2 ALTERNATIVES

2.1 INTRODUCTION

As noted in Chapter 1, "Introduction and Statement of Purpose and Need," this EIS/EIR has been prepared to evaluate the potential environmental impacts of the Phase 4b Project, and will be submitted to Congress in late 2010 to support approval of USACE's American River Watershed Common Features Project/Natomas Post-authorization Change Report (Common Features/Natomas PACR), which is an element of the American River Watershed Common Features Project General Re-evaluation Report (Common Features GRR). The Common Features/Natomas PACR includes all four project phases (1, 2, 3, and 4a, and 4b) of the Landside Improvements Project, which is a component of the Natomas Levee Improvement Program (NLIP). These project phases are summarized in Section 1.5, "Environmental Regulatory Framework and Relationship of this EIS/EIR to Other Documents." This EIS/EIR summarizes prior environmental analyses for all previously approved project phases, as well as previously released public draft documents of the Landside Improvements Project, and evaluates in detail the environmental effects of the proposed Phase 4b Project. This information will then become part of the overall request for Congressional review and approval of the Common Features/Natomas PACR.

This EIS/EIR evaluates the potential project-level impacts on the environment from implementation of the Phase 4b Project (Proposed Action/Proposed Project), hereinafter referred to in this chapter as "the project." This chapter describes the alternatives that were considered to provide additional flood risk reduction to the Natomas Basin consistent with the objectives in Chapter 1, "Introduction and Statement of Purpose and Need." The Phase 4b Project builds upon a program of improvements analyzed in previous environmental documents for achieving flood risk damage reduction for the 53,000-acre Natomas Basin, which is encircled by 42 miles of levees (**Plate 1-1**). Although they provide contrasting advantages and disadvantages, each of the action alternatives is considered feasible for the purpose of analysis based on relevant economic, environmental, social, technological, and legal factors. Three alternatives are evaluated at an equal level of detail in this EIS/EIR:

- No-Action Alternative,
- Adjacent Levee Alternative (Proposed Action), and
- Fix-in-Place Alternative.

These alternatives represent a reasonable range of alternatives, consistent with the requirements of NEPA and CEQA and when considered in the context of prior alternatives analyses described in previous environmental documents and which are incorporated by reference in this EIS/EIR (see **Appendix B1**). The action alternatives under consideration have been formulated to feasibly accomplish the primary objectives of the project as discussed in Chapter 1, "Introduction and Statement of Purpose and Need," of this EIS/EIR, which includes reducing the risk of flooding to the Natomas Basin. The action alternatives include components that could avoid or substantially lessen one or more of the project's significant effects.

2.1.1 NEPA/CEQA REQUIREMENTS FOR EVALUATION OF ALTERNATIVES

2.1.1.1 NEPA REQUIREMENTS

The NEPA Council on Environmental Quality Regulations (40 Code of Federal Regulations [CFR] Section 15012.14) require that an EIS include:

- an objective evaluation of reasonable alternatives;

- identification of the alternatives considered but eliminated from detailed study, along with a brief discussion of the reasons that these alternatives were eliminated;

- information that would allow reviewers to evaluate the comparative merits of the proposed action (i.e., proposed project) and alternatives;
- consideration of the no-action alternative;
- identification of the agency's preferred alternative, if any; and
- appropriate mitigation measures not already included in the proposed action or alternatives.

NEPA requires the analysis of the proposed action and of all alternatives at a substantially similar level of detail. The Council on Environmental Quality Regulations (40 CFR Section 1502.14) require agencies to rigorously explore and objectively evaluate all reasonable alternatives and to devote substantial treatment to each alternative considered, including the proposed action. All alternatives considered, including the preferred alternative, must be evaluated compared to the No-Action Alternative (future without project).

2.1.1.2 CEQA REQUIREMENTS

The California Code of Regulations (CCR) Section 15126.6(a) of the State CEQA Guidelines requires that an EIR:

(1) describe a range of reasonable alternatives to a proposed project, or to the location of the project, that would feasibly attain most of the basic project objectives but would avoid or substantially lessen any of the significant effects of the project; and

(2) evaluate the comparative merits of the alternatives.

An EIR need not consider every conceivable alternative to a proposed project, but must consider a range of reasonable, potentially feasible alternatives that will foster informed decision making and public participation.

The range of alternatives required to be evaluated in an EIR is governed by a "rule of reason" that requires the EIR to consider only those alternatives necessary to permit a reasoned choice. The EIR need examine in detail only those alternatives that the lead agency determines could feasibly attain most of the basic project objectives, taking into account factors that include site suitability; economic viability; availability of infrastructure; general plan consistency; other plans or regulatory limitations; jurisdictional boundaries; and whether the proponent can reasonably acquire, control, or otherwise have access to an alternative site (State CEQA Guidelines CCR Section 15126.6[f]). CEQA does not require the alternatives to be evaluated at the same level of detail as the proposed project.

The State CEQA Guidelines recommend that an EIR should briefly describe the rationale for selecting the alternatives to be discussed, identify any alternatives that were considered by the lead agency but were eliminated as infeasible, and briefly explain the reasons underlying the lead agency's determination (State CEQA Guidelines CCR Section 15126.6[c]).

An EIR must also evaluate a "no-project" alternative, which represents "what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services" (State CEQA Guidelines CCR Section 15126.6[e][2]). Under CEQA, the no-project alternative, like all of the alternatives, is compared to the proposed project.

2.1.2 ALTERNATIVES SCREENING

USACE and SAFCA formulated the project and a reasonable range of alternatives that would achieve the specific project objectives through the following steps:

- identification of the deficiencies in the Natomas levee system that must be addressed to provide at least 100-year (0.01 annual exceedance probability [AEP]) flood risk reduction as quickly as possible;
- identification of the deficiencies in the Natomas levee system that must be addressed to provide 200-year (0.005 AEP) flood risk reduction,
- identification of feasible remedial measures to address the deficiencies,
- determination of the likely environmental impacts of the remedial measures,
- development of a reasonable range of flood damage reduction alternatives for implementing the remedial measures; and
- identification of measures to ensure that each alternative would improve aviation safety, minimize impacts on significant cultural resource sites, and enhance habitat values.

Alternatives screening for the overall NLIP has been undertaken in a systematic manner through several environmental documents as summarized in this chapter and detailed in **Appendix B1**. A description of the flood risk reduction measures that SAFCA considered for developing alternatives is provided below.

2.1.3 TYPES OF FLOOD RISK REDUCTION MEASURES CONSIDERED

Designing effective flood risk reduction measures is an iterative process that involves identifying, evaluating, and comparing measures and preliminary alternatives to develop a reasonable range of final alternative plans for consideration by decision makers and the general public. For the NLIP Landside Improvements Project, engineering measures were developed and considered that alone or in various combinations would address the project objectives.

The engineering measures that were considered for the Phase 4b Project must meet several criteria. The design selected must adequately improve performance of the levee so that Federal Emergency Management Agency (FEMA) certification is possible. Generally, the requirements are to provide a sufficient height of levee raise (**Plate 1-3**) so that the levee height is adequate, levee stability meets levee design criteria, and/or seepage through or beneath the levee is reduced to levels acceptable to USACE. Measures considered are described below.

2.1.3.1 LEVEE IMPROVEMENTS

USACE has divided the flood damage reduction improvements within the Natomas Basin into nine reaches (Reaches A–I), as shown on **Plate 1-3**. USACE's reach designations differ from SAFCA's reach designations, which are more finely subdivided than the USACE system for the Sacramento River east levee, American River north levee, and the NCC. In **Plate 1-3**, lettered reaches follow the USACE designation, while numbered reaches follow the SAFCA designations:

- Sacramento River east levee: Reach A:16–20
- Sacramento River east levee: Reach B:5A–15
- Sacramento River east levee: Reach C:1–4B
- NCC: Reach D:1–7
- PGCC: Reach E: there are no SAFCA reaches, just station numbers

- NEMDC North: Reaches F–G
- NEMDC South: Reach H
- American River north levee: Reach I:1–4

Sacramento River East Levee (Reach A:16–20)

The existing levee in Sacramento River east levee Reach A:16–20 currently meets height requirements, and, therefore, no levee raise is necessary in this reach. However, the levee needs to be upgraded to meet USACE requirements regarding seepage through the levee and its foundation, slope stability, and free access for inspection, maintenance, and emergency flood fighting. Two engineering options were analyzed for the levee upgrade: the Fix-in-Place Method and the Adjacent Levee Method. Because these options have potentially different effects on the environment, they are analyzed as the two action alternatives in this EIS/EIR (see Sections 2.3, "Proposed Action," and 2.4, "Fix-in-Place Alternative"):

- **Fix-in-Place Method.** Most levee reaches in the Natomas Basin have a 2-to-1 horizontal-to-vertical (2H:1V) landside slope, which may not meet criteria for slope stability or access on the levee for maintenance and operation. This condition is found on Sacramento River east levee Reach A:16–20, which is a component of the Phase 4b Project. Using the Fix-in-Place method, the remedy would be to flatten the slope to a minimum 3-to-1 horizontal-to-vertical (3H:1V) landside slope by adding fill on top of the existing landside levee slope, thereby widening the base of the levee prism but not expanding the width of the levee crown (**Plate 2-1**, upper illustration). The Fix-in-Place method is compatible with the seepage remediation methods described under Section 2.1.3.2. By leaving the levee prism in the current alignment, this method requires vegetation clearance on the waterside of the levee to comply with USACE levee guidance that requires the removal of vegetation greater than 2 inches in diameter on the levee slopes and within 15 feet of the waterside and landside levee toes (USACE 2000). However, in reaches where the existing levee is already wide enough that the levee prism is considered clear of vegetation, such as in American River north levee Reach I:1–4, the Fix-in-Place method may be used to reduce the theoretical levee footprint to avoid encroachments on the landside.

  While the levee footprint (its base) size may not be substantially altered, mitigation for loss of habitat would be required by various regulatory agencies. Where the widening results in filling waters of the United States, including wetlands, mitigation would be required, generally at a 1:1 replacement ratio. Where the widening occurs on the landside or waterside and trees that provide habitat or are otherwise protected exist, the mitigation requirement is to plant replacement woodlands and/or shaded riverine aquatic (SRA) habitat. In some instances, irrigation and drainage ditches and canals exist at the toe of the levee, and would require relocation to ensure USACE's seepage and stability criteria are met. Widening of the existing levee may require the purchase of additional easements and/or rights-of-way, including areas for utilities and planting/replacement woodlands and other habitats. Proper construction of the widened levee may require excavation of a keyway trench in the foundation area at the toe of the levee.

- **Adjacent Levee Method.** This method combines slope flattening to 3H:1V with a widening of the existing levee crown by 15 to 20 feet on the landside. The concept of an adjacent levee is that the levee prism would be shifted landward (as shown in **Plate 2-1**, lower illustration), such that much of the vegetation on the waterside of the existing levee would be less likely to need to be cleared for levee operation and maintenance (see Section 2.1.3.4, "Management of Levee Vegetation and Structural Encroachments," below). This design potentially reduces the need to remove vegetation on the waterside to meet USACE vegetation guidance criteria. The irrigation and drainage ditches and canals that exist at the toe of the levee may require relocation farther to the landside. Construction of an adjacent levee may also require the purchase of additional easements and/or rights-of-way, including areas for utilities and planting of replacement woodlands and other habitats. Proper construction of the adjacent levee foundation often requires excavation of an inspection trench in the foundation soils. Because the Natomas Basin's natural levees have been augmented by human efforts, it is possible to find buried prehistoric features at considerable depth in the landside footprint.

