Lower Hassayampa River Watercourse Master Plan

Volume 6: Project Administration Report

Prepared for:

Flood Control District of Maricopa County

2801 W. Durango Street
Phoenix, AZ 85009

Prepared by:

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Road, Suite 201
Tempe, AZ 85284
www.jefuller.com

April 2006

Lower Hassayampa River Watercourse Master Plan

Volume 6: Project Administration Report

Prepared for:

Flood Control District of Maricopa County

2801 W. Durango Street
Phoenix, AZ 85009

Prepared by:

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Road, Suite 201
Tempe, AZ 85284
www.jefuller.com

Registered Professional Engineer (Civil)
CERTIFICATE NO.
26846
JONATHAN E.
FULLER
Date Signed 7-13-06
ARIZONA, U. S. A.

April 2006

Scope of Work

EXHIBIT A

SCOPE OF WORK

CONTRACT FCD 2004C001

Lower Hassayampa River Watercourse Master Plan

TABLE OF CONTENTS

1. GENERAL ____ 4

1.1. Project Description 4
1.2. Purpose 4
1.3. Location 4
1.4. General Requirements 4
1.5. Agencies 6
1.6. Contract Time 6
1.7. Project References 6

2. SCHEDULE AND PROJECT COORDINATION ____ 6

2.1. Schedule and Project Coordination 6
2.2. Site Visits 8
2.3. Subconsultant Management 9

3. WATERCOURSE MASTER PLANNING – PHASE I ____ 9

3.1. General 9
3.2. Data Collection and Existing Conditions Analysis 10
3.3. Project-Specific Tasks 10
3.4. Planning/Regulatory Coordination 11
3.5. Preliminary Alternatives 11
3.6. Lower Hassayampa River Watercourse Master Plan – Phase I Report 11

4. PUBLIC NOTIFICATION AND INVOLVEMENT ____ 12

4.1. General Requirements 12
4.2. Public Notification for Right of Entry 12
4.3. Introduction Brochure 12
4.4. Initial Press Release 13
4.5. Project Website 13
4.6. Public Meetings 13
4.7. Stakeholder Involvement 14

5. DATA COLLECTION AND ANALYSIS ____ 15

5.1. General Requirements 15
5.2. Data Collection – Hydrologic Models 15
5.3. Data Collection – River Behavior 16
5.4. Data Collection – Existing and Future Land Use 16
5.5. Data Collection – Existing Drainage Regulations, Stormwater Quality, and Required Permits. 16
5.6. Data Collection – Groundwater Recharge 16
5.7. Data Collection – Identification of Flooding Problems 17
5.8. Data Collection – Environmental Conditions 17
5.9. Data Collection Report 17

6. HYDROLOGY ____ 18

6.1. Existing Studies 18
6.2. Analysis 18

7. HYDRAULICS ____ 19

7.1. Existing Studies 19

7.2. Analyses 19
8. FLOODPLAIN DELINEATIONS 20
8.1. Floodplain Delineations 20
9. RIVER BEHAVIOR 21
9.1. Purpose 21
9.2. Data Collection 21
9.3. Field Investigations/Sediment Sampling 21
9.4. Geomorphic Analysis 22
9.5. Potential Bed Elevation Change Analysis 23
9.6. Sediment Transport Analysis 24
9.7. Potential Lateral Migration Analysis 25
9.8. Sediment Trend Analysis 27
9.9. Comparison of Sediment Transport Methods 27
10. DELIVERABLES 27
10.1. General 27
10.2. Reports 28
11. REFERENCES AND STANDARDS 29
11.1. Design Manuals, Policies and Procedures 29
11.2. Standards 30
11.3. Format 30

1. GENERAL

1.1. Project Description

1.1.1. The Lower Hassayampa River Watercourse Master Plan (WCMP) will be divided into two phases. The first phase will identify the existing river hydraulics, lateral migration and sediment transport issues and hazards, along with other data collection activities. This will require research into and location of historical photographs, geomorphic data, previous flood hazard reports and hydrology for the study area, including but not limited to drainage reports, existing topographic mapping, historical flooding information, as-built plans for existing structures, Federal Emergency Management Agency (FEMA) flood hazard boundary maps, and other pertinent information. In addition, the study will review and modify and/or develop existing condition models for the hydrology, hydraulics, and sediment transport associated with the lower Hassayampa River. The study will also make preliminary recommendations for alternatives and technical guidelines for consideration in the future Phase II study. Phase I of the WCMP study will include public outreach activities.

1.2. Purpose

1.2.1. The purpose of a WCMP is to identify and develop a plan and technical guidance/criteria for managing flooding hazards, lateral migration of the watercourse, and the cumulative impacts of existing and future development/encroachment into the floodplain consistent with A.R.S. §48-3609.01.

1.2.2. Currently, master planned communities being developed within the lower Hassayampa River valley and along the lower Hassayampa River have proposed encroachments into the watercourse. The Flood Control District of Maricopa County (DISTRICT) has also received several new applications to mine aggregate from the floodplain and floodway of the lower reach of the Hassayampa River. These mining applications under consideration may join several mines that are already operational. In an effort to provide sound and uniform technical information, guidance and criteria for development, the DISTRICT plans to initiate the Lower Hassayampa River WCMP.

1.3. Location

1.3.1. The project area generally includes the floodplain and erosion hazard areas of the lower Hassayampa River extending from the confluence with the Gila River to the Central Arizona Project (CAP) canal crossing, and Jackrabbit Wash from the Hassayampa River confluence to the CAP canal crossing, as shown on Figure 1.

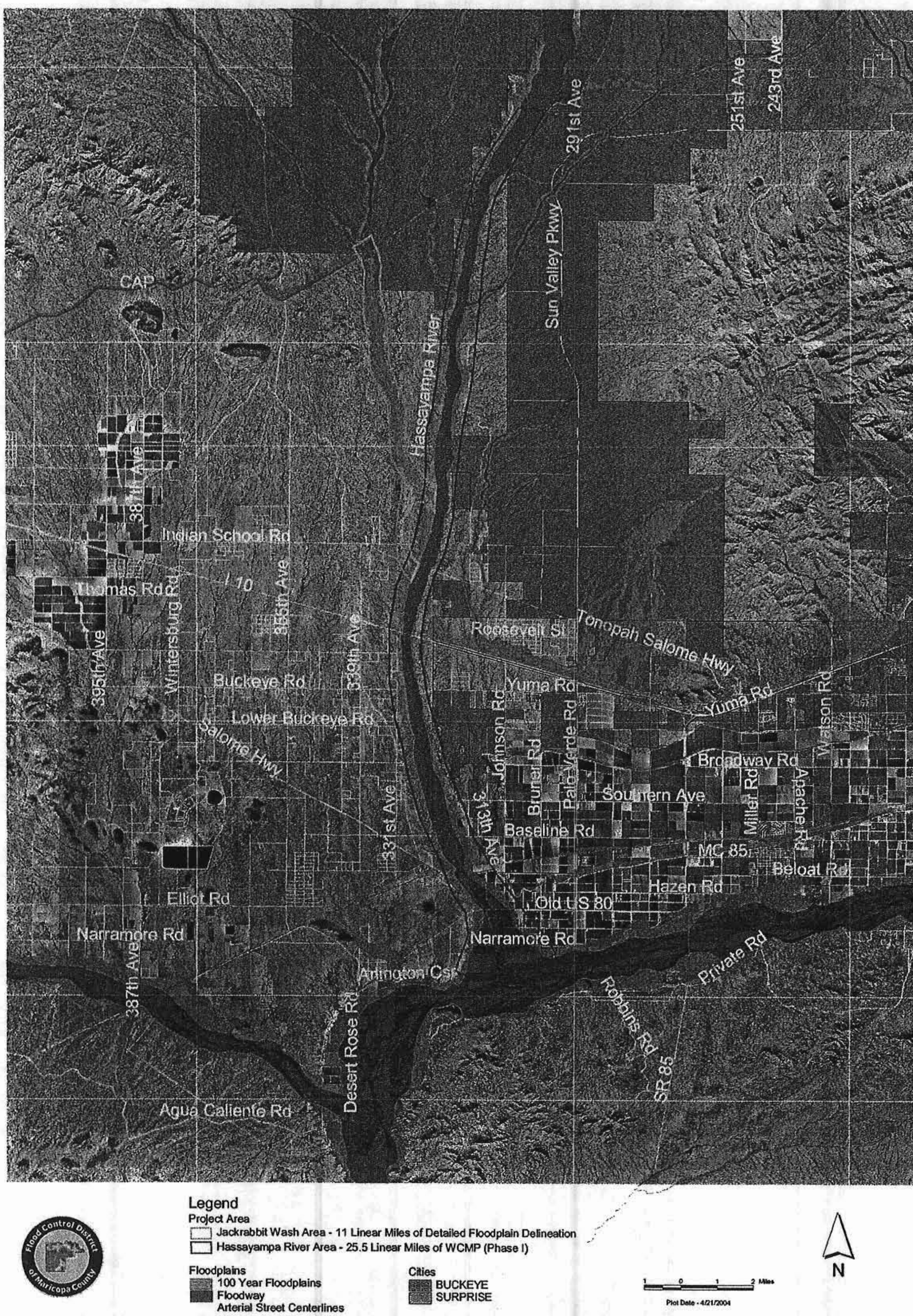
1.4. General Requirements

1.4.1. The CONSULTANT shall comply with the requirements of the DISTRICT's Consultant Guidelines, dated December 1, 2003, and as revised prior to the notice-to-proceed (NTP), for Section 1.0 (General Provisions) except as herein modified and for additions herein referenced.

1.4.2. In the event that there are conflicting requirements between this scope-of-work (SOW) and referenced requirements, this SOW shall govern. The DISTRICT's Project Manager shall make all final determinations.

1.4.3. A copy of the Consultant Guidelines can be obtained from the DISTRICT's website at http://www.fcd.maricopa.gov/Procurement/CONSULTANTGuidelines.asp.

Figure 1: Project Area
Lower Hassayampa River Watercourse Master Plan



1.5. Agencies

1.5.1. The following representatives will be receiving copies of project submittals and will act as an agency point-of-contact:

Marilyn DeRosa, PE, RG
Project Manager
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Joseph Blanton, AICP
Town Manager
Town of Buckeye
100 North Apache, Suite A
Buckeye, AZ 85326

1.6. Contract Time

1.6.1. The CONSULTANT shall complete the authorized SOW within the contract period of 400 calendar days, which includes review time for the DISTRICT.

1.7. Project References

1.7.1. The DISTRICT will provide the following data to the CONSULTANT at the project Kick-off Meeting:

a. Topographic mapping of the lower Hassayampa River in digital format.
b. Available current and historic digital aerial photographs.
c. Contact stereo pair prints of aerial photographs of the study reach.
d. Land uses and soil type mapping in digital format.
e. Hydrologic reports for the Hassayampa River:
   1. Hydrologic Analysis of the Hassayampa River in Maricopa County, dated May 2, 1988.
   2. HEC-1 for Jackrabbit Wash by Burgess-Niple and Associates.
f. Hydraulic reports and models for the Hassayampa River.
g. Most recent digital parcel data in GIS format. Updated versions will be supplied to the CONSULTANT as needed during the course of the project.
h. Any approved sand and gravel mining permit reports located within the study reach.
i. DISTRICT's Public Involvement and Public Information Guidelines, dated September 1, 2003 (PUBLIC INV. GUIDELINES).

1.7.2. The DISTRICT will provide the CONSULTANT with a signed copy of the "Verified Statement of Request for Public Records or Services" so the CONSULTANT can obtain the latest assessors' ownership data to develop the list of the property owners. The CONSULTANT shall obtain, review, and modify the data to ensure that it is current.

1.7.3. The CONSULTANT will use digital base mapping, land ownership, land use, soil types, and topology information provided by the DISTRICT to prepare base maps for the DRAFT and FINAL reports.

2. SCHEDULE AND PROJECT COORDINATION

2.1. Schedule and Project Coordination

2.1.1. The CONSULTANT shall perform the tasks as required in the Consultant Guidelines for Section 2.0 (Schedule and Project Coordination) listed below. Tasks listed in the Consultant Guidelines include:

2.1.1.1. Schedule. The CONSULTANT will submit a schedule for the project at the Kick-Off Meeting. The schedule will show coordination meetings, dates of all required submittals for each of the tasks in the SOW, significant project milestones, and DISTRICT review periods.

2.1.1.2. Schedule Updates. The CONSULTANT shall update the project schedule monthly.

2.1.1.3. Cost Distribution. A projection of estimated project costs consistent with the scheduled project man-hours and project schedule as provided in the fee proposal shall be submitted at the Kick-Off Meeting. The monthly expenditure forecast of costs shall be presented in tabular form.

2.1.1.4. Progress Reports. The CONSULTANT will submit monthly progress reports with the invoice. These reports shall discuss project activities for the same time period as included in the monthly invoices. The report shall be brief (no more than two [2] typed pages). At a minimum, the monthly report shall contain the following:

a. A description of the significant work accomplished during the reporting month by task as identified in the contract fee proposal.
b. A table showing the actual monthly invoice amounts to date and original project estimate cumulative monthly totals for the duration of the contract.
c. A graph showing the original monthly billing projection and the actual monthly invoiced amounts to date.
d. A brief description of the work to be accomplished in the following month by task.
e. A description of any problems encountered and actions to resolve the problems.

2.1.1.5. Weekly Coordination. The CONSULTANT shall call the DISTRICT's Project Manager once a week to provide a verbal progress report, unless directed otherwise by the DISTRICT's Project Manager.

2.1.1.6. Minutes and Conversation Logs. The CONSULTANT shall provide copies of minutes of meetings, and significant telephone conversations, and correspondence to the DISTRICT on a monthly basis. At the end of the project copies of all minutes, conversations, and correspondence shall be submitted in the Project Administration Report.

2.1.1.7. Team Meetings. The CONSULTANT shall participate in monthly coordination meetings with the DISTRICT's Project Manager and in milestone coordination meetings. The CONSULTANT is responsible for taking and distributing the minutes of all meetings. Whenever possible, coordination and milestone/deliverable review meetings will be combined. See Table 1 of this SOW for details on the number of planned meetings and CONSULTANT time.

2.1.1.8. Kick-Off Meeting. The CONSULTANT shall meet with the DISTRICT within fourteen (14) days of the NTP. At the meeting the CONSULTANT will submit the project schedule which shall include dates of all proposed coordination meetings, dates of all required submittals for each of the tasks in the SOW, significant project milestones, and DISTRICT review periods. The CONSULTANT will also submit a monthly estimation of the projected billings. The CONSULTANT shall bring the key project team members including the project checkers to the meeting to introduce them to the

DISTRICT staff who will be working on the project. The DISTRICT will provide to the CONSULTANT such project information and data as the DISTRICT may have, including hydrology reports and models, aerial topographic mapping, utility record drawings, and other information and data as outlined in the SOW. See Table 1 for details on the number of planned meetings and CONSULTANT time.

2.1.1.9. Project Review Meetings. Following the DISTRICT's review of project deliverables, the CONSULTANT shall meet with the DISTRICT Project Manager and review team to review the overall project status and to discuss the DISTRICT's review comments which will be provided to the CONSULTANT at least two (2) working days prior to the meeting. The CONSULTANT shall make every effort to obtain the review comments of outside agencies and utilities in advance of the review meeting, so that these comments can also be reviewed. These comments will be provided to the DISTRICT prior to the review meeting whenever possible. The CONSULTANT should be prepared to discuss all review comments and the status of the project. Any problems will be identified and discussed. See Table 1 for details on the number of planned meetings and CONSULTANT time.

2.1.2. Under Section 2.2.2.3. – Replace with the following: The CONSULTANT shall submit invoices monthly to Accounts Payable, Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona 85009, for processing and payment. A copy of the invoice along with the Progress Report will be forwarded to the DISTRICT's Project Manager for review and acceptance.

2.1.3. Under Section 2.4.4 – Replace with the following: Meetings shall be held at the offices of DISTRICT unless otherwise approved by the DISTRICT's Project Manager.

2.1.4. Lessons Learned Meeting. Upon acceptance of the FINAL Lower Hassayampa River Watercourse Master Plan – Phase I Report the CONSULTANT shall meet with the DISTRICT to review and analyze the overall project performance and complete the Evaluation Form as required in Section 1.5 of the Consultant Guidelines. See Table 1 for details on the number of planned meetings and CONSULTANT time.

2.1.5. Public Meetings. The CONSULTANT shall attend and participate in the public meetings as defined in Task 4 of this SOW. See Table 1 for details on the number of planned meetings and CONSULTANT time.

2.1.6. **(Optional) Additional Coordination Meetings.** The CONSULTANT and the DISTRICT Project Manager shall have up to twenty (20) additional coordination meetings budgeted as an optional item for the purpose of coordination with the project team or project partners as needed beyond those outlined in Tasks 2.1 and 4.7. See Table 1 for details on the number of planned meetings and CONSULTANT time. **This optional task is not authorized with the NTP; it may be authorized in writing by the DISTRICT based upon specific need as determined by the DISTRICT during the contract period.**

2.2. Site Visits

2.2.1. The CONSULTANT shall visit the project to become familiar with existing conditions and to facilitate the design and preparation of the contract documents.

2.2.2. It is anticipated that the CONSULTANT shall make a maximum of three (3) site visits. The first visit shall be at the inception of the Lower Hassayampa River Watercourse Master Plan – Phase I to become familiar with the area. At a minimum, the first site visit shall be coordinated with the DISTRICT's Project Manager. The CONSULTANT shall also visit the site with the DISTRICT's Project Manager after completion of the data collection to verify the data collected. The purpose of this second site visit is to verify that conditions along the lower Hassayampa River have not significantly changed. The remaining site visit is allotted for the purpose of analysis and formulation. See Table 1 for details on the number of planned meetings and CONSULTANT time.

2.3. Subconsultant Management

2.3.1. The work of any subconsultant utilized by the prime CONSULTANT for this contract shall be reviewed by the prime CONSULTANT for compliance with this SOW and these specifications prior to submittal for review by the DISTRICT. The CONSULTANT's Project Manager or Quality Control Reviewer shall review calculation sheets, reports, and drawings performed by the subconsultant for the DRAFT and FINAL Reports prior to their submittal to the DISTRICT. The reports to be reviewed will be those listed in Section 10 of this SOW. The CONSULTANT shall designate the QA/QC reviewer in writing to the DISTRICT with the initial project schedule for review and approval. The originating designer and the QA/QC reviewer/checker shall also initial and date the submittals.

2.3.2. The prime CONSULTANT shall ensure that the subconsultant's assigned tasks and submittals be completed within the approved project schedule.

3. WATERCOURSE MASTER PLANNING – PHASE I

3.1. General

3.1.1. Phase I will consist mainly of data collection including analysis of existing facilities, identification of past drainage and flooding problems, collection of existing flood photos, completion of existing conditions analyses, identification of flood hazard limits, and recommendations for preliminary alternatives to mitigate any found flood hazards for future studies. The CONSULTANT shall identify drainage problems by evaluating the impacts in the watercourse due to development, review the existing and future conditions hydrologic models, revising as necessary, perform hydraulic analyses, evaluate existing floodplain delineations and recommend for the delineation of additional floodplains, conduct sedimentation and geomorphic evaluations, conduct survey work, produce recommendations for interim development guidelines, and develop preliminary feasible alternatives to be recommended for consideration in Phase II of the projects. The CONSULTANT shall prepare a Data Collection Report and the Lower Hassayampa River Watercourse Master Plan – Phase I Report to document data collected, analyses, public involvement, and recommendations for items to be considered for the next phase of the study if applicable.

3.1.2. Phase II is not part of this contract and will only be conducted (as a separate contract) if feasible implementable recommendations are identified during this Phase I effort. Procedures for implementation of structural and non-structural plan features will be evaluated and recommended and, if required by the project SOW, development guidelines and erosion hazard non-encroachment areas will be refined.

3.1.3. Site visits, team meetings, public meetings and/or open houses, and stakeholder information and coordination are included as part of this SOW.

3.2. Data Collection and Existing Conditions Analysis

3.2.1. The CONSULTANT shall collect and review pertinent data from the DISTRICT, MCDOT, partner Towns and Cities, and other sources. Data to be collected and reviewed will include, but is not limited to, existing topographic mapping, utility quarter sections, as-built plans for existing structures, FEMA Flood Hazard Boundary Maps, FEMA-approved floodplain delineation studies, any Letters of Map Amendment and/or Revisions, drainage reports, site plans, future drainage improvement plans, land-use plans, development plans, and landfill closure plans. Interviews should be arranged with appropriate agencies or associations for information on drainage problems in the area. The CONSULTANT shall also develop a comprehensive list of possible existing and proposed developments impacting the project area.

3.2.2. The CONSULTANT shall develop a comprehensive list of flooding and drainage problems impacting the project area. This is an essential part of the Phase I task to document the need and necessity of the project. The CONSULTANT will research and obtain historic flood data such as precipitation data, newspaper articles, and historic flooding photos, to help establish past flooding within the project area. The CONSULTANT will provide a map, which indicates the location of flooding or problem areas identified by the flood data obtained.

3.2.3. The CONSULTANT shall prepare an Existing Facilities Exhibit containing an inventory of man-made or relevant drainage facilities within or affecting the project area. The inventory shall note the condition, size and/or capacity, level of protection, and ownership of these structures. These facilities will become part of the base map for the alternatives analysis. The CONSULTANT shall make maximum use of these facilities, where feasible, as part of the alternative plans.

3.2.4. The CONSULTANT shall research and become familiar with existing hydrologic and hydraulic studies and models affecting the project area.

3.2.5. The DISTRICT shall prepare a GIS map layer and accompanying database that includes land ownership, developments, and sand and gravel operations in the area. The land ownership base map will indicate whether property is publicly or privately held and ownership information.

3.2.6. The CONSULTANT will compile the data in a Data Collection Report. The Data Collection Report will contain a description of information collected for this project. Existing major natural washes and existing and planned man-made drainage facilities in the watershed should be shown on the Existing Facilities Exhibit to be submitted with the Data Collection Report. The CONSULTANT shall submit a DRAFT of this report followed by a FINAL once all data collection tasks are complete.

3.3. Project-Specific Tasks

3.3.1. Based on the project SOW, the CONSULTANT shall complete the following project-specific tasks. Detailed guidelines regarding methods for completing each of these tasks can be found in this SOW or in the DISTRICT's CONSULTANT GUIDELINES.

a. Project Administration and Coordination
b. Data Collection
c. Hydrologic Analysis
d. Hydraulic Analysis
e. FEMA Floodplain and Floodway Delineation
f. Field Surveys

g. River Behavior
   1. Geomorphic Analysis
   2. River Bed Analysis
   3. Lateral Migration Analysis
   4. Sediment Transportation Analysis
   5. Sediment Trend Analysis

h. Final Recommendations and Analysis

i. Public Involvement

3.4. Planning/Regulatory Coordination

3.4.1. The CONSULTANT shall complete an inventory and determine the status and relevance of any planning studies conducted by Maricopa County, partner Towns and Cities, and any other agencies working within the project area.

3.4.2. The CONSULTANT shall identify significant conditional development approvals by the Maricopa County Board of Supervisors; partner Towns and/or Cities' Councils, and any other agencies.

3.4.3. The CONSULTANT shall meet with planning staff from identified agencies to determine current policy thinking concerning land use, development standards, flood control, and environmental protection for the project area.

3.4.4. The CONSULTANT shall assess opportunities and obstacles created by adopted codes, ordinances, and development conditions.

3.4.5. The CONSULTANT shall identify planning issues resulting from policies and/or regulations pertinent to the project.

3.4.6. The CONSULTANT shall evaluate the Proposed Land Use Map with the findings of the River Behavior and Hydrology tasks and provide recommendations regarding proposed land uses that may be adversely impacted.

3.5. Preliminary Alternatives

3.5.1. The CONSULTANT shall develop preliminary feasible alternatives to be recommended for consideration in Phase II as discussed in Tasks 1.1 and 3.1. The alternatives development shall be limited to qualitative analyses including brainstorming and fatal flaw evaluation. Concept engineering, design, and/or economic analyses are not part of this task.

3.6. Lower Hassayampa River Watercourse Master Plan – Phase I Report

3.6.1. The DRAFT Report shall be submitted for review by the DISTRICT and other project participants. Upon receipt of review comments, the CONSULTANT shall incorporate appropriate revisions and complete the FINAL Report. The Report should include the following as applicable:

a. Executive Summary
b. Scope of Project
c. Public and Stakeholder Involvement
d. Existing Facilities
e. Existing Hazards
f. Evaluation Criteria
g. Recommendations to Regulators
h. Environmental Considerations
i. Implementation Recommendations

j. Summaries of the following:
   1. Hydrologic Analysis
   2. Hydraulic Analysis
   3. FEMA Floodplain and Floodway Delineation
   4. River Behavior
   5. Geomorphic Analysis
      i. Field Reconnaissance/Sediment Sampling
      ii. River Bed Analysis
      iii. Lateral Migration Analysis
      iv. Sediment Transportation Analysis
      v. Sediment Trend Analysis

k. Groundwater Recharge

l. References/Figures

m. Disk copies of applicable hydrologic and hydraulic models

n. Existing utilities

3.6.2. The DRAFT Report shall be submitted for review by the participating agencies. After the CONSULTANT has incorporated and resolved the DISTRICT's and the participating agencies comments, the CONSULTANT shall finalize the report.

4. PUBLIC NOTIFICATION AND INVOLVEMENT

4.1. General Requirements

4.1.1. The DISTRICT shall document all project public notification and involvement activities in the FINAL report. This shall include sign-in sheets, meeting notices and advertisements, brochures, and meeting minutes/summaries. However, all personal information shall be removed or made illegible.

4.1.2. The DISTRICT shall prepare a single project location map as required by Section 3. Public Notification and Involvement in the DISTRICT's PUBLIC INV. GUIDELINES.

4.2. Public Notification for Right of Entry

4.2.1. The CONSULTANT shall attempt to notify all property owners and obtain any necessary Rights-of-Entry (ROE) for the study area. The CONSULTANT shall furnish the DISTRICT with a list of all the property owners notified and a sample ROE letter for approval by the DISTRICT's Project Manager. The DISTRICT will supply the CONSULTANT with the DISTRICT's letterhead for the notification.

4.2.2. The DISTRICT will provide the CONSULTANT with assessors' data to develop the list of the property owners and a mailing list. The CONSULTANT shall review and modify the list to ensure that the current owner(s) are notified prior to entering their property. The CONSULTANT shall then supply the DISTRICT with a corrected mailing list of the property owners.

4.2.3. The DISTRICT will develop a Public Involvement Plan as part of this project. The CONSULTANT shall review and provide comments on the plan. This plan then shall be used as the basis of any public meetings and/or public involvement.

4.3. Introduction Brochure

4.3.1. The DISTRICT shall prepare an introduction brochure within 60 days of NTP and shall submit to the CONSULTANT for review and comment. The brochure shall be 8.5-inch x 14-inch, 4-color, and be tri-fold ready. The brochure shall contain/address the follow:

a. Announcing the beginning of the study.
b. The study schedule.
c. Introducing the public to the DISTRICT and the study process.
d. Providing a point of contact.
e. A questionnaire for the study area to solicit information of flooding and erosion hazards.

4.3.2. The DISTRICT will mail brochure to everyone located within study area boundaries.

4.3.3. The DISTRICT will provide the CONSULTANT with all returned (non-deliverable) mail. The CONSULTANT shall up-date the mailing list based on the returned mail.

4.3.4. The DISTRICT will provide a PDF of the brochure to the CONSULTANT so that the CONSULTANT can provide to public as needed. The DISTRICT will place the brochure on its website.

4.3.5. The CONSULTANT shall place brochures in key area locations within the study area such as schools, libraries, etc.

4.4. Initial Press Release

4.4.1. The DISTRICT will send out a press release regarding start of the study.

4.5. Project Website

4.5.1. The DISTRICT will develop a project page on its website.

4.5.2. The CONSULTANT shall review the DISTRICT's website and provide updated project information (such as project progress and schedule) to the DISTRICT. The DISTRICT will use this information to update the website. These reviews shall be done at the following times:

a. Start of Project.
b. Key project submittals.
c. At a minimum every three (3) months.

4.6. Public Meetings

4.6.1. The DISTRICT will prepare quarterly newsletters to serve as project updates as well as public meeting notices. A total of up to four (4) newsletters will be prepared in 8.5-inch x 11-inch, two-color format primarily with text and existing graphics produced as part of other tasks. The CONSULTANT shall attend public meetings as outlined in Table 1.

4.6.2. Public Meeting No. 1. This public meeting shall occur after completion of Data Collection to present the results from the Data Collection and to gather additional information from the public. Also, this meeting should inform the public about the next phase of the project. The CONSULTANT team attendance will be limited to two (2) team members including the Project Manager and the Stakeholder Coordinator.

4.6.3. Public Meeting No. 2. This public meeting shall occur after the CONSULTANT has submitted the DRAFT Lower Hassayampa River Watercourse Master Plan – Phase I Report and any draft floodplain delineations to obtain comments from the public and the stakeholders. The CONSULTANT team attendance will be limited to three (3) team members including the Project Manager, Floodplain Delineation Engineer and the Stakeholder Coordinator.

4.6.4. **(Optional) Public Meeting No. 3.** This public meeting shall occur after the CONSULTANT has completed the final floodplain delineations and prior to the submission to FEMA. This meeting is to inform the public of the results of the floodplain delineations and provide exhibits of what is being submitted to FEMA. The CONSULTANT team attendance will be limited to three (3) team members including the Project Manager, Floodplain Delineation Engineer and the Stakeholder Coordinator. **This optional task is not authorized with the NTP; it may be authorized in writing by the DISTRICT based upon specific need as determined by the DISTRICT during the contract period.**

4.6.5. The DISTRICT will design and place the advertisements for the public meetings. This shall include the following:

4.6.5.1. Place a legal advertisement to meet FEMA requirements for floodplain delineations.

4.6.5.2. Place at least two (2) display advertisements in area newspapers (one week apart) advertising the public meeting.

4.6.6. The DISTRICT will invite the identified stakeholders, elected officials in that area (mayor and town and/or city council), and town and/or city staff (town and/or city manager, engineer, and PIO) to each of the public meetings.

4.6.7. The DISTRICT will set up and reserve the meeting room and provide any required insurance and/or fees.

4.6.8. The CONSULTANT shall provide refreshments for the public meetings.

4.6.9. The DISTRICT will prepare the handouts, sign-in sheets, comment sheets, and graphic display boards (exhibits) for each of the public meetings.

4.6.10. The DISTRICT will post the public meeting on the DISTRICT website.

4.6.11. The DISTRICT shall work with the effected agencies to utilize their newsletters, bulletins, websites, etc., to advertise public meeting.

4.6.12. The DISTRICT will provide electronic copies of the exhibit boards and handouts to the CONSULTANT after the material has been finalized and prior to the public meeting. The electronic information then will be made available on the website by the DISTRICT.

4.6.13. The DISTRICT will prepare and send out a press release about the public meeting.

4.6.14. The DISTRICT and the CONSULTANT shall follow the DISTRICT's PUBLIC INV. GUIDELINES for holding a public meeting.

4.7. Stakeholder Involvement

4.7.1. The CONSULTANT will prepare a preliminary list of stakeholders for use in developing a stakeholder database and to be added to the mailing list, a preliminary stakeholder matrix of opportunities and issues, and a preliminary stakeholder involvement schedule. After review by the DISTRICT Project Manager, the CONSULTANT will finalize the matrix and keep it updated during the study. The CONSULTANT will work with the DISTRICT on updating the WCMP stakeholder database during the course of the study.

4.7.2. The DISTRICT and the CONSULTANT shall meet with stakeholders individually, as needed, to ensure that site and stakeholder specific issues are considered during the study. The DISTRICT's Project Manager is to be advised of meetings and given an opportunity to attend. The CONSULTANT shall keep a written summary of all meetings and will include them as part of the Project Administration Report. The CONSULTANT will budget for 12 individual meetings with stakeholders. See Table 1 for details on the number of planned meetings and CONSULTANT time.

4.7.3. **(Optional) Additional Stakeholder Meetings.** An additional 12 stakeholder meetings will be budgeted. See Table 1 for details on the number of planned meetings and CONSULTANT time. **This optional task is not authorized with the NTP; it may be authorized in writing by the DISTRICT based upon specific need as determined by the DISTRICT during the contract period.**

4.7.4. The CONSULTANT shall meet quarterly (a total of four [4] meetings) with sand and gravel interests operating within the lower Hassayampa River, officials from the Town of Buckeye, and the DISTRICT. The CONSULTANT shall invite ARPA in addition to individual sand and gravel operators within the river. The purpose of these meetings is to understand the current and if feasible, future operational needs of the operators, and to determine what influences these plans may have on the watercourse. A primary purpose of these meetings is to determine if mutually beneficial solutions may be possible. See Table 1 for details on the number of planned meetings and CONSULTANT time.

4.7.5. One other different stakeholder workgroup will be held twice (2 times) during the project. This other workgroup will be composed of public and private sector agencies as recommended by the CONSULTANT and approved by the DISTRICT's Project Manager. See Table 1 for details on the number of planned meetings and CONSULTANT time.

4.7.6. The CONSULTANT shall document this stakeholder involvement in the Lower Hassayampa River Watercourse Master Plan – Phase I Report. This shall include a summary of the meetings, issues identified by the stakeholder, and recommendations to resolve the stakeholder issues for future study.

5. DATA COLLECTION AND ANALYSIS

5.1. General Requirements

5.1.1. The CONSULTANT shall collect and review pertinent data from the DISTRICT and other outside sources. The CONSULTANT shall research and locate the existence of historical photographs, historical surveys, existing readily available remote sensing, and geomorphic data. Other data to be collected will include materials relevant to the project, such as previous flood hazard reports and hydrology for the study area, existing topographic mapping, historical flooding information, as-built plans for existing structures, FEMA Flood Hazard Boundary Maps and any Letters of Map Amendment and/or Revisions, and other pertinent information.

5.1.2. The DISTRICT shall allow the CONSULTANT to research DISTRICT general files and the Engineering Division library. The DISTRICT shall provide one (1) copy of pertinent data to the CONSULTANT. The DISTRICT will provide copies of the large format scanned historical and recent aerial photography of the study area at no cost to the CONSULTANT.

5.2. Data Collection – Hydrologic Models

5.2.1. The CONSULTANT shall collect the hydrologic models for Jackrabbit Wash, Wagner Wash, and the Buckeye-Sun Valley ADMP from the DISTRICT, as required in Task 6, Hydrology.

5.3. Data Collection – River Behavior

5.3.1. The CONSULTANT shall collect the following data in support of the River Behavior Analysis for the lower Hassayampa River corridor including:

5.3.1.1. Geometric data – stream channel alignments and geometry from previous floodplain studies, aerial topographic mapping (hardcopy and digital formats), ground surveys, historical and present USGS gage cross-sections, and previous sediment transport studies, if any.

5.3.1.2. Hydrologic and hydraulic data – historic flood hydrographs and peak discharge hydrographs from flood insurance studies covering the lower Hassayampa River, discharges based on USGS gage data, and water surface profiles and computer models from HEC-2 runs of the Hassayampa River flood insurance study (CBA 1988).

5.3.1.3. Sediment data – sediment gradation data from previous investigations, dredging and mining frequency, quantities and locations, previous sediment transport studies of the Gila and Hassayampa Rivers and the scour analysis for I-10 Bridge, and previous sediment yield studies for watersheds of similar character.

5.3.1.4. Current and historical aerial and ground photography.

5.3.1.5. Bridge scour studies – ADOT and local bridge studies and historic monitoring records of bed changes.

5.3.1.6. Sand and gravel mining plans – Currently permitted plans and future mining operations, including digital coverage of expired, existing, and proposed mining leases and/or property boundaries.

5.3.1.7. Levee and bank protection studies and plans, if any.

5.3.1.8. Utility crossing studies and plans.

5.4. Data Collection – Existing and Future Land Use

5.4.1. The CONSULTANT shall identify existing and future land use for the area within the Hassayampa River Valley corridor. The information will be gathered from local jurisdictions, Maricopa County, the MAG Land Use Plan and from site visits. Reference to Task 3.4.5.

5.5. Data Collection – Existing Drainage Regulations, Stormwater Quality, and Required Permits

5.5.1. The CONSULTANT shall obtain, document, and review the local jurisdictions existing drainage regulations and stormwater quality management practices.

5.6. Data Collection – Groundwater Recharge

5.6.1. The CONSULTANT shall prepare an inventory of potential groundwater recharge activities in or near the study area. Reference to Task 3.4.6.

5.6.2. Potential groundwater recharge data sources include, but are not limited to, ADWR, ADEQ, CAWCD, BIC, RID, the DISTRICT, WESTCAPS and its members, the Cities of Phoenix and Goodyear, the Town of Buckeye, , private enterprises, ADHS, Maricopa County Health Department, maps, and aerial photographs.

5.6.3. The CONSULTANT shall utilize existing data to evaluate the recharge feasibility of the watercourse as part of the CONSULTANT's recommendations.

5.7. Data Collection – Identification of Flooding Problems

5.7.1. Following the initial round of agency meetings and public meetings, the CONSULTANT shall prepare a list of flood control problems for the watercourse. The CONSULTANT shall generate a map/exhibit depicting any existing drainage structures and the areas of identified flooding events.

5.7.2. The CONSULTANT shall research the DISTRICT's engineering library, local newspapers, the local museums, and ASU library to find documentation and historic photographs of flooding events on the Hassayampa River. This information shall be documented in the Data Collection Report. All Photographs acquired shall be scanned and a TIF (or other acceptable format) file of each photo shall be submitted on a separated CD as part of the FINAL Data Collection Report. Additionally, the scanned photos shall have documentation attached to each file as to when, where, and by whom the photo was taken.

5.8. Data Collection – Environmental Conditions

5.8.1. The CONSULTANT shall prepare an environmental overview that will be used during the alternative analysis process and throughout the planning study. The purpose of the environmental overview is to collect and provide data that will assist the project team in evaluating the environmental issues and impacts associated with each alternative. The environmental overview shall address the ecological resources located within the study area.

5.8.2. Ecological Resources. The CONSULTANT shall conduct a planning level, non-intensive ecological investigation utilizing one (1) site visit, literature review(s) and current aerial photographs to identify, inventory, and locate existing ecological resources within the study location including the vegetation communities, wildlife, sensitive species and critical habitat, water resources, and wetlands. The CONSULTANT shall contact the U.S. Fish and Wildlife Service (FWS) to get the current list of Threatened and Endangered Species (including proposed or candidate species) and the Arizona Game and Fish Department (AGFD) to obtain information regarding the presence of listed Threatened and Endangered Species, Wildlife Species of Special Concern, and designated critical habitat in the study area. The CONSULTANT shall: 1) list and define the general habitat types and/or vegetation communities in the study area, and 2) determine which, if any special status species have been noted historically in study area. Special status species include federal and state listed, proposed, or candidate species. This information will be used to compare the potential environmental impacts among the alternatives. The CONSULTANT shall prepare a report summarizing the results of this investigation. The report shall include a description and maps or aerial photographs depicting the locations of the identified ecological resources.

5.9. Data Collection Report

5.9.1. The CONSULTANT shall prepare an initial report summarizing the data collection effort. The CONSULTANT shall submit a DRAFT of this report within 120 days of the NTP. The FINAL report will be included in the Lower Hassayampa River Watercourse Master Plan – Phase I Report as either a chapter(s) or as an appendix.

5.9.2. The report will be a summary of the data collected, which includes but is not limited to the following:

a. Engineering – Hydrology, Hydraulics, Sediment Transport

b. Groundwater Recharge
c. Environmental
d. Regulatory – Required Permits and Regulations
e. Existing and Future Land Use Plans

5.9.3. The report shall include sections that address each task item as specified in this SOW. This shall include exhibits, summaries, and listing of reference materials.

5.9.4. The data developed will also be compiled into a digital database included with the Data Collection Report. The database will be in tabular and GIS format to the extent logical to the nature of the collected data at the discretion of the CONSULTANT.

6. HYDROLOGY

6.1. Existing Studies

6.1.1. The CONSULTANT shall research and review existing surface water hydrologic studies of the area. A detailed listing of the collected data will be provided in the Data Collection Report.

6.2. Analysis

6.2.1. The CONSULTANT shall perform a current flood flow frequency analysis in accordance with the guidelines presented in the 1981 publication of "Guidelines for Determining Flood Flow Frequency," Bulletin #17B of the Hydrology Committee, U.S. Water Resources Council.

6.2.1.1. The CONSULTANT shall collect peak stream gage data from USGS and DISTRICT gages.

6.2.1.2. The CONSULTANT will determine peak flow rates for the 2-, 5-, 10-, 25-, 50-, and 100-year frequency floods.

6.2.1.3. The CONSULTANT shall review and assess the reasonableness of the results of the flood flow frequency analysis in comparison with past studies and explain any major differences.

6.2.2. The CONSULTANT shall determine the 2-, 5-, 10-, 25-, 50-, and 100-year peak discharges at the following locations along the study reach: at the confluence with the Gila River; at Stream Gage Station 09517000 (Arlington); at Interstate 10; at the confluence of Jackrabbit Wash; just above the confluence of Jackrabbit Wash; at Granite Reef Aqueduct, and at Stream Gage Station 09516500 (Morristown).

6.2.2.1. The CONSULTANT shall address flow attenuation and the contribution of Jackrabbit Wash in the determination of discharges in the lower Hassayampa River.

6.2.3. The CONSULTANT shall conduct a simplified HEC-1 model of the basin to develop potential hydrograph shapes and investigate future conditions discharges. The modeling shall be limited to approximately five (5) subbasins. Future conditions land use cover shall be interpreted from the future land use information collected in Task 5.

6.2.4. The CONSULTANT will use the existing HEC-1 model for Jackrabbit Wash prepared previously for the DISTRICT by Burgess-Niple and Associates.

6.2.5. The CONSULTANT will consider the results of USGS regression equation estimates of peak discharge for several key concentration points on the Hassayampa River and Jackrabbit Wash.

6.2.6. The CONSULTANT shall prepare hydrographs for use in the HEC-6 analyses.

6.2.7. The CONSULTANT shall prepare and submit an DRAFT Hydrology Report to the DISTRICT for review. The Report will document the results of the flood flow frequency analyses, the determination of discharges analyses, and the selection of the hydrographs for use in the HEC-6 analyses. The CONSULTANT will not proceed with the hydraulic analyses until such time that the DISTRICT has approved the DRAFT Hydrology Report.

6.2.8. The CONSULTANT shall submit a FINAL Hydrology Report as a Technical Data Notebook (TDN) in SS1-97 format. In addition, a section of the Lower Hassayampa River Watercourse Master Plan – Phase I Report will summarize the findings of the hydrologic analysis.

7. HYDRAULICS

7.1. Existing Studies

7.1.1. The CONSULTANT shall research and review existing hydraulic studies of the area. A detailed listing of the collected data will be provided in the Data Collection Report.

7.2. Analyses

7.2.1. The CONSULTANT shall develop a HEC-RAS hydraulic model to evaluate thalweg migration and bed elevation changes.

7.2.1.1. Cross sections for the HEC-RAS modeling will match the location and orientation of the effective FEMA HEC-2 model cross sections for three (3) cross sections of each mile of delineation. Sections will also be provided at all bridges, major dip crossings, and significant changes in the topography. All cross sections will be oriented left to right looking downstream with the thalweg as station 10,000.

7.2.1.2. Topographic mapping developed by the DISTRICT shall be used to generate the cross section data. The mapping was developed for a 1-inch = 200-feet scale and at a 2-foot contour interval.

7.2.1.3. The CONSULTANT will obtain the DISTRICT's approval of the cross section locations prior to cutting the cross sections.

7.2.1.4. The CONSULTANT shall provide a work map showing the cross section and thalweg 10,000 station locations. The topographic mapping provided by the DISTRICT will serve as the basis for the work map. All maps will include the scale, north arrow, contour interval, road names, and any other misc. cartographic data provided by the DISTRICT.

7.2.2. The CONSULTANT will use the results of the effective FEMA HEC-2 encroached (floodway) analysis to re-evaluate flow attenuation and estimate potential future conditions peak discharges in the lower Hassayampa River due to encroachment.

7.2.3. The developed HEC-RAS model will be used as the base hydraulics model for use in the Sediment Transport Analysis discussed in Task 9.7 of this SOW.

7.2.4. The CONSULTANT will identify the extent of the flooding using the information from the hydraulic model developed for this study. The CONSULTANT will make a qualitative comparison of the flooding extent identified from the newly developed hydraulic model, the effective FEMA floodplain limits, and the geomorphic floodplain determined in Task 9.4.3.4. The CONSULTANT will make a recommendation to the

DISTRICT as to whether or not the effective floodplain for the lower Hassayampa River should be re-studied. The deliverable for this task will be a brief letter memorandum to the DISTRICT of the recommendations and qualitative rationale for the recommendation. The memorandum will include a map comparing the flooding extents of the new hydraulic model, the effective FEMA floodplain limits, and the geomorphic floodplain. A new detailed FEMA-style floodplain is not part of this task.

7.2.5. The CONSULTANT shall prepare and submit for review and comment, a DRAFT report addressing the results of the analyses. The report will include a comparison of the natural to future conditions flows and sediment issues, and will include recommendations regarding encroachment of the watercourse. The FINAL report will be incorporated into the TDN for the Lower Hassayampa River Watercourse Master Plan – Phase I Report.

7.2.6. **(Optional) Two-Dimensional Modeling**. The CONSULANT shall develop a two-dimensional model (RMA2) to study flows in the lower three (3) miles of the lower Hassayampa River. The model will be developed such that the distribution of flows through the confluence area can be determined and presented. The model will extend far enough above the three (3) mile study reach so as to provide accurate flow distribution between the floodplain and overbanks at the upstream limit of the three (3) miles to be modeled. The model will be developed such that up to three (3) flow events can be modeled to view the hydraulic characteristics of the area. **The optional two-dimensional model is not authorized with the NTP and may be authorized in writing by the DISTRICT based upon specific need as determined by the DISTRICT during the contract period.** Project fee proposals and invoices shall list the authorized amounts for the optional two-dimensional model task separately from the balance of the contract amount, and shall list the total amounts authorized. Implementation of the optional two-dimensional model task may include an extension of the contract time period. The CONSULTANT's original schedule for the contract shall, therefore, not include a scheduled optional activity for the two-dimensional model.

7.2.7. **(Optional) Hydraulic Surveys.** The DISTRICT has existing photogrammetric mapping and it is not anticipated that photogrammetric mapping will be required under this SOW. However, the CONSULTANT shall evaluate the need for additional survey data, and shall make recommendations if additional survey data is required. If in the CONSULTANT's judgment, supplemental survey data is required, the CONSULTANT shall prepare and submit a plan done in accordance with chapter 3, Survey, Photogrametry and Mapping, of the Consultant Guidelines. **The optional surveys are not authorized with the NTP and may be authorized in writing by the DISTRICT based upon specific need as determined by the DISTRICT during the contract period.** Project fee proposals and invoices shall list the authorized amounts for the additional survey task separately from the balance of the contract amount, and shall list the total amounts authorized. Implementation of additional surveys will not include an extension of the contract time period. The CONSULTANT's original schedule for the contract shall, therefore, include a scheduled optional activity for the optional surveys.

8. FLOODPLAIN DELINEATIONS

8.1. Floodplain Delineations

8.1.1. The CONSULTANT shall perform a detailed floodplain delineation study for Jackrabbit Wash for the reach that will tie into the existing detailed floodplain just north of the CAP Canal to the Hassayampa River, including the breakout floodplain area upstream of the Salome Highway.

8.1.2. The CONSULTANT shall perform the tasks as required in the Consultant Guidelines for Section 11.0 (Floodplain Delineation Studies) except as noted in the following:

8.1.3. Section 11.1 Coordination shall be deleted and shall be done in accordance with this SOW.

8.1.4. The estimated length of the area to be re-delineated is approximately 10 linear miles from the confluence with the Hassayampa River to the CAP Canal as shown on Figure 1. This re-delineation shall replace the existing approximate floodplain delineation with a detailed floodplain delineation.

8.1.5. **(Optional) Floodplain Surveys.** The DISTRICT will provide digital 2-foot mapping at 1-inch = 200-feet scale and the associated survey notebooks for this task. However, the CONSULTANT shall perform any required additional surveys per Consultant Guidelines Section 3. Survey, Photogrammetry, and Mapping. If in the CONSULTANT's judgment, supplemental survey data is required, the CONSULTANT shall prepare and submit a plan done in accordance with Section 3. Survey, Photogrammetry and Mapping, of the Consultant Guidelines. **The optional surveys are not authorized with the NTP and may be authorized in writing by the DISTRICT based upon specific need as determined by the DISTRICT during the contract period.** Project fee proposals and invoices shall list the authorized amounts for the additional survey task separately from the balance of the contract amount, and shall list the total amounts authorized. Implementation of additional surveys will not include an extension of the contract time period. The CONSULTANT's original schedule for the contract shall, therefore, include a scheduled optional activity for the optional surveys. This shall include submitting the required survey field notebook(s), TDN, topographic base maps with the floodplains and the floodways, and reports.

9. RIVER BEHAVIOR

9.1. Purpose

9.1.1. The purpose of this task is to compile, analyze, and present the best available information representative of the fluvial processes for the Hassayampa River within the study corridor, including tributaries that significantly affect sediment supply and lateral stability. The CONSULTANT shall identify and document the current and historical patterns of aggradation/degradation as well as the patterns and potential for lateral migration of the channel system. Five (5) main analyses shall take place in order to satisfy the requirements of this SOW task: Geomorphic Analysis, Bed Elevation Analysis, Lateral Migration Analysis, Sediment Transport Analysis, and Sediment Trend Analysis.

9.2. Data Collection

9.2.1. The CONSULTANT shall collect the following data in support of the analyses identified in Task 9.1 and as described in Task 5.

9.3. Field Investigations/Sediment Sampling

9.3.1. The CONSULTANT shall conduct field visits to the study reach to observe and document channel and floodplain conditions for use in the geomorphic analyses, sediment transport analysis, and lateral stability assessment. During the field investigations, the CONSULTANT will holistically consider the river along with those tributary confluence areas that are required to understand sediment transport or that affect lateral stability of the study corridor. This investigation shall include: photographic documentation of sediment characteristics, inspection of flood control or drainage structures, staking of locations for collection of sediment samples, documenting geomorphic features such as, terraces, channels and sand bars, and evidence of past lateral channel movement, and descriptions of soil profiles and surficial characteristics.

9.3.2. Sediment Sampling and Testing. The CONSULTANT shall obtain and test samples of the existing channel bed and banks throughout the study reaches. Samples may be obtained from up to 25 locations determined by the CONSULTANT and approved by the DISTRICT. Representative samples shall be obtained from the channel bed (active transport layer) and primary channel banks, for a total of up to 50 samples. Visual estimates of bank sediment characteristics may be substituted for physical samples, at the discretion of the CONSULTANT, where bank conditions prevent normal sampling procedures. In addition, pebble count samples shall be obtained for the surface layer of the channel bed at each sampling location where a significant fraction of cobble-sized material is present. The sampling procedures shall be consistent with procedures described in the Bureau of Reclamation's, Computing Degradation and Local Scour, January 1984, or the US Army, Corps of Engineers, Sedimentation Investigations of Rivers and Reservoirs, dated October 31, 1995. Gradations (based on pebble counts or sieve analysis) of the sediment samples shall be plotted for both the channel bed and banks. Changes in the gradations throughout the study reach shall be documented.

9.3.3. Field Reconnaissance Report. The CONSULTANT shall prepare a field reconnaissance report that summarizes the field investigation and site survey including photographs to document field sediment information, observations of sand and gravel mine activity, levees, bridges, geomorphic features, etc. The field reconnaissance report shall be delivered as a chapter in the River Behavior Report.

9.4. Geomorphic Analysis

9.4.1. The purpose of the geomorphic analysis is to identify the current and historical geomorphology for the lower Hassayampa River study reach.

9.4.2. Stream Classification. The CONSULTANT shall prepare a stream classification description that documents key geomorphic features, describes on-going channel processes including movement of thalwegs, channel and floodplain characteristics, bed and bank control locations (natural and man-made) and hydrologic processes. The stream classification is to serve as the basis for selection of appropriate engineering and geomorphic analytical techniques. The present stream classification should be compared to historical channel and floodplain characteristics and processes to determine if the river has undergone any significant behavioral changes during the period of record.

9.4.3. Geomorphic Mapping of Surficial Landforms. The CONSULTANT shall prepare maps of geologically-recent landforms along the study reach. The objective in preparing the mapping is to identify evidence of geologically recent lateral channel movement, sediment distributions, and to constrain the limits of potential movement by the presence of geologically old surfaces. The CONSULTANT is to use the presence and degree of development of desert varnish, paleoflood evidence, degree of soil profile development, carbonate stage (caliche), archaeological information, surficial characteristics, as well as the interpretation of historical maps and photographs, and other available information as aids in determining geomorphic surfaces along the river corridor. The CONSULTANT will provide a backhoe and operator to excavate up to 20 soil pits to facilitate soil descriptions by the CONSULTANT.

9.4.3.1. Delineate main channel boundaries during the period of record of the maps, surveys, and aerial photos collected.

9.4.3.2. Delineate geomorphic functional surfaces (terraces, sand bars, etc.) during the period of photographic record, as shown on the oldest set of aerial photographs, the most recent set of aerial photographs, and sets of aerial photographs that bracket the time of up to two (2) large floods.

9.4.3.3. Delineate the historical limits of lateral migration indicated by comparison of historical aerial photography.

9.4.3.4. Delineate the Holocene floodplain limits.

9.4.4. The CONSULTANT shall identify representative reaches for the study.

9.4.5. Empirical Geomorphic Relationships. The CONSULTANT shall apply established empirical geomorphic relationships that describe channel pattern relationships, channel planiform, and channel geometry. The objective of these analyses is to predict lateral and vertical channel movement in response to ongoing natural processes. The CONSULTANT is to classify each defined reach as geomorphically stable (in equilibrium) or unstable. This information, in combination with projected disturbances to critical key geomorphic indicators resulting from urbanization of the watershed, is to be used to estimate the effects on the existing condition stability assessment of each reach.

9.4.6. The CONSULTANT shall submit a Geomorphic Analysis Report documenting and describing the above geomorphic analysis including exhibits.

9.5. Potential Bed Elevation Change Analysis

9.5.1. Scour Analysis. The CONSULTANT shall use the methods and guidelines provided in the Bureau of Reclamation manual titled "Computing Degradation and Local Scour" (January, 1984), the ADWR manual titled "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985), or the Federal Highway Administration's "Highways in the River Environment" (February 1990).

9.5.1.1. Local scour will be computed, if required and appropriate, for hydraulic base conditions.

9.5.1.2. Scour depths. The long-term and general scour depths shall be estimated using appropriate methodologies to be determined by the CONSULTANT.

9.5.2. Base Levels. Regional and local base levels will be identified and taken into consideration for calculating scour, equilibrium slope and armoring potential.

9.5.3. Natural and man-made constraints on bed lowering migration will be identified.

9.5.4. Equilibrium Slope. Equilibrium slope shall be estimated using appropriate methodologies to be determined by the CONSULTANT and approved by the DISTRICT.

9.5.5. Armoring. The potential for channel bed armoring will be evaluated, and the depth of scour required to form an armor layer shall be estimated using appropriate methodologies to be determined by the CONSULTANT and approved by the DISTRICT. The potential of the lower Hassayampa River to armor itself will be assessed for both the 10-year and 100-year peak discharges.

9.5.6. The CONSULTANT shall identify changes in bed elevation from the comparison of current and historical topographic mapping; current and historical USGS gage cross-section surveys; and current and historical bridge monitoring records.

9.5.7. The CONSULTANT shall prepare a Bed Lowering Analysis Report documenting and describing the potential for bed lowering based on the above analysis.

9.5.8. The CONSULTANT shall investigate evidence of long-term aggradation, including field data and information obtained by comparison of historical topographic data.

9.6. Sediment Transport Analysis

9.6.1. The purpose of the sedimentation analysis task is to simulate the long-term streambed profile response of the lower Hassayampa River based on natural and existing conditions within and along the river corridor. The CONSULTANT shall identify contributing sediment supplies from the major tributaries and upstream, if significant.

9.6.2. Sediment Transport Function Selection. The CONSULTANT shall identify three (3) DISTRICT approved total load and/or bed load sediment transport functions appropriate for the lower Hassayampa River to use in the sediment transport modeling.

9.6.3. Sediment Inflow. Inflowing sediment quantities shall be assessed based on the sediment sampling performed under Task 9.3 for the significant tributaries and upper Hassayampa River.

9.6.4. Sediment Transport – Modeling. The CONSULTANT shall develop four (4) base condition sediment models using HEC-6 for the lower Hassayampa River study length. The CONSULTANT shall recommend which specific scenarios shall be modeled for the four (4) base conditions. It is expected that at least one (1) will be based on the period of record for the USGS gage. The DISTRICT's Project Manager will approve the base condition scenarios before the CONSULTANT proceeds with the HEC-6 modeling. The base condition models will be developed using the updated hydraulic model from Task 7.2. The sediment model will establish existing base conditions of the lower Hassayampa River. The models will be modified, as appropriate. The models will be used to assess potential reaches of aggradation or degradation and to estimate the range of general scour for the various conditions. The impact of sediment deposition during major flood events will be evaluated regarding the alternatives.

9.6.5. Model Hydrology. The hydrologic record for the analysis will be developed from USGS records for the lower Hassayampa River for the period of record for the gage. A synthesized 100-year flood hydrograph will be added to the end of that historically based hydrologic record. The hydrographs for the other floods will be taken from the analysis performed under Task 6.2.

9.6.5.1. Sensitivity Analyses. The CONSULTANT will perform sensitivity analyses on the base models, as necessary, to evaluate sensitivity to input parameters such as Manning's "*n,*" inflowing sediment load, particle size, and transport function.

9.6.5.2. Model Limits. The upstream limit for the model will be selected so as to provide reasonably definable boundary (inflow) conditions. The downstream limit will extend to the confluence with the Gila River. Upstream and downstream boundary conditions will be determined.

9.6.5.3. Model Analyses. The sediment models will establish existing base conditions. The models will be modified as appropriate. The models will be used to assess potential reaches of aggradation or degradation for each reach assuming no bed control restraints. The impact of sediment (erosion or fill) during major flood events will be evaluated.

9.6.6. Sediment Transport – Reach Equations. The CONSULTANT shall perform a sediment transport analysis using sediment transport functions applied on a reach-by-reach basis for selected representative study reaches and compare these results with the HEC-6 model results. Digital versions of the spreadsheet or other automated calculations performed, as part of this task will also be delivered to the DISTRICT as part of this task. The purpose of the delivery of these spreadsheets is to allow the DISTRICT to replicate the CONSULTANT's calculations.

9.6.7. At a minimum, the same sediment transport functions selected under Task 9.6.2 for the HEC-6 analysis shall be used for the reach-by-reach analysis, along with up to three (3) additional equations (total of up to six [6] equations). The CONSULTANT will construct sediment rating curves for each transport function used that illustrate the change of transport capacity over a range of discharge rates. In addition, the CONSULTANT shall analyze and evaluate the results of up to four (4) headcutting models related to gravel pits. The CONSULTANT shall recommend which methods to evaluate and the DISTRICT's Project Manager will approve the selection of the models to be evaluated. Digital versions of the spreadsheet or other automated calculations performed as part of this task will also be delivered to the DISTRICT as part of this task. The purpose of the delivery of these spreadsheets is to allow the DISTRICT to replicate the CONSULTANT's calculations.

9.6.8. The analysis in Task 9.6.7 will include existing conditions, as well as currently permitted sand and gravel mines. The CONSULTANT will conduct an evaluation of mining scenarios, typical impacts, and alternative methods of evaluating impacts of mining using up to three (3) methodologies to be selected by the CONSULTANT and approved by the DISTRICT Project Manager. The objective of this evaluation will be to assess the results and effectiveness of using HEC-6 to model the impacts of sand and gravel mining, and to identify alternative methods for assessing the impacts of sand and gravel mining in the flood and erosion hazard zone. The evaluation will also include an assessment of safe yield for aggrading reach, if any such reaches are identified.

9.6.9. The analysis will include calculations for the 100-year, 10-year events, average annual and a typical runoff event.

9.6.10. Sediment Transport Report. The CONSULTANT shall prepare a narrative report describing the modeling procedure and assumptions. Results will be presented graphically and tabular to demonstrate the findings of the analyses.

9.7. Potential Lateral Migration Analysis

9.7.1. The CONSULTANT shall estimate the potential lateral migration of the lower Hassayampa River and Jackrabbit Wash downstream of the CAP, by analyzing historical information gathered during the data collection phase, and by the analysis of the geomorphic, hydraulic and sediment modeling investigations. The objective in preparing the mapping is to identify evidence of geologically recent lateral channel movement, to constrain the limits of potential movement by the presence of geologically old surfaces, and to differentiate between levels of severity of erosion hazards using the hydraulic and sediment model results in combination with the geomorphology results.

9.7.2. The CONSULTANT shall document and compare historical channel positions to identify the location and magnitude of historical change and lateral movement. The CONSULTANT will quantify and characterize channel changes that occurred during the period of record. The CONSULTANT will compare historical and recent topographic maps of the study reach to identify and quantify trends in lateral channel change.

9.7.3. If appropriate, channel locational probabilities shall be determined to help describe migration trends. Locational probability shall be defined based on the spatial and temporal duration, or other methods, as determined by the CONSULTANT.

9.7.4. Natural and man-made constraints on lateral migration shall be identified.

9.7.5. The CONSULTANT will determine if locations that have not been impacted by the main channel in the past have the potential to be impacted in the future based on present geomorphic and hydraulic conditions and projected future conditions resulting from urbanization of the watershed.

9.7.6. The CONSULTANT will investigate the types of flow events that may have been responsible for the observed changes in channel position, focusing on recurrence interval as well as the duration of the event.

9.7.7. The types of historical and potential channel migration will be identified, discussed, documented, and mapped to the extent possible.

9.7.8. The CONSULTANT will take into consideration information from the Sediment Transport Analysis identifying potential degradation in locations where there are known vertical controls.

9.7.9. Erosion Hazard Zone Boundaries. Erosion zone boundaries shall be identified for each study reach based on present geomorphic and hydraulic conditions. Three (3) zones are to be identified: (i) zones of severe erosion hazard resulting from a 100-year flood, (ii) zones of avulsion/lateral migration resulting from a series of storms over a 60- to 100-year period, and (iii) zones of long term erosion hazard potential for a period of 100- to 1,000-years based on the geomorphologic investigations. The delineation will be based on a Level Three Analysis from the DISTRICT's "Erosion Hazard Guidelines" (draft 2003) and will be in compliance with the State Standard Attachment 5-96, Level 3 requirements. Information supporting the delineations will be documented on a reach-by-reach basis for all reaches identified in Task 9.4.4. The CONSULTANT shall deliver the resulting erosion hazard boundaries in electronic format to the DISTRICT.

9.7.10. The CONSULTANT shall prepare a Lateral Migration Analysis Report that shall describe the results of the tasks for determining the potential lateral migration of the lower Hassayampa River. The report shall discuss how the potential lateral migration was determined, how the migration zones may be affected by urbanization of the watershed, and how the defined erosion hazards and potential for change resulting from urbanization may affect flood control issues within the area. The CONSULTANT shall submit a DRAFT report for review and comment. The CONSULTANT shall address all appropriate comments when the Lateral Migration Analysis Report is incorporated into the FINAL Lower Hassayampa River Watercourse Master Plan – Phase I Report. The CONSULTANT shall prepare maps showing channel boundary locations during the period of record, and prepare side-by-side plots of aerials photographs from different years of coverage.

9.8. Sediment Trend Analysis

9.8.1. The CONSULTANT shall develop a Sediment Trend Analysis that will be used as an analytical tool to evaluate the impact of future plans, including projected sand and gravel activities. The sediment trend analysis will be sufficient to project trends and impacts on infrastructure, but is not intended to be a site-specific management tool for regulating individual sand and gravel operations.

9.8.2. Lateral distribution of sediment over the period of record. Using the functional surfaces identified under Task 9.4, the CONSULTANT will determine whether there are geomorphic trends that support aggradation/degradation patterns predicted by the HEC-6 and hand calculations of sediment transport equation analyses.

9.8.3. Using the analyses from Tasks 9.4 through 9.7, identify how, presently and historically, sediment has been transported through the study reach and the expected river behavior. Discussions regarding sediment transport in relation to flow events, sand and gravel permits, and natural channel controls must be included along with discussions describing future conditions such as, impacts of encroachment, and extensive sand and gravel mining. Trends in aggradation and degradation should be identified and quantified.

9.8.4. The CONSULTANT shall prepare a narrative report describing the Sediment Trends for the lower Hassayampa River based on the sediment transport modeling, scour analysis, and lateral migration analyses performed. Supporting documentation for all topics of discussion should be provided as appendices to the report. This report will be included as a chapter in the River Behavior Report, and will include recommendations for future study, planning, and analysis.

9.9. Comparison of Sediment Transport Methods

9.9.1. The CONSULTANT shall conduct a comparison and evaluation of the results of the various sediment transport methods applied in Task 9.7 with the Trend Analysis (Task 9.8) and other approaches (Tasks 9.3 through 9.6). The primary purpose of the evaluation will be to make a recommendation for the preferred approaches for future Watercourse Master Plan studies. In particular, the success, accuracy, and need for future HEC-6 modeling will be addressed.

10. DELIVERABLES

10.1. General

10.1.1. The CONSULTANT shall submit all items 'sealed' by the appropriate registrant. Upon receipt of the FINAL submittal, the DISTRICT shall review the report and preliminary plans for the accurate incorporation of all final comments. If incomplete and/or incorrect incorporation of those comments is found as determined by the DISTRICT, the original documents shall be returned to the CONSULTANT for correction and re-submittal. Additionally, all costs to correct these deficiencies shall be at the sole expense of the CONSULANT.

10.1.2. The CONSULTANT shall submit computer files of the information to the DISTRICT delivered on CDROMs. All reports shall be prepared in MS Word and all spreadsheets shall be in MS Excel or an alternate format approved by the DISTRICT and shall be submitted with each required submittal. Data and plans shall be submitted in CADD ASCII.DXF format per the DISTRICT's Hydrologic Information System (HIS) database and shall comply with the DISTRICT's "HIS Data Delivery Specifications," Rev 3.1, dated June 1, 1998, or alternate format approved by the DISTRICT.

10.1.3. The CONSULTANT shall submit to the DISTRICT, unless otherwise specified in the SOW, five (5) paper copies of all DRAFT reports for review and five (5) paper copies with a CD containing a PDF version of all the FINAL reports (including graphics).

10.1.4. The CONSULTANT shall submit to the DISTRICT a CD of all FINAL graphics in the native format that it was created/developed.

10.2. Reports

10.2.1. Data Collection Report

10.2.1.1. The Data Collection Report will contain a description of the known flooding problems within the study area, the data collected, and the existing drainage structures in the area and discuss any surveying that has been performed. Existing major natural washes and existing and planned man-made drainage facilities in the watershed will be shown on the Existing Facilities Exhibit to be submitted with the Data Collection Report.

10.2.1.2. The Data Collection Report shall include but not limited to the following:

a. Executive Summary
b. Project Description
c. Scope of Project
d. Data Collection Results
   1. Current Conditions
   2. Future Conditions
   3. Areas of Past and Potential Flooding
   4. Existing and Future Development Plans
   5. Current and Future Transportation Plans
      i. Existing and Future Drainage Facilities Exhibit
      ii. Areas of Flooding
   6. Existing and Future Developments, and Land uses
   7. Major Utilities
   8. Historic Flooding Photos
   9. Historic Photos for the Project area
e. Environmental Permits and Approvals
f. Land
   1. Rights-of-Entry Requirements
   2. Land Use/Zoning Map
   3. Rights-of-Entry Requirements
   4. Existing Hydrology and Hydraulics Models
g. Summary of Models/Conditions
   1. Concerns
   2. References/Figures

10.2.2. The Hydrologic Report

10.2.2.1. The findings of the hydrologic study will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The report will be organized as specified by the DISTRICT, following SSA 1-97 format. The report shall be submitted as required in Task 6.

