

Volume 2 – Documentation

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona

Flood Control District of Maricopa County



Version 1.2 / September 2009
HDR Project No. 079902
FCD Contract No. 2007C031



Expires 12/31/09

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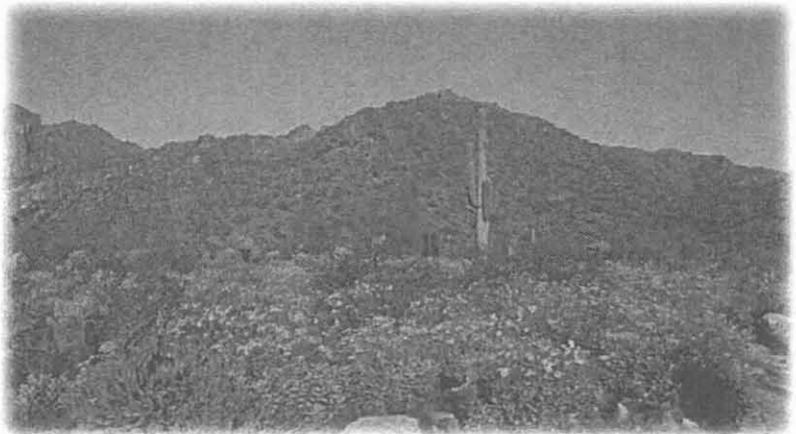
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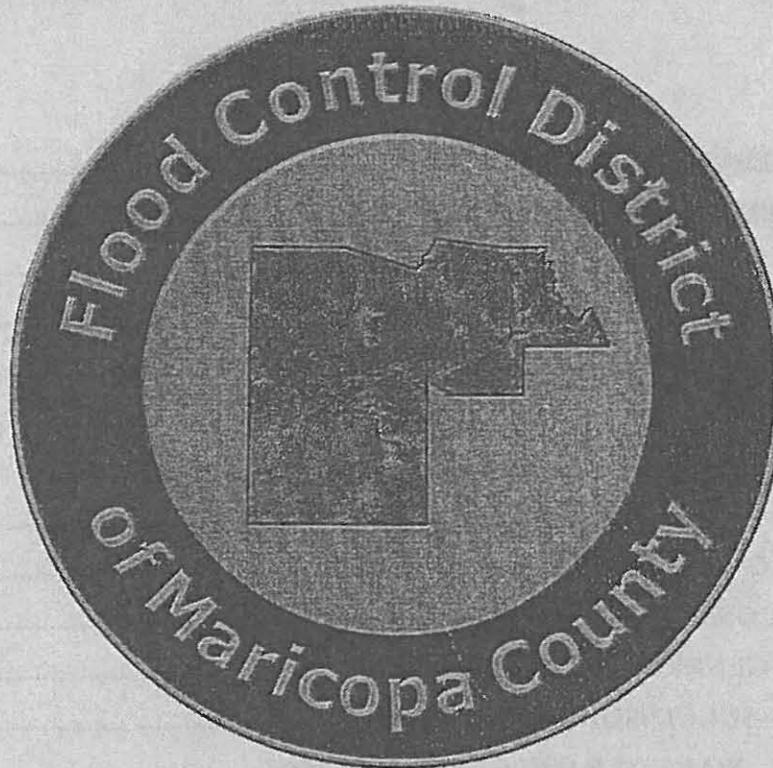
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Scope of Work (including Change Orders)

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona



COPY



CONTRACT FCD 2007C031

**LOOP 303 – WHITE TANKS AREA DRAINAGE MASTER PLAN UPDATE
(ADMPU) AREA HYDROLOGIC ANALYSIS**

BOARD OF DIRECTORS AGENDA ITEM C-69-08-039-5-00

**CONTRACT FCD 2007C031
LOOP 303 – WHITE TANKS ADMPTU AREA HYDROLOGIC ANALYSIS**

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CONTRACT FCD 2007C031

LOOP 303 – WHITE TANKS ADMPU AREA HYDROLOGIC ANALYSIS

Pursuant to the provisions of the Arizona Revised Statutes §48-3603, the Board of Directors of the Flood Control District of Maricopa County has the authority to enter into contracts.

The Flood Control District of Maricopa County, Arizona, hereinafter called "District", is desirous of having certain professional services performed in connection with Contract FCD 2007C031, Loop 303 – White Tanks ADMPU Area Hydrologic Analysis, hereinafter called the "Project" and as more fully described in Exhibit A, Scope of Work, and in accordance with Exhibit B, Fee Proposal, attached; and HDR ENGINEERING, INC., hereinafter called "Consultant", with its principal offices located at 3200 East Camelback Road – Suite 350; Phoenix, Arizona 85018-2311, is desirous of performing said services;

THEREFORE, the parties hereto mutually agree as follows:

SECTION I—SERVICES OF THE CONSULTANT

The Consultant, under the general supervision of the District Planning and Project Management Division Manager, shall prepare studies, reports, surveys, plans, drawings, specifications, and cost estimates as are necessary for the Project according to the directions and designated standards of the District, and in accordance with Exhibit A, Scope of Work. It is understood and agreed that the District's authorized representative shall be the Planning and Project Management Division Manager or his duly authorized representative, hereinafter called the "Agent". For purposes of this contract, the Agent's duly authorized representative shall be the Project Manager and he/she shall be the sole contact for administering this contract.

The Consultant shall meet periodically with the Agent so as to keep the District informed of the progress of the work in accordance with the schedule defined in Exhibit A, Scope of Work.

The Consultant shall promptly advise the Agent of any factors which develop during the Project that would likely result in construction or design costs in excess of budgetary constraints.

SECTION II—PERIOD OF SERVICE

The Consultant shall complete all work per the schedule provided in Exhibit A, Scope of Work, **within 275 calendar days** after receipt of the Notice to Proceed. Should extension of this contract period be necessary, and any such extension(s) continue the date of contract performance for a time period of more than one (1) year from the original date of contract expiration, adjustment(s) of the Consultant's fee(s) may, upon agreement by both the District and the Consultant, be made in accordance with the Consumer Price Index for Urban Consumers, Western Division, published by the U.S. Department of Labor, Bureau of Labor Statistics, using the published edition coinciding with the initial contract expiration date. Any such fee adjustment shall only apply to the extended contract time period.

SECTION III—PAYMENTS TO THE CONSULTANT

The Consultant shall be paid for work under this contract a **lump sum fee of \$697,663.00.**

The total contract amount will not exceed **Six Hundred Ninety-Seven Thousand Six Hundred Sixty-Three Dollars and Zero Cents (\$697,663.00)** plus any adjustments that have been approved in writing in accordance with the Maricopa County Procurement Code.

The District shall pay the Consultant upon completion of the work as accepted by the District, except that progress payments may be made as billed by the Consultant based on approved monthly progress reports subject to the limitations set forth in Exhibit A, Scope of Work. With each request for payment, the Consultant shall complete and provide the Maricopa County Small Business Enterprise Program Participation Reporting Form (Attachment 3)

SECTION IV—THE DISTRICT'S RESPONSIBILITIES

The District shall furnish the Consultant, at no cost to the Consultant, the following information or services for this Project:

- A. One copy of on-hand maps, records, survey ties, benchmarks, or other data pertinent to the Project. This does not, however, relieve the Consultant of the responsibility of searching records for additional information, for requesting specific information, or for verification of that information provided. The District does not warrant the accuracy or comprehensiveness of any such information.
- B. All available information and data relative to policies, standards, criteria, and studies, etc. impacting the Project as identified by the Consultant.
- C. Available staff for consultation with the Consultant during the performance of studies and plan development in order to identify the problems, needs, and other functional aspects of the Project.
- D. Prompt examination of documents submitted by the Consultant and rendering of decisions pertaining thereto in order to avoid unreasonable delay in the progress of the work by the Consultant. The District will keep the Consultant advised concerning the progress of the District's review of work.

SECTION V—AMENDMENTS

This contract may be amended by mutual agreement of the District and the Consultant.

Any alteration in the Scope of Work that will result in a substantial change in the nature of the Project so as to materially increase or decrease the contract fee will require negotiation of an amendment to the contract to be executed by the District and the Consultant. No work shall commence on the change until the contract amendment has been approved by the District and the Agent has notified the Consultant to proceed. It is distinctly understood and agreed that no claim for extra work performed or materials furnished by the Consultant will be allowed by the District except as provided herein, nor shall the Consultant do any work or furnish any materials not covered by this agreement unless such work is first authorized in writing by the District in accordance with the Maricopa County Procurement Code. Any such work or materials furnished by the Consultant without such written authorization first being given shall be at Consultant's own risk, cost, and expense. The Consultant hereby agrees to make no claim for such work or materials furnished without such written authorization.

SECTION VI—RECORDS

Records of the Consultant's expenses pertaining to this contract and records of accounts between the District and the Consultant shall be kept on a generally recognized accounting basis and shall be available upon request to the District or its authorized representative for audit during normal business hours.

All Consultant and District procurement records shall be retained for a period of one (1) year and disposed of in accordance with the records retention guidelines and schedules approved by the State of Arizona Department of Library, Archives, and Public Records unless applicable Federal regulations require a longer period of retention.

SECTION VII—PROJECT COMPLETION

If, during the course of this contract, situations arise which prevent completion within the allotted time, the Agent may grant an extension.

SECTION VIII—TERMINATION

The District may terminate this contract at any time upon reimbursement to the Consultant of expenses that include reasonable charges for time and material for the percentage of work satisfactorily completed and provided to the District.

The District reserves the right to postpone, terminate, or abandon this contract for the Consultant's failure to complete the Project on time or failure to comply with the provisions of the contract. The District also reserves the right to terminate any or all parts of this contract for its own convenience as the District may determine at its sole discretion.

The District hereby gives notice that pursuant to A.R.S. § 38-511 "A" this contract may be canceled without penalty or further obligation within three (3) years after execution if any person significantly involved in initiating, negotiating, securing, drafting, or creating a contract on behalf of the District is, at any time while the contract or any extension of the contract is in effect, an employee or agent of any other party to the contract in any capacity or a consultant to any other party of the contract with respect to the subject matter of the contract. Cancellation under this section shall be effective when written notice from the District Chief Engineer and General Manager is received by all of the parties to the contract. In addition, the District may recoup any fee or commission paid or due to any person significantly involved in initiating, negotiating, securing, drafting, or creating the contract on behalf of the District from any other party to the contract arising as a result of the contract.

The Consultant may terminate this contract in the event of nonpayment of fees as specified in SECTION III, PAYMENTS TO THE CONSULTANT.

SECTION IX—OWNERSHIP OF DOCUMENTS

A. All original documents including, but not limited to studies, reports, tracings, drawings, physical and computer models, estimates, field notes, investigations, design analysis, calculations, computer software, and specifications, prepared in the performance of this contract are to be and remain the

property of the District and are to be delivered to the Agent before final payment is made to the Consultant. The District will not reuse, alter or modify these documents without noting such modifications, alterations, or intent of their reuse, and will hold the Consultant harmless from any claims arising from such reuse, modifications, or alterations of the documents. The Consultant may retain reproducible copies of all such documents delivered to the District.

- B. If the Consultant retains reproducible copies of all such documents delivered to the District, the Consultant may not use those documents in regard to current or future claims or litigation against the District brought by another party or parties unless the documents are independently produced in accordance with a court order or procedural rules and notice of such production is given to the District immediately and prior to their production.
- C. Copies retained by the Consultant, sub-consultant(s), or any related entities are governed by Arizona Law regarding the use of public records and may not be used for commercial purpose without additional written permission from the District and the payment of all applicable fees.
- ~~D. The District reserves the right to reuse the documents as it sees fit.~~

SECTION X—COMPLIANCE WITH LAWS

The Consultant is required to comply with all Federal, State, and local laws, local ordinances and regulations. The Consultant's signature on this contract certifies compliance with the provisions of the I-9 requirements of the Immigration Reform and Control Act of 1986 for all personnel that the Consultant and any subconsultants employ to complete any Project. It is understood that the District shall conduct itself in accordance with the provisions of the Maricopa County Procurement Code.

SECTION XI—GENERAL CONSIDERATIONS

- A. The Consultant shall furnish to the District for approval, the names of its key employees, and of its subconsultants and their key employees, to be used on this Project prior to beginning the work under this contract. Any subsequent changes are subject to the written approval of the District.
- B. The Consultant shall perform, with its own firm, work amounting to fifty percent (50%) or more of the total amount of the contract value. Any deviation may be approved, in writing, at the discretion of the Agent.
- C. The failure of either party to enforce any of the provisions of this contract or to require performance of the other party of any of the provisions hereof shall not be construed to be a waiver of such provisions, nor shall it affect the validity of this contract or any part thereof, or the right of either party to thereafter enforce each and every provision.
- D. The Consultant shall be responsible for the cost of any additional design, field layout, testing, construction and supervision necessary to correct those errors or omissions attributable to the Consultant, and for any damage incurred by the District as a result of additional construction costs caused by such consultant errors or omissions.
- E. The fact that the District has accepted or approved the Consultant's work shall in no way relieve the Consultant's responsibility.

- F. It is mutually understood and agreed that this contract shall be governed by the laws of the State of Arizona, both as to interpretation and performance. Any action at law, suit in equity, or judicial proceeding for the enforcement of this contract, or any provision thereof, shall be instituted only in the courts of the State of Arizona.
- G. When this contract requires the Consultant to study specific geographic areas of Maricopa County (including but not limited to floodplain delineations, watercourse master plans, area drainage master studies, or any other site specific assignment) the Consultant agrees during the term of this contract and any extensions thereof that Consultant will not perform similar services for any clients other than the District within that specific geographic area without the written authorization and approval of the Chief Engineer and General Manager of the District.
- H. The Consultant agrees that it, its principals, employees, sub-consultants, agents and assigns, shall not accept employment as consultants, expert witnesses or otherwise in any pending or contemplated litigation against the District during the term of this contract and any extensions thereof without the written authorization and approval of the Chief Engineer and General Manager of the District.
- I. The Consultant agrees that it, its principals, employees, sub-consultants, agents and assigns, shall not accept employment as consultants, expert witnesses or otherwise in any future litigation against the District in regard to the subject matter of this contract without the written authorization and approval of the Chief Engineer and General Manager of the District.
- J. It is understood that the District shall have the right to seek and obtain in any court of competent jurisdiction an injunction to restrain a violation or alleged violation by the Consultant, its principals, employees, sub-consultants, agents or assigns, of the provisions of G., H., and I. of this section or of the provisions of B. of Section IX, and the right of action for full damages at law, in addition to any other remedies provided by this contract. In no case shall a waiver by the District of the right to seek relief under this provision constitute a waiver of any other or further violation.

SECTION XII—SUCCESSORS AND ASSIGNS

This contract shall not be assigned by either party without prior written approval of the other except that the Consultant may use in the performance of this contract without prior approval of the District, personnel or services of its related entities and affiliated companies as if they were an integral part of the Consultant; and it shall extend to and be binding upon the heirs, executors, administrators, successors and assigns of the parties hereto.

SECTION XIII—NO KICK-BACK CERTIFICATION

The Consultant warrants that no person has been employed or retained to solicit or secure this contract upon any agreement or understanding for a commission, percentage, brokerage, or contingent fee; and that no member of the Board of Directors or any employee of the District has any interest, financially or otherwise, in the Consultant's firm.

For breach or violation of this warranty, the District shall have the right to annul this contract without liability, or at its discretion, to deduct from the contract price or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

SECTION XIV—ANTI-DISCRIMINATION PROVISION

The Consultant agrees not to discriminate against any employee or applicant for employment because of race, religion, gender, age, disability, or national origin, and further agrees not to engage in any unlawful employment practices. The Consultant further agrees to insert the foregoing provisions in all subcontracts hereunder.

SECTION XV – SMALL BUSINESS ENTERPRISE (SBE) PROGRAM

The Maricopa County Small Business Enterprise Program is incorporated by reference. It is Maricopa County's policy to provide small businesses the opportunity to participate in the County's solicitation process and to be considered to fulfill the requirement for various commodities and services. No specific SBE participation percentage goal or dollar amount has been established for this contract.

SECTION XVI—INDEMNIFICATION

To the fullest extent permitted by law, the Consultant shall defend, indemnify, and hold harmless the Flood Control District of Maricopa County, Maricopa County, and their agents, representatives, officers, directors, officials, and employees from and against all claims, damages, losses, and expenses including, but not limited to, attorney fees, court costs, expert witness fees, and the cost of appellate proceedings, relating to, arising out of, or alleged to have resulted from the negligent acts, errors, omissions or mistakes relating to the performance of this Contract. The Consultant's duty to defend, indemnify, and hold harmless the Flood Control District of Maricopa County, Maricopa County, and their agents, representatives, officers, directors, officials, and employees shall arise in connection with any claim, damage, loss or expense that is attributable to bodily injury, sickness, disease, death, or injury to, impairment, or destruction of property, including loss of use resulting there from, caused by any negligent acts, errors, omissions, or mistakes in the performance of this Contract including any person for whose negligent acts, errors, omissions, or mistakes the Consultant may be legally liable.

The amount and type of insurance coverage requirements set forth herein will in no way be construed as limiting the scope of the indemnity in this paragraph.

The scope of this indemnification does not extend to the sole negligence of the Flood Control District of Maricopa County.

SECTION XVII—INSURANCE REQUIREMENTS

The Consultant, at the Consultant's own expense, shall purchase and maintain the herein stipulated minimum insurance from a company or companies duly licensed by the State of Arizona and possessing a current A.M. Best, Inc. rating of B++6. In lieu of State of Arizona licensing, the stipulated insurance may be purchased from a company or companies, which are authorized to do business in the State of Arizona, provided that said insurance companies meet the approval of the Flood Control District of Maricopa County. The form of any insurance policies and forms must be acceptable to the Flood Control District of Maricopa County.

All insurance required herein shall be maintained in full force and effect until all work or service required to be performed under the terms of the Contract is satisfactorily completed and formally accepted. Failure to do so may, at the sole discretion of the Flood Control District of Maricopa County, constitute a material breach of this Contract.

The Consultant's insurance shall be primary insurance as respects the Flood Control District of Maricopa County and Maricopa County, and any insurance or self-insurance maintained by the Flood Control District of Maricopa County or Maricopa County shall not contribute to it.

Any failure to comply with the claim reporting provisions of the insurance policies or any breach of an insurance policy warranty shall not affect the Flood Control District of Maricopa County's right to coverage afforded under the insurance policies.

The insurance policies may provide coverage that contains deductibles or self-insured retentions. Such deductible and/or self-insured retentions shall not be applicable with respect to the coverage provided to the Flood Control District of Maricopa County under such policies. The Consultant shall be solely responsible for the deductible and/or self-insured retention and the Flood Control District of Maricopa County, at its option, may require the Consultant to secure payment of such deductibles or self-insured retentions by a surety bond or an irrevocable and unconditional letter of credit.

The Flood Control District of Maricopa County reserves the right to request and to receive, within ten (10) working days, certified copies of any or all of the herein required insurance policies and/or endorsements. The Flood Control District of Maricopa County shall not be obligated, however, to review such policies and/or endorsements or to advise the Consultant of any deficiencies in such policies and endorsements, and such receipt shall not relieve the Consultant from, or be deemed a waiver of the Flood Control District of Maricopa County's right to insist on strict fulfillment of the Consultant's obligations under this Contract.

The insurance policies required by this Contract, except Workers' Compensation and Errors and Omissions, shall name the Flood Control District of Maricopa County, Maricopa County, and their agents, representatives, officers, directors, officials, and employees as Additional Insureds.

The policies required hereunder, except Workers' Compensation and Errors and Omissions, shall contain a waiver of transfer of rights of recovery (subrogation) against the Flood Control District of Maricopa County, Maricopa County and their agents, representatives, officers, directors, officials, and employees for any claims arising out of the Consultant's work or service.

REQUIRED INSURANCE COVERAGES

Commercial General Liability

Commercial General Liability insurance and, when necessary, Commercial Umbrella insurance with a limit of not less than \$1,000,000 for each occurrence, \$2,000,000 Products/Completed Operations Aggregate, and \$2,000,000 General Aggregate Limit. The policy shall include coverage for bodily injury, broad form property damage, personal injury, products, and completed operations and blanket contractual coverage, and shall not contain any provision that would serve to limit third party action over claims. There shall be no endorsement or modification of the CGL limiting the scope of coverage for liability arising from explosion, collapse, or underground property damage.

Automobile Liability

Commercial/Business Automobile Liability insurance and, if necessary, Commercial Umbrella insurance with a combined single limit for bodily injury and property damage of not less than \$1,000,000 each occurrence with respect to any of the Consultant's owned, hired, and non-owned vehicles assigned to or used in performance of the Consultant's work or services under this Contract.

Workers' Compensation

Workers' Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction of the Consultant's employees engaged in the performance of the work or services under this Contract; and Employer's Liability insurance of not less than \$1,000,000 for each accident, \$1,000,000 disease for each employee, and \$100,000 disease policy limit.

The Consultant waives all rights against the Flood Control District of Maricopa County, Maricopa County, and their agents, officers, directors, and employees for recovery of damages to the extent these damages are covered by the Workers' Compensation and Employer's Liability or commercial umbrella liability insurance obtained by the Consultant pursuant to this contract.

Errors and Omissions Insurance

Errors and Omissions insurance and, when necessary, Commercial Umbrella insurance, which will insure and provide coverage for errors or omissions of the Consultant, with limits of no less than \$1,000,000 for each claim.

Certificates of Insurance

Prior to commencing work or services under this Contract, the Consultant shall furnish the Flood Control District of Maricopa County with Certificates of Insurance in a form acceptable to the Flood Control District of Maricopa County, or formal endorsements as required by the Contract in the form provided by the Flood Control District of Maricopa County, issued by the Consultant's insurer(s), as evidence that policies providing the required coverage's, conditions, and limits required by this Contract are in full force and effect. **Such certificates shall identify this contract number and contract title.**

In the event any insurance policy(ies) required by this Contract is(are) written on a "claims made" basis, coverage shall extend for two (2) years past completion and acceptance of the Consultant's work or services and as evidenced by annual Certificates of Insurance.

If a policy does expire during the life of the Contract, a renewal certificate must be sent to the Flood Control District of Maricopa County fifteen (15) days prior to the expiration date.

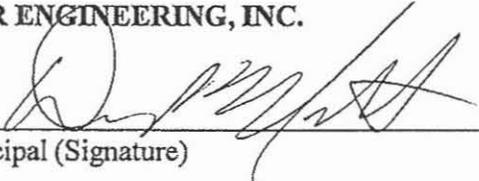
Cancellation and Expiration Notice

Insurance required herein shall not expire, be canceled, or materially changed without thirty (30) days prior written notice to the Flood Control District of Maricopa County.

SIGNATURE PAGE

IN WITNESS WHEREOF, the parties herein have executed this contract.

HDR ENGINEERING, INC.


Principal (Signature)

Don P. Manthe, P.E.

Printed Name

Vice President, Managing Principal

Title

January 25, 2008

Date

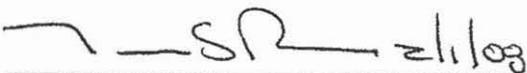
47-068-0568

Federal Tax Identification Number

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY:

ACCEPTED AND APPROVED:



Timothy S. Phillips, P.E. Date
Chief Engineer and General Manager

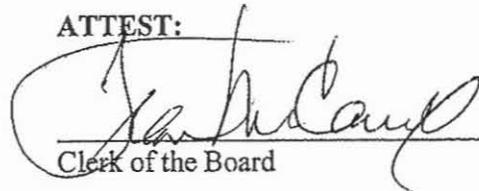


Chairman, Board of Directors

FEB 20 2008

Date

ATTEST:



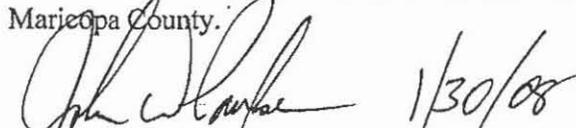
Clerk of the Board

FEB 20 2008

Date

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District of Maricopa County.



Deputy County Attorney

Date

CONTRACT FCD 2007C031

LOOP 303 – WHITE TANKS ADMPU AREA HYDROLOGIC ANALYSIS

ATTACHMENTS

Certificate of Performance

Certificate of Insurance

Maricopa County Small Business Enterprise (SBE) Participation Reporting Form

Certificate of Performance and Payment of All Claims

CONSULTANT CONTRACT

_____ hereby certifies to the Flood Control District of Maricopa County
(Name of Signer)
(District) that all lawful claims for labor, rental of equipment, material used, and any other claims by HDR Engineering, Inc. or subcontractors in connection with the Project described in District contract FCD 2007C031 for Loop 303 – White Tanks ADMPU Area Hydrologic Analysis have been paid.

HDR Engineering, Inc. understands that with receipt of payment for previously invoiced amounts plus any retained monies, that this is a settlement of all claims of every nature and kind against the District arising out of the performance of the District's contract **FCD 2007C031**, relating to the material, equipment, and work covered in and required by the contract.

The undersigned hereby certifies that to his/her knowledge, no contractual disputes exist in regard to this contract and that he/she has no knowledge of any pending or potential claims in regard to this contract.

Upon submission of this document and a separate invoice for any retained funds to the District, invoice processing will be completed within forty-five (45) calendar days.

State of Arizona)
)§
County of Maricopa)

Signed this _____ day of _____, 200__.

Signature

Title

SUBSCRIBED AND SWORN TO before me this _____ day of _____, 200__.

Notary Public

My Commission Expires:_____

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
 CERTIFICATE OF INSURANCE

CONTRACT FCD 2007C031

PROJECT TITLE: Loop 303 - White Tanks ADMPU
 Area; Hydrologic Analysis

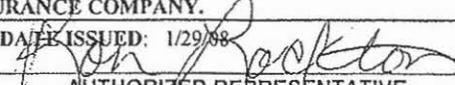
NAME AND ADDRESS OF INSURANCE AGENCY:		*INSURANCE COMPANIES AFFORDING COVERAGES:	
LOCKTON COMPANIES		Company Letter	A ZURICH INSURANCE COMPANY
444 W. 47TH STREET SUITE 900		Company Letter	B AMERICAN GUARANTEE & LIABILITY
KANSAS CITY, MO 64112-1906		Company Letter	C SENTRY INSURANCE COMPANY
NAME AND ADDRESS OF INSURED:		Company Letter	D
HDR ENGINEERING INC		Company Letter	E
8404 INDIAN HILLS DRIVE		Company Letter	F
OMAHA, NE 68114-4049		Company Letter	

This Certificate of Insurance certifies that policies of insurance listed below have been issued to the insured named above and are in full force at this time.

*CO. LTR.	TYPE OF INSURANCE	POLICY NUMBER	EFFECTIVE DATE (MM/DD/YY)	EXPIRATION DATE (MM/DD/YY)	LIMITS	
A	GENERAL LIABILITY: <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIAB. <input checked="" type="checkbox"/> OCCURRENCE <input checked="" type="checkbox"/> PREMISES OPERATIONS <input checked="" type="checkbox"/> BLANKET CONTRACTURAL <input checked="" type="checkbox"/> BROAD FORM PROPERTY DAMAGE <input checked="" type="checkbox"/> PERSONAL INJURY <input checked="" type="checkbox"/> PRODUCTS AND COMPLETED OPERATIONS HAZARD <input checked="" type="checkbox"/> EXPLOSION AND COLLAPSE <input checked="" type="checkbox"/> UNDERGROUND HAZARD <input checked="" type="checkbox"/> INDEPENDENT CONTRACTORS	GLO3504583	06/01/2007	06/01/2008	PRODUCTS/COMPLETED OPERATIONS AGGREGATE GENERAL AGGREGATE EACH OCCURRENCE	\$2,000,000 \$2,000,000 \$1,000,000
B	AUTOMOBILE LIABILITY: <input checked="" type="checkbox"/> ANY AUTO <input checked="" type="checkbox"/> ALL OWNED & NON-OWNED AUTOS	BAP3504584	06/01/2007	06/01/2008	COMBINED SINGLE LIMIT	\$2,000,000
B	<input checked="" type="checkbox"/> EXCESS LIABILITY UMBRELLA FORM	AUC3808400 (EXCL PROF. LIAB)	06/01/2007	06/01/2008	EACH OCCURRENCE AGGREGATE	\$1,000,000 \$1,000,000
C	<input checked="" type="checkbox"/> WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY	09-14910-02	06/01/2007	06/01/2008	Statutory limits and Employer's Liability: each accident Disease: each employee Disease: policy limit	\$1,000,000 \$1,000,000 \$1,000,000
D	<input checked="" type="checkbox"/> ENGINEERS PROFESSIONAL LIABILITY	EOC9260026-00	06/01/2007	06/01/2008	EACH CLAIM ANNUAL AGGREGATE	\$1,000,000 \$1,000,000
	<input checked="" type="checkbox"/> OTHER:	Except for Workers' Compensation Insurance and Professional Liability Insurance, Flood Control District of Maricopa County and Maricopa County, their agents, representatives, officers, Directors, Officials, and employees are named as Additional Insured's.				

Except for Workers' Compensation Insurance and Professional Liability Insurance, Flood Control District of Maricopa County (District), Maricopa County, and their agents, representatives, officers, Directors, Officials, and employees are named as Additional Insured's on those types of policies described herein which are required to be furnished by this contract entered into between the insured and the District. To the extent provided in contract PCD2007C031, insured shall hold harmless the District from liability arising out of any services provided or duty performed by insured as required by statute, law, purchase order or otherwise required, with the exception of liability for loss or damage resulting from the sole negligence of the District, its agents, employees, or indemnities. It is agreed that any insurance available to the named insured shall be primary of other sources that may be available. It is further agreed that no policy shall expire, be cancelled, or materially changed to affect the coverage available to the County without thirty (30) days written notice to the District. THIS CERTIFICATE IS NOT VALID UNLESS COUNTERSIGNED BY AN AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
 2801 WEST DURANGO STREET
 PHOENIX, ARIZONA 85009

DATE ISSUED: 1/29/08

 AUTHORIZED REPRESENTATIVE



Maricopa County Small Business Enterprise Program Participation Reporting Form

This form is to be submitted with each pay application or invoice. Any pay application or invoice without this form attached is subject to rejection as not being a completed pay application or invoice pursuant to the terms of the contract.

Name of Prime Consultant/Contractor

Contract No.

Contact Person

Project No.

Street Address

\$ _____
Amount of this Pay Application/Invoice

City, State ZIP

Complete below with information on the SBE firms utilized as subconsultants/subcontractors for this pay application/invoice. If work was self-performed and your firm, as the prime, is an SBE firm pursuant to A.R.S. § 41-1001, et seq., then you may list your firm as the SBE firm.

SBE Firm Name	SBE Firm Address	Type of Work Performed	\$ Pd to SBE this App/Inv
			\$
			\$
			\$
			\$
			\$
			\$
			\$
			\$
			\$
			\$

A mark in this box certifies that no SBE firms were utilized as the prime, subconsultant or subcontractor with respect to this pay application/invoice.

Date: _____

Signature

EXHIBIT A



SCOPE OF WORK

**CONTRACT FCD 2007C031
LOOP 303 / WHITE TANKS AREA DRAINAGE MASTER PLAN
UPDATE (ADMPU) AREA
HYDROLOGIC ANALYSIS**

EXHIBIT A
Contract FCD 2007C031
LOOP 303 / WHITE TANKS ADMPTU AREA HYDROLOGIC ANALYSIS

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1 GENERAL DESCRIPTION

1.1 PROJECT DESCRIPTION

- 1.1.1 This scope of work is for professional engineering services necessary for developing new hydrology for the Loop 303 / White Tanks Area Drainage Master Plan Update (ADMPU) study area.
- 1.1.2 The work is to develop a new hydrologic analysis due to the extensive development that has occurred in the area since the completion of the original update and include additional areas that were not updated in the previous update, to include the area south of McMicken Outlet Channel and west of El Mirage Drain. This analysis will also utilize the new NOAA 14 rainfall depth and re-analyze the L303/WTADMPU split flows occurring at various intersections. This scope of work includes, but is not limited to, existing conditions review including areas not reviewed in the previous study; reassess future conditions hydrology; hydraulics; surveying; coordination with other on going studies to include but not limited to the Loop 303 by Arizona Department of Transportation, public and stakeholder interaction and coordination.

1.2 PURPOSE

The purpose of the study is to develop new hydrologic models for the Loop 303/White Tanks watershed that includes:

- Hydrologically analyze existing developments (such as Sun City West and Sun City Grand) that were not analyzed in the ADMPU.
- Update land uses in all sub-basins to include developments that have occurred in the area since the completion of the hydrology for the Loop 303/White Tanks ADMPU.
- Update the rainfall depth as identified in NOAA 14.
- Update split flow rating curves occurring throughout the watershed.
- Compare the results of the hydrologic analysis with the design flows for the ADMPU Recommended Alternative structures, identify any significant differences, and make recommendations of further analyses.

1.3 LOCATION

The ADMP study area is generally bounded by the McMicken Dam on the north, Agua Fria River on the east, the Gila River on the south and the White Tank Mountain divide and Dean Road on the west. The total ADMP and watershed area is approximately two hundred and thirty-eight (238) square miles, which includes Unincorporated Maricopa County and portions of Avondale, Buckeye, El Mirage, Glendale, Goodyear, Litchfield Park, Surprise, and Luke Air Force Base. (See Figure 1). Portions of the study area are under federal and state ownership.

Loop 303/White Tanks ADMPU Hydrologic Analysis Project Area

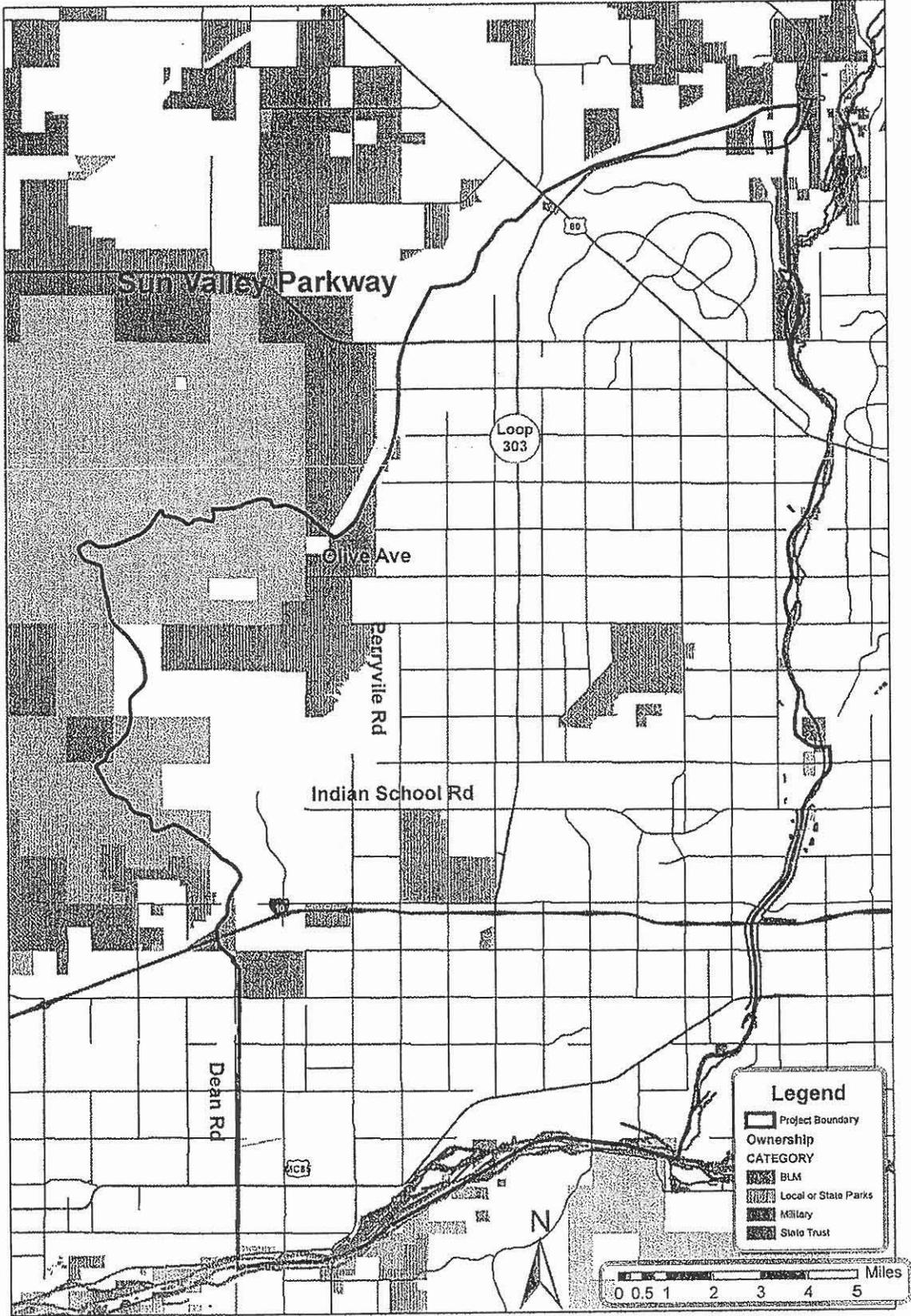


Figure 1: Location Map

2 SCHEDULE AND PROJECT COORDINATION

2.1 GENERAL REQUIREMENTS

- 2.1.1 The CONSULTANT shall comply with the requirements of the Flood Control District of Maricopa County's Consultant Guidelines Dated December 1, 2003 (CONSULTANT GUIDELINE) for the items of work referenced under this Scope of Work.
- 2.1.2 The CONSULTANT shall comply with the Section 1.0 – General Provisions.

2.2 DEFINITIONS

- 2.2.1 Unless specifically noted otherwise, definitions will be as per Section 1.2 of the CONSULTANT GUIDELINE.
- 2.2.2 PUBLIC STAKEHOLDER – Shall be the representatives or designate of the Cities and public officials listed in Section 2.3 of this Scope of Work and any other stakeholder within the project area as determined by the DISTRICT.
- 2.2.3 PRIVATE STAKEHOLDER – Shall be the representative of a developer, a landowner, an interested party, a utility company, or a governmental body not identified as a public stakeholder above.
- 2.2.4 PARTNER – Shall be the representatives from ADOT.
- 2.2.5 CIP – Shall be the proposed capital improvement projects identified in District Drainage Master Plans, Area Drainage Master Plans, Updates, and Candidate Assessment Reports within the project area. Additionally, this shall include similar projects proposed within the project area by other agencies and municipalities.

2.3 AGENCIES

- 2.3.1 The CONSULTANT shall coordinate with the following representatives who will be receiving copies of project report submittals (see Section 12:10 Deliverables for exact numbers) and will act as a point of contact:

Ms. Valerie Swick, Project Manager
Flood Control District of Maricopa County
(602) 506-2929

Mr. Steve Beasley, P.E., Transportation Engineering Manager
Arizona Department of Transportation
(602) 712-7645

- 2.3.2 The CONSULTANT shall coordinate with the following representatives from each jurisdiction in the area.

Matt Holm, AICP, Principal Comprehensive Planner
Bil Haas
Maricopa County Planning & Development
(602) 506-7162

Charles Andrews
City of Avondale
(623) 333-4216

Darryl Crossman, City Manager
City of Litchfield Park
(623) 935-5033

Scott Lowe, Public
Works Director
Town of Buckeye
(623) 327-3403

Bob Maki
City of Surprise
(623) 583-6025

Lance Calvert
City of El Mirage
(623) 876-2971

Richard Mousel
Luke Air Force Base
(623) 856-3635

Greg Rodzenko
Jayme Chapin
City of Glendale
(623) 930-2939

Elaina Abbassian
Arizona State Land
(602) 542-1619

Keith Brown, Assistant
City Engineer
City of Goodyear
(623) 882-7956

2.4 CONTRACT TIME

The CONSULTANT shall complete the Scope of Work within the contract period of two hundred seventy-five (275) calendar days, which includes review time for the DISTRICT and the AGENCIES, from Notice to Proceed.

2.5 PROJECT REFERENCES

The CONSULTANT will be provided the following data by the DISTRICT at the project Kickoff Meeting:

2.5.1 HEC-1 models and HEC-2 models for the Loop 303/ White Tanks ADMP Update study area, including:

- 100-yr 24-hr Existing and Future Conditions HEC-1 models, with and without CIP in place, Loop 303/White Tanks ADMP, by URS.
- 100-yr 24-hr Existing Conditions HEC-1 model, White Tanks/Agua Fria ADMS, by WLB
- 100-yr 24-hr HEC-2 models, White Tanks/Agua Fria ADMS, by WLB

2.5.2 All pertinent reports to District Projects including but not limited to:

- Bullard Wash Channel Improvement Project
- Dysart Drain
- Colter Channel
- Loop 303 Drainage Improvements Candidate Assessment Report Phase I
- Loop 303 Hydrology Update and Camelback Basins Candidate Assessment Report

2.5.3 Development Plans.

The DISTRICT will provide available development plans. The CONSULTANT will gather the remainder of the development plans.

2.5.4 The DISTRICT will provide the CONSULTANT with base mapping from the DISTRICT's GIS data base.

- Base mapping will include land ownership, land use types, and soil types.
- The land ownership maps will indicate whether property is publicly or privately held and the owning agency.
- 1990 2-foot CI Digital Topography for the Loop 303/White Tanks ADMP Hydrologic Update Watershed Area.
- 2007 Digital Aerial Photographs.
- Existing Flood Control District Facilities within the Study Area.

2.5.5 The CONSULTANT will use the digital information provided by the DISTRICT to prepare base maps for the interim and final reports.

2.6 OUT OF SCOPE ITEMS

2.6.1 Should the CONSULTANT feel that the DISTRICT, or any partner such as city or agency staff, is requiring the CONSULTANT to provide work that is not within the scope of the contract documents, the CONSULTANT must notify the DISTRICT Project Manager immediately in writing and describe the work which the CONSULTANT feels is out of scope. Such notification shall be provided to the DISTRICT Project Manager prior to the commencement of any such out of scope work.

2.6.2 It is the CONSULTANT's sole responsibility to assure that no additional services beyond the Scope of Work defined in the contract documents shall commence without the written authorization of the DISTRICT Project Manager.

2.6.3 No work defined in the original contract documents shall be delayed by the CONSULTANT's request for additional fee for a change or addition in the agreed Scope of Work unless so directed by the DISTRICT Project Manager.

2.6.4 Retroactive requests for additional fee shall neither be considered nor approved.

2.7 SCHEDULE AND PROJECT COORDINATION

2.7.1 SCHEDULE

2.7.1.1 The CONSULTANT shall 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 scope, significant project milestones, and DISTRICT review periods, formatted to conform to the Schedule Template (Exhibit 5 of the CONSULTANT GUIDELINES).

2.7.1.2 The schedule shall be developed in a computerized format that contains the anticipated beginning and end dates for the tasks identified in the scope, the time duration of each task, a bar chart (Gantt Chart) showing

the tasks and the overall duration of the project. The computer program MS Project, Version 4.0 or compatible is preferred. The CONSULTANT shall update this project schedule monthly.

2.7.1.3 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 and graphic form (Exhibit 6A of the CONSULTANT GUIDELINES).

2.7.1.4 The CONSULTANT shall allow for a minimum three (3) week review and comment period by the DISTRICT and other involved parties in the schedule for all reports and data identified in the scope of work.

2.7.2 PROJECT COORDINATION

2.7.2.1 Project Manager

2.7.2.1.1 The CONSULTANT shall appoint a Project Manager who is knowledgeable of the project and have responsible charge of the progress of each phase of the project. The Project Manager shall be the same person listed in the CONSULTANT's Technical Proposal, unless otherwise approved by the DISTRICT. The DISTRICT may request replacement of the Project Manager if it becomes apparent that this would be in the best interest of the project. The Project Manager shall be the point of contact for the DISTRICT. The DISTRICT may terminate this agreement if the Project Manager is not available or if the CONSULTANT is unable to provide a replacement Project Manager acceptable to the DISTRICT.

2.7.2.1.2 The Project Manager shall keep the DISTRICT informed of all coordination with outside agencies and other affected parties.

2.7.3 INVOICES

2.7.3.1 The CONSULTANT shall submit an estimate of the projected monthly billings at the Kick-Off Meeting. Thereafter, this estimate will be updated and submitted to the DISTRICT's Project Manager at least ten (10) days prior to the end of each quarter. This estimate will be based upon the percentage of work to be completed each month expressed as a percentage of the total contract amount and in dollars to be earned each month (earned value method).

2.7.3.2 CONSULTANT shall submit monthly (or other time intervals approved by the DISTRICT) invoices requesting progress payment, which reflect work accomplished during the invoice period. The invoices shall identify the project name, contract number; the DISTRICT's Project Control Number (PCN) and shall be completed as follows:

2.7.3.3 Lump Sum Contracts – Payments shall be based upon the amount of work accomplished to date. Payments due shall be computed based on percent complete for each work task and subcontracted service identified in the contract fee proposal. The task percent complete multiplied by the budget amount for the task per the fee proposal shall be shown with a total due for all work tasks; the amounts previously billed; the amount

due for the period; and the amount remaining for each task and the contract total. (Exhibit 6A of the CONSULTANT GUIDELINES)

- 2.7.3.4 Invoices shall be submitted to the DISTRICT's Accounts Payable for processing and payment. At the same time and under separate transmittal, a copy of the invoice will be provided to the DISTRICT's Project Manager, who will review and approve the basis of the payment request.

2.7.4 PROGRESS REPORTS

- 2.7.4.1 The CONSULTANT shall 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 description of the significant work accomplished during the reporting month by task as identified in the contract fee proposal.
- For contracts or work assignments greater than \$200,000, the CONSULTANT shall submit a table showing the actual monthly invoice amounts to date and original project estimate cumulative monthly totals for the duration of the contract. A graph showing the original monthly billing projection and the actual monthly invoiced amounts to date will be included.
- A brief description of the work to be accomplished in the following month by task.
- A description of any problems encountered and actions to resolve the problems.
- All authorized optional task shall be reported as a separate line item.

- 2.7.4.2 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.

- 2.7.4.3 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, correspondence, etc. shall be submitted in a Project Data Notebook.

- 2.7.4.4 The CONSULTANT shall provide a summary of the monthly and cumulative invoice amounts compared to the projected amounts as established at the project Kick-Off Meeting or as subsequently revised to reflect project change orders.

2.7.5 SCOPING SESSION (FOR REFERENCE ONLY)

- 2.7.5.1 The DISTRICT encourages the foundation of a partnering relationship with the CONSULTANT and its SUBCONSULTANTS. This cooperative relationship will be structured to draw on the strengths of

each organization and to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance intended to achieve completion within budget, on schedule, and in accordance with contract requirements.

- 2.7.5.2 The CONSULTANT and the DISTRICT will participate in a facilitated Scoping Session prior to the final submittal of the contract fee proposal. The DISTRICT will provide the facilitator for this session. During the session the content of the Scope of Work, the expected design product, and the anticipated level of effort to execute tasks and an anticipated contract schedule will be discussed and agreed upon. Those in attendance shall include representatives from the CONSULTANT, all major SUBCONSULTANTS, the DISTRICT, and other participating agencies, and may include utility representatives. The participation of the various parties will be coordinated between the CONSULTANT and the DISTRICT. The session will be from two to three (2 to 3) days in duration.
- 2.7.5.3 After completion of the scoping session, the CONSULTANT shall submit the final fee proposal within the timeline established by the Project Manager.
- 2.7.5.4 In the final fee negotiation process, the CONSULTANT shall have representatives present who are authorized to negotiate and sign the contract.
- 2.7.5.5 Following award of the contract, the cooperative relationship will continue.

2.8 MEETINGS

2.8.1 The following list of meetings will generally be held at the offices of the DISTRICT. CONSULTANT shall supply meeting minutes and agendas.

2.8.1.1 Kick-Off Meeting-- Combine with first Hydrology meeting

The CONSULTANT shall meet with the DISTRICT within fourteen (14) days of the Notice to Proceed. 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 scope, 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 QA/QC persons 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 Scope of Work.

2.8.1.2 Project Deliverable 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 DISTRICT will 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 CONSULTANT 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.

2.8.1.3 Data Collection Report Review Meeting

The CONSULTANT shall meet with the DISTRICT staff to review the overall project status and to discuss the Data Collection Report review comments that will be provided to the CONSULTANT at the meeting. The CONSULTANT should be prepared to explain all information and any assumptions made up to this point. Any problems will be identified and discussed.

2.8.1.4 Hydrology Meetings and Submittals

2.8.1.4.1 Site/Field Meeting (combine with Kickoff Meeting)

2.8.1.4.2 DRAFT Sub-basin delineation and data collection

2.8.1.4.3 DRAFT Hydrology comment resolution meeting

2.8.1.4.4 Final Results in the Field

2.8.1.5 FINAL Submittal Meeting

The CONSULTANT shall meet with the DISTRICT to make the final submittal of the hydrology and hydraulic analyses. The CONSULTANT shall supply the hydrologic and hydraulic data on CD-ROM. Spatial data should be in GIS format.

2.8.1.6 Lessons Learned Meeting

Upon completion of the project, the CONSULTANT shall facilitate a half (½) day workshop to review any Scope of Work (SOW) items, task items, project assumptions, methodologies, project issues, etc., that can provide insight to the Project Team for future projects.

2.8.1.7 Monthly Project Status Meetings

The CONSULTANT shall meet monthly with the DISTRICT's Project Manager and Project Team to review the overall project status. The CONSULTANT and SUBCONSULTANTS shall be prepared to provide status updates and discuss any new or outstanding issues. Any problems shall be identified and discussed. The CONSULTANT shall participate in regular monthly coordination meetings with the DISTRICT's Project Manager, milestone, review, and coordination meetings as specified within this Scope of Work. The CONSULTANT is responsible for providing an agenda, and taking and distributing the minutes of all meetings. Whenever possible, coordination and milestone/deliverable review meetings will be combined.

2.8.1.8 Public Stakeholder Meetings

The CONSULTANT shall meet with the DISTRICT's Project Manager and identified public stakeholders through out the Project on a monthly basis. The meetings will be held in conjunction with the monthly Project Status Meetings, whenever possible. The CONSULTANT and subconsultants shall be prepared to provide status updates and discuss any issues. Any problems shall be identified and discussed. The CONSULTANT and the DISTRICT Project Manager shall meet with officials from the towns, cities, agencies, utility representatives, project partners, and other interested public parties as may be appropriate and as identified in the Scope of Work. In addition, project partner expectations and requirements for the project will be identified and incorporated into the project whenever possible. Meetings with other agencies and utilities will be held as required and shall generally be held at their offices. The CONSULTANT shall invite the DISTRICT to all such meetings. The DISTRICT shall be copied on all meeting minutes.

2.8.1.9 Private Stakeholder Meetings

The CONSULTANT shall meet with the DISTRICT's Project Manager and identified private stakeholders through out the Project on an as needed basis (up to five (5) meetings). The CONSULTANT shall be prepared to provide status updates and discuss any issues. Any problems shall be identified and discussed. The CONSULTANT shall invite the DISTRICT to all such meetings.

2.8.1.10 Additional Meetings

The CONSULTANT may be directed to participate in additional meetings with stakeholders or public officials which are not otherwise included in this scope of work, up to eight (8) meetings. These meetings and payments are not authorized with the execution of the contract, and only will be authorized in writing by the DISTRICT as required. Project fee proposals and invoices shall list the authorized amounts for the additional meetings separately from the balance of the contract amount, and shall list the total amounts authorized.

3 SURVEY, PHOTOGRAMMETRY, AND MAPPING TASKS

3.1 SUPERVISORY QUALIFICATION REQUIREMENTS:

All survey work shall be supervised by a registered land surveyor.

3.2 GENERAL REQUIREMENTS

- 3.2.1 Unless otherwise directed by specific tasks identified in this SOW, all work shall be performed in accordance with the more stringent requirements or specifications of either this SOW and/or the following documents:
- 3.2.2 Federal Emergency Management Agency (FEMA), Flood Insurance Study: Guidelines and Specifications for Flood Hazard Mapping Partners, April 2003 herein referenced as FEMA Document.
- 3.2.3 In case of discrepancy between requirements or specifications between this SOW and FEMA Document, the DISTRICT's Project Manager shall determine which shall be the applicable requirement or specification.
- 3.2.4 Accuracy and Procedural Standards. All survey work performed to obtain topographic mapping shall meet or exceed FEMA minimum criteria as defined in the FEMA Document unless stated otherwise. This includes, but is not limited to, field control surveys and verification of profiles. Additionally, the DISTRICT and/or its agent may perform additional cross sections and random point testing of the photogrammetric in addition to the minimum criteria as defined in the FEMA Document to independently verify the accuracy of the mapping and Digital Terrain Model (DTM).
- 3.2.5 The CONSULTANT shall perform the Tasks as indicated in Section 3.5, Photogrammetric Mapping of this SOW to obtain the data required to develop the DTM and topographic mapping deliverables.
- 3.2.6 The CONSULTANT is responsible for ensuring that all required data products are provided for the entire project area as specified by the DISTRICT in Figure 1 of this SOW.
- 3.2.7 All digital mapping data shall be submitted to the DISTRICT using the Arizona Coordinate System, 1983, Central Zone (international feet) and in accordance with Section 3.4. The CONSULTANT shall reduce any terrestrial ground surveying measurements to said grid projection. The CONSULTANT shall provide the combined factor(s) used to reduce said ground measurements in the Project Survey Report.
- 3.2.8 The CONSULTANT shall verify the accuracy of the mapping by the procedures called for in the FEMA Document or other methods approved by FEMA and at a minimum shall analyze the Control Network, the aerial triangulation (AT), and Final DTM in addition to the surveys required within this Scope of Work.