Raised adjacent levees have been constructed or are in the approval process for Sacramento River east levee Reach C:1 to part way through Reach B:13 (Phase 2, 3, and 4a Projects). From the remainder of Sacramento River east levee Reach B:12 to Reach A:20 (Phase 4a and 4b Projects), the existing levee has sufficient height, and the proposed adjacent levee would be at the same height as the existing levee. The Phase 2, 3, and 4a Projects are summarized in Section 4.18, "Summary of Environmental Impacts and Mitigation Measures from Previous Natomas Levee Improvement Program Phase 1–4a Landside Improvements Projects."

Pleasant Grove Creek Canal and Natomas East Main Drainage Canal West Levee (North of Natomas East Main Drainage Canal Stormwater Pumping Station)

Two engineering options are also available for reaches where levee raising is required to meet the level of risk reduction required by the State for urbanized areas, such as the Natomas Basin. In the Phase 4b Project, these raises are proposed for the west levees of the Pleasant Grove Creek Canal (PGCC) (Reach E) and the Natomas East Main Drainage Canal (NEMDC) North (Reaches F–G). These options have similar environmental effects, and they are analyzed as part of both the Adjacent Levee Alternative (Proposed Action) (Section 2.3) and Fix-in-Place Alternative (Section 2.4):

- **Raise-in-Place Method.** Raising the levee in place would require the existing levee footprint to be widened at its base on one or both sides. This method may require replacement of public roadways that may be located on the crown of the levee. Although the levee footprint (its base) size may not be substantially altered, mitigation for loss of habitat would be required by various regulatory agencies. In some instances, irrigation and drainage ditches and canals exist at the toe of the levee, and would require relocation. Widening of the existing levee may require the purchase of additional easements and/or rights-of-way, including areas for utilities and planting/replacement woodlands and other habitats. Proper construction of the widened levee may require excavation of a keyway trench in the foundation area at the toe of the levee.

- **Adjacent Levee Raise Method.** In lieu of modifying the existing levee, a levee raise may also be achieved by constructing a new landside embankment adjoining the existing levee. This approach, which is similar to the adjacent levee method described above, allows sufficient levee height to be achieved without degrading the existing levee and rebuilding public roadways that may be located on top of the existing levee. However, it requires excavation of additional suitable material to build the adjacent structure. The irrigation and drainage ditches and canals that exist at the toe of the levee may require relocation farther to the landside. Construction of an adjacent levee may also require the purchase of additional easements and/or rights-of-way, including areas for utilities and planting of replacement woodlands and other habitats. Because the west levees of the PGCC and NEMDC, north of the NEMDC Stormwater Pumping Station, already substantially comply with levee vegetation guidance criteria, the adjacent levee is not needed as an option to avoid vegetation removal on the waterside (see 2.1.3.4, "Management of Levee Vegetation and Structural Encroachments," below).

2.1.3.2 SEEPAGE REMEDIATION

Pre-NLIP existing seepage remediation in the Natomas Basin has primarily addressed seepage through the levee embankment (through-seepage). Through-seepage occurs when the waterside slope is loaded by high river stage for a sufficient time to develop a steady state condition in the levee embankment in which water is seeping on the levee landside slope, removing material from the levee embankment by internal erosion and leading to slope instability. Through-seepage is the movement of water through the levee itself, when high-flow conditions, and/or wind and wave action exist on the waterside of the levee. Through-seepage may be addressed by construction of cutoff walls through the levee prism or drained stability berms on the landside slope. The cutoff walls provide a low-permeability barrier to water flow through the levee. Drained stability berms prevent levee material from being removed, drains the seepage water away from the levee, and also increases the stability of the levee slope. Underseepage or seepage through the levee foundation occurs during prolonged high river stages and results in high gradients at the levee landside toe due to build-up of the water pore pressure in the levee foundation to a high limit which may lead to levee collapse due to piping (removal of material from the levee foundation through sand

boils (**Plate 1-4**) or slope instability due to high water pore pressures in the foundation soils. Excessive underseepage gradients can be addressed by cutoff walls, seepage berms, and relief wells, or using a combination of these measures, which are discussed below.

Cutoff Walls

Cutoff walls use specialized earthen materials (often bentonite clay) constructed in the levee embankment, which extend into the levee foundation to a sufficient depth to reduce the seepage gradient at the landside toe of the levee below an allowable limit. Specialized equipment allows the cutoff walls to reach deep into the subsurface, to depths of 120 feet (**Plate 2-2**). Often the levee crown is "degraded," meaning that the levee embankment is excavated to create a wide working platform for the construction equipment to install the cutoff wall. A fully penetrating cutoff wall installed deep enough to reach a lower impervious layer in the foundation may reduce the seepage gradient to a very low limit. A partially penetrating wall, which does not reach the lower impervious strata in the foundation, may reduce the seepage gradient by increasing the seepage path, but sometimes the reduction is not sufficient to drop the gradient below the maximum allowable limit and an additional seepage berm or relief well is required. Fully penetrating cutoff walls are generally preferred, if it is constructible, because they are the least costly (particularly if a soil-bentonite [SB] mix is used and the depth of wall is less than 85 feet); are the most reliable under uncertain hydraulic and geotechnical conditions (e.g., water surface elevations above design and variations in foundation soil conditions); and, when combined with an adjacent levee, minimize construction disturbance outside the levee footprint.

If a fully penetrating wall is not feasible due to the foundation conditions (the lower impervious layer is non-existent or at a depth not possible to be reached with the existing equipment), then partially penetrating walls eventually supplemented with additional methods of seepage mitigation (such as seepage berms or relief well) may be used. Eventually, partially penetrating walls may be completely replaced by seepage berms or relief wells.

Seepage Berms

Seepage berms are wide, shallow features with relatively flat surface slopes graded to drain landward. They are typically constructed using material excavated from borrow sites. The berms may be constructed of any impervious material from the borrow sites or, to increase the berms efficiency and decrease the berm width, the random berm material may be placed on a free drainage layer 2–2.5 feet thick placed on a 6 inches of filter material to prevent removal of the fine foundation material by piping. Seepage berms may extend between a minimum of 80 feet to up to 500 feet landside of the toe of the levee or the adjacent levee (**Plate 2-3**). In areas of limited space, seepage berms are supplemented with relief wells at the landside toe of the seepage berms.

Constructing seepage berms rather than cutoff walls avoids the deep ground-disturbing work that may adversely affect cultural resources that may be present, while still achieving flood damage reduction objectives. It is possible to construct a seepage berm using specialized equipment that minimizes vibration and pressure on the immediate subsurface environment. This construction method is often used where sensitive historical features may be expected near the ground surface, and relief wells are omitted. A seepage berm without relief wells extends the levee footprint farther landside and depending upon adjacent land use, may require relocation of permanent structures or take affected agricultural land out of production, as well as other environmental impacts.

Relief Wells

Relief wells are controlled artificial springs that relieve the confined water pressures to safe values. This reduces the potential for the removal of soil via piping or internal erosion caused by the uplift pressures beneath elements of the levee or beneath landward soil next to the levee. Relief wells are usually spaced about 50–150 feet apart to decrease the gradients at the levee toe below the maximum allowable gradient between two adjacent wells and allow water to flow without pumping during times of high water table. Piezometers are used as a tool to verify relief well performance by measuring the hydrostatic pressure between the wells. Because relief wells may only flow on an intermittent basis, sometimes several years apart, it is necessary to conduct regular maintenance of

relief wells to ensure that they perform properly (**Plate 2-4**). Relief wells also require collection of water flowing through the wells during high river stages, which is then discharged back into the river through a pumping station. This may require excavation of a ditch along the landside toe of the levee or seepage berm or collecting the water through an underground piping system.

2.1.3.3 BANK EROSION CONTROL

Bank erosion poses either a high or moderate risk to the stability of the Sacramento River east levee at several locations upstream and downstream of Interstate 5 (I-5) where river flows and waves generated by boat wakes have weakened and undercut portions of the bank supporting the levee. The adjacent levee design would address the potential instability created by these bank erosion processes by enlarging the levee section and moving the levee foundation landward away from the eroding bank. These bank erosion processes could also be addressed by installing rock revetments or other engineered structures along the eroding banks so as to reduce further erosion and protect the foundation of the levee (as proposed for the NEMDC South; see Section 2.3.3.2, "Sacramento River East Levee," under "Pleasant Grove Creek Canal and Natomas East Main Drainage Canal – South Waterside Improvements").

2.1.3.4 MANAGEMENT OF LEVEE VEGETATION AND STRUCTURAL ENCROACHMENTS

USACE levee guidance requires the removal of vegetation greater than 2 inches in diameter on the levee slopes and within 15 feet of the waterside and landside levee toes (USACE 2000). USACE levee guidance also requires an assessment of encroachments on the levee slopes, including utilities, fences, structures, retaining walls, driveways, and other features that penetrate the levee prism (see Section 2.3.4.11, "Structural Encroachments"). Substantial encroachments are present on the Sacramento River east levee with a smaller number of encroachments on the other Natomas levees.

Vegetation Variance Request

During preparation of the DEIS/DEIR, SAFCA and the Central Valley Flood Protection Board (CVFPB), the non-Federal sponsors of the NLIP, requested a variance from the standard vegetation guidelines set forth in USACE's Engineering Technical Letter 1110-2-571 (USACE 2009a). The *CVFPB and SAFCA Vegetation Variance for the Common Features (Natomas Basin) Project, Post-Authorization Change Report* (also referred herein as "vegetation variance") was developed to comply with applicable provisions of the California Central Valley Flood System Improvement Framework that was adopted by the California Levees Roundtable on March 26, 2009 (Framework). The Framework specifically states that where, as in the case of the Phase 4b Project, major modifications of existing levee sections are required, such modifications:

> …will comply with the [USACE] levee vegetation standards, but may allow vegetation to remain if these projects can demonstrate that the public safety risks posed to levee integrity have been adequately addressed and engineered into project designs.

The Framework is to be used as a guide for vegetation on levees until the Central Valley Flood Protection Plan is completed in 2012.

The vegetation variance request was granted by USACE in June 2010, and vegetation will be allowed to remain on a portion of the waterside slope and berm of several of the levee segments comprising the perimeter levee system protecting the Natomas Basin, except the lower 1/3 of the slope of the NEMDC where trees must be removed to comply with USACE levee vegetation guidance. Although the variance was granted, this FEIS/FEIR retains the original scenarios presented in the DEIS/DEIR, which include both a with- and without-variance outcome to show the full range of potential adverse effects, including the worst-case scenario, as required under NEPA. The following sections describe the levee segments that are covered by this variance. Sections 2.3,

"Proposed Action," and 2.4, "Fix-in-Place Alternative," describe the vegetation removal assumptions used by this EIS/EIR to provide environmental analysis to support consideration of this variance request.

