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FINAL SUMMARY REPORT:
GUIDELINES FOR JURISDICTIONAL DETERMINATIONS FOR WATERS OF THE UNITED STATES IN THE ARID SOUTHWEST

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INTRODUCTION

1.1 Purpose and Design of this Document

Section 404 of the Clean Water Act (33 U.S.C. 1344) requires authorization for all discharges of dredged or fill material in waters of the United States, including jurisdictional wetlands. To comply with these requirements, it is necessary to be able to delineate the location and boundaries for waters of the United States (including wetlands) throughout the arid Southwest. In September of 2000, personnel from several Regulatory Districts in the South Pacific Division met to discuss identifying and characterizing waters of the United States, including wetlands and other special aquatic sites, in arid and semi-arid areas in the western United States.

In the past, because of the difficulties encountered when determining jurisdictional waters of the United States (including wetlands) in southern California, personnel from the U.S. Army Corps of Engineer District, Los Angeles, have requested technical assistance from the U.S Army Corps of Engineers Waterways Experiment Station (WES) in identifying and characterizing waters of the United States at Edwards AFB in the Mojave Desert. Specifically, WES assisted in providing a scientific basis for the characterization and identification of the physical and biological factors associated with desert washes, clay pans and playas at Edwards AFB in Los Angeles County, California. The final WES report, "Delineation and Characterization of Waters of the United States at Edwards Air Force Base, California," provides essential scientific information concerning jurisdictional determinations in arid and semi-arid areas and is an important component of this technical document.

The purpose of this technical document is to provide background information concerning both the physical characteristics of dryland fluvial systems and the relevant sections from the Code of Federal Regulations (33 CFR Part 328). In addition, this document will also provide numerous references and data sources to aid delineators throughout the western United States in determining the extent of Corps jurisdiction over rivers, streams and dry washes in the arid Southwest. Most importantly this document will provide a specific methodology, including a detailed checklist, for delineators in the western United States to utilize when conducting jurisdictional determinations for waters of the United States in arid and semi-arid areas. By utilizing the above methodology, jurisdictional determinations for arid and semi-arid areas should be more consistent throughout the western United States and documentation for our jurisdictional decisions will be improved.

2.1 Physical Characteristics of Dryland Areas

Watersheds in arid regions are typically isolated from ocean moisture, located in the rainshadow of large mountain ranges or in areas beneath semi-permanent high pressure systems. Arid climates are dominated by low annual rainfall, low soil moisture conditions and very high potential evapotranspiration levels. Due to the temporal and spatial variability of rainfall in dryland areas, most arid rivers are ephemeral, flowing only during storm events and remaining dry for most of the year. As a result, the analysis of streamflow and changes in channel morphology in dryland systems emphasizes flood events (Graf 1988). Flood events in dryland rivers generally consist of four types: flash floods, single peak events, multiple peak events and seasonal floods. These flood events are partly scale dependent, with flash floods occurring on smaller stream systems and seasonal floods characteristic of large throughflowing streams, similar to the Colorado River, which originate outside the dryland area (Graf 1988).

Due to the general lack of soil development and vegetation coverage in arid areas, peak discharges for very high magnitude storm events are larger for dryland basins than similar sized humid basins; however, this generalization is usually only valid for basins that are less than 2,600 km^2. In basins larger than 2,600 km^2, increased precipitation results in higher magnitude flood events in humid areas (Graf 1988). The general lack of developed soils and vegetation also results in reduced lag times between precipitation and surface flow in dryland river channels (Graf 1988). These dryland channels can be several hundred feet in width and, in many cases, there are portions of the year in which they may be completely dry. However, in years with above average precipitation, the entire channel width is often inundated with flow (Bull, 1991; Cooke 1984). To illustrate the dramatic variations in surface flow, for the Gila River in Arizona the peak discharge for a 50-year flood event is 280 times the annual flood. In contrast, the 50-year flood for a watershed in Pennsylvania is only two and one-half times as large as the annual flood (Graf 1988a). Because braided rivers are subject to very wide fluctuations in discharges over a short period of time, their channels frequently change configuration to accommodate these large variations in surface flow. Since sporadic large flow events characterize braided channels, dryland fluvial systems usually exhibit long periods of little morphologic change interspersed with short-term dramatic changes in channel configuration (Allen 1999; Graf 1988; Lustig 1965).

