



# **STORMWATER MANAGEMENT FOR DOUGLAS – AGUA PRIETA**

**SOUTHWEST CITIZENS FORUM MEETING  
Sierra Vista, AZ**

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**International Boundary and Water Commission  
United States Section**

**Engineering Services Division**

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# Study area

## **Watersheds Resulting in Transboundary Flooding in**

- **City of Douglas, Cochise County, Arizona**
  - Located in Southeast Arizona
  - Population 17,378
- **City of Agua Prieta, Sonora**
  - Located in Northeast Sonora
  - Population 79,138

**Average Annual Precipitation = 14 inches (356 mm)**

# Douglas - Agua Prieta Study Area



Whitewater Draw

US 191

SH 80

SH 80

U. S.

Palm Grove Wash

Douglas

Mexico

Agua Prieta

Alamito Creek

Mexico 2

Mexico 17

0 0.5 1 2 3 4 Miles





# Stakeholders

- **City of Douglas**
- **City of Agua Prieta**
- **International Boundary and Water Commission (IBWC) - U. S. and Mexican Sections**
- **Border Environment Cooperation Commission (BECC)**
- **Comisión Nacional del Agua (CONAGUA)**
- **United States Geological Survey (USGS)**
- **Cochise County, Arizona**



- **Need for the Drainage Study**

- **Ongoing Flooding Problems**

- **Possible Causes**

- **Increasing Urban Development**
- **Lack of Adequate Flood Control Structures**
- **Undersized Drainage Structures**
- **Undersized Downstream Channel System**
- **In-Channel Obstructions and Debris Blockage**
- **Re-establishment of Natural Flow Paths Following Legacy Fence Replacement with Bollards**



- **Objectives of the Study**

- **Obtain discharge estimates and hydrographs for various return periods at important locations within the watershed**
- **Determine the flood conveyance capacity of existing channels**
- **Explore flood mitigation alternatives**



- **References**

- **Some site information and pictures taken from other studies (ex. Baker 2011, 2012) and presentation of June 28, 2004 by Binational Study Group**
- **June 28, 2004 presentation contains good description of individual flooding events**

