LOWER COSUMNES RIVER FLOODPLAIN RESTORATION PROJECT:

FLOOD MODELING RESULTS

Prepared for:

THE NATURE CONSERVANCY

Prepared by:

ROBERTSON - BRYAN, INC.
Solutions for Progress

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April 2011

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1 INTRODUCTION

1.1 OVERVIEW OF PROPOSED RESTORATION PROJECT

The proposed Lower Cosumnes River Floodplain Restoration Project (Project) is the continuation of floodplain restoration activities by The Nature Conservancy (TNC) and the Cosumnes River Preserve (Preserve) in the lower reaches of the Cosumnes River.

The Project site is located in the lower portion of the Cosumnes River watershed (**Figure 1**), immediately upstream and adjacent to Twin Cities Road. The upstream boundary of the Project is the northern border of the Denier property and the Shaw Forest at river mile (RM) 7.9; the downstream boundary is Twin Cities Road at RM 5.1. The floodplain and riverine habitats in the Project area mark a transition from a region dominated by Delta influences—elevations at or near sea level, very low channel and floodplain gradients, and year-round tidal influences—to an area with a dominant seasonal flow pattern and higher channel and floodplain gradients. The tidal influence of the Delta extends to RM 4.5 on the Cosumnes River, which is only 0.6 mile from the downstream boundary of the Project.

The Project area—the primary channel of the Cosumnes River, several historical secondary channels, adjacent agricultural areas, and remnant Valley oak riparian forest—presents an opportunity to re-establish a flood pattern that will support the restoration of approximately 600 acres of habitat by breaching sections of existing levees.

Under existing conditions, an intact levee system protects the Project area from flooding at flows below approximately 8,000–10,000 cubic feet per second (cfs) at the Project site[1]—a 2.3- to 2.9-year return frequency. These levees also impair the flow of floodwater from the floodplain back into the river.

This restoration Project proposes removing approximately 2,700 feet of existing levee from four locations, transitioning the slope from the river channel to the floodplain elevation in two locations, and excavating drainage swales in one location. The proposed levee removals and slope transitions would allow flooding in the Project area to occur at 3,000 cfs—a 1.5-year return frequency. The proposed drainage swales would improve the drainage of floodwater from the floodplain and thereby reduce the potential of fish stranding.

The potential of re-establishing a suitable (i.e., more frequent) connection between the Cosumnes River and its floodplain was evaluated using a two-dimensional flood routing model – FLO-2D.

[1] In this report all references to flow rates necessary to inundate key Project locations at the Project site refers to flows in the Cosumnes River at Michigan Bar combined with estimated flows in Deer Creek and Badger Creek.

