4

FLOODPLAINS

AFFECTED ENVIRONMENT

A *base flood*, commonly referred to as a 100-year flood, is caused by a flood with a probability of occurring once every 100 years. The area where it occurs is referred to as the 100-year floodplain. To identify the locations and extent of the 100-year floodplains in the Study Area, two data sources were used. First, the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps were reviewed to determine the relationship of the proposed action to the boundaries of 100-year floodplains. Second, in areas where FEMA floodplain mapping was not available, geomorphology was used to identify and delineate any 100-year floodplains.

Because of the lack of FEMA floodplain mapping for the Gila River on Community land, geomorphology and aerial photography provided the best sources of data for analysis. Geomorphology is a type of geology that examines the structure of features along the ground surface. Geomorphologic analysis provided an understanding of the Gila River on Community land and the way the river might respond to imposed change, such as the influence of vegetative cover patterns, stream flow changes, and erosional and depositional changes (Rosgen 1996). Review of historical geomorphologic surveys and aerial photographs indicates a relatively stable Gila River channel profile over the last 90 years (Waters 2001).

An *encroachment* is an action within the limits of the 100-year floodplain. The regulatory floodway is the portion of the floodplain area reserved by federal, State, and/or local requirements in an unconfined and unobstructed manner to provide for discharge of a base flood so that the overall increase in water surface elevation is no more than 1 foot (not a significant increase), as established by FEMA. It is normally the channel defined by the ordinary high water mark (OHWM). Development in the floodway is allowed if it can be demonstrated that no rise in the base flood elevation will occur (Association of State Floodplain Managers 2003).

Existing Conditions

The FEMA Flood Insurance Rate Maps include Special Flood Hazard Areas (SFHAs), which are the 100-year floodplains. SFHAs are also areas where the National Flood Insurance Program floodplain management regulations must be enforced and where the mandatory purchase of flood insurance applies. SFHAs applicable to the proposed action are:

- **Zone A:** Areas subject to inundation by a 100-year flood that are generally determined using approximate methodologies. Detailed hydraulic analyses have not been performed; therefore, no Base Flood Elevations or flood depths are shown.
- **Zone A99:** Areas subject to inundation by a 100-year flood, but which will ultimately be protected from flooding upon completion of an under-construction federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, or levees, to consider the system complete for insurance rating purposes. Zone A99 may be used only when the flood protection system has reached specified statutory progress toward completion and when neither Base Flood Elevations nor depths are shown.
- **Zones AE and A1-30:** Areas subject to inundation by a 100-year flood that are determined by detailed methodologies. Base Flood Elevations are shown.
- **Zone AH:** Areas subject to inundation by shallow flooding under a 100-year flood (usually areas of ponding) where average depths are between 1 and 3 feet. Base Flood Elevations derived from detailed hydraulic analyses are shown in this zone.
- **Zone AO:** Areas subject to inundation by shallow flooding under a 100-year flood (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Some Zone AO sites have been designated in areas with high flood velocities such as alluvial fans and washes.
- **Zone AR:** Areas resulting from the decertification of a previously accredited flood protection system that have been determined to be in the process of being restored to provide base flood protection.

Moderate flood hazard areas are also shown on the Flood Insurance Rate Maps as Zone X. These are areas between the limits of the 100- and 500-year floodplains. Other flood areas labeled Zone X are areas of minimal flood hazard (areas outside the SFHA and higher than the elevation of the 500-year floodplain).

Areas in which flood hazards are undetermined, but possible, are shown as Zone D.

The Study Area crosses three 100-year floodplains. These are associated with an area north of the UPRR tracks that is intersected by an irrigation canal, the Salt River, and the Gila River (Figure 4-38).

A 100-year floodplain is located on the northern side of the UPRR tracks between 107th and 69th avenues. At approximately 73rd Avenue, the RID Canal crosses the railroad tracks, and an associated levee creates discontinuous 100-year floodplain areas north of the canal until it intersects with the Salt River floodplain to the east, outside of the Study Area. The SFHAs associated with this 100-year floodplain include Zones AH, AE, and X.

Because of dams and water diversions upstream of the Study Area, the Salt River is dry under normal hydrologic conditions. Floodplain widths along the Salt River vary from 1,900 feet near 79th Avenue to more than 7,000 feet in other Western Section Study Area locations. The SFHAs associated with this 100-year floodplain include Zones AH and X. The widest portions of the floodplain are associated with ponding that occurs in ineffective flow areas. The narrowest portions are where the floodwater conveyance is highest and the floodplain is contiguous with the floodway. The floodway width for the Salt River varies from 1,200 feet just upstream of 75th Avenue to 3,000 feet near the confluence with the Gila River.