Due to high air temperatures and characteristically coarse bed material, surface water in dryland fluvial systems is lost through both evapotranspiration and infiltration into the stream banks and channel bed. During flood events on small and medium sized dryland basins, flow duration is rarely long enough for evapotranspiration to result in substantial reduction in surface water; however, in larger throughflowing rivers, evapotranspiration can result in a downstream reduction in discharge (Graf 1988). In ephemeral streams, transmission losses through seepage cause flood peaks and total discharge values to decline in the downstream direction. These losses are so large that eventually most surface flows decline to zero (Graf 1988). The presence of large amounts of alluvium beneath the majority of dryland rivers results in the loss of runoff volumes at the surface, but does contribute to substantial groundwater recharge. In the Salt River in central

Arizona, a peak flow of 1,900 m^3s^{-1} flowed over a period of several weeks in its previously dry channel. Based on an analysis of discharge records, approximately 29% of the surface flow that entered the basin ended up as groundwater due to transmission losses (Graf 1988). Because of the large amounts of flow involved in transmission losses, accounting for seepage is an important requirement for predicting flood flows and water yield in dryland fluvial systems (Graf 1988).

Since dryland river systems are dominated by short, high magnitude storm events in areas with substantial coarse alluvium, many arid rivers exhibit braided channel morphology. Braided channels are generally characterized by abundant bedload, steep channel gradients, highly erodible banks and highly variable discharge (Leopold *et al.* 1964; Graf 1988). Compound channels, typical of large throughflowing rivers in arid areas, have two basic modes of surface flow: during low flows water occupies a single meandering channel while storm flows occupy a wider braided channel. A braided channel will typically have several subchannels of varying size but without a dominant one, while compound channels have one subchannel which is clearly dominant over the others (Graf 1988; Moody and Odem 1999). Compound channels represent an adjustment to a flow regime, which is dominated by near continuous low flows with a few high discharge events. Some medium to large dryland perennial streams develop this morphology naturally; however, it is commonly observed downstream of large water conservation and flood control reservoirs (Graf 1988).

In dryland river systems, flood events are almost always the forcing factors that convert meandering channels to a braided morphology. In several arid regions, large storm events have been responsible for changing the dominant channel configuration from meandering to braided in watersheds of varying sizes. The Gila River in eastern Arizona, in the late 1890's had a narrow (only meters wide in some areas) meandering stream channel, but in 1905 a series of large storm events eliminated the meandering channel and produced a braided channel more than a kilometer wide in some reaches (Graf 1988). In the 1940's, dense riparian vegetation and sedimentation narrowed the Gila River channel and, by the 1980's, the stream had a compound appearance similar to its meandering channel geometry of the 1890's (Graf 1988). Due to the role of large storm events, the change from braided back to meandering channel morphology is much slower than the change of meandering to a braided channel geometry.

Horizontal instability, resulting from changes in discharge, sediment load and riparian vegetation, is often present in dryland braided river systems. On large alluvial fans, the plugging of channels with sediment and debris results in dramatic changes in the location of active channels (Cooke *et al.* 1993; Graf 1988; Mount 1995). Rates of channel migration are highly variable and depend on the magnitude of storm flows and the resistance of channel substrate. In addition to horizontal instability, many dryland channels exhibit substantial vertical instability through entrenchment. In continuous channels, channel entrenchment can result from the rapid upstream migration of headcuts during large storm events (Allen 1999; Graf 1988). In general, channel entrenchment is the result of some change in the amount and/or rate of delivery of water and sediment to the river channel. Three common types of causal mechanisms for the above changes include land management, climatic change and internal adjustments (Graf 1988; Mount 1995). Although there is substantial debate in the literature regarding the causal link between specific land use changes and the associated physical processes that lead to channel entrenchment, many arid river systems can exhibit substantial vertical channel change during large storm events (Allen 1999; Graf 1988).