Adjacent Levees

One of the objectives of constructing an adjacent levee along the Sacramento River east levee is to facilitate acceptable management of existing vegetation and structural encroachments along the waterside of this levee. By making the levee wider and effectively moving the "designated levee" section landward (**Plate 2-1**, lower illustration), the separation between waterside vegetation and the levee prism would be increased, thus reducing the conflicts between applicable USACE levee operation and maintenance requirements, and waterside vegetation and structural encroachments. Because this design would allow vegetation to remain on the waterside under the proposed variance, valuable riparian habitat would be preserved, benefiting several special-status species. This riparian habitat, which is shown on **Plates 3-4c** and **3-4d**, also provides a migration corridor habitat for a variety of wildlife species that inhabit the Natomas Basin.

Section 2.3.4.10, "Vegetation Management," provides additional information on the relationship of the Adjacent Levee Alternative (Proposed Action) with management of levee vegetation. Construction of the adjacent levee would also involve removal of vegetation within 15 feet of the landside toe of the widened levee. The adjacent levee has been constructed and/or approved for Sacramento River east levee Reaches C:1–4B and B:5A–15 as part of the Phase 2 and 3 Projects.

Other segments of the Natomas Basin perimeter levee system may already be in compliance with levee vegetation guidance criteria or may qualify for a variance within the next several years because: (1) vegetation did not exist or has already been cleared within the 15-foot clearance zone; (2) these segments were previously overbuilt to the point where their levee prism could be considered clear of waterside or landside vegetation and would potentially qualify for a variance; or (3) planned improvements would ensure compliance through waterside slope flattening, shifting levee crowns in a landward direction, and removing any vegetation that would penetrate the levee prism. Levee segments falling into this category include most of the Natomas Cross Canal (NCC) south levee (Reach D:1–7), the PGCC west levee (Reach E), and the west levee of the NEMDC north of the NEMDC Stormwater Pumping Station (Reaches F–G).

Overbuilt Levees

An overbuilt levee is defined as a levee with land and waterside slopes of at least 3H:1V and a virtual levee crown (measured at the design water surface elevation) that is at least 35-feet wide (designated levee crown). Similar to the adjacent levee, the overbuilt levee allows for considering that the levee prism meets the criteria of having a 15-foot vegetation free zone from the projected waterside toe, such that much of the vegetation on the waterside of the existing levee is less likely to need to be cleared for levee operation and maintenance. Like the adjacent levee, to be in compliance, trees would not be allowed to remain within the area extending 15 feet landward from the toe of the overbuilt levee out to 15 feet from the toe of the projected waterside slope.

The American River north levee is an extension of the Sacramento River east levee that extends from I-5 to Northgate Boulevard, where it becomes the west levee of NEMDC South. This segment of the Natomas perimeter levee system is considered an overbuilt levee and may qualify for a variance from USACE levee vegetation guidance because it was widened beyond standard levee dimensions to support the Arden-Garden Connector transportation project. Also considered overbuilt and potentially eligible for a variance is the segment of the west levee of NEMDC South that extends from Northgate Boulevard to the Arden-Garden Connector. Although these levee segments are overbuilt to the extent that they may not need vegetation clearance on the waterside if a variance is granted, on the landside an extensive number of trees would be removed to accommodate the expanded levee footprint, including removal of vegetation within 15 feet of the new landside levee toe.

Non-Conforming Levees

The lower portion of the NEMDC west levee from the NEMDC Stormwater Pumping Station to Northgate Boulevard presents more challenging vegetation management options. This portion of the levee system was raised and strengthened by SAFCA in 1995–1996 as part of the American River Watershed Project authorized by Congress in the 1993 Defense Appropriations Act. The authorized project called for raising the levee to protect the Natomas Basin from the combined effects of high flows in the American River channel and high flows in Dry Creek and Arcade Creek, the tributary streams that drain foothill watersheds east of Natomas. SAFCA widened the existing levee section to the landside and raised the levee by two to three feet. Urban development along the landside of the levee constrained the space available for the project and the improved levee was designed and constructed with a 2:1 landside slope.

Project construction required landside tree removal to accommodate the widened footprint of the improved levee. However, with the concurrence of USACE and the State, to minimize the project's environmental effects, trees were allowed to remain in the maintenance area along the landside toe of the improved levee and along the waterside slope of the levee and waterside berm. It was felt that these trees would not impair the performance of the improved levee because there was adequate visibility of and access to both sides of the levee to conduct routine maintenance and flood fighting activities. Nor was there any significant concern regarding the impact of the remaining trees on the safety or structural integrity of the improved levee. Although nearly overtopped and subjected to prolonged high flow during the flood of 1986, the old levee had performed well with few signs of stress. With its increased height, the new levee performed even better during the flood of 1997. However, this levee is no longer considered in compliance with USACE levee vegetation guidance, and avoidance of landside tree clearing in this maintenance area would require a variance from USACE.

The Phase 3 Project analyzed the installation of cutoff walls through portions of the NEMDC west levee where it crosses the old streambeds of Dry Creek, Arcade Creek and Magpie Creek. The Phase 4b Project proposes construction of cutoff walls along the entire length of the NEMDC and PGCC west levee. Installation of these cutoff walls would address the risk of destabilizing underseepage in these locations which occupy approximately one-half the length of the levee between the NEMDC Stormwater Pumping Station and Northgate Boulevard. This risk was not considered to be substantial when the improvements described above were designed and constructed. Insofar as vegetation on or near the improved levee has also now been identified as a risk factor, removal would be required for all non-native trees from within the vegetation-free zone; all native trees that have a diameter at breast height (dbh) of four inches or less; and all larger native trees that are located on the waterside slope, the crown, or within 15 feet of the landside toe (or within the right-of-way, if less than 15 feet) (see 2.2.1.1, "No Phase 4b Project Construction"). Under a variance request, vegetation within 15 feet of the toe of the waterside slope of the west levee along NEMDC South would be allowed to remain.

Life Cycle Management Program

The following five risk factors are associated with levee vegetation:

- access (trees could obstruct access for routine maintenance and flood fighting);
- visibility (trees could impair routine levee inspection and high water condition monitoring);
- slope stability (trees could contribute to slope instability);
- seepage (tree roots could create seepage pathways); and
- windthrow (overturned trees could create destabilizing slip planes).

For non-conforming levees that may be granted a variance, implementation of a Life Cycle Management (LCM) program would use GIS- and field-based evaluation tools to ensure that new trees would not become established in the vegetation-free zone, and trees allowed to remain in this zone would be carefully monitored, trimmed and, if necessary, removed if they become an unacceptable risk to the performance of the levee due to age or infirmity.

2.1.4 ALTERNATIVES CONSIDERED IN PREVIOUS ENVIRONMENTAL ANALYSES AND INCORPORATED BY REFERENCE

The analyses of alternatives performed in the previous environmental documents from which this EIS/EIR is tiered, which are listed below, are summarized in **Appendix B1**. The alternatives analyses from these documents are incorporated by reference, herein. The material summarized in **Appendix B1** is provided to summarize the scope of analysis that has already been performed and thus shows which alternatives have been eliminated from further analysis or rejected by previous agency decisions.

The alternatives analyses incorporated herein by reference are from the following environmental documents:

- *Environmental Impact Report on Local Funding Mechanisms for Comprehensive Flood Control Improvements for the Sacramento Area,* State Clearinghouse No. 2006072098 (Local Funding EIR) (SAFCA 2007a);
- *Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project,* State Clearinghouse No. 2007062016 (Phase 2 EIR) (SAFCA 2007b);
- *Environmental Impact Statement for 408 Permission and 404 Permit to Sacramento Area Flood Control Agency for the Natomas Levee Improvement Project* (Phase 2 EIS) (USACE 2008);
- *Supplement to the Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project—Phase 2 Project,* State Clearinghouse No. 2007062016 (Phase 2 SEIR) (SAFCA 2009a);
- *Addendum to the Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project – Phase 2 Project,* State Clearinghouse No. 2007062016 (Phase 2 EIR 1st Addendum) (SAFCA 2009c);
- *2nd Addendum to the Environmental Impact Report on the Natomas Levee Improvement Program, Landside Improvements Project – Phase 2 Project,* State Clearinghouse No. 2007062016 (Phase 2 EIR 2nd Addendum) (SAFCA 2009d);
- *Environmental Impact Statement and Environmental Impact Report on the Natomas Levee Improvement Program, Phase 3 Landside Improvements Project,* State Clearinghouse No. 2008072060 (Phase 3 EIS and EIR) (USACE 2009b and SAFCA 2009b);
- *Addendum to the Environmental Impact Report on the Natomas Levee Improvement Program, Phase 3 Landside Improvements Project,* State Clearinghouse No. 2008072060 (Phase 3 EIR Addendum) (SAFCA 2009e); and
- *Environmental Impact Statement and Environmental Impact Report on the Natomas Levee Improvement Program, Phase 4a Landside Improvements Project,* State Clearinghouse No. 2009032097 (Phase 4a EIS and EIR) (USACE 2010 and SAFCA 2009f).

Relevant portions of these documents, where specifically noted, are summarized throughout this EIS/EIR. Printed copies of these documents are available to the public at USACE's office at 1325 J Street, Sacramento, California and at SAFCA's office at 1007 7th Street, 7th Floor, Sacramento, California, during normal business hours, and are also available on USACE's Web site, at http://www.spk.usace.army.mil and at SAFCA's Web site, at http://www.safca.org/Programs_Natomas.html.

2.1.5 ALTERNATIVES CONSIDERED, BUT ELIMINATED FROM FURTHER CONSIDERATION

Numerous alternatives have been considered by USACE and SAFCA to reduce flood risk in the Natomas Basin. These alternatives were evaluated and eliminated from further consideration during completion of previous environmental documents. This section briefly summarizes alternatives considered but eliminated in these documents. More detailed information on alternatives considered but eliminated is provided in **Appendix B1**.

The following alternatives were reviewed and eliminated from further consideration as described below:

- **Yolo Bypass Improvements.** This measure would involve lengthening the Fremont Weir and widening the Yolo Bypass to increase the amount of flood water conveyed through the bypass and reduce the amount of flood water conveyed through the Sacramento River channel downstream of the weir. This alternative was eliminated because: (1) it would be too costly for SAFCA to implement; (2) levee height increases and substantial seepage and slope stability remediation would still be required for the Natomas perimeter levee system, adding to costs; (3) these improvements lie outside of SAFCA's jurisdiction and would require Federal, State, and local cooperation and funding; and (4) the project objective of restoring 100-year (0.01 AEP) design flood levels to the Natomas Basin could not be achieved as quickly as possible. (Considered and eliminated in Phase 2 EIS.)

