DRAINAGE STUDY

FOR

CROWS LANDING INDUSTRIAL BUSINESS PARK

Stanislaus County

Prepared by:

AECOM

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EXECUTIVE SUMMARY

The proposed Crows Landing Industrial Business Park Project Site lies downstream of Little Salado Creek and receives runoff from an approximately 17 square mile area. A peak flow of 700 cubic feet per second (cfs) will be discharged from Little Salado Creek to the project site during a 100-year, 24 hour storm event. The peak discharge from the upstream tributary areas to the project site is controlled by the size of the existing double box culverts that convey the Little Salado Creek flow underneath the Delta Mendota Canal.

Under existing conditions, much of the runoff entering the proposed project site would pond against the California Northern railroad tracks, which are located across Highway 33 and adjacent to the northeastern corner of the site, and eventually flow towards the City of Patterson. The Marshall Drain has very little capacity, so any heavy storm would cause flooding on the site and in Patterson.

Improvements as part of the backbone infrastructure necessary for project development include widening the Little Salado Creek channel across the site and increasing the capacity of the culverts under the runway to carry the full 700 cfs discharge from Little Salado Creek to the northeast corner of the project site. Currently, a peak flow of approximately 250 cfs would reach this area. Other proposed improvements include full retention of flows from each leasehold site that will be developed in the future (not part of the backbone infrastructure) and raising of Davis Road west of the Delta Mendota Canal to block flows from ponding on that site.

To mitigate the increased flow that will be carried to the northeastern corner of the site, a multi-purpose detention pond will be constructed that will reduce the flows to equal to or below existing conditions and prevent impacts to the City of Patterson. This multi-purpose pond will have a capacity of 380 acre-feet and will be located near the Marshal Road and Crows Landing intersection with an estimated cost of $7.71 million.

A Conditional Letter of Map Revision (CLOMR) should not be pursued at this time since only a small portion of the site is in the floodplain, and the project can be permitted without a CLOMR. Only a Letter of Map Revision (LOMR) would need to be processed after the improvements have been made. Since the proposed site includes an on-site airport, all proposed stormwater management facilities must be in accordance with FAA regulations and guidance pertaining to drainage proposed airport operations.

1. INTRODUCTION

The proposed Crows Landing Industrial Business Park project (Project) is a 1,528-acre planned development on the site of the former Crows Landing Air Facility. The project site lies west of State Route 33 and east of Interstate 5, southeast of the City of Patterson, and approximately 2 miles northwest of the community of Crows Landing. The Delta Mendota Canal traverses the southern portion of the Project in a northwest/southeast direction. Little Salado Creek enters the project site along the western property boundary slightly northeast of the Delta Mendota Canal and discharges to the Marshall Drain.

The Marshall Drain is an underground pipe near the intersection of Marshall Road and State Route 33 that carries runoff to the San Joaquin River approximately 4.3 miles east of the project site. The project site generally slopes northeasterly with an elevation change of approximately 80 feet, with the lowest elevation near the intersection of State Route 33 and Marshall Road. The site includes roads and aviation improvements associated with the former air facility, and approximately 1,200 acres of the site are currently used for agricultural purposes.

This study provides information required for the County to better assess the feasibility of the planned development by preliminarily defining the storm drain system infrastructure improvements necessary to accommodate planned development. The site's existing and proposed hydrological conditions were analyzed, and the existing and proposed 100-year floodplain was mapped. Proposed improvements are shown with estimated constructions costs.

2. HYDROLOGY

Existing Conditions

This section describes the existing conditions within the project site and surrounding Study Area, including topography, soils, existing drainage patterns, and the resulting runoff. The Study Area is the contributing watersheds as shown on Figure's 1 and 4.

Upstream watersheds east of Interstate 5 between the California Aqueduct and Delta Mendota Canal consist of land that generally slopes to the northeast. The terrain west of Interstate 5 is characterized by rolling hills and range land with elevations ranging from 220 feet to 1,400 feet.

Figure 1 shows the existing watershed areas. The areas are broken down as follows:

- Little Salado Creek Tributary Area: The approximately 6,925-acre watershed area west of Interstate 5, which is tributary to Little Salado Creek.
- Subshed 1: The approximately 236-acre watershed area situated between Interstate 5 and the California Aqueduct.
- Subshed 2: The approximately 1,046-acre watershed area situated between the Delta Mendota Canal and the California Aqueduct.
- Project Site: The approximately 3,036-acre watershed area includes the 1,528-acre Subshed 3, which is the Project Site, and the surrounding area that extends from the Delta Mendota Canal to State Route 33.

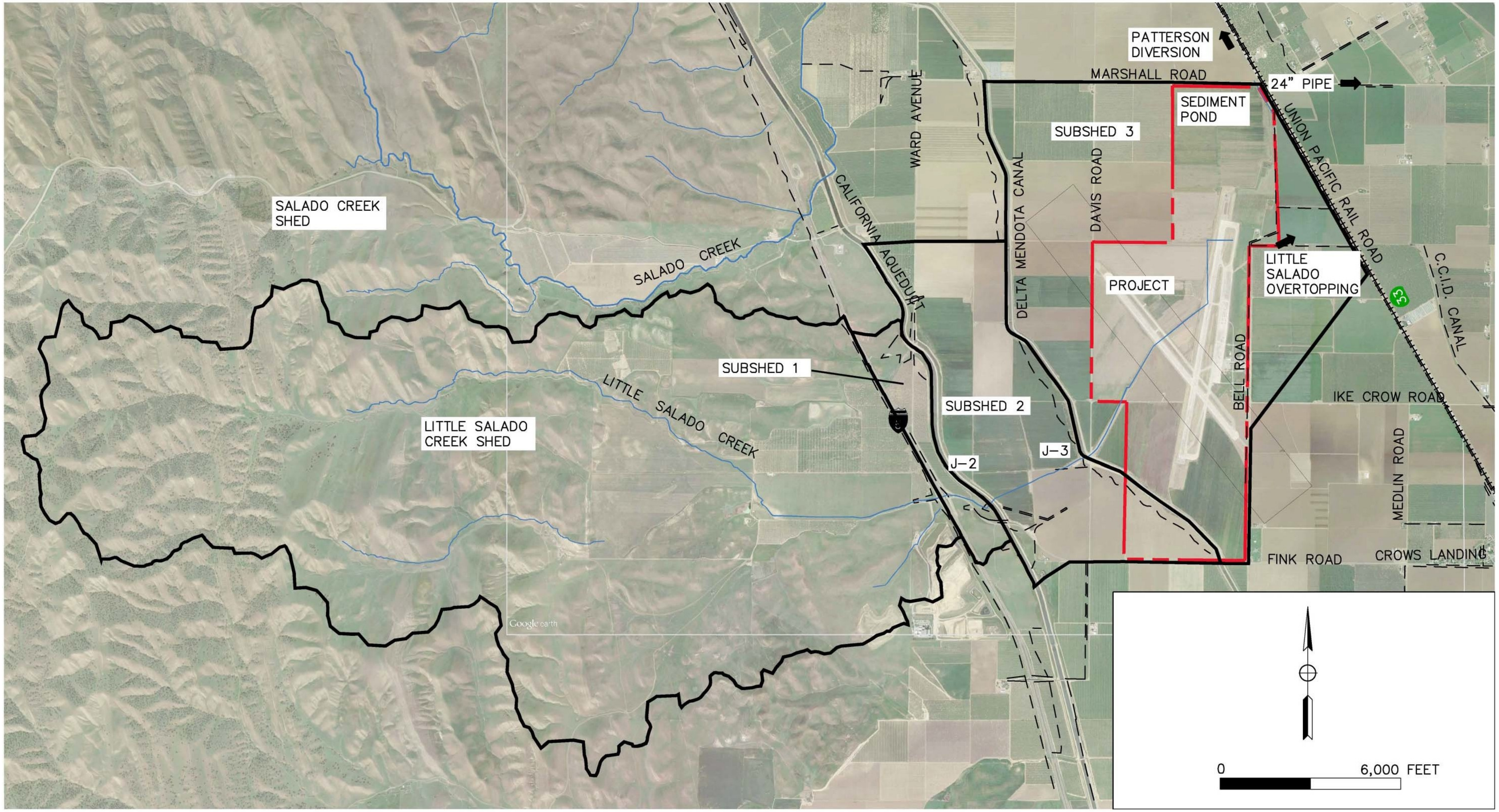

Figure 1 - Existing Watershed Areas

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Storm runoff from the Little Salado Creek watershed west of the California Aqueduct crosses both Interstate 5 and the California Aqueduct. From that point, runoff flows toward the Delta Mendota Canal while collecting runoff from Subshed 1. Subshed 2 drains that area between the California Aqueduct and the Delta Mendota Canal. Flow is conveyed under the Delta Mendota Canal by two, 5-foot-square box culverts that have capacity for only 700 cfs. This crossing is the only direct drainage connection to the project site from watershed areas to the west of the Delta Mendota Canal.

