	0.13	0.63	2.40	0.28	0.65	0.54	0.41	0.41	0.07	0.31	1.24	0.60
1997	0.44	2.23	0.26	14.05	0.28	2.60	1.60	0.41	1.42	0.21	0.60	0.72	2.07
1998	0.16	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.46
1999	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
2000	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
2001	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
2002	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
2003	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
2004	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47
2005	0.24	0.37	0.26	1.57	0.28	0.85	0.54	0.41	0.41	0.21	0.18	0.27	0.47

Note:

Units are mg/L.

TABLE 3-23

Monthly Average Dry Deposition Chloride Concentrations

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1976	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1977	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1978	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1979	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1980	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1981	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1982	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1983	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1984	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1985	0.10	0.14	0.14	0.15	0.12	0.09	0.07	0.07	0.09	0.12	0.11	0.09	0.11
1986	0.06	0.06	0.41	0.20	0.16	0.06	0.06	0.06	0.11	0.06	0.11	0.06	0.12
1987	0.06	0.23	0.22	0.32	0.09	0.06	0.06	0.06	0.06	0.06	0.08	0.20	0.13
1988	0.13	0.08	0.20	0.23	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.09
1989	0.06	0.06	0.06	0.06	0.06	0.08	0.06	0.06	0.18	0.12	0.15	0.19	0.09
1990	0.16	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
1991	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
1992	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
1993	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
1994	0.06	0.11	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.56	0.13	0.06	0.11
1995	0.22	0.06	0.30	0.24	0.06	0.25	0.06	0.06	0.12	0.09	0.09	0.09	0.14
1996	0.13	0.09	0.30	0.08	0.10	0.06	0.06	0.06	0.06	0.10	0.13	0.13	0.11
1997	0.06	0.07	0.07	0.22	0.06	0.06	0.06	0.06	0.06	0.12	0.10	0.06	0.08
1998	0.16	0.53	0.06	0.06	0.17	0.06	0.06	0.06	0.07	0.06	0.14	0.06	0.12
1999	0.06	0.06	0.07	0.29	0.50	0.06	0.11	0.08	0.06	0.10	0.06	0.07	0.13
2000	0.08	0.42	0.06	0.15	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.10
2001	0.06	0.06	0.06	0.25	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.10	0.08
2002	0.07	0.06	0.06	0.08	0.21	0.06	0.06	0.06	0.06	0.06	0.21	0.06	0.09
2003	0.06	0.25	0.18	0.13	0.24	0.06	0.06	0.06	0.06	0.19	0.22	0.13	0.14
2004	0.08	0.17	0.18	0.11	0.06	0.06	0.08	0.06	0.09	0.08	0.06	0.06	0.09
2005	0.06	0.07	0.06	0.08	0.08	0.18	0.07	0.06	0.24	0.17	0.17	0.06	0.11

Note:

Units are nanograms per liter of air.

