FMA 2010 ANNUAL CONFERENCE

When the Shoe Doesn't Fit….
Adapting to Changing Regulations
November 2-5, 2010
Loews Resort on Lake Las Vegas

TECHNICAL SESSION PRESENTATION SHORT ABSTRACTS
In Chronological Order

WEDNESDAY, NOVEMBER 2

11:00-12:30 Innovative Technologies and Methods in Mapping I

COMBINED USE OF MULTIPLE STORM CENTERINGS AND UNSTEADY-STATE HYDRAULIC ROUTING IN DEVELOPING FLOODPLAIN MAPS

Harvey Oslick, P.E., CFM, CPSWQ, Senior Associate, and
Sravan Paladugu, P.E., CFM, Project Engineer, RBF Consulting

For the Pleasant Grove Creek Watershed Study for the City of Roseville, a multiple storm centering approach with HEC-HMS modeling was used to develop system hydrology, and unsteady-state HEC-RAS was used to calculate multiple profiles used for floodplain mapping. This presentation will describe the innovative approach used to obtain the distinct advantages that this process has over traditional methods. Use of a multiple storm centering approach has typically been used to identify peak flows throughout drainage areas without the over- or under-estimation problems associated with application of general storms. Unsteady-state hydraulic routing has typically been used to account for backwater and storage routing conditions that cannot be simulated using standard hydrologic routing methods. However, the two methods have not commonly been used together, in part due to computational limitations. This study demonstrates how a large number of storm configurations (centers and axis angles) can be considered to identify key storm configurations and how these key storms configurations can be evaluated for multiple recurrence intervals to generate multiple profiles from which maximum flood conditions can be mapped. The Pleasant Grove Creek Watershed Study illustrates how this historically complex approach can be done efficiently. Differences between steady-state and unsteady-state results will be discussed, along with implications for using this approach for future studies.

MAKING FLOOD RISK REAL – ARKSTORM AND RISKMAP

Kathleen Schaefer, P.E., CFM, FEMA Region IX Engineer

A state-of-the-art meteorological model was created by the ARkStorm atmospherics team to estimate pressures, windspeeds, temperatures, and precipitation time series in nested grid with resolution up to 2 km. The windspeed time series are being used directly for ARkStorm damage modeling, but it was impractical to input the precipitation time series into a statewide hydrological and hydraulic model to produce floodmaps. Instead, ARkStorm is using FEMA's digital Flood Insurance Rate Maps, and the

associated National Flood Hazard Layer, as a representation of areas vulnerable to flooding under the ARkStorm scenario.

As a part of the Map Modernization Program, FEMA created a seamless, digital National Flood Hazard Layer. Building on the success of Map Modernization, FEMA is transitioning to a new program entitled RiskMAP. Risk MAP's vision is to collaborate with State, local, tribal entities to deliver quality flood hazard data that increases public awareness and leads to mitigation actions that reduce risks to life and property. An overview of how the seamless National Flood Hazard Layer was used to support the goals of both Risk MAP and ARkStorm, in this innovative pilot project, will be presented.

STATE OF HAWAII FLOOD HAZARD ASSESSMENT TOOL (FHAT)

Steve Lettau, Program Manager, Onyx Group
Carol Tyau-Beam, Hawaii State NFIP Coordinator, Department of Land and Natural Resources (DLNR)

The State of Hawaii has developed a public web site that allows users to conduct a preliminary flood hazard assessment on their property. The site, known as the Flood Hazard Assessment Tool (or FHAT), utilizes FEMA DFIRM databases as well as locally collected aerial imagery and parcel information. The tool also includes Letters of Map Change (LOMCs), both geographically and links to the documents. This provides easy access to current and accurate effective data. The FHAT allows users to search based on geography, street address or tax map key (TMK), the unique parcel identifier. Once located, users can produce a standard report indicating the results of this initial assessment. This standard reports includes background data as well as attribute data pulled from the GIS data layers specific to the active parcel.

The FHAT is also used to disseminate preliminary DFIRM mapping for public comment. Preliminary DFIRM database layers are included in the tool for public review. This enables the review to reach a wider audience as the public can view the preliminary maps on their computer and provide comment electronically to county coordinators. The FHAT also includes several other specialized features, such as the ability to initiate an elevation certificate for a property or view Flood Insurance Studies for each community. The tool is built on industry standard hardware and software, including the ESRI suite of products. This session will demonstrate the tool and its uses.

11:00-12:30 Flood Forecasting and Dam Failure Analysis

REAL TIME FLOOD FORECASTING OF THE WILLAMETTE BASIN USING HEC-CWMS / RESSIM MODELING

Daniel Christensen and Shali Bogavelli, WEST Consultants

The Corps of Engineers Hydrologic Engineering Center (HEC) is working with WEST Consultants, Inc. with enhancing the decision-making and management strategies for the Willamette Basin Flood Control Project by incorporating advanced information technology resources to its operation plans. Specifically, WEST Consultants, Inc. (WEST) was contracted by the HEC to modify the existing HEC-ResSim model of the Willamette Basin projects, by updating operation schemes and increasing the resolution of data inputs and outputs to better represent flood control, fish passage, and power production operations. This new HEC-ResSim model will be incorporated into the Corps Water Management System (CWMS), for real-time simulations during flood events.

The new CWMS model provides a consolidated, seemless simulation of the entire Willamette basin that can operate in real-time using hydrologic inputs from the National Weather Service River Forecast Center. It spans eleven counties, contains thirteen flood control reservoirs (three are re-regulating projects), and has a basin area of over 11,000 square miles. WEST configured, calibrated, validated, and tested the ResSim component and stress-tested the overall CWMS model to confirm the real-time forecasting capabilities. This paper presents the final ResSim model with calibration and validation results, and how the model will be incorporated into HEC-CWMS for real-time flood forecasting.

FLOOD FORECASTING USING CWMS FOR TRI LAKES OPERATION IN DENVER, CO

David S. Smith, P.E., CFM, D.WRE, Project Manager, WEST Consultants, Inc.

This presentation will describe one of three Corps Water Management System (CWMS) models recently developed by WEST for the Omaha District Corps of Engineers. CWMS is a real-time decision support system designed and developed by the Corps' Hydrologic Engineering Center to assist Corps' water managers by providing information about watershed and channel behavior and reservoir performance. The CWMS model (version 2.0) will assist the Omaha District in their decision-making for reservoir releases of the Tri Lakes Reservoirs to minimize flooding in the Denver Metro area, and it includes HEC-HMS and HEC-ResSim components. A demonstration of the model operation will be provided, including HEC-HMS and HEC-ResSim calibration options.

DAM FAILURE FLO-2D FLOOD HAZARD ASSESSMENT

Karen J. O'Brien, Engineer, FLO-2D Software, Inc.

The potential breach and failure of Pournari Dam near Arta Greece was simulated using the FLO-2D model. FLO-2D simulated the dam breach and the draining of $8x10^8$ m^3 from the Pournari Reservoir. The hydrograph from the breach simulation was routed downstream through existing river channels,

an afterbay, bridges, and unconfined over the floodplain. The floodwave peak discharge rapidly attenuates downstream from the dam. The hydrograph volume controls the area of inundation, not the peak discharge. The FLO-2D model has a complete dam breach component that simulates piping, channel breach and dam collapse.

The FLO-2D routing of the breach hydrograph indicates that essentially the entire river floodplain downstream of the dam would be inundated and subject to a high flood hazard with widespread damage and potential loss of life. Many small communities could sustain extensive flood impacts. The City of Arta is directly in the path of the dam breach floodwave and the potential evacuation time for the city of Arta is less than two hours after the breach is initiated. The eastern side of the city would inundate sooner and to a higher depth than the western side. Flooding around Arta initiates on the fringe of the city and extends inward. Evacuation routes were outlined. This paper outlines the FLO-2D dam breach component, discusses the breach data base, and presents the flood routing model and results.

11:00-12:30 Flood Damage Assessment, Reduction and Mitigation

COST EFFECTIVE STRUCTURE DATA COLLECTION AND FLOOD DAMAGE ASSESSMENT MODELING

Jim DeAngelo, CFM, Project Manager, Michael Baker Jr., Inc.

Flood damage assessment modeling is dependent upon a range of data sources; when collecting the data in support of flood damage reduction planning, quality of the data in relation to the needs of the project should be considered. Available third party data supplemented by field collected information can be used to support basin level structure inventory database development and damage valuation for flood damage reduction planning. More than four thousand structures within a range of representative communities throughout the Delaware River Basin in New Jersey, New York and Pennsylvania were inventoried, and surveyed for a comprehensive HEC FDA analysis. Light Detection and Ranging (LiDAR) data, digital orthophotography, previously developed photogrammetric mapping, custom programmed Global Positioning System enabled data collectors, and standardized community questionnaires provided timely and cost effective data collection.

After collection of the data and development of the hydraulic and HEC FDA modeling, comparisons between predicted damage values and reported NFIP insurance claim values were evaluated for further tailoring of data collection methodologies and analysis based on the data and budgetary needs of the project. By completing a model sensitivity analysis it became evident that more detailed data collection methods may not provide a greater level of confidence in HEC FDA derived damage values especially when the variance of other factors within the model are calculated. We will discuss several of the sensitivity analysis methodologies, and highlight key factors that should be considered in HEC FDA data collection and processing, and look at how several variables impact modeling results.

SOUTHERN CALIFORNIA WILDFIRES AND FLOOD THREAT MITIGATION SANTA BARBARA COUNTY'S APPROACH TO MULTIPLE FIRES AND THE CORRESPONDING FLOOD THREAT

Thomas Fayram, Deputy Public Works Director, and Jon Frye, Engineering Manager, Santa Barbara County Flood Control District

Southern California has experienced a series of wildfires over the past several years. These fires have cost Millions of Dollars in damages to homes and infrastructure, not to mention the actual Fire Suppression costs. In Santa Barbara County, 5 major wildfires have blackened hundreds of thousands of acres of land since 2007 which equates to the destruction of critical watershed vegetation. Downstream of these fires exists cities and infrastructure now at risk. In one case, the County had months to prepare for the coming winter. In another case, we had a mere 10 days from containment of the fire to the first rain of the season.

From the Zaca (240,000 acres),Gap, Tea, Jesusita, and La Brea Fires, the County of Santa Barbara not only developed, permitted, and implemented timely response plans for these fires but also fostered partnerships with private citizens and citizen groups for education and response.

FINDING PEAK FLOOD MITIGATION IN THE URBANIZED DRY CREEK WATERSHED IN PLACER AND SACRAMENTO COUNTY

Harvey Oslick P.E., CFM, CPSWQ (RBF), Thomas S. Plummer P.E., CFM (CESI),
Brian Keating P.E., CFM and Andrew Darrow P.E. (PCFCWCD)

A significant portion of the downstream 2/3^{rds} of the Dry Creek watershed is urbanized. A challenge in the Dry Creek Watershed Plan Update was to find mitigation for peak flood resulting from the current levels of development, as well as from projected remaining General Plan build out.

It was discovered prior to initiating the Plan Update that the previous plan models may not have accurately represented the projected benefits of the previously planned mitigation projects, and that at least in one case, the planned project would have changed the timing of watershed releases and increased peak flooding downstream. It was necessary to overhaul the modeling in the Plan Update to verify storm centering issues, watershed timing issues, and add hydraulic routing to the modeling so that watershed timing, volumetric and peak flooding issues could be better interpreted for mitigation planning and design. The Plan Update includes an updated set of planned improvements, based on updated design characteristics, resulting from the updated models. The evaluation of the benefits of local project mitigation will also change as the plan moves forward, and the requirements for such mitigation will (likely but a decision has not been made at the time of the writing of this abstract) be based on local and regional impacts and benefits in the future.

CERTIFICATION OF FLOOD ABATEMENT PRODUCTS

Angèle Morcos, Engineer, FM Approvals, Hydraulics - Member of the FM Global Group

Natural hazards, including flooding, continue to be the leading cause of commercial and industrial property damage worldwide. Until recently, there has been a limited amount of readily available guidance on choosing flood abatement protection. FM Global, one of the world's largest business property insurers, developed a test protocol to evaluate flood abatement products after recognizing the urgent demand for reliable and functional flood abatement products to mitigate potential losses. FM Standard 2510 is the first and only testing Standard in North America that provides third-party evaluation of opening barriers and temporary perimeter flood barriers. The standard includes performance criteria relating to structural resistance against hydraulic forces; component performance testing; and the consistency of product manufacturing. The program encourages the development of reliable flood proofing products and provides an opportunity to manufacturers to test and evaluate the sustainability of their product against extreme flood scenarios.

11:00-12:30 Restoration Techniques and Regulatory Objectives

INCORPORATING NATURAL CHANNEL DESIGN TECHNIQUES TO RESTORE FLOODPLAIN AND CHANNEL FUNCTIONS IN URBAN SETTINGS

Geoff Brownell, P.E. CFM, Reno Water Office Manager, and
Tami Norton, P.E., CFM, Water Resources Engineer, Michael Baker Jr., Inc.

Often in urban settings streams have been channelized and straightened for flood control and stormwater conveyance purposes without regard to sediment transport functions or a stable geomorphic geometry. Over time many channelized streams exhibit reaches of bank and bed erosion and areas of aggradation as the stream tries to reestablish a stable geometry within its new constraints. These processes can be highly destructive causing maintenance problems and threatening structures and property.

This paper will examine the use of Natural Channel Design Techniques to meet flood control objectives while preserving/restoring floodplain and channel functions. Natural channel design is often viewed as limited to rural landscapes and not appropriate or practical for more urban settings due to project constraints and tight corridors. While it is true that full restoration of a stream that reconnects the channel to its historic floodplain is most often not possible, there are many natural channel design techniques that can be incorporated into waterway improvement projects to improve long term project performance, such as reduction in maintenance costs, and provide a framework for other objects such as habitat enhancement and esthetic improvement.

RIPRAP CHANNEL GRADE CONTROL DESIGN METHODOLOGIES IN STREAM RESTORATION

Gerry A. Hester, P.E., Engineering Program Manager, Southern Nevada Water Authority

Understanding the hydraulics and forces involved with discharges over riprap gradient control structures is paramount to the long term success of most stream channel restoration projects. Rock-sizing methodologies, location and magnitude of hydraulic stresses, flow resistance, and energy dissipation have often proven to be challenging and many times, confusing to those involved with installing riprap channel gradient control as part of a stream restoration project. At the request of the Southern Nevada Water Authority, Colorado State University's Engineering Research Center conducted a wide range of large scale physical hydraulic modeling of rock riprap grade control structures to aid in further characterizing these methodologies. Discharges applied ranged from 5 to 208 cubic feet per second (0.25 to 10.40 cfs/lf). This presentation summarizes the results of this study, is supplemented with field observations, and is intended to give stream channel restoration professionals more confidence in channel stability design and application.

LESSONS FOR RIPARIAN VEGETATION MANAGEMENT IN THE FLOODWAY: INDIVIDUAL SPECIES' RESPONSES TO GEOMORPHOLOGY AND FLOW CHARACTERISTICS

Tom Griggs, Senior Restoration Ecologist, River Partners
Stefan Lorenzato, Environmental Program Manager, Yolo County Flood Control & Water Conservation District

Current flood-planning efforts in the Central Valley have exposed a significant lack of knowledge about the physical response of plant species to various velocities and depths of flows that can occur in the floodway. In flood planning, riparian and floodplain vegetation is usually described through the use of roughness coefficients and vegetation growth models and is often seen as a mass of inflexible, stems and "brush" that will plug the floodway, resulting in levee or channel failure, sedimentation, and reduction of conveyance capacity. However, new laws and efforts to obtain multiple benefits from floodplains now require wildlife habitat to be maintained and enhanced as part of floodway maintenance. A careful examination of plants exposed to flood flows reveals that species growth forms and stem-bending characteristics produce a variety of responses to flows of various velocities and depths. Understanding these responses provides opportunities to achieve flood flow conveyance objectives while enhancing wildlife habitat.

Here we review individual plant species adaptations to life in the channel and on the floodplain as a general guide for floodway maintenance. The general geomorphic location and each species' adaptations to flow velocity and sediment transport, will be described for several plants that are important components of wildlife habitat. Possible uses of these species as management tools to convey flows and sediment, protect structures from scour, reduce maintenance costs, and provide quality wildlife habitat will be discussed. In light of the current Central Valley Flood Protection

Planning effort, the time is right for considering new perspectives on vegetation maintenance in the Central Valley's floodways.

FINDING COMMON GROUND: DEVELOPING METRICS FOR FLOOD CONTROL AND ENVIRONMENTAL BENEFITS

John Carlon, Helen Swagerty, Tom Griggs, River Partners

Current efforts are underway to lay the groundwork for the 2012 roll-out of a new Central Valley Flood Protection Plan. One of the challenges is the charge by the CA Legislature (SB5) that the new plan will also include management for environmental benefits within the floodway. This is a new perspective on floodway maintenance that will require both flood engineers and environmental scientists to communicate. We present a framework for developing a common language that will incorporate the necessary quantitative descriptions of the floodway as to its ability to convey sediment and flows, while maintaining the ecological processes that support environmental benefits. Engineers and floodway managers require several metrics to develop a flood plan for a site or a reach Among these are channel form and hydraulic roughness, velocities and depth of flows, sediment transport potential, the nature of the soils (sediment) and underlying geology (meander rate and probability of under-seepage of levees), the composition and integrity of levees. Environmental benefits that can be described for the site or the reach include detailed description of vegetation – productivity, density and dbh of plant stems, location and abundance of wildlife populations based on different soil types. We will describe how these categories and metrics can serve as tools to evaluate potential performance of the floodway that would result in public safety and quality environmental benefits.

11:00-12:30 Levees – Inspection, Surveys, Monitoring and Inventory

THE ABC'S OF PERIODIC INSPECTIONS FOR THE USACE LEVEE SAFETY PROGRAM

Justin Nodolf, P.E., Water Resources Engineer, Tetra Tech, Inc.

The USACE Levee Safety Program Mission is to "assess the integrity and viability of levees and recommend actions to assure that levee systems do not present unacceptable risks to the public, property, and the environment." Through ARRA funding received by the USACE, a nationwide effort is underway to complete routine inspections on levees throughout the country.