10.2.2.2. Initial and draft findings of the hydrologic study will be presented in a separate report for review and comment by the DISTRICT.

10.2.3. The Hydraulics Report

10.2.3.1. The findings of the hydraulics analysis will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The report will be organized as specified by the DISTRICT, following SSA 1-97 format. The report shall be submitted as required in Task 6.

10.2.3.2. Initial and draft findings of the hydraulic analysis will be presented in a separate report for review and comment by the DISTRICT.

10.2.4. River Behavior Report

10.2.4.1. The CONSULTANT shall prepare the Report as per the requirements of Task 9 of this SOW. The River Behavior Report will include sections describing the methods and results of the following:

a. Field Reconnaissance
b. Geomorphic Analysis
c. Bed Lowering Analysis
d. Lateral Migration Analysis
e. Sediment Transport
f. Sediment Trend Analysis

10.2.5. Lower Hassayampa River Watercourse Master Plan – Phase I Report

10.2.5.1. The CONSULTANT shall prepare the Lower Hassaymapa Watercourse Master Plan – Phase I Report, Executive Summary that shall summarize the following as a minimum and the requirements of Task 3 of this SOW:

a. Description of Study Area
b. Scope of Project
c. Criteria and Objectives
d. Summaries of Findings in Other Reports
e. Stakeholders
f. Environmental and Permit Issues
g. References to Other Reports Developed as Part of this Scope of Work
h. List of Figures
i. Location Map
j. List of Tables
k. Peak Discharges

10.2.6. Project Adminstration Report

10.2.6.1. The Project Administration Report shall include copies of all schedules, correspondence, minutes of meetings and conversations with the DISTRICT, stakeholder involvement, affected agencies and others as appropriate. This report will be submitted as an appendix to the Master Plan – Phase I Report.

10.2.7. Monthly Progress Report

10.2.7.1. The CONSULTANT shall submit a Monthly Progress Report as specified in Task 2 of this SOW.

11. REFERENCES AND STANDARDS

11.1. Design Manuals, Policies and Procedures

11.1.1. "Drainage Design Manual for Maricopa County, Arizona, Volume I Hydrology," latest edition.

11.1.2. "Drainage Design Manual for Maricopa County Arizona, Volume II Hydraulics," latest edition.

11.1.3. "Drainage Design Manual for Maricopa County, Arizona, Volume III Erosion Control," latest edition.

11.1.4. "Urban Highways, Channel Lining Design Guidelines," February 1989, ADOT.

11.1.5. "Policy on Geometric Design of Highways and Streets," AASHTO, 1994, commonly referred to as the "Green Book," and "Maricopa County Department of Transportation Roadway Design Manual" latest edition and revisions shall be used, unless otherwise requested by DISTRICT.

11.1.6. "Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects," by the DISTRICT, latest edition.

11.1.7. "Channel Design Criteria for Major Watercourses," DISTRICT, latest edition.

11.1.8. "A Levee Policy for the National Flood Insurance Program," National Research Council, 1982.

11.2. Standards

11.2.1. GIS/HIS. The CONSULTANT shall prepare digital data in conformance with the Deliver specs (Rev. 3.1, dated June 1, 1998) Chapter 3 – Appendix C, CADD Delivery specs.

11.2.2. Unless otherwise approved in writing by the DISTRICT, the CONSULTANT shall use the following scales.

a. Alternative Analysis and Other – 1-inch = 1,200-feet
b. Preferred Analysis – 1-inch = 400-feet Horizontally, 1-inch = 40-feet Vertically

11.2.3. The CONSULTANT shall use a larger scale if necessary to obtain good clarity in the plans and reduced prints. The CONSULTANT shall be responsible for using a scale that results in good plan clarity.

11.3. Format

11.3.1. Drawings shall be in AutoCAD, Version 14 or higher format or as otherwise approved by the DISTRICT.

11.3.2. All lettering on drawings shall be vertical, plain, and legible. 'Architectural' style lettering shall not be accepted. The following lettering sizes apply:

a.	1/8-inch	Lettering and Notes
b.	5/32-inch	Subtitles
c.	7/32-inch	Main Titles

11.3.3. The CONSULTANT shall provide the DISTRICT with a sample sheet for the DISTRICT's approval. All drawings and graphics shall have the DISTRICT'S logo per the DISTRICT's PUBLIC INV. GUIDELINES.

Agendas

Lower Hassayampa Progress Meeting

December 7, 2004
10:00 AM to 11:00 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. **Topographic Mapping Update (District)**
   a. **Impact on project schedule**
2. **Project Status Update**
   a. **JEF/H&G**
      i. **Hassayampa River Q100**
      ii. **Geomorphic field work completed**
      iii. **2nd Team field trip**
   b. **CL Williams**
      i. **Stakeholder summary**
      ii. **Public involvement plan**
   c. **WEST**
      i. **Need topographic mapping to continue with Hassayampa**
      ii. **Jackrabbit submittal status**
3. **Deliverables & Review Schedule**
   a. **Topographic Mapping Delay Impact on Schedule – Pending**
   b. **Deliverables Due in December**
      i. **Quarterly Newsletter (District) - November**
      ii. **Hassayampa HEC-RAS? -**
      iii. **Jackrabbit 2nd Submittal - December**
4. **Public Involvement**
   a. **Next ARPA Meeting in January**

Lower Hassayampa Kickoff Meeting

June 17, 2002
3:30 AM to 5:00 PM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. – Gregory L. Jones

- Welcome
- Meeting Objectives – Develop the Project Coordination, Develop Action Items for the Data Collection Phase, and Discuss the Overall Project.

Team Member Introductions & Roles

- **District Team (Greg)**
  - District Designated Reviewers
    - Hydraulic Modeling –
    - Sediment Modeling –
    - Survey -
    - General Review –
- **Consultant Team (Jon)**
  - Consultant Designated Reviewers
    - Hydraulic Modeling – Jon Fuller
    - Sediment Modeling – Dennis Richards
    - General Review – Jon Fuller

Project Schedule (Jon)

- Milestone Dates
- FCDMC Deliverables
- Topographic Mapping

Progress Report

- Data Collection
- Hydraulic Modeling

Future Meetings

- Set Regular Team Meeting Date/Time
- Schedule Site Visit #1

Billing Issues

Lower Hassayampa Progress Meeting

August 3, 2004
9:00 AM to 11:00 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. – Gregory L. Jones/John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS – Jon Fuller

1. **Topographic Mapping Update (District)**
    a. **Scheduled mapping completion date**
    b. **Impact on project schedule**
2. **Project Status Update**
    a. **Data Collection**
    b. **Hydrologic Modeling**
    c. **Floodplain Delineation/HEC-RAS**
    d. **Stream Stability/Geomorphology/Sediment**
3. **Deliverables & Review Schedule**
    a. **Hydrology Report**
    b. **Functional Surface Analysis**
    c. **Data Collection Report**
    d. **Website/Stakeholder List/Brochure**
4. **Public Involvement**
    a. **Revised meeting date – September 16**
    b. **Draft newsletter**
    c. **Public Involvement Plan**
5. **Billing Issues**
    a. **No payment yet on June invoice.**
    b. **July invoice**

Lower Hassayampa Progress Meeting

September 6, 2005
10:00 AM to 11:30 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. – Gregory L. Jones/John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS – Jon Fuller

1. **Project Status Update**
    a. JEF/H&G
        i. Hydrology – Revised Q Impacts
        ii. HEC-6 Modeling – Report in progress
        iii. Lateral Migration Analysis – Draft report complete
        iv. ARPA Meeting: Sept 15 7:30 @ ARPA
    b. WEST
        i. Hassayampa River – HEC-RAS
        ii. Jackrabbit FDS Modeling
    c. CL Williams –
        i. Public Meeting #2
        ii. Stakeholder Meetings
        iii. Newsletter
    d. EDAW –
        i. Final Report Production
        ii. Final Report Outline
    e. Wass+Gerke –
        i. Environmental & Recharge Data Collection Summary
2. **Action Items From July Meeting**
    a. **FCDMC:**
        i. All addressed
    b. JEF/H&G:
        i. All addressed
    c. WEST:
        i. All addressed.
    d. CL Williams
        i. All addressed.
    e. EDAW

3. **Discussion Items**
    a. **Final Report Production**
        i. **Reports to EDAW: Sept 15**
        ii. **Report to team from EDAW: Nov 4 – 1 week review**
        iii. **Deliver Draft Report to District: Nov 18**
        iv. **Comments from District: Dec 12**
        v. **Final Report to District: Dec 30**
    b. **Stakeholder Meetings**
    c. **Hydraulic Modeling Deliverables**
        i. **Hassayampa – Floodway Change order**
        ii. **Jackrabbit Wash - TDN**
    d. **Alternative Evaluation Meeting – September 21 1pm @ JEF**
4. **Other Business**

Lower Hassayampa Progress Meeting

November 1, 2005
10:00 AM to 11:30 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS – Jon Fuller

1. **Project Status Update**
   a. JEF/H&G
      i. Brainstorming meeting
      ii. WCMP Report
   b. WEST
      i. Jackrabbit FDS - Status-timetable & public meeting readiness
      ii. Hassayampa Floodway evaluation
   c. CL Williams –
      i. Public Meeting #2
      ii. Stakeholder Meetings
      iii. Newsletter
   d. EDAW –
      i. Final Report Production
      ii. Final Report Outline
   e. Wass+Gerke –
2. **Action Items From Sept. Meeting**
   a. FCDMC:
      i. Addressed?
   b. JEF/H&G:
      i. Addressed?
   c. WEST:
      i. Addressed?
   d. CL Williams
      i. Addressed?
   e. EDAW
3. **Discussion Items**
   a. Final Report Production (below is schedule from Sept. meeting)
      i. Reports to EDAW: Sept 15

ii. **Report to team from EDAW: Nov 4 – 1 week review**
iii. **Deliver Draft Report to District: Nov 18**
iv. **Comments from District: Dec 12**
v. **Final Report to District: Dec 30**

b. **Public Meeting**
c. ***Stakeholder Meetings***

4. **Other Business**

Lower Hassayampa Progress Meeting

December 6, 2005
10:00 AM to 11:30 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS – Jon Fuller

1. **Project Status Update**
   a. JEF/H&G
      i. WCMP Report
   b. WEST
      i. Jackrabbit FDS - Status
   c. CL Williams –
      i. WCMP Report
   d. EDAW –
      i. Final Report Production
   e. Wass+Gerke –
2. **Action Items From November Meeting**
   a. FCDMC:
   b. JEF/H&G:
   c. WEST:
   d. CL Williams
   e. EDAW
3. **Discussion Items**
   a. Final Report Production (below is schedule from Sept. meeting)
      i. Final Report to District: Dec 30
   b. Change order for additional meetings
   c. Contract extension
   d. Additional meetings
4. **Other Business**

Lower Hassayampa
Progress Meeting

March 1, 2005
10:00 AM to 12:00 AM
@ Flood Control District Of Maricopa County's
New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. **Topographic Mapping Update (District)**
   a. **Approval Status**
2. **Project Status Update**
   a. **JEF/H&G**
      i. **Hydrology Report**
      ii. **Soil Pits – Right of Entry**
      iii. **ARPA – Stakeholder Coordination**
      iv. **Homeowner - Johnson**
   b. **CL Williams – Not attending**
   c. **WEST**
   d. **EDAW**
   e. **Wass+Gerke**
3. **Schedule Revisions**
   a. **Scope Item-by-Item Discussion**
   b. **Outstanding Deliverables**
   c. **Billing Goals**
4. **Action Items**
5. **Discussion**

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Lower Hassayampa Progress Meeting

May 3, 2005
3:30 PM to 5:00 PM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. Project Status Update
    a. JEF/H&G
        i. **Field Reconnaissance Report – Due April 30, Deliver May 30**
        ii. **Geomorphic Analysis – Due July 15, Need RAS (Soil Pits, S&G Pits)**
        iii. **Bed Elevation Change Analysis – Due July 15, Need RAS**
        iv. **HEC-6 Modeling – Due September 30, Need RAS (Sediment Data)**
        v. **Lateral Migration Analysis – Due August 15**
        vi. **Sediment Trend Analysis – Due October 30, Need HEC-6**
    b. WEST
        i. **Draft HEC-RAS Model Hassayampa**
        ii. **Jackrabbit FDS Modeling**
    c. **CL Williams – Not attending**
    d. **EDAW – Not attending**
    e. **Wass+Gerke – Not attending**
2. Discussion Items
    a. **Draft HEC-RAS Model**
        i. **Match RAS & HEC-6: Different Model, Different Purpose**
        ii. **HEC-RAS model purpose & use in project**
        iii. **Bank Stns, Lateral Weirs, Split Flows, Effective flow boundary, critical depth,**
    b. **HEC-6 Modeling – purpose & intent**
        i. **Fixed bed model target**
3. Action Items
    a. **FCDMC – Feedback on HEC-6 Hydrograph Selection (See memo)**
    b. **FCDMC – Feedback on Mining Scenario Selection (See memo)**
    c. **FCDMC – Feedback on draft Locational Probability Analysis**
    d. **FCDMC – Comments on Draft HEC-RAS submittal**
4. Other Business

Lower Hassayampa
Progress Meeting

June 1, 2005
10:00 AM to 11:30 AM
@ Flood Control District Of Maricopa County's
New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. **Project Status Update**
   a. JEF/H&G
      i. **Field Reconnaissance Report – Due April 30, Deliver June 30**
      ii. **Geomorphic Analysis – Due July 15, RAS in progress**
      iii. **Bed Elevation Change Analysis – Due July 15, RAS in progress**
      iv. **HEC-6 Modeling – Due September 30, In progress**
      v. **Lateral Migration Analysis – Due August 15**
      vi. **Sediment Trend Analysis – Due October 30, Need HEC-6**
   b. WEST
      i. **Draft HEC-RAS Model Hassayampa**
      ii. **Jackrabbit FDS Modeling**
   c. **CL Williams – Not attending**
   d. **EDAW – Not attending**
   e. **Wass+Gerke – Not attending**
2. **Discussion Items**
   a. **Hydrology Report Corrections**
   b. **Task 7.2.6 – Optional 2d Modeling: NOT recommended**
   c. **HEC-RAS Modeling – Jackrabbit, Hassayampa levee reach, review comments**
   d. **Task 7.2.2 – Attenuation Analysis: Recommended approach**
   e. **HEC-6 Modeling**
      i. **Hydrologic inputs – hydrograph shape, mean daily data set overlap, tributaries**
      ii. **Modeling scenarios – 4 scenarios selected, optimization target**
   f. **Sand & Gravel Mining Impact Analysis**
   g. **District Reviewer Status – KAG maternity leave**
   h. **Change Order Status**
3. **Action Items**
4. **Other Business**

Lower Hassayampa Progress Meeting

July 5, 2005
10:00 AM to 11:30 AM
@ Flood Control District Of Maricopa County's
New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. **Project Status Update**
    a. **JEF/H&G**
        i. **HEC-6 Modeling – Due September 30, In progress**
        ii. **Lateral Migration Analysis – Due August 15**
    b. **WEST**
        i. **Draft HEC-RAS Model Hassayampa**
        ii. **Jackrabbit FDS Modeling**
    c. **CL Williams –**
    d. **EDAW –**
    e. **Wass+Gerke –**
2. **Discussion Items**
    a. **Task 7.2.6 – Optional 2d Modeling: NOT recommended**
    b. **HEC-RAS Modeling – Jackrabbit, Hassayampa levee reach, review comments**
    c. **Task 7.2.2 – Attenuation Analysis: Recommended approach**
    d. **HEC-6 Modeling**
    e. **Sand & Gravel Mining Impact Analysis**
    f. **District Reviewer Status – KAG maternity leave**
    g. **Change Order Status**
3. **Action Items**
4. **Other Business**

Lower Hassayampa Progress Meeting

August 2, 2005
10:00 AM to 11:30 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. **Project Status Update**
   a. JEF/H&G
      i. **HEC-6 Modeling – Due September 30, In progress**
      ii. **Lateral Migration Analysis – Due August 15**
      iii. **Lower Reach Stakeholders – Schedule & Concept**
      iv. **ARPA Meeting: Sept 15 7:30 @ ARPA**
   b. WEST
      i. **Draft HEC-RAS Model Hassayampa**
      ii. **Jackrabbit FDS Modeling**
   c. CL Williams –
      i. **Public Meeting #2**
      ii. **Stakeholder Meetings**
      iii. **Newsletter**
   d. EDAW –
      i. **Final Report Production**
      ii. **Final Report Outline**
   e. Wass+Gerke –
      i. **Environmental & Recharge Data Collection**
2. **Action Items From July Meeting**
   a. FCDMC:
      i. **Jessica White - legal ads for the Jackrabbit Wash FDS placed?**
      ii. **John Hathaway - staff comments on recommended approach for Task 9.6.7.**
      iii. **John Hathaway - Reviewer for of the HEC-6 modeling.**
      iv. **Mike Duncan - comments on the Jackrabbit Wash FDS submittal.**
   b. JEF:
      i. **Jon Fuller - coordinate with Stantec & Dibble re projects in lower study reach.**
      ii. **Jon Fuller - coordinate with EDAW regarding production of final report.**
      iii. **Jon Fuller - coordinate with WGA re status & schedule for final deliverables.**
      iv. **Jon Fuller - coordinate with ARPA re schedule for next stakeholder meeting.**

c. WEST:
    i. Submit Hassayampa River HEC-RAS technical appendixes by August 1st.
d. CL Williams
    i. Chuck Williams - scheduling fall public meetings and stakeholder coordination.

3. Discussion Items
    a. Final Report Production
        i. Reports to EDAW: Sept 15
        ii. Report to team from EDAW: Nov 4 – 1 week review
        iii. Deliver Draft Report to District: Nov 18
        iv. Comments from District: Dec 12
        v. Final Report to District: Dec 30
    b. Stakeholder Meetings
    c. Hydraulic Modeling Deliverables
        i. Hassayampa – Recommendation re. LOMR, Maps/Alternatives
        ii. Jackrabbit Wash - TDN
    d. Alternative Evaluation Meeting
    e. HEC-6 Modeling
        i. Equations (Laursen-Copeland, Colby, Ackers-White, Yang) Memo Review
4. Other Business

Lower Hassayampa
Progress Meeting

September 7, 2004
9:00 AM to 11:00 AM
@ Flood Control District Of Maricopa County's
New River Conference Room

----- Agenda -----

INTRO. – Gregory L. Jones/John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS – Jon Fuller

1. **Topographic Mapping Update (District)**
   a. **Scheduled mapping completion date**
   b. **Impact on project schedule**
2. **Project Status Update**
   a. **JEF/H&G**
   b. **WEST**
   c. **WGA**
   d. **EDAW**
   e. **CLW**
3. **Deliverables & Review Schedule**
   a. **Hydrology Report Review Comments (9/6) - FCDMC**
   b. **Topographic Mapping (9/30) - FCDMC**
   c. **Public Meeting Notes (9/30) – FCDMC**
   d. **Agency Coordination Issues (9/30) – EDAW**
   e. **Update Mailing List (9/13) – CLW**
   f. **Stakeholder Meeting Documentation (9/30) – CLW**
   g. **Final Hydrology Report (9/30) - JEF**
   h. **Functional Surface Analysis - JEF**
   i. **Data Collection Report – (9/16) - JEF (Subs due today)**
4. **Public Involvement**
   a. **Public Meeting #1 – September 16**
   b. **Stakeholder Meetings**
5. **Billing Issues**
   a. **No payment yet on June or July invoice.**
   b. **August Invoice**

Lower Hassayampa Progress Meeting

October 5, 2004
9:00 AM to 11:00 AM
@ Flood Control District Of Maricopa County's
New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS – Ted Lehman

1. **Topographic Mapping Update (District)**
   a. **Scheduled mapping completion date**
   b. **Impact on project schedule**
2. **Project Status Update**
   a. **JEF/H&G**
      i. **Hydrology Report Review Comments Received from FCDMC (9/20)**
      ii. **Data Collection Report submitted 9/20 to John H.**
      iii. **Geomorphic field work initiated.**
   b. **WEST**
      i. **Field surveys initiated for Hassayampa**
      ii. **N-value report started for JRW**
      iii. **Awaiting review of XS layout and n- values on Hassayampa**
3. **Deliverables & Review Schedule**
   a. **Topographic Mapping (9/30?)- FCDMC**
   b. **Public Meeting Notes (9/30) – FCDMC**
   c. **Agency Coordination Issues – EDAW – on-going**
   d. **Final Hydrology Report under revision (10/31) - JEF**
4. **Public Involvement**
   a. **Public Meeting #1 held September 16**
   b. **Stakeholder Meetings held various dates in Sept.**

Lower Hassayampa Progress Meeting

November 2, 2004
9:00 AM to 11:00 AM
@ Flood Control District Of Maricopa County's New River Conference Room

----- Agenda -----

INTRO. –John Hathaway

- Meeting Objectives – Review team progress, discuss obstacles to future activities, and coordinate with District staff.

DISCUSSION ITEMS

1. **Topographic Mapping Update (District)**
   a. **Impact on project schedule**
2. **Project Status Update**
   a. **JEF/H&G**
      i. **Revised Hydrology Report Discussion**
      ii. **Data Collection Report Comments**
      iii. **Geomorphic field work initiated.**
   b. **WEST**
      i. **Awaiting review of XS layout and n- values on Hassayampa**
3. **Deliverables & Review Schedule**
   a. **Topographic Mapping Delay Impact on Schedule – Pending**
   b. **Deliverables Due in November-December**
      i. **Quarterly Newsletter (District) - November**
      ii. **Jackrabbit 1st Submittal - November**
      iii. **Hassayampa HEC-RAS? - December**
      iv. **Jackrabbit 2nd Submittal - December**
4. **Public Involvement**
   a. **Next ARPA Meeting in December**

Meeting Minutes

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: September 9, 2004

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: Lower Hassayampa River Watercourse Master Plan – Phase 1
Rock Products Stakeholder Coordination Meeting #1
Minutes: September 9, 2004

CC: Jan Farmer/ARPA
Jay Hicks/EDAW
Chuck Williams/CLW

The first of four scoped stakeholder coordination meetings with sand and gravel operators was held at the Flood Control District of Maricopa County (District) at 10:00 am on September 9, 2004. This memorandum summarizes the issues presented and discussed.

Attendance: The meeting sign-in sheet is attached.

District Attendees:
- John Hathaway – District Project Manager
- Greg Jones – District Regional Planning Manager
- David Boggs – District Sand & Gravel Permitting Branch Manager
- Tom Wergen – District Sand & Gravel Permitting
- Jon Fuller –Consultant Project Manager
- Jay Hicks –Consultant Planner

Stakeholders & Constituents:
- Rusty Bowers – ARPA, Executive Director
- Steve Trussell – ARPA, Community Relations Director
- Jan Farmer – ARPA – support staff
- Bill Peck – Rinker, West Division
- Tim Malcolm – Pioneer Landscaping Materials, Inc
- Jon Ahern – Kimley-Horn & Associates

Discussion Items:

1. The study limits include the Hassayampa River corridor from the Gila River confluence to the Central Arizona Project (CAP) canal crossing, and Jackrabbit Wash from the Hassayampa River confluence to the CAP canal crossing.
2. The objective of Phase 1 of the LHWCMP is characterize existing conditions, identify planning needs and constraints, and predict and understand river behaviour. Specific tasks include new hydraulic modelling of the Hassayampa River using new topographic mapping, new floodplain delineation of Jackrabbit Wash, sediment transport modelling of the Hassayampa River, and lateral erosion

hazard zone delineation for both rivers. Optional tasks include two-dimensional modelling of the levee reach of the Hassayampa River near the Gila River confluence, and submittal of revised hydraulic modelling of the Hassayampa River to FEMA as LOMR.

3. The LHWCMP Phase 1 does not include developing a river management plan or plan alternatives, but will include determining whether such a plan is needed.
4. Question/Answer Period.
   a. District: What are the concerns from the producers?
      Response: 1) Limits on mining operation, i.e., new regulations
      2) Loss of product resources (limit mineable land area)
      3) It was suggested that the District consider alternatives that enhance river channel stability through the activities from aggregate mining (a Phase 2 activity).

   b. District: Has the industry considered mining sources outside river corridor?
      Response: Material in uplands has too much clay and/or caliche.

   c. District: Are you saying you would like to see Phase 2 implemented?
      Response: If and when FCD initiates Hassayampa Phase 2, WCMP, ARPA requests representation and participation in the strategic planning efforts in developing alternatives and conceptual designs for Hassayampa WCMP.

   d. Stakeholder: What does the District need from ARPA?
      Response: 1) Access to property, possibly for soil pits
      2) Sediment sieve analysis results
      3) Future mining locations in development master plans

   e. Stakeholder: What are FCD structural goals?
      Response: There are no alternatives, structural or otherwise, included as part of Phase 1 of the LHWCMP. The study scope is to collect data and offer recommendations. The focus is to understand the existing (baseline) conditions of the river.

   f. Stakeholder: Is a (Agua Fria River type) channelization plan feasible?
      Response: That would be a Phase 2 planning activity. Progress in formulating alternatives will likely be driven by development timing and that for the near future, sand & gravel mining and concerns of the agricultural community may be the drivers rather than the proposed planned communities.

Action Items:

1. Rusty Bowers will discuss with Stakeholders provisions for FCD consultant (JE Fuller) to access operational sites for the assessment of riverine hazards within FCD SOW.
2. Sampling sediment grain size can be acquired from producers – no digging or trenching is required.
3. Next meeting set for December 2004. The meeting will be held at ARPA as part of a regular ARPA member meeting, and will consist of a brief project update and question/answer period. Jon Fuller and Jan Farmer will coordinate on meeting specifics. Stakeholders and constituents will be notified.
4. If Stakeholders have questions or concerns they can contact Jon Fuller or John Hathaway.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: January 20, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: Lower Hassayampa River Watercourse Master Plan – Phase 1
Rock Products Stakeholder Coordination Meeting #2
Minutes: January 20, 2005

CC: Jan Farmer/ARPA
Jay Hicks/EDAW
Chuck Williams/CLW

The second of four scoped stakeholder coordination meetings with sand and gravel operators was held at the Arizona Rock Products Association Offices at 7:30 am on January 20, 2005. This memorandum summarizes the issues presented and discussed.

Attendance: The meeting sign-in sheet is attached.

District Attendees:
John Hathaway – District Project Manager
Jon Fuller –Consultant Project Manager
Jay Hicks –Consultant Planner

Stakeholders & Constituents:
Rusty Bowers – ARPA, Executive Director
Steve Trussell – ARPA, Community Relations Director
Jan Farmer – ARPA – support staff
Members of ARPA Environmental Committee

Discussion Items:

1. Jon Fuller presented a brief overview of the LHWCMP Phase objectives and scope and gave a status report on completed tasks (data collection, initial stakeholder coordination, and hydrologic modelling), as well as tasks yet to be completed (floodplain delineation, erosion hazard delineation, sediment transport modelling). The latter tasks have been delayed due to delays in obtaining topographic mapping from the District.
2. Question/Answer Period.
    a. District: **Did the recent floods have any impacts**?
    Response: Not really. Pits filled with water.

    b. District: Our team would like access to the existing pits to support the geomorphic assessment and sediment transport study.
    Response: 1) The team should work with each operator individually.

c. Stakeholder: Since your report will be part of the public record, will your presence in the pit lead to disclosure of confidential information? What will you be looking at?
Response: Our report will be public record. We would like to observe subsurface soil conditions, such as material size, occurrence of carbonate, reddening, clay content, stratigraphy, and presence of a scour line. The information will be used to support and verify geomorphic mapping and sediment transport modelling. We will discuss our intent and objectives with the individual owners.

d. Stakeholder: Who are the other stakeholders?
Response: Public & regulatory agencies, utilities, farmers, and individual property owners.

e. Stakeholder: What has been the reaction to delineation of erosion hazards, particularly outside the 100-year floodplain?
Response: In general, affected landowners don't like hazards delineated on their property. However, there are significant long-term benefits to the general public when natural hazards are identified that are often better appreciated when natural disasters occur.

f. Stakeholder: What can ARPA and its members do?
Response: Be informed about the LHWCMP. Be thinking of management alternatives you would like addressed in Phase 2 if that phase is authorized by the District. Ask questions about the process and/or results.

g. Stakeholder: What management alternatives could be considered?
Response: A range could be considered (in Phase 2, not currently authorized), that might include preserving the status quo, implementing a Agua Fria channelization plan, or developing a river-specific mining plan.

h. Stakeholder: Watercourse master plans are technical and are not land use plans.
Response: Watercourse master plans are flood control plans based on technical information. Some elements may affect land use.

i. Stakeholder: Will the technical components be peer-reviewed?
Response: Yes, within the project team, plus District review. We're open to any additional review by ARPA so desired.

Action Items:

1. The next meeting with ARPA will be scheduled after completion of the floodplain delineation and sediment transport modelling. The study team is waiting for topographic mapping to determine the date when modelling will be completed.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: September 19, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: Lower Hassayampa River Watercourse Master Plan – Phase 1
Rock Products Stakeholder Coordination Meeting #3
Minutes: September 15, 2005

CC: Jan Farmer/ARPA
Jay Hicks/EDAW
Chuck Williams/CLW

The third of four scoped stakeholder coordination meetings with sand and gravel operators was held at the Arizona Rock Products Association Offices at 7:30 am on September 15, 2005. This memorandum summarizes the issues presented and discussed.

Attendance: Meeting attendance was noted by ARPA.

District Attendees:
- John Hathaway – District Project Manager
- Jon Fuller –Consultant Project Manager
- Jay Hicks –Consultant Planner

Stakeholders & Constituents:
- Steve Trussell – ARPA, Community Relations Director
- Jan Farmer – ARPA – support staff
- Members of ARPA Environmental Committee

Discussion Items:

1. Jon Fuller presented a brief overview of the LHWCMP Phase objectives and scope and gave a status report on completed tasks. The Phase 1 technical analyses are completed or nearly so. Draft reports will be generated by mid-October. The team will be begin the alternative brainstorming process on September 21st. Alternative evaluation will occur during Phase 2, which has not yet been scoped or contracted.
2. Discussion Items
   a. ARPA members requested to be included in the alternative brainstorming meeting. John Hathaway stated that the meeting is for project staff only. Given the preliminary level of planning that will occur at the brainstorming meeting, participation by stakeholders is not warranted. ARPA will be briefed about the outcome of the brainstorming at their October or November Environmental Committee meeting, and have an opportunity to comment at that time. At that meeting, the team will present maps and documentation of the study results to date. Formal participation by stakeholders in alternative evaluation will occur during Phase 2. John further offered to hold additional

meetings with ARPA to keep them informed and involved in the planning process.

b. Jon Fuller asked if there were specific alternatives that ARPA would like considered at the brainstorming meeting. No specific alternatives were suggested, but ARPA stressed the following:
    i. Aggregate resources are an important element in future growth of the LHWCMP study area. Allowance for future mining should be provided by the plan.
    ii. ARPA would like to be involved as early as possible in the planning process.
    iii. ARPA would like to be better informed about the results of the technical analyses completed as part of Phase 1. A briefing showing location, characteristics, etc. should be part of the next ARPA stakeholder presentation.
    iv. An Agua Fria River channelization plan might not be appropriate for the Lower Hassayampa River.
c. Several questions were raised about the results of the sand and gravel mining impacts analyses. Jon Fuller invited ARPA members to have their engineers contact him directly.
d. John Hathaway requested that ARPA prepare a rough estimate of the potential total demand for aggregate vs. time for the study area.
e. John Hathaway noted that Maricopa County is initiating an internal multi-agency planning effort for the far west valley.

Action Items:

1. ARPA will schedule the next stakeholder coordination meeting for November.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: June 17, 2004

TO: Greg Jones, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Kickoff Meeting Notes

CC: Project Team

<table>
<tr><td colspan="2">Meeting Time/Place:</td><td colspan="2">FCDMC 3:30 pm 6-17-04</td></tr>
<tr><td colspan="4">Attendance</td></tr>
<tr><td colspan="2">FCDMC</td><td>Consultant Team</td><td>Others</td></tr>
<tr><td>Greg Jones
Teresa Pinto
Cindy Overton
David Boggs</td><td>Kathryn Gross
Doug Williams
Cathy Regester
Melissa Lemke</td><td>Jon Fuller
Ted Lehman
Dennis Richards
Jay Hicks
Chuck Williams
Sara Gerke
Roland Wass</td><td></td></tr>
</table>

Issues Discussed

1. Greg Jones is the interim District project manager.
2. FCDMC Technical Reviewers will be the following:
   a. Hydraulics – Cathy Regester.
   b. Geomorphology – Kathryn Gross.
   c. Hydrology - Cathy Register.
   d. Sediment Modeling – Cathy Regester
   e. Survey - John Stock
   f. General Review - Thru FCD PM, but chances for all FCD staff to comment, if timely by deadline.
   g. Floodplain Delineation – Kathryn Gross
3. Lines of Communication. Greg Jones noted that "everyone can talk to everyone, but we should all copy the project managers at FCDMC (Greg) & JEF (Ted & JEF) on all email and correspondence.
4. Study Limits. The study limit is the upstream end of the CAP siphon crossing. The intent of the scope was to include the bank protection on the siphon crossing. JEF will check river mile station shown on the CBA/FDS work maps.
5. Billing. JEF should send a copy of the invoice package to Greg Jones. The June 2004 billing should be hand-delivered to the District project manager on June 30th.
6. Site Visit. The team picked a date - July 2nd. Participants will meet at 8 am at District. JEF, WGA, and CLW will provide 4WD vehicles. FCDMC staff will attempt to reserve a 4WD vehicle.

7. Monthly Team Meeting will be held on the 1st Tuesday of each month at 9 am at the District. Greg Jones will reserve a conference room. We recommend skipping the July 5th meeting, given the proximity to the kickoff meeting and initial site visit.
8. Schedule.
    a. Topographic mapping is scheduled for completion by June 30, 2004. The topo has been flown and digitized, and includes the Jackrabbit FDS area, the Hassayampa extension, and the extension to west on the Lower Hassayampa. District review should be completed by July 30, 2004. JEF won't use draft data, and will wait for approved mapping. JEF will write letter to the District stating that the topo is in our critical path, and that we need mapping by July 30th, or it will cause delays.
    b. The first public meeting will be held in the 3rd week of September (9/21/04 at 6 pm). The public involvement plan, to be prepared by the District, is due within 60 days of NTP. Jon Fuller & Chuck Williams will attend from the consultant team.
    c. The project schedule is incomplete pending input from District staff on District tasks.
9. Data Collection
    a. There is no District copy of the CBA FDS hydraulics report. JEF will need to attempt to get a copy from FEMA or CBA (Stantec).
    b. JEF will review data delivered by the District and identify missing items & notify Greg.
    c. David Boggs will provide paper copies of S&G mining reports, and will notify Ted Lehman when they are ready for pick up. David Boggs will set up and coordinate a site visit to S&G pits in the study area.
10. Miscellaneous Topics.
    a. Chuck has draft stakeholder list and will circulate for review. Chuck will contact ARPA.
    b. Project directory - JEF will put together a team contact list and circulate it for addition of agency contacts.
    c. Greg Jones reminded everyone that the objective of the study is to evaluate conditions, assess impacts, and recommend future studies. This is not a planning study, thus no alternatives and solutions are within the scope.

Action Items

1. JEF - check river mile station of upper study limit shown on FDS work maps
2. JEF - send a copy of the invoice package to Greg Jones
3. JEF - write letter to the District re. topo and critical path
4. JEF - get a copy of CBA hydraulics report from FEMA
5. JEF - review items provided by FCD from data request & identify missing items
6. JEF - put together a team contact list.
7. CLW - Chuck will contact ARPA to coordinate stakeholder meetings

8. FCDMC - David Boggs provide copies of S&G mining reports.
9. FCDMC - David Boggs set up site visit to S&G pits
10. FCDMC – provide complete data collection request
11. FCDMC – complete project schedule for District tasks, send to JEF

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: March 1, 2004

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
March 1, 2004 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 3-1-04		
Attendance			
FCDMC	**Others**	**Consultant Team**	
John Hathaway Cathy Register Melissa Lempke Kathryn Gross Bob Stevens David Boggs	Dempsey Helms/ASLD	Ted Lehman Jon Fuller Sara Lieske Joan Gable Jay Hicks Seema Anthony	Dennis Richards

Items Discussed:

1. Topographic Mapping
   a. The District delivered the new topographic mapping on February 25th.
      i. John Hathaway reported that the topographic mapping has been approved by the District and is ready for use in the LHWCMP.
   b. Ted noted the following two gaps in the new topographic mapping coverage:
      i. Upstream end of study reach. Missing coverage in the right overbank will be replaced scanned topographic maps from the effective FDS. Cross section data in the gap area to be used for HEC-RAS modeling may be obtained from the CBA HEC-2 cross sections.
      ii. Gila River confluence. Missing coverage will be replaced with the 4-ft contour interval mapping obtained from the MBJ Gila River FDS.
      iii. John Hathaway will research whether additional existing coverage is available from the District to fill the gaps in coverage.
2. Project Status
   a. JEF/H&G:
      i. Hassayampa Hydrology. The final Hydrology Report will be delivered March 3, 2005. Floodplain delineations will use the (CBA) effective Q100. The Q10 & Q2 will be based on the statistical analyses completed by JEF.
      ii. Geomorphic Analysis. Soil pit excavations are scheduled for March 14th – 16th. Right of entry was obtained from ASLD and several private landowners.

   iii. ARPA Coordination. The second coordination meeting was held with ARPA on January 20th. The team conducted a site visit to the three existing sand and gravel operations (Hanson, Rinker, Pioneer) on February 10th.
   iv. Jon met with Mr. & Mrs. Johnson, long-time residents along the river on February 11th.
  b. WEST – No progress due to topographic mapping delay.
  c. WGA – No progress due to topographic mapping delay.
  d. EDAW – No progress due to topographic mapping delay.
  e. CLW – No progress due to topographic mapping delay.

3. Schedule
  a. The team discussed the revised schedule. A revised schedule will be prepared by JEF for distribution to the team. The following key milestones were identified:
     i. The HEC-RAS hydraulic model of the Hassayampa River will be completed by May 18. The Hydraulics Report (WEST) will be completed by July 13.
     ii. The TDN for Jackrabbit Wash (WEST) will be completed by August 17 (ready for FEMA submittal).
     iii. The geomorphic and sediment transport tasks (JEF) will be completed by September 30, except for the sediment trend analysis and report which will be completed by November 16.
     iv. A public meeting for the floodplain delineation may be held in July or August, pending a decision by Tim Murphy.
     v. The 2nd public meeting will be held in the late fall, with the newsletter issued (District) in the prior month.
  b. The schedule will be extended by change order to June 30, 2006 to accommodate FEMA review.
  c. The team will eliminate several monthly project meetings to accommodate the schedule extension without increasing the number of meetings.

4. Other Business/Action Items
  a. JEF will issue a revised project schedule for review by team members.
  b. JEF will coordinate with WEST regarding HEC-6 & HEC-RAS modeling.
  c. John Hathaway will process a change order for a time extension.
  d. EDAW will meet with new Town of Buckeye staff, and obtain the revised Parks & Recreation Plan.

5. Next meeting. The next meeting is April 5th at 10 am at the District.

The meeting adjourned about 11:30 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: May 4, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
March 1, 2004 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 3:30 am 5-3-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway Cathy Register Kathryn Gross Diana Stuart	None	Ted Lehman Jon Fuller Hari Sundaraghavan Leo Kreymborg

Items Discussed:

1. Project Status:
   a. JEF/H&G:
      i. Field Reconnaissance Report – was due April 30, and will be provided by May 30. This report is not in the critical path for other tasks. A draft report has been prepared and needs to finalized.
      ii. Geomorphic Analysis – soil pits were excavated and described. A visit to existing sand and gravel operations was conducted to observe subsurface conditions. The Geomorphic Analysis Report is due July 15th.
      iii. Bed Elevation Change Analysis – this report is due July 15th, and requires a completed HEC-RAS model to proceed.
      iv. HEC-6 Modeling - preliminary tasks have been initiated. Modeling can begin next month with approval of preliminary HEC-RAS modeling.
      v. Lateral Migration Analysis – this report is due August 15th.
      vi. Sediment Trend Analysis – this report is due October 30th.
   b. WEST:
      i. The draft HEC-RAS model has been submitted for review by JEF and the District. District comments are expected by May 11.
      ii. HEC-RAS modeling of Jackrabbit was initiated. Preliminary results were discussed for the breakout and confluence areas.
   c. WGA – Not attending, no pending deliverables.
   d. EDAW – Not attending, no pending deliverables.
   e. CLW – Not attending, no pending deliverables.

2. Hydraulic Modeling Issues:
    a. HEC-RAS/HEC-6 Compatibility. It was decided that because the Hassayampa River HEC-RAS (objective is to evaluate existing FIS delineation & assess need for new floodplain delineation) and HEC-6 (objective is to evaluate expected profile changes & establish base condition sediment continuity model) have different objectives, there is no need to have the fixed-bed HEC-6 model reproduce water surface elevations or velocities in the HEC-RAS. Therefore, the HEC-RAS and HEC-6 models may have different input (bank stations, ineffective flow boundaries, roughness coefficients, etc) and output, and HEC-6 modeling can begin immediately, rather than waiting for final approval of the finalized hydraulic model.
    b. Documentation. Because the WEST HEC-RAS model and HEC-RAS models prepared by JEF for the geomorphic analysis may have minor or significant differences, the deliverables will carefully document the differences, objectives, and results. The digital deliverables will be clearly marked so that appropriate HEC-RAS models can be identified and used in future work assignments and applications.
    c. HEC-6 Modeling Scenarios. JEF submitted a memorandum describing proposed HEC-6 hydrographs and modeling scenarios. District staff recommended revising the memorandum, consideration of alternate scenarios, and/or better documentation of the objectives for the proposed scenarios. The revised HEC-6 modeling scenario memorandum is attached. JEF will coordinate with David Boggs on any requirements he may have for HEC-6 modeling.
    d. HEC-RAS Modeling: Hassayampa/Gila River Confluence. WEST is preparing a memorandum that recommends modeling approaches for the Gila River confluence area to the SPRR Bridge, as per Optional Scope Item 7.2.6. WEST will include recommendations on how to model the levees downstream of Old US80, whether two-dimensional modeling is appropriate, and an assessment of whether the existing FIS modeling is adequate for floodplain management and planning.
    e. HEC-RAS Modeling: Jackrabbit/Hassayampa Confluence. WEST should consider FEMA guidelines for starting water surface elevation. WEST stated that preliminary results indicate that because of the high channel slope, the model is not sensitive to starting water surface elevation. Because of the delta/fan like character of the confluence area, the District would like floodway limits defined to address potential channel movement and to consider all possible flow paths.
    f. HEC-RAS Modeling: Jackrabbit Wash Breakout. Modeling scenarios for the break out area were discussed. WEST will perform sensitivity analyses of the breakout modeling to determine appropriate methodologies and inundation limits along the breakout flow path.

3. Action Items.
    a. FCDMC:

   i. Review WEST HEC-RAS model.
   ii. Review and comment on JEF sand and gravel impact approach.
   iii. Deliver comments on JEF locational probability analysis.

b. JEF:
   i. Revise HEC-6 modeling scenario memorandum
   ii. Coordinate with David Boggs on modeling scenarios
   iii. Begin HEC-6 modeling
   iv. Complete Field Reconnaissance Report

c. WEST:
   i. Complete Hassayampa/Gila confluence modeling recommendation memorandum.
   ii. Submit preliminary Jackrabbit Wash deliverables.
   iii. Sensitivity analyses of Jackrabbit Wash break out flows.

4. Next meeting. The next meeting will be changed to June 1 at 10:00 am from the regular time and date.

The meeting adjourned about 5:20 pm.

LHWCMP Meeting 9-7-04
FCDMC 9 am

Greg
1. Buckeye Council Meeting tonight
2. Topo mapping - plan on 9/30. Some errors in data are being corrected. Cooper & Wilson mapping, 2 other firms doing check sections, and reviewing.
3. Status
A) JEF - geomorph mapping, functional analysis, data collection report. Need sub team data collection reports this week. Historical photo documentation is very close, probably a week or two. JEF making some corrections after draft done last week. DBB - deliverable? TWL - digital & paper. GLJ - would like it as tiff with world files, submit to HIS department, NOT a GIS submittal. TWL - Walnut Grove dam failure in 1890, research dam break modeling to test potential impact on geomorphic surfaces in our study reach. Result - may have been 140,000 to 175,000 cfs at old US80 (about 200,000 cfs at Jackrabbit Wash), three times the Q100, with stage of about three feet above the 100-year. Village of Seymour destroyed, location unknown. Therefore, there may be deposition/erosional features well above the 100-year.
B) WEST - Submitted xns for review, n value report. WOrking on Jackrabbit n value report soon. GLJ - draft hydrology report? Cathy will review this week, Greg wants to know what comments before sending to consultant.
C) WGA - no Sara
D) EDAW - map of open space, zoning, general plan, TOB updating parks and recreation plan (Larry Harmor). Good map by a real estate group (Nate Nathan). Updating developer contact list. GLJ - copy of parks and rec plan? No, not done yet, draft just starting. DBB - any S&G has sand and gravel in master planns - Festival Ranch & Douglas Ranch. Greg thinks in the Hassayampa. Thinks its in the Master plan (done for Buckeye). Festival Ranch will use former mining site, Jay thinks. DBB will get shape file coverage, sent via email to Seema & Ted (from Eric F).
E) CLW - mailing list corrected, brochure mailed. Stakeholder meetings this week and next.

Questions
1. Greg - will issue letter (JOH) approving survey for WESt.
2. Greg - needs stuff for powerpoint, examples of data collecion, aerials, state archives stuff is copyrighted & can't be reproduced.
3. A/R doesn't know about cancelling June payment & reissuing. Greg will check.

Public Meeting Discussion
ML - need boards & maps, Eric was out sick. Tonight will use only project area map. Everything else for meeting is done. Bring extra brochures for handouts.

STakeholders
1. Greg working on Buckeye for the developer list. Belmont is outstanding, Jay is working on it too, as is Greg.
2. Buckeye parks & recr - we need to track the potential impact. Is general plan being updated? Anything in floodplain? We need to get involved in the planning process - Greg says John should do this.
3. Send Jay Hicks the s&g stakeholder letter.
4. Review agenda
A) Greg off agenda, John in as replacement.
B) Jon bring 10 copies of Products & Deliverable Overview, after Chuck formats. ML will call to verify # of copies.
C) Numerous handouts by Chuck
D) Jon - make 40 8.5x11 study area maps copies.

Attendance
KAG
CR
Cindy Overton
JEF
TWL
J Hicks
Seema
Greg Jones
John Hathaway
Melissa L
CLW
Gary Freeman
Bob Stevens
DBB

Next month
1. WEST - as-builts to JEF

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: June 1, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
June 1, 2005 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 6-1-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway Cathy Regester Kathryn Gross Diana Stuart Mike Duncan David Boggs Melissa Lempke Jessica White	None	Ted Lehman Jon Fuller Hari Sundaraghavan Leo Kreymborg Dennis Richards Chuck Williams

Items Discussed:

1. Project Status:
   a. JEF/H&G:
      i. Field Reconnaissance Report. To be provided by June 30. This report is not in the critical path for other tasks.
      ii. Geomorphic Analysis. To be provided by due July 15th.
      iii. Bed Elevation Change Analysis. To be provided by July 15th. Work on HEC-RAS is proceeding.
      iv. HEC-6 Modeling. HEC-6 modeling is proceeding, with work on the fixed bed model in progress this month.
      v. Lateral Migration Analysis. To be provided by August 15th.
      vi. Sediment Trend Analysis. To be provided by October 30th.
   b. WEST:
      i. Mapping data for the HEC-RAS model was revised and resubmitted. Comments by JEF peer review were addressed in resubmittal. District comments are expected by June 2. The draft hydraulic modeling report for the Hassayampa River will be submitted by June 17th.
      ii. HEC-RAS modeling of Jackrabbit was initiated last month. Draft N value report, cross location and preliminary results will be submitted by June 17th. Per District and team decision, discharges in the main channel will not be reduced below the break out.

   c. WGA – Not attending, no pending deliverables.
   d. EDAW – Not attending, no pending deliverables.
   e. CLW – No pending deliverables. Next action item is for public meetings and newsletter in late September and October.
2. Discussion Items:
   a. Hydrology Report Corrections. Cathy Regester will distribute the page corrections provided by JEF within the District.
   b. Task 7.2.6. The team recommends not authorizing this optional task, for reasons explained in a separate memorandum. District staff will consider the recommendation and respond prior to the next team meeting.
   c. HEC-RAS Model – Hassayampa River. Review comments will be provided by Cathy Regester via email this week. JEF, WEST and Cathy will meet to discuss the comments at 9 am on June 7 at the District. HEC-6 modeling scenarios have been agreed upon with Bing Zhao and JEF, as has an optimization method and target (root mean square of mean bed elevation change). If the optimization method produces inconclusive results, JEF will default to using sensitivity analyses of changes in N values and inflow sediment load. Ted Lehman presented the hydrology data/method used to obtain hydrograph data for the HEC-6 models. Historical data is derived from the highest mean daily discharge from three gages (Box Canyon, Morristown, & Arlington), with flows less than 100 cfs not included to eliminate minor flows and minimize consideration of irrigation tailwater flows in the lower reach. The hydrograph shape is derived from the HEC-1 modeling.
   d. Task 7.2.2. The team recommended and the District concurred that flow attenuation modeling can be completed using the HEC-RAS unsteady flow routine, rather than HEC-2 as stated in the scope. John Hathaway will provided written confirmation via email.
   e. Sand & Gravel Impact Analysis. Initial work on this task was initiated but is stalled pending completion of HEC-6 modeling. JEF requests District comments on the memo outlining the recommended approach.
   f. District Review for Geomorphology & Sediment Transport. JEF requests that the District identify staff that will review geomorphology deliverables during Kathryn Gross' maternity leave as soon as possible to facilitate coordination. Cathy Regester will review sediment transport modeling. Mike Duncan will review floodplain delineations.
   g. Change Order. JEF provided information supporting the change order request related to the delays in topographic mapping.

3. Action Items.
   a. FCDMC:
      i. Jessica White/Melissa Lempke will determine if legal ads for the Jackrabbit Wash FDS were already placed.
      ii. John Hathaway will coordinate response to Task 7.2.6 recommendation (2d modeling).
      iii. John Hathaway will provide written confirmation via email that Task 7.2.2 can be completed using HEC-RAS rather than HEC-2.

iv. John Hathaway will obtain staff comments on the JEF memo describing the recommended approach for Task 9.6.7.
v. John Hathaway will identify the District reviewer replacing Kathryn Gross.
vi. John Hathaway and Doug Williams will process the time delay change order.
vii. John Hathaway will check on the due date for June billings (July 5th?) to facilitate billings from JEF subconsultants.

b. JEF:
   i. Jon Fuller will provide the District with additional copies of the memo describing the recommended approach for Task 9.6.7.

c. WEST:
   i. Submit Jackrabbit Wash and Hassayampa River HEC-RAS deliverables by June 17th.

4. Next meeting. July 5th, 10 am at the District.

The meeting adjourned about 11:45 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: July 5, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
July 5, 2005 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 7-5-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway Diana Stuart David Boggs Jen Pokorski	None	Ted Lehman Jon Fuller Leo Kreymborg Dennis Richards

1. Action Items.
   a. FCDMC:
      i. Jessica White/Melissa Lempke will determine if legal ads for the Jackrabbit Wash FDS were already placed (from June Mtg).
      ii. John Hathaway will obtain staff comments on the JEF memo describing the recommended approach for Task 9.6.7.
      iii. John Hathaway will identify the District reviewer(s) replacing Kathryn Gross and for review of the HEC-6 modeling.
      iv. John Hathaway will process the time delay change order.
      v. Mike Duncan will provide review comments on the Jackrabbit Wash FDS submittal.
   b. JEF:
      i. Jon Fuller will provide the District with additional copies of the memo describing the recommended approach for Task 9.6.7.
      ii. Jon Fuller will coordinate with Stantec (Pat Ellison) & Dibble (Dan Frank) regarding proposed development projects in the lower study reach.
      iii. Jon Fuller will coordinate with EDAW regarding scheduling for production of the final report.
      iv. Jon Fuller will coordinate with WGA regarding status & schedule for final deliverables.
      v. Jon Fuller will coordinate with ARPA regarding schedule for next stakeholder meeting.
      vi. Jon Fuller will be prepared to discuss final deliverables schedule at the August team meeting.

c. WEST:
   i. Submit Hassayampa River HEC-RAS technical appendixes by August 1st.
d. CL Williams
   i. Chuck Williams will contact Jessica White regarding scheduling fall public meetings and stakeholder coordination, and will be prepared to discuss action items at the next team meeting.

2. Project Status:
   a. JEF/H&G:
      i. HEC-6 Modeling. HEC-6 modeling is proceeding on schedule. JEF has a working base model, and is troubleshooting the model using discharges of 20,000 – 60,000 cfs, testing sediment inflow sensitivity. Submittal of a draft base model is expected with three weeks.
      ii. Lateral Migration Analysis. HEC-RAS modeling for the channel stability assessment is progressing. Summaries of the geomorphic analyses are being written.
   b. WEST:
      i. The draft report for the Hassayampa HEC-RAS model was submitted for review on June 16th. Comments by Cathy Regester are due July 11th.
      ii. Initial submittals for the Jackrabbit Wash FDS (section alignment, bank stations, channel baseline) were made on June 17th. Comments by Mike Duncan are expected later this week.
   c. WGA – Not attending, no pending deliverables.
   d. EDAW – Not attending, no pending deliverables.
   e. CLW – No pending deliverables.

3. Discussion Items:
   a. Task 7.2.6. The District accepted the team's recommendation to not authorize this optional task, for reasons explained in a separate memorandum.
   b. Sand & Gravel Impact Analysis. Initial work on this task was initiated but is stalled pending completion of HEC-6 modeling. JEF requests District comments on the memo outlining the recommended approach for Task 9.6.7.
   c. District Review for Geomorphology & Sediment Transport. JEF requests that the District identify staff that will review geomorphology deliverables during Kathryn Gross' maternity leave as soon as possible to facilitate coordination. Cathy Regester will review sediment transport modeling. Mike Duncan will review floodplain delineations.
   d. Change Order. The change order has been routed for signature internally at the District.

4. Next meeting. August 2nd, 10 am at the District.

The meeting adjourned about 10:40 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: August 2, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
August 2, 2005 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 8-2-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway Diana Stuart David Boggs Jen Pokorski Michael Duncan Cathy Regester Jessica White	None	Ted Lehman Jon Fuller Leo Kreymborg Chuck Williams Jay Hicks Seema Anthony Sara Gerke Lieske

1. Action Items.
   a. FCDMC:
      i. John Hathaway will identify the District reviewer(s) replacing Kathryn Gross and for review of the river behavior analysis (geomorphology).
      ii. John Hathaway will explore mechanisms for authorizing floodway modeling of the Hassayampa River upstream of the SPRR Bridge using the existing optional floodplain modeling tasks by August 5th.
      iii. Mike Duncan will provide review comments on the Jackrabbit Wash FDS submittal.
      iv. Cathy Regester will review the JEF memorandum describing the three recommended sediment transport functions.
   b. JEF/H&G:
      i. Jon Fuller will schedule a teleconference to decide whether to proceed with floodway modeling on the Hassayampa River upstream of the SPRR Bridge for August 5th.
   c. WEST:
      i. Leo Kreymborg will submit the Hassayampa River HEC-RAS technical appendixes, the revised HEC-RAS model, and the Hydraulics Report by August 5th.
      ii. Leo Kreymborg will prepare a labor estimate for floodway modeling upstream of the SPRR Bridge by August 5th.
      iii. Leo Kreymborg will provide Michael Duncan with a digital copy of the HEC-RAS model for Jackrabbit Wash.

d. CL Williams
    i. Chuck Williams will contact Jessica White regarding scheduling fall public meetings and stakeholder coordination, and will be prepared to discuss action items at the next team meeting.
e. EDAW
f. ALL
    i. Send logos to EDAW for use in final report graphics.
    ii. Submit reports to EDAW by September 15th.

2. Project Status:
    a. JEF/H&G:
        i. HEC-6 Modeling. HEC-6 modeling is proceeding on schedule. JEF delivered for District review a memorandum documenting the three recommended sediment transport functions for use in HEC-6 modeling and the spreadsheet-based sediment transport analysis.
        ii. Lateral Migration Analysis. HEC-RAS modeling for the channel stability assessment nearly complete. The lateral stability report (river behavior analysis) is in progress.
        iii. Stakeholder. JEF met with engineers (Dibble – Johnson; Stantec – Gladden) representing new proposed developments along the levee reach of the lower Hassayampa River. The objective of the meeting was to facilitate cooperation in engineering design of drainage facilities along the river within the new developments.
        iv. ARPA. The next ARPA stakeholder meeting will be held at 7:30 am on September 15th at the ARPA offices in Phoenix. The final ARPA stakeholder meeting will be held in October or November to present final results and recommendations.
        v. Brainstorming Alternatives Meeting. The brainstorming meeting will be held 9:00 am -12:00 pm September 21 at the JEF office. Lunch will be provided. Representatives from each team will attend
    b. WEST:
        i. WEST will provide response to District comments and the revised Hydraulics Report on Friday, August 5. After discussion of the objective and future intended use of the Hassayampa River HEC-RAS modeling, the following objectives/uses were identified:
            1. The District does not intend to submit a LOMR for the reach below the SPRR Bridge due to likely future channelization, expected minimal change in floodplain boundaries, and anticipated challenges addressing FEMA criteria for reaches with non-certified levees.
            2. The HEC-RAS modeling provides improved accuracy over the HEC-2 modeling provided with the effective Flood Insurance Study.
            3. The HEC-RAS modeling is suitable for planning purposes and preliminary evaluation of flood control alternatives.
            4. The reach upstream of the SPRR Bridge is hydraulically

straightforward. The HEC-RAS model for this upper reach will be evaluated as part of the preliminary alternatives analysis for a possible LOMR submittal (Phase 2).

ii. The WEST Hydraulics Report will include a discussion (with maps) of the differences between the HEC-RAS model floodplain limits and the effective floodplain delineation so the need for a LOMR can be assessed by the team and the District.

iii. The team discussed the need for floodway modeling on the Hassayampa River upstream of the SPRR Bridge, with the following conclusions:

1. Floodway modeling may be useful to assess whether a LOMR is needed and may be important for floodplain management and permitting.
2. WEST will estimate the labor required to prepare a floodway model from the CAP to the SPRR Bridge.
3. The District will investigate whether existing optional tasks can be used to fund floodway modeling.

iv. Initial submittals for the Jackrabbit Wash FDS (section alignment, bank stations, channel baseline) were made on June 17th. Comments from Mike Duncan are expected by Friday, August 5th.

v. Floodplain and floodway work maps should be completed and available for Public Meeting #2 on October 19th. If the maps are not available, public notice will be completed by the District via individual mailings to the few landowners in the study reach.

c. WGA

i. Sara Lieske will provide a summary update of the findings of the recharge & environmental tasks at the next team meeting (9/6/05).

d. EDAW

i. Jay Hicks presented a draft outline of the Phase 1 final report. The final report is intended to be a summary document suitable for presentation to stakeholders, County Supervisors, and the general public. Individual technical reports will be submitted as Appendix Volumes. All reports will have similar covers and spine covers, but may have individual formats that best suit presentation of the subject material by each team member. The following modifications of the outline were recommended:

1. Combine the River Behavior Analysis & the Geomorphic Analysis Reports (3.5 & 3.6).
2. The Final Recommendations Section will include a recommendation on whether and how to proceed with Phase 2, how to use the technical documents and work products generated in Phase 1, specific recommendations from each of the topics in Section 3, and how to move forward with the preliminary alternatives identified.

ii. Draft reports are due to EDAW by September 15th.

iii. The draft final report will be submitted to the District by November

18, with review by December 12, and resubmittal by December 30.

  iv. Each team member will seal their work product when delivered. Jon Fuller will seal the final report.

e. CLW
  i. Public Meeting #2 will be held 6:00-8:00 pm on October 19th in Buckeye.
  ii. Chuck Williams will prepare a critical path chart showing deadlines for production of Newsletter #2, public meeting graphics, and stakeholder coordination.
  iii. Chuck Williams will set up stakeholder coordination meetings for October, prior to Public Meeting #2.

3. Discussion Items:
   a. Discussion items were addressed in the Status Report notes.

4. Next meeting. September 6, 10 am at the District.

The meeting adjourned about 11:30 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: September 7, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
September 6, 2005 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 9-6-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway Diana Stuart David Boggs Jen Pokorski Michael Duncan Dave Degerness Jessica White	None	Jon Fuller Leo Kreymborg Chuck Williams Jay Hicks Sara Gerke Lieske

1. Action Items.
   a. FCDMC:
      i. John Hathaway will process authorization for optional tasks for additional stakeholder and coordination meeting after receiving a justification letter and costs from JEF.
      ii. Jessica White will revise the public meeting/newsletter time line.
      iii. Jessica White will reserve the location for the public meeting on November 9th.
      iv. John Hathaway will check with MCDOT & Buckeye (@ District meeting on Sept 9th) regarding locations of future bridge crossings prior to the Alternatives Brainstorming Meeting.
      v. District staff will provide comments, if any, to EDAW asap on the proposed report outline.
      vi. John Hathaway will check the status of Change Order #2.
      vii. John Hathaway will reserve a meeting room for the October 11th team meeting.
   b. JEF/H&G:
      i. Jon Fuller will confirm the ARPA meeting date & time with Jan Farmer.
      ii. Jon Fuller will investigate the method used to compute skew for the hydrologic analysis.
      iii. Jon Fuller will meet with John Hathaway & Chuck Williams to plan stakeholder and brainstorming meetings.

c. WEST:
    i. Leo Kreymborg will meet with Michael Duncan to discuss floodway modeling for Jackrabbit Wash and the Jackrabbit Wash break floodway model.
    ii. Leo Kreymborg will provide JEF with an estimate of the completion date for the Jackrabbit Wash floodplain/floodway delineation.
d. CL Williams
    i. Chuck Williams will proceed with scheduling & planning stakeholder coordination meetings.
    ii. Chuck Williams will serve as facilitator for the alternative brainstorming meeting.
e. Wass-Gerke
    i. WGA will deliver the environmental and recharge reports to JEF & EDAW this month.
f. ALL
    i. Send logos to EDAW for use in final report graphics.
    ii. Submit reports to EDAW by September 15th.

2. Project Status:
    a. FCDMC
        i. Dave Degerness will replace Cathy Regester for a portion of technical review of modeling, lateral stability studies, and HEC-6 modeling, as part of his new duties in the newly formed Computer Applications/ River Mechanics Branch, to be led by Bing Zhao.
    b. JEF/H&G:
        i. Hydrology. The District directed JEF & the LHWCMP team to proceed using the hydrology data as currently formulated in the approved Hydrology Report. Possible revisions to 100-year discharge estimates will be considered as part of Phase 2, should that project be authorized in the future.
        ii. HEC-6 Modeling. HEC-6 modeling will be completed and the draft report prepared this month.
        iii. Lateral Migration Analysis. The draft lateral stability report is complete and is being reviewed internally.
        iv. The Task 9 Reports will be delivered for review by the next team meeting in October.
        v. ARPA. The next ARPA stakeholder meeting will be held at 7:30 am on September 15th at the ARPA offices in Phoenix. The final ARPA stakeholder meeting will be held in October or November to present final results and recommendations.
        vi. Brainstorming Alternatives Meeting. The brainstorming meeting will be held 12:30 pm to 5:00 pm September 21 at the JEF office. Lunch will be provided. Representatives from each team will attend.
    c. WEST:
        i. The Hydraulics Report for the Hassayampa River has been approved.
        ii. The on-going Jackrabbit Wash floodway delineation was discussed.

   d. WGA
      i. Sara Lieske will provide a summary update of the findings of the recharge & environmental tasks at the next team meeting (9/6/05).
   e. EDAW
      i. EDAW is awaiting delivery of draft reports by team members.
   f. CLW
      i. Public Meeting #2 will be held 6:00-8:00 pm on November 9th in Buckeye.
      ii. The need for additional stakeholder and coordination meetings was discussed and was deferred to a separate meeting on September 7th.
   g. Wass + Gerke
      i. Sarah Leiske presented a summary of findings on environmental, permitting, and recharge issues.

3. Discussion Items:
   a. Discussion items were addressed in the Status Report notes.

4. Next meeting. October 11th at 10 am at the District.

The meeting adjourned about 11:30 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: October 5, 2004

TO: John Hathaway, PE/FCDMC

FROM: Ted Lehman, PE

RE: LHWCMP Team Meeting Notes
October 5, 2004 Project Team Meeting

CC: File

Meeting Time/Place:		FCDMC 9:00 am 10-5-04	
Attendance			
FCDMC		**Consultant Team**	**Others**
John Hathaway Cindy Overton Cathy Register	Kathryn Gross Bob Stevens David Boggs	Ted Lehman	

Items Discussed:

1. Topographic mapping of the study area is almost complete. The most recent update from John Stock (as of 10/5/04 prior to the meeting) is that it should be ready very soon. John H. suggested the team anticipate a 10/18/04 delivery. He asked for a revised project schedule once the mapping is in hand. In addition, John asked again about Mr. Fuller's earlier comments about the potential for the team to make up for some of the lost time. John's interest was in the possibility of not needing a change order at the end of the existing contract to make up for the lost time and potential additional meetings, etc. that might result from a time extension. Ted suggested that we make a best estimate of the schedule needed in October and then revisit the need for additional contract time sometime around Feb. 2005.
2. Project Status
    a. JEF/H&G:
        i. We have received comments on the draft Hydrology from Cathy and are in the process of obtaining the HECFFA program to evaluate potential impacts on the computed statistics. Cathy indicated her initial tests on one data set revealed no differences compared to the HECWRC model output. JEF hopes to have the final report completed by the end of October pending receipt of the model executable from the Corps vendor.
        ii. FCD comments on the DCR were received from John H. at this meeting. Overall John was pleased with the content and format of the report. Specific comments were discussed in the meeting. No problems are anticipated revising the DCR to address the specific

comments.

iii. Geomorphic field work initiated. Plan to be in field two days a week upon Jon's return starting 10/20. We plan to camp overnight and be in the field W/Th. Until we're finished. This component does not include the soil trenches which still require right of entry.

b. WEST – Approval of optional survey task received from FCD. FCD comments on the n-value selection, cross sections, bank stations, and hydraulic baseline also received at this meeting. Cathy R. noted that WEST should review her comments and then discuss with her before making any revisions. WEST has also started the n-value report for Jackrabbit Wash.

c. WGA - no report.

d. EDAW – Continues to coordinate and collect info from Buckeye concerning planned developments. One of John H.'s comments on the DCR also addressed getting summary copies of these developments plans in and near the river added to the DCR. Ted will follow up with EDAW to that end.

e. CLW – No report.

3. Other Business
   a. John H. will check with Melissa L. regarding the Public Meeting Notes. CLW indicated the Stakeholder Meeting Notes are being finalized prior to today's meeting though he was not able to be present today.
   b. It was noted that 20 persons attended the public meeting on 9/16 in Buckeye.