TABLE 3-24
Monthly Chloride Concentrations for Bouquet Reservoir
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	55	55	55	55	55	55	56	56	56	56	56	56	56
1976	57	57	57	57	58	59	60	61	62	63	64	65	60
1977	66	67	67	68	68	67	65	63	62	60	58	57	64
1978	55	54	52	50	50	50	50	51	51	51	51	51	51
1979	52	52	52	52	52	52	53	53	53	53	53	53	53
1980	54	54	54	53	53	52	51	50	50	49	48	47	51
1981	46	46	45	46	46	47	48	48	49	50	50	51	48
1982	52	52	53	53	53	53	53	54	54	54	54	54	53
1983	54	54	54	54	54	55	55	55	55	55	55	55	55
1984	55	55	55	56	56	56	56	56	56	56	56	56	56
1985	57	57	57	57	57	57	57	57	57	57	58	58	57
1986	58	58	58	58	58	57	57	57	56	56	56	56	57
1987	55	55	55	55	56	56	56	57	57	57	58	58	56
1988	58	59	59	59	60	60	59	59	58	57	56	56	58
1989	55	54	52	52	52	53	53	53	53	54	54	54	53
1990	54	54	55	55	55	55	56	56	56	56	56	57	55
1991	57	57	57	58	58	58	58	58	59	59	59	59	58
1992	60	60	60	60	60	61	61	61	61	61	61	61	60
1993	61	60	60	60	60	60	60	60	60	60	60	60	60
1994	60	59	59	59	59	59	59	59	59	59	59	59	59
1995	59	59	58	58	58	58	58	58	58	59	59	60	59
1996	60	61	61	62	62	63	63	63	64	64	65	65	63
1997	66	66	67	67	68	68	69	69	69	70	70	71	68
1998	71	72	72	73	73	73	73	73	73	73	73	73	73
1999	73	73	73	73	73	73	73	73	73	73	73	73	73
2000	73	73	73	73	73	73	73	73	73	73	73	73	73
2001	73	73	73	73	73	73	73	74	75	76	77	78	74
2002	79	80	81	82	83	84	85	86	87	88	89	91	85
2003	92	93	94	95	96	97	98	99	100	101	102	103	97
2004	104	105	106	107	108	108	108	108	108	108	108	108	107
2005	108	108	108	108	108	108	108	108	108	108	108	108	108

Notes:

Concentrations were estimated from groundwater chloride concentration data at Well SCWD-Clark, which is located in Bouquet Canyon.

Units are mg/L.

TABLE 3-25
Monthly Chloride Concentrations for Castaic Lagoon
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	45	45	46	46	46	47	47	48	48	51	49	45	47
1976	45	45	43	43	42	43	45	47	47	47	48	47	45
1977	47	46	47	48	48	49	52	54	52	53	51	50	50
1978	52	56	56	52	51	52	55	55	56	55	54	53	54
1979	52	51	53	51	50	51	50	48	52	52	49	48	51
1980	49	49	48	46	46	46	46	46	48	47	46	45	47
1981	45	45	43	44	43	44	44	48	50	50	57	62	48
1982	62	65	67	67	67	68	71	71	69	59	56	55	65
1983	55	53	52	47	46	44	46	44	44	42	38	37	46
1984	38	39	40	40	38	37	36	36	35	35	31	28	36
1985	29	29	30	31	33	34	35	38	40	42	45	51	36
1986	54	58	62	67	65	68	71	72	76	72	69	66	67
1987	65	64	62	59	58	57	58	58	59	59	60	64	60
1988	71	78	81	81	81	81	81	81	81	81	81	81	80
1989	99	118	116	117	119	123	125	122	115	103	93	93	112
1990	95	99	106	108	110	112	112	118	101	101	109	114	107
1991	114	114	114	114	112	110	110	114	119	119	116	113	114
1992	113	111	105	105	103	101	101	107	106	106	106	106	106
1993	106	98	88	88	85	81	81	86	78	78	73	69	84
1994	69	68	68	68	65	62	62	68	68	68	68	68	67
1995	68	67	67	67	67	67	67	62	59	59	57	55	64
1996	55	54	66	59	61	46	50	57	51	52	49	49	54
1997	48	46	47	50	45	44	48	47	51	44	48	51	47
1998	48	53	45	46	45	47	47	45	44	44	43	44	46
1999	42	42	42	42	41	41	41	42	39	41	43	52	42
2000	52	52	58	58	57	60	61	57	58	57	54	58	57
2001	62	66	67	69	69	70	67	72	70	73	78	81	70
2002	83	84	85	86	86	85	79	76	73	74	77	82	81
2003	85	88	93	89	87	82	79	75	69	66	59	60	78
2004	62	67	71	70	70	67	67	66	63	63	65	64	66
2005	66	59	51	49	48	45	45	45	44	44	45	46	49

Notes:
Chloride concentrations in Castaic Lagoon were assumed to be consistent with those in Castaic Lake.
Units are mg/L.