Under contract to the USACE Tetra Tech has performed periodic levee inspections for the Huntington, Chicago, Portland, and Los Angeles Districts of the USACE over 2009 - 2010. Policy guidance has been developed by the USACE that details the program purpose and special considerations for the inspection. The inspections required application of that guidance to real life situations. This presentation covers specific issues that arose during the inspections over 4 Districts. Of particular interest is the application of particular guidance across a range of environments (i.e. arid southwest to

the pacific northwest). Issues dealt with during these inspections include vegetation on levees, aggradation and degradation in the rivers, and stability of levee slopes. An integral part of the Periodic Inspection process is the use of the Levee Inspection System (LIS) – a geospatial application written for ESRI ArcGIS. This presentation will cover the use of that tool and how it supports the inspection process.

DEVELOPING CUSTOM TOOLS TO SUPPORT USACE'S NATIONAL LEVEE DATABASE

Carrie Muenks, GIS Specialist II, and Michael J. Bishop, CFM, Project Manager, Michael Baker Jr., Inc.

The U.S. Army Corps of Engineers (USACE) is leading the development of the nationwide long-term levee inventory. To aid USACE in creating standardized levee data intended for the National Levee Database (NLD), a customized ESRI ArcGIS extension was created that will be utilized by all USACE Districts, allowing data input from ground surveys, quality assessment, visualization, basic analysis, and ongoing maintenance of levee data. The USACE Levee Inventory Tools extension was designed to incorporate levee data from external sources, perform necessary QC checks associated with NLD data validation, create levee centerline records from 3-dimensional survey points, and plot levee centerlines and cross section profiles for review and basic analysis. This extension enables easier compliance with data standardization rules, improves efficiency and effectiveness, and ensures the quality of the levee inventory efforts in all USACE Districts, so that each Districts' levee information can be seamlessly integrated into one national source.

LEVEE SURVEYS/INVENTORIES VIA MOBILE LIDAR

Travis Clark, Assistant Vice President, Michael Baker Jr. Inc.

Mobile terrestrial LiDAR (Light Detection and Ranging) capitalizes on technological advancements in sensor-design to assist communities with the inventory/survey of their levees. Providing a more efficient and cost-effective solution to traditional surveying, mobile LiDAR facilitates the capture of all levee topography elements, including height and slope, and ventures beyond the typical 2-D data collection paradigm to incorporate 3-D modeling of elements– vegetation, structures, etc. – to assess levee vulnerabilities due to encroachments. This presentation will highlight Baker's mobile LiDAR capabilities and demonstrate the practical application for levee surveys/inventories.

CHANGING THE WAY WE THINK ABOUT LEVEE MONITORING: DISTRIBUTED FIBER OPTIC SENSING SYSTEMS

Daniele Inaudi, Chief Technical Officer, SMARTEC SA
Joseph O. Church, Business Development Manager, ROCTEST, INC

Civil Engineers and levee professionals face many challenges in levee operation and maintenance (O&M), levee inspection, and levee safety. The sheer size and scale of these mammoth structures, age, and uncertainty of materials, all combine to present a difficult array of parameters for the levee

professional to navigate when analyzing the existing levee condition and safety. Recent advances in instrumentation technologies and applications are providing new ways the Civil Engineer monitor levee structures, and present engineers with new monitoring tools never thought possible. Distributed fiber optic technologies provide sensors that are of scale and size to finally match the levee, and present an interesting, reliable, cost effective way of monitoring these structures. With a single sensing cable, one can measure strain and temperature, every meter, over a distance of tens of kilometers, allowing the early detection and precise localization of settlements and leakages.

This paper will present three phases of investigation. Phase 1 will present a literature review, including traditional, discrete sensor arrays. The second phase of the paper will present a literature review investigating levee construction and failure methods. The third phase of the paper will address a new technology application; fiber optics distributed monitoring systems, and explores how this technology offers engineers a new tool for O&M, inspection, and safety warning systems. Application examples will be presented to illustrate this concept.

11:00-12:30 Arid Regions – Flood Damage Assessment, Reduction and Mitigation

ALLUVIAL FAN FLOODPLAIN EVALUATION AND DELINEATION - A NEW METHOD TO IDENTIFY FLOOD AND SEDIMENT HAZARD AREAS ON ALLUVIAL FANS

Leonardo R. Kreymborg, P.E., CFM, and Iwan M. Thomas, P.E., Senior Engineer, PBS&J
Tom Christensen, P.E., Senior Engineer, and Dan Yamanaka, P.E., Senior Engineer, California Department of Water Resources

The Alluvial Fan Floodplain Evaluation and Delineation (AFFED) Project is one component of the California Department of Water Resources FloodSAFE Initiative with the goals of reducing flood risk to residents of California, their homes and property, the State's infrastructure, and public trust resources; developing a sustainable flood management system for the future; and reducing the adverse consequences of floods when they do occur.

To achieve these goals the AFFED project will develop two separate hazard areas, an approximate preliminary flood hazard area and an area within the flood hazard that is subject to an elevated sedimentation hazard. These hazard boundaries will be created for all alluvial fans within a ten-county study area in Southern California utilizing a methodology that includes the use of hundreds or thousands of two-dimensional computer models on active and inactive alluvial fans. Geomorphic principles will be applied by experienced engineers to supplement those results. The approach will be a predictive analytical process in which precipitation, topography, and the amount of available alluvium upstream will be accounted for when determining the hazard areas. In order to efficiently utilize large numbers of complex two-dimensional models, a suite of tools was created to quickly gather model inputs, run simulations, and summarize results in a meaningful format. The creation of

flood and sediment deposition hazard zones based on 2-D computer simulations allows for local planning personnel to see the relative levels of risk across vast areas containing many alluvial fans.

THE PIEDMONT FLOOD HAZARD ASSESSMENT MANUAL: A STATUS UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Kathryn Gross CFM, Senior Hydrologist, and Greg Jones P.E., AICP, Regional Area Planning Manager,
Flood Control District of Maricopa County

Through the application of the current Piedmont Manual over the last 10 years, the District has recognized that each fan has unique hazards and that the current delineation methodology and associated flood zone designations have some limitations. Flood zone designations associated with specific types of flood hazards were applied to all fans regardless of the severity of the flood hazard and led to misconceptions about the severity of the flood hazards and risk of flooding relative to normal planning periods. The Alluvial Fan Refinement Study was initiated to refine the current Piedmont Manual methodology to include physical-based analytical techniques that could quantify some of the key alluvial fan flood characteristics found in Maricopa County. The results of the study recommend an approach to the 3 Stage process that includes the use of tools relying on both engineering and geomorphic analyses to arrive at a more robust composite method for analyzing flood hazards on alluvial fan landforms. The next steps for the District include testing the new approach on unstudied alluvial fan landforms within Maricopa County and updating the Piedmont Flood Hazard Assessment Manual based on the results of the application of the method.

ASSESSMENT OF ALLUVIAL FAN FLOODING HAZARDS AND PROPOSED MITIGATION, THOUSAND PALMS, CALIFORNIA

Philip J. Shaller, Parmeshwar L. Shrestha, Doug Hamilton, Neil Jordan, Macan Doroudian, and Massoud Rezakhani, Exponent, Inc.

A multi-disciplinary flood hazard study was performed for four contiguous housing tracts encompassing a total area of approximately 80 acres. The tracts are located in a complex alluvial fan setting in the unincorporated community of Thousand Palms, California. The flood hazard at this location originates in three watersheds in the Little San Bernardino Mountains and Indio Hills. Historical accounts and aerial photos of a >100-year recurrence flood in 1977 were used to evaluate pre-development flooding patterns in the area. The site is subject to distributed flooding from two alluvial fans and concentrated flow from a third watershed that is conveyed to the site along a fixed boundary channel (“fosse”) located between the two fans. Peak flows to the site were calculated using a combination of regional hydrology developed by the Bechtel Corporation, and local hydrology carried out using CVWD-adopted alluvial fan flow procedures. The Bechtel report identified discrete flooding sources and provided 100-year peak discharges for each of these watersheds. Because the subject tracts are located approximately one mile downslope from the mountain front, the distribution of surface flow on the intervening alluvial fans was modeled to obtain an estimate of the flow reaching

the subject tracts. The adopted statistical methodology is referred to as *single alluvial fan flow to a line of finite length*. The proposed development plan incorporated a detention basin at the upstream margin of the property, streets in the community and an open channel network into a comprehensive flood conveyance system for the four subject tracts.

HYBRID MAPPING FOR PRECISE FLOODPLAIN DELINEATIONS IN ARID REGIONS

John Hathaway, P.E., CFM, Watercourse Planning Manager, Flood Control District of Maricopa County, Arizona

Confidence in the accuracy of topographic mapping is essential to reliable floodplain studies. In the past, four-foot contour interval mapping was the practical and affordable standard of precision for riverine applications. However, the norm for arid regions often includes low-relief alluvial fan, sheet, and distributary flow patterns, and four-foot mapping is simply inadequate for the task. Fortunately, technological advances make two-foot mapping of large areas practical and affordable, while quality control refinements enable its precision to approach that of one-foot mapping.

While highly promoted by vendors, LiDAR by itself has not resulted in substantial savings in cost or time to delivery over traditional photogrammetry. The huge volume of LiDAR-generated data sets can be overwhelming, and accurate vector (breakline) identification, critical to reliable topography, cannot be consistently achieved with airborne LiDAR alone. Use of redundant airborne and ground-based GPS, blind panel protocols, and independent DTM checks are the keys to achieving the precision necessary for arid region floodplain analysis. A hybrid approach – the selective use of both airborne and mobile ground-based LiDAR in combination with traditional photogrammetry – greatly enhances the quality and confidence of the mapping and can offer substantial cost savings in unique situations. This paper describes the Flood Control District's recent experience with airborne and ground-based GPS, improved quality control specifications, and the hybrid approach to modern floodplain mapping.

2:00-3:30 Hydraulic Modeling

IMPROVING BRIDGE SCOUR CALCULATIONS USING DETAILED 2D RIVER HYDRODYNAMICS

Reinaldo Garcia, Noemi Gonzalez & Jim O'Brien, FLO-2D Software, Inc.
Brian Schalk & Nathanael Vaughan, JE Fuller Hydrology & Geomorphology

Traditionally 1-dimensional velocity and depth average estimates have been used to determine local pier scour. However, large rivers usually present considerable lateral variations of velocities and depths that cannot be captured by this 1-dimensional modeling. In addition, the 1-dimensional approximation is not able to predict the velocity vectors which can have a significant influence on the scour depth. In this paper we present how using the 2-dimensional hydrodynamic modeling results computed with RiverFLO-2D can be advantageous when calculating local pier scour. We show the advantages of the 2-dimensional modeling approach through a "real world" application at the Tanana River Railroad

Crossing near Salcha, Alaska. The Tanana River is a regional, braided watercourse with a 100-year discharge of approximately 130,000 cfs. At the railroad crossing the Tanana River is over one-half mile wide. The model was calibrated using observed flood water marks corresponding to a near 100-year event. Preliminary project results indicate that using the RiverFLO-2D model, scour depths estimates can be up to 10% smaller than those predicted when using a 1-dimensional model.

OVERVIEW OF NCHRP PROJECT NO. 24-29: SCOUR AT BRIDGE FOUNDATIONS ON ROCK

Jeffrey R. Keaton, Ph.D., P.E., Senior Principal Engineering Geologist, MACTEC Engineering and Consulting, Inc., Su K. Mishra, Ph.D., P.E., Senior Technical Advisor, HDR Inc.
Paul E. Clopper, P.E. Senior Hydraulic Engineer, Ayres Associates

Rock scour is a rock-water interaction problem. National Cooperative Highway Research Program Project 24-29 is geotechnical site characterization in scour-relevant terms for use by hydraulic engineers. Project goals are time-rate of scour and design scour depth at bridge foundations on rock for integration with Federal Highway Administration Hydraulic Engineering Circular HEC-18, Evaluating Scour at Bridges.

Rock scour in natural channels is related to five processes: 1) physical and chemical weathering of exposed rock surfaces, 2) soluble rock dissolution, 3) cavitation, 4), durable rock quarrying and plucking, and 5) degradable rock abrasion. Bridge sites in Florida, Oregon, New York, Utah, and California visited in 2008 provided a range of conditions, data, and samples for the project.

THE CHALLENGES IN DEVELOPING A HYDRAULIC ANALYSIS OF THE YUBA GOLDFIELDS

Rajat Saha, Ph.D., CFM, Ben Tustison, P.E., Don Trieu, P.E. and Pro Mitra, PE, MBK Engineers

The Yuba River Goldfields is located on both sides of the Yuba River in Yuba County, California just northeast of the City of Marysville. It encompasses approximately 10,000 acres and was formed from dredging of the hydraulic mining debris from the Yuba River starting in late 1800s. “Training walls”, constructed from mining debris, are the primary means of slowing Yuba River water from entering the Goldfields. Because the Goldfields is filled with oddly shaped gravel mountains, ravines, streams and ponds, water moves through the gravel piles by surface flow, subsurface flow, and seepage, which makes for a complex area to model hydraulically. In addition, ongoing mining operations continually change the topography within the Goldfields.

The purpose of this hydraulic study is to analyze how flood waters move through the Goldfields, evaluate the consequences of failure of training walls that confine the river channel and develop the resultant floodplains. In this study, a two-dimensional hydraulic model of the Goldfields was developed using Flo-2D to simulate movement of flood water through the Goldfields. High resolution LiDAR data

from the CVFED study were utilized to develop the model. The challenges associated with developing the model; including working with large LiDAR data set, developing the hydrologic inputs, representing one-dimensional channels, selecting the optimal two-dimensional grid size, parameterizing the floodplain elements, and mapping the results were discussed. This information could be used to better understand the associated flood risk and to serve as a basis for evaluation of alternatives to reduce the risk of flooding.

PRACTICAL APPLICATION OF FROUDE NUMBER IN THE FLO-2D MODEL TO CONTROL FLOODWAVE PROPAGATION ON ALLUVIAL FANS

Jimmy S. O'Brien, Ph.D., P.E., President, FLO-2D Software, Inc., Reinaldo Garcia, Ph.D., Senior Hydraulic Engineer, FLO-2D Software, Inc.

Hydraulic flood routing models often have both large scale (creating volume conservation problems) and small scale (on the order of individual computation timesteps) numerical surging. Flood routing models that do not have volume conservation routines or models that have artificial volume conversation reporting through the use of control surfaces may mask problems associated with numerical surging. With large timesteps, over-steepening of the flood frontal wave can generate high velocities. On a smaller scale, the numerical surging may be related to mismatched flow conditions associated with hydraulic structures, boundary conditions, or perhaps variation from normal depth flow caused by poorly correlated slope, flow area and roughness. Mobile bed conditions may also caused mismatched hydraulic parameters.

The application of a limiting Froude number that controls the n-value variation during a flood simulation can improve the prediction of flow hydraulics by providing a more realistic assessment of flow hydraulics and smoothing out potential numerical surging. In the FLO-2D flood routing model, limiting Froude numbers can avoid extending periods or long spatial distributions of supercritical flow. This is important for mobile bed flow where sediment entrainment essentially limits hydraulics to critical flow. For steep alluvial fans, the critical flow condition is widely recognized to limit velocities. In large, mild slope rivers where the Froude number rarely exceeds 0.5 during flood conditions, the FLO-2D Froude number control can predict more realistic and consistent flow hydraulics. Through the application of the limiting Froude number, FLO-2D automates the spatial and temporal distribution of the n-value for both channel and overland unconfined flow effectively calibrating the flood model to bankfull flow conditions during the simulation.

2:00-3:30 Cutting Edge Modeling Tools

THE UPDATE ELEVATIONS TOOL – A NEW HEC-GEORAS FEATURE

Cameron Ackerman, P.E., D.WRE, Senior Hydraulic Engineer, Hydrologic Engineering Center
Brian A. Brown, P.E., and Thomas Molls, Ph.D., P.E., David Ford Consulting Engineers, Inc.

HEC-GeoRAS has been enhanced with the addition of the Update Elevations Tool. Currently, using HEC-GeoRAS, elevations are assigned to cross section cut-lines from a terrain dataset (TIN or DEM). Using the Update Elevations Tool, cross section elevation data can now be updated from an additional terrain data source, such as bathymetric (or survey) point data. In this process, the cross section elevations are first derived from a primary terrain dataset and then updated, within user specified limits, based on an additional terrain dataset. In this presentation, we will describe the development and capabilities of the new Update Elevations Tool and demonstrate the effectiveness of HEC-GeoRAS to utilize elevation data from multiple terrain datasets.

The Update Elevations Tool was initially developed for use in the California Department of Water Resources Central Valley Floodplain Evaluation and Delineation Program (CVFED). The Update Elevations Tool will streamline the process of cutting cross sections using HEC-GeoRAS, where the elevations are a combination of underwater bathymetry and above water LiDAR data. The Update Elevations Tool was developed jointly by David Ford Consulting Engineers, the Hydrologic Engineering Center (HEC), and Environmental Research Systems Institute (ESRI).

A RAPID HYDRODYNAMIC FLOOD MODELING TOOL FOR DECISION SUPPORT FOR THE CENTRAL VALLEY OF CALIFORNIA

Chris Bowles, Ph.D., and Chris Campbell, M.S., cbec, inc., eco engineering
Rob Lamb, Ph.D., and Jeremy Benn, B. Eng., JBA Consulting

Major floodplain management planning efforts are currently underway in the Central Valley of California, and are approaching critical stages. Future efforts may be focused on providing outlines for concepts to enable flood management planning decisions to be made. Identification and prioritization of locations where future multi-objective floodplain management opportunities exist should be undertaken. Issues such as flood risk management, ecosystem enhancement/mitigation, and agricultural sustainability should all be considered when undertaking this assessment of opportunities.

Therefore, a Decision Support Tool (DST) is required that should be able to analyze vast areas of the floodplains of the Central Valley extremely rapidly, at relatively low cost, and with a suitable level of accuracy appropriate for a screening level approach required at this stage of the flood planning process. Other component parts to the DST will be required such as techniques and algorithms (methodologies) which should be combined to meet the demands of ecological and feasibility assessments (for example ecologically beneficial flow events, and agricultural sustainability assessments). A rapid, 2-dimensional hydrodynamic modeling platform, capable of modeling large

areas in a computationally efficient manner, that could form the foundation of the DST, has been developed and is presented here. Results of a demonstration model are presented for the Sacramento River and tributaries from Sacramento to Ord Ferry. Implementation of this model would not duplicate current modeling and mapping efforts currently underway, but rather would augment their findings at a scale over the Central Valley, and help inform future efforts.