On the east side of the Delta Mendota Canal, the box culverts drain into an open channel that continues in a northeasterly direction through the project site, crossing through the culverts beneath the runways. The open channel ultimately drains toward the low point of the project site near the intersection of State Route 33 and Marshall Road. At this low point, runoff drains through a linear sedimentation basin towards a raised concrete control structure. The control structure contains a 24-inch outlet controlled by a slide-gate valve.

The 24-inch outlet discharges to the 24-inch “Marshall Drain”, which runs parallel to Marshall Road for approximately 4.3 miles to its final discharge point at the San Joaquin River. Excess stormwater runoff is known to accumulate in the northeast portion of the project site, primarily a result of limited discharge capacity within the 24-inch Marshall Drain Line. Appendix A contains photos of the Little Salado Creek as it crosses the project site. During heavy rainfall events, runoff pools against the railroad tracks, eventually over-tops the railroad, and then flows northwesterly towards the San Joaquin River. In addition, flows migrate north towards the City of Patterson and contribute to flooding in that area.

Peak discharges and runoff volumes from the project site and off-site watersheds were determined using the NRCS Technical Release 55 (TR-55) and the Hydrologic Modeling System (HEC-HMS) software, Version 4.0, developed by the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC). This section provides a brief summary of the input parameters used in the analysis.

Soils were classified according to ratings determined by the United States Department of Agriculture’s Natural Resources Conservation Service (NRCS). The NRCS classifies soils into four Hydrologic Soil Groups based on the soil’s runoff potential (NRCS TR-55):

- **Group A** soils are sand, loamy sand, or sandy loam. These soils have low runoff potential and high infiltration rates (greater than 0.30 inches per hour [in/hr]) even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels, and have a high rate of water transmission.
- **Group B** soils are silt loam or loam. These soils have moderate infiltration rates (0.15 – 0.30 in/hr) when thoroughly wetted and consist primarily of moderately drained soils with moderately fine to moderately coarse textures.
- **Group C** soils are sandy clay loam. These soils have low infiltration rates (0.05 – 0.15in/hr when thoroughly wetted and consist primarily of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
- **Group D** soils are clay loam, silty clay loam, sandy clay, silty clay, or clay. These soils have the highest runoff potential and very low infiltration rates (0.0 – 0.05 in/hr) when thoroughly wetted. They consist primarily of clay soils with a high swelling potential and/or soils with a permanent high water table.

The off-site Little Salado Creek drainage area soils range from Type C to Type D. Type C is the predominant soil type, accounting for 72 percent of the soils. See Figure 2 for a soils map of the Study Area.

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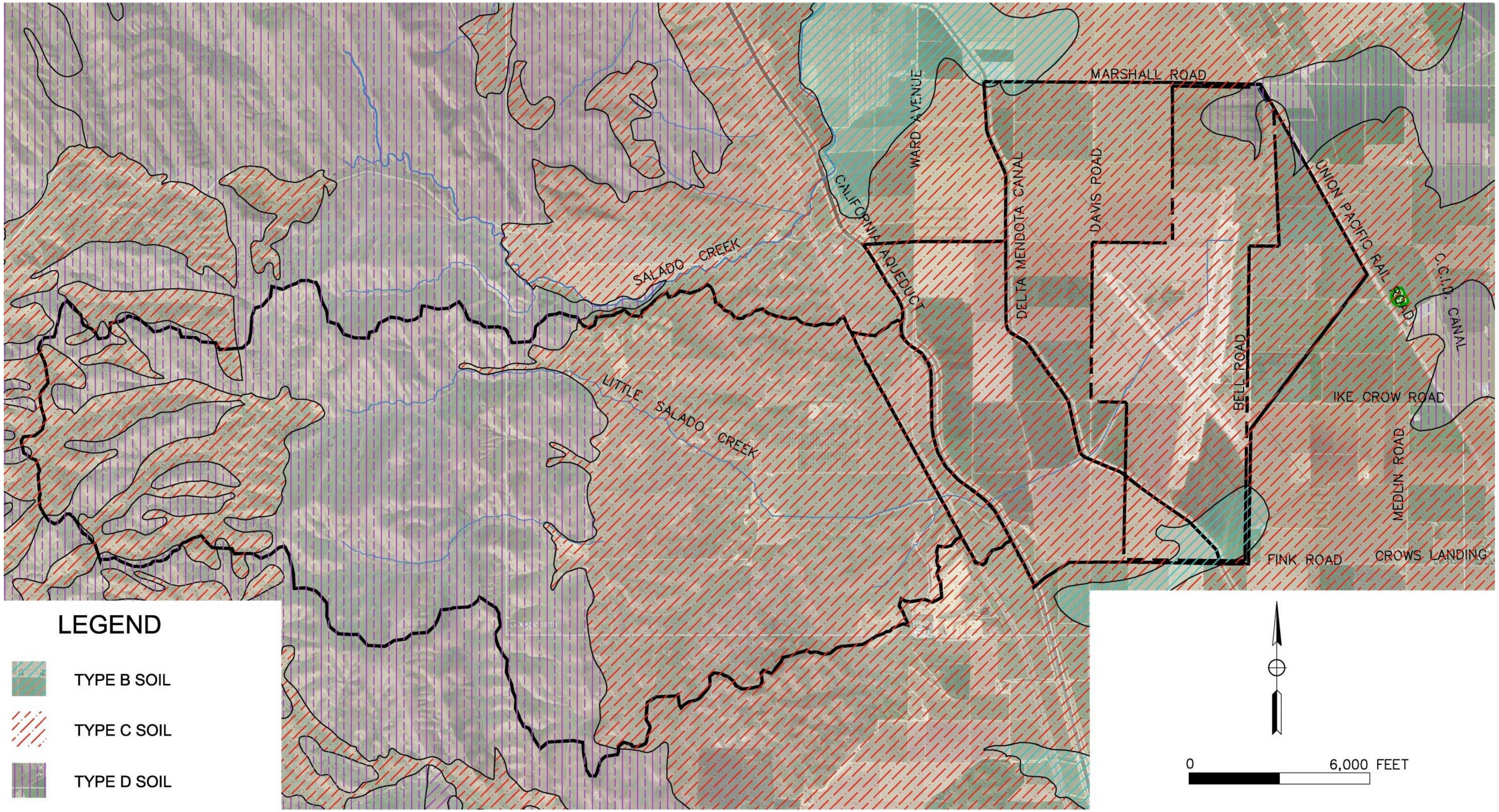

Figure 2 - Soils Map

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Composite Curve Numbers (CNs) were used per TR 55 to estimate runoff from the watershed areas. These CNs are characterized and determined by the cover type, treatment and soil conditions within a given watershed. Composite CNs for the project site and off-site tributary areas were determined using the soils information shown in Figure 2, and weighted based on the acreage of the particular soil type within a given watershed.

Composite CNs for the tributary areas are summarized below in Table 1.

Table 1 - Existing Composite NRCS TR-55 Curve Numbers

Watershed	Area (sq. mi.)	Composite CN
Little Salado Creek	10.8	83
Subshed 1	0.4	82
Subshed 2	4.1	82
Project Site	4.4	84

Design storm events are described in terms of depth, duration, and frequency of occurrence. The 100-year, 24-hour storm event was selected as the design storm for this analysis. The 10-year and 500-year storm events were also analyzed in case a FEMA CLOMR is pursued. The depths for the re-occurrence intervals were taken from the Stanislaus County Drainage Design Standards and are shown in Table 2.

Table 2 - Design Rainfall Data

Design Storm Frequency	24-Hour Rainfall (inches)
10-year	2.03
100-year	3.13
500-year	4.02

The rainfall distribution used was the NRCS Type I rainfall distribution. Figure 3 shows the HEC-HMS schematic of the existing conditions model developed for this analysis.