FEMA mapping does not extend onto Community land upstream of the Gila River's confluence with the Salt River. The upstream areas (from the Salt River and Gila River confluence) are shown on the *Surficial Geologic Map of the Gila River Indian Community, Arizona* (Waters 2001). The streambed alluvium (designated T-0) and Holocene Terrace (T-1) geomorphology correspond with the floodplain mapping at the confluence of the Gila and Salt rivers. Determination of specific flood hazards is difficult because of limited information, which includes the *Surficial Geologic Map of the Gila River Indian Community, Arizona*, topographic information, and existing drainage studies. Areas downstream of the confluence of the Salt and Gila rivers—south of Baseline Road and west of 99th Avenue—are mapped as Zone D.

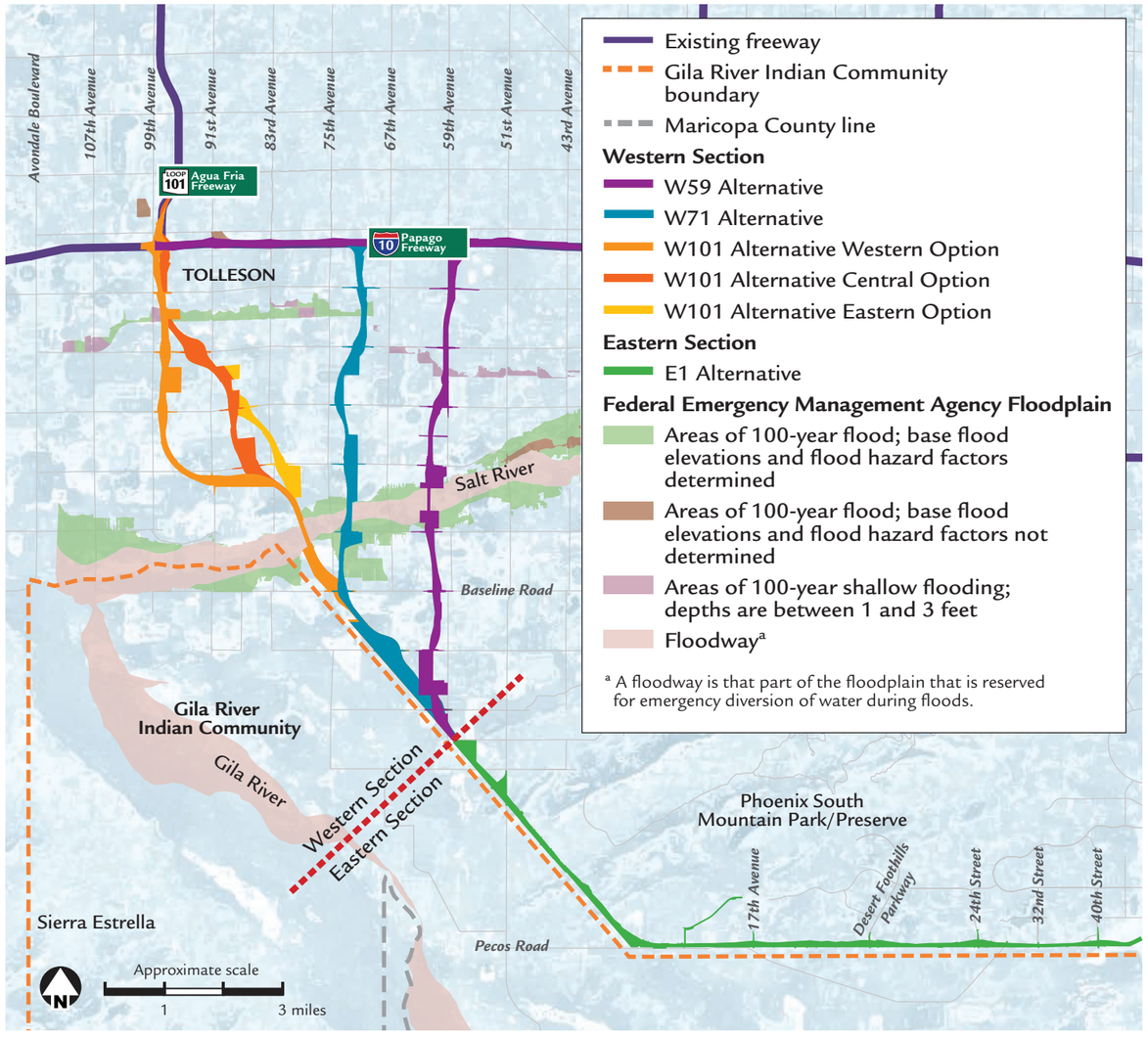
Watercourse Descriptions

Salt River

The Salt River is the largest tributary in the Gila River Basin, with its headwaters in rugged mountain terrain at elevations exceeding 7,000 feet in northern Arizona. The Salt River enters the Gila River at the western edge of the greater Phoenix metropolitan area. The Salt River watershed is approximately 5,980 square miles in size. Prior to construction of upstream water supply dams, the Salt River was perennial. Historical records indicate the Salt River had a wide, braided channel and experienced annual floods. Above its confluence with the Gila River, the Salt River has estimated 100- and 500-year peak discharge capacities of 162,000 cubic feet per second (cfs) and 235,000 cfs, respectively (USACE 2000).

Throughout the Study Area, flows in the Salt River are controlled by six upstream water supply and hydropower dams operated by SRP. Only the Roosevelt Dam, on the Salt River, now has allocated flood control storage that may be used to diminish peak flood flows through controlled releases. The other dams must release water in anticipation of flood flows to provide any attenuation. The Salt River largely remains dry downstream of the dams. In addition, during the past two decades, the riverbed has undergone substantial changes because of urbanization and sand and gravel mining. These activities have generally narrowed and deepened the main channel. In some portions of the Salt River, water has been reintroduced. Examples of this include development of Tempe Town Lake and construction of the City of Phoenix 91st Avenue WWTP. In 1999, the City of Tempe impounded the Salt River behind an innovative, inflatable rubber dam to create the 200-acre Tempe Town Lake. In times of high upstream discharges from the reservoirs, the dam can be rapidly deflated to allow peak flows to pass into the main channel.

Figure 4-38 100-year Floodplains