Meeting adjourned about 10 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: November 1, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
November 1, 2005 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 11-1-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway Diana Stuart David Boggs Michael Duncan Jessica White Bing Zhao Cathy Regester	None	Ted Lehman Leo Kreymborg Chuck Williams Seema Anthony

1. Action Items.
   a. FCDMC:
      i. John Hathaway will investigate status of letter regarding recommendation for hydrology.
   b. JEF/H&G:
      i. Ted Lehman to check on status of justification letter and costs for optional additional stakeholder and coordination meetings.
      ii. Ted and Leo were to check out existing contour data between Hassayampa and Jackrabbit Wash to see if gap in DTM is also in contours. – Leo followed up following meeting indicating the shapefile contours match up with no gap. These will be used for the FDS workmaps.
      iii. JEF to identify if/who will run computer/GIS at public meeting next week.
      iv. JEF will bring computer and/or projector to public meeting for ppt and/or floodplain GIS.
      v. JEF will supply summary text for WCMP Report to EDAW in week of 11/15.
      vi. JEF will submit River Behavior Report (Task 9) to FCD for review by end of Nov.
      vii. Ted to look for carto feature layers for Hassayampa mapping for Jackrabbit workmaps for WEST.
   c. WEST:

  i. Leo K. will coordinate with Mike Duncan regarding tie in of floodway at breakout to the main Jackrabbit floodway
  ii. Leo K. to have work maps and FDS report submittal to FCD in about 3 weeks.
  iii. Leo K. will supply JEF with floodplain and floodway lines electronically for use in Arcview at public meeting next week.
  iv. Leo K. will modify Hydraulics Report to include discussion of the Hassayampa floodway analysis and will update the unsteady flow/attenuation analysis using the 'new' floodway limits. Leo will include the unsteady analysis models with the modified Hydraulics Report.

d. CL Williams
  i. Chuck Williams will meet with John Hathaway to figure out details on powerpoint show for public meeting.
  ii. Chuck will lead ARPA/Stakeholder meeting with John H. and Jon F. next week (11/10).
  iii. Chuck will summarize results of stakeholder and public meeting feedback for inclusion in WCMP Report in the week of 11/15.

e. Wass-Gerke

f. ALL

2. Project Status:

a. FCDMC
  i. Mike Duncan continues review on Jackrabbit floodway. To discuss with Leo K.
  ii. John H. suggested that Phase 2 be timed to take advantage of regional transportation study for the area scheduled for NTP in Jan. '06. Any work in advance of that plan should assume crossings of LH on section line every mile.
  iii. Hydrology recommendation letter status not known. Bing stated that the approximate recommended Q is now 63000 cfs for the lower river with a suggestion for use of 68000 cfs based on expected probability results.

b. JEF/H&G:
  i. HEC-6 Modeling. Completed and draft report prepared. Under internal review.
  ii. Lateral Migration Analysis. Completed and draft report prepared. Under internal review.
  iii. The Task 9 Reports (River Behavior Report) will be delivered for review by the end of Nov..
  iv. ARPA. The final ARPA stakeholder meeting will be held in next week on 11/10.
  v. JEF will supply EDAW with text for WCMP Report river behavior discussion by the week of 11/15.
  vi. JEF will submit River Behavior Report to Bing and Dave Degerness for review by the end of Nov.

c. WEST:
   i. Jackrabbit floodway is still under review at FCD.
   ii. Hassayampa floodway analysis to be completed by Thurs. or Fri. of this week. Results - generally a narrower floodway though locally wider.
d. WGA – no report
e. EDAW
   i. EDAW is awaiting delivery of draft reports by team members, especially JEF. Data Collection, Hydrology, Groundwater, Environmental, and Planning and Regulatory sections received.
f. CLW
   i. Public Meeting #2 will be held 6:00-8:00 pm on November 9th in Buckeye at the Chamber of Commerce. Attendees to be: Chuck, Jon F., John H., Mike D., Jessica, Jen, and a computer/GIS tech. operator.
   ii. Brochure/newsletters/invitations were sent to about 500 addresses.
   iii. Last stakeholder meeting last week. Poorly attended, but those who came mattered. Developers meeting also held, which was well attended. Parties from both groups want Phase 2 to go forward, but Buckeye wants FCD to pay for it. Douglas Ranch consultant (WPA) is looking to locate two bridge locations across the river. WPA would like to get the WCMP reports and models to help them in crossing location selection. Developers expressed concern about the aesthetic impact of sand and gravel mining. Potential utility impacts from mining also expressed as a concern (especially the PVNGS water line).
   iv. Chuck noted as result of some discussion that the Existing Facilities Exhibit should be brought to the public meeting.

3. Discussion Items:
   a. Discussion items were addressed in the notes above.

4. Next meeting. December 6th at 10 am at the District.

The meeting adjourned about 11:15 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: November 2, 2004

TO: John Hathaway, PE/FCDMC

FROM: Ted Lehman, PE

RE: LHWCMP Team Meeting Notes
November 2, 2004 Project Team Meeting

CC: File

Meeting Time/Place:		FCDMC 9:00 am 11-2-04	
Attendance			
FCDMC		**Consultant Team**	**Others**
John Hathaway Cathy Register Melissa Lempke	Kathryn Gross David Boggs	Ted Lehman Jon Fuller Gary Freeman	

Items Discussed:

1. Project Status
   a. JEF/H&G:
      i. Hydrology Report. JEF prepared a written response to the District's review comments and revised the hydrology report. The 100-year discharge estimates achieved using the HEC-FFA are a function of the how the high/low threshold option (SI Record) is used. All of the estimates are significantly less than the 100-year discharge used in the effective FDS prepared by Cella Barr & Associates. The District will meet internally and review the recommended discharges in the Hydrology Report, and provide a final decision on a discharge by the December 7, 2004 team meeting. The current revision of the Hydrology Report will be used for the duration of the project, but will be revised if needed as a final deliverable at the end of Phase 1.
      ii. Geomorphic Analysis. JEF anticipates finishing the detailed field reconnaissance this month. Soil pit excavations are scheduled for completion in January and February, although the team is identifying potential sites as the field work progresses. JEF will conduct the 2nd team site visit on December 3, 2004 for any interested District and team staff. Kathryn Gross indicated she had reviewed the preliminary surficial mapping and historical aerial chronology that they were acceptable.
      iii. Data Collection Report. Cindy Overton will be providing additional comments on the Data Collection Report. The Report will be updated and re-submitted as one of the final project deliverables. The team is attempting to obtain as-built information from Kinder-Morgan (gas

line), SRP-APS (power lines), ATT (communication lines). John Hathaway will check with Dorothy Haynes, an engineer with the AZ Corporation Commission for possible sources of information on utility crossings. David Boggs noted that there are potential locational problems with the ATT as-built information.

iv. ARPA Coordination. Lynn Thomas & David Boggs will attend the next ARPA Stakeholder meeting to be held at the ARPA offices in December.

b. WEST – WEST received some of the new topographic mapping at the meeting, and will provide an update to the schedule after reviewing the mapping.
c. WGA - No report.
d. EDAW – No report.
e. CLW – No report. CLW will provide a summary of the Stakeholder & Public Involvement activities at next month's team meeting.
f. District – The second quarterly newsletter will be delayed until December and will include the updated schedule, the results of the hydrologic analysis (with District concurrence on the recommended discharges), a recommendation of whether the floodplain will be redelineated, and a summary of stakeholder and public concerns.

2. Other Business/Action Items
   a. JEF will update the project schedule by November 12, with input from WEST.
   b. JEF will prepare a letter to the District documenting the delay in the schedule and increase in project fees, if any, resulting from the delay in receipt of the topographic mapping. The letter will be provided with the schedule update.
   c. JEF will invite ASLD to the next ARPA coordination meeting.
   d. JEF will copy Dempsey Helms/ASLD on meeting summaries.
   e. JEF will coordinate with ARPA regarding the date and agenda for the next ARPA Stakeholder meeting.
   f. JEF will finalize revisions to the Hydrology Report
   g. JEF will continue to pursue as-built plans for utility crossings.
   h. CLW will provide a summary of Stakeholder and Public Meetings by December 7, 2004.
   i. WEST will provide a estimate of schedule impacts related to the topographic mapping by November 10, 2004.
   j. Cathy Register will coordinate a District final decision on the recommended peak discharge for the Hassayampa River.
   k. John Hathaway will coordinate with the AZ Corporation Commission engineer regarding as-built plans.

Meeting adjourned about 10 am.

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: December 6, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
December 6, 2005 Project Team Meeting

CC: File

Meeting Time/Place:	FCDMC 10:00 am 12-6-05	
Attendance		
FCDMC	**Others**	**Consultant Team**
John Hathaway David Boggs Michael Duncan Jessica White Cathy Regester Kathryn Gross Jen Pokorski	None	Leo Kreymborg Chuck Williams Sara Lieske Jon Fuller

1. Action Items.
    a. FCDMC:
        i. John Hathaway will investigate status of letter regarding recommendation for hydrology.
        ii. John Hathaway will investigate contract extension through February 28, 2006, and closing project to all but FEMA review, which would be picked up under an on-call project.
        iii. John Hathaway will process charge for additional meetings & coordination tasks, to be billed on a time & materials basis.
    b. JEF/H&G:
        i. Finish River Behavior Report Chapters 4, 6, and 7.
    c. WEST:
        i. Respond to Jackrabbit Wash TDN review comments.
        ii. Review Hydraulics report to include floodway task, and a map of the draft floodway.
    d. CL Williams
        i. Chuck Williams will format the previously provided stakeholder information as a stand alone volume for the final report.
    e. Wass-Gerke
        i. No action. Tasks are complete.
    f. EDAW
        i. Finalize report by January 15, 2006

2. Project Status:
    a. FCDMC
        i. Review of Jackrabbit Wash TDN in progress.
        ii. Michael Duncan reported that FEMA review has been slow and may take longer than six months.
    b. JEF/H&G:
        i. Draft report Chapters 1, 2, 3, and 5 submitted with remain Chapters due by Monday.
        ii. Jon summarized study results: The Hassayampa River is vertically stable in existing conditions, but subject to extreme lateral instability.
    c. WEST:
        i. Making final revisions to TDN documents.
        ii. Negative surcharges on floodways persist due to critical flow and cannot be removed without unacceptable modifications to the floodway.
    d. WGA:
        i. Recharge is issue for consideration in Phase 2, specifically the timing of effluent deliveries and design of recharge to obtain recharge credits.
    e. EDAW
        i. EDAW is awaiting delivery of draft reports by team members, especially JEF & WEST.
    f. CLW
        i. Key stakeholder issues are:
            1. Proceed with Phase 2
            2. Coordinate infrastructure, especially bridges
            3. Coordinate in-stream mining
3. Discussion Items:
    a. Schedule extension as noted above.
    b. Wood-Patel is requesting the HEC-RAS and HEC-6. John will coordinate the delivery as items are approved.

4. Next meeting: No future team meetings are schedule. Remaining meetings will be for review of deliverables and additional coordination as needed.

The meeting adjourned about 10:55 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: December 7, 2004

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
December 7, 2004 Project Team Meeting

CC: File

Meeting Time/Place:		FCDMC 10:00 am 12-7-04	
Attendance			
FCDMC		**Consultant Team**	
John Hathaway Cathy Register Melissa Lempke	Kathryn Gross	Ted Lehman Jon Fuller Sara Lieske	Joan Gable Chuck Williams

Items Discussed:

1. Project Status
   a. JEF/H&G:
      i. Hassayampa Hydrology. The District has decided to use the effective FDS 100-year discharges for the Hassayampa River. The District will prepare a memorandum documenting the rationale for using the effective FDS discharges, which will be incorporated into the revised hydrology report prepared by JEF. JEF will use the District-selected discharge in the HEC-6 model as one of the modeling scenarios, but will also prepare a model based on the previously recommended 100-year peak discharge. If possible within the existing scope of services, the team will evaluate differences in hydraulics and floodplain width related to use of the effective FDS discharges. Ted noted that the discharge and resulting floodway has consequences for the sediment modeling and the erosion hazard zone delineation, particularly where the floodway is impacted.
      ii. Geomorphic Analysis. JEF has completed the field work. Soil pit excavations are scheduled for completion in January and February, although the team is identifying potential sites now.
      iii. JEF conducted the 2nd team site visit on December 3, 2004.
      iv. ARPA Coordination. ARPA requested to move the next stakeholder coordination meeting with ARPA to January. Jon will coordinate with Jan Farmer/ARPA on the date and time, and will forward the information to the appropriate team members.
   b. WEST – WEST's work is stalled pending receipt of topographic mapping from the District.

c. WGA - Sara introduced Dr. Joan Gable who will be assisting with the project during Sara's upcoming maternity leave.
d. EDAW – No report.
e. CLW – CLW provided a summary of the Stakeholder & Public Involvement activities from September. The key stakeholder issues include the following:
    i. Concern about what regulatory discharge will be used for floodplain delineation on the Hassayampa River.
    ii. Advocacy for redelineation of the Hassayampa River floodplain downstream of I-10.
    iii. Advocacy for tamarix removal in the levee reach.
    iv. Concerns about related District studies, such as the Buckeye-Sun Valley ADMS, the El Rio WCMP, and the Buckeye FRS project.
    v. Advocacy for advancing the LHWCMP to Phase 2.
    vi. Interest in District buyouts of floodway homes near the Gila River confluence.
f. District – It was decided to not send the second scheduled newsletter due to lack of progress on floodplain mapping caused by delays in topographic mapping. The next newsletter will be prepared once the schedule is updated, a decision on hydrology is documented, and topographic mapping is completed.

2. Other Business/Action Items
    a. JEF will update the project schedule when topographic mapping is finalized and approved.
    b. JEF will prepare a letter to the District documenting the delay in the schedule and increase in project fees, if any, resulting from the delay in receipt of the topographic mapping. The letter will be provided with the schedule update.
    c. JEF will obtain the date/time for the next ARPA coordination meeting.
    d. The District will provide a memorandum documenting their decision regarding the 100-year peak discharge for the Hassayampa River.
    e. JEF will send a copy of the meeting notes from the first ARPA stakeholder meeting.
    f. JEF will contact Teri George/DEA to identify the project that is grading the upper terrace on the east side of the floodplain near the Jackrabbit Wash confluence.
    g. JEF will create a PDF graphical file showing the existing floodplains, study limits, and geographic features to be used in stakeholder coordination.
    h. Kathryn Gross will ask Tom Loomis about progress in using FLO-2D for floodway delineation.
    i. JEF will send Chuck contact information for the fiber optic line owned by Wiltel.
    j. JEF will send Chuck contact information for ARPA stakeholders.

3. Next meeting. The January meeting will be cancelled unless the final topographic mapping is provided by the District. The next meeting is February 1st at 10 am.

The meeting adjourned about 11 am.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: September 7, 2004

TO: Greg Jones, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Team Meeting Notes
September 7, 2004 Project Team Meeting

CC: File

Meeting Time/Place:		FCDMC 9:00 am 9-7-04	
Attendance			
FCDMC		**Consultant Team**	**Others**
Greg Jones Cindy Overton Melissa Lemke Cathy Register	Kathryn Gross John Hathaway Bob Stevens David Boggs	Jon Fuller Ted Lehman Gary Freeman Jay Hicks Seema Anthony Chuck Williams	

Items Discussed:

1. Greg will make a presentation at the Buckeye Town Council meeting tonight.
2. Topographic mapping of the study area is still in progress. The original submittal by Cooper & Wilson has been reviewed, and some data are being revised.
3. Project Status
   a. JEF/H&G: The team has completed the draft geomorphic mapping, historical photographic documentation, and functional surface analysis, and is working on the data collection report, all of which should be submitted for review by mid month. Only the data collection report is a formal (scoped) deliverable, with the remainder being progress reports. David Boggs & Greg Jones requested that the deliverable be provided to the District GIS Department as *.tif files with world files, in addition to the paper copies. Greg will let the GIS Department know that this is not a formal deliverable for review. Ted Lehman discussed the results of his hydrologic analysis of the 1890 Walnut Grove dam failure intended to examine potential impacts on geomorphic surfaces in our study reach. Ted's modeling indicates the dam break flood may have peaked at 140,000 to 175,000 cfs at the old US80 alignment (about 200,000 cfs at Jackrabbit Wash), which is about three times the 100-year peak discharge, with a stage of about three feet above the 100-year WSEL. Therefore, there may be geologically young deposition/erosional features well above the active floodplain that need to be considered separately from other surfaces. Greg Jones would like to see Cathy Register's review comments

on the hydrology report prior to sending them to JEF.

   b. WEST – The team has submitted cross section alignments for review, as well as the n value report for the Hasssayampa River, and is working on the Jackrabbit n value report. GLJ - draft hydrology report? Cathy will review this week, Greg wants to know what comments before sending to consultant. WEST will provide copies of bridge as-builts to JEF.
   c. WGA - no report.
   d. EDAW – The team is making a map of open space, zoning, general plans. The Town of Buckeye is starting to update their parks and recreation plan (Larry Harmor is a contact). Also, other planning maps have been prepared by a real estate group, possibly led by Nate Nathan. The team is updating the developer contact list. David Boggs discussed possible sand and gravel mining locations shown in master plans, possibly for the Festival Ranch & Douglas Ranch projects. David Boggs had the FCDMC GIS Department send shape files of the current mining locations to Seema & Ted.
   e. CLW – The team has corrected the mailing list, mailed the brochure, and planned stakeholder meetings to be held this week and next.

4. Other Business
   a. Greg Jones will issue a letter approving optional survey task for WEST this week. John Hathaway will write the letter.
   b. Greg Jones needs information for his public presentation PowerPoint, such as examples of data collection materials and aerials. Photographs from the State Archives are copyrighted & can't be reproduced.
   c. Greg is working with the District's A/R department to find the June payment.
5. Public Meeting Discussion
   a. Melissa Lempke has everything on track for the first public meeting. The District will bring extra brochures for handouts.
6. Stakeholder Meetings Discussion
   a. Greg is working on the Town of Buckeye for the developer list. Chuck thinks that Belmont is the one contact that is most significant of those still outstanding. Jay is working on finding developer contacts as well.
   b. Greg noted that we need to track the potential impact of the Buckeye Parks & Recreation plan update, specifically in regard to general plan updates, proposed planning in the floodplain. Greg designated John Hathaway as responsible for this coordination.
   c. Greg asked that John Hathaway replace him on the Stakeholder agenda.
   d. Chuck provided numerous handouts of draft information.

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: August 3, 2004

TO: Greg Jones, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Progress Meeting #1 Notes

CC: Project Team

Meeting Time/Place:		FCDMC 9:00 am 8-2-04	
Attendance			
FCDMC		**Consultant Team**	**Others**
Greg Jones	Kathryn Gross	Jon Fuller	
Teresa Pinto	John Hathaway	Ted Lehman	
Cindy Overton	Bob Stevens	Dennis Richards	
Melissa Lemke		Seema Anthony	
		Chuck Williams	
		Sara Gerke	

Issues Discussed

1. John Hathaway is now officially in the "river czar" position and will assume LHWCMP project manager duties in the future.
2. JEF delivered a letter to Greg noting that the topographic mapping to be provided by the District is behind schedule and that a time extension request is forthcoming due to the delay. WEST and JEF will discuss what time extension is appropriate, and whether additional cost will be incurred. Greg noted that the topographic mapping has been delivered to the District, but has not yet been reviewed or approved. Greg estimated that the mapping could be approved within 30 days.
3. WEST is processing the paper work for the no cost change order exercising the optional survey task. This change order can be approved by Tim Phillips.
4. Project Status. Project team members summarized the status of data collection, hydrologic modeling, hydraulic modeling, geomorphic analysis, and public involvement tasks. The following key issues were discussed:
    a. Data collection. Data collection is underway with no significant problems to report. EDAW is resolving a discrepancy between Buckeye's current land use plan shown on their website and those previously provided to the project team. Greg will assist EDAW with coordination Jay Harmor (sp?), who has been slow to respond to telephone messages. WGA has made progress in the environmental and recharge data collection evaluations and will coordinate with EDAW regarding drainage issues from private developments with drainage and water master plans.
    b. Hydrologic Modeling. The draft Hydrology Report was submitted to Cathy Register last week. JEF is currently modeling the 1891 Walnut

Deleted: AuAugAJune 30, 2004

Deleted: Kickoff

Deleted: 3:30

Deleted: pm

Deleted: 6

Deleted: 17

Deleted: Doug Williams

Deleted: David Boggs¶

Deleted: Cathy Register¶
Melissa Lemke

Deleted: Jay Hicks

Deleted: ¶
Roland Wass

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Bullets and Numbering

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Grove dambreak event to estimate impact on the study reach.

c. Geomorphic Analysis. Historical aerial photographs have been obtained, rectified, and interpretation is underway. JEF expects to submit draft *functional surface analysis and geomorphic mapping in late August for* review by Kathryn Gross.

d. Hydraulic Modeling. WEST modeling is in progress, but is in need of topographic mapping and survey data. WEST submitted preliminary cross section alignments to the District for review. The N value report should be submitted within two weeks.

5. Deliverables. Ted Lehman outlined what was needed from team members for the Data Collection Report, which is due in mid-September. Ted would like a bibliography of data collected, categorized by topic, with a paragraph description for the three to five most important references for each topic, of why it's an important document, its significance for the WCMP process, and how to find the document (library, contact, call number). More specific instructions will be forthcoming.

6. Public Involvement.
   a. The District has completed a draft public involvement plan. Comments on the plan and newsletter are due today. Melissa Lempke will adjust the critical path calendar to reflect a public meeting date of September 16th. The public meeting date was changed to accommodate the Buckeye Town Council meeting. Project information has been posted on the District website. Team should look at website and send comments to Melissa.
   b. Chuck Williams presented a draft stakeholder data base and meeting schedule. EDAW will provide the private developer information to Chuck for inclusion in the database.
   c. Greg will develop a presentation for the Buckeye City Council to be given before public meeting. Melissa will schedule the Council presentation, probably for the Council meeting September 7th. Greg would like team members to pass along any information or graphics of interest for use in the presentation.

7. Other Items:
   a. Greg requested that he be copied on the notice for all deliverables when they are submitted so that he can track the status of review and help maintain the project schedule. Greg will inform John Hathaway.
   b. Greg requested that the team document all agency contact, especially where there has been slow or no response, so that he can assist.
   c. JEF will send a letter to Linda Hannan & Wannett Maxwell noting our address change.
   d. JEF will send the team members the team contact list.

Deleted: *8/3/2004*

Deleted: *6/30/2004*

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Superscript

Formatted: Superscript

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Deleted: ¶
<#>Greg Jones is the interim District project manager.¶
<#>FCDMC Technical Reviewers will be the following:¶
<#>Hydraulics –

Formatted: No bullets or numbering, No widow/orphan control, Don't adjust space between Latin and Asian text, Don't adjust space *between Asian text and numbers*

Deleted: <#> Kathryn Gross

Deleted: <#> Cathy Regester. ¶
<#>Geomorphology – Kathryn Gross.¶
<#>Hydrology - Cathy Register.¶
<#>Sediment Modeling –

Deleted: <#>Unknown, but review will be done by Engineering Division (Ed Raleigh or Amir Motamedi)

Deleted: <#> Cathy Regester¶
<#>Survey - John Stock¶
<#>General Review - Thru FCD PM, but chances for all FCD staff to comment, if timely by deadline.¶
<#>Floodplain Delineation – Kathryn Gross¶
<#>Lines of Communication. Greg Jones noted that "everyone can talk to ... [1]

Formatted: Not Superscript/ Subscript

Formatted: Not Superscript/ Subscript

Formatted: Not Superscript/ Subscript

***Formatted:** Not Superscript/* Subscript

Formatted: Not Superscript/ Subscript

Cathy Regester
Survey - John Stock
General Review - Thru FCD PM, but chances for all FCD staff to comment, if timely by deadline.
Floodplain Delineation – Kathryn Gross

Lines of Communication. Greg Jones noted that "everyone can talk to everyone, but we should all copy the project managers at FCDMC (Greg) & JEF (Ted & JEF) on all email and correspondence.

Study Limits. The study limit is the upstream end of the CAP siphon crossing. The intent of the scope was to include the bank protection on the siphon crossing. JEF will check river mile station shown on the CBA/FDS work maps.

Billing. JEF should send a copy of the invoice package to Greg Jones. The June 2004 billing should be hand-delivered to the District project manager on June 30th.

Site Visit. The team picked a date - July 2nd. Participants will meet at 8 am at District. JEF, WGA, and CLW will provide 4WD vehicles. FCDMC staff will attempt to reserve a 4WD vehicle.

Monthly Team Meeting will be held on the 1st Tuesday of each month at 9 am at the District. Greg Jones will reserve a conference room. We recommend skipping the July 5th meeting, given the proximity to the kickoff meeting and initial site visit.

Schedule.

Topographic mapping is scheduled for completion by June 30, 2004. The topo has been flown and digitized, and includes the Jackrabbit FDS area, the Hassayampa extension, and the extension to west on the Lower Hassayampa. District review should be completed by July 30, 2004. JEF won't use draft data, and will wait for approved mapping. JEF will write letter to the District stating that the topo is in our critical path, and that we need mapping by July 30th, or it will cause delays.

The first public meeting will be held in the 3rd week of September (9/21/04 at 6 pm). The public involvement plan, to be prepared by the District, is due within 60 days of NTP. Jon Fuller & Chuck Williams will attend from the consultant team.

The project schedule is incomplete pending input from District staff on District tasks.

Data Collection

There is no District copy of the CBA FDS hydraulics report. JEF will need to attempt to get a copy from FEMA or CBA (Stantec).

JEF will review data delivered by the District and identify missing items & notify Greg.

David Boggs will provide paper copies of S&G mining reports, and will notify Ted Lehman when they are ready for pick up. David Boggs will set up and coordinate a site visit to S&G pits in the study area.

Miscellaneous Topics.

Chuck has draft stakeholder list and will circulate for review. Chuck will contact ARPA.

- Project directory - JEF will put together a team contact list and circulate it for addition of agency contacts.
- Greg Jones reminded everyone that the objective of the study is to evaluate conditions, assess impacts, and recommend future studies. This is not a planning study, thus no alternatives and solutions are within the scope.

Action Items

JEF - check river mile station of upper study limit shown on FDS work maps
JEF - send a copy of the invoice package to Greg Jones
JEF - write letter to the District re. topo and critical path
JEF - get a copy of CBA hydraulics report from FEMA
JEF - review items provided by FCD from data request & identify missing items
JEF - put together a team contact list.
CLW - Chuck will contact ARPA to coordinate stakeholder meetings
FCDMC - David Boggs provide copies of S&G mining reports.
FCDMC - David Boggs set up site visit to S&G pits
FCDMC – provide complete data collection request
FCDMC – complete project schedule for District tasks, send to JEF

LHWCMP Team Mtg
8/3/04 at FCDMC 9 am
New River Conference Room

Attendance
CLW, Seema, Sara, Teresa Pinto, KAG, Greg Jones, Melissa Lemke, John Hathaway, TWL, JEF, Bob Stevens, Dennis Richards, Cindy Overton

Introduction - Greg
1. John H now officially in czar position
2. No cost change order, WEST has paper work.
3. Letter for time extension because of topo delay. Topo been delivered but not approved yet. Approval expected within 30 days.
4. WEST & JEF to discuss & request day for day extension.
5. Survey change order approved by Tim P in house.
6. Project Status
A) DAta collection. Got library info, BUREC as-builts for siphons & CSA at HR siphon (new after 93). Water line for PVNP d/s of UPRR. Walnut Grove dam failure reconstruction - preliminary 700000 cfs peak HEC-1, USGS comparison. 1891 flood at 200,000 cfs in our reach affects geomorphic interpretation.
B) Hydro Rpt submitted to Cathy Register last week. Copy to WEST next week.
C) Aerial photo collected & rectified. Waiting on one set from ASCS. 1934, 1949, 1953 (1st whole set), 1964-6, 1970, 1972, 1988 (CBA), 1992, 1997-8, 2001, 2003, 2004. Done functional surface mapping, will submit to KAG with preliminary geomorphic mapping in August for review.
D) WEST - got as-builts for 2 hwy bridges and UPRR, but elevations was problem, so we're doing as-built survey to specify datum. Submitted cross section alignment, revised since. Working on n value report. Working through levee impact analysis. No reponse from Cathy yet on alignment. N value report ready this week. Cathy on vacation this week.

Greg - please copy me and John when you submit, so that I can be aware of submittals and reviewers.

E) EDAW - Reviewing GIS data from District & JEF for land use. Discrepancy with Buckeye's web site land use plan. Have preliminary list of developments. Jay working with Jay Harmor/Buckeye, but had poor response.

Greg - document calls, lack of response, and copy him so he can help.

F) WGA - did one site invesigation. Sent USFWS & AZGF letters for official response. Recharge 209 plans for MAG, shows some activity. Looking at WWTP known discharge. Also CAP recharge. Wil coordinate with EDAW re. Drainage master plans issues.

3. Deliverables
A) Data Collection report. TWL would like bibliography, categorize by topic, for each topic 3-5 most important references w/ paragraph of why its an important document, significance for WCMP process, how to find the document (library, contact, call number)

Public Involvement
1. Melissa - draft plan handed out, with responses to comments. Got JEF comments, need CLW & GLJ comments. Will adjust critical path calendar because Buckeye Town Council meets on our proposed meeting date. Looks like 9/16 is best date. It is. Now is some information on the District website, including the project location map. Team should look at website and send comments to Melissa, in active projects section. Mtg at Buckeye Community Center.

CLW - the critical path has review schedule we need to adhere to. John H has comments. Stakeholder involvement. CLW has draft data base. He needs private developer info from EDAW. Workgroups & individual meetings - Agency + Utility = group 1. Private section = group 2. For Buckeye, Greg recommends a presentation to City Council before public meeting. Set up a powerpoint for public meeting and use it at Council briefing. Combine Farm Bureau, NRCD, and ID's. Greg will take lead & make presentation to Town of Buckeye. Melissa will schedule, probably for Council meeting on 7th. Greg will need some graphics from team. Anything of interest from team, pass along to Greg. TWL has a few items.

5. Billing - send officially letter to Linda Hannan & Wannet Maxwell with address change.

6. Other - TP - What is desired outcome for this project? GLJ - Technical baseline & answer to whether should we go to Phase 2.

Send team contact list to team.

Lower Hassayampa Watercourse Master Plan Alternative – Brainstorming Evaluation
Justification for LHWCMP Phase 2

1. Stakeholders have uniformly requested Phase 2 be authorized
2. Pace & scale of development justifies Phase 2 planning effort
3. Results in WCMP, a vehicle for regional planning & recommended alternative
4. Narrow window of opportunity for developer funding of plan elements, e.g. channel downstream of SPRR
5. Cost-effective to proactively plan in Phase 2, rather than retrofit flood control later
6. Fits with BOS directed multi-agency planning effort for West Valley
7. Existing template of Hassayampa-Jackrabbit is clean, relatively unmarred by development.
8. Downstream development & channelization may be sensitive to cumulative impacts increasing discharge.
9. Effective, enforceable plan more likely with few jurisdictions (County, Buckeye)

Lower Hassayampa Watercourse Master Plan Reach Characteristics
Hassayampa-Gila Confluence
Reach Limits: Gila River Low Flow Channel to Arlington Canal Siphon

- Gillespie Dam sediment deposition zone
- Tamarix forest
- Gila River floodplain/floodway
- No active development
- Potential sand & gravel mining
- District 1000-ft. corridor
- Hassayampa River delta area
- Shallow groundwater (< 3 m)
- Groundwater salinity
- Groundwater pollution (DDT)
- Robbin's Butte wildlife conservation area
- Potential T&E species habitat
- Perennial flow from irrigation tailwater
- Permanent open water
- Channelized & developed upstream
- Very incised channel with tall vertical cut banks – high lateral erosion potential

Lower Hassayampa Watercourse Master Plan Reach Characteristics
Hassayampa River Downstream of SPRR
Reach Limits: Arlington Canal Siphon to SPRR Bridge

- Urgent development pressure
- Channelization likely
- Existing structures
    - Old US 80 Bridge
    - SPRR Railroad Bridge – shallow spread footings
    - Narramore Road At-Grade Crossing
    - Arlington Canal Siphon
    - Kinder-Morgan Gas Pipeline @ SPRR
    - Fiber Optic Cable @ SPRR
    - Palo Verde NGS Large Diameter Water Line

- Buckeye Canal outfall
- Agriculture – irrigated farm fields
- Wide floodway
- Shallow flooding of agricultural fields
- Poor floodplain delineation
- Levees
  - Not engineered
  - Privately owned
- Tailwater Flow – Near Perennial
- Tamarix Growth in Channel Bottom
- Few Landowners, Large Parcels
- Bedrock (Basalt) Bluff to West

Lower Hassayampa Watercourse Master Plan
Reach Characteristics

Hassayampa River Upstream of SPRR

Reach Limits: SPRR Bridge to CAP Siphon

- Wide floodplain occupies entire valley bottom between terraces
- Wide erosion hazard zone occupies entire valley bottom
- Existing sand & gravel mining
- Historical agriculture of valley bottom land
- Structures
  - I-10 Bridge
  - Tonopah Salome Highway At-Grade Crossing
  - Baseline Road At-Grade Crossing
  - APS/WAPA Transmission Line Towers
  - CAP Siphon
- Future CAP Linear Recharge
- Future Effluence Discharge
- Limited Grazing
- Tributary control of channel width at Daggs, Wagner, and Jackrabbit Wash confluences
- Numerous Master-Planned Communities in Development

Lower Hassayampa Watercourse Master Plan
Reach Characteristics

Jackrabbit Wash

Reach Limits: Hassayampa River Low Flow Channel to CAP Siphon

- Highly vegetated floodplain and channels
- Highly braided channels, multiple flow paths
- Floodplain & erosion hazard zone occupies entire valley bottom between terraces
- Natural, relatively undisturbed floodplain
- No existing bridge crossings
- Breakout flow to south upstream of Hassayampa River confluence
- Coarse bed material potentially suitable for mining
- Structures
  - CAP Siphon

Lower Hassayampa Watercourse Master Plan Alternative – Brainstorming Evaluation		
Alternative #1: Non-Structural/Floodplain Management		
River Reach	**Opportunities**	**Constraints**
Confluence		
Main Stem Below SPRR	Channelization likely by private owners	Poor effective floodplain mapping Private land owners favor channelization Existing channel is undersized
Main Stem Above SPRR	Major master plan communities	Wide floodway may favor channelization Private land owners favor channelization Sand & gravel mining impacts Many unbuildable parcels in floodway
Jackrabbit Wash	Minimal existing development	Wide floodway may favor channelization Private land owners favor channelization

Issues – Further Analysis Needed

Compliance. Enforceability of recommended plan. Identify tools.
Hydrology. Resolve regulatory discharge for Hassayampa.
Transportation – master plan of proposed crossings
Implementation – enforcement of erosion hazard zones
Floodplain delineation – redelineation of floodplain & floodway downstream (new topo, new discharge, possible channelization)
Rules of development – sand & gravel, encroachment, crossings, effluent release, erosion hazard zones
Sand & Gravel Mining Guidelines/Plan – reach-specific guidelines, including Levee Reach, evaluate impacts of mine spacing vs. depth vs. volume vs. position in floodplain vs. demand.

Fatal Flaws

Lack of enforceability of river management plans
Long history of river encroachment & disturbance in Maricopa County

Lower Hassayampa Watercourse Master Plan Alternative – Brainstorming Evaluation		
Alternative #2: Channelization		
River Reach	**Opportunities**	**Constraints**
Confluence	Connectivity with Gila River trails Tamarix eradication funding	Gila River floodway/floodplain/erosion Gillespie Dam lawsuit implications Topographic mapping is old (~1993) Need upstream containment to channelize No WCMP planned for Gila River reach
Main Stem Below SPRR	Channelization already proposed Few landowners, large parcels in reach Perennial water Trail connectivity Disturbed reach – restoration opportunity Regional 404 permit – enforcement Water quality enhancement features Ground water, storm water Habitat enhancement, mitigation bank Mitigate Buckeye FRS release modification impacts	Pace of development vs. planning process 404 Permit – EA/EIS, existing habitat Capacity of existing structures (US80) SPRR bridge foundation Existing channel capacity < Q100 Shallow ground water
Main Stem Above SPRR	Sand & gravel mining Master planned community open space Future bridge crossings	Future bridge & utility crossings Sand & gravel mining permit footprints CAP linear recharge sites & discharge Fracture land ownership CAP Siphon
Jackrabbit Wash		High habitat value of floodplain CAP Siphon

Issues – Further Analysis Needed

- Sedimentation Engineering – assess potential for delta aggradation in Gila River floodplain, assess historical aggradation in lower HR reaches due to Gillespie Dam with degradation after 1993 breach, interaction with Gillespie dam backwater deposition reach, increase/decrease in sediment delivery to downstream reaches (esp. Gila River), potential sediment capture area in sand & gravel mine at confluence, scour at structures (bridges, flumes, utility crossings), stable slope/grade control need, HEC-6 model of alternative to compare with existing conditions
- Environmental Permits – tamarix control, perennial water issues for 404 permitting, habitat, regional 404 permit for recommended plan as enforcement/implementation tool, explore mitigation banking options
- Resource Study – cultural resource inventory, landscape character analysis
- Design Issues – types of channelization, materials, scour & erosion protection, channel width (floodway or narrower), containment at upstream end of piecemeal segments, design flow (Q100, SPF), utility conflicts
- Land Ownership – channelization on private land, ASLD land or BLM land
- Implementation – piecemeal construction, interim impacts to adjacent reaches, land ownership (private, ASLD, BLM), phasing plan, operations and maintenance, ownership of facilities
- Vegetation Control – for confluence & main stem below SPRR reaches, tamarix control increase channel capacity, needs environmental permit, long-term plan to continue action, plan for replacement species in eradication areas, funding
- Hydraulic modeling of channelization – starting WSEL in confluence area, capacity of hydraulic structures (bridges, levees), channel configuration (low flow, terrace, etc) modeling, unsteady flow analysis of channel to determine impact on peak discharge, update Gila River floodplain hydraulic model at confluence (effective FIS has old Dames & Moore model with higher Q100)
- Hydrologic – impact on peak discharge of channelization (loss of attenuation, cumulative impact), level of protection
- Bridge Design – evaluate cost/benefit of bridge width to determine likely channelization width,

• Transportation – master plan of proposed crossings • Recharge Siting & Impact – locations, impact on vegetation (roughness), scour, opportunities, floodplain compatibility • Channel alignment – land ownership, tributary confluences, open space opportunities, trails, sand & gravel mining, possible re-alignment below SPRR along Black Butte. • Jackrabbit Wash breakout cutoff levee (prevent breakout) vs. channelization of breakout flow
Fatal Flaws Channel in Gila River floodway & erosion zone subject to destruction, making low cost/benefit ratio Need for public ownership and/or maintenance of constructed channel, levees, etc. Sediment delivery to Gila – increase or decrease

Lower Hassayampa Watercourse Master Plan Alternative – Brainstorming Evaluation		
Alternative #3: Do Nothing (Status Quo)		
Reach	**Opportunities**	**Constraints**
Confluence		
Main Stem Below SPRR		Private ownership
Main Stem Above SPRR		Private ownership
Jackrabbit Wash		Private ownership
Issues – Further Analysis Needed Likely development scenarios with cost implications		
Fatal Flaws Does not address stakeholder intent & concerns. Does not meet District objective for watercourse planning. Likely to have cumulative impact issues from encroachment & mining. Floodway width creates pressure for revision & narrowing		

Lower Hassayampa Watercourse Master Plan
Alternative – Brainstorming Evaluation

Alternative #4: Area Wide River Management Plan Needs

Plan Element	Opportunities	Constraints	Phase 2 Analyses Needed
Interim Development Task Force	Address development issues during period until Phase 2 of LHWCMP is authorized & contracted.	Need contract	None. Wrap into Phase 2 alternatives
Sand & Gravel Mining Guidelines – river specific plan	Capture sediment in confluence area ARPA cooperation possible Develop streamlined permit criteria	ARPA acceptance Conflicts with adjacent land uses	Reclamation guidelines Example mining plans Material demand forecast Mining district analysis
Bridge Design Guidelines –	On-going or future ADOT, MCDOT, & MAG study coordination		Economics of bridge length v. cost Impacts of narrow bridge on channel
Implementation Funding	Developer impact fee study Tamarix control grants AFR style channelization	Limited financial resources	Channel ownership & maintenance
Acquisition	Some lands available by tax auction Wide floodway	Trust Lands auction timetable Political ramifications of condemnation Funding mechanism Gaps in land available for acquisition	Identification of key land parcels Identify acquisition corridor
Effluent Discharge	Wildlife & habitat enhancement	Seasonal supply Future supply uncertain	Floodplain impacts of vegetation Scour/stable slope analysis Timing of water availability vs. need
Economic			Cost-benefit of various alternatives
Reach Limits			Consider expanding reach to Vulture Mtns
Coordination with Related District, County & Buckeye Studies	Buckeye ADMP Sun Valley ADMP Buckeye FRS Rehabilitation West Valley Planning Study	CanaMex Corridor	Regional trails plan coordination Buckeye FRS rehabilitation impacts

Fatal Flaws

Lack of "buy-in" from Town of Buckeye would lead to unenforceable, ineffective plan. Can be addressed by coordination with Town Planning & Development staff, as well as Town Council.

Reach Characteristics

1. Hassayampa River - Gila River Confluence
    a. Reach limits: Gila River low flow channel to Arlington Canal Siphon
    b. Gillespie Dam sediment deposition zone
    c. Tamarix forest
    d. Gila River floodplain/floodway
    e. No active development
    f. Potential sand & gravel mining
    g. District 1000-ft. corridor
    h. Hassayampa River delta area
    i. Shallow groundwater (< 3 m)
    j. Groundwater salinity
    k. Groundwater pollution (DDT)
    l. Robbin's Butte wildlife conservation area
    m. Potential T&E species habitat
    n. Perennial flow from irrigation tailwater
    o. Permanent open water
    p. Channelized & developed upstream
    q. Very incised channel with tall vertical cut banks – high lateral erosion potential
2. Hassayampa River – Downstream of SPRR Bridge
    a. Reach limits: Arlington Canal to SPRR Bridge
    b. Urgent development pressure
    c. Channelization likely
    d. Existing structures
        i. Old US 80 Bridge
        ii. SPRR Railroad Bridge – shallow spread footings
        iii. Narramore Road At-Grade Crossing
        iv. Arlington Canal Siphon
        v. Kinder-Morgan Gas Pipeline @ SPRR
        vi. Fiber Optic Cable @ SPRR
        vii. Palo Verde NPP Large Diameter Water Line
        viii. Buckeye Canal outfall
    e. Agriculture – irrigated farm fields
    f. Wide floodway
    g. Shallow flooding of agricultural fields
    h. Poor floodplain delineation
    i. Levees
        i. Not engineered
        ii. Privately owned
    j. Tailwater Flow – Near Perennial
    k. Tamarix Growth in Channel Bottom
    l. Few Landowners, Large Parcels
    m. Bedrock (Basalt) Bluff to West
3. Hassayampa River – Upstream of SPRR Bridge
    a. Reach limits: SPRR Bridge to CAP Siphon

b. Wide floodplain occupies entire valley bottom between terraces
c. Wide erosion hazard zone occupies entire valley bottom
d. Existing sand & gravel mining
e. Historical agriculture of valley bottom land
f. Structures
    i. I-10 Bridge
    ii. Tonopah Salome Highway At-Grade Crossing
    iii. Baseline Road At-Grade Crossing
    iv. APS/WAPA Transmission Line Towers
    v. CAP Siphon
g. Future CAP Linear Recharge
h. Future Effluence Discharge
i. Limited Grazing
j. Numerous Master-Planned Communities in Development

4. Jackrabbit Wash
    a. Reach limits: Hassayampa River low flow channel to CAP Siphon
    b. Highly vegetated floodplain and channels
    c. Highly braided channels, multiple flow paths
    d. Floodplain & erosion hazard zone occupies entire valley bottom between terraces
    e. Natural, relatively undisturbed floodplain
    f. No existing bridge crossings
    g. Breakout flow to south upstream of Hassayampa River confluence
    h. Coarse bed material potentially suitable for mining
    i. Structures
        i. CAP Siphon

Letters

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, PE CFM
Jolene Tallsalt Robertson, BS
Cory Helton, EIT, MS
Rob Lyons, PE
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

August 12, 2005

John Hathaway, PE
Flood Control District of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

RE: Lower Hassayampa Watercourse Master Plan (LHWCMP)
Change Order Request #2: Optional Task for Floodway Modeling

Dear John:

As discussed at the most recent team progress meeting, please accept this request for a change in scope for additional work under Task 7 HYDRAULICS and to delete the existing optional task for Two-Dimensional Modeling (Task #7.2.6).

At the July 5, 2005 progress meeting, the project team recommended, and District staff concurred, to not authorize Task 7.2.6 (Optional Two-Dimensional Modeling). The rational for not authorizing Task 7.2.6 was outlined in a memorandum to John Hathaway/FCDMC from Jon Fuller dated May 31, 2005. The following paragraph from the May 31, 2005 memorandum summarizes the rationale:

> *A well developed two-dimensional model would provide a more accurate depiction of the 100-year floodplain. However, a two-dimensional model which incorporates the main channel berms would be complex, would take a long time to develop, and could not be submitted to FEMA unless the berms were removed. A two-dimensional model without the berms would be acceptable to FEMA, but would not reflect the actual conditions. Given that there is an effective floodplain delineation in place, and that the reach is likely to be channelized in the future, there is no need to expend District funds on new floodplain delineations in this area.*

At the August 2, 2005 progress meeting, the project team and District staff determined that the LHWCMP study objectives would be better met by preparing a floodway model for the Hassayampa River upstream of the Southern Pacific Railroad Bridge (SPRR). An updated floodway model is required for the following reasons:

1. Significant channel changes in channel position have occurred since the effective FDS was completed in the 1980's. Channel position has a direct impact on floodway delineation.
2. The floodway is the key tool used by District and local agency floodplain managers to determine areas where no development should occur.

3. The floodway delineation has implications for sand & gravel management and regulation.
4. The floodway delineation has implications for delineation of erosion hazard zones.
5. An important deliverable for the LHWCMP is to identify reaches where the effective floodplain delineation study (FDS) is inaccurate, and to determine whether the District should proceed with a LOMR during Phase 2 of the study. Floodway mapping will allow the team to make a more informed decision prior to investing District funds.
6. Stakeholders have identified revisions to the effective FDS as a key concern.

Therefore, based on the reasons outlined above, JE Fuller/Hydrology & Geomorphology, Inc. (JEF) recommends the following:

1. Delete Task 7.2.6 (Optional Two-Dimensional Modeling - decrease <$23,073.74>)
2. Add to authorized Task 7.2.4 (Optional Floodway Modeling Flooding Extent Comparison by delineating a floodway between the UPRR bridge and the upper limit of the study area - increase $19,238.16)

A draft scope of services for additional work under Task 7.2.4 is provided below:

> Task 7.2.4. The CONSULTANT shall redelineate the floodway upstream of the SPRR Bridge using the HEC-RAS hydraulic model. The floodway shall be delineated using Method 4, as specified in 11.5.6.1 of the Consultants Guidelines. The CONSULANT may also use Method 5, an optimized version of Method 4, as needed to achieve a more optimal delineation. In addition, manual adjustments of the Method 4 or 5 encroachments stations may be required in order to achieve a smooth floodway boundary and/or to eliminate negative surcharges. Reasonable efforts will be made to eliminate or reduce negative surcharges. The CONSULTANT shall submit a draft floodway model to FCD for review, along with exhibit maps showing the draft floodway. Any review comments from FCD will then be incorporated, and the floodway modified accordingly if necessary. Documentation of the floodway delineation shall be incorporated by revising the Hydraulic Report, which replaces the original hydraulic report. A floodway data table will be included in the revised report. New exhibit maps showing the newly delineated floodway will replace the original set of the exhibit maps. A new set of CDs will be submitted reflecting the updated report and hydraulic model with the floodway.

A fee schedule ($19,238.16) to perform floodway modeling is attached. Please do not hesitate to call me if you have any questions regarding this matter.

Sincerely,

JE Fuller/Hydrology & Geomorphology, Inc.

Jonathan Fuller, PE, RG, PH, CFM
Principal

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, PE CFM
Jolene Tallsalt Robertson, BS
Cory Helton, EIT, MS
Rob Lyons, PE
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

September 7, 2005

John Hathaway, PE
Flood Control District of Maricopa County
2801 W. Durango Rd
Phoenix, AZ 85009

RE: Lower Hassayampa Watercourse Master Plan

Dear John:

As discussed at the most recent team progress meeting, please accept this request to authorize the following two optional tasks for the above-referenced project:

- Task 2.1.6 – (Optional) Additional Coordination Meetings: $27,745.50
- Task 4.7.3 – (Optional) Additional Stakeholder Meetings: $24,414.51
    - Total Amount: $52,160.01

Authorization for these two tasks is needed to address increased coordination with new impending developments that propose to channelize the lower reaches of the Hassayampa River, new sand & gravel excavations, coordination regarding potential changes in hydrologic data, and to support a West Valley planning task force proposed by Supervisor Willcox.

The approved fees associated with these tasks are summarized above.

Please contact me if you require additional information.

Sincerely,

JE Fuller/Hydrology & Geomorphology, Inc.

Jonathan Fuller, PE, PH, RG, CFM
Principal

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.
Pat Deschamps, P.E., L.S.

Mike Kellogg, M.S., G.I.T.
Cory Helton, M.S.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

December 6, 2005

Carla Cristelli
Western Area Power Authority
PO Box 6457
Phoenix, AZ 85005-6457
602-605-2630 fax

RE: Lower Hassayampa Watercourse Master Plan -
Request for as-built and ownership information for power transmission line across the Hassayampa River in Maricopa County, Arizona

Dear Ms. Cristelli:

The Flood Control District of Maricopa County (District) is preparing a Watercourse Master Plan for the Lower Hassayampa River. JE Fuller/ Hydrology & Geomorphology, Inc. is the prime consultant to the District for this study. The study reach extends from the Central Arizona Project Canal crossing to the Gila River confluence. The study is intended to provide an in-depth understanding of the river and its floodplain, areas threatened by potential erosion and scour by the watercourse, and existing and proposed land uses and features.

The District recognizes the importance of potential impacts to utilities as part of the watercourse planning process as well as the constraints those utilities have to viable potential alternatives. We have noted major power transmission lines in the field crossing the Hassayampa River at several locations in Maricopa County, Arizona as listed below:

T1N, R5W, Sec. 10, S1/2,

T1N, R5W, Sec. 15, NW1/4

T3N, R5W, Sec. 11, SE1/4

T3N, R5W, Sec. 13, W1/2

T3N, R5W, Sec. 14, E1/2

T4N, R4W, Sec. 31, W1/2

T4N, R5W, Sec. 36, SE1/4

In order to provide an adequate inventory of important infrastructure in the study area, we would like to request information regarding the specific planimetric and vertical location of the transmission line towers. If as-built or design plan data are available, especially for the footings/foundations, we would like to obtain copies if possible. Again, the purpose it to provide an inventory to the planning process in order to accurately identify potential impacts and constraints as the District's planning process proceeds.

Please call me or the District's project manager, John Hathaway (602-506-1501) if you have any questions regarding the Watercourse Master Plan or this request. Thank you in advance for your assistance with this matter.

Sincerely,
JE Fuller/Hydrology & Geomorphology, Inc.

Ted Lehman, PE
Assistant Project Manager

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, PE CFM
Jolene Tallsalt Robertson, BS
Cory Helton, EIT, MS
Rob Lyons, PE
Emili Kovelski, PE
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

December 6, 2005

John Hathaway, PE
Flood Control District of Maricopa County
2801 W. Durango Rd
Phoenix, AZ 85009

RE: Lower Hassayampa Watercourse Master Plan

Dear John:

As discussed at the most recent team progress meeting, please accept this request to authorize the following two optional tasks for the above-referenced project:

- Task 2.1.6 – (Optional) Additional Coordination Meetings: $27,745.50
- Task 4.7.3 – (Optional) Additional Stakeholder Meetings: $24,414.51
    - Total Amount: $52,160.01

Authorization for these two tasks is needed to address increased coordination with new impending developments that propose to channelize the lower reaches of the Hassayampa River, new sand & gravel excavations, coordination regarding potential changes in hydrologic data, and to support a West Valley planning task force proposed by Supervisor Willcox.

The approved fees associated with these tasks are summarized above.

Please contact me if you require additional information.

Sincerely,

JE Fuller/Hydrology & Geomorphology, Inc.

Jonathan Fuller, PE, PH, RG, CFM
Principal

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, P.E., R.G., P.H., CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.

Pat Deschamps, P.E., L.S.
Mike Kellogg, M.S., G.I.T.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

6101 S. Rural Rd., Suite 110
Tempe, Arizona 85283
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

June 2, 2004

Doug Williams, AICP
FCDMC
2801 W. Durango Street
Phoenix, AZ 85009

RE: data collection requests for FCD2004C001 – Lower Hassayampa Watercourse Master Plan

Mr. Williams:

This letter is to formally request copies of certain information and data associated with our efforts on your behalf for the Lower Hassayampa Watercourse Master Plan. In particular, many of these data are GIS data resident in your GIS database.

- 10-ft topo (elv-1208.shp) (received)
- 2-foot topography (received available)
- 2004 or most recent digital orthographic aerial photographs
- public land survey (township, range, sections, and section corners) (received)
- GDAC points
- existing land use coverage (received)
- future land use coverage (received)
- Assessor parcel data
- FEMA floodplains (received)
- FDS cross section locations (apparently not available for Hassayampa)
- Drainage basins boundaries for the Hassayampa River from headwaters to its confluence with the Gila
- DRGs for entire watershed (item above)
- Jurisdictions
- Open space (parks, schools, etc.) (appears to be captured in various land use coverages)
- Natural features (some of this is in the various alris_ coverages)
- Natural resources (not sure what's meant by this)

Sincerely,
JE Fuller/Hydrology & Geomorphology, Inc.

Ted Lehman, PE,
Assistant Project Manager

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, P.E., R.G., P.H., CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.
Pat Deschamps, P.E., L.S.

Mike Kellogg, M.S., G.I.T.
Cory Helton, M.S.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

6101 S. Rural Rd., Suite 110
Tempe, Arizona 85283
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

June 18, 2004

Gregory Jones, PE
Regional Area Manager
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

RE: FCD 2004C001 – Lower Hassayampa Watercourse Master Plan (LHWCMP)
Topographic Mapping Schedule

Dear Gregory:

It has come to our attention that there may be delays in providing the topographic mapping for the LHWCMP study area at the Project Kickoff meeting on June 17, 2004. To maintain the project schedule, and meet our commitments to the District, it is imperative that approved, final topographic mapping be provided by July 30, 2004. In the Scope of Work for the LHWCMP, this information was to be provided at the Kickoff Meeting per Task 1.7. The receipt of the topographic mapping is in the critical path. Failure by the District to meet the current Project Schedule for delivery of the topographic mapping will result in delays in the LHWCMP, and increased administration and other costs not currently budgeted in the fees negotiated for LHWCMP.

Thank you for your attention to this matter.

Sincerely,

JE Fuller/Hydrology & Geomorphology, Inc.

Jonathan Fuller, PE, RG, PH, CFM
Principal

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.
Pat Deschamps, P.E., L.S.

Mike Kellogg, M.S., G.I.T.
Cory Helton, M.S.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

October 21, 2004

WilTel Communications
Attn: Linda Rodgers
11th Floor
100 S. Cincinnati Avenue
Tulsa, OK 74103

RE: Lower Hassayampa Watercourse Master Plan -
Request for information regarding fiber optic line parallel to Union Pacific Railroad across the Hassayampa River in Maricopa County, Arizona

Dear Ms. Rodgers:

The Flood Control District of Maricopa County (District) is preparing a Watercourse Master Plan for the Lower Hassayampa River. JE Fuller/ Hydrology & Geomorphology, Inc. is the prime consultant to the District for this study. The study reach extends from the Central Arizona Project Canal crossing to the Gila River confluence. The study is intended to provide an in-depth understanding of the river and its floodplain, areas threatened by potential erosion and scour by the watercourse, and existing and proposed land uses and features. The project is currently in the data collection phase and technical analysis phase.

The District recognizes the importance of potential impacts to utilities as part of the watercourse planning process as well as the constraints those utilities have to viable potential alternatives such as river channelization. We have noted a WilTel fiber optic line marked in the field crossing the Hassayampa River parallel to the Union Pacific Railroad alignment in T1S, R5W, Sec. 2 in Maricopa County, Arizona. A map showing the location is also attached.

In order to provide an adequate inventory of important infrastructure in the study area, we would like to request information regarding the specific planimetric and vertical location of the pipeline. If as-built or design plan data are available we would like to obtain copies if possible. Again, the purpose it to provide an inventory to the planning process in order to accurately identify potential impacts and constraints as the District's planning process proceeds.

Please call me or the District's project manager, John Hathaway (602-506-1501) if you have any questions regarding the Watercourse Master Plan or this request. Thank you in advance for your assistance with this matter.

Sincerely,
JE Fuller/Hydrology & Geomorphology, Inc.

Ted Lehman, PE
Assistant Project Manager

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.
Pat Deschamps, P.E., L.S.

Mike Kellogg, M.S., G.I.T.
Cory Helton, M.S.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

October 6, 2004

Don Quinn
Kinder Morgan Energy Partners
1100 Town & Country
Orange, CA 92868

RE: Lower Hassayampa Watercourse Master Plan -
Request for information regarding petroleum products pipeline parallel to Union Pacific Railroad across the Hassayampa River in Maricopa County, Arizona

Dear Mr. Quinn:

The Flood Control District of Maricopa County (District) is preparing a Watercourse Master Plan for the Lower Hassayampa River. JE Fuller/ Hydrology & Geomorphology, Inc. is the prime consultant to the District for this study. The study reach extends from the Central Arizona Project Canal crossing to the Gila River confluence. The study is intended to provide an in-depth understanding of the river and its floodplain, areas threatened by potential erosion and scour by the watercourse, and existing and proposed land uses and features. The project is currently in the data collection phase.

The District recognizes the importance of potential impacts to utilities as part of the watercourse planning process as well as the constraints those utilities have to viable potential alternatives. We have noted a Kinder Morgan pipeline marked in the field crossing the Hassayampa River parallel to the Union Pacific Railroad alignment in T1S, R5W, Sec. 2 in Maricopa County, Arizona.

In order to provide an adequate inventory of important infrastructure in the study area, we would like to request information regarding the specific planimetric and vertical location of the pipeline. If as-built or design plan data are available we would like to obtain copies if possible. Again, the purpose it to provide an inventory to the planning process in order to accurately identify potential impacts and constraints as the District's planning process proceeds.

Please call me or the District's project manager, John Hathaway (602-506-1501) if you have any questions regarding the Watercourse Master Plan or this request. Thank you in advance for your assistance with this matter.

Sincerely,
JE Fuller/Hydrology & Geomorphology, Inc.

Ted Lehman, PE
Assistant Project Manager

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, CFM
Cory Helton, EIT, MS
Rob Lyons, EIT
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

February 18, 2005

Bill Peck
Rinker Materials
P.O. Box 52140
Phoenix, AZ 85072

RE: Right-of-Entry Request – Hassayampa River property

Dear Mr. Peck:

As part the Lower Hassayampa River Watercourse Master Plan (LHWCMP) study, JE Fuller / Hydrology & Geomorphology, Inc. (JEF) has been tasked by the Flood Control District of Maricopa County to evaluate river behavior within the study reach. To do that, we need to assess the degree of soil development within the river corridor. Such an evaluation requires analysis of the subsurface soils in addition to those found at the surface. This is accomplished by excavating a small soil pit (5 ft deep, 3 ft wide) with a backhoe, and evaluating the degree of soil development within the soil column. JEF has identified 2 proposed soil pit locations within your property.

This letter is a formal request by JEF to allow the excavation of the proposed soil pits. The pits will only remain open for a few hours and then will be immediately backfilled. It is JEF's standard policy that minimum surficial disturbance occur during a soil pit evaluation, including disturbance to vegetation and other natural landscape features. Additionally, every care is made to return the soil pit location to its previous state and minimize any evidence of disturbance. Attached to this letter is a map showing the locations of the proposed soil pits.

Please sign this letter below to acknowledge your authorization for JEF to access your property and perform our soil analysis. Enclosed is a stamped return envelope. Please contact me if you have any questions at (480) 222-5706.

Thank you,

Sincerely,

Mike Kellogg
Hydrologist
JE Fuller/Hydrology & Geomorphology, Inc.

______________________________ ______________
(signature) Date

____
(please print name)

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, CFM
Cory Helton, EIT, MS
Rob Lyons, EIT
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

February 16, 2005

Dick Maes
Vistoso Partners
1121 W. Warner Rd., Suite 109
Tempe, AZ 85284

RE: Right-of-Entry Request – Hassayampa River property

Dear Mr. Maes:

As part the Lower Hassayampa River Watercourse Master Plan (LHWCMP) study, JE Fuller / Hydrology & Geomorphology, Inc. (JEF) has been tasked by the Flood Control District of Maricopa County to evaluate river behavior within the study reach. To do that, we need to assess the degree of soil development within the river corridor. Such an evaluation requires analysis of the subsurface soils in addition to those found at the surface. This is accomplished by excavating a small soil pit (5 ft deep, 3 ft wide) with a backhoe, and evaluating the degree of soil development within the soil column. JEF has identified 2 proposed soil pit locations within your property.

This letter is a formal request by JEF to allow the excavation of the proposed soil pits. The pits will only remain open for a few hours and then will be immediately backfilled. It is JEF's standard policy that minimum surficial disturbance occur during a soil pit evaluation, including disturbance to vegetation and other natural landscape features. Additionally, every care is made to return the soil pit location to its previous state and minimize any evidence of disturbance. Attached to this letter is a map showing the locations of the proposed soil pits.

Please sign this letter below to acknowledge your authorization for JEF to access your property and perform our soil analysis. Enclosed is a stamped return envelope. Please contact me if you have any questions at (480) 222-5706.

Thank you,

Sincerely,

Mike Kellogg
Hydrologist
JE Fuller/Hydrology & Geomorphology, Inc.

______________________________ ______________
(signature) Date

____
(please print name)

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, CFM
Cory Helton, EIT, MS
Rob Lyons, EIT
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

February 16, 2005

Laurine Hill
335 Deerfield Drive
Moraga, CA 94556

RE: Right-of-Entry Request – Hassayampa River property

Dear Ms. Hill:

As part the Lower Hassayampa River Watercourse Master Plan (LHWCMP) study, JE Fuller / Hydrology & Geomorphology, Inc. (JEF) has been tasked by the Flood Control District of Maricopa County to evaluate river behavior within the study reach. To do that, we need to assess the degree of soil development within the river corridor. Such an evaluation requires analysis of the subsurface soils in addition to those found at the surface. This is accomplished by excavating a small soil pit (5 ft deep, 3 ft wide) with a backhoe, and evaluating the degree of soil development within the soil column. JEF has identified 2 proposed soil pit locations within your property.

This letter is a formal request by JEF to allow the excavation of the proposed soil pits. The pits will only remain open for a few hours and then will be immediately backfilled. It is JEF's standard policy that minimum surficial disturbance occur during a soil pit evaluation, including disturbance to vegetation and other natural landscape features. Additionally, every care is made to return the soil pit location to its previous state and minimize any evidence of disturbance. Attached to this letter is a map showing the locations of the proposed soil pits.

Please sign this letter below to acknowledge your authorization for JEF to access your property and perform our soil analysis. Enclosed is a stamped return envelope. Please contact me if you have any questions at (480) 222-5706.

Thank you,

Sincerely,

Mike Kellogg
Hydrologist
JE Fuller/Hydrology & Geomorphology, Inc.

______________________________ ________________

Laurine Hill Date

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, CFM
Cory Helton, EIT, MS
Rob Lyons, EIT
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

February 18, 2005

Larry Walker
2914 W. Eastman Dr.
Anthem, AZ 85086

RE: Right-of-Entry Request – Hassayampa River property

Dear Mr. Walker:

As part the Lower Hassayampa River Watercourse Master Plan (LHWCMP) study, JE Fuller / Hydrology & Geomorphology, Inc. (JEF) has been tasked by the Flood Control District of Maricopa County to evaluate river behavior within the study reach. To do that, we need to assess the degree of soil development within the river corridor. Such an evaluation requires analysis of the subsurface soils in addition to those found at the surface. This is accomplished by excavating a small soil pit (5 ft deep, 3 ft wide) with a backhoe, and evaluating the degree of soil development within the soil column. JEF has identified 2 proposed soil pit locations within your property.

This letter is a formal request by JEF to allow the excavation of the proposed soil pits. The pits will only remain open for a few hours and then will be immediately backfilled. It is JEF's standard policy that minimum surficial disturbance occur during a soil pit evaluation, including disturbance to vegetation and other natural landscape features. Additionally, every care is made to return the soil pit location to its previous state and minimize any evidence of disturbance. Attached to this letter is a map showing the locations of the proposed soil pits.

Please sign this letter below to acknowledge your authorization for JEF to access your property and perform our soil analysis. Enclosed is a stamped return envelope. Please contact me if you have any questions at (480) 222-5706.

Thank you,

Sincerely,

Mike Kellogg
Hydrologist
JE Fuller/Hydrology & Geomorphology, Inc.

______________________________ ______________
(signature) Date

____
(please print name)

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, PE
John Wallace, PE
Ted Lehman, PE
W. Scott Ogden, PE
Pat Quinn, PE, RLS
Jeff Despain, PE

Mike Kellogg, GIT, MS, CFM
Hari Sundararaghavan, PhD, CFM
Cory Helton, EIT, MS
Rob Lyons, EIT
Brooks Dillard, EIT
Annette Griffin, AAS

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

February 21 2005

David Sawyers
Pioneer Sand Co.
1638 East Deer Valley Road
Phoenix, AZ 85024

RE: Right-of-Entry Request – Hassayampa River property

Dear Mr. Sawyers:

As part the Lower Hassayampa River Watercourse Master Plan (LHWCMP) study, JE Fuller / Hydrology & Geomorphology, Inc. (JEF) has been tasked by the Flood Control District of Maricopa County to evaluate river behavior within the study reach. To do that, we need to assess the degree of soil development within the river corridor. Such an evaluation requires analysis of the subsurface soils in addition to those found at the surface. This is accomplished by excavating a small soil pit (5 ft deep, 3 ft wide) with a backhoe, and evaluating the degree of soil development within the soil column. JEF has identified 3 proposed soil pit locations within your property.

This letter is a formal request by JEF to allow the excavation of the proposed soil pits. The pits will only remain open for a few hours and then will be immediately backfilled. It is JEF's standard policy that minimum surficial disturbance occur during a soil pit evaluation, including disturbance to vegetation and other natural landscape features. Additionally, every care is made to return the soil pit location to its previous state and minimize any evidence of disturbance. Attached to this letter is a map showing the locations of the proposed soil pits.

Please sign this letter below to acknowledge your authorization for JEF to access your property and perform our soil analysis. Enclosed is a stamped return envelope. Please contact me if you have any questions at (480) 222-5706.

Thank you,

Sincerely,

Mike Kellogg
Hydrologist
JE Fuller/Hydrology & Geomorphology, Inc.

____________________________________ _______________
(signature) Date

____
(please print name)

Transmittals

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 South Kyrene Road, Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

May 18, 2005

TRANSMITTAL

John Hathaway, P.E.
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

- Five (5) copies of the corrected pages 37 & 47 to the final Hydrology Report for the Lower Hassayampa River Watercourse Master Plan.
- Five (5) copies of CDs containing the corrected files

During review of the hydrology for preparation of the HEC-6 scenarios, we noticed omissions from two tables on pages 37 and 47 of the final hydrology report. These have been corrected and updated on the attached documents and CDs. Please replace these items in the 5 original final copies delivered to you on March 2nd.

Please let me know if you have any questions.

JE Fuller/Hydrology & Geomorphology, Inc.

5/18/05
Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 South Kyrene Road, Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

August 9, 2005

TRANSMITTAL

John Hathaway, P.E.
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc. on behalf of our consultant team member WEST Consultants:

- Five (5) copies of the final Hydraulics Report for the Lower Hassayampa River Watercourse Master Plan.

The reports include CDs with the final report, the HEC-RAS models, ArcView shapefiles of the cross sections, flood inundation limits, TIN, and other related information.

Please note two things:

1) One of the Volume II notebooks is incomplete. Cathy R. has the remaining portions from an earlier submittal. Please have her add those items (as-builts I believe) to the incomplete Volume II binder included here.

2) Leo wanted me to indicate that while these are identified as "final" documents, he is ready to provide modifications if any additional comments are forthcoming. Moreover, if the floodway change order goes through successfully, these reports may be modified or amended to reflect the floodway analyses.

Please let me know if you have any questions.