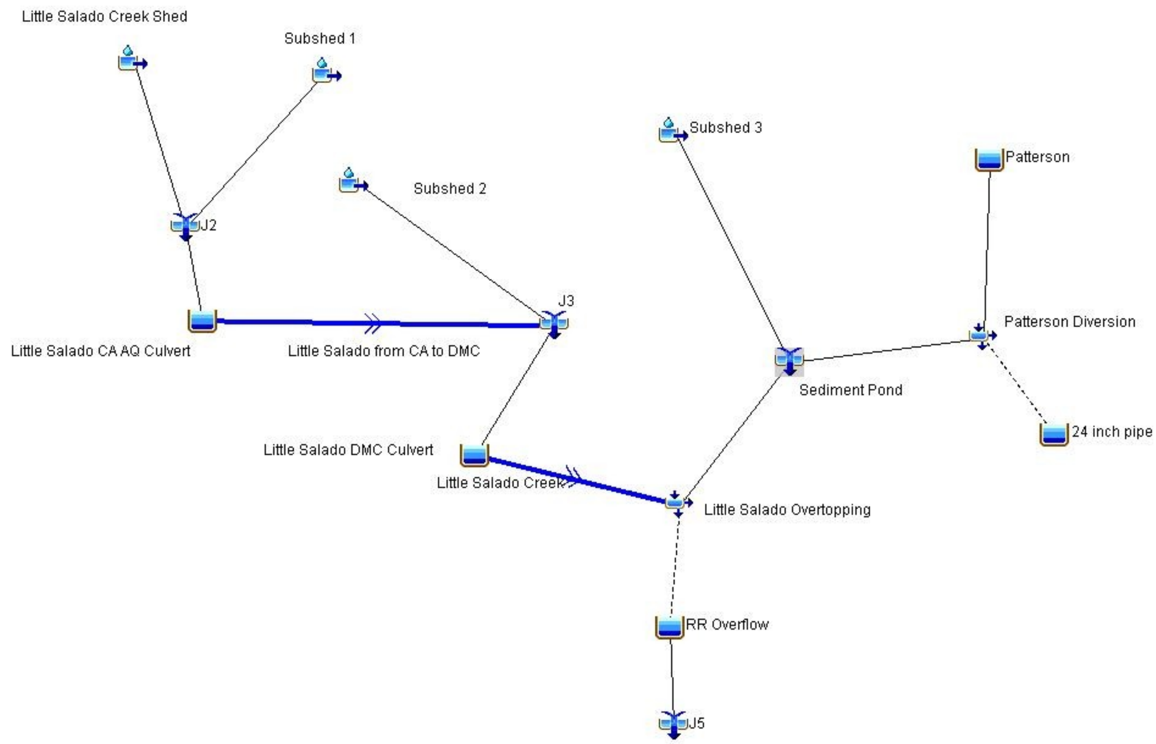

Figure 3 - HEC-HMS Existing Basin Model Schematic

Stage-storage discharge curves were developed for hydraulic structures, such as culverts and over-chutes, and were utilized to determine runoff attenuation behind the California Aqueduct and Delta Mendota Canal. Significant ponding occurs behind the embankments of these canals. The hydraulic stage versus discharge curves were developed using HEC-RAS using a series of flows. The resulting water surface elevations were used to measure the storage volumes at those elevations.

Under existing conditions, the channel crossing the site does not have the capacity to carry all the runoff entering the site. In addition, the culverts under the existing runway are inadequate to carry the runoff.

<u>Proposed Conditions</u>

Development of the project site will require the construction of storm drainage infrastructure to accommodate the off-site runoff from upstream tributary areas. Following the construction of storm drainage infrastructure, the significant amount of runoff that would currently pond on the site will be routed through the site, resulting in much larger peak flows. By requiring all future leasehold development to retain all runoff on site, additional peak flows from the site are not anticipated and the HMS modeling reflects this.

Figure 4 shows the proposed drainage areas, which are the same as the existing conditions except that the on-site areas have been modified to reflect the proposed development.

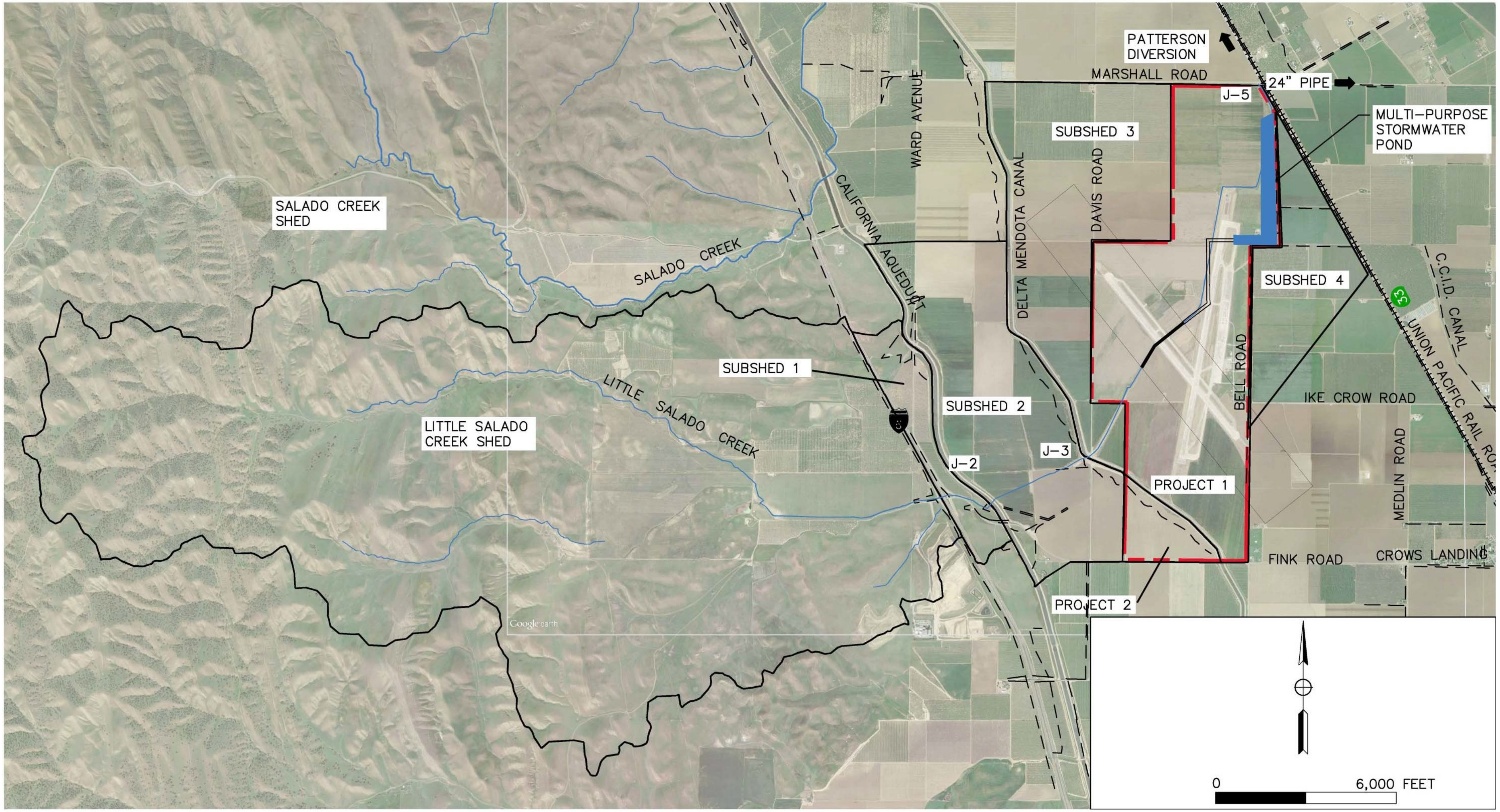

Figure 4 - Proposed Watershed Areas

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Runoff curve numbers were updated for the proposed conditions and are shown in Table 3.

Table 3 - Developed Composite NRCS TR-55 Curve Numbers

Watershed	Area (sq. mi.)	Composite CN
Little Salado Creek	10.8	83
Subshed 1	0.4	82
Subshed 2	3.9	82
Subshed 3	1.6	84
Subshed 4	0.7	84
Project Site 1	2.3	94.3
Project Site 2	0.2	94.2

Figure 5 shows the proposed condition HEC-HMS model configuration.