3.3 DATA COLLECTION

- 3.3.1 The CONSULTANT shall collect and review pertinent data from the DISTRICT and other outside sources. Data to be collected shall include existing digital topographic mapping for the purpose of surface profile comparison, Maricopa County Department of Transportation (MCDOT) Geodetic Control Survey data, orthophotography, and other pertinent information.
- 3.3.2 The CONSULTANT will provide Data Collection Report within thirty (30) days of Notice to Proceed (NTP) summarizing the data collected and the data collection effort.
- 3.3.3 The CONSULTANT shall obtain the control data from the existing mapping to ensure that there are no discrepancies.
- 3.3.4 The DISTRICT will provide the following data to the CONSULTANT:
 - 3.3.4.1 Existing digital mapping and DTM adjacent to the project area.
 - 3.3.4.2 Control data used for the existing mapping. Geodetic Densification and Cadastral Survey (GDACS) control data can be obtained form www.mcdot.maricopa.gov/survey/home.htm.

3.4 SUPERVISORY QUALIFICATION REQUIREMENTS

The CONSULTANT shall conduct all field surveys and prepare all mapping necessary to complete the project. All survey work shall be supervised by an Arizona Registered Land Surveyor (RLS). The Surveyor shall make a final review of all deliverables before sealing and signing them, certifying to their accuracy and completeness as required under Arizona Revised Statutes prior to releasing them to the DISTRICT.

3.5 SURVEY SUPPORT

- 3.5.1 Horizontal Control Datum. All horizontal control surveys shall be tied and delivered in NAD 83 (1992 epoch). Arizona coordinate system, 1983, central zone using the international feet as the units of measurement (ARS § 33-132). All horizontal control points and corresponding coordinates shall be listed in the Project Survey Report. Horizontal control points shall also be noted on the appropriate plan sheets.
- 3.5.2 Vertical Control Datum. All vertical surveys shall be based on NAVD 88, per FEMA Documents. The Consultant shall utilize the published values for the Geoid Inclined Plane provided by Maricopa County Department of Transportation GDACS during the survey collection procedures on and as shown Attached (GEOID INCLINED PLANE PARAMETERS).

3.5.3 Aerial Control Points. The CONSULTANT shall systematically set aerial targets and establish horizontal and vertical control points throughout the areas to be mapped for use in compilation by the CONSULTANT. The controls for the aerial mapping shall be in sufficient numbers and shall be in locations that will be compatible with the mapping accuracy requirements. All aerial control points shall be positioned at a 5 cm (two-sigma) Federal Geodetic Control Subcommittee accuracy standard in both horizontal and vertical position. Ties shall be made to existing monuments including section and/or quarter corner monuments if during the course of field navigating to the designated aerial control target and/or blind targets said monuments are visible and within approximately 200 feet. Said monument, if found, shall be located using RTK for a minimum of 180 epochs and will tie into the nearest primary and secondary control points from MCDOT Geodetic Control Network. The DISTRICT will not hold the CONSULTANT responsible for any defects or inaccuracies with regard to the legal position of any section/quarter corners collected during the course of this project. Should the methodology of performing the aerial control survey be a static network the CONSULTANT is not required to collect data on existing monuments including section and/or quarter corner monuments.

3.5.4 Blind Aerial Targets. In addition to the aerial targets required for the photogrammetry, one (1) blind aerial target shall be set every other square mile throughout the project or as otherwise approved by the District's Project Manager. These blind aerial targets shall be spaced throughout the Project Area, and both horizontal and vertical values shall be established and documented. The location of the blind targets will be agreed to by District's Project Manager and the CONSULTANT. All blind targets shall be positioned at a 5 cm (two-sigma) Federal Geodetic Control Subcommittee accuracy standard in both horizontal and vertical position. Ties shall be made to existing monuments including section and/or quarter corner monuments if during the course of field navigating to the designated blind targets said monuments are visible and within approximately 200 feet. Said monument, if found, shall be located using RTK for a minimum of 180 epochs and will tie into the nearest primary and secondary control points from MCDOT Geodetic Control Network. The DISTRICT will not hold the CONSULTANT responsible for any defects or inaccuracies with regard to the position of any section/quarter corners collected during the course of this project.

3.5.4.1 Tasks 3.5.3 & 3.5.4 shall be performed utilizing RTK procedures with the following standards of practice:

3.5.4.1.1 Should the CONSULTANT utilize Trimble GPS equipment for Aerial Control Points and Blind Targets the minimum settings must be applied in the data collector for collection in "Observed Control Point":

3.5.4.1.1.1 QC1 & QC2 records must be recorded

3.5.4.1.1.2 Occupation time shall be no less than 180 seconds with a minimum of 180 measurements

- 3.5.4.1.1.3 Horizontal tolerance set to 0.030ift and Vertical tolerance set to 0.050ift
 - 3.5.4.1.1.4 The above guidelines, though specific to Trimble products, are intended to be globally utilized by other manufactures in their specific language and protocol.
 - 3.5.4.1.1.5 Each point shall be occupied a minimum of two times with a minimum of a 2 hour shift in the satellite constellation. Project Survey Report should show the deltas (N,E,Z) between first and second observation.
 - 3.5.4.1.1.6 The above guidelines, though specific to Trimble products, are intended to be globally utilized by other manufactures in their specific language and protocol
- 3.5.5 Blind Aerial Target Protocol. The SUBCONSULTANT shall furnish the ground surveyed horizontal and vertical positions of the blind aerial targets directly to the DISTRICT. The DISTRICT will provide approximate values of the blind aerial targets to the CONSULTANT to aid in identification on the aerial photographs. The CONSULTANT shall independently determine the elevation and coordinates of these blind targets, with ninety-five (95%) of the points meeting the accuracy requirements established in the FEMA Document for the required project accuracy. The CONSULTANT will then furnish the calculated positions of the blind aerial targets to the DISTRICT for comparison with the surveyed positions furnished by the SUBCONSULTANT.
- 3.5.6 AT Refinement. Upon approval of the blind panel comparison results the DISTRICT will furnish the surveyed positions of the blind aerial targets to the CONSULTANT. The surveyed location of the blind targets may then be used to improve the aero triangulation solution, at the discretion of the CONSULTANT, prior to proceeding with the topographic mapping.
- 3.5.7 Aerial paneling materials are to be removed following completion of the aerial photography, while the actual surveyed markers are to remain in place.
- 3.5.8 Global Positioning System (GPS) Base Stations.
- 3.5.8.1 The CONSULTANT shall systematically select the location of GPS Base Stations (Base Stations) to support aerial photography data acquisition missions to ensure the reliability of horizontal and vertical control throughout the Project Area. The CONSULTANT shall limit the baseline distance between the Base Stations and the airborne receiver to a maximum of eight (8) miles, and there shall be a minimum of four (4) GPS Base Stations operated simultaneously during the flight. The CONSULTANT shall submit for approval the proposed locations of the Base Stations as part of the Flight Plan.

- 3.5.8.2 The Base Stations shall be located on a MCDOT B Order Geodetic Control point or a point of higher order if available. Where required control points are not readily available, the CONSULTANT shall conduct surveys to establish the control points with a positional accuracy of 0.2 feet in support of 2-foot contours.
- 3.5.8.3 The CONSULTANT shall ensure that there are no obstructions or radio frequency sources within the field of view of the Base Station that could degrade or block data reception at the receiver.
- 3.5.8.4 The Base Station GPS receivers shall be geodetic quality, dual frequency, and capable of collecting C/A, P Code and carrier phase measurements. Data shall be collected once per second for all satellites at least 10° above the horizon.
- 3.5.8.5 The CONSULTANT shall include documentation in the Project Survey Report describing the make and model of the receiver, antenna model or production number, operators, and redundant height measurement in feet.

3.5.9 Airborne GPS

- 3.5.9.1 A GPS receiver in the aircraft, interfaced to the aerial camera, shall be used to obtain GPS time and position information at the mid-exposure pulse for each captured image.
 - 3.5.9.2 Upon completion of each mission, CONSULTANT shall process the GPS data from the airborne and ground base station receivers to establish precise GPS coordinates for the geometric center of each aerial image. CONSULTANT shall provide documentation in the Project Survey Report of the repeatability of the final airborne GPS solutions. Comparisons between forward, reverse, and combined solutions between multiple ground base stations should achieve repeatability of better than 0.4' (12 cm) in all three components (X, Y and Z) for two-foot contour interval mapping.
 - 3.5.9.3 CONSULTANT shall verify and document in the Project Survey Report that a PDOP < 4 was maintained at all times during the flight. If this was not achieved, the CONSULTANT shall re-fly the area unless otherwise approved in writing by the DISTRICT's Project Manager.
 - 3.5.9.4 The airborne GPS process and derived results shall be documented in a Project Survey Report. This at a minimum shall contain the results of the airborne GPS positions, a graphic showing the camera exposure stations and flight lines; and there shall be a graphic showing the forward/reverse solutions demonstrating the precision of the final airborne GPS results. These graphics shall be to a scale that all text and graphic data is clear and legible.
- 3.5.10 Project Survey Report. The benchmarks and aerial control points shall be shown on maps and plan sheets. Survey data will be documented in a Project Survey Report. The Project Survey Report shall be 8½-inch by 11-inch in size and bound together. Any 11-inch by

17-inch maps shall be fan-folded and included in the report. The Project Survey Report shall include the following:

3.5.10.1 The Project Survey Report shall include the following:

1. A Table of Contents Sheet
2. A "SURVEYORS SUMMARY AND CERTIFICATION" which should include the following:

A background of GPS

Survey Summary which includes the following:

- General discussion of the firm(s) responsibilities and overall approaches and procedures
- Specific static procedures
- Discussion of the procedures, equipment, control found and set, software utilized to process
- Discussion of "Blind Target" procedures
- Discussion of the Airborne GPS ground support and processing of Airborne GPS missions if any
- Discussion of structure survey procedures
- Discussion of DTM and cross section surveys and any other additional profiles along roadways etc.
- Certification Coordinate List Reports that are certified by an Arizona Registered Land Surveyor

3. Primary Control Coordinate List
4. NGS Quality Control Differences Report
5. GPS Session Information for Static Network of Primary Control should include the following:
 - a. GPS SESSION TABLE
 - b. MAP OF GPS VECTORS
 - c. COORDINATE ADJUSTMENT SUMMARY
 - d. GPS BASELINE PROCESSING SUMMARY
 - e. GPS CLOSURE LOG REPORT
 - f. SUMMARY OF COVARIANCES REPORT
 - g. STANDARDIZED RESIDUALS REPORT
6. Blind Target Control Coordinate List
7. Airborne GPS Coordinate List
8. DTM Coordinate List
9. Cross Section Coordinate List

10. Airborne GPS Survey shall include the following:

- a. Discussion of ground units utilized for the missions as well as those in the aircraft
- b. Processing Summary Information Report
- c. Any other data or screen captures of the processing settings and edits that would be helpful
- d. Map of aircraft travel and event marker positions
- e. Coordinate Result Report of the Camera position (x,y,z) showing the following data:

Column/Variable Contents, Units and Description:

01: Station		Name given to station, GIS feature or camera mark
02: Northing	Int. Feet	North (y) coordinate in US State Plane Projection
03: Easting	Int. Feet	East (x) coordinate in US State Plane Projection
04: H-MSL	Int. Feet	Height above the Geoid (mean sea level)
05: H-Ell	Int. Feet	Height above the current ellipsoid
06: Undulation	Int. Feet	Height of the Ellipsoid above the Geoid
07: GPSTime	Seconds of the Week	Time of epoch or feature--Receiver time frame
08: Week	GPS Weeks	Week number starting at Jan 4, 1980
09: Q		Quality factor where 1 is best and 6 is worse
10: NS		Number of total satellites (GPS+GLONASS)
11: AmbStatus		Status of carrier phase ambiguities--Either 'Float' or 'Fixed'
12: PDOP		Position Dilution of Precision, a measure of X, Y, Z position
13: SunElv	Deg, Min, Sec (signed)	Elevation of the sun above horizon (at position and time)

- f. Forward/Reverse or Combined Separation Plots
- g. PDOP, HDOP & VDOP Plots
- h. Estimated Position Accuracy Plot
- i. Float or Fixed Ambiguity Plot
- j. Number of Satellites Bar Plot
- k. Quality Factor Plot

11. LiDar Calibration Survey shall include the following:

- a. Map of Survey
- b. Conventional Raw Data collected in the field
- c. LiDar Calibration Coordinate Report

12. Metadata for Control Stations which shall include the following:

- a. NGS Recovery Station Sheets
- b. GPS Log Sheet
- c. "Go To" sheets by "GDACS"
- d. "Sky" Plot sheets by GDACS"
- e. Supporting Pictures

13. Metadata for Primary Control Targets & Blind Target shall include the following:

- a. Monument Log Sheets
- b. GPS Log Sheets
- c. Supporting Pictures

3.5.10.2 Copies of all survey notebooks and office calculations or printout of digital files developed with data collectors shall be submitted with the Project Survey Report. All field collected survey data obtained using conventional survey methods shall be noted in standard 5" by 7" hardbound survey books. All survey data collected electronically shall be submitted in an ASCII text file (must be readable in MS Word and Word Perfect).

3.5.10.3 Details of benchmarks, aerial control, and other horizontal and vertical control points shall be tabulated in the Project Survey Report. At a minimum, the table shall summarize for each point the point number, horizontal coordinates, elevation, the datum upon which the benchmark was originally established, horizontal and vertical order and class, monument type, ground to grid conversion factor, and a detailed description of the point location for ready recovery in the field.

3.5.10.4 The control point summary shall include a base map of suitable scale to show the location of the benchmarks and aerial control points.

3.5.10.5 The Project Survey Report shall be sealed by an Arizona Registered Land Surveyor.

3.5.11 Survey Tasks

3.5.11.1 Tasks 3.5.10.2 through 3.5.10.3 shall be performed utilizing RTK procedures with the following standards of practice (where RTK is not practical the option to utilize conventional/traditional survey equipment may be necessary):

3.5.11.1.1 Should the CONSULTANT utilize Trimble GPS equipment for DTM Checks, Field Cross Sections & Structure Surveys the minimum settings must be applied in the data collector for collection in "Topo Point mode":

3.5.11.1.1.2 QC1 & QC2 records must be recorded

3.5.11.1.1.3 Occupation time shall be no less than 5 seconds with a minimum of 3 measurements

3.5.11.1.1.4 Horizontal tolerance set to 0.049ift and Vertical tolerance set to 0.066ift

3.5.11.1.1.5 The above guidelines, though specific to Trimble products, are intended to be globally utilized by other manufactures in their specific language and protocol.

3.5.11.2 DTM Checks – Survey SUBCONSULTANT shall perform on-the-ground surveys of Digital Terrain Model (DTM) check shots. The DISTRICT has a standard that a minimum of four (4) check shots per tile

are required. For the purpose of this project blind targets and cross section data can account for DTM checks. Additionally the photogrammetrist will be collecting DTM data within a 200' x 200' square in strategic locations. Should a blind target or primary control point fall in a tile prior to performing the DTM checks said point may count as one of the four (4) check shots. Should a cross section be completed prior to the DTM checks, one (1) point of the cross section may be applied toward one (1) of the four (4) DTM check shots. The survey SUBCONSULTANT shall make a reasonable attempt to proportionately disburse the positions of the DTM check shots throughout the individual tiles. CONSULTANT shall not be provided the results of the DTM check shots. The survey SUBCONSULTANT shall submit the results of the DTM check shots directly to the DISTRICT. The deliverable shall be in a Microsoft Excel spreadsheet and shall include the point number, northing, easting, elevation, description & note (PNEZDN). The description and note fields must indicate the Sheet/Tile name and the name of the wash if applicable.

3.5.11.3 Field Cross Sections - Survey SUBCONSULTANT shall perform on-the-ground surveys of cross sections as directed by the District. Ten (10) Cross Sections shall be surveyed, not less than 1200' in length (600' from center of wash) or until 300' past the top of bank. All break lines (grade-breaks) along the cross section alignments shall be collected and no point shall be further than 50' from another. Cross section alignment shall be perpendicular to the main thread of the streambed. The SUBCONSULTANT shall not provide the results of the surveyed cross sections to the mapping firm without prior approval from the District's Project Manager. The SUBCONSULTANT shall submit the results of the surveyed cross sections directly to the DISTRICT. The deliverable must be in a Microsoft Excel spreadsheet and shall include the point number, northing, easting, elevation, description & note (PNEZDN). The description and note fields shall indicate the Sheet/Tile name and the name of the wash, if applicable.

3.5.11.4 Subsidence Checks - Survey SUBCONSULTANT shall perform checks as identified by CONSULTANT and may include survey control checks, profile surveys & cross section surveys.

3.6 PHOTOGRAMMETRIC MAPPING

3.6.1 General Requirements

3.6.1.1 The CONSULTANT shall perform photogrammetric mapping to prepare 2-foot contour interval digital topographic mapping at 1" = 200' mapping scale for the identified site survey locations (up to 150 locations, approximate dimensions of six hundred (600) feet square plus several half- to one-mile long corridors at six hundred feet in width). Two-foot contours shall be discontinued for slopes in excess of 15% where only the index contours shall be provided.

3.6.1.2 General Definitions and Associated Requirements

- a. ENDLAP - Consecutive photos in each flight line shall have an average forward overlap of 60%, plus or minus 2%.
- b. SIDELAP - Sidelap between adjacent parallel flight lines shall average 30%, plus or minus 5%.
- c. CRAB - Crab (left-right deflection about the vertical axis) shall not exceed 3° between successive exposures or flight lines.
- d. TILT - Camera shall not deviate more than 3° from the vertical axis at the instant of exposure, nor shall it exceed 5° between successive exposure stations.
- e. FLIGHT ALTITUDE - Deviation from the planned flight altitude shall not exceed 5%.

3.6.2 Mission Planning

- 3.6.2.1 The CONSULTANT shall submit their flight plan prior to the project kickoff meeting. The flight plan shall be of a known, even engineering scale, and shall show at a minimum the project boundary, model outlines, flight lines with assigned altitudes, and control locations. Mapping limit boundaries shall fall within neat model limits of the photography. CONSULTANT shall be responsible for ensuring that photo scales and corresponding flight altitudes are appropriate to the accuracy and resolution needs of the project.
- 3.6.2.2 CONSULTANT shall furnish calibration reports for the aerial cameras proposed for use on the project. Calibration reports shall be current within 2 years.
- 3.6.2.3 Prior to each flight mobilization requiring the use of airborne GPS, the CONSULTANT shall verify and include documentation that there will be a minimum of six (6) satellites in the sky at least 15° above the horizon and a positional dilution of precision (PDOP) < 4.
- 3.6.2.4 The CONSULTANT is required to document and submit any weather or air traffic restrictions which might negatively impact the delivery schedule for the project.
- 3.6.2.5 The CONSULTANT shall be responsible for coordination of the aerial photo acquisition missions, ensuring that all targets have been set in advance of the flight, and that all GPS ground base stations are in place to support airborne GPS data collection.

3.6.3 Airborne Data Acquisition

- 3.6.3.1 Airborne photographic operations shall be conducted in compliance with all applicable laws and in full cooperation with federal air traffic control authorities.
- 3.6.3.2 Aerial photography shall be acquired using a precision aerial mapping camera equipped with forward motion compensation, and a 6" nominal focal length lens having an AWAR of 95 or better. Fresh fine grain aerial negative film shall be used for the photography.
- 3.6.3.3 Acquisition of aerial photography shall be conducted during clear weather conditions with a sun angle of not less than 30 degrees
- 3.6.3.4 Airborne GPS
 - 3.6.3.4.1 A GPS receiver in the aircraft, interfaced to the aerial camera, shall be used to obtain GPS time and position information at the mid-exposure pulse for each captured image.
 - 3.6.3.4.2 Upon completion of each mission, CONSULTANT shall process the GPS data from the airborne and ground base station receivers to establish precise GPS coordinates for the geometric center of each aerial image. CONSULTANT shall provide documentation in the Project Survey Report of the repeatability of the final airborne GPS solutions. Comparisons between forward, reverse, and combined solutions between multiple ground base stations should achieve repeatability of better than 0.4' (12 cm) in all three components (X, Y and Z) for two-foot contour interval mapping.
 - 3.6.3.4.3 CONSULTANT shall verify and document in the Project Survey Report that a PDOP < 4 was maintained at all times during the flight. If this was not achieved, the CONSULTANT shall re-fly the area unless otherwise approved in writing by the CONSULTANT'S Project Manager.
 - 3.6.3.4.4 The airborne GPS process and derived results shall be documented in a Project Survey Report. This at a minimum shall contain the results of the airborne GPS positions, a graphic showing the camera exposure stations and flight lines; and there shall be a graphic showing the forward/reverse solutions demonstrating the precision of the final airborne GPS results. These graphics shall be to a scale that all text and graphic data is clear and legible.

3.6.4 Photo Lab Services

- 3.6.4.1 The CONSULTANT shall perform a quality control review of the aerial negatives to ensure that that all photography complies with the project's flight plan, and industry standard tolerances for flight altitude, tilt, sidelap, endlap, and crab. All negatives shall be clear, sharp, and free of blemishes or damage.
- 3.6.4.2 CONSULTANT shall produce all contact prints using an automatic dodging printer. The CONSULTANT shall store all negatives in an appropriate climate controlled storage facility.

3.6.5 Film Scanning

Aerial negatives shall be converted to digital raster images using a precision photogrammetric scanner at a resolution appropriate to the needs of the project. The CONSULTANT specifically forbids interpolation of digital raster images to a resolution finer than that achieved by the scanning device.

3.6.6 Aerotriangulation

- 3.6.6.1 The CONSULTANT shall perform digital analytical aerotriangulation (DAAT) in order to tie together the individual aerial photo images taken to cover the project, verify the integrity of the framework of ground and airborne GPS control, and bridge a series of control points into every photo, georeferencing the entire image database and enabling its use for photogrammetric mapping applications.
- 3.6.6.2 The positional accuracy of horizontal and vertical photo control established by DAAT must meet or exceed each of the following conditions:
- The horizontal RMSE of the final block adjustment must not exceed 1/15,000 of the flight height.
 - The vertical RMSE of the final block adjustment must not exceed 1/9,000 of the flight height.
 - The maximum allowable error of any vertical or horizontal point must not exceed 3 RMSE.
 - The mean of all points (taking into account positive and negative signs) must not exceed 1/15,000 of the flight height.
- 3.6.6.3 The digital aerotriangulation process and derived results shall be documented in the Project Survey Report.
- 3.6.6.4 CONSULTANT shall produce a flight index map documenting the position of each exposure, and providing metadata for the photo acquisition flights. The flight index map shall be submitted in hardcopy form, as well as digitally in DXF file format.

3.6.7 Digital Terrain Modeling (DTM)

The CONSULTANT shall perform terrain data extraction using photogrammetric methods. This may include interactive or automated means (autocorrelation). Where automated data extraction is used, it is required that all point information be corrected to ground level.

3.6.8 Contour Generation

3.6.8.1 CONSULTANT shall use DTM created for this project to generate contours at 2-foot intervals of the selected site survey locations. Topographic features shall include index and intermediate contour lines, depression contours with ticks, obscured contours represented with dashed lines, and spot elevations. Spot elevations shall be placed along roadways, and in road intersections, saddles, depressions, and on significant high points.

3.6.8.2 Contour lines shall be smooth and aesthetically pleasing to the same level shown on the attached sample topographic map. However, smoothing shall be accomplished through the addition of points near the vertices, not by curve-fitting or splining.

3.6.8.3 Every index contour shall be labeled at the appropriate location(s). Contour strings shall be in true 3D, and shall carry their elevations as an attribute. Elevations shall be rounded to the nearest even number.

3.6.9 Planimetric Mapping

All planimetric features commensurate with 1" = 200' scale mapping, including but not limited to buildings, roads, fences, and trees shall be extracted from the aerial imagery by the SUBCONSULTANT using stereoscopic photogrammetric techniques. A complete list of features to be captured is attached to and made a part of this SOW. Only buildings larger in dimension of 10' by 10' shall be collected by the SUBCONSULTANT. The SUBCONSULTANT is not required to collect any bushes or cacti vegetation features.

3.6.10 Edge Matching

3.6.10.1 The CONSULTANT recognizes that the terrain may have changed between two projects of disparate mapping dates, and that a successful, accurate tie may not be possible without additional work. As such, the CONSULTANT shall analyze, document, and make recommendations on the digital mapping data sets provided by the DISTRICT for previously mapped adjoining project areas, to establish whether they can be successfully edge mapped to mapping created for the current project.

3.6.10.2 The CONSULTANT requires that reasonable edge mapping to the existing adjacent mapped areas, be performed as part of the current project. Minor mismatches and overlaps between data features shall be permitted.

3.6.11 Map Finishing

- 3.6.11.1 Topographic mapping of the identified site surveys shall be formatted and finished in compliance with the requirements of the CONSULTANT.
- 3.6.11.2 Data features between tiles shall match graphically and mathematically between map tiles, with no gaps, overshoots, crossing segments, angular inflections or other obvious transitions. This task is restricted to matching between tiles within this project only.
- 3.6.11.3 Each orthophotographic image shall include:
 - 3.6.11.3.1 A general note with the state plane coordinate system, the horizontal and vertical datum, the location of control, and the date and height of the flight.
 - 3.6.11.3.2 A sealed DVD signed by an Arizona Registered Land Surveyor.

3.7 DELIVERABLES

- 3.7.1 Digital submittals shall be made on CD-ROM or DVD-ROM disks unless otherwise specified.
- 3.7.2 The CONSULTANT shall deliver the following items:
 - 3.7.2.1 Initial Project Schedule (Baseline)
 - 3.7.2.2 Two printed copies of the proposed Flight Plan.
 - 3.7.2.3 One hard copy of the Results of the AT.
 - 3.7.2.4 One hard copy of the Blind panel Information.
 - 3.7.2.5 Technical Memorandum of the results of edge mapping concerns and recommendations.
 - 3.7.2.6 One (1) complete set of 9" by 9" black and white contact prints, and one (1) complete set of negatives of the aerial photography.
 - 3.7.2.7 Two (2) flight index map documenting the aerial photo acquisition flight and metadata.
 - 3.7.2.8 Two (2) copies (hardcopy and PDF) of the Project Survey Report. Supporting digital survey data in ASCII file format (must be readable on MS Word and Word Perfect).

4 DATA DELIVERY STANDARDS

4.1 GIS FORMAT/CAD FORMAT

The CONSULTANT may select either a GIS Format or a CAD format for data deliveries unless noted otherwise within this Scope of Work.

4.1.1 GIS FORMAT SUBMITTALS

CONSULTANT shall follow the GIS standards by delivering the data identified below in Arc/Info format as identified in: "Data Delivery Specifications: The Hydrologic Information System (HIS) REV. 3.1 June 1, 1998" Flood Control District of Maricopa County, or latest edition.

STANDARD FEATURE LIST FOR MAPPING PROJECTS

<i>FEATURE LIST</i>
<i>SURVEY DATA</i>
HORIZONTAL & VERTICAL CONTROL POINT
PHOTO CENTER
GRID TICKS / LINES
<i>SHEET FORMAT</i>
GRID LABELS
NEAT LINE
ACCURACY NOTES
ATMT LOGO
BAR SCALE
BORDER
DATUM NOTES
NORTH ARROWS
SHEET INDEX
TITLE BLOCK
TITLE BLOCK TEXT
<i>RECREATION & OPEN SPACE</i>
ATHLETIC, BASEBALL, FOOTBALL FIELD
CAMP GROUND
CEMETERY
PARK
PICNIC AREA
RACETRACK
PUBLIC SWIMMING POOL
RECREATION TEXT CALLOUTS
GOLF COURSES
GOLF FAIRWAY
GOLF TEXT
GOLF WATER TRAP

AIRFIELD FEATURES

APRON
APPROACH ZONE
HELIPAD
MISC
RUNWAY / TAXIWAY SHOULDER
RUNWAY SURFACE
TAXIWAY SURFACE
TEXT CALLOUTS

TOPOGRAPHY

INDEX CONTOUR
INDEX CONTOUR OBSCURED
INDEX CONTOUR DEPRESSION
INDEX CONTOUR DEPRESSION OBSCURED
INTERMEDIATE CONTOUR
INTERMEDIATE CONTOUR OBSCURED
INTERMEDIATE CONTOUR DEPRESSION
INTERMEDIATE CONTOUR DEPRESSION OBS
SPOT ELEVATION
WATER LEVEL
CONTOUR LABELS

ROADWAY FEATURES

PAVED ROAD
UNPAVED ROAD > 8' WIDE
TRAILS < 8' WIDE
PARKING PAVED
PARKING UNPAVED
DRIVEWAY > 200' LONG
ROAD / STREET NAMES

UTILITIES

PIPELINE EXPOSED
PIPE EXISTING
PIPELINE TEXT
POWER POLE
TRANSMISSION TOWER (SYMBOL)
HEADWALL / CULVERT
OIL TANK / RESERVOIR
RAILROAD TRACK EXISTING (SINGLE)

RR TRACK ABANDONED
<i>FENCES & BARRIERS</i>
RETAINING WALL - MAJOR
WALL - MAJOR
FENCE - MAJOR
<i>HYDROLOGY</i>
WATER EDGE LINE
DRAINS / FLOW LINE / STREAMS
MARSH AREA PATTERN
MARSH AREA LINE
SPRING
<i>VEGETATION</i>
TREE-LARGE > 10' TALL
TREELINE OVER 10' HIGH
VEG- TEXT
LABEL AREAS OF DENSE BUSHES, SCATTERED BUSHES
DO NOT SHOW INDIVIDUAL CACTUS
<i>UNDEFINED</i>
UNDEFINED OBJECT
UNDEFINED AREA
UNDEFINED CALLOUTS
TEXT CALLOUTS
<i>STRUCTURAL FEATURES</i>
BRIDGE
OVERHEAD WALKWAYS
TUNNEL
BUILDING LONGEST SIDE > 20'
SMOKE STACK
STORAGE TANKS
STRUCTURE BASE / FOOTING
STRUCTURE TEXT
<i>WATER STRUCTURES</i>
CANAL TOP
DAM

DIKE HEAD - LARGE
DIKE TOE
SPILLWAY
WATER STRUCTURE TEXT
MISCELLANEOUS
TEXT ANNOTATION
OBSCURED AREA LINE
DTM (SEPARATE FILE)
MASS POINTS (REG PTS, RANDOM PTS)
SPOT POINTS
BREAKLINES
EXTERIOR BOUNDARY
MISC

4.1.2 CAD FORMAT SUBMITTALS

CONSULTANT shall follow the CADD standards and should deliver digital data in ASCII DXF format from either AutoCAD Version 13 or newer or Microstation Version 7.01 or newer per the following specs book: "Data Delivery Specifications: Computer Aided Drafting & Design REV 1.0 January 2000" Flood Control District of Maricopa County, latest edition. The CAD Drafting standards in which all plans shall be prepared can be found at the Website of the Flood Control District of Maricopa County at <http://www.fcd.maricopa.gov/Resources/CAD/default.asp>.

5 PUBLIC INVOLVEMENT

5.1 Introductory Brochure

The CONSULTANT shall prepare a general brochure within the first sixty (60) days from the NTP to introduce the project the public and stakeholders. The brochure shall be in tri-fold format. Also within the first sixty (60) days, the CONSULTANT shall prepare a mailer/advertisement to introduce the project to the public and stakeholders in electronic (PDF) format. The DISTRICT will make the copies, place the advertisement, prepare a press release and place the brochures at public locations in the study area (such as City offices). The DISTRICT shall maintain the project page on the Flood Control District website, including updates as necessary.

5.2 Conclusion Brochure

The CONSULTANT shall create a display ad and a brochure at the end of the project to announce the findings. The brochure shall be in tri-fold format and the display ad shall be in electronic (PDF) format. The DISTRICT will make the copies, place the advertisement, prepare a press release and place the brochures at public locations in the study area (such as City offices).

6 RIGHTS-OF-WAY AND EASEMENTS

- 6.1 The CONSULTANT shall identify required rights-of-entry and supply locations to the DISTRICT in GIS format. The DISTRICT will acquire rights-of-entry for any required site investigations. The CONSULTANT shall coordinate the schedule of any field investigations with the DISTRICT's Agent.
- 6.2 The DISTRICT will provide existing rights-of-way information as provided from Maricopa County Assessors Office in a digital format for use by the CONSULTANT.

7 ENVIRONMENTAL EVALUATION

This Section Not Used.

8 GEOTECHNICAL INVESTIGATION

This Section Not Used.

9 HYDROLOGY

9.1 CONSULTANT

The CONSULTANT shall perform complete and detailed hydrologic analysis of the project area in order to fulfill the specific requirements identified in the Scope of Work.

9.2 PROCEDURES

The CONSULTANT shall follow the procedures outlined in the Drainage Design Manual for Maricopa County, Volume I Hydrology, *latest revision or draft as directed by the DISTRICT*, for all hydrologic modeling and calculations and the Scope of Work, General Requirements and Procedures. See also Section 9.5.

9.3 RETURN FREQUENCY

Hydrologic modeling shall be completed for the specific frequency and duration required by the Scope of Work as follows:

Rainfall Event		Existing Conditions		Future Conditions		2017 Conditions	
Frequency	Duration	w/o CIP***	w/ CIP	w/o CIP	w/ CIP	w/o CIP	w/ CIP
100-year	24-hour	x	x	x	x	x	x
" "	6-hour *	x	x	x	x		
" "	2-hour *	x	x	x	x		
" "	10-day **	x		x			

* Also used to determine the retention volume
 ** Only for portions of watershed that drain to White Tanks FRS # 3 and #4
 *** CIP refers to FCD ADMP structures and any large structures identified by the District.

9.4 EXISTING STUDIES AND FIELD RECONNAISSANCE

9.4.1 The CONSULTANT shall research and give consideration to all existing hydrologic studies of the area and shall become familiar with the general hydrology of the area. Field reconnaissance shall be done to determine the following:

- Verify sub-basin delineations boundaries
- Verify flow patterns
- Determine the actual current land use for parcels
- Identify flow diversion locations caused by natural obstructions, drainage structures, storm drains, site grading, etc.

9.4.2 The CONSULTANT shall provide a one week notice, if possible, of all field trips. The District Project Manager and Hydrologist will be invited to all field trips.

9.4.3 The CONSULTANT shall review and become familiar with the existing and future condition models, developed under the Loop 303/White Tanks ADMP Update (URS, 2003), for 100-year 24 hour storm events. The CONSULTANT will also review the interface between the Loop 303 and Buckeye/Sun Valley ADMS models to ensure consistent basin delineation and runoff modeling.

9.5 EXISTING CONDITIONS HYDROLOGY MODELS

The CONSULTANT shall use a combination of the latest aerial photo plus field verification to identify development and infrastructure that are constructed or will be constructed as of June 1, 2008. Also, all split flows will require new rating curves. DTHETA, volumetric soil moisture deficit at the start of rainfall, will have to be calculated for all agriculture fields. Finally, the initial condition of irrigation canals must be determined.

9.5.1 WATERSHED AND SUB-BASIN DELINEATIONS

Using appropriate hydrologic judgment, sub-basins are to be identified that provide reasonable depiction of the watershed condition. The sub-basins must be as homogeneous as possible, using watershed area, watershed type (mountainous and flat lands or urban and undeveloped areas), and time of concentration as criteria. Sub-basin breakdowns will be done in sufficient detail to provide peak discharges at structures, major road crossings, confluences, and at boundary lines. An appropriate time step and number of ordinates is to be selected that allows for complete

calculation of the flood hydrograph without sacrificing resolution of the flood peak. All calculations or assumptions used in developing sub-basin and routing parameters shall be documented and made a part of the appendix for the hydrology report. Field surveys may need to be taken for HEC-1 modeling purposes. The sub-basin delineation should be at least as detailed as that in the Loop 303/White Tanks ADMPU.

9.5.2 COMPUTER MODELING

- 9.5.2.1 The Consultant shall use the U.S. Army Corps of Engineers computer program HEC-1, Version 4.1, to develop a hydrologic model for the area or as otherwise approved by the DISTRICT.
- 9.5.2.2 The next version of the District's computer program DDMSW including the NOAA Atlas 14 precipitation values will be used to develop HEC-1 input data. The specific hydrologic techniques to be used are:
 - 9.5.2.3 Rainfall Excess: The Green and Ampt methodology will be utilized for estimation of rainfall losses.
 - 9.5.2.4 Unit Hydrograph: The Clark or S-Graph method should be used. The choices in methodology will be to the discretion of the Consultant, with approval from the District.
 - 9.5.2.5 The Times of Concentration and Lag times shall be adjusted for the appropriate return frequency using the Drainage Design Manual, Volume I and DDMSW.
 - 9.5.2.6 Channel Routing: The choice of methodology will be at the discretion of the Consultant, with approval from the District. Average cross sections will be developed utilizing available mapping and field reconnaissance data. Sufficient field cross sections will be taken to ensure that routing reaches are reasonable and representative of field conditions. The HEC-1 routing parameters for the reaches will be adjusted where hydraulic models are available. The resulting velocities and depths, for all reaches, must be assessed for realistic values.
 - 9.5.2.7 Reservoir Routing: Detailed analysis of structures and ponding areas will be accomplished using the Modified Puls reservoir routing option of HEC-1. Stage versus discharge tables for hydraulic structures will be estimated using appropriate hydraulic methodology. The CONSULTANT shall gather all plans available for stormwater storage in the project area over 2 acre-feet in volume. The design or as-build plans of the storage areas will be checked against 2007 aerial photographs. Should the condition appear to vary from the plans, the area will be field checked and an approximate volume obtained. Up to 30 stormwater storage areas will be checked.
 - 9.5.2.8 Channel Transmission Losses: Attempts should be made to estimate infiltration losses through channel bottoms based on existing field data or literature. If sufficient data is not available, the final report must acknowledge so and explain how the peaks and volumes of flow are affected by not including the transmission losses.

- 9.5.2.9 The District will provide appropriate references to facilitate parameter estimation.
- 9.5.2.10 Output of the computer model should be reviewed to see if the peak flows and volumes are realistic. An adjustment to input for obtaining the most realistic results is normal to the scope.
- 9.5.2.11 The peak discharges and unit discharges for the sub-basins should be graphically presented and compared to regional discharge curves. Major differences must be discussed in the final report.

9.6 FUTURE CONDITIONS HYDROLOGY MODELS

- 9.6.1 The CONSULTANT shall develop a future land use condition model with and without the DISTRICT's proposed drainage infrastructure in place, for the 100-year 24-hour and 100-year 6-hour storm events using the methodology described above in Section 9.5. The future land use will be determined based on the latest planning map from each city within the study area. The HEC-1 model will include:
- Adjusted Time of Concentration (T_c) due to change in flow path and 'n' values
 - Add retention per existing regulation including efficiency rating
 - Adjusted RTIMP
 - Reorganize model structure as necessary to follow a logical order.
- 9.6.2 At the request of the DISTRICT, the CONSULTANT will develop a 100-yr 24-hr future land use condition model projected out to the year 2017. This will be determined by considering land use, zoning, development plans, public infrastructure plans, and associated time frames.

9.7 MAPS

- 9.7.1 The CONSULTANT shall develop the hydrologic base maps using information obtained during the Data Collection phase of the project and the best available topographic mapping supplied by the District. Spatial data will be supplied in GIS format.
- 9.7.2 The CONSULTANT shall develop Municipality Maps that highlight the details and results of the study within the boundaries of each municipality within the study area.

The municipalities included are:

- City of Avondale
- Town of Buckeye
- City of El Mirage
- City of Glendale
- City of Goodyear
- City of Litchfield Park
- City of Surprise
- Luke Air Force Base

The maps will be supplied in hard copy (24x36, two copies) and electronic (PDF and GIS format).

9.8 HYDROLOGIC REPORT

Upon completion of the hydrology models the CONSULTANT shall prepare a stand-alone Hydrologic Report that documents the results of the Existing and Future Conditions hydrology.

9.9 RESULTS COMPARISON AND RECOMMENDATIONS

Upon completion of the hydrology models the CONSULTANT shall prepare a technical memorandum which will compare and justify the results of the models. This will include a comparison of the results with previous studies and explain the differences as they relate to development, use of NOAA Atlas 14, etc. Finally, the report will include recommendations in cases where the differences are significant.

10 HYDRAULICS

10.1 STANDARDS

- 10.1.1 The CONSULTANT shall perform hydraulic tasks as specified in other sections of this scope of work and in accordance with the CONSULTANT GUIDELINES Section 10 and in the following Section unless otherwise specified in this scope of work. The CONSULTANT shall follow the procedures outlined in the Drainage Design Manual for Maricopa County, Volume 2, Hydraulics, 1995, unless otherwise specified in this scope of work.
- 10.1.2 The CONSULTANT shall research and give consideration to existing drainage studies of the area.
- 10.1.3 The CONSULTANT shall calculate approximate split flow rating curves based on weir and momentum equations (as appropriate). The calculations will be supplied in Excel spreadsheet format and shall include details of all equations used.
- 10.1.4 The CONSULTANT shall use a structures design model, where available, or Manning's equation to determine channel capacity.

10.2 FIELD VISITS

The CONSULTANT shall become familiar with the watershed by conducting field visits to:

- 10.2.1 Identify flow diversion locations caused by natural obstructions, drainage structures, storm drains, site grading, streets and roads, etc.
- 10.2.2 Evaluate whether field cross-sections are necessary at key hydraulic flow split locations.

11 FLOODPLAIN DELINEATION

This Section Not Used.

12 PLANNING

12.1 PROJECT-SPECIFIC TASKS

The CONSULTANT shall complete the following project-specific tasks as specified in this SOW. Detailed guidelines regarding methods for completing each of these tasks can be found in the SOW and/or the CONSULTANT GUIDELINES.

- Data Collection
- Hydrologic Analysis
- Hydraulic Analysis
- Stakeholder Involvement

12.2 DATA COLLECTION AND EXISTING CONDITIONS ANALYSIS

- 12.2.1 The CONSULTANT shall collect and review pertinent data from the DISTRICT, MCDOT, ADOT, municipalities and other sources. Data to be collected and reviewed shall 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.
- 12.2.2 The CONSULTANT shall prepare an Existing Facilities Exhibit containing an inventory of all man-made or relevant drainage facilities within the project area, including stock ponds. The inventory shall note the condition, size and/or capacity, level of protection, and ownership of these structures.
- 12.2.3 The CONSULTANT shall prepare a GIS map layer and accompanying database that includes all developments greater than 80 acres in the area. The map will also indicate whether property is publicly or privately held, ownership information, name of development if applicable, and date of approved final plat.
- 12.2.4 The CONSULTANT shall compile the data in a Data Collection Memorandum. The Data Collection memorandum shall contain a description of information collected for this project, and will be formatted for future inclusion as an appendix to the Hydrologic Report (see Section 9.8). 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 Existing Facilities Exhibit will be prepared in either GIS or AutoCAD format. The CONSULTANT shall submit a DRAFT of this report within sixty (60) days of the Notice to Proceed.
- 12.2.5 The Data Collection Memorandum should include the following as applicable:
- Data Collection Results
 - Current Conditions
 - Existing and Future Development Plans
 - Grading and Drainage Plans

- Current and Future Transportation Plans
- Existing and Future Drainage Facilities
- Parcel Ownership (Data to develop will be provided by the DISTRICT)
- Location map of Planned Communities (Developments >80 acres)
- Map of Jurisdictions and Public ownership
- Existing Hydrology/Hydraulics
- Summary of Models/Conditions
- Existing Facilities Exhibit

12.3 PRELIMINARY ALTERNATIVES FORMULATION AND ANALYSIS

This Section Not Used.

12.4 PROPOSED ALTERNATIVE ANALYSIS

This Section Not Used.

12.5 RECOMMENDED ALTERNATIVE ANALYSIS

This Section Not Used.

12.6 STAKEHOLDER INVOLVEMENT

12.6.1 The CONSULTANT shall develop the Stakeholder Involvement Plan within twenty one (21) days of Notice to Proceed. The Plan will include a list of public and private stakeholders for use in developing a database, preliminary agendas for the initial stakeholder meetings, and a stakeholder's matrix and a stakeholder involvement schedule. The Plan is anticipated to include 2 tracks, one for public and one for private stakeholders. After the DISTRICT Project Manager has approved the Plan, the CONSULTANT will finalize the Plan and keep it updated.

12.6.2 The CONSULTANT shall update the database upon Notice to Proceed with input from the DISTRICT. After the DISTRICT has approved the initial database, the CONSULTANT shall schedule and conduct a Stakeholder Working Group Kick-off Meeting. The meeting agenda will include:

- An overview of the study Purpose and Goals
- Schedule and Milestones
- Identification of Stakeholder Opportunities and Constraints
- Development of Future Meeting Dates (if necessary)

12.6.3 PUBLIC STAKEHOLDER COORDINATION

The CONSULTANT shall coordinate as needed with staff from identified agencies to confirm current policy thinking concerning land use, development standards, flood control, CIP, development projects and associated time frames. Public stakeholders shall be given copies of all draft and final deliverables as specified in task 12.9 to review and comment on. The identified agencies are:

- Appropriate planning staff with the FCDMC
- Maricopa Association of Governments (MAG)
- Arizona Department of Transportation
- Maricopa Water Conservation District
- Luke Air Force Base
- Maricopa County Department of Transportation (MCDOT)
- Roosevelt Irrigation District
- Buckeye Water Conservation and Irrigation District
- Arizona State Land Department
- City of Avondale
- Town of Buckeye
- City of El Mirage
- City of Glendale
- City of Goodyear
- City of Litchfield Park
- City of Surprise

12.7 SITE VISITS

- 12.7.1 The CONSULTANT and DISTRICT shall participate in site visits as specified in Section 2.8.
- 12.7.2 The CONSULTANT shall visit the area as necessary to verify the model input data.

12.8 REPORTS

- 12.8.1 All reports or documents shall be submitted to the DISTRICT for review in draft form. Upon receipt of review comments, the CONSULTANT shall incorporate appropriate revisions and complete the report. The CONSULTANT shall incorporate a three (3) week DISTRICT review time in the project schedule.
- 12.8.2 The following documents or reports shall be developed:
- Stakeholder Involvement Plan
 - Data Collection Memorandum
 - Existing Facilities Exhibit
 - Planned Communities Map (GIS)
 - Municipality Maps (GIS)
 - Stand Alone Hydrologic Report
 - Existing Conditions Hydrology
 - Future Conditions Hydrology
 - Recommendations Technical Memorandum

12.9 DELIVERABLES

- 12.9.1 The CONSULTANT shall submit ALL items sealed by a registered civil engineer in the State of Arizona, unless stamped "draft" or "not for construction". 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, the original documents shall be returned to the CONSULTANT for correction and re-submittal.
- 12.9.2 The CONSULTANT shall submit computer files of the information to the DISTRICT delivered on Compact Disk (CDROM) or other approved media as approved the Project Manager.
- 12.9.3 Reports, documents, figures, exhibits, and tables shall be submitted in a version of Microsoft Word 2000 and/or Microsoft Excel 2000, or later version, or other acceptable software format as determined by the DISTRICT.
- 12.9.4 Plans should be in Micro Station (dgn) format or AutoCAD (dwg) in accordance with the "CADD Drafting Standards" Section of these Guidelines.
- 12.9.5 The CONSULTANT shall submit four (4) paper copies and two (2) electronic copies of each DRAFT report, estimates, schedules or drawings to the DISTRICT. The DISTRICT shall supply ADOT with copies as needed. The CONSULTANT shall submit one (1) paper copy and (1) electronic copy of each DRAFT report, estimate, schedules or drawings to the following directly: Arizona State Land, City of Avondale, Town of Buckeye, City of El Mirage (electronic only), City of Glendale (electronic only), City of Goodyear, City of Litchfield Park, City of Surprise and Luke Air Force Base.
- 12.9.6 The CONSULTANT shall submit four (4) paper copies, two (2) electronic copies in PDF format, and one (1) electronic copy in the original software format of each FINAL report, estimates, schedules or drawings to the DISTRICT and two (2) paper copies for each FINAL report, estimates, schedules or drawings to each participating agency. Prior to the FINAL submittal, the CONSULTANT and the DISTRICT shall agree to the actual numbers of each report volume required.

13 PRE-DESIGN

This Section is not used.

14 FINAL DESIGN AND CONSTRUCTION DOCUMENTS

This Section is Not Used.

15 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

15.1 Independent Review

The CONSULTANT shall independently check all design drawings and calculations. Each drawing and every calculation sheet shall be initialed and dated by both the designer and checker for each and every submittal of design drawings and calculations. The CONSULTANT shall verify the completeness of the check before submitting drawings or calculations to the DISTRICT. Submittals received which have not been initialed and dated,

or that appear to have not been checked, will be returned. Re-submittal shall be made within two (2) working days, and no formal contract time extension will be considered for the re-submittal.

15.2 Recheck of Plans

Upon DISTRICT review of any submittal by the CONSULTANT, if more than five (5) significant comments are identified on five (5) or more sheets, the CONSULTANT shall be asked to retrieve the models or reports for rechecking. The CONSULTANT shall recheck the plans, make appropriate corrections and resubmit the plans within seventy two (72) hours after being returned to the CONSULTANT. No additional contract time or fee will be provided for the rechecking.

15.3 Design Calculations

All design calculations submitted to the DISTRICT shall be complete in detail and shall be checked. All engineering assumptions made during the design other than standard engineering judgments shall be documented with appropriate references on the calculation sheets.

15.4 Review Qualifications

The person checking the calculations shall not be the originator and shall possess equal or better qualifications than the originator.

15.5 Calculations Checks

Calculations can be either hand calculations or computer generated calculations. Computer generated calculations can be used for either the design or the check, but cannot be used for both the design and the check. All hand calculations and computer-generated calculations shall be sealed by a registered engineer prior to submittal to the DISTRICT. HEC-1 and HEC-RAS modeling are exempt from the hand calculation requirement.

15.6 SUBCONSULTANT Review

The work of any SUBCONSULTANTS utilized by the prime CONSULTANT for this contract (i.e., civil design, and structural design) shall be reviewed by the prime CONSULTANT for compliance with the scope of work and project specifications prior to submittal for review by the DISTRICT.

15.7 QA/QC Procedures

The CONSULTANT shall submit a copy of its QA/QC procedures with the technical proposal. The procedure should outline the CONSULTANT's method of checking plans and calculations, including the use of check prints. Check prints should be kept on file during the term of the contract for review by the DISTRICT.

15.8 Sealing of Documents and Plans

All final contract documents including all final reports, specifications, engineer's estimates, and plans shall be sealed by a Professional Engineer registered in the State of Arizona. In addition, all interim submittals with the exception of the plans shall be sealed and shall be stamped preliminary.

16 MAINTENANCE PLAN

This section is not used.

17 CADD/DRAFTING STANDARDS

CONSULTANT shall follow the CADD/DRAFTING Standards as specified in the latest edition of the DISTRICT's Drafting Guides.

18 DIGITAL ORTHOPHOTOS

This section not used.

19 DESIGN REFERENCES, SPECIFICATIONS AND STANDARDS

19.1 STANDARD DETAILS AND SPECIFICATIONS

- 19.1.1 "Uniform Standard Specifications for Public Works Construction", and "Uniform Standard Details for Public Works Construction", 1998 Arizona, and all revisions through 2002, Maricopa Association of Governments (MAG).
- 19.1.2 "Flood Control District of Maricopa County Engineering Division 2002 Computer Aided Drafting Guidelines."
- 19.1.3 "Maricopa County Supplement to the MAG Standard Details", by Maricopa County Highway Department (now referred to as MCDOT), shall be utilized as part of the design criteria.
- 19.1.4 Use standard MAG details on plans unless otherwise requested by FCDMC. Arizona Department of Transportation (ADOT) standard details may be used, as approved and when appropriate, then modified to be referenced to MAG specifications.

19.2 DESIGN MANUALS, POLICIES, GUIDES, AND PROCEDURES

- 19.2.1 "Drainage Design Manual for Maricopa County, Arizona, Volume I Hydrology", January 1, 1995.
- 19.2.2 "Drainage Design Manual for Maricopa County Arizona, Volume II Hydraulics", January 28, 1996.
- 19.2.3 "Drainage Design Manual for Maricopa County, Arizona, Volume III Erosion Control", January 1, 1993."

- 19.2.4 Urban Highways, Channel Lining Design Guidelines”, February 1989, ADOT.
- 19.2.5 Structural design shall be in accordance with current AASHTO Specifications. Street and maintenance road crossings shall be designed to accommodate HS20-44 loading. Calculations shall be based on service loads and the working stress method.
- 19.2.6 “Pipe Selection Guidelines and Procedures” February 1, 1996, ADOT with March 21, 1996 revisions.
- 19.2.7 “A Policy on Geometric Design of Highways and Streets”, 4th Edition, AASHTO, 2001, 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 the DISTRICT.
- 19.2.8 “Roadside Design Guide”, 2002, AASHTO, to be used to establish clear distances and other related safety issues.

20 LANDSCAPE PLANNING AND DESIGN

This section is not used.

EXHIBIT B



FEE PROPOSAL

CONTRACT FCD 2007C031

LOOP 303/WHITE TANKS AREA DRAINAGE MASTER PLAN
UPDATE (ADMPU) AREA
HYDROLOGIC ANALYSIS

EXHIBIT B - FEE PROPOSAL - TABLE A

CONSULTANT COST PROPOSAL SUMMARY

CONSULTANT: HDR Engineering, Inc. CONTRACT NO.: FCD2007C031

PROJECT NAME: Loop 303/White Tanks ADMPU Area Hydrologic Analysis

DIRECT LABOR			
Classifications	Man-hours	Hourly Rates	Labor Costs
Project Principal	2	73.50	147
Project Manager	662	50.00	33,100
Quality Control Engineer	86	59.00	5,074
Project Engineer	844	36.00	30,384
Staff Engineer	1591	31.00	49,321
GIS Specialist	68	32.50	2,210
Public Involvement Specialist	120	31.50	3,780
Admin. Assistant	12	21.50	258
Total	3385		

Consultant's Subtotal Direct Labor \$ 124,274

Consultant's Overhead @ 153.86% of Direct Labor \$ 191,208

Consultant's Profit @ 10% of Direct Labor plus Overhead \$ 31,548

Consultant's Total Labor \$ 347,030

DIRECT AND OUTSIDE EXPENSES	
DESCRIPTION	EXPENSE AMOUNT
Mileage (Auto)	2,399
Reproduction	6,150
Technology Charge (\$3.70/hr)	12,525
Miscellaneous (postage, messenger)	360
Aerial Mapping	220,750

Consultant's Total Direct and Outside Expenses \$ 242,184

EXHIBIT B - FEE PROPOSAL - TABLE A

CONSULTANT

COST PROPOSAL SUMMARY

SUBCONSULTANT(S)		
NAME OF SUBCONSULTANT	TASK	TOTAL COST
A Team Professional Associates	Survey	108,449

Total Subconsultant(s) \$ 108,449

Consultant's Total Labor \$ 347,030

Consultant's Total Direct and Outside Expenses \$ 242,184

Total: \$ 589,214

Consultant's Totals of Labor and Direct and Outside Expenses \$ 589,214

TOTAL PROPOSED FEE \$ 697,663
(Inclusive of Consultant and Subconsultant[s] total proposed fee.)