8/9/05

JE Fuller/Hydrology & Geomorphology, Inc. — Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

December 12, 2005

TRANSMITTAL

John Hathaway, PE
Flood Control District of Maricopa County
2801 W Durango
Phoenix, AZ 85009

Enclosed are the following materials for FCDMC review provided by JEFuller/Hydrology & Geomorphology, Inc. for the Lower Hassayampa River Watercourse Master Plan:

1. Two copies: Chapter 4 – Bed Elevation Analysis

2. Two copies: Historical Photo Comparison Exhibit Book

Mike Kellogg, RG, CFM

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

December 15, 2005

TRANSMITTAL

John Hathaway, PE
FCDMC
2801 W. Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. Two (2) copies of Chapter 6 – Lateral Migration Report for the LHWCMP.

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

December 20, 2005

TRANSMITTAL

John Hathaway, PE
FCDMC
2801 W Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. Two (2) copies of Chapters 5, 7, 8, 9, & 10 of the LHWCMP River Behavior Report.

I will email an updated table of contents later today.

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

January 4, 2006

TRANSMITTAL

Dave Degerness, P.E.
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Dave,

Enclosed is a DVD containing the data requested in regard to your review of the Lower Hassayampa River Watercourse Master Plan – Chapter 6.

Let me know if you need any additional information.

Mike

-ORIGINAL REQUEST-

John,

I would like to request more data in my review of the Lateral Migration Analysis Chapter 6. What I would like is the following.

1. Rectified Photos that support Table 6-1

2. Rectified Photos that support Table 6-2

3. GIS shape file for River reaches in this study.

4. All spreadsheets that are used in figures 6.1 to 6.4.

5. Rectified photos that support table 6.4.

6. All GIS files and spreadsheets that were used.

Thanks. Dave

____________________________ _____________________

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

January 25, 2006

TRANSMITTAL

Dave Degerness, P.E.
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Dave,

Enclosed is a DVD containing the rectified 1992 and 1997-98 aerial data sets. Let me know if they still do not work in ArcView.

Mike

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

March 3, 2006

TRANSMITTAL

John Hathaway, PE
FCDMC
2801 W Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. Four (4) copies of the draft *Lower Hassayampa River Watercourse Master Plan - River Behavior Report* for FCDMC final review.

Mike Kellogg

____________________________ ____________________

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

April 7, 2006

TRANSMITTAL

Jay Hicks
EDAW
455 North 3rd Street
Suite 272
Phoenix, Arizona 85004

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. Four copies of the *Lower Hassayampa River Watercourse Master Plan – River Behavior Report* for final cover and binding.
2. Four copies of the *Lower Hassayampa River Watercourse Master Plan – Historical Photo Exhibit Book* for final cove and binding. Please bind the exhibit book with spiral binding (not comb binding), as it stands-up better over time.

Three copies will be submitted to FCDMC, one copy is for our library.

If you have any questions regarding the reports please let me know.

Thank you,

Mike Kellogg, R.G., CFM

JE Fuller/Hydrology & Geomorphology, Inc. | Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 South Rural Road, Suite 110
Tempe, AZ 85283
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

April 22, 2004

TRANSMITTAL

Sharon McGuire
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. Five (5) signed copies of the fee proposal documents, revised as requested.

____________________________ ____________________

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 South Rural Road, Suite 110
Tempe, AZ 85283
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

June 18, 2004

TRANSMITTAL

Leo Kreymborg, P.E.
WEST Consultants
960 W. Elliot Road, Suite 201
Tempe, AZ 85284

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

One set of 9 CD-ROMs containing GIS data from the FCDMC.

Please let me know if you have any questions.

More data will be forthcoming (I've been talking with Eric Feldman and have a few other items on order).

Thanks!

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 South Rural Road, Suite 110
Tempe, AZ 85283
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

June 23, 2004

TRANSMITTAL

Leo Kreymborg, P.E.
WEST Consultants
960 W. Elliot Road, Suite 201
Tempe, AZ 85284

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

Two CD-ROMs containing the 2004 Mr. SID format color orthophotos from the FCDMC.

Please let me know if you have any questions.

Thanks!

____________________________ ____________________

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 South Rural Road, Suite 110
Tempe, AZ 85283
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

June 23, 2004

TRANSMITTAL

Seema Anthony
EDAW
502 S. College Ave., Suite 201
Tempe, AZ 85281

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

Five (5) CD-ROMs containing GIS data from the FCD, 2001 and 2003 orthophotos (mostly 2003 on the Hassayampa, with 2001 for most of Jackrabbit Wash) and 2004 Mr. SID format color orthophotos from the FCDMC.

Please let me know if you have any questions.

Thanks!

________________________ __________________

JE Fuller/Hydrology & Geomorphology, Inc. Date

Sara Lieske, WGA, 808 E. Osborn Road, Suite 101, Phoenix, AZ 85014

Joe Alwin, CL W, 4720 W. Maverick Lane, Lakeside, AZ 85929

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 South Kyrene Road, Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

July 27, 2004

TRANSMITTAL

Cathy Register
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc. for your review:

- Two (2) copies of the draft Hydrology Report for the Lower Hassayampa River Watercourse Master Plan.

The reports include CDs with the HEC-1 models, the HECWRC files, and ArcView shapefiles of the drainage basin boundaries, and other related information.

Please let me know if you have any questions.

JE Fuller/Hydrology & Geomorphology, Inc.

7/27/04
Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

August 24, 2004

TRANSMITTAL

Greg Jones, PE
Flood Control District of Maricopa County
2801 W Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. One copy of the revised change order request from WEST Consultants.

____________________________ ______________________

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

September 7, 2004

TRANSMITTAL

Greg Jones, PE
Flood Control District of Maricopa County
2801 W Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc. at your request:

5 CD ROMs of semi-rectified aerial photographs from 1934, 1953, 1964-66, 1972, & 1988.

As mentioned in the meeting today, the 1992 set are currently being processed. I will transmit a copy of that set once they are complete.

9/7904

JE Fuller/Hydrology & Geomorphology, Inc.

Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

September 8 2004

TRANSMITTAL

Greg Jones, PE
Flood Control District of Maricopa County
2801 W Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc. at your request:

2 CD ROMs of semi-rectified aerial photographs from 1992, & 1997.

The 1997 photos came from FCD originally, but were found to be poorly rectified. We re-did them to provide higher quality data extraction for the WCMP.

JE Fuller/Hydrology & Geomorphology, Inc.

9/8/04
Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

September 13, 2004

TRANSMITTAL

Kathryn Gross
Flood Control District of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1 copy – Draft Lower Hassayampa River Watercourse Master Plan Historical Photo Comparison Exhibit Book

1 copy – Draft Lower Hassayampa River Watercourse Master Plan Historical Bed Elevation Comparison Plots

1 copy – Draft Lower Hassayampa River Watercourse Master Plan 24"x36" Overlay Plot Maps (4 sheets)

1 copy – Draft Lower Hassayampa River Watercourse Master Plan 24"x36" Geomorphic Mapping of Surficial Landforms Map (1 sheet)

1 copy – Delivery memorandum

JE Fuller/Hydrology & Geomorphology, Inc. Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

September 20, 2004

TRANSMITTAL

John Hathaway, PE
Flood Control District of Maricopa County
2801 W Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc. for your review:

- 2 copies of the Draft Data Collection Report (DCR)
- 1 copy of Simons & Li report on Old US 80 Hwy bridge for your library

The draft DCR also contains 11 CDs with pdfs of the report, plates, and GIS data including the semi-rectified historic aerials and topography collected.

Please let Jon or I know if you have any questions.

JE Fuller/Hydrology & Geomorphology, Inc.

9/20/04

Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

February 28, 2005

TRANSMITTAL

Leo Kreymborg, P.E.
WEST Consultants
960 W. Elliot Road, Suite 201
Tempe, AZ 85284

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

Three CDs containing the final approved topography from the Flood Control District for the remaining areas of the Lower Hassayampa River WCMP and Jackrabbit Wash.

JE Fuller/Hydrology & Geomorphology, Inc.

2/28/05

Date

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 South Kyrene Road, Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

March 2, 2005

TRANSMITTAL

John Hathaway, P.E.
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

- Five (5) copies of the final Hydrology Report for the Lower Hassayampa River Watercourse Master Plan.

The reports include CDs with pdfs and MS Word docs of the final report, the HEC-1 models, the HECWRC files, ArcView shapefiles of the drainage basin boundaries, and other related information.

Please let me know if you have any questions.

JE Fuller/Hydrology & Geomorphology, Inc. — 3/2/05

Date

JE FULLER/HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. Kyrene Rd., Suite 201, Tempe, Arizona 85284 - (480) 752-2124 / Fax (480) 839-2193

FAX TRANSMITTAL

Fax #: 926-9091	Date: 2/21/05
To: David Sawyers	From: Mike Kellogg
Company: Pioneer Sand Co.	Total Pages: 3
Project: Hassayampa River Study	

Message:

David,

Attached is a right-of-entry request letter and location map for our proposed soil pit locations within your property on the Hassayampa River. If the letter meets your approval, please sign and fax back to me. If you have any questions please let me know.

Thank you,

Mike Kellogg

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8400 S. Kyrene Rd., Suite 201
Tempe, AZ 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

December 6, 2005

TRANSMITTAL

Leo Kreymborg, PE
WEST Consultants
960 W. Elliot Rd, Suite 201
Tempe, AZ 85284-1137

Attached are the following materials provided by JEFuller/ Hydrology & Geomorphology, Inc.:

1. HEC-6 write up & digital data for your review.

Please call Hari (x 215) if you need additional information to complete your review. A speedy & thorough review would be nice, as would an estimated time to complete. Thanks!

JE Fuller/Hydrology & Geomorphology, Inc.   Date

Memoranda

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: April 8, 2005

TO: John Hathaway, P.E./FCDMC

FROM: Jon Fuller, PE, RG, PH, CFM

RE: LHWCMP Task 9.6.4 Sediment Transport – Modeling Base Conditions Scenarios

CC: Hari Sundaraghavan, PhD, CFM

Task 9.6.4 requires District approval of HEC-6 base model scenarios prior to modeling currently scheduled to begin by April 15, 2004. This memorandum outlines the recommended modeling scenarios to be developed using the updated hydraulic model created under Task 7.2. The following HEC-6 base model scenarios are recommended:

1) Scenario #1: Period of Record Flows. The period of record flows for the Lower Hassayampa River will be obtained from USGS gauge records. The historical record of mean daily flows for the Hassayampa River stations is shown in Figure 1. These data will be analyzed and incorporated into the HEC-6 model for this scenario.

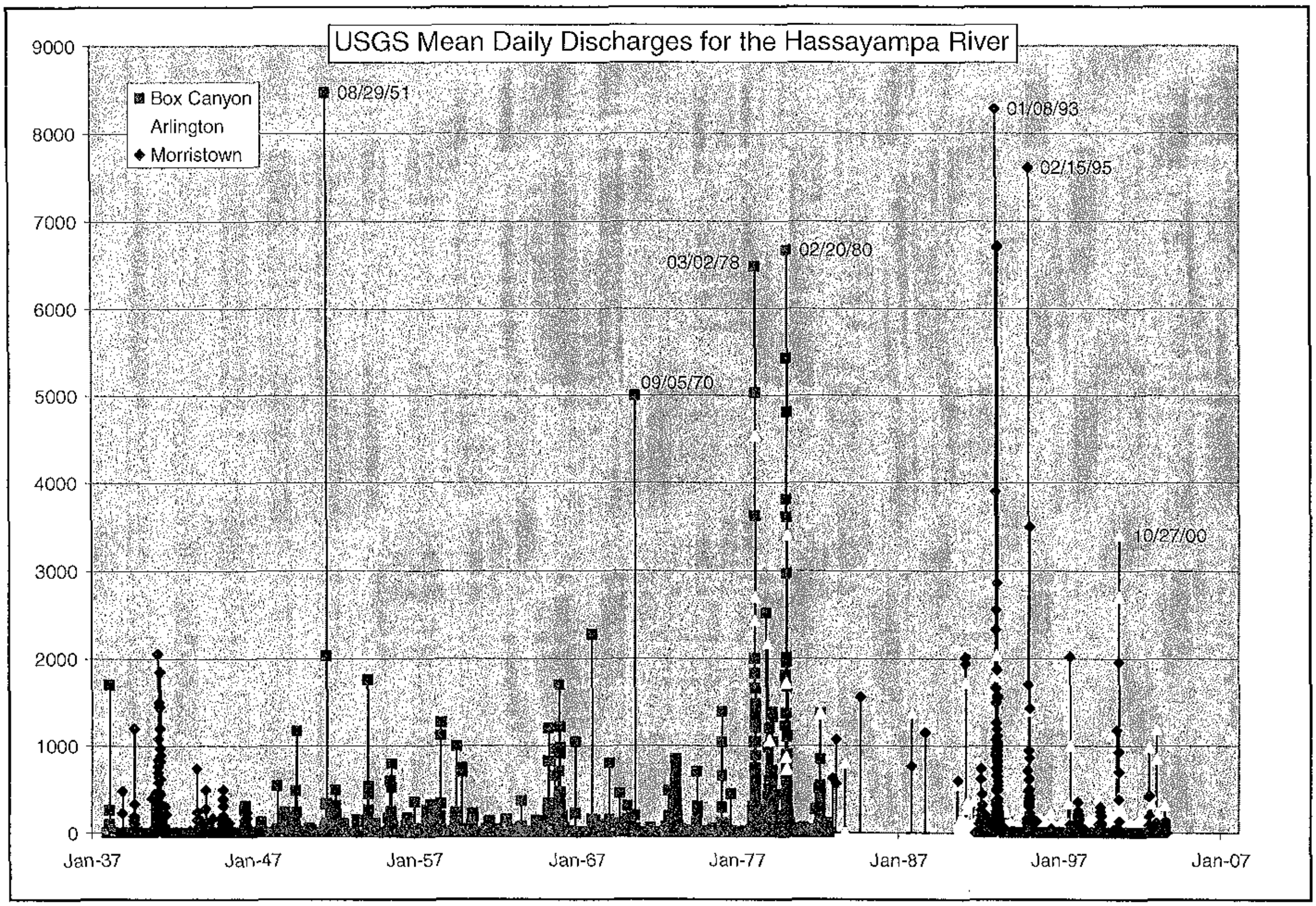


Figure 1. Period of Record Mean Daily Flows for the Hassayampa River

2) Scenario #2: Effective FDS 100-year Hydrograph. The hydrograph for the 100-year flood event for the Lower Hassayampa River will be developed using the peak discharges from the effective floodplain delineation study (i.e. CBA, 1988) in scaled to the hydrograph shape

developed in the Hydrology Report (Task 6, JEF, 2005) for this study. Figure 2 shows a plot of this hydrograph at the Gila River confluence.

3) Scenario #3: HECFFA 100-year Hydrograph. The hydrology report prepared as part of the Lower Hassayampa River Watercourse Master Plan presented a 100-year hydrograph based on updated hydrology for the watersheds developed using HEC-1 and HECFFA. Figure 2 shows a plot of this hydrograph at the Gila River confluence. This hydrograph represents a significantly lower peak flow compared to that of the effective floodplain delineation study, especially downstream of Jackrabbit Wash. The impact of the HECFFA 100-year hydrograph on expected river behavior will be investigated for this scenario.

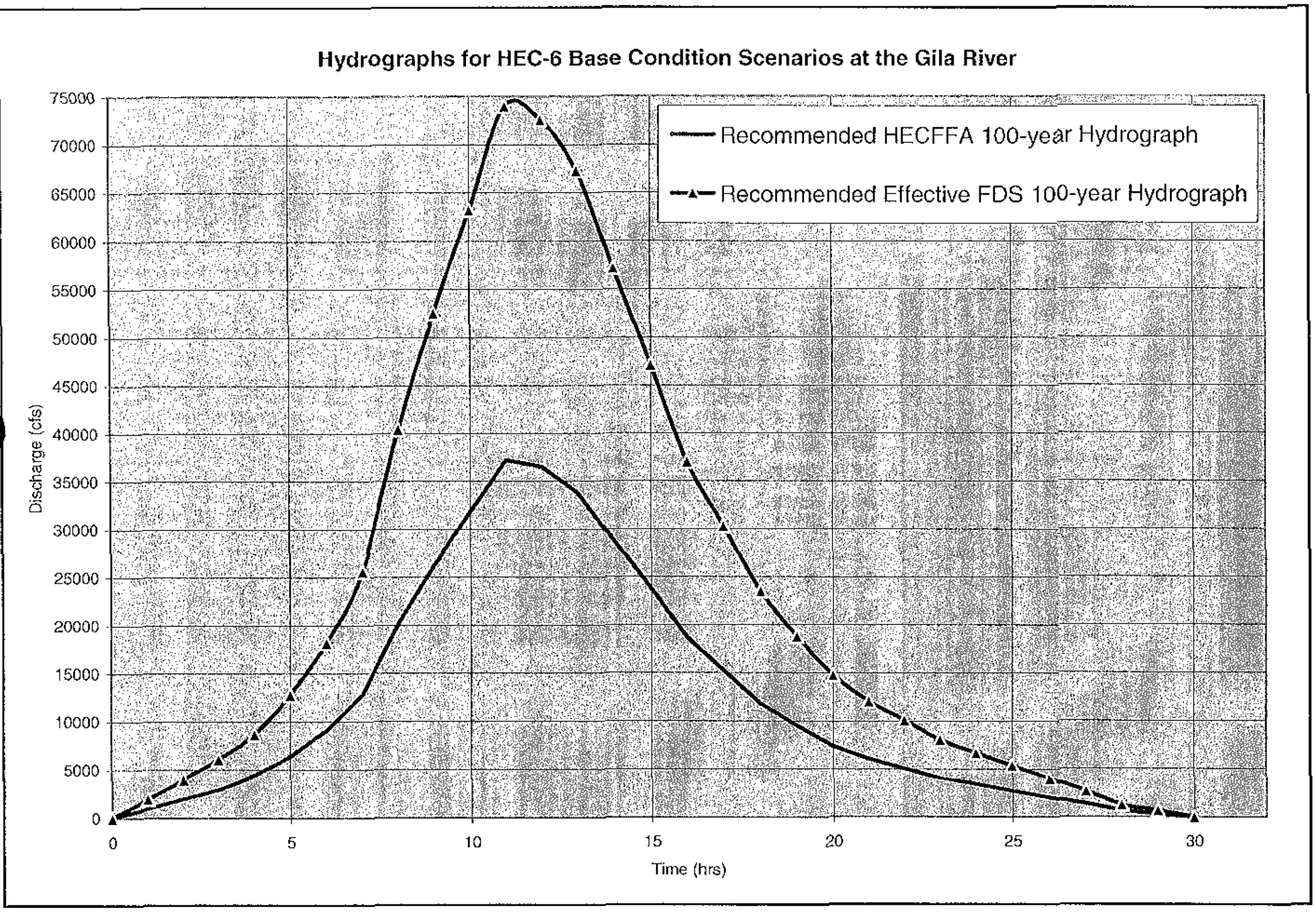


Figure 2. Hassayampa River Hydrographs for HEC-6 Base Conditions at the Gila River Confluence

4) Scenario #4: Tributaries Sediment Inflow. There are three significant tributaries to the Lower Hassayampa River within the study reach: a) Jackrabbit Wash b) Wagner Wash and c) Daggs Wash. The geomorphic analysis indicated that flow from these tributaries deliver considerable amounts of sediment to the Lower Hassayampa River. The impact of these tributaries will be studied by incorporating the additional tributary sediment flows into the HEC-6 model. This model scenario will be particularly useful for assessing development impacts from the White Tanks piedmont.

Expedited review and approval of the recommended modeling scenarios is requested. Please call me to discuss as needed.

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: May 2, 2005

TO: Leo Kreymborg, P.E., WEST Consultants

FROM: Ted Lehman, P.E. & Hari Sundararaghavan, PhD, P.E., JE Fuller

RE: review of draft hydraulic model for LHWCMP

CC: File

Thanks for the rapid response to the delivery of the topography in getting this model assembled. We appreciate your efforts to help us get this project moving again.

We have reviewed the draft hydraulic model for the lower Hassayampa River that you submitted to us and FCD last week. Hari, who will be conducting the HEC-6 analysis, has a number of specific comments that he feels need to be addressed to aid the development of the HEC-6 model. Some of these items may be a function of the thalweg definition approach you used (which we discussed and agreed to previously) and/or specific characteristics of the model resulting from comments received previously from the District. In addition, Ted has some additional comments and observations based on his review of the delivered model and data.

1) Flow optimization does not converge. Is there a way to achieve convergence? If not, can we estimate the amount of error resulting from the failure to converge?
2) River mile station numbers must be set based on the distance along the centerline. It appears the FIS model numbers are used even though the cross-section cutlines are not the same. As I recall we decided go with this approach to make comparison to the effective FIS model easier, correct?
3) XS 27.610, 27.43, 8.03 – Block obstruction must be used rather than the ineffective flow in the left side.
4) XS 23.350 – The cutline must be extended to the right to contain the flow
5) XS 13.610, 13.510 – Block obstruction must be used to block the gravel pits. Presently, the pits convey flow.
6) XS 11.09 – Should the bridges be modeled as 1 bridge? Would this be better from hydraulics point of view?
7) XS 23.07, 27.78 – Right bank station may be moved a little to the right side.
8) XS 4.82, 24.30 – Bank Stations may need to moved to widen main channel
9) Reaches 2 and 3 – The distance between the bank stations are probably too large. Adjust the bank stations to match regime width.
10) XS 26.1, 26.0, 25.9, 23.73, 23.63, 23.45, 21.93 21.65, 17.39, 16.44, 16.35, 14.83, 11.62, 7.28 and 3.25 – Bank station located near thalwegs may be moved to a higher elevation – preferably match the height at the other side.
11) Ineffective areas from XS 24.87 to 26.38 – Are these needed?
12) XS 18.71 – Flow widens rapidly from XS 18.81 in the left side of the XS. It is necessary to adjust ineffective areas

13) XS 6.99 – Ineffective area location at the left side may be adjusted so that it is consistent with the upstream and downstream cross-sections.
14) Left Ineffective Area location seen on top of aerials jumps abruptly between XS 0.59 to 0.63. The ineffective areas need to be moved to get a more gradual transition.
15) Ineffective flow area may be needed on the right side near XS 23.15 to 23.54
16) Ineffective flow area may be needed on the right side near XS 16.91 to 17.1
17) Ineffective flow area may be needed on the right side near XS 14.55 to 15.02
18) Use Block obstructions rather than ineffective areas to block gravel pit between XS 12.37 to 12.85.
19) Value of manning's n seems high at XS 0.82 to 1.39 in the main channel. Check if it is alright.
20) Only 1 cfs is specified at XS 2.57 in Reach 3 and 3.97 in Reach 2 – Is this reasonable? Isn't there a flow split?
21) There are big jumps in effective manning's n and top width values in Reach 2 between XS 1.07 to 1.11. Check the manning's n values and ineffective limits in these cross-sections.
22) Reach 2; XS 3.910 – Critical depth is located at thalwegs? Why is it like this?
23) Reach 3; XS 2.57 – Thalweg is not located between the bank stations. The bank stations may be moved to avoid this.
24) XS 26.95 – The bank stations may be moved so that there is flow consistency in the left overbank in this region.
25) XS 20.8 and 23.07 – The left bank station may be moved a little to the left.
26) XS 20.32, 19.66 and 18.9 - The left bank station may be moved a little to the right.
27) Ineffective areas are needed upstream of XS 15.97.
28) The left ineffective area may be moved to the right at XS 11.09.
29) XS 27.04 and 27.89. It appears that the main channel is on the right side of the cross-section rather than the left. The bank stations and the centerline may be moved to the right.
30) XS 21.74 - The right bank station may be moved to the left.
31) Ineffective areas may be added at the right of XS 6.71 and 15.4.
32) The ineffective area may be moved to the right at XS 12.85.
33) The ineffective area may be moved to the left at XS 9.74.
34) A more gradual transition of the ineffective area is needed between XS 2.78 and 3.06. Ineffective area needs to be added at XS 3.06.
35) XS 22.31 to XS 22.85 – The centerline may need to be shifted to left as most of the flow is on the left side.
36) Lateral weir at locations 0.95 to 2.55 at the left overbank should flow into the right overbank of Reach 2. Presently, it is flowing into the left overbank.
37) In some cross-sections the weir height is below the ground elevation. Is it needed to make the weir elevation a tiny bit higher than the adjacent ground elevation?
38) At some cross-sections, the weir does not extend entirely between cross-sections. Is it better to a tiny weir on top of the ground elevation for the part without weir?
39) Smaller event flows may be added based on scope of work.

40) The selection of bank station locations is frequently curious. We need to discuss the criteria we want to use for selection of bank station locations. Look at the LB stations at RM 26.85 – 26.38 and bank stations for RM 26.19 – 25.43, 24.2 - 20.0, and 18.81-18.14 for examples of places where we have questions.
41) The use of the thalweg as defined presents some unexpected juxtapositions when looking through the profile data, such as bank stations at the thalweg elevation, etc. We will need to have good clear explanations in the report to avoid criticism of some of these apparent "problems".
42) There is a big rise in the WSE for a reach upstream of Old US 80. Why is this?
43) Again, are we sure the bridge data for Old US 80 reflect the most recent modifications (i.e. late this past fall)?
44) The ineffective flow elevations seem a little too high at Old US 80. If flow can go over the roadway into the ROB, at some lesser depth it would seem like the area would begin to flow effectively. Comparison with the upstream WSE at 2.660 and the high weir elevation at 2.65 D/S show the WSE 0.8 ft above the weir. Should this flow be effective? (about 560 cfs if effective)
45) Why are there n values for some segments carried out to 6 significant digits? (e.g. RM 9.17)
46) Where do the channel low n values come from for RM 1.72? Similarly, at RM 1.58, the bare dirt road surely has a low n-value, but does the entire reach represented by this cross section? Probably not.
47) The model reports a negative weir flow at RM 3.6. Is this possible?
48) The cross section orientation in the Reach 2 model seems unnecessarily complex. Consider realignment of these sections.
49) What are the rational for the "half weirs" in some of the lateral structures? (e.g. RM 3.0)

Lower Hassayampa River Watercourse Master Plan

Task 9.6.4 Sediment Transport – Modeling

Base Conditions Scenarios

The base conditions model will be developed using the updated hydraulic model from Task 7.2. The modeling scenarios to be considered for the base conditions model are presented in the following sections.

1) Period of Record: The period of record for the Lower Hassayampa River will be obtained from the USGS record. The historical record of mean daily flows for the Hassayampa River stations is shown in the figure below. These data will be analyzed and incorporated into the HEC-6 model for this scenario.

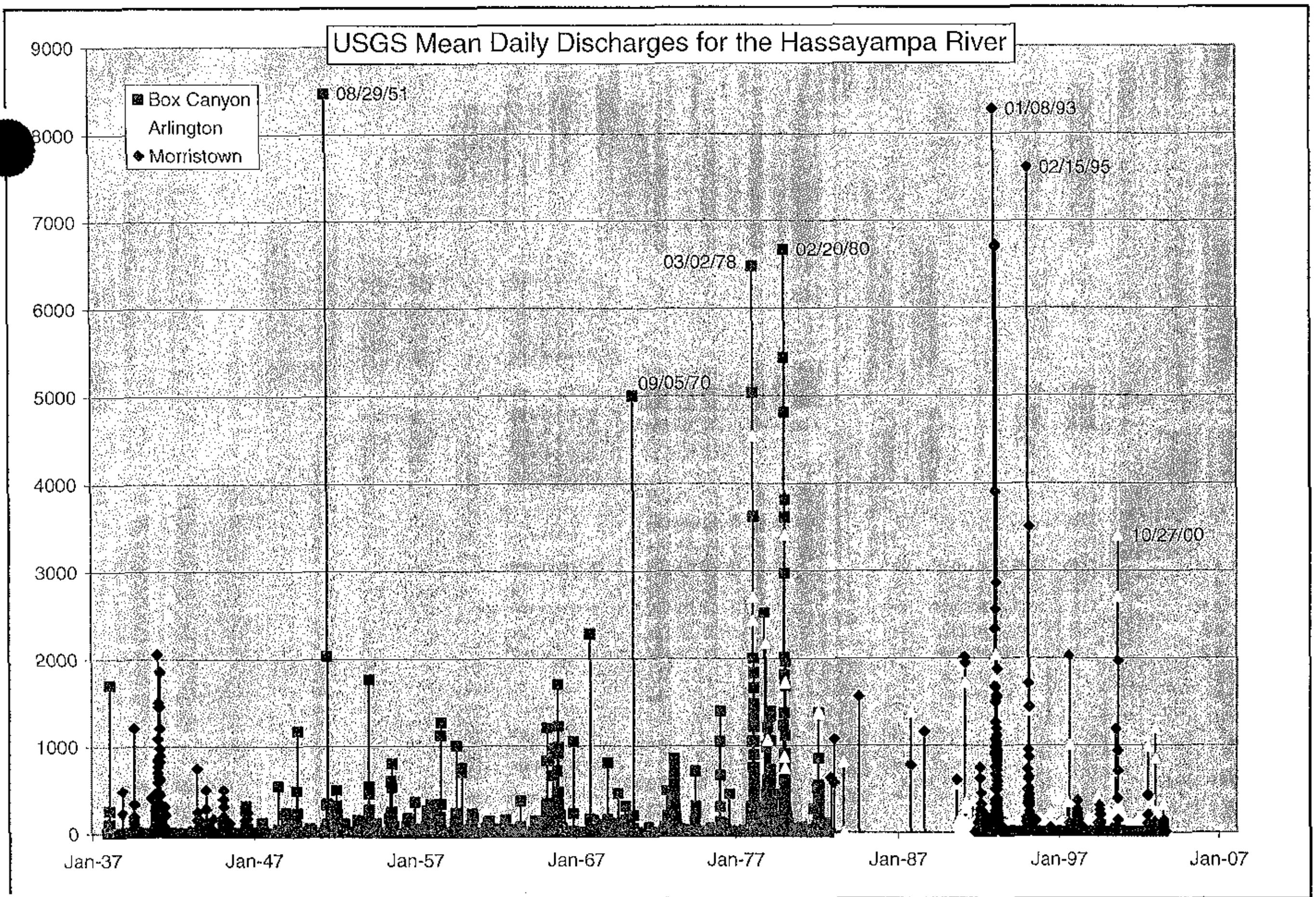


Figure 1. Period of Record Mean Daily Flows for the Hassayampa River

2) 100-year Hydrograph from the Effective FDS: The hydrograph for the 100-year flood event for the Lower Hassayampa River will be developed using the peak discharges from the effective floodplain delineation study (i.e. CBA, 1988) in scaled to the hydrograph shape developed in the Hydrology Report (JEF, 2005) for this study. This hydrograph will be incorporated into the HEC-6 model for this scenario. Figure 2 shows a plot of this hydrograph at the Gila River confluence.

3) HECFFA 100-year Hydrograph from Hydrology Report (JEF, 2005): The hydrology report prepared as part of the Lower Hassayampa River Watercourse Master Plan presents a 100-year hydrograph based on updated hydrology for the watersheds developed using HEC-1 and HECFFA. Figure 2 shows a plot of this hydrograph at the Gila River confluence. This hydrograph represents a significantly lower peak flow compared to that of the effective floodplain delineation study, especially downstream of Jackrabbit Wash. The impact of the HECFFA 100-year hydrograph will be investigated for this scenario.

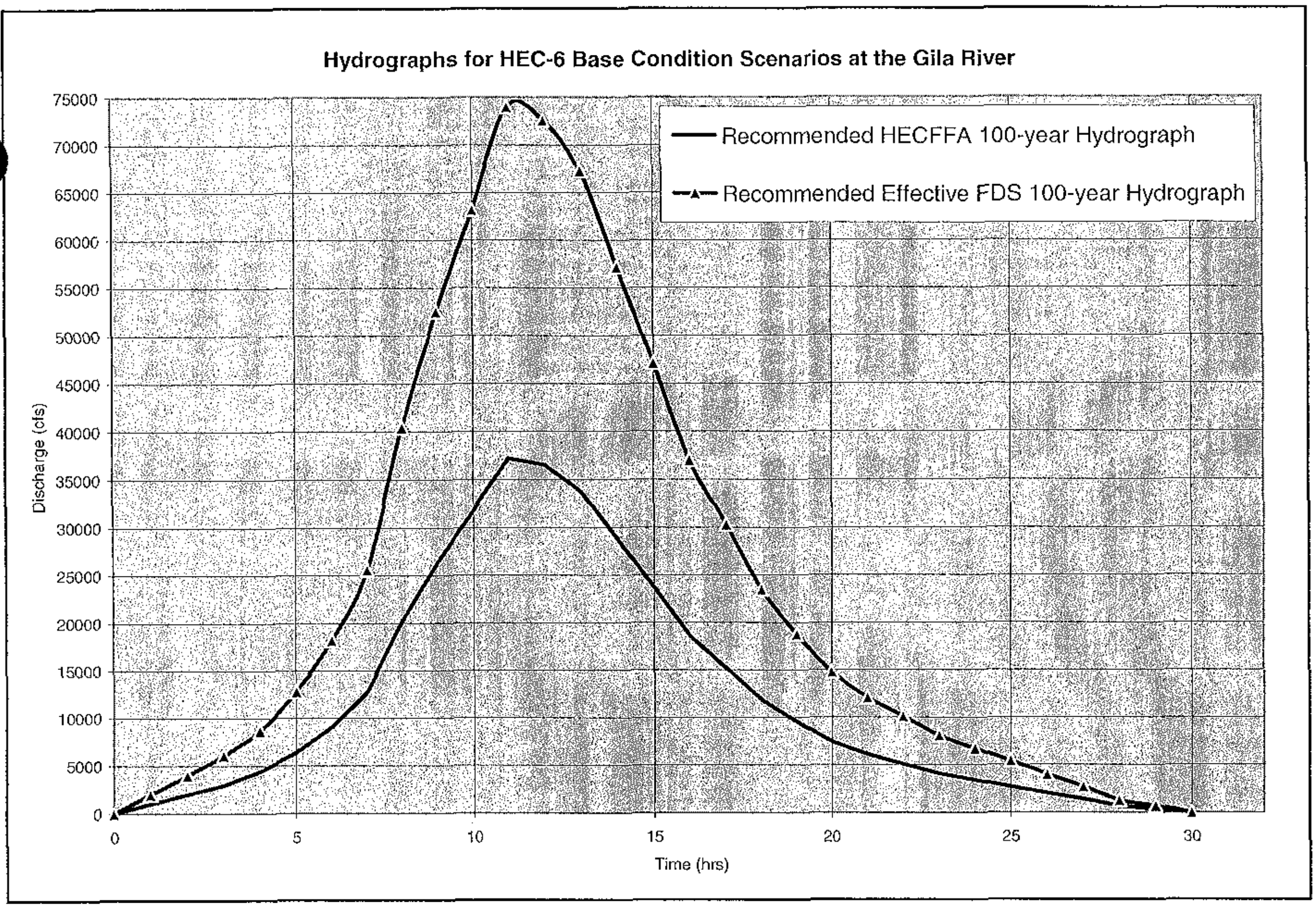


Figure 2. Hassayampa River Hydrographs for HEC-6 Base Conditions at the Gila River Confluence

4) Impact of Tributaries: There are three significant tributaries to the Lower Hassayampa River within the study reach: a) Jackrabbit Wash b) Wagner Wash and c) Daggs wash. Flows in these tributaries bring in considerable amounts of sediment into the Lower Hassayampa River. The impact of these tributaries will be studied by incorporating the additional tributary sediment flows into the HEC-6 model.

Lower Hassayampa River

Watercourse Master Plan

Pit Scour Analyses

Submitted to:

Flood Control District of Maricopa County

2801 W. Durango Street

Phoenix, AZ 85009

Submitted by:

JE Fuller/Hydrology & Geomorphology, Inc.

8400 S. Kyrene Road, Suite 201

Tempe, AZ 85284

1 INTRODUCTION

An evaluation of the capabilities of the models to predict the headcut and tailcut development for instream gravel pits is investigated. Based on literature review and preliminary analysis, the following models were selected for the analysis: ADOT Procedure, HEC-6, FLUVIAL-12 and BRISTARS. A detailed description on the development of the models and the analyses performed are presented. A summary of the results predicted by the models as well a discussion on the pros and cons of each model is also presented.

2 MODEL DEVELOPMENT

The data selection and other aspects of development of the models are presented in this section

2.1 Model Geometry

The focus for this part of the study is to evaluate the effectiveness of the selected models in the estimation of pit-scour. To enable effective comparison, a simple geometry is considered for the models where the channel is rectangular in shape with a rectangular instream pit. The dimensions of the rectangular channel and the pit were chosen to approximately represent a typical mining scenario at the Lower Hassayampa River. A summary of the selected parameters are presented in Table XX.

Description	Parameter Value
Width of the Channel	
Pit width	
Pit length	
Slope of the channel	
Downstream Reach	

Length	
Upstream Reach Length	
Manning's n	

2.2 Flow Hydrograph

The flow hydrographs for the 100 year and the 10 year events were analyzed. The recent floods 2004-2005 is also considered as to represent a typical runoff event. The flood hydrographs were discretized as needed in the each of the selected models.

Figure

2.3 Sediment Data

The sediment data was selected from a set of samples collected along the Hassayampa river. The sediment gradation was selected to represent the overall nature of the sediments found in the Lower Hassayampa River. The presence of fine material in the river suggests the use of Yang's equation for the sediment transport calculations. As a measure to investigate sensitivity of the model, XXX equation is considered as an alternative equation.

3 MODEL ANALYSES

3.1 ADOT PROCEDURE

Simons, Li and Associates developed a procedure for the Arizona Department of transportation. The procedure presents a methodology for calculating long-term and short-term pit scour and in documented in the ADOT report. A numerical model was developed by SLA to investigate various scenarios of upstream and downstream scour due to an instream mining pit. Based on the results from the numerical model, regression equations are presented for the scour depth and scour length at the upstream and downstream end of the pit.

A spreadsheet was developed to perform the calculations presented in the SLA report. The details of the calculations are presented in the Appendix. The results are summarized in Table XX for the 10-year, 100-year and the typical runoff events.

Flow Event	Headcut		Tailcut	
	Length of Scour	Scour Depth	Length of Scour	Scour Depth
10-year				
100-year				
Typical Runoff				

The details of thge

The advantages of this model includes: a) The procedure was specifically developed to analyze pit scour b) Incorporates Arid conditions where the flow enters an empty pit, fills it and then flows downstream, c) Simple method to estimate the scour parameters and d) Armoring is included.

The disadvantages include: a) Model is applicable only to a pit unaffected by scour from previous flow events b) Model is developed based on simple geometries and does not include site specific geometries and c) The procedure has to be coded into a spreadsheet.

3.2 HEC-6

U.S. Army Corps of Engineers (USACE) developed a general purpose 1-D sediment transport model - HEC-6. The model predicts unsteady sediment transport by solving 1-D energy equation using cross-sectional data along the centerline of the channel.

The advantages of the model includes: a) A general purpose model that uses site specific data b) The model is widely used b) Incorporates several sediment transport equations and c) The model is freely available.

The model simulations were performed for the 10-year, 100-year as well as the typical flood run-off event. The results are presented in Figures XXX and XXX. Figure XXX shows the changes in the thalweg. The results indicate some accumulation inside the pit. However, the model fails to predict any headcut or tail development. Model instabilities can also be noted at the downstream model where a zig-zag pattern is observed in the post-sedimentation thalwegs. The zig-zag pattern is a typical outcome of numerical problems and are generally overcome by reducing the internal calculation time-steps as well increasing distance between the cross-sections. Reducing the time-steps increases the total number of computations while reducing the number of cross-sections results in reduced accuracy in the computations. Experimentation with the time-step and the cross-section spacing revealed that the extent of the zig-zag can be reduced but not eliminated. The zig-zag nature was also significantly reduced when the channel slope was lower.

3.3 FLUVIAL-127

FLUIVIAL-12 is a general purpose model is developed by Prof. Howard Chang. The model features are similar to that of the HEC-6 model with one significant difference: The model is capable of predicting changes in cross-section due to erosion, deposition as well as lateral movements.

The results of the model simulations are presented in Figures XXX and XXX. The progression of the sedimentation inside the pit as well as the headcut and tailcut developments can be clearly seen. It appears the computed changes in the thalwegs tends to follow a somewhat realistic progression. The headcut is deeper and more pronounced than the than the tailcut while the tailcut is progressing to a longer distance.

3.4 BRISTARS

The **BRI-STARS** (**BRI**dge **S**tream **T**ube model for **A**lluvial **R**iver **S**imulation) model was developed by Federal Highway Administration (FHWA). This is a generalized semi-two-dimensional water and sediment-routing computer model that includes an integrated graphical interface. The model can be used to solve complicated river engineering problems with limited data and resources and is capable of computing alluvial scour/deposition for subcritical, supercritical, or a combination of water surface profiles that pass through critical depth. The model is also capable of simulating the channel widening/narrowing phenomenon as well as local scour due to highway encroachments. It contains a subset of Federal Highway Administration's WSPRO subroutines for computing bridge hydraulics.

The model can be used in bridge scour evaluations, and modeling of general scour in alluvial streams in the vicinity of bridge crossings and highway encroachments. **BRI-STARS'** webpage claims that it is particularly useful for evaluating sites where contraction scour and/or effects of in-stream mining activities are of a concern.

The model is freely available. In addition, the web-search revealed an article on application of this model for pit scour analysis conducted for a site in Albania.

4 CONCLUSIONS AND RECOMMENDATIONS

The pit-scour analyses have been performed with the following four procedures: ADOT procedure, HEC-6, FLUVIAL-12 and BRISTARS. The evaluation of the procedures has indicated that each method has its own advantages and disadvantages. The ADOT procedure is different from the others since it involved regressions equations and the development of spreadsheets to evaluate them. The HEC-6, FLUVIAL and BRISTARS models require same amount of effort in the development of the input data with HEC-6 being the most complex. The input data for these three models are similar in nature with three main parts: cross-section data, inflow hydrograph and sediment data. The sediment data includes the gradation data as well as the sediment load.

The HEC-6 model is not specifically developed for analysis for pit scour ab) the bed change is spread across the cross-section – may affect ability to accurately represent the bed evolution and c) The model needs have flow in the entire reach that is being modeled – may not be suitable for predicting pit scour in semi-arid regions.

The disadvantages include the fact that the model is only available in the form of a commercial software.

5 REFERENCES

Simons, Li and Associates, "Effects of in-stream mining on Channel Instability," FHWA Report Number: FHWA-AZ89-250, Arizona Department of Transportation (ADOT), June 1989 (3 Volumes).

Howard H. Chang, "Generalized Computer Program FLUVIAL-12 Mathematical Model for Erodible Channels," Users Manual, June 1998 Updated Version.

US Army Corps of Engineers, "HEC-6, Scour and Deposition in Rivers and Reservoirs," User's Manual, Aug 93, 286 pp.

Albert Molinas, "User's Manual for BRI-STARS (BRIdge Stream Tube model for Alluvial River Simulation)," US Department of Transportation Federal Highway Administration, Publication No. FHWA-RD-99-190, February 2000.

Models considered

The models considered for the analysis of the pit scour are presented below. A preliminary analysis of the following models was performed to investigate the available features and feasibility of application to pit scour analysis. A brief description of the models is provided below:

ADOT Procedure:

Simons, Li and Associates developed this procedure for the Arizona Department of transportation. The procedure presents a methodology for calculating long-term and short-term pit scour. A numerical model was developed by SLA to investigate various scenarios of upstream and downstream scour due to an instream mining pit. Based on the results from the numerical model, regression equations were developed to for the scour depth and scour length at the upstream and downstream end of the pit. The advantages of this model includes: a) The procedure was specifically developed to analyze pit scour b) Incorporates Arid conditions where the flow enters an empty pit, fills it and then flows downstream, c) Simple method to estimate the scour parameters and d) Armoring is included. The disadvantages include: a) Model is applicable only to a pit unaffected by scour from previous flow events b) Model is developed based on simple geometries and does not include site specific geometries and c) The procedure has to be coded into a spreadsheet.

HEC-6

USACE developed a general purpose 1-D sediment transport model. The model predicts unsteady sediment transport by solving 1-D energy equation using cross-sectional data along the centerline of the channel. The advantages of the model includes: a) A general purpose model that uses site specific data b) The model is widely used b) Incorporates several sediment transport equations and c) The model is freely available. The disadvantages are: a) Not specifically developed for analysis for pit scour b) the bed change is spread across the cross-section – may affect ability to accurately represent the bed evolution and c) The model needs have flow in the entire reach that is being modeled – may not be suitable for predicting pit scour in semi-arid regions.

FLUVIAL-12

FLUIVIAL-12 is a general purpose model is developed by Prof. Howard Chang. The model features are similar to that of the HEC-6 model with one significant difference: The model is capable of predicting changes in cross-section due to erosion, deposition as well as lateral movements. This makes this model more favorable for application for pit scour analysis. In addition, the FLUVIAL 12 manual demonstrates the results from a pit scour analysis with and without a downstream grade control. The disadvantages include the fact that the model is only available in the form of a commercial software.

BRISTARS

The **BRI-STARS** (**BRI**dge **S**tream **T**ube model for **A**lluvial **R**iver **S**imulation) model was developed by FHWA. This is a generalized semi-two-dimensional water and sediment-routing computer model that includes an integrated graphical interface. The model can be used to solve complicated river engineering problems with limited data and resources and is capable of computing alluvial scour/deposition for subcritical, supercritical, or a combination of water surface profiles that pass through critical depth. The model is also capable of simulating the channel widening/narrowing phenomenon as well as local scour due to highway encroachments. It contains a subset of Federal Highway Administration's WSPRO subroutines for computing bridge hydraulics. The model can be used in bridge scour evaluations, and modeling of general scour in alluvial streams in the vicinity of bridge crossings and highway encroachments. **BRI-STARS'** webpage claims that it is particularly useful for evaluating sites where contraction scour and/or effects of in-stream mining activities are a concern. The model is freely available. In addition, the web-search revealed an article on application of this model for pit scour analysis conducted for a site in Albania.

GSTARS

Generalized Stream Tube model for Alluvial River Simulation (GSTARS) was developed by Dr. Chih Ted Yang of the US Bureau of Reclamation. This model performs water surface profile computations by solving energy and momentum equations to compute backwater conditions. The procedure uses the stream tube concept and the theory of minimum energy dissipation rate where minimum total stream power principle is used to compute channel width and depth. The advantages include: a) Sediment transport rate computed using 12 different methods, b) Incorporates a channel bank side stability criteria and c) Includes a bed sorting and armoring algorithm based on sediment size fractions. The disadvantages are similar to that of HEC-6. In addition, the model is actively developed and the current version is not publicly available.

EFC1D

This is a 1-D hydrodynamic and sediment transport model developed by John Hamrick, Ph.D. for EPA. The model is presently maintained by Tetra Tech, Inc. with ongoing development support from the U.S. EPA. The model includes complete EFDC sediment and contaminant transport capabilities and can simulate bi-directional unsteady flows. The model includes armoring capabilities. The model advantages and disadvantages appear similar to that of HEC-6. The model has additional capabilities of modeling pollutant and contaminant transport adding additional complexities.

CCHE1D

Based on US Congress' mandate, USDA funded National Center for Computational Hydroscience and Engineering (NCCHE) to develop state-of-the-art numerical models for simulating flow and sedimentation processes in the natural environment. CCHE1D is a software package for the simulation of one-dimensional unsteady flows and sediment transport in dendritic channel networks. The software package has been designed to facilitate the combined modeling of watershed and channel processes. CCHE1D's hydrodynamic model includes special procedures for the computation of flow across hydraulic structures like culverts, low and high-drop structures, bridge crossings, and measuring flumes. The sediment transport module computes non-equilibrium transport of non-uniform sediment mixtures. It has been designed for long-term predictions of channel morphological changes, and it can be used to evaluate the effectiveness of in-channel remedial and control structures on the sediment yield. While model appears promising for the application of pit scour analysis, it is still underdevelopment and is available only for beta-testing.

CHARIMA

CHARIMA is a general-purpose computer code was developed by Dr. Forrest M. Holly Jr. to simulate steady or unsteady water, sediment, and contaminant movement in simple or complex systems of channels. Mobile-bed capabilities include bedload and/or suspended-load transport of mixtures of noncohesive or cohesive sediment, along with the associated short- or long-term bed-level changes (aggradation and degradation), bed-sediment sorting, and armoring. The advantages and disadvantages appear similar to HEC-6 with the additional constraint of being not available due to ongoing continuous development.

Models Selected

The following models were selected for further investigation based on the information collected, the availability of the model/methodology and a judgement on possibility of successful application of the model to pit-scour analyes: 1) ADOT Procedure, 2) HEC-6 3) FLUVIAL-12 and 4) BRISTARS. The feasibility of the models for pit-scour analysis will be studied by applying the models to pit-scour scenarios. The scenarios will include several simple pit configurations that represent the pits and riverine environment found in the Hassayampa river.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: May 4, 2005

TO: John Hathaway, P.E./FCDMC

FROM: Jon Fuller, PE, RG, PH, CFM

RE: LHWCMP Task 9.6.4 Sediment Transport – Modeling Base Conditions Scenarios

CC: Hari Sundaraghavan, PhD, PE, CFM

Task 9.6.4 requires District approval of HEC-6 base model scenarios prior to modeling that was scheduled to begin by May 1, 2005. This memorandum outlines the recommended modeling scenarios to be developed using the updated hydraulic model created under Task 7.2. The overall objectives of the HEC-6 modeling task include the following:

1. Establish base condition models that can be used and/or modified for evaluating management alternatives in Phase 2 of the Watercourse Master Plan.
2. Establish base condition models and modeling guidelines that can be used or conveyed to consulting engineers working for private developers in the floodplain or sand and gravel mining interests.
3. Provide a tool for assessing the expected streambed profile response of the Hassayampa River in natural and existing conditions. In particular, the model will be used to help identify aggrading or degrading stream reaches, and to assess the impact of sediment transport and deposition on regulatory water surface elevations and flood hazards.
4. Test the effectiveness of assessing headcut/tailcut potential at in-stream sand and gravel excavations, as well as estimating safe yield from aggrading reaches (Task 9.6.7 & 8).

Given the objectives listed above, the following HEC-6 base model scenarios are recommended:

1) Scenario #1: Period of Record Flows. The period of record flows for the Lower Hassayampa River will be obtained from USGS gauge records. The historical record of mean daily flows for the Hassayampa River stations is shown in Figure 1. These data will be analyzed and incorporated into the HEC-6 model for this scenario. The period of record model will include tributary sediment inflow at the Daggs/Wagner Wash and Jackrabbit Wash confluences. Water inflow at the confluences will be estimated based on a simplified approach using available hydrologic data or watershed area.

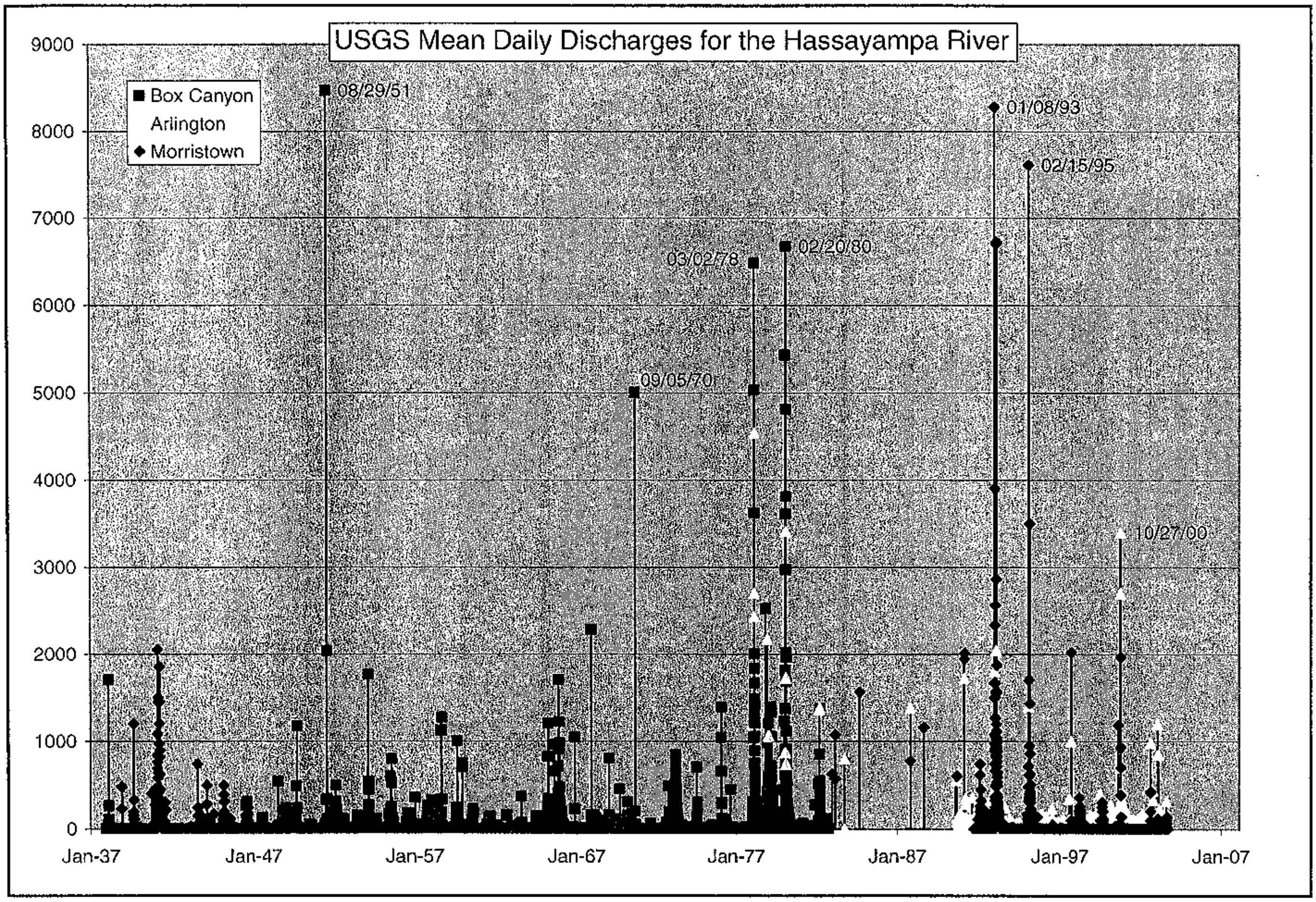


Figure 1. Period of Record Mean Daily Flows for the Hassayampa River

2) Scenario #2: Period of Record Without Tributary Sediment Inflow. Period of record flows from Scenario #1 will be used, but no tributary sediment inflows will be simulated. Instead, only sediment supply from the Hassayampa watershed and the river reach itself will be modeled. The objective of this scenario will be to establish a base condition model for evaluation of potential impacts due to the sediment supply deficit resulting from imminent development in the White Tank piedmont and lower Jackrabbit Wash watersheds.

3) Scenario #3: Effective FDS 100-year Hydrograph. Many engineers preparing sand and gravel mining analyses or development impact analyses have traditionally modeled a single 100-year hydrograph in HEC-6 as the basis of their engineering design. In addition, a single 100-year hydrograph HEC-6 model is required for Task 9.6.7 (mining impacts analysis). Therefore, the hydrograph for the 100-year flood event for the Lower Hassayampa River will be developed using the peak discharges from the effective floodplain delineation study (i.e. CBA, 1988) as scaled to the hydrograph shape developed in the Hydrology Report (Task 6, JEF, 2005) for this study. Figure 2 shows a plot of this hydrograph at the Gila River confluence.

4) Scenario #4: Low Flow Long Duration Hydrograph. Significant channel change was observed during the winter floods of 2005. A long-duration hydrograph based on the winter 2005 flood will be prepared from USGS mean daily flow records. The objective of this modeling scenario will be to test channel response to a bankfull or channel forming discharge

compared to channel flood behavior or long-term channel response. We anticipate that some changes in the HEC-6 input files will be required (effective flow limits, bank stations, movable bed limits, N values, etc.) will be required compared to the 100-year hydrograph model

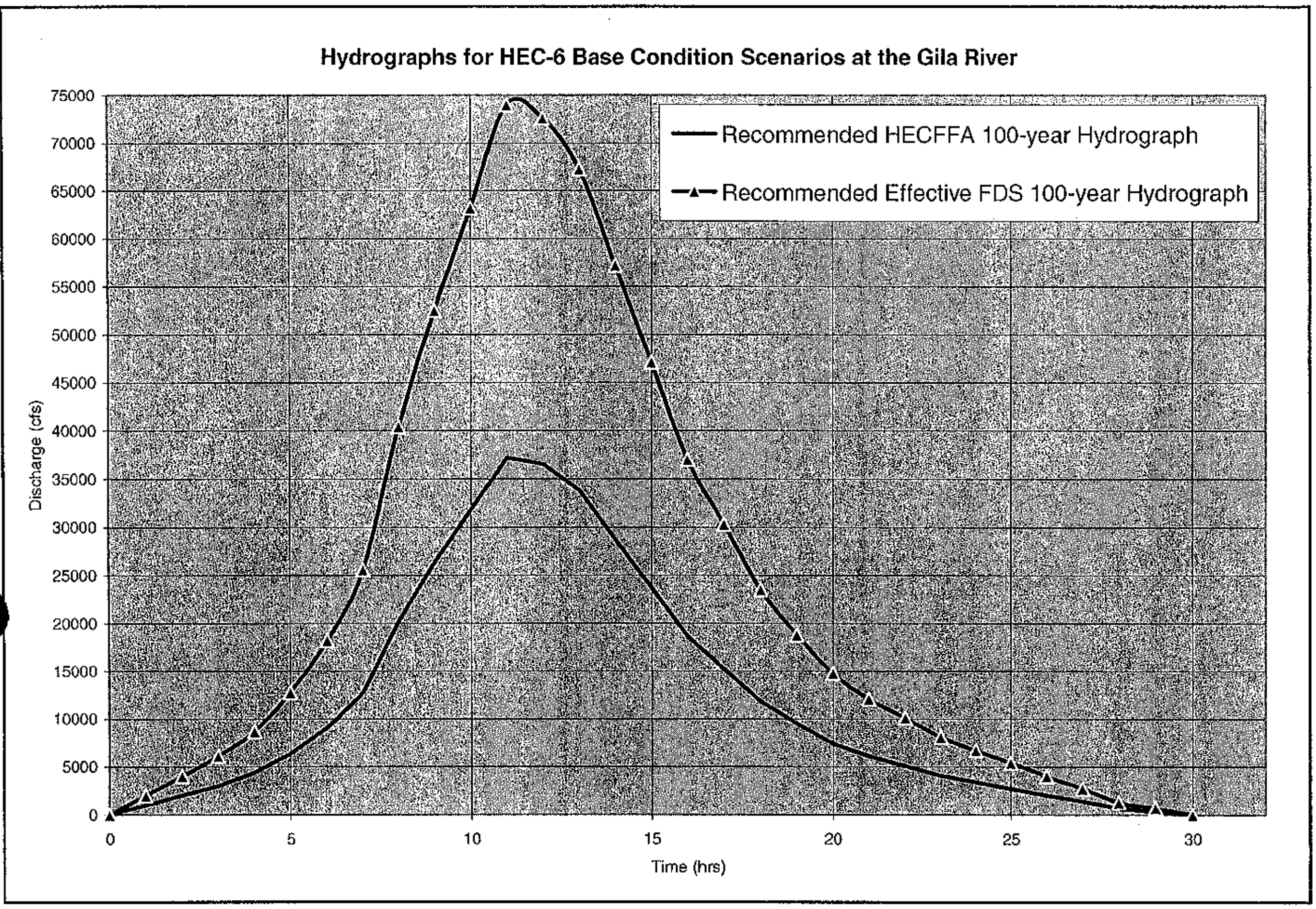


Figure 2. Hassayampa River Hydrographs for HEC-6 Base Conditions at the Gila River Confluence

Expedited review and approval of the recommended modeling scenarios is requested. Please call me to discuss as needed.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: May 18, 2005

TO: John Hathaway, P.E., Bing Zhao, P.E., PhD,
FCDMC

FROM: Jon Fuller, P.E.

RE: HEC-6 modeling scenarios for LHWCMP

CC: File

John,

We have reviewed Dr. Bing's revised scenarios for the HEC-6 modeling received on Mon. the 16th. Conceptually, we believe we can implement these approaches for the HEC-6 model development for the LHWCMP.

We do, however, have a few specific concerns regarding whether the resolution of the data sets (specifically the hydrology and the topography) are sufficient to produce a meaningful result in the calibration process described in Scenarios #2 and #3. In particular, the hydrologic data is mean daily average flows and was collected at different times at the three Hassayampa gaging stations. Also, the 1989 (FDS) topography was 4-foot contour mapping. Therefore, detection of bed elevation changes may be within the error of the mapping itself.

In addition, we have concerns that limits to the number of iterations of calibration runs needed to satisfactorily address Dr. Bing's expectations. Likewise, we do not see the need to run a set number of iterations if the first few do not result in enhanced model performance.

Therefore, we suggest that we develop some more specific measures of the hydrologic and topographic data resolution and their influence on preliminary model performance before we finalize the specific scenarios to be addressed for the LHWCMP. In addition, we suggest that any iterative calibration processes be limited to up to 5 runs with different input parameter sets (i.e. inflow sediment loads and Manning's n-values) and the "best performing" model based on the error analysis of mean bed elevation be selected for application to Scenario's #1 and #4.

Once we have a better idea as to these items, we will come back to you for final selection of the HEC-6 modeling scenarios.

Dr. Bing's proposed scenario descriptions are provided below for reference.

1) Scenario #1: Period of Record Flows with the Effective FDS 100-year hydrograph at the end. The inflow hydrograph at the Hassayampa River for the HEC-6 model should include the USGS gauge records (mean daily values) from 1937 to 2005 and the effective FDS 100-year hydrograph (CBA, 1988) at the end. The hydrograph for the 100-year flood event for the Lower Hassayampa River will be developed using the peak discharges from the effective floodplain delineation study (i.e. CBA, 1988) as scaled to the hydrograph shape developed in the Hydrology Report (Task 6, JEF, 2005) for this study. The inflow hydrograph at the tributaries (Daggs/Wagner Wash and Jackrabbit Wash) will be estimated based on a simplified approach. The sediment inflow rating curves for both Hassayampa River and tributaries will be developed by assuming that the upstream reach is equilibrium or using measured sediment inflow data whenever the data is available during the project time period.

2) Scenario #2: Calibration of inflow sediment load in the HEC-6 model based on the bed elevation from the current mapping data and the predicted bed elevation at the end of HEC-6 simulation time period. The cross-section data for the beginning of the simulation may be from the effective FDS mapping (CBA, 1988) or the field cross-section measurement taken in the past near FCDMC's stream gages. The information on the field cross-section measurement taken in the past may be obtained from FCDMC. Sediment/discharge rating curve values are the parameters to be calibrated such that the bed elevation values at certain cross-sections from the current mapping data will match the simulated bed elevations at those cross sections at the end of the simulation time period. Sum of the mean squared errors will be the criterion to measure the difference. The simulation period will be from the time when the field cross-section data or the effective FDS mapping data was collected to the time when the current mapping data was collected. Special attention shall be paid to the vertical datum change between the two mapping data set.

3) Scenario #3: Further calibration of Manning's n values based on the calibrated HEC-6 model from Scenario #2 based on the bed elevation from the current mapping data and the HEC-6-predicted bed elevation. After the calibration is done for both sediment inflows and Manning's n values, the sediment inflow load and Manning's n values will be put back to the HEC-6 model for Scenario #1.

4) Scenario #4: Tributary sediment inflows will be removed from the calibrated HEC-6 model. Period of record flows from Scenario #1 will be used, but no tributary sediment inflows will be simulated. Instead, only sediment supply from the Hassayampa watershed and the river reach itself will be modeled. The objective of this scenario will be to establish a base condition model for evaluation of potential impacts due to the sediment supply deficit resulting from imminent development in the White Tank piedmont and lower Jackrabbit Wash watersheds.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: May 31, 2005

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Task 7.2.6: Two-Dimensional Modeling

CC: Ted Lehman, PE
Hari Sundaraghavan, PE, PhD
Leo Kreymborg, PE/WEST

Task 7.2.6 of the LHWCMP scope of work is an optional task for two-dimensional modeling of the lower three miles of the LHWCMP study reach (hereafter, "the levee reach"). A location map for the lower three miles of the Hassayampa River study reach near the confluence with the Gila River is shown in Figure 1. ***This memorandum summarizes the team's justification for recommending that the optional task not be authorized, i.e., no two-dimensional modeling be performed as part of the LHWCMP Phase 1 contract.***

Hydraulic modeling of the 100-year floodplain in the levee reach is complicated by the non-engineered berms along the main channel, by wide flat overbanks with agricultural levees and topographic breaks between fields, and by the significant elevation difference along the long confluence with the Gila River. The primary objective of the optional two-dimensional modeling proposed in Task 7.2.6 is to provide a more accurate depiction of the 100-year floodplain and floodway. More accurate hydraulic data also could be applied in the sediment transport modeling tasks and for evaluation of channelization alternatives in Phase 2 of the LHWCMP.

While, it is possible that two-dimensional would provide better hydraulic data for some modeling scenarios, we offer the following reasons why two-dimensional modeling would not offer improved results given the overall objectives of the LHWCMP:

1. Discharge. The District has elected to use the 100-year discharge from the effective floodplain delineation study prepared by Cella Barr & Associates. Preliminary HEC-RAS results indicate that without a change in discharge, it is likely that changes in the floodplain limits will be minimal.
2. Regulatory Constraints. Because the main channel berms and any farm levees in the study reach are not engineered structures with as-built plans, FEMA regulations require that floodplain delineations be prepared assuming the berms and levees are not present. In the past, these FEMA restrictions have resulted in delineations that were difficult to apply.
3. Floodway. Floodway modeling techniques using two-dimensional modeling has not yet been approved by FEMA. Use of non-FEMA floodway modeling techniques is not recommended, and may result in removal of floodways from the FIRM, which has significant regulatory consequences.

4. Sediment Transport. Sediment transport modeling (Task 9.6) will be completed using a one-dimensional model. Hydraulic data from a two-dimensional model would be difficult to apply for the types of sediment transport modeling proposed for the LHWCMP. In addition, most of the bed-material load will be conveyed in the main channel, which is more one-dimensional in character, rather than in the overbank, which would be primarily a depositional area.
5. Flow Attenuation. Preliminary HEC-RAS and HEC-1 modeling indicate minimal flow attenuation in the levee reach, probably due to its relatively short length and conveyance of the bulk of the hydrograph within the main channel. Alternative methods of assessing flow attenuation in the levee reach have been proposed in other project memoranda.
6. Complexity. A two-dimensional model that properly accounted for the hydraulics of the main channel berms and farm levees would be difficult to develop and verify. RMA-2, the model cited in the LHWCMP scope of work, has instability issues in shallow flooding areas similar to the reach overbanks. FLO-2D can model levees, but would require additional survey to characterize the overtopping elevations, and would not address potential levee failures adequately.
7. Phase 2 Alternatives. Feedback from landowners and developers indicates that there is strong public support for considering a channelization alternative for the levee reach. If channelization is proposed, an entirely new model will need to be created, and will likely be a more riverine (i.e., one-dimensional) condition than existing conditions.

Conclusions

A well developed two-dimensional model would provide a more accurate depiction of the 100-year floodplain. However, a two-dimensional model which incorporates the main channel berms would be complex, would take a long time to develop, and could not be submitted to FEMA unless the berms were removed. A two-dimensional model without the berms would be acceptable to FEMA, but would not reflect the actual conditions. Given that there is an effective floodplain delineation in place, and that the reach is likely to be channelized in the future, there is no need to expend District funds on new floodplain delineations in this area.