TABLE 3-26
Monthly Average Chloride Concentration from Lake Piru Releases and Spills
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Average**
1975	44	37	37	38	40	40	42	46	46	46	47	48	43
1976	48	44	44	45	46	46	47	54	54	54	54	56	49
1977	56	58	58	59	60	60	62	68	68	68	68	48	61
1978	43	41	29	29	39	40	39	35	35	35	33	28	36
1979	28	31	32	32	33	33	34	35	35	35	35	36	33
1980	36	30	30	30	30	30	31	33	33	33	33	33	32
1981	33	33	33	33	34	34	35	41	41	41	41	43	37
1982	43	43	43	44	45	45	37	23	23	23	23	23	35
1983	23	23	23	23	23	23	23	23	23	23	23	22	23
1984	22	22	22	22	22	22	25	27	27	27	41	58	28
1985	43	27	27	27	27	27	31	36	36	36	36	37	33
1986	41	43	43	45	47	47	51	54	54	54	54	55	49
1987	56	56	56	55	54	54	56	58	58	58	60	61	57
1988	77	68	68	73	77	77	80	83	83	83	86	86	79
1989	87	89	89	90	103	103	104	105	105	105	101	99	98
1990	103	106	105	99	99	101	103	104	110	111	115	117	106
1991	115	112	97	98	93	91	84	83	89	102	104	102	98
1992	80	72	68	66	65	64	66	66	66	64	71	66	68
1993	60	49	49	49	48	46	46	48	55	55	45	45	50
1994	45	45	45	45	45	46	46	47	48	56	59	59	49
1995	51	42	42	41	39	37	36	33	33	32	36	38	38
1996	38	38	35	37	38	37	35	35	33	41	44	40	37
1997	39	39	37	36	36	41	46	46	46	42	43	45	41
1998	41	32	32	32	29	27	27	28	28	28	30	32	31
1999	32	32	32	32	31	31	31	31	31	33	38	38	33
2000	38	38	38	38	38	40	40	43	45	45	44	47	41
2001	46	43	43	43	43	43	48	55	55	55	53	53	48
2002	54	56	56	56	63	63	65	70	70	69	67	67	63
2003	68	69	69	69	68	68	68	68	68	71	77	77	70
2004	77	66	66	66	65	65	65	72	72	72	47	36	64
2005	35	27	27	27	27	28	29	31	31	31	31	31	30

Note:
Units are mg/L.

TABLE 3-27

Monthly Average Chloride Concentrations in Streamflow at the Lang Gage

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	41	38	36	36	38	42	47	50					41
1976		38	40	42	43	47	62		42				45
1977	43	49	44	46	45	48				41	33	31	42
1978	29	24	27	30	33	36	41	38	37	34	33	31	33
1979	30	29	30	31	36	37	47		43	38	37	32	36
1980	30	25	30	32	35	39	50				42	41	36
1981	36	33	32	33	36	39	45	53	51	36	35	33	39
1982	33	31	31	32	37	38	45	42	39	34	32	31	35
1983	31	23	26	30	33	35	34	33	33	35	33	34	32
1984	35	39	39	43	52	52	65	48	45	38	32	31	43
1985	32	34	35	38	42	43	52	45	40	35	34	33	39
1986	32	30	31	33	36	39	43	44	42	38	36	35	36
1987	35	34	35	36	38	39	44	45	34	32	32	32	36
1988	32	33	33	33	34	38	39	42	46	39	38	39	37
1989	46	34	34	34	40	40	50	40	38	38	42	45	40
1990	51	64		48	47	47	47	46	47	43	42	37	47
1991	34	30	30	31	36	36	42	44	41	39	34	32	36
1992	32	32	32	33	37	38	45	51	38	37	32	29	36
1993	23	26	30	32	35	38	40	48	40	37	35	30	35
1994	29	23	29	30	33	35	39	46	41	38	36	36	35
1995	38	42	45	56							43	36	43
1996	32	31	31	34	37	41	49	65		39	35	33	39
1997	33	33	37	39	42	51	52	41	39	35	32	31	39
1998	23	24	27	30	32	34	39	38	39	37	35	34	33
1999	35	35	35	35	36	38	39	41	40	40	42	39	38
2000	34	33	32	34	35	40	40	42	39	39	40	35	37
2001	31	30	31	33	35	39	43	48	42	37	34	34	36
2002	35	36											35
2003		41	40	36	42	61						58	46
2004		31								40		25	32
2005	26	26	26	28	29	31	34	37	39	33	34	75	35

Notes:

Months with no data represent no-flow conditions.