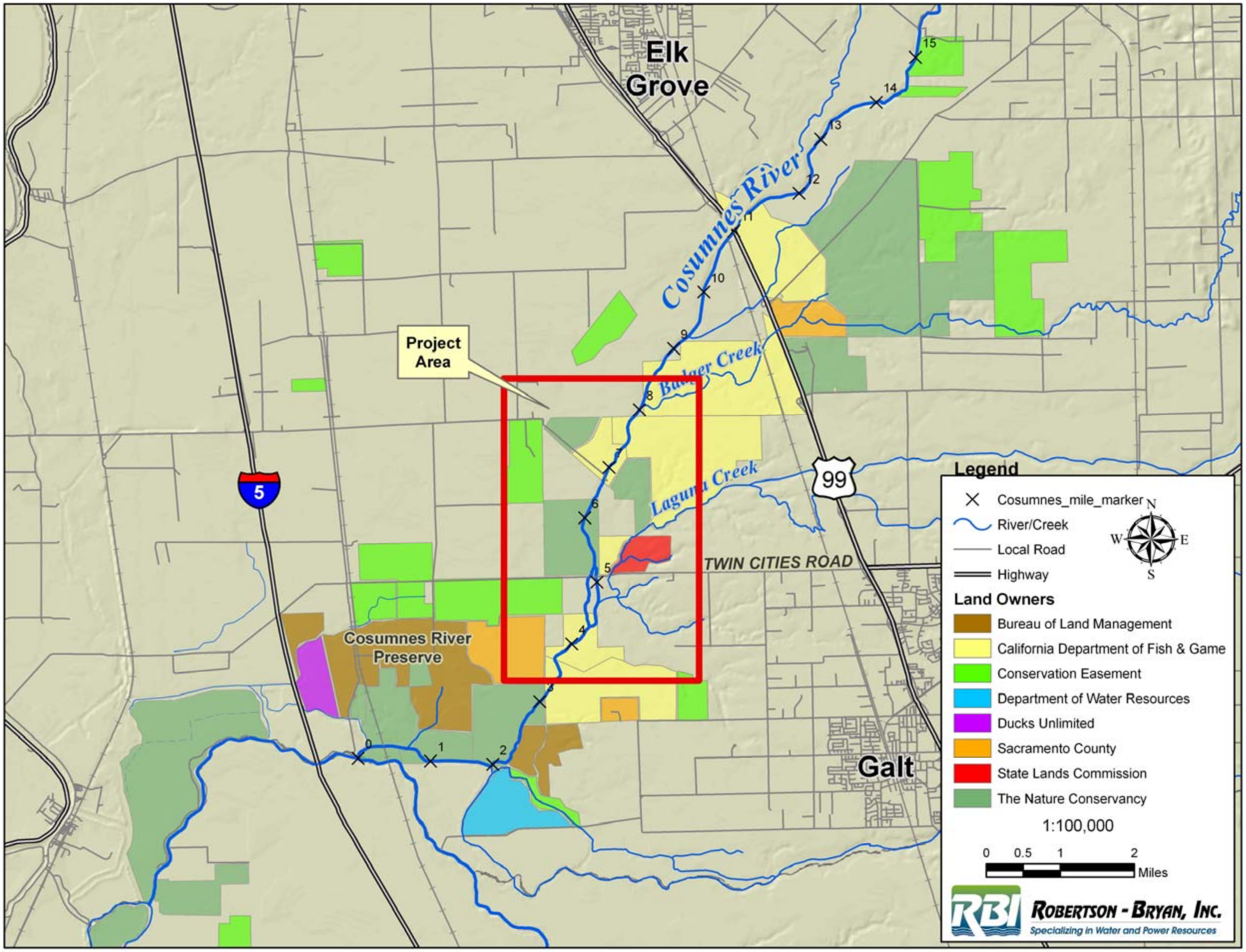

Figure 1. Location of the Project Area.

The Project model covers 10.4 square miles of floodplain and 5 miles of river channel and provides a platform for establishing the Project area flood pattern under existing conditions and potential project conditions. Alternative Project scenarios were developed with varying configurations of levee breaches and potential restoration actions, with the goal of effecting more frequent flooding of the Project area floodplain.

1.2 FLOODPLAIN RESTORATION PLANNING EFFORTS

In 1995, the Preserve partners launched an ambitious, multi-faceted program of restoration in the bottomlands of the lower Cosumnes River. The effort capitalized on land acquisition over the previous decade, beginning with TNC's first acquisition in 1984, which created opportunities for large-scale restoration activities. The effort drew upon best available science and brought in important new partners. Efforts to date have resulted in the hydrologic reconnection of approximately 1,200 acres of seasonal wetlands, breaching or removal of approximately 6 miles of levees, and initiation of natural reforestation processes on 300 acres of historic floodplain. These efforts were closely coordinated with private landowners adjacent to the Preserve and demonstrate the range of values associated with floodplain restoration, including the practical benefit of increasing flood storage and reducing flood stages on the Cosumnes River and providing seasonal floodplain habitat for a range of native species.

Since completion of initial restoration efforts, the Preserve partners have acquired additional properties in the lower Cosumnes floodplain. A significant portion of this acreage is in the bottomlands of the river corridor, with a unique combination of soils and elevations suitable for floodplain wetlands and riparian forest restoration, if a natural flood regime can be restored by breaching or removing levees.

Three properties, owned by Preserve Partners, are integral to the Project (**Figure 2**):

- 491-acre Denier II property, acquired by TNC in 2000
- 319-acre Oneto Horseshoe property, acquired by TNC in 2007
- 223-acre Shaw Central property, acquired by DFG in 1998

These three properties contain the primary Cosumnes River channel, several historical secondary channels, active agricultural areas, and remnant Valley oak riparian forest. Collectively, these properties present an opportunity to re-establish a flood pattern that will support the restoration of approximately 1,000 acres of habitat by breaching sections of existing levees and transitioning the slope from the river to the floodplain.