SIMPLIFYING H&H MODEL DEVELOPMENT WITH A SOFTWARE TOOLBOX

Thomas S. Plummer P.E., CFM (CESI), Harvey Oslick P.E., CFM, CPSWQ (RBF)
Brian Keating P.E., CFM, and Andrew Darrow P.E. (PCFCWCD),
Carl Walker P.E. (City of Roseville)

During the development of the Dry Creek Watershed Plan Update (performed for the Placer County Flood Control and Water Conservation District), and Pleasant Grove Creek Watershed Update (performed for the City of Roseville) it was necessary to develop some additional software tools to simplify the process of adapting the local model development standards to new tools such as HEC-HMS. A software toolbox was developed by CESI, for these watersheds which provides a "Black Box" toolset for conversion of the base data management spreadsheet directly into complete HMS model sets integrating the local standards for precipitation development, and kinematic wave methodologies. Tools are also provided to assist in geo-rectifying the data, back checking the models, and confirming HEC-RAS inflows are complete and not redundant.

The toolbox assisted greatly in streamlining model preparation times and enabled the consultants to input significantly enhanced details into the watershed update models. The additional details used in the models contributed significantly to the resulting model calibrations, which have been found to be very accurate in predicting hydrograph shape and peaks for historical events. The resulting calibrations were found to be extremely well defined for both low flow and high flow flood events. The models which were originally developed for peak flood evaluations have been found to be sensitive enough to evaluate the impacts of LID and Hydromod issues. These models will be used in flood prediction in the future, and are currently being used to evaluate watershed impacts by various projects.

2:00-3:30 Levees – Remediation, Certification and Flood Planning I

DECERTIFICATION – REMEDIATING OR REMAPPING POST-PAL LEVEES

Mark Seits, P.E. CFM, Vice President, HDR Engineering, Inc.
Mike Fox, P.E., Chief, Water Resources Division, San Bernardino County Flood Control District

In a letter dated August 15, 2006, FEMA formally requested the San Bernardino County Flood Control District (District) to provide the necessary documentation for FEMA to continue to show the existing levees as providing protection from the base flood on the new countywide Digital Flood Insurance Rate Map (DFIRM). All certification requirements are outlined in FEMA Procedural Memorandum 34 - Draft

Certification Procedures and Plan, dated August 22, 2005 (PM 34), and must be followed. In order to meet the requirements as set forth by FEMA, HDR worked with the District to develop and implement a plan to evaluate and certify their levees. The evaluation process consisted of researching all available data, assessing existing levee conditions and performance (including if the designated structure us truly a levee), and categorizing the levees based on the research and assessment. Levees were categorized as follows:

- Category 1 – Levees meet 44 CFR 65.10 and all data and complete documentation is available
- Category 2 – Levees may meet 44 CFR 65.10, but additional data or documentation is needed
- Category 3 – Levees do not currently meet 44 CFR 65.10

Provisionally Accredited Levee (PAL) agreements (per FEMA PM 43) were signed in August 2007 for the Category 2 levees. The District was given two years to provide the necessary certification documents. This two-year PAL period is now over and the post-PAL period is ongoing. The purpose of this presentation is to discuss the results of the PAL process, where the District is today with the levee certification, what FEMA is doing to remap the area behind the decertified levees, and the next steps for addressing the Category 3 levees deficiencies.

CASE STUDY - LEVEE CERTIFICATION AND REMEDIATION –
ALAMEDA COUNTY, CA

Craig Hall, P.E., G.E., Kleinfelder, Inc.
Dan Matthies, P.E., CFM, Moses Tsang, P.E., Morley John, Gerald Plotner, P.E., Wood Rodgers

This presentation will provide a case study to explore the methods used to streamline the work required to certify approximately 22 miles of riverine levees in Alameda County. The consultants will present the methods developed to refine the reaches needing certification, and the methods developed to refine the reaches needing remediation.

The presentation will reflect on the additional resources used in the initial “up-front” portion of the certification evaluation program to help focus the resources used in the latter portion of the evaluation program on the reaches of the levee system that required certification. “Up-front” geotechnical engineering included performing an extensive geomorphology study of the area and using the relatively inexpensive cone penetration tests (CPTs) for the majority of the field exploration point with exploratory borings to calibrate the CPT results. The “up-front” portion of the evaluation process allows those areas not requiring further geotechnical evaluation to be removed early into the process. Remaining areas were evaluated further during the later portion of the evaluation program. The latter portion of the evaluation program consisted of more closely spaced CPTs and borings to further refine the areas requiring mitigation. The presentation will also reflect on the field exploration required to modify the more conservative USACE approach to levee evaluation to a more reasonable and practical approach. The methods used resulted in reducing the levee reaches requiring certification from 22 miles to 11 miles, and the levee reaches requiring remediation from 9,000 ft to 4,000 ft., thus focusing the Flood Control Districts funds appropriately.

FEMA ACCREDITATION OF SOUTH YUBA COUNTY, CA LEVEE SYSTEM

Paul Brunner, P.E. TRLIA Executive Director, and Ric Reinhardt, P.E. TRLIA Program Manager
Three Rivers Levee Improvement Authority

The purpose of this paper is to describe the levee certification process including Quality Control measures that Three Rivers Levee Improvement Authority (TRLIA) used to recently obtain FEMA accreditation for the Reclamation District (RD) 784 levee system in accordance with the provisions of 44 Code of Federal Regulations (CFR) § 65.10 for the RD 784 Levee System to become fully accredited in the National Flood Insurance Program (NFIP).

TRLIA, a joint powers authority of Yuba County and Reclamation District 784, has been working diligently since 2004 to obtain the necessary funding, permits, environmental documents, and designs to construct the levee improvements and repairs for the 29 miles of levees maintained by Reclamation District 784. The total project cost was just over $400 million. A system of earthen levees was designed and constructed to withstand both 100-year and 200-year storm flows from the Yuba River, the Feather River, the Bear River, and the Western Pacific Interceptor Canal (WPIC) in South Yuba County; Ca. TRLIA also formed an assessment district to fund operations and maintenance of the flood protection system. Evaluation, design and construction of repairs of the RD 784 Levee System were accomplished by a team of engineering consultants under TRLIA's management. This presentation will outline the technical evaluations performed with respect to levee certification and corresponding Engineer's Opinion as well as TRLIA's system certification.

2:00-3:30 Arid Regions – Levees, Non-Levee Embankments and Vegetation

CLARK COUNTY LEVEE PROJECT: AN INFORMATIVE LOOK AT LEVEE ACCREDITATION IN ARID REGIONS

Brian Rowley, P.E., CFM, Associate Project Manager and Harshal Desai, P.E., CFM, Group Manager, PBS&J
Kevin Eubanks, P.E., CFM, Assistant General Manager, Clark County Regional Flood Control District

Recent floods in New Orleans and elsewhere have raised questions about the flood protection provided by our nation's levees. As part of the Flood Map Modernization effort, FEMA has implemented procedures to verify that levees shown on effective NFIP flood maps continue to meet the levee requirements outlined in the NFIP regulations (44 CFR 65.10).

In September 2008, FEMA identified eight structures in Clark County and requested that they be investigated and/or re-accredited if applicable. Of these eight structures, two were categorized as non-levee roadway embankments, three were engineered structures designated as provisionally accredited levees (PALs), and the remaining three were non-engineered structures that did not meet levee criteria. A collaborative effort was undertaken by the Clark County Regional Flood Control District, the

respective communities, and the engineering consultant team to evaluate these structures in relation to the NFIP regulations. This effort involved field survey and reconnaissance, biological surveys, H&H analysis, geotechnical evaluation, sediment transport modeling, and erosion analysis. The organization and development of levee documentation and proper analysis required high levels of expertise and extensive coordination. This presentation will provide an overview of the levee accreditation project and discuss specific issues and considerations related to the unique nature of levees in Clark County, which are prone to short-duration flood events along adjacent ephemeral washes and alluvial fans. Lessons learned about the evolving levee accreditation practice will be shared to provide levee owners, regulatory agencies, and consultants with insight on the adaptation of federal levee standards in arid regions.

NON-LEVEE EMBANKMENTS - THE UNTOLD STORY

Michael C. Nowlan, P.E., CFM, Wood Rodgers

This presentation will explore the issues being evaluated and the responses being formulated under the current white paper being developed by the Association of State Floodplain Managers surrounding non-levee embankments with respect to hydrology and hydraulics, particularly in arid regions. FEMA recently issued Procedure Memorandum #51 (Guidance for Mapping of Non-levee Embankments) which offers limited direction from FEMA, as the appropriate responses to all the issues surrounding non-levee embankments are still under development.

Wherever there are human populations present in the United States, there are constructed man-made embankments, i.e. roads, railroads, irrigation facilities, etc. The primary purpose of these man-made structures is not directly related to regional flooding and runoff control, however, these structures often attenuate and/or redirect runoff, and many of them have been treated as blocking flooding on FEMA's FIRMs. Dealing with these structures has created significant consternation amongst local jurisdictions as many of these structures are creating upstream attenuation and reducing downstream peak flow in hydrologic and hydraulic modeling. A thorough review of how embankments are or can be accredited, and thorough guidelines for how to model the effects of such structures on the Special Flood Hazard Area is necessary and should be put together by those experienced with such structures in the floodplain management community.

SIX YEARS OF USING TALL POT TREES FOR NON-IRRIGATED ARID LAND PROJECTS

Diana Stuart, Environmental Program Manager
Flood Control District of Maricopa County, Arizona

The Flood Control District of Maricopa County, Arizona began growing "tall pot trees" in 2003 to revegetate its project sites because of a need to find a cheaper and more sustainable alternative to using expensive or unfeasible irrigation systems. The District's project sites are often remote and most lack access to water supplies. Standard nursery container plants - even arid species - would not survive establishment without irrigation, and the success of hydroseeding was often a hit or miss proposition.

Borrowing the techniques developed by Dr. David Bainbridge (formerly of San Diego State University) and California's Joshua Tree National Park, amongst others, the District has become a regional leader in growing and using tall-pot-grown trees. The District's Tall Pot Nursery has a capacity for 8000 trees, and there are now several commercial growers of tall pot trees to supply non-District projects throughout the southwest. Over the past six years, the District has planted approximately 12,000 tall pot trees in a dozen project sites with survival rates between 73% and 98%. We will discuss our techniques and secrets to success.

4:00-5:30 Flood Risk Communication Strategies and Tools I

NOT IN A 100 YEARS? –
CHANGING PUBLIC UNDERSTANDING OF STORMS

Michael C. Nowlan, P.E., CFM, Wood Rodgers
Thomas Grisa, P.E., Brookfield Public Works

This presentation will explore the current groundswell of activity within the Floodplain Management Community to derive a new way of clearly communicating storm magnitude with the public while avoiding confusion using probabilistic references. The "100-year storm" connotation continues to be confusing to the public and "percent-chance storm" and "annual exceedance probability" references, while more technically correct amongst floodplain managers, has not brought clarity to the public.

Mr. Thomas Grisa, P.E., has formulated an empirical method of scaling the magnitude of storm event rainfall to help classify storms in a more understandable way with the public. His methods and the response issues raised at the 2010 ASFPM Conference will be shared and an open question and answer session is anticipated to gain feedback from the FMA community to help shape this issue.

CROWD-SOURCING, ALERTS, AND OTHER INNOVATIVE STRATEGIES FOR COMMUNICATING AND MANAGING FLOOD RISK

Tim L. Tinker, DrPH, Director, Center of Excellence for Risk and Crisis Communications
Booz Allen Hamilton, Inc.
Brigadier General (Ret) Gerry Galloway, Glenn L. Martin Institute Professor of Engineering,
Department of Civil and Environmental Engineering,
University of Maryland

Communicating flood risk is a complex endeavor with multiple perspectives, approaches and components as each flood-risk situation is unique and has numerous challenges: geo-spatial mapping and depiction of flood data; the geographic proximity of involved parties, the type and extent of exposure, potential risks, possible actions and others. Adding to this complexity is the rapidly changing communications landscape and its implications for disseminating flood risk messages and engaging an already skeptical, and often, distrustful public. Fortunately, a wealth of new communication platforms

and strategies are emerging which present the possibility of reaching and engaging more people in productive and ongoing dialogues about flood risk and notifying those at risk of immediate threats. For example, "crowd-sourcing" is a new methodology enabled by the introduction of new technologies such as social media and social networks to involve and actively solicit large groups for an open exchange of information, ideas and opinions. These latter dialogues, their substance and outcomes, are intended to inform the flood risk enterprise of policies, plans, processes and partnerships. Alerts get the risk message out, but often miss many who do not use or understand the opportunity.

Through evidence-based research, discussion of common pitfalls and forward-thinking next steps, the presenters will provide participants with a suite of strategies and tools for engaging communities about flood risk. More specifically, participants will be introduced to and apply new strategies and tools via: concrete examples, success stories and lessons learned; opportunities and innovations in new media policy, strategy and practice; top trends in the application of new and emerging media to flood risk assessment, management and communications; insights on strategies robust enough to withstand high intensity, resource constrained, and multiple flood risk issues and events; and the changing dynamics and collaborative models for public-private partnerships in new media and social networks.

FLOOD RISK NOTIFICATION PROGRAM-CENTRAL VALLEY LEVEE FLOOD PROTECTION ZONES

Alex Yescas, P.E., CFM, Senior Water Resources Engineer, PBS&J
Ricardo Pineda, P.E., CFM, California Department of Water Resources, Chief of Floodplain Management Branch

The Flood Risk Notification Program was initiated following the adoption of Assembly Bill 156 in 2007. One of the initiatives from the bill required the Department of Water Resources (DWR) to develop Levee Flood Protection Zone (LFPZ) maps. The LFPZ maps identify areas that are protected by State-Federal Project Levees in the Central Valley. This effort was completed in December 2008. In addition to developing the maps, the bill requires that on or before September 1, 2010, and on or before September 1 of each year thereafter, DWR shall provide written notice to each landowner whose property is determined to be entirely or partially within a LFPZ.

The presentation will discuss the efforts carried out by the Flood Risk Notification Program team. The efforts involved included the determination of impacted properties and development of the notice to the landowners. Initial estimates determined that over 300,000 properties are impacted by LFPZs. The notice to the landowner provides information regarding the potential risks of living near a levee and the flooding sources that could impact their property. In addition to providing landowners a notice, a web viewer is in development that provides the landowners and the public the benefit of viewing their properties proximity to a flooding source. The landowner will also be able to determine the approximate depth and category of flooding, either shallow or deep flooding, from simply typing in their site address or assessor's parcel number.

TURDUCKEN, LEVEES (OR NON-LEVEE EMBANKMENTS) AND THE INFORMATION AGE – HOW OVER-STUFFING CAN RUN AFOUL

Lisa Messano, CFM, Communications and Outreach Specialist, Michael Baker Jr., Inc.

A turducken is a dish consisting of de-boned turkey stuffed with de-boned duck, which is stuffed with a small de-boned chicken. There are several variations and cultural references to the culinary practice of nested birds, including references to scenarios concerning when non-food elements are 'stuffed' into others. We live in an age where we have grown accustomed to the ability to instantly access knowledge and information that would have been difficult or impossible to find previously. With the advent of the internet, wikis and numerous media sources, our appetite for simplified, bite-sized facts and figures has increased along with the instant access. And once we have access, a new hunger develops to further roll this information into statistics. But statistics and numbers only tell part of the story.

This presentation will consider how we define the term levee and the challenges that are presented by attempting to 'stuff' structures that provide flood protection into one definition. Case studies will be provided for levees that have been mapped as provisionally accredited on Digital Flood Insurance Rate Maps. This information will be presented from an outreach and communication perspective.

4:00-5:30 Floodplain Restoration – Case Studies

FLOODPLAIN AND FISHERIES RESTORATION TO IMPROVE FUNCTIONALITY OF AN ALTERED RIVER

Brooke Marshall Garcia, P.E., Water Resources Business Class Manager, and
Kenneth Ferjancic, Vice President, Director of Fisheries, HDR, Inc.

The result of many years of modification to the Albuquerque reach of the Middle Rio Grande as well as upstream influences include alterations to the natural water course, channelization of the river, and upstream hydraulic modifications (Cochiti Dam) impacting peak discharge rates and event timing. Major byproducts of the modifications include reduced upstream sediment supply (encouraging degradation downstream) and the presence of non-native vegetation and fish species. These conditions have resulted in loss of habitat for the endangered Rio Grande silvery minnow (RGSM) and the Southwester Willow Flycatcher (WIFL). HDR is providing river restoration services for the Albuquerque Bernalillo County Water Utility Authority (ABCWUA), for mitigation as part of the approval process of a new water treatment plant. The restoration objectives are to mechanically encourage inundation of designed river features to provide habitat for all life stages of the RGSM and to improve riparian habitat for the WIFL.

Project objectives include: Non-native vegetation clearing and floodplain expansion; Terrace lowering (re-establish floodplain hydraulic connectivity); High-flow side channels; Channel widening/bank stabilization; Bank destabilization; River bar/island enhancement. To assist in the recovery of the

RGSM, as required by a Biological Opinion issued by the USFWS, HDR has designed natural refugia for rearing this species to augment the natural population. These facilities are designed to minimize adverse genetic and environmental impacts associated with conventional rearing practices.This work is performed for the New Mexico Interstate Stream Commission and the Bureau of Reclamation..

EVALUATING STREAM RESTORATION AND FLOODPLAIN IMPROVEMENT TECHNIQUES IN THE PINECLIFF CREEK WATERSHED

Alex Haptemariam, P.E., CFM; Sudhanshu Mishra, P.E., CFM

Pinecliff Park is located in Fredrick County, Maryland. Pinecliff Creek flows through Pinecliff Park and is a second order tributary to the Monocacy River. Changes in the hydrologic and sediment regimes associated with the historic clearing of forests for agriculture and subsequent residential development have caused the stream to undergo significant morphological changes throughout the watershed. In addition, alterations to the stream reaches in the Park have contributed to unstable channel conditions. These alterations included floodplain fill and channelization to accommodate construction of athletic fields, playgrounds, picnic areas, and parking lots along the middle and lower reaches of Pinecliff Creek.