FEE PROPOSAL - TABLE A

SUBCONSULTANT COST PROPOSAL SUMMARY

SUBCONSULTANT: A Team Professional Associates, Inc. CONTRACT NO.: FCD2007C031

PROJECT NAME: Loop 303/White Tanks ADMPU Area Hydrologic Analysis

DIRECT LABOR			
Classifications	Man-hours	Hourly Rates	Labor Costs
Registered Land Surveyor	94	45.15	4,244
Project Manager	47	27.60	1,297
Survey Crew (2 Person/GPS)	306	63.00	19,278
Survey Crew (3 Person/GPS)	130	87.00	11,310
Party Chief	12	25.00	300
CAD Technician	16	20.00	320
Researcher	2	19.00	38
Total	607		

Subconsultant's Subtotal Direct Labor	\$	36,787
Subconsultant's Overhead @ 168.00% of Direct Labor	\$	61,803
Subconsultant's Profit @ 10 % of Direct Labor plus Overhead	\$	9,859
Subconsultant's Total Labor	\$	108,449

DIRECT AND OUTSIDE EXPENSES	
DESCRIPTION	EXPENSE AMOUNT

Subconsultant's Total of Direct and Outside Expenses	\$	0
Subconsultant's Total Labor	\$	108,449

SUBCONSULTANT'S TOTAL PROPOSED FEE \$ 108,449

EXHIBIT B - FEE SCHEDULE - TABLE A

DERIVATION OF ESTIMATED DIRECT EXPENSES

TRAVEL

Mileage (Personal vehicles)					
	<u>Trips</u>	<u>Mi / Trip</u>	<u>Cost / Mi</u>	<u>Total</u>	
Site Visits	40	104.1	0.485	\$	2,019
To FCDMC	31	25.3	0.485	\$	380
				\$	-
Lodging				\$	-
Per Diem				\$	-
TOTAL TRAVEL COST				\$	2,399

REPRODUCTION IN HOUSE

	<u>Sets</u>	<u>No. Copies</u>	<u>Cost</u>	<u>Total</u>	
Photo Copies/Month	9	1000	\$0.05	\$	450
Submissions	<u>Sets</u>				
Data Collection	15	200	\$1.00	\$	3,000
Draft Hydrology	10	100	\$1.00	\$	1,000
Final Hydrology	10	150	\$1.00	\$	1,500
Recommendations Memo	10	20	\$1.00	\$	200
TOTAL REPRODUCTION COSTS				\$	6,150

COMPUTER USE

	<u>No. Hours</u>	<u>Cost/Hr</u>	<u>Total</u>	
Technology Charge	3385	\$3.70	\$	12,525
TOTAL COMPUTER USE			\$	12,525

MISC EXPENSES

	<u>No. of Months</u>			
Misc Postage	9	\$15	\$	135
Messenger/Delivery Service	9	\$25	\$	225
TOTAL MISC			\$	360

TOTAL DIRECT EXPENSES

\$ 21,433

EXHIBIT B - TABLE C

CONSULTANT/SUBCONSULTANT NAME: HDR Engineering, Inc.

CONSULTANT/SUBCONSULTANT
ESTIMATED MAN-HOURS AND DIRECT LABOR

Contract No.: FCD 2007C031

PROJECT NAME: Loop 303/White Tanks ADMPU Area Hydrologic Analysis

DATE: January 14, 2007

DIRECT LABOR CLASSIFICATIONS

CONTRACT TASK/PHASE	Project Principal (\$73.50/HR)	Project Manager (\$50.00/HR)	Quality Control Engineer (\$59.00/HR)	Project Engineer (\$36.00/HR)	Staff Engineer (\$31.00/HR)	GIS (\$32.50/HR)	Public Invol. Specialist (\$31.50/HR)	Admin Assist (\$21.50/HR)		TOTAL	TOTAL
										MAN-HOURS	LABOR
2.7.1 Schedule		20								20	\$1,000
2.7.2 Project Coordination	2	318								320	\$16,047
2.7.3 Invoices		8								8	\$400
2.7.4 Progress Reports		16								16	\$800
2.8 Meetings		81		56	58		4			199	\$7,990
3.0 Survey										0	\$0
5.1 Brochure at beginning							42			42	\$1,323
5.2 Brochure at end							42			42	\$1,323
6.1 Rights-of-entry				2	8					10	\$320
9.4.1 Research and field		8		20	104					132	\$4,344
9.4.3 Review existing models		2		26						28	\$1,036
9.5.1 Existing - subbasins		40		96	300					436	\$14,756
9.5.2 Existing - computer		80		320	400					800	\$27,920
9.5.2.7 Existing - Storage invest				8	40					48	\$1,528
9.6.1 Future - computer		4		104	110					218	\$7,354
9.6.2 2017 Model		2		12	36	20				70	\$2,298
9.7.2 Municipality Maps		2		2	18	28				50	\$1,640
9.8 Hydrologic Report		20		40	24	8		8		100	\$3,616
9.9 Recommendations		16		10	8			2		36	\$1,451
10.1 Split Flow rating curves		12		46	262					320	\$10,378
10.2 Split Flow field visits		8		44	44					96	\$3,348
12.2.1 Public Data		4		36	120					160	\$5,216
12.2.2 Existing Facilities Exhibit		2		10	20	8				40	\$1,340
12.2.3 Develop >80ac. Map		1		2	17	4				24	\$779
12.2.4 Data Collection Memo		2		10	22			2		36	\$1,185
12.6.1 Stakeholder Invol Plan		4					20			24	\$830
12.6.2 Stakeholder kick-off mtg		4					12			16	\$578
12.6.3 Public Stakholder coord		8								8	\$400
15.1 QA/QC			86							86	\$5,074
Totals	2	662	86	844	1591	68	120	12	0	3385	\$124,274

PAGE 1 OF 2

CONSULTANT/SUBCONSULTANT NAME: A Team Professional Associates

EXHIBIT B - TABLE C

Contract No.: FCD 2007C031

PROJECT NAME: Loop 303/White Tanks ADMPU Area Hydrologic Analysis

CONSULTANT/SUBCONSULTANT ESTIMATED MAN-HOURS AND DIRECT LABOR

DATE: January 14, 2007

DIRECT LABOR CLASSIFICATIONS

CONTRACT TASK/PHASE	RLS (\$45.15/H R)	Proj Manager (\$27.60/H R)	Survey Crew 2 man/GPS (\$63/HR)	Survey Crew 3 man/GPS (\$87/HR)	Party Chief (\$25/HR)	Cad Tech (\$20/HR)	Research (\$19/HR)	Clerical (\$18.35/ HR)	TOTAL	TOTAL
									MAN-HOURS	LABOR
2.8.1.1 Kickoff Meeting	4	0	0	0	0	0	0	0	4	\$181
2.8.1.2 Project Deliv. Review Meetings	8	0	0	0	0	0	0	0	8	\$361
2.8.1.7 Monthly Project Review Meetings	8	0	0	0	0	0	0	0	8	\$361
2.8.1.6 Lessons Learned Meetings	4	0	0	0	0	0	0	0	4	\$181
3.3 Data Collection	17	5	0	0	0	6	0	0	28	\$1,026
3.5.3 Aerial Control Points (26)	6	6	0	50	4	4	2	0	72	\$5,005
3.5.4 Blind Aerial Targets(41)	8	8	66	0	8	6	0	0	96	\$5,060
3.5.8 GPS Base Stations	1	2	0	20	0	0	0	0	23	\$1,840
3.5.9 Airborne GPS	12	0	0	0	0	0	0	0	12	\$542
3.5.10 Project Survey Report	24	24	0	0	0	0	0	0	48	\$1,746
3.5.11.2 DTM Checks(500)	1	1	210	0	0	0	0	0	212	\$13,303
3.5.11.3 Field Cross Sections (5)	1	1	30	0	0	0	0	0	32	\$1,963
3.5.11.4 Subsidence Checks	0	0	0	60	0	0	0	0	60	\$5,220
Totals	94	47	306	130	12	16	2	0	607	\$36,787

EXHIBIT A



SCOPE OF WORK

**CONTRACT FCD 2007C031
LOOP 303 / WHITE TANKS AREA DRAINAGE MASTER PLAN
UPDATE (ADMPU) AREA
HYDROLOGIC ANALYSIS
CIP CHANGES CHANGE ORDER**

Scope of Work:

- HDR will make changes in the future conditions assumptions to correspond to future roadway planning efforts. ADOT/PB will give CIP model changes to HDR in ready-to-use format. Subbasin boundaries will not change with the exception of the Butler Road change. No other changes will be made to HDR's subbasin boundaries as submitted on March 9, 2009. HDR will not independently check or validate the changes, they will be used as-is. No adjustments will be made to the model to parameters given to HDR by ADOT/PB.
- Valerie Swick would like to see HDR add a "length" parameter into the GIS deliverable. HIS delivery standards do not include this as a normal delivery parameter.
- Future conditions land use: Direction was given to HDR by FCDMC to create future conditions land use by using existing conditions land use, then only add planning overlays onto land uses 900, 750, and 700. All other land use type will remain the same.
- Future conditions retention: Existing conditions retention will be used for all areas where land use is unchanged from existing conditions. Retention will be added onto areas where land use has been changed (the former 900, 750, and 700 land uses under existing conditions). This retention will be calculated per the jurisdictional requirements (i.e. 100-yr 2-hr in most areas, with the exception of 100-yr 6-hr in Goodyear).
- Velocity outliers: Velocities will be checked for all areas where the velocity is reported at
 - 15 fps or greater
 - 1 fps or less, except where less than 100 cfs
 - Anywhere Q goes up during routing procedures (indicates instability)
 - Adjustments will be made to fix velocities meeting these criteria and comment will be put into model on what adjustments were made
- "0" cfs diversions will remain. In other words, unless the 0 cfs diversions cause the model calculations to become incorrect, it will remain as is.
- No additional field checks will be performed of the routing cross sections.
- Additional CIP information received after April 22, 2009 will not be incorporated without additional fee.
- Weekly meetings will be held between HDR and FCDMC/ADOT for the months of April, May, and June. 3 people from HDR will attend the meetings and each meeting will be 1.5 hours maximum in length.
- Bi-weekly meetings will be held between HDR and FCDMC/ADOT for the months of July and August. 3 people will attend the meetings and each meeting will be 1.5 hours in length.
- Additional project management hours will be given to cover out-of-scope work only.
- FCDMC will work to correct the DDMSW error where the UI cards get cut-off. The fix will be available to HDR by May 25th to avoid any schedule delays.
- FCDMC will give HDR the discharge component of WT#4 improvements by April 24th to avoid schedule delays. The format will be given as a stage-storage-discharge curve.
- A factor will be applied to existing routes on agricultural and undeveloped land (land use 900, 750, and 700) to arrive at a future condition's routing cross section and length. This factor will be determined during a weekly meeting. A GIS shapefile for future routes will not be created.

EXHIBIT A



SCOPE OF WORK

**CONTRACT FCD 2007C031
LOOP 303 / WHITE TANKS AREA DRAINAGE MASTER PLAN
UPDATE (ADMPU) AREA
HYDROLOGIC ANALYSIS
LAND USE CHANGE ORDER**

9.5.1.1 LAND USE

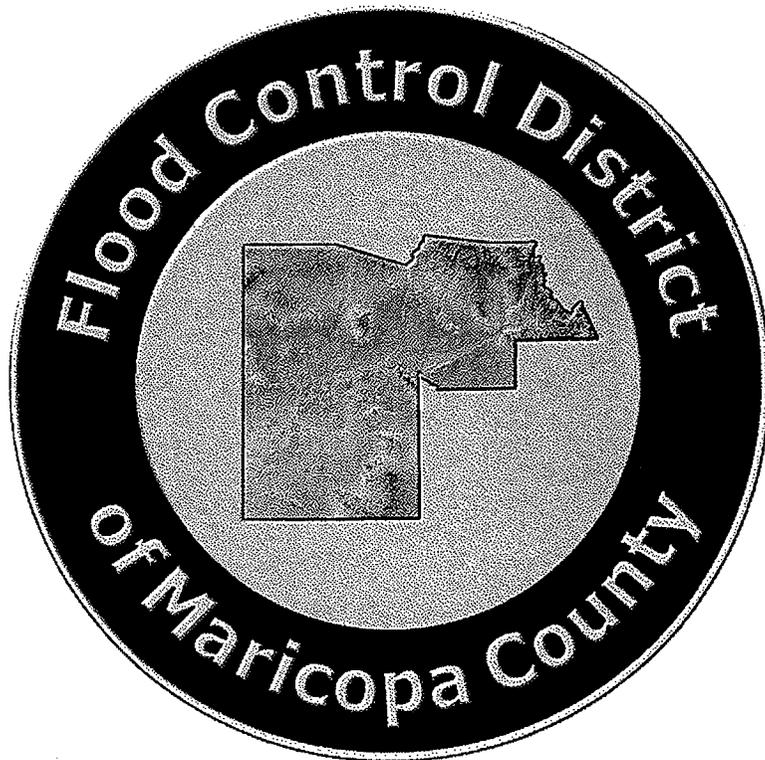
The CONSULTANT shall determine the existing and future conditions land use.

9.5.1.1.1 The CONSULTANT will create a GIS shape file depicting actual current land use for the watershed. This will include any developments constructed as of June 1, 2008.

9.5.1.1.2 The CONSULTANT will create a GIS shape file depicting the future conditions land use by modifying the file provided by the DISTRICT.

9.5.1.1.3 The CONSULTANT will use GIS extraction tools to create input into DDMSW software to reflect the existing conditions and future conditions land use.

EXHIBIT A



SCOPE OF WORK

**CONTRACT FCD 2007C031
LOOP 303 / WHITE TANKS AREA DRAINAGE MASTER PLAN
UPDATE (ADMPU) AREA
HYDROLOGIC ANALYSIS
SENSITIVITY ANALYSIS CHANGE ORDER**

9.10 SENSITIVITY ANALYSIS

The CONSULTANT shall perform a sensitivity analysis to determine the best approach for application of areal reduction in the watershed.

9.10.1 The CONSULTANT will create a pair of hydrologic models for a test portion of the watershed with a consistent flow stem direction (either east or south) as far as flow split diversions are concerned. These models would disregard the criterion of maintaining the largest flow in the split on the flow stem.

9.10.2 The CONSULTANT will create a third model maintaining the largest flow split on the main stem (without hard-coding any areal reduction), and a fourth model that contains hard-coded reductions. The hard-coded model will form the basis of comparison.

9.10.3 All models will be run for two types of storms: a low-recurrence local storm (100-year, 6-hour) and a low-recurrence general storm (100-year, 24-hour).

9.10.4 The flow differences between all of the models will be compared on a node-by-node basis. Recommendations for the preferred application method will be made with concurrence by the DISTRICT. A Technical Memorandum documenting the results will be created.

Comments and Comment Responses

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona





Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: January 21, 2009
Time: 8:00 AM - 11:30 AM
Location: HDR (Arizona Room)
Subject: LP 303/WT ADMPU - Hydrologic Analysis Draft Model Review Comments
Prepared by: HDR/Jennifer Gagnon

Attachments: None.

Attendees:

FCDMC

Valerie Swick
John Holmes
Amir Motamedi
Steven Tucker

HDR Team

Linda Potter
Dave Buras
Elisa Cote
Mark Fountain
Janelle Moyer
Jennifer Gagnon

Meeting Discussion:

1. N basins that include L303 - Drainage report HDR has did not address off site flow. Need to relook at all the areas that drain Loop 303. District may have another report for this area they could provide to HDR.
2. N05 is a concern of Steven's - There is a McDOT drainage report we can't find. Wall serves as a drainage boundary? N05 needs to be divided. North part breaks out and goes to the east, into the channel. Or Valerie suggests moving the boundary to the south. Elisa can get the drainage report for Courte Bella from DEI. McDOT is putting in a large culvert to El Mirage assuming flows are to east, if this is not the case, they need to be informed.
3. Offsite flows reaching Sun City Grand - Are they broken out correctly? (N01, N02, N03, N04). HDR used the drainage report that was available, but it was not complete. HDR needs to obtain the most current and complete Master Drainage Report for Sun City Grand.
4. HDR used 80% of the retention quoted in the drainage reports.
5. Amir said they might have some other reports. Any areas discussed during today's meeting that are determined to be missing information, Amir will see if he can find any other reports and transmit them to HDR.
6. Amir asked about a write up stating how HDR determined n-values, because they did not appear to be consistent. HDR will determine consistent n-values.
7. Question about the width of the Corte Bella golf course routing. Amir will attach examples to his comments.
8. Steven said, as a general comment, a lot of the routings seemed longer that he would have expected. Twice as long in some cases. HDR to give them a hard copy of the flow path routes because the District has not seen route documentation yet.

9. Sun City West – N14 does not seem to have an outlet. Width of channels in SCW - Amir thinks is larger than we showed. We need to show them the CAD file we prepared for the cross sections.
10. N22 – N27 Comments are n values related on the routing. Based on El Mirage Town site report. N25-N26 has a dirt channel, but used 0.016. Needs revision.
11. N23 – N24 dirt channel had 0.013 for overbank. Needs revision.
12. L01 to L03 – Looks ok because of the golf course wall, commenting KM cards will help with questions like this. L01 route length is extremely long.
13. L03, L04, L07 had a specific diversion routine/ rating curve developed for it. (Linda showed the calculations from the report).
14. Amir observed that retention was about 60 to 70 acre feet per square mile. Very uniform.
15. L02 outlet needs to be reviewed, does it cross 303? Documentation will greatly help resolve question.
16. D06 – D07 golf course channel are very, very shallow. HDR will provide cross section documentation to show routing assumptions. (It will really attenuate the flows) Amir says there was a Sun City Grand HEC1 with golf course routing, but we never received it. He will look again.
17. CPD02 Bell at Reems. Reems Road channel is supposed to convey Sun City Grand overflow. HDR shows a 50/50 split to the east that is being questioned. Should it all go to the south? We will re-evaluate and let them know ASAP. Look at outlet for D07 and what was intended for offsite flow in the Mountain Vista development.
18. The route HDR has for D05 to D14 was questioned as far as length and width and n value, but not sure if the District was looking at same reach we measured. May need to break it into two routing sections because the cross section changes dramatically.
19. D10 Reems Road channel modeled as 3 foot deep, based on assumptions, unless specifically stated in a report. The District would like for us to state the assumptions, so they know what our philosophy was. Route documentation was not included in the draft report, but will be provided ASAP.
20. Was divert card based on Reems Road Channel being in place? (D10, D19) Yes.
21. Some routing cross sections have same first and last two elevations the same. HEC-1 sometimes does not handle flat areas like this correctly. Amir suggests adding a tenth of a foot to first and last points for modeling purposes.
22. D13 to D23 diversion was reviewed. Culvert goes from D13 to D14 to the east. After capacity is exceeded, flow to the SE, then to the south. Greenway to Litchfield.
23. Routing to east in D14 – width of the channel was questioned as there doesn't seem to be a representative cross section. Overall map with routing and cross sections would help FCDMC in their review. D14 outlets to the south into a channel. Make sure there is no diversion to the east. Check size on culvert, will flow be contained or will flow overflow to road?
24. D08 to D16 route also all goes to the south in a channel, none to the east (Sarival is 4 feet higher).

25. L06 diversion – 2500 cfs goes to the south, then breaks out to the east. HDR to review NE corner of L10 as flow may go east of development instead of west as modeled. L06 needs to be revised to outfall to L11, not L10.
26. General routing comment in HEC1: make sure the middle 4 points are the "main channel" and lowest in the section.
27. L07 – L08 routing is channel, not street (ok) (ignore comment).
28. L08 – L12 All flow goes to south, not to the east (there is a culvert under the road).
29. L10 – L11 route is ok, flow routed around wall per Sierra Montana report.
30. L12 Floodplain needs to be looked at, just include the statement in the report. Low point north of intersection conveys flow east before south, so floodplain delineation may change.
31. D19 outlet is based on street flow, no culvert (it's plugged).
32. D23 need to include a culvert to the east in split flow calculation.
33. D24 (diversion was explained) (2 way scupper).
34. D25 (Waddell/Dysart) Channel on east edge only takes flow from north basin, not Rose View development. HDR to double check that Rose View development actually takes all onsite flows south.
35. FCDMC discussed that HDR might assume the CLOMR for D37-D39 is approved for existing conditions model and that the floodplain is removed. FCD will discuss this and give HDR direction by next week on how to model the existing conditions for this area. CLOMR not approved as of March deadline for existing conditions. If CLOMR assumed as approved for modeling, HDR will document that FCD gave this direction for modeling.
36. CPD38 divert over railroad, based on old mapping, at low point.
37. D42 depth of route questioned. HDR to double check.
38. D26 storage backing up within channel. Unsure of railroad overtopping elevation. Documented in draft submittal.
39. D27 storage backing up within channel. Is there enough freeboard? Need documentation.
40. Need to be sure storage is not being double counted in D26-D27.
41. D53 HDR to confirm outlet elevations. Outlet elevations higher than inlet? The District will look for a CLOMR for the gas station in the NE corner of basin.
42. Not included in the model (according to Amir):
 - a) White Tanks #3 inlet improvements - W05 – solution is to move the basin boundary, not to model a diversion.
 - b) Discussion about whether flows splits/ponding at White Tanks are modeled correctly (L22 canal overshoot).
 - c) White Tanks #3 emergency spillway rating curve is different that what WLB did. FCDMC will provide.
 - d) White Tanks #4 is missing from the model.
 - e) Reems Road Channel and Basin is missing from the model. Was under construction.
 - f) Falcon Dunes golf course storage survey needs to be added.

- g) Dysart Road Channel – El Mirage to Dysart routing is different? Look at as-builts.
- h) Camelback Road Channel is missing. Look at the floodplain on North side of the road from Loop 303 to Bullard. Does floodplain still exist?
- i) Drainage Report for Luke Air Force Base (seems to be modeled ok), but is the basin in B11 online storage or offline storage? Dreaming Summit.
- j) Coulter Channel top width and cross section plans need to be checked. Request Colter Channel report from FCD.
- k) Overflow from Verado across Tuthill – FCD believes there shouldn't be any flow over road.

Action Items:

- 1. HDR to send routing documentation to Valerie, copy to others.
- 2. FCDMC will search for any reports or plans that we don't have. HDR to make a request list.
- 3. FCDMC to pdf preliminary comments to Linda by tomorrow, other comments as they are developed.
- 4. Regroup in 2 weeks to review/resolve comments.

Next meeting scheduled for Tuesday, February 3, 2009 at 8:00 AM at HDR.

Subject: Comment Resolution Meeting	
Client: FCDMC	
Project: L303/WT ADMPU AHA	Project No: 79902
Meeting Date: 4/16/09	Meeting Location: FCDMC
Notes by: L.Potter	

Attendees:

- Linda Potter/HDR
- Mark Forest/HDR
- Valerie Swick/FCDMC
- Amir Motamedi/FCDMC
- John Holmes/FCDMC
- Elisa Cote/HDR

Topics Discussed: Comment Resolution – comments on March submittal

Action/Notes:

The team met to discuss comments received on HDR's March 9th submittal. Resolutions:

- ADOT would like to make changes in the future conditions assumptions to correspond to future roadway planning efforts. ADOT/PB will give CIP model changes to HDR in ready-to-use format. ADOT/PB will redline HDR's CIP schematic. ADOT/PB will cross-check subbasins between URS and HDR model and give translation via redlined schematic. Assumption will be that subbasin boundaries WILL NOT change. (No changes will be made to HDR's subbasin boundaries as submitted on March 9, 2009). HDR will not independently check or validate the results, they will be used as-is since these changes can not be verified by HDR. No adjustments will be made to the model to parameters given to HDR by ADOT/PB.
- Valerie Swick would like to see HDR add a "length" parameter into the GIS deliverable. HDR will check HIS delivery standards to see if this would be outside the scope and determine level of effort to be reflected in the change order.
- Future conditions land use: Direction was given by FCDMC to create future conditions land use by using existing conditions land use, then only add planning overlays onto land uses 900, 750, and 700. All other land use type will remain the same. It is recognized that this future land use mapping will be a departure from the planning and zoning information previously provided for HDR's use, but will be potentially more realistic. This approach will be documented in the deliverable the time required to make the changes and documentation will be reflected in the change order.
- Future conditions retention: Existing conditions retention will be used for all areas where land use is unchanged from existing conditions. Retention will be added onto areas where land use has been changed (the former 900, 750, and 700 land uses under existing conditions). This retention will be calculated per the jurisdictional requirements (i.e. 100-yr 2-hr in most areas, with the exception of 100-yr 6-hr in Goodyear). As with the item above, it is recognized that will be a departure from the planning and zoning information previously provided for HDR's use, but will be potentially more realistic. This approach will be documented in the deliverable the time required to make the changes and documentation will be reflected in the change order.
- Routing reaches/Velocity outliers: Velocities will be checked for all areas where the velocity is reported at
 - o 15 fps or greater
 - o 1 fps or less, except where less than 100 cfs
 - o Anywhere Q goes up during routing procedures (indicates instability)

- Adjustments will be made to model parameters is needed to reflect reasonable velocity estimates considering that the reported velocities are based on flood wave celerity which can be 1.3 to 1.7 times average channel velocity and comments will be put into model to document adjustments made
- "0" cfs diversions will remain, unless this results in modeling errors. In other words, unless the 0 cfs diversions cause the model calculations to become incorrect, it will remain as is in order to maintain future model flexibility.
- No additional field checks will be performed of the routing cross sections. It is recognized that model parameters are a best estimate based on very limited data.
- HDR is requesting any new information on Northern Parkway – channel geometry, basin locations, etc. – that may come up from FCDMC's 4/16/09 meeting. Information must be received ASAP.
- Basin location south of I-10 – John Holmes will verify which rating curve should be used.
- Any additional comment clarifications will be addressed in future meetings or by telephone. It is anticipated that remaining comments not reviewed for lack of time will fall under the categories discussed or can be resolved with minimal effort. If that is not the case, HDR will contact FCDMC for additional clarification.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: May 1, 2009
Time: 1:30 PM - 3:30 PM
Location: FCDMC
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC

Valerie Swick
John Holmes
Amir Motamedi

HDR Team

Linda Potter
Jennifer Gagnon
Elisa Cote

Meeting Resolutions:

1. FCDMC will provide as-built plans for the section of Dysart Drain between Falcon Dunes to the River. The plans HDR had were not the most recent plans.
2. N06 needs to add a divert for a portion of the flow to go directly to the McMicken outlet channel.
3. Grand Avenue channel – subbasin boundaries will not change, but D28 needs to route to the north to the channel along Grand Avenue. D15 will route to D28, and a concentration point will be added. After the concentration point, the flow will go directly to the River.
4. HDR will assume that PB/ADOT's design for the L303 system will use off-line basins. The information HDR got from PB/ADOT for the L303 design does not go farther south than Northern Avenue. HDR will use the Camelback CAR model for the information on the basins along Camelback Road. HDR will use PB/ADOT's "ex-split" model for the Northern Avenue channel west of L303.
5. The Tuthill channel card needs to start with zero flow and the volume needs to increase.
6. Prasada development: FCDMC and ADOT will resolve the Prasada issues and give HDR direction.
7. John Holmes will get all of the information associated with the Camelback CAR to HDR.
8. W43: HDR will check the areas that use land use 320. It appears to be rock/sand mining operations, in which case the Kn and RTIMP values need to be changed to reflect the existing conditions. This can be easily done by decreasing the values, as long as land use 320 isn't used for anything else.
9. FCDMC will clip out the correct geometry for the Reems Road channel and give it to HDR. John Holmes will call Kristin to get the CLOMR and email it to HDR.
10. North Inlet Channel – HDR will change to reflect the dual channels by putting in a divert, route, and recombine. The storage will be removed at the start of the channel. FCDMC will provide HDR with the HEC-1 model.

11. Resolution to fix areas where UI card is cut off – FCDMC directed HDR to change the agricultural Kn value to 0.10 which should shorten the UI card to fit within the allowable lines. This is in lieu of re-programming DDMSW to allow for more lines for the UI card.
12. The Olive/Dysart intersection was previously determined to have been routed correctly due to the low spot occurring west of the intersection. HDR will move the symbol on the schematic to reflect this condition to avoid confusion.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: May 5, 2009
Time: 1:30 PM - 4:00 PM
Location: HDR (MC Conference Room)
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC/ADOT

Valerie Swick
John Holmes
Amir Motamedi
Gary Sun/PB
Dennis Crandall/ADOT

HDR Team

Linda Potter
Jennifer Gagnon
Elisa Cote

Meeting Resolutions:

1. The Camelback CAR report is forthcoming.
2. L303 CIP: HDR will use the PEC report/model for the L303 system design south of I-10, The Aspen Camelback CAR model from I-10 to Northern, the PB "ex-split" model from Northern to the north, and the PB "ex-split" model for the I-10 TI area from Thomas to I-10.
3. The Prasada split will put in retention basins near Olive and Waddell. PB will email the basin locations to HDR.
4. The information on the Northern Channel will be taken from the "ex-split" model west of L303.
5. The I-10 West Diversion channel information will be taken from the "ex-split" model.
6. Retention as Prasada: HDR will put in 100-year 2-hour retention for all of Prasada, even though some areas might have first-flush only.
7. HDR requested the HEC-1 model for PEC's design of the L303 system south of I-10. John Holmes will provide.
8. Pebble Creek - 1' CI mapping is available for the McDowell/I-10 area. Gary Sun will provide topo and information on the Pebble Creek area to HDR. There is a disagreement on how flows are routed in this area.
9. The I-10 East Diversion Channel will be eliminated from the CIP models.
10. Northern Parkway design information will be taken from the AT&SF model by Hoskin-Ryan. John Holmes will check this area - 194A should go into collector channel.
11. Verrado - MAG and the Verrado Development Master Plan disagree for future land use. HDR will use the land use from the Verrado Development Master Plan. A table was given to HDR with the preferred RTIMP values and land use values. HDR will email the GIS files on future land use to FCDMC and FCDMC will fix the GIS shapefiles. HDR will still need to do custom RTIMP values in this area.
12. FCDMC will get the Arroyo Seco reports from Hoskin Ryan and transmit to HDR.

13. W36: add 100-year 2-hour retention for Pasquelletti Ranch Phase I. HDR will approximate areas for retention with percentages (i.e. so many are built today, but the future areas will have on-lot retention).
14. Tuthill Channel (WT#4 outlet channel) – HDR was directed to use the Dibble Engineering design for the Tuthill channel. Valerie will provide the report to HDR ASAP.
15. HDR requested the HEC-1 file for the North Inlet Channel. FCDMC indicated that it's not available, but HDR needs it to determine diversion percentages. FCDMC will check with Bobbie Ohler to obtain the model.
16. The Litchfield Road storm drain is too small for this type of modeling (nuisance flows only) and will be removed from the CIP model.
17. Gannett Fleming is creating plans for the Jackrabbit Channel (from WT#3 to WT #4). HDR is using these plans for our CIP model. There will not be a basin.
18. The Bullard Wash channel CIP design will be taken from the 100% Wood Patel 2007 plans, which include a basin at I-10.
19. Future conditions routing, where agricultural use becomes developed: HDR will use a standard cross section of 6' deep, 4:1 sideslopes, 25' bottom width, 0.035 n-value, and extend the cross section on each side with a long flat slope.
20. Future conditions routing: HDR will lengthen the routes by a factor of 1.33 (2/1.5) in areas where agricultural land becomes developed in the future.
21. Luke AFB – may need to remove the storage route. HDR to investigate source of storage route and provide recommendation.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: May 13, 2009
Time: 1:30 PM - 3:30 PM
Location: FCDMC Engineering Conference Room
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC/ADOT
Valerie Swick
John Holmes
Amir Motamedi

HDR Team
Linda Potter
Jennifer Gagnon
Elisa Cote

Meeting Resolutions:

1. HDR must have all outstanding information received before this Friday in order to meet end of May deadline.
2. Reems Road Channel will have no breakout (i.e. all flow contained in new channel) once the channel is built (future CIP conditions).
3. Routing in the agricultural areas will be looked at where flow forced around berm-type features. Need for cross sections to adequately reflect features.
4. John Holmes will contact Wood Patel for plans for Bullard Wash north of I-10.
5. HDR will use approved Waddell CAR hydrology for CIP conditions for improvements associated with Waddell CAR.
6. Pebble Creek area – HDR will put in diversion so that retention basin drainage reflects bleed pipe going to south. However, if flows exceed capacity of the basin and there is overflow, they will be routed to the southwest.
7. The routing for Bullard Wash south of I-10 will be a flat section with a low-flow channel in existing conditions.
8. Amir is attempting to get land use GIS file from Wood Patel before Friday. They need approval from their client to release it.
9. HDR gave FCDMC the revised schematic for the Verrado area. FCDMC will review it.
10. The roughness coefficients in the mountainous areas need to be revised to reflect rougher conditions.
11. HDR will revise the routing of the area north of I-10 (directly north of FRS#4). Some flow will go south before reaching the Jackrabbit channel.
12. The North Inlet Channel is an existing facility. HDR requested plans for the NIC South. The previous HEC-1 model by others is missing the routing for the parallel channel, but HDR will add this route in.

13. The cross section for Bullard Wash south of I-10 should handle 3,200 cfs. Besides that, geometry is unknown.
14. The portion of the Reems Road channel between Waddell and Cactus has not been built. HDR can assume that the future cross section will be the same as the cross section immediately downstream. The Bell Road to Greenway section will be taken from FCDMC's field notes. A 4' depth is typical for this channel.
15. Falcon Dunes AT&SF Basin 194A – John Holmes discussed with Hoskin-Ryan and agree that HDR's routing is correct, there is an error with the Hoskin-Ryan model. John directed HDR to take flows southeast as shown by HDR schematic.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: May 21, 2009
Time: 10:00 AM - 11:15 AM
Location: HDR/Nano Conference Room
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC/ADOT

Valerie Swick

John Holmes

HDR Team

Linda Potter

Elisa Cote

Meeting Resolutions:

1. Existing drainage facilities and CIP facilities maps were distributed to FCDMC to review.
2. FCDMC will check into the PEC CAR model of the L303 system south of I-10. HDR found inconsistencies between the HEC-1 model, the plan set, and the report.
3. Tuthill channel sections were discussed. They appear to vary in size and get smaller downstream. Valerie indicated that this channel has only been conceptually designed, and that HDR can use a general section for now. The design of the Tuthill channel will happen after the L303 project.
4. HDR will be sending the Existing and Existing with CIP schematics over to FCDMC for review today and is requesting a quick turnaround.
5. HDR will place a comment card in our model if we deviate from other's modeling approaches. This is anticipated to occur at subbasins L40 and B97.
6. The S62 boundary may be impacted by a recent shopping center. Valerie will check to see if this area drains into FRS#4 or into the lower Tuthill Channel.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: June 19, 2009
Time: 9:00 AM - 10:00 AM
Location: FCDMC/Engineering Conference Room
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC/ADOT

Valerie Swick
Amir Motamedi
Debbi Shortal
Greg Jones

HDR Team

Linda Potter
Elisa Cote
Jennifer Gagnon

Meeting Resolutions:

1. A separate meeting will be held with ADOT to discuss comments. Comments have not been received from them to date. HDR requested advance notice of the comments prior to the meeting so that preparation can be performed.
2. HDR/Elisa Cote will send a list of unstable routes (there are only a few on the Future with CIP models) to FCDMC. HDR attempted to resolve instability in several ways, but were unable to get these routes to stabilize.
3. HDR will send out a graphical version of the 2017 facilities to ADOT and FCDMC to accompany the schematic, which was sent out last week.
4. Valerie will be out of town for 5 weeks. Debbi will be the point of contact while Valerie is gone, but she should be cc'd on all correspondence.
5. HDR will send out a CD with all models and backup information to Gary Sun and Dennis Crandall. This CD is organized such that ADOT should have an easier time reviewing the models; however, ADOT was previously sent all of the information on the CD.
6. HDR/Linda Potter will send meeting minutes from the comment resolution meetings to Debbi.
7. HDR will begin to look at the results of the model in order to formulate recommendations. FCDMC indicated that the "why" question is important, i.e. why are the results different from the previous URS model? This portion of the project was previously on hold until the models were far enough along to make observations. The team agreed that the models are now at that point and that the recommendation portion of the project can begin.
8. FCDMC will investigate the increased volumes at WT 3 and 4, and get back to HDR in about one week.
9. All comments are to be returned to HDR by Mon 6/29.
10. HDR is to re-submit with with comment resolution by Fri 7/10.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: June 25, 2009
Time: 2:30 PM - 3:30 PM
Location: HDR/MC Conference Room
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC/ADOT

John Holmes
Amir Motamedi
Debbi Shortal
Michael Duncan

HDR Team

Linda Potter
Elisa Cote
Jennifer Gagnon

ADOT Team

Dennis Crandall
Gary Sun/PB

Meeting Resolutions:

1. The Camelback Basins selection process has been delayed. The CAR model is acceptable to use in the L303/ADMPU AHA model to approximate the design of the future Camelback Basins.
2. ADOT/PB has requested that we compare the results of the new AHA model to the "ex-split" model instead of using the URS model at certain locations. ADOT/PB will send HDR a list of the locations that they would like for us to compare with "ex-split".
3. A discussion was held about the RTIMP (percent impervious) values that are being used in the AHA model. The previous models had lower RTIMP values, but it was noted that they were selected before the publication of the Drainage Design Manual for Maricopa County (DDMMC). The AHA model is using agreed-upon values that fit within the ranges defined in the DDMMC. The team agreed upon using the previously-agreed upon RTIMP values.
4. B77 subbasin: The way retention is being routed will be changed to more accurately reflect existing conditions.
5. A discussion was held about the modeling of the Pebble Creek retention basin. HDR disagrees with showing all flow going to the south – only the flow that leaves the basin through the 24" bleed pipe will go south. It is HDR's position that any overflow of the basin will go to the southwest. HDR will check the model as the DI/DQ cards may have gotten reversed. The approved LOMR model shows that all flow is contained within the basin. HDR will verify to see if the flows based on the new model are also contained within the basin.
6. The next comment resolution meeting will be held on Wednesday, 7/1/2009.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: July 1, 2009
Time: 1:30 PM - 3:00 PM
Location: FCDMC/Pass Mountain Conference Room
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter

Attachments: None.

Attendees:

FCDMC/ADOT

John Holmes
Amir Motamedi
Debbi Shortal
Michael Duncan
Greg Jones

HDR Team

Linda Potter
Elisa Cote
Jennifer Gagnon

ADOT Team

Dennis Crandall
Gary Sun/PB

Meeting Resolutions:

1. Schedule – the scheduled delivery of the draft final documents is on 7/10/09. In order for HDR to meet this deadline, all comments must be obtained and resolved by the end of this week. HDR will pdf all of the documentation, but will also provide printed copies of the maps for ease of review.
2. The FCDMC has created a spreadsheet tool that allows for visual checking of the routes. Amir will send the tool to HDR for use on this project.
3. The Kn values in the mountainous areas (MB02) will be changed to better reflect actual conditions. A value of 0.050 was suggested by FCDMC based on published literature. HDR agreed and will make the change to the MB02 models.
4. Esperanza will provide additional backup on the North Inlet Channel comments.
5. The Camelback Basins appear to have incorrect volumes based on the rating tables in the appendix of the CAR. Check DB252. HDR will check – this may have been wrong in the CAR model as well.
6. The channel route B46B47 in the CIP models may need revision (looks like remnant from existing conditions model). HDR will check and revise.
7. The RTIMP values for Goodyear Airport were 13 in the former models, and 35 in HDR's model. HDR believes that the 35% is appropriate, but would like FCDMC's concurrence as the increased flows causes downstream infrastructure to be undersized. FCDMC will investigate and provide HDR with information by COB July 2nd.
8. Subbasin L39 will be changed to be split into two subbasins at Butler Road per agreed-upon previous change order.
9. A discussion was held about the flows produced in Sun City Grand. Bing Zhao may have done previous work on this area – John will contact Bing to get additional information if it is available. The previous model broke this area up into 4 different basins. HDR indicated that the master drainage report did not match the constructed improvements, so a retention volume was calculated at 80% of the design intent retention (will check report, couldn't recall if it was either 100-year 2-hour or 100-year 6-hour that was intended for the development).

The only retention provided for the subdivision is in the golf courses. The difference in flow (772 cfs in "ex-split" versus 912 cfs in HDR model) causes the improvements that are currently under construction to be undersized. John will get the information by July 2nd in order to avoid a delay in the 7/10 submittal.

10. HDR will add explanations in the report and in the models on what "existing", "existing with CIP", "future", and "future with CIP" means...it can be confusing to others.
11. B24 – comment resolved. The intersection with Dysart is actually in the middle of the subbasin so the direction is correct as-is.
12. A discussion was held about what to do when the flow is not contained within the cross sections. Vertical extensions are ok with FCDMC as long as they are reasonable. In areas where the flow is not contained within the cross section by a reasonable amount, they will be investigated for diversions. In some cases, the diversions are being modeled but might not occur in the model until after the route, so the vertical extension is appropriate.
13. The future Tuthill Channel basin was not modeled in HDR's models as it is only conceptual at this point and no information exists. Per a previous meeting with Valerie, this is acceptable.
14. For future CIP channels, an approximation was made for routing cross sections and lengths. They do not exactly match the design plans in some cases, but are definitely accurate enough for the purposes of hydrologic routing. The reasons that they don't match exactly is to avoid breaking our routes into numerous routing reaches in order to make minor changes in cross sections – an overall average was used and minor structures were ignored. Additionally, the lengths in the hydrology model must match our electronic GIS lengths which might not exactly match the lengths in the design plans. This was acceptable to FCDMC.
15. The stage-storage-discharge curve for Falcon Dunes will be corrected.



Flood Control District of Maricopa County (FCDMC)
Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Contract FCD 2007C031
HDR Project No. 79902

MEETING NOTES

Meeting Date: August 5, 2009
Time: 8:30 AM - 3:00 PM
Location: HDR/Grand Canyon Conference Room
Subject: LP 303/WT ADMPU - Hydrologic Analysis Comment Resolution
Prepared by: HDR/Linda Potter and Elisa Cote

Attachments: None.

Attendees:

FCDMC/ADOT

John Holmes
Amir Motamedi
Valerie Swick

HDR Team

Linda Potter
Elisa Cote
Jennifer Gagnon
Mark Forest

ADOT Team

(None)

Meeting Resolutions:

1. Differences exist in the loss parameters used in the WLB, URS, and the HDR models for the subbasins in MB02 (which drain to the Flood Retarding Structures #3 and #4). The differences in the RTIMP's used in the URS model was approximately half of what was used in the WLB and HDR model. Some of the basins have rock outcrop areas that drain over pervious soil and perhaps the RTIMP should be revisited since they may not be effective according to the definition of RTIMP. HDR will revisit the following basins and determine what the effective RTIMP should be: W04, W12, W13, W14, W18, W19, W25, W43, W45, W51, W52, W53, and W54. The determination will be based on aerial analysis and engineering judgment. The determined RTIMP values will be sent to FCD for approval before finalizing the model.
 - a) Resolution/Action Items: HDR will examine effective RTIMP's of the basins listed above and send to FCDMC for approval before finalizing the model.
2. There is a difference between the FEMA published flows for Cholla Wash and HDR's results. It was determined the flows in Cholla Wash were based on the WLB report. No further action needed. The differences will be discussed in report section for WT#3.
 - a) Resolution/Action Items: HDR will discuss the differences in the report.
3. Area where Tuthill Wash crosses I-10 in the multi-barrel 12x8 box culverts: According to the calculations prepared by HDR, the culverts can handle approximately 6000 cfs. This is based on the amount of ponding(head) that can occur before the flow overtops to the east. Flow above the 6000 cfs will overtop to the east and enter the 12x12 vehicle underpass. From the 1990 topography it seems that any flow that does overtop to the east will not end up at Jackrabbit due to a high point in the topography, numerous culverts under I-10 and an existing berm. The District would prefer that a split flow is added back in the model for ease of future use. This area will be visited on Monday August 10th before a final determination is made.
 - a) Resolution/Action Items: The team will review this area in the field before making a final determination in the modeling of this area.
4. Jackrabbit Trail Channel – FCDMC indicated that the Jackrabbit Channel design was based on future conditions. In the future model, HDR used the MAG land use that shows everything

downstream of the dam is developed. The design was based on everything being built out except for a swath of land that would be used as the outfall. This difference between the previous design flows and the new model flows will be explained in the report.

- a) Resolution/Action Items: HDR will discuss differences in land use in the report, but no changes to land use will be made.
5. L303 - The following three areas will be looked at during the Monday field visit: Cotton and Waddell, Citrus and Indian School, and Cotton and Broadway.
 - a) Resolution/Action Items: The calculations have been reviewed and seem reasonable compared to the information used; however, the team will examine these areas in the field prior to final acceptance.
 6. Reems Rd-URS had a split flow at Sunrise and Bell Rd where HDR does not. This area will be visited during the field visit to examine the possibility of split flow at this location.
 - a) Resolution/Action Items: The team will look at this area in the field before a final determination is made on whether to include this split flow.
 7. Dysart Drain-The flow split at D59 is directing more flow to Dysart Drain at Bullard Ave than the previous model, which had the flow going to the southeast. Ultimately the flow arrives at the same location at the next concentration point. Since this one segment of the channel may require improvements to accommodate this flow, it will be looked at in the field on Monday. In addition, the rating curve at Falcon Dunes needs to be corrected at upper end of rating curve. This should not affect the model output.
 - a) Resolution/Action Items: The team will look at the D59 split in the field before a final determination is made. The Falcon Dunes rating curve will be corrected by HDR.
 8. Dysart Drain – HDR has more flow across the “curve” in the railroad tracks (at CPD63) than the previous model, as well as differences in the split flows along Dysart Road. Therefore, the HDR model is showing more flow arriving at the Drain.
 - a) Resolution/Action Items: HDR will discuss this difference in the report.
 9. Waddell CAR- The District is requesting a detailed write up in this area to explain the flow differences from the previous models.
 - a) Resolution/Action Items: HDR will discuss the differences between the old model and HDR’s model for Lower El Mirage Wash in the report.
 10. Colter Channel-the retention at B11 has been updated as well as the rating curve. The area was allowed direct discharge into the channel without additional retention. Some of the flows may drain to the Old Murphy Dam site, which will be examined in the field. Additionally, it is unknown if the school has additional retention. This will be visited on Monday as well.
 - a) Resolution/Action Items: This area will be visited by the team to determine general drainage patterns and retention to determine if a change in the model is necessary.
 11. Bullard Wash-The basin at Indian School has been removed from the plan for the channel.
 - a) Resolution/Action Items: For information only. No action necessary.

12. RID Overchute-Flows are lower than the design flows. Discussion in report will state that even though there seems to be capacity, a more detailed model should be developed to determine the amount of capacity.
 - a) Resolution/Action Items: HDR will add discussion in the report on the area, and add a recommendation for further future study in the report.
13. ADOT Basins-These basins were large pits that were not designed to hold a certain amount of capacity. Therefore, their really isn't a good source to compare volumes. However, more work would be needed in the future to determine actual performance of the basins since this regional model did not go to that level of detail.
 - a) Resolution/Action Items: HDR will add discussion in the report on the area, and add a recommendation for further future study in the report.
14. D52-It is not possible to determine if the fields at this high school have retention. This site will be visited during the field visit.
 - a) Resolution/Action Items: The team will visit the area in the field before a final determination on retention is made.
15. Floodplains-A map and write up will be prepared pointing out the differences in the flow amounts in the existing floodplains. A map and table will be prepared. John Holmes will check for CLOMR's and LOMR's that might not be reflected in the published linework.
 - a) Resolution/Action Items: HDR will prepare a floodplain map for inclusion in the report. John Holmes will provide information on CLOMR's and LOMR's within the study boundary for inclusion on HDR's map.
16. HDR will make a list of EVERY change made to the models between the previous July submittal and the submittal in August. This will prevent the District from having to do a complete review of the models again, so they can focus on the changes.
 - a) Resolution/Action Items: HDR will keep a running list of any model changes that are made between the previous submittal and the next submittal.
17. HDR will get the 2017 model to the District and ADOT by Friday, August 7th.
 - a) Resolution/Action Items: HDR will give the 2017 model to the District and ADOT by Friday, August 7th.
18. For the purposes of this model, if an area cannot be definitively determined within the scope of this project, HDR will indicate that it warrants additional investigation.
 - a) Resolution/Action Items: HDR will add text in the report for areas that warrant additional investigation.
19. Valerie Swick will look at the modeling of the WT#4 Outlet Channel (former Tuthill Channel) to see if there should be storage added to the HDR model.
 - a) Resolution/Action Items: Valerie will give a recommendation to HDR on the modeling of the WT#4 Outlet Channel. The model will remain as-is unless direction is received before COB on Monday, August 10th.

20. The field visit will begin at 11:00am at the District on Monday, August 10th. The following areas will be visited:

- a) Colter Channel/B11 area
- b) Cotton at Waddell, Cotton at Cactus, Citrus at Indian School
- c) Cotton at Broadway
- d) Sun City Grand – area of potential flooding
- e) Bullard at Olive (D59)
- f) Dysart School
- g) Tuthill at I-10

} L303 1/4
Bell
area?

21. The submittal date of August 14th for the revised documents will be discussed at the conclusion of the field meeting on August 10th. The feasibility of meeting the date may depend on the resolution of the items investigated in the field. Should the date no longer seem feasible, HDR will inform the District immediately at the conclusion of the meeting.



Memorandum

To: Valerie A Swick – FCDMC Project Manager
From: Guihua Li/Gary Sun - PB
Date: March 20, 2009
Project: Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Subject: Comments on March 2009 Hydrology Report

We have reviewed the March 2009 Hydrology Report submittal and offer the following comments:

1. Volume 1 – Report and Documentation:

- **Study Needs and Purpose –**
 - The report failed to acknowledge that ADOT is a partner for this study, and the results will be utilized for the final design of the FCDMC and ADOT jointly-funded SR303L regional channels and basins from north of Bell Road to Gila River.
 - Need to add “Executive Summary” to the Hydrology Report.
- **1.2 Existing Conditions –**
 - Provide the basis or source of the capital improvement project (CIP) because the CIP will be revised and updated. CIP facilities shown on Figure 4 didn't reflect the current proposed SR303L regional channels and basins (See comments below in **Figures**).
 - Need to explain the differences on the proposed SR303L drainage system between the CIP used and the selected alternative from the Level III ADMPU (February 2005).
 - The proposed SR303L shall be shown between US 60 and I-10 as a part of the CIP since the ADOT will include the SR303L regional channels and basins with the freeway construction.
- **2.8 Storage Investigation –** Did any basin as-built plans use for storage volume calculations besides using the drainage reports? Did an 80% effective on the calculated storage volumes apply to these existing basins as well?
- **2.10 Areal Reduction –** It didn't mention that the Sensitivity Analysis was performed. It shall include the explanation of why a Sensitivity Analysis was done as an out-of-scope item including purpose, approach, findings and conclusions and recommendations. Not even a map was shown what area was selected to conduct the sensitivity analysis, and it doesn't explain why the hard coded method (or manual input) is better than the main flow stem method to specify the cumulative tributary area in the HC record.
- **Table 4.1.1 –** Provide the source for URS 1/19/04 peak flows listed in the table. It seems that the values were not taken from the ADMPU HEC-1 model L33PE4H.DAT prepared by URS.
- **5.0 REFERENCES –** There are differences on References used in the Hydrology Report and the Data Collection Report. The reviewers cannot figure out what references you used in the report and will not look it up in a report with a separated cover.
- **Figures –**
 - Figure 1 was shown on Page 1 as well as shown in the back of the report.
 - Only Figure 1 shows most of the major corridors except the Union Pacific Railroad. Please show all the major corridors on all of figures and maps.



- o Figure 2 is not mentioned in the text, and the color copy of this figure failed to show the stakeholder boundaries per Legend.
- o Figure 3 is not legible (Cannot see the background such as roads, subdivisions, section lines, etc.).
- o Figure 4 doesn't represent the current proposed SR303L regional channels and basins. The SR303L regional channel starts at Clearwater Blvd. (One mile north of Bell Road) not at Greenway Road as shown. Cactus Road Basin was eliminated, and Waddell Road and Olive Avenue Basins were added. The location of Camelback Road/SR303L Basin shall be located at the northwest corner of Camelback Road and SR303L. Another Camelback Basin located at the south side of Camelback Road shall be shown between the SR303L and Bullard Wash.
- o Figures 7 and 8 show that I-10 is discontinuous through sub-basins S36 and B63. I-10 is a physical barrier, and a routing in these sub-basins shall be performed for the culverts under the I-10.
- o Add Figures 1.4.2, 3.1.1 and 3.1.2 which were referred in the text on Pages 3 and 10, respectively.
- **List of Appendices** – Explain the purpose of including the Flow Summary from the 2004 ADMPU. Why the peak flow comparison tables between the original ADMS and the URS model output are needed for this study? Since it was decided to use a different sub-basin ID for this study, it will need to add an equivalent sub-basin ID or a location identifier before making any comparison.