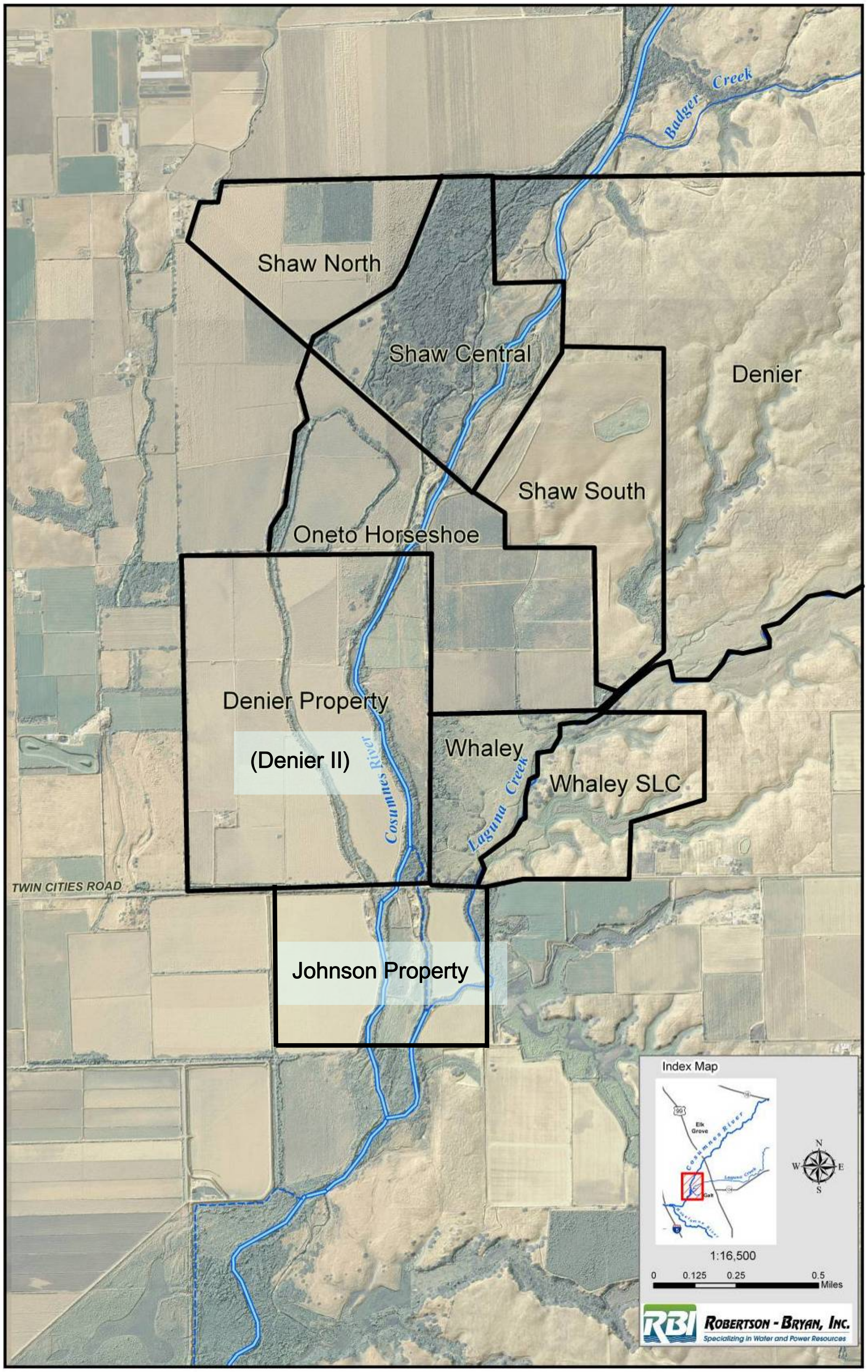

Figure 2. Properties within and adjacent to the Project area.

Following acquisition of the key properties by TNC and DFG, initial planning and modeling efforts were completed between 2004 and 2008 using resources from the CALFED-funded Cosumnes and Mokelumne Rivers Floodplain Integrated Resources Management Plan (Management Plan) process. The purpose of the Management Plan was to evaluate the feasibility of implementing floodplain improvement projects that provide flood management, ecosystem restoration, and groundwater recharge opportunities along the lower Cosumnes and Mokelumne rivers.

The vision for this Project was generated from efforts by the Management Plan's Confluence Reach Focus Group, which consisted of stakeholders from the lower reach of the Cosumnes River. The Focus Group's primary goal for the Confluence Reach was to re-establish floodplain inundation and channel-floodplain connectivity of sufficient frequency, timing, duration, and magnitude to support the restoration and maintenance of functional natural floodplain, riparian, and riverine habitats. Initial planning efforts focused on modeling various Project elements to determine the most efficient methods for increasing inundation of the Project area by reducing flood return frequency.

1.3 Key Project Locations and Intended Restoration Actions

The majority of the Project area has historically supported agricultural practices, including row crops and vineyards. Agriculture in the floodplain necessitated the construction of levees to protect agricultural operations from flooding when the Cosumnes River overtops its banks. As a result, levees are the dominant landform features in the Project area that influence the potential restoration of floodplain function. **Figure 3** shows the locations of all levees in the Project area. Figure 3 also shows the key locations within the Project area and introduces the restoration actions. The restoration actions are those that will be implemented as a means to reconnect the river to its floodplain at a lower recurrence interval. The key locations and intended restoration actions are described in detail in the following sections.

Shaw Forest

Beginning at the upstream boundary of the Project area, the Shaw Forest is the dominant landscape feature. The Shaw Forest is a prime example of Central Valley Valley Oak riparian forest and one of the largest remnant stands on the Cosumnes River.

There are no constructed levees between the Shaw Forest and the Cosumnes River and under current conditions the forest regularly floods at flows of 7,000 cfs or greater. Light Detection and Ranging (LIDAR) imagery show several secondary channels that convey flood flows through the forest. The most prominent channel begins near the upstream boundary of the forest. This channel is nearly at-grade with the Cosumnes River and conveys water into the interior of the forest, where the channel branches into smaller channels.