The upper reach of Pinecliff Creek was relocated, channelized, and dammed to provide a water source for an ice skating pond. The unstable conditions include significant aggradations along the upper reaches and incision of the streambed, Streambank erosion, widening of the channel, and lateral migration along the middle and lower reaches. The unstable channel conditions in the park have so severely impacted the upper reaches that a wetland trail system is no longer accessible to the public. Failure of the dam and continued instability along the upper reach is threatening to eliminate the water supply for the ice skating pond. Unstable channel conditions along middle and lower reaches in the park are threatening the adjacent athletic fields, parking lots, footbridge, and newly installed water main. This presentation discusses the restoration of Pinecliff Creek and the adjacent floodplain to improve the overall conditions along the stream corridor within the boundaries of the park, to prevent damage to public land infrastructure, and to reduce the need for future maintenance.

AGUA HEDIONDA CREEK RESTORATION PROJECT

Tory R. Walker, P.E., CFM, LEED GA
President, Tory R. Walker Engineering, Inc.

The Agua Hedionda Creek Restoration Project will restore about 4000 feet of creek, including riparian and upland habitat through a City of Vista, California park. Tory R. Walker Engineering, Inc. studied the creek and watershed, preparing hydrologic, hydraulic and sediment studies, all culminating in a Preliminary Design Report. Four alternative grade and bank stabilization features were evaluated and designed with the natural beauty and biotic functions of this important resource in mind. This natural creek system, set within an urbanizing watershed, presents a number of opportunities and challenges that will likely help shape the direction for similar projects in the next decade. Competing interests of

the various resource agencies must be met. Sediment pre-loading within the system is proposed, as this will be an important aspect of maintaining a sediment balance within the downstream system. Two sewer lines and an important 33-inch water line cross and also parallel the creek for some distance, requiring careful planning, design and coordination with other agencies.

This paper will present some of the important findings of our study, describe the opportunities and challenges that are defining whether or not this and similar projects will be truly successful, and summarize our evaluation of each of the four alternative designs.

4:00-5:30 Levees – Remediation, Certification and Flood Planning II

THE TWISTS AND TURNS OF THE FEMA PAL PROCESS

Patti Sexton, Program Manager, P.E., CFM, Tetra Tech, Inc.

Tetra Tech has processed 26 levee certifications over 50 miles of levee since the release of PM34. This presentation will discuss processing within the PAL program that is "off the beaten path." This includes: (1) delisting levees due to extensive channel incisement - how this impacts the USACE classification of the system and local sponsor responsibilities, (2) segmentation – when its worthwhile to segment a single system into a channel and levee system, (3) interior drainage and why it can be Pandora's box, (4) vegetation on levees – how FEMA's criteria differs from USACE criteria and what that means for the status of a levee, and (5) freeboard analysis on southwestern levees – when does R&U help.

ENGINEERING CHALLENGES OF THE NATOMAS LEVEE IMPROVEMENT PROJECT

Mark Stanley, Principal Geotechnical Engineer, and
Craig Hall, Senior Project Manager, Kleinfelder

Identified as the urban area with the highest risk of flooding second only to New Orleans, the Natomas Basin presents major engineering challenges with respect to flood protection. The basin is home to 70,000 residents with projected growth to over 300,000. Levees protecting the basin were de-certified in 2006. Facing potential flood depths in excess of 20 feet and a building moratorium, residents of the basin voted to fund improvements and restore levee certification. This highly ambitious project is tasked with constructing 50 percent of improvements necessary to provide 100-year flood protection by 2011 and providing 200-year flood protection by 2013.

Engineering challenges will be discussed including the evolving geotechnical design and analysis standards; the selection of appropriate engineering alternatives and their effects on existing hydraulic infrastructure that must be maintained during construction including upgrades to pump stations that provide internal drainage and roadways and intersections on levees; and land constraints with levees that bordered residential neighborhoods; also how issues of levee vegetation, maintenance, seismic

hazards are being addressed. This presentation will highlight some key lessons learned and the engineering solutions developed to solve challenges associated with this complex, fast-tracked project. Participants awareness of potential challenges will be raised and they will be equipped anticipate similar issues on projects they may be involved with in the future.

CARGO SHIP COLLIDES WITH DELTA LEVEE

Mike Mirmazaheri, PE, CFM, Manager, Delta Levees Program,
California Department of Water Resources

The Delta contains many assets and provides services of significant importance to the State. These assets and services are protected and facilitated by a levee system which requires good maintenance and systematic improvement. The Delta levees protect large populations in Sacramento and Stockton and provide conveyance of fresh water to 25 million Californians. Major water conveyance facilities including the California Aqueduct, the Harvey O. Banks Delta Pumping Plant, and the North and South Bay Aqueducts of the State Water Project, are dependent on Delta waterways. Major federal facilities in the Delta are the Central Valley Project's Tracy Pumping Plant, Delta-Mendota Canal, Delta Cross Channel and Contra Costa Canal. The East Bay Municipal Utility District Mokelumne Aqueduct also crosses the Delta. Bradford Island is one of the eight western Delta islands identified essential in protection of water quality for industrial and municipal use in California. Bradford Island has approximately eight miles of levees and is surrounded by the San Joaquin River and False and Fishermans Sloughs. The San Joaquin River is used for navigation by major cargo companies. On August 27, 2009, a 570-foot freighter ran into the levee on the north side of Bradford Island causing significant damage to the levee and raising concerns about levee failure. The local agency immediately proceeded with the repair work and spent more than a million dollars to restore the facility. Although there are many bridges and roadways to access most part of the Delta; Bradford Island can only be accessed by a ferry.

A NEW APPROACH TO FLOOD PLANNING - DEFENSE IN DEPTH

Ronald E. Baldwin, Director of Emergency Operations,
San Joaquin County Office of Emergency Services

For many years, the flood insurance program has provided a process for certifying that levees meet the 100-year protection standard, thereby removing most insurance and land use restrictions from subsequent floodplain development. An unfortunate side affect of this focus on the primary levee can be an attitude that because the levee meets this theoretical certification it will perform its function unfailingly into the future. The result is that the question of what to do if the primary levee does fail ends up being addressed in an informal or non-existent manner.

However, in almost every community protected by levees opportunities exist to limit flood extent, depth, and/or duration if a levee does fail. A new approach to flood planning, "defense in depth", helps ensure that these opportunities can be effectively exploited if needed. This new concept

encourages officials to look behind their primary levees for opportunities to limit damages if the unthinkable does occur. San Joaquin County has been developing flood contingency maps for the last ten years using these new planning concepts. These maps display information critical to rapid situation analysis and decision-making along with procedures for joint flood fight operations. In 2009, the Federal Emergency Management Agency Region IX Hazard Mitigation Branch provided a grant to develop a guide with model maps to assist others that may want to initiate a similar program. This presentation will discuss the program history and rationale and will show examples of maps. Current maps can be viewed at www.sjmap.org/oesfcm.

4:00-5:30 Arid Regions – Geomorphic and Geologic Methods

GEOMORPHIC ASSESSMENT OF FLOOD HAZARD, TRAVERTINE POINT AREA, SOUTHEASTERN CALIFORNIA

Philip J. Shaller, Parmeshwar L. Shrestha, Douglas Hamilton, Kristina Cydzik, Macan Doroudian, and Massoud Rezakhani, Exponent, Inc.

As part of a flood hazard investigation, a geomorphic assessment was performed for the Travertine site, located on the western shore of the Salton Sea, just north of the Imperial/Riverside County line in southeastern California. The site lies at the distal margin of an alluvial piedmont that descends eastward from the Santa Rosa Mountains. During much of Pleistocene time, climatic conditions were conducive to the development of large alluvial fans that built out from the mountain front. With the onset of Holocene interglacial conditions, the carrying capacity of streams diminished, alluvial fan deposition generally ceased, the Pleistocene alluvial fans were incised, and the locus of sedimentation migrated eastward towards the center of the basin. Today, floodwaters are constrained largely to incised channels in the alluvial piedmont. The periodic presence of large, freshwater lakes (Lake Cahuilla and its predecessors) fed by the Colorado River in late Holocene time modified the geomorphology below the old shoreline. Lacustrine processes reduced local relief, deposited a veneer of lake sediments, and dissolved desert varnish on old alluvial surfaces. Because of this activity and the limited amount of time (300-400 years) that has elapsed since desiccation of the most recent lake, active channels that extend below the old shoreline exhibit minimal lateral confinement or incision. Since the early 1900s, agricultural development has further modified and/or obscured the geomorphology below the old shoreline. Evaluation of pre-development flood hazard conditions in this area required the evaluation of older maps, air photos, and LiDAR-based topography.

QUANTITATIVE TECHNIQUE FOR ASSESSING THE GEOMORPHIC THRESHOLDS FOR FLOODPLAIN INSTABILITY AND BRAIDING IN SEMI-ARID ENVIRONMENTS

David Dust PhD, PE, Colorado State University, Department of Geosciences

As part of a research project for the Southern California Coastal Water Research Project (SCCWRP), methods were developed for assessing the current stability state of a floodplain in terms of the probability that a floodplain will become unstable and severely erode its banks, due to the changes in water and/or sediment supply often associated with urbanization. To provide a geomorphic foundation for this research, a reach-scale classification system and a catchment-scale conceptual model were created to synthesize the observed floodplain forms into three basic floodplain continuums for the semi-arid environment of southern California: armored, non-armored, and active-regional alluvial fan. These continuums are comprised of three to five basic alluvial floodplain forms (cascade, step-pool, plane-coarse-bed, plane-mixed-bed, plane-fine-bed, pool-riffle, braided, and dune-ripple). For the non-armored floodplain continuum, a floodplain state diagram has been generated to quantitatively describe the natural downstream progression of floodplain forms and geometry, using specific stream power and the width-to-depth ratio as the state and shape metrics, respectively. Based on field data for 91 cross sections along 14 individual watercourses located through southern California, this floodplain state diagram provided the basis to define geomorphic thresholds for both floodplain instability and braiding using logistic regression analyses. This method for defining floodplain instability thresholds may provide a unique management tool by providing a quantitative means to assess the stability state of watercourses in terms of probability, which only requires a reference discharge, cross sectional geometry, and basic hydraulic computations.

MODELING ALLUVIAL FAN FLOOD HAZARDS FROM GEOLOGIC MAPS – PUTTING TO PRACTICE ALLUVIAL FAN TASK FORCE GEOLOGIC MAP PRODUCTS

Jeremy T. Lancaster, Thomas E. Spittler′ and William R. Short, California Geological Survey

As a technical consultant to the California Alluvial Fan Task Force (AFTF), the California Geological Survey (CGS) is working with the California Department of Water Resources (DWR) to provide three products consistent with the AFTF pre-project screening approach. These products are (1) maps of areas underlain by Quaternary sediment that may include alluvial fans for the AFTF 10-county study area (the Alluvial Fan Footprint Map), (2) a compilation map of available surficial geologic data, and (3) new surficial geologic maps of portions of the AFTF study area. These maps will provide the basic geologic data necessary to develop relative hazard maps for areas where alluvial fan flood hazard information is unavailable.

Putting to practice these products, the AFTF Integrated Approach pre-project screening tools (AF 1&2) identify the general distribution of alluvial fans (Product 1) on the basis of the extent of alluvial fans defined on surficial geologic maps, or where published maps are absent, by the National Research Council's (1996) Stage 1 procedure. The approach to determining the relative hazard of alluvial fan

flooding utilizes the basic data of products 2 & 3, and is defined based on the topographic position and age of the alluvial fan deposits as: high ≈ Latest Holocene fan surfaces and historic channels and washes, or whole fan areas subject to historic and future migration of flow paths; moderate ≈ Late Pleistocene to Late Holocene alluvial fan terraces, moderately incised and raised above younger channels and washes; low ≈ Early to Late Pleistocene relict fans elevated significantly above historically flooded surfaces. These breaks differ from the fluvial flood hazard designation of a 1% flood in that they consider not just the relatively frequent floods but the lower frequency events that are extremely hazardous and that are responsible for the development of the alluvial fan morphology. The relative flood hazards assessment is supplemented with the delineation of debris flow hazard areas.

THURSDAY, NOVEMBER 4

9:00-10:30 Flood Risk Communication Strategies and Tools II

CUTTING THROUGH THE CLUTTER: EFFECTIVE COMMUNICATION STRATEGIES TO CONNECT WITH STAKEHOLDERS AND WIN COMMUNITY SUPPORT

Kim Floyd, Principal, Kim Floyd Communications

Each year, some of the best-engineered solutions fail and great projects are shelved because they lack support from the community. Meanwhile, communicating effectively has never been more challenging. The stakes are only getting higher, especially as they relate to Integrated Flood Management programs and projects. When you have less than one percent of your budget available for public outreach, tens of thousands of stakeholders and tons of junk mail, how can you effectively connect with your target audience, let alone win its support? The right messages delivered with the wrong tools will miss the mark, waste precious budget, delay or kill your project and harm your reputation. These days, communication tactics must be differentiated to meet the needs of individual communities and audiences.

This session covers strategies for identifying stakeholders' preferred means of communication, barriers to effective communication and solutions to overcome those challenges. Kim Floyd has more than 16 years of experience and a specialty in public outreach for Integrated Flood Management programs, projects and funding measures. She'll share proven, cost-effective communication tactics that put communities to work *for* you, not against you.

BUILDING BLOCKS OF EFFECTIVE COMMUNICATION

Julie Hildreth, NFIP FloodSmart

Communities in California, Hawaii, Nevada and across the nation are facing a variety of issues affecting the flood risk and flood insurance needs of their residents. Map changes, expiring PAL agreements, heightened flood risks due to wildfires and damaged dams are just a few. What is the best way to engage residents in a conversation about flood insurance? Advertising? Social media? Through local advocates like you? All of the above? Join representatives from the National Flood Insurance Program's FloodSmart campaign as they examine the building blocks of a truly effective, local outreach campaign. You will also hear examples of local campaigns that have worked. You will leave with tools, messages and ideas to help you develop an outreach campaign for your community.

COMMUNICATING YOUR FLOOD CONTROL PROJECT IN TIMES OF "TRANSPARENCY"

Ingrid Norgaard, Community Outreach Specialist, ICF International

The Obama administration's proposed revisions to CEQ's Principles and Guidelines, to be carried out by federal agencies responsible for flood management, are intended to provide transparency into their planning processes beyond those required by NEPA or other state environmental laws, to allow the public a greater opportunity to be involved in flood reduction efforts in their communities. Increased dialogue with and within the community can lead to greater support for the projects agencies embark upon to limit flood risks. A goal is mutual benefit for both government and citizens as dialogue with the public throughout the planning process for flood-reduction activities shows the public that the agency is committed to informing and engaging them and also demonstrates a level of transparency that the public is seeking, in turn ideally engendering public trust and support.

Typical concerns about expanding the public's role in agency planning processes are that it lengthens project timelines, increases planning costs, and may incite public controversy. While these side effects may be true in varying degrees under some circumstances, it has also been the case that carefully managed public processes have resulted in projects that are executed with greater efficiency, quality, and ultimate success through cultivating public understanding and support, or, at least, neutrality.
This poster will explore how the revised P&G could impact the ways in which outreach is conducted in relation to flood management projects, highlight proven strategies and tactics to effectively engage all project stakeholders, and call attention to communication success stories.

THE ROLE OF FLOODPLAIN MANAGEMENT ASSOCIATIONS IN COMMUNICATING RISK

Jeanne Ruefer, Accenture, RPML Region IX

The Risk MAP National Outreach Strategy calls for development of key relationships with other FEMA programs, Federal agencies, and industry associations for the communication of flood risk. This presentation will explore the role of floodplain management associations in general and FMA in particular in undertaking the risk communication role. The use of new technology and social media will also be explored. Key messages and delivery techniques for specific regional risks will be explored.

9:00-10:30 Flood Risk Management Planning and Approaches

COST-EFFECTIVE, LONG-TERM STRATEGIC WATERSHED PLANNING ANALYSIS – AN EXAMPLE FROM MOHAVE COUNTY, ARIZONA

Mike Kellogg, R.G., CFM, Project Manager, JE Fuller/Hydrology & Geomorphology, Inc.

Identification of existing and future flood hazards is often conducted on a site-specific basis to address local flooding problems, frequently ignoring regional or watershed-wide hazard sources. Ideally, such analyses would best be conducted on a watershed scale to identify hazards beginning at the mountain front and extending across the piedmont to the valley axial river system. A cost-effective, watershed-scale approach has been developed and applied to four large watersheds in Mohave County, Arizona. The approach includes a combination of geomorphic assessments and two-dimensional hydraulic modeling, resulting in a regional comprehensive flood hazard assessment.

The results of the regional approach included identification of existing regulatory floodplain delineations that did not adequately depict the actual flood hazards. In areas with projected population growth, flood risks associated with planned future development were identified. The analysis also allowed for the development of flood hazard management strategies and planning-level solutions to address prioritized areas of future development exposed to flood risks. The solutions identified areas that required regional and/or local flood mitigation measures, areas where floodplain delineations or re-delineations were needed, and areas of special flood or erosion hazards. The overall objectives were to identify and prioritize flood hazard areas for future, more-detailed, site-specific studies and design projects. The regional approach provided Mohave County with an implementation framework for the future studies and capital improvements.

USING FEMA'S WATERSHED APPROACH FOR PLANNING NEW COMMUNITY FLOOD STUDIES

Wen Chen, Ph.D, P.E., CFM, Senior Engineer, Michael Baker Jr., Inc.
Edward Curtis, P.E., CFM, Senior Engineer, FEMA Region IX

Under the FEMA Risk Mapping, Assessment, and Planning (Risk MAP) program starting in Federal Fiscal Year 2010, all newly initiated floodplain mapping studies will be watershed-based. The USGS HUC-8 watershed will be the basis for prioritization and cataloging of Flood Insurance Rate Map update efforts. Typically a new study will be conducted for a sub-watershed within a HUC-8 watershed and the selection will be determined by the risk, need, and validation status of the sub-watershed. The risk to population and the built environment is determined by the output of FEMA's most recent national annualized loss estimate and ranked in terms of Risk Decile from 1 to 10. The need is determined by the availability of base map information including quality topographical data and requests from communities to study newly developed areas or restudy areas where flooding conditions have changed over time. The validation status of the sub-watershed is measured by the degree to which existing flood hazard data meets FEMA's current mapping standards. These factors form a decision-making

matrix which produces an initial sub-watershed assessment. New studies will be initiated for the sub-watersheds with the highest rankings from the assessment within a HUC-8 watershed.