2. Existing Conditions HEC-1 Model with CIP Projects –

- o **Flow Splits:** Explain why there are still flow splits to the east and the southeast across the SR303L at northwest corners of Bell Road, Greenway Road, and Indian School Road. The SR303L regional channels and basins shall intercept all off-site flows from west of SR303L, i.e.; no flows will spill to the east and the southeast. Table 1 shows the flow splits at these locations, and the results showed that the flows to the east are ranging 37% to 96% of the total flows.

Table 1 - Peak Flows Splits at Some Intersections along SR303L

Location	Flow at NW corner	Flow to South	South to Southeast	Flow to East	% of Flow to East vs. Total flow
Bell Road/SR303L	338	5	8	324	96%
Greenway Road/SR303L	7	1	0	6	86%
Indian School Road/SR303L	660	384	29	247	37%
I-10/SR303L	599	157	0	442	74%

- o **Peak Flow at Greenway Road and SR303L:** Explain why the 100-yr 24-hr peak flow at the northwest corner of Greenway Road and SR303L is only 7 cfs which is very low.
- o **Flow Break-Out:** Explain why there is flow break-out to the east across SR303L at the northwest quadrant of the proposed I-10/SR303L System TI. The proposed McDowell Road/I-10 Basins will intercept all the flows west of SR303L, and no flow will go to the



east across the proposed depressed Ramp SW, SR303L, and Ramp WN which will be approximately 30 feet below the existing ground.

- o **Basin Routing:** Explain why the Northern Avenue Basin, Camelback Road Basin and McDowell Road/I-10 Basins were not modeled. These basins will reduce the peak discharge significantly, and the bleed-off flows from these basins will need to be considered for the sizes of the downstream channels.
- o **ADMPU Selected Alternative:** The Level III Selected Alternative Map and related tables for SR303L from the ADMPU were included in the Volume 5. Sub-basin data, "B" sub-basins and Volume 7, Sub-basin data, "L" sub-basins. Explain why the HEC-1 model didn't follow this selected alternative for the SR303L drainage system. It will be helpful to know the differences between the CIP used and the selected alternative when is making comparison on the results of peak flows.
- o **SQ Card:** At Cactus Road Basin, the outflow record (SQ card in HEC-1) isn't the same as the original ADMPU HEC-1 model (L33PE4H.DAT).
- o **SR303L Channel Routing:** Explain why a Manning's "n" value of 0.022 to 0.038 was used for the SR303L channel routing. An "n" value of 0.013 or 0.015 shall be used for the SR303L concrete-lined channel.
- o **SR303L Channel Routing:** Explain why a wide and shallow channel (50' bottom & 2' deep) was used for the SR303L regional channels from Greenway Road to Waddell Road, from Cactus Road to Peoria Ave, and from Indian School Road to Thomas Road. A reasonable channel size will be an 8' to 26' wide bottom width, approximately 5' to 6' deep.
- o **I-10 West Channel:** Explain why this channel from west of Perryville Road to Citrus Road (shown on the CIP map) was not included in the HEC-1 model.
- o **Pebble Creek Development:** The subdivision detention basin will release the bleed-off flow into a small basin located at the northwest quadrant of the I-10/Sarival Avenue TI, eventually draining into the existing channel through the Canyon Trail development. This flow shall not be routed to the northwest of RID Canal and the northeast corner of I-10/SR303L TI as shown in the HEC-1 model.
- o **Canyon Trail Development:** Explain why this development was not incorporated in the HEC-1 model.
- o **Peak Flow Comparison:** It is important to make the peak flow comparison at every mile street along the proposed SR303L and provide explanation of the results.
- o **S-Graph:** The Agriculture S-graph shall not be used for Sub-basin L03 which is mostly developed (Arizona Traditions North Subdivision). It is located at north of Bell Road west of the Sun City Grand development.

I have the following comments concerning the retention in the future conditions submittal without CIP for the White Tanks ADMP hydrology:

- 1) There were several watersheds where retention was reduced for future conditions. The filling in of existing retention is not a common practice. Retention was reduced in future conditions for basins L06, L08, L11, D18, D17, D20, D26, D42, D53, D32, D31, D46, D47, B82, L56, S02 etc. *should be same or more -*
- 2) There were several watersheds where there was no retention at all for future conditions even though the land is currently agriculture and the future condition was developed. Unless the entire drainage area is to be developed in residential lots exceeding an acre (outside of subdivision regulation), this assumption is not reasonable. No retention was included for basins D37, L18, D40, D39, L25, L26, D74, D69, D31, D7, B94, etc. *10 ac/ft. / sq. mi. - as normal - but some were 10% of that.*
- 3) Retention volumes seemed to be much closer to first flush volumes than 100-yr 2-hr volumes for many watersheds, when there was no apparent reason for the waiving of retention requirements. Retention volumes were extremely low for basins L12, L13, D16, D35, D38, L17, L19, D29, D30, D34, D41, D58, D59, D61, L38, L39, L24, D27, L34, D57, D45, D48, D50, D60, D63, D62, D61, D73, D64, D65, D78, D71, D72, D75, D68, D24, D25, B37, L44, L53, L54, L57, L58, L63, L60, B43, B44, B45, B46, B47, B48, B55, B63, B95, B37, etc.
- 4) There were several watersheds where there was a significant increase in retention though the lack of developable area within the watershed made it highly unlikely that the retention would ever be fulfilled. Retention volumes were unrealistically high for basins D15, D27, L28, B12, B72, etc. Basins D36 and D52 should have had retention in existing conditions that is reflected in future conditions.
- 5) The typical agricultural basin model consisted of combining the basin hydrograph with a hydrograph routed from the north flowing south, a hydrograph from the west flowing east, and a hydrograph sheet-flowing diagonally to the southeast. One of the effects of development is the elimination of the diagonal sheet-flows. This effect does not seem to have been modeled.

new level

21 units of water
2.5 mg

FCDMC - Cont. Comments from 4-6-09

Check channel and storage routing parameters for the following:

1. Indicate the source of the stage-storage table used for SR359, the storage route upstream of the UPRR. Also, typical cross-sections for the Loop 303 channel between I-10 and the Gila River is too wide. See the CAR report entitled: Loop 303 Drainage Improvements I-10 to Gila River in the Data Collection folder.
2. Reems Road Channel – HDR model does not match design geometry. CLOMR HEC-1 model submitted to HDR on 4-6-09, HEC-1 model entitled rrw1.
3. Colter Channel – HDR does not match As-built plans for channel geometry. See As-built plans in the Data Collection folder, entitled Colter Channel FCD 93-08.
4. Dysart Drain – HDR typical cross-section = 10' bottom, As-built plans show 20' bottom. See As-built plans in the Data Collection folder, entitled Dysart Drain Improvements Reems Road to Agua Fria River.
5. ATSF Channel – indicate source of data for typical cross-sections on KM card.
6. Jackrabbit Channel – indicate source of data for typical cross-sections on KM card.
7. Tuthill Channel - indicate source of data for typical cross-sections on KM card.
8. Loop 303 Channel – HDR model does not match design geometry – PB will provide model to HDR.
9. Loop 303 Channel, I-10 to the Gila River, does not match proposed Channel and Basin. See the PDF file in the Data collection folder, entitled: A470_991Loop303DrainageImprovements_I10toGilaRiverCAR..., by PEC, for proposed cross-sections.
10. Northern Parkway Channel – indicate the source of data for typical cross-sections on KM card.
11. I-10 Basins – indicate the source of data used for the I-10 Basins from B73 to B83.
12. White Tanks #3 FRS NIC (North Inlet Channel) – check the As-builts and reports in the Data Collection folder for the typical cross-sections of the earthen and concrete channels.

JWH



Flood Control District

of Maricopa County

INTEROFFICE MEMORANDUM

Date: June 29, 2009
To: Linda Potter
HDR
From: John Holmes, Hydrology
Engineering Division
Subject: Loop 303 Drainage Improvements

Following Comments by Julie Cox, dated 6-26-09:

I was tasked with identifying where and why there were differences between the HDR existing conditions model and the design discharges and/or volumes for both existing and proposed basins and channels. I reviewed both the URS and HDR existing condition models. I focused on the following: (1) Bullard Wash (existing), (2) ADOT basins (existing), (3) SR303L Channel South (proposed) and (4) MC85/SR 303L/Railroad Basin (proposed).

(1) Bullard Wash – I added a diversion immediately after route B48B54. See Table 1 below for a comparison of the discharges at key concentration points downstream of the diversion. Based on the “Bullard Wash Channel Improvements I-10 to Lower Buckeye Road Design Report”, the 100-yr design discharge is 3200 cfs. At Lower Buckeye Road (CP69), the HDR existing condition model with diversion is 3232 cfs. This is comparable to the design discharge of 3200 cfs.

TABLE 1

LOCATION	HDR EXISTING COND WITHOUT DIVERSION (cfs)	HDR EXISTING COND WITH DIVERSION (cfs)
CPB54	3653	3334
CPB57	3689	3296
CPB58	3705	3292
CPB59	3885	3483

CPB65	3922	3506
CPB66	3844	3403
CPB68	3771	3309
CPB69	3713	3232
CPB70	4225	3761
CPB93	4242	3778
CPB94	4229	3763

(2) ADOT Basins – The discharges and volumes differ significantly between the HDR and URS models. For a sample of five sub-basins that contribute to the ADOT basins, the discharges and volumes are less for the HDR existing condition model. There are actually sixteen sub-basins that contribute to the ADOT basins. For both the URS and HDR existing condition models, I performed sensitivity analyses for several loss parameters. For sub-basins B83, B72, B73, B74, and B84, I modified RTIMP, DTHETA, and IA. I only changed one parameter per model to identify the effects on the resulting volumes. I replaced the URS loss parameters with the HDR loss parameters. Then I replaced the HDR loss parameters with the URS loss parameters. See Table 2 below for the differences in loss parameters.

TABLE 2

SUB	SUB	RTIMP	RTIMP	DTHETA	DTHETA	IA	IA
URS	HDR	URS	HDR	URS	HDR	URS	HDR
287D	B83	0	51	0	0.31	0.5	0.2
288B	B72	14	22	0.20	0.26	0.30	0.22
287A	B73	16	20	0.06	0.029	0.42	0.32
287B	B74	54	66	0.21	0.27	0.23	0.16
287C	B84	48	48	0.15	0.20	0.27	0.18

See Table 3 below for the differences in resulting volumes for the ADOT basins in the HDR existing condition model. All volumes are in acre-feet.

TABLE 3

ADOT BASIN LOCATION (HDR ID)	HDR BASE MODEL VOLUME	HDR W/ URS RTIMP VOLUME	HDR W/ URS DTHETA VOLUME	HDR W/ URS IA VOLUME
SRB73	15	14	19	15
SRB74	92	77	98	91
SRB84	285	256	291	283
SRB83	27	12	26	26

See Table 4 below for the differences in resulting volumes for the ADOT basins in the URS existing condition model. All volumes are in acre-feet.

TABLE 4

ADOT BASIN LOCATION (URS ID)	URS BASE MODEL VOLUME	URS W/ HDR RTIMP VOLUME	URS W/ HDR DTHETA VOLUME	URS W/ HDR IA VOLUME
SR287A	28	30	24	28
SR287B	117	210	113	118
SR287C	479	570	474	479
SR287D	219	239	219	219

RTIMP is the most sensitive of the loss parameters. The URS model with the HDR RTIMP produced significantly higher volumes than the URS base model. This makes sense. In order to see why the HDR volumes decreased rather than increased, I investigated retention diversions for the upstream sub-basins contributing flow to the existing ADOT basins. Sub-basins B71, B72, B73, B74, B75, B75A, B76, B76A, B77, B78, B79, B80, B81, B82, B83, and B84 contribute to the ADOT basins. Sub-basin retention for these sixteen sub-basins totals 351.8 ac-ft, or 22 ac-ft

per sub-basin. This could account for the volumes decreasing rather than increasing due to the increased RTIMP values.

Additional comment: Warning messages appear throughout the HDR output. They should be able to eliminate these warning messages.

- End of Julie Cox Comments

Following Comments by John Holmes, dated 6-29-09

I was tasked with analyzing the Existing Conditions w/o CIP (Base Model) MB02 HEC-1 HDR L303/White Tanks ADMPU AHA in relation to Qs and Volumes which impact FCD major structures, mainly WT#3 FRS and WT#4 FRS based on the Existing Conditions w/o CIP URS model.

1. The URS model indicates that the total Q reaching CP43, at Tuthill Dike Wash and I-10, is 8794 cfs and a volume of 559 ac-ft, with a cumulative area of 13.90 sq. mi.
2. The HDR model indicates that the total Q reaching CPW58, also at Tuthill Dike Wash and I-10, is 7886 cfs and a volume of 738 ac-ft, with a cumulative area of 14.92 sq. mi.
3. The URS model indicates that the total Q reaching the WT#4 FRS reservoir is 6896 cfs and a volume of 767 ac-ft; with a cumulative area of 18.57 sq. mi.
4. HDR model indicates that the total Q reaching the WT#4 FRS (CPS60) reservoir is 9138 cfs and a volume of 919 ac-ft, with a cumulative area of 19.46 sq. mi.
5. The HDR model indicates that the total Q reaching the WT#3 FRS reservoir is 9630 cfs and a volume of 1287 ac-ft, with a cumulative area of 21.58 sq. mi.
6. Additionally, the URS model indicates that the total Q reaching the WT#3 FRS (CPWT3) reservoir is 7618 cfs and a volume of 901 ac-ft; with a cumulative area of 20.52 sq. mi.

Subbasin parameters should be adjusted to provide a volume approximate to the ADMPU model output due to the design capacities of the two structures. Please see the attached spreadsheet which details the results from sample sub-basins in WT3 and WT4 sub-watersheds.

1. I recommend that the Kn values for the MB02 model (White tanks Mtns watershed) be changed to .050 based on the DRAFT Hydrology Manual, pages 5-30 and insert A-83. The closest similar watershed in Arizona as published by the USACE, "Guide for Estimating Basin Factor Kn", is at the Salt River near Roosevelt, AZ: estimated Kn = 0.050.
2. The Effective RTIMP values used in the URS study for the ADMPU hydrology are shown on the spreadsheet with the HDR estimated RTIMP values. HDR: Please check the RTIMP values for the White Tanks sub-watersheds to determine if estimated RTIMP values are Total RTIMP or Effective RTIMP. Effective RTIMP values should be used in the HDR AHA model.
3. According to the Verrado Development Master Drainage Plan, "retention is to be provided to maintain the 100-yr stormwater flows leaving the property at or below existing peak flow rates."

- End of John Holmes Comments

Following Comments by Esperanza Foreman, dated 6-26-09:

L303/ White Tanks ADMP

Review Comments Existing Conditions with CIP in place:

This review is to make sure that the HEC-1 model takes into consideration the proposed design parameters of the CIP structures in the Northeast, Dysart, White Tanks, Southwest Regions, Bullard Region south of I-10 and Loop 303 Region north of Northern Avenue.

Northeast Region:

There are not proposed CIP facilities for this region at this time.

Dysart Region:

1. AT & SF Railroad Channel: Length and slope of some reaches in the primary channel do not match with the values proposed in the Candidate Assessment Report.
2. The secondary channel is not modeled according to the parameters in the Candidate Assessment Report.
3. Figure 4 (CIP Facilities) shows the AT & SF primary and secondary channels as one channel.
4. Northern Parkway Drainage Improvement is not in the HEC-1 model. However it is shown in Figure 4 (CIP Facilities and Future Facilities)

White Tanks Region:

5. North Inlet Channel is not modeled according to the NIC Data Report.

Southwest Region:

Tuthill Channel:

6. Length of reaches do not match with the lengths proposed in the Conceptual Design Plans.
7. Some cross sections are not modeled according to the conceptual Design Plans.
8. On the schematic, CPS71 is labeled as CPS70. Please correct.
9. Union Pacific Basin is not in the HEC-1 model

SR 303L Channel South:

10. Cross section and length of reaches do not match with the cross sections and lengths proposed in the "Loop 303 drainage Improvements I-10 to Gila river Candidate Assessment Report"

Bullard Wash Region south of I-10:

Bullard Wash Channel:

11. Cross section and length of reaches do not match with the design criteria contained in the "Bullard Wash Channel Improvements Interstate 10 to Lower Buckeye Road Design Report".

Loop 303 Region North of Northern Avenue:

12. The Cactus Road /SR 303L Basin that appears on Figure 4 (CIP Facilities) is not in the HEC-1 model.

- End of Comments by Esperanza Foreman

Following comments by Amir Motamedi, dated 6-25-09:

My task was to review the existing conditions HDR model with the design models for our structures (URS, WLB, etc.) in Northwest and Dysart Regions, and try to explain the differences. Here is the list of my comments:

- 1 Reems Road Channel: The HDR flows are much lower than the current design (see Reems Road CLOMR). It appears that the flows coming in from the north at Bell Road are about the same, however most of the flows coming in from the west at the mile roads have been reduced drastically due to retention, causing much lower flows in the Reems Road Channel. This seems plausible.
- 2 Dysart Drain: The same trend as #1 continues downstream into Dysart Drain, reducing the flows drastically.
- 3 Stage Storage Discharge for Falcon Dunes is incorrect.
- 4 ATSF proposed channel, the flows have decreased, refer to Esperanza's comments on channel location.
- 5 Waddell Road CAR: I could not access the report, but I assume the same is true.
- 6 The rating curve on the Loop 303 at Camelback Basin did not match the ASPEN report.
- 7 One segment of the Camelback Road Channel missing from the model.

Thanks,

Amir M. Motamedi, P.E.
Hydrology and Hydraulics Branch Manager
Flood Control District of Maricopa County
Tele:(602) 506-4871
Fax: (602) 506-4601

Addendum to Esperanza Foreman's Comments 7-2-09

L303/ White Tanks ADMP

This is an *addendum (italics)* to the comments made by Esperanza Foreman, dated 6-26-09. **Please refer to the numerals in the 6-29-09 document.**

Dysart Region:

1. *Please Disregard.*
2. *Please Disregard.*

White Tanks Region:

5. North Inlet Channel is not modeled according to the NIC Data Report.

HEC-1 model, route W0512B (from Olive Avenue to Northern Avenue) states that the cross section is from North Inlet Channel As-Built Plans. Several drop structures are used to maintain flat channel slopes and drop the 36 feet elevation difference from Olive Avenue to Northern Avenue and insure non erosive velocities. The model gives a continuous slope (0.0170 ft/ft) to the channel increasing the velocity.

Southwest Region:

Tuthill Channel:

6. Length of reaches do not match with the lengths proposed in the Conceptual Design Plans.
7. Some cross sections are not modeled according to the conceptual Design Plans.

a) Reach S62S64 in HEC-1 is a trapezoidal channel with $L=5430'$, $n=0.045$ and $s=0.0077$ ft/ft (between Van Buren and Yuma Road). The Conceptual Design Plans have trapezoidal channel with $L=3278'$, $s=0.007$ ft/ft

SR 303L Channel South:

10. Cross section and length of reaches do not match with the cross sections and lengths proposed in the "Loop 303 drainage Improvements I-10 to Gila river Candidate Assessment Report"
- a) *Van Buren to Yuma, the typical Right of Way (ROW) is 75'. Proposed channel width is 44' with side slopes 4:1 to 5:1; HEC-1 reach S13S19 is a channel 30' width with side slopes 2:1.*
 - b) *Yuma to Lower Buckeye, the typical ROW is 55'. Proposed channel width is 37'. HEC-1 reach S19S20 has a width of 47.6'.*

- c) *175 Avenue to UPRR (Broadway), the typical ROW is 110'. The proposed channel width is 78' with a minimal bottom of 20' and side slopes 4:1 to 5:1. HEC-1 reach S26S31 has a width of 30', bottom of 8' and side slopes 2:1.*
- d) *Railroad Basin to Gila River, the typical ROW is 135'. The proposed channel has a width of 105' with minimal bottom of 35'. HEC-1 reach S31S27 is 1760' wide.*

Bullard Wash Region south of I-10:

Bullard Wash Channel:

- 11. Cross section and length of reaches do not match with the design criteria contained in the "Bullard Wash Channel Improvements Interstate 10 to Lower Buckeye Road Design Report".
 - a) *North of Yuma, the design criteria are: slope between 0.002ft/ft and 0.003ft/ft, n between 0.036 and 0.038 and side slopes 6:1 to 12:1. HEC-1 Reach S13S19 has a slope of 0.0048ft/ft, n= 0.013, and side slopes of 2:1.*
 - b) *Please review all the reaches.*

End of Esperanza's Comments

Potter, Linda A

From: Sun, Gary [SunG@pbworld.com]
Sent: Friday, June 26, 2009 4:55 PM
To: Potter, Linda A
Cc: Greg Jones; Steve Beasley; Li, Guihua; Valerie Swick - FCDX; Debbi Shortal - FCDX; John Holmes - FCDX; Amir Motamedi; Dennis Crandall; Michael Duncan - FCDX
Subject: RE: Loop 303/White Tanks ADMPU AHA - Comments on HDR's HEC-1 Model for Future Conditions with CIP Facilities In Place
Attachments: Recommended Flow Comparison Locations & Corresponding HEC-1 ID.pdf
Importance: High

Linda,

Per your request in our 6/25 meeting, attached is a list of HEC-1 ID from the EX-SPLIT model at the concentration points along SR303L. We'll like to see Flow Comparison at these concentration points where PB has completed 30% SR303L plans between Van Buren Street and US 60 (Grand Avenue).

Let me know if you need any additional information. Thanks!

Bailang Gary Sun, P.E.
Senior Engineering Manager

PB

1501 W. Fountainhead Pkwy #400

Tempe, AZ 85282

Direct: 480-921-6897

Mobile: 602-790-0585

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E-mail: sung@pbworld.com

<http://www.pbworld.com>

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Recommended Flow Comparison Locations and Corresponding HEC-1 IDs

Locations	ADOT/PB HEC-1		HDR HEC-1	
	ID	Flow (cfs)	ID	Flow (cfs)
NW Corner of SR303L and Clearview Blvd	CP106	409	L02	
NW Corner of SR303L and Bell Rd	!LP0	772	CPL05	
NW Corner of SR303L and Greenway Rd	!LP	818	CPL09	
NW Corner of SR303L and Waddell Rd	!LP1	1234	CPL13	
NW Corner of SR303L and Cactus Rd	!LP2	2456	CPL19	
NW Corner of SR303L and Peoria Ave	!LP3	4018	CPL27	
NW Corner of SR303L and Olive Ave	!LP4	2005	CPL34	
NW Corner of SR303L and Northern Ave	!LP5	2082	CPL39	
NW Corner of SR303L and Glendale Ave	!LP6	1758	CPL44	
NW Corner of SR303L and Bethany Home Rd	!LP7	1943	CPL49	
NW Corner of SR303L and Camelback Rd	!LP8	2588	CPL54	
NW Corner of SR303L and Indian School Rd	!LP9	652	CPL58	
NW Corner of SR303L and Thomas Rd	!LP10	700	CPL64	
NW Corner of SR303L and McDowell Rd	!LP12	1416	CPL68	
NW Corner of SR303L and I-10	!LP12	2383	CPL72	
SW Corner of SR303L and I-10	SRLP12	483	SRL72	
NW Corner of SR303L and Van Buren St	!LP13	526	CPS13	



To: Valerie A Swick – FCDMC Project Manager
From: Guihua Li/Gary Sun - PB
Date: June 25, 2009
Project: Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Subject: Comments on June 2009 HEC-1 Model with Future Conditions and CIP Facilities

We have reviewed the June 2009 HEC-1 Model for Future Conditions with CIP Facilities In Place and offer the following comments:

1. Percent of Impervious Area (HEC-1 LG Record):

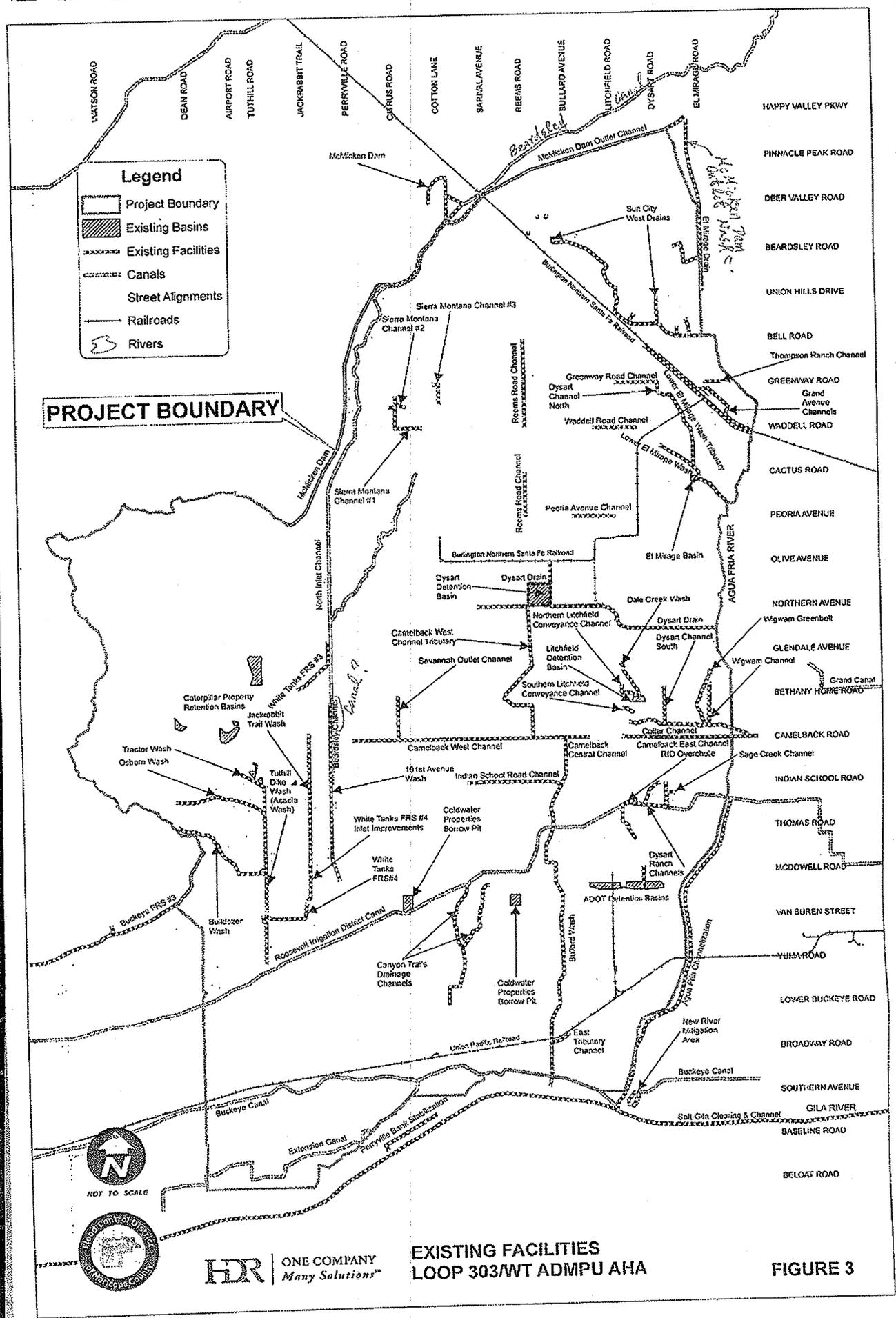
- Percent of impervious area (RTIMP) is the percent of sub-basin which is impervious. RTIMP used (78% to 88%) in the HEC-1 LG records were too high.
- The impervious areas are very sensitive to the computed peak discharges. PB ran one sub-basin, L13, as a test for the sensitivity of the percent of impervious area to the computed peak discharge. The results indicated that as the percent of impervious area decreases from 80% to 50%, the peak discharge reduces from 1,177 cfs to 807 cfs which is roughly 31% decrease in the computed peak discharge.
- Need to double check the future land uses of the following sub-basins:

Sub-Basin ID	Percent of Impervious Area (RTIMP) used In LG Record
L13	80%
L19	80%
L27	78%
L34	80%
L39	79%
L44	79%
L49	81%
L54	76%
L58	80%
L61	80%
L62	79%
L63	81%
L64	84%
L67	88%
L72	86%

Legend

-  Project Boundary
-  Existing Basins
-  Existing Facilities
-  Canals
-  Street Alignments
-  Railroads
-  Rivers

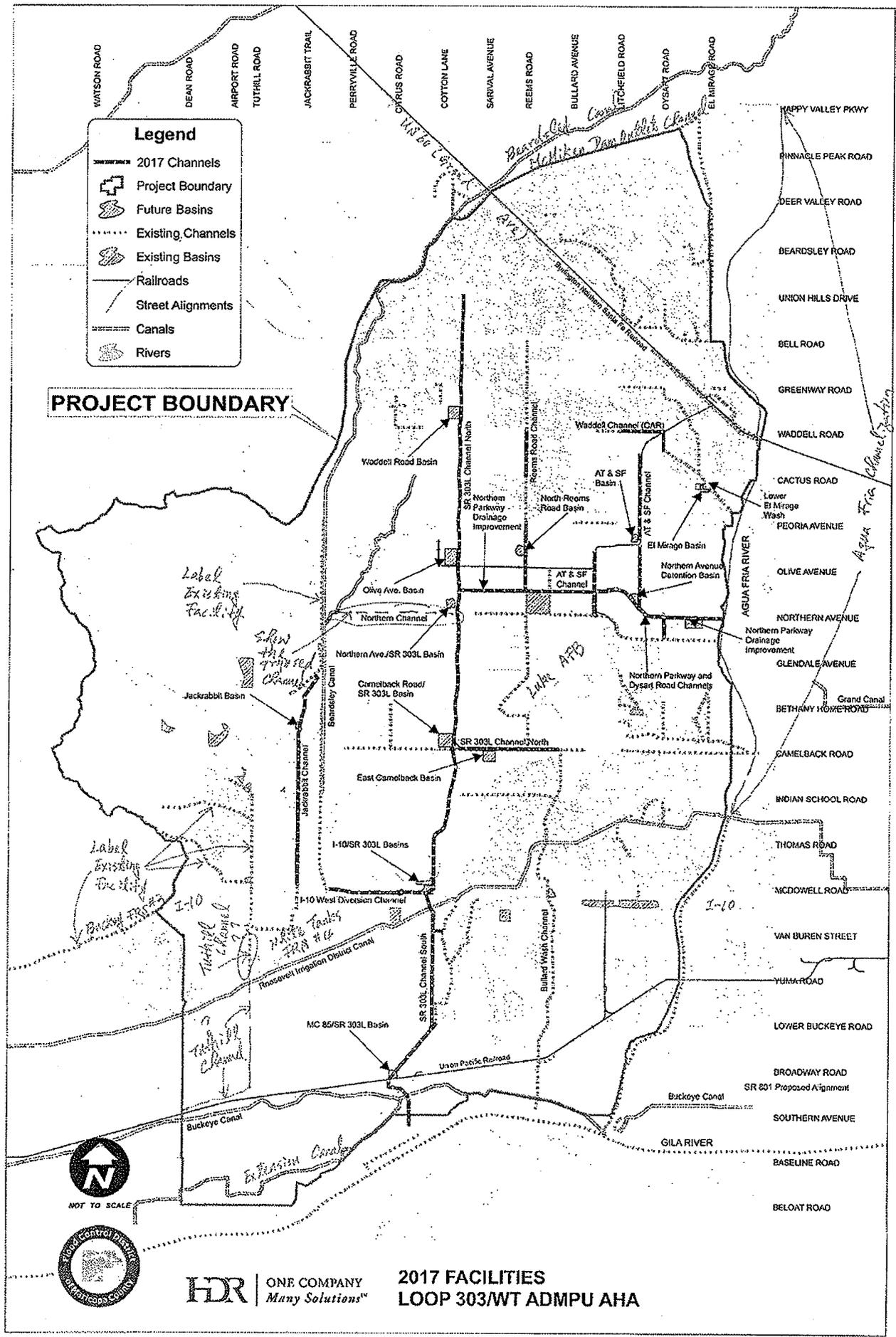
PROJECT BOUNDARY



Legend

- 2017 Channels
- Project Boundary
- Future Basins
- Existing Channels
- Existing Basins
- Railroads
- Street Alignments
- Canals
- Rivers

PROJECT BOUNDARY



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**2017 FACILITIES
LOOP 303/WT ADMPU AHA**



Memorandum

To: Valerie A Swick – FCDMC Project Manager
From: Guihua Li/Gary Sun - PB
Date: June 24, 2009
Project: Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Subject: Comments on HDR's June 2009 Revised Figure 4 (Future Facilities) and New Figure (2017 Facilities)

We have reviewed the HDR's June 2009 Revised Figure 4 for Future Facilities and a new figure for 2017 Facilities. We compared these figures with Figure 3 (Existing Facilities) from HDR's March 2009 Volume 1 – Hydrology Report and offer the following comments:

1. All Three Figures:

- **Show all major corridors:** Only railroads, rivers and most of canals were shown. Need to label I-10, US60 (Grand Avenue), MC85, Loop 303, proposed SR303L, and proposed SR801.
- **Label significant land mark:** Luke Air Force Base (LAFB), Goodyear Airport and Phoenix International Raceway.
- **Legend:** Add a legend for DAM.

2. Figure 3 – Existing Facilities (See attached redlines):

- Label McMicken Dam Outlet Wash.
- Verify "Beardsley Channel". Is it "Beardsley Canal"?

3. Figure 4 – Future Facilities (See attached redlines):

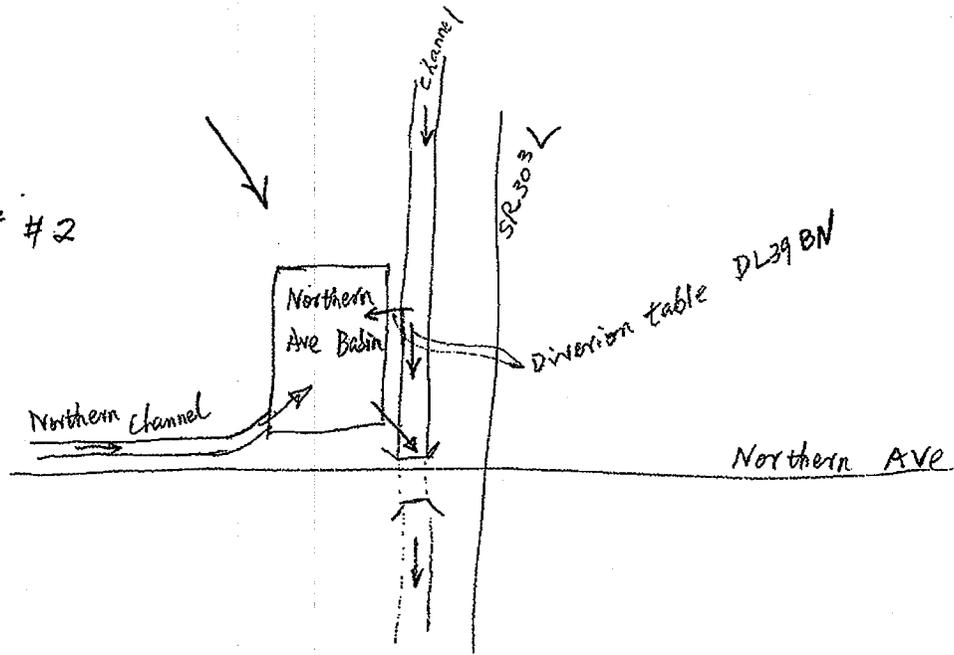
- Move the Legend box for clarity.
- Label all existing features as shown on Figure 3.
- What is the CIP facility shown south of LAFB? Why it did not show on Figure X for 2017 Facilities?
- There is a basin located just north of the proposed Bullard Wash Channel. Is there a name for this basin?
- Based on the discussions between ADOT and FCDMC, the SR303L Channel South and MC85/SR303L Basin will be constructed by FCDMC around 2015, definitely by 2017. ADOT will complete the I-10/SR303L T.I. Phase I construction prior 2017. Some segments of SR303L and drainage systems will be completed by 2017. Show these completed facilities as existing facilities on Figure 4.
- What is the proposed construction schedule for MCDOT's Northern Parkway? Some of the drainage system may be constructed by 2017.
- Show the proposed El Rio Watercourse Master Plan which is a 17-mile watercourse master plan along the Gila River that stretches from the confluence of the Agua Fria River to SR85.
- Show the proposed Agua Fria Watercourse Master Plan which is a 15-mile watercourse master plan (including channelization) between Indian School Road and Happy Valley Parkway.



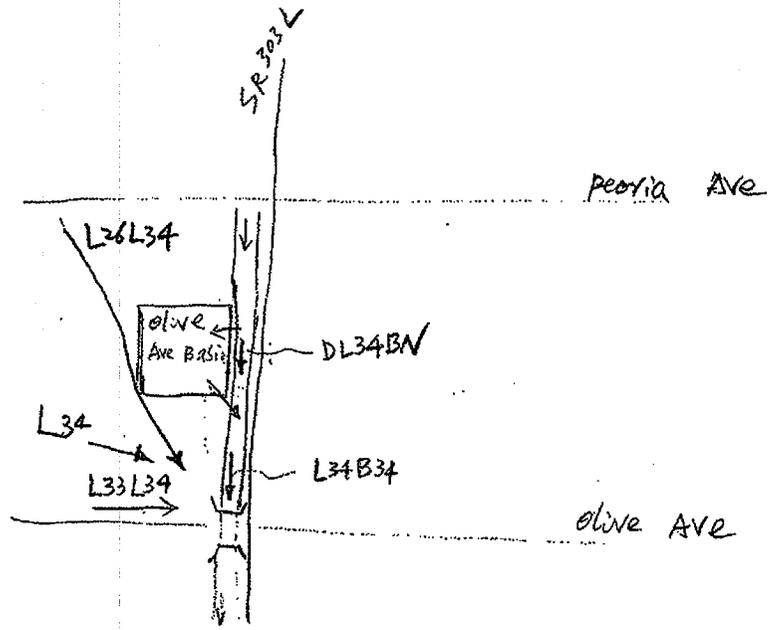
4. **Figure X – 2017 Facilities (See attached redlines):**

- There were only 3 features were shown differently from Figure 4 – Future Facilities. They are Tuthill Channel, Bullard Wash Channel and the proposed CIP facility south of LAFB.
- Why the proposed Tuthill Channel was shown differently from Figure 4?
- Why the proposed CIP facility south of LAFB did not show on this Figure?
- The line for the proposed Northern Channel is missing.

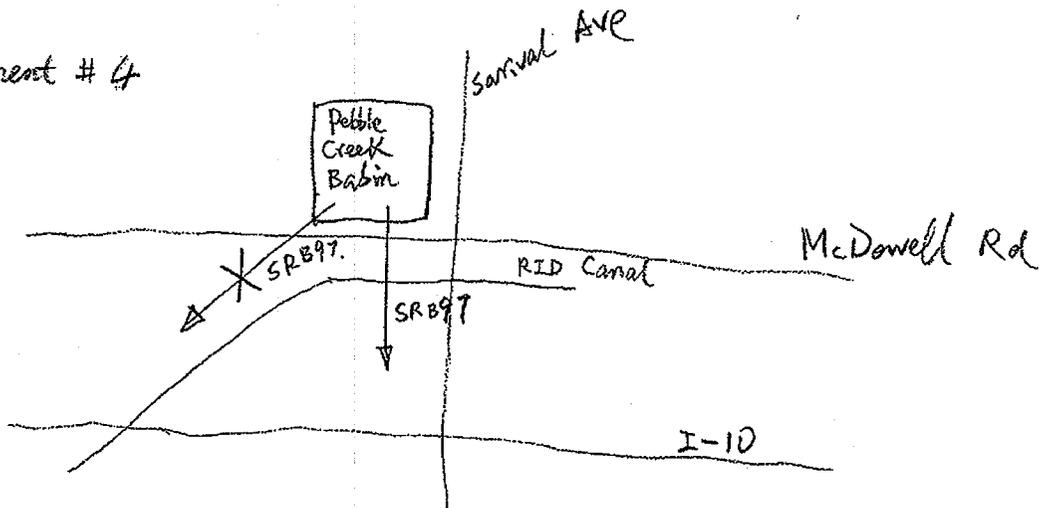
Sketch for comment # 2



Sketch for comment # 3



Sketch for comment # 4



Potter, Linda A

From: Esperanza Foreman - FCDX [erf@mail.maricopa.gov]
Sent: Monday, July 06, 2009 11:40 AM
To: Potter, Linda A
Cc: Amir Motamedi - FCDX; John Holmes - FCDX; Greg Jones - FCDX; Debbi Shortal - FCDX; Valerie Swick - FCDX
Subject: RE: Approach for comment

Linda,

The approach that you are proposing to bump up the n-value to slow down the velocity in the portion of the North Inlet Channel from Olive to Northern is acceptable. Please refer to page 7 of the North Inlet Channel, White Tanks- FRS #3 Design Data Report January, 2007.

In reference to my comments about Bullard Wash Region south of I-10, please disregard comment 11.

Thanks,

Esperanza

From: Potter, Linda A [mailto:Linda.Potter@hdrinc.com]
Sent: Monday, July 06, 2009 9:29 AM
To: John Holmes - FCDX
Cc: Debbi Shortal - FCDX; Greg Jones - FCDX; Amir Motamedi - FCDX; Sun, Gary; dcrandall@azdot.gov; Esperanza Foreman - FCDX; Julie Cox - FCDX
Subject: Approach for comment

Hello, John – for Esperanza's comment 5, it is indicated that numerous drop structures are employed to keep the velocities down in the portion of the North Inlet Channel from Olive to Northern. We are proposing to bump up the n-value to slow down the velocities, as modeling the numerous drop structures is not really plausible for a regional model such as this. Is the approach acceptable?

From: John Holmes - FCDX [mailto:jwh@mail.maricopa.gov]
Sent: Thursday, July 02, 2009 2:24 PM
To: Potter, Linda A
Cc: Debbi Shortal - FCDX; Greg Jones - FCDX; Amir Motamedi - FCDX; Sun, Gary; dcrandall@azdot.gov; Esperanza Foreman - FCDX; Julie Cox - FCDX; John Holmes - FCDX
Subject: Detention data Sheets for Sun City Grand / Addendum - Review Comments from FCD: Esperanza Foreman, Julie Cox & John Holmes

Linda,

Attached, below, are the addendum comments from FCD Engineering and the data sheets from the URS ADMPU TDN showing the Detention volumes calculated for Sun City Grand.

Please review these data sheets to aid in the process of identifying appropriate detention volumes for Sun City Grand development in the HDR model. Does this information match that which HDR used in the new hydrologic analysis? What is your opinion?

Also, has the issue been addressed concerning how the EXISTING retention calculations were made in the HDR models? Was NOAA 2 or NOAA 14 rainfall estimates used to calculate the 100-yr 2-hr and 100-yr 6-hr retention volumes? Greg pointed out to me this morning that we need to check with you to be sure that HDR has considered the fact that EXISTING retention has been based on NOAA 2 rainfall estimates, not NOAA 14. What is your response to this concern?

Please let me know if you have any questions or concerns.

Thanks,

John

John Holmes | Flood Control District of Maricopa County | 2801 W. Durango Street | Phoenix, AZ 85009

Main: 602-506-1501 | Direct: 602-506-3320 | FAX: 602-506-4601 | jwh@mail.maricopa.gov

<<Detention data Sheets for Sun City Grand - URS HEC-1 model Loop 303 White Tanks ADMPU 2002.pdf>>
<<AddendumtoCommentsExistingCIP2_ESperanza.doc>> <<WhiteTankCommentsAddendum070109_John_H.doc>>
<<WhiteTankComments070109.doc>>



Flood Control District of Maricopa County

INTEROFFICE MEMORANDUM

Date: July 1, 2009

To: Linda Potter
HDR

From: John Holmes, Hydrology
Engineering Division

Subject: Loop 303 Drainage Improvements – *Addendum to comments submitted on June 29, 2009.*

I was tasked with analyzing the Existing Conditions w/o CIP (Base Model) MB02 HEC-1 HDR L303/White Tanks ADMPU AHA in relation to Qs and Volumes which impact FCD major structures, mainly WT#3 FRS and WT#4 FRS based on the Existing Conditions w/o CIP URS model.

1. The URS model indicates that the total Q reaching CP43, at Tuthill Dike Wash and I-10, is 8,794 cfs and a volume of 559 ac-ft, with a cumulative area of 13.90 sq. mi.
2. The HDR model indicates that the total Q reaching CPW58, also at Tuthill Dike Wash and I-10, is 7,886 cfs and a volume of 738 ac-ft, with a cumulative area of 14.92 sq. mi.
3. The URS model indicates that the total Q reaching the WT#4 FRS reservoir is 6896 cfs and a volume of 767 ac-ft; with a cumulative area of 18.57 sq. mi.
4. HDR model indicates that the total Q reaching the WT#4 FRS (CPS60) reservoir is 9138 cfs and a volume of 919 ac-ft, with a cumulative area of 19.46 sq. mi.
5. The URS model indicates that the total Q reaching the WT#3 FRS (CPWT3) reservoir is 7,618 cfs and a volume of 901 ac-ft; with a cumulative area of 20.52 sq. mi.
6. The HDR model indicates that the total Q reaching the WT#3 FRS reservoir is 9,630 cfs and a volume of 1,287 ac-ft, with a cumulative area of 21.58 sq. mi.

Summarized in Table 1 (*Addendum*) below:

URS	WT#3 FRS (CPWT3) - WT#4 FRS (CPWT4) - Tuthill Dike Wash @ I-10 (CP43)
HDR	WT#3 FRS (CPW20) - WT#4 FRS (CPS60) - Tuthill Dike Wash @ I-10 (CPW58)

URS	CPWT3	CPWT4	CP43
Q cfs	7618	6896	8794
Vol ac-ft	901	767	559

HDR	CPW20	CPS60	CPW58
Q cfs	9630	9138	7886
Vol ac-ft	1287	919	738

Q cfs	9630	9138	7886
Vol ac-ft	1287	919	738
Design	WT#3FRS	WT#4FRS	
Storage*	2575 ac-ft	964 ac-ft	

*Storage of Floodwater to spillway - based on 100-yr event

(Addendum: sentence deleted) Please see the attached spreadsheet which details the results from sample sub-basins in WT3 and WT4 sub-watersheds.

1. *Addendum:* I recommend that the Kn values for the MB02 model (White tanks Mtns watershed) be changed to .050 based on the DRAFT Hydrology Manual, page 5-30 and insert A-83. The closest similar watershed in Arizona as published by the USACE, "Guide for Estimating Basin Factor Kn", is at the Salt River near Roosevelt, AZ: estimated Kn = 0.050.
2. The Effective RTIMP values used in the URS study for the ADMPU hydrology are shown on the spreadsheet with the HDR estimated RTIMP values. HDR: Please check the RTIMP values for the White Tanks sub-watersheds to determine if estimated RTIMP values are Total RTIMP or Effective RTIMP. Effective RTIMP values should be used in the HDR AHA model.
3. According to the Verrado Development Master Drainage Plan, "retention is to be provided to maintain the 100-yr storm water flows leaving the property at or below existing peak flow rates." – (Discussion point)
4. *Addendum:* Storage capacity of WT#3 FRS, based on the ½ PMF, is: Sediment 193 ac-ft, Floodwater (Notch Spillway) 2,575 ac-ft, Freeboard 3,900 ac-ft. / Drainage area 20.49 mi²
5. *Addendum:* Storage capacity of WT#4, based on the ½ PMF, Sediment (design) 72 ac-ft, Borrow Pit 420 ac-ft, Floodwater (design) 964 ac-ft, Freeboard (design) 2,250 ac-ft, Best current estimate 1,935 ac-ft.
6. *Addendum:* The review model output indicates that the 100-yr event results in an estimated volume of 1,287 ac-ft in WT#3 FRS. Since there should be no significant change to the modeling parameters, other than rainfall estimate for WT3 sub-watershed, the flow and volume to WT#3 FRS should be within a close range to estimated values in the URS base model. However, the HDR model shows a flow increase of 21% into the dam, and a volume increase of 30%.
7. *Addendum:* Similar increases occur in results of the HDR model compared to the URS model for WT#4 FRS, as well, approx. 17% higher flow and volume.

- End of John Holmes Comments

Comparison of Qs and Volumes based on HEC-1 Existing Conditions models by URS (ADMPU HEC-1 model) and HDR (AHA model) - with changes to RTIMP and Kn values

URS ID	Area	Kn	Dtheta	URS		HDR ID	Area	Kn	Dtheta	HDR Δ		HDR Vol	HDR Δ		HDR Vol
				Q	Vol (ac-ft)					RTIMP	Q		RTIMP&Kn	Q	
WT3						WT3									
1	1.94	0.05	0.35	1573	122	W03	1.97	0.03	0.35	1992	157 10_20	1883	126 .05/.03	1252	122
2	1.82	0.05	0.35	1339	131	W04	2.03	0.03	0.35	2172	174 12_21	2086	146 .05/.03	1396	142
6	0.45	0.05	0.35	746	28	W08	0.45	0.03	0.35	784	37 10_20	759	30 .05/.03	581	29
7	0.31	0.05	0.35	484	20	W09	0.34	0.03	0.35	621	28 10_20	602	23 .05/.03	474	22
WT4						WT4									
27*	1.00	0.05	0.36	1153	99	W46*	0.93	0.03	0.35	1277	82 21_16	1292	89 .05/.03	1260	87
39*	0.77	0.05	0.35	628	40	W54*	0.98	0.03	0.26	1225	84 0_21	1120	53 .05/.03	738	51
37	0.95	0.05	0.35	909	62	W52	1.12	0.03	0.35	1445	88 9_17	1397	74 .05/.03	1356	72
38*	0.76	0.05	0.35	911	44	W53*	0.57	0.03	0.32	1074	39 4_11	1050	32 .05/.03	1023	32
40*	0.52	0.05	0.35	586	34	W55*	0.50	0.03	0.33	765	37 11_17	746	32 .05/.03	531	31
42*	1.18	0.05	0.35	1055	67	W57*	1.16	0.03	0.29	1750	97 0_19	1667	64 .05/.03	1150	62

* Verrado Development Subbasins



INTEROFFICE MEMORANDUM

Date: June 15, 2009

To: Linda Potter, P.E.
Project Manager, HDR

From: John Holmes, Hydrologist
H & H Branch, Engineering Division, FCDMC

Via: Amir Motamedi, P.E.,
H & H Branch Manager, Engineering Division, FCDMC

Valerie Swick, Project Manager
Planning and Project Management Division, FCDMC

Subject: Loop 303/White Tanks ADMPU Area Hydrologic Analysis – H&H Review
for submittal dated 6-1-09

Comments by John Holmes:

1. Please provide us with the updated Storage Basin Excel Spreadsheet showing the changes made in the stage-storage discharge tables. For example, the spreadsheet submitted to us on 4-3-09 shows a different distribution of flows prior to HDR adding "0" flow in field one (1) of the SQ cards for Storage Routes.
2. Realizing that HDR has been directed to modify n-values for the following routes: W07W08, W09W10, W11W12, W12W13 and W23W24. Also, please indicate on KM cards that n-values deviate from the n-value table. This will avoid confusion if future model modifiers know that engineering judgment was used.
3. The following routes were not selected for modification. However, there are some inconsistencies in n-values shown in the model which do not reflect those in the table of n-values which HDR submitted to FCD. Please comment on these inconsistencies or make necessary changes:
 - a. Route W04W05 – "clean straight earth" has n-value of 0.038; assigned n-value is 0.022? N-value of 0.038 is for ag/cultivated land, right?
 - b. Route W13W16 – "natural desert wash w/ vegetation" has n-value of 0.022; assigned value table is 0.035? W33W35 – "clean straight earth" has assigned n-value of 0.022, not 0.032. Do we need additional notation on KM card here, or n-values changed? Also, complete KM card.

- c. W45W46 – line cut-off; complete channel material description.
 - d. W49W51 - shouldn't the n-values be 0.035 per channel material description in table?
 - e. W57W58 – I thought that the “avg value for cultivated areas” in Maricopa County, from other KM card notes for ag fields was 0.038 Kn values?
 - f. W38S60 – “concrete channel” has assigned n-value of 0.016 to 0.020. You have 0.038 to 0.035?
 - g. W58S60 - “earth w/ sparse trees and shrubs” has assigned n-value of 0.032, not 0.022.
 - h. Route L03L04 has n-values of 0.032, 0.013 and 0.032 w/ ½ street section. Shouldn't the lower n-value be on the right or left bank?
 - i. Route L05D06, L06L07: same comment as. Route D02D10 has n-values of 0.022 for earth w/sparse trees and brush. According to the approved table, n-values should be 0.032?
4. North Inlet Channel – Olive to W1#3 FRS - Flows for almost the entire length of the NIC Channel and the west split into Beardsley Canal Wash/Cholla Wash are higher than the design flows according to the North Inlet Channel Design Data Report.
5. The rating table in SRW20 needs to show that the gated and by-pass outlets are closed in the existing condition hydrology for the entire rating table. The HDR model shows both outlets are open from elevations 1208.6 to 1218.0. Please change.
6. The rating table in SRS60 needs to show that the gated outlets are closed in the existing conditions hydrology for the entire rating table. The HDR model shows both east and west gated outlets are open from elevation 1043.0 to 1054.0. Please change.
7. Stage-storage routing needs to be modeled below CPW58 for the 4-10x8 BC'S at I-10 and Tuthill Dike Wash. Then, if there is spill to the east, the 12x12 vehicle drive-thru box also needs to be modeled and the remaining culverts under I-10 to the east to Jackrabbit Trail.