Units are mg/L.

TABLE 3-28
Annual Average Chloride Concentrations from Surface Industrial Point-source Discharges
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	City of Santa Clarita	Keysor Century Corporation	Saugus WRP	Six Flags Magic Mountain, Inc.	Texaco Trading and Transportation, Inc.	Valencia WRP	Val Verde County Park Swimming Pool
1975	0	2	123	199	63	131	303
1976	0	2	122	199	63	149	303
1977	0	2	142	199	63	121	303
1978	0	2	138	199	63	113	303
1979	0	2	125	199	63	130	303
1980	0	2	99	199	63	142	303
1981	0	2	101	199	63	141	303
1982	0	2	111	199	63	151	303
1983	0	2	101	199	63	125	303
1984	0	2	99	199	63	107	303
1985	0	2	98	199	63	96	303
1986	0	2	114	199	63	108	303
1987	0	2	121	199	63	106	303
1988	0	2	142	199	63	143	303
1989	0	2	153	199	63	161	303
1990	0	2	139	199	63	163	341
1991	168	2	127	199	63	142	392
1992	168	2	126	199	63	150	393
1993	168	2	111	199	64	146	392
1994	168	2	117	199	78	146	392
1995	168	2	109	199	61	138	392
1996	168	2	109	199	63	134	393
1997	168	2	115	199	63	138	392
1998	168	2	119	199	64	142	392
1999	168	2	141	199	53	160	392
2000	168	2	151	199	65	167	393
2001	169	3	167	185	56	166	392
2002	172	3	175	199	58	185	412
2003	172	3	173	199	58	198	412
2004	172	3	159	199	58	182	412
2005	172	3	127	199	58	147	412

Note:
Units are mg/L.

TABLE 3-29

Annual Average Chloride Concentrations from Subsurface Industrial Point-source Discharges

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	College of the Canyons	Mobile Oil Newhall Station	Mobile SS#11	Mobile SS#18	Piru WWTP	Truck and RV Sales	Veterans of Foreign Wars	H.R. Textron Valencia Facility	Trans Technology Corp.
1975	169	170	170	48	59	166	166	170	170
1976	169	170	170	48	59	166	166	170	170
1977	169	170	170	48	59	166	166	170	170
1978	169	170	170	48	59	166	166	170	170
1979	169	170	170	48	59	166	166	170	170
1980	169	170	170	48	59	166	166	170	170
1981	169	170	170	48	59	166	166	170	170
1982	169	170	170	48	59	166	166	170	170
1983	169	170	170	48	59	166	166	170	170
1984	169	170	170	48	59	166	166	170	170
1985	169	170	170	48	59	166	166	170	170
1986	169	170	170	48	59	166	166	170	170
1987	169	170	170	48	59	166	166	170	170
1988	169	170	170	48	74	166	166	170	170
1989	169	170	170	48	95	166	166	170	170
1990	169	170	170	48	98	166	166	170	170
1991	169	170	170	48	115	166	166	170	170
1992	169	170	170	48	134	166	166	170	170
1993	169	170	170	48	128	166	166	170	170
1994	169	170	170	48	106	166	166	170	170
1995	169	170	170	48	83	166	166	170	170
1996	169	170	170	48	78	166	166	170	170
1997	169	170	170	48	74	166	166	170	170
1998	169	170	170	48	72	166	166	170	170
1999	169	170	170	48	73	166	166	170	170
2000	169	170	170	49	93	166	166	170	170
2001	169	170	170	51	86	166	166	170	170
2002	169	170	170	57	86	166	166	170	170
2003	169	170	170	57	100	166	166	170	170
2004	169	170	170	57	111	166	166	170	170
2005	169	170	170	57	140	166	166	170	170

Note:

Units are mg/L.