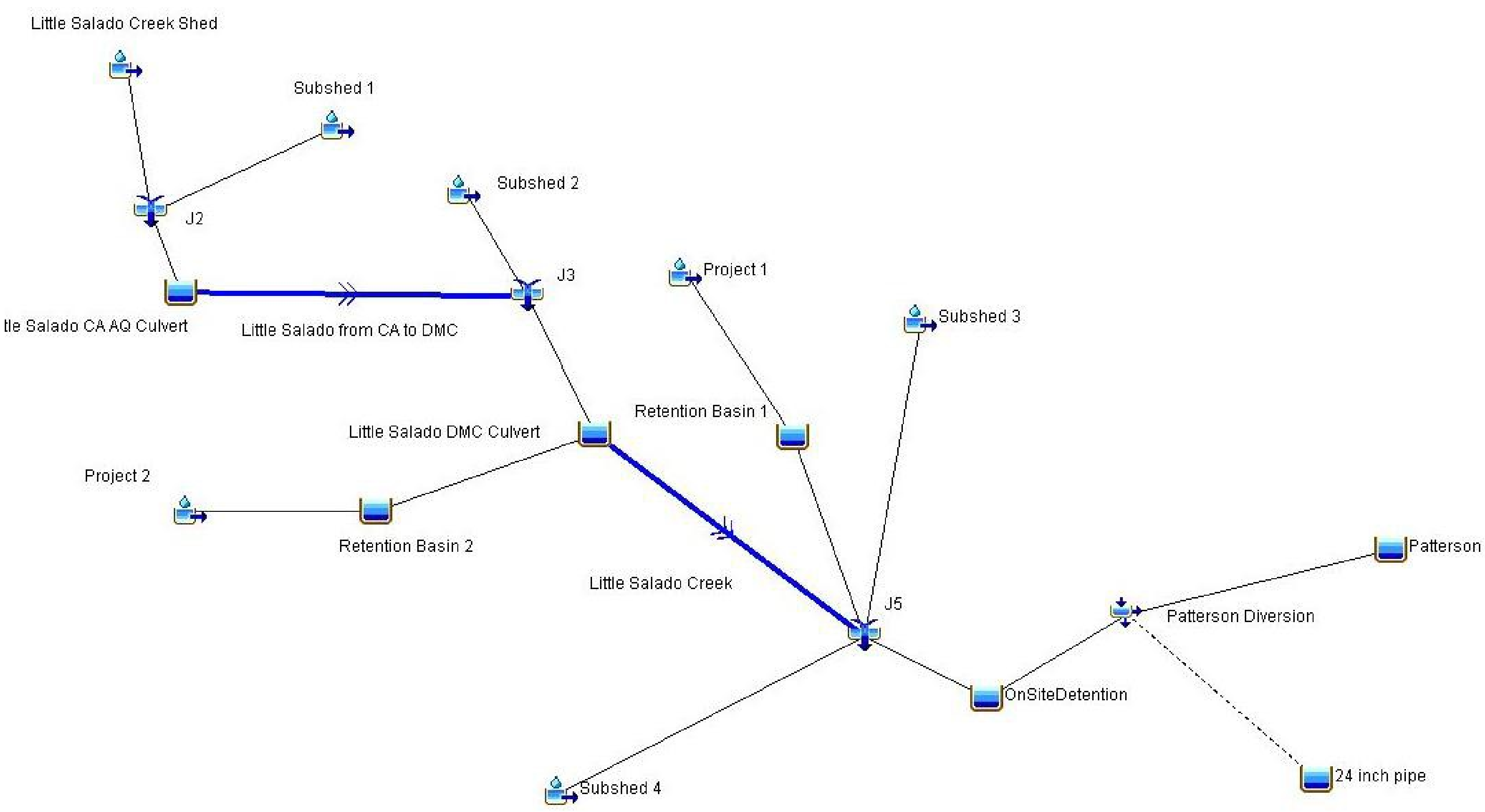

Figure 5 - HEC-HMS Proposed Basin Model Schematic

Results

The HEC-HMS model results for the existing and proposed conditions are shown in Table 4

Table 4 - Hydrology Output (10, 100, and 500-Year, 24-Hour Storm Events)

Element	10-Year Event		100-Year Event		500-Year Event	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
	Peak Discharge (cfs)	Peak Discharge (cfs)	Peak Discharge (cfs)	Peak Discharge (cfs)	Peak Discharge (cfs)	Peak Discharge (cfs)
Little Salado Creek Shed	941	941	2,312	2,312	3,560	3,560
Subshed 1	30	30	78	78	122	122
J2	971	971	2,389	2,389	3,681	3,681
Little Salado CA AQ Culvert	839	839	1,383	1,383	1,667	1,667
Little Salado from CA to DMC	839	839	1,383	1,383	1,667	1,667
Subshed 2	87	76	217	191	338	297
J3	925	909	1,584	1,573	1,966	1,953
Project 2	N/A	38	N/A	60	N/A	84
Retention Basin 2	N/A	0	N/A	0	N/A	16
Little Salado DMC Culvert	676	675	700	700	700	700
Little Salado Creek	675	675	700	700	700	700
Little Salado Overtopping	250	N/A	250	N/A	250	N/A
J5	425	796	450	1,056	450	1,245
Project 1	N/A	937	N/A	1,532	N/A	2,102
Retention Basin 1	N/A	0	N/A	0	N/A	144
Subshed 3	276	113	607	264	905	401
Subshed 4	N/A	42	N/A	97	N/A	148
OnSiteDetention	N/A	357	N/A	784	N/A	923
Patterson Diversion[2]	515	347	846	773	1,144	912
24 inch pipe[2]	8	11	8	11	9	11

1 Those elements with N/A did not exist in the Existing Condition or were eliminated in the Proposed Condition.

2 These are locations where flows are leaving the project site

Under existing conditions, the peak, 100-year discharge on Little Salado Creek at the California Aqueduct is 2,312 cfs. The peak discharge through the culvert and into Subshed 2 is 1,383 cfs due to flood attenuation behind the California Aqueduct. The peak discharge reaching the Delta Mendota Canal culverts are 1,584 cfs, which is then attenuated to 700 cfs through the Delta Mendota Canal culverts. Flows in excess of this amount would pool west of the Delta Mendota Canal and eventually overtop the Delta Mendota Canal.

Under proposed conditions, Little Salado Creek across the project site will have the capacity to convey the full 700 cfs across the site. This eliminates the pooling along the railroad tracks to the east, however, peak flows flowing north towards Patterson would be increased without mitigation. Under proposed conditions, this increase in flow will be mitigated by developing a detention pond on the northeast corner of the site. Under existing conditions, approximately 850 cfs (100-year event) would flow towards Patterson. Without mitigation, this discharge would be increased to nearly 1,050 cfs. During a 10-year event, the increase is even greater (270 cfs) and, therefore, controls the amount of reduction in peak flows that must be achieved. Therefore, the detention pond must reduce this peak flow by approximately 270 cfs to prevent adverse effects on the City of Patterson.

3. PROPOSED INFRASTRUCTURE

For the purposes of this study, it has been assumed that all future, private development will be required to retain up to the 100-year event on-site. This requirement will greatly reduce the amount of runoff to be conveyed or detained downstream and, therefore, greatly reduces the amount of drainage infrastructure that is required for this development.

New backbone drainage infrastructure will be required to enable subsequent on-site development. Two infrastructure items are common to the alternatives discussed in this section:

- Raising Davis Road by approximately 4 feet to protect the area west of the Delta Mendota Canal and
- Increasing the capacity of Little Salado Creek by widening the channel and increasing the culverts capacity under the runway. Off-site flows would be conveyed through the site via the expanded open channel and culverts to the northeast corner of the project.

See Figure 6 for the area of Little Salado Creek affected by the proposed improvements described in this document.

Based on their proximity to existing runway infrastructure, the design of the channels will need to address guidance set forth in FAA orders and guidance. FAA Order 13, Design, provides guidance for drainage facilities constructed on Airports. FAA AC 150/5200-33B, “Wildlife Hazard Attractants on and Near Airports,” provides guidance for open water facilities constructed within the critical zone for wildlife hazards, which is defined as the area 10,000 feet of aircraft movement areas and within 5 miles of approach departure areas. The following design criteria will apply:

- The portion of the on-site channel between runway pavements and the Ike Crow Road Extension must remain underground, as no open water can be constructed within the airport fence.
- The sides of the on-site channel must include steep slopes and armoring (rather than vegetation) to make them less attractive to wildlife.
- None of the proposed on-site channels will include features that provide habitat for flora or fauna.