End of John Holmes' comments

Comments by Amir Motamedi:

Following are my comments on the HEC-1 submittal for the portion south of Dysart and north of I-10:

- 1) Comment cards on Detention basins indicate fractions of the original detention that vary greatly, sometimes 25%, sometime 75%, sometimes 50%. Why?
- 2) Colter Channel: The flows estimated by this submittal exceed the maximum design of this channel in almost entire reach. I assume the issue is the outflow from the Dreaming Summit, and the way retention has been calculated. We should discuss with the consultant.
- 3) Bullard Wash: Bullard wash design capacity is exceeded north of I-10. I assume it is due to the diversions at Camelback. We should investigate and discuss with the consultant.
- 4) RID Overchute: The estimated flows are well below the design. Partly because of the way retention was accounted for in Wigwam development (B77). Additionally, flows north of RID east of Dysart should flow west into RID project. Lets discuss with consultant.
- 5) Ag areas had unit discharges of 350-450 cfs/sq. mile, and urban areas had discharge of 1,100 to 1,800 cfs/sq. mile (before retention) looks reasonable.
- 6) ADOT basins: Stage Storage looks to match that of the 2004 URS report, but the stage/discharge did not. The only difference was at the high end of the basin, probably won't effect the results. Please check and correct if necessary.
- 7) UI cards, for most part, captured the entire unit volume. Few Agriculture areas did not end in zero, but the difference is negligible (at least in my area). No change necessary.
- 8) I did not get a chance to review all the routings, but the ones within our (FCD's) channel looked OK.

End of Amir Motamedi's comments.

Comments by Steven Tucker:

I have the following comments on the White Tanks ADMP submittal:

- 1) The combine KK labeled CPD64 should be transposed with the combine KK labeled Dummy that follows it.
- 2) There should be a route N07N06.
- 3) There are several routing cross-sections that are not near large enough to carry the anticipated flows. The cross-sections should be extended to better model actual conditions. The worst of these cross-sections are N21N22, D14D15, D06D07, L11L12, L24L26, RRMS, L36L38, L38L39, D58D69, and D74D78. D74D78 appears to be a faulty cross section. Please check the RX and RY cards.
- 4) The model has all of N04 being retained, and all other flows (from N04A, N04B, N03, and N03B bypassing the retention. It seemed to me that all of the flows

entered one large detention basin that was metered into the Bodine Channel. This area could be more accurately modeled.

- 5) There are several watersheds that retain all or almost the entire 100-year 24-hour storm. This may be due to stringent retention requirements of certain municipalities beyond the 100-year 2-hr, or it may be due to retention designed for NOAA2 being modeled with a NOAA14 storm. Verification was not submitted for the existing retention volumes. Please evaluate to make sure this is a reasonable occurrence.

End of Steven Tucker's comments.

Comments by Esperanza Foreman:

Here are my comments to the review.

1- The Design capacity of Bullard Wash is 3200 cfs. South of I-10 the flows estimated for all the reaches of this wash are between 3688 and 4223 cfs. Please provide a solution to maintain the flows in Bullard Wash at or below 3200 cfs.

2- In agricultural areas, the expected numbers of cfs per square mile are between 200 and 400. In several basins the numbers are between 425 and 547. Please explain.

3- In Desert/Range areas, the expected numbers are between 300 and 600. In several basins those numbers are between 900 and more than 1700 cfs per square mile. Please explain.

4- Please check the "n" values for reaches B63B65 and B71B72.

5- Check NSTPS value on reaches S01B67 (76), S71S78 (149), S82S83 (30).

End of Esperanza Foreman's comments.

Potter, Linda A

From: Potter, Linda A
Sent: Monday, July 06, 2009 3:56 PM
To: 'Greg Jones - FCDX'; John Holmes - FCDX
Cc: Debbi Shortal - FCDX; Amir Motamedi - FCDX; Sun, Gary; dcrandall@azdot.gov; Esperanza Foreman - FCDX; Julie Cox - FCDX
Subject: RE: Detention data Sheets for Sun City Grand / Addendum - Review Comments from FCD: Esperanza Foreman, Julie Cox & John Holmes

In all cases except those listed below, the estimate was made from what was built – an estimate of the area and depth was done in CAD/GIS/field visits, so therefore precipitation did not play a factor. There were only a few other subbasins where we actually calculated based on NOAA 2 precipitation (2.7 in), and all of those are around the Sun City area:

- D01
- D02
- D04 (only the Sun Village portion)
- D06
- D07
- L01
- L02

Please let me know if you have additional questions.

From: Greg Jones - FCDX [mailto:glj@mail.maricopa.gov]
Sent: Monday, July 06, 2009 2:51 PM
To: Potter, Linda A; John Holmes - FCDX
Cc: Debbi Shortal - FCDX; Amir Motamedi - FCDX; Sun, Gary; dcrandall@azdot.gov; Esperanza Foreman - FCDX; Julie Cox - FCDX
Subject: RE: Detention data Sheets for Sun City Grand / Addendum - Review Comments from FCD: Esperanza Foreman, Julie Cox & John Holmes

What about areas that have retention but no report?

Greg

From: Potter, Linda A [mailto:Linda.Potter@hdrinc.com]
Sent: Monday, July 06, 2009 10:42 AM
To: John Holmes - FCDX
Cc: Debbi Shortal - FCDX; Greg Jones - FCDX; Amir Motamedi - FCDX; Sun, Gary; dcrandall@azdot.gov; Esperanza Foreman - FCDX; Julie Cox - FCDX
Subject: RE: Detention data Sheets for Sun City Grand / Addendum - Review Comments from FCD: Esperanza Foreman, Julie Cox & John Holmes

The existing retention calculations were done using the precipitation used by the existing development if it did not match the report – In other words, we used P=2.7 inches for calculating the retention for L02 (Sun City Grand), which is what the Del Webb Grand Ave Project (1994) used (100yr, 2hr P=2.7 inches).

From: John Holmes - FCDX [mailto:jwh@mail.maricopa.gov]
Sent: Thursday, July 02, 2009 2:24 PM
To: Potter, Linda A
Cc: Debbi Shortal - FCDX; Greg Jones - FCDX; Amir Motamedi - FCDX; Sun, Gary; dcrandall@azdot.gov; Esperanza Foreman - FCDX; Julie Cox - FCDX; John Holmes - FCDX
Subject: Detention data Sheets for Sun City Grand / Addendum - Review Comments from FCD: Esperanza Foreman, Julie Cox & John Holmes

Linda,

Attached, below, are the addendum comments from FCD Engineering and the data sheets from the URS ADMPU TDN showing the Detention volumes calculated for Sun City Grand.

Please review these data sheets to aid in the process of identifying appropriate detention volumes for Sun City Grand development in the HDR model. Does this information match that which HDR used in the new hydrologic analysis? What is your opinion?

Also, has the issue been addressed concerning how the EXISTING retention calculations were made in the HDR models? Was NOAA 2 or NOAA 14 rainfall estimates used to calculate the 100-yr 2-hr and 100-yr 6-hr retention volumes? Greg pointed out to me this morning that we need to check with you to be sure that HDR has considered the fact that EXISTING retention has been based on NOAA 2 rainfall estimates, not NOAA 14. What is your response to this concern?

Please let me know if you have any questions or concerns.

Thanks,

John

John Holmes | Flood Control District of Maricopa County | 2801 W. Durango Street | Phoenix, AZ 85009

Main: 602-506-1501 | Direct: 602-506-3320 | FAX: 602-506-4601 | jwh@mail.maricopa.gov

<<Detention data Sheets for Sun City Grand - URS HEC-1 model Loop 303 White Tanks ADMPU 2002.pdf>>
<<AddendumtoCommentsExistingCIP2_ESperanza.doc>> <<WhiteTankCommentsAddendum070109_John_H.doc>>
<<WhiteTankComments070109.doc>>

Consolidated Comments
L303/WT ADMPU AHA Draft Submittal



Job No.	No.
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Project: Loop 303/White Tanks ADMPU AHA	Computed: LP	Date: January 2009
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Subject: Comments on December 2008 Submittal	Checked: LP	Date: March 2009
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Task: Responses	Sheet	Of
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Comment	by	Response
Is it necessary to change all the sub-basin IDs which were used in ADMP Update HEC-1 models? If so please provide the cross references between ADMP Update sub-basin IDs and ADMP Update AHA sub-basin IDs.	PB	Yes. This was a request from FCDMC since the previous ID's were hard to follow. Also, this is a new model and does not have the same subbasins as the previous model. Cross references will not be provided.
Please explain why a new Region 2, Northeast Region (which does not belong to the Loop 303 Corridor/White Tanks watershed) was added in this ADMP Update AHA? We didn't find any cross drainage from Region 2 across US60 (Grand Avenue) to the south from the HEC-1 schematic.	PB	Per the scope of the project, this area was to be included. This area is not part of any other existing master plan or study.
An existing earthen channel located along the south side of Camelback Road from SR303L to Bullard Wash was constructed by SunCor Development Company. This channel should be reflected in the HEC-1 schematic since it intercepts several breakout flows from Camelback Wash along the north side of Camelback Road.	PB	Will comply. The subbasin boundaries were revised to include this area within the same subbasins as the northern channel.
Please show the names of existing SR303L, I-10, US60, and the north-south direction arterial road names in the drawings. Please show existing Loop 303 between US60 and El Mirage Road. It shall be noted that the alignment of "Future Loop 303 freeway" is also the existing Loop 303 roadway.	PB	Will comply.
Please check the sub-basins S36 and B63 drainage boundaries. The northern boundaries of these two sub-basins should be I-10.	PB	Disagree. The small area to the north of I-10 is a localized depression that drains into the southern basin via a culvert under the freeway.
PB has obtained a copy of drainage area map for two existing subdivisions, Pebble Creek Phase 2 and Palm Valley Phase 8, which are located along the north side McDowell Road between SR303L and Pebble Creek Parkway (see attached PDF file). Please revise your sub-basin delineations within these two subdivisions accordingly.	PB	Will comply. Some minor revisions were made to these based on as-built conditions.
A LOMR for Pebble Creek Phase 2 and Palm Valley Phase 8 development has been approved by FEMA on 4/23/2007. Please update your HEC-1 schematic per the LOMR HEC-1 model.	PB	Will comply, unless as-built conditions were found to differ from the LOMR.
Based on the Pebble Creek Phase 2 and Palm Valley Phase 8 LOMR, the flow at the northwest corner of McDowell Road and Sarival Avenue routes through the subdivision's detention basin and bleed off to a temporary basin located at the northwest quadrant of I-10 Overpass at Sarival Avenue.	PB	Will comply. A storage route was added.

Consolidated Comments
L303/WT ADMPU AHA Draft Submittal

Comment	by	Response
Flow diversion at the northwest corner of Thomas Road and Citrus Road is different from the ADMP Update. The HEC-1 schematic showed no diversion southeast to sub-basin L68. Is there any existing drainage facilities which prevent the flow split to southeast per the ADMP Update?	PB	No. The flow split is valid as modeled.
Documentation (comments 1 - 5)	PB	Will comply.
Under subbasin data, drainage flow path slope calculations for some subbasins are incorrect. Please check the formula used to calculate the slopes in the Excel file (EX_L303_subbasin-Input.xls)	PB	Will comply. There was an additional worksheet to be deleted.
It is difficult to follow the spreadsheets for Street intersection diversions. Formula for slope ratios and composite ratios used are incorrect unless the R/W widths and Street Slopes are exactly the same.	PB	Revisions will be made to the spreadsheet for the ratios. However, the spreadsheet itself will not be modified for clarity.
Some errors on picking street type parameters (a, m, c & r) were found on 3 of the 5 spreadsheets.	PB	Will comply
Check "assumed" outflow structures	PB	Will comply
Sensitivity Analysis - why is it hard coded instead of main flow stem for areal reduction?	PB	The main flow stem method was found to be much more difficult for the end user. Because of the complexity of the model, several instances of "competing main flow stems" occurred and resulted in many dummy diversions. FCDMC and project team chose to back to the hard coded method.
Why no storage behind UPRR at S09?	PB	Storage added.
There needs to be consistency in the naming of the spreadsheet documents. You can definitely tell that these were done by at least three different people. All the rating curves were checked between the spreadsheets and the HEC-1 model	VS	Will comply
Calculations sheets that are included on the CD but are not used: Spreadsheet Model not used, Weir spreadsheet calculations used instead. These should not be included on the CD. AirportRdDS74.pdf, BA_CR.pdf, BA_GR.pdf CT_CR.pdf, L3_BE.pdf, PP_GR.pdf	VS	Will comply
Spreadsheet Model not used in HEC-1 model. I don't know why these are not included in the HEC-1 model. BCanalChuteDW02.pdf BCanalChuteDW21.pdf GlendalePerryvilleDL40.pdf	VS	Will comply
Split Flow Calculations Documentation Report Extra Calculation Sheets in Report I don't know if these extra sheets were included in the original document that HDR gave us or if that got duplicated in our reproduction, but there are a couple of sheets that are in the document twice. Cactus at Bullard (DD33) Bethany Home at Cotton (DL48) Bethany Home at Loop 303 (DL49)	VS	Will comply
Split Flow not used in HEC-1 Model. There are a few calculation sheets that were not used in the model. They need to be removed if not used. Loop303 at Bell Road. (L3_BE.pdf) Glendale at Perryville (DL40) Beardsley Canal Overchute, Beth Home Rd. (DW21)	VS	Will comply

Consolidated Comments
L303/WT ADMPU AHA Draft Submittal

Comment	by	Response
Miscellaneous Location: SR85 at Sarival (DS09) The Weir Spreadsheet names this location at MC85_SarivalDS09.pdf but the Location on the spreadsheets calls it out as SR85. This should read MC85.	VS	Will comply
Location: Broadway & Jack Rabbit Trail (S48) The second diversion shows all the flows being diverted out. This is not done in any of the other spreadsheets. I don't understand what is going on here.	VS	The spreadsheet was set up to do either single or double divers. Therefore, if there is only a single divert, the spreadsheet will show no flow in one of the three directions.
Draft Existing Conditions Hydrology Model - Documentation Report Non-documented diversions: Block 307: Greenway Rd. just west of El Mirage Rd. Block 437: Citrus Rd. at Bell Rd. Block 2097: Beardsley Canal south of Cactus Rd. Block 5903: South of Indian School and East of L303 Block 6398: Cotton Ln north of Broadway	VS	Will comply
Diversion Coding: Line 1882: All the other rating curves do not include the curb and sidewalk values. I don't think this one should either.	VS	Will comply.
Missing Diversion: As stated above the second diversion is missing, but because it is so small in relationship to the overall flow I am assuming it is not included in the HEC-1 model. Block 2024: Cactus Rd. @ RR tracks Block 2173: Peoria @ Cotton Ln.	VS	Correct, it is 0% of the overall flow.
Extra Diversion Line: There is an extra diversion line that is not needed: Line 2670: RR Tracks @ Olive and L303	VS	Will comply
Miscellaneous: Block 6137: Why is there an extra set of zeros in the rating curve?	VS	
Drainage areas north of Deer Valley Rd. do not reflect the diversions by Loop 303 and development (flows along Pinnacle Peak).	ST	Will comply.
Combine at CPD 36 is wrong. It should read: HC 3	ST	Will fix.
Re-check reach lengths. For example, W27W28 has a reach length of 10346 ft. but basin W28 is only 0.992 sq. mi. Check all reach lengths for accuracy.	ST	Will comply.
The stage-storage-discharge table of the railroad trestle (at the U.P.R.R. and Citrus Rd. alignment) of the former study, "SR359", has been used at SRS27 and at SRS32. A "Combine" should be added upstream, and only one trestle stage-storage-discharge routing should be used. (See Figure #1, Attachment #1).	MD	Will comply
I compared the subbasin-only discharges for 13 subbasins, that are east and west of Cotton Lane and south of I-10. The HDR-Update discharges are much much higher, ranging from 40% to 180% higher, with an average of 86% higher, than the previous study. (See Figure #2, Attachment #1).	MD	Agree. Land use and Kn values were incorrect in this submittal. Will correct.
The UI records of the Update have a much shorter time duration than the URS study; and it appears that this is due to the much lower Kn values of these subbasins; see below. As the comments below show, much of the area still has an agricultural land use. (See Figure #2, Attachment #1).	MD	Agree. Land use and Kn values were incorrect in this submittal. Will correct.

Consolidated Comments
L303/WT ADMPU AHA Draft Submittal

Comment	by	Response
The S13S14 Routing, at just south of the intersection of Van Buren Street and Cotton Lane, routes 842 cfs in a channel in an eastwardly direction; but the upstream end is restricted by a 2 at 6 ft. by 4 ft. by 120 ft. long box culvert. Assuming a headwater depth of about 6 ft., the box culvert can only convey approx. 400 cfs. It looks like some flows will go southward rather than getting into the channel. (See Figure #3, Attachment #1).	MD	Will comply.
For the area around the intersection of Van Buren Street and Perryville Road the routings should be to the southeast, from DP S34 to CP S44, as shown: (See Figure #4, Attachment #1).	MD	Will comply.
At Bethany Home Road and 183rd Avenue, near CP L46, there is a double barrel culvert that takes flows to the south. The ends of the culvert are highlighted with 2 red rectangles below: (See Figure #5, Attachment #1). When this house was built (in 2003), the existing culvert was extended to the south. The resulting culvert is 2 CMP pipes, 33 inches high by 49 inches wide by 370 feet long. The pipe slope from the grading plan is 0.0076 ft/ft The pipe can convey about 100 cfs to the large north-south channel (based on a Tailwater of 2 ft., Ke of 0.5, n=0.024, and a Headwater of inches, which is 18 inches above the top of pipe). However, the split flow spreadsheet shows zero culvert flows (at the lower left of the sheet) for this location, and the sche-matic only shows 27 cfs going to the south: Location: Bethany Home @ 183 rd (DL46). (See Attachment #1, Figure #5).	MD	Diversion will be updated.
Add descriptions to model using KM cards of projects and structures. For example, identify Falcon Dunes (golf course/retention basin) located at SRD70 STORAGE.	JH	Will comply
The AHA HEC-1 does not include the delineation and drainage for the Cortibella development, north of Pinnacle Peak Rd. Check the drainage report for this development (Possibly CVL study) and add data to HEC-1 model. Flow will not reach Deer Valley Road	JH	Cortibella flows concentrate at the southeast corner of the development. Included in the model per the drainage report for Cortibella and field investigations.
The AHA HEC-1 does not include flows into the Cortibella development from the Loop 303 drainage. Include culverts and inflow from Loop 303 into this area.	JH	Will comply.
Show more detailed hydrology of the Sun City Expansion area which outfalls into the Bodine Channel.	JH	Will comply.
Check the Stanley Consultants hydrology for the "orphan area" north of Grand Ave. and incorporate into AHA HEC-1.	JH	Will comply.
Check routed flows along north side of Camelback Rd. from L54 to B54 with the effective floodplain model.	JH	Revised to include breakout channel.
Model Camelback Road Channel on south side of Camelback Rd. from Loop 303 to Bullard Wash.	JH	Revised basin boundaries to include breakout channel.
Remove divert at DD462.	JH	Disagree. See diversion calc's.
Include retention basin Dreaming Summit as on-line in B11.	JH	Will comply.
The routing from Subbasin B08 is blocked across Litchfield Rd. The schematic shows a breakout across the road. Instead it is suppose to be routed to the south.	JH	Disagree, unles something was recently constructed. Per our Luke AFB CAR, the flow traverses Litchfield Rd and goes into Dreaming Summit. No conveyance facilities exist to the south.

Consolidated Comments
L303/WT ADMPU AHA Draft Submittal

Comment	by	Response
Check the Luke AFB Drainage Plan for existing drainage in and out of the base and surrounding areas.	JH	Already completed. Incorporated Luke AFB CAR information.
Check capacity of Jackrabbit Channel.	JH	Will comply. Will split across Jackrabbit Road under existing conditions.
Check existing dams in White Tanks Mountains. Have they been modeled in HEC-1?	JH	Yes, per Verrado storage numbers.
NOTE: All of the attached comments are not final comments. Once the HEC-1 model has been corrected, results will be reviewed with additional comments to follow.	JH	N/A
Using DDMSW, check the velocities of the routings. Many are too high as well as percent attenuation.	JH	Will comply. Roughness values will be updated.
Schematic connects CPD34 with CPD36. HEC-1 does not.	EF	Will comply.
At L39, Schematic shows retention. HEC-1 does not.	EF	No retention, will remove from schematic
After CPL29, Schematic shows storage. HEC-1 does not.	EF	No retention, will remove from schematic
At B59, HEC-1 shows retention. Schematic does not.	EF	Added to schematic.
After CPW35, Schematic shows storage. HEC-1 does not.	EF	Added to HEC-1.
After CPS60, Schematic shows storage. HEC-1 does not.	EF	Will input new WT#3 storage.
Will there be channel transmission losses on natural channels?	AM	No. Few natural channels, most of which are planned to be improved. Left out to be conservative.
Check culvert size in SR B09 storage	FCD	Storage removed.
Please explain overflow over Beadsley Canal. Does WT#3 inlet prevent this?	AM	Yes, will remove overflow.
Check routing lengths for Perryville Road wash (L35L40, L40L45, AND L45L46)	FCD	Will comply.
Check L48 Divert - most flows go south per floodplain?	FCD	Pending. Depends on how flow arrives.
The following retention basin volumes seem high. Please check. B71, L56, B71	ST	B71 is ok. L56 reduced to 93.5 ac-ft
The following retention basin volumes seem low. Please check. B77, L28	ST	B77 increased to 73.6 ac-ft, There is no retention in L28
The following reach lengths seem very long. L52L57, L53L58, L54L55, B58B59, B95B96	ST	Will check and revise as necessary.
W48 and W47 should be combined then routed. W50 and CP49 should be combined then routed.	ST	Will comply.
Determine cross sections on the 148 reaches from S01B66 to W61S65 where they were all estimated at 3' deep and 4:1 side slopes	FCD	Will comply.
Some subbasins have an assigned impervious value that is not according to the development shown on the aerial.	FCD	Land use was not correct for this submittal, thus all of the %impervious were incorrect as well. Will be corrected.
check storage S60 (WT#4)	FCD	Will update with storage curves off of website.
check storage S44 (ponding north of RID)	FCD	Added.
check storage S06 Borrow Pit	FCD	Increased retention to account for borrow pit.
check storage S66 ponding north of RID	FCD	Added.
check storage S71 ponding north of Buckeye Canal	FCD	Storage route is ok.
check storage S45 ponding north of RID	FCD	New subdivision here.
check storage S26 ponding north of UPRR	FCD	Minimal storage according to 1990 topo.
check storage B94 ponding north of Buckeye Canal	FCD	Minimal storage according to 1990 topo.
check storage B32 ponding west of Agua Fria River	FCD	Added storage route.
check storage B33 ponding west of Agua Fria River	FCD	Minimal storage according to 1990 topo.

Consolidated Comments
L303/WT ADMPU AHA Draft Submittal

Comment	by	Response
Check NSTPS on the following reaches: S01B67, S09S24, S82S83, S32S33, S71S78, S74S80	FCD	Will comply.
Download and use the stage/storage/discharge curves for WT#3 and WT#4 that are on the website as of Jan 2009.	JH	Will comply.
Check divert at D46	FCD	Appears to be correct as is; however, will be updating that area to reflect the Reems Road channel and basin.
Rc cards, field 6, suggest leaving blank	AM	Will remove "ELMAX" values
All Kn values need to be checked and updated	AM	Will comply
On all routings, RS and RC field 3, suggest using 0 instead of -1 as HEC-1 is known to do weird stuff	AM	This is a DDMSW automatic input. Changing it will require manual override.
Suggest with put in JD for 5, 20 and delete 120 and 150 sq mi.	AM	DDMSW auto-fill in.
Is there retention in the golf course in N07?	AM	Yes. Will estimate, although don't have topo and not specified in any reports.
Is there any retention in Sun City West?	AM	Per 1977 report, no retention was provided in Sun City West.
Check routing through L01L03, looks like you are routing through L04 not L03	AM	Ok as is, not routing through L04. Will update graphical representation of route on schematic.
Check routing through L02D06. This flow can not cross L303 to the east. Big wall, raised. Show flow to the south to Bell Road	AM	Ok as is. Discussed during comment resolution meeting.
Check Sun City Grand retention - is it 100-year 6-hr?	AM	Unknown, need report.
Check L10L11 route - can any flow escape to the south?	AM	No, drainage report indicates will handle expected flow. Will need to verify once revised model is run.
Check for culverts at D23 divert - flow east first?	AM	Yes, will comply.
Check D25 basin - should portion of basin be in D26? See CP D14.	AM	Diversion was added.
Check storage at D27 - there seems to be a rather large diameter pipe under t-bird road. Where will the water store? What is the source of the rating?	AM	See storage calc's.
Are we double counting the storage in D53 with both retention storage and discharge storage?	AM	This area will be updated. There are two separate storage areas, did work on this will Waddell CAR that will be added.
Check to see if flows will overtop the Beardsley canal instead of going south in L20 and L21.	AM	Will add storage then check to see if flows more likely to overtop or head south. Might be completely retained.
Divert at D46 is wrong. It should go south through culvert first.	AM	Agree, will fix divert.
What happened to Reems Road Basin at D46 and D58?	AM	Added storage route.
Check storage at SRB09. is this Dreaming Summit?	AM	Deleted, this drains into Dreaming Summit on-line basin.
Need new basin by Wood Patel at CP B65 at I-10	AM	This is for future conditions only.

ITEM	TASK	COMMENT BY	RESPONSE
1	Slow down routing of flows in WT area	FCDMC	N-values were too low and will be increased in WT area.
2	DW25RE, SRW25, DW26RE, SRN26 Check Verrado for double counting retention	FCDMC	Verrado area re-done: under existing conditions, a mix between the Verrado MDR and old caterpillar proving grounds existing conditions. Storage was double counted at W25, W26, and W43. This was corrected
3	Add model details to model at beginning	FCDMC	Will Comply.
4	SRW05-Identify source of this storage relationship	FCDMC	SRW05 Deleted.
5	W05W12-Check route vs construction plans; there are 2 channels	FCDMC	Fixed to reflect dual channels.
6	W07W08-Very low "n" value, zero travel time	FCDMC	N-values were too low and will be increased in WT area.
7	W09W10-Very low "n" value	FCDMC	N-values were too low and will be increased in WT area.
8	W11W12-Very low "n" value	FCDMC	N-values were too low and will be increased in WT area.
9	W12W13-Only 1/2 flow goes down channel, why such low "n" value	FCDMC	N-values were too low and will be increased. Dual channel will be reflected with dual routes. Diversion into each channel per FCDMC.
10	W18-Something wrong with Kn value	FCDMC	Appears correct at 0.03 per Land Use 900 (vacant).
11	DW19RE-Is this retention in place?	FCDMC	Verrado area re-done: under existing conditions, a mix between the Verrado MDR and old caterpillar proving grounds existing conditions.
12	SRW20-Please change to show gates closed	FCDMC	Will remove any outflow up to 1208.60 to show gates closed.
13	W23W24-Adjust "n"	FCDMC	N-values were too low and will be increased in WT area.
14	W43-Why such high impervious? No homes?	FCDMC	Resolved at meeting. OK as is.
15	DR43RE-What retention?	FCDMC	Double counting retention in verrado, remove DW43RE
16	SRW43-Double counting?	FCDMC	Double counting retention in verrado, remove DW43RE
17	SRW44-Need to increase by 0.1	FCDMC	SRW44 Deleted.
18	W46-Urban. Should be higher % impervious?	FCDMC	Resolved at meeting. OK as is.
19	W53-Some urban some golf course, check impervious	FCDMC	Resolved at meeting. OK as is.
20	W57-Low imperviousness	FCDMC	Resolved at meeting. OK as is.
21	DW57RE-Looks like all flow should go through the retention	FCDMC	Adjusted to match Verrado MDR report.
22	SRW58-SV values must increase	FCDMC	Will Comply.
23	SRW58-Something wrong with SQ cards	FCDMC	Will Comply.
24	SRW58-What is the source?	FCDMC	Will Comply. Storage behind I-10. Recently regraded and we had new topo created for this area.
25	Can 12x12 still get water through it?	FCDMC	Will revise storage calc's and add a diversion to reflect flow diversion across I-10 through this structure.
26	W13W16-Only 1/2 down new channel	FCDMC	Revise per NIC plans.
27	W24-Is there a retentin basin here?	FCDMC	Not accoring to Verrado Report or Caterpillar Report. See exhibit, Plate 5 and 9 of Verrado Report 204
28	SRW25, W25W26 Note!	FCDMC	Verrado area re-done: under existing conditions, a mix between the Verrado MDR and old caterpillar proving grounds existing conditions. Storage was double counted at W25, W26, and W43. This was corrected
29	SRW26, W26W27 Note!	FCDMC	Verrado area re-done: under existing conditions, a mix between the Verrado MDR and old caterpillar proving grounds existing conditions. Storage was double counted at W25, W26, and W43. This was corrected
30	SRW43, W43W44 Note!	FCDMC	Verrado area re-done: under existing conditions, a mix between the Verrado MDR and old caterpillar proving grounds existing conditions. Storage was double counted at W25, W26, and W43. This was corrected
31	W45-Is there storage here?	FCDMC	Verrado area re-done: under existing conditions, a mix between the Verrado MDR and old caterpillar proving grounds existing conditions. Storage was double counted at W25, W26, and W43. This was corrected
32	W46W54-Zero travel time.	FCDMC	Will check velocities and adjust parameters if necessary. Per comment resolution meeting, ranges were developed that will be considered out of spec and checked.
33	DW56RE, W56W57 Note!	FCDMC	Ignore comment.
34	SRW58-Flow increasing	FCDMC	Indicates instability in the model. Will check revised model and resolve.
35	Land subsidence maps require Figure IDs and reference in the text	JH-ECwCIP	Will comply.
36	Map of "Locations for Future Study" requires a Figure ID and reference in the text	JH	Will comply

37	Kn default value for Ag land may be too high (0.15Kn) considering the variable nature of field conditions and perimter flow. We would like to consider a more moderate value of 0.075Kn. What do you think about this value?	JH	Will change Kn value of Ag lands to 0.10
38	Channel geometry is incorrect for Reemes Road Channel between Peoria Ave and the future Northern Parkway. Correct geometry and HEC-1 sequence cards based on the CLOMR HEC-1 are included on the accompanying CD.	JH	Reemes Road revised geometry received from FCDMC and will be input.
39	Please respond to all notes from field verifications completed by H&H Branch on 2-6-09. These field notes (and photos) were submitted to HDR on 2-9-09 to be	JH	completed. See response spreadsheet (under separate cover)
40	At Dysart and Olive there is a flow split, per field verification on 2-6-09. This is also, modeld in the ATSF RR Channel & Basin CAR report by Hoskin-Ryan, for the existing conditions HEC-1 w/CIP. Change this in the existing conditions w/ and w/out CIP models. Correct Volume 6-Subbasin Data-"D" Subbasins for D64.	JH	Resolved at meeting. OK as is. Low point is to the west of the intersection.
41	At SRD26 STORAGE the SQ at surface elevation 108' is 1268 cfs. HY-8 quick analysis of this culvert indicates 1300 cfs at one-third that surface elevation (based on culvert measurements taken in the field on 2-6-09, and channel measurements taken from GIS aerial mapping in 2008). Please update rating tables and document sources for all storage routing tables.	JH	Storage deleted.
42	Also, per previous comment by AMM, but not addressed in this revision, by modeling the stage-storage and the channel routing for El Mirage Wash, north of Waddell Rd., you are double counting the wedge storage caused by the culvert at the RR tracks. Use the stage-storage table in this case (SRD26) and delete the storage routing (D26D27).	JH	SRD26 deleted.
43	Indicate the source of the stage-storage table used for SR59, the storage route upstream of the UPRR. Also, typical cross-sections for the Loop 303 channel between I-10 and the Gila River is too wide. See the CAR report entitled: Loop 303 Drainage Improvements I-10 to Gila River in the Data Collection folder.	JH 4-8-09	Will revise area per PEC CAR report.
44	Reems Road Channel – HDR model does not match design geometry. CLOMR HEC-1 model submitted to HDR on 4-6-09, HEC-1 model entitled rmw1.	JH 4-8-09	Reemes Road revised geometry received from FCDMC and will be input.
45	Colter Channel – HDR does not match As-built plans for channel geometry. See As-built plans in the Data Collection folder, entitled Colter Channel FCD 93-08.	JH 4-8-09	As-built plans received and will be corrected.
46	Dysart Drain – HDR typical cross-section = 10' bottom, As-built plans show 20' bottom. See As-built plans in the Data Collection folder, entitled Dysart Drain Improvements Reems Road to Agua Fria River.	JH 4-8-09	As-built plans received and will be corrected.
47	ATSF Channel – indicate source of data for typical cross-sections on KM card.	JH 4-8-09	CAR report and HEC-1 received and correct sections will be input and KM cards added.
48	Jackrabbit Channel – indicate source of data for typical cross-sections on KM card.	JH 4-8-09	Will add KM card.
49	Tuthill Channel - indicate source of data for typical cross-sections on KM card.	JH 4-8-09	Tuthill channel plans were received but no HEC-1. It appears that there might be storage, but since no information was received, it will not be modeled.
50	Loop 303 Channel – HDR model does not match design geometry – PB will provide model to HDR.	JH 4-8-09	Agreement reached on what sources of data will be used for each section of the L303 improvements. Will be cited in KM cards.

51	Loop 303 Channel, I-10 to the Gila River, does not match proposed Channel and Basin. See the PDF file in the Data collection folder, entitled: A470_991Loop303DrainageImprovements_I10toGilaRiverCAR..., by PEC, for proposed cross-sections.	JH 4-8-09	Agreement reached on what sources of data will be used for each section of the L303 improvements. Will be cited in KM cards.
52	Northern Parkway Channel – indicate the source of data for typical cross-sections on KM card.	JH 4-8-09	Will use the sections from the AT&SF CAR for design information on the Northern Parkway channel.
53	I-10 Basins – indicate the source of data used for the I-10 Basins from B73 to B83.	JH 4-8-09	Storage based on modified URS input. Comment card will be added.
54	White Tanks #3 FRS NIC (North Inlet Channel) – check the As-builts and reports in the Data Collection folder for the typical cross-sections of the earthen and concrete channels.	JH 4-8-09	Will revised based on NIC as-built plans.
55	Add file name and detail to Existing Conditions with CIP model	FCDMC-ECwCIP	Will comply.
56	N2AN01-Check length-I cannot get this distance from GIS measurement	FCDMC	Length will be revised.
57	N03A-Imperviousness changed from Ex Cond w/o CIP model-should be the same	FCDMC	Resolved during meeting. Ignore comment, insignificant difference based on area in shapefile. Ok as is.
58	N03N04-This routing appears too long, please check	FCDMC	Length will be revised.
59	N05N06-RC Card incorrect order, but RX and RY need to be reversed to show 3' depth channel near L bank of XS	FCDMC	Will comply.
60	N22-I do not see where 0.76mi can be measured in this subbasin	FCDMC	Length checked. Ok as is.
61	N22-Also GIS Shape File-line #685 along Greenway St is high lighted. Length 2600. Is this the drainage path for N22 Basin?	FCDMC	This is part of the LWC length. It goes from top of basin to Greenway and then east.
62	N22-Should this street also be routing N22N23?	FCDMC	No. N22 drains to N25. No revision necessary.
63	L01-Existing Conditions w/o CIP has different impervious number, check?	FCDMC	Difference is 33 vs 32. The only difference is the land use slight area difference 0.162 vs 0.161. Ok as is.
64	L03-Kn value ok but S-graph used is Ag. Should be Valley S-Graph similar to surrounding subbasins	FCDMC	Will comply.
65	There are several watersheds wehre the retention was reduced for future conditions.	SLT	Comment resolution meeting developed approach to future land use. Only areas of vacant land will be changed.
66	There were several watersheds where there was no retention at all for future conditions even though the land is currently ag and the future condition was developed.	SLT	Comment resolution meeting developed approach to future land use. Only areas of vacant land will be changed.
67	Retention volumes seemed to be much closer to first flush volumes than 100yr 2hr volumes for many watersheds, when there was no apparent reason for the waiving of retention requirements.	SLT	Comment resolution meeting developed approach to future land use. Only areas of vacant land will be changed.
68	There were several watersheds where there was a significant increase in retention though the lack of developeable area within the watershed made it highly unlikely that the retention would ever be fulfilled.	SLT	Comment resolution meeting developed approach to future land use. Only areas of vacant land will be changed.
69	The typical agriculturel basin model consisted of combining the basin hydrograph with hydrograph routed from the north flowing south, and a hydrograph from the west flowing east, and a hydrograph sheet-flowing diagonally to the southwest. One of the effects of development is the elimination of the diagonal sheet flows. This effect does not seem to have been modeled.	SLT	Comment resolution meeting developed approach to future conditions routing, which is a factor to lengthen route and basic developed
70	Basins W21 & W28 are not modeled by HDR. These basins are south of WT3 FRS & west of Jackrabbit Trails. These flows are likely to be captured by an improved WT3 outlet channel	RR	No change to existing conditions. Changed for CIP conditions to split the basins.
71	W21A-Due to it's location adjacent to the emergency spillway and principal outlet, the basin was revised to reflect no future development	Hoskin/Ryan	Disagree - will go with Verrado MDR land use, or MAG if not covered by Verrado MDR.

72	W28A-Updated to reflect retention based upon the planned future Medium Lot Residential land use and retention diversion was provided for 80% of required retention volume	Hoskin/Ryan	Will use either Verrado MDR land use, or MAG if not covered by Verrado MDR.
73	DW33RE-Diversion was deleted because W33 (Litchfield Heights and Beautiful Arizona Estate) does not provide retention	Hoskin/Ryan	No retention provided or needed.
74	W34 and W35-Need to update per Verrado MDR. The future conditions land use should not be business park as shown in model. Storage route SRW35 should only route the flow from Verrado, exclude the flow from Jackrabbit Channel	Hoskin/Ryan	Revised per Verrado MDR. SRW35 only exists during existing conditions, removed for CIP conditions.
75	W36-revise to reflect no retention within the existing Pasqualetti Mountain Ranch and retention within the future Arroyo Seco development.	Hoskin/Ryan	Per comment resolution meeting, will determine percentage of un-built and then calculate retention based on un-built lots.
76	W37-Consider breaking up W37 into W37A and W37B. W37A directly contributes to Jackrabbit Channel. Basin W37B concentrates along the north side of McDowell Road, and then joins Jackrabbit Channel at the intersection of McDowell Road and Jackrabbit Trail. Retention volumes should be updated for 2 sub-basins. Valencia Estates does not provide retention, while the future Arroyo Seco development will provide retention	Hoskin/Ryan	Per comment resolution meeting, basin configuration is acceptable as is. No change.
77	Flow through existing 12x12, 2-42" CMPs, and 17-36" CMPs under I-10 between Tuthill Road and Jackrabbit Trail is not included in model.	Hoskin/Ryan	Will add divert at SRW58 to reflect portion of flow to south through culverts.
78	The report failed to acknowledge that ADOT is a partner for this study, and the results will be utilized for the final design of the FCDMC and ADOT jointly-funded SR303L regional channels and basins from north of Bell Road to Gila River.	ADOT-march '20	Will revise.
79	Need to add "Executive Summary" to the Hydrology Report.	ADOT-march '20	Will revise.
80	Provide the basis or source of the capital improvement project (CIP) because the CIP will be revised and updated. CIP facilities shown on Figure 4 didn't reflect the current proposed SR303L regional channels and basins (See comments below in Figures).	ADOT-march '20	Table generated that shows the source of all CIP projects. Will also add source to KM cards.
81	Need to explain the differences on the proposed SR303L drainage system between the CIP used and the selected alternative from the Level III ADMPU (February 2005).	ADOT-march '20	Will revise to show L303 improvements per information provided by PB, ADOT, and FCDMC
82	The proposed SR303L shall be shown between US 60 and I-10 as a part of the CIP since the ADOT will include the SR303L regional channels and basins with the freeway construction.	ADOT-march '20	Will revise to show L303 improvements per information provided by PB, ADOT, and FCDMC
83	Did any basin as-built plans use for storage volume calculations besides using the drainage reports? Did an 80% effective on the calculated storage volumes apply to these existing basins as well?	ADOT-march '20	Yes and yes. Sources provided in KM cards. 80% effective was used.
84	It didn't mention that the Sensitivity Analysis was performed. It shall include the explanation of why a Sensitivity Analysis was done as an out-of-scope item including purpose, approach, findings and conclusions and recommendations. Not even a map was shown what area was selected to conduct the sensitivity analysis, and it doesn't explain why the hard coded method (or manual input) is better than the main flow stem method to specify the cumulative tributary area in the HC record.	ADOT-march '20	Will add discussion on Sensitivity Analysis

85	Provide the source for URS 1/19/04 peak flows listed in the table. It seems that the values were not taken from the ADMPU HEC-1 model L33PE4H.DAT prepared by URS.	ADOT-march '20	Will take from L33PE4H provided by PB. Differences in this model exist from different sources.
86	There are differences on References used in the Hydrology Report and the Data Collection Report. The reviewers cannot figure out what references you used in the report and will not look it up in a report with a separated cover.	ADOT-march '20	Per comment resolution with FCDMC, entire table of references will not be provided. Specific references noted in KM cards in model. CIP sources in KM cards and table in report.
87	Figure 1 was shown on Page 1 as well as shown in the back of the report.	ADOT-march '20	photocopy error, no action needed
88	Only Figure 1 shows most of the major corridors except the Union Pacific Railroad. Please show all the major corridors on all of figures and maps.	ADOT-march '20	Will add where appropriate, prudent, and in scope. Impossible to show all in every map.
89	Figure 2 is not mentioned in the text, and the color copy of this figure failed to show the stakeholder boundaries per Legend.	ADOT-march '20	photocopy error, will fix shading
90	Figure 3 is not legible (Cannot see the background such as roads, subdivisions, section lines, etc.).	ADOT-march '20	photocopy error, will fix shading
91	Figure 4 doesn't represent the current proposed SR303L regional channels and basins. The SR303L regional channel starts at Clearwater Blvd. (One mile north of Bell Road) not at Greenway Road as shown. Cactus Road Basin was eliminated, and Waddell Road and Olive Avenue Basins were added. The location of Camelback Road/SR303L Basin shall be located at the northwest corner of Camelback Road and SR303L. Another Camelback Basin located at the south side of Camelback Road shall be shown between the SR303L and Bullard Wash.	ADOT-march '20	SR303L improvements determined in comment resolution meeting. Entire system revised.
92	Figures 7 and 8 show that I-10 is discontinuous through sub-basins S36 and B63. I-10 is a physical barrier, and a routing in these sub-basins shall be performed for the culverts under the I-10.	ADOT-march '20	B63 barrier is I-10. During existing conditions, S36 has a localized sump so boundary is appropriate. During CIP conditions the boundary is revised to be I-10.
93	Add Figures 1.4.2, 3.1.1 and 3.1.2 which were referred in the text on Pages 3 and 10, respectively.	ADOT-march '20	Will comply.
94	Explain the purpose of including the Flow Summary from the 2004 ADMPU. Why the peak flow comparison tables between the original ADMS and the URS model output are needed for this study? Since it was decided to use a different sub-basin ID for this study, it will need to add an equivalent sub-basin ID or a location identifier before making any comparison.	ADOT-march '20	Will take from L33PE4H provided by PB. Differences in this model exist from different sources.
95	Explain why there are still flow splits to the east and the southeast across the SR303L at northwest corners of Bell Road, Greenway Road, and Indian School Road. The SR303L regional channels and basins shall intercept all off-site flows from west of SR303L, i.e.; no flows will spill to the east and the southeast. Table 1 shows the flow splits at these locations, and the results showed that the flows to the east are ranging 37% to 96% of the total flows.	ADOT-march '20	All flow splits removed for CIP conditions per "ex-split" model and direction by PB.
96	Explain why the 100-yr 24-hr peak flow at the northwest corner of Greenway Road and SR303L is only 7 cfs which is very low.	ADOT-march '20	Recommendations section will provide explanations for areas with drastic changes.
97	Explain why there is flow break-out to the east across SR303L at the northwest quadrant of the proposed I-10/SR303L System TI. The proposed McDowell Road/I-10 Basins will intercept all the flows west of SR303L, and no flow will go to the east across the proposed depressed Ramp SW, SR303L, and Ramp WN which will be approximately 30 feet below the existing ground.	ADOT-march '20	The design for the TI area will be taken from PB's "ex-split" model.

98	Explain why the Northern Avenue Basin, Camelback Road Basin and McDowell Road/I-10 Basins were not modeled. These basins will reduce the peak discharge significantly, and the bleed-off flows from these basins will need to be considered for the sizes of the downstream channels.	ADOT-march '20	Basins taken from specific sources per comment resolution meetings. See spreadsheet that details sources for all CIPs.
99	The Level III Selected Alternative Map and related tables for SR303L from the ADMPU were included in the Volume 5. Sub-basin data, "B" sub-basins and Volume 7, Sub-basin data, "L" sub-basins. Explain why the HEC-1 model didn't follow this selected alternative for the SR303L drainage system. It will be helpful to know the differences between the CIP used and the selected alternative when is making comparison on the results of peak flows.	ADOT-march '20	Improvements taken from specific sources per comment resolution meetings. See spreadsheet that details sources for all CIPs.
100	At Cactus Road Basin, the outflow record (SQ card in HEC-1) isn't the same as the original ADMPU HEC-1 model (L33PE4H.DAT).	ADOT-march '20	Cactus Road basin has been removed per PB's "ex-split" model.
101	Explain why a Manning's "n" value of 0.022 to 0.038 was used for the SR303L channel routing. An "n" value of 0.013 or 0.015 shall be used for the SR303L concrete-lined channel.	ADOT-march '20	Will revise to concrete n-value
102	Explain why a wide and shallow channel (50' bottom & 2' deep) was used for the SR303L regional channels from Greenway Road to Waddell Road, from Cactus Road to Peoria Ave, and from Indian School Road to Thomas Road. A reasonable channel size will be an 8' to 26' wide bottom width, approximately 5' to 6' deep.	ADOT-march '20	Will revise per supplied models (ex-split, Camelback CAR, etc.)
103	Explain why this channel from west of Perryville Road to Citrus Road (shown on the CIP map) was not included in the HEC-1 model.	ADOT-march '20	Will revise per ex-split model
104	The subdivision detention basin will release the bleed-off flow into a small basin located at the northwest quadrant of the I-10/Sarival Avenue TI, eventually draining into the existing channel through the Canyon Trail development. This flow shall not be routed to the northwest of RID Canal and the northeast corner of I-10/SR303L TI as shown in the HEC-1 model.	ADOT-march '20	Overflow will go along canal first before overflowing canal. Will put in diversion to reflect bleed pipe, but the rest will not overflow canal. Agreed upon with FCDMC during comment resolution meeting.
105	Explain why this development was not incorporated in the HEC-1 model.	ADOT-march '20	It was. Will be small change during existing and CIP conditions for connection channel. Will model.
106	It is important to make the peak flow comparison at every mile street along the proposed SR303L and provide explanation of the results.	ADOT-march '20	Recommendations section will provide explanations for areas with drastic changes, and agreed-upon locations along L303
107	The Agriculture S-graph shall not be used for Sub-basin L03 which is mostly developed (Arizona Traditions North Subdivision). It is located at north of Bell Road west of the Sun City Grand development.	ADOT-march '20	Will change to Valley S-graph
108	EX_SPLIT.DAT Model-Because of Prasada development a split basin concept (replacing the Cactus Road Detention Basin with Waddell Road Detention Basin and Olive Avenue Detention Basin) was adopted in the SR303L from Peoria Avenue to Bell Road project. ADMPU HEC-1 model was revised to reflect both Waddell Road Detention Basin and Olive Avenue Detention Basin.	ADOT	Will use ex-split model for CIP changes
109	EX_SPLIT.DAT Model-A modification was made to include the basin bleed-off pipe flow into the total flow in the downstream channel	ADOT	Will use ex-split model for CIP changes

110	EX_SPLIT.DAT Model-HEC-1 modeling for the area located at north of McDowell Road and east of SR303L were revised based on Pebble Creek Phase 2 and Palm Valley Phase 8 developments. The Pebble Creek Phase 2 and Palm Valley Phase 8 development LOMR has been approved by FEMA on 4/23/2007. Del Rio Engineering provided the HEC-1 model for the LOMR.	ADOT	Overflow will go along canal first before overtopping. Will put in diversion to reflect bleed pipe, but the rest will not overflow canal. Agreed upon with FCDMC during comment resolution meeting.
111	EX_SPLIT.DAT Model-McDowell Road Detention Basin proposed in the ADMPU has been divided into two detention basins based on the coordination with Perryville Complex.	ADOT	Will use ex-split model for CIP changes in this area.
112	EX_SPLIT.DAT Model-Proposed 303L/I-10 TI (ultimate condition) on-site drainage system was included in the HEC-1 model. There are total 11 on-site detention basins.	ADOT	Will use ex-split model for CIP changes in this area.
113	The point of dividing up N07 from N05 is that N07 is not routed to N05. N05 drains to N06 and a significant is diverted to the Agua Frida River and never reached CPN06	FCDMC-3/10/09'	Added diversions to reflect openings in Corte Bella walls. Some goes south and some east
114	L01 and N27-Note 25 nodes. For smaller basin N27, only 11. Indicate that Tc length is still unrealistically long. 95% of basin has 1/2 the lag time.	FCDMC-3/10/09'	Tc length revised.
115	D15D26-This is misleading. D15 is not routed to D26. It should be routed to D28	FCDMC-3/10/09'	Routing fixed per comment resolution meetings.
116	D08-Unusually long lag time for basin size	FCDMC-3/10/09'	Tc length revised.
117	L13-Need to add UI Cards to all basins that don't end with 0 in distribution	FCDMC-3/10/09'	FCDMC directed us to change ag Kn value to shorten hydrograph. Adding to truncated hydrographs outside HDR's scope.
118	L09D16-Length indicates channel flow. X-sec indicates overland flow. Can't have both overland length ~6000'	FCDMC-3/10/09'	Changed to ag cross section
119	This should be moved forward. D15 should be routed to this then it is routed to river	FCDMC-3/10/09'	Routing fixed per comment resolution meetings.
120	D28-Per field visit D28 should not be routed to D44	FCDMC-3/10/09'	Routing fixed per comment resolution meetings.
121	L11L18-Length suggests channel. X-sec suggests overland flow. Can't have both. Overland plan ~5600ft	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
122	L13D29-Length indicates roadside channel flow. X sec indicates overland flow. Overland length >6000'	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
123	D16D30-Length indicates roadside channel flow. X sec indicates overland flow. Can't have reduction for both. Overland length >7700'	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
124	D49-See output. Q too high	FCDMC-3/10/09'	Will check output once model revised.
125	L26L34-Length indicates roadside channel flow. X sec indicates overland flow. Can't have reduction for both. Overland length >7700'	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
126	L27D57-Length indicates roadside channel flow. X sec indicates overland flow. Can't have reduction for both. Overland length >7700'	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
127	D45D58-Length indicates roadside channel flow. X sec indicates overland flow. Can't have reduction for both. Overland length >7700'	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
128	D46D59-Length indicates roadside channel flow. X sec indicates overland flow. Can't have reduction for both. Overland length >7700'	FCDMC-3/10/09'	Resolution was reached. Agricultural land will have diagonal routes across fields, unless some sort of limiting structure exists. The cross section will reflect appropriate route/section combination.
129	Ag Q/A is in 150-250 cfs/mi2 it is ok, but what Kn values were used?	FCDMC-3/10/09'	No action - resolved during comment resolution meeting.
130	Check high Q/A for B92, W61, W60, S62, S61, S63, S64	FCDMC-3/10/09'	Will check output once model revised.
131	Include 5sq mi and 20sq mi precip data	FCDMC-3/10/09'	Will comply
132	Remove 120, 150 and 300 sq mi precip data	FCDMC-3/10/09'	Will comply
133	Identify source for all storage routes	FCDMC-3/10/09'	Source added to KM cards.

