MEMORANDUM

TO: Deborah Hathaway P.E., S.S. Papadopulos & Assoc.

FROM: Paul Schmidt E.I.T., Tetra Tech

RE: Gila River HEC-RAS Methodology

DATE: June 24, 2010

The purpose of this memorandum is to describe the methodology and assumptions used in creating the HEC-RAS model and floodplain shapefiles for the Gila River for S.S. Papadopulos and Associates. A brief overview of how HEC-RAS calculates hydraulic parameters is followed by a discussion of how the model was constructed and how the flood mapping was carried out.

The Hydraulic Engineering Center River Analysis System (HEC-RAS) was developed by the U.S. Army Corps of Engineers and is a widely accepted software program for modeling open channel flow. Using equations derived from the principles of conservation of energy, mass, and momentum, HEC-RAS calculates water surface profiles using the standard step method. The standard step method employs an iterative process to solve for the water surface elevation between cross-sections, one of them with a known water surface elevation and the adjacent one with an unknown water surface elevation. The solution is achieved when the energy equation is balanced. In natural channels, sub-critical flow is the typical flow condition. Therefore the Gila River HEC-RAS model was run using the sub-critical flow regime. Under the sub-critical flow regime the downstream end of the study reach serves as the boundary condition. That is, the most downstream cross-section is given a known water surface elevation and the standard step calculations proceed upstream from cross-section to cross-section. Hence, this type of calculation is called a standard step, backwater calculation.

The original HEC-RAS model of the Gila River was produced using cross-sections generated from LIDAR data. Since this reach is dynamic in nature, the decision was made to update this model. In the spring of 2010 approximately 25 cross-sections of the original, roughly 140 cross-sections in the model were surveyed by hand. Typically every third cross-section from the original model was surveyed. However, due to difficulties pertaining to land/river access there are large gaps in the middle of the study reach where new survey information could not be obtained and the original cross-sections remained unchanged. See the attached figure. In the areas where new survey information was obtained, cross-sections located in between the newly surveyed sections were updated with interpolated data.

Once all geometric data in the model was updated, six flows were modeled. These were 75, 250, 500, 750, 1000, and 3000 cfs. Downstream boundary conditions were determined assuming normal flow and using Manning's equation to determine a starting water surface elevation. HEC-RAS only computes 1-dimensional flow. Also, steady flow with no flow changes was assumed. Meaning that when 75 cfs was run through the model, this was the flow running through each and every cross-section simultaneously. Flow changes along the reach due to such factors as tributaries, diversions, evapo-transpiration, and seepage where not accounted for. Such a detailed analysis was beyond the scope of this project.

After modeling of all six flows was completed, HEC-GeoRAS was used together with GIS to create shapefiles of the floodplain for each of the flows. HEC-GeoRAS is an add-on piece of software for HEC-RAS that can be used for delineating floodplain extents in GIS where terrain data already exists. HEC-GeoRAS creates a virtual water surface from the model results and overlays this information on top of the LIDAR data. The program then delineates the floodplain in GIS by subtracting the LIDAR surface elevation from the water surface elevation. If the result is positive, then that particular area is considered to within the floodplain. If the result is negative, then that particular area is considered to be outside the floodplain. The floodplain boundary is drawn where the difference between the two surfaces is zero. After HEC-GeoRAS was run, the resulting shapefiles were reviewed and verified for accuracy based on available information from the models. Some areas required some manual revisions in order to produce the final shapefiles for each flow.

UPSTREAM STUDY LIMIT

UPDATED

HWY 211 BRIDGE

HWY 180 BRIDGE

UNCHANGED

UPDATED

UNCHANGED

UPDATED

UNCHANGED

UPDATED

DOWNSTREAM STUDY LIMIT