This approach is demonstrated in the selection of the east portion of Ballona Creek Watershed in Los Angeles County as a new study within the Santa Monica HUC-8 Watershed (HUC 18070104). The Ballona Creek Watershed totals about 130 square miles and is highly urbanized with 1.6 million residents, which is about 60% of the total population in the Santa Monica HUC-8 watershed. The hydrology has not been updated for the watershed since 1979, and recent hydrologic data by USACE are available. Further assessment indicated that 7 out of 8 letters of map revision (LOMRs) were issued in the east portion of the Ballona Creek Watershed. The assessment determined that approximately 80 square miles of the Bellona Creek watershed should be analyzed with a 2-dimensional unsteady hydraulic model that should also include updated hydrology. The effort is estimated to impact 15 stream miles and 10 map panels.

THE VALUE ADDED TO FLOOD CONTROL PROJECTS BY USE OF EXTERNAL REVIEW PANELS

David T. Williams, PhD, P.E., PH, CFM, CPESC, DWRE, F.ASCE, President, David T. Williams and Associates
Leslie F. Harder, Jr., PhD, PE, GE, Senior Water Resources Technical Advisor, HDR Engineering
George L. Sills, PE, Manager, George Sills Geotechnical Engineering
Ray E. Martin, PhD, PE, Consultant, Ray E. Martin LLC

Shortly after Hurricane Katrina, the USACE formed the Interagency Performance Evaluation Task Force (IPET) to study the levee system in the New Orleans area. The American Society of Civil Engineers (ASCE) also formed a review group, the External Review Panel, to review work performed and reported by IPET. The ASCE panel stated that they believed many of the major deficiencies in the levee system could have been avoided by a high-level review of the design and plans by a group of external experts called the External Independent Technical Review Panel (EITR).

The Sacramento Area Flood Control Agency (SAFCA) also obtained an outside review board of experts called the Board of Senior Consultants (BOSC) to independently review current flood control design and plans within their area. The BOSC, comprised of the authors of this paper, has been reviewing this work for approximately two years and meeting periodically with the design teams. During these reviews and meetings, the board has discovered several areas where sufficient engineering and/or geotechnical investigations had not been conducted. The reviews also found other areas where over-engineering criteria had been specified. With thoughtful modifications to these criteria, project money could be reduced without reducing public safety. This paper discusses the mandates for an EITR, the requirements for members of an EITR, their duties, how the EITR works, and the value added to the projects within SAFCA by the BOSC review board that would make more efficient projects as well as improve public safety.

9:00-10:30 Floodplain Mapping – Case Studies

FEMA PROCEDURE MEMORANDUM NO. 51— GUIDANCE FOR MAPPING OF NON-LEVEE EMBANKMENTS APPLIED: CASE STUDY - MISSOULA COUNTY, MONTANA

Celinda Adair, CFM, CPP, Map Modernization/Risk MAP Program Manager,
State of Montana, Dept. of Natural Resources and Conservation

After the release of Procedure Memorandum No. 51, and the identification of inconsistencies in mapping practices where non-levee embankments existed, FEMA Region VIII applied PM 51 to the Missoula, Montana countywide DFIRM conversion project. This proved to be a unique challenge given the debate occurring nationally over how and when to implement PM 51 and the project's budget and schedule constraints. The effort to address issues specific to the Missoula project led to FEMA Region VIII's development of the Letter of Reasonable Assurance (LoRA) option, which was utilized in one instance. Yet this solution proved unsuccessful for addressing the rest of the non-levee embankment areas identified, so a variety of other ideas were entertained in order to find a road forward that local, state, and federal entities could support. Recently, a method was identified and agreed upon and the Missoula project is proceeding. The aim of this presentation is to convey the range of options considered and utilized for applying PM 51 to an ongoing project in the hopes that this knowledge and a discussion of the process and efforts that lead to an agreed upon solution, will benefit other communities that may face the same situation now or in the future.

CALIFORNIA COASTAL ANALYSIS AND MAPPING PROJECT: CALIFORNIA PACIFIC COASTAL FLOOD STUDIES

Darryl Hatheway, Sr. Coastal Scientist, BakerAECOM

The FEMA Production and Technical Services team of BakerAECOM plans to conduct for FEMA Region IX a detailed open coast study (including wave modeling, wave run-up assessments, wave overtopping analysis, and dune and bluff erosion assessments) to remap the coastal flood risk on DFIRMs along the coastlines of both Southern and Northern California. Currently, BakerAECOM is performing a review and analysis of available data for consideration and use in new coastal hazard studies of the Pacific Ocean coast of California, excluding the San Francisco Bay area. Data gaps will be determined during this process and filled, technical approaches reviewed, work plan established, and an outreach framework developed.

The California Pacific Coastal Study will be conducted in accordance with FEMA's draft February 2005 Pacific guidelines for new coastal studies, *Guidelines and Specifications for Flood Hazard Mapping Partners*, Appendix D. The initial efforts will focus on Northern California studies from Point Conception north to the California-Oregon border, followed by the Southern California study from Point Conception south to the California-Mexico border. The California Pacific Coastal flood studies can be tracked on the new Region IX coastal webpage found at www.r9coastal.org. Region IX and BakerAECOM will utilize accepted as well as alternative modeling approaches that provide the best

science and understanding of the coastal processes that cause the coastal hazards present along the California Pacific coastlines as part of the coastal study plan.

THE LONELIEST DFIRM IN AMERICA, THE LAST OF THE NEVADA COUNTYWIDES AND OTHER TALES

James M. Johnston, CFM, GISP, Technical Manager, Michael Baker Jr., Inc.

As the last four Countywide DFIRMs that FEMA has planned in Nevada get underway this is an excellent opportunity to review the variety of floodplain mapping projects funded in Nevada under Map Mod and now Risk Map. This presentation will review the history of DFIRM projects in Nevada and explore the range of approaches employed by FEMA to modernize floodplains across the state.
We'll look at Clark County which was one of the first DFIRMs in the nation in 2003. Other counties funded and completed under Map Mod will be examined with a focus on the challenges of changing requirements and procedures from FEMA. Working with CTP's will be discussed in the context of the Carson River Watershed Conservancy District. FEMAs new watershed approach to mapping is being planned in Nye County. An effort to create more accurate floodplains via the use of Depth Grids is underway in Lyon County that may change how FEMA creates maps in the future. Finally we will look at the last four countywide studies in Nevada and see how the evolution of the process will benefit the mapping along the Loneliest Road in America.

TRANSATLANTIC PERSPECTIVES ON FLOOD RISK MAPPING, UNCERTAINTY AND MANAGEMENT FROM THE UK, IRELAND AND ARGENTINA

Paul Robinson, Senior Water Resources Specialist, Halcrow, Inc.

Flooding is one of the most destructive and common hazards faced by many countries including the United States. In the US, FEMA is embarking on the Risk MAP program to Map, Assess and Plan mitigation measures in response to flood risks. This presentation will share experiences and lessons learned from similar projects on the River Thames (England), River Lee (Ireland) and Buenos Aires in Argentina. These projects have mapped flood risk, uncertainty, and planned sustainable management measures to mitigate these risks against the back-drop of potential future climate change. In Buenos Aires a novel "dual-layer" approach was taken to modeling flood events so that the risk could be mapped to property-level of detail. 1D-2D modeling has been utilized to accurately assess the complex River Lee floodplain risk in the City of Cork. The Lower Thames project has drawn on both property-level mapping and 1D-2D modeling to enable development of a flood risk management strategy for the area between Windsor and west London. This "Lower Thames Flood Risk Management Strategy" assessed the physical, economic, environmental and social implications of a range of alternative measures before the Environment Agency of England and Wales presented a recommended integrated risk management approach to the public. This approach includes: structural measures such as diversion channels, control structure modifications and local defenses; as well as non-structural measures to raise public awareness and preparedness. It also piloted "floodplain management tools" that can inform development and emergency planners and enhance their decision making and emergency response.

11:00-12:30 Financial Flood Protection – Case Studies

SOLVING BAY AREA FLOOD CONTROL FUNDING CHALLENGES: USING LOCAL FUNDING TO REDUCE THE NUMBER OF SFHA PROPERTIES IN THE CITY OF SAN MATEO

John W. Bliss, P.E., Vice President and Thomas Brightbill, P.E. Engineer,
SCI Consulting Group

Many bay-side cities surrounding the San Francisco Bay Area contain a significant number of parcels within the Special Flood Hazard Area (SFHA). Owners of properties within the SFHA may have restrictions on development, and are typically required to purchase flood insurance at ever-increasing rates. Further, current FEMA re-mapping efforts are likely to enlarge the SFHA zones, resulting in an increased number of SFHA parcels within these cities. By improving existing flood control facilities to FEMA standards or constructing new facilities, these cities may reduce the number of SFHA parcels within their jurisdictions. In many cases, the costs of these improvements, when spread amongst the affected properties, result in a lower per parcel rate than the annual costs of the flood insurance. In such cases, there is a strong incentive to establish a local funding mechanisms to pay for these improvements instead of paying the higher flood insurance rates.

Case Study: In 2009, the City of San Mateo successfully implemented a Proposition 218–compliant benefit assessment that will fund $7.5 million worth of improvements and will result in over 6,000 properties, mostly single family homes, removed from the SFHA. The per single family rate for this assessment is less than $80.00 per year which is significantly less than the cost of flood insurance. San Mateo was able to complete this funding process rapidly and without the need for federal funding. A thorough description of this effort will be presented by the principal engineers responsible for the design and implementation of this assessment.

FUNDING AND COMMUNITY BASED PLANNING STRATEGIES FOR FLOOD PROTECTION - 6 CASE STUDIES

David Dickson, MIG, Inc.

In March, 1998 voters of Napa Valley approved, by the required 2/3 majority, a sales tax increase to raise the $220 million local share of a county-wide $450 million flood protection and watershed improvement Plan. The layers of funding put together under David's leadership includes Sales Tax Revenue Bonds (issued June, 1999); $34 million low interest EPA loan; FEMA Hazard Mitigation Grants; environmental restoration grants from the California Coastal Conservancy, EPA, CALFED, and Bureau of Reclamation; State and Federal Highway monies; Community Development Block Grants (CDBG) and Army Corps of Engineers funding. As construction of the Napa Projects have proceeded over the past 10 years in Napa, Yountville, St Helena and other areas of the Napa Valley, David has worked with many communities around the Western States to implement similar planning and funding efforts including Washoe County, Nevada, the Pajaro River in Santa Cruz/Monterey counties, Marin county's

Ross Valley watershed, Alameda county's San Lorenzo Creek watershed, LA county's San Gabriel River watershed, and others.

David will share the elements of success for these projects which all include an extensive Community Coalition planning process which he designed and facilitated involving over 25 local stakeholder organizations, 27 Federal, State, Regional, and local government organizations, extensive public opinion surveys, and professional issues based campaigns, and ultimately local financing to leverage State and Federal funds.

ABLE STORM WATER PUMP STATION: A DALLAS PARTNERSHIP BETWEEN PUBLIC WORKS AND COMMUNITY REDEVELOPMENT

Rodrigo Vizcaino, P.E., CFM, Project Engineer, HDR Engineering, Inc.

The City of Dallas is in the process of upgrading and expanding the capacity of the storm water pump stations that are part of the Trinity River Interior Drainage System. This System is essential for the control of flooding in the areas adjacent to the Trinity River Floodway. The new pump station will contain three 2,750 HP concrete volute pumps (CVP), making them ideal for high flow and moderate head situations. This storm water system is also a major economic development focus for the City. Current estimates indicate that the redevelopment within the Able sump area will add about $3 billion to the tax base of the City of Dallas, generating $27 million in annual revenues for the City. Therefore, a landscaping plan has been developed to increase the aesthetic appearance of the Able sump area and to provide a major amenity for the public.

In summary, the existing Able Pump Station is part of a major flood control system for the City that needs to be improved. The engineering analysis indicates that the Able Station must be relocated and improved. The Able sump area will be improved aesthetically and will be a major economic development focus for the City. This project is an example of how to leverage a typical public works project into an economic development engine for the citizens.

11:00-12:30 Flood Risk Standard and Guidelines

BUILDING STANDARD CODE UPDATES FOR DEEP FLOODING ZONES

Yung-Hsin Sun, PhD, PE, Vice President, MWH Americas

The California Building Standard Code (Code) includes regulations for buildings in the 100-year floodplain. Many shallow flooding concerns can be remedied by elevating structures above the base flood elevation; however, elevation is not effective in the many deep flooding areas protected by Federal-State levee systems in California's Central Valley, where flood depths could exceed 20 feet should levees fail. Recent California legislation calls for an integrated flood management approach to address flood risk above the base flood for urban areas, and target social, economic and environmental

sustainability for areas receiving protection from the Federal-State levee system. The legislation identifies Code updates as part of the strategy to improve public safety and reduce property damage. The potential for loss of life and significant property damage were evident in the 2005 Katrina and Rita storm events. Adequate building code requirements could help protect public safety and reduce property damages due to flooding. This presentation summarizes the challenges and strategy in assisting the State of California to develop Code amendments to address legislative requirements, the potential benefits to public safety and flood damage reduction, and the implications on building industry and local land use.

ADDRESSING 2007 FLOOD RISK MANAGEMENT LEGISLATION – A HANDBOOK FOR LOCAL COMMUNITIES

Tracey Ferguson, Associate Planner, PBS&J
Ricardo Pineda, P.E., CFM, Chief of Floodplain Management Branch,
California Department of Water Resources

Wading through the California flood legislation passed in 2007, which links local land use planning decisions with regional flood management and requires local jurisdictions to incorporate flood risk management information into local planning documents, zoning codes, and plans is no easy task for city and county officials, planners, and engineers. The new legislation creates challenges in interpreting and effectively implementing the provisions of the laws, as well as in identifying the most current and appropriate floodplain information specific to each community. In response, the California Department of Water Resources (DWR) has developed a Handbook to assist local communities with a better understanding of the complex new legislation. With the use of the Handbook, local communities will be able to understand and navigate the requirements and more efficiently consult with DWR and local flood management agencies to respond.

This session will provide an overview of the 2007 flood legislation including Assembly Bill 162, Senate Bill 5, and others that outline a comprehensive approach to improving flood management at the State, regional, and local levels. Session panelists will break down the requirements into understandable pieces; provide guidance on how to comply with the legislation; discuss the schedule for compliance; as well as how to implement the requirements into local documents, codes, and plans. Join us for an informative discussion with the team that prepared the Handbook on compliance consisting of DWR and the State's consultant, PBS&J, to clear up any confusion you may have about the new legislative requirements.

11:00-12:30 Arid Regions - Modeling

TWO-DIMENSIONAL HYDRAULIC MODELING FOR ALLUVIAL FAN FLOODPLAIN IDENTIFICATION IN BORREGO VALLEY, CALIFORNIA

Dragoslav Stefanovic, Ph.D., P.E., D.WRE, Director of Applied Research, and
Cameron Jenkins, Hydraulic Engineer, WEST Consultants, Inc.

Local and regional regulatory agencies are faced with the responsibility of ensuring that development on or near alluvial fans is carried out at an acceptable level of risk. This case study describes a project in Southern California which lies within an area of alluvial and flood deposit terrain northwest of the Borrego Sink in the Borrego Valley, San Diego County. The main purpose of the study is to determine the impact of proposed development on the flooding of the project site and adjacent areas for the 100-year flood event. A two-dimensional hydraulic model (FLO-2D) was constructed to analyze alluvial fan flood hazards, compute 100-year floodplain depths, and address on-site and off-site flow paths. The key elements of this model and the modeling results for several design alternatives are presented here.

EVALUATION OF METHODS USED TO ESTIMATE RAINFALL LOSSES IN THE ARID WEST

Annjanette Dodd, Senior Project Manager, Manhard Consulting, Inc.

The NRCS Curve Number (CN) method has been used extensively, and with wide acceptance, to estimate rainfall losses. The CN method was developed from an empirical analysis of 24-hour rainfall-runoff data from small catchments monitored by the USDA. A CN represents the runoff potential of a watershed based on soil type, vegetation type and treatment, surface condition antecedent moisture. Typically, during hydrologic model development, CN values are taken from published tables CN's for site-specific hydrologic soil-cover groupings. These "off-the-shelf" values are too conservative for large catchments, especially in semi-arid and arid regions.

A large fraction of rainfall losses in the arid west is due to infiltration, which is controlled by soil properties, the soil structure, vegetation type and treatment, and surface cover. The Green and Ampt model is a physically based model of infiltration under ponded conditions. Formulations of this model have been incorporated into most, if not all, major hydrological simulation models. The Green and Ampt model works under the assumption that water enters the soil as a sharp, vertical wetting front that travels as a function of the hydraulic conductivity. Hydrologic simulations were conducted using radar rainfall estimates of precipitation during actual storm events using both CN and Green and Ampt methods in SWMM5. Gage-adjusted NEXRAD data was used to represent the spatial and temporal distribution of precipitation over the storm. Detailed land use, soils, topography, and elevation data were used to characterize each watershed. Use of the Green and Ampt model produced better results of hydrologic response when compared to CN methods.

ADVANCED METHODS USED IN HYDROLOGIC MODEL DEVELOPMENT, EXAMPLES IN THE ARID WEST

Annjanette Dodd, Senior Project Manager, Manhard Consulting, Inc.

Models of the hydrologic response of design storms are sensitive to the parameters in the methods used to estimate abstractions and route flow through the watershed. Model calibration using precipitation and observed flows from actual storm events can help ensure parameters used to characterize abstractions and flows are representative of actual watershed conditions. Model calibration is important, for example, because "off-the-shelf" values for Curve Numbers based on a watershed's characteristics in the arid west have shown to largely underestimate infiltration and overestimate runoff.

Advanced methods that can be used in hydrologic model development are presented for watersheds in western Nevada. These methods include 1) the representation of precipitation, both spatially and temporally, using gage-adjusted radar rainfall for actual storms at 1-km grid spacing and 5-minute intervals, 2) GIS representation of detailed land use, soils, topography and elevation data, 3) sensitivity analysis, and 3) calibration to flows, volumes and high water marks observed during the storm.