Large alluvial fans are also a typical landscape feature in dryland watersheds (Graf 1988). Alluvial fans serve as transfer systems for materials eroded from mountain masses and destined for deposition in adjacent basins. Individual alluvial fans are variable in size depending on their age and the supply of sediment available for their construction (Graf 1988). The location of fans in arid regions is influenced by several factors including the lack of vegetation that results in the position of drainage channels being unfixed, the distinctive topography in the transition area between mountain slopes and the valley floor and areas where the percentage of highland is greater than the bordering lowland area. Fans in drylands tend to be larger than those in humid regions, probably because continually flowing streams typical of humid areas remove materials relatively quickly from distal parts of the fans. Alluvial fans originate where confined streams issue from mountain fronts onto open basin floors. In general, alluvial fan development can be linked to a combination of stream channel widening and channel migration (Graf 1988). As a result, alluvial fans are characterized by braided channels with many threads that reduce flow velocity and increase deposition on the alluvial fan surface (Graf 1988). The form of fans has three basic elements consisting of the channels, elevated or old fan surfaces and recent depositional areas down slope of the channels. The overall shape of a fan system includes a catchment area, the feeder channel and the fan. The feeder channel connects the catchment area to the fan and is usually constricted as a result of confinement within a tight valley. The channels below the feeder channel are the distributaries and the local braided discharges on the fan itself (Cook *et al.* 1993). Based on the above physical characteristics, alluvial fans in arid areas will include some channels subject to Section 404 of the Clean Water Act. However, due to channel migration, alluvial fans will also support numerous historic channels, which only convey flow during extremely large storm events. Based on the above, Corps jurisdiction over channels occurring on alluvial fans will usually be confined to the feeder channel, the current main distributary channels for the alluvial fan and their direct tributaries.

In the arid Southwest, riparian areas are an important component of the overall ecosystem, serving as an interface between upland and aquatic habitat. Riparian corridors in arid areas form a long narrow habitat area that exhibits distinctive vegetation, soil and hydrology (Cowardin et al. 1979). Some researchers have suggested that patterns of woody riparian vegetation may be associated with certain fluvial landforms including depositional bars, floodplains and terraces (Hupp and Osterkamp 1985). Fluvial processes that form floodplains and terraces create new surfaces for the establishment of riparian species. As a result, much of the variability in riparian communities comes from disturbance caused by flood events and associated changes in channel morphology. Augmented stream flow, by occupying pre-existing recruitment sites, increasing seed mortality and reducing topographic complexity in the channel, can reduce riparian vegetation establishment and recruitment in stream channels.

Furthermore, the direct effects of flood events on riparian vegetation can include mechanical damage, saturation, and propagule transport (Bendix and Hupp 2000). By augmenting the magnitude and frequency of storm flows, as with increased urbanization, channel geometry is modified, increasing the channel width to depth ratio and eliminating flood terraces that support important riparian habitat for wildlife species (Allen 1999 and Dominick and O'Neil 1998).

In studying rainfall and runoff patterns in dryland fluvial systems, the paucity of available data presents substantial problems. In addition, the high spatial and temporal variability in rainfall and runoff requires an especially long period of record for observations, which is not available for many dryland areas (Allen 1999; Graf 1988). Typically, reliable climate stations are widely separated and observations usually only cover a small fraction of existing arid regions. Due to the high spatial variability in rainfall patterns in arid areas, extrapolation of rainfall data even a short distance from a rainfall gage can result in substantial error (Graf 1988). Similar problems with data availability also complicate studies of discharge and water yield in dryland fluvial systems. Since jurisdictional determinations in dryland river systems will, by necessity, emphasize "ordinary" storm events, a relatively large climatic data set is required to capture an adequate number of flood events to analyze changes in discharge over time. As part of any jurisdictional determination for dryland river systems, limitations of the available climatic data must be recognized and extrapolation of recorded data should be minimized. Two good sources for rainfall, runoff and temperature data for arid and semi-arid areas in the South Pacific Division are the Western Regional Climate Center in Reno, Nevada and the United States Geological Survey. Both of these agencies also have data, mostly summaries, available on the Internet.

2.2 Definition of Waters of the United States

In 33 CFR Part 328.3, waters of the United States are defined as those waters which are currently used or were used in the past or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide and all interstate waters including interstate wetlands. The lateral limits of jurisdiction in those waters may be divided into three categories. The categories include the territorial seas, tidal waters and non-tidal waters. The above definition of waters of the United States also includes all other waters such as intrastate lakes, rivers, streams (including intermittent and ephemeral streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes or natural ponds, where the use, degradation or destruction of which could affect interstate or foreign commerce (Department of Defense 1986).