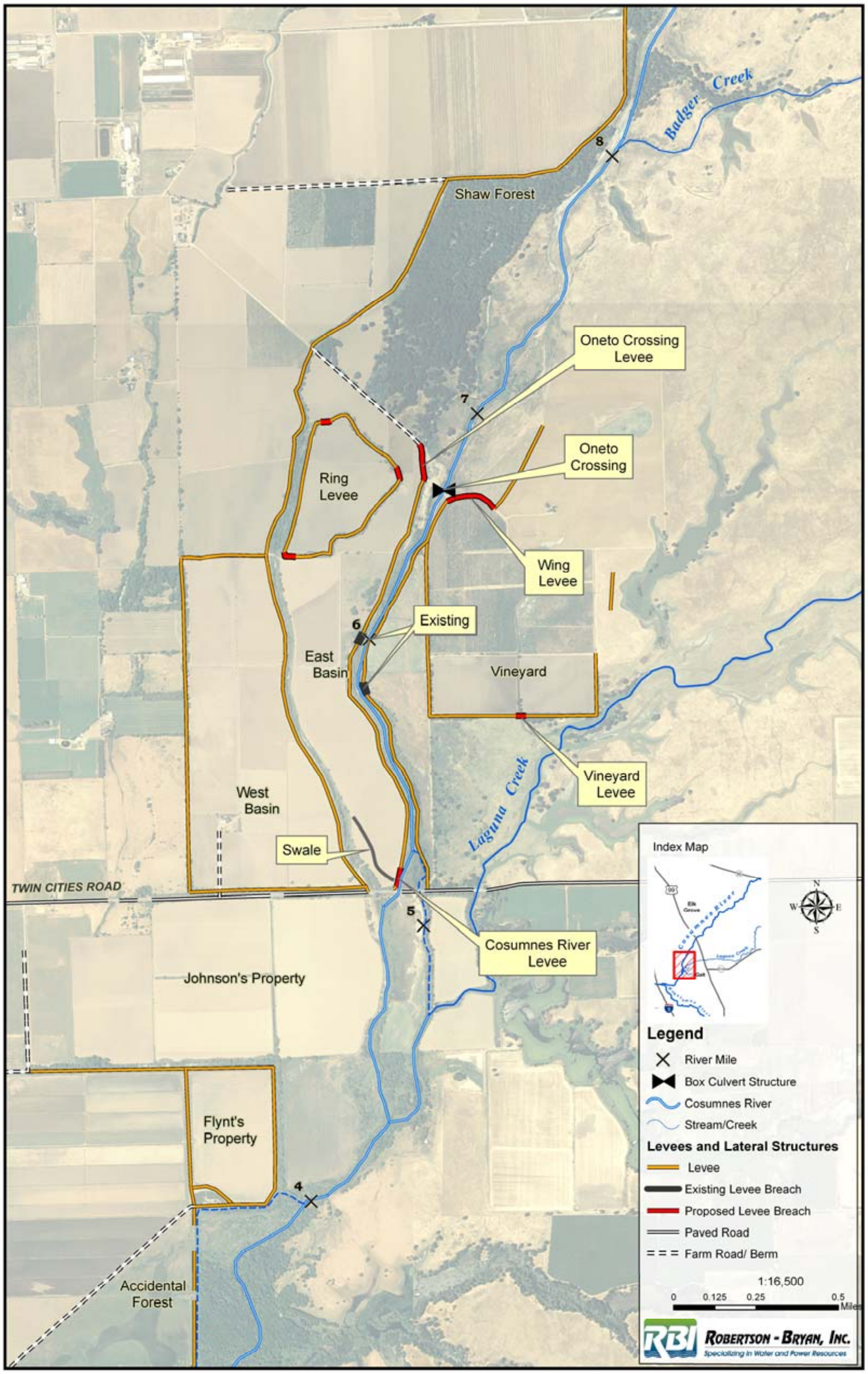

Figure 3. Key Project locations and Intended Restoration Actions in the Project area.

Another secondary channel, which can be seen in the LIDAR imagery, exists along the eastern boundary of the forest. During moderate flood events, typically 7,000 to 10,000 cfs, this channel conveys water from the downstream forest boundary, up gradient into the forest interior. This reverse flow is caused by a backwater effect from the Cosumnes River channel, partially created by the Oneto Crossing—a concrete crossing of the Cosumnes River channel located just downstream of the Shaw Forest (Figure 3).

No construction activities are planned for the Shaw Forest.

Oneto Crossing Levee

Levees upstream of the Oneto Crossing protect agricultural fields in the East Basin. These levees are approximately 4 feet above the natural channel bank, 16 feet above the channel bottom, and set back from the channel by 200–700 feet. Restoration of the East Basin floodplain is one of the primary objectives of the Project. Restoration of this floodplain basin will require eliminating agricultural practices, establishing a more frequent flood pattern, and improving drainage. Increasing the flood frequency to a 1.4-year interval (or 3,000 cfs) will support riparian forest restoration efforts in the floodplain.

The proposed Project will improve flooding of the East Basin to a 1.4-year recurrence by removing 1,200 feet of levee on the right bank of the Cosumnes River above the Oneto Crossing and transitioning the slope from the river channel to the floodplain by removing sediment that was deposited because of the levee. These actions will allow floodwater to enter the Ring Levee area and the East Basin.

Ring Levee

The Ring Levee area includes the Oneto Horseshoe property and a unique feature known as the Ring Levee. The Ring Levee is located in the floodplain immediately below Shaw Forest and at the top of the East Basin (Figure 3). This unique levee feature is covered with large mature Valley oaks. The original purpose and use of the levee is unknown, other than it provides some flood protection to the interior, which has historically been farmed in row crops. The Ring Levee offers topographic diversity to this portion of the floodplain that has otherwise been leveled for agricultural purposes. The mature Valley oaks on the levee provide important habitat in the floodplain and offer a potential source of recruitment for riparian species.