The Salt River floodplain is the more prominent of the two delineated floodplains in the Study Area.

Gila River

The reach of the Gila River upstream of the Salt River confluence and downstream of the Coolidge Dam (San Carlos Reservoir) has a watershed characteristic of the Basin and Range lowlands province. The Gila River watershed (located in Arizona and New Mexico) is approximately 57,900 square miles in area. Two dams on the Gila River system, upstream of the Salt River confluence, help regulate flow. Coolidge Dam, primarily a water supply dam, is located on the Gila River upstream of the confluence of the San Pedro and Gila rivers. Tat Momolikot Dam is a flood control facility located on Santa Rosa Wash. The estimated 100-year discharge capacity for the Gila River, downstream of the Salt River confluence, is 227,000 cfs (USGS 1989).

The Gila Drain is an SRP irrigation return flow channel that discharges to the Gila River. The Gila Drain conveys minor flood flows and irrigation tailwater from areas northeast of the Study Area into the Study Area at I-10 and Pecos Road. Flows from the drain are ultimately discharged into the Gila River on Community land (ADOT 1998). Flows are captured in the Gila Drain, which passes east-to-west through the Study Area and under 51st Avenue south of St. Johns (Komatke), on Community land. Larger flows that cannot be contained in the Gila Drain can be expected to break out into the Gila Drain Floodway. The Gila Drain Floodway watershed includes outflow from the 48th Street Basin, SEVRDS/Santan Channel Detention Basin, and miscellaneous irrigation return water flows. The SEVRDS is part of a large watershed that drains the eastern portion of the Phoenix metropolitan area. The SEVRDS/Santan Channel intercepts the off-site flow originating in this watershed and ultimately discharges these flows to the Gila Drain Floodway. The detention facility provides treatment of "first-flush" stormwater to remove suspended sediment, nutrients, and other pollutants. Flows from the Gila Drain enter the Gila River west of the community of St. Johns (Komatke), on Community land.

Summary of Flooding Risk and Flooding History

Flooding risk is based on the potential for damage during a 100-year or lesser flood. Several factors unrelated to the proposed action may affect flooding risk. These include operation of the upstream reservoir system on the Salt River, future water resource facilities, and sand and gravel mining activities. Changes in water-related facilities include modifications completed in the late 1990s to Roosevelt Dam to increase its height and reservoir storage capacity. The increased height of the dam is intended to provide dedicated flood control storage for runoff from the upper Salt River Basin.