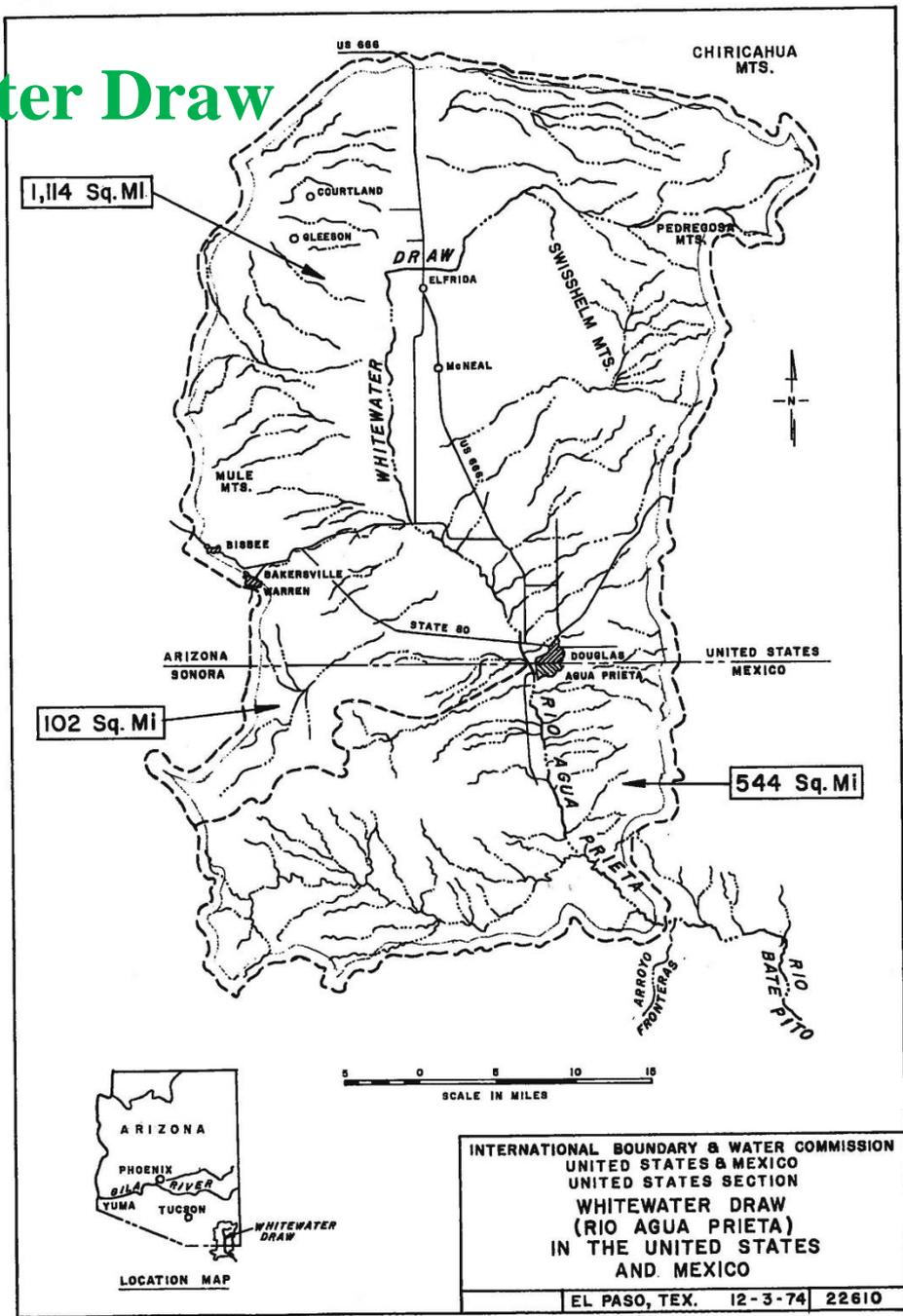
# Flooding from a 2-Year Storm



## Flooding in Agua Prieta from 2012 Storm



# Whitewater Draw





# Whitewater Draw (Rio Agua Prieta in Mexico)

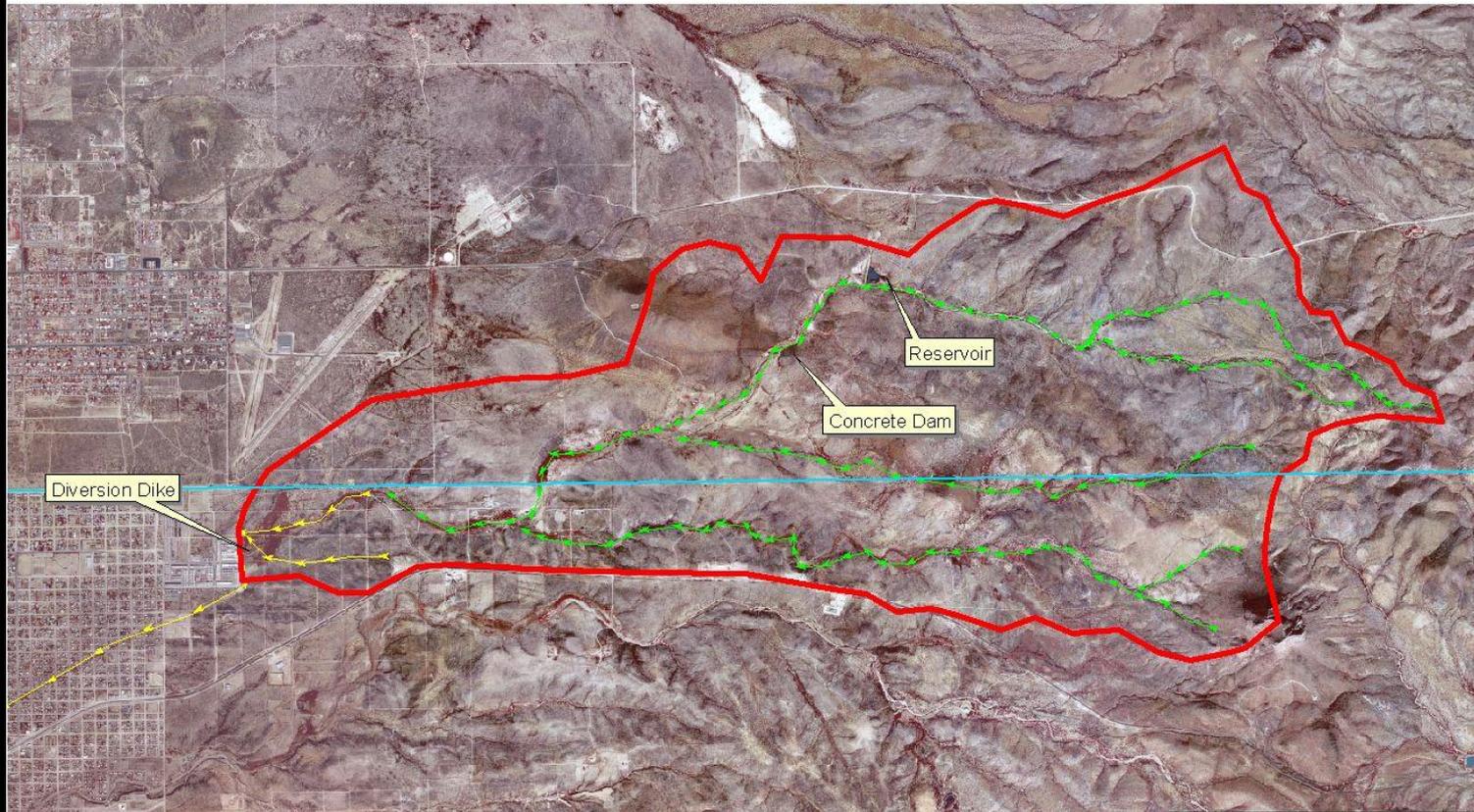
- **USGS Gaging Station 09537500**
  - Located Downstream of State Highway 80 and upstream of confluence with Palm Grove Wash
  - Period of Record: 1916 to present
  - Flood Frequency 100-Year Discharge = 8021 cfs (227.1 cms)
- **Palm Grove Wash (above Whitewater Draw confluence)**
  - FEMA 100-Year Discharge = 17,000 cfs (481.4 cms)
- **Above Discharge Estimates Useful for Calibration and Checks for Proposed Study**