11:00-12:30 GIS Applications in Floodplain Modeling and Mapping I

COMBINING HEC-RAS AND GIS TO AUTOMATE FLOODPLAIN MAPPING

Sam Crampton, Dewberry

Hydrologic Engineering Center's River Analysis System (HEC-RAS) software is commonly used to perform hydraulic analysis for floodplain delineation studies. In addition to floodplains, the hydraulic analysis also includes modeling a floodway in detailed floodplain study areas. Floodway modeling is an iterative process where the 1% annual chance flood discharge is restricted within a floodway without exceeding a designated increase, called the surcharge (usually 1 foot), in water surface elevation. An engineer models flows along a reach to meet FEMA surcharge requirements.

In this research, we present a tightly coupled system comprising of a commercial GIS (ArcGIS) and HEC-RAS that automates HEC-RAS's floodway encroachments modeling. In this automated approach, an initial floodway is developed by running HEC-RAS in an iterative fashion with minimal user intervention. The HEC-RAS executable engine is run from within the ArcGIS environment. The results from the automated process are presented in ArcGIS. The visual environment provides a comprehensive platform to edit, remodel, spatially analyze and map floodway boundaries. Four different encroachments options are supported which eliminates the need for a modeler to switch between HEC-RAS and GIS during the floodway modeling process. Additionally, the visual environment provides interactive tools so that the modeler can fine-tune the floodway model while remaining in ArcGIS. The final step in the floodway modeling process is to develop a smooth floodway boundary that can be mapped on a DFIRM. Several auto-mapping methods are provided to complete the

mapping task. This visual floodway modeling tool increases the productivity of a modeler by saving an appreciable amount of modeling time. The transfer of HEC-RAS model output into the ArcGIS environment facilitates quick and efficient spatial analysis.

A GIS-BASED APPROACH TO A LIVING STORMWATER MASTER PLAN

Harshal Desai, P.E., CFM, Group Manager, Brian Rowley, P.E., CFM, Associate Project Manager, and Stephen Bourne, P.E., Senior Project Manager, PBS&J

Across the country, flood control districts and other entities charged with designing, constructing, maintaining, and operating flood control facilities require a straight-forward process for managing their assets, tracking modifications, and updating stormwater master plans. Stormwater master plans are developed to reduce and mitigate flood losses by providing community officials with a resource that can be used to understand flood risk and plan for efficient usage of available funding. Significant investments of time and resources are required at the onset of a new master plan update to ensure that pertinent H&H information and a current inventory of existing and planned stormwater infrastructure are properly accounted for. Employing Geographic Information Systems (GIS) enables flood control agencies to maintain a "living" database and offers a simpler, more cost-effective process for keeping critical information up to date.

GIS-based plans enable community officials, engineers, and even private developers to share data, rapidly identify problem areas, and evaluate impacts of any changes in the watershed on a case-by-case basis. GIS platforms and custom tools can be used to automate the planning process, generate input for H&H analysis, and organize model output into a useful product for interpretation, reporting, and decision making. For these reasons, GIS systems offer significant, tangible benefits to flood control districts and decrease overall resource demands. This presentation will highlight GIS applications and technologies that have been used by flood control districts and other entities to facilitate efficient use of available resources and continual updates to GIS data and associated stormwater master plans.

2:00-3:30 Funding Strategies for Flood and Stormwater Projects

HOW TO FULLY FUND YOUR STORMWATER PROGRAM WHILE FRUSTRATING PLAINTIFF ATTORNEYS

C. Warren Campbell, PhD, P.E., CFM, Hall Professor of Civil Engineering, Western Kentucky University

An increasingly popular method of funding stormwater programs is the stormwater utility (SWU). Currently, there are more than 1100 SWUs in the U.S. A community that enacts a SWU charges a fee for handling stormwater and dedicates the revenue from the fee to the stormwater program. There are right ways and wrong ways to enact SWUs. Experience has shown that if you spring the idea of a new fee without proper preparation, a very vocal minority will react as if you had proposed to kill the first born of every family in town. The mayor and city council will be deluged by letters, emails, phone calls, and twitters running 99 to 1 against the "rain tax". All of this furor is caused by a monthly fee

that may amount to less than the cost of a glass of wine in a restaurant. Once the fee is enacted, it may be challenged in court, or may be repealed by the town after a demagogue or demagogues ride into office on a popular wave of ignorance. How can these pitfalls be avoided? This presentation will demonstrate methods to avoid or win court challenges through the use of failure stories. We learn more from our failures than from our successes. Better yet, we will learn from other people's failures.

FINANCING FLOOD CONTROL IMPROVEMENTS: RECENT COURT DECISIONS AFFECTING PROPOSITION 218 ASSESSMENT ELECTIONS

Andrea P. Clark, Downey Brand

Among financing options for local agencies that are required to fund local cost shares of flood improvement projects, Proposition 218 assessments play an important role. The legal landscape continues to shift in this area, particularly in California, where two significant Proposition 218 cases have been decided so far in 2010. This session will summarize recent court decisions in California that will impact Proposition 218 elections, including *Tiburon v. Bonander* and *Greene v. Marin County Flood Control and Water Conservation District*. This session will primarily focus on Proposition 218 as a funding mechanism and will discuss how the shifting legal arena impacts the already-complex process of financing through a Proposition 218 process.

This session is geared primarily toward floodplain managers and engineers in California, although if needed I could expand the discussion to financing more broadly in order to attract a Nevada audience as well (including securing a Nevada attorney to discuss legal financing issues in that state).

THE RECLAMATION DITCH SYSTEM - THE PROBLEM AND A SOLUTION

Dave Foote, P.E., and Ben Shick, P.E., Schaaf & Wheeler, Consulting Civil Engineers,
Manuel Quezada, Project Manager, Monterey County Water Resources Agency (MCWRA)

The Reclamation Ditch is a system of lateral drains and pump stations which drain a series of natural lakes for a 157 square mile watershed in Monterey and San Benito Counties of California. The system was not designed to any flood standard and its facilities have reached hydraulic capacity. The MCWRA is responsible for operation and maintenance (O/M) of the Reclamation Ditch system (System) from Monterey Bay thru the City of Salinas, about 20 miles of channel thru agricultural and urbanized areas. The System does not currently meet the public's demand for flood control to protect lives and property. Approximately $1.2 million is collected annually for operation, maintenance, capital improvements, and reserves. These funds are not sufficient.

To convey flows from a 100-year flood event and meet established flood protection standards will require capital improvements. Two steps are envisioned. First, an Impact Fee Ordinance is proposed to fund the capital improvements necessary for new development to mitigate the hydraulic impacts resulting from increased runoff. Second, the remaining capital funds needed to bring the existing/mitigated System up to established flood protection standards for the 100-year flood event

are planned to be obtained through a 218 process. Impact fees are subject to the Mitigation Fee Act and cannot be used for funding of O/M activities.

CALIFORNIA STORM DRAINAGE FEES - PAST, PRESENT AND FUTURE

Daniel J. Schaaf, P.E., Schaaf & Wheeler Consulting Civil Engineers,
Jeanette Hahn, and Tim Seufert, NBS

California communities are being financially burdened with increased storm drainage efforts required by the conditions of the National Pollutant Discharge Elimination System (NPDES) administered by the State Regional Water Quality Control Boards. The requirements for eliminating trash and pollutants from the storm drain systems are arduous and expensive. Along with these water quality requirements, California's storm drain systems are aging, the population is increasing and the demands on our systems are higher than ever. Formulating strategies to fund these activities and their ongoing maintenance is difficult.

The history of funding storm drain projects in the Western United States is technically complex and politically charged. The State of California has many unique facets curbing the creation of storm drain utilities in a simplified manner. The passage of Proposition 218 is the greatest hurdle to communities in establishing storm drain fees. There are funding alternatives that can be implemented to generate funds for storm system improvements, operation and maintenance. There are cities that have successfully passed storm drain utility fees and others who have failed. Establishing a multidisciplined team of professionals, reaching out to the public early and often in the process and maintaining focused approach can improve the chances of successfully creating a storm drain fee.

2:00-3:30 Flood Risk Management in California – Current Efforts

DWR - USACE CENTRAL VALLEY FLOOD HYDROLOGY STUDY:
STATUS AND NEXT STEPS

Mitch Russo, P.E., Water Resources Engineer, CA Department of Water Resources
Brad Moore, P.E., Hydraulic Engineer, US Army Corps of Engineers
Nathan Pingel, P.E., Vice President, David Ford Consulting Engineers, Inc.

In late 2007, the California Department of Water Resources (DWR) estimated that 1.8 million Californians lived in the so-called 100-year floodplain. California's growing population will increase this vulnerability. Further, a changing climate may expand the areas subject to inundation and may envelop more land and more people. Lastly, the flood control system that protects Californians in the Central Valley is aging and the information upon which floodplain management decisions must be made is incomplete or out of date.

In 2007, the state initiated the FloodSAFE California program, which aims to increase flood protection and improve flood preparedness and response. To achieve the FloodSAFE goals, the data upon which it depends must be updated. In support of these efforts, DWR has tasked the US Army Corps of Engineers, Sacramento District (Corps) to complete a hydrologic analysis of the Sacramento and San Joaquin river basins, specifically focused at developing hydrologic input to assess the federal-state levee system, located in the Central Valley. The goal of the hydrologic analysis is to develop the required flood frequency curves and associated volumes at key locations in the watershed, to support Central Valley floodplain mapping efforts. DWR has also tasked the Corps to complete a climate variability analysis to assess potential impacts of climate change scenarios. In this presentation, we will describe the current status of the hydrology study in assessing the existing conditions of the system. Further, we will introduce the climate variability study and describe the procedures to complete that analysis.

FLOOD HAZARD MANAGEMENT IN THE COACHELLA VALLEY

Georgia Celehar-Bauer, Principal Stormwater Engineer, Coachella Valley Water District
Joey Howard, Principal, and Ken Rood, Principal, Northwest Hydraulic Consultants, Inc

The Coachella Valley Water District (CVWD) provides protection to the Coachella Valley by intercepting and conveying regional flood flows to the Salton Sea. The stormwater conveyance system consists of the 50-mile long Whitewater River/Coachella Valley Stormwater Channel (WWRSC/CVSC) and related tributary stormwater facilities. CVWD is also the National Flood Insurance Program (NFIP) Administrator for unincorporated areas that are subject to flooding and lie within their Stormwater Service Area. The Coachella Valley has been one of the fastest growing areas in the United States over the last 10 years and its population increased by 45 percent. Forecasts call for a 300 percent increase in the population of the Eastern Coachella Valley by 2040, accompanied by conversion of flood prone areas on the valley floor and on alluvial fans land from open space and agriculture to urban uses.

CVWD has learned and continues to learn many lessons as it manages its flood control system and administers floodplains within this area. A recent response has been to prepare a Drainage Development Manual (DDM) that formalizes their policies and standards and provides criteria, standards, and guidelines to assist developers and their engineers in identifying and quantifying flood hazards and developing suitable flood protection facilities. Our presentation will discuss some of the issues that are addressed in the DDM and review the common technical and administrative problems encountered when analyzing flood hazards and developing flood protection with their Stormwater Service Area.

WHAT IS THE STATE PLAN OF FLOOD CONTROL?

Eric Clyde, P.E., D.WRE, Principal Engineer, Mary Jimenez, P.E., Supervising Engineer, MWH Americas, Inc. and Loren Bottorff, PE, Consultant

The State Plan of Flood Control (SPFC) has evolved over more than 150 years; the current version is a result of numerous technical, political, and public policy decisions based on a succession of governmental priorities, engineering concepts, and best practices that have changed over time.

Following the voter approved 2006 flood bonds (Propositions 1E and 84), California legislators adopted several bills addressing flood protection and liability in 2007, Language in these measures required that information on the SPFC "*…be updated by the department and compiled into a single document entitled 'The State Plan of Flood Control.'*" The SPFC Descriptive Document is the first time that an inventory of the SPFC has been compiled or referenced in a single document. Until now, much of the information on the SPFC has been individually maintained for each of the many State-Federal flood protection projects that together provide flood protection along the Sacramento and San Joaquin rivers, tributaries and distributaries.

Accompanying the SPFC Descriptive Document is a Technical Memorandum (TM), Historical Reference Document for the SPFC that describes how local, State, and Federal perspectives evolved between the Gold Rush and the present regarding flood management in California, and how these changing perspectives drove development of the SPFC that exists today. In particular, this TM discusses the combination of hydrologic, socioeconomic, and political factors that influenced development of the SPFC. This presentation will provide a summary of the history of the SPFC to help address common misconceptions regarding the inception, composition, purpose, and expectations of future performance of the State-Federal flood management system.

SYSTEM WIDE ANALYSIS FOR FLOOD MANAGEMENT PLANNING

Anna Fock, P.E., Supervising Engineer, Eric S. Clyde, P.E., D.WRE, Principal Engineer, Josh Yang, Associate Engineer, MWH Americas, Inc.

The California Department of Water Resources (DWR) is preparing a sustainable, integrated flood management plan called the Central Valley Flood Protection Plan (CVFPP), for adoption by the Central Valley Flood Protection Board by July 1, 2012, as required by Senate Bill 5, also known as the Central Valley Flood Protection Act of 2008. The CVFPP is to provide a systemwide approach to protecting lands currently protected from flooding by existing facilities of the State Plan of Flood Control (SPFC).

As part of effort to develop baseline information for the CVFPP, multiple technical tasks have been undertaken for the Sacramento and San Joaquin river basins and the Delta to identify the following: reservoir storage and releases (modeling of 13 reservoirs), peak river flows and water surface elevations (modeling of over 1,000 river miles), peak water surface elevations in the Sacrament-San

Joaquin River Delta (modeling of about 1,000 miles of waterways), floodplain delineation, and flood damage cost estimates. Over a dozen computer models were used and enormous amounts of data were generated as part of this effort. This presentation will describe the complexity and challenges of model selection, modeling coordination, data collection, defining scenarios, data transfer among models, and evaluation approaches.

2:00-3:30 GIS Applications in Floodplain Modeling and Mapping II

URBAN STORMWATER MODELING: USING XPSWMM AND GIS TO DEVELOP A ROBUST 1D H&H MODEL

Brian Janes, Project Manager Water Resources, Dan Stucky, Project Engineer, Brian Rowley, Associate Project Manager, PBS&J

Stormwater master planning for urban areas can present significant challenges, including data collection and management, hydrologic parameter development, and accurate hydraulic modeling of complicated storm drain networks. PBS&J is currently modeling approximately 14 square miles within the City of Sparks using XPSWMM and GIS. The results from this modeling effort will be used to identify existing storm drain deficiencies, predict flood prone areas, identify future capital improvement projects, and aid in prioritizing the City storm drain Capital Improvement Project budget.

This project utilizes XPSWMM's GIS import and simultaneous hydrologic/hydraulic modeling abilities, models both the storm drain and roadway conveyance capacities, incorporates NEXRAD rainfall data, and summarizes conceptual/constructible master plan improvements for the identified problem areas. The master plan models developed with this project simulate dual drainage interaction between storm drains (subsurface conduits) and overland street flow (surface) in a parallel system. The models are dynamic, unsteady flow models that account for the timing of the hydrographs and incorporate both closed conduit and open channel routing links, overland routing reaches, and storage/backwater effects in the conduits, streets, and detention areas.

PMP TO THE MAX: FINDING THE CRITICAL PROBABLE MAXIMUM STORM ORIENTATION: PART II

Gil Inouye, P.E., Senior Engineer, Woolpert, Inc.

The determination of the Probable Maximum Precipitation (PMP) and the corresponding Probable Maximum Storm (PMS) event for a particular basin has tremendous impact on public safety in the design of dams and levees. Determining the Probable Maximum Flood (PMF) from the PMS is also extremely important when analyzing flood risk to critical structures. The methodology for determining the PMP and PMS is well documented in the Hydrometerological Report No. 51 (HMR 51) prepared by the National Weather Service (NWS). The Corps of Engineers has created a computer application called HMR 52 that automates much of methodology detailed in HMR 51. This paper will discuss using Geographic Information Systems (GIS) in the application of determining the PMP and the PMS. This

paper will show that by using GIS technology, one can more efficiently and more accurately implement the methodology in HMR 51 for determining the PMP and PMS for a given basin. Automated basin delineations using GIS enhances the HMR 51 methodology. The automation of PMP determination from All-Season PMP maps in HMR 51 and automation of storm orientation for maximum basin average precipitation using GIS increases accuracy and saves time when determining the PMS. The Leon Watershed case study in HMR 52 will be used as a case study using GIS techniques and a comparison report will compare the manual versus GIS techniques. This paper is a continuation of a paper given at this conference in 2007 and adds new material.

4:00-5:30 Public Involvement and Outreach

OUTREACH AND ENGAGEMENT FOR THE CENTRAL VALLEY FLOOD PROTECTION PLAN – LESSONS LEARNED

Vanessa Nishikawa, P.E., Principal Engineer, Craig Moyle, Supervising Public Affairs Specialist,
MWH Americas, Inc.

Fresh from the images of liquefied levees and an inundated New Orleans by Hurricane Katrina in 2005, California voters approved a $5 billion bond to address and begin to solve chronic flood management challenges in the state. In response to voters, the State legislature passed a series of flood protection and liability bills in 2007. These bills included a requirement that the California Department of Water Resources (DWR) prepare by 2012 an integrated and sustainable flood management plan for the State and Federal flood management system in Sacramento and San Joaquin River valleys called the Central Valley Flood Protection Plan (CVFPP). To create a broadly supported CVFPP, DWR must balance public safety with economic and environmental sustainability, while recognizing the values and perspectives of multiple parties through a robust public and stakeholder outreach and engagement program.

This presentation will highlight the recent completion of Phase 1 of the four-phase CVFPP planning and engagement process that featured nearly 200 stakeholders who volunteered thousands of hours in Phase 1. It will dissect the initial planning stages to create a communication plan based on the identified technical needs and engagement approaches based current best management practices and prior efforts, such as the Sacramento and San Joaquin River Basins Comprehensive Study. It will chronicle the lessons learned during Phase 1 including the results of co-creation of content in real-time with stakeholders and how this experience and feedback contributed to shaping outreach and engagement activities for Phase 2.