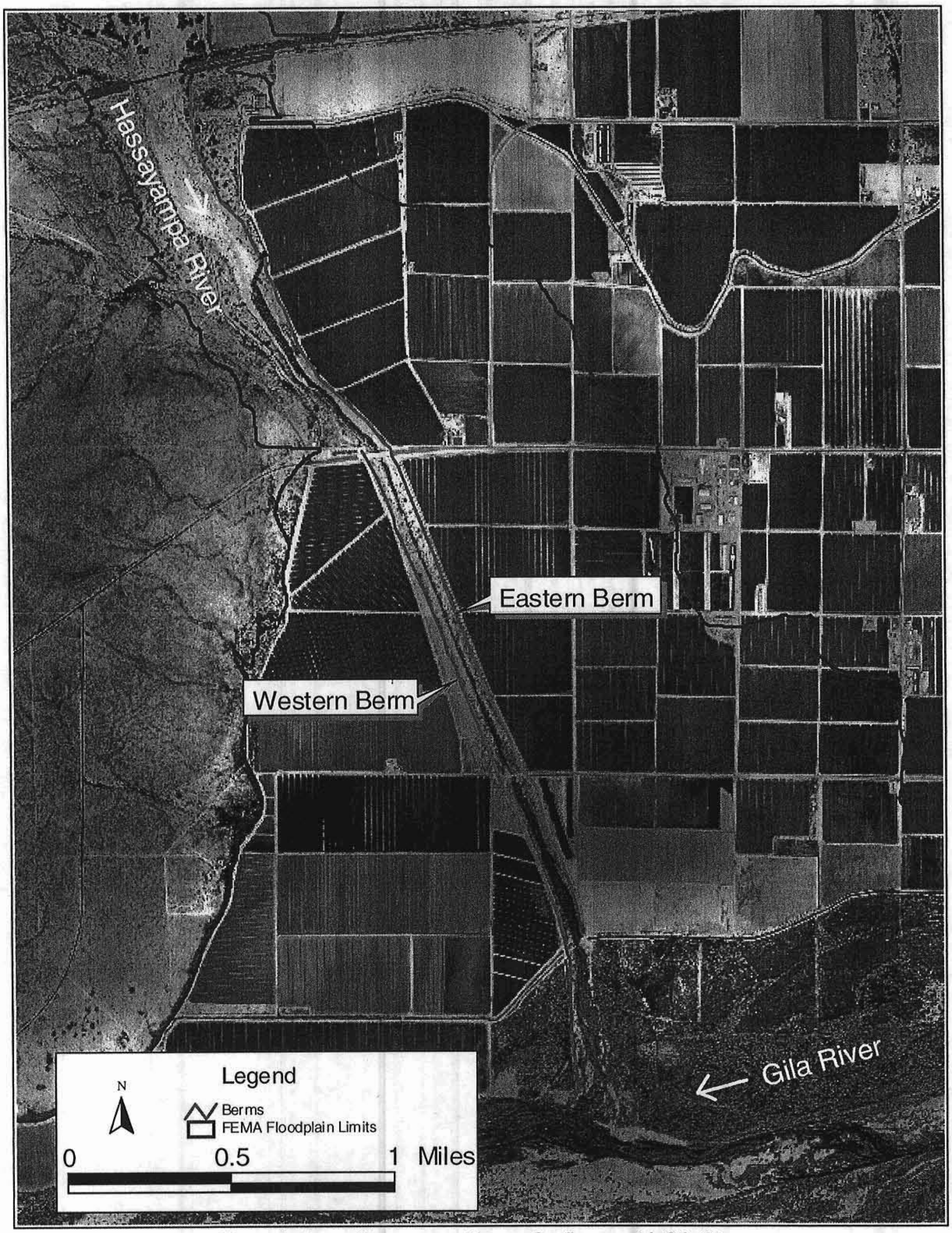


Figure 1. Lower Hassayampa River at Confluence with Gila River

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: July 15, 2005

TO: LHWCMP Subconsultants

FROM: Jon Fuller, PE

RE: LHWCMP Retention Release

CC: File

The enclosed check is for release of retention funds (5%) collected thus far. From this point forward, retention held will be 5% of each billing. Please call if you have questions.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: July 27, 2005

To: John Hathaway, PPM

From: Catherine W. Regester, Engineering Division

Subject: Lower Hassayampa WCMP
Draft *Hydraulics Report*
Revised Proposed Cross Sections, Bank Stations, and Hydraulic Baseline
Submittal of June 16 and July 22, 2005

I have completed my review of the subject submittal and have the following questions/comments for the consultant:

1. I am still not clear how the heights of the blocked obstructions at the pits were set. How does the channel slope of 0.005 figure into the calculation? Please include a more detailed write-up on page 14 of the *Hydraulics Report*, in the paragraph discussing the blocked obstructions. I think this is a minor point and don't foresee any change in the water surface elevations. I would just like to have this clarified in the report.

2. In Table 3-2, Bridge Data, I think it would be helpful to include one more column for the date of the design or as-built plans.

3. The report says that as-built or design plans were used for modeling the bridges. Didn't we get survey data at the bridges? Please provide the plans or survey data so that the bridge modeling may be verified.

4. In Table 3-5 on page 23 of the *Hydraulics Report*, there is a significant change in the channel 'n' value between the Cella Barr and WEST studies (composited 'n' value) for sections 0.35 to 1.58. Is it likely that there has been a significant growth in vegetation in this area since the Cella Barr study? I would like to try to explain this difference, if possible, and include it in the report.

5. Please revise the paragraph in the *Hydraulics Report* relating to the spill over the US 80 bridge embankment to reflect the latest modeling results. If there is flow over the embankment perhaps we should consider using this flow as the starting discharge for the Right Bank reach.

cc: Bing Zhao
Jon Fuller
Ted Lehman
Leo Kreymborg
Michael Duncan

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: August 1, 2005

TO: John Hathaway, P.E./FCDMC

FROM: Jon Fuller, PE, RG, PH, CFM

RE: Task 9.6.2 Selection of Sediment Transport Equations

CC: Ted Lehman, PE
Hari Sundararaghavan, PhD, PE, CFM

Task 9.6.2 requires District approval of HEC-6 sediment transport functions appropriate for the lower Hassayampa River to use in the sediment transport modeling. This memorandum outlines the selection process used to select the recommended sediment transport functions.

The selection of the sediment transport equations was based on the parameter ranges of the data used in the development of the sediment transport equations. The documentation of the US Army Corps of Engineers' SAM software program provides the parameter ranges involved for several sediment transport equations.

The selection of the equations was performed using the HEC-RAS results, sediment sampling data, and a comparison of this information with the parameter ranges of the sediment transport equations. The following table presents a summary of this comparison:

Parameter	Median HEC-RAS or Measured Value	Ackers White (Flume Data)	Toffaleti Transport Function	Yang Transport Function
Particle Size (mm)	0.5	0.04-7	0.095-0.76	0.15-1.7
Velocity (fps)	7.0	0.07-7.1	0.7-7.8	0.8-6.4
Slope (ft/ft)	0.004	0.00006-0.037	0.000002-0.0011	0.000043-0.028
Depth (ft)	2.7	0.01-1.4	0.7-56	0.04-50
Top Width (ft)	1866	0.23-4	0.8-3640	0.44-1750

Three equations, Ackers-White, Colby and Yang, are considered as they compare reasonably well with the HEC-RAS results and the measured sediment data. Based on the data summarized above, engineering judgment, and past HEC-6 modeling experience, we recommend that the Ackers-White, Toffaleti and Yang equations be used in the HEC-6 model. All these three equations were developed for sand-bed rivers. The Ackers-White equation was developed for sand-bed rivers with subcritical flow while Toffaleti equation was developed for large sand-bed rivers. In addition to these equations, Colby equation and Laursen-Copeland equations were also considered. Preliminary runs using Colby resulted in numerical problems with HEC-6 unable to complete the runs. The Laursen-Copeland equation over-predicts the transport of fine material and in the absences of armoring can lead to erroneous results. Therefore, the Colby equation and Laursen-Copeland equation were not considered. SAM-AID predicted good matches for the Engelund-Hansen equation and Van Rijn equations. However, these equations are not supported by HEC-6. As a result, these two equations were dropped from the considerations.

A SAM-AID print-out which aided in the selection process is provided at the end of this memorandum.

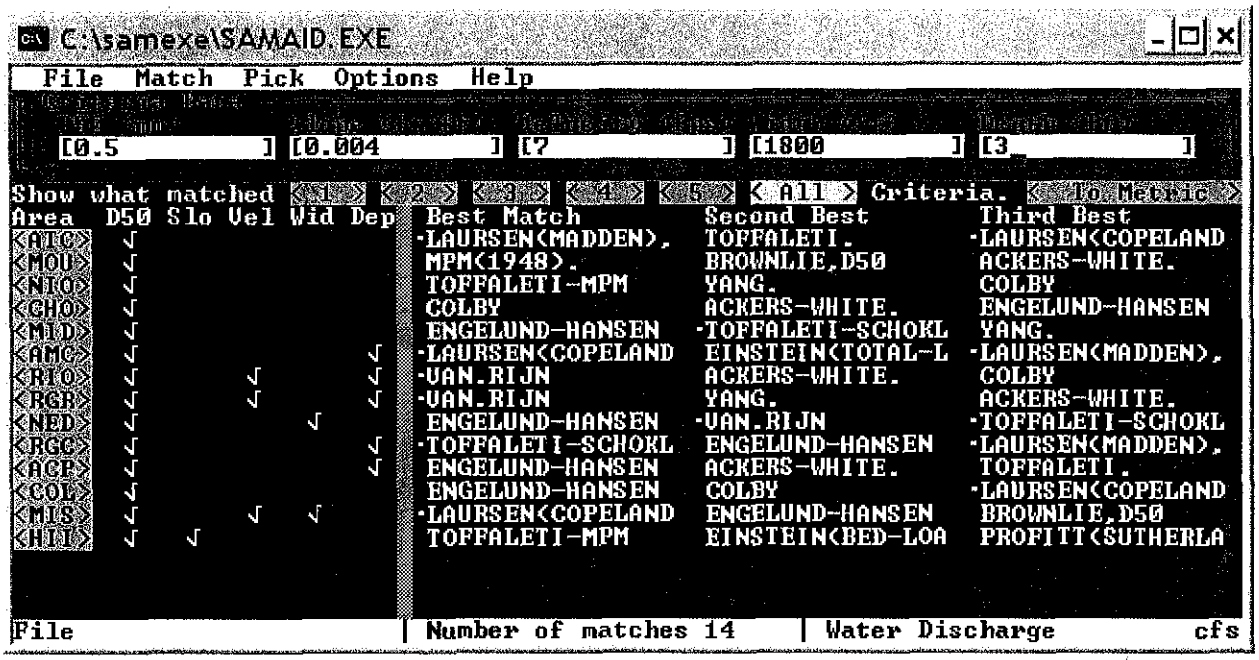
Expedited review and approval of the recommended modeling scenarios is requested. Please call me to discuss as needed.

Reference

US Army Corps of Engineers, "SAM Hydraulic Design Package for Channels," September, 2002. Available at http://www.ayresassociates.com/Web_SAMwin/docs.htm.

US Army Corps of Engineers, "HEC-RAS Hydraulic Reference Manual"

Dr. R. Copeland, 2005, Personal communications via Email.



TO:	Cathy Regester, FCDMC
FROM:	Leo Kreymborg, WEST Consultants
CC:	Ted Lehman, JEF Inc.
	Jon Fuller, JEF Inc.
DATE:	Monday December 5, 2005
RE:	Your November 30 comments on Lower Hassayampa Floodway

Cathy,

I have uploaded a zip file to:

ftp://ftpsite.westconsultants.com/Outgoing/Leo/LowerHassayampa/

called 20051205LowerHassayampa.zip. This file contains the updated HEC-RAS model and the shapefiles discussed below.

Below are your comments in bold and my responses interspersed:

1. Please verify that the floodway was developed using the equal conveyance reduction methodology (Method 4). Provide written documentation in the Hydraulics Report.

The floodway was developed using method 4 and method 5. Method 5 is an optimized version of method 4, and was mentioned in the scope of work, the draft which is included in the zip file. The report will include a discussion of this.

2. The right side encroachment station for section 4.09 should be moved in such that the right side ineffective flow area is not included in the floodway.

I have moved the encroachment to the ineffective flow limit. The zip file has an approximate floodway shapefile, so you can see what the floodway will look like in this region where the encroachments were changed. The floodway shapefile we sent previously will be modified to reflect the changes if you approve them.

3. Please explain the floodway delineation along the right side from section 12.47 to section 12.75. The Profile Delta WS is less than 0.2 ft in this area. I would recommend that the floodway be moved in to, at least, the right side limit of the Jackrabbit Wash floodway. A separation between the Jackrabbit and Hassayampa floodways may also be appropriate in this area.

This was done to eliminate negative surcharges. After discussing the issue with you on the phone this morning, I redelineated this region, now allowing a negative surcharge of as much as 0.04 at some sections. This brings in the proposed floodway somewhat. What it will look like with the new encroachments is also shown in the floodway shapefile in the zip file.

4. Sections 12.94 through 13.04 show right side ineffective flow areas included in the floodway. Please explain why these ineffective flow areas are included in the floodway or adjust the floodway limits such that these areas are not included in the floodway.

The ineffective flow limits on these cross-sections are quite subjective, looking at it again I thought it justified to move both the ineffective flow areas farther out on these cross-sections. I also adjusted the encroachment stations. The change of the ineffective flow limits causes the base water surface elevations to change slightly, from 1072.28 to 1072.37 at section 12.94 (increase of 0.09), from 1075.25 to 1074.90 at section 13.04 (drop of 0.35 feet), and slightly smaller drops for a few cross-sections upstream. These differences are so minor that they should have no visible impact on the proposed floodplain. I am attaching a shapefile of the ineffective flow limits. The proposed approximate floodway shapefile reflects all these changes.

5. If we were to decide to submit this floodway to FEMA, we would need to adjust the upstream floodway to tie-in to the effective floodway; or, we would need to terminate the new floodway at a point where it will tie-in to the effective floodway.

Understood.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: September 30, 2004

To: File

From: John Hathaway

Subject: Lower Hassayampa WCMP
Draft Data Collection Report

I have completed my review of the subject submittal received September 23, 2004 and have the following questions/comments for the consultant:

Table of Contents

1. Appendices: As-Builts – List the facilities included in the As-Built plans.

2. Appendices: CD-ROMs – List of the contents of each CD-ROM. This need not be detailed. Something similar to the labels on the CD-ROMs will be sufficient.

3. Appendices: Provide an "Addenda" place-holder appendix for "additional data... discovered during the course of the study...[to be] added to this report," as mentioned in the Executive Summary. This can be used to list such material if needed.

Executive Summary through Data Collection Results – No Comments.

Engineering

4. Page 8: *Watershed Work Plan, Buckeye Watershed (SCS, 1963)* – Regarding Buckeye FRS No. 1, 2, and 3. The text states, "Only Buckeye FRS No. 1 has an effect on the LHWCMP study reach." Per conversation with Brett Howey, FCD Dam Safety (602-506-4609, bah@mail.maricopa.gov), the Buckeye FRS No. 1, 2, and 3 are interconnected, and drain impounded water through the FRS No. 1 outlet. He's working on the Buckeye Infrastructure Rehabilitation project. Valerie Swick, FCD Planning Branch (602-506-2929, vas@mail.maricopa.gov), is project manager for the Buckeye-Sun Valley ADMP. Part of that effort will look into hydrology and hydraulics of the FRS and the several irrigation canals below the FRS. My sense is the impact of all three FRS draining through the FRS No. 1 outlet would not have any significant effect on the peak flow into the Hassayampa River, but would affect the duration of flow. My notes from the internal coordination meeting with Brett and Valerie indicate a 10-day

drawdown of the FRSs for the 100-year event. Please check with Brett and Valerie and revise the text to reflect the interconnection of the three FRSs.

5. Page 9: *CAP Siphon Design (Maish, 1976)* – In reference to the "pdf of two Maish reports are included in the Data Collection Report," please note on which CD-ROM these can be found.

6. Page 10: *CAP Bank Stabilization (Higgins & Lynch, 1997)* – Same comment on the pdf for this report.

7. Page 11: *Hassayampa River Flood Insurance Re-study (Cella Barr & Associates, 1988)* – Minor typo in last sentence ("HEC-2 models are provide<u>d</u> on CD with this report.") and same comment on which CD this is located. Same typo and comment on the last sentence of the succeeding paragraph regarding the Dames & Moore FIS.

8. Page 12: *CAP Bank Stabilization* – Minor typo in next to last sentence, "and threats <u>to</u> delivery of water to needed areas."

<u>Historic Aerial Photography</u>

9. Table 1: General comment – indicate the number of the CD where the "Other" column in the table indicates the photos are on CD.

<u>Historic Ground Photos</u>

10. Tables 3, 4, and 5: General comment – Add column or otherwise indicate which CD each photo is located.

<u>Existing and Future Land Uses</u>

11. The proposed development projects of Belmont, Douglas Ranch, Trillium, Sun Valley, and Sun Valley South are adjacent to or overlap the Hassayampa River and Jackrabbit Wash. It is essential that the existing Development Master Plans or the equivalent be considered in formulating the LHWCMP. The existing plans of development need to be reviewed and pertinent portions included in the Data Collection Report. The Town of Buckeye and Maricopa County Department of Planning & Development should be contacted to review the applicable documents, ascertain their approval status, and obtain copies of the appropriate portions of these project plans. Would the hydrology and hydraulic design for Sun Valley Parkway be a useful document to locate? I believe it was produced by Collar, Williams and White Engineering (now Rick Engineering) c. 1987. MCDOT may have a copy, due to their involvement with the project.

<u>Sand and Gravel Mining</u>

12. Per the September 10, 2004 Stakeholder Meeting with Arizona State Land Department, there is a feasibility study and mineral assessment underway to guide ASLD asset management with regard to marketing State Trust Land for sand & gravel mining purposes. It has also been rumored that the proposed major developments, cited above in comment #11, have designated certain areas for aggregate mining to support the

respective development projects. To the extent information on potential mining sites is available it needs to be included in the Data Collection Report.

Existing Facilities Exhibit

13. There needs to be more information on existing facilities, either in the text or on the exhibit, itself. The specifics are as follows:

• According to David Boggs, FCD Sand & Gravel Mining Permit Branch (602-506-4715, dbb@mail.maricopa.gov), there is a fiber-optic line located two hundred feet or so south of the Tonopah-Salome Highway. It is also just upstream of an active sand & gravel mining pit. With only about 13 feet of cover, potential head cutting could threaten it. As-builts for the fiber-optic line along with information on the mining permit are available from Tom Wergen, FCD Sand & Gravel Mining Permit Branch (602-506-7591, tew@mail.maricopa.gov). Be aware that a survey blunder was discovered during the permitting process. It is believed the surveyor mistook a property corner for a section corner, resulting in a discrepancy between the record location and the actual location of the fiber-optic line on the order of 3,000 feet. Verify the location in light of this, though the records may have already been corrected. Ownership of this utility should be determined along with the ownership of the fiber-optic line shown to cross downstream of the Union Pacific Railroad bridge.

• Inspection of aerial photographs in the vicinity of the confluence of Daggs Wash and Wagner Wash with the Hassayampa River leave some questions about how many power transmission lines cross the river. This is based on the apparent convergence of three faint lines representing construction/maintenance roads for the respective power lines. These three roads are also shown on the Existing Facilities Exhibit map. Please verify the number, location, and alignment of power transmission lines in this vicinity.

• All power transmission lines should be identified by name and voltage (e.g. Parker Dam-Phoenix 161 kV Power Transmission Line, Mead-Liberty 345 kV Power Transmission Line, etc.) and ownership (e.g. Western Area Power Authority or WAPA, Arizona Public Service, Pinnacle West Capital Corporation, Salt River Project, etc.).

• As-builts should be obtained for the transmission tower foundations, including type of foundation (cast-in-place reinforced concrete spread footing, cylindrical pier, pile, or "grillage" type foundation) and depth and the precise location of individual towers within the LHWCMP corridor. This is necessary to evaluate potential threats to these facilities from lateral migration and stream bed degradation. Paul Richards, Senior Project Leader – Transmission Construction Projects for APS might be able to provide guidance on transmission line name, voltage, and ownership along with obtaining as-builts. A two-year old business card of his lists his phone number as (602) 371-6186 and email address as paul.richards@aps.com. Give him my regards.

• This comment is specific to the Existing Facilities Exhibit. Are the locations of the power transmission towers on the aerial photograph of the Daggs Wash/Wagner Wash area accurate or merely schematic? If they are accurately located, the exhibit is more useful by giving a sense of which towers may be impacted by the river. If not, there should be some explanation of how these facilities will be evaluated. The usefulness of the ground photograph of the three power transmission lines south of I-10 is limited. It does give a sense that the towers are near the cut bank, but it doesn't show "how close" or illustrate the character of the overbank area to aid in evaluating threats due to lateral migration and degradation. I suggest this photograph be supplemented with an aerial photo like the one for the three lines crossing the Hassayampa River near the Daggs Wash/Wagner Wash confluence.

• It is my understanding that the petroleum pipeline downstream of the Union Pacific Railroad Bridge belongs to Kinder-Morgan. As-builts should be obtained for this pipeline. Besides Kinder-Morgan, the Arizona Corporation Commission might be a source of as-builts.

• Starting from the upper left hand corner of the Exhibit and working down the left side and up the right side, add the following labels: Union Pacific Railroad and bridge to the aerial photo depicting the location of the fiber-optic line and petroleum pipeline; Old US Hwy. 80 and Salome Hwy. to the aerial of the same; the Gila River on the aerial and map; and Buckeye FRS No. 1 and outlet on the aerial depicting I-10.

References

14. Page 38: Phillips, Jeff V., et al., 1998, Method to estimate effects of flow-induced vegetation changes on channel conveyances of streams in central Arizona, prepared in cooperation with the Flood Control District of Maricopa County…there appears to be repeated or garbled text.

15. Page 39: Roeske, R.H., 1971, Floods of September 1970 in Arizona, Utah, and Colorando – minor typo.

Plates

16. Plate 2 – Recent Satellite and Aerial Photo Imagery: What is the band(s)/type of satellite imagery (e.g. Near IR, false color IR, etc.)?

17. Plate 3 – Existing and Future Land Uses: Regarding sand & gravel mines, the text describes 4 permitted and 2 closed aggregate mines. Plate 4 shows these referenced to the parcel boundaries and permit numbers. Is there a discrepancy on Plate 3 that shows only three aggregate mining land use sites that appear to correspond to FA96-032, FA0-049, and FA00-161? What about FA95-022 (closed), FA01-113, and FA93-001 (closed)?

All-in-all, the Data Collection Report is well put together. Most of the comments are minor. There are important pieces of information that need to be included: proposed development plans and potential sand & gravel mining areas – conceptual as they may be, a fiber-optic line that was missed, more specific identification and accurate location of power transmission lines and towers, as-builts of transmission tower foundations and the petroleum pipeline, and identification of utility owners.

cc: Jon Fuller

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: December 16, 2005

TO: John Hathaway, PE

FROM: Ted Lehman, PE

RE: Final Data Collection Report for LHWCMP

CC: Jon Fuller, PE; File

John,

This memorandum provides our response to your comments on the draft Data Collection Report dated September 30, 2004. This memo accompanies our submittal of the Final Data Collection Report.

Our responses are organized following your review comments which are shown in italics.

Table of Contents

1. *Appendices: As-Builts – List the facilities included in the As-Built plans.*

2. *Appendices: CD-ROMs – List of the contents of each CD-ROM. This need not be detailed. Something similar to the labels on the CD-ROMs will be sufficient.*

3. *Appendices: Provide an "Addenda" place-holder appendix for "additional data… discovered during the course of the study…[to be] added to this report," as mentioned in the Executive Summary. This can be used to list such material if needed.*

All of these items have been addresses and incorporated into the final report. The Addenda includes WGA's complete *Report on Drainage and Stormwater, Recharge and Environmental Conditions* as well as copies of development plans for the area obtained by EDAW (see also comment number 11).

Executive Summary through Data Collection Results – No Comments.

Engineering

4. *Page 8: Watershed Work Plan, Buckeye Watershed (SCS, 1963) – Regarding Buckeye FRS No. 1, 2, and 3. The text states, "Only Buckeye FRS No. 1 has an effect on the LHWCMP study reach." Per conversation with Brett Howey, FCD Dam Safety (602-506-4609, bah@mail.maricopa.gov), the Buckeye FRS No. 1, 2, and 3 are interconnected, and drain impounded water through the FRS No. 1 outlet. He's working on the Buckeye Infrastructure Rehabilitation project. Valerie Swick, FCD Planning Branch (602-506-2929, vas@mail.maricopa.gov), is project manager for the Buckeye-Sun Valley ADMP.*

Part of that effort will look into hydrology and hydraulics of the FRS and the several irrigation canals below the FRS. My sense is the impact of all three FRS draining through the FRS No. 1 outlet would not have any significant effect on the peak flow into the Hassayampa River, but would affect the duration of flow. My notes from the internal coordination meeting with Brett and Valerie indicate a 10-day drawdown of the FRSs for the 100-year event. Please check with Brett and Valerie and revise the text to reflect the interconnection of the three FRSs.

Mr. Howey and pertinent documents were consulted regarding the operation of the FRSs. Changes have been made to the text to reflect the current operation of these facilities.

5. *Page 9: CAP Siphon Design (Maish, 1976) – In reference to the "pdf of two Maish reports are included in the Data Collection Report," please note on which CD-ROM these can be found.*

6. *Page 10: CAP Bank Stabilization (Higgins & Lynch, 1997) – Same comment on the pdf for this report.*

7. *Page 11: Hassayampa River Flood Insurance Re-study (Cella Barr & Associates, 1988) – Minor typo in last sentence ("HEC-2 models are provided on CD with this report.") and same comment on which CD this is located. Same typo and comment on the last sentence of the succeeding paragraph regarding the Dames & Moore FIS.*

8. *Page 12: CAP Bank Stabilization – Minor typo in next to last sentence, "and threats to delivery of water to needed areas."*

The typographical errors have been corrected and reference to the CD-ROM has been added to the text in these sections.

Historic Aerial Photography

9. *Table 1: General comment – indicate the number of the CD where the "Other" column in the table indicates the photos are on CD.*

The suggested data has been added to the "Other" column in Table 1.

Historic Ground Photos

10. *Tables 3, 4, and 5: General comment – Add column or otherwise indicate which CD each photo is located.*

A sentence has been added to the text providing reference to the appropriate CD for the data listed in Tables 3-5.

<u>*Existing and Future Land Uses*</u>

11. *The proposed development projects of Belmont, Douglas Ranch, Trillium, Sun Valley, and Sun Valley South are adjacent to or overlap the Hassayampa River and Jackrabbit Wash. It is essential that the existing Development Master Plans or the equivalent be considered in formulating the LHWCMP. The existing plans of development need to be reviewed and pertinent portions included in the Data Collection Report. The Town of Buckeye and Maricopa County Department of Planning & Development should be contacted to review the applicable documents, ascertain their approval status, and obtain copies of the appropriate portions of these project plans. Would the hydrology and hydraulic design for Sun Valley Parkway be a useful document to locate? I believe it was produced by Collar, Williams and White Engineering (now Rick Engineering) c. 1987. MCDOT may have a copy, due to their involvement with the project.*

<u>*Sand and Gravel Mining*</u>

12. *Per the September 10, 2004 Stakeholder Meeting with Arizona State Land Department, there is a feasibility study and mineral assessment underway to guide ASLD asset management with regard to marketing State Trust Land for sand & gravel mining purposes. It has also been rumored that the proposed major developments, cited above in comment #11, have designated certain areas for aggregate mining to support the respective development projects. To the extent information on potential mining sites is available it needs to be included in the Data Collection Report.*

<u>*Existing Facilities Exhibit*</u>

13. *There needs to be more information on existing facilities, either in the text or on the exhibit, itself. The specifics are as follows:*

- *According to David Boggs, FCD Sand & Gravel Mining Permit Branch (602-506-4715, dbb@mail.maricopa.gov), there is a fiber-optic line located two hundred feet or so south of the Tonopah-Salome Highway. It is also just upstream of an active sand & gravel mining pit. With only about 13 feet of cover, potential head cutting could threaten it. As-builts for the fiber-optic line along with information on the mining permit are available from Tom Wergen, FCD Sand & Gravel Mining Permit Branch (602-506-7591, tew@mail.maricopa.gov). Be aware that a survey blunder was discovered during the permitting process. It is believed the surveyor mistook a property corner for a section corner, resulting in a discrepancy between the record location and the actual location of the fiber-optic line on the order of 3,000 feet. Verify the location in light of this, though the records may have already been corrected. Ownership of this utility should be determined along with the ownership of the fiber-optic line shown to cross downstream of the Union Pacific Railroad bridge.*

- *Inspection of aerial photographs in the vicinity of the confluence of Daggs Wash and Wagner Wash with the Hassayampa River leave some questions about how many power transmission lines cross the river. This is based on the apparent convergence of three faint lines representing construction/maintenance roads for the respective power lines. These three roads are also shown on the Existing Facilities Exhibit map. Please verify the number, location, and alignment of power transmission lines in this vicinity.*

- *All power transmission lines should be identified by name and voltage (e.g. Parker Dam-Phoenix 161 kV Power Transmission Line, Mead-Liberty 345 kV Power Transmission Line, etc.) and ownership (e.g. Western Area Power Authority or WAPA, Arizona Public Service, Pinnacle West Capital Corporation, Salt River Project, etc.).*

- *As-builts should be obtained for the transmission tower foundations, including type of foundation (cast-in-place reinforced concrete spread footing, cylindrical pier, pile, or "grillage" type foundation) and depth and the precise location of individual towers within the LHWCMP corridor. This is necessary to evaluate potential threats to these facilities from lateral migration and stream bed degradation. Paul Richards, Senior Project Leader – Transmission Construction Projects for APS might be able to provide guidance on transmission line name, voltage, and ownership along with obtaining as-builts. A two-year old business card of his lists his phone number as (602) 371-6186 and email address as paul.richards@aps.com. Give him my regards.*

• This comment is specific to the Existing Facilities Exhibit. Are the locations of the power transmission towers on the aerial photograph of the Daggs Wash/Wagner Wash area accurate or merely schematic? If they are accurately located, the exhibit is more useful by giving a sense of which towers may be impacted by the river. If not, there should be some explanation of how these facilities will be evaluated. The usefulness of the ground photograph of the three power transmission lines south of I-10 is limited. It does give a sense that the towers are near the cut bank, but it doesn't show "how close" or illustrate the character of the overbank area to aid in evaluating threats due to lateral migration and degradation. I suggest this photograph be supplemented with an aerial photo like the one for the three lines crossing the Hassayampa River near the Daggs Wash/Wagner Wash confluence.

• It is my understanding that the petroleum pipeline downstream of the Union Pacific Railroad Bridge belongs to Kinder-Morgan. As-builts should be obtained for this pipeline. Besides Kinder-Morgan, the Arizona Corporation Commission might be a source of as-builts.

• Starting from the upper left hand corner of the Exhibit and working down the left side and up the right side, add the following labels: Union Pacific Railroad and bridge to the aerial photo depicting the location of the fiber-optic line and petroleum pipeline; Old US Hwy. 80 and Salome Hwy. to the aerial of the same; the Gila River on the aerial and map; and Buckeye FRS No. 1 and outlet on the aerial depicting I-10.

References

14. *Page 38: Phillips, Jeff V., et al., 1998, Method to estimate effects of flow-induced vegetation changes on channel conveyances of streams in central Arizona, prepared in cooperation with the Flood Control District of Maricopa County…there appears to be repeated or garbled text.*

15. *Page 39: Roeske, R.H., 1971, Floods of September 1970 in Arizona, Utah, and Colorando – minor typo.*

Plates

16. *Plate 2 – Recent Satellite and Aerial Photo Imagery: What is the band(s)/type of satellite imagery (e.g. Near IR, false color IR, etc.)?*

17. *Plate 3 – Existing and Future Land Uses: Regarding sand & gravel mines, the text describes 4 permitted and 2 closed aggregate mines. Plate 4 shows these referenced to the parcel boundaries and permit numbers. Is there a discrepancy on Plate 3 that shows only three aggregate mining land use sites that appear to correspond to FA96-032, FA0-049, and FA00-161? What about FA95-022 (closed), FA01-113, and FA93-001 (closed)?*

All-in-all, the Data Collection Report is well put together. Most of the comments are minor. There are important pieces of information that need to be included: proposed development plans and potential sand & gravel mining areas – conceptual as they may be, a fiber-optic line that was missed, more specific identification and accurate location of power transmission lines and towers, as-builts of transmission tower foundations and the petroleum pipeline, and identification of utility owners.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: January 10, 2006

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP

CC: File

Table 1. Meeting Details

Task No.	Meeting	Total No.	Hour/ Mtg	JEF Hours	WEST Hours	CLW Hours	EDAW Hours	WGA Hours	Total	Persons /Mtg
2.1.1.7	Team	13	4	88	44	32	32	24	220	4.2
	Held 14 team meetings thru 12/05 (2004: 8/3; 9/7, 10/5, 11/2, 12/7) (2005: 3/1, 5/3, 6/1, 7/5, 8/2, 9/6, 11/1, 12/6)									
2.1.1.9	Kickoff	1	4	8	4	4	4	4	24	6.0
	Held on 6/17/04									
2.1.1.10	Review	8	4	32	32	8	4	4	80	2.5
	Held at least 8 review meetings through 1/5/06 JEF:8/25/05, 10/6/05 WEST: 6/7/05, 10/14/04, 5/26/05, 8/8/05, 12/16/05, 1/5006									
2.1.4	Lessons Learned	1	4	8	4	4	4	4	24	6.0
	To be held after completion									
2.2.2	Site Visits	3	10	60	30	30	30	30	180	6.0
	Held two site visits. Last site visit after final report review.									
4.7.2	Ind. Stakeholder	12	4	48	16	48	24	8	144	3.0
	2004: 9/9 (4 mtgs) 2005: 8/16, 8/19 (2 mtgs), 10/27									
4.7.4	ARPA	4	4	16	0	0	8	0	24	1.5
	Held 4 meetings through 12/05 (2004: 9/9) (2005: 1/20, 9/19, 11/10)									
4.7.5	Other Workgroup	2	4	8	0	8	0	0	16	2.0
	Can't find the dates, but we met with the Johnson/Gladden Group twice									
4.6.2-3	Public	2	8	16	8	16	0	0	40	2.5
	Held 2 public meetings (11/9/05)									
	Meetings Not in Scope Public Mtg #2 Preparation: 11/1/05 Public Mtg #2 Preparation: 10/25/05 Brainstorming Planning Mtg: 9/13/05 Brainstorming Mtg: 9/21/05									

Memorandum **JE Fuller/ Hydrology & Geomorphology, Inc.**

DATE: February 28, 2006

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE, PH, RG, CFM

RE: Lower Hassayampa River Watercourse Master Plan
Response to District Review Comments
Chapter 4, River Behavior Analysis Report

CC: Hari Sundararaghavan, PhD, PE
Ted Lehman, PE

As of February 16, 2006, we have received all comments from the District on the draft LHWCMP River Behavior Analysis Report submitted on December 15, 2005. We met with the District reviewers and project manager on February 16, 2006 to discuss the comments and determine how best to respond. District review comments were provided in the following memoranda:

- Memorandum from David Degerness, PE to John Hathaway, PE dated February 16, 2006 re. Chapters 1-3.
- Memorandum from Kathryn Gross to John Hathaway, PE dated February 9, 2006, re. Chapters 1-3, 6, 7, 8, 9, & 10.
- Memorandum from Richard Waskowsky, Hydrologist to John Hathaway, PE dated December 29, 2005, re. Chapter 4: Channel Bed Elevation Analysis.
- Memorandum from David Degerness, PE to John Hathaway, PE dated January 23, 2006, re. Chapter 5: Sediment Transport Analysis; Chapter 7: Sediment Trend Analysis; Chapter 8: Summary.
- Memorandum from David Degerness, PE to John Hathaway, PE dated January 30, 2006, re. Chapter 6: Lateral Migration Analysis.

The District reviewers requested written responses to review comments. The District comments are provided below, with the JEF response shown in italics font immediately after each comment.

February 16, 2006 Review Memorandum re. Chapters 1-3 (Degerness)

I have finished my review of the above referenced material and I have no comments at this time.

JEF Response. No response needed.

February 9, 2006 Review Memorandum for Chapters 1-3, 6, 7, 8, 9, & 10 (Gross)

Chapter 1

1. No concerns.

JEF Response. No response needed.

Chapter 2

1. On page 2-3, Channel Width, Pattern and Sinuosity – Could an "old school" citation be included along with the Rosgen citation?

   JEF Response. Suitably "old-school" citations to Dusty Ritter and Stan Schumm were added.

2. On page 2-8, Figure 2-5 – Was there rectification issues between the 1934 set and the 1964 and 2005 sets of aerial photography? Is the wash that appears just east of the white tank wash deposit area in the 1964 and 2005 photos White Tank Wash? No action required.

   JEF Response. There were no unusual rectification issues at the noted location, but what the eagle-eyed reviewer noticed was a slight shift in the figure plot window. We revised the plot window to show a better match between years of coverage. The noted wash is in fact White Tanks Wash, or at least the historical path of it, most of which is cut off by the upstream flood retarding structure.

3. On page 2-97, 2.9 Summary – Could a summary of the avulsion discussions be added here as well?

   JEF Response. A summary of the avulsion discussion was included in Section 2.9.

Chapter 3

1. Page 3-8, 3.3.1 Geomorphic Mapping and Lateral Stability – Interesting addition of minimum rate "equation" of width of floodplain corridor and vertical changes between surfaces. No response required.

   JEF Response. No response needed.

2. Page 3-9, 3.3.2.1 Previous Geologic Mapping – Please include the geologic maps used for the study in the appendices.

   JEF Response. Our response to this comment was discussed with and approved by the reviewer. It was decided that to save a few trees, we would provide copies of the AZGS reports with surficial mapping to the District for their library. Copies in the appendix become troublesome and costly when numerous copies of the report are requested, both for this study and in the future. Consultants are not typically required to provide copies of all referenced reports. The AZGS map units boundaries are also included in the project GIS.

3. Page 3-10, 3.3.3 Geomorphic Units – Breakdown of units is reasonable. Excellent descriptions provided. I like how the percentages of the units are presented as well.

   JEF Response. Thank you. We appreciate the positive feedback.

4. Page 3-16, 3.4.1.1 Soil Development – What is the intent of presenting the soil development information? It appears that general descriptions of the horizons are supplied and occasionally the information is tied back to the Hassayampa study.

Should each horizon have a general description as well as a connection back to the Hassayampa as to how this layer was either represented or not? For example, A horizon gives just a general description, B horizon Clays starts with general description includes a sentence mentioning the study area then goes back to general description. B horizon Calcium Carbonate provides only a general description, no mention of lack or prevalence of Calcium Carbonate in the study area. C horizon provides only study information.

JEF Response. Reviewer's point is taken. We cleaned up the text to be consistent in style and reference to the study area. The intent of presenting the soil development information was to describe how observations of soil development can be used in assessing geomorphic surface age, which is then used to assess the stability history of the stream.

5. Page 3 –19 3.4.1.2 Soil Pit Analyses – Please make sure the soil pit data is included in the appendices as text states (appendix X).

   JEF Response. Soil pit field forms are provided in the appendix. Note that summaries of the field data are provided in the tables in the text, and are in a much more legible and useable format in the report tables.

6. Page 3-23, Table 3-3 Pit ID 24 – District recommends using a more flattering picture for the spoil material.

   JEF Response. We think the spoil pile looks great, but we are open to any District-supplied photoshop rendering it chooses.

7. Page 3-58, 3.5.2 Results – Could an additional discussion be added regarding the consistency or lack thereof of the extent of each geomorphic unit? Did reaches with bars tend to always have bars in the same area? Did that amount of floodplain terrace area change significantly over time? Also, based on the analysis is there a preferred flood form or pattern and a preferred low-medium flow form or pattern?

   JEF Response. Additional descriptive text was provided as recommended. The active channel, bars, and floodplain terraces varied considerably with time in response to flooding. There was only broad consistency in location, except as noted near tributary confluences. The tributary terraces provided more permanence, but were readily eroded where the main channel abutted them. Loss of terrace in one area appears to have been generally compensated by terrace formation in other areas. Precise measurement of the surface type area was not computed for each year of coverage. The existing channel pattern appears to be the preferred pattern. The flood channel pattern is essentially a bigger version of the low flow pattern, although there is natural tendency for the flood channel to be somewhat straighter.

8. Overall the geomorphic unit mapping appears reasonable. One question regarding Reach 2, shown on page 3-27 Figure 3-9, towards the southern end of the reach on river left the geomorphic unit is classed as tributary deposits. Does this area really exhibit more influence from the tributaries than the river? No action is expected to be taken by the consultant.

JEF Response. Our mapping of the tributary terrace deposit on river left in Reach 2 is based in part on our interpretation of historical aerial photographs, which perhaps give a clearer indicate of the surface genesis than do more recent aerials. Recently, the surface has been disturbed by agricultural grading that obscures some of the surficial characteristics. Our opinion is that the surface, because it has been located away from the active channel for a long time (most recently due in part to human activities) the surface has experienced the influence of tributary sedimentation to a greater degree than main stem processes. No doubt portions of the soil profile underlying the deposit are genetically derived from the Hassayampa, but the surface expression is more related to the tributaries.

9. Page 3-80, 3.7 Summary first bullet – Classification mentions stability. Doesn't classification cover pattern as well? Could channel pattern be covered in the summary somewhere?

   JEF Response. Stream classification does include channel pattern, and a statement regarding pattern was added to the bullet item. The objective of the classification exercise was to assess and predict relative stability relative to stream type.

10. Overall, geomorphic information provided appears reasonable.

    JEF Response. No response needed.

<u>Chapter 4 - Not reviewed.</u>
JEF Response. No response needed.

<u>Chapter 5 – Not reviewed.</u>
JEF Response. No response needed.

<u>Chapter 6</u>

1. Lateral migration analyses and report text appear reasonable (6.1-6.4)

   JEF Response. No response needed.

2. Erosion Zones. Discussion on methods appears reasonable. A description of what technical information formed the basis of each erosion zone appears reasonable. However, based on the results some of the erosion zones seem a little extreme.

   JEF Response. We note that the reviewer provided a GIS layer identifying specific points of concern (Comment #9). We address each point of concern in our response to Comment #9.

3. Erosion Zones. It may be reasonable to include discussion on level of scale of the analysis. This may come in handy for individuals along the Pleistocene-Holocene boundary.

   JEF Response. We added a statement regarding the scale of analysis to the methodology section (6.5.1). Site specific analyses that refine erosion boundaries based on more detailed site information should be expected by District regulatory staff.

4. Severe Zone. Some active channel and bar areas are minor (small avulsion locations?) which may be pushing the extent to somewhat unrealistic distances when the minimum distance is measured from these locations in the overbank area. Could the minimum distance be applied only to the main channel?

   JEF Response. *Our interpretation of the historical and geologic record is that severe erosion can occur along the avulsive channel paths, particularly those where an incipient avulsive flow path already exists. Our description of the Severe EHZ was revised to include this interpretation.*

5. Severe Zone. Some locations appear to be more impacted by avulsive or high velocity overbank flows. Since these locations may not be impacted by bank retreat would they be better classified in the lateral migration zone? If the avulsion hazard is more severe on the Hassayampa River that the consultant feels it needs to belong in the severe category, please include discussion in the severe category stating that the zone contains both bank retreat and avulsion channel changes.

   JEF Response. *See reponse to #4 above.*

6. Lateral Migration. Some locations along the lateral migration zone appear to be excessive. A majority of the delineation actually lies outside of the floodplain. In these locations it is questionable as to whether planning and development would even look to see if erosion should be a problem. Although the geomorphology indicates that there is high erosion potential, is it appropriate to base the zone's extent on maximum changes in the whole reach?

   JEF Response. *We met with the reviewer to discuss specific locations of concern and mutually agreed to any revisions. The rationale for placing the zone as delineated is explained more fully in the text, but is reiterated here to justify our response. First, the maximum observed change is only one of several factors on which the delineation is based. Second, our experience has taught us that unless there is a physical constraint or difference (different geology, structural measures, altered hydrology, etc), the observed maximum change is an excellent proxy for the <u>minimum</u> expected change, especially where the observational period of record does not include a flood near the magnitude of the design flood. Third, given the severe consequence of error in erosion hazard delineation, and the uncertainty associated with predicting long-term river behavior, some level of conservatism is warranted. Finally, limiting the predicted erosion to the maximum observed change in only that reach fails to recognize the continuity of the river system, creates questions about reach definition, and omits useful information that can be obtained by observing not only adjacent stream reaches, but also adjacent river systems.*

7. Long Term. Limited review was performed as this is just an informational zone for the District. No concerns were identified.

   JEF Response. *No response needed.*

8. Jackrabbit Wash Erosion Zone. Appears reasonable. Limited Level 3 identifying the boundary between the Holocene and Pleistocene geologic units was performed.

   JEF Response. *No response needed.*

9. Specific locations. Attached is a shape file (ehzquest.shp) containing points in general locations where the erosion zones seemed excessive. Points 1-16 are locations where the severe zone appeared excessive with the exception of point 7 which appeared under conservative (does not appear to be set 511 feet back). Points with no identification numbers refer to general locations where the lateral migration zone appears excessive. A comment column is partially filled out in the shape file as well. Time constraints limited my ability to present my comments in my standard form.

   JEF Response. We met with the District review, examined each of the points in question, and agreed upon revisions or more detailed explanations justifying the original line placement. We offer the following responses for each numbered point in the GIS file:

   - *FID #16. EHZ line placement based on high depth-velocity zones. Text will be added to Chapter 6 describing the approach, and distinguishing tributary terraces and tributary delta terraces.*
   - *FID #0. Descriptive text will be added to the GIS data table.*
   - *FID #9. Recommendations for development guidelines will be added to Chapter 8 for this are of wide LHEHZ.*
   - *FID #5, 11, 21, 22, & 23 will be revised per the reviewer comments.*
   - *FID #1, 2, 3, 7, 8, 9, 12, 13, 14, 15, 19, 20, 24, 25, 27, 28. Discussed and resolved.*

<u>Chapter 7</u>

1. No comments.

   JEF Response. No response needed.

<u>Chapter 8</u>

1. No comments.

   JEF Response. No response needed.

<u>Chapter 9</u>

1. No comments.

   JEF Response. No response needed.

<u>Chapter 10</u>

1. No comments.

   JEF Response. No response needed.

<u>Appendices</u>

1. No appendices were provided for my review. Please make sure all pertinent information is included in the appendices for the final report

JEF Response. Appendixes will included in the final draft of the report.

Digital Data

1. Please provide all shape files used to develop data for the River Behavior Report, including geomorphic units for each year of analysis.

JEF Response. The requested shape files will be provided.

Typographical Errors and Misc.

JEF Response. All typographic errors noted have been corrected.

1. Page 2-98, last paragraph – Please correct "Sediment Trent Analysis" with "Sediment Trend Analysis".

2. Page 3-11 – In the text describing the geomorphic units it states that seven units were interpreted. Only six are included in the bullet list. IT appears that Tributary Deposits are the unit missing from the list.

3. Page 3-12, 3.3.3.2 end of paragraph – Please correct "with minor gravels, somewhat usually". Should it be "somewhat" or "usually"?

4. Page 3-15 – Is anything supposed to be on this blank page?

5. Page 3-17 – Soil Pit Analyses. Presently it appears that two outline numbers are provided. Please correct.

6. Page 3-25, Results – The first sentence still contains placeholder information for the exhibits and appendices please make sure the correct exhibit and appendix references are applied for the final report.

7. Page 3-68 Hey Equation – In the current text there is a Microsoft Word text stating a reference is missing. Please correct for final report.

8. Page 6-20, 6.5.1.3 Geomorphic Mapping – In the second paragraph please correct "were made to distinguish are at imminent risk…" with were made to distinguish areas at imminent risk…"

December 29, 2005 Review Memorandum for Chapter 4 (Waskowsky)

1. On Page 4-1, it is indicated that the City of Tucson's manual was used to estimate scour. However, in the scope of work (page 23 of 30; section 9.5.1) this manual was not listed as one of the references that should be used. Rather, the consultant should cite and use ADWR's "Design Manual for Engineering Analysis of Fluvial Systems"

(March, 1985). Also, the total scour equation does not list long-term scour as one of the components. Please correct this mistake. Please also compute the long-term scour depth and add it to the total scour depth. The long-term scour may be from HEC-6.

JEF Response. After discussion with District staff, JEF agreed to use the ADWR scour equations because District staff felt so strongly that use of the ADWR equations was essential. However, we note for the record that scope item 9.5.1.2 reads "Scour depths. The long-term and general scour depth shall be estimated using appropriate methodologies to be determined by the consultant." Given the quoted description, despite language identifying the ADWR Manual as well as other manuals in a previous paragraph, we believe we were justified in using the COT equations. Our reasons for preferring the COT Manual include the following: (1) The City of Tucson Manual was written more recently by the same authors that prepared ADWR Manual and uses essentially the same equations as those outlined in the earlier ADWR Manual. The differences in methodologies include the safety factor (specified by COT, subjective for ADWR, but the District mandates the same value as COT), the general scour equation (which was shown to be insignificant by HEC-6 modeling and the COT equations; ADWR uses a contraction scour equation for general scour, which is difficult to apply on a reach basis), and the long-term scour (which is included in the ADWR equation, but not the COT equation). The bend scour, thalweg depth, antidune scour, and local scour elements are equivalent, particularly given the agreed upon bend angle to be used. (2) The City of Tucson scour method was previously accepted for use by the District on watercourse master plan studies and other river mechanics studies, and is the methodology presented at the recent scour training seminars presented by AFMA at the District. (3) The objective of the scour analysis is not site design, but rather the assessment of regional trends. The effort involved with making the slight change in methodology did not cause any substantive change to the results, and certainly did not change any of the overall conclusions of the study. (4) Pat Quinn, a JEF employee, was one of the co-authors of the ADWR Manual and was ADWR's project manager for developing the ADWR Manual. Pat has no strong preference between the ADWR and COT equations.

Long-term scour is computed elsewhere in Chapter 4, and was not neglected in the scour analysis. The conclusion in Chapter 4, based on a variety of methodologies including HEC-6 modeling, indicates that no significant long-term scour has occurred in the period of record, and that either no long-term scour, insignificant long-term scour, or aggradation is expected. Therefore, a value of zero was added to the scour equation table in Chapter 4.

2. In section 4.3 – Equilibrium Slope, four equations (AMAFCA, BUREC, Bray, and Henderson equations) are used to estimate the equilibrium slope. Please do not use these equations since three of them are not applicable to this study, and AMAFCA's equation is originally from ADWR. Please do not use AMAFCA's simplified equation. Instead, follow the example given on pages 5.79-5.82 of ADWR's "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985) for calculating the equilibrium slope iteratively. Also, check if supply reach is in equilibrium

JEF Response. We deleted reference to the Bray, Henderson, and BUREC equations since, as noted by the District reviewer, the former two were developed for gravel bed streams and appear to predict slopes too flat for the sand-bed Hassayampa River. We also deleted references to the BUREC equation at the direction of the District, although we note that given its formulation, we see no explicit reason why the BUREC equation would not be applicable to the study reach. Simply deleting results because the results *are anomalous or unexpected is not good science. We prefer to report the results, consider the potential ramifications, and use judgment to select the most reasonable course of action.*

We also note the following to explain why we chose the methodologies we used: (1) The simplified AMAFCA equation applies to the characteristics of the study reach (wide, sand bed, transport limited streams, subcritical) and its use is therefore justified. (2) Experienced gained performing stability assessments on more than 300 rivers in seven arid-west states leads us to recognize the failure of any one equation to work in every situation, as well as the value of considering a range of results. Outliers and trends can be assessed more readily by examining a range of results than by a single data point obtained by applying a single methodology. (3) Examination of the original publications and documentation for the various equilibrium slope equations reveals that none are precise, providing at best something better than order-of-magnitude results, or the expected direction of change. Reliance on a single equation is not prudent. (4) The historical topographic data, field observations, slope profile analysis, and HEC-6 modeling all indicate that the existing condition is at or near equilibrium. No equilibrium slope adjustment is expected, particularly since the watershed has been relatively undisturbed (recall that this is an existing conditions assessment). (5) Scope item 9.5.4 reads "Equlibrium slope. Equilibrium slope shall be estimated using appropriate methodologies to be determined by the consultant and approved by the District." The language seems to imply that we would have some say in the methodologies used. (6) The equilibrium slope equations used were those used in the previous watercourse master plan studies all of which have been previously approved of by District staff.

We note the following with respect to the ADWR iterative methodology: (1) There is no scope requirement to use the ADWR iterative method. (2) The ADWR manual provides a simplified equation, applicable to wide channels (W/D > 10), using coefficients from Table 5.6a. (3) The ADWR Manual notes that no equilibrium slope analysis is warranted if historical data show that the reach is at or near equilibrium and the watershed is relatively undisturbed such that sediment supply is not changed (See Eq'n 5.11), which is the case for existing conditions in the study reach. (4) The ADWR Manual notes that a slope adjustment is not likely if the Manning's n, sediment supply, discharge, and channel geometry are unchanged, as is the case for the LHWCMP. The method recommended by the District is more appropriate for the future conditions assessment that will be part of the Phase 2 of the LHWCMP.

Other practical limitations inhibit use of the ADWR method. First, as shown in the HEC-6 results, transport capacity varies between cross sections due primarily to significant changes in channel geometry. Therefore, some averaging of hydraulic characteristics is required which inevitably dilutes the results. Second, the District did not authorize the task in which bankfull capacity would be estimated (neglecting the difficulty of estimating bankfull discharge on ephemeral braided stream systems). Third, no measured sediment rating curve data are available from which to derive the required coefficients. Fourth, the ADWR iterative method assumes sediment deficit or surplus will be met by slope adjustments, rather than width adjustments (historical data contract this assumption). Therefore, it will overpredict slope change if the channel has freedom to adjust laterally. Fifth, the ADWR method uses reach-averaged hydraulic variables – so either we iterate slope by cross section (several hundred iterations needed) or average variables by reach. Sixth, there are no real pivot points from which to project slope adjustments. Seventh, as noted in the ADWR Manual, "Due to complex interaction of variables, simplifying assumptions, the results can be very subjective and only useful in qualitative sense."

Nevertheless, the report and methodology was modified as requested by the District reviewer.

3. On Page 4-2, the antidune trough depth is shown to be calculated with $Z_a = 0.0137*V_m^2$ and $½Z_a$ is added to the total scour. This is incorrect. In the ADWR manual (1985) the crest-to-trough depth is calculated with $Z_a = 0.027* V_m^2$ (formula 4.25 on page 4.24) and $½Z_a$ is added to the total scour. Please correct the formulas to be consistent with the ADWR manual. Also, the spreadsheet provided by the consultants has errors in antidune scour. The formula used is $Z_a = 0.137*V_m^2$. Rather, the formula should be $Z_a = 0.027* V_m^2$, and the "if statement" in the spreadsheet should not be used. Please correct the antidune formula in all spreadsheets (Scour-2yr, 10yr, 50yr, 100yr, and FDS). In the report (first sentence after the antidune formula on page 4-2), it indicates that the anti-dune trough depth is limited to a maximum of ½ the flow depth. Please remove this sentence.

   *JEF Response. The equation shows the ½ factor applied twice (0.0137 = ½ * 0.027). The equation will be revised in the text of the report and the spreadsheet will be corrected.*

   The ADWR Manual in fact states that the antidune trough depth is in fact limited to a maximum of ½ the flow depth (See p. 7.32, 3rd paragraph).

4. The 100-year peak flows used in the consultants' spreadsheet are different from those in WEST Consultants' 100-year HEC-RAS model. Please clarify and correct the differences. Also the scour results of FDS and 100-year are reported in the report. Is FDS based on the 1988 FEMA flow rates? Please clarify the peak flows for FDS and the 100-year flood. On page 4-7, the first paragraph discusses the flow rates for 2-, 10-, and 100-year peaks, but Table 4-2 lists the results for 2-, 10-, 50-, 100-year peaks and FDS.

   JEF Response. The District has not rendered a final decision on peak discharges for the Hassayampa River. District staff previously agreed that both the FDS 100-year and peak discharges described in the Hydrology Report would be used to bracket the range of possible values. An explanation to this affect will be added to the report. The 50-year results will be removed from Table 4-2, since they are not required by the scope of services.

   Differences between WEST HEC-RAS modeling and JEF HEC-RAS modeling were discussed repeatedly at LHWCMP team meetings, as were differences between FDS and 100-year discharge estimates. This issue is also addressed in the Hydrology Report.

5. The estimated thalweg scour was assumed to be 1 foot. Was this estimate based on field visits? Please submit any documentations such as field visit photos showing the low flow channel depth.

   JEF Response. As indicated in the ADWR Manual (Section 5.3.13), thalweg "scour" is more of a concern for constructed channels, rather than natural channels. In the past, we have argued that no thalweg component should be used in the scour equations for natural channels. However, District reviewers have ***mandated*** *that we use a thalweg depth of at least one foot, regardless of field observations. The ADWR Manual uses one to two feet as a rule of thumb where field data are lacking. The reviewer is directed to Chapters 2 and 3 for field documentation of existing channel conditions.*

A statement regarding the sources of the one foot estimate will be added to the text.

6. While it is true that local scour only acts at certain locations (i.e. the I-10 bridges, Union Pacific bridge and the old US 80 bridge), at these locations the scour can be significant. Please compute local scour estimates at these locations using HEC-18 (Richardson and Davis, 2001). Please estimate the scour hole dimensions to determine the scour impact on banks for total scour computation. Also, show the scour in the reach using RAS river stations.

   JEF Response. It is my recollection from the scoping meetings and from early discussions with the original District reviewers that new bridge scour analyses would not be required. Nevertheless, we will compute local scour using the WEST HEC-RAS or existing bridge scour reports. Computation of scour hole dimensions is not authorized by our scope of work. We would be happy to complete additional analyses when authorized (and funded) by the District.

   The Old US 80 Bridge is now fully lined by CSA. As such local scour is not at issue. Furthermore, we note that the entire scour analysis (Task 9.5.1: single event, long-term, local) was scoped for a total of 32 hours for the entire 28 mile study reach (1.1 hrs/mile). The District's expectations for the level of detailed scour analysis should be tempered in light of the funding the District was willing to authorize. Finally, it is noted with respect to comment #6 and other scour related comments that the objective of the scour analyses was to assess potential existing condition bed elevation changes, not to prepare design information for future channelization (a possible Phase 2 activity). Determination of whether a bridge is scour critical may fit within the scoped objective, but evaluation of scour hole geometry does not.

7. On page 4-4, bend scour was calculated from a reach-averaged bend angle and applied over a whole reach. Please compute the bend scour without using the "reach-averaged" concept. Please follow the procedure that starts on page 5.105 of the ADWR manual. Please use Eq. 5.27 in ADWR manual to determine the distance downstream of the curvature. When the main channel is straight, the thalweg bend angle should be used for computing the bend scour. The bend scour and local scour should be applied to specific cross-sections at each of the four reaches. Please show the scour in the reach using RAS river stations.

   JEF Response. The watercourse master plan is a regional, rather than a site-specific study. Thus, the bend scour was computed on a reach basis to identify trends rather than design criteria for specific locations, and follows the procedures used in previous watercourse master plans. Applying the ADWR bend scour equations in the manner suggested would lead to under-design of toe-down at any point where the future river channel alignment changed from a straight to sinuous, as is predicted. Application of the bend scour (depth plus scour hole length) at each bend of the 28-mile study reach would be an effort that far exceeds the authorized 32 hours.

   At the District comment resolution meeting, it was decided to use a bend angle of 60° to achieve the maximum bend scour depth given in the COT Manual bend scour formula. The District also identified a concern that the scour results table might be used by unknown parties in the future to obtain design scour depths. Therefore, a note will be added to the scour results table and the relevant text indicating that the results are not to be used for design purposes.

8. On page 4-4, it is indicated that a practical rule of thumb for estimating the maximum long-term scour is to measure the height of the floodplain above the channel bottom. What is the reference and validity of this rule?

   JEF Response. The rule of thumb is a matter of common sense and field experience, rather than a published rule. Its validity is based on engineering judgment derived from 20 plus years of river studies on more than 300 streams in Arizona. The concept is that the depth of the channel below the surrounding floodplain (or modern terraces) is a record of the (maximum, net) long-term scour that has occurred in recent geologic time. We find this rule of thumb to be a practical reality check on other numerical and historical methods. Interestingly, the ADWR Manual reports a similar conclusion (scour limited by stable bank height) on page 5.79.

9. On page 4-7, the equilibrium slope equation has an error (i.e. the n/1.49 term should be raised to the power of 2). Please compare equation 5.11 on page 5.75 of the ADWR manual.

   JEF Response. The typographic error was corrected.

10. In section 4.6, the data derived from the USGS quadrangles does not have enough precision to give accurate estimates of scour. Please leave this data off of the plots of the cross-sections.

    JEF Response. The scope calls for consideration of historical topographic data. There are only a few sources of historical topographic data. While we agree with the District that the USGS data lacks the precision of the more recent data sets, we believe that some historical trends can be elucidated by consideration of the USGS data, as explained in our analysis. Furthermore, it is our preference to include all data and explain discrepancies in the text, rather than to exclude data that does not fit the pre-conceived notion of how it should look.

11. On page 4-10, nu (ν) is the kinematic viscosity and its units are [ft^2/sec]. The report incorrectly indicates nu to be kinematic velocity with a wrong unit.

    JEF Response. The typographic error was corrected.

12. In the cross-sectional stable slope spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS), the equation for Tc in Lane's Tractive Force method is wrong. It uses 10^(1*logD50 – 1.79755) to calculate Tc, but this does not match the curve (Figure 4) in the BUREC manual (Pemberton and Lara, 1984). Please correct this mistake.

    JEF Response. We checked the spreadsheet and found that the equation correctly predicts the values intended from a specific curve on Figure 4 of Pemberton & Lara. Regardless, the results make no difference to the overall conclusion that with zero sediment inflow, slope reduction (degradation) is expected.

13. In the spreadsheet (Stableslope-Summary), the reach-averaged value for the Shields method uses Lane's results (column 14) from the cross-sectional stable slope

spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS). The correct column is column 12. Also, in the same spreadsheet (Stableslope-Summary), the Lane's value uses the Shields value (column 12) from the cross-sectional stable slope spreadsheets. The correct column is column 14. Please correct the mistakes in the spreadsheet even though the final average stable slope of four methods does not change.

JEF Response. The spreadsheet was corrected.

14. Please submit a GIS line shape file for the five reaches.

JEF Response. GIS shape files were submitted previously.

15. The second sentence in second paragraph on page 4-12 indicates that the equilibrium slope equations predict long-term degradation. This is based on the average slope of simplified AMAFCA, Bray, Henderson, and BUREC equations. As indicated earlier in this review comment document, Bray, Henderson, and BUREC equations are not applicable to this study and should not be used. The simplified AMAFCA method should not be used. Instead, the ADWR iterative method should be used. Please make changes to this sentence accordingly after the ADWR method is used to compute the equilibrium slope.

JEF Response. See response to comment #2.

January 23, 2006 Review Memorandum for Chapters 5, 7, & 8

1. Figure 5-2 indicates the mean daily discharges used in the HEC6 modeling. I have tried running several of the models and they take considerable time to run. How necessary is it to run all the mean discharges in the model? There are many flows that seem insignificant from a sediment transport standpoint. Can the flows be cut back to include only those flows above a certain threshold, say the channel forming discharge?

   JEF Response. Flows selected for modeling were dictated to JEF by District staff. The reviewer may wish to review literature regarding effective discharge computations relative to flow duration. Selection of only flows above bankfull would miss much of the effective sediment transport. The spreadsheet based analysis indicated that most of the sediment volume is moved at flows less than 500 cfs. However, to shorten the run time, we increased the time step and eliminated flows below 500 cfs (rather than 100 cfs) and found that tThe HEC-6 model results were not significantly different.

2. Section 5.3.1.2 discusses scaling of the HEC-1 model results to the peak discharges established by FEMA in the effective FIS for each tributary. The consultant should discuss the scaling procedure in more detail for the reader and explain why the scaling was done. Are the FEMA effective discharges that much different from the LHWCMP produced hydrology for the washes?

JEF Response. An explanation was added to the text. The tributary and main stem hydrology is discussed in detail in the Hydrology Report, which was previously approved by the District. Basically, the HEC-1 hydrograph ordinates were adjusted by the ratio of the peak relative to the FDS peak discharge.

3. Section 5.3.1.3 discusses the leveed reach and how flows are taken out of the system. It was determined that 3 flow changes in Reach 1 were sufficient to model the flow changes. Figure 5-4 appears to indicate that for the 75,000 cfs flow there are four flow change locations as is indicated by four flow plateaus. I do not know which is correct or if I am interpreting the figure incorrectly. Perhaps additional graphics or explanation in the section will clarify this situation for the reader.

   JEF Response. The report text will be clarified. Three flow changes is equivalent to four flow rates (i.e., n - 1=3).

4. Figure 5-5. Is this the final sediment inflow rating curve for the Hassayampa River or one of the tributaries? The caption for figure 5-5 should be described as saying this is the curve for the Hassayampa River.

   JEF Response. The figure caption and report text will be clarified.

5. Section 5.4.1, page 5-7. The consultant should remove the statement "If this assumption is valid." The previous sentence states the assumption in this technique. The validity of this assumption shouldn't be called into question any more that it has been by the previous statement.

   JEF Response. The sentence does not call the assumption into question, it is merely a transitional phrase linking the two sentences. We will try to find a different phrasing that is less confusing.

6. Section 5.4.1, page 5-7. Why were the flow rates of 500 to 80,000 cfs chosen for incoming sediment load development? Consultant should elaborate as to why these were chosen.

   JEF Response. The report text will be elaborated as requested. Flows from 500 cfs to 80,000 cfs cover the range of discharges modeled.

7. Sections 5.4.2 and 5.4.3, pages 5-7 and 5-8. What flow rates were used for incoming sediment load development for Jackrabbit and Wagner Washes? Consultant should list those flows and describe why they were used for load development.

   JEF Response. The report text will be clarified, and will include a list of incoming flows.

8. Table 5-3 on page 5-16 is supposed to summarize the base modeling results as well as the results from modeling scenarios #1 and #2 as is described in the middle paragraph on page 5-15. Table 5-3 should either be improved, discussed in more detail or another table made which reflects the results on the inflow calibration and the n value calibration.

JEF Response. Table 5-3 presents the base modeling results while sections 5.5.3.1 and 5.5.3.2 discuss Modeling Scenarios #1 and #2. The text will be improved and discussed in more detail.

9. The column titled "04-88 Difference" in table 5-3 should be labeled "04-87 Difference" since that is the basis of your comparison.

   JEF Response. The text was changed as requested.

10. It appears in reading section 5.5.3 of the report that model calibration was performed using the 1987 FDS model for scenarios 1 to 3 and that scenario 4 used the 2004 WEST HEC-RAS model for base model development. Was the basis for the calibration in scenarios 1 to 3 to try to obtain the 2004 profile or channel geometry by systematically changing the modeling parameters for the 1987 FDS model? I am reading the words "improve the forecast of the 2004 channel topography". Please describe in more clear words the purpose of the model calibration.

    JEF Response. The report text will be clarified.

11. Figure 5-11 on page 5-20 indicates two bed change profiles, one with the 10 year discharge and one with the 50 year discharge. The text on page 5-19 that describes this figure does not mention anything about what the figure 5-11 is depicting. Consultant should describe the scenarios the figure is showing.

    JEF Response. The report text will be clarified and Figure 5-11 will be discussed.

12. Section 5.5.4, page 5-24. The modeling results should reference a profile plot of the Hassayampa River for the thalweg elevation or the average bed surface elevation showing the initial bed profile and the ending bed profile. This should help in discussing the modeling results.

    JEF Response. A profile plot will be added to the report. The predicted changes are too small to be seen on any reasonably sized plot, so a discussion of differences will be added to the text.

13. Somewhere in the report a table and explanation to go along with it should be provided describing the total sediment load that has passed through the system at the end of the USGS mean flow data and at the end of the entire hydrologic modeling sequence. This should be done for the base model.

    JEF Response. A table of total sediment load will be added to the report.