TABLE 3-30
Annual Indoor Water Use Fractions for the Upper Basin Water Purveyors' Water Supply Systems in GSWIM
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

	Indoor Water Use Fraction	
CY	**Saugus and Valencia WRPs**	**Piru WWTP**
1975	0.3303	0.1101
1976	0.3303	0.1101
1977	0.3303	0.1101
1978	0.3303	0.1101
1979	0.3303	0.1101
1980	0.3303	0.1101
1981	0.3208	0.1177
1982	0.3881	0.1405
1983	0.4454	0.1956
1984	0.3505	0.1130
1985	0.3413	0.1112
1986	0.3517	0.1132
1987	0.3538	0.1018
1988	0.3324	0.1188
1989	0.3205	0.1419
1990	0.3295	0.1742
1991	0.3591	0.1829
1992	0.3845	0.2470
1993	0.4011	0.3404
1994	0.3728	0.4312
1995	0.395	0.6601
1996	0.3392	0.3791
1997	0.2959	0.3243
1998	0.3669	0.3521
1999	0.3157	0.2774
2000	0.3111	0.2861
2001	0.3166	0.5363
2002	0.3005	0.5443
2003	0.3167	0.5489
2004	0.2991	0.4258
2005	0.3489	0.4305

TABLE 3-31
Reference Evapotranspiration at Piru #101 Station
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	2.37	2.45	3.46	3.98	5.38	5.71	7.05	6.48	5.75	3.68	2.53	2.44	51.28
1976	2.76	2.71	4.38	4.73	5.96	7.45	7.26	6.95	5.62	4.75	3.50	2.48	58.55
1977	2.31	3.49	3.97	5.10	5.30	6.15	7.69	6.68	5.43	4.33	3.41	2.19	56.05
1978	2.03	2.49	3.71	4.13	7.05	7.09	7.23	6.45	6.02	4.25	2.66	1.96	55.07
1979	1.78	2.39	3.48	5.10	6.00	7.21	7.13	6.48	6.35	4.03	2.86	2.49	55.30
1980	2.03	2.96	3.90	5.28	5.02	6.60	7.44	6.56	4.85	4.25	2.98	2.49	54.36
1981	2.32	3.13	3.77	5.23	6.11	6.59	7.36	6.97	5.64	4.37	2.94	2.33	56.76
1982	2.46	2.80	4.08	5.33	6.11	6.59	7.36	7.11	5.57	4.76	2.70	2.18	57.05
1983	2.65	2.70	3.80	4.84	6.09	5.89	7.93	7.69	5.91	4.76	2.61	2.12	56.99
1984	2.92	3.40	4.92	5.66	7.45	6.57	7.98	7.26	6.79	4.32	2.57	1.85	61.69
1985	2.36	2.95	3.90	5.57	5.88	7.06	8.04	7.12	5.54	4.46	2.42	2.69	57.99
1986	2.84	2.76	4.16	5.39	5.99	6.42	6.93	6.65	4.74	4.37	3.25	2.31	55.81
1987	2.14	2.55	3.76	5.57	5.53	5.50	6.11	5.90	5.12	3.75	2.57	1.57	50.07
1988	2.23	3.24	4.88	4.77	6.44	6.49	7.00	6.34	5.35	4.03	2.68	2.17	55.62
1989	2.48	2.52	4.41	5.84	6.06	6.41	7.24	6.21	5.65	4.23	3.37	2.92	57.34
1990	2.61	2.67	4.08	5.26	6.28	7.00	7.88	6.70	6.10	4.82	3.26	2.34	59.00
1991	2.53	2.80	3.41	5.71	6.19	6.21	7.09	6.93	5.64	4.75	3.10	2.27	56.63
1992	3.62	2.66	2.53	5.89	5.45	6.45	6.96	7.69	6.03	4.40	4.79	2.73	59.20
1993	2.75	2.29	4.86	6.43	7.14	7.86	7.26	7.65	6.47	5.33	4.24	3.67	65.95
1994	4.30	3.56	4.80	5.56	5.20	7.36	7.39	7.44	5.62	5.04	3.86	3.36	63.49
1995	2.51	3.80	4.26	5.16	5.00	6.61	8.47	8.61	6.56	5.17	3.62	2.71	62.48
1996	2.97	2.38	4.12	6.69	7.05	7.37	8.20	7.86	5.77	5.01	3.68	2.59	63.69
1997	2.07	3.47	5.40	6.30	7.61	6.27	7.15	7.38	6.21	5.31	2.73	3.29	63.19
1998	2.02	1.86	3.49	4.95	5.51	6.30	8.35	8.30	4.66	5.22	3.61	3.90	58.17
1999	3.57	3.50	3.91	4.96	5.93	6.96	8.07	7.72	5.63	6.51	3.48	4.53	64.77
2000	2.56	2.27	4.70	5.58	7.14	7.84	8.14	8.03	5.92	3.79	3.65	3.83	63.45
2001	3.10	2.26	3.53	4.06	6.38	7.16	7.07	6.99	6.05	4.42	2.70	2.65	56.37
2002	3.31	4.81	5.29	5.28	7.24	7.85	8.54	7.87	6.96	4.11	4.49	2.36	68.11
2003	4.70	3.18	5.32	4.81	5.94	5.43	8.16	8.96	6.59	5.63	3.19	2.96	64.87
2004	3.41	3.13	5.70	6.36	7.89	7.34	8.39	7.69	6.77	3.99	3.09	3.66	67.42
2005	2.16	2.67	4.05	5.59	6.37	6.12	6.95	6.57	5.49	4.07	3.32	2.19	55.55

