Memorandum

Date:	October 22, 2014
To:	Upper Santa Ana River HCP Team
Cc:	Doug Headrick, Bob Tincher, Heather Dyer, HTAC
From:	Brendan Belby, Scott Fleury, Leo Lentsch
Subject:	**Upper Santa Ana River Hydrology Analysis Update**

This memo summarizes the hydrology data collection and analysis performed to date to develop the baseline hydrologic condition for use in the Ecological Limits of Hydrologic Alteration (ELOHA) method as part of the HCP effects analysis. ICF is currently working simultaneously on the first 3 steps of the ELOHA process: 1) Assessment Reach Determination, 2) Hydrologic Foundation, and 3) River Reach Classification. The section below summarizes the work performed to date to complete steps 1-3, followed by the next steps for developing the hydrologic baseline condition and assessing hydrologic alteration.

Work Performed

1. Relevant literature related to the Upper Santa Ana River watershed was compiled and reviewed. Most of these sources are listed in ICF's February 3, memo *2014 Upper SAR HCP Preliminary Data Summary*.

2. Created a hydrology table that describes the hierarchy of drainages and reaches within the HCP and includes information on covered species that could be affected by a hydro covered activity, designated critical habitat, and available hydrology data (see Table 1 for a full description of the hydro table information). The table was distributed to the HCP and HTAC for review and comments. The table is continually updated as new information is obtained.

Table 1. Description of information contained within the hydrology analysis table.

Column	Description
Drainage	The name of the drainage.
Tributary To	The name of the receiving water drainage downstream.
Reach ID	A unique ID assigned by ICF in sequential order from downstream to upstream.
Downstream Boundary	The downstream boundary of the reach break. Usually a confluence with another drainage or a covered activity or other facility.
Upstream Boundary	The upstream boundary of the reach break. Usually a confluence with another drainage or a covered activity or other facility.
Reach Length (mile)	The total length of channel within the drainage reach.
Reach Facilities	Any facility (e.g., recharge basin, effluent outfall) with potential to alter natural drainage hydrology, but not necessarily a covered activity.
Covered Activity	The unique ID of a facility (e.g., recharge basin, effluent outfall) with the potential to alter natural drainage hydrology that has been identified as a covered activity.
Potential Hydrology Effect	The general potential effect of the facilities' operation on natural drainage hydrology.
Description	The covered project footprint and potential flow changes were analyzed as biological effects.
Covered Species	A list of the covered species that could be affected within the project footprint or within the downstream wetted channel.
Critical Habitat	Lists any critical habitat designated for species within the reach.
USGS Gage	Listing of the USGS gages, active or inactive, located within the reach.
USGS Gage Record	The years of daily and peak flow availability at the USGS gage.
Included in Geoscience Analysis	Notes if a Geoscience modeling node is available for the reach.
Included in Wildermuth Analysis	Notes if a Wildermuth modeling node is available for the reach.

Table 2 shows statistics for the number of drainages, and reaches within the drainages, that contain hydro covered activities. The number of drainages containing at least one covered activity is 20, with a total length of 151.4 miles. The mileages do not include lengths upstream of the most upstream hydro covered activities since the upper reach limits are yet to be determined. Additional length will be added as control reaches upstream of the covered activities are defined. The number of individual reaches within the drainages that contain a covered activity is 28, with a total length of 100.9 miles. Note the drainage sum of 151.4 miles is longer because it includes reaches within the drainage that do not contain a covered activity. The table also shows values for three drainages (Warm Creek (lower); Warm Creek (upper); Chino Creek) that do not contain hydro covered activities, but are included since they are located downstream of drainages with covered activities. In summary, 166.2 miles of channel either contain a covered activity directly, or are downstream of a covered activity.

Table 2. Summary of drainages and reaches potentially affected by hydro covered activities.

	Contains a Covered Activity	Does not Contain a Covered Activity but Downstream of a Covered Activity	Total
Drainages			
Number	20	3 Warm Creek (lower); Warm Creek (upper); Chino Creek	23
Miles	151.4	14.8	166.2
Reaches			
Number	28	22	50
Miles	100.9	65.3	166.2

3. Key to Step 1 of the ELOHA process, Assessment Reach Determination, is understanding the distribution of covered activities and covered species. To aid in this understanding, ICF created 3 hydrology maps that cover the geographic extent of the HCP Study Area. Most of the information contained in the hydrology table is also depicted in the maps. The drainage network and reach breaks are mapped, as well as existing and proposed effluent discharge locations and wastewater treatment plants. The covered activities determined to have potential hydrology effects are mapped and labeled with a unique ID that can be correlated with the hydrology table for additional information describing the nature of the activity. Locations of USGS gages and hydrology model nodes from both Geoscience and Wildermuth are shown on the maps. Mapping of the covered species is shown as both occurrence and habitat presence throughout the drainage network. The mapping is based on existing species datasets, reports, and the local expertise of ICF and Riverside-Corona Resource Conservation District Biologists (RCRCD) within the watershed. The critical habitat layer for the Santa Ana Sucker is also displayed on the maps. The maps were distributed to the HCP and HTAC for review and comments. The maps are continually updated as new information is obtained.
4. Conducted individual meetings with the HCP participating agencies to discuss potential hydrology effects from covered activities and to discuss data needs and data availability. Table 3 lists the hydrology data received to date from the agencies.
5. Calculated hydrographs and annual and monthly flow exceedance values for 27 USGS gages with long-term mean daily records. Also analyzed the USGS gage data based on 4 time periods over the gaging record to detect trends in the flow exceedance values.
6. Performed Log-Pearson Type III peak flow analysis on all USGS gages with a suitable peak flow gaging record.