- **Reduced Natomas Urban Levee Perimeter.** This measure would involve construction of a cross levee running east to west across the Natomas Basin along an alignment north of Elkhorn Boulevard to protect existing developed areas in the City and County of Sacramento. This alternative was eliminated because: (1) it is inconsistent with current Federal and State authorizations and would strand Federal, State, and local investments already made in improving the NCC south levee and Sacramento River east levee pursuant to past Congressional authorization; (2) it would result in the need to raise State Route (SR) 99 or otherwise protect SR 99 from flooding; (3) it would divide Reclamation District (RD) 1000 and disrupt several portions of the Natomas Basin irrigation and drainage system and require reconfiguration of these systems; (4) it would present significant barriers to achieving the goals of the *Natomas Basin Habitat Conservation Plan* (NBHCP); (5) it would have substantially greater costs than other alternatives without achieving any additional flood damage reduction benefit; and (6) it would leave a portion of the Basin currently planned for development by Sutter County (i.e., *Sutter Pointe Specific Plan* mixed-use development project) outside the urban levee perimeter and likely cause Sutter County to exercise its rights under SAFCA's joint exercise of powers agreement to prevent the expenditure of Consolidated Capital Assessment District funds on this measure. (Considered and eliminated in Local Funding EIR and Phase 2 EIS.)

- **Construction of a New Setback Levee.** This alternative would involve construction of a 5-mile-long levee along the northern reaches of the Sacramento River east levee parallel to the existing levee alignment but set back from the existing alignment by 500–1,000 feet. This alternative was eliminated because it is infeasible due to: (1) the presence of waterside residences along the existing levee from the southern end of Sacramento River east levee Reach C:2 to the American River north levee, and the need to maintain access to these residences from Garden Highway; (2) the proximity of the Sacramento River east levee to the Airport, and the need to prevent project features from increasing potential hazards to aviation safety; and (3) the possibility that utility relocations (power poles) and flood damage reduction measures could encroach into surface slopes of runway approach zones. (Considered and eliminated in Phase 2 EIR and Phase 2 EIS.)

- **Raise Levee in Place with a 1,000-Foot Levee Setback in the Upper 1.4 Miles along the Sacramento River East Levee.** This alternative would have provided a location for a substantial amount of tree planting on the waterside of the setback levee, contributing to the offsetting mitigation for the loss of the trees that may need to be removed along the existing levee to meet USACE criteria. This alternative was eliminated because it was unlikely that the new setback levee would provide 100-year (0.01 AEP) flood protection per USACE

criteria. (Considered and eliminated in Phase 2 EIR, and analyzed, but not selected as the Proposed Action, in Phase 2 EIS.)

- **Construct an Adjacent Setback Levee with a 500-Foot Levee Setback in the Upper 1.4 Miles along the Sacramento River East Levee.** This alternative was evaluated because it would provide the opportunity for partially offsetting the loss of landside tree groves through the establishment of new riparian plantings in the levee setback area, as well as woodland plantings on the landside of the adjacent setback levee. This alternative was eliminated because it would require substantially greater quantities of borrow material with greater impacts on Important Farmland and transportation and circulation. (Considered and eliminated in Phase 2 EIR, and analyzed, but not selected as the Proposed Action, in Phase 2 EIS.)

- **No SAFCA Levee Improvements—Private Levees in Natomas.** This alternative was analyzed assuming that there would be no SAFCA project providing flood damage reduction in the Basin, thus causing private developers to separately fund and implement individual flood damage reduction in the form of private compartment levees that would protect new developments. This alternative was eliminated because it would (1) only partially meet the objective of providing 100-year (0.01 AEP) flood risk reduction, (2) potentially lead to increased fragmentation of habitat for special-status species, and (3) increase projected flood damages without a commensurate reduction in flood risk. (Considered and eliminated in Local Funding EIR and Phase 2 EIR.)

- **Natomas 100-Year Protection.** SAFCA analyzed the impacts associated with creation of one new assessment district, which would provide only 100-year (0.01 AEP) flood protection to the Natomas Basin, and which would use funding raised through existing Capital Assessment District Number 3 to provide the local share of the cost of completing improvements to provide 100-year (0.01 AEP) flood risk reduction to the lower American River and South Sacramento Streams Group areas (SAFCA 2007a). This alternative was eliminated because it would fail to provide groundwork for the creation of 200-year (0.005 AEP) flood risk reduction over time (SAFCA 2007a). Because this alternative represents an alternative to the proposed funding mechanisms and not an alternative to the proposed levee improvements, this alternative was not considered to be an alternative to the Phase 2 Project and was not included in the Phase 2 EIS. (Considered and eliminated in Local Funding EIR.)

- **No-Action Alternative—Airport Compartment Levee.** The Phase 2 EIS evaluated and eliminated from further consideration the No-Action Alternative—Airport Compartment Levee. The prior discussion, which is hereby incorporated by reference, is summarized as follows (see also **Appendix B1** for a summary of the impacts associated with the Airport Compartment Levee).With no authorization of the Phase 2 Project, SAFCA would not be able to meet timing objectives for providing the Natomas Basin with at least a 100-year (0.01 AEP) flood risk reduction and achieving a 200-year (0.05 AEP) flood risk reduction. Federal and State floodplain regulations would prevent new development in most of the Natomas Basin. Either the Airport would be compelled to operate within its existing footprint, abandoning its current plans for modernization and expansion, or, alternatively, the Airport may construct its own limited flood damage reduction structure (i.e., a ring levee) to protect existing facilities and its expansion area. This alternative was eliminated because: (1) construction of a separate levee around the Airport would be under the responsibility and jurisdiction of another agency (Sacramento County Airport System [SCAS]), over which SAFCA would have no jurisdiction, and would require a lengthy process that is completely separate from the Proposed Action; (2) the timeline for that process is unknown and there are no design plans that would enable an accurate evaluation of potential environmental impacts; and (3) the action would require SCAS to prepare a separate CEQA and, potentially, NEPA environmental document. (Considered and eliminated in Phase 2 EIR and Phase 2 EIS.)

  In addition to the reasons provided in the Phase 2 EIS, design plans are not available for this alternative, thus preventing USACE and SAFCA from accurately evaluating its potential impacts; implementation of the Airport Compartment Levee would not meet any of the goals and objectives of the project; the residents,

residences, and businesses within the Natomas Basin would not receive flood protection; implementation of the Airport Compartment Levee would only protect the Airport; and SCAS has not proposed such a project and, therefore, it is not considered a reasonable alternative.

- **Cultural Resources Impact Reduction Alternative.** The Phase 3 Project Proposed Action includes construction of deep cutoff walls in Sacramento River east levee Reach B:5A–9B, which have the potential to result in significant and unavoidable impacts on known prehistoric resources, previously unidentified cultural resources, and human remains. Construction of a 500-foot-wide seepage berm rather than deep cutoff walls would avoid the deep ground-disturbing work that may adversely affect potential cultural resources, while still achieving flood damage reduction objectives. This alternative was eliminated because of the intensity and severity of environmental impacts associated with construction, including the temporary closure, disruption, and redesign of all or portions of the Teal Bend Golf Club. This alternative would have resulted in impacts on ten environmental topic areas (hydrology and hydraulics, sensitive aquatic habitats, vegetation and wildlife, special-status terrestrial species, paleontological resources, transportation and circulation, air quality, visual resources, recreation, utilities and service systems, and hazards and hazardous materials) that would be potentially more substantial than those associated with the Proposed Action; and there would be a net increase in the number, intensity, and severity of environmental impacts relative to the Proposed Action. (Considered and eliminated in Phase 3 EIS and EIR.) See **Appendix B1** for analyses of each specific environmental issue area.

  Although this alternative was eliminated in the Phase 3 EIS and EIR as an alternative to the Phase 3 Project Proposed Action, 500-foot-wide seepage berms were analyzed in the Phase 4a EIS and EIR as part of the Phase 4a Project Proposed Action to represent the worst-case scenario because it is anticipated that at least one very large cultural site may require avoidance (CA-Sac-16/H), and additional previously undiscovered cultural resource sites may be present.

- **Levee Raise-in-Place Alternative.** This alternative includes raising and strengthening the existing levee in Sacramento River east levee Reach B:5A–9B rather than constructing the adjacent levee. All other components of the Phase 3 Project were the same for this alternative. This alternative was found to have a greater number of significant and unavoidable impacts compared to the Phase 3 Project Proposed Action, including in the environmental issue areas of biological resources, transportation and circulation, and recreation. (Considered and eliminated in Phase 3 EIS and EIR.)

- **Raise and Strengthen Levee-in-Place (RSLIP) Alternative.** The RSLIP Alternative includes raising and strengthening the existing levee in Sacramento River east levee Reach B:10–15 rather than constructing the adjacent levee. All other components of the Phase 4a Project were the same for this alternative. This alternative was found to have a greater number of significant and unavoidable impacts in the environmental issue area of biological resources compared to the Phase 4a Project Proposed Action. (Considered and eliminated in Phase 4a EIS and EIR.)

The following additional alternative was considered by USACE to reduce flood risk in the Natomas Basin, but was eliminated from further consideration.

- **Upstream Transitory Storage.** Various upstream transitory storage measures were evaluated as part of the Common Features/Natomas PACR/Phase 4b Project. Initial evaluation indicates that these measures would not be cost-effective. Downstream benefits would not be increased to a degree sufficient to justify the costs associated with implementing this alternative, including: construction of intake and outtake structures for water to enter and leave the detention basins, improvements to the perimeter levees around the detention basin(s) to current standards, acquisition costs of real estate easements for water storage, and acquisition and/or relocation of existing properties in the storage basins. In addition, the need to correct deficiencies related to seepage and stability in the levees around the entire perimeter of the Natomas Basin has to be addressed regardless of any use of upstream storage measures. Because of the extent and likely cost of these

improvements, all of which would lie outside the project footprint and outside the project proponent(s)'s jurisdiction, these measures would require an unprecedented degree of State, Federal, and local cooperation and funding. For this reason, this measure was not pursued as a component of the Common Features/Natomas PACR/Phase 4b Project, but is considered worthy of further evaluation as part of the State's pending update of the State Plan of Flood Protection for the Central Valley. (Considered and eliminated in Phase 4b EIS/EIR.)

2.1.6 ALTERNATIVES CARRIED FORWARD FOR EVALUATION IN THIS EIS/EIR

The following Phase 4b Project alternatives were carried forward for detailed analysis in this EIS/EIR:

- **No-Action Alternative**—Under NEPA, the expected future without-project conditions; under CEQA, the existing condition at the time the notice of preparation was published (November 5, 2009) as modified by what would be reasonably expected to occur in the foreseeable future if the Phase 4b Project were not approved (two scenarios are proposed).