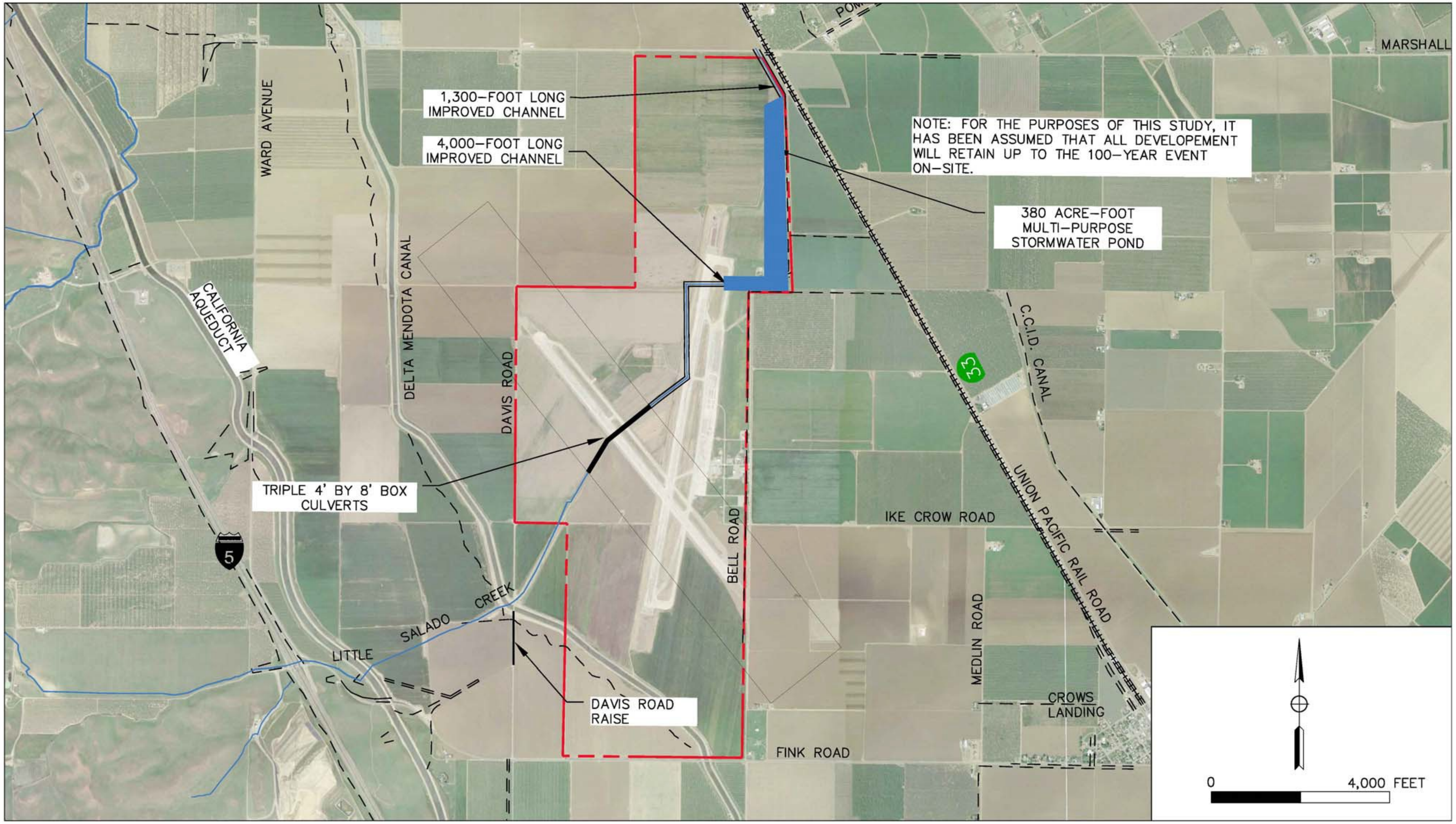

Figure 6 - Proposed Improvements

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On-site Detention/Storage

A detention pond would be constructed in the northeast portion of the project site to detain flows to so no increase in the peak flows above existing conditions will occur. In the HEC-HMS model the peak flows from Junction J5 were routed through the detention pond with an outflow restriction at the downstream end which will limit peak flows to less than the maximum allowable rates (existing conditions peak flows). A stage-storage-discharge rating curve, as shown in Table 5, was developed to model the proposed pond. Based on this model, the pond would require a capacity of approximately 180 acre-feet and cover an area of approximately 40 acres. In addition, this pond will have capacity to retain up to a 2-year storm event in the bottom of the pond. This additional 200 acre-feet of "dead" storage will be retained to allow groundwater recharge as described in the Groundwater section of this report.

Table 5 - Stage-Storage-Discharge Curve

Elevation (ft)	**Storage (Acre-Feet)**	**Flow (cfs)**
110.5	0	0
115	198	0
116	244	95
117	290	275
118	337	530
119	384	790
120	432	950

Figure 6 shows a layout for the proposed detention pond. Figure 7 shows the peak inflow and outflow hydrographs for the proposed detention pond.

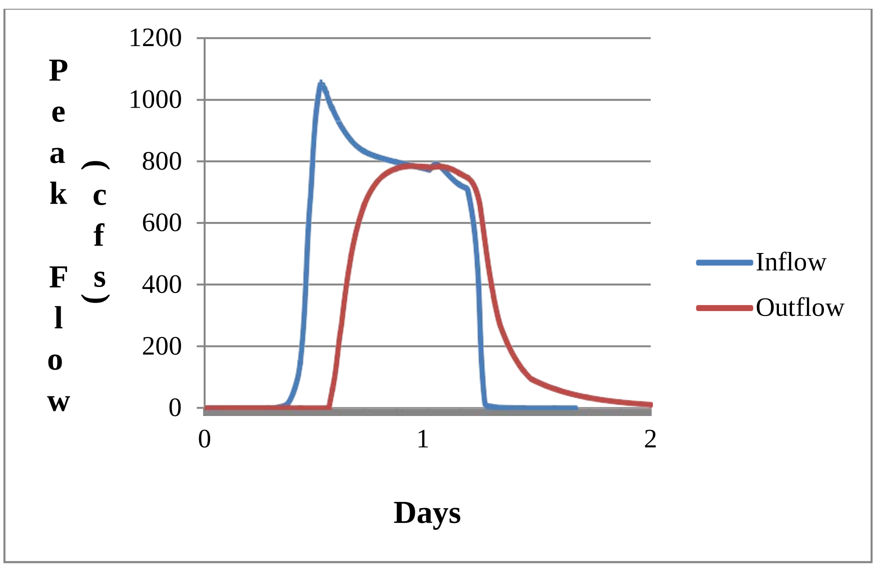

Figure 7 - Detention Pond 100-Year Inflow and Outflow Hydrographs

Table 6 below provides an estimated cost for the backbone infrastructure.

Table 6 - Preliminary Construction Cost Estimate for Backbone Infrastructure

Phase 1A

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Davis Road Raise	1	LS	$225,250	$225,250
				Subtotal:	$225,250
				25% Contingency:	$56,313
				Total	$281,563

Phase 1b

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	On-Site Channel Earthwork	40,000	CY	$10	$400,000
2	Detention Basin Earthwork	368,807	CY	$5	$1,844,035
3	Detention Basin Inlet/Outlet Works	1	EA	$50,000	$50,000
4	Infiltration Trenches	16,791	CY	$25	$419,780
5	Triple 4 by 8 Box Culverts	2,085	LF	$800	$1,668,000
6	Headwalls	2	EA	$25,000	$50,000
				Subtotal:	$4,431,815
				25% Contingency:	$1,107,954
				Total	$5,539,768

Phase 2

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Detention Basin Earthwork	113,925	CY	$5	$569,623
2	Infiltration Trenches	5,187	CY	$25	$129,670
				Subtotal:	$699,294
				25% Contingency:	$174,823
				Total	$874,117

Phase 3

ITEM NO.	DESCRIPTION OF WORK	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Detention Basin Earthwork	132,268	CY	$5	$661,342
2	Infiltration Trenches	6,022	CY	$25	$150,549
				Subtotal:	$811,892
				25% Contingency:	$202,973
				Total	$1,014,865

FAA warns against the construction of open water ponds within 10,000 feet of aircraft movement areas. Based on the pond's proximity to the airport, the pond will be designed and constructed in accordance with guidance set forth in FAA Advisory Circular 150/5200-33B. Applicable design considerations will include the use of steep slopes and armoring. FAA guidance also states that open water features drain within 48 hours of a 10-year storm event.

4. FLOODPLAIN MAPPING

Existing Conditions

The FEMA defined floodplain as shown on Figure 8 shows Zones A (100-year no elevations determined) and X (500-year or 100-year with depths less than one-foot) on the project site. Zone X areas do not require LOMR's or flood insurance. This floodplain information is based on FEMA Panel 06099C0765E, effective date September 26, 2008.

It appears that the Zone A defined area is incorrectly mapped because the limits shown do not correlate to any topographic features. Figure 8 shows the existing conditions 100-year floodplain limits determined as part of this study.

Approximate A Zones are those areas not studied by the detailed hydrologic/hydraulic methods. FEMA allows the County Floodplain Manager to allow development in A Zones if base flood elevations have been determined and the development is outside the limits of the 100-year floodplain. Since we have determined the base flood elevations will be contained within the channel in this area, no CLOMR is necessary for this development. Eventually, a LOMR will need to be processed for the area currently in FEMA Zones A and X, so the development on this portion of the project will not be subject to flood insurance.

As part of this study we also determined peak flows on Salado Creek to investigate the possibility that runoff from that watershed were combining with runoff from Little Salado Creek to create a larger floodplain as shown on the FEMA panel. The results of this analysis show that the over-chute across the Delta Mendota Canal that carries runoff from Salado Creek towards Patterson would only pass 112 cfs during a 100-year event. Therefore, it does not appear that flows from Salado Creek are traveling south to Little Salado Creek.

Raising Davis Road will protect that portion of the project south of the DMC from flooding but will cause more area to the west of Davis Road to be inundated during large flood events. The inundation will be deeper than under current conditions, however, the duration will be short. The existing floodplain west of the DMC is not currently mapped by FEMA so no letter of map change will be required as part of this development. In the future, if the area west of Davis Road is mapped by FEMA it would probably be categorized as a Zone A or AE.