Notes:
ETo data are available for download at http://www.cimis.water.ca.gov/cimis/ftonStationDetailData.do?stationId=101.
Units are inches.

TABLE 3-32

Calibrated Water Duty Factor Values by Land Use Code and Month

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

LUC Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Native Vegetation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Riparian Vegetation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Barren	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vacant	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Water	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Improved Pasture	0.319	0.180	0.261	0.429	0.5949	0.650	0.723	0.704	0.552	0.372	0.228	0.238
Strawberries	0.276	0.097	0.152	0.118	0.201	0.553	0.628	0.247	0.027	0.080	0.137	0.214
Nursery Crops	0.288	0.103	0.122	0.235	0.489	0.556	0.626	0.605	0.466	0.288	0.139	0.226
Truck Crops	0.294	0.146	0.269	0.487	0.258	0.321	0.290	0.115	0.117	0.195	0.238	0.256
Citrus and Avocado	0.310	0.192	0.237	0.322	0.432	0.477	0.519	0.520	0.413	0.345	0.229	0.278
Golf Course	0.309	0.180	0.261	0.429	0.594	0.651	0.723	0.704	0.552	0.372	0.228	0.238
Urban Commercial/Industrial	0.154	0.081	0.114	0.192	0.288	0.317	0.354	0.344	0.269	0.178	0.104	0.119
Rural Commercial/Industrial	0.231	0.122	0.171	0.288	0.431	0.476	0.531	0.516	0.404	0.266	0.156	0.179
Urban High-density Residential	0.119	0.063	0.088	0.148	0.222	0.245	0.273	0.265	0.207	0.137	0.080	0.092
Urban Low-density Residential	0.265	0.140	0.197	0.331	0.496	0.547	0.611	0.593	0.464	0.306	0.179	0.205
Rural High-density Residential	0.202	0.107	0.149	0.251	0.377	0.416	0.464	0.451	0.353	0.233	0.136	0.156
Rural Low-density Residential	0.265	0.140	0.197	0.331	0.496	0.547	0.611	0.593	0.464	0.306	0.179	0.205

Note:

Units are feet.