- **Adjacent Levee Alternative (Proposed Action)**—An adjacent levee would be constructed along the Sacramento River east levee Reach A:16–20; and, where required for this levee, cutoff walls, seepage berms, and relief wells would be installed for seepage remediation. A cutoff wall would be installed in the American River north levee east of Gateway Oaks Drive to Northgate Boulevard, and the landside slope would be flattened. The NEMDC west levee would be raised in place or widened from just south of Elkhorn Boulevard to Sankey Road, and the landside slope would be flattened and seepage remediation would be constructed as necessary. Waterside erosion protection would be constructed in locations along the PGCC and NEMDC (south of Elkhorn Boulevard). Culverts located beneath the PGCC would be upgraded or removed, and replacement flood storage would be provided as needed. At the SR 99 crossing of the NCC, seepage remediation would be installed and a moveable barrier system would be constructed to prevent overflow from reaching the landside of the NCC south levee. The western portion of the West Drainage Canal would be realigned to the south, and the remaining portion of the existing canal would be improved to reduce bank erosion and sloughing, decrease aquatic weed infiltration, improve RD 1000 maintenance access, and enhance giant garter snake habitat connectivity. Irrigation canals and ditches would be relocated either to make room for expanded levee sections or to reduce underseepage potential. Discharge pipes for RD 1000 pumping plants and City of Sacramento sump pumps would be raised to cross the levee above design flood water surface elevation. Parcels in the South Fisherman's Lake and Triangle Properties Borrow Areas and at the West Lakeside School Site would be excavated and reclaimed as agricultural land. Woodland groves would be established to compensate for impacts along the Sacramento River east levee Reach A:16–20, American River north levee Reach I:1-4, and NEMDC.

- **Fix-in-Place Alternative**—The Sacramento River east levee would be improved in place in Sacramento River east levee Reach A:16–20 and seepage remediation would be implemented. The Fix-in-Place Alternative would be the same as described for the Adjacent Levee Alternative (Proposed Action) except that the crown of the Sacramento River east levee would not be widened. This type of levee improvement would narrow the overall landside footprint by 15 feet but would require a greater extent of levee degrade to construct cutoff walls and a greater extent of encroachment removal along the Sacramento River east levee compared to the Adjacent Levee Alternative (Proposed Action).

The above three alternatives are described in detail in the remaining portions of this chapter. The Adjacent Levee Alternative (Proposed Action) and Fix-in-Place Alternative were developed for consideration with a focus on improvements to the Sacramento River east levee Reach A:16–20. Phase 4b Project improvements to the American River east levee Reach I:1-4, NEMDC west levee, PGCC west levee, NCC south levee, West Drainage Canal, and modifications to the landscape and irrigation/drainage system would be similar under the Adjacent Levee Alternative (Proposed Action) and Fix-in-Place Alternative.

As noted above, the Adjacent Levee Alternative (Proposed Action) and Fix-in-Place Alternative would use differing methods to achieve flood damage reduction objectives for the Sacramento River east levee Reach A:16–20. Therefore, the differences between the Adjacent Levee Alternative (Proposed Action) and Fix-in-Place Alternative, including effects on habitats, are the result of these differences in design of the Sacramento River east levee.

2.2 NO-ACTION ALTERNATIVE

2.2.1 NO-ACTION ALTERNATIVE—NO FLOOD DAMAGE REDUCTION MEASURES

For the purposes of NEPA compliance, the No-Action Alternative serves as the baseline against which the impacts and benefits of the action alternatives are evaluated. The No-Action Alternative consists of the conditions that would be reasonably expected to occur in the foreseeable future if Congress does not provide authorization for USACE to construct the Phase 4b Project and USACE does not grant SAFCA permission to alter the existing levees or a permit to discharge dredged or fill material into waters of the United States for the Phase 4b Project.

Without USACE permission or permits, SAFCA would not proceed with implementation of the Phase 4b Project (even though not all of the project components require USACE permission and/or permits) because SAFCA would not be able to achieve the overall project purpose, which is to upgrade the levees to reduce flood risk.

As noted under Section 2.1.3.4, "Management of Levee Vegetation and Structural Encroachments," with the exception of NEMDC South (Reach H), the presumption for the Phase 2, 3, and 4a Projects is that waterside vegetation would be eligible for a variance from USACE levee vegetation guidance criteria because, depending on the reach, the levee is already overbuilt or the levee would be upgraded to a sufficient width (adjacent levee method) such that the new levee prism would be clear of waterside vegetation. It is also assumed that the American River north levee (Reach I:1–4), a construction element addressed as part of the Phase 4b Project, may not be eligible for a variance and would potentially require waterside vegetation clearance even without the proposed levee improvements. Therefore, the No-Action Alternative assumes that no waterside vegetation is cleared except where it is required for modifications to the pumping plants analyzed as part of the Phase 2, 3, and 4a Projects; and as part of compliance with USACE levee vegetation clearance along the west levee of NEMDC South (Reach H), the south levee of the NCC (Reach D:1–2), and the north levee of the American River (Reach I:1–4).

As discussed in Section 1.3.10, "General Re-evaluation of the Common Features Project," USACE is preparing a GRR on the Common Features Project, including Natomas Basin levee improvements, that is expected to be presented to Congress in 2010. The earliest that Federal construction under a Congressionally re-authorized USACE project could begin would be 2012. Therefore, it is assumed that USACE and/or the State of California or SAFCA would begin repairs on the Natomas Basin levee system in 2012 at the earliest, and would complete the improvements providing flood risk reduction by 2016.

Based on the criteria that USACE and SAFCA, in coordination with the State, have used to select alternatives for detailed analysis, it is reasonable to assume that one of the two action alternatives described below (the Adjacent Levee Alternative [Proposed Action] and Fix-in-Place Alternative) would be implemented by USACE and/or the State or SAFCA and that the environmental effects of project construction would be the same as, or very similar to, those of the action alternatives evaluated in this EIS/EIR. In the period before implementation of flood damage reduction measures for the Natomas Basin, however, there would remain a high potential for a major levee failure and flooding of the Natomas Basin. (USACE evaluation of geotechnical information and other data indicate that a future flood event with an approximately 3% or greater probability of occurring in any year could cause a major levee failure.)

Therefore, the No-Action Alternative analyzed in this EIS/EIR consists of two scenarios: No Phase 4b Project Construction and Potential Levee Failure. "No Phase 4b Project Construction" refers to the impacts that would

result because the Phase 4b Project would not be constructed as part of the NLIP. "Potential Levee Failure" refers to the impacts that could occur if the Natomas Basin perimeter levee system failed. These two components of the No-Action Alternative are further described below, and the analysis contained in Chapter 4, "Environmental Consequences and Mitigation Measures," is presented using these subheadings.

2.2.1.1 NO PHASE 4b PROJECT CONSTRUCTION

Under the No Phase 4b Project Construction Alternative, the Phase 4b Project would not be constructed. Under CEQA, the baseline environmental condition would be the physical conditions in the Phase 4b Project area existing at the time of the publication of the Notice of Preparation. The NEPA baseline condition for determining significance of impacts includes the full range of construction that would be implemented in the Natomas Basin except for the Phase 4b Project.

Under this scenario, key segments of this system would continue to provide less than 100-year (0.01 AEP) flood risk reduction, and the entire Natomas Basin would be permanently designated as a FEMA special flood hazard area subject to development restrictions and mandatory flood insurance requirements pursuant to the regulations of the National Flood Insurance Program.

Even without construction of the Phase 4b Project, a substantial number of structural features may need to be removed from the waterside of the existing levees to meet USACE requirements as described in *Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, and Embankment Dams* (USACE 2000). As part of its ongoing operations and maintenance (O&M) activities, RD 1000 would be initially responsible for removal of any encroachments that would threaten levee integrity. Without construction of an adjacent levee along Sacramento River east levee Reach A:16–20, which is within the Phase 4b Project footprint, approximately 19 acres of waterside vegetation would require removal to comply with the USACE levee vegetation guidance (see Chapter 4, "Environmental Consequences and Mitigation Measures," for a detailed discussion of the impacts related to the No-Action Alternative). Because the American River north levee is considered overbuilt, including a section of NEMDC South from Northgate Boulevard to the Arden-Garden Connector, it may be eligible for a variance from USACE levee vegetation guidance.

However, without a variance, vegetation would need to be removed from the waterside in a worst-case scenario. Along the NEMDC South north of the Arden-Garden Connector (Reach H), a variance would be requested to allow waterside vegetation to remain within 15 feet (waterward) of the waterside levee toe, with approximately 0.57 acres of vegetation to be removed from the levee slope (see **Table 4.7-2** in "Biological Resources"). This 0.57 acre of vegetation is primarily the canopy area of 18 trees varying between approximately 2 to 55 inches dbh that occur in the lower 1/3 of the levee slope, and 3 trees varying between approximately 26 and 46 inches dbh that occur in the upper 2/3 of the levee slope (ending at the waterside hinge point). The memorandum summarizing the results of the tree survey conducted for these trees is detailed in **Appendix D3**. Replacement plantings for these trees, which provide riparian and SRA habitat value, would be consistent with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG) guidelines for appropriate riparian species and spacing according to the terms of the permits discussed below. Under a worst-case scenario, approximately 1.15 acres of vegetation would be cleared to within 15 feet of the waterside levee toe in the event a variance is not granted. Along the NCC south levee (Reach D), vegetation on the lower 1/2 of the waterside levee slope would be eligible for a variance from USACE's levee vegetation guidance. However, without a variance, vegetation would need to be removed from the waterside in a worst-case scenario. Mitigation implementation would be considered part of levee maintenance and would be the subject of a future, separate environmental document. Environmental permits and other regulatory approvals would also be required, which may include a California Fish and Game Code Section 1602 Streambed Alteration Agreement, Clean Water Act Section 401 permit, and/or Clean Water Act Section 404 permit.

Without Phase 4b Project improvements, Federal and State floodplain regulations would effectively prevent most new development in most of the Natomas Basin. Existing residential, commercial, and industrial development

would continue to be concentrated in the southeastern portion of the Basin, south of Elkhorn Boulevard, occupying approximately one-third of the 53,000 acres encompassed by the perimeter levee system. Approximately two-thirds of the Basin, generally north of Elkhorn Boulevard, would remain in some form of agricultural, agricultural support, or open space use along with Airport uses. The Airport may be compelled to operate within its existing footprint, abandoning its current plans for modernization and expansion; alternatively, the Airport may construct its own limited flood damage reduction structure (i.e., a ring levee) to protect existing facilities and its expansion area. As of December 31, 2007, all agricultural leases on Airport property expired and have not been renewed. Some new development could occur along the eastern fringe of the Basin. The special flood hazard designation in the Natomas Basin would interrupt the regional blueprint for future (2030) growth adopted by the Sacramento Area Council of Governments and Valley Vision in 2006 (**Plate 2-5**). Up to 60,000 dwelling units and associated commercial and industrial developments that the blueprint anticipates will be located in the Natomas Basin would need to be redirected to other areas in the region over the next two decades. The Basin's existing residential, commercial, and industrial structures and their contents, with a replacement value of approximately $8.2 billion, or approximately $7.2 billion if the Airport facilities are excluded, would remain subject to a relatively high risk of flooding. The risk of environmental damage resulting from flooding in the urbanized portion of the Basin would remain relatively high.