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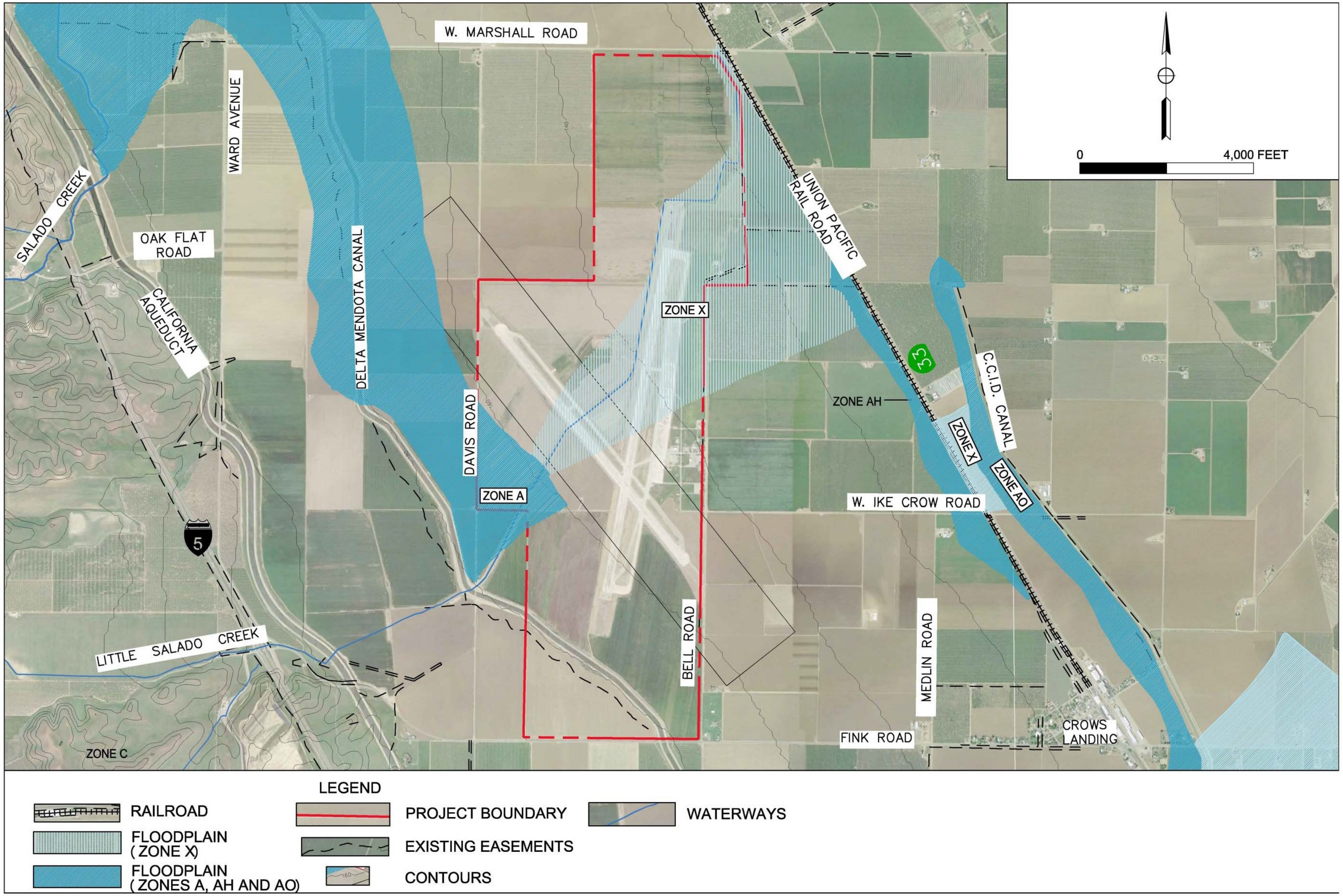

Figure 8 - FEMA Floodplain

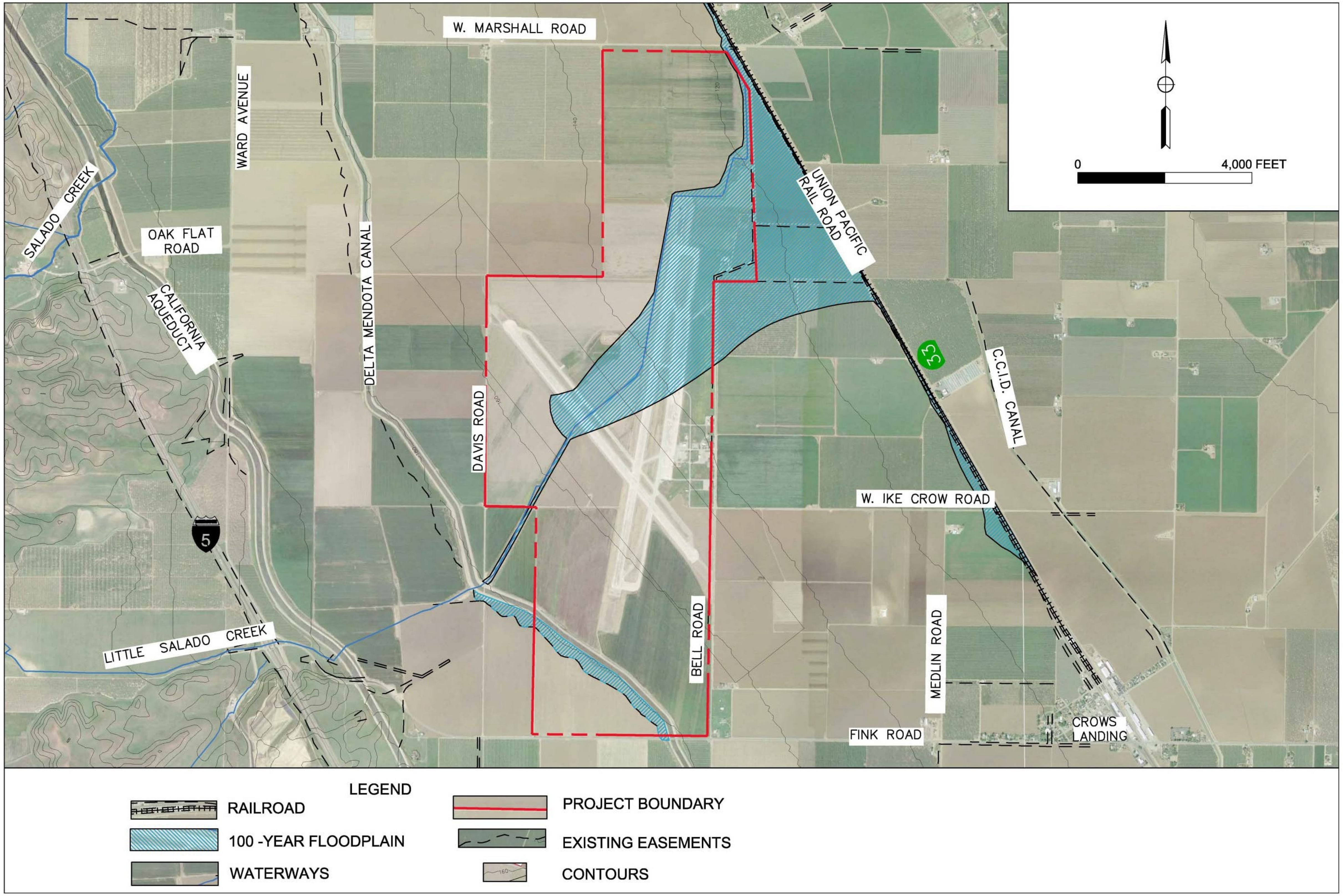

Figure 9 - Existing Floodplain

The limits of the 100-year floodplain were determined for the existing conditions by developing a one-dimensional hydraulic model using HEC-RAS. The existing conditions model simulates a 100-year flood event using hydrologic inputs from HEC-HMS that incorporate flood flows that enter Little Salado Creek from the Delta Mendota Canal culvert. During a 100-year storm event Little Salado Creek would experience overtopping at locations where the channel is too narrow and at the culverts conveying flow under the existing airstrip.

To determine the limits of the floodplain, stream and overbank cross sections were developed at intervals sufficient to adequately characterize the flow carrying capacity of the stream and overbanks. AECOM developed cross sections from a topographic survey by the United States Geologic Survey (National Elevation Dataset) augmented by GPS survey points collected during field visits. These additional points were taken at culvert crossings, along the existing channel, and at select roads and railroad locations. These cross sections were used to create the geometry file for the existing conditions floodplain analysis.

At each cross section, Manning’s coefficients were used to define the roughness of the channel and bank. Manning’s values of 0.045 for the channel and overbanks were selected based on USGS recommendations (USGS, 1967), site visits, and site photographs.