TABLE 3-33

Monthly Flows from the Camulos Ranch Diversion

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1976	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1977	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1978	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1979	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1980	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1981	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1982	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1983	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1984	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1985	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1986	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1987	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1988	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1989	0	0	0	134	139	134	139	139	134	139	134	0	1,091
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	58	56	58	56	58	58	56	58	56	0	515
1993	0	0	88	85	88	85	88	88	85	88	85	0	778
1994	0	0	46	45	46	45	46	46	45	46	45	0	412
1995	0	0	52	50	52	50	52	52	50	52	50	0	460
1996	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	50	49	50	49	50	50	49	50	49	0	447
1999	0	0	0	0	0	29	300	300	290	300	290	300	1,808
2000	0	0	0	0	271	271	280	280	271	280	271	271	2,196
2001	0	0	0	96	373	361	373	373	361	373	276	0	2,585
2002	0	0	0	277	373	361	373	373	361	373	361	156	3,006
2003	0	0	0	0	0	140	288	288	279	288	279	223	1,786
2004	0	0	0	0	0	140	288	288	279	288	279	223	1,786
2005	0	0	0	0	0	140	288	288	279	288	279	223	1,786

Note:
Units are acre-feet.

TABLE 3-34
Monthly Flows from the Isola Diversion
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	0	0	64	62	64	62	64	64	62	64	62	0	567
1976	0	0	64	62	64	62	64	64	62	64	62	0	567
1977	0	0	64	62	64	62	64	64	62	64	62	0	567
1978	0	0	64	62	64	62	64	64	62	64	62	0	567
1979	0	0	64	62	64	62	64	64	62	64	62	0	567
1980	0	0	64	62	64	62	64	64	62	64	62	0	567
1981	0	0	64	62	64	62	64	64	62	64	62	0	567
1982	0	0	64	62	64	62	64	64	62	64	62	0	567
1983	0	0	64	62	64	62	64	64	62	64	62	0	567
1984	0	0	64	62	64	62	64	64	62	64	62	0	567
1985	0	0	64	62	64	62	64	64	62	64	62	0	567
1986	0	0	64	62	64	62	64	64	62	64	62	0	567
1987	0	0	64	62	64	62	64	64	62	64	62	0	567
1988	0	0	64	62	64	62	64	64	62	64	62	0	567
1989	0	0	64	62	64	62	64	64	62	64	62	64	630
1990	0	0	33	62	64	62	64	64	62	64	62	64	600
1991	0	0	33	62	64	62	64	64	62	64	62	64	600
1992	0	0	33	62	64	62	64	64	62	64	62	64	600
1993	11	0	12	16	26	24	27	40	44	34	31	8	273
1994	0	8	2	11	36	42	36	36	30	9	4	2	216
1995	1	0	1	0	0	0	8	28	29	0	0	0	67
1996	0	0	0	0	0	0	53	103	105	113	53	38	465
1997	15	0	0	0	57	48	48	76	61	97	98	0	500
1998	0	0	0	0	0	0	0	0	18	111	131	57	317
1999	0	0	0	0	0	0	84	93	88	96	78	87	526
2000	56	0	0	0	0	0	65	117	127	128	129	83	705
2001	80	0	0	0	0	24	109	116	102	87	70	0	588
2002	0	0	0	0	27	72	56	56	53	116	107	103	590
2003	0	0	0	0	0	0	0	21	134	146	80	55	436
2004	128	0	0	0	0	0	0	43	146	135	25	0	477
2005	0	0	0	0	0	0	0	0	0	0	0	0	0

Note:
Units are acre-feet.