134	B65B66-Check this routing	FCDMC-3/10/09'	Can only use topo and aerial to determine. No other information received.
135	SRB66-Remove -1. (typ) What is this storage?	FCDMC-3/10/09'	Deleted
136	B89-Q/A high?	FCDMC-3/10/09'	Will check output once model revised.
137	B89B92-Check Routing. Should be sheet flow	FCDMC-3/10/09'	Cross section taken from existing topo
138	B92-Too high of % impervious	FCDMC-3/10/09'	The RTIMP will be changed for the airport site.
139	B93-Is there any retention?	FCDMC-3/10/09'	Only 0.6 ac-ft, From Goodyear 4 Industrial
140	S12-Check kn, sheet flow	FCDMC-3/10/09'	RTIMP=23%, 46.7% land is 550 with RTIMP 25% and 11.9% land is 610 with RTIMP 95%
141	S13-Is there any retention? In oval?	FCDMC-3/10/09'	Retention based on small basin within developed area. No retention estimated in oval.
142	B100S-should this go through Canyon Trails?	FCDMC-3/10/09'	Ok as is. No change necessary
143	S17-Should there be retention? Check. Important	FCDMC-3/10/09'	Agricultural land use. No retention for existing conditions. Retention will be added for CIP conditions
144	DS16RE-What is the source of this retention	FCDMC-3/10/09'	Final Drainage Report for Canyon Trails Unit 3 Infrastructure, Final Drainage Report for Curtis Commons, Remaining retention volume estimated from aerial.
145	S06-How about the irrigated lots, does that go into Canyon Trails?	FCDMC-3/10/09'	No
146	DS08RE and DS09RE-CMX put lesser basin	FCDMC-3/10/09'	DS08RE ok as is. DS09RE revised to 22.33 ac-ft.
147	DS22RE-Single lot is this on-lot retention?	FCDMC-3/10/09'	Yes
148	DS23RE-Does the single lots to the north combine w/industrial retention?	FCDMC-3/10/09'	No definitive answer available. Will leave as is.
149	DS03RE-Please check, retention is much smaller than others	FCDMC-3/10/09'	Retention should be modified to 55.04 ac-ft
150	L70S35-Move comment card up. Comment in S35 (Basin)	FCDMC-3/10/09'	Will comply
151	S45-Should we put ultimate % impervious?	FCDMC-3/10/09'	Part of future land use resolution.
152	S45-Aerial photo shows all infrastructure in w retention	FCDMC-3/10/09'	Part of future land use resolution.
153	S46-Should increase to Ult % impervious?	FCDMC-3/10/09'	Part of future land use resolution.
154	DS36RE-Source of retention? ADOT?	FCDMC-3/10/09'	There is a large gravel borrow pit for the storage routing, and the track oval provides retention. Comment card will be added.
155	S39-Aerial photo shows grading. What is it? Any retention?	FCDMC-3/10/09'	Some mass grading has been done. No information on topo available.
156	S32-Should this ponding be accounted for?	FCDMC-3/10/09'	Accounted for in SR3227
157	DS26RE-Source of retention?	FCDMC-3/10/09'	Source is aerial. No topo available
158	CPS51-Check numbers	FCDMC-3/10/09'	Will revise.
159	W59-Any retention? Check Kn	FCDMC-3/10/09'	No retention. Kn correct per land use.
160	S61-Check Kn	FCDMC-3/10/09'	60.4% land use = 900 (vacant), Kn=0.03
161	S62-Check Kn	FCDMC-3/10/09'	89.9% land use=900 (vacant), Kn=0.03
162	S63-Check Kn	FCDMC-3/10/09'	80.5% land use = 620 (airport), Kn=0.02
163	S64-Check Kn	FCDMC-3/10/09'	99.7% land use = 900 (vacant), Kn=0.03
164	S67-Check Kn	FCDMC-3/10/09'	48.1% land use = 900 (vacant), Kn=0.03 and 30.9% land use =120, Kn=0.04
165	S68-Better Q/A. Any retention?	FCDMC-3/10/09'	No retention
166	All storage should start with 0 volume at start of hydrograph	FCDMC-3/10/09'	Will comply
167	B20-RTIMP too high.	FCDMC-3/10/09'	99.6% land use =320 (RTIMP=55). Gravel pits will have modified Kn
168	B21-RTIMP too high	FCDMC-3/10/09'	60.1% land use=160 (RTIMP=35)
169	B22-RTIMP too high	FCDMC-3/10/09'	92% land use =320 (Industrial RTIMP=55). Gravel pits will have modified Kn
170	B27-RTIMP too high	FCDMC-3/10/09'	98.2% land use = 320 (Industrial RTIMP=55). Gravel pits will have modified Kn
171	B76-RTIMP may be greater	FCDMC-3/10/09'	Ok as is. No change necessary
172	B75-RTIMP may be greater	FCDMC-3/10/09'	Ok as is. No change necessary
173	B75A-RTIMP may be greater	FCDMC-3/10/09'	Ok as is. No change necessary
174	Explain route in KM card if ID field on KK card not long enough. For exampel B76B78 is B79B to B78	FCDMC-3/10/09'	Will add KM card.
175	B77-RTIMP may be greater	FCDMC-3/10/09'	Ok as is. No change necessary
176	B77B78-Route may be too long	FCDMC-3/10/09'	Will revise
177	B82-RTIMP too low	FCDMC-3/10/09'	Ok as is. No change necessary
178	L46-RTIMP may be too low	FCDMC-3/10/09'	Ok as is. No change necessary
179	L47-RTIMP may be too low	FCDMC-3/10/09'	Ok as is. No change necessary
180	L72-RTIMP seems high	FCDMC-3/10/09'	Ok as is. No change necessary

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ITEM	TASK	COMMENT BY	RESPONSE
COMMENTS BY JOHN HOLMES			
1	1	Provide updated Storage Basin Excel spreadsheet showing the changes made from previous submittal.	JH at FCDMC All excel files will be provided.
2	2	Indicate on KM cards for routes W07W08, W09W10, W11W12, W12W13 and W23W24 that n-values deviate from the predetermined n-value table.	JH at FCDMC KM cards revised. These routes should have a channel of 0.035 and overbank of 0.045. Except W12W13 should be 0.032 for earth with sparse trees and shrubs
3	3a	Verify route W04W05 n-value. Doesn't match predetermined table.	JH at FCDMC N-value and KM card revised. The channel should have a n value of 0.035 and an overbank of 0.035
4	3b	Verify route W13W16 and W33W35 n-values. Don't match predetermined table. Complete KM cards for these routes.	JH at FCDMC W13W16 n-value = 0.0032 from aerial earth with sparse trees and shrubs, N-value and KM card revised. W33W35 looks like a man made channel therefore a n-value is 0.022 for clean straight earth and a 0.032 overbank for the shrubs
5	3c	W45W46 - line cut-off, complete channel material description	JH at FCDMC KM card revised
6	3d	W49W51 - shouldn't the n-values be 0.035 per channel material description in table?	JH at FCDMC N-value revised to 0.035 for natural channel with vegetation
7	3e	W57W58 - I thought that the "avg value for cultivated areas" in Maricopa County, from other KM card notes for ag fields was 0.038 Kn values?	JH at FCDMC This area is not AG. KM card revised. The channel is a clean straight earthen channel with very little to no vegetation
8	3f	W38S60 - "concrete channel" has assigned n-value of 0.016 to 0.020. You have 0.038 to 0.035?	JH at FCDMC This is natural channel. The area is natural channel with sparse trees and shrubs. The n value will be modified to 0.035
9	3g	W58S60 - "earth w/ sparse trees and shrubs" has assigned n-value of 0.032, not 0.022.	JH at FCDMC This is natural channel. The area is natural channel with sparse trees and shrubs. The n value will be modified to 0.035
10	3h	Route L03L04 has n-values of 0.032, 0.013 and 0.032 w/ 1/2 street section. Shouldn't the lower n-value be on the right or left bank?	JH at FCDMC The channel and ROB has been modified to show 0.013
11	3i	Route L05D06, L06L07: same comment as Route D02D10 has n-values of 0.022 for earth w/ sparse trees and brush. According to the approved table, n-values should be 0.032?	JH at FCDMC Reemes Road channel (D02D10) will be modified to 0.032
12	4	North Inlet Channel - Olive to WT#3 FRS - Flows for almost the entire length of the NIC Channel and the west split into Beardsley Canal Wash/Cholla Wash are higher than the design flows according to the North Inlet Channel Design Data Report.	JH at FCDMC The flow split was taken from the HEC-1 provided to HDR. No change needed.
13	5	The rating table in SRW20 needs to show that the gated and by-pass outlets are closed in the existing condition hydrology for the entire rating table. The HDR model shows both outlets are open from elevations 1208.6 to 1218.0. Please change.	JH at FCDMC Comment in last submittal was to show no flow up to 1208.6. Will modify again per new comment. The new values show only the outflow at spillway from rating table.
14	6	The rating table in SRS60 needs to show that the gated outlets are closed in the existing conditions hydrology for the entire rating table. The HDR model shows both east and west gated outlets are open from elevation 1043.0 to 1054.0. Please change.	JH at FCDMC The gates will be shown as closed. The east and west spillway values were added to determine the spillway discharge.
15	7	Stage-storage routing needs to be modeled below CPW58 for the 4-10x8 BC's at I-10 and Tuthill Dike Wash. Then, if there is spill to the east, the 12x12 vehicle drive-thru box also needs to be modeled and the remaining culverts under I-10 to the east to Jackrabbit Trail.	JH at FCDMC The culverts can handle all of the flows that arrive, therefore there is no split. No change needed.
COMMENTS BY AMIR MOTAMEDJ			
16	1	KM cards on detention basins indicate fractions of the original detention that vary greatly. Why?	AM at FCDMC Wording of KM cards need to be revised. This means that a percentage of the total basin has retention.
17	2	The Colter Channel flows exceed the max design capacity of the channel. Need to discuss.	AM at FCDMC No action needed.
18	3	The Bullard Wash design capacity is exceeded north of I-10. Need to discuss.	AM at FCDMC No action needed.
19	4	The flows at the RID Overchute are well below the design possibly due to the Wigwam development retention calculations (B77). Flows north of RID east of Dysart should flow west into RID project. Need to discuss.	AM at FCDMC Retention will be revised. According to offsite drainage report and field observation Wigwam South provides 100yr 2hr retention. 80% of 40.10 ac-ft is 32.08. Not sure if Wigwam Golfcourse provides retention or not. We are missing report and topo does not indicate retention.
20	5	Ag areas had unit discharges of 350-450 cfs/sq.mi. and urban areas had discharges of 1,100 to 1,800 cfs/sq.mi. (before retention) looks reasonable.	AM at FCDMC No action needed.
21	6	ADOT basins: Stage Storage matches URS report, but stage discharge does not. Please check and correct if necessary.	AM at FCDMC Stage discharge was revised from URS model. See HDR documentation for Basins B73, B74, B83 and B84. All four storages will be updated.
22	7	UI cards, for most part, captured the entire unit volume. Few agriculture areas did not end in zero, but the difference is negligible. No change necessary.	AM at FCDMC No action needed.
23	8	Did not get a chance to review all the routings, but the ones within FCD channels looked ok.	AM at FCDMC No action needed.
COMMENTS BY STEVEN TUCKER			
24	1	The combine KK labeled CPD64 should be transposed with the combine KK labeled Dummy that follows it.	ST at FCDMC DDMSW only allows 5 combined hydrographs, so this concentration point was split into two. CPD64 renamed as CPD64A and DUMMY renamed as CPD64B for clarity.
25	2	There should be a route N07N06.	ST at FCDMC Route N07N06 added.
26	3	Extend x-sections where flow is not contained. Noted: N21N22, D14D15, D06D07, L11L12, L24L26, RRMS, L38L38, L38L39, D58D69, and D74D78. D74D78 appears to be a faulty cross-section, check RX and RY cards.	ST at FCDMC Will comply.
27	4	Model has all N04 being retained, and all other flows (from N04A, N04B, N03, and N03B bypassing the retention.) It seemed to me that all of the flows entered one large detention basin that was metered into the Bodine Channel. This area could be more accurately modeled.	ST at FCDMC Agree. The retention will be added after the CP.
28	5	There are several watersheds that retain all or almost the entire 100-year, 24-hour storm. This may be due to stringent retention requirements of certain municipalities beyond the 100-year, 2-hr, or it may be due to retention designed for NOAA2 being modeled with a NOAA14 storm. Verification was not submitted for the existing retention volumes. Please evaluate to make sure this is a reasonable occurrence.	ST at FCDMC Retention was checked against a NOAA 2 calculated amount for each basin and checked against reports, plans, etc. Many areas did construct additional retention beyond the NOAA 2 required amounts. The retention appears reasonable.
COMMENTS BY ESPERANZA FOREMAN			
30	1	The design capacity of Bullard Wash is 3200 cfs. South of I-10 the flows estimated for all reaches of this wash are between 3688 and 4223 cfs. Please provide a solution to maintain the flows in Bullard Wash at or below 3200 cfs.	EF No action needed. It is beyond HDR's scope to provide solutions.

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31	2	In agricultural areas, the expected numbers of cfs per square mile are between 200 and 400. In several basins the numbers are between 425 and 547. Please explain.	EF	Each basin was modeled for conditions specific to the subbasin. Input parameters appear correct. In general, the loss parameters used in this model are consistent, and slightly different than the previous models.
32	3	In Desert/Range areas, the expected numbers are between 300 and 600. In several basins those numbers are between 900 and more than 1700 cfs per square mile. Please explain.	EF	The Kn values in the mountainous areas will be modified to 0.050. Steep slopes appear to be the culprit. All basins with higher than normal cfs per square mile will be checked for input accuracy.
33	4	Please check the "n" values for reaches B63B65 and B71B72.	EF	Route B63B65 is a straight channel with sparse trees and brush (n value=0.032), Rotue B71B72 is golf course and the Golf course n value used (n value=0.025)
34	5	Check NSTPS value on reaches S01B67 (76), S71S78 (149), S82S83 (30).	EF	NSTPS will be checked after model is rerun. In general, the NSTPS are calculated by DDMSW and should be correct. Previous checks of the software indicate that the NSTPS calculation is correct.
COMMENTS BY JOHN HOLMES-HEC 1, MB02				
35		Replace FRS#3 w/McMicken Dam in L21	JH at FCDMC	Will comply.
36		Replace FRS#3 w/McMicken Dam in L22	JH at FCDMC	Will comply.
37		Replace FRS#3 w/McMicken Dam in W02	JH at FCDMC	Will comply.
38		Replace North Inlet Channel Main Wash with Cholla Wash	JH at FCDMC	Will comply.
39		W12W13-See Model L303M3LA, Route RCPLOB FRS#3 Channel	JH at FCDMC	No action needed. Route taken from Plans provided by FCD.
40		W49W51-n value table shows 0.035	JH at FCDMC	See comment 6
41		W52W53-Complete KM card	JH at FCDMC	Will comply.
COMMENTS BY AMIR'S-HEC 1, MB01				
42		B08-Vacant land, not Mobile Home	AM at FCDMC	98.3% is vacant, 1 percent is Airport, and 0.6 percent is small residential
43		DB09RE-why 75% and not 80% retention used?	AM at FCDMC	Will revise comment for clarification
44		DB11RE-why 25% retention used?	AM at FCDMC	New Retention 74.8 ac-ft, 88.7acft from Litchfield Park Detention Facility and 4.82 from Unit 1. Will reword
45		DB77RE-why 50% retention used?	AM at FCDMC	New Retention and new wording. See Comment 19
46		SRB83-Does not match 2004 SQ	AM at FCDMC	Will be modified
47		SRB73-Last value still 55 cfs based on 2004	AM at FCDMC	Will be modified
48		SRB74-Does not match 2004 study	AM at FCDMC	Will be modified
49		B24-Should go across Dysart west into RID	AM at FCDMC	Flow goes east.
50		DB77RE-This detention is only for the north half?	AM at FCDMC	Detention amount modified for only Wigwam South. Retention appears in all areas of the subbasin.
COMMENTS BY PB JUNE 23, 2009-HEC 1, EX and EX/W CIP				
51	1	Since the HDR's model adopted the ADOT/PB HEC-1 Model fro the segment of SR303L the peak flow comparison table should be shown between the HDR's flows and ADOT/PB flows.	PB for ADOT	The peak flow comparison for the Existing w/CIP model will compare HDR's flows with portions of the EX_SPLIT model along the Loop 303 according to the email received from Gary Sun.
52		Need to calibrate the HEC-1 results and explain the differences in peak flows	PB for ADOT	Differences at key points will be discussed in the recommendation section. Calibration not possible, would need actual flooding data, high water marks, etc. in order to calibrate.
53		The peak flow at the SR303L/Bell Road is 921 cfs which is 19% higher than 772 cfs as shown in the ADOT/PB and URS HEC-1 models. ADOT is ready to install the RCBC at Bell Road and there is no place to provide more detention north of Bell Road. Please provide an explanation of the peak increase. Is it caused by combining four drainage sub-basins 101, 102A, 105, 106 into one big sub-basin L02 as shown in the HDR model?	PB for ADOT	The previous HEC-1 models were incorrect in our opinion. The documentation provided to us on July 7th is the same report we used to get the retention volume for our model. The previous model had 0% RTIMP (percent impervious) which is incorrect and "temporary" retention that does not exist anymore. The HDR model has 31% RTIMP and loss parameters that are appropriate to the basin. No change needed.
54		The flow comparison table did not show peak flows at the correct locations along SR303L: SR303L at Waddell Road, Cacus Road, Peoria Road, Olive Road, Glendale Road.	PB for ADOT	This will be modified and will compare the flows with the EX_SPLIT model at these locations.
55	2	The Northern Detention Basin lateral weir diversion rating curve provided by PB is the ratio of flow diverted into Northern Detention Basin versus the total flows from the SR303L channel and the local drainage sub-basin excluding the flow from mteh future FCDMC's Northern Channel. In the HDR HEC-1 model the total flow includes the flow from this Northern Channel. Flow from Northern Channel should be directly discharged in the the Northern Detention Basin and should not be included in the SR303L Channel diversion.	PB for ADOT	Will comply.
56	3	Olive Ave Detention Basin is located at approximately one half mile north of Olive Avenue. The off-site flow from west along Olive Avenue should not be combined with the flow into Olive Ave. Detention Basin. The flow should be combined with the local sub-basin flow routed the flow and routed the SR303L channel flow at the northwest corner of Olive Ave and SR303L.	PB for ADOT	Will comply.
57	4	The detention basin outflow from the Pebble Creek Subdivision Detention Basin located at the northwest corner of Sarival Ave and McDowell should flow toward south to an existing basin located at the northwest quadrant of the I-10/Sarival Ave TI. This existing subdivision detention basin will no have any overtopping occur during the 100-year event based on the HEC-1 model approved by FEMA.	PB for ADOT	The basin in the CIP model is located after the divert. It should be before the divert. The retention is located after the CP, we will modify. However, should the basin not contain the flow with the new runoff amounts, the overtopping will go to the southwest, not to the south. Only flow through the bleed pipe will go south.
58	5	In HDR's HEC-1 model south of Camelback Road, the Camelback CAR's HEC-1 model was used. Using ADOT/PB's rating curve for the I-10/SR303L Basins is not appropriate if the flow fro mthe SR303L channel at Camelback Road is to be diverted across the SR303 to the east toward Bullard Wash. The rating curve needs to be modified so that hte max. water surface elevation in hte I-10/SR303L basins will be higher and fully utilized the avaiabel storage volume.	PB for ADOT	No action needed. It is beyond the scope to modify design of future structures. If a different rating curve is required, it will need to be provided to HDR.
59		The channel flow from Citrus Rd to the TI shouldbe deleted because the flow will enter I-10/SR303L basins at Citrus Rd. The channel routing in the ADOT/PB HEC-1 mdoel was used because interim I-10 basin was designed for the Phase I conditions wth McDowell Road Upper and Lower Basins in place.	PB for ADOT	Route L71L72 will be deleted.
COMMENTS BY PB JUNE 24, 2009-REVISED FIGURE 4 AND NEW FIGURE (2017 FACILITIES)				
60	1	Show all major corridors: only railroads, rivers, and most of canals shown. Need to label I-10 ,US60, MC85, Loop 303, aproposed SR303L, and proposed SR801	PB for ADOT	Will comply.

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61		Label significant land marks: LAFB, Goodyear Airport, PIR	PB for ADOT	Will comply.
62		Legend: Add a legend for DAM	PB for ADOT	Will comply.
63	2	Figure 3-Existing Facilities Map: Label McMicken Dam Outlet Wash	PB for ADOT	Will comply.
64		Verify "Beardsley Channel" Is it Beardsley Canal?	PB for ADOT	Will comply.
65	3	Figure 4 Future Facilities Map: Move the Legend box for clarity	PB for ADOT	Will comply.
66		Label all existing features as shown on Fig 3	PB for ADOT	Will comply.
67		What is the CIP facility shown south of LAFB? Why is it not shown on Figure X for 2017 Facilities	PB for ADOT	This is part of the LAFB Drainage Improvements. It is a channel and then improvement of Bullard Wash to Camelback. It is not anticipated to be constructed by 2017.
68		There is a basin located just north of the proposed Bullard Wash Channel. Is there a name for this basin?	PB for ADOT	This basin will be labeled. It is the 1-10 Bullard Wash Basin
69		Based on the discussions between ADOT and FCDMC, the SR303L Channel south and MC85/SR303L Basin will be constructed around 2015, definitely by 2017. ADOT will complete the I-10/SR303L TI Phase I Construction prior to 2017. Some segments of SR303L and drainage system will be completed by 2017. Show these completed facilities as existing facilities on Fig 4.	PB for ADOT	The SR303L will be shown as a CIP project, not an existing project.
70		What is the proposed construction schedule for MCDOT's Northern Parkway? Some of the drainage system may be constructed by 2017.	PB for ADOT	Northern Parkway will be constructed by 2017
71		Show the proposed El Rio Watercourse Master Plan which is a 17-mile watercourse master plan along the Gila River that stretches from the confluence of the Agua Fria River to SR85	PB for ADOT	Since the rivers are outside our study limits, they will not be shown.
72		Show the proposed Agua Fria Watercourse Master Plan which is a 15-mile watercourse master plan (including channelization) between Indian School Road and Happy Valley Parkway.	PB for ADOT	Since the rivers are outside our study limits, they will not be shown.
73	4	Figure X-2017 Facilities: There are only 3 features were shown differently from Figure 4-Future Facilities. They are the Tuthill Channel, Bullard Wash Channel and the proposed CIP facility south of LAFB.	PB for ADOT	Yes. Those are the only projects projected not to be built by 2017. This was determined by interviews with the FCDMC and other stakeholders.
74		Why the proposed Tuthill Channel was shown differently from Figure 4?	PB for ADOT	Because the Tuthill channel will not be built by 2017.
75		Why the proposed CIP facility south of LAFB did not show on this Figure?	PB for ADOT	Because the LAFB improvements will not be built by 2017
76		The line for the proposed Northern Channel is missing.	PB for ADOT	Will add.
COMMENTS BY PB JUNE 24, 2009-REVISED FIGURE 4 AND NEW FIGURE (2017 FACILITIES)				
77	1	Percent of impervious area (RTIMP) is the percent of sub-basin which is impervious. RTIMP used (78%-88%) in the HEC-1 LG records were too high.	PB for ADOT	RTIMP was based on land use parameters in District manual based on projected land use. No change will be made.
78		The impervious areas are very sensitive to the computed peak discharges. PB ran one sub-basin L13 as a test for the sensitivity of the percent impervious area to the computed peak discharge. The results indicated that as the percent of impervious area decreased from 80% to 50% the peak discharge reduces from 1177 cfs to 807 cfs which is roughly 31% decrease in the computed peak discharge. Need to double check the future land uses of the following sub-basins:	PB for ADOT	No action needed. The RTIMP was based on land use parameters in the District manual based on projected land use. No change will be made.
79		L13	PB for ADOT	Mostly land use 810-Office
80		L19	PB for ADOT	Mostly land use 810-Office
81		L27	PB for ADOT	Mostly land use 810-Office
82		L34	PB for ADOT	Mostly land use 810-Office
83		L39	PB for ADOT	Mostly land use 810-Office
84		L44	PB for ADOT	Mostly land use 810-Office
85		L49	PB for ADOT	Mostly land use 810-Office
86		L54	PB for ADOT	Mostly land use 810-Office
87		L58	PB for ADOT	Mostly land use 810-Office
88		L61	PB for ADOT	Mostly land use 810-Office
89		L62	PB for ADOT	Mostly land use 810-Office
90		L63	PB for ADOT	Mostly land use 810-Office
91		L64	PB for ADOT	Mostly land use 810-Office
92		L67	PB for ADOT	Mostly land use 230 and 610-Commercial and Transportation
93		L72	PB for ADOT	0.6 Ac 610 and 0.242 230
AMENDED COMMENTS BY ESPERANZA FOREMAN, JUNE 26, 2009 (REV JULY 2, 2009)				
1		Please disregard.	EF	No action needed.
2		Please disregard.	EF	No action needed.
3		Figure 4 (CIP Facilities) shows the AT&SF primary and secondary channels as one channel	EF	Figure 4 is only a graphical representation of approximate locations. Both channels are shown where they deviate.
4		Northern Parkway drainage improvements are not in the HEC-1 model.	EF	The Northern Parkway drainage improvements are reflected in the CIP model as taken from the AT&SF CAR HEC-1 model per agreement with FCDMC and HDR during comment resolution meetings.
5		North Inlet Channel is not modeled according to the NIC data report.	EF	Since the routing resolution in a regional model does not allow for the inclusion of all of the drop structures, the decrease in velocities will be modeled by increasing the n-values. Agreement on this methodology was received via email.
6		Tuthill Channel: Length of reaches do not match with the lengths proposed in the conceptual design plans.	EF	Lengths and slopes cannot match exactly with the plans. An average value of the lengths, slopes, and cross sections are typically used for a regional model such as this. No change will be made.
7		Some cross sections are not modeled per the conceptual design plans.	EF	Lengths and slopes cannot match exactly with the plans. An average value of the lengths, slopes, and cross sections are typically used for a regional model such as this. No change will be made.
8		On the schematic, CPS71 is labeled CPS70. Please correct.	EF	Will comply.
9		The Union Pacific Basin is not in the HEC-1 model.	EF	Per Valerie Swick, no design information on this basin exists at this point. It is acceptable to leave it out.

Loop 303/White Tanks ADMPU Area Hydrologic Analysis
Comments on the June 2009 Submittal

10	Cross section and length of reaches do not match with the cross sections and lengths proposed in the "Loop 303 Drainage Improvements I-10 to Gila River Candidate Assessment Report"	EF	Proposed sections were taken from the provided CAR HEC-1, which does not match the CAR report. Per the comment resolution meeting, the info from the HEC-1 will be used. Lengths and slopes cannot match exactly with the plans. An average value of the lengths, slopes, and cross sections are typically used for a regional model such as this.
11	Cross section and length of reaches do not match with the design criteria contained in the "Bullard Wash Channel Improvements Interstate 10 to Lower Buckeye Design Report".	EF	The routes to the south of Van Buren were taken from the CLOMR HEC-RAS model provided to us from John Holmes.
COMMENTS BY JULIE COX, DATED 6-26-2009			
1	For information only, no action needed	JRC	No action needed.
2	ADOT basins - for informatin only, no action needed	JRC	No action needed. Please note that the ADOT basin modeling has been changed slightly to better represent conditions.
3	Warning messages appear throughout the output. They should be able to eliminate these warning messages.	JRC	Warning messages associated with routing cross sections not containing the flow will be fixed. However, the warning message associated with potential instability in the routes is for information only and cannot be removed.
AMENDED COMMENTS BY JOHN HOLMES, DATED 6-29-2009 (REV JULY 1, 2009)			
1 THRU 4	For information only, no action needed		No action needed.
1	Addendum: I recommend that the Kn values for MB02 model (White Tanks Mtns watershed) be changed to 0.050 based on the DRAFT Hydrology Manual, page 5-30 and insert A-83.	JH at FCDMC	MB02 Kn will be changed for vacant land use types.
2	The effective RTIMP values used in the URS study for the ADMPU hydrology are shown on the spreadsheet with the HDR estimated RTIMP values. HDR: Please check the RTIMP values for the White Tanks sub-watersheds to determine if estimated RTIMP values are Total RTIMP or Effective RTIMP. Effective RTIMP values should be used in the HDR AHA model.	JH at FCDMC	Percent impervious is based on land use for this entire model. We have not heard of "effective impervious", but all values in the model are per the agreed upon RTIMP by category. In order to remain within the scope of this project, the only option without a change order is to change the percent impervious for land use categories. No change will be made.
3	For information only, no action needed	JH at FCDMC	No action needed.
4	For information only, no action needed	JH at FCDMC	No action needed.
5	For information only, no action needed	JH at FCDMC	No action needed.
6	The review model output indicates that the 100-year event results in an estimated volume of 1,287 ac-ft in WT#3 FRS. Since there should be no significant change to the modeling parameters, other than rainfall estimate for WT#3 sub-watershed, the flow and volume to WT#3 should be within a close range to estimate values in the URS model. However the HDR model shows a flow increase of 21% into the dam, and a volume increase of 30%.	JH at FCDMC	Disagree. This new model uses recommended values for loss parameters per the DDMMC, where as the URS model was an update of the several older models that used loss parameters that pre-dated the DDMMC. Unless calibration data is available to suggest the results of the HDR model are incorrect, we have no reason to believe that our model is not a better estimation than their model for the design event. Additionally, it is our opinion that it is important to be consistent with parameters in a regional model to provide the same level of protection to the area when designing future improvements. The Kn will be changed to be 0.050 in the mountainous regions per the previous comment and may affect the results.
7	Similar increase occur in results of the HDR mode compared to the URS model for WT#4 FRS, as well, approx. 17% higher flow and volume.	JH at FCDMC	Disagree. See previous comment response.
COMMENTS BY AMIR MOTAMEDI, DATED 6-25-2009			
1	For information only, no action needed	AM at FCDMC	No action needed.
2	For information only, no action needed	AM at FCDMC	No action needed.
3	Stage storage discharge for Falcon Dunes is incorrect.	AM at FCDMC	Will correct.
4	ATSF proposed channel, the flows have decreased, refer to Esperanza's comments on channel location	AM at FCDMC	The channel is modeled per the AT&SF CAR HEC-1 model.
5	Waddell Road CAR: I could not access the report, but I assume the same is true.	AM at FCDMC	The improvements for the Waddell Road CAR are modeled according to the CAR report.
6	The rating curve on the L303 at Camelback Basin did not match the ASPEN report.	AM at FCDMC	The basin located at the corner of Camelback and Loop 303 was taken from the HEC-1 REC-EWP.OUT route DB237.
7	One segment of the Camelback Road channel is missing from the model.	AM at FCDMC	Route B46B47 will be modified.

Loop 303/White Tanks ADMPU AHA
Comments on July 2009 Submittal

ITEM	TASK	COMMENT BY	RESPONSE
COMMENTS BY PB - Guihua Li/Gary Sun			
1	1	Table 4.1.1. The peak discharges shown in the Table 4.1.1 are not the same as those shown in the HEC-1 output file at CPL39, CPL72, SRL72.	PB for ADOT Will correct those locations
2	2	Table 4.1.1. The HEC-1 ID at the northwest corner of SR303L and Olive Avenue should be CPL34B instead of CPL34.	PB for ADOT Will correct
3	3	Flow at SR303L and Clearview Blvd: The flow from L02 at the northwest corner of Clearview Blvd and SR 303L seems can not 100% pass through the Clearview Blvd and get into the proposed SR303L channel. This is because the Clearview Blvd is elevated approximate 18' above the existing ground. Based on the field observation, the flow will enter the SR303L channel via 12 13" high by 10' long wall openings	PB for ADOT We are showing this same location for the flow entering SR303L, at the wall openings as you have indicated. The drainage gets to that point by crossing Clearview before it gets elevated at the golf course crossing, but the ultimate outfall is the wall openings. Not sure what this comment is requesting - a stage storage to meter the hydrograph through the wall openings? Please clarify.
4	4	Final Hydrology report - state the reason or purpose of ADOT's participation in the study fee. Add a description for the 2017 conditions, did not see any previous discussion on areal reduction in the text, need to provide the 2017 model.	PB for ADOT Will revise report text. Waiting on comments from PB and the District on the 2017 land use map we provided on July 1st. Need comments in a timely manner before we can create the 2017 model.
COMMENTS BY DEBBI SHORTAL			
5	1	Preliminary look at the report shows that it must be updated to reflect the new information from this submittal. This is found through the submittal. Therefore, no further comments will be provided at this time regarding the report and supporting documentation. The District will review within an adequate review period upon submittal of an updated version, provided by HDR, that reflects the changes in the models, input, results, and associated explanation of changes and updated technical data and addition volumes, etc, for the 7/10 submittal. You should, however, consider any comments on the report from ADOT or District Hydrology - John Holms and Amir Motamedi.	DLS at FCDMC Disagree. Please clarify where you perceive the deficiencies to be located. We cannot respond to this without additional information. We updated all calculations, models, report text, etc. We provided updated backup information, inserted new information where necessary. We provided generalized explanations for the differences. We must know specifically what the District perceives to need updating. We would be happy to discuss this with you at a comment resolution meeting.
COMMENTS BY AMIR MOTAMEDI			
6	1	Existing conditions w/o CIP model: The retention amount for subbasin B11 was changed from 23.5 ac-ft to 74.8 ac-ft, neither matches the data on the retention spreadsheet. Please verify the correct retention is being used.	AM at FCDMC The storage will be updated.
COMMENTS BY ESPERANZA FOREMAN			
7	1	On page 6 of 23 of the final report, numeral 3.3 Precipitation, it is stated: "... for a mountainous region is 4.14 inches and 3.47 inches for all other subbasins." Should be 3.941 and 3.48 respectively.	EF at FCDMC Will correct.
8	2	On page 9 of 23, tabel 2.4.2: Kn should be 0.06 instead of 0.6	EF at FCDMC Will correct.
9	3	In Dysart region, SRD53, is this the "El Mirage Basin"? HEC-1 identifies it as West Cactus Basin. Data source is not specific in KM records. Please correct either the map or model KM card.	EF at FCDMC Will correct.
10	4	Please note in Figure 4 that the following structures have not been included in the model: a) Northern Parkway Drainage Improvement b) LAFB Drainage improvements c) the basin north of I-10 and East of Bullard Wash Channel.	EF at FCDMC Disagree. All of these have been included in the model. We would be happy to show you exactly where these have been incorporated; they are shown on the schematic and are in the model.
COMMENTS BY JOHN HOLMES			
11	1	Report comments: Add an n-value table for typical reach routing to the report or appendices based on agreed upon n-values for channel routing.	JH at FCDMC Will comply.
12	2	Item #15 on HDR Comment Resolution spreadsheet: the rating curve for the 4-10x8' BCs at I-10 and Tuthill Dike Wash and the split flow must be modeled. Your comment resolution says that the boxes can handle all flow; please verify that 7000 cfs can go through the culverts.	JH at FCDMC Will provide documentation. There is some flow that does not go through the main 4-10x8 boxes, but directly adjacent to these boxes is a 12'x12' box that will take the remainder of the flow. The flows recombine downstream as shown in the schematic.
COMMENTS BY STEVEN TUCKER			
13	1	The existing and future conditions models do not take into account the retention of Dysart High School in Basin D52.	SLT at FCDMC Will add this retention.
14	2	The existing conditions model does not take into account the Veramonte subdivision in Basin D36, and therefore the added retention in the future conditions model is questionable.	SLT at FCDMC Will correct.
Report Redlines			
15		Various minor text comments	SLT at FCDMC Will comply, except the last bullet on the first page was correct on listing the Tuthill Channel. This is the channel that is part of the Buckeye ADMP - is there another name for it to avoid confusion with the northern Tuthill Channel? Perhaps "South Tuthill Channel"?

Miscellaneous Maps and Photo Log

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona

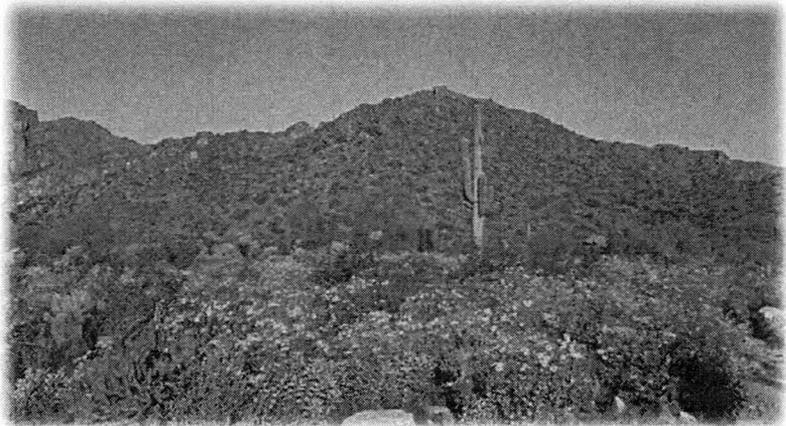
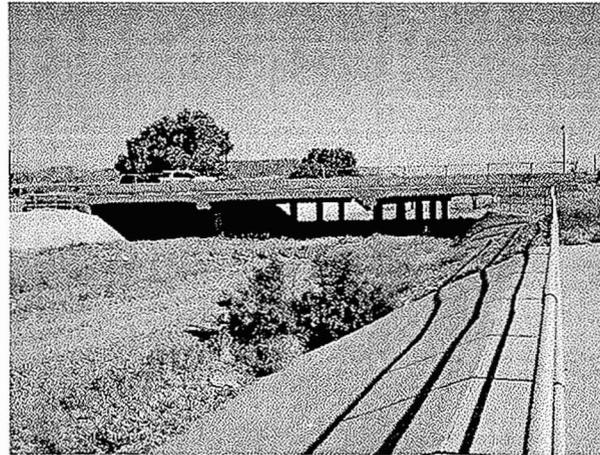


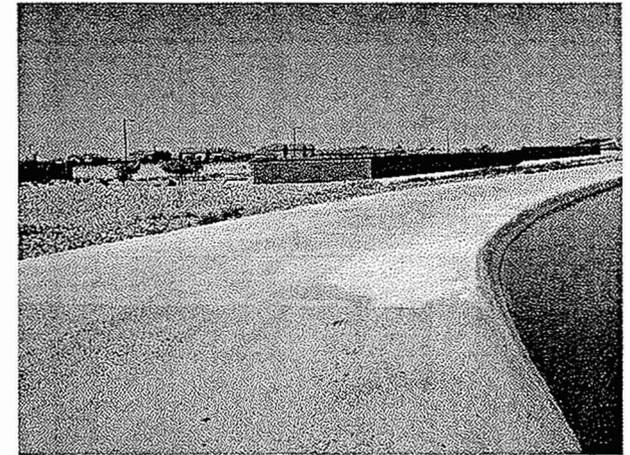
PHOTO LOG
Loop 303 / White Tanks ADMPU AHA



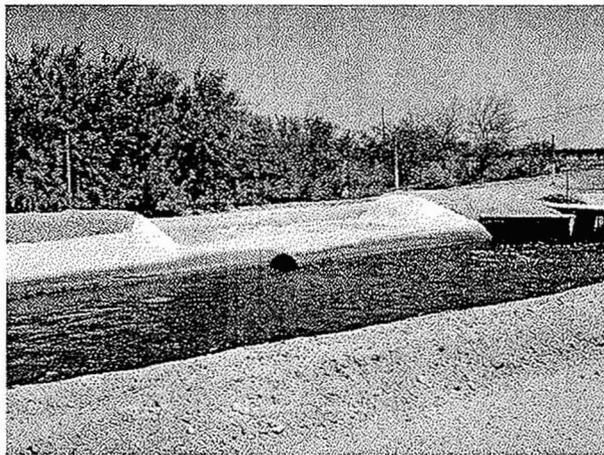
Site 1 – Broadway Rd. & Citrus Rd. Looking Northwest



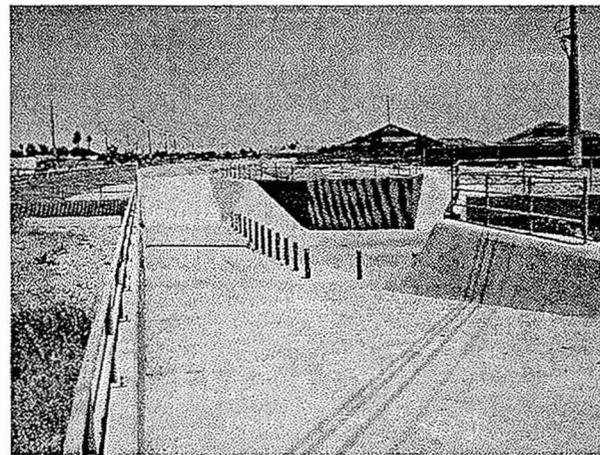
Site 2 – MC85 at Bullard Wash Looking North



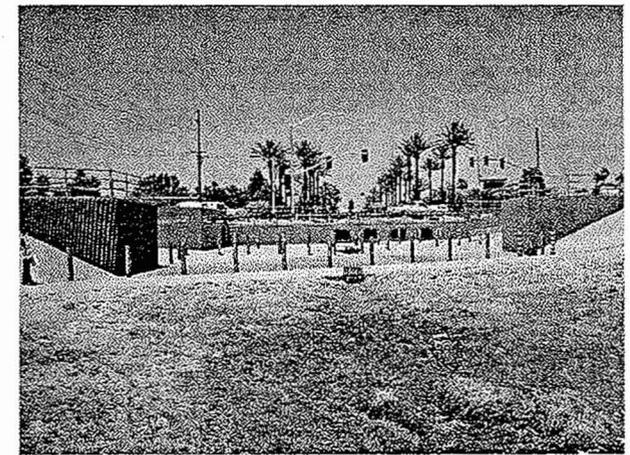
Site 3 – RID Spillway Near I-10 Looking Southwest



Site 4 – RID at Airport Rd. Looking Northeast

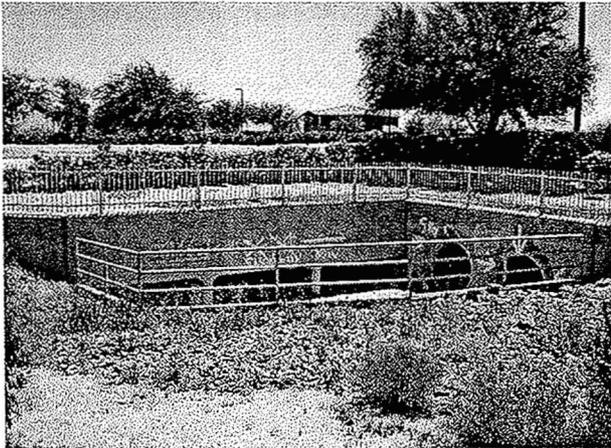


Site 5 – RID at Indian School Rd. Looking East

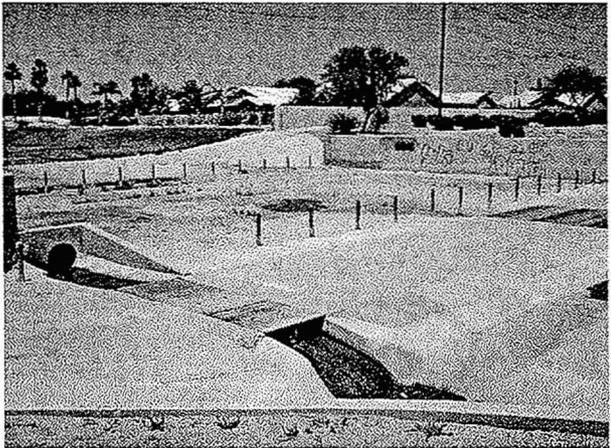


Site 6 – RID at Indian School Rd. Looking North

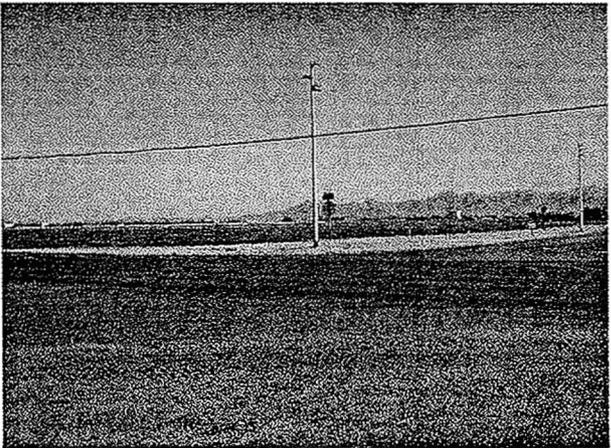
PHOTO LOG
Loop 303 / White Tanks ADMPU AHA



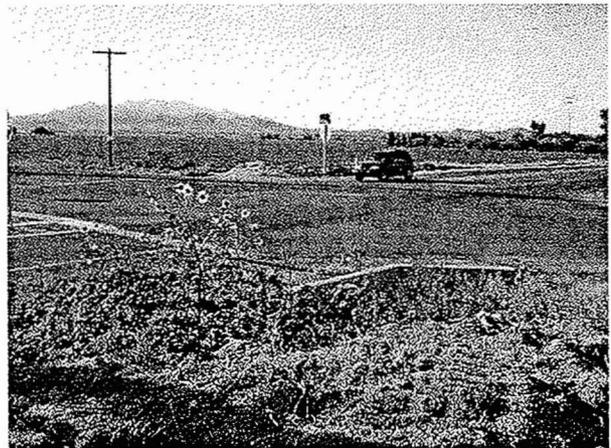
Site 7 – RID at 144th Ave. Looking Southwest



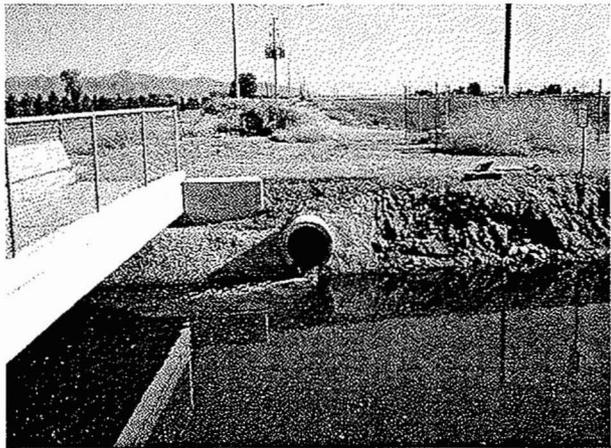
Site 8 – RID Between Pebble Creek Pkwy & Bullard Ave. Looking Northeast



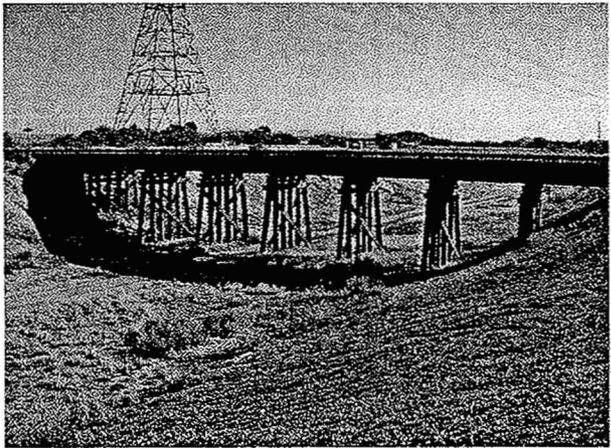
Site 9 – MC85 & Airport Rd. Looking Northwest



Site 10 – Broadway Rd. & Jackrabbit Trail Looking Southeast



Site 11 – Southern Ave. & Airport Rd. Looking North



Site 12 – McMicken Dam Outlet Channel at Grand Ave. Looking Upstream

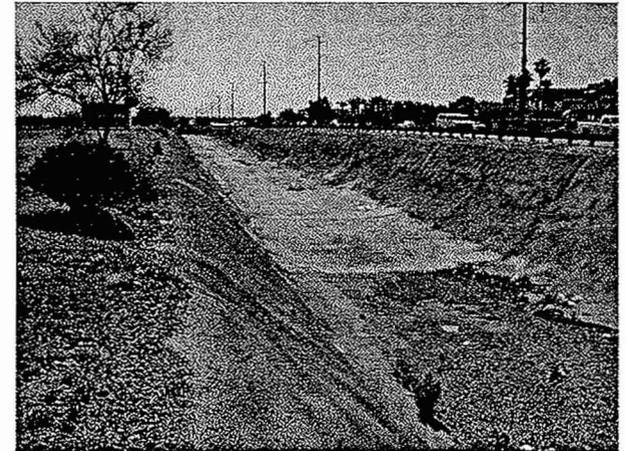
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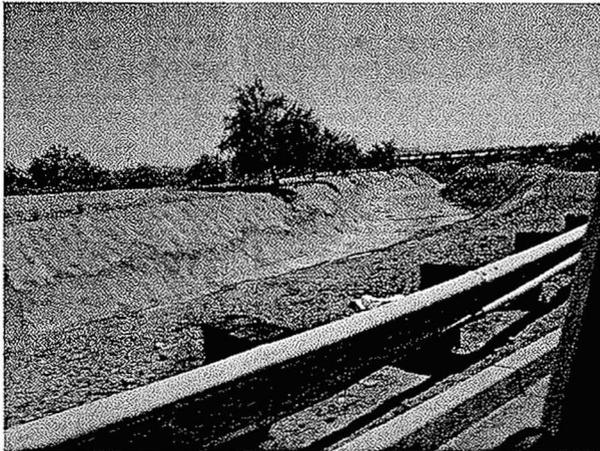
Site 13 – Sun City West Drain at Deer Valley Rd. Alignment and 151st Ave



Site 14 – Corte Bella Country Club Outlet Looking Upstream



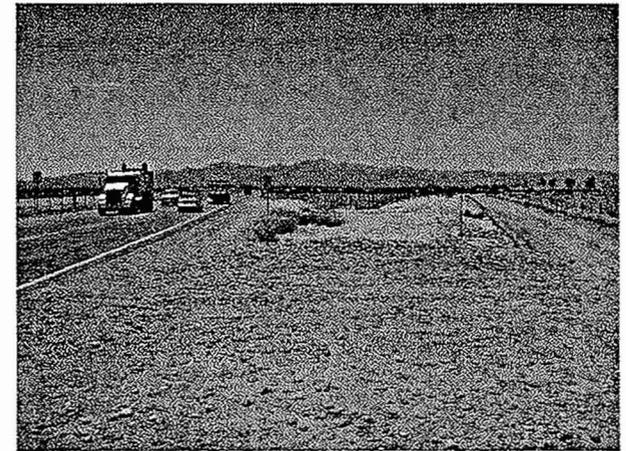
Site 15 – Bell Rd. Channel at El Mirage Rd Looking Downstream



Site 16 – Bell Rd. Channel at Agua Fria Confluence

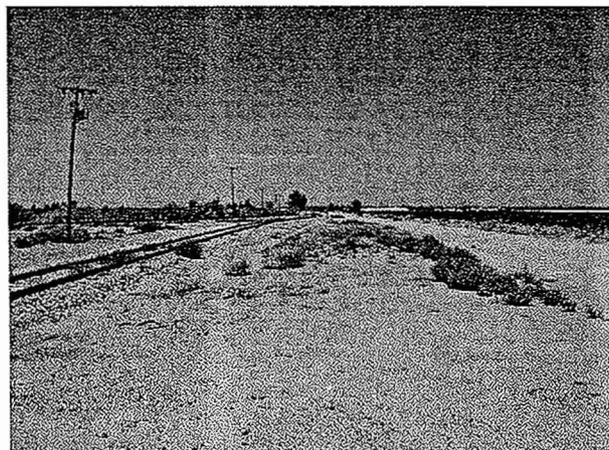


Site 17 – Culverts under Camelback Rd. North of Palm Valley Phase 5

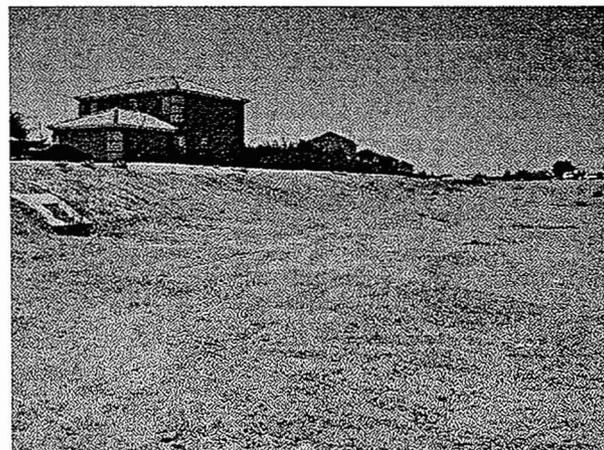


Site 18 – Northern Ave. at the Railroad Looking West

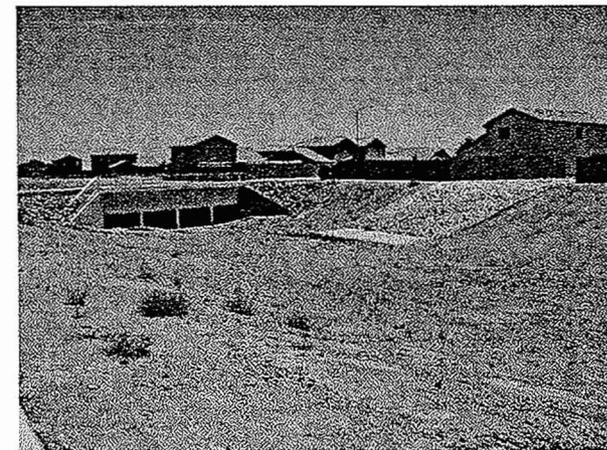
PHOTO LOG
Loop 303 / White Tanks ADMPU AHA