14. Consultant should also provide a 100 year model and describe those results via a bed profile graph and discuss the total sediment load passing through the system.

    JEF Response. JEF specifically recommended that such a model be one of the scenarios considered and the District staff specifically mandated that we not. The modeling scenarios used were previously approved in advance by District staff.

15. Section 5.6.1.1, page 5-24. A figure or set of figures should be provided that show the 10 reaches used in this analysis.

    JEF Response. A figure showing the reaches will be provided.

16. Section 5.6.1.1, page 5-24. A figure should be provided showing the 100 year hydrograph and its discretization. Also, the peak flow rate of 75,000 cfs does not match the peak flow of 57,000 cfs provided in figure 5.3 of the report.

    JEF Response. A figure showing the discretization will be provided.

17. Tables 5-4 and 5-5 have numerous errors in the "total" boxes for several reaches.

    JEF Response. Tables 5-4 and 5-5 will be edited. The "errors" are due to rounding and the number of significant figures used.

18. Section 5.6.2, page 5-27. The consultant should define the safe yield term as used by ADOT.

    JEF Response. A definition of safe yield will be provided. Safe yield is a term used in the District's scope of work (9.6.8). The concept of safe yield is that the amount of aggrading sediment (the "excess") can be removed from a stream without adverse impact. Frankly, I don't believe that any significant amount of sediment can be removed from the stream system without a consequent adjustment of morphology. Further, unless there has been a disturbance to the system, there can be no such thing as excess sediment, as the stream will have adjusted to the sediment supply in some manner. A change in sediment supply must have some consequent impact, if there is sufficient runoff to enter and exit the reach.

19. Section 7.1.2, page 7-3. The reaches as labeled in this section are backwards from the reaches that are described in section 5.6 of the report. Reach 1 in section 7.1.2 is closest to the Gila River and reach 10 in section 5.6 is closest to the Gila River. Consistency should be maintained throughout the report.

    JEF Response. The labeling will be reversed to be consistent. However, note that the number of reaches selected for the sediment continuity analysis is based on hydraulic characteristics. The number of reaches used in the geomorphic and planning analysis reflected the intent and data of those evaluations, and included geographic features, sources of sediment supply (tributaries), political boundaries, and other non-engineering concerns.

20. Section 7.1.5, page 7-4. Generally, how deep is the non-scoured layer below the river thalweg?

    JEF Response. The non-scouring layer observed in the active aggregate excavations was generally greater than 10 feet below the existing bed elevation. A statement to this affect will be added to the report.

The following comments pertain to the HEC6 modeling done in support of this project.

21. How was the 1 cfs incoming load rate developed for the Hassayampa River? I don't see it in any of the recirculation models.

    JEF Response. 1 cfs was added to cover the range of flows from almost 0 cfs. No inflowing sediment load is expected at 1 cfs, so it is set as 0 tons/day. Text will be revised to explain this.

22. The total load for 2,000 cfs should be 2365 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

23. The total load for 5,000 cfs should be 6730 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed

24. The total load for 20,000 cfs should be 92885 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

25. The total load for 50,000 cfs should be 302446 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

26. The total load for 80,000 cfs should be 666546 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

27. All models should be commented with the following information: project name, consultant who did the work, the date of the model, and an explanation of what the model is modeling. Also include comments for the different incoming sediment loads by tributary name (Jackrabbit, Hassayampa above study area, and Daggs/Wagner). Comment the flows used in the Q records by stating the start of the USGS mean flow data, end of the USGS mean flow data, start of the 100 year data and the end of the 100 year data.

    JEF Response. Comment records will be added to the HEC-6 models.

28. The readme.txt file did not include a definition for the basetrib model. Only upon opening it did I discover that it includes the sediment inflow for Daggs/Wagner Wash and Jackrabbit Wash. The readme.txt file should be updated to include a description of this model.

JEF Response. The readme.txt file will be updated as requested.

29. What will be the true base conditions model that will be used for alternative modeling and dissemination to the public for sand and gravel projects?

    JEF Response. The scenario #4 model would be most appropriate for alternative modeling. I believe the report indicates that HEC-6 modeling of individual sand and gravel projects is not the best approach.

30. The Wagner/Daggs Wash sediment inflow for 1000 cfs used the "Sediment Inflow at the upstream boundary" instead of using the "Sediment outflow at the downstream boundary".

    JEF Response. The value will be changed.

31. Same as comment #30 except for 2000 cfs.

    JEF Response. The value will be changed.

32. The Wagner/Daggs Wash 4000 cfs total load should be 3494 tons/day. Load fraction is ok.

    JEF Response. The value will be changed.

33. The Wagner/Daggs Wash 6000 cfs total load should be 12972 tons/day. Load fraction is ok.

    JEF Response. The value will be changed.

34. The Wagner/Daggs Wash 8000 cfs total load should be 23077 tons/day. Load fraction is ok.

    JEF Response. The value will be changed.

35. The rating curve provided in the model is off by 5000 cfs. For every elevation given the flow rate is 5000 cfs higher than it should be. Either field 4 or field 5 on the RC record is incorrectly input.

    JEF Response. The rating curve will be changed to start from 0 cfs to be more clear. The values were entered correctly, but used a starting discharge of 5,000 cfs.

36. The models as well as the report should mention that only flows above 100 cfs where used from the USGS mean daily flow data.

    JEF Response. A comment record will be added to the HEC-6 model input file. The model was changed in response to comment #1 to include flows above 500 cfs.

37. Why does each particular set of hydrologic data begin and end with 15,000 cfs and 32,200 cfs?

JEF Response. The values represent the 10-year and 50-year flows and are used to obtain HEC-6 outputs with the average bed elevation with these two flows run for a very small duration. The text will be changed to explain this.

38. The FCD needs more data to validate the minus flow records provided in the hydrologic data set. This may include more explanation in Section 5.3.1.3 of the report, the HEC-RAS model used to develop the incoming/outgoing relationship, the curve used to develop the flow relationship or any other data that would be useful for hydrologic data evaluation and validation. For example, event # 1675 which should be the peak flow rate for the 100 year hydrograph has the following flow rate sequence:

    EVENT #1675
    Q 35802 -28816 -10820 -10362 23500 7500

    Examination of Table SB-2 for this event gives flow rates that are higher than the hydraulic flow rates identified in Table 3-1 for section 3 of the hydraulic report. Cross sections 4 through 15.11 in Table SB-2 have a flow rate of 85,800 cfs while the same cross sections in Table 3-1 from the hydraulic report have flow rates in the vicinity of 74,000 to 75,000 cfs.

    JEF Response. The 100-year hydrographs shown in Figure 5 3 were obtained by scaling the hydrographs from the HEC-1 hydrology model to the FIS peak flows. In other words, the shapes of the hydrographs were obtained from the hydrologic modeling (see LHWCMP Hydrology report) and were scaled to give peak flows that matched the FIS study peak flows. This matching was done for the upstream Hassayampa River, Wagner-Daggs Wash tributary system and the Jackrabbit Wash. The flow hydrograph at the downstream end of the HEC-6 model near the Gila River was obtained by adding these three hydrographs. This was done because the HEC-6 model does not have the capability to attenuate the hydrograph as flow goes downstream. The downstream hydrograph obtained through summation of upstream hydrographs results in a hydrograph with peak flows that are higher than the attenuated hydrograph. This approach was adopted as it represents more conservative approach with respect to sedimentation results.

    The text will be changed to explain this.

The following comments are in regards to the QuickSedTrans excel spreadsheet.

39. The Meyer-Peter-Mueller equation (1948) is based on the Metric System. Equation was coded as English units. Input parameters should be converted to metric and results converted back to English. Or you can use English unit equations converted by the Bureau of Reclamation (Simons and Senturk, 1992).

    JEF Response. The methodology presently used is based on the procedure in HEC-RAS hydraulics reference manual. As per the recommendation, the methodology will be changed to use the original equation as presented in the ASCE Manual 54.

40. In the Toffaleti Sub routine of the VBA code the following sequence was observed:

```
If (zom< (1.5*zv)) then
        Zom= 1.5*zv
        End If
```

It should be coded:

```
        If (zom < zv) then
                Zom =1.5*zv
        End If
```

JEF Response. The above code is based on the HEC-6 source code and source code in Yang's "Sediment Transport, Theory and Practice". It appears that both these codes may be in error. The code will be changed as per recommendation.

41. In Toffaleti subroutine Mi was coded as: Mi=f4 * gssLi / (yaf4 – ddf4). It should have been coded: Mi=f4 *gssLi / (yaf4 –ddf4) *f4. Multiplication by f4 was not included in the code.

*JEF Response. The code is based on Eq. 6.29 in Yang's "Sediment Transport, Theory and Practice" and 2.236j in ASCE Manual 54. f4 is same as η_3. ya = D/11.24, yaf4 = ya^f4, dd = 2*di, ddf4=dd^f4, gssLi is same as q_{sLi}. The code appears correct.*

42. A reference should be given for the friction factor equation coded as the following:

```
Friction_factor = (2.82843 / (bcoeff – 3.75 + 2.5 * Log (2# * (flow_depth_in_ft / d90)))) ^ 2#
```

JEF Response. A reference will be added to the spreadsheet code.

43. In the fifth to last line in the code a conversion was used. That conversion number should be 86400 instead of the coded 84600.

JEF Response. The value will be changed in the code.

44. Please review your code because we found a few errors after our review. Please put detailed comments in the code such as reference, equation numbers in the reference and variable definitions. We know you used ASCE Manual 54, but you need to put reference in code and chapter 5 of the report.

JEF Response. Reference codes will be added. We assume that the errors found "after your review" are reported in the review memoranda.

The following comments are in reference to the Pit Scour-100yr Excel file.

45. The 100 year hydrograph shown on the worksheet "short term method inputs" does not match the DT interval and flow from the headcut and tailcut computations. Cumulative time was used in the computations instead of using interval time in the computations. This will affect the results of the computations. Worksheets should be redone using interval time.

    JEF Response. The input data describing the hydrograph had cumulative time instead of time-interval. The input data in the worksheet will be changed.

46. How was Tf calculated or why was the flow rate of 1,650 cfs used for the filling flow rate for the given pit volume of 24,000,000 cubic feet? Please explain why 1,650 cfs was chosen.

    JEF Response. The duration to the fill the pit is computed by comparing the flow volume and pit volume. Tf is determined as when the total flow volume equals or exceeds the pit volume.

47. The worksheet for the "short term headcut-sand" has Wc = 2.6 * DT ^0.43. Wc should be equal to 2.6 * Q ^0.43. Calculations should be redone using Q raised to the appropriate power.

    JEF Response. The spreadsheet will be changed.

48. Because of the previous comment the remaining columns or variables are incorrect in the "short term headcut-sand" worksheet.

    JEF Response. The remaining columns will be changed automatically in the spreadsheet when review comment #47 is addressed.

49. In the "short term-tailcut" worksheet dimensionless time Tstar should not be cumulative. It should be computed for each time step.

    JEF Response. The value will be fixed automatically in the spreadsheet when review comment #45 is addressed.

50. The maximum possible scour in the "short term-tailcut" worksheet uses the equation for headcut scour from Table 11.1 of the ADOT Manual "Effects of In-Stream Mining on Channel Stability, June 1989." Downstream scour should use equation 11.2 from Table 11.1.

    JEF Response. Table 11.1 provides "Sand" bed Scour equations and Table 11.2 provides "Gravel" bed scour equations. Since the sand-bed conditions are valid in this study, the equations from Table 11.1 were used.

51. The headcut scour profile in worksheet "short-term scour profiles" does not have values for Ys for each of the values of Ls. The ratio from Table 11.3 in the ADOT

manual should have been applied to the Ysmax value of 14.1 feet from "short term-headcut sand" worksheet. This would give the value Ys for each value of Ls.

JEF Response. The table will be updated.

52. Please review Excel files for the 10-year and the recent floods Excel files and amend Table 5-8 in chapter 5 of the report based upon the previous comments for the 100 year pit scour.

JEF Response. Any changes to the 100-year scenario will be tracked to the 10-year and recent flood scenarios.

The following comment is in reference to Chapter 7 – Sediment Trend Analysis.

53. Page 7-4, the third bulleted item describing the non-scouring layer in the Hassayampa River. Generally, how deep is the non-scouring layer in the river bed? Can a depth be given in the report?

JEF Response. See response to Comment #20.

The following comment is from Chapter 8 – Summary.

54. Page 8-1, section 8.1 General Recommendations. Item one recommending adoption of the lateral migration erosion hazard zones should be removed from the text of the report.

JEF Response. At the comment resolution meeting, the District review retracted this comment.

January 30, 2006 Review Memorandum for Chapter 6 (Degerness)

1. The report and the supplied spreadsheet data should reference what the baseline point was for determining the lateral migration distances and any other geomorphologic parameters. The baseline point for the study was the left bank station from the WEST floodplain study.

   JEF Response. The report text was modified as requested.

2. The Excel spreadsheet Lateral_migration, worksheet "Cumulative" alternates between the years of 1934 and 1949 when determining the bank station change for stations 0.82 to 5.87 when it appears that 1934 data is available for left bank calculations. Consultant should explain why this was done for this portion of the study.

JEF Response. There was a formula error in Lateral_migration.xls spreadsheet file, which has been corrected, along with the corresponding table and discussion in Chapter 6.

3. The Excel spreadsheet Lateral_migration, worksheet "All Data", the columns labeled "Bank Station Change 1934 –1951" should be labeled "Bank Station Change 1934-1949".

JEF Response. The heading label in Lateral_migration.xls spreadsheet file was corrected.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: March 24, 2006

TO: John Hathaway, PE/FCDMC

FROM: Jon Fuller, PE, RG, PH, CFM

RE: LHWCMP River Behavior Report
Response to District Comments

CC: File

As of March 22, 2006, we have received comments from the District on the revised draft LHWCMP River Behavior Analysis Report submitted on March 3, 2006. As of March 23rd, Kathryn Gross indicated that she would not have additional comments. District review comments were provided in the following memoranda:

- Memorandum from David Degerness, PE to John Hathaway, PE dated March 21, 2006 re. Chapters 5-8.
- Memorandum from Richard Waskowsky, Hydrologist to John Hathaway, PE dated March 21, 2006, re. Chapter 4: Channel Bed Elevation Analysis.

The District reviewers requested written responses to review comments. The District comments are provided below, with the JEF response shown in italics font immediately after each comment. I deleted the text trail on comments the District stated were resolved.

It is my understanding, based on our discussion at a comment resolution meeting on April 4, 2006, that all comments are now addressed. The final report will be submitted as soon as it can be printed.

Memorandum from David Degerness re. Chapters 5-8

The Engineering Application Development and River Mechanics Branch has finished its review and has the following comments to JEF responses. The consultant should submit written responses to these comments to the FCD.

1. Figure 5-2.
   FCD response (3/20/06). No further comment.
2. Section 5.3.1.2
   FCD Response (3/20/06). We have no further comments.
3. Section 5.3.1.3
   FCD Response (3/20/06). We have no further comments.
4. Figure 5-5.
   FCD Response (3/20/06). We have no further comments.
5. Section 5.4.1, page 5-7.
   FCD Response (3/20/06). We have no further comments.
6. Section 5.4.1, page 5-7.
   FCD Response (3/20/06). We have no further comments.
7. Sections 5.4.2 and 5.4.3, pages 5-7 and 5-8.

FCD Response (3/20/06). We have no further comments.

8. Table 5-3
   FCD Response (3/20/06). We have no further comments.
9. Table 5-3.
   FCD Response (3/20/06). We have no further comments.
10. Model.
    FCD Response (3/20/06). We have no further comments.
11. Figure 5-11.
    FCD Response (3/20/06). We have no further comments.
12. Section 5.5.4, page 5-24.
    FCD Response (3/20/06). We have no further comments.

13. Somewhere in the report a table and explanation to go along with it should be provided describing the total sediment load that has passed through the system at the end of the USGS mean flow data and at the end of the entire hydrologic modeling sequence. This should be done for the base model.

    JEF Response. A table of total sediment load will be added to the report.

    FCD Response (3/20/06). FCD acknowledges JEF response by addition of table 5-4 to report. The long term flows only value of 204 ac. ft may be in error. After 195 days of flow (event #196) we obtain 173 ac. ft from output Table SA-1. The $VOL A command should be used in the model hydrology to report sediment leaving the system at the most downstream cross section in total tons. The load through the system for the long term flows and 100 year event of 265 ac. ft obtained from Table SA-1 is fine. Consultant should investigate the load through the system for the long term flows.

    JEF Response. The table has been corrected and modified as requested.

    The table is updated. Model rerun with $VOL command.
14. 100 year model.
    FCD Response (3/20/06). We have no further comments.
15. Section 5.6.1.1
    FCD Response (3/20/06).. We have no further comments.
16. Section 5.6.1.1, page 5-24..
    FCD Response (3/20/06). We have no further comments.
17. Tables 5-4 and 5-5.
    FCD Response (3/20/06).. We have no further comments
18. Section 5.6.2, page 5-27.
    FCD Response (3/20/06). We have no further comments
19. Section 7.1.2, page 7-3.
    FCD Response (3/20/06). We have no further comments.
20. Section 7.1.5, page 7-4.

FCD Response (3/20/06). We have no further comments.

The following comments pertain to the HEC6 modeling done in support of this project.

21. Incoming load rate.
    FCD Response (3/20/06). We have no further comments
22. Load fractions.
    FCD Response (3/20/06). We have no further comments.
23. Load fractions.
    FCD Response (3/20/06). We have no further comments.
24. Load fractions.
    FCD Response (3/20/06).. We have no further comments.
25. Load fractions.
    FCD Response (3/20/06). We have no further comments.
26. Load fractions.
    FCD Response (3/20/06). We have no further comments.
27. Comment records.
    FCD Response (3/20/06). We have no further comments.

28. The readme.txt file did not include a definition for the basetrib model. Only upon opening it did I discover that it includes the sediment inflow for Daggs/Wagner Wash and Jackrabbit Wash. The readme.txt file should be updated to include a description of this model.

    JEF Response. The readme.txt file will be updated as requested.

    FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

    JEF Response. A miscommunication occurred regarding the reviewer's need for the revised models. The requested change was made to all models which will be provided on CD with the final submittal.

29. What will be the true base conditions model that will be used for alternative modeling and dissemination to the public for sand and gravel projects?

JEF Response. The scenario #4 model would be most appropriate for alternative modeling. I believe the report indicates that HEC-6 modeling of individual sand and gravel projects is not the best approach.

FCD Response (3/20/06). FCD acknowledges the JEF response. The report does not explicitly state that the base conditions model should be used for alternative modeling. If one reads the report carefully you can discern this fact due to the models insensitivity to tributary sediment inflow, etc. FCD acknowledges that HEC-6 modeling of individual sand and gravel projects is not the best approach.

JEF Response. Statements explicitly stating that the Scenario #4 model is intended for alternative modeling were added to the scenario description, to the HEC-6 summary, and to the chapter summary.

30. The Wagner/Daggs Wash sediment inflow for 1000 cfs used the "Sediment Inflow at the upstream boundary" instead of using the "Sediment outflow at the downstream boundary".

    JEF Response. The value will be changed.

    FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model. That model has zero sediment inflow for Jackrabbit and Wagner-Daggs Wash.

    JEF Response. A miscommunication occurred regarding the reviewer's need for the revised models. The requested change was made to all models which will be provided on CD with the final submittal.

31. Same as comment #30 except for 2000 cfs.

    JEF Response. The value will be changed.

    FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

    JEF Response. A miscommunication occurred regarding the reviewer's need for the revised models. The requested change was made to all models which will be provided on CD with the final submittal.

32. The Wagner/Daggs Wash 4000 cfs total load should be 3494 tons/day. Load fraction is ok.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

JEF Response. A miscommunication occurred regarding the reviewer's need for the revised models. The requested change was made to all models which will be provided on CD with the final submittal.

33. The Wagner/Daggs Wash 6000 cfs total load should be 12972 tons/day. Load fraction is ok.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

JEF Response. A miscommunication occurred regarding the reviewer's need for the revised models. The requested change was made to all models which will be provided on CD with the final submittal.

34. The Wagner/Daggs Wash 8000 cfs total load should be 23077 tons/day. Load fraction is ok.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

JEF Response. A miscommunication occurred regarding the reviewer's need for the revised models. The requested change was made to all models which will be provided on CD with the final submittal.

35. The rating curve provided in the model is off by 5000 cfs. For every elevation given the flow rate is 5000 cfs higher than it should be. Either field 4 or field 5 on the RC record is incorrectly input.

JEF Response. The rating curve will be changed to start from 0 cfs to be more clear. The values were entered correctly, but used a starting discharge of 5,000 cfs.

FCD Response (3/20/06). The rating curve supplied in the HEC-6 model is still incorrect when compared against Figure 5-7 on page 5-15 of the draft report dated February 2006.

JEF Response. The rating curve plot was not shown correctly in the previous submittal. This has been fixed.

36. Flows above 100 cfs.
    FCD Response (3/20/06). We have no further comments.
37. Hydrologic data.
    FCD Response (3/20/06). We have no further comments.

38. The FCD needs more data to validate the minus flow records provided in the hydrologic data set. This may include more explanation in Section 5.3.1.3 of the report, the HEC-RAS model used to develop the incoming/outgoing relationship, the curve used to develop the flow relationship or any other data that would be useful for hydrologic data evaluation and validation. For example, event # 1675 which should be the peak flow rate for the 100 year hydrograph has the following flow rate sequence:

    EVENT #1675
    Q 35802 -28816 -10820 -10362 23500 7500

    Examination of Table SB-2 for this event gives flow rates that are higher than the hydraulic flow rates identified in Table 3-1 for section 3 of the hydraulic report. Cross sections 4 through 15.11 in Table SB-2 have a flow rate of 85,800 cfs while the same cross sections in Table 3-1 from the hydraulic report have flow rates in the vicinity of 74,000 to 75,000 cfs.

JEF Response. The 100-year hydrographs shown in Figure 5 3 were obtained by scaling the hydrographs from the HEC-1 hydrology model to the FIS peak flows. In other words, the shapes of the hydrographs were obtained from the hydrologic modeling (see LHWCMP Hydrology report) and were scaled to give peak flows that matched the FIS study peak flows. This matching was done for the upstream Hassayampa River, Wagner-Daggs Wash tributary system and the Jackrabbit Wash. The flow hydrograph at the downstream end of the HEC-6 model near the Gila River was obtained by adding these three hydrographs. This was done because the HEC-6 model does not have the capability to attenuate the hydrograph as flow goes downstream. The downstream hydrograph obtained through summation of upstream hydrographs results in a hydrograph with peak flows that are higher than the attenuated hydrograph. This approach was adopted as it represents more conservative approach with respect to sedimentation results.

The text will be changed to explain this.

FCD Response (3/20/06). FCD acknowledges JEF response. Please add a comment in the report that indicates that the flow rate of 35802 cfs is only for the main stem levee reach (below cross-section 2.19) and it is not for the entire river. The peak flow rate below cross-section 2.19 for the entire cross-section including the main stem and overbank flows is 85800 cfs which is higher than 74100 cfs (the FEMA effective).

JEF Response. The text was changed to explain this issue.

The following comments are in reference to the Pit Scour-100yr Excel file.

39. 100 year hydrograph.
    FCD Response (3/20/06). We have no further comments.
40. Tf.
    FCD Response (3/20/06). We have no further comments.
41. Short term headcut-sand.
    FCD Response (3/20/06). We have no further comments.
42. Short term headcut-sand" worksheet.
    FCD Response (3/20/06). We have no further comments.
43. Tstar.
    FCD Response (3/20/06). We have no further comments.

44. The maximum possible scour in the "short term-tailcut" worksheet uses the equation for headcut scour from Table 11.1 of the ADOT Manual "Effects of In-Stream Mining on Channel Stability, June 1989." Downstream scour should use equation 11.2 from Table 11.1.

JEF Response. Table 11.1 provides "Sand" bed Scour equations and Table 11.2 provides "Gravel" bed scour equations. Since the sand-bed conditions are valid in this study, the equations from Table 11.1 were used.

FCD Response (3/20/06). JEF used the correct table to obtain the appropriate formulas for the sand bed condition but applied the maximum headcut scour calculation for the maximum downstream scour calculation. This is incorrect use of methodology outlined in the ADOT procedure. Because a comparison is made in the spreadsheet between Ysmax and Ys the downstream pit scour will never exceed one-half of the pit depth. This is acceptable for the headcut scour procedure according to Table 11.1 in the ADOT manual but is not acceptable for downstream scour. Downstream scour may exceed one-half of the pit depth for values of dimensionless time less than 0.84. Consultant should recalculate the downstream scour profile based upon a scour depth of 18 feet.

JEF Response. The modifications were incorporated into the spreadsheet. The results are updated in the Appendix.

45. Headcut scour profile.
    FCD Response (3/20/06). We have no further comments.
46. Excel files.
    FCD Response (3/20/06). We have no further comments.

The following comment is in reference to Chapter 7 – Sediment Trend Analysis.

47. Page 7-4, the third bulleted item
    FCD Response (3/20/06). We have no further comments.

The following comment is from Chapter 8 – Summary.

48. Page 8-1, section 8.1.
    FCD Response (3/20/06). We have no further comments.

January 30, 2006 Review Memorandum for Chapter 6 (Degerness)

1. The report and the supplied spreadsheet data should reference what the baseline point was for determining the lateral migration distances and any other geomorphologic parameters. The baseline point for the study was the left bank station from the WEST floodplain study.

JEF Response. The report text was modified as requested.

FCD Response (3/20/06). The FCD has read chapter 6 several times and we cannot locate what the baseline point is supposed to be for the measured distances. Consultant should be more specific as to where the text is located in chapter 6.

JEF Response. Oops. It's now in Section 6.2.

2. The Excel spreadsheet Lateral_migration
   FCD Response (3/20/06). We have no further comments.
3. The Excel spreadsheet Lateral_migration.
   FCD Response (3/20/06). We have no further comments.

March 21, 2006 Review Memorandum for Chapter 4

1. Scour Equations
   FCDMC Response (March 21, 2006) – Comment Resolved.
2. Equilibrium Slope
   FCDMC Response (March 21, 2006) – Comments Resolved.

3. FCDMC Comment (December 29, 2005) - On Page 4-2, the antidune trough depth is shown to be calculated with $Z_a = 0.0137*V_m^2$ and $½Z_a$ is added to the total scour. This is incorrect. In the ADWR manual (1985) the crest-to-trough depth is calculated with $Z_a = 0.027* V_m^2$ (formula 4.25 on page 4.24) and $½Z_a$ is added to the total scour. Please correct the formulas to be consistent with the ADWR manual. Also, the spreadsheet provided by the consultants has errors in antidune scour. The formula used is $Z_a = 0.137*V_m^2$. Rather, the formula should be $Z_a = 0.027* V_m^2$, and the "if statement" in the spreadsheet should not be used. Please correct the antidune formula in all spreadsheets (Scour-2yr, 10yr, 50yr, 100yr, and FDS). In the report (first sentence after the antidune formula on page 4-2), it indicates that the anti-dune trough depth is limited to a maximum of ½ the flow depth. Please remove this sentence.

*JEF Response. The equation shows the ½ factor applied twice (0.0137 = ½ * 0.027). The equation will be revised in the text of the report and the spreadsheet will be corrected.*

The ADWR Manual in fact states that the antidune trough depth is in fact limited to a maximum of ½ the flow depth (See p. 7.32, 3rd paragraph).

FCDMC Response (March 21, 2006) – We want to make sure that you are aware that you missed one decimal place in your spreadsheet. In your spreadsheet, you used 0.137 instead of 0.0137. Please check. Here is the equation in spreadsheet "Scour – FDS":

=IF(**0.137***'RAS-FDS'!$AX284^2>'RAS-FDS'!$BC284/2,'RAS-FDS'!$BC284/2,**0.137***'RAS-FDS'!$AX284^2)

JEF Response. The comment refers to the old version of the spreadsheet. A revised spreadsheet was submitted. Further discussions with the reviewer after 3/21/06 identified an error in the antidune scour equation formula which has also been corrected and the text and tables modified.

4. FCDMC Comment (December 29, 2005) - The 100-year peak flows used in the consultants' spreadsheet are different from those in WEST Consultants' 100-year HEC-RAS model. Please clarify and correct the differences. Also the scour results of FDS and 100-year are reported in the report. Is FDS based on the 1988 FEMA flow rates? Please clarify the peak flows for FDS and the 100-year flood. On page 4-7, the first paragraph discusses the flow rates for 2-, 10-, and 100-year peaks, but Table 4-2 lists the results for 2-, 10-, 50-, 100-year peaks and FDS.

JEF Response. The District has not rendered a final decision on peak discharges for the Hassayampa River. District staff previously agreed that both the FDS 100-year and peak discharges described in the Hydrology Report would be used to bracket the range of possible values. An explanation to this affect will be added to the report. The 50-year results will be removed from Table 4-2, since they are not required by the scope of services.

Differences between WEST HEC-RAS modeling and JEF HEC-RAS modeling were discussed repeatedly at LHWCMP team meetings, as were differences between FDS and 100-year discharge estimates. This issue is also addressed in the Hydrology Report.

FCDMC Response (March 21, 2006) – From an in-house FCDMC statistical analysis of peak discharges on the Lower Hassayampa River, it was determined that the peak flow is close to the 74,100 cfs which is the effective FEMA value. You were also on the email list when the District was performing such an analysis. Please use 74,100 cfs for all work in HEC-6 and scour estimation for the 100-year flow.

JEF Response. District staff previously agreed that both the FDS 100-year and peak discharges described in the Hydrology Report would be used to bracket the range of possible values. These values were used in the HEC-6 model and the scour estimates. Per direction of the District we will remove the 100-year (non-FDS) information from the report.

5. FCDMC Comment (December 29, 2005) - The estimated thalweg scour was assumed to be 1 foot. Was this estimate based on field visits? Please submit any documentations such as field visit photos showing the low flow channel depth.

JEF Response. As indicated in the ADWR Manual (Section 5.3.13), thalweg "scour" is more of a concern for constructed channels, rather than natural channels. In the past, we have argued that no thalweg component should be used in the scour equations for natural channels. However, District reviewers have mandated that we use a thalweg depth of at least one foot, regardless of field observations. The ADWR Manual uses one to two feet as a rule of thumb where field data are lacking. The reviewer is directed to Chapters 2 and 3 for field documentation of existing channel conditions.

A statement regarding the sources of the one foot estimate will be added to the text.

FCDMC Response (March 21, 2006) – Which District reviewers are being referenced? The current District reviewers or reviewers for the past projects? All that was asked was where the one foot assumption was obtained, and what was the supporting documentation. In the draft of chapter 4, there was not a reference for this assumption, and chapters 2 and 3 were not included in the packet that was to be reviewed. Please refer to Chapter 10 in the 2003 Draft Hydraulics Manual for the selection of low flow incisement.

JEF Response. It was past (not current) District reviewers who mandated use of one foot for a thalweg depth. A technical reference for the estimate was added to the report. Chapters 2 and 3 were submitted to the District for review, and comments from District reviewers were provided (see above). The one foot thalweg depth estimate we used conforms to the guidance in Chapter 10 of the District's draft Hydraulics Manual.

6. Local scour.
   FCDMC Response (March 21, 2006) – Comment Resolved.
7. Bend scour.
   FCDMC Response (March 21, 2006) – Comment Resolved.

8. FCDMC Comment (December 29, 2005) - On page 4-4, it is indicated that a practical rule of thumb for estimating the maximum long-term scour is to measure the height of the floodplain above the channel bottom. What is the reference and validity of this rule?

JEF Response. The rule of thumb is a matter of common sense and field experience, rather than a published rule. Its validity is based on engineering judgment derived from 20 plus years of river studies on more than 300 streams in Arizona. The concept is that the depth of the channel below the surrounding floodplain (or modern terraces) is a record of the (maximum, net) long-term scour that has occurred in recent geologic time. We find this rule of thumb to be a practical reality check on other numerical and historical methods. Interestingly, the ADWR Manual reports a similar conclusion (scour limited by stable bank height) on page 5.79.

FCDMC Response (March 21, 2006) – Reference to published documentation will make the report more credible. Many years experience especially those outside sediment transport engineering and fluid mechanics does not necessarily accumulate correct engineering knowledge which is beyond simple field observation. If the ADWR Manual said this on page 5.79, please refer to this documentation in your report. However, on page 5.77, the ADWR manual reads "In addition to stable bank heights being a potential control for the equilibrium slope…". This stable bank height discussion does not specifically point to the practical rule of thumb, and it would be good if a better reference was found. Therefore, we recommend removing the usage of "practical rule of thumb" especially in a technical report, or referenced with verifiable published documentation.

JEF Response. In the District's original comment, the reviewer asked for the source and validity of the rule of thumb. Our original response attempted to provide an explanation. To comply with the current review comment, I edited the text of Chapter 4 and removed the reference to the rule of thumb.

9. Equilibrium slope equation.
   FCDMC Response (March 21, 2006) – Comment resolved.
10. USGS quadrangle data.
    FCDMC Response (March 21, 2006) – Comment Resolved.
11. Page 4-10, nu (v).
    FCDMC Response (March 21, 2006) – Comment resolved.

12. FCDMC Comment (December 29, 2005) - In the cross-sectional stable slope spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS), the equation for Tc in Lane's Tractive Force method is wrong. It uses 10^(1*logD50 – 1.79755) to calculate Tc, but this does not match the curve (Figure 4) in the BUREC manual (Pemberton and Lara, 1984). Please correct this mistake.

JEF Response. We checked the spreadsheet and found that the equation correctly predicts the values intended from a specific curve on Figure 4 of Pemberton &Lara. Regardless, the results make no difference to the overall conclusion that with zero sediment inflow, slope reduction (degradation) is expected.

FCDMC Response (March 21, 2006) – The equation calculates a critical tractive force of 0.0077lb/ft^2 which is equal to 37.35 g/m^2. Reading from Figure 4 in Pemberton and Lara (1984) from the curve for "recommended values for canals with clear water" with a D_{mean} a of 0.48 mm, leads to a value of a 140 g/m^2, which is not equal to what the curve fit calculated (37.35 g/m^2). Please correct or explain the discrepancies. Regardless of the results, if there are mistakes, then they need to be corrected because in the future other people may use this equation for other purposes. Please re-verify it.

JEF Response. The equation was verified.

13. Stableslope-Summary.
    FCDMC Response (March 21, 2006) – Comment resolved.

14. FCDMC Comment (December 29, 2005) - Please submit a GIS line shape file for the five reaches.

    JEF Response. GIS shape files were submitted previously.

    FCDMC Response (March 21, 2006) – The GIS files need to be put in the CD that should come with the report.

    JEF Response. The GIS files will be on the CD.

15. Equilibrium slope.
    FCDMC Response (March 21, 2006) – Comment resolved.

The following comments are in regards to the QuickSedTrans excel spreadsheet.

16. Meyer-Peter-Mueller equation.
    FCDMC Response (March 21, 2006) –the District accepts the HEC-RAS result.
17. Toffaleti Sub routine:
    FCDMC Response (March 21, 2006) – Comment resolved.
18. Toffaleti subroutine Mi.
    FCDMC Response (March 21, 2006) – Comment resolved.
19. Friction factor equation:
    FCDMC Response (March 21, 2006) – Comment resolved.
20. Conversion number.

FCDMC Response (March 21, 2006) – Comment resolved.

21. Please review your code

FCDMC Response (March 21, 2006) – Comment resolved.

March 21, 2006; New Comments Regarding Revised Draft (sent March 2, 2006).

1. FCDMC Comment (March 21, 2006) - **In Table 4-6 on page 4-22, the "Armor v. Scour" and "Armor v. Slope" columns are somewhat confusing. Is it possible to give a more concise explanation in the discussion about the table on the previous page, or could the columns be combined into one, since they both basically indicate the same result?**

   JEF Response. The confusing columns in Table 4-6 have been deleted.

2. FCDMC Comment (March 21, 2006) - **In Table 4-6 on page 4-22, the column notes indicate that both the "Armor v. Slope" and "Armor v. Scour" columns are being compared to column one, which is the "Reach" column. It appears this actually should indicate that the columns are being compared to the "Depth to Armor" column (column 2).**

   JEF Response. The confusing columns in Table 4-6 have been deleted.

3. FCDMC Comment (March 21, 2006) - **In "Sub Toffaleti" subroutine, "If (CLi>100#) Then" should be replaced with "If (C2d>100#) Then".**

   JEF Response. The requested change was made.

PVNGS Water Reclamation Supply System (WRSS) Pipeline Right-of-Way Encroachment Request No. ________

Date: 7/22/2004

REQUESTER CONTACT: Ted Lehman
COMPANY: JE Fuller/Hydrology & Geomorphology, Inc.
ADDRESS: 8400 S. Kyrene Road, Suite 201 Tempe, AZ 85284
PHONE: (Office) 480-222-5709 (Cell) ________ (Fax) 480-839-2193
E-MAIL: ted@jefuller.com

PROPERTY OWNER / DEVELOPER CONTACT NAME: ________
COMPANY: ________
ADDRESS: ________
PHONE: (Office) ________ (Cell) ________ (Fax) ________
E-MAIL: ________

CITY and CONTACT NAME: ________
ADDRESS: ________
PHONE: (Office) ________ (Cell) ________ (Fax) ________
E-MAIL: ________

OTHER CONTACT NAME: ________
COMPANY: ________
ADDRESS: ________
PHONE: (Office) ________ (Cell) ________ (Fax) ________
E-MAIL: ________

LOCATION OF PROJECT: (Main Cross Roads, Address, Township, Range, Section, ¼ Section)

We are currently working on a Watercourse Master Plan for the Flood Control District of Maricopa Co. for the Hassayampa River. We are performing detailed hydraulic and sediment transport analyses for the river. We are aware that the WRSS pipeline crosses the Hassayampa River in our project area. We are interested to obtain plan and profile of the pipeline under the river floodplain. Thank you in advance for your help with this request.

PERMIT #: ________

PVNGS Water Reclamation Supply System (WRSS) Right-of-Way Encroachment Request

DESCRIPTION OF PROPOSED ENCROACHMENT (Including construction method(s)/equipment, ongoing operation, maintenance and access requirements):

No encroachment is proposed. We are simply requesting on the planimetric and vertical location of the pipeline.

PROPOSED SEPARATION BETWEEN EQUIPMENT / STRUCTURES AND WRSS PIPELINE:

N/A

PROPOSED SCHEDULE:

We plan to complete our data collection no later than mid- September 2004

ATTACHED DRAWINGS IF APPLICABLE:

Yes, please.

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, P.E., R.G., P.H., CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.
Pat Deschamps, P.E., L.S.

Mike Kellogg, M.S., G.I.T.
Cory Helton, M.S.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

August 2, 2004

Gregory Jones, PE
Regional Area Manager
Flood Control District of Maricopa County
2801 W. Durango
Phoenix, AZ 85009

RE: FCD 2004C001 – Lower Hassayampa Watercourse Master Plan (LHWCMP)
Topographic Mapping Schedule

Dear Greg:

The topographic mapping to be provided by the District for the LHWCMP study area was scheduled for delivery on July 30, 2004, as noted in my previous letter dated June 18, 2004. Per the Scope of Work for the LHWCMP, this information was to be provided at the Kickoff Meeting (June 17, 2004) per Task 1.7. To date, this mapping has not been delivered. The receipt of the topographic mapping is in the critical path.

This letter documents that the topographic mapping is past due and will negatively affect our approved Project Schedule for the LHWCMP, as well as cause increased administration and other costs not currently budgeted in the fees negotiated for LHWCMP.

Thank you for your attention to this matter.

Sincerely,

JE Fuller/Hydrology & Geomorphology, Inc.

Jonathan Fuller, PE, RG, PH, CFM
Principal

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: September 13, 2004

TO: Kathryn Gross

FROM: Mike Kellogg

RE: Lower Hassayampa River Watercourse Master Plan
Draft Submittal Documents

CC: Greg Jones, John Hathaway

Kathryn,

The attached hard copy material is being submitted to provide to you an update of our progress on the Lower Hassayampa River Watercourse Master Plan project. These documents are not intended for a formal review by the District, but rather for informational purposes. To date, none of the data have been field verified and are subject to change pending field investigation. If you have any questions or comments regarding the data please give me a call or feel free to stop by our office.

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: October 28, 2004

TO: John Hathaway, P.E., FCDMC

FROM: Ted Lehman, P.E., JEF

RE: response to comments dated Sept. 20, 2004 on draft Hydrology Report dated July 2004

CC: Cathy Regester, FCDMC; File

We have reviewed the District's comments and modified our Hydrology Report as needed. Responses to the specific comments are provided below.

1. HECFFA is the FEMA approved frequency analysis software and should be used instead of HECWRC.

   - We have obtained and rerun the frequency analyses using the HECFFA. The results did not change at all using the same regional skew coefficients and other input data. However, the treatment of historical peak data can differ between HECWRC and HECFFA depending on how it's treated. The net result has been a change to the computed results and recommended discharges for the LHWCMP. The report has been modified to reflect these new results.
   - See also number 2 below.

2. Please provide a discussion of the quality of the data being used in the frequency analyses. This discussion should include such items as period of record, discontinuous data, "historical peaks" (particularly, at the Box Canyon gage – what happens if the three historical peaks are not included in the analyses?), "estimated peaks", recorded discharges only above a certain value, etc. How would "0" discharge for some of the missing years affect the analyses? References for the data used in the analyses should also be included in the report.

   - All of the data used were taken from published data from the USGS and/or FCDMC. Given the relatively small number of direct discharge measurements, rating curves for the Hassayampa stations are based on a small number of slope-area estimates and/or step-backwater models. For any particular annual peak discharge, the error is probably on the order of +/- 20% especially for the largest floods whose magnitudes have been estimated primarily by means of slope-area surveys. The various errors associated with stage-discharge relationships in Maricopa County, their magnitude, and directions are also discussed in Tillery, et al. (2001). This reference and citation have been added to the report .
   - Historic peaks were only designated if identified as such in earlier published data. Specifically, for Box Canyon, Pope & others (1998) identifies three historic peak discharges for 1925, 1927, and 1937. In addition, the September 1970 flood is identified for Box Canyon as the largest flood since 1890 (Walnut Grove Dam failure) and the largest flood since 1916 for the Morristown and Arlington

stations. Treatment as historic peaks effectively extends the period of record assuming a similar distribution for missing years not in the systematic record. Depending on the approach, a weighting factor is also applied to any flows exceeding the maximum historic peak discharge. The HECFFA provides for an additional option for designation of high thresholds that can further affect the computed frequency statistics. In addition, for Box Canyon, designation of historic peaks also extends the record through a couple of gaps in the recent systematic record, in particular the 1983-1992 period. Analyses were computed treating the historic peaks 1) as part of a broken systematic record, 2) as historic peaks using the QH cards (old HECWRC approach), 3) with Sept. 1970 flood as a high threshold flow using the SI record in HECFFA, and 4) without inclusion at all. The results of these four approaches are compared in the revised report. The results using the 1970 flood as the high threshold for a given period (1890 for Box Canyon and 1916 for Morristown and Arlington per Pope & others (1998)) produce appreciably lower 100-year flood peaks that the other approaches. The results are, however, well in line with the previously published USGS results (Pope & others, 1998). Treating the data as a broken systematic record produces the highest discharge estimates. Use of the QH records produces identical results to the HECWRC as reported in the draft report. Our recommendation is to use the results of the HECFFA analyses using SI record with the September 1970 flood as a high threshold per the USGS (Pope & others, 1998).

- Zero discharges do affect the statistical analyses. The HECFFA performs a conditional probability adjustment to the years of zero flow and reports the adjusted statistics. These statistics are then used in the final results where adjustments for regional skew or other weighting are applied. The zero years are accounted for in the length of the systematic record. Arlington is the only station with affirmative zero flows in the systematic record (other than the 1954 and 1956 values and Morristown – see comment 4). Deleting the zero year makes little change in the results, whereas changing it to a slightly positive number (e.g. 40 cfs) increases the 100-year estimate by about 5 percent. A comparison has been provided in the report.

- References to all of the data sources have been included in the revised report. Data sources are either the USGS or FCDMC.

3. It appears that the data used in the frequency analyses may be a mixture of summer and winter storms. Please check and justify the treatment of the data per the guidelines in Bulletin 17B.

   - Given the relatively short period of record we do not typically separate populations of storm types for analyses in Maricopa County. However, it is true to observe that floods can be generated on the Hassayampa River by different types of meteorological events. Bulletin 17B recommends that assignment to different meteorological sources not be made based on calendar dates alone. For example, the recent rain in Maricopa County this October were winter cyclonic type storms. However, past Octobers have seen tropical storm remnant events. Similarly, storms that occurred in August may be thunderstorm or tropical storm remnant type in origin. Assigning a storm type to the historic record of the Hassayampa River stream gage data is therefore not recommended and was not applied to this study. In addition, the sample size for each storm type would be reduced and increase the uncertainty of each subset of statistics. Comments regarding different storm types have been added to the discussion in the report.

4. Regarding the gage at Morristown, for the years 1954 and 1956, the published USGS data (the 5th reference in your list) shows "0" discharge for these two years. The USGS website has no value listed for these two years. You, also, have not included this data in your analyses. Please explain. What effect would including these years as 0 cfs have on the analyses. Additionally, for the discharge on Nov. 18, 1986, the date is mistakenly input as the year 986.

   - The USGS collected data for 1954 and 1956 but recorded only maximum stage values. No rated discharge values were reported. We searched through the files at the USGS Tempe office but were unable to find any other information beyond the maximum recorded stage numbers for 1954 and 1956. Unfortunately, the systematic rated data stop in 1947 and restart in 1964. Examination of the stage data for these periods reveals a shift in the rating curves so that extrapolation to the 1950's data is likely error prone. Nevertheless, a frequency analysis with educated best-guesses for the reported stages was made. Comparison of the results is shown in the table below. Note that without the additional two years of data, the results for all frequencies is slightly higher than the with "best-estimates" analysis. Use of 0 cfs for these years would not be appropriate as we know from the stage data that some level of flow did occur. This discussion has been added to the report.

Analysis	10-year	20-year	50-year	100-year
Without 1954 & 1956 data	15,800	23,000	33,900	43,000
With "best-estimates" for '54 and '56	15,500	22,200	32,300	40,500
% Difference	1.9	3.5	4.7	5.8

   - The 986 has been corrected to 1986 in the input data.

5. Regarding the analysis at the gage at Box Canyon: For the year 1993, the discharge input into the HECWRC is 25,640 cfs. Please identify the source of this discharge value.

   - This value is based on observation of high water marks in the stilling well of the gage I made while working in the Data Collection Branch of the Flood Control District in 1993. Although the gage was not operating properly at that time, we have a high confidence that the high water marks recorded represent the maximum for that water year. Cathy R. asked Dave Gardner, who currently holds my old position, about the source of this and he confirmed that the data in the station folder for Box Canyon, ALERT station 5308.

6. On page 8 of the report, the last paragraph refers to a "pink" area on Figure 6. However, there doesn't appear to be a "pink" area on Figure 6. Should this be the "hatched" area?

   - Yes. The text reflected an older version of Figure 6. The text has been updated to match the depiction of the area in Figure 6.

7. Please include the actual regional regression equation(s) in the report.

   - They have been included in the final report.

8. Please include a land use map in the report and explain how the hydrologic parameters for the land uses were obtained. Cite references and/or show photos, if necessary. Please include photos to support the selection of Kn values.

   - In regard to comments # 8 – 14, reference is made to the scope of work for the simplified HEC-1 hydrologic modeling task. The objective was:

     - develop hydrograph shape for HEC-6
     - assess direction and relative magnitude of future condition Qs

     It was not intended to be a detailed hydrologic analysis upon with to base the flood discharge estimates.

   - As stated in the draft report, future conditions were modeled based on adjustment of the RTIMP values only. No Kn adjustments were made. As to the selection of the future condition RTIMP values, Table 19 provides the rationale for selection. The exact distribution within the large subbasins is not important to the parameterization since HEC-1 is a lumped-parameter model.

9. Are there any areas of rock outcrop in the soils?

   - While there are certainly areas of rock outcrop in the soils in the watershed, it was assumed that none of these areas were hydrologically directly connected to the basin outlet points of interest. Therefore, no RTIMP amount was assigned to modeled basins for rock outcrop.

10. Please explain the assumption of 1.5 for the flood wave celerity in Table 11. Wave celerity is a velocity. However, the 1.5 in the table does not appear to have units. Is the value 1.5 a ratio of the wave velocity to the average cross section velocity based on a particular shape channel? If so, please give references to justify the selection of 1.5.

    - Yes. The wave celerity shown in Table 11 is supposed to represent the ratio of wave velocity to average cross section velocity and is therefore dimensionless. The value of 1.5 was selected based on guidance in Training Document No. 30 (USACE, 1990), field data, and engineering judgment. Table 11 will be corrected to refer to the ratio and a citation to TD No. 30 will be added.

11. What Q was used in the HEC-RAS to determine the RAS travel time? Please include the HEC-RAS digital data and hard-copy printout in the next submittal.

- As mentioned in the draft report on page 14 directly above Table 11, the RAS model used to compute travel time was an imported version of the Cella Barr FDS HEC-2. An electronic version of the model will be added to the disk within the final report. It is our view however that a hard copy for the report is unwarranted copies of the CBA models are already on file at the District.

12. For the simplified HEC-1 model, it is not clear why sub-basin H1 would be generating less runoff than sub-basins H2. Please explain.

    - The basic reasons are the differences in the parameters used for the unit hydrographs. Specifically, the basin roughness, Kn, and the initial abstractions, IA, are higher in basin H1. The rationale for the differences lies in the proportion of the watershed that lies within heavily forested or chaparral environments. Basin H2, on the other hand, is predominantly desert with comparatively sparse vegetation cover. The other reason is the S-graph selected. Basin H1 used the Phoenix Mountain S-graph while basin H2 used the Desert Rangeland. Given the description of each S-graph and the guidance provided in the Drainage Design Manual, this assignment is deemed appropriate.

13. Please label concentration points and gage locations on the watershed map.

    - A gage location map and additional labels to the watershed map have been added as requested.

14. The results of the frequency analyses are showing attenuation of flows as you move down the watershed. From Table 12, the simplified HEC-1 is showing the opposite, with flows increasing as you move downstream. It would seem that more calibration of the HEC-1 model to the gage data is needed. For example, the precipitation distribution for the 1951 storm is available in the Corps' Design Memorandum No. 2 Hydrology Part 2 (plate 23). It should be used instead of the SCS Type II distribution for this 1951 storm. Since the storm did not cover Jackrabbit Wash watershed, this would be appropriate for calibration of the upstream sub-basins. If the observed hydrograph is available, it is recommended that the HEC-1 optimization method be used to calibrate the LG cards.

    - The HEC-1 model was created solely for the purpose of developing a hydrograph shape to apply the results of the statistical frequency analysis. Given the level of effort assumed in the scope, the model developed is sufficient to this task.

    - As to the "calibration" to the 1951 storm, as mentioned in the comment records for the Aug. 1951 model, we did run a version of the model using temporal rainfall distribution reported in the Corps' Hydrology Part 2. That model generated zero runoff. Therefore, another approach was needed. Again, the performance of the model with the large historic storms was conducted to help provide some level of confidence in the hydrograph **shape** produced by the model. We believe the existing model does a good job at that meeting that objective.

- The resulting HEC-1 model with all its limitations produces a 100-year discharge result using the synthetic 100-year rainfall quite comparable to the regression equation results and (revised) statistical analyses at Box Canyon.

15. Why was 55,000 cfs chosen as the Q for the WCMP? The highest flow from the frequency analyses was 52,500 cfs. Would 52,500 have been more appropriate? It would seem, if we were confident with the results of the frequency analyses, we would accept the results at each of the gages instead of applying one value to the entire system. Please explain why one value was chosen. If there is some question regarding the reliability/quality of the data (see comment #2) and a reason for not accepting the results of the new frequency analyses or not accepting the results as being more reliable than the previous analyses, then, please provide an explanation in the report.

    - This has been revised based on the revised statistical frequency results. However, it is our judgment that building in attenuation to the regulatory floodplain model opens the door to adverse impacts from encroachment and/or future increases in discharge due to development. The values recommended for the WCMP are recommended for *planning* purposes. The "unadjusted" results can still be used for other applications as warranted.

16. The last sentence of the section *Interpolation of Qs for different locations* says: "Additional analysis of attenuation effects will be performed as part of the detailed hydraulic modeling portions of the WCMP." Does this mean that you intend to revisit the Qs during the hydraulic analyses? If not, I think attenuation should be looked at now – particularly at the confluence with Jackrabbit Wash.

    - No. We do not intend to change the Qs based on the result of the detailed hydraulic modeling. The results of those analyses will be interpreted as part of the overall river behavior evaluation in the WCMP Report. In addition, those interpretations and analyses will be used to provide information for the future planning analyses for the lower Hassayampa including the alternatives brainstorming, development, and evaluation.

17. We need to address potential channelization as a part of the future conditions analysis. This was the method we had discussed for analyzing future conditions during the scoping meetings.

    - Our understanding of the potential channelization analysis is that it will be addressed as part of the unsteady hydraulic modeling. Specifically, the effect of encroachment to the existing floodway limits on downstream discharges will be evaluated. Again, the results of those analyses will be reported in the WCMP Report.
    - Channelization inside the effective floodway limits would be a component of an alternatives analysis which is not part of the current scope.

18. Please include the "WCMP – routed Morristown" hydrograph on Figure 22.

    - This has been revised for the final report.

19. Only one set of peak discharges is proposed for the HEC-6T analyses. Is it reasonable to apply the same discharges to the entire reach of the river – particularly both upstream and downstream of the confluence with Jackrabbit Wash?

    - First, we will be using HEC-6, not 6T since 6T is a proprietary model not freely available to other potential users (e.g. mining applicants).

    - Second, the HEC-6 analysis will look at several discharge levels and scenarios. All of those have not been selected yet. One of those could be to contrast a condition with similar Qs throughout the study reach. Another scenario might be more event-specific analysis which has the bulk of runoff generated from upstream of the study reach with little or no inflow downstream. We will make a decision and recommendation on the specific discharge scenarios for the HEC-6 modeling a little later in the project. We will present these to the District and get your approval before we proceed with the HEC-6 modeling.

20. Why weren't JD records used? Explain.

    - Again, the primary purpose of the simplified HEC-1 analysis was to generate a hydrograph shape for application to the HEC-6 modeling. JD records could easily be added to the model by others if needed. Note however that in HEC-1 the product of NPLAN, NRATIO, and NQ cannot exceed 4800. The model produced for this study used 6 plans to facilitate examination of single subbasin response to significant rainfall.

DATE: September 10, 2004

TO: John Hathaway, FCDMC

FROM: Chuck Williams

RE: Lower Hassayampa River Watercourse Master Plan – Phase 1
Arizona State Land Department Stakeholder Meeting
Minutes: September 10, 2004

CC: Jon Fuller, JE Fuller
Greg Jones, Flood Control District of Maricopa County

The stakeholder coordination meeting with agencies and utilities was held at the Arizona State Land Department Room 325 at 1:00 pm on September 10, 2004. This memorandum summarizes the issues presented and discussed.

Attendance: The meeting sign-in sheet is attached.

District Attendees:
- John Hathaway – District Project Manager
- Greg Johnson - Flood Control District of Maricopa County
- Chuck Williams – Stakeholder Coordinator
- David Boggs – FCDMC
- Ted Lehman - JE Fuller

Stakeholders:
- Gary Slusher - ASLD
- Dempsey Helms - ASLD
- Gordon Taylor – ASLD
- V. Ottozawa - ASLD

Discussion Items:

1. The study limits include the Hassayampa River corridor from the Gila River confluence to the Central Arizona Project (CAP) canal crossing, and Jackrabbit Wash from the Hassayampa River confluence to the CAP canal crossing.

2. The objective of Phase 1 of the LHWCMP is characterizing existing conditions, identify planning needs and constraints, and predict and understand river behavior. Specific tasks include new hydraulic modeling of the Hassayampa River using new topographic mapping, new floodplain delineation of Jackrabbit Wash, sediment transport modeling of the Hassayampa River, and lateral erosion hazard zone delineation for both rivers. Optional tasks include two-dimensional modeling of the levee reach of the Hassayampa River near the Gila River confluence, and submittal of revised hydraulic modeling of the Hassayampa River to FEMA as LOMR.

3. The LHWCMP Phase 1 does not include developing a river management plan or plan alternatives, but will include determining whether such a plan is needed.

4. Question/Answer Period.

Stakeholder:

1. Please put ASLD on the El Rio mailing list.

Response: Noted

Stakeholder:

1. We want to see how it plays out between Douglas Ranch and Sun Valley Developments.
2. How many bridge crossings are needed would be useful information.
3. Nothing on disposition plan now – there is a draft that is not ready for release.

Response: We don't know about number of bridge crossings at this time. We have heard that maybe 8 may be needed.

Stakeholder:

1.Will provide GIS of land info to the project team as ASLD has done in the past.

Response: Thank you

Stakeholder:

1. ASLD would like to be invited to future sand & gravel meetings.

Response: Noted and will do

Stakeholder:

1. ASLD also wants to be invited to progress meetings.

Response: Noted and will do

Stakeholder:

1. What influences will this have on the permitting stage ay FCDMC?.
2. ASLD will do parallel Sand & Gravel identifications.

Response:

1. Information will be available to regulatory as it is developed.
2. River mechanics study looking at baseline now not details of each development.
3. Phase II would be to evaluate how can infrastructure be safely installed.
4. FCDMC will work with Buckeye for 404 Regional Permit authority if Buckeye so desires.

Stakeholder:

1. Less than 10% of each river mile is suitable for Sand & Gravel operations.
2. ASLD want to manage watercourse and land as an asset for the State.
3. What is the team doing about FEMA floodway/floodplains?
4. Ask Phil Pearthree about active/inactive alluvial fan areas that are in the Buckeye/Sun Valley ADMS.

Response: Will bring Buckeye ADMS team down to brief ASLD.

Stakeholder:

1. ASLD is willing to use systematic approach
2. Some people came to ASLD on recharge projects – real projects are OK.
3. Ask Cindy Stepanovich – ADWR Water Rights about recharge issues in the project area.
4. ASLD wants to us to go to Phase II especially to see results of the structural and non- structural analysis.
5. ASLD is willing to share data with FCDMC but expect the same back.
6. If flood protection response projects are needed that is ok.
7. What level environmental analysis is needed for this study and is it available for ASLD

Response: 1.Noted and will include the comments in the report.

2. An overview environmental analysis is all that is scoped and yes the results will be available to ASLD when completed.

Stakeholder:

1. We need the report right away when it is available.
1. We want to be involved and know best areas for development and the areas where there are hydraulic and geologic controls.
2. Gary has already done some preliminary S & G analysis and identification of suitable areas.
3. Gordon will be primarily interested in the phase II results when that happens,
2.

Response:

4. Noted and Thank You.

Action Items:

1. Dempsey will be POC for projects.
2. Victoria Corrella is another ASLD contact to use.
3. Greg setting up meeting with Buckeye & El Rio team to brief ASLD.
4. Dempsey will provide GIS layers and S & G info to FCDMC.
5. FCDMC will provide models as developed.
6. Will invite Dempsey to progress meetings.

If Stakeholders have questions or concerns they can contact Chuck Williams or John Hathaway.

DATE: September 8, 2004

TO: John Hathaway, FCDMC

FROM: Chuck Williams

RE: Lower Hassayampa River Watercourse Master Plan – Phase 1
Water Users / Agricultural Stakeholder Meeting
Minutes: September 8, 2004

CC: Jon Fuller, JE Fuller
Greg Jones, Flood Control District of Maricopa County

The stakeholder coordination meeting with water users and agricultural interests was held at the Buckeye Irrigation District at 1:00 pm on September 8, 2004. This memorandum summarizes the issues presented and discussed.

Attendance: The meeting sign-in sheet is attached.

District Attendees:
John Hathaway – District Project Manager
Jon Fuller-Consultant Project Manager
Chuck Williams – Consultant Stakeholder Coordinator

Stakeholders:
T. Gladden
Warren Gable – Arlington Canal Co.
Jackie Meck – Buckeye WCDD
Jeannette Fish – Maricopa County Farm Bureau
Joan Gable – Wass/Gerke &Associates
Stan Ashby – Roosevelt ID
Murray Johnson, Jr. – Shiloh Ranch

Discussion Items:

1. The study limits include the Hassayampa River corridor from the Gila River confluence to the Central Arizona Project (CAP) canal crossing, and Jackrabbit Wash from the Hassayampa River confluence to the CAP canal crossing.

2. The objective of Phase 1 of the LHWCMP is to characterize existing conditions, identify planning needs and constraints, and predict and understand river behavior. Specific tasks include new hydraulic modeling of the Hassayampa River using new topographic mapping, new floodplain delineation of Jackrabbit Wash, sediment transport modeling of the Hassayampa River, and lateral erosion hazard zone delineation for both rivers. Optional tasks include two-dimensional modeling of the levee reach of the Hassayampa River near the Gila River confluence, and submittal of revised hydraulic modeling of the Hassayampa River to FEMA as LOMR.

3. The LHWCMP Phase 1 does not include developing a river management plan or plan alternatives, but will include determining whether such a plan is needed.

4. Question/Answer Period.

Stakeholder: Concerned about groundwater recharge upstream that moves water downstream potentially creating flooding problems. Are there flood records? Is there any chance for making it look like the Agua Fria River?

Response:

1. Yes, there are flood records and we no are not developing alternatives as part of Phase I.

Stakeholder: You should take it to next step for developing alternatives for a plan.

Response:

1. Thank you for the comment we will include it in our report.

Stakeholder: Concerned about Luke Wash flooding due to changes in flood regime.

1. In 1934 the Hassayampa was 12 feet deep and now that Gillespie Dam is broken the river will get deeper and deeper.
2. Tamarisk is an issue that should be addressed.
3. What about channeling the Gila River near SR 85. Next step is to address problems past El Rio from SR 85 to Gila Bend

Response: We are only doing a limited environmental review as part of the study. A detailed tamarisk management study and plan is not part of this phase of the project. If Phase II is authorized we will consider that task at that time.

Stakeholder: Will El Rio be channelized?

Response:

1. Channelization will be considered as one of the El Rio alternatives
2. Depth to groundwater is about 8 ft deep, we will probably open it up to that depth if we do channelize.

Stakeholder:

1. There are 12 wells on El Rio. Worried about open channels on the El Rio project then the water will back up at the Hassayampa.
2. Look at confluence of Hassayampa and Gila River.
3. Make sure there are no problems with upstream improvements.
4. 9" – 10" rain a few years back up at Jackrabbit Wash that reeked havoc downstream.
5. Why not burns the tamarisk like we used to do?
6. We cleaned the Hassayampa in 1980 and then the Gila was cleaned out of vegetation as well and it worked.Why don't you do that now?
7. Hassayampa drops a lot of sediment into the Gila so you need to consider that.
8. What is the possibility of buying land as reserve for open space?
9. If you put in a channel then you must maintain it and make sure that the channel goes far enough downstream and that you don't create flooding that will destroy private property at the end.
10. Sand & Gravel will be an issue due to the major developments in the area.

Response: Thank you for the comments we will include them in our report.

Stakeholder: If you were to channel the Hassayampa when would you do it? We used to clean it out and push up levees to protect ourselves.

Response:

1. The Army Corps of Engineers stopped you from channeling. If you wanted to do it again you would need permits from them and FCDMC.
2. FCDMC wouldn't be recommending channelizing for 5 years minimum due to the process.

Stakeholder:

1. Cut brush out of Hassayampa so water can flow.
2. Channel is being choked by vegetation near level areas.
3. Murray Johnson is also a contact for info.

4. Gladden might be developing using Tom Johnson as the engineer on his development.
5. Johnson Farm is in floodway but never seen flooding since 1934

Response: Thank you for the comments we will include them in our report.

Action Items:
1. None

If Stakeholders have questions or concerns they can contact Chuck Williams or John Hathaway.

JE Fuller/ Hydrology & Geomorphology, Inc.

Jon Fuller, PE, RG, PH, MS, CFM
Brian Iserman, P.E.
John Wallace, P.E.
Ted Lehman, P.E.
W. Scott Ogden, P.E.
Jeffrey A. Despain, P.E.
Pat Deschamps, P.E., L.S.

Mike Kellogg, M.S., G.I.T.
Cory Helton, M.S.
Rob Lyons, E.I.T.
Brooks Dillard, E.I.T.
Nick Headley, A.A.S.
Annette Griffin, A.A.S.

8400 S. Kyrene Rd., Suite 201
Tempe, Arizona 85284
1-877-752-2124 (toll free)
480-752-2124 (voice)
480-839-2193 (fax)
www.jefuller.com

The Flood Control District of Maricopa County (District) is preparing a Watercourse Master Plan for the Lower Hassayampa River. The study reach extends from the Central Arizona Project crossing to the Gila River confluence. The study is intended to provide an in-depth understanding of the river and its floodplain, areas threatened by potential meandering of the watercourse, and existing and proposed land uses and features. The project is currently in the data collection phase.

The District recognizes the importance of coordination with stakeholders in the study area. Sand and gravel miners are one of the key stakeholder groups. Therefore, on behalf of the District, you have been invited to the second of four coordination meetings to be held over the twelve month project duration.

Please call Jon Fuller or the District's project manager, John Hathaway (602-506-1501) if you have any questions regarding the meeting.

AGENDA

1. Overview of Watercourse Master Plan Objectives
2. Review of Watercourse Master Plan Scope
3. Project Status Report
    a. Data Collection
    b. Stakeholder Coordination
    c. Hydrology
    d. Floodplain Delineation
    e. Erosion Hazard Delineation
    f. Sediment Transport Modeling
4. Team Needs
    a. December 2004-January 2005 Floods
    b. Pit access – inspect channel and floodplain subsurface
    c. Soil pits
        i. Algene Ventures
        ii. David Sawyer
        iii. Richard Sparks – still owner?
5. Question/Answer Period
6. Action Items

Lower Hassayampa Watercourse Master Plan

Flood Control District of Maricopa County
Arizona Rock Products Association - Stakeholder Coordination Meeting #3
September 15, 2005

The Flood Control District of Maricopa County (District) is preparing a Watercourse Master Plan for the Lower Hassayampa River. The study reach extends from the Central Arizona Project crossing to the Gila River confluence. The study is intended to provide an in-depth understanding of the river and its floodplain, areas threatened by potential meandering of the watercourse, and existing and proposed land uses and features. Currently the project team is completing the technical analyses and is preparing to outline potential river management alternatives for consideration if the District proceeds with Phase 2 of the Plan.

The District recognizes the importance of coordination with stakeholders in the study area. Sand and gravel material suppliers are one of the key stakeholder groups. Therefore, on behalf of the District, you have been invited to the third of four coordination meetings to be held over the twelve month project duration. Please call Jon Fuller (480-222-5710) or the District's project manager, John Hathaway (602-506-1501) if you have any questions regarding the meeting.

AGENDA

1. Overview of Watercourse Master Plan Objectives

2. Review of Watercourse Master Plan Scope

3. Project Status Report
    a. Hydrology

    b. Floodplain Delineation

    c. Erosion Hazard Delineation

    d. Sediment Transport Modeling

    e. Sand & Gravel Mining Impacts Analysis

    f. Alternative Formulation

4. Opportunities for Stakeholders
    a. Recommendation to Proceed with Phase 2?

    b. Elements for Consideration in Phase 2?

    c. ARPA Preferred Alternatives?

5. Question/Answer Period

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: August 24, 2004

TO: Greg Jones, PE/FCDMC

FROM: Jon Fuller, PE

RE: LHWCMP Sand & Gravel Coordination

CC: David Boggs, PE/FCDMC
John Hathaway, PE/FCDMC
Jay Hicks, RLA/EDAW

Per Jan Farmer, who is acting as the Arizona Rock Products Association (ARPA) liaison for the LHWCMP, informs me that there are no ARPA members operating in the Hassayampa River floodplain. According to the floodplain use permit information I obtained from David Boggs, the information in Table 1 summarizes the sand and gravel mining permit status for the study area. Four active operations exist within the LHWCMP study limits.