In addition to the geometry data file, a HEC-RAS flow file was developed for the unsteady-state flow simulation. An unsteady flow model was required because over-flowing of the channel would occur and the ground continues to slope away from the channel on the right bank. A steady-state model would not allow us the ability to “capture” this flow. An unsteady model allowed us to do this by modeling lateral weirs to allow simulation of the overflowing of the right bank of the on-site channel. The beginning downstream boundary condition was based on the HEC-HMS simulation results.

Appendix E includes existing condition simulation results in the form of cross sections, profiles, and tabulated hydraulic computations. The limits of the existing floodplain matched relatively well with the FEMA defined floodplain as shown on Figure 10.

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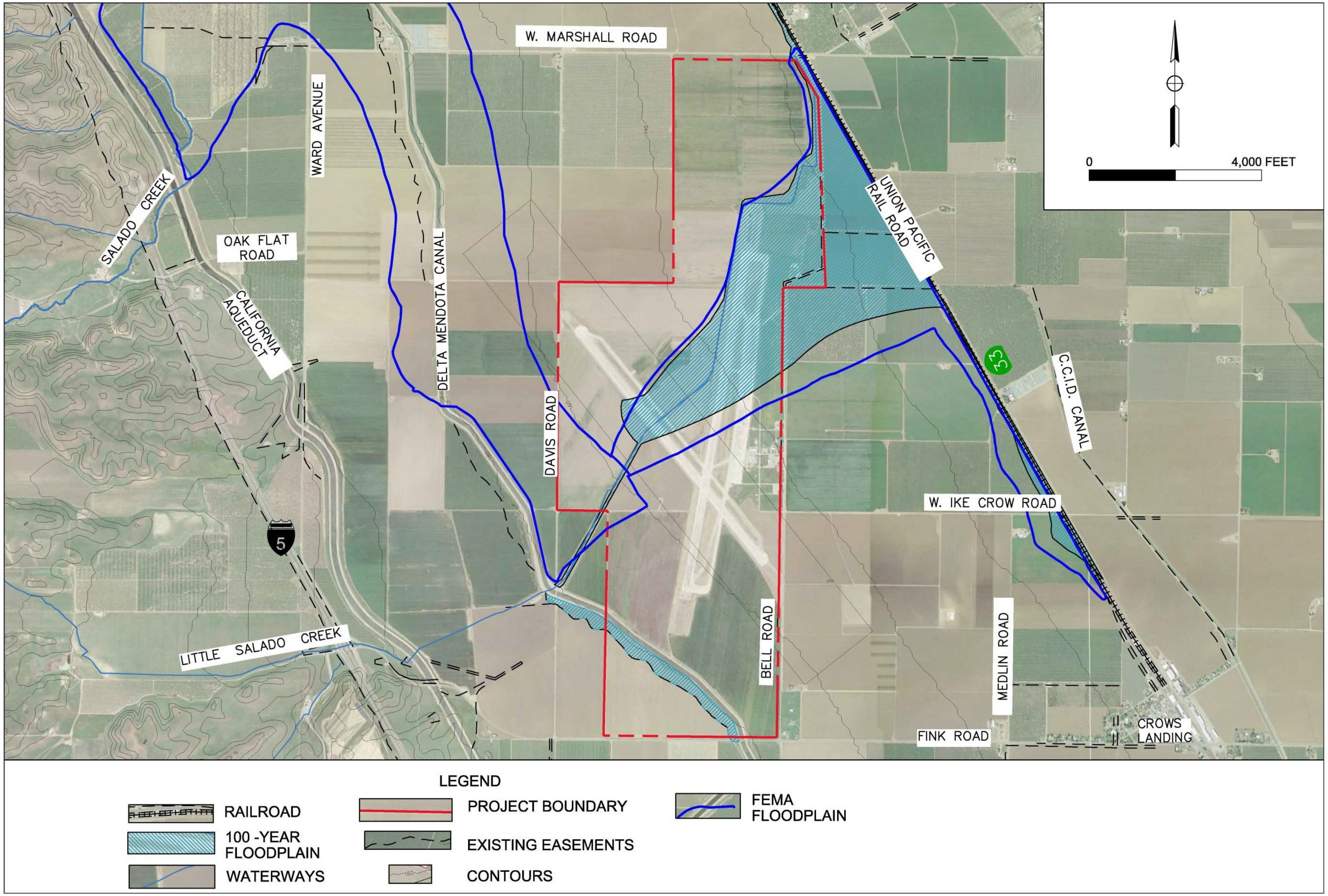

Figure 10 - Floodplain Comparison

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Once water overtops the embankments of the Little Salado Creek it flows northeast until reaching the railroads tracks east of Highway 33. Once the ponding is deep enough, flows both overtop the railroad tracks (flowing northeast east towards the San Joaquin River) and Marshall Road flowing northerly to Patterson.

Proposed Conditions

A hydraulic model was used to simulate the 100-year storm with the project site developed and improvements complete. The model includes hydrologic inputs from HEC-HMS that incorporate site runoff from developing the project area and flood flows that enter Little Salado Creek from the Delta Mendota Canal culvert. In the model the flood flows were conveyed without overtopping Little Salado Creek by widening the channel, reducing vegetation to increase the capacity and reflect better maintenance, and increasing the capacity of the culverts under the runway. The proposed floodplain is shown on Figure 11.

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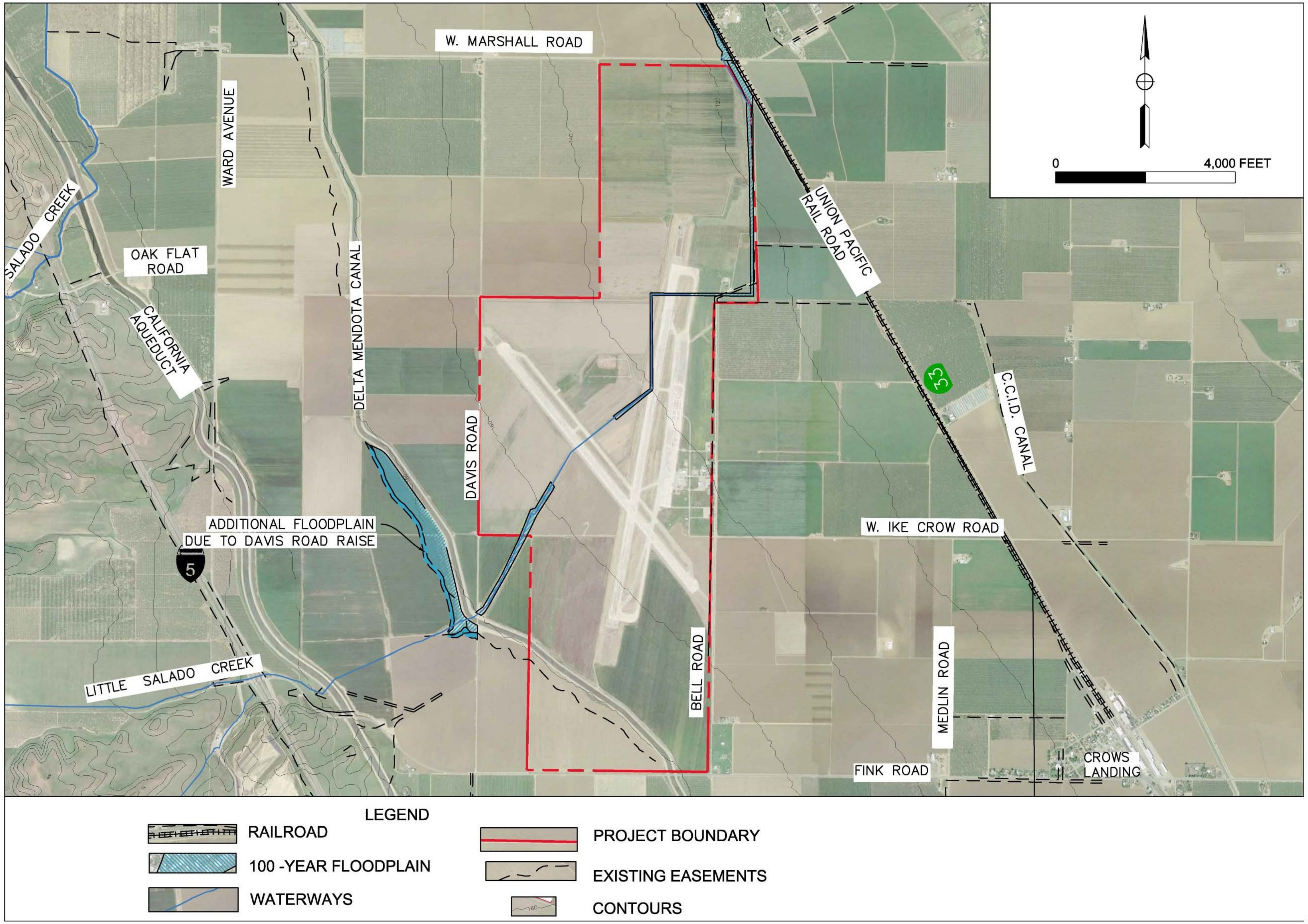

Figure 11 - Proposed FEMA Floodplain

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5. GROUNDWATER RECHARGE

To determine the amount of additional recharge into the shallow aquifer, AECOM utilized average annual discharge at gaging stations on Orestimba and Del Puerto Creeks provided by Jacobson-James and Associates, Inc. The following table shows the results of flow gage records for Del Puerto and Orestimba Creeks:

Watershed	Size (mi^2)	Average Discharge (acre-ft/year)	Discharge Per mi^2 (acre-ft/year)
Del Puerto Creek	73	5,107	70
Orestimba Creek	134	12,348	92
Salado, Little Salado, and Crow Creek	67	5,444	81
Total	**274**	**22,899**	

The estimated discharge near the mountain front from the watersheds of Salado, Little Salado, and Crow Creeks was estimated by taking the average per acre discharge from the other two watersheds and multiplying by the estimated combined area of these watersheds. For little Salado Creek, the calculated average annual discharge using this approach would be 81 acre-ft/year/square mile x 10.8 square miles = 874 acre-ft/year.