Site 19 – Olive Ave. at the Railroad Looking North



Site 20 – El Mirage Wash North of Cactus Road
Looking Upstream



Site 20 – El Mirage Wash at 127th Ave. & Scotts Dr.
Looking Upstream

LOCATIONS RECOMMENDED FOR FURTHER STUDY

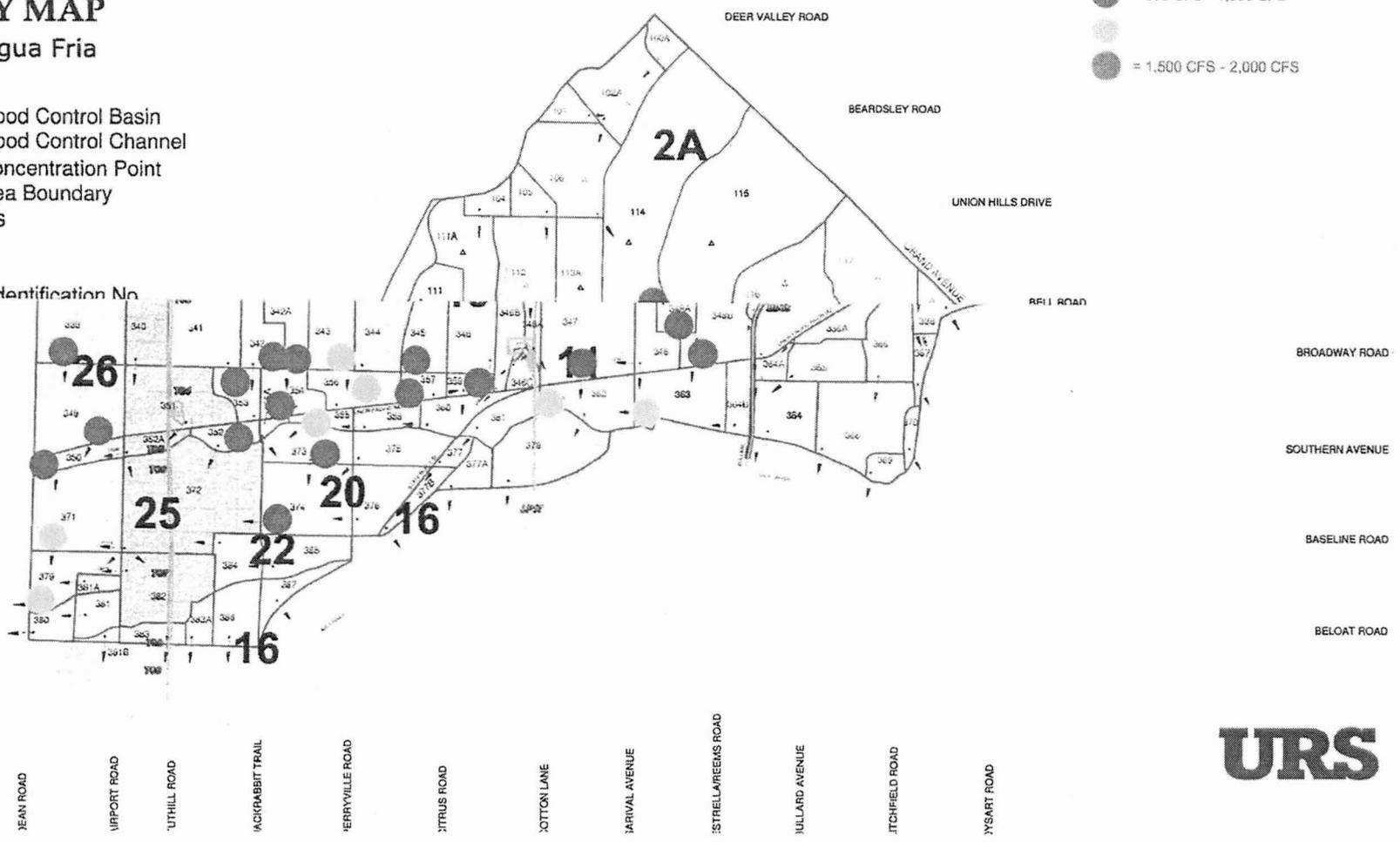
LOOP 303 CORRIDOR/WHITE TANKS AREA DRAINAGE MASTER PLAN UPDATE PROPOSED\WITH PROJECTS IN PLACE

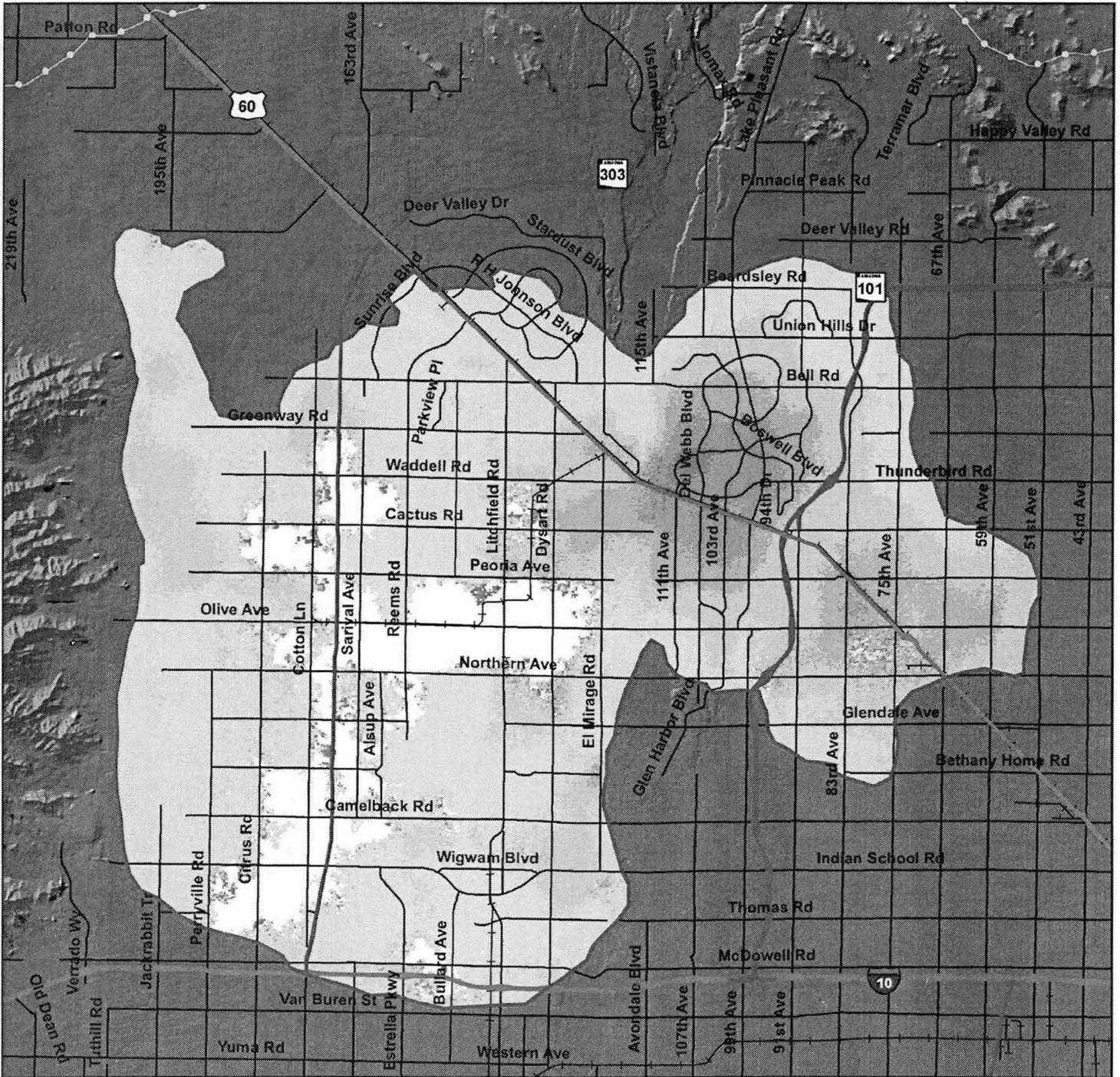
HEC-1 KEY MAP

White Tanks / Agua Fria
Legend

-  Proposed Flood Control Basin
-  Proposed Flood Control Channel
-  Proposed Concentration Point
-  Drainage Area Boundary
- 2C** Super Basins
-  Flow Path
-  Retention
- 111 Sub-basin Identification No

-  = 500 CFS - 1,000 CFS
-  = 1,500 CFS - 2,000 CFS





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Land Subsidence in Western Metropolitan Phoenix
 Based on ADWR EnviSat Time-Series InSAR Data
 Time Period of Analysis: 1.1 Years 01/22/2007 To 02/11/2008

01/22/2007 To 02/11/2008

Subsidence

- Decorrelation/No Data
- 2.0 To -3.0 cm
- 1.5 To -2.0 cm
- 1.0 To -1.5 cm
- 0.5 To -1.0 cm
- 0 To -0.5 cm

- Subsidence Feature
- Hardrock
- CAP Canal

Arizona Highways and Interstates

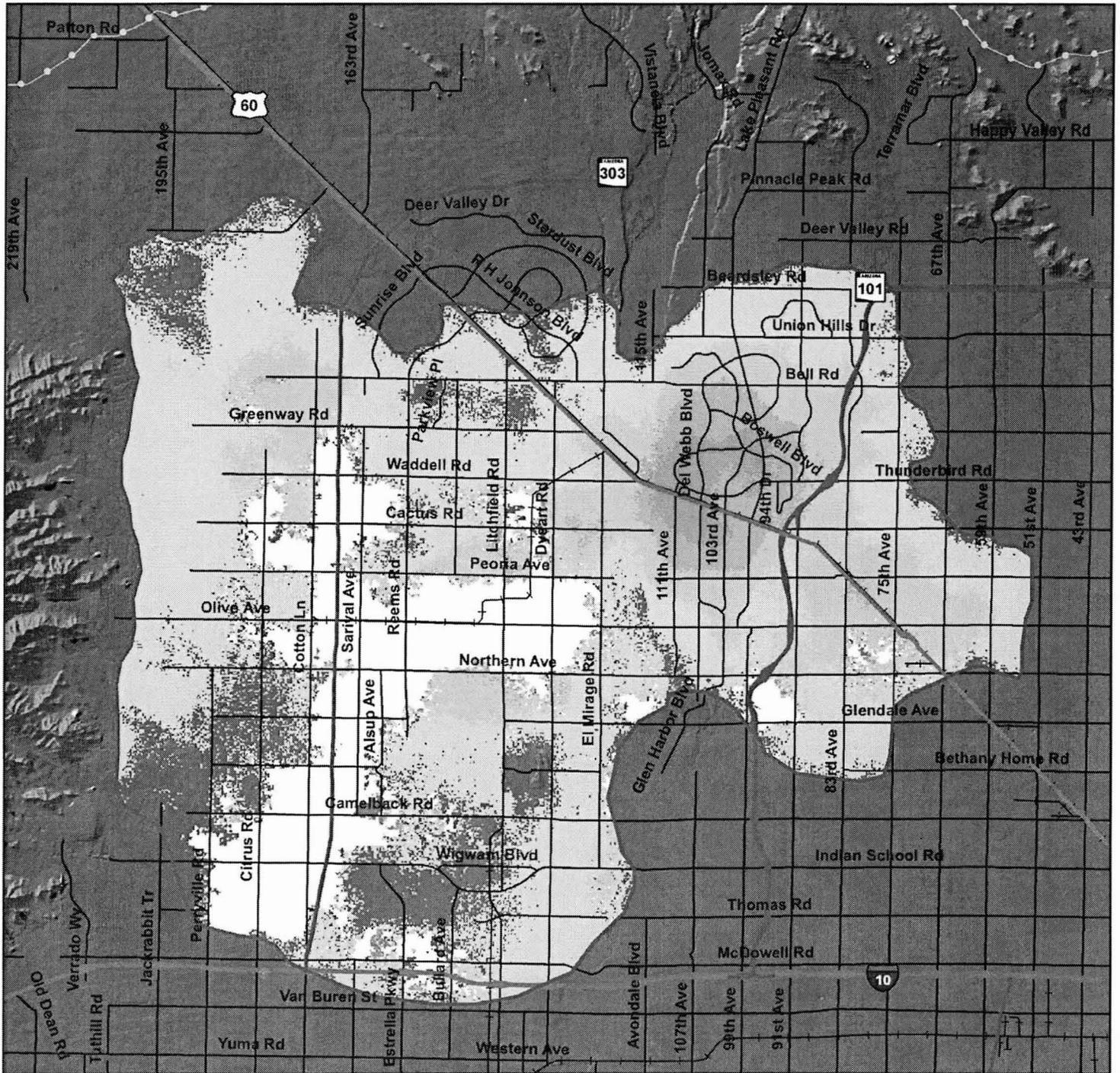
- Interstate
- US
- State
- Roads
- Railway

1:183,029



Decorrelation (white areas) are areas where the phase of the received satellite signal changed between satellite passes, causing the data to be unusable. This occurs in areas where the land surface has been disturbed (i.e. bodies of water, snow, agriculture areas, areas of development, etc).





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Land Subsidence in Western Metropolitan Phoenix
 Based on ADWR EnviSat Time-Series InSAR Data
 Time Period of Analysis: 1.9 Years 03/13/2006 To 02/11/2008

03/13/2006 To 02/11/2008

Subsidence

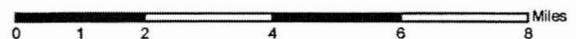
- Decorrelation/No Data
- 5 To -6 cm
- 4 To -5 cm
- 3 To -4 cm
- 2 To -3 cm
- 1 To -2 cm
- 0 To -1 cm

- Subsidence Feature
- Hardrock
- CAP Canal

Arizona Highways and Interstates

- Interstate
- US
- State
- Roads
- Railway

1:183,029

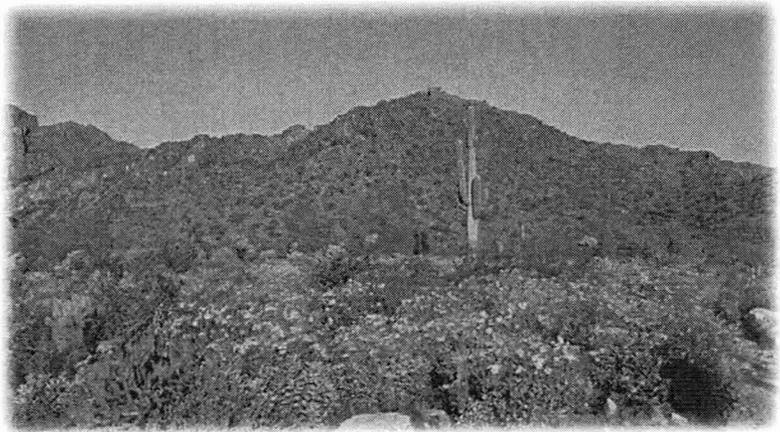


Decorrelation (white areas) are areas where the phase of the received satellite signal changed between satellite passes, causing the data to be unusable. This occurs in areas where the land surface has been disturbed (i.e. bodies of water, snow, agriculture areas, areas of development, etc).



Memorandums and Investigations

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona



To: Valerie Swick/FCDMC
John Holmes/FCDMC

From: Linda Potter/HDR

Project: Loop 303/White Tanks ADMPU Area
Hydrologic Analysis

CC: File

Date: June 23, 2008

Job No: 79902

RE: Loop 303/WhiteTanks ADMPU Area Hydrologic Analysis – Hydrologic Modeling Technical Approaches

This memo documents the proposed technical approaches and assumptions that will be used with the new regional HEC-1 hydrology model created for the Loop 303/White Tanks ADMPU Area Hydrologic Analysis (Loop 303/WT ADMPU AHA) project.

1. Precipitation – Due to the large size of the watershed, it was unknown if precipitation estimates would vary significantly across the watershed. In order to determine the precipitation variability, numerous locations within the watershed were surveyed using NOAA Atlas 14 data. The watershed was divided into two distinct areas: subbasins generally located within the White Tank Mountains/foothills (the far western portion of the watershed), and all other subbasins, which are similar and located in milder terrain. The results indicate that precipitation estimate variability is generally low within each of the two regions (see attached spreadsheet for numerical results). Therefore, a basin average precipitation value for each region will be used in the HEC-1 model.
2. S-graphs will be used and converted into unit hydrographs to perform the hydrologic routing. The Clark Unit Hydrograph will not be used as it has an upper watershed limit of 10 square miles.
3. Rainfall losses for each subbasin will be calculated using Green and Ampt. Channel transmission losses will be assumed to be zero in man-made and lined channels. Normal depth routing will be used.
4. Stock ponds and agricultural water quality storage basins will be assumed to be full in all storm events.
5. Canals, railroad embankments, and roadway embankments will be assumed to remain intact and functional during all storm events unless a reasonable expectation of failure exists. An example of a reasonable expectation of failure would be overtopping of an embankment during a storm event where the overtopping location was not specifically designed to carry such flows.
6. Conveyance from detention basin bleed pipes will be ignored for pipe sizes 24" in diameter and smaller. Basins will be assumed to be 80% effective, including underground retention.
7. The time step used will be 5 minutes and the number of ordinates will be 600.
8. Areal Reduction: as previously discussed, a sensitivity analysis will be performed on areal reduction as it relates to diversions in the model. The results of the sensitivity analysis will determine the methodology.

To: Valerie Swick, FCDMC John Holmes, FCDMC	
From: Linda Potter, HDR Huagao Tan, HDR	Project: Loop 303/White Tanks ADMPU Area Hydrologic Analysis
CC: Janelle Moyer, HDR Elisa Cote, HDR File	
Date: September 17, 2008	Job No: 79902

RE: Loop 303/WhiteTanks ADMPU Area Hydrologic Analysis – Hydrologic Modeling Approach to Agricultural Land

I. Review of Previous Methodologies

Two previous methodologies in the area were reviewed and discussions were held with District staff. Findings are summarized below:

A. Technical Memorandum by G. V. Sabol, January 1992 (“Sabol Method”)

This study developed a new Lag relation for unit hydrograph. The traditional Lag equations in use are:

$$Lag = 26K_n \left(\frac{LL_{ca}}{S^{1/2}} \right)^{0.33} \quad \text{by USBR} \quad (1)$$

and

$$Lag = 24K_n \left(\frac{LL_{ca}}{S^{1/2}} \right)^{0.38} \quad \text{by Corps of Engineers} \quad (2)$$

This study recommended the following equation:

$$Lag = CL \left(\frac{LL_{ca}}{S^2} \right)^{0.25} \quad (3)$$

Where CL is a coefficient. For agricultural watershed,

$$CL = 4.5A^{0.1}S^{0.3} \quad (4)$$

Where A is drainage area in square miles, S is watershed slope in feet per mile.

Equation (3) was developed based on Equations (1) and (2) and a very rough similitude analysis. Equation (4) was developed with regression analysis using USBR data. It should be noted that data for agricultural watershed are not available. Equation (4) was actually obtained by applying a resistance factor (3) to the equation for Mountain and Desert Watershed.

The new Lag equation (Eq. 3) may be a theoretical improvement over the traditional Lag equation. The new Lag equation is more sensitive to slope than the traditional equations. This greater sensitivity to slope may lead to improved estimates of Lag. Another advantage of the new Lag equation is that the equation can be applied by using readily obtainable watershed characteristics without subjective decisions, such as selection of Kn in the traditional Lag equations.

B. Buckeye/Sun Valley Area Drainage Master Plan, Agricultural Pilot Study – Hydrology Report, by Entellus, January 2005 (“Entellus Method”)

This study refined current methods and assumptions used to determine runoff from irrigated farmlands. Current methods used in Maricopa County assume that agricultural areas are completely saturated with irrigation water prior to a storm.

This study performed a rainfall/runoff study for a 5 square mile area within the Buckeye/Sun Valley watershed. The pilot study area is almost entirely agricultural farm lands. The study included: Data Collection, Calibration of Parameters, Modeling of the Pilot Study Area, and Recommendations for District Methodology Changes. Data was collected from various sources to determine typical hydrologic characteristics of the fields within the study area, mainly from Buckeye/Sun Valley National Resources Conservation District (NRCD). There were no measurements of rainfall runoff available in the area. Instead, the NRCD irrigation efficiency data was used that included measurements of irrigation flows, tailwater volumes and timing. This data was used to calibrate hydrologic parameters. The calibrated hydrologic parameters were used to model the pilot study area. Recommendations were made on how the District methodology could be modified to represent agricultural developments throughout Maricopa County.

The following parameters were calibrated in this study: Lag Time, Soil Moisture Deficit, and Initial Abstraction. The recommended parameter values are compared with those by the District in **Table 1**.

C. Discussions with District Staff and Stakeholders

Informal discussions were held with Julie Cox and Amir Motamedi at the District. They indicated that using the modified methods will result in significantly reduced flows, and should be considered before designing infrastructure. Additionally, a potential for increased runoff exists for future conditions, as future development may actually contribute more flow (even with 100-year, 2-hour retention) than agricultural conditions.

II. Conclusions

1. The Lag equation developed by Sabol may be a theoretical improvement over the traditional Lag equation. This by itself may have value to the theoretical hydrologist, but offers little to the practicing hydrologist. The empirical coefficient equation was developed based on very limited data. Further study is needed.
2. The Entellus study did a comprehensive analysis on the characteristics of agricultural watershed. It includes in-depth discussions on the many factors affecting the various hydrologic parameters. It then refined current methods and assumptions used to determine runoff from agricultural areas in Maricopa County.

3. The suggested parameters by Entellus were developed using very limited data. Further studies are needed to further develop the recommended parameters.
4. Using the Entellus method will significantly reduce the resulting peak flows.

Table 1 - Comparison of Parameters

Parameter	District Methodology Value	Entellus Recommended
Flow Routing	Flow routed along roadways	Route flow through fields or ditches unless evidence supports doing otherwise.
Lag Time Equation (Kn)	$0.6 < Kn < 0.15$	Kn = 0.20
IA	0.5 inch	1.0 inch
DTHETA	0	0.05 ~ 0.22 (see Table 4.3 of the report)
PSIF	Varies	Use current District recommended values
XKSAT	Varies	Use current District recommended values
RTIMP	0%	Use current District recommended values

III. Recommendations

HDR recommends using the current parameter values as published in the *Drainage Design Manual for Maricopa County – Hydrology* for modeling land that is currently utilized for agricultural purposes in the Loop 303/White Tanks ADMPU Area Hydrologic Analysis project. These parameter values are

summarized above in **Table 1**, above, under the "District Methodology Value" column. The modified methods by Sabol and Entellus are not recommended for use on this study for the following reasons:

- The entire study area is anticipated to be redeveloped in the future. Using reduced amounts in the model may result in undersized regional drainage facilities in the future.
- Agricultural use of the land varies significantly in terms of runoff parameters. The land may not be farmed every year, irrigation delivery is variable, crops are rotated, growing seasons vary, and even tilling directions may be switched which can affect runoff. Agricultural practices are dynamic in nature and impossible to predict, and therefore cannot be relied upon as a justification for reduced runoff rates.

RETENTION BASIN DESIGN VS. ACTUAL VOLUMES

Report Name	Prepared for:	Prepared by:	Date:	# Basins	Volume Provided from Report (ac-ft)	Volume determined from aerial (assumed 4:1 side slopes and 3' deep) (ac-ft)
Final Drainage Report for Rancho Mirage	Marwest Group	Hook Engineering, Inc.	6/2/99	4	8.50	8.56
Bel Fleur Final Drainage Report	Hancock Communities	Sage Engineering Corp.	4/12/99	4	6.66	7.91
Master Hydrology Report for Countryside	Ryland Homes	Landmark Engineering, Inc	3/10/00	9	29.98	37.25
Final Drainage Report for Sun City Grand Phase 3 Park Place	Del Webb Home Construction, Inc.	Stanley Consultants, Inc.	4/12/01	2	3.05	3.88
Master Drainage Report for Roseview	Woodside Homes	Coe & Van Loo Consultants, Inc.	3/1/99	6	46.40	46.95
TOTAL				25		



RETENTION BASIN CALCULATIONS
MASTER DRAINAGE REPORT FOR ROSEVIEW
RETENTION VOLUME CALCULATION RECORD
(100-year, 6-hour)

Retention Basin ID	Contributing Area	Total Area (acres) A	Weighted C value C	Precip. depth (inches) P	Volume Required (acre · ft) V _{req}	Volume Provided	
						Depth (ft)	Volume Available (acre · ft)
R1	Parcel 1&						
	Lennar at Rosesview	71.5	0.65	2.40	9.3	3.0	9.8
R2	Parcel 2&3	52.0	0.65	2.40	6.8		
	Parcel 6	15.5	0.65	2.40	2.0		
	Lennar at Roseview	44.6	0.65	2.40	5.8		
	Total	112.1	0.65	2.40	14.6	3.0	17.8
R3	Dysart Rd.						
	(Portion of Parcel 1& Parcel 2)	1.1	0.80	2.40	0.2	3.0	0.4
R4	Dysart Rd.						
	(Portion of Parcel 2+ Parcel 3	2.0	0.80	2.40	0.3		
	Parcel 3	7.0	0.65	2.40	0.9		
	Total	9.0	0.68	2.40	1.2	3.0	1.4
R5	Parcel 3	17.2	0.69	2.40	2.4		
& R6	Parcel 4	27.9	0.67	2.40	3.7		
	Parcel 5	43.9	0.65	2.40	5.7		
	Parcel 6	9.0	0.68	2.40	1.2		
	Waddel Rd.	2.3	0.80	2.40	0.4		
	(Portion of Parcel 4)						
	Dysart Rd.	2.8	0.80	2.40	0.4		
	(Portion of Parcel 3 + Parcel 4)						
	Total	103.1	0.68	2.40	13.9	3.0	17.0
Totals:		296.8			39.1		46.4

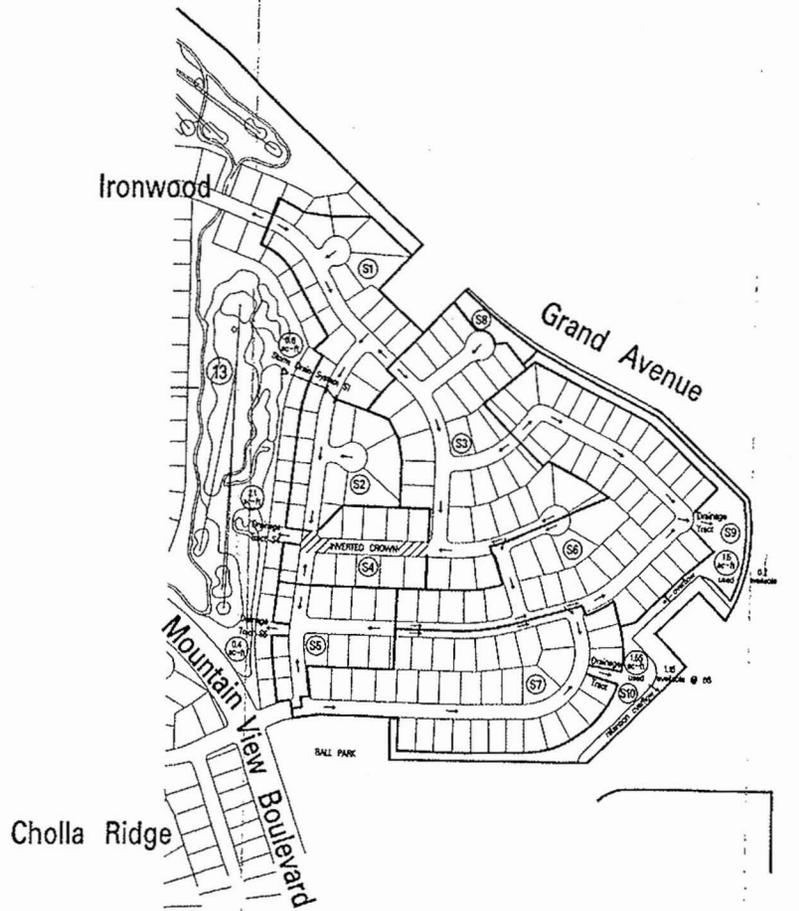
NOTES:

- 1) These volume available calculations are preliminary, however, adequate retention will be provided for each retention basin. Final volume calculations will be provided within the final drainage report.
- 2) C values used to determine the peak flows are as follows: residential areas; C=0.65 and for collector and arterial roads; C=0.80



Del Webb's Sun City Grand®

DRAINAGE REPORT
Sun City Grand Phase III



"Park Place" Subdivision

LEGEND

- (S1) Catch Basin
- Flow direction
- Catch Basin
- Storm Drain Pipe
- Manhole
- ◊ Orchest
- Storm Drain System
- 100' 100'-0" 2'-1/2" storm valve

DRAINAGE MAP



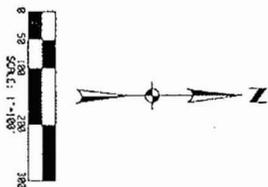
A Stanley Group Company
Engineering, Environmental
and Construction Services - Worldwide





Retention Volume Calculations 100-yr, 2-hr. Prec'p 2.7 -inches
Run-off Coefficient 0.65

(1) Drainage Area	(2) Contributing Area (Ac)	(3) Runoff Coefficient C	(4) Retention Volume Required For Drainage Area Only (c.f.)	(5) Carry-Over Retention Volume From U.S. Drainage Areas (c.f.)	(6) Total Retention Required At Basin (c.f.)	(7) Area Ret. Basin Bot, Ab (s.f.)	(8) Area Ret. Basin Top, At (s.f.)	(9) Area Ret. Basin Avg, Aa (s.f.)	(10) Maximum High-Water Elevation. H.W.E.	(11) Bot. Ret. Basin El.	(12) Maximum Ret. Basin Depth (ft)	(13) Volume Retention Provided (c.f.)	(14) Excess Retention Volume (c.f.)	(15) Carry-Over Retention Volume To D.S. Drainage Areas (c.f.)
F	26.3	0.65	167,548		167,548	88,300	145,000	116,650	1216.5	1215.0	1.5	174,975	7,427	0
K	43.6	0.65	277,760	0	277,760	94,000	148,000	121,000	1211.0	1208.0	3.0	363,000	85,240	0
L	15.7	0.65	100,019	0	100,019	200	11,500	5,850	1207.0	1204.0	3.0	17,550	0	82,469
M	14.5	0.65	92,374	82,469	174,844	51,200	74,500	62,850	1206.0	1203.0	3.0	188,550	13,706	0
T	3.8	0.65	24,208	0	24,208	3,800	12,800	8,300	1213.0	1210.0	3.0	24,900	692	0
U	21.1	0.65	134,421	0	134,421	27,500	57,600	42,550	1206.0	1203.0	3.0	127,650	0	6,771
V	7.5	0.65	47,780	6,771	54,551	11,300	22,000	16,650	1203.0	1200.0	3.0	49,950	0	4,601
W	26.3	0.65	167,548	4,601	172,149	117,200	157,400	137,300	1201.0	1199.5	1.5	205,950	33,801	0
X	3.9	0.65	24,846	0	24,846	5,400	15,200	10,300	1207.0	1204.0	3.0	30,900	6,054	0
Y	11.3	0.65	71,988	0	71,988	30,000	51,600	40,800	1207.0	1204.0	3.0	122,400	50,412	0



1 20 1 04 1325 SCALE 1" = 100' 0 10 20 30 40 50 60 70 80 90 100	REVISIONS NO. DATE BY 1 11/15/98 2 11/15/98 3 11/15/98 4 11/15/98 5 11/15/98	SHEET NO. 1 OF 1		sage engineering corporation 3114 S. 48th St. - SUITE B PHOENIX, ARIZONA 85040 480-256-5971 FAX 480-252-3381		SHEET NO. 1 OF 1





sage engineering corporation

3414 S. 48th Street
Suite 8
Phoenix, Arizona 85040
(602) 966-9971

PROJECT BEL FLEUR
SUBJECT RETENTION REQUIREMENT

PROJECT NUMBER 1216098
SHEET NO. 1 OF 1
DATE 4/15/99 BY RPA

PROJECT GROSS AREA : 45.41 ACRES = 1,978,060 S.F.

$$V = C \frac{L}{12} A$$

C = 0.65 FOR SINGLE FAMILY RESIDENTIAL

$$L_{2HR}^{100yr} = 2.6 \text{ IN.}$$

$$A = 1,978,060 \text{ SF}$$

$$V = .65 \left(\frac{2.6}{12} \right) (1,978,000) = \boxed{278,577 \text{ cu ft. of STORAGE REQ'D}}$$

Basin VOLUMES

$$\text{TRACT D (SMALL)} = 13405.5 \text{ cuft}$$

$$\text{TRACT C} = 24737.4 \text{ cuft}$$

$$\text{TRACT E} = 166568.4 \text{ cuft}$$

$$\text{TRACT D (LARGE)} = 85484.7 \text{ cuft}$$

$$\boxed{290,196 \text{ cuft of STORAGE REQ'D}}$$



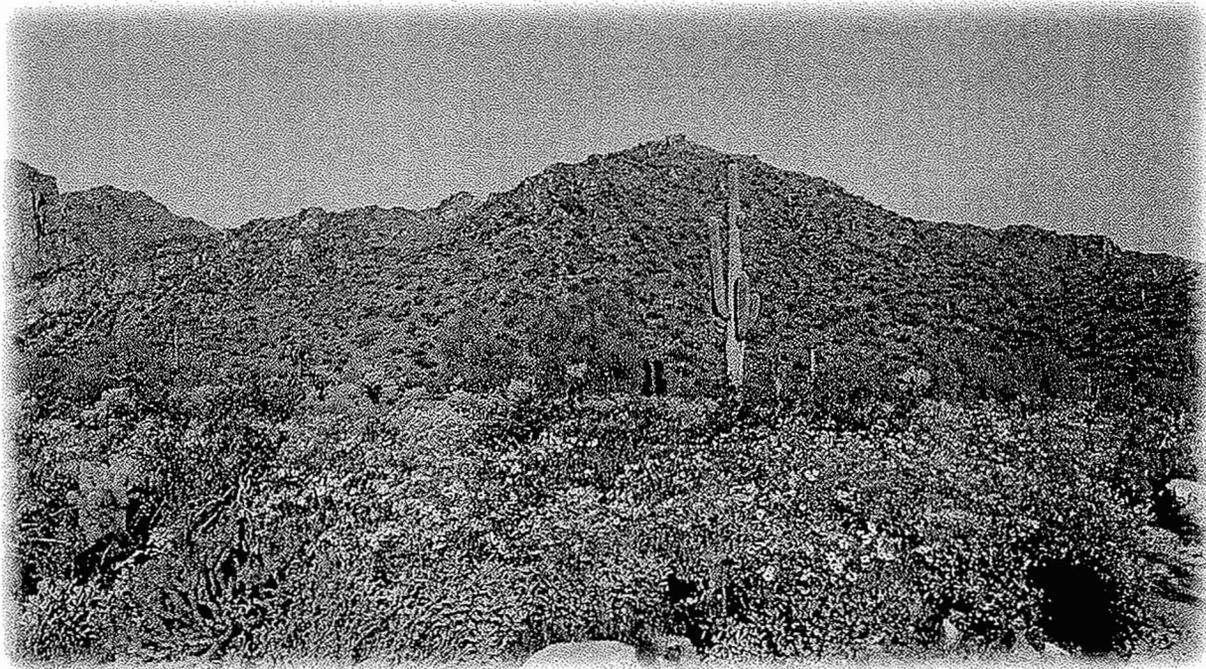
Retention Basin calculations can be found in Appendix E, the results of which, are summarized below:

Basin #	Volume Required (CF)	Volume Provided (CF)
1	22,910	17,254*
2	160,883 + 5,656* = 166,539	159,880
3	56,349	53,203**
4	<u>118,318 + 3,146** = 121,464</u>	<u>129,412</u>
Totals	358,460	370,371

* Excess runoff not contained in Basin #1 will overflow and be contained in Basin #2. ** Excess runoff not contained in Basin #3 will overflow and be contained in Basin #4. Appendix E contains the overall detailed retention calculations for this project.

The results of the percolation tests for the project as performed by Foree & Vann, Inc. are included in Appendix F. The results indicate stabilized infiltration rates of 26.7 and 16.0 minutes per inch, which are equivalent to 5.34 and 3.20 hours per foot (min./in. x 1 hr./60 min. x 12 in./ft.), respectively. Based on the test results, we can conclude that all retention basins on the project will drain in less than 36 hours. Calculations for each basin are provided below:

<u>BASIN</u>	<u>DEPTH</u>	X	<u>PERC. RATE</u>	=	<u>DRAIN TIME</u>
1	3 ft.		5.34 hours/ft.		16.0 hours
2	3 ft.		5.34 hours/ft.		16.0 hours
3	3 ft.		3.20 hours/ft.		9.6 hours
4	3 ft.		3.20 hours/ft.		9.6 hours



Draft Sensitivity Analysis Memo

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona

Flood Control District of Maricopa County



Version 1.0 / September 2008
HDR Project No. 079902
FCD Contract No. 2007C031

To: Valerie Swick, P.H., E.I.T, CFM, Flood Control District of Maricopa County		
From: Linda Potter, P.E., CFM	Project: Loop 303 / White Tanks ADMPU Area Hydrologic Analysis	
CC: Steve Beasley, P.E., Arizona Department of Transportation		
Date: September 19, 2008	Job No: HDR-79902	FCD 2007C031

RE: Loop 303 / White Tanks ADMPU AHA – Sensitivity Analysis Memorandum

Introduction

This memorandum summarizes the work performed under the Sensitivity Analysis task item of Contract FCD2007C031, Change Order 1, Task 9:10, for the Loop 303 / White Tanks Area Drainage Master Plan Update – Area Hydrologic Analysis (ADMPU AHA). The purpose of the Sensitivity Analysis is to determine the best approach for application of areal reduction in the watershed.

Background

The Loop 303 / White Tanks ADMPU AHA study area is approximately 238 square miles and generally bounded by McMicken Dam on the north, the Agua Fria River on the east, the Gila River on the south, and the White Tank Mountain divide and Dean Road on the west. Due to the large size of the watershed, a reduction factor is necessary to convert point rainfall to an equivalent uniform depth to reflect the size of the watershed.

The rainfall depths from the isopluvial maps in the Drainage Design Manual of Maricopa County (DDMMC) are point rainfalls for specified frequencies and durations. This is the depth of rainfall that is expected to occur at a point in a watershed for the specified frequency and duration. However, this depth is not averaged to reflect the areal extents of the rainfall over the basin that would occur during a storm, since the intensity tends to decrease rapidly with increasing area in Maricopa County. A reduction factor is used to convert the point rainfall to an equivalent uniform depth of rainfall over the entire watershed.

For single storm simulations, the point rainfall is reduced according to the size of the watershed and introduced in the model as a fixed input parameter. When multiple storm simulations are performed, the area reduction is executed in HEC-1 using the JD records. The JD records allow for dynamic point rainfall corrections that occur at each sub-basin for which a flow hydrograph is generated.

Application of areal reduction is particularly important in watersheds that have numerous flow diversions. In general, a flow diversion is modeled at a location where the inflow (described in the DI record) approaching a certain location (node) divides in two components (outflow and diversion) due to the topography or to the presence of hydraulic structures. The outflow component is the flow that continues on the same flow stem as the inflow, while the diversion component is the flow that is being diverted off the main flow stem and is described in the DQ record.

Diversion simulations performed in a model using areal reduction encounter overestimated peak flows due to a "loss" of tributary area when hydrograph combines occur downstream of a diversion. The issue may be corrected by manually introducing the cumulative tributary area in the second field of the hydrograph combine (HC) record. However, such manual corrections are labor intensive and prone to errors, particularly when the models are complex and/or cover a large watershed.

Modeling Approach – Special Considerations

The "loss" of tributary area occurs because the flow diverted from the main flow stem does not "carry" the tributary area accumulated upstream of the diversion. Hence, at the location where the diverted flow is retrieved, the tributary area accumulated upstream of the hydrograph combine will not account for this upstream area associated with the retrieved flow.

From a modeling stand point at diversions, there are several aspects that must be considered:

1. The proportion of flow diverted with respect to the total inflow at that location;
2. Whether the diversion is retrieved back into the model or not;
3. The location where the diversion is retrieved back into the model; and
4. The character of the storm being modeled (local or general) and its recurrence interval.

The first aspect becomes very important, particularly when the diverted flow is a large fraction of the incoming flow. A general rule should be that the larger fraction of the flow stays on the main flow stem while the smaller fraction is diverted. However, there are situations where the split occurs in equal or close-to-equal fractions, and identifying the main flow stem is not intuitive. In such cases, the other aspects of split flow modeling should be considered and may determine how the split flow is set up.

The second aspect is intuitive and easy to determine; if a flow is completely diverted out of the model, there is no reason to be concerned with respect to areal reduction. This situation typically occurs at the fringes of the watershed, but it may also occur inside the watershed when a retention basin with no bleed-off line (or with a low-capacity bleed-off line) is being modeled. In these cases, no special modeling is necessary.

The third aspect refers to the most common situation where the diversion is retrieved back into the model. The location where the diversion is retrieved makes a difference with respect to whether the tributary area upstream is inclusive of the area associated with the divert or not. If the diversion is brought back into the same flow stem it departed from, there will be no need to consider the tributary area accumulated upstream, as the area was accounted for along the main flow stem.

If the diverted flow is retrieved on a different flow stem than the one it departed, further analysis is needed. The relative weight of the diverted flow with respect to the combined flow at the node downstream of the location of diversion retrieval should be considered. More importantly, the relative weight of the tributary area "lost" by the diversion and the cumulative tributary area on the flow stem where the diversion is retrieved must be evaluated.

If the flow stem cumulative tributary area is much larger (one or more orders of magnitude) than that "lost" by the diverted flow, the effect of not accounting the "lost" tributary area is negligible. However, if the situation is reversed and the "lost" tributary area is much larger than that of the

flow stem, hard-coding an area correction in the HC record may be necessary. As previously mentioned, problems may arise during future use of a model that contains hard-coded information, as these are rarely examined and appropriately adjusted by future users that are unfamiliar with the unique conditions of the watershed.

The fourth aspect emphasizes that the magnitude of the flows generated by different types of storms is different. Such differences have an impact on the split ratio at certain diversions (street intersections, for example) that are sensitive to flow stage and flow direction. Under these conditions, hard-coding for a specific storm creates a fine-tuned model that does not have "dynamic flexibility" built in. Any changes in the model topology, particularly with respect to the split flow ratios would require hard-coding corrections downstream of these locations.

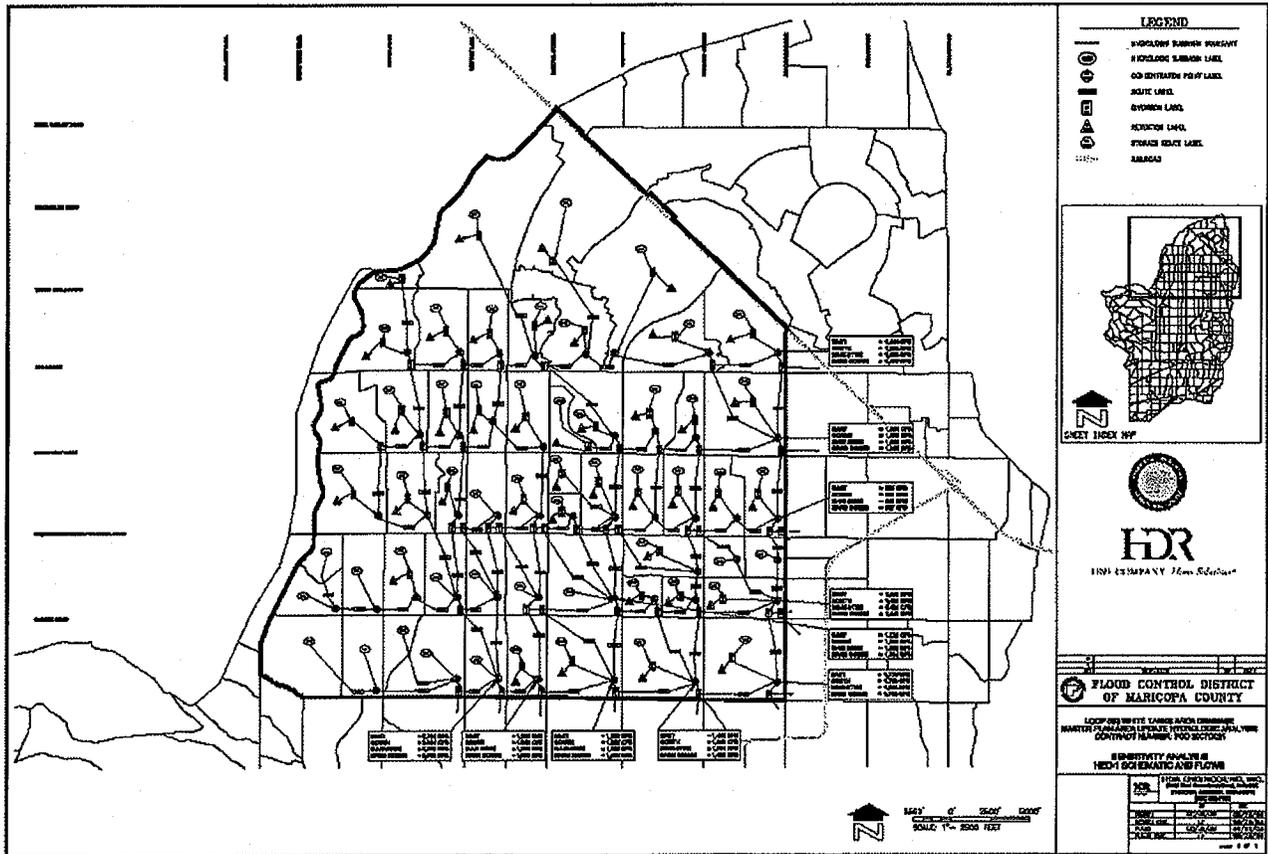
Methodology

To maintain the end-user flexibility and the "dynamic ability" of the model to adapt, it is preferred to avoid hard-coding of areal corrections, and allow the areal associations to remain with the main flow stem. However, as discussed above, this may induce unacceptable errors. Therefore, this sensitivity analysis determines how sensitive the model is to different ways of approaching the split flow modeling.

The following methodology was followed:

1. Preparation of a hydrologic model for the test area. The test area is a 34 square mile area within the 238 square mile watershed as shown in **Sheet 1**. The general flow direction is to the southeast, and flow splits tend to occur at intersections where some flow goes east and some to the south.
2. Reconfiguring of the hydrologic model to force a main flow stem ("East" and "South" models). The model described above was adapted into two non hard-coded models, each of them maintaining a consistent main flow stem direction (one east and one south) as far as flow split diversions are concerned. These models disregard the distribution of diverted flow; the main flow stem is forced to be always according to direction (either east or south), not according to flows. Therefore, in HEC-1, the main flow stem will maintain the reduction even if it is only a small percentage of the flow.
3. Reconfiguring of the hydrologic model to account for the main flow stem ("Main Flow" model). A third, non hard-coded hydrologic model was created that maintains a main flow stem according to the four modeling aspects discussed above in the special considerations section, for instance, examining the relative flow amounts at each diversion. For example, if 90% of the flow goes east and 10% of the flow goes south, then the eastern direction would be considered the main flow stem.
4. Adding hard-coded areal reduction ("Hard Coded" model). A fourth model was created based on the third model; this model will be hard-coded to maintain correct areal reduction and will be termed the "hard-coded base" model. It will be used as a basis of comparison for the results of the other models.

The models were run for two types of storms: a low recurrence local storm (100-year, 6-hour) and a low recurrence general storm (100-year, 24-hour). In all cases, the general storm yielded higher peak flows and was used as the basis for comparison.



Sheet 1 – Sensitivity Analysis Area

DRAFT

Special Modeling Considerations

The initial models were created using actual watershed data. However, initial results indicated a few changes would result in a better sensitivity analysis. This included adding some split flow locations and removal of portions of retention in individual subbasins.

The addition of split flow locations was necessary to avoid recombines within the model. For example, the western portion of the model resulted in all of the flow diversions recombining at one location in the middle of the model, before appreciable area had been accumulated. Therefore, a few strategic splits were added to avoid having the diversion brought back into the same flow stem it departed from, which would negate the purpose of the sensitivity analysis.

Additionally, portions of retention were removed when a majority of flow was retained within the subbasin. This was done to avoid skewing the model results due to on-site retention versus true areal reduction. Please note that retention was not eliminated from subbasins, only adjusted to more realistic levels as defined by the volume calculation in Drainage Design Manual of Maricopa County (DDMMC) using the 100-year, 2-hour rainfall depth.

Results

The four models, "East", "South", "Main Flow", and "Hard Coded" were created and simulated in HEC-1. Sheet 1 contains the HEC-1 schematic that was used as the basis for the four models. Table 1, below, contains a summary of the results. Reference the Appendices for more detailed information and HEC-1 output.

Table 1 – Model Results (100-year, 24-hour)

Node	"East"	"South"	"Main Flow"	"Hard Coded"	East	South	Main
	Flow (cfs)				Deviation from "Hard Coded" (%)		
CP D04	1444	1475	1458	1457	-1.0	1.5	0.1
CP D13	1836	1833	1833	1835	0.1	-0.2	-0.2
CP D23	638	592	810	877	-19.3	-23.0	-5.4
CP D36	1448	1430	1462	1449	-0.1	-1.5	1.0
CP D48	1776	1763	1804	1785	-0.7	-1.8	1.5
CP L27	2704	2694	2687	2760	-4.5	-5.3	-5.9
CP D45	1950	1959	1932	1936	1.1	1.9	-0.3
CP D46	1908	1908	1834	1930	-1.8	-1.8	-7.7
CP D47	1463	1619	1501	1498	-2.8	9.8	0.2
CP D30	1726	1748	1660	1754	-2.3	-0.5	-7.6

Table 2 – Cumulative Areas

Node	East	South	Main Flow	Hard Coded
	Cumulative Area (sq mi)			
CP D04	10.32	0.89	5.91	6.50
CP D13	2.93	6.94	6.94	5.74
CP D23	7.07	7.93	13.88	3.02
CP D36	3.42	10.94	1.00	4.08
CP D48	10.37	11.93	1.00	6.42
CP L27	6.97	10.27	14.95	7.84
CP D45	7.46	3.48	7.24	5.04
CP D46	8.38	10.98	18.96	6.93
CP D47	9.38	7.94	7.94	8.14
CP D30	1.42	7.06	18.04	4.74

The sensitivity analysis resulted in differences of flows and cumulative areas based on the four modeling approaches. For example, the forced directional routing at concentration point CPD04 resulted in an almost 10 square mile cumulative area difference, and CPD30 had a difference of almost 17 square miles between two of the scenarios. Flow amounts generally remained within acceptable tolerances, with some exceptions (discussed below).

CPD23 was noted to have flow differences around 20% in the "East" and "South" scenarios from the hard-coded model. These differences are not due to areal reduction; they are caused by the highly directional nature of the flow splits within the drainage area contributing to that point. The flow splits in both scenarios leading to that concentration point cause a larger proportion of flow to be diverted out of the model. This is not expected to be a problem during actual watershed modeling, as it only occurs in the artificial modeling scenarios where directionality was forced in a direction and not based on actual data.

Recommendations

The results of the main stem flow model were within acceptable modeling tolerances, with the maximum deviation from the hard-coded model being less than 8% of the total flow amount. The "East" and "South" models have deviations above acceptable ranges, approaching 25% of the total flow amount. This was expected as previously described, and illustrates the importance of areal reduction considerations.

As discussed above, every watershed has unique aspects that must be considered when applying areal reduction. In general, the L303/White Tanks ADMPU study area tends to act like several smaller watersheds within the larger watershed. This is due to the numerous man-made collection structures that have been developed. These collection structures tend to act as recombiners in respect to areal reduction, where diverted flow recombines with the main flow stem. However, this occasionally does not occur until after a significant area has been accumulated, and it is important that the final model does not contain local flow errors.

It is recommended that the L303/White Tanks ADMPU Area Hydrologic Analysis model use the "main flow stem" method (as described above) for areal reduction, where the model is structured to follow the main flow stem but avoids hard-coding of areas in the model. This will

lessen the potential for errors from future users of the model, who may not adjust the hard-coded areas according to changes they make. However, the model will require examination, and should an unacceptable local areal reduction error occur with this method, an occasional hard-coding of the area into the model may be necessary.

DRAFT

CIP Source Information Documentation

Loop 303/White Tanks ADMPU Area Hydrologic Analysis in
Maricopa County, Arizona



North Inlet Channel-Ex and Ex w/CIP

Diversion at Olive (DW05SE):

- Diversion from L303M3LA.OUT model given to HDR by FCDMC 05062009, Run date 10Nov06
- Split is called D3, main flow goes south. SIDEWR goes east and then parallel.
- SIDEWR does not have a route associated with it.
- Route from Olive to Northern will be from White Tanks FRS #3 North Inlet Channel plans FCD Contract No 2005C019
- Routes from Northern to Glendale will be from the White Tanks FRS#3 North Inlet Channel South Channel plans FCD Contract No 2007C021

Divert at Olive Rd and Perryville-D3

KK	DW05SE									
KM										
DT	DW05SE									
DI	600	800	1000	1200	1400	1600	2000	2400	2715	2800
DQ	105	163	361	498	640	792	1100	1437	1605	1630

- Route-RCP3

KK	W0512A								
RS									
RC	0.05	0.03	0.05	5606	0.0083				
RX	1010	1015	1020	1050	1100	1275	1580	1750	
RY	1251	1249	1249	1245	1244.9	1250	1250	1254	

Typical section for route W0512B from NIC North Channel Plans for Ex and Ex w/CIP Model

KK	W0512B							
RS								
RC	0.022	0.022	0.022	5494	0.0170			
RX	100	120	135	165	220	300	315	379
RY	1244.65	1239.65	1239.5	1232	1231.9	1239.5	1239.65	1255.65

Typical section for route W12W13 from NIC South Channel Plans for Ex and Ex w/CIP Model

- Section is at 535+00 in plans

KK	W12W13							
RS								
RC	0.022	0.022	0.022	2062	0.0051			
RX	100	120	162.5	205	355	397.5	440	460
RY	1218.38	1218.18	1211.1	1203.98	1204.45	1211.53	1218.65	1218.85

Typical section for route W13W16 from NIC South Channel Plans for Ex and Ex w/CIP Model

- Section is at 523+00 in plans

KK	W13W16							
RS								
RC	0.022	0.022	0.022	6257	0.0051			
RX	100	115	162.03	209.05	359.05	435.88	464.97	479.97
RY	1216.92	1216.77	1208.93	1201.09	1203.09	1215.90	1223.54	1223.69

RC	0.035	0.035	0.035	5296	0.0038			
RX	9932.04	9945.17	9964.3	9970.46	10023.52	10027.39	10042.02	10056.64
RY	1120.48	1117.13	1113.79	1112.48	1112.38	1113.41	1116.95	1120.48

D07 Diverts at Corte Bella Country Club Ex and Ex w/CIP

- Original Diverts are Below:

KK DI1S

KM DIVERT FLOW ALONG NORTH BOUNDARY IN EXISTING CHANNEL (BASED ON 1972 AERIAL)

KM TOTAL FLOW AT DIVERSION (DI CARD)

KM CONTINUING FLOW=DI1S (DI-DQ CARDS)

KM DIVERTED FLOW=DI1E (DQ CARD)

DT DI1E

DI 0 9 64 243

DQ 0 9 38 127

* DDM ***** Preserved *****

KKRTDI1S

KM ROUTE HYDROGRAPH DI1S THROUGH DRAINAGE AREA B2 (GOLF COURSE CHANNEL)

RS 1 FLOW -1

RC .035 .03 .035 3000 .005

RX 1000 1004 1264 1272 1282 1290 1296 1300

RY 1288 1286 1286 1284 1284 1286 1286 1288

KK DI2S

KM DIVERT FLOW ALONG NORTH BOUNDARY IN EXISTING CHANNEL (BASED ON 1972 AERIAL)

KM TOTAL FLOW AT DIVERSION (DI CARD)

KM CONTINUING FLOW=DI1S (DI-DQ)

KM DIVERTED FLOW=DI1E (DQ)

DT DI2E

DI 0 11.4 22.9 152.3 289.9

DQ 0 11.4 18 83.2 162

*

KK RT-B1

KM ROUTE HYDROGRAPH SR-B1 THROUGH DRAINAGE AREA B5 (GOLF COURSE CHANNEL)

RS 2 FLOW -1

RC .035 .03 .035 3110 .0067

RX 100 120 196 200 300 301 380 400

RY 1285 1284 1281 1280 1280 1281 1284 1285

KK DI3S

KM DIVERT FLOW ALONG NORTH BOUNDARY IN EXISTING CHANNEL (BASED ON 1972 AERIAL)

KM TOTAL FLOW AT DIVERSION (DI CARD)

KM CONTINUING FLOW=DI3S (DI-DQ)

KM DIVERTED FLOW=DI3E (DQ)

DT DI3E

DI 0 64.8 209 452

DQ 0 64.8 171 345

* DDM ***** Preserved *****

KK RT-3S

KM ROUTE HYDROGRAPH DI3S THROUGH DRAINAGE AREA B6 (GOLF COURSE CHANNEL)

RS 1 FLOW -1

RC .035 .03 .035 1500 .005

RX 1000 1004 1264 1272 1282 1290 1296 1300

RY 1279 1277 1277 1275 1275 1277 1277 1279

KK DI4S

KM DIVERT FLOW ALONG NORTH BOUNDARY IN EXISTING CHANNEL (BASED ON 1972 AERIAL)

KM TOTAL FLOW AT DIVERTION (DI CARD)

KM CONTINUING FLOW=DI4S (DI-DQ)

KM DIVERTED FLOW=DI4E (DQ)

DT DI4E

DI 0 138.7 164.6 352.2 558

DQ 0 138.7 159.8 299.2 450

- Original diverts main flow is to the south. On HDR model main flow will be to east with the exception of DN07D.