I will contact representatives from the following mining operations:

1. Hanson Aggregate – Bob Gilbert 602-685-4800
2. Sparks – Richard Sparks 602-993-8800
3. Rinker/United Metro – Dan English 602-809-0843
4. Western Rock – Mike Quackenbush 602.935.5908 (not working phone)
5. Pioneer – David Sawyers 602-989-2585
5. Bill Matthews/KHA 602-944-5500

Contact will consist of a telephone call to verify the address and correct contact person, with a follow-up letter describing the LHWCMP objective, the meeting date/time/place, and the objective of the stakeholder coordination.

Coordination Items:
1. District is completing Phase 1 of LHWCMP
2. Stakeholder coordination is an issue
3. Mining operators – one of four meetings over course of year
4. Verify Address, Name
5. Meeting date is September 9, 10 am at FCDMC

Meeting Agenda
1. Describe Study Objectives
2. Describe Study Scope
3. Potential Benefits of Study
4. Questions & Answers
5. Action Items:
    a. List of concerns

b. Future meeting date(s)

	Table 1. Lower Hassayampa River Sand & Gravel Operations					
	Operation Name	**FCDMC Permit #**	**Location (STR)**	**Permit Status**	**Contact** Same as FA 00-161 (Sparks)	**Notes**
1	Union Rock & Materials	FA 91-31	T4N-R4W-19 Near CAP	Abandoned	William Peck PO Box 8007 Phoenix, AZ 85066	Associated with Toyota Proving Grounds602-276-4211
2	Tanner	FA 93-01	T3N-R5W-35 Upstream Jackrabbit Wash	Abandoned	Boyce Smith – Mark Krumm PO Box 52151 Phoenix, AZ 85072-2151	602-437-7878
3	Western Sand & Rock	FA 95-022	T1S-R5W-2 (NE4) Baseline Rd	Permit new in 2004 per FCDMC	Mike Quackenbush 570 Villa Nueva Litchfield Park, AZ 85340	623-932-1391 No answer
4	Hanson Aggregate	FA 96-032A	T2N-R5W-27&34 Downstream Tonopah Highway	Approved	Bob Gilbert 4127 E. Van Buren St, Suite 205 Phoenix, AZ 85008	602-685-4800
5	Sparks	FA 00-161	T4N-R4W-19	Approved	Richard Sparks 770 E. Thunderbird Rd, Suite C Phoenix, AZ 85022-5307	602-993-8800 Same as FA91-31
6	Rinker	EA 00-049	T2N-R5W-27	Approved	Dan English 701 North 44th Street Phoenix, AZ 85008	602-809-4023
7	Pioneer	FA-01-113A	T2N-R5W-14 @ Jackrabbit Wash confluence	Active	David Sawyers 1404 W. San Pedro Gilbert, AZ 85233	480-833-0441
NA	Interested Party				Bill Matthews, PE Kimley Horn & Associates 7878 N. 16th St, Suite 300 Phoenix, AZ 85020	602-944-5500
NA	Interested Party				Jan Farmer Arizona Rock Products Association 916 W. Adams St. Phoenix, AZ 85007	602-271-0346

Table 2. LHWCMP Mining Information Summary									
	Operation Name	**Permit #**	**Engineer**	**FIRM Zone**	**Depth**	**Size (Ac)**	**Reclamation Plan**	**Tax ID**	
1	Union Rock & Materials	FA91-031	E. Gappinger	Floodway Floodplain	8 ft.	12.9 ac	2:1 slopes		
3	Western Sand & Rock	FA95-022	None	Floodway Floodplain	10 ft.	3.6 ac (ROB) 3.8 ac (LOB)	No	401-30-002A 401-30-003A	
4	Hanson Aggregate	FA96-032A	CMG	Floodplain Floodway	10 ft channel 40 ft overbank	5 ac - channel 27 ac - overbk	5:1 slopes		
5	Sparks	FA00-161	Kimley Horn	Floodplain	10 ft.			503-84-003 503-84-004 503-84-005 503-84-006	
6	Rinker	FA00-049			40 ft	17 ac		504-09-005J	
7	Pioneer	FA01-113	Kimley Horn (Bill Matthews)	Floodway	30 ft		Not yet	504-03-011A 504-03-011B	

Flood Control District
of Maricopa County

MEMORANDUM

Date: March 21, 2006

To: John Hathaway, Project Manager, Planning and Project Management Division

From: Bing Zhao, PhD, PE, Engineering Application Development and River Mechanics Branch Manager, Engineering Division

Richard Waskowsky, Hydrologist, Engineering Application Development and River Mechanics Branch, Engineering Division

Subject: Lower Hassayampa River Watercourse Master Plan (LHWCMP) – Chapter 4: Channel Bed Elevation Analysis

The Engineering Application Development and River Mechanics Branch has finished its review and has the following comments to JEF responses (sent March 2, 2006, received March 6, 2006). The consultant should submit written responses to these comments to the FCD.

1. FCDMC Comment (December 29, 2005) - On Page 4-1, it is indicated that the City of Tucson's manual was used to estimate scour. However, in the scope of work (page 23 of 30; section 9.5.1) this manual was not listed as one of the references that should be used. Rather, the consultant should cite and use ADWR's "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985). Also, the total scour equation does not list long-term scour as one of the components. Please correct this mistake. Please also compute the long-term scour depth and add it to the total scour depth. The long-term scour may be from HEC-6.

   JEF Response. After discussion with District staff, JEF agreed to use the ADWR scour equations because District staff felt so strongly that use of the ADWR equations was essential. However, we note for the record that scope item 9.5.1.2 reads "Scour depths. The long-term and general scour depth shall be estimated using appropriate methodologies <u>to be determined by the consultant</u>." Given the quoted description, despite language identifying the ADWR Manual as well as other manuals in a previous paragraph, we believe we were justified in using the COT equations. Our reasons for preferring the COT Manual include the following: (1) The City of Tucson Manual was written more recently by the same authors that prepared ADWR Manual and uses essentially the same equations as those outlined in the earlier ADWR Manual. The differences in methodologies include the safety factor (specified by COT, subjective for ADWR, but the District mandates the same value as COT), the general scour equation (which was shown to be insignificant by HEC-6 modeling and the COT equations; ADWR uses a contraction scour equation for general scour, which is difficult to apply on a reach basis), and the long-term scour (which is included in the ADWR equation, but not the COT equation). The bend scour, thalweg depth, antidune scour, and local scour elements are equivalent, particularly given the agreed upon bend angle to be used. (2) The City of Tucson scour method was previously accepted for use by the District *on watercourse master plan studies and other river mechanics studies, and is the methodology presented at the recent scour training seminars presented by AFMA at the District. (3) The objective of the scour analysis is not site design, but rather the assessment of regional trends. The effort involved with making the slight change in methodology did not cause any substantive change to the results, and certainly did not change any of the overall conclusions of the study. (4) Pat Quinn, a JEF employee, was one of the co-authors of the ADWR Manual and was ADWR's project manager for developing the ADWR Manual. Pat has no strong preference between the ADWR and COT equations.*

Long-term scour is computed elsewhere in Chapter 4, and was not neglected in the scour analysis. The conclusion in Chapter 4, based on a variety of methodologies including HEC-6 modeling, indicates that no significant long-term scour has occurred in the period of record, and that either no long-term scour, insignificant long-term scour, or aggradation is expected. Therefore, a value of zero was added to the scour equation table in Chapter 4.

FCDMC Response (March 21, 2006) – The District accepts the compromise set forth in the Comment Resolution Meeting on February 16, 2006. Comment Resolved.

For the record, although Section 9.5.1.2 reads "Scour depths. The long-term and general scour depth shall be estimated using appropriate methodologies to be determined by the consultant", Section 9.5.1 which reads "Scour Analysis. The CONSULTANT shall use the methods and guidelines provided in the Bureau of Reclamation manual titled "Computing Degradation and Local Scour" (January. 1984), the ADWR manual titled "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985), or the Federal Highway Administration's "Highways in the River Environment" (February 1990)". Thus, the consultant can choose appropriate methodologies outlined in the aforementioned manuals, of which the COT manual is not one. The use of the COT manual is NOT within the scope of work. The previous use of COT methods for other projects and the AFMA course do not warrant the use for this specific project, otherwise they should be in the Scope of Work.

2. FCDMC Comment (December 29, 2005) - In section 4.3 – Equilibrium Slope, four equations (AMAFCA, BUREC, Bray, and Henderson equations) are used to estimate the equilibrium slope. Please do not use these equations since three of them are not applicable to this study, and AMAFCA's equation is originally from ADWR. Please do not use AMAFCA's simplified equation. Instead, follow the example given on pages 5.79-5.82 of ADWR's "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985) for calculating the equilibrium slope iteratively. Also, check if supply reach is in equilibrium

   JEF Response. We deleted reference to the Bray, Henderson, and BUREC equations since, as noted by the District reviewer, the former two were developed for gravel bed streams and appear to predict slopes too flat for the sand-bed Hassayampa River. We also deleted references to the BUREC equation at the direction of the District, although we note that given its formulation, we see no explicit reason why the BUREC equation would not be applicable to the study reach. Simply deleting results because the results are anomalous or unexpected is not good science. We prefer to report the results, consider the potential ramifications, and use judgment to select the most reasonable course of action.

   We also note the following to explain why we chose the methodologies we used: (1) The simplified AMAFCA equation applies to the characteristics of the study reach (wide, sand bed, transport limited streams, subcritical) and its use is therefore justified. (2) Experienced gained performing stability assessments on more than 300 rivers in seven arid-west states leads us to recognize the failure of any one equation to work in every situation, as well as

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

the value of considering a range of results. Outliers and trends can be assessed more readily by examining a range of results than by a single data point obtained by applying a single methodology. (3) Examination of the original publications and documentation for the various equilibrium slope equations reveals that none are precise, providing at best something better than order-of-magnitude results, or the expected direction of change. Reliance on a single equation is not prudent. (4) The historical topographic data, field observations, slope profile analysis, and HEC-6 modeling all indicate that the existing condition is at or near equilibrium. No equilibrium slope adjustment is expected, particularly since the watershed has been relatively undisturbed (recall that this is an existing conditions assessment). (5) Scope item 9.5.4 reads "Equilibrium slope. Equilibrium slope shall be estimated using appropriate methodologies to be determined by the consultant and approved by the District." The language seems to imply that we would have some say in the methodologies used. (6) The equilibrium slope equations used were those used in the previous watercourse master plan studies all of which have been previously approved of by District staff.

We note the following with respect to the ADWR iterative methodology: (1) There is no scope requirement to use the ADWR iterative method. (2) The ADWR manual provides a simplified equation, applicable to wide channels (W/D > 10), using coefficients from Table 5.6a. (3) The ADWR Manual notes that no equilibrium slope analysis is warranted if historical data show that the reach is at or near equilibrium and the watershed is relatively undisturbed such that sediment supply is not changed (See Eq'n 5.11), which is the case for existing conditions in the study reach. (4) The ADWR Manual notes that a slope adjustment is not likely if the Manning's n, sediment supply, discharge, and channel geometry are unchanged, as is the case for the LHWCMP. The method recommended by the District is more appropriate for the future conditions assessment that will be part of the Phase 2 of the LHWCMP.

Other practical limitations inhibit use of the ADWR method. First, as shown in the HEC-6 results, transport capacity varies between cross sections due primarily to significant changes in channel geometry. Therefore, some averaging of hydraulic characteristics is required which inevitably dilutes the results. Second, the District did not authorize the task in which bankfull capacity would be estimated (neglecting the difficulty of estimating bankfull discharge on ephemeral braided stream systems). Third, no measured sediment rating curve data are available from which to derive the required coefficients. Fourth, the ADWR iterative method assumes sediment deficit or surplus will be met by slope adjustments, rather than width adjustments (historical data contract this assumption). Therefore, it will overpredict slope change if the channel has freedom to adjust laterally. Fifth, the ADWR method uses reach-averaged hydraulic variables – so either we iterate slope by cross section (several hundred iterations needed) or average variables by reach. Sixth, there are no real pivot points from which to project slope adjustments. Seventh, as noted in the ADWR Manual, "Due to complex interaction of variables, simplifying assumptions, the results can be very subjective and only useful in qualitative sense."

Nevertheless, the report and methodology was modified as requested by the District reviewer.

FCDMC Response (March 21, 2006) – This is a Scoping issue again. However, the District accepts the compromise to use the simplified AMAFCA equation and the simplified ADWR equation for the calculation of equilibrium slope. Comments Resolved.

For the record, the BUREC equation was not in the Scope of Work. It should be deleted because when reviewing the reference cited in the report, MacBroom 1981, questions were raised about the reliability of the equation as printed in the reference. In the MacBroom report, units are not explicitly listed for the equation and the original BUREC reference is not referenced. When researched further, the equation appears to closely resemble the Schoklitsch equation given in the Pemberton and Lara report, (1984); except the K coefficient is not the same. The coefficient in MacBroom's book is 0.00021 on page 46. The coefficient in Schoklitsch equation is 0.00174. Due to these issues, the equation was asked to be excluded from the study. The Schoklitsch equation is for clear water inflow condition. The simplified AMAFCA and the simplified ADWR equations are for sediment-laden condition.

One should not blindly use equations which are not applicable to the study area. Consultants should research the assumptions and data which were originally used to develop the equations. Averaging equations of different assumptions without understanding how they were derived is not prudent. The use of methodologies in past studies does not indicate use or applicability to the present study because rivers are different such as sediment grain size and slope. For example, Bray's paper was based on d50 ranging from 26 mm to 145 mm which is definitely much bigger than the sand sizes (d50 from 0.25 mm to 1.5 mm) in the Lower Hassayampa River. In addition, averaging equations of clear water condition and sediment-laden condition is not correct. As mentioned above, the consultant should research and use the most applicable equations for the present study.

Since the simplified AMAFCA slope is the simplified version of the simplified ADWR method, we approve it. For the record, the ADWR iterative method is still the most reasonable one to use. Since the Lower Hassayampa River is very wide, it is okay with us if you use the simplified ADWR method. Most of the seven points raised in your response are not major issues to us. The key thing is that the consultants should follow the scope of work. There is no need to argue about a scope of work that was agreed upon by everyone.

3. FCDMC Comment (December 29, 2005) - On Page 4-2, the antidune trough depth is shown to be calculated with $Z_a = 0.0137*V_m^2$ and $\frac{1}{2}Z_a$ is added to the total scour. This is incorrect. In the ADWR manual (1985) the crest-to-trough depth is calculated with $Z_a = 0.027*V_m^2$ (formula 4.25 on page 4.24) and $\frac{1}{2}Z_a$ is added to the total scour. Please correct the formulas to be consistent with the ADWR manual. Also, the spreadsheet provided by the consultants has errors in antidune scour. The formula used is $Z_a = 0.137*V_m^2$. Rather, the formula should be $Z_a = 0.027*V_m^2$, and the "if statement" in the spreadsheet should not be used. Please correct the antidune formula in all spreadsheets (Scour-2yr, 10yr, 50yr, 100yr, and FDS). In the report (first sentence after the antidune formula on page 4-2), it indicates that the anti-dune trough depth is limited to a maximum of ½ the flow depth. Please remove this sentence.

*JEF Response. The equation shows the ½ factor applied twice (0.0137 = ½ * 0.027). The equation will be revised in the text of the report and the spreadsheet will be corrected.*

The ADWR Manual in fact states that the antidune trough depth is in fact limited to a maximum of ½ the flow depth (See p. 7.32, 3rd paragraph).

FCDMC Response (March 21, 2006) – We want to make sure that you are aware that you missed one decimal place in your spreadsheet. In your spreadsheet, you used 0.137 instead of 0.0137. Please check. Here is the equation in spreadsheet "Scour – FDS":

=IF(**0.137***'RAS-FDS'!$AX284^2>'RAS-FDS'!$BC284/2,'RAS-FDS'!$BC284/2,**0.137***'RAS-FDS'!$AX284^2)

4. FCDMC Comment (December 29, 2005) - The 100-year peak flows used in the consultants' spreadsheet are different from those in WEST Consultants' 100-year HEC-RAS model. Please clarify and correct the differences. Also the scour results of FDS and 100-year are reported in the report. Is FDS based on the 1988 FEMA flow rates? Please clarify the peak flows for FDS and the 100-year flood. On page 4-7, the first paragraph discusses the flow rates for 2-, 10-, and 100-year peaks, but Table 4-2 lists the results for 2-, 10-, 50-, 100-year peaks and FDS.

   JEF Response. The District has not rendered a final decision on peak discharges for the Hassayampa River. District staff previously agreed that both the FDS 100-year and peak discharges described in the Hydrology Report would be used to bracket the range of possible values. An explanation to this affect will be added to the report. The 50-year results will be removed from Table 4-2, since they are not required by the scope of services.

   Differences between WEST HEC-RAS modeling and JEF HEC-RAS modeling were discussed repeatedly at LHWCMP team meetings, as were differences between FDS and 100-year discharge estimates. This issue is also addressed in the Hydrology Report.

   FCDMC Response (March 21, 2006) – From an in-house FCDMC statistical analysis of peak discharges on the Lower Hassayampa River, it was determined that the peak flow is close to the 74,100 cfs which is the effective FEMA value. You were also on the email list when the District was performing such an analysis. Please use 74,100 cfs for all work in HEC-6 and scour estimation for the 100-year flow.

5. FCDMC Comment (December 29, 2005) - The estimated thalweg scour was assumed to be 1 foot. Was this estimate based on field visits? Please submit any documentations such as field visit photos showing the low flow channel depth.

   JEF Response. As indicated in the ADWR Manual (Section 5.3.13), thalweg "scour" is more of a concern for constructed channels, rather than natural channels. In the past, we have argued that no thalweg component should be used in the scour equations for natural channels. However, District reviewers have <u>mandated</u> that we use a thalweg depth of at least one foot, regardless of field observations. The ADWR Manual uses one to two feet as a rule of thumb where field data are lacking. The reviewer is directed to Chapters 2 and 3 for field documentation of existing channel conditions.

   A statement regarding the sources of the one foot estimate will be added to the text.

   FCDMC Response (March 21, 2006) – Which District reviewers are being referenced? The current District reviewers or reviewers for the past projects? All that was asked was where the one foot assumption was obtained, and what was the supporting documentation. In the draft of chapter 4, there was not a reference for this assumption, and chapters 2 and 3 were not included in the packet that was to be reviewed. Please refer to Chapter 10 in the 2003 Draft Hydraulics Manual for the selection of low flow incisement.

6. FCDMC Comment (December 29, 2005) - While it is true that local scour only acts at certain locations (i.e. the I-10 bridges, Union Pacific bridge and the old US 80 bridge), at these locations the scour can be significant. Please compute local scour estimates at these locations using HEC-18 (Richardson and Davis, 2001). Please estimate the scour hole

dimensions to determine the scour impact on banks for total scour computation. Also, show the scour in the reach using RAS river stations.

JEF Response. It is my recollection from the scoping meetings and from early discussions with the original District reviewers that new bridge scour analyses would not be required. Nevertheless, we will compute local scour using the WEST HEC-RAS or existing bridge scour reports. Computation of scour hole dimensions is not authorized by our scope of work. We would be happy to complete additional analyses when authorized (and funded) by the District.

The Old US 80 Bridge is now fully lined by CSA. As such local scour is not at issue. Furthermore, we note that the entire scour analysis (Task 9.5.1: single event, long-term, local) was scoped for a total of 32 hours for the entire 28 mile study reach (1.1 hrs/mile). The District's expectations for the level of detailed scour analysis should be tempered in light of the funding the District was willing to authorize. Finally, it is noted with respect to comment #6 and other scour related comments that the objective of the scour analyses was to assess potential existing condition bed elevation changes, not to prepare design information for future channelization (a possible Phase 2 activity). Determination of whether a bridge is scour critical may fit within the scoped objective, but evaluation of scour hole geometry does not.

FCDMC Response (March 21, 2006) – In the ADWR methodology and current draft Hydraulics Manual, the local scour is one of the components of total scour. Also, in a Watercourse Master Plan, it would seem to be prudent, at the minimum, to list where local scour could be an issue in the watercourse. Thus, the District made the comment to calculate local scour at all relevant locations, i.e. the bridge locations. Scour hole geometry gives good information about the extent of the pier scour and its potential impact on channel banks and utility crossing. However, since it is not specifically mentioned in the scope of work, the District accepts the compromise set forth in the Comment Resolution Meeting on February 16, 2006. Comment Resolved.

7. FCDMC Comment (December 29, 2005) - On page 4-4, bend scour was calculated from a reach-averaged bend angle and applied over a whole reach. Please compute the bend scour without using the "reach-averaged" concept. Please follow the procedure that starts on page 5.105 of the ADWR manual. Please use Eq. 5.27 in ADWR manual to determine the distance downstream of the curvature. When the main channel is straight, the thalweg bend angle should be used for computing the bend scour. The bend scour and local scour should be applied to specific cross-sections at each of the four reaches. Please show the scour in the reach using RAS river stations.

JEF Response. The watercourse master plan is a regional, rather than a site-specific study. Thus, the bend scour was computed on a reach basis to identify trends rather than design criteria for specific locations, and follows the procedures used in previous watercourse master plans. Applying the ADWR bend scour equations in the manner suggested would lead to under-design of toe-down at any point where the future river channel alignment changed from a straight to sinuous, as is predicted. Application of the bend scour (depth plus scour hole length) at each bend of the 28-mile study reach would be an effort that far exceeds the authorized 32 hours.

At the District comment resolution meeting, it was decided to use a bend angle of 60° to achieve the maximum bend scour depth given in the COT Manual bend scour formula. The District also identified a concern that the scour results table might be used by unknown parties in the future to obtain design scour depths. Therefore, a note *will be added to the scour results table and the relevant text indicating that the results are not to be used for design purposes.*

FCDMC Response (March 21, 2006) – It is noted that reach-averaging the bend angle will lead to a smaller angle than can occur on the Hassayampa River. In turn, this smaller angle will under-predict scour depths at places where bends become significant. Therefore, the District accepts the compromise to use the maximum bend angle possible in a conservative estimate of bend scour. Comment Resolved.

8. FCDMC Comment (December 29, 2005) - On page 4-4, it is indicated that a practical rule of thumb for estimating the maximum long-term scour is to measure the height of the floodplain above the channel bottom. What is the reference and validity of this rule?

   JEF Response. The rule of thumb is a matter of common sense and field experience, rather than a published rule. Its validity is based on engineering judgment derived from 20 plus years of river studies on more than 300 streams in Arizona. The concept is that the depth of the channel below the surrounding floodplain (or modern terraces) is a record of the (maximum, net) long-term scour that has occurred in recent geologic time. We find this rule of thumb to be a practical reality check on other numerical and historical methods. Interestingly, the ADWR Manual reports a similar conclusion (scour limited by stable bank height) on page 5.79.

   FCDMC Response (March 21, 2006) – Reference to published documentation will make the report more credible. Many years experience especially those outside sediment transport engineering and fluid mechanics does not necessarily accumulate correct engineering knowledge which is beyond simple field observation. If the ADWR Manual said this on page 5.79, please refer to this documentation in your report. However, on page 5.77, the ADWR manual reads "In addition to stable bank heights being a potential control for the equilibrium slope...". This stable bank height discussion does not specifically point to the practical rule of thumb, and it would be good if a better reference was found. Therefore, we recommend removing the usage of "practical rule of thumb" especially in a technical report, or referenced with verifiable published documentation.

9. FCDMC Comment (December 29, 2005) - On page 4-7, the equilibrium slope equation has an error (i.e. the n/1.49 term should be raised to the power of 2). Please compare equation 5.11 on page 5.75 of the ADWR manual.

   JEF Response. The typographic error was corrected.

   FCDMC Response (March 21, 2006) – Comment resolved.

10. FCDMC Comment (December 29, 2005) - In section 4.6, the data derived from the USGS quadrangles does not have enough precision to give accurate estimates of scour. Please leave this data off of the plots of the cross-sections.

    JEF Response. The scope calls for consideration of historical topographic data. There are only a few sources of historical topographic data. While we agree with the District that the USGS data lacks the precision of the more recent data sets, we believe that some historical trends can be elucidated by consideration of the USGS data, as *explained in our analysis. Furthermore, it is our preference to include all data and explain discrepancies in the text, rather than to exclude data that does not fit the pre-conceived notion of how it should look.*

FCDMC Response (March 21, 2006) – There is no pre-conceived notion of how it should look. Consultants should use their engineering knowledge to select the accurate data. Mixing data of different levels of accuracy is not a good practice. However, we allow you to put it into the report this time since you added a note/disclaimer about the accuracy of the data. Comment Resolved.

11. FCDMC Comment (December 29, 2005) - On page 4-10, nu (v) is the kinematic viscosity and its units are [ft^2/sec]. The report incorrectly indicates nu to be kinematic velocity with a wrong unit.

    JEF Response. The typographic error was corrected.

    FCDMC Response (March 21, 2006) – Comment resolved.

12. FCDMC Comment (December 29, 2005) - In the cross-sectional stable slope spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS), the equation for Tc in Lane's Tractive Force method is wrong. It uses 10^(1*logD50 – 1.79755) to calculate Tc, but this does not match the curve (Figure 4) in the BUREC manual (Pemberton and Lara, 1984). Please correct this mistake.

    JEF Response. We checked the spreadsheet and found that the equation correctly predicts the values intended from a specific curve on Figure 4 of Pemberton &Lara. Regardless, the results make no difference to the overall conclusion that with zero sediment inflow, slope reduction (degradation) is expected.

    FCDMC Response (March 21, 2006) – The equation calculates a critical tractive force of 0.0077lb/ft^2 which is equal to 37.35 g/m^2. Reading from Figure 4 in Pemberton and Lara (1984) from the curve for "recommended values for canals with clear water" with a D_{mean} a of 0.48 mm, leads to a value of a 140 g/m^2, which is not equal to what the curve fit calculated (37.35 g/m^2). Please correct or explain the discrepancies. Regardless of the results, if there are mistakes, then they need to be corrected because in the future other people may use this equation for other purposes. Please re-verify it.

13. FCDMC Comment (December 29, 2005) - In the spreadsheet (Stableslope-Summary), the reach-averaged value for the Shields method uses Lane's results (column 14) from the cross-sectional stable slope spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS). The correct column is column 12. Also, in the same spreadsheet (Stableslope-Summary), the Lane's value uses the Shields value (column 12) from the cross-sectional stable slope spreadsheets. The correct column is column 14. Please correct the mistakes in the spreadsheet even though the final average stable slope of four methods does not change.

    JEF Response. The spreadsheet was corrected.

    FCDMC Response (March 21, 2006) – Comment resolved.

14. FCDMC Comment (December 29, 2005) - Please submit a GIS line shape file for the five reaches.

    JEF Response. GIS shape files were submitted previously.

    FCDMC Response (March 21, 2006) – The GIS files need to be put in the CD that should come with the report.

15. FCDMC Comment (December 29, 2005) - The second sentence in second paragraph on page 4-12 indicates that the equilibrium slope equations predict long-term degradation. This is based on the average slope of simplified AMAFCA, Bray, Henderson, and BUREC equations. As indicated earlier in this review comment document, Bray, Henderson, and BUREC equations are not applicable to this study and should not be used. The simplified AMAFCA method should not be used. Instead, the ADWR iterative method should be used. Please make changes to this sentence accordingly after the ADWR method is used to compute the equilibrium slope.

    JEF Response. See response to comment #2.

    FCDMC Response (March 21, 2006) – The District accepts the compromise to use the simplified AMAFCA equation and the simplified ADWR equation for the calculation of equilibrium slope. Also, due to issues with the BUREC equation, the District asked for it to be excluded.

    The District thanks the Consultant for its cooperation. Comment resolved.

The following comments are in regards to the QuickSedTrans excel spreadsheet.

16. The Meyer-Peter-Mueller equation (1948) is based on the Metric System. Equation was coded as English units. Input parameters should be converted to metric and results converted back to English. Or you can use English unit equations converted by the Bureau of Reclamation (Simons and Senturk, 1992).

    JEF Response. The methodology presently used is based on the procedure in HEC-RAS hydraulics reference manual. As per the recommendation, the methodology will be changed to use the original equation as presented in the ASCE Manual 54.

    FCDMC Response (March 21, 2006) – Whether or not the MPM equation in the ASCE Manual 54 can be directly used for English system is still a question. Basically, there are two sources that publish two different equations. However, investigation of this issue may be beyond the Scope of Work. The District is currently reviewing the derivations of the formula. Verification of the units for the MPM equation is not within the Scope of Work. The HEC-RAS-based MPM equation was already chosen by you. As of now, the District accepts the HEC-RAS result, unless we find out that the HEC-RAS-based equation is wrong and the results are very different from the correct one.

17. In the Toffaleti Sub routine of the VBA code the following sequence was observed:

```
If (zom< (1.5*zv)) then
        Zom= 1.5*zv
        End If
```

It should be coded:

```
        If (zom < zv) then
                Zom =1.5*zv
        End If
```

JEF Response. The above code is based on the HEC-6 source code and source code in Yang's "Sediment Transport, Theory and Practice". It appears that both these codes may be in error. The code will be changed as per recommendation.

FCDMC Response (March 21, 2006) – Your cooperation is appreciated. Comment resolved.

18. In Toffaleti subroutine Mi was coded as: Mi=f4 * gssLi / (yaf4 – ddf4). It should have been coded: Mi=f4 *gssLi / (yaf4 –ddf4) *f4. Multiplication by f4 was not included in the code.

*JEF Response. The code is based on Eq. 6.29 in Yang's "Sediment Transport, Theory and Practice" and 2.236j in ASCE Manual 54. f4 is same as η_3. ya = D/11.24, yaf4 = ya^f4, dd = 2*di, ddf4=dd^f4, gssLi is same as q_{sLi}. The code appears correct.*

FCDMC Response (March 21, 2006) – The code is correct after verification since multiplication by f4 is already used in front of gssLi in the equation. Comment resolved.

19. A reference should be given for the friction factor equation coded as the following:

```
Friction_factor = (2.82843 / (bcoeff – 3.75 + 2.5 * Log (2# * (flow_depth_in_ft / d90)))) ^ 2#
```

JEF Response. A reference will be added to the spreadsheet code.

FCDMC Response (March 21, 2006) – Your cooperation is appreciated. Comment resolved.

20. In the fifth to last line in the code a conversion was used. That conversion number should be 86400 instead of the coded 84600.

JEF Response. The value will be changed in the code.

FCDMC Response (March 21, 2006) – Thank you for the change. Comment resolved.

21. Please review your code because we found a few errors after our review. Please put detailed comments in the code such as reference, equation numbers in the reference and variable definitions. We know you used ASCE Manual 54, but you need to put reference in code and chapter 5 of the report.

JEF Response. Reference codes will be added. We assume that the errors found "after your review" are reported in the review memoranda.

FCDMC Response (March 21, 2006) – Your cooperation is appreciated. Comment resolved.

March 21, 2006; New Comments Regarding Revised Draft (sent March 2, 2006).

1. FCDMC Comment (March 21, 2006) - **In Table 4-6 on page 4-22, the "Armor v. Scour" and "Armor v. Slope" columns are somewhat confusing. Is it possible to give a more concise explanation in the discussion about the table on the previous page, or could the columns be combined into one, since they both basically indicate the same result?**

2. FCDMC Comment (March 21, 2006) - **In Table 4-6 on page 4-22, the column notes *indicate that both the "Armor v. Slope" and "Armor v. Scour" columns are being* compared to column one, which is the "Reach" column. It appears this actually should indicate that the columns are being compared to the "Depth to Armor" column (column 2).**

3. FCDMC Comment (March 21, 2006) - **In "Sub Toffaleti" subroutine, "If (CLi>100#) Then" should be replaced with "If (C2d>100#) Then".**

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

Flood Control District
of Maricopa County

MEMORANDUM

Date: March 21, 2006

To: John Hathaway, Project Manager, Planning and Project Management Division

From: Dave Degerness, PE, Senior Civil Engineer, Engineering Application Development and River Mechanics Branch Manager, Engineering Division

CC: Bing Zhao, PhD, PE, Engineering Application Development and River Mechanics Branch Manager, Engineering Division

Subject: Lower Hassayampa River Watercourse Master Plan (LHWCMP) – Chapter 5: Sediment Transport Analysis; Chapter 6: Lateral Migration Analysis; Chapter 7: Sediment Trend Analysis; Chapter 8: Summary

The Engineering Application Development and River Mechanics Branch has finished its review and has the following comments to JEF responses. The consultant should submit written responses to these comments to the FCD.

1. Figure 5-2 indicates the mean daily discharges used in the HEC6 modeling. I have tried running several of the models and they take considerable time to run. How necessary is it to run all the mean discharges in the model? There are many flows that seem insignificant from a sediment transport standpoint. Can the flows be cut back to include only those flows above a certain threshold, say the channel forming discharge?

   JEF Response. Flows selected for modeling were dictated to JEF by District staff. The reviewer may wish to review literature regarding effective discharge computations relative to flow duration. Selection of only flows above bankfull would miss much of the effective sediment transport. The spreadsheet based analysis indicated that most of the sediment volume is moved at flows less than 500 cfs. However, to shorten the run time, we increased the time step and eliminated flows below 500 cfs (rather than 100 cfs) and found that tThe HEC-6 model results were not significantly different.

   FCD response (3/20/06). The model run time is now around 11 minutes compared to the 4 hours of before. If results are similar this is good. No further comment.

2. Section 5.3.1.2 discusses scaling of the HEC-1 model results to the peak discharges established by FEMA in the effective FIS for each tributary. The consultant should discuss the scaling procedure in more detail for the reader and explain why the scaling was done. Are the FEMA effective discharges that much different from the LHWCMP produced hydrology for the washes?

JEF Response. An explanation was added to the text. The tributary and main stem hydrology is discussed in detail in the Hydrology Report, which was previously approved by the District. Basically, the HEC-1 hydrograph ordinates were adjusted by the ratio of the peak relative to the FDS peak discharge.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

3. Section 5.3.1.3 discusses the leveed reach and how flows are taken out of the system. It was determined that 3 flow changes in Reach 1 were sufficient to model the flow changes. Figure 5-4 appears to indicate that for the 75,000 cfs flow there are four flow change locations as is indicated by four flow plateaus. I do not know which is correct or if I am interpreting the figure incorrectly. Perhaps additional graphics or explanation in the section will clarify this situation for the reader.

   JEF Response. The report text will be clarified. Three flow changes is equivalent to four flow rates (i.e., n - 1=3).

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

4. Figure 5-5. Is this the final sediment inflow rating curve for the Hassayampa River or one of the tributaries? The caption for figure 5-5 should be described as saying this is the curve for the Hassayampa River.

   JEF Response. The figure caption and report text will be clarified.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

5. Section 5.4.1, page 5-7. The consultant should remove the statement "If this assumption is valid." The previous sentence states the assumption in this technique. The validity of this assumption shouldn't be called into question any more that it has been by the previous statement.

   JEF Response. The sentence does not call the assumption into question, it is merely a transitional phrase linking the two sentences. We will try to find a different phrasing that is less confusing.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

6. Section 5.4.1, page 5-7. Why were the flow rates of 500 to 80,000 cfs chosen for incoming sediment load development? Consultant should elaborate as to why these were chosen.

   JEF Response. The report text will be elaborated as requested. Flows from 500 cfs to 80,000 cfs cover the range of discharges modeled.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

7. Sections 5.4.2 and 5.4.3, pages 5-7 and 5-8. What flow rates were used for incoming sediment load development for Jackrabbit and Wagner Washes? Consultant should list those flows and describe why they were used for load development.

   JEF Response. The report text will be clarified, and will include a list of incoming flows.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

8. Table 5-3 on page 5-16 is supposed to summarize the base modeling results as well as the results from modeling scenarios #1 and #2 as is described in the middle paragraph on page 5-15. Table 5-3 should either be improved, discussed in more detail or another table made which reflects the results on the inflow calibration and the n value calibration.

   JEF Response. Table 5-3 presents the base modeling results while sections 5.5.3.1 and 5.5.3.2 discuss Modeling Scenarios #1 and #2. The text will be improved and discussed in more detail.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

9. The column titled "04-88 Difference" in table 5-3 should be labeled "04-87 Difference" since that is the basis of your comparison.

   JEF Response. The text was changed as requested.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

10. It appears in reading section 5.5.3 of the report that model calibration was performed using the 1987 FDS model for scenarios 1 to 3 and that scenario 4 used the 2004 WEST HEC-RAS model for base model development. Was the basis for the calibration in scenarios 1 to 3 to try to obtain the 2004 profile or channel geometry by systematically changing the modeling parameters for the 1987 FDS model? I am reading the words "improve the forecast of the 2004 channel topography". Please describe in more clear words the purpose of the model calibration.

    JEF Response. The report text will be clarified.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

11. Figure 5-11 on page 5-20 indicates two bed change profiles, one with the 10 year discharge and one with the 50 year discharge. The text on page 5-19 that describes this figure does not mention anything about what the figure 5-11 is depicting. Consultant should describe the scenarios the figure is showing.

    JEF Response. The report text will be clarified and Figure 5-11 will be discussed.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

12. Section 5.5.4, page 5-24. The modeling results should reference a profile plot of the Hassayampa River for the thalweg elevation or the average bed surface elevation showing the initial bed profile and the ending bed profile. This should help in discussing the modeling results.

    JEF Response. A profile plot will be added to the report. The predicted changes are too small to be seen on any reasonably sized plot, so a discussion of differences will be added to the text.

FCD Response (3/20/06). FCD acknowledges JEF response. It still would have been nice to have a relative difference graph having degradation over the period of time being negative and aggradation shown as a positive result for the river stationing. This would look similar to figures 6.1 and 6.2 in chapter 6 of the report. We have no further comments.

13. Somewhere in the report a table and explanation to go along with it should be provided describing the total sediment load that has passed through the system at the end of the USGS mean flow data and at the end of the entire hydrologic modeling sequence. This should be done for the base model.

JEF Response. A table of total sediment load will be added to the report.

FCD Response (3/20/06). FCD acknowledges JEF response by addition of table 5-4 to report. The long term flows only value of 204 ac. ft may be in error. After 195 days of flow (event #196) we obtain 173 ac. ft from output Table SA-1. The $VOL A command should be used in the model hydrology to report sediment leaving the system at the most downstream cross section in total tons. The load through the system for the long term flows and 100 year event of 265 ac. ft obtained from Table SA-1 is fine. Consultant should investigate the load through the system for the long term flows.

14. Consultant should also provide a 100 year model and describe those results via a bed profile graph and discuss the total sediment load passing through the system.

JEF Response. JEF specifically recommended that such a model be one of the scenarios considered and the District staff specifically mandated that we not. The modeling scenarios used were previously approved in advance by District staff.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

15. Section 5.6.1.1, page 5-24. A figure or set of figures should be provided that show the 10 reaches used in this analysis.

JEF Response. A figure showing the reaches will be provided.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

16. Section 5.6.1.1, page 5-24. A figure should be provided showing the 100 year hydrograph and its discretization. Also, the peak flow rate of 75,000 cfs does not match the peak flow of 57,000 cfs provided in figure 5.3 of the report.

JEF Response. A figure showing the discretization will be provided.

FCD Response (3/20/06). FCD acknowledges JEF response. A table of modeled flows was provided by the consultant showing the true modeled peak flows of 85,000 cfs in the Hassayampa River at Jackrabbit Wash, which is higher than the FEMA regulatory flow of 76,120 cfs for the Hassayampa River at Jackrabbit Wash. This will provide a more conservative estimate of sediment transport in the river as is noted by the consultant. The diversion method of flows in the hydrologic data set providing a flow in the Hassayampa River above its confluence with

Jackrabbit Wash of 54,800 cfs matches closely with figure 5.3 of the report and is very close to the FEMA flow of 55,980 cfs. We have no further comments.

17. Tables 5-4 and 5-5 have numerous errors in the "total" boxes for several reaches.

    JEF Response. Tables 5-4 and 5-5 will be edited. The "errors" are due to rounding and the number of significant figures used.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments

18. Section 5.6.2, page 5-27. The consultant should define the safe yield term as used by ADOT.

    JEF Response. A definition of safe yield will be provided. Safe yield is a term used in the District's scope of work (9.6.8). The concept of safe yield is that the amount of aggrading sediment (the "excess") can be removed from a stream without adverse impact. Frankly, I don't believe that any significant amount of sediment can be removed from the stream system without a consequent adjustment of morphology. Further, unless there has been a disturbance to the system, there can be no such thing as excess sediment, as the stream will have adjusted to the sediment supply in some manner. A change in sediment supply must have some consequent impact, if there is sufficient runoff to enter and exit the reach.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments

19. Section 7.1.2, page 7-3. The reaches as labeled in this section are backwards from the reaches that are described in section 5.6 of the report. Reach 1 in section 7.1.2 is closest to the Gila River and reach 10 in section 5.6 is closest to the Gila River. Consistency should be maintained throughout the report.

    JEF Response. The labeling will be reversed to be consistent. However, note that the number of reaches selected for the sediment continuity analysis is based on hydraulic characteristics. The number of reaches used in the geomorphic and planning analysis reflected the intent and data of those evaluations, and included geographic features, sources of sediment supply (tributaries), political boundaries, and other non-engineering concerns.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

20. Section 7.1.5, page 7-4. Generally, how deep is the non-scoured layer below the river thalweg?

    JEF Response. The non-scouring layer observed in the active aggregate excavations was generally greater than 10 feet below the existing bed elevation. A statement to this affect will be added to the report.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

The following comments pertain to the HEC6 modeling done in support of this project.

21. How was the 1 cfs incoming load rate developed for the Hassayampa River? I don't see it in any of the recirculation models.

JEF Response. 1 cfs was added to cover the range of flows from almost 0 cfs. No inflowing sediment load is expected at 1 cfs, so it is set as 0 tons/day. Text will be revised to explain this.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments

22. The total load for 2,000 cfs should be 2365 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

23. The total load for 5,000 cfs should be 6730 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

24. The total load for 20,000 cfs should be 92885 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

25. The total load for 50,000 cfs should be 302446 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

26. The total load for 80,000 cfs should be 666546 tons/day. Load fractions are input correctly.

    JEF Response. The value will be changed.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

27. All models should be commented with the following information: project name, consultant who did the work, the date of the model, and an explanation of what the model is modeling. Also include comments for the different incoming sediment loads by tributary name (Jackrabbit, Hassayampa above study area, and Daggs/Wagner). Comment the flows used in the Q records by stating the start of the USGS mean flow data, end of the USGS mean flow data, start of the 100 year data and the end of the 100 year data.

    JEF Response. Comment records will be added to the HEC-6 models.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

28. The readme.txt file did not include a definition for the basetrib model. Only upon opening it did I discover that it includes the sediment inflow for Daggs/Wagner Wash and Jackrabbit Wash. The readme.txt file should be updated to include a description of this model.

JEF Response. The readme.txt file will be updated as requested.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

29. What will be the true base conditions model that will be used for alternative modeling and dissemination to the public for sand and gravel projects?

JEF Response. The scenario #4 model would be most appropriate for alternative modeling. I believe the report indicates that HEC-6 modeling of individual sand and gravel projects is not the best approach.

FCD Response (3/20/06). FCD acknowledges the JEF response. The report does not explicitly state that the base conditions model should be used for alternative modeling. If one reads the report carefully you can discern this fact due to the models insensitivity to tributary sediment inflow, etc. FCD acknowledges that HEC-6 modeling of individual sand and gravel projects is not the best approach.

30. The Wagner/Daggs Wash sediment inflow for 1000 cfs used the "Sediment Inflow at the upstream boundary" instead of using the "Sediment outflow at the downstream boundary".

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model. That model has zero sediment inflow for Jackrabbit and Wagner-Daggs Wash.

31. Same as comment #30 except for 2000 cfs.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

32. The Wagner/Daggs Wash 4000 cfs total load should be 3494 tons/day. Load fraction is ok.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

33. The Wagner/Daggs Wash 6000 cfs total load should be 12972 tons/day. Load fraction is ok.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

34. The Wagner/Daggs Wash 8000 cfs total load should be 23077 tons/day. Load fraction is ok.

JEF Response. The value will be changed.

FCD Response (3/20/06). FCD has not received any new modeling files other than the base conditions model.

35. The rating curve provided in the model is off by 5000 cfs. For every elevation given the flow rate is 5000 cfs higher than it should be. Either field 4 or field 5 on the RC record is incorrectly input.

    JEF Response. The rating curve will be changed to start from 0 cfs to be more clear. The values were entered correctly, but used a starting discharge of 5,000 cfs.

    FCD Response (3/20/06). The rating curve supplied in the HEC-6 model is still incorrect when compared against Figure 5-7 on page 5-15 of the draft report dated February 2006.

36. The models as well as the report should mention that only flows above 100 cfs where used from the USGS mean daily flow data.

    JEF Response. A comment record will be added to the HEC-6 model input file. The model was changed in response to comment #1 to include flows above 500 cfs.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

37. Why does each particular set of hydrologic data begin and end with 15,000 cfs and 32,200 cfs?

    JEF Response. The values represent the 10-year and 50-year flows and are used to obtain HEC-6 outputs with the average bed elevation with these two flows run for a very small duration. The text will be changed to explain this.

    FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

38. The FCD needs more data to validate the minus flow records provided in the hydrologic data set. This may include more explanation in Section 5.3.1.3 of the report, the HEC-RAS model used to develop the incoming/outgoing relationship, the curve used to develop the flow relationship or any other data that would be useful for hydrologic data evaluation and validation. For example, event # 1675 which should be the peak flow rate for the 100 year hydrograph has the following flow rate sequence:

    EVENT #1675
    Q 35802 -28816 -10820 -10362 23500 7500

    Examination of Table SB-2 for this event gives flow rates that are higher than the hydraulic flow rates identified in Table 3-1 for section 3 of the hydraulic report. Cross sections 4 through 15.11 in Table SB-2 have a flow rate of 85,800 cfs while the same cross sections in Table 3-1 from the hydraulic report have flow rates in the vicinity of 74,000 to 75,000 cfs.

    JEF Response. The 100-year hydrographs shown in Figure 5 3 were obtained by scaling the hydrographs from the HEC-1 hydrology model to the FIS peak flows. In other words, the shapes of the hydrographs were obtained *from the hydrologic modeling (see LHWCMP Hydrology report) and were scaled to give peak flows that matched the FIS study peak flows. This matching was done for the upstream Hassayampa River, Wagner-Daggs Wash tributary system and the Jackrabbit Wash. The flow hydrograph at the downstream end of the HEC-6 model near the Gila River was obtained by adding these three hydrographs. This was done because the HEC-6 model does not have the capability to attenuate the hydrograph as flow goes downstream. The downstream hydrograph obtained through summation of upstream hydrographs results in a hydrograph with peak flows that are higher than the attenuated hydrograph. This approach was adopted as it represents more conservative approach with respect to sedimentation results.*

The text will be changed to explain this.

FCD Response (3/20/06). FCD acknowledges JEF response. Please add a comment in the report that indicates that the flow rate of 35802 cfs is only for the main stem levee reach (below cross-section 2.19) and it is not for the entire river. The peak flow rate below cross-section 2.19 for the entire cross-section including the main stem and overbank flows is 85800 cfs which is higher than 74100 cfs (the FEMA effective).

The following comments are in reference to the Pit Scour-100yr Excel file.

39. The 100 year hydrograph shown on the worksheet "short term method inputs" does not match the DT interval and flow from the headcut and tailcut computations. Cumulative time was used in the computations instead of using interval time in the computations. This will affect the results of the computations. Worksheets should be redone using interval time.

JEF Response. The input data describing the hydrograph had cumulative time instead of time-interval. The input data in the worksheet will be changed.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

40. How was Tf calculated or why was the flow rate of 1,650 cfs used for the filling flow rate for the given pit volume of 24,000,000 cubic feet? Please explain why 1,650 cfs was chosen.

JEF Response. The duration to the fill the pit is computed by comparing the flow volume and pit volume. Tf is determined as when the total flow volume equals or exceeds the pit volume.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

41. The worksheet for the "short term headcut-sand" has Wc = 2.6 * DT ^0.43. Wc should be equal to 2.6 * Q ^0.43. Calculations should be redone using Q raised to the appropriate power.

JEF Response. The spreadsheet will be changed.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

42. Because of the previous comment the remaining columns or variables are incorrect in the "short term headcut-sand" worksheet.

JEF Response. The remaining columns will be changed automatically in the spreadsheet when review comment #47 is addressed.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

43. In the "short term-tailcut" worksheet dimensionless time Tstar should not be cumulative. It should be computed for each time step.

JEF Response. The value will be fixed automatically in the spreadsheet when review comment #45 is addressed.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

44. The maximum possible scour in the "short term-tailcut" worksheet uses the equation for headcut scour from Table 11.1 of the ADOT Manual "Effects of In-Stream Mining on Channel Stability, June 1989." Downstream scour should use equation 11.2 from Table 11.1.

JEF Response. Table 11.1 provides "Sand" bed Scour equations and Table 11.2 provides "Gravel" bed scour equations. Since the sand-bed conditions are valid in this study, the equations from Table 11.1 were used.

FCD Response (3/20/06). JEF used the correct table to obtain the appropriate formulas for the sand bed condition but applied the maximum headcut scour calculation for the maximum downstream scour calculation. This is incorrect use of methodology outlined in the ADOT procedure. Because a comparison is made in the spreadsheet between Ysmax and Ys the downstream pit scour will never exceed one-half of the pit depth. This is acceptable for the headcut scour procedure according to Table 11.1 in the ADOT manual but is not acceptable for downstream scour. Downstream scour may exceed one-half of the pit depth for values of dimensionless time less than 0.84. Consultant should recalculate the downstream scour profile based upon a scour depth of 18 feet.

45. The headcut scour profile in worksheet "short-term scour profiles" does not have values for Ys for each of the values of Ls. The ratio from Table 11.3 in the ADOT manual should have been applied to the Ysmax value of 14.1 feet from "short term-headcut sand" worksheet. This would give the value Ys for each value of Ls.

JEF Response. The table will be updated.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

46. Please review Excel files for the 10-year and the recent floods Excel files and amend Table 5-8 in chapter 5 of the report based upon the previous comments for the 100 year pit scour.

JEF Response. Any changes to the 100-year scenario will be tracked to the 10-year and recent flood scenarios.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

The following comment is in reference to Chapter 7 – Sediment Trend Analysis.

47. Page 7-4, the third bulleted item describing the non-scouring layer in the Hassayampa River. Generally, how deep is the non-scouring layer in the river bed? Can a depth be given in the report?

JEF Response. See response to Comment #20.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

The following comment is from Chapter 8 – Summary.

48. Page 8-1, section 8.1 General Recommendations. Item one recommending adoption of the lateral migration erosion hazard zones should be removed from the text of the report.

JEF Response. At the comment resolution meeting, the District review retracted this comment.

FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

January 30, 2006 Review Memorandum for Chapter 6 (Degerness)

1. The report and the supplied spreadsheet data should reference what the baseline point was for determining the lateral migration distances and any other geomorphologic parameters. The baseline point for the study was the left bank station from the WEST floodplain study.

   JEF Response. The report text was modified as requested.

   FCD Response (3/20/06). The FCD has read chapter 6 several times and we cannot locate what the baseline point is supposed to be for the measured distances. Consultant should be more specific as to where the text is located in chapter 6.

2. The Excel spreadsheet Lateral_migration, worksheet "Cumulative" alternates between the years of 1934 and 1949 when determining the bank station change for stations 0.82 to 5.87 when it appears that 1934 data is available for left bank calculations. Consultant should explain why this was done for this portion of the study.

   JEF Response. There was a formula error in Lateral_migration.xls spreadsheet file, which has been corrected, along with the corresponding table and discussion in Chapter 6.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

3. The Excel spreadsheet Lateral_migration, worksheet "All Data", the columns labeled "Bank Station Change 1934 –1951" should be labeled "Bank Station Change 1934-1949".

   JEF Response. The heading label in Lateral_migration.xls spreadsheet file was corrected.

   FCD Response (3/20/06). FCD acknowledges JEF response. We have no further comments.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: 2-22-06

To: John Hathaway, P.E., Project Manager

From: Mike Duncan, PE, CFM, Flood Delineation Branch

Subject: Lower Hassayampa WCMP
Floodplain Delineations (Jackrabbit and T2N-R5W-S27N Washes - WEST Consultants)
Review Comments

Object of review: Floodplain work maps received on 2-1-06, and
Draft TDN dated December 2005

1. On all work map sheets, at just below ELEVATION REFERENCE MARKS, NATIONAL GEODETIC should be replaced with NORTH AMERICAN.

2. On all work map sheets, at ELEVATION REFERENCE MARKS, this format should be used:

ELEVATION CONVERSION FACTOR: NGVD29 ELEV. = NAVD88 ELEV. - X.XX FT.

3. At the work map lines of comments 1 and 2 above, the font size is much too small.

4. On all work map sheets, at the NOTES, the font size should be increased.

5. On all work map sheets, at the CROSS SECTION legend, "Encroached" should be replaced with "Floodway".

6. The work maps need a cover sheet that includes: vicinity map, a township-range-section grid, major road names, contract information, etc.

7. On sheets 2, 3, 5, 6, 7, 10, etc., the legend for the county boundary should be removed, and the legend for the corporate limits should like that of the other sheets.

8. On map sheet 15, at the corporate limits legend, "corporate" is misspelled.

9. On map sheet 10, around xsec. 4.164, a "stub" of Administrative Floodway is needed to connect the new Zone AE to the existing (tributary) Zone A with Administrative Floodway.

10. On map sheet 11, just upstream of xsec. 4.921, a new Zone A is needed to connect the new Zone AE to the existing Zone A.

11. On sheet 12, at the west part of xsec. 5.868 , add a Zone A note and the correct heavy line for the narrow wedge of new Zone A.

12. On sheet 14, at the west end of xsec. 7.003, add a Zone A note for the wedge of new Zone A.

13. As you know, the final cover sheet of the TDN will need an engineer's stamp.

14. Add FEMA application form MT-2 Form 1 to the TDN

    Community number for TOWN OF BUCKEYE is 040039

    Community number for MARICOPA COUNTY (UNINCORPORATED AREAS) is 040037,

  including a MT-2 Form 1 Page 2 of 2 for Town of Buckeye

    Woodrow C. Scoutten, P.E., Town Engineer

    leave phone number blank,

  and including a 2nd MT-2 Form 1 Page 2 of 2 for Maricopa County (Unincorporated Areas)

    Timothy S. Phillips, P.E., Chief Engineer and General Manager

    phone 602-506-1501

15. Remove form MT-2 Form 3. (I do not see any information, such as structures, on it.)

16. A disc with all of the RAS files needs to be included in the TDN.

17. A full paper copy of the RAS report file needs to be included in the TDN.

District Review Comments

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: September 20, 2004

To: Greg L. Jones, PPM

From: Catherine W. Regester

Subject: Lower Hassayampa WCMP
Draft Hydrology Submittal

I have completed my review of the subject submittal and have the following questions/comments for the consultant:

1. HEC-FFA is the FEMA approved frequency analysis software and should be used instead of HECWRC.
2. Please provide a discussion of the quality of the data being used in the frequency analyses. This discussion should include such items as period of record, discontinuous data, "historical peaks" (particularly, at the Box Canyon gage – what happens if the three historical peaks are not included in the analyses?), "estimated peaks", recorded discharges only above a certain value, etc. How would "0" discharge for some of the missing years affect the analyses? References for the data used in the analyses should also be included in the report.
3. It appears that the data used in the frequency analyses may be a mixture of summer and winter storms. Please check and justify the treatment of the data per the guidelines in Bulletin 17B.
4. Regarding the gage at Morristown, for the years 1954 and 1956, the published USGS data (the 5th reference in your list) shows "0" discharge for these two years. The USGS website has no value listed for these two years. You, also, have not included this data in your analyses. Please explain. What effect would including these years as 0 cfs have on the analyses. Additionally, for the discharge on Nov. 18, 1986, the date is mistakenly input as the year 986.
5. Regarding the analysis at the gage at Box Canyon: For the year 1993, the discharge input into the HECWRC is 25,640 cfs. Please identify the source of this discharge value.
6. On page 8 of the report, the last paragraph refers to a "pink" area on Figure 6. However, there doesn't appear to be a "pink" area on Figure 6. Should this be the "hatched" area?
7. Please include the actual regional regression equation(s) in the report.
8. Please include a land use map in the report and explain how the hydrologic parameters for the land uses were obtained. Cite references and/or show photos, if necessary. Please include photos to support the selection of Kn values.

9. Are there any areas of rock outcrop in the soils?

10. Please explain the assumption of 1.5 for the flood wave celerity in Table 11. Wave celerity is a velocity. However, the 1.5 in the table does not appear to have units. Is the value 1.5 a ratio of the wave velocity to the average cross section velocity based on a particular shape channel? If so, please give references to justify the selection of 1.5.

11. What Q was used in the HEC-RAS to determine the RAS travel time? Please include the HEC-RAS digital data and hard-copy printout in the next submittal.

12. For the simplified HEC-1 model, it is not clear why sub-basin H1 would be generating less runoff than sub-basins H2. Please explain.

13. Please label concentration points and gage locations on the watershed map.

14. The results of the frequency analyses are showing attenuation of flows as you move down the watershed. From Table 12, the simplified HEC-1 is showing the opposite, with flows increasing as you move downstream. It would seem that more calibration of the HEC-1 model to the gage data is needed. For example, the precipitation distribution for the 1951 storm is available in the Corps' Design Memorandum No. 2 Hydrology Part 2 (plate 23). It should be used instead of the SCS Type II distribution for this 1951 storm. Since the storm did not cover Jackrabbit Wash watershed, this would be appropriate for calibration of the upstream sub-basins. If the observed hydrograph is available, it is recommended that the HEC-1 optimization method be used to calibrate the LG cards.

15. Why was 55,000 cfs chosen as the Q for the WCMP? The highest flow from the frequency analyses was 52,500 cfs. Would 52,500 have been more appropriate? It would seem, if we were confident with the results of the frequency analyses, we would accept the results at each of the gages instead of applying one value to the entire system. Please explain why one value was chosen. If there is some question regarding the reliability/quality of the data (see comment #2) and a reason for not accepting the results of the new frequency analyses or not accepting the results as being more reliable than the previous analyses, then, please provide an explanation in the report.

16. The last sentence of the section *Interpolation of Qs for different locations* says: "Additional analysis of attenuation effects will be performed as part of the detailed hydraulic modeling portions of the WCMP." Does this mean that you intend to revisit the Qs during the hydraulic analyses? If not, I think attenuation should be looked at now – particularly at the confluence with Jackrabbit Wash.

17. We need to address potential channelization as a part of the future conditions analysis. This was the method we had discussed for analyzing future conditions during the scoping meetings.

18. Please include the "WCMP – routed Morristown" hydrograph on Figure 22.

19. Only one set of peak discharges is proposed for the HEC-6T analyses. Is it reasonable to apply the same discharges to the entire reach of the river – particularly both upstream and downstream of the confluence with Jackrabbit Wash?

cc: Bing Zhao
John Hathaway

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: September 30, 2004

To: File

From: John Hathaway

Subject: Lower Hassayampa WCMP
Draft Data Collection Report

I have completed my review of the subject submittal received September 23, 2004 and have the following questions/comments for the consultant:

Table of Contents

1. Appendices: As-Builts – List the facilities included in the As-Built plans.

2. Appendices: CD-ROMs – List of the contents of each CD-ROM. This need not be detailed. Something similar to the labels on the CD-ROMs will be sufficient.

3. Appendices: Provide an "Addenda" place-holder appendix for "additional data… discovered during the course of the study…[to be] added to this report," as mentioned in the Executive Summary. This can be used to list such material if needed.

Executive Summary through Data Collection Results – No Comments.

Engineering

4. Page 8: *Watershed Work Plan, Buckeye Watershed (SCS, 1963)* – Regarding Buckeye FRS No. 1, 2, and 3. The text states, "Only Buckeye FRS No. 1 has an effect on the LHWCMP study reach." Per conversation with Brett Howey, FCD Dam Safety (602-506-4609, bah@mail.maricopa.gov), the Buckeye FRS No. 1, 2, and 3 are interconnected, and drain impounded water through the FRS No. 1 outlet. He's working on the Buckeye Infrastructure Rehabilitation project. Valerie Swick, FCD Planning Branch (602-506-2929, vas@mail.maricopa.gov), is project manager for the Buckeye-Sun Valley ADMP. Part of that effort will look into hydrology and hydraulics of the FRS and the several irrigation canals below the FRS. My sense is the impact of all three FRS draining through the FRS No. 1 outlet would not have any significant effect on the peak flow into the Hassayampa River, but would affect the duration of flow. My notes from the internal coordination meeting with Brett and Valerie indicate a 10-day

drawdown of the FRSs for the 100-year event. Please check with Brett and Valerie and revise the text to reflect the interconnection of the three FRSs.

5. Page 9: *CAP Siphon Design (Maish, 1976)* – In reference to the "pdf of two Maish reports are included in the Data Collection Report," please note on which CD-ROM these can be found.

6. Page 10: *CAP Bank Stabilization (Higgins & Lynch, 1997)* – Same comment on the pdf for this report.

7. Page 11: *Hassayampa River Flood Insurance Re-study (Cella Barr & Associates, 1988)* – Minor typo in last sentence ("HEC-2 models are provided on CD with this report.") and same comment on which CD this is located. Same typo and comment on the last sentence of the succeeding paragraph regarding the Dames & Moore FIS.

8. Page 12: *CAP Bank Stabilization* – Minor typo in next to last sentence, "and threats to delivery of water to needed areas."

Historic Aerial Photography

9. Table 1: General comment – indicate the number of the CD where the "Other" column in the table indicates the photos are on CD.

Historic Ground Photos

10. Tables 3, 4, and 5: General comment – Add column or otherwise indicate which CD each photo is located.

Existing and Future Land Uses

11. The proposed development projects of Belmont, Douglas Ranch, Trillium, Sun Valley, and Sun Valley South are adjacent to or overlap the Hassayampa River and Jackrabbit Wash. It is essential that the existing Development Master Plans or the equivalent be considered in formulating the LHWCMP. The existing plans of development need to be reviewed and pertinent portions included in the Data Collection Report. The Town of Buckeye and Maricopa County Department of Planning & Development should be contacted to review the applicable documents, ascertain their approval status, and obtain copies of the appropriate portions of these project plans. Would the hydrology and hydraulic design for Sun Valley Parkway be a useful document to locate? I believe it was produced by Collar, Williams and White Engineering (now Rick Engineering) c. 1987. MCDOT may have a copy, due to their involvement with the project.

Sand and Gravel Mining

12. Per the September 10, 2004 Stakeholder Meeting with Arizona State Land Department, there is a feasibility study and mineral assessment underway to guide ASLD asset management with regard to marketing State Trust Land for sand & gravel mining purposes. It has also been rumored that the proposed major developments, cited above in comment #11, have designated certain areas for aggregate mining to support the

respective development projects. To the extent information on potential mining sites is available it needs to be included in the Data Collection Report.

Existing Facilities Exhibit

13. There needs to be more information on existing facilities, either in the text or on the exhibit, itself. The specifics are as follows:

- According to David Boggs, FCD Sand & Gravel Mining Permit Branch (602-506-4715, dbb@mail.maricopa.gov), there is a fiber-optic line located two hundred feet or so south of the Tonopah-Salome Highway. It is also just upstream of an active sand & gravel mining pit. With only about 13 feet of cover, potential head cutting could threaten it. As-builts for the fiber-optic line along with information on the mining permit are available from Tom Wergen, FCD Sand & Gravel Mining Permit Branch (602-506-7591, tew@mail.maricopa.gov). Be aware that a survey blunder was discovered during the permitting process. It is believed the surveyor mistook a property corner for a section corner, resulting in a discrepancy between the record location and the actual location of the fiber-optic line on the order of 3,000 feet. Verify the location in light of this, though the records may have already been corrected. Ownership of this utility should be determined along with the ownership of the fiber-optic line shown to cross downstream of the Union Pacific Railroad bridge.

- Inspection of aerial photographs in the vicinity of the confluence of Daggs Wash and Wagner Wash with the Hassayampa River leave some questions about how many power transmission lines cross the river. This is based on the apparent convergence of three faint lines representing construction/maintenance roads for the respective power lines. These three roads are also shown on the Existing Facilities Exhibit map. Please verify the number, location, and alignment of power transmission lines in this vicinity.

- All power transmission lines should be identified by name and voltage (e.g. Parker Dam-Phoenix 161 kV Power Transmission Line, Mead-Liberty 345 kV Power Transmission Line, etc.) and ownership (e.g. Western Area Power Authority or WAPA, Arizona Public Service, Pinnacle West Capital Corporation, Salt River Project, etc.).

- As-builts should be obtained for the transmission tower foundations, including type of foundation (cast-in-place reinforced concrete spread footing, cylindrical pier, pile, or "grillage" type foundation) and depth and the precise location of individual towers within the LHWCMP corridor. This is necessary to evaluate potential threats to these facilities from lateral migration and stream bed degradation. Paul Richards, Senior Project Leader – Transmission Construction Projects for APS might be able to provide guidance on transmission line name, voltage, and ownership along with obtaining as-builts. A two-year old business card of his lists his phone number as (602) 371-6186 and email address as paul.richards@aps.com. Give him my regards.

- This comment is specific to the Existing Facilities Exhibit. Are the locations of the power transmission towers on the aerial photograph of the Daggs Wash/Wagner Wash area accurate or merely schematic? If they are accurately located, the exhibit is more useful by giving a sense of which towers may be impacted by the river. If not, there should be some explanation of how these facilities will be evaluated. The usefulness of the ground photograph of the three power transmission lines south of I-10 is limited. It does give a sense that the towers are near the cut bank, but it doesn't show "how close" or illustrate the character of the overbank area to aid in evaluating threats due to lateral migration and degradation. I suggest this photograph be supplemented with an aerial photo like the one for the three lines crossing the Hassayampa River near the Daggs Wash/Wagner Wash confluence.

• It is my understanding that the petroleum pipeline downstream of the Union Pacific Railroad Bridge belongs to Kinder-Morgan. As-builts should be obtained for this pipeline. Besides Kinder-Morgan, the Arizona Corporation Commission might be a source of as-builts.

• Starting from the upper left hand corner of the Exhibit and working down the left side and up the right side, add the following labels: Union Pacific Railroad and bridge to the aerial photo depicting the location of the fiber-optic line and petroleum pipeline; Old US Hwy. 80 and Salome Hwy. to the aerial of the same; the Gila River on the aerial and map; and Buckeye FRS No. 1 and outlet on the aerial depicting I-10.

References

14. Page 38: Phillips, Jeff V., et al., 1998, Method to estimate effects of flow-induced vegetation changes on channel conveyances of streams in central Arizona, prepared in cooperation with the Flood Control District of Maricopa County…there appears to be repeated or garbled text.

15. Page 39: Roeske, R.H., 1971, Floods of September 1970 in Arizona, Utah, and Colorando – minor typo.

Plates

16. Plate 2 – Recent Satellite and Aerial Photo Imagery: What is the band(s)/type of satellite imagery (e.g. Near IR, false color IR, etc.)?

17. Plate 3 – Existing and Future Land Uses: Regarding sand & gravel mines, the text describes 4 permitted and 2 closed aggregate mines. Plate 4 shows these referenced to the parcel boundaries and permit numbers. Is there a discrepancy on Plate 3 that shows only three aggregate mining land use sites that appear to correspond to FA96-032, FA0-049, and FA00-161? What about FA95-022 (closed), FA01-113, and FA93-001 (closed)?