In the Preamble for 33 CFR Part 328.3, the definition for waters of the United States is further clarified, indicating that certain water bodies are generally not considered waters of the United States. Water bodies usually not considered waters of the United States include non-tidal drainages and irrigation ditches excavated on dry land [in cases where an irrigation ditch connects two waters of the United States or where it contributes flow to a water of the United States, the irrigation ditch may qualify as a regulated water, even if it is constructed in uplands – see Headwaters v. Talent Irrigation District 243 F.3d 526 (9th Cir. 2001], artificially irrigated areas which would revert to upland if the irrigation ceased, artificial lakes or ponds created by excavating and/or diking dry land to collect and retain water and which are used exclusively for such purposes as stock watering, irrigation, settling basins or rice growing, artificial reflecting or swimming pools or other small ornamental bodies of water created by excavation and/or diking dry land to retain water for primarily aesthetic reasons and water filled depressions created in dry land and incidental to construction activity and pits excavated in dry land for the purpose of obtaining fill, sand or gravel unless and until the construction or excavation operation is abandoned and resulting body of water meets the definition of waters of the United States. Although the above water bodies are typically not considered waters of the United States, the Corps of Engineers reserves the right, on a case-by-case basis, to determine that a particular water body within the above categories represents a jurisdictional water of the United States. The United States Environmental Protection Agency also has the right to determine on a case-by-case basis if any of the above bodies of water constitute jurisdictional waters of the United States (Department of Defense 1986).

With non-tidal waters, in the absence of adjacent wetlands, the extent of the Corps jurisdiction is defined by the "ordinary highwater mark" (Department of Defense 1986). In 33 CFR Part 329.1, the "Ordinary Highwater Mark" for non-tidal rivers is defined as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation or the presence of litter and debris (Department of Defense 1986). In general, the OHWM for a stream is usually determined through an examination of the recent physical evidence of surface flow in the stream channel. In dryland fluvial systems typical of the desert areas, the most common physical characteristics indicating the OHWM for a channel usually include, but are not limited to: a clear natural scour line impressed on the bank; recent bank erosion; destruction of native terrestrial vegetation; and the presence of litter and debris. For many small desert wash systems, the presence of continuous well-developed upland vegetation in the stream channel is a good indicator that it only conveys surface flow during extremely large storm events and, as a result, would not usually constitute a jurisdictional water of the United States. However, the presence of native riparian species in a dry wash is usually a good indicator that the stream channel usually exhibits surface flow during both small and moderate storm events.

In their analysis of jurisdictional waters of the United States at Edwards AFB in southern California, WES also utilized the following indicators as physical evidence of an ordinary highwater mark: the type and shape of mud cracking, surface staining (faint to dark reddish-brown stains from ponded water), algal crusts and algal flakes (cyanophytes (blue green algae), *Oscillartoria* sp. and *Microcoleus* sp. and other types of bacteria undergo ecological succession in response to variations in moisture). By identifying the species of algae/bacteria present in a low-lying area, WES was able to determine the amount of surface moisture that was ordinarily present in the given water body. In addition to the standard indicators for the ordinary highwater mark, the above physical indicators were used to delineate the extent of waters of the United States for playas, clay pan complexes and dry washes at Edwards AFB in Los Angeles County, California (U.S. Army Corps of Engineers 1996).

Because braided rivers are subject to very wide fluctuations in discharges over a short period of time, their channels frequently change configuration to accommodate these extremely large variations in surface flow. As a result, dryland fluvial systems usually exhibit long periods of little morphologic change interspersed with short-term dramatic changes in channel configuration (Allen 1999; Graf 1988; Lustig 1965). When conducting jurisdictional determinations in arid areas, Regulators and environmental consultants should be cognizant of the above physical characteristics of dryland fluvial systems and insure that the horizontal extent of our jurisdiction includes small to moderate storm events, but is not so expansive that it incorporates field evidence from the 25-year, 50-year or 100-year storm event. In addition, braided streams can exhibit a small low flow channel from short-term recessional flows; however, any jurisdictional determination for waters of the United States should incorporate physical evidence associated with small to moderate storm events not evidence from recessional flows. Based on the above, the horizontal extent of Section 404 jurisdiction will usually include the active stream channel(s) and flood terraces immediately adjacent to these active braids. However, flood terraces that are several feet higher than the active stream channel may not be inundated by small or moderate storm events and, as a result, may not be regulated as waters of the United States. Alluvial fans in arid areas will also include channels subject to Section 404 of the Clean Water Act. However, due to channel migration, alluvial fans will also support numerous historic channels, which only convey flow during extremely large storm events. As a result, Corps jurisdiction over channels occurring on alluvial fans will usually be confined to the feeder channel, the current main distributary channels for the alluvial fan and their direct tributaries.