- Our Diverts and Routes will be as follows:

KK	DN07A							
KM								
DT	DN07AS							
DI	0	9	64	243	1000			
DQ	0	0	26	116	116			

KK	DN07B							
KM								
DT	DN07BS							
DI	0	11.4	22.9	152.3	289.9	1000		
DQ	0	0	4.9	69.1	127.9	127.9		

KK	DN07C							
KM								
DT	DN07CS							
DI	0	64.4	209	452	1000			
DQ	0	0	38	107	107			

KK	DN07D							
KM								
DT	DN07DS							
DI	0	138.7	164.6	352.2	558	1000		
DQ	0	138.7	159.8	299.2	450	450		

KK	N7AN05							
RS								
RC	0.035	0.03	0.035	10408	0.005			
RX	1000	1004	1262	1272	1282	1290	1296	1300
RY	1288	1286	1286	1284	1283.9	1286	1286	1288

KK	N7BN05							
RS								
RC	0.035	0.03	0.035	8067	0.0067			
RX	100	120	196	200	300	301	380	400
RY	1285	1284	1281	1280	1279.9	1281	1284	1285

KK	N7CN05							
RS								
RC	0.035	0.03	0.035	6212	0.005			
RX	1000	1004	1264	1272	1282	1290	1296	1300
RY	1279	1277	1277	1275	1274.9	1277	1277	1279

Loop 303 from Clearview to Camelback Rd Ex w/CIP

- Model for this segment of Loop 303 will be taken from the EX_SPLIT.DAT model received on May 6, 2009 from PB.

Clearview to Bell Road-RCHNL1

KK	L02L05								
RS									
RC	0.035	0.015	0.035	5263	0.0045				
RX	0	3	5	17	25	37	49	52	
RY	1290	1290	1289	1283	1283	1289	1290	1290	

Bell Road to Greenway-RLPO

KK	L05L09								
RS									
RC	0.035	0.015	0.035	5376	0.0036				
RX	0	3	5	16	26	37	57	60	
RY	1269.5	1268.5	1268.5	1263	1263	1268.5	1268.5	1269.5	

Greenway to Waddell Basin Divert-RLPUS

KK	L0913B								
RS									
RC	0.035	0.015	0.035	3314	0.0037				
RX	0	3	5	15	29	39	59	62	
RY	1248	1247	1247	1242	1242	1247	1247	1248	

Waddell Basin Divert-DLP2A

KK	DL13BN								
KM									
DT	DL13BR								
DI	0	120	300	400	500	600	700	783	900
DQ	0	0	119.8	194.4	278.8	367.9	466.2	549.	663.0

Storage thru Waddell Basin-SRLP2A

KK	SRL13B									
KM										
RS										
SV	0	0.48	1.95	4.98	9.10	13.45	18.05	22.89	27.99	33.34
SV	38.96	44.86	51.02	57.47	64.20	71.91	79.96	88.17		
SE	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232
SE	1233	1234	1235	1236	1237	1238	1239	1240		
SQ	0	6.2	18.4	19.4	20.2	21.1	22.0	22.9	23.7	24.5
SQ	25.22	26.1	26.8	27.5	28.2	245.3	767.1	1687.8		

KK	SRL13B									
KM										
RS										
SV	0	0.48	1.95	4.98	22.89	33.96	64.2	71.91	79.96	88.17
SE	1223	1224	1225	1226	1230	1233	1237	1238	1239	1240
SQ	0	6.2	18.4	19.4	22.9	25.22	28.2	245.3	767.1	1687.8

Route from Waddell Basin overflow combine to Waddell Road-RLPDS

KK	L13B13								
RS									
RC	0.035	0.015	0.035	1594	0.0036				
RX	0	3	5	15	31	41	61	64	
RY	1134	1133	1132.9	1128	1127.9	1132.9	1133	1134	

Route from Waddell Road to Drop Structure 5-RLP1-1

KK	L13D55								
RS									
RC	0.035	0.015	0.035	2450	0.0035				
RX	0	3	5	17	33	45	65	68	
RY	1227	1226	1225.9	1220	1220.1	1225.9	1226	1227	

Route from Drop Structure 5 to Cactus Road-RLP1-2

	DS5L19								
RS									
RC	0.035	0.015	0.035	2632	0.0033				
RX	0	3	5	17	42	54	74	77	
RY	1217	1216	1215.9	1210	1209.9	1215.9	1216	1217	

Route from Cactus Road to Drop Structure 7-RLP2-1

KK	L19DS7								
RS									
RC	0.035	0.015	0.035	2065	0.0040				
RX	0	3	5	17	52	64	84	87	
RY	1204	1203	1202.9	1197	1196.9	1202.9	1203	1204	

Route from Drop Structure 7 to Peoria Ave-RLP2-2

KK	DS7L27								
RS									
RC	0.035	0.015	0.035	3055	0.0033				
RX	0	3	5	17	62	74	94	97	
RY	1196	1195	1194.9	1189	1189	1194.9	1195	1196	

Route from Peoria Ave to Concentration Point in L34-RLP3-1

KK	L27L34								
RS									
RC	0.035	0.015	0.035	2233	0.0034				
RX	0	3	5	17	62	74	94	97	
RY	1177	1176	1175.9	1170	1169.9	1176	1176	1177	

Olive Basin Divert-DLP3A

KK	DL34BN									
KM										
DT	DL34BR									
DI	0	415	1000	1500	2000	2500	3000	3500	4000	4500
DQ	0	0	356	688	956	1301	1714	2144	2567	3027

Storage thru Olive Basin-SRLP3A

KK	SRL34B									
KM										
RS										
SV	0	1.76	6.08	14.84	30.50	50.78	71.58	92.9	114.74	137.11
SV	160.02	183.46	207.45	231.99	257.08	282.74	310.25	338.42	366.89	395.64
SE	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166
SE	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176
SQ	0	11	36.5	59.5	67.5	74.3	81.4	87.9	94.0	99.7
SQ	105.0	110.1	125.4	158.6	205	260.2	531.2	1478.5	2805.3	5584.1

KK	SRL34B									
KM										
RS										
SV	0	1.76	6.08	14.84	92.9	207.45	310.42	338.42	366.89	395.64
SE	1157	1158	1159	1160	1164	1169	1173	1174	1175	1176
SQ	0	11	36.5	59.5	87.9	125.4	531.2	1478.5	2805.3	5584.1

Route from Olive Basin overflow combine to Olive Road-RLP3-2

KK	L34B34								
RS									
RC	0.035	0.015	0.035	2685	0.0026				
RX	0	3	5	15	41	51	71	74	
RY	1174	1173	1173	1167	1167	1173	1173	1174	

Route from Olive Road to Drop Structure 11-RLP4-1

KK	34DS11								
RS									
RC	0.035	0.015	0.035	1942	0.0046				
RX	0	3	5	16	42	53	73	76	
RY	1161.5	1160.5	1160.5	1155	1155	1160.5	1160.5	1161.5	

Route from Drop Structure 11 to Concentration Point in L39-RLP4-2

KK	DS1139								
RS									
RC	0.035	0.015	0.035	1075	0.0032				
RX	0	3	5	17	53	65	75	78	
RY	1150	1149	1149	1143	1143	1149	1149	1150	

Northern Basin Divert-2DLP5

KK	DL39BN									
KM										
DT	DL39BR									
DI	0	407	1000	1500	2000	2500	3000			
DQ	0	0	263	508	778	1115	1452			

Storage thru Northern Basin-SRLP5

KK	SRL39B									
KM										
RS										
SV	0	1.55	5.79	14.58	29.76	51.34	75.57	101.24	127.03	153.39
SV	1080.31	207.82	235.91	264.58	293.85	323.72	355.57			
SE	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133
SE	1134	1135	1136	1137	1138	1139	1140			
SQ	0	16.2	56.5	35.3	78.2	83.5	88.4	93.1	97.6	102.0
SQ	113.0	123.8	176.2	235.3	301.7	369.1	1007.6			

KK	SRL39B									
KM										
RS										
SV	0	1.55	5.79	14.58	51.34	127.03	207.82	293.85	323.72	355.57
SE	1124	1125	1126	1127	1129	1132	1135	1138	1139	1140
SQ	0	16.2	56.5	35.3	83.5	97.6	123.8	301.7	369.1	1007.6

Route from Northern to Drop Structure 13-RLP5-1

KK	39DS13								
RS									
RC	0.035	0.015	0.035	2427	0.0034				
RX	0	10	13	23	43	53	73	74.8	
RY	1130	1130	1129	1124	1124	1129	1129.4	1130	

Route from Drop Structure 13 to Glendale Ave-RLP5-2

KK	DS1344								
RS									
RC	0.035	0.015	0.035	2700	0.0028				
RX	0	10	13	25	47	59	79	80.8	
RY	1121	1121	1120	1114	1114	1120	1120.4	1130	

Route from Glendale to Drop Structure 14-RLP6-1

KK	44DS14							
RS								
RC	0.035	0.015	0.035	2567	0.0038			
RX	0	10	13	25	50	62	82	83.8
RY	1109	1109	1108	1102	1102	1108	1108.4	1109

Route from Drop Structure 14 to Bethany Home Road-RLP6-2

KK	DS1449							
RS								
RC	0.035	0.015	0.035	2480	0.0041			
RX	0	10	13	25	50	62	82	83.8
RY	1097	1097	1096	1090	1090	1096	1096.4	1097

Route from Bethany Home to Drop Structure 154-RLP7-1

KK	49DS15							
RS								
RC	0.035	0.015	0.035	1899	0.0043			
RX	0	10	13	25	57	69	89	90.8
RY	1087	1087	1086	1080	1080	1086	1086.4	1097

Route from Drop Structure 15 to Camelback Road-RLP7-2

KK	DS1554							
RS								
RC	0.035	0.015	0.035	3152	0.0033			
RX	0	10	13	25	57	69	89	90.8
RY	1077	1077	1076	1070	1070	1076	1076.4	1077

Loop 303 Channel Camelback to Bullard Wash Ex w/CIP

- Model for this segment is from the Camelback CAR dated August 15, 2008 received from FCDMC on May 5, 2009
- The HEC-1 model is called REC-EWP.OUT, run date July 14, 2008

Route from west of Loop 303 to southeast corner of Loop 303 and Camelback Road-DIAG

KK	L54W2E							
RS								
RC	0.020	0.02	0.020	1400	0.0057			
RX	1000	1010	1035	1036	1076	1077	1082	1092
RY	1069	1069	1069	1065	1065	1069	1069	1069

Route from southeast corner of Loop 303 and Camelback to Sarival Avenue-~R237

KK	W2EB56							
RS								
RC	0.032	0.032	0.032	2640	0.0039			
RX	100	124	125	126	145	146	147	171
RY	18	10	10	10	10	10	10	18

Route from Sarival Avenue to Alsup Road-~R238

KK	B46B47							
RS								
RC	0.032	0.032	0.032	1680	0.0015			
RX	100	124	125	126	167	168	169	193
RY	18	10	10	10	10	10	10	18

Storage thru Reems Road Basin-DB252

KK	SRB48							
KM								
RS								
SV	0	23.9	68.5	109.8				
SQ	0	409	817	1156				

Route from Reems Road Basin to the Bullard Wash-~R240

KK	B48B54							
RS								
RC	0.032	0.032	0.032	4128	0.0004			
RX	100	124	125	126	166	167	168	192
RY	18	10	10	10	10	10	10	18

Loop 303 Channel Camelback to McDowell Road Ex w/CIP

- Model for this segment is from the Camelback CAR dated August 15, 2008
- The HEC-1 model is called REC-EWP.OUT, run date July 14, 2008

Storage thru Camelback Basin at northwest corner of Camelback and Loop 303-DB237

KK	SRL54							
KM								
RS								
SV	0	4.8	9.8	15.1	20.6	26.5	32.6	
SQ	0	45	91	136	182	222	257	

Route from Camelback Basin to Indian School Road-RLP8

KK	L54L58							
RS								
RC	0.020	0.02	0.020	5306	0.0034			
RX	100	108	109	110	116	117	118	126
RY	18	10	10	10	10	10	10	18

Route from Indian School to Thomas Rd-RLP9

KK	L58L63							
RS								
RC	0.020	0.020	0.020	1423	0.0038			
RX	100	108	109	110	116	117	118	126
RY	18	10	10	10	10	10	10	18

KK	L63L64							
RS								
RC	0.020	0.020	0.020	4081	0.0038			
RX	100	108	109	110	116	117	118	126
RY	18	10	10	10	10	10	10	18

Route from Thomas Road to McDowell Road-RLP10

KK	L64L67							
RS								
RC	0.020	0.020	0.020		0.0032			
RX	100	108	109	110	118	119	120	128
RY	18	10	10	10	10	10	10	18

KK	L67L68							
RS								
RC	0.020	0.020	0.020	802	0.0032			
RX	100	108	109	110	118	119	120	128
RY	18	10	10	10	10	10	10	18

I-10 Diversion Channel Ex w/CIP

- The model that will be used for this portion of the CIP model will be the EX_SPLIT.DAT model sent to HDR by PB on May 6, 2009.

Route from 191st Ave to Perryville Road-R10W1

KK	W32L65								
RS									
RC	0.030	0.030	0.030	1714	0.0042				
RX	0	34.2	39.2	44.2	49.2	54.2	59.2	93.4	
RY	1045.4	1039.7	1039.7	1039.7	1039.7	1039.7	1039.7	1045.4	

Route from Perryville Road to 185th Ave-R10W2

KK	L65L69								
RS									
RC	0.030	0.030	0.030	1515	0.0042				
RX	0	34.2	39.8	44.8	49.8	54.8	59.8	94.6	
RY	1045.4	1039.7	1039.7	1039.7	1039.7	1039.7	1039.7	1045.4	

Route from 185th Ave to 183rd Ave-R10W3

KK	L69L70								
RS									
RC	0.030	0.030	0.030	1041	0.0036				
RX	0	37.8	44.8	51.8	58.8	65.8	72.8	110.6	
RY	1021.2	1014.9	1014.9	1014.9	1014.9	1014.9	1017.9	1021.2	

Route from 183rd Ave to Citrus Rd-R10W4

KK	L70L71								
RS									
RC	0.015	0.015	0.015	2645	0.0036				
RX	0	10	20	32	44	56	66	76	
RY	1021	1021	1021	1015	1021	1021	1021	1021	

No Route documented for Citrus to the I-10 Basin, will use the same cross section as L70L71

KK	L71L72								
RS									
RC	0.015	0.015	0.015	5319	0.0036				
RX	0	10	20	32	44	56	66	76	
RY	1021	1021	1021	1015	1021	1021	1021	1021	

Storage at northwest corner of I-10 and Loop 303-SRLP12

KK	SRL72									
KM										
RS										
SV	0	3.55	11.54	24.3	45.12	76.37	119.28	171.99	230.67	295.08
SV	364.38	439.60	521.85	614.90	716.37	820.28	927.24	1037.27		
SE	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012
SE	1013	1014	1015	1016	1017	1018	1019	1020		
SQ	0	9.5	34.7	63.7	74	82.8	138.6	202.1	272.9	340.10
SQ	384	413.5	441.9	468.9	494.5	519.1	542.8	565.5		

- Need to modify basin L72 for the proposed I-10 Diversion Channel

KK	SRL72									
KM										
RS										
SV	0	3.55	24.3	76.37	171.99	295.08	364.38	614.9	927.24	1037.27
SE	1003	1004	1006	1008	1010	1012	1013	1016	1019	1020
SQ	0	9.5	63.7	82.8	202.1	340.1	384	468.9	542.8	565.5

Waddell Road Area and El Mirage Basin Improvements Ex w/CIP

- The information for this improvement was taken from the Waddell Road Drainage Improvements CAR Final prepared by HDR April 10, 2009.
- The HEC-1 model used was RECPLANW.OUT
- These improvements are along Litchfield Road between Waddell and Sweetwater Road and along Waddell between Litchfield and Dysart and along Dysart Road between Waddell and north of Sweetwater.

Route from Litchfield Road to AT&SF Alignment -R137

KK	D23D24								
RS									
RC	0.035	0.035	0.035	2646	0.0044				
RX	894	906	912	918	926	930	934	942	
RY	1157	1155	1154	1153	1153	1154	1155	1157	

Route from AT&SF Alignment to Dysart Road-R138

KK	D24D25								
RS									
RC	0.03	0.03	0.03	2701	0.0020				
RX	1000	1018	1019	1020	1026	1027	1028	1046	
RY	1100	1094	1094	1094	1094	1094	1094	1100	

Route from Waddell Road to Sweetwater along west side of Dysart Rd-RLLE

KK	D25D39								
RS									
RC	0.030	0.030	0.030	2020	0.004				
RX	0	20	25	30	35	41.5	51.1	82.3	
RY	10	0	0	0	0	0	4.8	10	

Route from Sweetwater to Cactus Rd-RLLE1

KK	D39D42								
RS									
RC	0.030	0.030	0.030	5691	0.0039				
RX	0	30	38	54	76.5	104	139	154	
RY	10	4	4	0	0	0	7	10	

Route from Waddell to Cactus Rd-RLE2

KK	D27D42								
RS									
RC	0.030	0.030	0.030	5599	0.0020				
RX	0	24.4	34.4	44.4	54.4	64.4	74.4	98.8	
RY	1128.5	1122.4	1122.4	1122.4	1122.4	1122.4	1122.4	1128.5	

Storage behind the proposed 20x10ft con-arch at Cactus-SRLE3

KK	SRD42								
KM									
RS									
SV	0	0.64	4.6	17.3	27.6	56.3			
SE	1105.3	1108	1110	1112	1114	1116			
SQ	0	0	139	426	827	1295			

Route from con-arch to Cactus Detention Basin-RLE3

KK	D42D53								
RS									
RC	0.030	0.030	0.030	1558	0.0020				
RX	0	10	22	97	171	172	184	194	
RY	3.5	3	0	0	0	0	3	3.5	

AT&SF Railroad Channel Ex w/CIP

- Model for this improvement is the AT&SF.OUT received from FCD on April 24, 2009

Route from Waddell Road to Sweetwater (for future?)-R137

KK	D23D28								
RS									
RC	0.035	0.035	0.035	4800	0.0044				
RX	894	906	912	918	926	930	934	942	
RY	1157	1155	1154	1153	1153	1154	1155	1157	

Route from Sweetwater to Cactus-RRR2

KK	D38D40								
RS									
RC	0.035	0.035	0.035	2595	0.0015				
RX	0	10	20	36	76	92	100	110	
RY	1140	1140	1140	1136	1136	1140	1140	1140	

Route from Litchfield Road to AT&SF Channel-R151

KK	D36D40								
RS									
RC	0.08	0.035	0.035	2600	0.0027				
RX	1000	1090	1710	2160	2240	2268	2269	2270	
RY	1141	1140	1138	1136	1136	1137	1137	1137	

Route from Cactus Road to Varney Rd-RRR3

KK	D4049A								
RS									
RC	0.013	0.013	0.013	1983	0.0013				
RX	0	10	20	28	43	51	60	70	
RY	1130	1130	1130	1126	1126	1130	1130	1130	

Route from Varney Rd to Peoria-RRRW

KK	D4049B								
RS									
RC	0.013	0.013	0.013	3185	0.0033				
RX	0	10	20	20.1	34.9	35	40	50	
RY	1130	1130	1130	1126	1126	1130	1130	1130	

Route from Peoria to Mountain View Rd Alignment-RRR4

KK	D49D63								
RS									
RC	0.035	0.035	0.035	950	0.0015				
RX	0	10	20	36	86	102	110	120	
RY	1114	1114	1114	1110	1110	1114	1114	1114	

Storage behind the new basin located at railroad curve-SRRR5

KK	SRD63								
KM									
RS									
SV	0	4.55	22.1	52.9	108.2	174.6	245	336	397
SE	1095	1098	1100	1102	1104	1106	1108	1110	1112
SQ	0	35	60	335	715	915	1065	1225	1385

Route from Storage behind AT&SF railroad to Olive Ave-RRR5

KK	D63D64								
RS									
RC	0.035	0.035	0.035	2580	0.0015				
RX	0	10	20	36	86	102	110	120	
RY	1114	1114	1114	1110	1110	1114	1114	1114	

Route from Olive Ave to Northern Parkway Basin-RRR6

KK	D64D74								
RS									
RC	0.035	0.035	0.035	4000	0.0015				
RX	0	10	20	36	86	102	110	120	
RY	1114	1114	1114	1110	1110	1114	1114	1114	

Route from Litchfield Rd to Northern Parkway Basin (part of Northern Parkway)-R196B

- Channel has 12ft bottom, 4:1 backslope, 6:1 foreslope, unlined

KK	D73A74								
RS									
RC	0.025	0.025	0.025	2050	0.003				
RX	1500	1501	1588	1600	1612	1630	1699	1700	
RY	1102	1101	1101	1098	1098	1101	1101	1102	

Storage behind the new basin located at Northern Parkway-SRRR7

- Outlet pipe is 36"

KK	SRD74									
KM										
RS										
SV	0	0.5	4.2	12.7	23.7	36	49	62	75	89
SE	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082
SQ	0	5	20	35	50	152	325	500	550	620

Route from CP south of basin east-RRR7

- Basin 78 needs to be split into 2 basins at Northern Ave

KK	D78ACP								
RS									
RC	0.013	0.013	0.013	1500	0.0013				
RX	0	10	20	28	43	51	60	70	
RY	1080	1080	1080	1076	1076	1080	1080	1080	

Route from Dysart to 135th Ave Alignment (part of Northern Parkway)-R197

- Channel has 24ft bottom width, 4:1 BS, 6:1 FS, 3' flow depth, unlined

KK	D74A78								
RS									
RC	0.025	0.025	0.025	1300	0.003				
RX	1500	1501	1588	1600	1624	1642	1697	1700	
RY	1096	1095	1094	1091	1091	1094	1095	1096	

Route from CP78A to Dysart Drain-RRR8

KK	78A78B								
RS									
RC	0.013	0.013	0.013	2300	0.0013				
RX	0	10	20	28	43	51	60	70	
RY	1080	1080	1080	1076	1076	1080	1080	1080	

Route from Olive to Northern Parkway-R181

KK	D6172A								
RS									
RC	0.013	0.013	0.013	2800	0.004				
RX	0	10	19	20	35	36	40	50	
RY	1104	1104	1104	1100	1100	1104	1104	1104	

Route from Northern Parkway to Dysart Drain-R195B

KK	D72A72								
RS									
RC	0.013	0.013	0.013	2300	0.004				
RX	0	10	20	28	43	51	60	70	

RY	1100	1100	1100	1096	1096	1100	1100	1100
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Northern Parkway Channel Ex w/CIP

- Model for this improvement is the ATSF.OUT received from FCD on April 24, 2009

Route from Sarival to Reems Rd-R192B

KK	68A69A							
RS								
RC	0.25	0.025	0.25		0.003			
RX	1500	1501	1588	1600	1612	1630	1699	1700
RY	1146	1145	1145	1142	1142	1145	1145	1146

Route from Reems Rd to 151st Ave

- North collector channel from Dysart Drain Improvements Reems Rd to Agua Fria River plans.
- Channel is Section G-G on sheet D02-Sta 10+00

KK	69A70A							
RS								
RC	0.013	0.013	0.013		0.0014			
RX	100	107.1	110.1	113.1	125.1	128.1	131.1	135.12
RY	1108.0	1103.3	1101.3	1099.3	1099.2	1101.3	1103.3	1106.0

Route from 151st Ave and Farm Rd thru Falcon Dunes-

- North collector channel from Dysart Drain Improvements Reems Rd to Agua Fria River plans.
- Channel is Section I-I on sheet D02-Sta 222+00
- This is only a low flow channel so maybe we should take a section thru the golf course?

KK	D70A70							
RS								
RC								
RX								
RY								

Route from Reems Rd thru Falcon Dunes

- North collector channel from Dysart Drain Improvements Reems Rd to Agua Fria River plans.
- There is only a low flow channel so we should take a section thru golf course?

KK	D69D70							
RS								
RC								
RX								
RY								

Route from Bullard Ave to 143rd Ave-R194D

KK	71A72A							
RS								
RC	0.025	0.025	0.025	2660	0.003			
RX	1500	1501	1588	1600	1612	1630	1699	1700
RY	1102	1101	1101	1098	1098	1101	1101	1102

Storage either north or south of Northern Parkway-SR198

- Outlet pipe is 2-36"

KK	SRD75							
KM								
RS								
SV	0	3	7	12	17	22	27	32
SE	1076	1077	1078	1079	1080	1081	1082	1083
SQ	0	16	40	76	104	304	674	1096

Route from Northern Parkway Basin to Dysart Drain-R198

KK	D75D79							
RS								
RC	0.03	0.025	0.030	3120	0.0029			
RX	1000	1050	1070	1090	1090	1220	1230	1270

RY	1083	1082	1078	1076	1076	1078	1080	1083
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Route from 175th Ave to Basin SRS31-This route not include in HEC-1 will use the same cross section from above route-RLP15

KK	S26S31								
RS									
RC	0.013	0.013	0.013		0.0056				
RX	0	11	12.6	14.2	15.8	17.4	19.	30	
RY	925	919.5	919.5	919.5	919.5	919.5	919.5	925	

Storage behind SPRR at 177th Ave-SR359

KK	SRS31								
KM									
RS									
SV	0	0.1	5.9	19.1	33.6	49.2	142.2	163.5	184.7
SE	891.28	893	894	895	896	897	902	903	904
SQ	0	59	98	129	158	200	450	1135	1270

Route from Loop 303 Basins to south-R359

KK	S31S27								
RS									
RC	0.075	0.075	0.075	1790	0.002				
RX	1000	1001	1002	1220	2380	2758	2759	2760	
RY	900	897	897	896	896	897	897	900	

Route from Loop 303 Basins to south-From cross sections in report

KK	S27S82								
RS									
RC	0.04	0.04	0.04		0.0004				
RX	0	10	15	20	55	60	65	75	
RY	4	2	1	0	0	1	2	4	

Route from Loop 303 Basins to south-From cross sections in report

KK	S8281A								
RS									
RC	0.04	0.04	0.04		0.0004				
RX	0	10	15	20	55	60	65	75	
RY	4	2	1	0	0	1	2	4	

Route from Loop 303 Basins to south-From cross sections in report

KK	S81A25								
RS									
RC	0.04	0.04	0.04		0.0004				
RX	0	10	15	20	55	60	65	75	
RY	4	2	1	0	0	1	2	4	

Jackrabbit Trail Channel/White Tanks FRS #3 Outfall Channel Ex w/CIP

- The channel cross sections are from the Preliminary Design Plans for White Tanks FRS #3 Outfall Channel FCD Contract No 2004C019 dated December 08, 2008 prepared by Gannett Fleming
- A portion of the channel is east of Jackrabbit Trails. Our basin boundary is west of Jackrabbit Trails.

Route from Bethany Home Road to Jackrabbit Estates

KK	21A28A							
RS								
RC	0.045	0.035	0.045		0.0013			
RX	100	137.5	145.5	151.5	156.5	162.5	170.5	208
RY	1190	1180.62	1180.62	1178.62	1178.62	1180.62	1180.62	1190

Route from Jackrabbit Estates to Box Culvert under Jackrabbit Trail

- There is a large detention basin located south of Jackrabbit Estates. I believe Valerie said to ignore this. Need to verify.

KK	W28A33							
RS								
RC	0.045	0.035	0.045		0.0020			
RX	100	137.5	145.5	151.5	156.5	162.5	170.5	208
RY	1180	1170.62	1170.62	1168.62	1168.62	1170.62	1170.62	1180

- There is an 1185ft box culvert. Should this be modeled?

Route from large box culvert to Indian School Rd

KK	W33W35							
RS								
RC	0.045	0.035	0.045		0.0013			
RX	100	137.5	145.5	151.5	156.5	162.5	170.5	208
RY	1160	1150.62	1150.62	1148.62	1148.62	1150.62	1150.62	1160

- We have a storage route at SRW35. The plans do not show a basin or large ponding area. Suggest remove SRW35.

Route from Indian School Rd to Thomas Rd

KK	W3536A							
RS								
RC	0.045	0.035	0.045	754	0.0020			
RX	100	137.5	145.5	115.5	156.5	162.5	170.5	198.64
RY	1150	1140.62	1140.62	1138.62	1138.62	1140.62	1140.62	1150

KK	W3536B							
RS								
RC	0.045	0.045	0.045	2200	0.0015			
RX	100	111	123	135	185	197	209	229
RY	1140.11	1140	1137	1134	1133.9	1137	1140	1140.2

KK	W3536C							
RS								
RC	0.045	0.035	0.045	2238	0.0020			
RX	100	137.5	145.5	115.5	156.5	162.5	170.5	198.64
RY	1130	1120.62	1120.62	1118.62	1118.62	1120.62	1120.62	1130

Route from Thomas to McDowell

KK	W36W37							
RS								
RC	0.045	0.035	0.045		0.0020			
RX	100	137.5	145.5	115.5	156.5	162.5	170.5	198.64
RY	1100	1090.62	1090.62	1088.62	1088.62	1090.62	1090.62	1100

White Tanks FRS #4 Inlet Improvements- Ex and Ex w/CIP

- The channel cross sections are from the As-Built Design Plans for the Construction of White Tanks #4 FRS Inlet Improvements-Roosevelt Street to McDowell Rd FCD Contract No 94-09 FCD Project No 470050

Route from I-10 to FRS Outfall I-10-Sta 19+31.29 to 28+00 Cross Section

KK	W37S60							
RS								
RC	0.013	0.013	0.013		0.0015			
RX	100	104.6	108.6	112.6	148.6	152.6	1056.6	162.4
RY	1051.8	1048.5	1046.5	1045.5	1044.9	1046.9	1048.9	1051.8

White Tanks Channel/Tuthill Channel Ex w/CIP

- CIP concept and channel routes were taken from the Buckeye Area DMP FCD Contact No 2004C058 Conceptual Design Plans for the White Tanks System dated April 2009 prepared by Dibble Engineering provided to HDR by FCD.

Route from outlet of RCBC to Yuma Rd-WT-11

- There are 2-8x4 RCBC planned, 2324ft, s=0.0024, should these be modeled?

KK	S62S64								
RS									
RC	0.045	0.045	0.045	3278	0.0077				
RX	100	112	119	126	139	146	153	165	
RY	1020	1018.3	1017.3	1016.3	1016.2	1017.3	1018.3	1020	

Route from Yuma Rd to BWCCD Canal-WT-10

KK	S64S67								
RS									
RC	0.045	0.045	0.045	685	0.0051				
RX	100	110	124	138	172	186	200	210	
RY	1116	1112.6	1112.6	1110.6	1110.5	1112.6	1114.6	1116	

- Storage behind RID Canal, SRS67, will be removed

Route from BWCCD Canal to Lower Buckeye Rd-WT-08 and WT-09

KK	S6468A								
RS									
RC	0.045	0.045	0.045	2578	0.0067				
RX	100	137.5	151.5	165.5	199.5	213.5	227.5	265	
RY	1000	998.7	996.7	994.7	994.6	996.7	998.7	1000	

KK	S6468B								
RS									
RC	0.045	0.045	0.045	1876	0.0053				
RX	100	134	148	162	198	212	226	260	
RY	986	984.4	982.4	980.4	980.3	982.4	984.4	986	

Routes from Lower Buckeye Rd to Broadway Rd-WT-06 and WT-07

- Flow becomes smaller after Lower Buckeye Rd. Why? Is there a flow split? We do not have the model.

KK	S6869A								
RS									
RC	0.045	0.045	0.045	2590	0.0068				
RX	100	104.5	118.5	132.5	157.5	171.5	185.5	190	
RY	960	959.4	957.4	955.4	955.3	957.4	959.4	960	

KK	S6869B								
RS									
RC	0.045	0.045	0.045	2590	0.0085				
RX	100	103.5	117.5	131.5	155.5	169.5	183.5	187	
RY	940	938.5	937.5	935.5	935.4	937.5	938.5	940	

Route from Broadway Rd to UPRR-WT-05

KK	S69S70								
RS									
RC	0.045	0.045	0.045	3458	0.0078				
RX	100	122	136	150	172	186	200	222	
RY	910	909.6	907.6	905.6	905.5	907.6	909.6	910	

- Flow crosses the UPRR and continues west just north of BWCCD Canal.
- Removed the divert at the intersection of BWCCD and Airport Rd.

Route flow from UPRR to Airport Rd-WT-04

KK	S70S71							
RS								
RC	0.030	0.030	0.030	3193	0.0012			
RX	100	107.5	121.5	135.5	160.5	174.5	188.5	196
RY	896	894.9	892.9	890.9	890.8	892.9	894.9	896

Route from Airport Rd to Dean Rd and the boundary of our study-WT-03

KK	S70S71							
RS								
RC	0.030	0.030	0.030	5278	0.0005			
RX	100	117.5	131.5	145.5	181.5	195.5	209.5	227
RY	894	891.5	889.5	887.5	887.4	889.5	891.5	894

- Because the flow fluctuates I suspect some storage behind roads and the railroad. We do not have the Buckeye HEC_1 model.

Camelback Channel-Litchfield Rd to AFR-Ex and Ex w/CIP Models

- Used aerial and topo but we have as-built plans
- Plans used are Camelback Rd Litchfield to El Mirage Rd Project No 68227 prepared by Cella Barr August 1999 for Maricopa County DOT
- Do not have complete set of plans. Depth based on plan and profile.

Route from Litchfield to Dysart Rd-65+00

KK	B16B17							
RS								
RC	0.013	0.013	0.013		0.0015			
RX	100	102	106	110	115	119	123	125
RY	1038.3	1037.3	1035.3	1033.3	1033.2	1035.3	1037.3	1038.3

Route from Dysart to El Mirage Rd-115+00

KK	B17B18							
RS								
RC	0.013	0.013	0.013		0.0032			
RX	100	102	106	110	115	119	123	125
RY	1028.4	1027.4	1025.4	1023.4	1023.3	1025.4	1027.4	1028.4

- Route from El Mirage Rd to AFR is an earthen channel with 4:1 side slopes. Have no info on this portion of channel.

Bullard Wash I-10 to Lower Buckeye Ex w/CIP

- Route geometry will be determined from the Bullard Wash Improvement I-10 to Phase I Proposed CLOMR HEC-RAS model received from FCD on May 19, 2009
- We have plans but the cross section detail sheets were missing. Requested sheets from FCD but received HEC-RAS.

Route from I-10 to Van Buren Rd-River Section 23390.8

KK	B65B66							
RS								
RC	0.036	0.036	0.036		0.003			
RX	100	132.9	167.7	188.6	230.5	246.4	290.7	315.4
RY	978.90	974.2	973.9	971.9	971.8	973.9	974.2	978.9

Route from Van Buren Rd to Yuma-River Section 18226.7

KK	B66B68							
RS								
RC	0.036	0.036	0.036		0.0030			
RX	100	126.7	172.7	183	213.6	221.8	293.2	313.4
RY	963.53	958.83	958.53	956.53	953.43	958.53	958.83	963.53

Route from Yuma to Lower Buckeye-River Section 16366.6

KK	B68B69							
RS								
RC	0.033	0.025	0.033		0.0029			
RX	100	133.4	149.1	221.8	231.2	273.6	289.3	308.7
RY	958.2	955.7	952.2	951.2	951.1	952.2	955.7	958.8

Bullard Wash from Lower Buckeye to Gila River-Ex and Ex w/CIP

- Currently using Aerial and Topo
- These cross sections from As-Builds for Bullard Wash Channel Improvements Project FCD No 4700731 prepared by Sverdrup dated August 1998

Route from Lower Buckeye Rd to UPRR-C1

KK	B69B70							
RS								
RC	0.035	0.022	0.035	4243	0.00121			
RX	100	115	121	127	207	211	215	225
RY	942	937	935	933	932.9	935	937	942

Route from UPRR to Broadway Rd-A3

KK	B70B93							
RS								
RC	0.035	0.022	0.035	1068	0.00121			
RX	100	110	114	118	198	202	206	216
RY	920	915	913	911	910.9	913	915	920

Route from Broadway to Gila River-A2

KK	B93B94							
RS								
RC	0.035	0.022	0.035	4243	0.00146			
RX	100	115	121	127	207	211	215	225
RY	918	913	911	909	908.9	911	913	918

Dysart Drain-Ex Conditions and Ex w/CIP

- Currently using aerial and topo.
- Will be using As Built plans for Dysart Drain Improvements Project Reems Rd to Agua Fria River Channel Improvements FCD No 94-38, LAFB No 87-3002 sealed May 1995

Route from Falcon Dunes to Bullard Ave-No 13

KK	D70D71							
RS								
RC	0.013	0.013	0.013		0.0011			
RX	100	107	110	113	123	126	129	136
RY	1094.5	1089.83	1087.83	1085.83	1085.73	1087.83	1089.83	1094.5

Route from Bullard Ave to 143rd Ave-No 11

KK	D71D72							
RS								
RC	0.013	0.013	0.013		0.0011			
RX	100	109	112	115	139	142	145	152.5
RY	1090	1084	1082	1080	1079.9	1082	1084	1089

Route from 143rd Ave to Litchfield Rd-No 09

KK	D72D73							
RS								
RC	0.013	0.013	0.013		0.0045			
RX	100	112	116	120	128	132	136	148
RY	1086.5	1080.5	1078.5	1076.5	1076.4	1078.5	1080.5	1086.5

Route from Litchfield Rd to Dysart Rd-No 4

KK	D73D78							
RS								
RC	0.013	0.013	0.013		0.0019			
RX	100	108.5	114.5	120.5	135.5	141.5	147.5	156
RY	1073	1068.33	1064.33	1060.33	1060.23	1064.33	1068.33	1073

Route from Dysart Rd to El Mirage Rd-No 2

KK	D78D79							
RS								
RC	0.013	0.013	0.013		0.0009			
RX	100	108.5	114.5	120.5	135.5	141.5	147.5	156
RY	1068	1062.33	1058.33	1054.33	1054.23	1058.33	1062.33	1068

Route from El Mirage Rd to AFR-No 1

KK	D79D80							
RS								
RC	0.013	0.013	0.013		0.0009			
RX	100	109.33	117.33	125.33	135.33	143.33	151.33	160.66
RY	1064.5	1059.83	1055.83	1051.83	1051.73	1055.83	1059.83	1064.5

Colter Channel –Ex and Ex w/CIP

- Currently using aerial and topo but we have as-built plans
- FCDMC Plans for the Construction of Colter Channel Proj No 93-08 prepared by CRSS Civil Engineers, dated August 1993

Route from Litchfield Rd to Dysart Rd-20+00 and 50+00

KK	B1011A							
RS								
RC	0.022	0.022	0.022		0.006			
RX	100	107.5	119.5	125.5	129	135	147	154.5
RY	1056.6	1055.3	1053.3	1052.3	1051.9	1053.3	1055.3	1056.6

KK	B1011B							
RS								
RC	0.022	0.022	0.022	2760	0.0017			
RX	100	103.9	115.9	127.9	172.9	184.9	196.9	200.8
RY	1051.9	1051.2	1049.2	1047.2	1046.8	1049.2	1051.2	1051.9

Route from Dysart Rd to Wigwam Creek Rd-74+00

KK	B11B12							
RS								
RC	0.022	0.022	0.022		0.0017			
RX	100	109.9	121.9	133.9	178.9	190.9	202.9	212.8
RY	1045.95	1044.3	1042.3	1040.3	1039.9	1042.3	1044.3	1045.95

Route from Wigwam Creek Rd to El Mirage-99+00

KK	B12B14							
RS								
RC	0.022	0.022	0.022		0.0021			
RX	100	109.9	121.9	133.9	178.9	190.9	202.9	212.8
RY	1036.6	1034.9	1032.9	1030.9	1030.5	1032.9	1034.9	1036.6

Route from El Mirage to AFR-99+00

KK	B14B15							
RS								
RC	0.022	0.022	0.022		0.0016			
RX	100	112	118	124	238	244	250	262
RY	1027	1025	1024	1023	1022.9	1024	1025	1027

Comment 56: N2AN01 Modify length

KK	N2AN01							
RS								
RC				2385.6				
RX								
RY								

Comment 58: N03N04 Modify length

KK	N03N04							
RS								
RC				7852.6				
RX								
RY								

Comment 59: Reverse Order of Route

- I believe this route is correct. Please advice.

Comment 64: L03 Change S-graph from Ag to Valley

Comment 75: Pasqualletti Mountain Ranch

- Retention for existing conditions outside of Ph 1. A=107ac, C=0.65, i=2.7, V=15.65
- For future conditions add retention for all except for the 97.73 ac in Phase 1 of above report. Retention was waived for Ph1
- This is retention for existing conditions

KK	DW36RE							
KM								
DT	RW36	12.5						
DI	0	250	500	5000				
DQ	0	250	500	5000				

Comment 104: Divert for 24" bleed pipe-DIPC2

- This divert is taken from the Ex-Split model prepared by PB and provided to HDR by FCD

KK	DB97SE							
KM								
DT	DB97S							
DI	0	3.64	9.79	11.49	13.26	14.83	16.24	5000
DQ	0	3.64	9.79	11.49	13.26	14.83	16.24	16.24

Comment 114: L01 Tc long

- New Lca used will be 6326.2

Comment 116: D08 Tc long

- New Lca used will be 5015.7

Comment 118: L09D16 length will be modified

KK	L09L19							
RS								
RC								
RX								
RY								

Comment 121: L11L18 length will be modified

KK	L11L18							
RS								
RC								
RX								
RY								

Comment 122: L13D29 length will be modified

KK	L13D29							
RS								
RC								

RX								
RY								

Comment 123: D16D30 length will be modified

KK	D16D30							
RS								
RC								
RX								
RY								

Comment 125: L26L34 length will be modified

KK	L26L34							
RS								
RC								
RX								
RY								

Comment 126: L27D57 length will be modified

KK	L27D57							
RS								
RC								
RX								
RY								

Comment 127: D45D58 length will be modified

KK	D45D58							
RS								
RC								
RX								
RY								

Comment 128: D46D59 length will be modified

KK	D46D59							
RS								
RC								
RX								
RY								

Comment 138: B92 RTIMP too high

- Manually change RTIMP to 35

Comment 146: DS09RE Check Retention

KK	DS09RE							
KM								
DT		22.3						
DI								
DQ								

Comment 149: DS03RE Check Retention

KK	DS03RE							
KM								
DT		55.04						
DI								
DQ								

Comment 154: DS36 Check Retention

KK	DS36RE							
KM								
DT		106.2						
DI								
DQ								

Comment from field notes

KK	SRB11									
KM										
RS										
SV	0	39.77	83.06	129.95	180.50	233.43	289.07			
SE	1058	1060	1062	1064	1066	1068	1070			
SQ	0	110.88	313.62	536.37	701.78	835.04	949.79			

Luke Air Force Base Outfall Ex w/CIP

- The Luke AFB CAR was prepared by HDR on October 2004 FCD Contract No 2003C018
- Conceptual design plans were prepared and all improvements are based on this report and conceptual design plans.

Divert from Glendale to Dysart Drain

- This is a dual storm drain system along Lalomai Road and Kachina Road, each with a design flow of 416cfs.
- The main flow will be in the pipe for ease of modeling

KK	DB02SD							
KM								
DT	DB02LR							
DI	0	200	400	800	832	1200	5000	
DQ	0	0	0	0	0	368	4168	

Divert along Litchfield Rod for new storm water system

- This will be a closed conduit system consisting of 2-54" RCP connecting to 2-12x5ft RCBC and then connecting to 2-12x6RCBC and discharging into Dysart Drain
- The main flow will be in the pipe for ease of modeling

KK	LR02SD							
KM								
DT	LR02LR							
DI	0	200	400	800	1426	1500	5000	
DQ	0	0	0	0	0	74	3574	

Route from the outlet in basin B50 into new channel south of Super Sabre Rd

- Channel begins at pump station located at south east corner of site to Bullard Wash where it will combine and discharge into improved channel.

KK	B50B51							
RS								
RC	0.013	0.013	0.013		0.0013			
RX	100	102	106	110	120	124	128	130
RY	1070	1069	1067	1065	1064.9	1067	1069	1070

Bullard Wash Improvements

- Channelization of Bullard Wash from Super Sabre Rd to Camelback Rd

KK	B51B52							
RS								
RC	0.030	0.030	0.03		0.0031			
RX	100	108	116	124	164	172	180	188
RY	1064	1062	1060	1058	1057.9	1060	1062	1064

Verrado Area-MB01 for Ex and Ex w/CIP

- Route geometry, storage and retention taken from Verrado Planning Unit Drainage Plan for Portions of Planning Unit V (Phase 3 North-South of Tractor Wash and Intrawest Resort) and Update to DMP dated May 10, 2006 and prepared by Wood Patel & Assoc.
- Some information taken from existing conditions HEC-1 and some information taken from Post Development Conditions HEC-1.

Storage in W25-SRW25 Ex and Post Dev Cond

KK	SRW25									
KM										
RS										
SV	0	1.05	9.43	26.91	54.31	92.89	138.67	176.47	190.08	219.05
SV	249.57									
SE	1443	1446	1450	1454	1458	1462	1466	1469	1470	1472
SE	1474									
SQ	0	0	0	0	0	0	0	0	265	1377
SQ	2963									

KK	SRW25									
KM										
RS										
SV	0	1.05	26.91	54.31	92.89	138.67	176.47	190.08	219.05	249.57
SE	1443	1446	1454	1458	1462	1466	1469	1470	1472	1474
SQ	0	0	0	0	0	0	0	265	1377	2963

Storage in W26-SRW26 Ex and Post Dev Cond

KK	SRW26									
KM										
RS										
SV	0	0.68	20.68	57.58	95.91	102.34	117.65	130		
SE	1319	1320	1330	1340	1347	1348	1350	1351		
SQ	0	0	0	0	0	265	1377	2000		

Storage in W43-SRW43 Ex and Post Dev Cond

KK	SRW43									
KM										
RS										
SV	0	6.04	20.38	53.82	120.38	216.24	325.98	455.42	606.1	645.49
SV	685.61	767.98								
SE	1272	1276	1280	1284	1288	1292	1296	1300	1304	1305
SE	1306	1308								
SQ	0	0	0	0	0	0	0	0	0	0
SQ	928	8950								

KK	SRW43									
KM										
RS										
SV	0	6.04	20.38	53.82	325.98	455.42	606.10	645.49	685.61	767.98
SE	1272	1276	1280	1284	1296	1300	1304	1305	1306	1308
SQ	0	0	0	0	0	0	0	0	928	8950

Divert into sports complex offline basin-DSPOB1 Post Dev Cond

KK	DW46RE									
KM										
DT	RW46									
DI	0	35	98	179	276	520	888	1339	1859	2439

DQ	0	0	0	0	0	135	382	701	1080	1509
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Divert into golf course-DGOB3 Post Dev Cond

KK	DW53RE									
KM										
DT	RW53	42								
DI	0	1000	1500	2000	2500	3000	3500	4000	4145	4500
DQ	0	10	115	290	460	715	980	1100	1145	1260

Divert into golf course-DGOB5 Post Dev Cond

KK	DW55RE									
KM										
DT	RW55	42								
DI	0	55	101	537	1297	2269	4708	7684	11074	
DQ	0	0	0	382	1080	1984	4269	7072	10310	

Storage in W57-SR42 Post Dev Cond

KK	SRW57									
KM										
RS										
SV	0	24.4	29.6	35.7	42	48.5	55.2	62.2	69.3	76.7
SE	1084	1090	1091	1092	1093	1094	1095	1096	1097	1098
SQ	0	0	0	0	368	1040	1912	2944	4114	5410

Storage in W19-SR16 Ex and Post Dev Cond

KK	SRW19									
KM										
RS										
SV	0	1	31	114	270	502	807	1319	1388	1460
SE	1198	1200	1210	1220	1230	1240	1250	1260	1261	1262
SQ	0	0	0	0	0	0	0	0	0	135

Storage in W34-SR29 Ex and Post Dev Cond

KK	SRW34									
KM										
RS										
SV	0	0.99	12.73	23.45	36.25	50.68	54.76	59.33	83.20	
SE	1164.5	1166	1170	1172	1174	1176	1177.5	1178	1180	
SQ	0	0	0	0	0	0	0	88	6226	

General Changes:

Route from development in the south west corner of Glendale and Dysart, north to Litchfield Rd-Ex and Ex w/CIP

- Route taken along Thunderbird, with walls on either side

KK	B04B02							
RS								
RC	0.016	0.016	0.016		0.0011			
RX	100	101	124.1	124	184	184.1	207	208
RY	1090	1082	1081.9	1081.4	1081.3	1081.9	1082	1090

Route from Litchfield Road to Bullard Wash tributary outlet thru LAFB-Ex and Ex w/CIP

- Route taken at roadway and parking lots north and south of roadway per Aerial and Topography

KK	B02B50							
RS								
RC	0.016	0.016	0.016		0.0016			
RX	100	120	140	142	172	174	194	214
RY	1075	1074.5	1074	1073.5	1073.4	1074.	1074.5	1075

Divert Detention Basin at RID Overchute-Ex and Ex w/CIP

- Divert is per RID Overchute Project Phase 2 Plans and Design Report

KK	DB78BN							
KM								
DT	RD78BN	18.4						
DI	0	250	500	1000	10000			
DQ	0	250	500	1000	10000			

Route from I-10 to Van Buren. FRS #4 Inlet Channel.

- Route taken Aerial and Topography

KK	W58S60							
RS								
RC	0.022	0.022	0.022					
RX	100	115.5	121.8	142	179.3	191.3	199.6	207.8
RY	1072	1070	1064	1062	1061.9	1064	1065	1066

Divert at 175th Ave and RR Track

- Based on existing topography
- Main flow to the West

KK	DS26SE							
KM								
DT	DS26^							
DI	37.5	197.13	950.11	2315.66				
DQ	0	0	231.48	781.24				

Divert at Greenway at Litchfield

- Based on existing topography
- Main flow to the East

KK	DD131							
KM								
DT	DD131S							
DI	519.18	917.29	1650.65	2842.39				
DQ	18.75	121.13	423.44	996.33				

KK	DD132							
KM								
DT	DD132S							
DI	500.43	796.16	1227.20	1846.06				
DQ	112.43	318	584.20	899.44				

Divert at Peoria and Reems

- Based on existing topography
- Main flow to the East

KK	DD461								
KM									
DT	DD461S								
DI	2358.70	2658	3619.38	5112.35					
DQ	2342	2534.57	3070.80	3928.10					

KK	DD462								
KM									
DT	DD462S								
DI	16.70	123.43	548.58	1184.24					
DQ	16.70	56.35	109.33	172.85					

Storage route at Falcon Dunes-

- Storage based on new stage storage calculations provided to HDR by FCD on March 02, 2009

KK	SRD70									
KM										
RS										
SV	0	0	0.1	0.4	0.8	1.6	2.7	4.4	6.6	9.5
SV	17.3	38.4	51.7	69.9	94.1	141.8	285.9			
SE	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088
SE	1089.9	1092.5	1093.5	1094.5	1095.5	1097	1102			
SQ	0	0	0	0	0	0	0	0	0	0
SQ	0	67	110	160	211	300	555			

KK	SRD70									
KM										
RS										
SV	0	0.1	0.8	2.7	6.6	17.3	38.4	69.9	141.8	285.9
SE	1079	1081	1083	1085	1087	1089.9	1092.5	1094.5	1097	1102
SQ	0	0	0	0	0	0	67	160	300	555

Route from L303 to Canyon Trails Channel

- Cross section based on visual measurement of sheet 13 of the Loop 303 Drainage Improvements CAR Phase II FCD Proj No 2005C014 dated Dec 2007. No topo available.

KK	S13S14								
RS									
RC	0.022	0.022	0.022						
RX	100	104	108	112	137	141	145	149	
RY	983	982	981	980	979.9	981	982	983	