2.2.1.2 POTENTIAL LEVEE FAILURE

The same conditions with respect to development within the Natomas Basin, as described above for the No Phase 4b Project Construction scenario, would exist for the Potential Levee Failure scenario. Without Phase 4b Project improvements to the Natomas perimeter levee system, the risk of levee failure would still remain high because to achieve the full benefits of flood damage reduction in the Natomas Basin, all phases of the NLIP must be implemented. Wind and wave run-up or seepage conditions could cause portions of this system to fail, triggering widespread flooding and extensive damage to the Basin's existing residential, commercial, agricultural, and industrial structures. Extensive damage to utilities, roadways, and other infrastructure systems would also likely occur. According to the Sacramento County Department of Water Resources, a levee failure could result in nearly complete inundation of the Basin with water level depths that could average 10 to 20 feet, and potentially reach over 30 feet in some areas (Sacramento County Department of Water Resources 2008); however, the magnitude of the flood damage would depend upon the location of the levee breach, severity of the storm, and river flows at the time of a potential levee failure (Sacramento County Department of Water Resources 2009).

Because impacts associated with a potential levee failure are largely unknown and would depend on the location and extent of flooding, many of these potential impacts are considered too speculative for meaningful consideration. A general, qualitative discussion of the likely impacts is nonetheless provided in this EIS/EIR.

2.2.2 NO-ACTION ALTERNATIVE—IMPLEMENTATION OF PHASE 1, 2, 3, AND 4a PROJECTS ONLY

USACE has already authorized construction of the Phase 1 and 2 Projects. Under this alternative, it is reasonably foreseeable as part of the NEPA environmental baseline that USACE will authorize construction of the Phase 3 and 4a Projects, but will not authorize the Phase 4b Project. Each of these project phases has independent utility from the Phase 4b Project. This alternative includes the following Phase 1, 2, 3, and 4a Project activities:

Phase 1 Project (Completed in 2008)

- **NCC south levee improvements: Seepage remediation**—Construct a seepage cutoff wall along the centerline of the NCC south levee in Reach D:1–3 (to overlap the Sacramento River east levee by approximately 500 feet) and reconstruct the levee.

Phase 2 Project (Currently under construction)

- **NCC south levee improvements: Levee raising and seepage remediation**—Raise and realign the NCC south levee to provide additional height and more stable waterside and landside slopes, and to reduce the need to remove waterside vegetation. Construct seepage cutoff walls through the levee crown in Reach D:3–7.

- **Sacramento River east levee (Reach C:1–4B): Levee raising and seepage remediation**—Construct an adjacent levee from the NCC to the end of Reach C:4B, raised where needed to provide adequate height. Use a combination of cutoff walls, seepage berms, and relief wells for seepage remediation where required.

- **Construction of a new Giant Garter Snake (GGS)/Drainage Canal between the North Drainage Canal and Elkhorn Reservoir**—Construct a new canal designed to provide drainage and associated giant garter snake habitat (referred to as the "GGS/Drainage Canal") from the North Drainage Canal to the slough east of Elkhorn Reservoir in Reach C:4B and B:5A–6B.

- **Relocation of the Elkhorn Canal (highline irrigation canal) between the North Drainage Canal and Elkhorn Reservoir**—Relocate approximately 10,500 feet of the canal and construct the relocated canal several hundred feet east of the landside toe of the Sacramento River east levee in Reach C:4B–6A.

- **Removal of a deep culvert at the location of Pumping Plant No. 2**—Excavate and remove approximately 400 feet of the existing levee section adjacent to the RD 1000 Pumping Plant No. 2 site to expose a deep culvert and possible voids under the levee; remove the deep culvert; reconstruct the levee adjacent to the pumping plant's sump with levee embankment fill; and demolish, remove, and relocate the remnants of the pumping plant within the project footprint.

- **Habitat creation and management**—Establish habitat features for giant garter snake in the new GGS/ Drainage Canal. Recontour and create managed marsh and grassland on lands used as borrow sources to offset project effects on giant garter snake and Swainson's hawk habitats. Establish grassland on the slopes of the adjacent levee and seepage berms. Install woodland plantings to offset the loss of portions of tree groves within the landside levee footprint.

- **Infrastructure relocation and realignment**—Realign and relocate irrigation and drainage canals and other infrastructure, such as utility poles, as needed to accommodate the flood damage reduction measures.

- **Encroachment management**—Remove encroachments as required to meet the criteria of USACE, the CVFPB, and FEMA.

- **Reclamation of borrow sites**—Excavate earthen material at the borrow sites, then return the sites to preconstruction uses or suitable replacement habitat.

Phase 3 Project (Preliminary construction began in fall 2009; major levee construction planned to begin in 2010)

- **Sacramento River east levee (Reach B:5A–9B): Levee raising and seepage remediation**—Construct a raised adjacent levee from just north of Elverta Road to just south of I-5. Use cutoff walls, seepage berms, and relief wells where required to reduce seepage potential. Acquire additional land in Reach B:9B to maintain a 450-foot protection corridor to prevent land uses that would be incompatible with proposed levee improvements.

- **Pleasant Grove Creek Canal (PGCC) west levee: Levee raising, slope flattening, and widening, and seepage remediation**—Raise the existing levee between Howsley Road and Sankey Road, flatten and widen the levee slopes, and construct cutoff walls or seepage berms to reduce seepage potential.

- **Natomas East Main Drainage Canal (NEMDC) west levee from Elkhorn Boulevard to NEMDC Stormwater Pumping Station: Levee widening and flattening and seepage remediation**—Widen and flatten the slopes of the existing levee and construct a cutoff wall to reduce seepage potential.

- **NEMDC west levee from NEMDC Stormwater Pumping Station to Northgate Boulevard: Seepage and slope stability remediation**—Construct a cutoff wall in the existing levee and/or reconstruct portions of the levee where required to reduce seepage potential and slope instability.

- **Relocation of portions of the Elkhorn Canal downstream of Elkhorn Reservoir**—Pipe approximately 9,400 feet of the canal between the new adjacent levee and Teal Bend Golf Club in Reach B:6B–7, and in an area adjacent to the landside residential properties in Reach B:8; and reconstruct the canal parallel to the adjacent levee at a distance of approximately 200 feet from the levee in Reach B:7–9A.

- **Construction of a new GGS/Drainage Canal downstream of Elkhorn Reservoir**—Construct a new canal designed to provide drainage and associated giant garter snake habitat (GGS/Drainage Canal) between Elkhorn Reservoir and the West Drainage Canal at I-5.

- **Habitat creation and management**—Establish habitat features for giant garter snake in the new GGS/ Drainage Canal. Recontour and create managed marsh and grassland on lands used as borrow sources to offset project effects on giant garter snake and Swainson's hawk habitats. Establish grassland on the slopes of the adjacent levee and seepage berms. Install woodland plantings to offset the loss of portions of tree groves within the landside levee footprint.

- **Infrastructure relocation and realignment**—Realign and relocate irrigation and drainage canals and other infrastructure, such as utility poles, as needed to accommodate the flood damage reduction measures.

- **Removal of landside vegetation**—In Reach B:10–12A of the Sacramento River east levee, clear landside vegetation in a 670-foot-wide corridor to prepare for future flood damage reduction work.

- **Encroachment management**—Remove encroachments as required to meet the criteria of USACE, the CVFPB, and FEMA.

- **Reclamation of borrow sites**—Excavate earthen material at the borrow sites, then return the sites to preconstruction uses or suitable replacement habitat.

- **Reconfiguration of Airport West Ditch**—Modify irrigation distribution and agricultural drainage systems and infrastructure to allow for dewatering of the Airport West Ditch.

- **Acquisition of right-of-way**—Acquire right-of-way through fee title or easement interest within the footprint of the project features and at the borrow sites, and prevent encroachments into the flood damage reduction system.

Phase 4a Project (Preliminary construction planned to begin in spring/summer 2011)

- **Sacramento River east levee (Reach B:10–15): Levee raising/rehabilitation and seepage remediation**—Construct an adjacent levee, raised in Reach B:10–11B, with cutoff walls, seepage berms, and relief wells, where required, to reduce seepage potential. Cutoff wall construction would continue 24 hours per day, 7 days per week (24/7).

- **Sacramento River east levee (Reach C:4B): Seepage remediation**—Install cutoff wall in the adjacent levee from Stations 190+00 to 201+50 to provide additional seepage remediation.

- **NCC south levee: Levee raising and seepage remediation at two locations**—At the Natomas Central Mutual Water Company (NCMWC) Bennett Pump Station and Northern Main Pump Station, raise the NCC south levee, flatten levee side slopes, install cutoff wall, and modify or replace the existing pumps and motors to reflect raising the discharge pipes above the 200-year design flood elevation. Cutoff wall construction would continue 24/7.

- **Replacement of South Lauppe Pump**—At Sacramento River Mile 77.2 (left bank), remove the pump, intake, and support structure prior to initiation of a separate USACE project to construct bank protection at the site. Following completion of USACE's bank protection project, SAFCA would reconstruct the pump, intake, and support structure.

- **Modification of Private River Pumps**—Raise discharge pipes and upgrade motors and pumps at nine private river pumps at NCC south levee Reach D:1 and Sacramento River east levee Reaches C:1–2 and B:11A–12A to be compatible with approved and proposed levee improvements.

- **Riverside Canal (highline irrigation canal) relocation and extension**—Extend the relocated canal upstream of Powerline Road in Reach B:11B–12B of the Sacramento River east levee; relocate the canal east of the adjacent levee in Reach B:13–15 and east of the adjacent levee, residences, and tree groves in Reach B:15–17; and construct a piped section in Reach B:15–18B at the toe of the new adjacent levee.

- **Modifications to NCMWC Riverside Pumping Plant**—Raise the pumping plant's discharge pipes above the 200-year design water surface and modify or replace the plant's existing pumps and motors to accommodate the raised discharge pipes. In-water construction would include use of dredge pumps to remove sediment so that new pumps could be installed, but no dewatering involving use of a cofferdam is anticipated.

- **Modifications to RD 1000 Pumping Plants Nos. 3 and 5**—Raise the pumping plants' discharge pipes above the 200-year design water surface, extend the pipes to tie into existing discharge pipes within the waterside bench, replace or modify pumps and motors, and perform other seepage remediation, including relocating the landside stations away from the levee to accommodate the raised discharge pipes. Most of these modifications would take place above the Sacramento River's normal summer and fall water surface elevations; however, reconstruction of the Pumping Plant No. 3 outfall and the removal of a deep culvert at Pumping Plant No. 3 would require dewatering.

- **Development of new and replacement groundwater wells**—Abandon approximately 13 agricultural wells and replace the wells in locations outside the footprint of the levee improvements. Additionally, construct five new wells to provide a water supply for habitat mitigation features. Drilling of the wells would require construction to continue 24 hours per day for up to 3 days to avoid collapse or seizing of drill equipment within the hole.

- **Borrow site excavation and reclamation**—Excavate earthen material at the borrow sites and then return the sites to preconstruction uses or suitable replacement habitat. For the Phase 4a Project levee and canal improvements along the Sacramento River east levee, the Fisherman's Lake Borrow Area is anticipated to be the primary source of soil borrow material. However, additional borrow sites may be needed for Phase 4a Project work along the Sacramento River including the I-5 Borrow Area; the Elkhorn Borrow Area; South Sutter, LLC; Krumenacher; the Airport north bufferlands; and the Twin Rivers Unified School District stockpile site. For the Phase 4a Project construction on the NCC south levee, the Brookfield borrow site is anticipated to be the primary source of soil borrow material. Some of these borrow sites (Elkhorn Borrow Area; Airport north bufferlands; Krumenacher; Twin Rivers Unified School District stockpile site; and South Sutter, LLC) have been fully analyzed in previous environmental documents; therefore, their potential impacts are incorporated by reference into this EIS/EIR. The Fisherman's Lake and I-5 Borrow Areas are fully analyzed in the Phase 4a EIS and EIR.