In its current configuration, the Ring Levee floods at flows above 8,000 cfs. Flood flows reaching the Ring Levee generally enter the floodplain via the two Shaw Forest secondary channels. The interior of the Ring Levee is flooded from the northwest corner, through a low point in the levee. Floodwater leaves the interior of the Ring Levee through a low point at the southwest corner.

A goal of the Project is to increase the flooding frequency of the area interior to the Ring Levee to a 1.5-year recurrence interval or less by constructing 100-foot breaches at three locations — the northwest corner, the northeast corner, and the southwest corner. The breaches on the north side will allow floodwater to enter the interior of the Ring Levee at flows as low as 3,000 cfs. The single breach on the south side of the Ring Levee will allow water to drain from the interior of the ring into the East Basin.

Vineyard and East Floodplain

The Vineyard and East Floodplain are located on the east side of the Cosumnes River. These floodplains are separated from the river by a series of levees that protect the agricultural areas east of the river from flows below 3,000 cfs. The 125-acre Vineyard area is surrounded on the north, west, and south sides by levees (Figure 3). The east side of the Vineyard abuts a large track of upland habitat. Laguna Creek passes along the southeast corner of the Vineyard. The levees to the south and east of the Vineyard protect the area from high flows spilling out of the creek.

The East Floodplain covers the area from the northern border of the Vineyard downstream to Twin Cities Road (Figure 3). A levee along the eastern bank of the Cosumnes River separates the river from the floodplain, which consists of riparian trees, shrubs, and grasslands. This levee is breached at RM 5.9, which has lead to the formation of a large sand splay in the floodplain. Floodwaters draining from the East Floodplain re-enter the east channel of the Cosumnes River split above Twin Cities Road.

The proposed Project would remove 800 feet of the existing eastern levee above the Oneto Crossing that protects the Vineyard and East Floodplain from flows below 8,000 cfs. Removing this levee accomplishes two goals. First, it improves the movement of flood flows through the Eastern Floodplain area and, second, it reduces the volume of floodwater entering the East Basin on the opposite side of the river. Reducing the volume of water entering the East Basin would reduce the potential for overtopping the interior levee that separates the East and West basins. Flooding of the Vineyard and the East Floodplain would still occur at approximately 8,000 cfs in the proposed Project. 200 feet of levee on the southern side of the vineyard would also be removed to drain back the floodwater back into the Cosumnes River.

Cosumnes River Levee

The Cosumnes River is leveed on both the east and west sides of the river downstream of the Oneto Crossing to Twin Cities Road. The capacity of this river reach is limited to 4,500 cfs due to two existing levee breaches—one on the east side at RM 6.0 and one on the west side at RM 5.9 (Figure 3).

The Proposed Project will remove a 200-foot section of levee on the west side of the Cosumnes River near Twin Cities Road to allow floodwaters to drain from the East Basin back into the Cosumnes River after floodplain inundation occurs.

East Basin

Restoration of the East Basin floodplain is one of the primary objectives of the Project. Upon removal of the Oneto Crossing Levee and subsequent grading, floodwaters will flow into the East Basin on a 1.4-year recurrence interval. However, initial modeling data showed that floodwaters, once in the East Basin, would not easily drain back into the Cosumnes River. The 200-foot levee breach on the west side of the Cosumnes River will facilitate some East Basin drainage, but initial modeling efforts determined that constructing swales will further facilitate floodplain draining, thus alleviating fish stranding and mosquito abatement concerns.

The Proposed Project will construct a 900 foot swale in the East Basin to facilitate drainage following inundation events.

West Basin

The West Basin is separated from the East Basin by an interior levee that provides additional protection from flooding. The West Basin begins to flood when the Cosumnes River reaches approximately 10,000 cfs; however, in order for the West Basin to flood, flows must be sustained at that magnitude for more than a day, which provides the necessary volume of water in the floodplain needed to backwater flows from the Johnson property located south of Twin Cities Road or overtop the existing low points in the interior levee.

A low-lying berm, approximately 1.5-2 feet in elevation, is located on the northern boundary of the West Basin. The landowner to the north of the West Basin plans to increase the height of this berm by 1.5 feet as a means to provide additional protection to the agricultural area north of the West Basin. Due to the fine-scale limitations of the LIDAR elevation data, which was used to establish floodplain elevations in the FLO-2D grid system, the height of this berm is shown in the existing conditions model parameters to range from 2.5–3.5 feet in elevation. Therefore, because the final berm height is expected to be between 3–3.5 feet no modifications to the berm elevation was made for the purposes of running the project conditions events.

No construction actions are planned for the West Basin, other than landowner modifications to the low-lying berm located north of the West Basin and restoration plantings.