# Alamito Creek

Grupo Bi Nacional  
28-29 Julio, 2004

## Mapa Fotografico de Sub-Cuencas

USDA-NRCS



### Leyendo

- Frontera Internacional
- Frontera de sub-cuenca 1 (2130 hectáreas, 5285 acres)
- Arroyos de sub-cuenca 1
- Zona de Aditivo, sub-cuenca 1

Diversion Dike

Reservoir

Concrete Dam





# Alamito Watershed Details

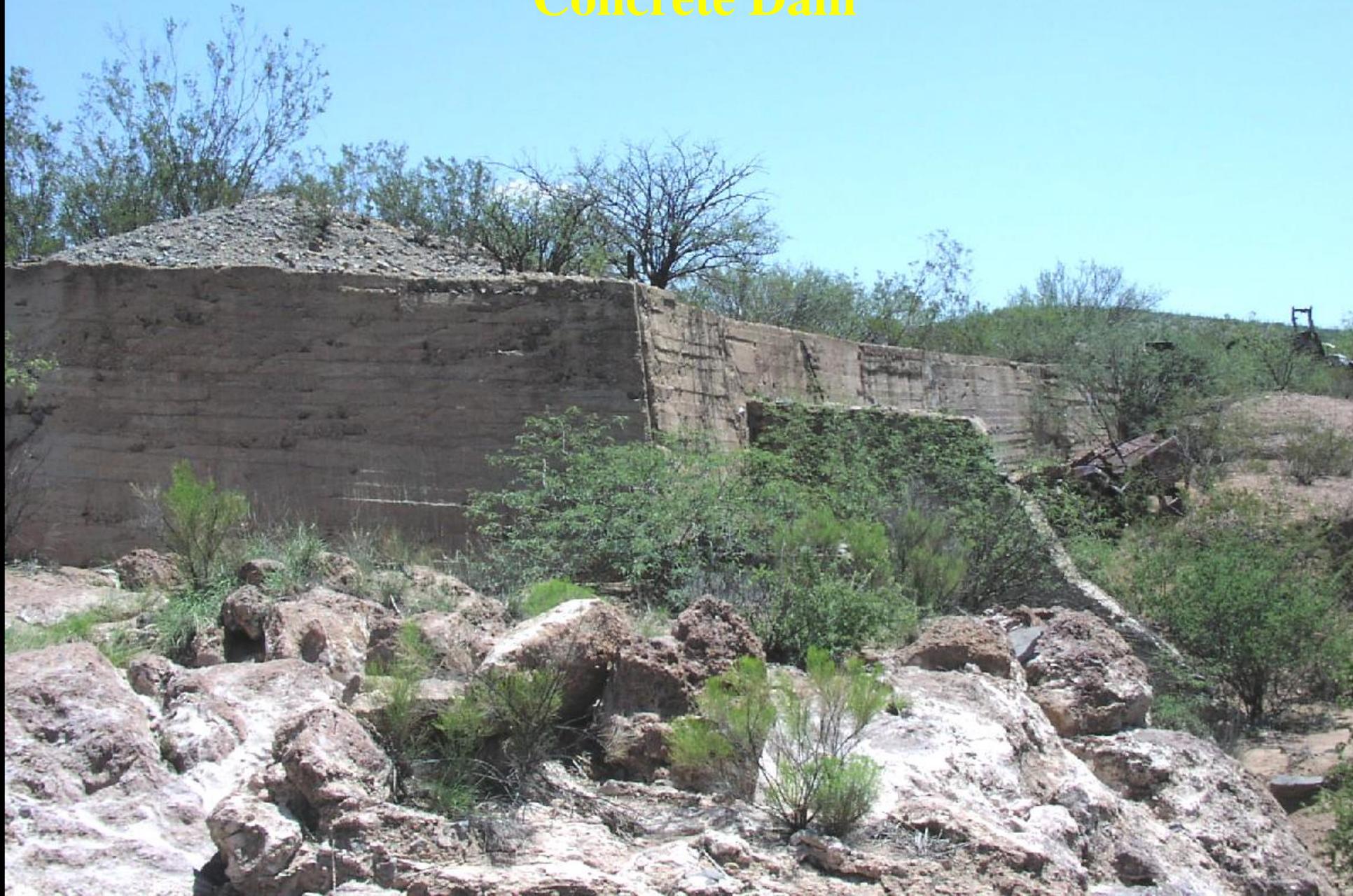
- **Description**

- **Tributaries in both U. S. and in Mexico**
- **Flows west towards Agua Prieta**
- **Shallow Soils Mostly Above Bedrock**
- **Low Subsurface Storage, Brushy vegetation**

- **General Note**

- **Baker (2011) includes watershed delineation near border along Whitewater Draw**
- **Baker (2012) includes watershed delineation near border for Alamito Creek**

# Concrete Dam



# Charco Reservoir





# Survey

- **Existing Drainage Structures (ex. Bridges, Culverts)**
- **Detention Basins**
- **Channels**
  - (where As-Built data, LiDAR data unavailable)



# HYDROLOGY

- **Hydrologic Model Development**

- **USACE HEC-HMS (Hydrologic Modeling System) Software**
- **Sub-Basin Delineation (LiDAR, Topographic Data)**
- **Design Rainfall (NOAA 14) <http://hdsc.nws.noaa.gov/hdsc/pfds/>**
- **Soils Natural Resources Conservation Service (NRCS)**
- **Land Use (City Maps)**
- **Channels**
- **Reservoirs / Detention Ponds**

- **Hydrologic Analysis**

- **Obtain Existing Condition Hydrographs and Peak Discharge Estimates (2-, 5-, 10-, 25-, 50-, 100-Year)**
- **Obtain Proposed Condition Hydrographs and Peak Discharge Estimates (2-, 5-, 10-, 25-, 50-, 100-Year) – Ex. With Detention Ponds**



# HYDRAULICS

- **Hydraulic Model Development**
  - **USACE HEC-RAS (River Analysis System) Software**
  - **Selection of Study Reaches (Based on Areas Prone to Flooding)**
  - **Cross Sections (LiDAR, survey)**
  - **Manning Roughness Coefficients and Parameters**
  - **Hydraulic Structures (Bridges, Culverts)**
- **Hydraulic Analysis (Steady and Unsteady Modeling)**
  - **Existing Flow Capacities in Study Reaches**
  - **Existing Condition WSEL (2-, 5-, 10-, 25-, 50-, 100-Year)**
  - **Proposed Condition WSEL (2-, 5-, 10-, 25-, 50-, 100-Year)**  
(Mitigation Using Detention Ponds)
  - **Mitigation Alternatives Analysis (Channel Widening, Removal of Structures in Constricted Reaches)**
  - **Floodplain Mapping**

**WSEL = Water Surface Elevations**

Erosion – Head cutting resulting from concentrated flows immediately south of the border fence on the Mexican side





# EROSION PROTECTION

- **Headcuts, Sedimentation**
  - **Erosion and Scour Depth Calculations**  
(Function of soil properties and hydraulic variables such as flow velocity)
  - **Erosion Protection**  
(Loose riprap, Grouted riprap, Concrete Lining, Geotextiles)



# SCHEDULE

- **Hire Consultant**
- **Notice to Proceed (NTP)**
- **14 CD - Flood Problems Assessment Report**
- **50 CD – 30% Report (Hydrologic Modeling)**
- **120 CD – 50% Report (Hydraulics – Steady State)**
- **200 CD – 75% Report (Hydraulics – Unsteady, Mitigation Alternatives, Erosion)**
- **250 CD – 90% Report**
- **280 CD – Final Report (Hard Copies & Digital pdf and Models)**

**CD = Calendar Days from NTP**

- **Interim Reviews by Binational Technical Committee (BTC) – IBWC (U. S. and Mexican Sections) and BECC**
- **BTC review comments to be provided fifteen (15) days after each submittal (30%, 50%, 75% and 90%)**



# STATUS

- **Drainage study approach presented to stakeholders at the Binational Meeting (U. S. and Mexico) of the IBWC in Douglas, AZ on May 15, 2014.**
- **Scope of Work (SOW) finalized based on stakeholder inputs.**



# QUESTIONS & DISCUSSION