- **Habitat creation and management**—Establish a habitat complex in the Fisherman's Lake Borrow Area (Fisherman's Lake Habitat Complex) through the creation of approximately 140 acres of agricultural upland habitat; establishment of perennial native grasses on levee slopes, seepage berms, and access and maintenance areas; creation of up to 120 acres of managed seasonal and perennial marsh; and establishment of woodlands consisting of native riparian and woodland species at locations along the landside of the Sacramento River east levee.

- **Infrastructure relocation and realignment**—Realign and relocate private irrigation and drainage infrastructure (wells, pumps, canals, and pipes); and relocate utility infrastructure (power poles) as needed to accommodate the levee improvements and canal relocations.

- **Landside vegetation removal**—In Reach B:12B–15 of the Sacramento River east levee, clear landside vegetation in a corridor up to 660 feet wide to prepare for Phase 4a Project levee and canal improvement work.

- **Waterside vegetation removal**—Up to 4 acres of waterside vegetation would be removed due to replacement of pumping plants and construction of outfalls in Reach B:10–15 of the Sacramento River east levee.

- **Right-of-way acquisition**—Acquire lands within the Phase 4a Project footprint along the Sacramento River east levee, NCC south levee, and at associated borrow sites.

- **Encroachment management**—Remove encroachments as required to meet the criteria of USACE, CVFPB, and FEMA.

- **Exchange of properties between SAFCA and SCAS in Reaches C:4A and B:5B–6 of the Sacramento River east levee—**SAFCA and SCAS would carry out a land exchange that would support expansion of Airport bufferlands along the eastern edge of the new Elkhorn Irrigation Canal and provide SAFCA additional habitat mitigation land along the upper portion of the Sacramento River east levee outside of the 10,000-foot Airport Critical Zone.

Even assuming implementation of the Phase 1, 2, 3, and 4a Projects, under the Phase 4b Project No-Action Alternative the Natomas Basin would still face elevated flood risks because some components of the Natomas perimeter levee system would remain unimproved (primarily the Sacramento River east levee Reach A:16–20 and American River north levee Reach I:1–4). Those risks would be reduced by the Phase 4b Project because the Phase 4b Project includes the remaining improvements needed to achieve the NLIP's overall project objective of bringing the entire 42-mile Natomas Basin perimeter levee system into compliance with applicable Federal and state standards for levees protecting urban areas.

2.3 PROPOSED ACTION

2.3.1 POST-AUTHORIZATION CHANGE REPORT

As noted above and in Chapter 1, "Introduction and Statement of Purpose and Need," this EIS/EIR will support approval of USACE's Common Features/Natomas PACR. The Common Features/Natomas PACR includes all four project phases (1, 2, 3, and 4a and 4b) of the Landside Improvements Project, which is a component of the NLIP. This EIS/EIR summarizes environmental analyses for all previously approved project phases, as well as previously released public draft documents of the Landside Improvements Project, including alternatives previously considered, analyzed, and rejected from further consideration, and evaluates at a project-level the environmental effects of the proposed Phase 4b Project.

2.3.2 NATOMAS LEVEE IMPROVEMENT PROGRAM

SAFCA has developed the NLIP to address identified deficiencies in the levee system protecting the Natomas Basin in Sacramento and Sutter Counties, California. The objectives of the NLIP, as adopted by SAFCA, are to: (1) provide at least 100-year (0.01 AEP) flood risk reduction to the Natomas Basin as quickly as possible; (2) provide 200-year (0.005 AEP) flood risk reduction to the Basin over time; and (3) avoid any substantial increase in annual flood damages as new development occurs in the Basin. The relationship of the Landside Improvements Project phases, including the Phase 4b Project, to one another and their relationship to this EIS/EIR are summarized in Section 1.5.4, "Natomas Levee Improvement Program Environmental Documentation and Relationship of this EIS/EIR to Other Documents."

2.3.3 PHASE 4b PROJECT

2.3.3.1 INTRODUCTION

The Phase 4b Project would address underseepage, stability, erosion, penetrations, and levee encroachments along approximately 3.4 miles of the Sacramento River east levee in Reach A:16–20, approximately 1.8 miles of the American River north levee (Reach I:1–4), approximately 6.8 miles of the NEMDC west levee (Reaches F–G), approximately 3.3 miles of the PGCC west levee (Reach E), and the gaps left in the improvements of previous phases at levee penetrations and road crossings on the NCC south levee. The Phase 4b Project would also include relocation of the existing irrigation and drainage canals landside of the levee slopes, and relocation and modifications of the pumping plants, bridges, encroachments, and any penetrations of the levee embankment. Vegetation removal within the levee right-of-way to address USACE requirements and any environmental mitigation are also included in the Phase 4b Project. Levee height deficiencies would also be addressed along the northern segment of the NEMDC west levee and along the PGCC west levee. The Phase 4b Project also includes the proposed extension of a levee raise in Reach B:12A–13 that was previously addressed as part of the Phase 4a Project.

Construction of the Phase 4b Project is anticipated to begin as early as 2012 and is expected to be completed in 2013, assuming receipt of all required environmental clearances, permits, and approvals for project implementation. For the purposes of environmental analysis, the construction schedule would be as follows:

- American River north levee (Reach I:1–4) and NEMDC South (Reach H)—start construction as early as 2012 and complete in 2013.
- NEMDC North (Reaches F–G)/PGCC (Reach E) and Sacramento River east levee (Reach A:16–20)—start construction in spring 2013 and complete in 2016.

In a worst-case scenario, construction of the Phase 4b Project would overlap with construction of levee improvements previously addressed as part of the Phase 3 and 4a Projects (and approved by SAFCA and USACE [Phase 2 and 3 Projects]). Construction of the Phase 4a Project, which was analyzed in the Phase 4a EIS and EIR (USACE 2010 and SAFCA 2009f), would begin in 2011 and be completed in 2012. Therefore, for purposes of the environmental analysis, it is assumed that Reach B:13–15 of the Sacramento River east levee and all of the relocation of the Riverside Canal from the Phase 4a Project would be constructed simultaneously with portions of the Phase 4b Project in 2012. **Table 4.11-1** in Section 4.11, "Air Quality," shows detailed construction assumptions.

The Phase 3 EIS and EIR (USACE 2009b and SAFCA 2009b) analyzed the impacts of installation of a cutoff wall in NEMDC South (Reach H) and levee raising, slope flattening, and widening along the PGCC west levee. Because these elements are contained within or otherwise associated with the proposed improvements of the Phase 4b project at NEMDC South (Reach H) and PGCC (Reach E), they would be constructed at the same time, as shown in **Table 2-1**.

Table 2-1
Overlapping Environmental Coverage of the Phase 3 and 4b Projects

Project Element	Construction Timing/Overlap	Phase 3 Project Environmental Coverage	Phase 4b Project Environmental Coverage
NEMDC South (Reach H)	2013–2016	Cutoff wall installation	Levee raising south of Elkhorn Boulevard (Stations 313+00 to 318+00), erosion repair, and pumping plant modifications (Compliance with levee vegetation guidance along the west levee of NEMDC South [north of the Arden-Garden Connector] would be completed by 2016)
PGCC west levee (Reach E)	2013–2016	Levee raising, slope flattening, levee widening, and installation of a cutoff wall	Levee raising, additional levee widening, seepage berm option, PGCC culvert remediation, erosion repair, and excavation of soil borrow material from the Triangle Properties Borrow Area

Note:
[1] For the PGCC west levee, the levee raise analyzed as part of the Phase 3 Project would be constructed as part of the levee raise addressed in the Phase 4b Project. Therefore, air quality emissions for overlapping construction on the PGCC are equivalent to the emissions estimated for the PGCC component of the Phase 4b Project.
Source: Data compiled by AECOM in 2010

Phase 3 Project levee improvements along the Sacramento River east levee Reach B:5A–9B would be entirely constructed in 2010 and would not overlap with construction of the Phase 4b Project; however, as noted **Table 2-1**, construction of the NEMDC South cutoff wall (included in the Phase 3 Project) would overlap with construction of the Phase 4b Project.

2.3.3.2 ADJACENT LEVEE ALTERNATIVE (PROPOSED ACTION)

Plate 2-6 provides an overview of the elements of the Adjacent Levee Alternative (Proposed Action) along with previous project phases. The Adjacent Levee Alternative (Proposed Action) has the following major elements:

- **Sacramento River east levee (Reach A:16–20): Levee widening/rehabilitation and seepage remediation**—Construct an adjacent levee with flattened landside slope and cutoff walls, seepage berms, and relief wells, where required, to reduce potential underseepage and seepage through the levee (**Plates 2-7a** and **2-7b**). Cutoff wall construction may be conducted 24/7, except in the urbanized area east of the Interstate 80 (I-80) overcrossing, where it would be restricted to daytime hours.
- **Sacramento River east levee (Reach B:10–15)**: **Levee raise extension**—Extend levee raise within Phase 4a Project footprint from Station 635+00 to 680+00 to address levee height requirements.
- **American River north levee (Reach I:1–4): Slope flattening and seepage remediation**—Flatten the slope and install cutoff walls in the American River north levee from just east of Gateway Oaks Drive to Northgate Boulevard **(Plate 2-9)**. Cutoff wall construction would be restricted to daytime hours.
- **NEMDC North (Reaches F–G): Levee raising, slope flattening, and seepage remediation**—Raise the levee in place or construct an adjacent levee, flatten slopes, and install cutoff walls from Sankey Road to Elkhorn Boulevard. Cutoff wall construction may be conducted 24/7.
- **PGCC (Reach E) and NEMDC South (Reach H): Levee raising and slope flattening**—Raise the levee in place or construct a raised adjacent levee and flatten slopes from Howsley Road to Sankey Road on the PGCC west levee (**Plate 2-13**). On the NEMDC South, install a cutoff wall, flatten the slope, and raise the levee in place or construct an adjacent levee for approximately 500 feet south of Elkhorn Boulevard (**Plate 2-14**). Cutoff wall construction may be conducted 24/7.

- **PGCC (Reach E) and NEMDC South (Reach H): Waterside improvements**—Erosion repair and rock slope protection at locations where erosion around the outfall structures penetrating the levee has been observed. Construct additional remediation to protect against damage caused by beavers and burrowing animals (**Plates 2-13** and **2-14**).

- **PGCC (Reach E) culvert remediation**—Upgrade or remove five culverts that currently drain the area east of the PGCC by passing water under the canal to drainage ditches along the landside of the PGCC west levee (**Plate 2-13**). Under the culvert removal option, construct detention basins east of the PGCC levee to provide replacement storage for drainage. Depending on the design of the detention basins, pumping stations may be needed to discharge water out of the basins and into the PGCC. Installation of culverts under Pierce-Roberts drain, Pleasant Grove Creek, and Curry Creek may also be needed to interconnect drainage subbasins.