CREATING A BROADLY SUPPORTED VISION FOR IMPROVING INTEGRATED FLOOD MANAGEMENT IN THE CENTRAL VALLEY

Kari Shively, P.E., Principal Engineer, Craig Wallace, P.E., Senior Engineer, MWH Americas, Inc.

California voters approved $5 billion in State funding for flood risk management in 2006 and legislators passed several bills addressing flood protection and liability in 2007. As part of this legislation, the California Department of Water Resources is required to prepare a sustainable, integrated Central Valley Flood Protection Plan (CVFPP) for the Central Valley by 2012. To create a successful flood management plan, DWR must balance public safety with economic and environmental sustainability, while recognizing the values and perspectives of a broad range of stakeholders.

To do this, DWR has implemented an innovative planning process designed to promote understanding related to integrated flood management from state, federal, local, regional, tribal and other perspectives. Through the use of facilitated regional and topic specific stakeholder meetings, the initial phases of the planning process have defined existing conditions, identified problems and opportunities from various perspectives, defined goals and objectives, and developed regional management actions designed to address the broad goals. Future phases will generate regional and system-wide solutions for inclusion in the draft 2012 CVFPP. Collaborative planning strategies and lessons learned from this effort are directly applicable to restoration and planning efforts throughout the United States.

RIPARIAN SANCTUARY: INTEREST-BASED COLLABORATION MODEL FOR PUMPING PLANT PROTECTION AND RIPARIAN RESTORATION ON THE SACRAMENTO RIVER

Helen Swagerty, Senior Restoration Biologist/Project Manager, River Partners

There is a long standing divergence between agricultural interests, flood protection and habitat restoration on the Sacramento River. River meander threatens the operation of the $11 million Princeton-Codora-Glenn and Provident Irrigation Districts (PCGID-PID) pumping plant that supplies irrigation to 30,000 acres in Glenn and Colusa Counties. As the opposing bank retreats along the boundary of the US Fish and Wildlife Service (USFWS) Sacramento River National Wildlife Refuge's Riparian Sanctuary Unit (Sacramento River Mile 178), it modifies the angle of approach of the water flowing pass the fish screens at the pumping plant. Flows become more direct and may trap fish against the screen. However, the Riparian Sanctuary Project, a joint effort between the USFWS and PCGID-PID, demonstrates a process of finding sustainable solutions to protect the pumping plant, while restoring 500 acres of riparian habitat and contributing to species recovery.

The Riparian Sanctuary project employs an approach founded on an open, science-based, flexible practice of providing stakeholders with enough information to evaluate and participate in developing solutions. The process is rooted in a multi-disciplinary investigation that includes hydraulic modeling, river meander analysis and habitat restoration design, which considers bank stabilization, restoring natural river processes, and maintaining the flow split between the Sacramento River and the Butte

Basin Overflow Area. Planning efforts in Phase I represented a major step in engaging the local community, scientific experts and land managers towards making sound floodplain management decisions. Currently, Phase II is focused on additional technical investigations, developing appropriate environmental compliance and permitting documents and project design.

DEVELOPING OUTREACH PROGRAMS AND ENGAGING THE PUBLIC THROUGH COMMUNITY LISTENING SESSIONS

Summer Waters, Extension Agent, Water Resources, University of Arizona Cooperative Extension, Maricopa County, Dr. Channah Rock, Assistant Water Quality Specialist and Professor, Soil Water and Environmental Science Dept., University of Arizona, Cooperative Extension

The listening session format provides a model for engaging the public and stakeholders in developing water related outreach and educational programs. By contextualizing what the public sees as important, agencies can better convey crucial information. This project was an undertaking of Arizona Cooperative Extension. The Maricopa County office served as a pilot for a statewide effort that began with a meta-analysis of five research reports exploring water issues and policies in Arizona and other Western states in order to identify gaps in knowledge related to individual attitudes, levels of awareness, and behaviors related to water issues. Next, a format for community involvement was created using a base model developed by the Oklahoma Water Resource Research Institute. Two initial listening sessions were held during which all members of the general public were invited to participate in voicing their concerns and interests about water resource issues. Comments were elicited using a qualitative data collection method that allowed participants drive the discussion and raise topical issues while the researchers and educators objectively recorded comments. Researchers documented 152 comments, which were grouped into five main categories. A facilitated working session was held during which 26 selected participants developed recommendations to address each of the five main themes. As a result, Cooperative Extension is revising outreach efforts in Maricopa County so that critical information is delivered in contexts that are better received by the public. This method can serve as a useful model for similar public outreach related to flood hazard awareness and RiskMAP.

4:00-5:30 Integrated Approaches in Floodplain Management

INTEGRATING LAND USE AND FLOOD MANAGEMENT PLANNING

John Moynier, Vice President, Dewberry

Benjamin Franklin once said, “We know the value of water when the well runs dry.” Mr. Franklin could have just as easily added, we know the value of flood protection when the levee fails. Aside from air, water is perhaps the most fundamental element for all living things; and yet, we’ve historically taken water resources planning for granted, or at least these planning efforts have typically been disconnected from land use planning and flood management efforts. Unfortunately, we’ve reached a point where we can no longer afford make land use, water resource, and flood management planning

decisions in a vacuum. Today, integration is the catch phrase and integrated management planning is the new standard we all must love by. Flood control projects often have different goals than water supply projects, and land use planners often pay little attention to either when making critical decisions. Environmental considerations are becoming increasingly important, if not the driving force. This four-sided equation is where the action is today, and integrating these competing goals is the art and science of the future for water resource professionals. For most of the population, water resource planning only becomes an issue when the water becomes polluted or the river floods; when we face use restrictions or receive notice of a rate increase. All of our water resources are valuable, and we are slowly coming to realize the need for an integrated approach to the use and management of these resources.

As demands for water resources increase and these resources become more limited, there is increasing pressure to share and manage these resources. The consideration of potential impacts becomes a high civic priority, and new regulations are implemented to govern uses. It is important for us as professionals to understand the dynamics of source water protection, as well as treatment and delivery of potable water supplies, storm water and wastewater management, water reuse, watershed management, and flood protection. The decisions we make today regarding how we manage our existing water resources, and how we make our future land use planning and flood management decisions, are some of the most important and pressing issues facing us today.

THE LIVING RIVER CORRIDOR AS A COMPONENT OF A SUSTAINABLE WATERSHED

John Cobourn, University of Nevada Cooperative Extension, Incline Village, NV

The concept of a sustainable watershed is often cited as the goal of successful integrated watershed management. True integrated watershed management must consider water quality, water quantity, wildlife habitat, and flooding problems in an integrated fashion. Setting a goal of sustainability requires a willingness to foster communication and coordination among many stakeholders. It also requires an unflinching willingness to look into the future and predict the consequences of our actions on communities and the resources that sustain them.

When a community is growing, and a river flows through it, today's land use decisions will have important consequences for residents in the future. In developing river valleys, agricultural landowners are often faced with the pressure to sell for urban and residential development. But river channels don't just flood over their banks; they can also change course and wash away property and even structures close to their banks. Because of this risk, some communities have set aside wide corridors that are dedicated to open space and agricultural land use. From geomorphic, public safety, wildlife habitat, water quality, and long term infrastructure cost perspectives, establishing a "living river corridor" is a good step toward a sustainable watershed. Case studies show that while such a river corridor can be accomplished, the process for doing so usually requires a strong, inclusive watershed group, public education, and finding ways to compensate property owners for creating conservation easements near river channels.

ENVIRONMENTAL PROGRAM MANAGEMENT FOR COASTAL PROTECTION ALONG THE ROMANIAN BLACK SEA COAST

Neal J. Gruber, Black & Veatch Corporation, Roger J. Kuhns, SustainAudit, LLC, Mystic, CN, USA, Joan F. Steurer, Black & Veatch Corporation, USA, Julie Dean Rosati, United States Army Corps of Engineers, Coastal and Hydraulics Laboratory, Mobile, Alabama, USA, Adrian Stanica, National Institute of Marine Geology and Geoecology – GeoEcoMar, Romania, Paul Ginther, Black & Veatch Corporation, USA, Jack Mozingo, Black & Veatch Corporation, USA, Timothy Ehlinger, University of Wisconsin, Milwaukee, WI, USA, Lucica Tofan, Ovidius University, Constanta, Romania

The Romanian Black Sea coast is undergoing substantial erosion, significantly damaging both infrastructure and the natural environment. This vital economic, cultural, and natural resource is diminishing rapidly; in some key areas, beaches are expected to be absent in less than 20 years. The COASTEROSION program provides technical assistance to the Romanian Ministry of Environment to define all components of an Integrated Coastal Zone Management System (ICZMS). The ICZMS, based on the Engineer Research and Development Center's (ERDC, U.S. Army Corps of Engineers) principles of Regional Sediment Management (RSM), prepares Romania to manage coastal sediment regionally from the Danube Delta to the Bulgarian border. This project, supported by a U.S. Trade and Development Agency grant, brought together a team of experts from both the United States and Romania, led by Black & Veatch with significant voluntary contributions from ERDC, USACE.

The purpose of the ICZMS is to combine RSM with coastal science, institutional strengthening arrangements, and geospatial support. RSM uses state-of-the-art hydrodynamic and sediment transport modeling to consider scenarios of development, predicting the regional impacts of coastal projects.

4:00-5:30 Levees – FEMA PAL Process and BFEs

SETTING BFES ON THE INSIDE OF A LEVEE BATHTUB

Dave Peterson, P.E., Principal, and Chris Fritz, P.E., Project Engineer, Peterson Brustad Inc.

FEMA is actively re-mapping the Yuba City basin of Butte and Sutter Counties, which is protected on 3 sides by levees. The Sutter-Butte Flood Control Agency has begun a major program to improve and accredit these levees. However, due to sequencing of improvements, interim residual 100- and 200-yr floodplains will be mapped at the southern end of the basin. Potential levee breaks from non-accredited levees uphill would fill up and potentially overtop the 23' deep levee-confined southern end of the basin. This paper will address the policy issue of whether to map the 100- and 200-yr flood elevations at the minimum levee elevation, or at a higher elevation to reflect surcharging of the levee as a weir. FEMA guidelines do not address this situation for BFE mapping, and the California DWR is using this case to help set policy and guidelines for 200-yr floodplain mapping.

LEVEE PROTECTION ZONE BFES BASED ON COMPOSITE BREACH ANALYSIS

Dave Peterson, P.E., Principal, and Chris Fritz, P.E., Project Engineer, Peterson Brustad Inc.

FEMA is actively re-mapping the Yuba City basin of Butte and Sutter Counties, which is protected on 3 sides by levees. As part of its efforts to study and improve these levees, the Sutter-Butte Flood Control Agency is developing composite risk maps from a number of potential levee breaks. These composite risk maps provide a valid basis for assessment district cost spreading, but also provide a reasonable basis for BFE mapping. The maps provide the maximum flood depth at each location in the basin which would result from the breaks analyzed. This exercise involves HECRAS (unsteady) modeling to estimate levee breach hydrographs, Flo2D modeling of the breach hydrographs over the floodplain, and GIS/spreadsheet compositing. The methodology is presented as a reasonable alternative to the standard levee-segment-removal procedure in FEMA's guidelines. SBFCA's composite maps will be provided to FEMA for its use in preparation of interim FIRMs.

4:00-5:30 Innovative Technologies and Methods in Mapping II

AIRBORNE AND MOBILE LIDAR FOR FLOODPLAIN, COASTAL AND RIVERINE MAPPING

Brenda Burroughs, Michael Baker Jr, Inc.

The application of LiDAR (Light Detection and Ranging) technology within the Geospatial industry over the past decade has revolved around aerial applications, but through recent advancements in sensor design, the technology is available via mobile terrestrial solutions for floodplain, coastal, and riverine mapping.

Airborne LiDAR, with accuracies of 5-30cm, has been widely supporting floodplain and coastal mapping initiatives in recent years. Data is used to three-dimensionally model the elevation of the earth's surface as well as identify and view detailed topographic and land features with a high level of confidence. The expansion of LiDAR into the mobile terrestrial realm provides a new, ground-level high-resolution perspective with survey grade accuracies. The two complimenting technologies present further data fusion opportunities on large projects, where areas that may not be visible or captured with airborne LiDAR can be seamlessly meshed with terrestrial collections. LiDAR can be quickly deployed to capture volumetric data for beach replenishment and monitoring, or provide a baseline for pre-storm conditions for 4D change-detection modeling, as well as for rapidly identifying areas experiencing dune erosion, vegetation encroachment/decline, human impact, and effortless modeling/planning for appropriate mitigation remedies.

THE FUTURE IN FLOODPLAIN MAPPING

Dave Minkel, Geodetic Advisor to Arizona, National Geodetic Survey

Significant changes, planned by the National Geodetic Survey, to the National Spatial Reference System (NSRS) will positively affect floodplain mapping in less than a decade. These changes are needed to allow surveyors and engineers improved accuracy and better utilization of Global Navigation Satellite System (GNSS) technology. Planned changes to the NSRS include the definition of a new vertical datum to replace NAVD 88 and the definition of a new horizontal (geometric) datum to replace NAD 83. This paper will discuss these new datums, the need for their implementation, and considerations for a smooth transition to the new datums.

Additionally, a GNSS Real-time Network (RTN) being established in Mohave County Arizona by the Mohave County Flood Control District and the Arizona Height Modernization Program will be discussed. The Mohave RTN is meant to be a solution to the sparse vertical control network currently found in Mohave County; with a small tax base and an area of approximately 13,470 sq mi, conventional leveling would be a cost prohibitive means to establish vertical control. The RTN will also be the basis of a pilot project with the National Geodetic Survey (NGS) and the Federal Emergency Management Agency (FEMA). The goal of the project is to define and publish agency-endorsed (i.e. NGS and FEMA) guidelines for the use and operation of technology. These guidelines will, to the greatest extent possible, be defined with consideration to maximizing the utility of the new datums.

HIGH RESOLUTION TOPOGRAPHIC AND BATHYMETRIC MAPPING OF FLOOD CONTROL FEATURES FROM A WATERBORNE VESSEL

Todd Mitchell, Remote Sensing Manager, Fugro West, Inc.

New technology has introduced the capability of capturing high resolution and high accuracy topographic data both above and bathymetric data below the water surface from a small survey vessel. Integration of mobile laser scanning (LiDAR), multi-beam bathymetric sonar and coupled GPS and inertial positioning has created a cost-effective method for remotely sensing benthic, riparian and onshore topographic features from the same waterborne sensor platform. This technique is a major milestone for practical and cost-effective evaluation of the state of both anthropogenic and natural waterways as well as near-shore coastal regions. It also provides a method for extending the reach of floodplain and levee aerial LiDAR surveys below the water line. Resulting data sets can be used to accurately model flood inundation, perform environmental studies, identify geohazards, model silt/sediment dynamics (scour and accumulation), investigate slope stability/landslide (including seamless evaluation of subaerial and underwater slope failure features) and classify bottom surface material and hardness. Data capture and analysis can further be expanded to include inspection of near-shore infrastructure such as levee stability and seepage, culverts, storm sewer inlets, bridge structures (including the underside), pilings and foundations as well as dam integrity and identification of fracturing, sinkholes, and piping beneath dam foundations.

FRIDAY, NOVEMBER 5

9:00-10:30 Floodplain Modeling I

UNCERTAIN FLOW PATHS POINT AWAY FROM 1-DIMENSIONAL MODELING - AN ANALYSIS OF THE WIKIEUP DIKE, WIKIEUP, ARIZONA

Joseph Thomas, CFM, Engineer and Amanda Banks, P.E., CFM, Project Manager, AECOM
Edward Curtis, P.E., CFM, Senior Civil Engineer, FEMA Region 9

With the renewed interest in our nation's levee systems and the need to accurately reflect them on FEMA's flood maps, communities around the nation are being confronted with the deaccreditation of their levees as it pertains to the regulatory 1-percent-annual-chance flood event. Areas previously thought to be protected by levees, dikes, or diversion structures are now being reanalyzed and in many cases these are not straightforward riverine analyses. Wikieup, Arizona (Mohave County) is one such place. Several characteristics of the surrounding terrain and watercourses indicated that a traditional, steady-state, 1-dimensional riverine model would inadequately capture the true flood hazard. Among these traits were a perched dike/diversion structure, no easily identifiable failure point on the dike, and several possible routes for overflow to make its way to Big Sandy River. Weighing the pros and cons of various alternatives, a 2-dimensional unsteady FLO-2D model was selected. Although not without its own set of challenges, this approach was able to more robustly and accurately simulate this unique scenario and in the end delivered a more accurate estimation of the flood hazard in the Wikieup area.

This presentation will discuss the pros and cons of the modeling methodology utilized, the applicability of the approach to future flood studies and the lessons learned from this project. It is hoped that others will gain experience from exposure to the benefits and limitations of a 2-dimensional model and be able to use said experience to meet the needs of their communities.

RELEASE OF NEW "WATER SURFACE PROFILE GRADIENT" (WSPG) SOFTWARE BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

Colby T. Manwaring, B.S., M.S. CEng, P. E., President, and Michael Crenshaw, B.S., P. E., CFM, Stormwater & Flood Product Manager, XP Software, Inc.
Dr. Iraj Nasseri, Ph.D. CEng, Los Angeles County Dept. of Public Works, Water Resources Division

The Water Surface Profile Gradient (WSPG) model is a hydraulic analysis system that computes and plots uniform and non-uniform steady flow water surface profiles and pressure gradients in open channels or closed conduits with irregular or regular sections. The WSPG model has been available as a DOS-based program or in the WSPG-W menu-driven interface program.

The Los Angeles Dept of Public Works (LACDPW), in cooperation with XP Software, has undertaken a major revision to the WSPG numerical model and the user-interface. The goals of the revision are as follows:

1. Upgrade the WSPG code from FORTRAN to C++/C# programming language.
2. Add capability to WSPG to handle branched (dendritic) drainage networks in single model runs.
3. Add various computational enhancements and reporting enhancements to the WSPG engine.
4. Embed the new WSPG model into a Graphical User Interface (GUI) that allows interactive model building, model review, and input/output file handling.
5. Embed the new WSPG model into the XPSWMM GUI to allow CAD/GIS interaction, advanced modeling building, linkage to a fully dynamic hydraulic model, and advance graphical reporting tools.
6. Link the WSPG model to the LACDPW's MODRAT hydrologic model within the XPSWMM interface.