Major flows occur in the Salt and Gila rivers only when water is released from the upstream water storage facilities. These releases occur when runoff from the watershed is expected to exceed the capacity of the reservoirs. Smaller flows may result from storms within the watershed downstream of dams. Studies of rainfall and runoff relationships indicate that the greatest runoff quantities and resultant floods occur in the winter season. Floods of record within the watershed include:

- 300,000 cfs in 1891 on the Salt River prior to completion of the dams within the system
- 250,000 cfs in 1891 on the Gila River downstream of the confluence with the Salt River, at Gillespie Dam
- 212,000 cfs in 1980 on the Salt River (largest since construction of the dams within the system)
- 32,850 cfs in January 1993 on the Gila River upstream of its confluence with the Salt River (Maricopa County Department of Emergency Management 2005)
- 17,594 cfs in January 2010 on the Gila River downstream of the confluence with the Salt River, at 116th Avenue (FCDMC 2010)

Flood flows in the river systems continue to have the potential to alter the human-modified and natural landscapes. There have been five floods on the Salt River in excess of 100,000 cfs since 1978: 1978 (two), 1980, 1983, and 1993. Flood damage potential has been reduced by upstream dam improvements. Major 2004 winter storms (December) in the Salt River watershed prompted SRP to release 30,000 cfs from Granite Reef Dam into the Salt River, requiring the deflation of the Tempe Town Lake Dam. This was the first release into the Salt River since Tempe Town Lake was constructed. A second release from Granite Reef Dam began in the fall of 2010 to refill Tempe Town Lake after replacement of the last of the dam's four large rubber bladders. (One of the bladders failed and drained the lake at a rate of 15,000 cfs in July 2010. The other three bladders were also replaced under a planned replacement schedule.) The area at the confluence of the Gila and Salt rivers has experienced numerous floods, with property damage through inundation and scouring effects. Wildlife habitat restoration and associated flows from the 91st Avenue WWTP are being addressed through USACE, Los Angeles District (*Tres Rios Arizona Feasibility Report* [USACE 2000]).

Flooding in the northern portion of the Western Section of the Study Area is caused by the interception of sheet flow from the rise in ground elevation associated with the UPRR railbed and the RID Canal channel.

ENVIRONMENTAL CONSEQUENCES

Action Alternatives, Western Section

All Western Section action alternatives would affect floodplains. Two 100-year floodplains would be affected: one associated with the Salt River and one north of the UPRR tracks (referred to as the UPRR floodplain). FHWA policies and procedures for the location and hydraulic encroachments on floodplains are set forth in 23 C.F.R. § 650. This section of the DEIS summarizes the evaluation of the proposed action in relation to applicable provisions of those regulations, including flooding risks, impacts on natural and beneficial floodplain values, probable incompatible floodplain development, measures to minimize floodplain impacts, alternatives to encroachment, and the potential for significant encroachment.

All Western Section action alternatives would laterally cross the Salt River and UPRR floodplains. The Salt River has an associated federally mapped floodplain and regulatory floodway. The UPRR floodplain is federally mapped, but, unlike the Salt River floodplain, it is not associated with a regulatory floodway. There is no alternative to crossing the Salt River or the UPRR floodplain because both form a continuous east-to-west feature across the Study Area. All Western Section action alternatives would result in limited encroachment on the floodplain and limited flooding risk.

Table 4-42 lists estimates of floodplain encroachment for the W59 (Preferred) Alternative and the other Western Section action alternatives and options. The estimates of encroachment include all the area within the proposed R/W of each action alternative; thus, more than just the project footprint (e.g., that area occupied by freeway structures and fill needed to create or stabilize these structures) is included. The floodway acreage is included in the Salt River floodplain total.

The acreage estimates are the potential extent of encroachment if the roadway were completed entirely on embankment fill. The extent of encroachment is expected to be smaller than that shown in Table 4-42, which would further reduce flooding risk in the Study Area. The Salt River floodplain crossings would include bridges, and the UPRR floodplain crossings would include either bridges or flood mitigation structures, such as basins and diversion structures. Minor design modifications that could further mitigate floodplain impacts, if warranted, are typically considered during the design process.

The W101 Alternative would have the least overall floodplain encroachment potential. In addition, the W101 Alternative would have the least potential for encroachment on the floodplain associated with the Salt River. The W71 Alternative would have the greatest potential for encroachment on the UPRR floodplain. The W71 Alternative would also have the potential to encroach on the greatest amount of floodplain in the Study Area.