TABLE 3-35

Monthly Flows from the Piru Mutual Diversion

Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	48	33	49	112	143	139	144	144	139	109	92	95	1,247
1976	49	46	52	139	143	139	144	144	139	95	92	95	1,278
1977	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1978	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1979	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1980	49	46	52	139	143	139	144	144	139	95	92	95	1,278
1981	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1982	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1983	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1984	49	46	52	139	143	139	144	144	139	95	92	95	1,278
1985	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1986	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1987	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1988	49	46	52	139	143	139	144	144	139	95	92	95	1,278
1989	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1990	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1991	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1992	49	46	49	139	143	139	144	144	139	95	92	95	1,275
1993	49	45	49	139	143	139	144	144	139	95	92	95	1,273
1994	36	32	36	100	104	100	104	104	100	69	67	69	921
1995	36	33	36	101	104	101	105	105	101	69	67	69	927
1996	53	50	53	152	157	152	157	157	152	104	101	104	1,391
1997	49	44	49	137	142	137	142	142	137	94	91	94	1,257
1998	50	46	50	142	146	142	146	146	142	97	94	97	1,299
1999	45	41	45	127	131	127	131	131	127	87	84	87	1,165
2000	75	70	75	213	221	213	221	221	214	146	142	146	1,958
2001	146	132	146	142	146	142	146	146	142	146	142	146	1,722
2002	146	132	146	142	146	142	146	146	142	146	142	146	1,722
2003	146	132	146	142	146	142	146	146	142	146	142	146	1,722
2004	146	137	146	142	146	142	146	146	142	146	142	146	1,727
2005	146	132	146	142	146	142	146	146	142	146	142	146	1,722

Note:
Units are acre-feet.

TABLE 3-36
Monthly Flows from the Piru Spreading Grounds Diversion
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1975	0	0	0	659	2,147	1,888	424	0	0	0	0	0	5,118
1976	0	0	0	0	1,864	1,853	0	0	0	0	0	0	3,717
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	42	894	1,501	1,181	4,222	3,217	0	0	729	2,052	56	0	13,894
1979	0	0	1,495	2,473	765	198	78	0	1,050	678	0	0	6,737
1980	0	140	1,832	3,459	3,321	3,655	3,027	0	0	2,182	0	0	17,616
1981	0	0	0	0	0	2,011	2,450	959	0	0	0	0	5,420
1982	0	0	1,137	1,105	2,585	2,378	753	0	1,321	4,214	2,535	2,559	18,587
1983	2,445	2,576	2,714	2,318	2,305	0	0	0	0	0	0	0	12,358
1984	0	0	0	0	91	160	0	0	0	0	0	0	251
1985	0	0	0	0	0	400	1,901	0	0	0	0	0	2,301
1986	0	0	0	0	0	277	1,139	3,129	84	0	0	0	4,629
1987	0	14	38	52	286	622	117	55	18	0	0	0	1,202
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	51	166	811	115	61	39	9	12	13	23	16	1,315
1991	23	0	156	50	0	13	5	1	0	0	0	9	257
1992	234	1,362	1,680	2,105	2,402	615	0	0	0	1,200	2,944	314	12,856
1993	395	543	0	1,334	2,660	1,705	1,924	166	194	3,015	1,577	1,192	14,705
1994	569	271	371	92	99	33	0	8	0	1,072	790	1,555	4,860
1995	106	638	107	1,050	1,679	1,231	144	1,094	1,243	247	0	29	7,568
1996	48	31	219	81	19	10	25	30	0	0	47	137	647
1997	161	197	79	62	11	50	206	319	164	228	50	0	1,527
1998	105	0	1	1,759	2,362	2,215	122	0	0	0	655	800	8,019
1999	154	61	2	0	55	8	3	2	0	364	0	0	649
2000	0	0	27	10	0	0	0	0	0	0	0	5	42
2001	0	0	451	1,352	489	0	0	0	0	0	11	55	2,358
2002	26	19	124	113	120	101	88	111	32	0	0	0	734
2003	0	0	0	19	28	14	11	0	0	0	0	0	72
2004	21	23	0	3	9	1	4	1	0	0	0	33	95
2005	1	887	0	0	0	0	0	0	0	0	0	0	888

Note:
Units are acre-feet.

TABLE 3-37
Monthly Recycled Water Rates
Task 2B-1 – Numerical Model Development and Scenario Results, East and Piru Subbasins

CY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2003	0	0	0	0	0	0	0	2	23	13	10	2	50
2004	1	0	14	29	66	59	62	63	91	26	0	10	420
2005	4	2	8	34	45	58	66	56	67	38	20	21	418

Note:
Units are acre-feet.