All-in-all, the Data Collection Report is well put together. Most of the comments are minor. There are important pieces of information that need to be included: proposed development plans and potential sand & gravel mining areas – conceptual as they may be, a fiber-optic line that was missed, more specific identification and accurate location of power transmission lines and towers, as-builts of transmission tower foundations and the petroleum pipeline, and identification of utility owners.

cc: Jon Fuller

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: October 4, 2004

To: John Hathaway, PPM

From: Catherine W. Regester

Subject: Lower Hassayampa WCMP
Draft *Selection of Manning's Roughness Coefficient*
Proposed Cross Sections, Bank Stations, and Hydraulic Baseline
Submittal of August 23, 2004

I have completed my review of the subject submittal and have the following questions/comments for the consultant on the Draft 'n' value report:

1. The 'n' value determinations need to follow the procedures presented in the District's *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*, including the determination of a 'n' value for the bed material and the three additional components as described in the publication.
2. It does not appear that the 'n' value determinations have considered the depth of flow to the height of the vegetation. The Draft report, for many of the 'n' value category descriptions, refers to photographs in the District's publication (noted in #1 above) for back-up verification of the chosen 'n' values. However, in the District's publication, most of the 'n' values are shown as varying with the depth of flow. It is not clear why the depth of flow has not been considered for the 'n' value selection. If comparisons are to be made to the published photographs, depths of flow, as well as vegetative type and cover, should be considered.
3. For most of the 'n' value categories, it is stated that the chosen 'n' value was determined "to be on the conservative side". Please note that what is "conservative" in one aspect of the study, may not be in another. The District prefers to see the most reasonable estimate of the 'n' values as substantiated by the photographs and calculations and not to see the assignment of a "conservative" value.
4. There are two cross sections in the District's 'n' value publication which are within the study area: At the CAP Canal and Below Old U.S. Highway 80. I realize that changes may have occurred over the years, but are these applicable to any areas in the Draft report.
5. In the first paragraph of page 5 of the Draft report, it says that "On page 87, Thomsen and Hjalmarson (1991) use an n-value of 0.027 to describe the sandy channel shown in photographs 25C and 25D". It appears to me that they used 0.025. Please check.
6. For the "Agricultural" category, please provide a discussion of what types of crops are typically grown in the area and at what stage of growth the crops may be during the 100-year flood event. I will provide a copy of a USDA, Agricultural Research Service publication

(*Friction Factors for Vegetated Waterways of Small Slope*, Jan. 1977) which presents the results of some studies on various crops, including cotton, sorghum, and wheat. This may or may not be of use. Obviously, the flows in the test studies are much smaller than the Hassayampa flows.

7. In the Draft report, the photographs refer to a WPT#. What is this?
8. Although coordinates for the photographs are helpful, please provide a description referring to the HEC cross section number and the channel, left, or right overbank.
9. Please provide a discussion of how the chosen 'n' values compare to those in the effective HEC-2 study. If differences, please explain.
10. I have not checked in great detail, however, in looking at the 'n' value shape file coverage, I noticed at cross section 18.52, there is an area of Tall Sparse Vegetation (Channel) which is shown completely in the left overbank area. The 'n' values are shown in the report as different for channel and overbank. If this is actually the case, then the channel/overbank areas need to be closely checked. In some areas, the 'n' values are shown partially within the channel and partially within the overbank. How was it determined which 'n' value should apply?
11. There is a "Disturbed Area" shown in the shape file coverage between cross sections 8.13 and 9.64 in the right overbank. Please check and verify that this is correct.
12. Please correct the spelling of "Coefficient" on the cover sheet of the report.

My comments on the proposed cross section alignments, bank stations, and hydraulic baseline are as follows:

1. Using the proposed methodology for setting the hydraulic baseline, there are several instances where the flows (based on the effective study) are not parallel to the baseline and not perpendicular to the cross section. For example, please see cross sections 19.56 and 19.66. Looking at the effective flooding and the new baseline, I would expect the cross section alignments for these two sections to be closer to the effective than to the proposed alignments. Additionally, please review the alignment of effective and new cross section 19.47.

2. Generally the cross section's position along the hydraulic baseline is used for the channel reach length. Please review the alignments and position of the baseline to ensure that the hydraulic model will be appropriate for the Sediment Transport Analysis.

3. Please review the right bank stations at cross sections 5.19 to 5.76, 13.42 to 14.08, and 21.65 to 22.59.

4. Please explain the re-alignment of the cross sections in the left overbank downstream of Old US Highway 80.

5. For future submittals, I would like to receive a strip map with all pertinent data plotted for review.

cc: Bing Zhao
John Hathaway

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: February 9, 2006

To: John Hathaway, P.E., Project Manager

From: Kathryn Gross

Subject: LHWCMP River Behavior Report- December 2005 submittal

The following are my comments on the River Behavior Report submitted in December 2005. The primary portion of my review encompasses Chapters 1-3, 7, 8, 9 and 10. I have also included supplemental comments regarding Chapter 6 although the primary review function was provided by others at the District.

Chapter 1

1. No concerns.

Chapter 2

1. On page 2-3, Channel Width, Pattern and Sinuosity – Could an "old school" citation be included along with the Rosgen citation?
2. On page 2-8, Figure 2-5 – Was there rectification issues between the 1934 set and the 1964 and 2005 sets of aerial photography? Is the wash that appears just east of the white tank wash deposit area in the 1964 and 2005 photos White Tank Wash? No action required.
3. On page 2-97, 2.9 Summary – Could a summary of the avulsion discussions be added here as well?

Chapter 3

1. Page 3-8, 3.3.1 Geomorphic Mapping and Lateral Stability – Interesting addition of minimum rate "equation" of width of floodplain corridor and vertical changes between surfaces. No response required.
2. Page 3-9, 3.3.2.1 Previous Geologic Mapping – Please include the geologic maps used for the study in the appendices.
3. Page 3-10, 3.3.3 Geomorphic Units – Breakdown of units is reasonable. Excellent descriptions provided. I like how the percentages of the units are presented as well.

4. Page 3-16, 3.4.1.1 Soil Development – What is the intent of presenting the soil development information? It appears that general descriptions of the horizons are supplied and occasionally the information is tied back to the Hassayampa study. Should each horizon have a general description as well as a connection back to the Hassayampa as to how this layer was either represented or not? For example, A horizon gives just a general description, B horizon Clays starts with general description includes a sentence mentioning the study area then goes back to general description. B horizon Calcium Carbonate provides only a general description, no mention of lack or prevalence of Calcium Carbonate in the study area. C horizon provides only study information.

5. Page 3 –19 3.4.1.2 Soil Pit Analyses – Please make sure the soil pit data is included in the appendices as text states (appendix X).

6. Page 3-23, Table 3-3 Pit ID 24 – District recommends using a more flattering picture for the spoil material.

7. Page 3-58, 3.5.2 Results – Could an additional discussion be added regarding the consistency or lack thereof of the extent of each geomorphic unit? Did reaches with bars tend to always have bars in the same area? Did that amount of floodplain terrace area change significantly over time? Also, based on the analysis is there a preferred flood form or pattern and a preferred low-medium flow form or pattern?

8. Overall the geomorphic unit mapping appears reasonable. One question regarding Reach 2, shown on page 3-27 Figure 3-9, towards the southern end of the reach on river left the geomorphic unit is classed as tributary deposits. Does this area really exhibit more influence from the tributaries than the river? No action is expected to be taken by the consultant.

9. Page 3-80, 3.7 Summary first bullet – Classification mentions stability. Doesn't classification cover pattern as well? Could channel pattern be covered in the summary somewhere?

10. Overall, geomorphic information provided appears reasonable.

Chapter 4 - Not reviewed.

Chapter 5 – Not reviewed.

Chapter 6

1. Lateral migration analyses and report text appear reasonable (6.1-6.4)

2. Erosion Zones. Discussion on methods appears reasonable. A description of what technical information formed the basis of each erosion zone appears reasonable. However, based on the results some of the erosion zones seem a little extreme.

3. Erosion Zones. It may be reasonable to include discussion on level of scale of the analysis. This may come in handy for individuals along the Pleistocene-Holocene boundary.

4. Severe Zone. Some active channel and bar areas are minor (small avulsion locations?) which may be pushing the extent to somewhat unrealistic distances when the minimum distance is

measured from these locations in the overbank area. Could the minimum distance be applied only to the main channel?

5. Severe Zone. Some locations appear to be more impacted by avulsive or high velocity overbank flows. Since these locations may not be impacted by bank retreat would they be better classified in the lateral migration zone? If the avulsion hazard is more severe on the Hassayampa River that the consultant feels it needs to belong in the severe category, please include discussion in the severe category stating that the zone contains both bank retreat and avulsion channel changes.

6. Lateral Migration. Some locations along the lateral migration zone appear to be excessive. A majority of the delineation actually lies outside of the floodplain. In these locations it is questionable as to whether planning and development would even look to see if erosion should be a problem. Although the geomorphology indicates that there is high erosion potential, is it appropriate to base the zone's extent on maximum changes in the whole reach?

7. Long Term. Limited review was performed as this is just an informational zone for the District. No concerns were identified.

8. Jackrabbit Wash Erosion Zone. Appears reasonable. Limited Level 3 identifying the boundary between the Holocene and Pleistocene geologic units was performed.

9. Specific locations. Attached is a shape file (ehzquest.shp) containing points in general locations where the erosion zones seemed excessive. Points 1-16 are locations where the severe zone appeared excessive with the exception of point 7 which appeared under conservative (does not appear to be set 511 feet back). Points with no identification numbers refer to general locations where the lateral migration zone appears excessive. A comment column is partially filled out in the shape file as well. Time constraints limited my ability to present my comments in my standard form.

Chapter 7

1. No comments.

Chapter 8

1. No comments.

Chapter 9

1. No comments.

Chapter 10

1. No comments.

Appendices

1. No appendices were provided for my review. Please make sure all pertinent information is included in the appendices for the final report

Digital Data

1. Please provide all shape files used to develop data for the River Behavior Report, including geomorphic units for each year of analysis.

Typographical Errors and Misc.

1. Page 2-98, last paragraph – Please correct "Sediment Trent Analysis" with "Sediment Trend Analysis".

2. Page 3-11 – In the text describing the geomorphic units it states that seven units were interpreted. Only six are included in the bullet list. IT appears that Tributary Deposits are the unit missing from the list.

3. Page 3-12, 3.3.3.2 end of paragraph – Please correct "with minor gravels, somewhat usually". Should it be "somewhat" or "usually"?

4. Page 3-15 – Is anything supposed to be on this blank page?

5. Page 3-17 – Soil Pit Analyses. Presently it appears that two outline numbers are provided. Please correct.

6. Page 3-25, Results – The first sentence still contains placeholder information for the exhibits and appendices please make sure the correct exhibit and appendix references are applied for the final report.

7. Page 3-68 Hey Equation – In the current text there is a Microsoft Word text stating a reference is missing. Please correct for final report.

8. Page 6-20, 6.5.1.3 Geomorphic Mapping – In the second paragraph please correct "were made to distinguish are at imminent risk…" with were made to distinguish areas at imminent risk…"

I have no more comments at this time.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: January 30, 2006

To: John Hathaway, P.E.

From: David Degerness, P.E.

Subject: Lower Hassayampa Watercourse Master Plan: Chapter 6, Lateral Migration Analysis by JE Fuller. Submitted to the District in December, 2005.

I have finished my review of the above referenced document and I have the following comments. JE Fuller should provide written responses to the comments.

1. The report and the supplied spreadsheet data should reference what the baseline point was for determining the lateral migration distances and any other geomorphologic parameters. The baseline point for the study was the left bank station from the WEST floodplain study.

2. The Excel spreadsheet Lateral_migration, worksheet "Cumulative" alternates between the years of 1934 and 1949 when determining the bank station change for stations 0.82 to 5.87 when it appears that 1934 data is available for left bank calculations. Consultant should explain why this was done for this portion of the study.

3. The Excel spreadsheet Lateral_migration, worksheet "All Data", the columns labeled "Bank Station Change 1934 –1951" should be labeled "Bank Station Change 1934-1949".

2801 West Durango Street   Phoenix, Arizona 85009   Phone: 602-506-1501   Fax: 602-506-4601

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: January 23, 2006

To: John Hathaway, P.E.

From: David Degerness, P.E.

Subject: Chapter 5 Sediment Transport Analysis, Chapter 7 Sediment Trend Analysis; Chapter 8 Summary: Lower Hassayampa River Watercourse Master Plan supplied to the FCD December 2005.

I have finished my review and I have the following comments for the above referenced documents. JE Fuller should provide written responses to each of the comments and submit them back to the District so we know they have read and understood all the comments.

1. Figure 5-2 indicates the mean daily discharges used in the HEC6 modeling. I have tried running several of the models and they take considerable time to run. How necessary is it to run all the mean discharges in the model? There are many flows that seem insignificant from a sediment transport standpoint. Can the flows be cut back to include only those flows above a certain threshold, say the channel forming discharge?

2. Section 5.3.1.2 discusses scaling of the HEC-1 model results to the peak discharges established by FEMA in the effective FIS for each tributary. The consultant should discuss the scaling procedure in more detail for the reader and explain why the scaling was done. Are the FEMA effective discharges that much different from the LHWCMP produced hydrology for the washes?

3. Section 5.3.1.3 discusses the leveed reach and how flows are taken out of the system. It was determined that 3 flow changes in Reach 1 were sufficient to model the flow changes. Figure 5-4 appears to indicate that for the 75,000 cfs flow there are four flow change locations as is indicated by four flow plateaus. I do not know which is correct or if I am interpreting the figure incorrectly. Perhaps additional graphics or explanation in the section will clarify this situation for the reader.

4. Figure 5-5. Is this the final sediment inflow rating curve for the Hassayampa River or one of the tributaries? The caption for figure 5-5 should be described as saying this is the curve for the Hassayampa River.

5. Section 5.4.1, page 5-7. The consultant should remove the statement "If this assumption is valid,". The previous sentence states the assumption in this technique. The validity of this assumption shouldn't be called into question any more that it has been by the previous statement.

6. Section 5.4.1, page 5-7. Why were the flow rates of 500 to 80,000 cfs chosen for incoming sediment load development? Consultant should elaborate as to why these were chosen.

7. Sections 5.4.2 and 5.4.3, pages 5-7 and 5-8. What flow rates were used for incoming sediment load development for Jackrabbit and Wagner Washes? Consultant should list those flows and describe why they were used for load development.

8. Table 5-3 on page 5-16 is supposed to summarize the base modeling results as well as the results from modeling scenarios #1 and #2 as is described in the middle paragraph on page 5-15. Table 5-3 should either be improved, discussed in more detail or another table made which reflects the results on the inflow calibration and the n value calibration.

9. The column titled "04-88 Difference" in table 5-3 should be labeled "04-87 Difference" since that is the basis of your comparison.

10. It appears in reading section 5.5.3 of the report that model calibration was performed using the 1987 FDS model for scenarios 1 to 3 and that scenario 4 used the 2004 WEST HEC-RAS model for base model development. Was the basis for the calibration in scenarios 1 to 3 to try to obtain the 2004 profile or channel geometry by systematically changing the modeling parameters for the 1987 FDS model? I am reading the words "improve the forecast of the 2004 channel topography". Please describe in more clear words the purpose of the model calibration.

11. Figure 5-11 on page 5-20 indicates two bed change profiles, one with the 10 year discharge and one with the 50 year discharge. The text on page 5-19 that describes this figure does not mention anything about what the figure 5-11 is depicting. Consultant should describe the scenarios the figure is showing.

12. Section 5.5.4, page 5-24. The modeling results should reference a profile plot of the Hassayampa River for the thalweg elevation or the average bed surface elevation showing the initial bed profile and the ending bed profile. This should help in discussing the modeling results.

13. Somewhere in the report a table and explanation to go along with it should be provided describing the total sediment load that has passed through the system at the end of the USGS mean flow data and at the end of the entire hydrologic modeling sequence. This should be done for the base model.

14. Consultant should also provide a 100 year model and describe those results via a bed profile graph and discuss the total sediment load passing through the system.

15. Section 5.6.1.1, page 5-24. A figure or set of figures should be provided that show the 10 reaches used in this analysis.

16. Section 5.6.1.1, page 5-24. A figure should be provided showing the 100 year hydrograph and its discretization. Also, the peak flow rate of 75,000 cfs does not match the peak flow of 57,000 cfs provided in figure 5.3 of the report.

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

17. Tables 5-4 and 5-5 have numerous errors in the "total" boxes for several reaches.

18. Section 5.6.2, page 5-27. The consultant should define the safe yield term as used by ADOT.

19. Section 7.1.2, page 7-3. The reaches as labeled in this section are backwards from the reaches that are described in section 5.6 of the report. Reach 1 in section 7.1.2 is closest to the Gila River and reach 10 in section 5.6 is closest to the Gila River. Consistency should be maintained throughout the report.

20. Section 7.1.5, page 7-4. Generally, how deep is the non-scoured layer below the river thalweg?

The following comments pertain to the HEC6 modeling done in support of this project.

21. How was the 1 cfs incoming load rate developed for the Hassayampa River? I don't see it in any of the recirculation models.

22. The total load for 2,000 cfs should be 2365 tons/day. Load fractions are input correctly.

23. The total load for 5,000 cfs should be 6730 tons/day. Load fractions are input correctly.

24. The total load for 20,000 cfs should be 92885 tons/day. Load fractions are input correctly.

25. The total load for 50,000 cfs should be 302446 tons/day. Load fractions are input correctly.

26. The total load for 80,000 cfs should be 666546 tons/day. Load fractions are input correctly.

27. All models should be commented with the following information: project name, consultant who did the work, the date of the model, and an explanation of what the model is modeling. Also include comments for the different incoming sediment loads by tributary name (Jackrabbit, Hassayampa above study area, and Daggs/Wagner). Comment the flows used in the Q records by stating the start of the USGS mean flow data, end of the USGS mean flow data, start of the 100 year data and the end of the 100 year data.

28. The readme.txt file did not include a definition for the basetrib model. Only upon opening it did I discover that it includes the sediment inflow for Daggs/Wagner Wash and Jackrabbit Wash. The readme.txt file should be updated to include a description of this model.

29. What will be the true base conditions model that will be used for alternative modeling and dissemination to the public for sand and gravel projects?

30. The Wagner/Daggs Wash sediment inflow for 1000 cfs used the "Sediment Inflow at the upstream boundary" instead of using the "Sediment outflow at the downstream boundary".

31. Same as comment #30 except for 2000 cfs.

32. The Wagner/Daggs Wash 4000 cfs total load should be 3494 tons/day. Load fraction is ok.

33. The Wagner/Daggs Wash 6000 cfs total load should be 12972 tons/day. Load fraction is ok.

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

34. The Wagner/Daggs Wash 8000 cfs total load should be 23077 tons/day. Load fraction is ok.

35. The rating curve provided in the model is off by 5000 cfs. For every elevation given the flow rate is 5000 cfs higher than it should be. Either field 4 or field 5 on the RC record is incorrectly input.

36. The models as well as the report should mention that only flows above 100 cfs where used from the USGS mean daily flow data.

37. Why does each particular set of hydrologic data begin and end with 15,000 cfs and 32,200 cfs?

38. The FCD needs more data to validate the minus flow records provided in the hydrologic data set . This may include more explanation in Section 5.3.1.3 of the report, the HEC-RAS model used to develop the incoming/outgoing relationship, the curve used to develop the flow relationship or any other data that would be useful for hydrologic data evaluation and validation. For example, event # 1675 which should be the peak flow rate for the 100 year hydrograph has the following flow rate sequence:

    EVENT #1675

Q 35802 -28816 -10820 -10362 23500 7500

Examination of Table SB-2 for this event gives flow rates that are higher than the hydraulic flow rates identified in Table 3-1 for section 3 of the hydraulic report. Cross sections 4 through 15.11 in Table SB-2 have a flow rate of 85,800 cfs while the same cross sections in Table 3-1 from the hydraulic report have flow rates in the vicinity of 74,000 to 75,000 cfs.

The following comments are in regards to the QuickSedTrans excel spreadsheet.

39. The Meyer-Peter-Mueller equation (1948) is based on the Metric System. Equation was coded as English units. Input parameters should be converted to metric and results converted back to English. Or you can use English unit equations converted by the Bureau of Reclamation (Simons and Senturk, 1992).

40. In the Toffaleti Sub routine of the VBA code the following sequence was observed:

```
If (zom< (1.5*zv)) then
    Zom= 1.5*zv
End If
```

It should be coded:

```
If (zom < zv) then

        Zom =1.5*zv

End If
```

41. In Toffaleti subroutine Mi was coded as: Mi=f4 * gssLi / (yaf4 – ddf4). It should have been coded: Mi=f4 *gssLi / (yaf4 –ddf4) *f4. Multiplication by f4 was not included in the code.

42. A reference should be given for the friction factor equation coded as the following:

    Friction_factor = (2.82843 / (bcoeff – 3.75 + 2.5 * Log (2# * (flow_depth_in_ft / d90)))) ^ 2#

43. In the fifth to last line in the code a conversion was used. That conversion number should be 86400 instead of the coded 84600.

44. Please review your code because we found a few errors after our review. Please put detailed comments in the code such as reference, equation numbers in the reference and variable definitions. We know you used ASCE Manual 54, but you need to put reference in code and chapter 5 of the report.

The following comments are in reference to the Pit Scour-100yr Excel file.

45. The 100 year hydrograph shown on the worksheet "short term method inputs" does not match the DT interval and flow from the headcut and tailcut computations. Cumulative time was used in the computations instead of using interval time in the computations. This will affect the results of the computations. Worksheets should be redone using interval time.

46. How was Tf calculated or why was the flow rate of 1,650 cfs used for the filling flow rate for the given pit volume of 24,000,000 cubic feet? Please explain why 1,650 cfs was chosen.

47. The worksheet for the "short term headcut-sand" has Wc = 2.6 * DT ^0.43. Wc should be equal to 2.6 * Q ^0.43. Calculations should be redone using Q raised to the appropriate power.

48. Because of the previous comment the remaining columns or variables are incorrect in the "short term headcut-sand" worksheet.

49. In the "short term-tailcut" worksheet dimensionless time Tstar should not be cumulative. It should be computed for each time step.

50. The maximum possible scour in the "short term-tailcut" worksheet uses the equation for headcut scour from Table 11.1 of the ADOT Manual "Effects of In-Stream Mining on Channel Stability, June 1989." Downstream scour should use equation 11.2 from Table 11.1.

51. The headcut scour profile in worksheet "short-term scour profiles" does not have values for Ys for each of the values of Ls. The ratio from Table 11.3 in the ADOT manual should have been applied to the Ysmax value of 14.1 feet from "short term-headcut sand" worksheet. This would give the value Ys for each value of Ls.

52. Please review Excel files for the 10-year and the recent floods Excel files and amend Table 5-8 in chapter 5 of the report based upon the previous comments for the 100 year pit scour.

The following comment is in reference to Chapter 7 – Sediment Trend Analysis.

53. Page 7-4, the third bulleted item describing the non-scouring layer in the Hassayampa River. Generally, how deep is the non-scouring layer in the river bed? Can a depth be given in the report?

The following comment is from Chapter 8 – Summary.

54. Page 8-1, section 8.1 General Recommendations. Item one recommending adoption of the lateral migration erosion hazard zones should be removed from the text of the report.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: December 29, 2005

To: John Hathaway, Project Manager, Planning and Project Management Division

From: Richard Waskowsky, Hydrologist, Engineering Application Development and River Mechanics Branch, Engineering Division

CC: Bing Zhao, PhD, PE, Engineering Application Development and River Mechanics Branch Manager, Engineering Division

Subject: Lower Hassayampa River Watercourse Master Plan (LHWCMP) – Chapter 4: Channel Bed Elevation Analysis

I have finished my review and have the following comments. The consultant should submit written responses to these comments to the FCD.

1. On Page 4-1, it is indicated that the City of Tucson's manual was used to estimate scour. However, in the scope of work (page 23 of 30; section 9.5.1) this manual was not listed as one of the references that should be used. Rather, the consultant should cite and use ADWR's "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985). Also, the total scour equation does not list long-term scour as one of the components. Please correct this mistake. Please also compute the long-term scour depth and add it to the total scour depth. The long-term scour may be from HEC-6.

2. In section 4.3 – Equilibrium Slope, four equations (AMAFCA, BUREC, Bray, and Henderson equations) are used to estimate the equilibrium slope. Please do not use these equations since three of them are not applicable to this study, and AMAFCA's equation is originally from ADWR. Please do not use AMAFCA's simplified equation. Instead, follow the example given on pages 5.79-5.82 of ADWR's "Design Manual for Engineering Analysis of Fluvial Systems" (March, 1985) for calculating the equilibrium slope iteratively. Also, check if supply reach is in equilibrium

3. On Page 4-2, the antidune trough depth is shown to be calculated with $Z_a = 0.0137*V_m^2$ and $½Z_a$ is added to the total scour. This is incorrect. In the ADWR manual (1985) the crest-to-trough depth is calculated with $Z_a = 0.027* V_m^2$ (formula 4.25 on page 4.24) and $½Z_a$ is added to the total scour. Please correct the formulas to be consistent with the ADWR manual. Also, the spreadsheet provided by the consultants has errors in antidune scour. The formula used is $Z_a = 0.137*V_m^2$. Rather, the formula should be $Z_a = 0.027* V_m^2$, and the "if statement" in the spreadsheet should not be used. Please correct the antidune

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

formula in all spreadsheets (Scour-2yr, 10yr, 50yr, 100yr, and FDS). In the report (first sentence after the antidune formula on page 4-2), it indicates that the anti-dune trough depth is limited to a maximum of ½ the flow depth. Please remove this sentence.

4. The 100-year peak flows used in the consultants' spreadsheet are different from those in WEST Consultants' 100-year HEC-RAS model. Please clarify and correct the differences. Also the scour results of FDS and 100-year are reported in the report. Is FDS based on the 1988 FEMA flow rates? Please clarify the peak flows for FDS and the 100-year flood. On page 4-7, the first paragraph discusses the flow rates for 2-, 10-, and 100-year peaks, but Table 4-2 lists the results for 2-, 10-, 50-, 100-year peaks and FDS.

5. The estimated thalweg scour was assumed to be 1 foot. Was this estimate based on field visits? Please submit any documentations such as field visit photos showing the low flow channel depth.

6. While it is true that local scour only acts at certain locations (i.e. the I-10 bridges, Union Pacific bridge and the old US 80 bridge), at these locations the scour can be significant. Please compute local scour estimates at these locations using HEC-18 (Richardson and Davis, 2001). Please estimate the scour hole dimensions to determine the scour impact on banks for total scour computation. Also, show the scour in the reach using RAS river stations.

7. On page 4-4, bend scour was calculated from a reach-averaged bend angle and applied over a whole reach. Please compute the bend scour without using the "reach-averaged" concept. Please follow the procedure that starts on page 5.105 of the ADWR manual. Please use Eq. 5.27 in ADWR manual to determine the distance downstream of the curvature. When the main channel is straight, the thalweg bend angle should be used for computing the bend scour. The bend scour and local scour should be applied to specific cross-sections at each of the four reaches. Please show the scour in the reach using RAS river stations.

8. On page 4-4, it is indicated that a practical rule of thumb for estimating the maximum long-term scour is to measure the height of the floodplain above the channel bottom. What is the reference and validity of this rule?

9. On page 4-7, the equilibrium slope equation has an error (i.e. the n/1.49 term should be raised to the power of 2). Please compare equation 5.11 on page 5.75 of the ADWR manual.

10. In section 4.6, the data derived from the USGS quadrangles does not have enough precision to give accurate estimates of scour. Please leave this data off of the plots of the cross-sections.

11. On page 4-10, nu (ν) is the kinematic viscosity and its units are [ft^2/sec]. The report incorrectly indicates nu to be kinematic velocity with a wrong unit.

12. In the cross-sectional stable slope spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS), the equation for Tc in Lane's Tractive Force method is wrong. It uses 10^(1*logD50 – 1.79755) to calculate Tc, but this

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

does not match the curve (Figure 4) in the BUREC manual (Pemberton and Lara, 1984). Please correct this mistake.

13. In the spreadsheet (Stableslope-Summary), the reach-averaged value for the Shields method uses Lane's results (column 14) from the cross-sectional stable slope spreadsheets (i.e. Stable Slope-2yr, Stable Slope-10yr, Stable Slope-50yr, Stable Slope-100yr and Stable Slope-FDS). The correct column is column 12. Also, in the same spreadsheet (Stableslope-Summary), the Lane's value uses the Shields value (column 12) from the cross-sectional stable slope spreadsheets. The correct column is column 14. Please correct the mistakes in the spreadsheet even though the final average stable slope of four methods does not change.

14. Please submit a GIS line shape file for the five reaches.

15. The second sentence in second paragraph on page 4-12 indicates that the equilibrium slope equations predict long-term degradation. This is based on the average slope of simplified AMAFCA, Bray, Henderson, and BUREC equations. As indicated earlier in this review comment document, Bray, Henderson, and BUREC equations are not applicable to this study and should not be used. The simplified AMAFCA method should not be used. Instead, the ADWR iterative method should be used. Please make changes to this sentence accordingly after the ADWR method is used to compute the equilibrium slope.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: November 30, 2005

To: John Hathaway, PPM

From: Catherine W. Regester, Engineering Division

Subject: Lower Hassayampa WCMP
Hassayampa Floodway
Submittal of November 2 and 7, 2005

I have completed my review of the subject submittal and have the following questions/comments for the consultant:

1. Please verify that the floodway was developed using the equal conveyance reduction methodology (Method 4). Provide written documentation in the Hydraulics Report.
2. The right side encroachment station for section 4.09 should be moved in such that the right side ineffective flow area is not included in the floodway.
3. Please explain the floodway delineation along the right side from section 12.47 to section 12.75. The Profile Delta WS is less than 0.2 ft in this area. I would recommend that the floodway be moved in to, at least, the right side limit of the Jackrabbit Wash floodway. A separation between the Jackrabbit and Hassayampa floodways may also be appropriate in this area.
4. Sections 12.94 through 13.04 show right side ineffective flow areas included in the floodway. Please explain why these ineffective flow areas are included in the floodway or adjust the floodway limits such that these areas are not included in the floodway.
5. If we were to decide to submit this floodway to FEMA, we would need to adjust the upstream floodway to tie-in to the effective floodway; or, we would need to terminate the new floodway at a point where it will tie-in to the effective floodway.

cc: Amir Motamedi
Jon Fuller
Ted Lehman
Leo Kreymborg
Michael Duncan

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

Memorandum WEST Consultants, Inc.

DATE: June 15, 2005

TO: Catherine W. Regester, P.E., Flood Control District of Maricopa County

FROM: Leo Kreymborg, P.E. & Iftekhar Ahmed, Ph.D., P.E., WEST Consultants, Inc.

RE: Response to Catherine W. Regester's June 2 comments on *Selection of Manning's Roughness Coefficient, HEC-RAS* Proposed Cross Sections, Bank Stations, and Hydraulic Baseline submittal of May 18 for Lower Hassayampa WCMP

CC: Ted Lehman, P.E., John Fuller, P.E., Hari Sundararaghavan, Ph.D., P.E., JE Fuller Hydrology & Geomorphology, Inc.
Dennis Richards, P.E., D.WRE, WEST Consultants, Inc.

File

Thank you for your June 2 comments on our draft *Selection of Manning's Roughness Coefficient, HEC-RAS* Proposed Cross Sections, Bank Stations, and Hydraulic Baseline submittal of May 18 for Lower Hassayampa WCMP. We have revised the hydraulic model for the lower Hassayampa River based on your comments, and our meeting of June 8. Our responses are given below following your boldfaced comments.

1. **From x-sec 25.70 to the upstream limit of the study, the channel bank stations have been moved from the previous submittal from, essentially, the east side of the floodplain to the west side of the floodplain. It is explained that the west side appears to have the deeper channel section and more area for conveyance of the 100-yr flows. I agree that this is what the cross sections indicate. However, in looking at the topography and aerial photos of the upstream area, it appears to me that the tendency of the river would be to direct the majority of flows toward the east bank. Additionally, the lower 'n' value areas (0.028) are found on the east side of the channel. ('n' = 0.035 in the area currently identified as channel.) I'm wondering if the west side is looking like the larger conveyance area due to the cross section orientation.**

   We agree, and have moved the hydraulic baseline (the thalweg or 10,000 line) close to the east bank in this upstream study reach to capture the natural course of the river main channel along the sandy (low Manning's *n*) bottom.

2. **The majority of the model does not break the 'n' values at the channel bank stations. I have seen in previous versions of HEC-RAS where having a break, even if the 'n' value does not change, can make a difference in the calculations. Does this impact any of the calculations in this study.**

We ran a test where we introduced break in Manning's *n* at bank stations for a few selected cross sections. We did not see any change in the water surface elevations compared with no break conditions. The calculation in HEC-RAS is not impacted in this study for not having *n* value breaks at the channel bank stations.

3. **At cross section 24.87, the 'n' values are not consistent with the upstream and downstream cross sections.**

   This has been fixed in the current model.

4. **From x-sec 22.78 to 23.35, the main channel stationing includes what appears to be a small channel which may carry drainage from some of the east side tributaries. The small channel is identified as the thalweg and 10,000 station; and, is located within a 0.035 'n' value area. I am questioning whether this small channel and the 0.035 'n' value area between it and the sandy bottom channel should have been included in the HEC-RAS main channel stationing.**

   We have moved the hydraulic baseline (the thalweg or the 10,000 line) closer to the right bank in this reach to maintain main channel definition. The left bank stations (23.54 through 22.69) have been moved in, and the right bank stations (23.07 through 22.03) have been moved out to maintain consistency.

5. **From x-sec 22.21 to 23.45, the main channel stationing is shown on the east side of floodplain. From the HEC-RAS cross sections. I am wondering if the cross section orientation in this area is the reason that it appears that the channel flows should be shown in the in the 0.028 and east side, smaller, 0.025 'n' value area rather than that on the west side. Additionally, the original submittal showed an 0.035 'n' value "island" area. However, the area seems to have changed to an 0.025 and 0.028 'n' value. Is this correct?**

   The Manning's *n* value of 0.035 reported in the original submittal was in error. We have re-oriented cross sections 22.31 through 22.97 to capture the sandy portions of the channel within the left and right bank stations on either side of the island. In the original submittal we had used HEC-GeoRAS to pick up Manning's *n* values from polygons developed in ArcViewGIS. However, in case of very small gaps between polygons, HEC-GeoRAS can record erroneous Manning's *n* values, which is what we suspect to have happened in the original submittal. We have developed scripts to resolve this problem outside HEC-GeoRAS, and correct Manning's *n* values have been incorporated in the current hydraulic model.

6. **X-Sec 19.19 to 19.66: Please check the right bank station locations.**

   We noted that the right bank stations at cross section numbers 19.09 and 19.00 were misaligned with those upstream and downstream. The right bank stations for these two cross sections have been moved out to preserve a gradual change in main channel definition.

7. **X-Sec 18.71 to 18.81: Please check the left and right bank station locations. They do not appear to be consistent with the upstream and downstream cross sections.**

   The left bank stations at cross section numbers 18.62, 18.71, and 18.81 have been moved out to capture the sandy portion to the east of the island in this area. Consistency is maintained with bank stations upstream and downstream.

8. **X-Sec 16.16 and 17.20: There is an abrupt change in the main channel definition between these two sections and the adjoining downstream section.**

   At cross sections upstream of cross section 17.01, the left bank stations have been moved in to maintain main channel definition down to cross section number 16.16. The right bank stations at 16.44 and 16.35 have been moved out while the right bank stations at 15.87, 15.78, and 15.68 have been moved in to maintain main channel definition downstream.

9. **X-Sec 11.62 to 12.75: The left channel definition changes in this reach.**

   The left bank stations at cross sections 12.75 through 11.33 have been moved out to represent proper left channel definition in the vicinity of the pits.

10. **X-Sec 7.37 to 8.03: Appears that left channel banks may need to move in somewhat.**

    Per our June 8 telephone conversation with you, we have left the bank stations as is in this reach of the river.

11. **Document how heights of blocked obstructions were determined.**

    The blocked obstructions at the pits upstream of Interstate-10 were used to represent dead storage. It was assumed that water will spill over once the pits are filled with water. Therefore, the most efficient way to define the blocked obstruction height was to confer to the channel slope between the cross sections upstream and downstream of the pit locations. A uniform slope of 0.005 was used to define the blocked obstruction heights. The elevations have been revised versus the last submittal.

12. **Is there a spreadsheet with the composite 'n' value calculations?**

    We have used method described in Chow (1959) to composite the Manning's *n* values. We have generated a log text file showing results of calculations. The sample below shows the wetted perimeters for water sub-areas at cross section number 14.27, and the corresponding base Manning's *n* values. The "Logcomp.txt" file is included on the CD for this submittal. The formula used is given in the Manning's *n* report.

"River=1 Reach=1, Sec=14.27 Left Bank=9215.500000, RightBank=10143.160000:
From station 9215.500000 to 10143.160000, wetted perimeters and n-values are
Perimeter: 89.838180 , n-value=0.035000, p/n=2566.805156
Perimeter: 236.102849 , n-value=0.025000, p/n=9444.113959
Perimeter: 403.446306 , n-value=0.028000, p/n=14408.796659
Perimeter: 196.428451 , n-value=0.025000, p/n=7857.138059
Perimeter: 4.632953 , n-value=0.035000, p/n=132.370098
Sum of p/n: 34409.223930
Total perimeter: 930.448741
Composite n = Total perimeter / (Sum of p/n) = 0.027041"

13. **For the right overbank lateral weir, at river station 1.55, the elevation of the weir at section 1.49 is given as 826.66. At river station 1.45, the elevation of the weir is given as 826.04. From the cross section plot, it appears that 826.04 is correct. Please check.**

    This was an error and has been fixed.

14. **Please provide justification for the selection of the weir coefficient (C) in the lateral weir calculations. Generally, the District uses Hager's Equation. I can supply an Excel spreadsheet for calculating C using Hager's Equation, if requested.**

    We developed a spreadsheet to compute side weir discharge coefficients based on Hager's (1987) method reported by Davis & Holley (1988). Hager (1987) derived an analytical function which can be used to convert a discharge coefficient for a normal weir transverse to the direction of flow in the main channel into a discharge coefficient for the same weir used as a side weir. Our calculations suggest an average weir discharge coefficient of 2.0 along the bermed reaches upstream (left overbank) and downstream (left and right overbank) of the old U.S. 80 Highway Bridge. The spreadsheet is included on the CD.

15. **The 'n' value report discusses a *HEC-6T* analysis. I believe this should be *HEC-6*.**

    Yes, it should be *HEC-6* for this project. We have corrected this and the Manning's *n* report is included on the CD.

Additional Changes to the model not addressed in the comments:

Additional changes discussed below were made to the model to capture flows in the sandy areas and maintain consistency in main channel definition. If you prefer the previous definition in some reaches of the river, please advise.

1. The 3-mile reach starting at cross section 24.30 up to the upstream model boundary is heavily braided. As mentioned in the response to Comment number 1 above, the hydraulic baseline was relocated close to the east (left) bank to capture the natural course of the channel from cross section 25.81 to the upstream model boundary. To capture the significant flow in the local inflow channel that enters the model boundary in the northwest (channel right), the bank stations were widened in this reach. The main channel definition was maintained downstream of the CAP canal, between cross sections and 25.24 and 24.20, by moving the left bank stations out. The sandy portion at either side of the island downstream of the CAP canal has been captured.

2. Cross sections 26.29, 26.19, and 26.10 were re-cut as the originals appeared crooked with the new hydraulic baseline (these were not discussed in your comments or the June 8 meeting). The revised cross sections were doglegged in the sandy portion of the channel.

3. As mentioned in response to comment number 5 above, we have re-oriented cross sections 22.31 through 22.97 to capture the sandy portions of the channel within the left and right bank stations on either side of the island in this reach. Upstream of 22.97 the main channel narrows within the sandy portion. Here, the left bank station were moved in to capture the sandy portions and maintain contraction and expansion in the upstream and downstream, respectively.

4. Upstream of the Interstate-10 Bridges, the main channel bank stations have been widened up to the pit locations to capture flow east of the sandy bottom. A flow split occurs at 14.08 (with visible island in the channel) and continues downstream with significant flow in the channel close to the east bank. In order to maintain main channel definition, bank stations were adjusted down to the Interstate-10 Bridge.

References

Chow, V.T. (1959). *Open Channel Flow.* McGraw-Hill, New York, NY.

Hager, W.H. (1987). Lateral Outflow Over Side Weirs. *Journal of Hydraulic Engineering,* ASCE, 113(4), 491-504.

Davis, J.E., and E.R. Holley (1988). Modeling Side-Weir Diversions for Flood Control. *Hydraulic Engineering, Proceedings of the 1988 ASCE National Conference*, Colorado Springs, CO.

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: June 2, 2005

To: John Hathaway, PPM

From: Catherine W. Regester, Engineering Division

Subject: Lower Hassayampa WCMP
Draft *Selection of Manning's Roughness Coefficient*
Proposed Cross Sections, Bank Stations, and Hydraulic Baseline
Submittal of May 18, 2005

I have completed my review of the subject submittal and have the following questions/comments for discussion:

1. From x-sec 25.70 to the upstream limit of the study, the channel bank stations have been moved from the previous submittal from, essentially, the east side of the floodplain to the west side of the floodplain. It is explained that the west side appears to have the deeper channel section and more area for conveyance of the 100-yr flows. I agree that this is what the cross sections indicate. However, in looking at the topography and aerial photos of the upstream area, it appears to me that the tendency of the river would be to direct the majority of flows toward the east bank. Additionally, the lower 'n' value areas (0.028) are found on the east side of the channel. ('n' = 0.035 in the area currently identified as channel.) I'm wondering if the west side is looking like the larger conveyance area due to the cross section orientation.

2. The majority of the model does not break the 'n' values at the channel bank stations. I have seen in previous versions of HEC-RAS where having a break, even if the 'n' value does not change, can make a difference in the calculations. Does this impact any of the calculations in this study.

3. At cross section 24.87, the 'n' values are not consistent with the upstream and downstream cross sections.

4. From x-sec 22.78 to 23.35, the main channel stationing includes what appears to be a small channel which may carry drainage from some of the east side tributaries. The small channel is identified as the thalweg and 10,000 station; and, is located within a 0.035 'n' value area. I am questioning whether this small channel and the 0.035 'n' value area between it and the sandy bottom channel should have been included in the HEC-RAS main channel stationing.

5. From x-sec 22.21 to 23.45, the main channel stationing is shown on the east side of floodplain. From the HEC-RAS cross sections. I am wondering if the cross section

orientation in this area is the reason that it appears that the channel flows should be shown in the in the 0.028 and east side, smaller, 0.025 'n' value area rather than that on the west side. Additionally, the original submittal showed an 0.035 'n' value "island" area. However, the area seems to have changed to an 0.025 and 0.028 'n' value. Is this correct?

6. X-Sec 19.19 to 19.66: Please check the right bank station locations.

7. X-Sec 18.71 to 18.81: Please check the left and right bank station locations. They do not appear to be consistent with the upstream and downstream cross sections.

8. X-Sec 16.16 and 17.20: There is an abrupt change in the main channel definition between these two sections and the adjoining downstream section.

9. X-Sec 11.62 to 12.75: The left channel definition changes in this reach.

10. X-Sec 7.37 to 8.03: Appears that left channel banks may need to move in somewhat.

11. Document how heights of blocked obstructions were determined.

12. Is there a spreadsheet with the composite 'n' value calculations?

13. For the right overbank lateral weir, at river station 1.55, the elevation of the weir at section 1.49 is given as 826.66. At river station 1.45, the elevation of the weir is given as 826.04. From the cross section plot, it appears that 826.04 is correct. Please check.

14. Please provide justification for the selection of the weir coefficient (C) in the lateral weir calculations. Generally, the District uses Hager's Equation. I can supply an Excel spreadsheet for calculating C using Hager's Equation, if requested.

15. The 'n' value report discusses a *HEC-6T* analysis. I believe this should be *HEC-6*.

cc: Bing Zhao
Jon Fuller
Ted Lehman
Leo Kreymborg

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: February 9, 2005

To: File

From: Catherine W. Regester, Engineering Division, Hydrology/Hydraulic Branch

Subject: Lower Hassayampa Watercourse Master Plan (WCMP)

On November 23, 2004, a meeting was held between District personnel and JE Fuller Hydrology & Geomorphology, Inc (JE Fuller), the District's consultant for the subject WCMP. The purpose of the meeting was for JE Fuller to present the results of their updated hydrologic analyses as identified in the WCMP's Scope of Work. Those in attendance from the District were John Hathaway (PPM), Tim Murphy (Reg), David Boggs (Reg), Lynn Thomas (Reg), Kathryn Gross (Reg), Bing Zhao (Eng), Joe Tram (Eng), and Catherine Regester (Eng). JE Fuller was represented by Jon Fuller and Ted Lehman.

On December 1, 2004, a follow-up meeting was held with District personnel to determine the discharge rates (Q) to be used in the analyses for the WCMP. District personnel in attendance were John Hathaway (PPM), Amir Motamedi (Reg), David Boggs (Reg), Lynn Thomas (Reg), Kathryn Gross (Reg), Bing Zhao (Eng), Joe Tram (Eng), and Catherine Regester (Eng).

A spreadsheet was prepared and presented by Catherine Regester identifying various Qs that had been determined by various agencies and consultants over the years for the Hassayampa River. A brief discussion followed regarding the reasons for many of the differences. Treatment of "historical peaks" was one factor influencing the statistical analyses.

A subsequent discussion followed regarding the years of record, reliability of the data, and the statistical methodology. Based on this discussion, it was decided that the effective FEMA Qs would be used in the analyses for the WCMP. This decision was based on the limited number of years of record available for the statistical analyses and the fact that the effective Qs still fell within the 95% confidence limits of the new analyses performed by JE Fuller.

cc: John Hathaway
Amir Motamedi
Tim Murphy
Bing Zhao
Joe Tram
David Boggs
Lynn Thomas
Kathryn Gross

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: September 20, 2004

To: Greg L. Jones, PPM

From: Catherine W. Regester

Subject: Lower Hassayampa WCMP
Draft Hydrology Submittal

I have completed my review of the subject submittal and have the following questions/comments for the consultant:

1. HEC-FFA is the FEMA approved frequency analysis software and should be used instead of HECWRC.
2. Please provide a discussion of the quality of the data being used in the frequency analyses. This discussion should include such items as period of record, discontinuous data, "historical peaks" (particularly, at the Box Canyon gage – what happens if the three historical peaks are not included in the analyses?), "estimated peaks", recorded discharges only above a certain value, etc. How would "0" discharge for some of the missing years affect the analyses? References for the data used in the analyses should also be included in the report.
3. It appears that the data used in the frequency analyses may be a mixture of summer and winter storms. Please check and justify the treatment of the data per the guidelines in Bulletin 17B.
4. Regarding the gage at Morristown, for the years 1954 and 1956, the published USGS data (the 5th reference in your list) shows "0" discharge for these two years. The USGS website has no value listed for these two years. You, also, have not included this data in your analyses. Please explain. What effect would including these years as 0 cfs have on the analyses. Additionally, for the discharge on Nov. 18, 1986, the date is mistakenly input as the year 986.
5. Regarding the analysis at the gage at Box Canyon: For the year 1993, the discharge input into the HECWRC is 25,640 cfs. Please identify the source of this discharge value.
6. On page 8 of the report, the last paragraph refers to a "pink" area on Figure 6. However, there doesn't appear to be a "pink" area on Figure 6. Should this be the "hatched" area?
7. Please include the actual regional regression equation(s) in the report.
8. Please include a land use map in the report and explain how the hydrologic parameters for the land uses were obtained. Cite references and/or show photos, if necessary. Please include photos to support the selection of Kn values.

9. Are there any areas of rock outcrop in the soils?

10. Please explain the assumption of 1.5 for the flood wave celerity in Table 11. Wave celerity is a velocity. However, the 1.5 in the table does not appear to have units. Is the value 1.5 a ratio of the wave velocity to the average cross section velocity based on a particular shape channel? If so, please give references to justify the selection of 1.5.

11. What Q was used in the HEC-RAS to determine the RAS travel time? Please include the HEC-RAS digital data and hard-copy printout in the next submittal.

12. For the simplified HEC-1 model, it is not clear why sub-basin H1 would be generating less runoff than sub-basins H2. Please explain.

13. Please label concentration points and gage locations on the watershed map.

14. The results of the frequency analyses are showing attenuation of flows as you move down the watershed. From Table 12, the simplified HEC-1 is showing the opposite, with flows increasing as you move downstream. It would seem that more calibration of the HEC-1 model to the gage data is needed. For example, the precipitation distribution for the 1951 storm is available in the Corps' Design Memorandum No. 2 Hydrology Part 2 (plate 23). It should be used instead of the SCS Type II distribution for this 1951 storm. Since the storm did not cover Jackrabbit Wash watershed, this would be appropriate for calibration of the upstream sub-basins. If the observed hydrograph is available, it is recommended that the HEC-1 optimization method be used to calibrate the LG cards.

15. Why was 55,000 cfs chosen as the Q for the WCMP? The highest flow from the frequency analyses was 52,500 cfs. Would 52,500 have been more appropriate? It would seem, if we were confident with the results of the frequency analyses, we would accept the results at each of the gages instead of applying one value to the entire system. Please explain why one value was chosen. If there is some question regarding the reliability/quality of the data (see comment #2) and a reason for not accepting the results of the new frequency analyses or not accepting the results as being more reliable than the previous analyses, then, please provide an explanation in the report.

16. The last sentence of the section *Interpolation of Qs for different locations* says: "Additional analysis of attenuation effects will be performed as part of the detailed hydraulic modeling portions of the WCMP." Does this mean that you intend to revisit the Qs during the hydraulic analyses? If not, I think attenuation should be looked at now – particularly at the confluence with Jackrabbit Wash.

17. We need to address potential channelization as a part of the future conditions analysis. This was the method we had discussed for analyzing future conditions during the scoping meetings.

18. Please include the "WCMP – routed Morristown" hydrograph on Figure 22.

19. Only one set of peak discharges is proposed for the HEC-6T analyses. Is it reasonable to apply the same discharges to the entire reach of the river – particularly both upstream and downstream of the confluence with Jackrabbit Wash?

cc: Bing Zhao
John Hathaway

Schedules

LOWER HASSAYAMPA WATERCOURSE MASTER PLAN

Project Schedule (September 1, 2004)

TASK	TEAM LEAD	COMPLETION DATE
		5/19/2004
Task 1. General		
Task 1.7.1 Project References	FCDMC	6/21/2004
Task 1.7.2 Verified Statement of Request for Public Records	FCDMC	6/21/2004
Task 2.1. Schedule & Project Coordination	JEF	6/23/2005
Task 2.1.1.1 Schedule	JEF	6/21/2004
Task 2.1.1.1 Schedule Updates	JEF	6/23/2005
Task 2.1.1.3 Cost Distribution	JEF	6/23/2005
Task 2.1.1.4 Progress Reports	JEF	6/23/2005
Task 2.1.1.5 Coordination Conference Calls	JEF	6/23/2005
Task 2.1.1.6 Meeting Minutes & Conversation Logs	JEF	6/23/2005
Task 2.1.1.7 Team Meetings	JEF	6/23/2005
Task 2.1.1.8 Kick-Off Meeting	JEF	6/21/2004
Task 2.1.1.9 Project Review Meetings	JEF	6/23/2005
Task 2.1.2 Invoices	JEF	6/23/2005
Task 2.1.4 Lessons Learned Meeting	JEF	6/23/2005
Task 2.2 Site Visits	JEF	2/7/2005
Task 2.3 Subconsultant Management	JEF	6/23/2005
Task 2.3.1 QA/QC Review Prior to Submittal	JEF/WEST	6/23/2005
Task 2.3.1 Designate QA/QC Reviewer	JEF	6/17/2004
Task 3.2 Data Collection & Existing Conditions Analysis	JEF	See Task 5
Task 3.2.5 GIS Map Layer of Ownership, Development, Mining	FCDMC	6/17/2004
Task 3.4 Planning/Regulatory Coordination	EDAW	6/23/2005
Task 3.4.1-5 Agency Coordination & Issue Identification	EDAW	9/30/2004
Task 3.4.6 Evaluate Land v. Hydrology & River Behavior Analyses	EDAW	3/28/2004
Task 3.5 Preliminary Alternatives	JEF	6/18/2005
Task 4.1 General Requirements	FCDMC	6/23/2005
Task 4.1.1 Meeting Documentation	FCDMC	5/29/2005
Task 4.1.2 Project Location Map	FCDMC	6/17/2004
Task 4.2 Public Notification for Right of Entry	CLW	10/18/2004
Task 4.2.2 Assessor's Data Provided to Consultant	FCDMC	6/17/2004
Task 4.2.3 Public Involvement Plan	FCDMC	7/31/2004
Task 4.3 Introduction Brochure	FCDMC	9/13/2004
Task 4.3.1 Introduction Brochure	FCDMC	7/19/2004
Task 4.3.2-3 Develop & Mail Brochure	FCDMC	8/19/2004
Task 4.3.3 Update Mailing List	CLW	9/6/2004
Task 4.3.5 Place Brochure	CLW	7/31/2004
Task 4.4 Press Release	FCDMC	6/17/2004
Task 4.5 Project Website	FCDMC	6/17/2004
Task 4.5.2 Review of Website	CLW	7/15/2004
Task 4.6 Public Meetings	FCDMC	6/23/2005
Task 4.6.1 Quarterly Newsletters	FCDMC	6/23/2005
Task 4.6.2-14 Public Meetings	FCDMC	6/23/2005
Task 4.6.8 Refreshments	WGA	6/23/2005
Task 4.7 Stakeholder Involvement	CLW	6/23/2005
Task 4.7.1 Stakeholder List	CLW	6/23/2005
Task 4.7.2 Individual Stakeholder Meetings	CLW	6/23/2005
Task 4.7.4 Quarterly Stakeholder Meetings - ARPA, Mining, Buckeye	CLW	6/23/2005
Task 4.7.5 Stakeholder Meetings	CLW	6/23/2005
Task 4.7.6 Stakeholder Documentation	CLW	6/23/2005
Task 5.1 General Requirements	JEF	9/16/2004
Task 5.1.2 District Provides Report & Information Copies	FCDMC	6/17/2004
Task 5.2 Data Collection Hydrologic Models	JEF	9/16/2004
Task 5.3 Data Collection River Behavior	JEF	9/16/2004
Task 5.4 Data Collection Existing & Future Land Use	EDAW	9/16/2004
Task 5.5 Data Collection Existing Regulations	EDAW	9/16/2004
Task 5.6 Data Collection Groundwater Recharge	WGA	9/16/2004
Task 5.7 Data Collection ID Flooding Problems	JEF	9/16/2004
Task 5.8 Data Collection Environmental Cond'ns	WGA	9/16/2004
Task 5.9 Data Collection Report	JEF	9/16/2004
Task 6.2 Hydrology Analysis	JEF	8/29/2004
Task 6.2.1-6 Hydrology Analyses	JEF	7/15/2004
Task 6.2.7 Draft Hydrology Report	JEF	7/16/2004
Task 6.2.8 Final Hydrology Report	JEF	8/20/2004
Task 7.2 Hydraulics Analyses	WEST	2/21/2005
Task 7.2.1-4 HEC-RAS Model of Hassayampa River	WEST	1/10/2005
Task 7.2.5 Draft Hydraulics Report	WEST	2/21/2005
Task 8.1 Floodplain Delineation for Jackrabbit Wash	WEST	6/23/2005
Task 8.0 FCDMC Provides Topographic Mapping	FCDMC	9/30/2004
Task 8.1 Jackrabbit Wash Floodplain Delineation	WEST	6/23/2005
Task 9.3 River Behavior Field Investigations	JEF	2/21/2005
Task 9.3.3 Field Reconnaissance Report	JEF	4/11/2005
Task 9.4 River Behavior Geomorphic Analysis	JEF	5/16/2005
Task 9.4.6 Geomorphic Analysis Report	JEF	4/21/2005
Task 9.5 River Behavior Bed Elevation Change	JEF	1/17/2005
Task 9.5.7 Bed Lowering Analysis Report	JEF	3/21/2005
Task 9.6 River Behavior Sediment Transport	JEF	4/11/2005
Task 9.6.10 Sediment Transport Report	JEF	6/23/2005
Task 9.7 River Behavior Lateral Migration Analysis	JEF	4/11/2005
Task 9.7.10 Lateral Migration Analysis Report	JEF	6/23/2005
Task 9.8 River Behavior Sediment Trend Analysis	JEF	4/11/2005
Task 9.8.4 Sediment Trend Analysis Report	JEF	6/23/2005
Task 9.9 River Behavior Comparison Models	JEF	6/24/2005
Task 10.2 Reports	JEF	
Task 10.2 Final Report	EDAW	6/23/2004

LEGEND

Consultant Authorized Tasks

FCDMC Review

Internal Team Review

X Deliverable

X District Obligation

X Meeting

JEFuller/Hydrology and Geomorphology, Inc.4/11/2006

LOWER HASSAYAMPA WATERCOURSE MASTER PLAN

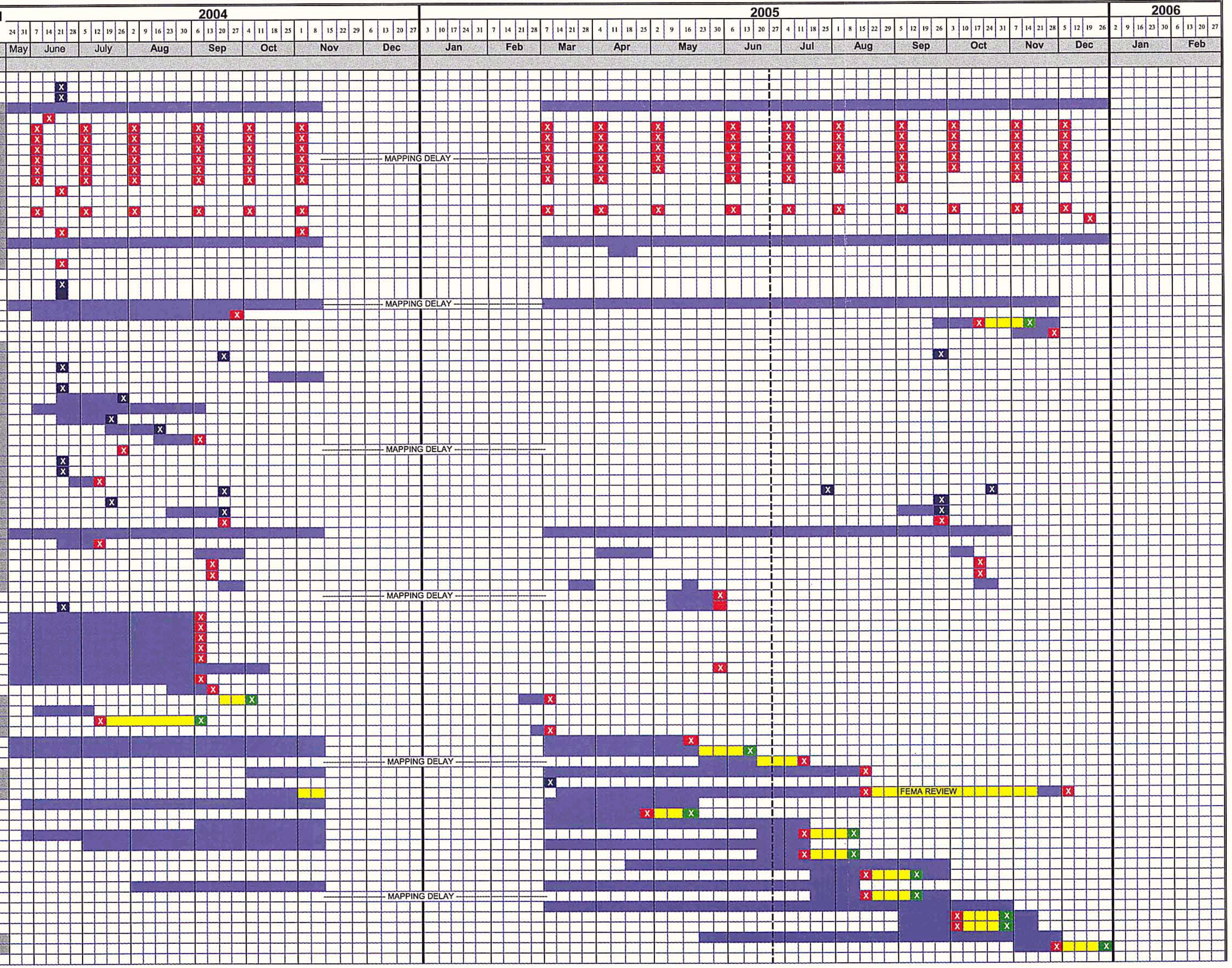
Project Schedule (September 1, 2004)

TASK	TEAM LEAD	COMPLETION DATE	2004																																2005																																																				2006								
			24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13	20	27
			May		June				July				Aug					Sep				Oct				Nov					Dec				Jan					Feb				Mar				Apr				May					Jun				Jul				Aug					Sep				Oct					Nov				Dec				Jan					Feb			

LOWER HASSAYAMPA WATERCOURSE MASTER PLAN

Project Schedule (March 1, 2005)

TASK	TEAM LEAD	COMPLETION DATE
		5/19/2004
Task 1. General		
Task 1.7.1 Project References	FCDMC	6/21/2004
Task 1.7.2 Verified Statement of Request for Public Records	FCDMC	6/21/2004
Task 2.1. Schedule & Project Coordination	JEF	6/23/2005
Task 2.1.1.1 Schedule	JEF	6/21/2004
Task 2.1.1.1 Schedule Updates	JEF	6/23/2005
Task 2.1.1.3 Cost Distribution	JEF	6/23/2005
Task 2.1.1.4 Progress Reports	JEF	6/23/2005
Task 2.1.1.5 Coordination Conference Calls	JEF	6/23/2005
Task 2.1.1.6 Meeting Minutes & Conversation Logs	JEF	6/23/2005
Task 2.1.1.7 Team Meetings	JEF	6/23/2005
Task 2.1.1.8 Kick-Off Meeting	JEF	6/21/2004
Task 2.1.1.9 Project Review Meetings	JEF	6/23/2005
Task 2.1.2 Invoices	JEF	6/23/2005
Task 2.1.4 Lessons Learned Meeting	JEF	6/23/2005
Task 2.2 Site Visits	JEF	2/7/2005
Task 2.3 Subconsultant Management	JEF	6/23/2005
Task 2.3.1 QA/QC Review Prior to Submittal	JEF/WEST	6/23/2005
Task 2.3.1 Designate QA/QC Reviewer	JEF	6/17/2004
Task 3.2 Data Collection & Existing Conditions Analysis	JEF	See Task 5
Task 3.2.5 GIS Map Layer of Ownership, Development, Mining Operations	FCDMC	6/17/2004
Task 3.4 Planning/Regulatory Coordination	EDAW	6/23/2005
Task 3.4.1-5 Agency Coordination & Issue Identification	EDAW	9/30/2004
Task 3.4.6 Evaluate Land v. Hydrology & River Behavior Analyses	EDAW	3/28/2004
Task 3.5 Preliminary Alternatives	JEF	6/18/2005
Task 4.1 General Requirements	FCDMC	6/23/2005
Task 4.1.1 Meeting Documentation	FCDMC	5/29/2005
Task 4.1.2 Project Location Map	FCDMC	6/17/2004
Task 4.2 Public Notification for Right of Entry	CLW	10/18/2004
Task 4.2.2 Assessor's Data Provided to Consultant	FCDMC	6/17/2004
Task 4.2.3 Public Involvement Plan	FCDMC	7/31/2004
Task 4.3 Introduction Brochure	FCDMC	9/13/2004
Task 4.3.1 Introduction Brochure	FCDMC	7/19/2004
Task 4.3.2-3 Develop & Mail Brochure	FCDMC	8/19/2004
Task 4.3.3 Update Mailing List	CLW	9/6/2004
Task 4.3.5 Place Brochure	CLW	7/31/2004
Task 4.4 Press Release	FCDMC	6/17/2004
Task 4.5 Project Website	FCDMC	6/17/2004
Task 4.5.2 Review of Website	CLW	7/15/2004
Task 4.6 Public Meetings	FCDMC	6/23/2005
Task 4.6.1 Quarterly Newsletters	FCDMC	6/23/2005
Task 4.6.2-14 Public Meetings	FCDMC	6/23/2005
Task 4.6.8 Refreshments	WGA	6/23/2005
Task 4.7 Stakeholder Involvement	CLW	6/23/2005
Task 4.7.1 Stakeholder List	CLW	6/23/2005
Task 4.7.2 Individual Stakeholder Meetings	CLW	6/23/2005
Task 4.7.4 Quarterly Stakeholder Meetings - ARPA, Mining,	CLW	6/23/2005
Task 4.7.5 Stakeholder Meetings	CLW	6/23/2005
Task 4.7.6 Stakeholder Documentation	CLW	6/23/2005
Task 5.1 General Requirements	JEF	9/16/2004
Task 5.1.2 District Provides Report & Information Copies	FCDMC	6/17/2004
Task 5.2 Data Collection Hydrologic Models	JEF	9/16/2004
Task 5.3 Data Collection River Behavior	JEF	9/16/2004
Task 5.4 Data Collection Existing & Future Land Use	EDAW	9/16/2004
Task 5.5 Data Collection Existing Regulations	EDAW	9/16/2004
Task 5.6 Data Collection Groundwater Recharge	WGA	9/16/2004
Task 5.7 Data Collection ID Flooding Problems	JEF	9/16/2004
Task 5.8 Data Collection Environmental Cond'ns	WGA	9/16/2004
Task 5.9 Data Collection Report	JEF	9/16/2004
Task 6.2 Hydrology Analysis	JEF	8/29/2004
Task 6.2.1-6 Hydrology Analyses	JEF	7/15/2004
Task 6.2.7 Draft Hydrology Report	JEF	7/16/2004
Task 6.2.8 Final Hydrology Report	JEF	8/20/2004
Task 7.2 Hydraulics Analyses	WEST	2/21/2005
Task 7.2.1-4 HEC-RAS Model of Hassayampa River	WEST	1/10/2005
Task 7.2.5 Draft Hydraulics Report	WEST	2/21/2005
Task 8.1 Floodplain Delineation for Jackrabbit Wash	WEST	6/23/2005
Task 8.0 FCDMC Provides Topographic Mapping	FCDMC	9/30/2004
Task 8.1 Jackrabbit Wash Floodplain Delineation	WEST	6/23/2005
Task 9.3 River Behavior Field Investigations	JEF	2/21/2005
Task 9.3.3 Field Reconnaissance Report	JEF	4/11/2005
Task 9.4 River Behavior Geomorphic Analysis	JEF	5/16/2005
Task 9.4.6 Geomorphic Analysis Report	JEF	4/21/2005
Task 9.5 River Behavior Bed Elevation Change	JEF	1/17/2005
Task 9.5.7 Bed Lowering Analysis Report	JEF	3/21/2005
Task 9.6 River Behavior Sediment Transport	JEF	4/11/2005
Task 9.6.10 Sediment Transport Report	JEF	6/23/2005
Task 9.7 River Behavior Lateral Migration Analysis	JEF	4/11/2005
Task 9.7.10 Lateral Migration Analysis Report	JEF	6/23/2005
Task 9.8 River Behavior Sediment Trend Analysis	JEF	4/11/2005
Task 9.8.4 Sediment Trend Analysis Report	JEF	6/23/2005
Task 9.9 River Behavior Comparison Models	JEF	6/24/2005
Task 10.2 Reports	JEF	
Task 10.2 Final Report	EDAW	6/23/2004



LEGEND

Consultant Authorized Tasks

X Deliverable

JEFuller/Hydrology and Geomorphology, Inc.4/11/2006

LOWER HASSAYAMPA WATERCOURSE MASTER PLAN

Project Schedule (March 1, 2005)

TASK	TEAM LEAD	COMPLETION DATE

2004

May	June	July	Aug	Sep	Oct	Nov	Dec
24, 31	7, 14, 21, 28	5, 12, 19, 26	2, 9, 16, 23, 30	6, 13, 20, 27	4, 11, 18, 25	1, 8, 15, 22, 29	6, 13, 20, 27

2005

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3, 10, 17, 24, 31	7, 14, 21, 28	7, 14, 21, 28	4, 11, 18, 25	2, 9, 16, 23, 30	6, 13, 20, 27	4, 11, 18, 25	1, 8, 15, 22, 29	5, 12, 19, 26	3, 10, 17, 24, 31	7, 14, 21, 28	5, 12, 19, 26

2006

Jan	Feb
2, 9, 16, 23, 30	6, 13, 20, 27

FCDMC Review
Internal Team Review
X District Obligation
X Meeting