Risks Associated with the Proposed Action

Risks are the consequences associated with the probability of flooding attributable to encroachment. The mitigation measures described in the section, *Mitigation*, beginning on page 4-106, would minimize the potential for property loss or hazard to life. Developments south of the freeway in the Western Section would have a higher level of flood protection than now exists because the freeway off-site drainage system would be designed to collect runoff for up to a 100-year storm, which would protect the freeway from flooding and, additionally, anything downstream of the freeway.

Impacts on Natural and Beneficial Floodplain Values

Natural and beneficial floodplain values associated with the Salt River floodplain include:

- wildlife habitat
- open space
- scientific research opportunities
- outdoor recreation
- agriculture
- natural flood control
- mining and industry (building material source)
- water quality maintenance
- groundwater recharge

As previously mentioned, the Salt River has been substantially altered from its natural condition. Control of flow by upstream dams and reservoirs has resulted in the channel being dry throughout most of the year. Major flow occurs only when water is released from the upstream facilities. The dry channel has been subject to sand and gravel operations, which have further altered the channel configuration. These alterations can increase some beneficial values and decrease others, such as wildlife habitat.

Because of these altered conditions, freeway facilities would not further diminish the natural floodplain values. Open space and outdoor recreational opportunities would be preserved. Because of urbanization adjacent to the Salt River and the continuing sand and gravel mining operations, wildlife habitats in the affected areas are of low value. The ability for wildlife to move freely within the remaining habitat would continue because bridges associated with any of the action alternatives would not impede movement. Therefore, the proposed action would not diminish values of remaining habitat. Bridge piers would have a negligible impact on the floodplain's capacity for groundwater recharge. Other activities, within the definition of natural and beneficial values, are not known to occur in the affected areas. Therefore, the proposed action would have no such impacts.

Table 4-42 Estimated Acreage of Floodplain Impacts, Western Section, Action Alternatives

Action Alternative/ Option	Salt River Floodplain Encroachment[a]	Union Pacific Railroad Floodplain Encroachment[a]	Total Floodplain Encroachment[a]
W59	53	4	57
W71	117	10	127
W101 Western Option	19	33	52
W101 Central Option	19	29	48
W101 Eastern Option	19	29	48

Note: There are no designated floodplains in the Eastern Section.
[a] based on right-of-way footprints

Support of Incompatible Floodplain Development

The 100-year floodplain associated with the Salt River is dominated by agriculture, mining, and undeveloped open space. Each Western Section action alternative and option would be a controlled-access facility and would cross the 100-year floodplain with structures above the 100-year floodwater surface elevation. Floodplain management regulations are enforced by FCDMC, with statutory authority as prescribed under A.R.S. §§ 48-3603 and 48-3609. In addition, the action alternatives and options are consistent with existing

development plans of the City of Phoenix and Maricopa County (see the section, *Land Use*, beginning on page 4-3). The freeway would provide improved access to future development, which, in turn, would be consistent with floodplain regulations. The action alternatives would not contribute to incompatible floodplain development.

Measures to Minimize Floodplain Impacts

The measures described in the section, *Mitigation*, beginning on this page, would be effective in minimizing impacts associated with encroachments into 100-year floodplains.

Alternatives to Encroachment

Potential encroachments into 100-year floodplains are quantified in Table 4-42. Encroachments on the Salt River floodplain and the UPRR floodplain by any of the Western Section action alternatives and options were determined to be unavoidable. Both floodplains extend across the entire width of the Western Section of the Study Area. The location of the encroachments correlates to the established western logical terminus at I-10 (Papago Freeway) for any of the action alternatives and options.

Potential for Significant Encroachment

Significant encroachment, as defined in 23 C.F.R. § 650, Subpart A, would occur when the highway encroachment and any base floodplain development would involve one or more of the following construction or flood-related impacts:

- interruption or termination of a transportation facility needed for emergency vehicles or one that provides a community's only evacuation route
- significant risk
- significant adverse impact on natural and beneficial floodplain values

Regardless of action alternative, the proposed action would not have the potential to interrupt or terminate transportation facilities needed for emergency vehicles or emergency evacuation routes. The proposed action would neither create a substantial risk nor adversely affect natural or beneficial floodplain values. Therefore, the proposed action would not have a significant encroachment on floodplains.

Action Alternative, Eastern Section

The E1 (Preferred) Alternative would not cross any federally mapped floodplains. The Eastern Section action alternative would have no impact on floodplains in the Study Area.