To improve the consistency of jurisdictional determinations in arid and semi-arid areas, Regulators and environmental consultants should try to utilize available hydrologic information for the given water body, including estimates of runoff associated with the 1-year through 100-year storm events. The SCS Direct Runoff Method is a relatively simple technique that has been developed to estimate the volume of runoff associated with a given precipitation event in a watershed (Ward and Elliot 1995). The SCS Direct Runoff Method only requires data for the depth of rainfall, runoff potential for the soils, estimates of antecedent soil moisture and a land use description. The Rational Method is a common equation that is used to estimate the peak flows associated with various storm events in a watershed and its sub-basins (Dunn and Leopold 1978 and Ward and Elliot 1995). The Rational Method requires estimates for the average rainfall intensity for the given magnitude of the storm event (e.g. 1-year, 5-year or 100-year), the catchment area and the longest flow path in the basin (hydraulic length). Using Manning’s Equation, the velocity of flow in a given stream channel (feet per second), based on the channel bed slope, the hydraulic radius of the stream channel and the roughness of the channel, can be calculated. With basic information concerning the channel geometry, Manning’s Equation can be used to estimate the area of a stream channel that is inundated by a variety of storm events, including the 2-year or 5-year storm event (Ward and Elliot 1995). Detailed information concerning the above methods for estimating discharge in stream channels is available in most hydrology text-books (Dunn and Leopold 1978 and Ward and Elliot 1995). Using available hydrologic information and reliable estimates for storm flows, Regulators and environmental consultants should ensure that the horizontal extent of Corps jurisdiction is consistent with reliable discharge data and/or estimated storm flows for the given fluvial system.

3.1 Methodology for Use of the Jurisdictional Checklist

For the purposes of this document, factors for determining waters of the United States in arid and semi-arid regions were grouped into three general categories including flow regime, geomorphic feature and general indicators of surface flow. For the flow regime category, valid indicators of waters of the United States include intermittent or ephemeral surface flow with channel vegetation, intermittent or ephemeral surface flow with no channel vegetation or adjacent vegetation, intermittent or ephemeral surface flow with surrounding vegetation, but no channel vegetation, perennial surface flow and perennial, intermittent or ephemeral standing water. For the geomorphic feature category, various types of water bodies were included from lakes and depressional wetlands to arroyos and desert washes. The purpose of this category is to identify the general type of water body present and to ensure that the selected flow regime and geomorphic feature are consistent. Furthermore, this category also allows delineators to characterize the general channel morphology present and indicate the general geomorphic setting for the water body. Indicators of surface flow include litter, debris, a natural scour line impressed on the bank, absence of native vegetation and eroded stream banks. The above three categories form a 5 by 10 matrix and, for a water body to be considered jurisdictional, it must match one of the indicators for flow regime, geomorphic feature and surface flow (e.g. you must be able to check at least one of the boxes in the matrix). The greater the number of boxes that can be marked in the attached matrix, the more physical evidence that is present to support taking jurisdiction over the given water body. When utilizing the attached matrix, users should be aware that the flow regime and geomorphic features opposite from each other in the matrix are roughly representative of each other. Although perennial streams are included in the attached matrix, this methodology assumes that these types of stream systems will be relatively rare in arid areas and, without the presence of adjacent wetlands, exhibit much clearer evidence of an ordinary highwater mark when compared to braided ephemeral and intermittent stream channels.

As part of the above methodology, there are a number of assumptions that the user must consider when utilizing the attached matrix. First, a basic assumption for the above methodology is that accurate jurisdictional determinations can be made in arid regions utilizing the physical manifestations of flow regime, geomorphic features and/or general indicators of surface flow. Furthermore, given a similar set of physical data, this methodology assumes that experienced delineators would reach similar conclusions regarding the presence or absence of waters of the United States and the location of the ordinary highwater mark. Another basic assumption of this methodology is that the greater the number of boxes checked in the matrix, the more physical evidence available to justify the presence of a water of the United States. Given that dryland fluvial systems are dominated by dynamic flow events, the physical evidence in stream channels is subject to large-scale changes over a short period of time. As a result, jurisdictional determinations based on the above methodology have a finite life span and may need to be updated after very large storm events. Furthermore, since the Regulatory Program is based on federal regulations that can be modified both by Congress and case law, any jurisdictional determination based on the above methodology may need to be modified to be consistent with the current definition for waters of the United States.

The third page of the attached matrix is a list of common terms for various water bodies. Many of the terms are specific to various types of stream channels and desert washes that occur predominately in arid and semi-arid regions. The main purpose of this list is to provide a common set of terms for delineators in the western United States to use when discussing jurisdictional determinations in variety of arid and semi-arid regions in the western United States. In addition, this list also defines several terms for different types of stream channels that are not as common, but may be useful to delineators when trying to describe a specific geomorphic feature observed in the field.

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