2 RE-ESTABLISHING FLOODPLAIN FUNCTION

2.1 OVERVIEW OF FLOODPLAIN MODELING

The potential of re-establishing a suitable (i.e., more frequent) connection between the Cosumnes River and its floodplain in the Project area was evaluated using a two-dimensional flood routing model – FLO-2D. The Project model covers 10.4 square miles of floodplain and 5 miles of river channel and provides a platform for evaluating the flood pattern of the Project area under existing conditions and potential project conditions.

2.2 FLO-2D MODEL

The FLO-2D model is a suite of programs consisting of a two-dimensional flood routing model that numerically routes a flood hydrograph over a system of square-grid elements while predicting the area of inundation and simulating flood wave attenuation. The model is effectively used for analyzing river overbank flows and also to analyze unconventional flooding problems such as unconfined flows over complex alluvial fan topography, split channel flows, mud flows, and urban flooding.

Channel flow in FLO-2D is simulated one-dimensionally with the channel geometry represented either by naturally shaped, rectangular, or trapezoidal cross sections. The equation of motion is solved by computing the average flow velocity across a grid element boundary one direction at a time. FLO-2D is on FEMA's list of approved hydraulic models for riverine and unconfined alluvial fan flood studies. It is being used by a number of federal agencies, including the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Geological Survey (USGS), National Resource Conservation Service, U.S. Fish and Wildlife Service, and the National Park Service. Please refer to the FLO-2D user's manual for a detailed description of the input parameters required and theoretical assumptions and limitation of the FLO-2D model (FLO-2D Version 2004.10, October 2004).

The topography for the FLO-2D model of the Project area is established using LIDAR data developed by UC Davis. The LIDAR data provides enhanced topographic resolution relative to readily available USGS data. The 1-meter resolution LIDAR dataset forms the basis for establishing floodplain elevations into the FLO-2D computational grid system. The total number of grid elements within the computation grid of the model is a key factor in producing a stable model and in optimizing the model run time.

After testing the model for various grid sizes, a 100-by-100-foot grid size was selected, which optimizes model run time while providing a sufficient level of elevational detail needed for the purposes of this evaluation. Channel cross-section geometry is also extracted from the LIDAR dataset at multiple locations along the Cosumnes River and Laguna Creek. These cross-sections are used in the FLO-2D channel flow routine.

The split channel of Cosumnes River at Twin Cities Road was considered as a single combined channel with an enlarged cross-section to maintain the same channel capacity as the two separate channels. Laguna Creek and Badger Creek inflows were included in the model by developing a correlation to Cosumnes River flows using HEC-1 data provided by David Ford Engineers (2004). Levees along the Cosumnes River were identified from aerial photographs and the locations of levees were verified by field visits. Elevations of these levees were extracted from the LIDAR dataset and input into the model.

2.3 FINAL PROJECT SCENARIO

Prior to developing the final Project scenario, four alternative Project scenarios were developed and evaluated. These alternative Project scenarios were discussed in detail in the "**Lower Cosumnes River Floodplain Restoration Project**" report submitted by RBI as a part of "**Cosumnes and Mokelumne Rivers Floodplain Integrated Resources Management Plan**" in April 2008. Among the proposed restoration actions eliminated from future consideration were removing the entire Vineyard and east Floodplain levee, raising the levee that separates the East and West basins by 15–20 feet, breaching the southern levee of the West Basin, and constructing drainage swales on the Johnson's property.

Upon review of the four alternative Project scenarios modeling results, a final Project scenario was selected based on establishing connectivity between the river and its floodplain at a lower recurrence interval (i.e., 1.5 year) while not creating impacts to neighbors and local infrastructure. The final Project scenario includes the following restoration actions, which upon implementation will allow floodplain inundation at lower recurrence intervals:

- **Oneto Crossing Levee -** Removing 1200 feet of the right bank Oneto Levee and transitioning the slope from the river to the floodplain
- **Vineyard and East Floodplain -** Removing 800 feet of the left bank Oneto Crossing Levee and 200 feet of levee on south side of the vineyard
- **Ring Levee -** Constructing three 100-foot breaches in the Ring Levee
- **Cosumnes River Levee -** Breaching 200 feet of levee along the lower Cosumnes River just above Twin Cities Road
- **Floodplain Swale -** Constructing a 900 foot drainage swale in the East Basin to facilitate drainage of floodwaters back into the Cosumnes River

The FLO-2D model incorporated the above restoration actions for simulation in the Project conditions modeling.

3 3.5-YEAR FLOOD MODELING

3.1 EXISTING CONDITIONS MODELING AND MODEL CALIBRATION

The FLO-2D model was calibrated with the physical conditions in the Project area on March 23, 2005, when the Cosumnes River experienced an instantaneous peak flow of 12,800 cfs (3.5-year return frequency). Laguna Creek and Badger Creek inflows were included in the model by developing a correlation to Cosumnes River flows using HEC1 data provided by David Ford Engineers during their *Design Storm Runoff Analysis for Cosumnes and Mokelumne River watersheds (2004)*. Physical features of this model include two levee breaches on the Denier II Property—one into the East Basin and one into the East Floodplain (Figure 3).