No-Action Alternative

The No-Action Alternative would have no impact on floodplains in the Study Area. Growth projections supported by affected jurisdictions' planning policies for the Phoenix metropolitan area, however, indicate that land in the Study Area will be developed within the next 20 years. If a freeway were not constructed, it is expected that floodplains would need to be crossed in several locations at major arterial streets to enable transportation into and out of the Study Area. Some streets now cross the Salt River at grade and have been periodically closed because of minor channel flooding.

MITIGATION

Mitigation of the 100-year floodplain encroachments of the Western Section action alternatives would be accomplished by constructing bridge and culvert structures, where appropriate, to accommodate 100-year floodwaters. Design changes would be evaluated during the project design phase to further mitigate the impact.

The proposed action would affect floodplains. The Salt River and UPRR floodplains extend across the entire width of the Western Section of the Study Area. The location of the encroachments correlates to the established western logical terminus at I-10 (Papago Freeway) for all of the action alternatives and options.

Mitigation measures would minimize the potential for property loss or hazard to life. Developments to the south and west of the freeway in the Western Section would have a higher level of flood protection than now exists. The following describes measures to minimize impacts on floodplains as a result of the proposed action.

None of the action alternatives would completely avoid causing impacts because any freeway in the southwestern Phoenix metropolitan area and located near the Salt and Gila rivers would necessarily encroach onto floodplains.

ADOT Design Responsibilities

The Maricopa County Floodplain Regulations define a *floodway* as "the channel of a river or other watercourse and the adjacent land areas necessary in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot." The floodway is the stream channel and the portion of the adjacent floodplain that must remain open to permit passage of a base flood. Bridge structures for all of the action alternatives would be designed to cross floodplains in such a way that their support piers and abutments would not contribute to a rise in floodwater elevation of more than a foot. Floodplain impacts would be minimized by implementing transverse crossings of the floodplains and avoiding longitudinal encroachments. Any of the action alternatives would require comprehensive analyses of hydrology, hydraulics, sediment transport, and erosion to minimize the impacts of encroachment. ADOT would conduct these analyses during the design phase. As indicated in Section 505(a) of the Floodplain Regulations for Maricopa County:

> In accordance with A.R.S. § 48-3613, written authorization shall not be required, nor shall the Board prohibit the following except that before any construction authorized by this subsection may begin, the person shall submit plans for the construction to the Floodplain Administrator for review and comment: a. Construction of bridges, culverts, dikes and other structures necessary to the construction of public highways, roads and streets intersecting or crossing a watercourse.

The Maricopa County Floodplain Manager would be given an opportunity to review and comment on the design plans.

On-site Drainage

Design criteria for on-site drainage would be based on ADOT's *Roadway Design Guidelines* (2007a) and

Highway Drainage Design Manual – Hydrology (1993) and on FHWA's *Urban Drainage Design Manual* (2001b).

Off-site Drainage

ADOT's *Roadway Design Guidelines* (2007a) provides criteria to be used for off-site flows affected by the proposed action:

- Culverts would be sized based on the design discharge of a 100-year storm.
- Increases in water surface elevations as a result of the new facilities would be contained within the existing and proposed R/W or as noted in accordance with Section 611.3.C.
- Culverts would be designed to be self-cleaning, Section 611.3.E.
- Reinforced concrete box culvert and reinforced concrete pipe would be provided with adequate cover.

If an action alternative were to become the Selected Alternative, it would need comprehensive hydrologic, hydraulic, sediment transport, and erosion-related assessments regarding potential 100-year flood effects associated with ephemeral washes. Results would provide information necessary to make a determination regarding what mitigation measures would need to be implemented. Measures may include physical structures associated with the freeway such as culverts. These measures would be determined during the design phase.

CONCLUSIONS

Implementation of any of the Western Section action alternatives would involve crossing the Salt River and UPRR floodplains, with the W71 Alternative having a substantially greater impact on floodplain acreage (127 acres) than would either the W59 (Preferred) Alternative (57 acres) or W101 Alternative and its Options (48–52 acres). Regardless of the action alternative identified as the Selected Alternative, if an action alternative were to be so identified, impacts on the overall natural and beneficial values of the floodplain would be negligible. The differences in floodplain impacts among action alternatives in the Western Section would be inconsequential, and impacts from floodplain encroachment would be effectively mitigated through an elevated crossing (on piers) of the floodplain, using appropriate bridge design. Under the No-Action Alternative, continuing urbanization in the foreseeable future would likely lead to further encroachment into federally mapped floodplains.

The E1 (Preferred) Alternative would not cross any federally mapped floodplains.