The latest release has met and exceeded the above goals, providing LACDPW and the engineering community a new tool for drainage system design. Capabilities of the software, gained efficiency in handling complex hydraulic systems, open channel/closed conduit transitions for culverts, pipe systems, or bridges, and branched network capability will be discussed and demonstrated.

9:00-10:30 Modeling Climate Change Impacts

POTENTIAL IMPACT OF CLIMATE CHANGE ON BEAR RIVER LEVEE SYSTEM IN THE CENTRAL VALLEY OF CALIFORNIA

Manas Borah, Ph.D., P.E., CFM, Project Manager, AECOM
Shyamal Chowdhury, Ph.D., CFM, Principal, Wood Rodgers

In a 2009 report, U.S. Global Change Research Program noted that increased frequency and altered timing of flooding will increase risks to people, ecosystems, and infrastructure in the Southwest Region of the United States. An ongoing study by AECOM for the Federal Emergency Management Agency seeks to quantify how the 1-percent annual chance (base) flood may change based on an ensemble of climate model projections through the year 2100 and how this change may impact the National Flood Insurance Program.

This study uses existing climate change models reported on in the Intergovernmental Panel on Climate Change Fourth Assessment Report and U.S. Climate Change Science Program reports and investigates the sensitivity of flooding to extreme climate indices for different climate change scenarios. Relationships were developed between stream flow discharge, climate, and basin characteristics to predict how climate change and population growth might impact flooding over the next 100-years. A Monte Carlo sampling frame work was used to quantify the uncertainty associated with our estimated change in stream flow discharge. The projected changes in base flood discharges in the southwest

region will be used to evaluate the subsequent potential changes in base flood elevation for the Bear River. Possible reduction in levee free board and overtopping of the levee as a result of increased flood elevation will also be analyzed.

RISK BASED HYDRAULIC IMPACT ANALYSIS –
FIRMLY ROOTED IN THE DETERMINISTIC HYDRAULIC WORLD

Michael Archer, Supervising Engineer, MBK Engineers

Risk based hydraulic impact analysis as it is currently being applied is highly dependent on deterministic hydraulic model simulations. There is no other practical method of developing the information needed for the risk analysis, such as stage-frequency curves, flow-stage transform functions and inflow-outflow relationships. This presentation will focus on the hydraulic analysis that underlies the risk based analysis and will not address the risk analysis itself. The process used to develop the hydraulic relationships for the risk analysis that were previously noted will be presented using real world applications as examples. Key issues in this process, including levee performance assumptions (should levees fail or not), quantification of hydraulic uncertainty, using stage or flow as the basis of the hydraulic relationships, and determination of the appropriate locations at which to specify impacts, will be discussed. Some of the options available for each of these issues and their advantages and disadvantages will be discussed. The purpose of this presentation is not to provide answers but to illustrate and stimulate discussion on issues that have come to light in early applications of the relatively young procedure of using risk analysis to assess potential hydraulic impacts.

DEVELOPMENT AND ASSESSMENT OF STREAMFLOW PROJECTIONS UNDER CHANGING CLIMATE SCENARIOS OVER THE COLORADO RIVER BASIN

William Paul Miller, Hydrologic Engineer, United States Bureau of Reclamation, Boulder Canyon Operations Office

Streamflow projections by Bureau of Reclamation (Reclamation) and other water management agencies have traditionally been based upon historical streamflow records and have assumed that future mean streamflow and variability is adequately represented through past observations. Previous studies have indicated that as climate change impacts affect the hydroclimatology of the Colorado River Basin, temperature and precipitation changes directly impact the magnitude and timing of streamflow. The World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset has recently been made available through a joint effort between Reclamation, Santa Clara University, and the Lawrence Livermore National Laboratory and provides statistically downscaled climate projection data from a myriad of climate models over the continental United States. While most research regarding streamflow projections at the regional scale has focused on the utilization of teleconnection indices, little has been done using temperature and precipitation projections from the WCRP CMIP3 dataset. In this study, streamflow projections are derived using projections of temperature and precipitation from the WCRP CMIP3 dataset and National

Weather Service River Forecast System. These streamflow projections are subsequently used to develop projections of Reclamation reservoir operations under changing climate scenarios.

9:00-10:30 Urban Stormwater Management Solutions I

MEETING TAHOE BASIN TOTAL MAXIMUM DAILY LOAD (TMDL) GOALS THROUGH THE USE OF INNOVATIVE TECHNIQUES AND ANALYSIS METHODOLOGIES

Mark Gookin, P.E., CFM, Principal and Mary Horvath, P.E., CFM, Associate, Wood Rodgers
Matt Nussbaumer, P.E., and Paul Frost, P.E., Nevada Department of Transportation

Stormwater discharges within the Lake Tahoe Basin are highly regulated due to recognition of the Lake as one of the largest and clearest high-altitude lakes in the world. Methodologies to implement effective source control and treatment strategies must consider nine environmental thresholds established by the Tahoe Regional Planning Agency (TRPA) as well as physical constraints related to the challenging topographic conditions, surrounding land uses, and the need to avoid adverse flooding impacts. The evaluation of potential water quality project features has steadily developed to the current uses of the Stormwater Quality Implementation Committee (SWQIC) guidelines for the Formulation and Evaluation of Alternatives (FEA) and the recent adoption of the Pollutant Load Reduction Model (PLRM) for quantification of anticipated benefits.

Analysis of stormwater quality features is challenging due to the lack of empirical data, very highly variable rainfall and runoff conditions, commingling of flows from pubic and private properties, and the influences of varying maintenance practices. The presentation will describe the approaches to Tahoe Basin stormwater quality improvements, address pitfalls in both analysis and design techniques, and will explore current trends in the implementation of improvements.

AN INNOVATIVE NON-PETROLEUM RHIZOBIUM TROPICI BIOPOLYMER FOR SOIL STABILIZATION

Mr. Christopher Griggs and Dr. Steven Larson, USACE-ERDC,
Environmental Laboratory, Vicksburg, MS, USA

Modifications have been made to the extracellular polysaccharide (EPS) produced by *Rhizobium tropici* ATCC 49672 to yield a dry salt of the polymer that can be transported as a low weight material and re-constituted on-site using non-potable water. The biopolymer is a “green”, abiotic material produced through aerobic microbial action. This biomimetic technology using EPS of terrestrial bacterial origin, takes advantage of natural functions of soil adhesion, enhanced water retention, biofilm strength, and persistence in the soil. Cross-linkages offered by embedded EPS encourage soil particle aggregation and contribute to erosion control and soil stability. Specific applications of biopolymer soil additives include erosion control where traditional techniques are not effective and decreased potential for transport of contaminants in stormwater runoff.

A RISK-BASED APPROACH TO DRAW-DOWN CRITERIA FOR DETENTION AND RETENTION BASINS

Jim Schaaf, Ph.D., P.E., Schaaf & Wheeler, Consulting Civil Engineers

Computer modeling of the inflow-outflow-storage relationships for detention or retention basins is common today. These simulations are used to determine whether a basin meets performance criteria which usually include maximum outflow discharge and maximum water surface elevation. Each of these simulations assumes a starting basin condition – which usually is empty, i.e., has all basin zero storage available at the start of the simulated design event.

The time it takes for the basin to come back to this starting condition after the design event is often ignored and is sometimes assumed to be just a measure of water quality of the outflow. This paper will make the point that the draw-down time is a measure of the risk of the project meeting or not meeting performance criteria. A risk-based draw-down criterion is developed using published DWR rainfall statistics and elementary probability theory.

11:00-12:30 Floodplain Modeling II

ADVANCED FLOODPLAIN MODELING TECHNIQUES IN SALVADOR CREEK, NAPA COUNTY, CALIFORNIA

Carlos Diaz, P.E., Project Engineer, and Rick Jorgensen, P.E., Project Manager, Winzler & Kelly
Richard Thomasser, Operations Manager, Napa County Flood Control and Water Conservation District

A flood reduction study (Study) was completed on Salvador Creek for the Napa County Flood Control and Water Conservation District (District). The Study built on previous modeling efforts which utilized MIKE software, and is unique in the fact that the Study represents one of the first successful linkages in North America of three MIKE software packages: MIKE 11 for one dimensional open channel flow, MIKE 21 for two dimensional overland flow, and MIKE URBAN for rainfall runoff modeling and pipe network flow. These three models were dynamically coupled to provide a detailed representation of flooding interactions between the storm drain network, the Salvador Creek channel, and floodplain and street overland flooding. The MIKE URBAN model was developed to improve the previously utilized MIKE 11 hydrology, and was developed to reflect City of Napa's Storm Drain Master Plan subbasin delineations and the City's storm drain pipe network within the Salvador Creek watershed. The dynamically coupled model was then utilized to investigate various flood reduction alternatives including detention, flood walls, storm drain outfall flap gates, and bypass channels. The model has provided the District with a valuable tool for analyzing cost benefit ratios of flood reduction strategies and will serve the District as a foundation for future modeling and alternatives analysis.

URBAN 100-YEAR FLOODPLAIN MODELING USING FLO-2D MODEL

Liang Xu, Senior Engineer, and Gabriel Vallin, Assistant Engineer, Santa Clara Valley Water District

The 2D (FLO-2D) hydraulic model was developed to characterize hydraulic conditions (water depth and inundation limits) in the Permanente Creek floodplain for the 100-year flood event. The study area extends from the foothills of the Santa Cruz Mountains to the San Francisco Bay. The area is urbanized and would experience significant overland flow during the 100-year flood event. The following topics are addressed: (1) complexity of urban overland flow and need of using 2D model; (2) the FLO-2D model set-up and calibration using historical flooding events; (3) comparison of the 2D results with the FEMA flooding limits; and (4) sensitivity analyses to understand the effects of hydraulic parameters and urban features.

COOLING TANK FAILURE INUNDATION STUDY

Stephen Blanton, P.E., CFM, Michael Rounds, P.E., and Kevin G. Coulton, P.E., CFM,
AECOM

This study was conducted to assess the impacts of the potential failure of a proposed 10 million gallon water storage tank in downtown Los Angeles and the resulting rapid discharge of water from the tank and subsequent inundation of the surrounding heavily urbanized area. FLO-2D, a two-dimensional hydraulic model, was used together with LIDAR terrain data to estimate the spatial extent and depths of inundation. The modeling determined that the maximum storage volume of the cooling tank was greater than the storage capacity of the low elevation areas in the vicinity of the proposed tank and within a nearby parking garage; this resulted in the conveyance of shallow flow along a street alignment with stormwater drain inlets reducing surface flows. The objectives, methods, and results of the modeling will be presented along with an assessment of potential mitigation methods.

11:00-12:30 Levees - Design and Products

A SETBACK LEVEE STORY:
WHAT DO YOU DO WHEN ROCK ARMOR DOESN'T WORK?

Thomas W. Smith, President, RiverSmith Engineering
Hans Carota, Engineering Intern, Ayres Associates

Bank erosion on the Sacramento River levee adjacent to the City of West Sacramento was into the levee slope and this site was designated as a high priority for repair by the US Army Corps of Engineers. Ayres Associates under a contract to the Corps was asked to develop an alternatives report for repair of this site and follow-up with plans and specifications for the selected repair features.

Initial studies found rock armor to be the most economical alternative for this site, but subsequent hydraulic analyses found that installing the repair section significantly changed velocity distributions within this reach of the river and reduced freeboard by about 0.3 ft. Following this finding the alternatives report was revisited and following coordination with the local sponsor and California DWR, a setback levee was selected as the most appropriate repair features.

The design phase of this project is nearly completed and the job will be going to construction shortly. This presentation will provide an overview of the major issues that were involved in getting this project through the design and environmental review process. Issues included the relocation of a 1000 psi gas line, relocation of a county road, removal and relocation of endangered elderberry shrubs, foundation seepage issues, source of adequate borrow materials, determination of setback distances, and the use of detailed hydraulic modeling to eliminate the need for any new rock armor.

REDUNDANCY IN LEVEE DESIGN – OVERTOPPING PROTECTION USING ANCHORED SOFT ARMOR

John Oldenburger III, P.E., Western Region Engineer, Propex

The absence of erosion protection and slope stabilization on the back side of levees has left appropriately sized levees vulnerable to catastrophic failure during an overtopping event. Often improvements to the landside of levees are either overlooked during the planning and design phases or identified as financially excessive. The vulnerability of our nation's levee system was observed during Hurricane Katrina, as some levee breaches were caused by wave overtopping and the resulting erosion on the landside of levees. This erosion lead to rapid degradation of the structural integrity of the levee system and resulted in catastrophic flooding.

An Anchored High Performance Turf Reinforcement Mat (HPTRM) can be used to minimize the potential for erosion during an overtopping event and to add redundancy to a levee design system. In November 2009, the Corps of Engineers, Sacramento District and local sponsor, Napa County Flood Control and Water Conservation District, installed an Anchored HPTRM on the backside of a Napa River levee reach that experienced significant erosion during a 2006 overtopping event. The Corp's objective was to reduce long-term maintenance of the vegetated, yet unarmored levee surface. An Anchored HPTRM has many advantages over traditional hard armor techniques, including cost-effectiveness, environmental benefits, and compatibility with Low Impact Development (LID).

THE ECONOMICS OF REPLACING EARTHEN LEVEES WITH MONOLITHIC CAST-IN-PLACE CONCRETE & STEEL FLOOD CONTROL STRUCTURES

Frank K. Johnson, P.E., CEO, MegaMold™ Technology Company LLC

The decision-making process today with regard to designing flood control structures is dominated by more than engineering or economic considerations. Since funding for these facilities stems primarily from government sources, politics plays a significant role in their design and construction. This

explains why, in the 21st century, modern society still uses earth embankments and sand bags to protect the lives and valuable properties of its urban populations. While locally available fill material at one time was cheaper to acquire and put in place as levees along waterways than any alternative means of flood control, that is no longer the case.

Today, using advanced construction technologies that make underwater forming and casting possible, it is faster and more economical to construct permanent multi-functional cast-in-place concrete and steel flood control structures than repair or enlarge earthen levees reinforced with concrete slabs and T-walls. With these new technologies, it becomes economically feasible to consider replacing dysfunctional and inadequate earthen levees with concrete and steel flood control structures designed to withstand 500 year storms or more. Such durable maintenance-free facilities would eliminate forever the threat of catastrophic flooding in low lying urban areas along major waterways in the United States. These same technologies also make it possible to economically construct sea walls, off-shore barrier reefs and other under water concrete works designed to prevent coastal erosion and facilitate restoration of storm damaged properties.

11:00-12:30 Urban Stormwater Management Solutions II

SAN DIEGO HMP - SOUTHERN CALIFORNIA'S FIRST APPROVED HYDROMODIFICATION MANAGEMENT PLAN

Eric Mosolgo, Project Manager, Brown and Caldwell
Sara Agahi, Watershed Protection Program, County of San Diego

The San Diego Hydromodification Management Plan is scheduled for approval by the San Diego RWQCB on June 9, 2010. Upon approval, it will be the first approved HMP in Southern California. Adoption of the San Diego HMP will mark a shift toward susceptibility-based approaches in hydromodification management.

The San Diego HMP designates flow control approaches based upon receiving channel susceptiblity to erosion. Project-specific lower flow thresholds will be determined with a combination of stream assessment tools and critical flow calculations specific to the receiving stream. HMP applicability will be determined through use of a decision matrix. Certain exemptions may be applied for situations where projects discharge runoff directly to a hardened conveyance system or to a large river conveyance system. The HMP also allows for implementation of stream restoration solutions.

The HMP encourages use of Low Impact Development (LID) integrated facilities to provide both water quality treatment and hydromodification flow control. A BMP Sizing Calculator has been devleoped to assist in the analysis and design of storm water management facilities. The Sizing Calculator includes a mitigation suite of bioretention basins, flow-through planter boxes, and extended detention facilities. For LID solutions, sizing factor have been generated for varying lower flow thresholds and rainfall

gauges describing San Diego's diverse climate. Extended detention basin designs are generated using an automated basin sizing algorithm.

INFILL AND INFILTRATION - WHERE URBAN DRAINAGE MEETS LOW IMPACT DEVELOPMENT (LID) AND "GREEN" IN WEST SACRAMENTO

Toby Wong, P.E. and Mark Collier, P.E., City of West Sacramento
Mark Rodgers, P.E. and John Hodgson, P.E., Principal and Michael C. Nowlan, P.E., CFM, Associate, Wood Rodgers

Recent urban redevelopment efforts in the City of West Sacramento were faced with meeting stormwater quantity and quality requirements and determining a site-specific advantageous way to deal with on-site storm drainage. The urban infill development "green" efforts considered the use of on-site subsurface infiltration to address the storm water quality and quantity concerns with surprising results.

This presentation provides an in-depth review of the challenges of meeting storm water runoff quantity and quality goals for high density urban development immediately adjacent to the Sacramento River. The presentation also details the advantages and disadvantages evaluated to determine the optimal solution, while also improving onsite runoff through the City of West Sacramento. The discussion will include examination of groundwater interference with infiltration assuming rising river levels, hydraulic interference with existing underground contamination plumes, and statistical coincidence efforts to evaluate the concurrence of local rainfall and high river levels for reliable long-term operations during frequent and infrequent events.

FLOODING AND OTHER ENVIRONMENTAL CHALLENGES: GETTING TO THE ROOT OF THE PROBLEM ELIMINATE FLOODS, REDUCE WATER & ENERGY, SEQUESTER CARBON ALL IN ONE

Linda Flournoy, President, Planning & Engineering for Sustainability

The **Healthy Efficient Soils Program (HESP)** is a cost-effective soil and landscape management strategy applied on a site or community-specific basis to reduce, and even eliminate, site contribution to flooding and pollution. These inexpensive and low maintenance techniques are indispensable to multi-objective Watershed Management. HESP will allow you to: maximize water use, capture and storage; increase detention and infiltration; reduce runoff and erosion; improve surface and groundwater water quality; increase groundwater quantity; normalize stream flows; reduce hydro-modification; reduce expensive structural solutions; allow more day-lighting of streams; reduce or eliminate potable water use; increase vegetation health, durability and density; reduce site energy footprint; significantly enhance carbon sequestration (50-200 times); reduce greenhouse gas emissions; reduce earthquake risk; and many other benefits. HESP provides valuable tools for the sustainability of local communities.