Since the goal is to eventually produce up to 489 acre-feet/year a method of capturing and infiltrating this runoff was developed. A proposed dual purpose stormwater pond will be constructed to both infiltrate and detain runoff from Little Solado Creek along Bell Road south of Marshall Road. This pond will have a total capacity of 380 acre-feet; 200 acre-feet of retention storage (for infiltration) in the bottom and 180 acre-feet of detention storage above that. The 200 acre-feet is based on the volume of a 2-year storm which has a 50% chance of being exceeded in any given year. The 180 acre-feet is the necessary volume to attenuate flows downstream. This additional depth of 5-feet in the pond cannot flow out of the pond except by infiltration.

The runoff into the multi-purpose stormwater pond must be drawn down in 48 hours or less due to its proximity to the airplane runway. The existing soils in the area of the multi-purpose stormwater pond (primarily hydrologic soil group C), which tend to not infiltrate quickly, cannot draw down the pond in 48-hours. Therefore, about 20% of the pond bottom will have to be improved to allow infiltration by adding a 24-inch layer of ¾” crushed rock that allows an infiltration rate of ½” per hour.

NOTE: If the County selects an on-site wastewater treatment alternative, one option will be to discharge highly treated effluent to the stormwater pond for infiltration into the upper aquifer. This would require a reevaluation of the area of pond bottom that would receive engineered improvements to enhance infiltration, which could exceed 20% of the pond bottom. This on-site treatment alternative is discussed in the CLIBP Wastewater Master Plan.

6. PHASING COSTS

The overall cost for the backbone infrastructure has been broken-out by phase based on the proposed phasing shown on Figure 12. The proposed detention basin can be constructed in phases starting with Phase 1. Table 7 gives a summary of costs per phase.

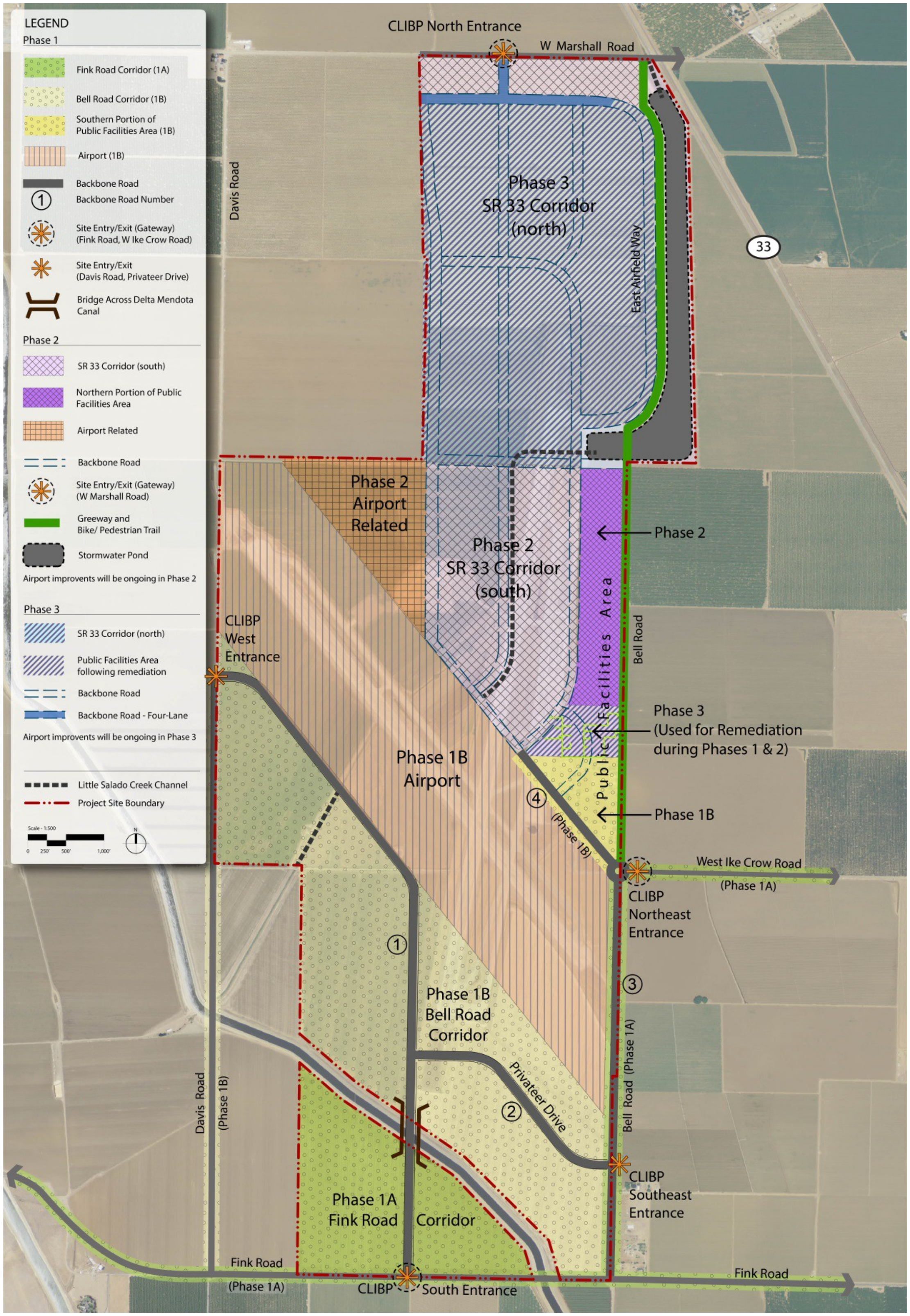

Figure 12 – Phasing Map

Table 7 – Costs by Phase

Phase 1A	Phase 1B	Phase 2	Phase 3	Total
$281,563	$5,539,768	$874,117	$1,014,865	$7,710,313

7. CONCLUSIONS AND RECOMMENDATIONS

Under existing conditions, significant runoff would pond behind the California Aqueduct and then the Delta Mendota Canal, which significantly reduces peak flows reaching the project site. The existing culverts under the runway and the Little Salado Creek channel downstream of the runway do not have capacity to carry the peak flows reaching this area. The Marshall Drain has virtually no capacity. The result is ponded runoff on the project site and eventually runoff is diverted towards Patterson.

Improvements to on-site infrastructure must be made prior to and during leasehold development. All new leasehold development will be required to provide full retention of the 100-year event on-site which will substantially reduce the amount of new runoff due to impervious surfaces. The capacity of the existing culverts that pass beneath the runway must be increased, and the Little Salado channel must be improved. Following these improvements, much more flow will reach the Marshall Drain, and much more runoff would be diverted towards Patterson. To mitigate this increase, either a detention pond or new channel must be constructed.

Prior to any new development, additional design of these improvements needs to be completed and this analysis updated to match the planned improvements. The recommendations in this report are based on preliminary sizing of improvements which in turn are based on preliminary topographic information.

In addition, further topographic survey information for that area between the Delta Mendota Canal and California Aqueduct are recommended to better assess the ponding that would occur from Little Salado and Salado Creek flows that would pond behind the Delta Mendota Canal.

It is not recommended that a CLOMR be pursued at this time. Since only a small portion of the site is in the floodplain and the project can still be permitted without a CLOMR, only a LOMR would have to be processed after the improvements have been made. In addition, since the area west of the Delta Mendota Canal is not shown to be in the floodplain when it should be, processing a CLOMR for this area may be detrimental to the project. The raising of Davis Road west of the Delta Mendota Canal would block runoff from ponding on the project site and allow development on that parcel. However, obtaining FEMA approval for what would essentially act as a levee would require full designs of the road for submittal to FEMA. If Stanislaus County decides to pursue a CLOMR, additional topographic surveys, soils analysis, and design plans would have to be prepared to support the CLOMR.

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