7. Calculated hydrographs and annual and monthly flow exceedance values for the 34 nodes of mean daily flow on the mainstem Santa Ana River from the Wildermuth (2010) report *Addendum to the 2008 Santa Ana River Wasteload Allocation Model Report Scenario 7*. All 6 of the Scenario 7 alternatives were analyzed. Also analyzed the modeled data based on 4 time periods over the 1950-1999 precipitation record used in the model to detect trends in flow exceedance values based on water year type.

8. Calculated hydrographs and annual and monthly flow exceedance values for ten years of daily RIX and RPU effluent flows for the period 01/01/2004 to 10/07/14 provided by the San Bernardino Municipal Water Department and RPU, respectively. Also analyzed the flow data based on 4 time periods over the gaging record to detect trends in the flow exceedance values.

9. Requested daily flow data from Geoscience's hydrology model. Determined there are 52 nodes in Geoscience's model that are located on reaches for which flow data should be obtained and analyzed.

10. Created a mosaic file of the San Bernardino County Area A 2013 LiDAR data tiles and used the LiDAR to digitize the centerline of all drainages containing hydro covered activities. Created longitudinal elevation profiles of all drainage centerlines and enabled channel slope calculation of any reach distance within the drainage for use in ELOHA Step 3, River Reach Classification.

Table 3. Summary of hydrology data received to date from the HCP agencies.

Agency	**Hydrology Data Received**
Conservation District	Received 2009-2014 recharge data for Mill Creek, SAR, and State water
East Valley	No hard data yet, but new water recycling facility (Sterling) expected to reduce water to RIX by 6 mgd based on current conditions.
Flood Control	Flood Control says no expected hydrology impacts, but peak flow capacity of Rialto Channel will increase as a result of the project
IEUA	Daily data for recharge since 2005 inception for existing basins being covered: Wineville, Victoria, San Sevaine 1-5, Lower Day, Montclair 1-3
Rialto	Expect to receive water discharge info. Current average discharge of their WWTP is 6 mgd.
RPU	Received daily discharge since 2004 for their WWTP.
Valley District	None
Water Department	Received daily discharge since 2004 for their WWTP.
West Valley	No natural flow recharge existing so none expected. For 17.01, there is USGS gage on their canal, but this is water released by SCE.

Next Steps to Establish the Hydrology Baseline Condition

Assessment Reach Determination

1. ICF recommends that the initial list of assessment reaches include 50 reaches (Table 2). The assessment will prioritize reaches that have potential effects by covered activities as well as aquatic covered species. The prioritization will be made in large part by excluding reaches not identified as either habitat for covered species or designated as USFWS critical habitat. This recommendation will be presented to the HCP Team for concurrence.

Hydrologic Foundation

1. Perform hydrograph and exceedance analysis on flow data provided by the agencies in Table 3 for which analysis has not already been completed.
2. Obtain the Geoscience modeled hydrology data and perform hydrograph and exceedance analysis on the mean daily flow values.
3. Look into the details describing the assumptions used in both the Geoscience and Wildermuth hydrology data. For example, is the method Geoscience used to account for flow diversion into the recharge basins reflective of how the agencies have operated the basins, and appropriate for our assessment needs? The assumptions used in the model will be compared with any measured recharge data supplied by the agencies to compare. Edits to the modeled data may need to be made to account for differences. The Wildermuth data includes 6 different modeling scenarios that all make different assumptions about effluent outfall discharge rates. ICF needs to determine which of the scenarios is most representative of the baseline condition. The values used in Wildermuth's model will be compared with the measured effluent flow data supplied to ICF by the agencies to determine how closely the modeled data simulates actual data, and which alternative is most representative of the baseline condition.
4. We recommend using the previous 10 years as the time period for the baseline condition. ICF has been requesting the previous 10 years of data from the agencies since this is a period that includes a mixture of drier and wetter than average conditions, yet does not extend too far back that land use and operating conditions may be appreciably different than they are now.
5. Once the previous steps listed have been completed, ICF will develop baseline hydrographs for the assessment reaches using the best available data.

Reach Classification

1. In addition to the channel slopes already calculated for the study reaches, another key parameter for the river reach classification will be determination of representative channel dimensions within the reaches. Channel size (and width to depth ratio) is often a reflection of flow regime, sediment caliber and supply, bank materials, and vegetation. Variability in channel size can also indicate instability and direct alteration (e.g., channelization). The

width and depth configuration of the channel also influences hydraulics, including flow depths and habitat availability. Understanding of the channel size, and how potential changes in flow will translate into changes in depth, velocity, and sediment transport, and thus alter habitat availability, is necessary for future work in ELOHA Step 5, Flow-Ecology Relationships. Once the list of assessment reaches has been approved from the candidate reaches listed in Table 2, representative channel dimensions will be determined for the reaches based on the LiDAR data sets. The LiDAR data may need to be supplemented with data available from existing hydraulic models or field ground-truthing, particularly in reaches requiring bathymetry data if they contained water during the LiDAR collection, and thus the bathymetry elevations were not capture.

Hydrologic Alteration

1. The baseline hydrograph development work described above will serve as input to the hydrologic alteration assessment. ICF will perform a sample analysis on two to three reaches that demonstrates the approach that will ultimately be implemented on all of the assessment reaches to describe the hydrologic alteration associated a covered activity. New hydrographs and exceedance analysis plots will be created and compared with the baseline condition to show how the proposed covered activity potentially affects hydrologic conditions in the assessment reaches. Results of the sample analysis will be presented to the HCP Team for concurrence on approach before the same methods are used on all the assessment reaches.