Model results for the existing conditions indicated that the floodplain area between the Cosumnes River and Laguna Creek downstream of Twin Cities Road starts flooding at approximately 3,000 cfs. At approximately 4,000 cfs, the Cosumnes River starts to flow into the Shaw Forest channel at a location approximately 0.25 miles upstream of the Oneto Crossing; however, Shaw Forest does not experience overland flooding until the Cosumnes reaches approximately 7,000 cfs. The floodplain outside the Ring Levee starts to flood at 8,000 cfs. The Ring Levee floods after a sustained flow of 8,000 cfs for more than 6 hours, which creates the floodwater volume necessary to overtop low points in the Ring Levee. The East Basin also begins to flood at about 8,000 cfs, and holds floodwater for a considerable period before the interior levee, between the East and West basins, is overtopped, and floodwater enters the West Basin.

Calibration of the model was based on comparison of model generated inundation maps and aerial photographs taken the day after the peak flow. Overall, the model showed good results, accurately representing the extent of flooding in the Project area. No high-water surveys were available to numerically validate the modeling results. **Appendix A** provides inundation maps for the Existing Condition model simulation.

3.2 PROJECT CONDITIONS MODELING

Using the restoration actions described in Section 2.3, the Project conditions were modeled using the 3.5-year hydrology. The model results indicated that removal of the Oneto Levee and transitioning the slope from the river to the floodplain allowed floodwater to enter the floodplain adjacent to the Ring Levee at approximately 3,000 cfs (i.e., at a 1.5 year recurrence interval) as compared to approximately 8,000 cfs during existing conditions. The breaches on the north side of the Ring Levee allow floodwater to inundate the interior of the Ring Levee at flows as low as

3,000 cfs. Removing 800 feet of the left bank Oneto Crossing Levee allows the vineyard to flood at approximately 8,000 cfs. The levee breach and the floodplain swale at Twin Cities Road allow floodwater to backwater into the East Basin at flows as low as 3,000 cfs.

The single breach on the south side of the Ring Levee allows water to drain from the interior of the ring into the East Basin. As the flood recedes, the levee breach at Twin Cities Road and drainage swale allow floodwater to drain the East Basin, which significantly reduces the potential for creating fish stranding conditions in the floodplain.

In general, compared to existing conditions, the 3.5-year Project conditions modeling results show that the Project site floods up sooner and drains faster but the area of flooding and maximum depths remains approximately the same.

Appendix B provides inundation maps for the 3.5-year Project conditions model simulation.

4 10-YEAR FLOOD MODELING

4.1 10-YEAR HYDROLOGY

The Cosumnes River experienced an approximate 10-year flood event on April 4, 2006, with an instantaneous hourly peak of 32,600 cfs at Michigan Bar after receiving approximately 4.5 inches of rain. USGS maintains the stage gauge at Michigan Bar. Average daily flows at this gauge are available since October 1, 1907, and hourly flows are available from January 1, 1984. Hourly flow data at Michigan Bar during this flood event was used to estimate flows in Deer Creek, Laguna Creek and Badger Creek using the flow correlation to Cosumnes River developed by David Ford Engineers (2004). **Figure 4** shows the flows in the Cosumnes River (including Deer Creek), Laguna Creek, and Badger Creek used for the 10-year flood event modeling.

Events less than a 10-year return period generally confine themselves to the channelized areas upstream of Highway 99; accordingly the translation of the Michigan Bar hydrograph to this region may slightly overestimate peak conditions, but generally represent the 10-year recurrence conditions.

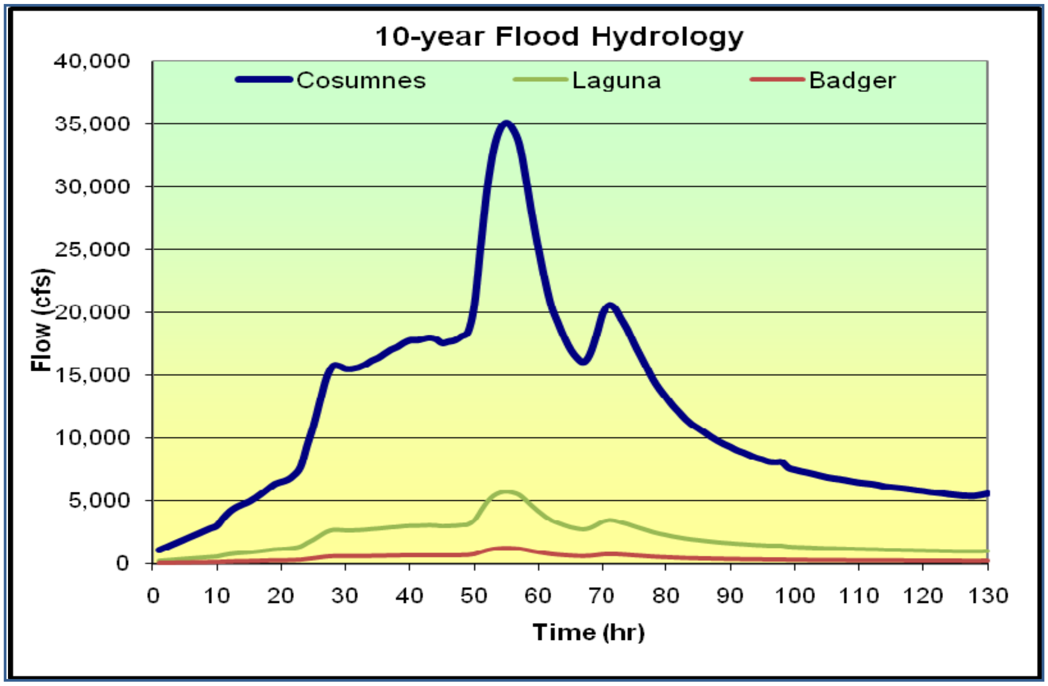

Figure 4. Cosumnes River, Laguna Creek, and Badger Creek Flows during the 10-year flood event.

4.2 EXISTING CONDITIONS MODELING

With the physical conditions in the Project area used during the model calibration, FLO-2D model was executed for the 10-year flood event. The simulation covered the 10-year, 130-hour event with results in and around the Project area displayed in three snapshots for:

- Peak flow
- Moment of largest areal flooding
- When most of the flood has receded

Peak Flow

This snapshot was taken at hour 55 when flow in the Cosumnes River is approximately 35,100 cfs. The extent of flooding at this hour is shown in **Figure 1 of Appendix C**. The model indicated that by hour 55, the whole Project area is inundated with water depths ranging from 8 to 12 feet in Ring Levee, East Basin, West Basin, and Johnson's property.

Moment of Largest Areal Flooding

This snapshot was taken at hour 67, when flow in the Cosumnes River is receding and is approximately 16,000 cfs. The extent of flooding at this hour is shown in **Figure 2 of Appendix C**. The model indicated that by this time the whole Project area is inundated with slightly greater water depths than observed at the time of peak flow (hour 55) ranging from 9 to 14 feet in Ring Levee, East Basin, West Basin, and Johnson's property.

Receding Hydrograph

This snapshot was taken at the end of the hydrograph at hour 130, when flow in the Cosumnes River has receded to approximately 5,600 cfs. The extent of flooding at this hour is shown in **Figure 3 of Appendix C**. The model indicated that by this time water in the floodplain has been draining back into the river and the water levels have receded to 7 to 11 feet in Ring Levee, East Basin, West Basin, and Johnson's property.

4.3 PROJECT CONDITIONS MODELING

We evaluated three snapshots of the simulation for the same moments of time as described for existing condition.

Peak Flow

This snapshot was taken at hour 55 when flow in the Cosumnes River is approximately 35,100 cfs. The extent of flooding at this hour is shown in **Figure 4 of Appendix C.** As observed during the existing conditions, the model indicated that by this time the entire Project area is inundated, with water depths ranging from 8 to 12 feet in Ring Levee, East Basin, West Basin, and Johnson's property, the same as existing condition.

Moment of Largest Areal Flooding

This snapshot was taken at hour 67 when flow in the Cosumnes River is receding and is approximately 16,000 cfs. The extent of flooding at this hour is shown in **Figure 5 of Appendix C**. The model indicated that, as observed during existing conditions, the entire Project area is inundated with slightly greater water depths than at the time of peak flow (hour 55), ranging from 9 to 14 feet in Ring Levee, East Basin, West Basin, and Johnson's property, the same as existing condition.

Receding Hydrograph

This snapshot was taken at the end of the hydrograph at hour 130 when flow in the Cosumnes River has receded to approximately 5,600 cfs. The extent of flooding at this hour is shown in **Figure 6 of Appendix C**. The model indicated that the water levels has receded to 6–9 feet in Ring Levee, East Basin, West Basin, and Johnson's property, which are lower than the water depths during existing conditions. This is due to floodwater draining back into the river through the swale created in East Basin and the breach in the Cosumnes River levee.

4.4 SUMMARY OF 10-YEAR MODELING RESULTS

Results of the 10-year modeling shows that floodwater enters and exits the floodplain in the same locations and at the same flow rates as described in the 3.5-year modeling results but that the volume of water in the 10-year event inundates the floodplain for a longer period of time and at depth much greater than during the 3.5-year event. In general, compared to existing conditions, the 10-year Project conditions modeling results show that the Project site floods sooner and drains faster, but the area of flooding and maximum depths remains approximately the same.

5 CONCLUSION

The FLO-2D model was used to evaluate the potential of re-establishing a connection between the Cosumnes River and its floodplain in the Project area. The goal of achieving more frequent flooding of the Project area floodplain, ideally at a recurrence interval of every 1.5 years, or approximately 3,000 cfs, can be achieved by implementing the restoration actions described in Section 2.3 above. Also, by closely comparing the 3.5-year and 10-year modeling results to existing conditions, it can be concluded that the area of flooding and the peak water depths does not change when modeling Project conditions for the 3.5-year and 10-year hydrology; however, the Project area does inundate sooner (i.e., at lower flows) and drains quicker under Project conditions, as compared to existing conditions.

6 REFERENCES

David Ford Consulting Engineers. 2004. *Cosumnes and Mokelumne River watersheds – Design storm runoff analysis.* Prepared for Sacramento County Department of Water Resources.