- **SR 99 NCC Bridge remediation (Reach D:6)**—Construct a moveable barrier system or a stop log gap at the south end of the SR 99 bridges to be used at high river stages to prevent overflow from reaching the landside of the NCC south levee. Modify the bridge deck connections to the supporting piers and abutments as needed to resist uplift pressure during high water stages. Install additional seepage remediation consisting of seepage cutoff walls where the bridges cross the NCC south levee (Reach D:6). Cutoff wall construction may be conducted 24/7.

- **West Drainage Canal**—Realign the West Drainage Canal to shift an approximately 1-mile portion, starting at I-5, to an alignment farther south of the Airport Operations Area. Modify the existing canal east of the alignment to reduce bank erosion and sloughing, decrease aquatic weed infiltration, improve RD 1000 maintenance access, and enhance giant garter snake habitat connectivity.

- **Riego Road Canal (highline irrigation canal) relocation**—Relocate approximately 4,000 feet of irrigation canal, approximately 250 feet of buried irrigation piping and culverts, and several irrigation turn-out structures away from the proposed levee footprint for the northern segment of the NEMDC west levee (Reaches F–G).

- **NCC south levee ditch relocations**—Relocate the Vestal Drain ditch and Morrison Irrigation Canal landward to reduce underseepage potential at the NCC south levee (Reach D:2, 5, and 6).

- **Modifications to RD 1000 Pumping Plants**—Raise and/or replace the discharge pipes for Pumping Plant Nos. 1A and 1B along the Sacramento River east levee and Pumping Plant Nos. 6 and 8 along the NEMDC west levee (Reaches G–H). Construct new outfall structures for Pumping Plant Nos. 6 and 8, requiring dewatering of portions of the NEMDC. Construction for Pumping Plant Nos. 6 and 8 may be conducted 24/7.

- **Modifications to City of Sacramento Sump Pumps**—Raise and/or replace the discharge pipes for City Sump 160 (Sacramento River east levee Reach A:19B), City Sump 58 (American River north levee [Reach I:3]), and City Sump 102 (NEMDC west levee at Gardenland Park [Reach H]). Construct new outfall structures, requiring dewatering of portions of the Sacramento River, the low-flow channel of the NEMDC along the waterside of the American River north levee, and the NEMDC. Relocate pump stations as needed to accommodate the proposed levee improvements. Construction City Sump 102 may be conducted 24/7.

- **Borrow site excavation and reclamation**—Excavate earthen material at the borrow sites and then return the sites to preconstruction uses or suitable replacement habitat. For levee improvements along the Sacramento River east levee (Reach A:16–20) and the American River north levee (Reach I:1–4), the proposed South Fisherman's Lake Borrow Area (**Plate 2-7a**) and the West Lakeside School Site (**Plate 2-17**) are anticipated to be the primary source of soil borrow material. A portion of the Fisherman's Lake Borrow Area (identified on **Plate 2-6**), which was fully analyzed in the Phase 4a EIS/EIR, could provide additional borrow material for these improvements. The proposed Triangle Properties Borrow Area (**Plate 2-13**) would be the primary source of borrow material for levee improvements along the PGCC (Reach E) and NEMDC North (Reaches F–G). The Krumenacher borrow site and Twin Rivers Unified School District stockpile site (**Plate 2-14**), which were fully analyzed in previous environmental documents, would be the source of borrow material for

improvements to NEMDC South and back-up sources for NEMDC North (Reaches F–G). The South Fisherman's Lake Borrow Area, the West Lakeside School Site, and the Triangle Properties Borrow Area are fully analyzed in this EIS/EIR.

- **Habitat creation and management**—Enhance connectivity between northern and southern populations of giant garter snake in the Natomas Basin by improving habitat conditions along the West Drainage Canal; establish woodlands consisting of native riparian and woodland species in the vicinity of the American River Parkway as compensation for woodland impacts along the Sacramento River east levee (Reach A:16–20), American River north levee (Reach I:1–4), PGCC (Reach E), and NEMDC (Reaches F–H); and create up to 200 acres of managed marsh from Brookfield borrow site to compensate for impacts to giant garter snake habitat as a result of loss of rice from levee and canal improvements, widen and extend the Chappell Ditch south of the borrow site to enhance delivery of surface water, and improve the adjacent Chappell Drain.

- **Infrastructure relocation and realignment**—Relocate and realign private irrigation and drainage infrastructure (wells, pumps, canals, and pipes) and water and sanitary sewer lines, and relocate utility infrastructure (power poles) as needed to accommodate the levee improvements and canal relocations. Well construction may be conducted 24/7.

- **Landside vegetation removal**—In Sacramento River east levee Reach A:16–20, American River north levee Reach I:1–4, and NEMDC South (Reach H), vegetation would be cleared to prepare for Phase 4b Project levee and canal improvement work. To comply with USACE vegetation guidance, all vegetation would be cleared at least 15 feet from the landside toes of the improved levees (Sacramento River east levee Reach A:16–20 and American River north levee Reach I:1–4).

- **Waterside vegetation removal**—Waterside vegetation would be removed due to erosion control measures and modifications to pumping plants along the Sacramento River east levee (Reach A:16–20), NEMDC west levee (Reaches F–H), and PGCC west levee (Reach E). However, it is assumed that construction of an adjacent levee (the Adjacent Levee Alternative [Proposed Action]) in Sacramento River east levee Reach A:16–20 would allow the levee to qualify for a variance from USACE vegetation guidance criteria such that removal of waterside vegetation would not be necessary. Along the American River north levee Reach I:1–4, the levee is already considered overbuilt, and therefore it may also qualify for a variance from USACE vegetation guidance, allowing waterside vegetation to remain. Like the American River north levee, a section of NEMDC South from Northgate Boulevard to the Arden-Garden Connector is also assumed to be overbuilt enough that clearance of waterside vegetation would also not be necessary under a variance request to USACE. In the event a variance is not granted for the American River north levee (including the segment between Northgate Boulevard and the Arden-Garden Connector), waterside vegetation could be removed from the upper two-thirds of the levee slope. Along the west levee of NEMDC South north of the Arden-Garden Connector (Reach G), at a minimum, if a variance request is granted by USACE, vegetation removal would be required for all non-native trees from within the vegetation-free zone; all native trees that have a dbh of four inches or less; and all larger native trees that are located on the waterside slope, the crown, or within 15 feet of the landside toe (or within the right-of-way, if less than 15 feet). Under a worst-case scenario, vegetation with stem widths that have a dbh greater than two inches would be cleared to within 15 feet of the waterside levee toe.

- **Bank protection**—Bank protection would be constructed along the NEMDC South (Reach H) and PGCC (Reach E) to address the waterside erosion sites because, as noted above, the adjacent levee would be constructed in Sacramento River east levee Reaches A–C:1–20 under the NLIP; no erosion protection is needed along the left bank of the Sacramento River. The distance from the projected levee slope of the new adjacent levee to the current bank location is sufficient to guarantee that bank erosion would not intrude into the projected levee slope in the near future.

- **Right-of-way acquisition**—Acquire lands within the Phase 4b Project footprint along the Sacramento River east levee (Reach A:16–20), American River north levee (Reach I:1–4), NEMDC west levee (Reaches F–G), PGCC west levee (Reach E), and at associated borrow sites.

- **Encroachment management**—Remove encroachments as required to meet the criteria of USACE, CVFPB, and FEMA. SAFCA would be required to submit a variance request to CVFPB, and then ultimately to USACE, requesting confirmation that SAFCA's adjacent levee design for the Sacramento River east levee (Reach A–C:1–20), American River north levee (Reach I:1–4), and NEMDC west levee (Reaches F–G) sufficiently addresses USACE's guidance regarding vegetation on levees, if SAFCA chooses to implement the project without Federal participation.

- **Natomas Levee Class 1 Bike Trail Project**—Construct a bicycle and pedestrian trail along the 42-mile loop of the Natomas Basin levee perimeter in the northwestern portion of the County of Sacramento, southern portion of Sutter County, and a portion of the City of Sacramento (program-level analysis only, because site-specific details are not available).

Flood Risk Reduction Components

Sacramento River East Levee (Reach A:16–20)

Levee improvements would be constructed within Reach A:16–20 (Station 780+00 to Station 956+82) of the Sacramento River east levee, a distance of approximately 3.3 miles (**Plates 2-7a** and **2-7b**), and include the following components:

- **Adjacent Levee.** A new levee would be constructed adjoining the existing Sacramento River east levee in Reach A:16–20. In these reaches, the existing levee already meets height requirements. Therefore, the top of the new levee would be no higher than the elevation of the existing levee crown, except in locations where sections would be raised to accommodate raising of drainage discharge pipe crossings. With no levee raise, the adjacent levee crown would be graded to drain towards the landside; therefore, no surface drainage outlets across Garden Highway would be required. The landside slope of the adjacent levee would be 3H:1V for Reach A:16–19A and varying 3H:1V to 2H:1V for Reach A:19B–20. The levee typical dimensions are shown in **Plates 2-8a** through **2-8d**. The adjacent levee is designed to avoid removal of vegetation on the waterside of the levee, providing a vegetation-free levee prism corresponding to USACE requirements.

- **Cutoff Walls.** Three-foot-wide cutoff walls made of either SB, cement bentonite (CB) or soil-cement-bentonite (SCB) would be installed either through the existing levee or along the landside toe of the existing levee. Depending on the construction method used, the top of the cutoff walls would be at least 5 feet above the existing ground surface at the landside toe of the levee (within either the new adjacent setback levee or existing levee) and extend to a depth of 110 feet below ground surface in some areas. Locations and depths would be determined during engineering design. The maximum linear extent would be approximately 17,700 feet (Reach A:16–20).

- **Seepage Berms.** Where the need for seepage berms is anticipated (Reach A:16–19A), widths would range from 100 to 300 feet. **Table 2-2** shows the locations of worst-case seepage berm widths by reach. Depending upon the width and geotechnical considerations, maximum thickness would be 6–9 feet. All berms would gradually slope downward to about 4 feet thick at the landside edge, with a 3H:1V slope to ground level. A gravel surface patrol road would be constructed near the outside edge of the seepage berm. Final locations of the seepage berms would be determined during engineering design.

Table 2-2
Maximum Limit of Flood Damage Reduction Improvements by Sacramento River East Levee Reach

Reach (Cross-Section Plate)	Stationing	Adjacent Levee	Seepage Remediation	Maximum Limit of Flood Damage Reduction Improvements	
		Approximate Distance from Center Line of Garden Highway		Approximate Distance from Center Line of Garden Highway	Approximate Distance from Existing Levee Toe
A:16 (Plate 2-8a)	780+00 to 799+00	83 feet	300-foot-wide seepage berm and/or cutoff wall	460 feet	405 feet
A:16, 17, 18A (Plate 2-8a)	799+00 to 848+00	83 feet	100-foot-wide seepage berm (+ potential relief wells) and/or cutoff wall	230 feet	175 feet
A:18B, 19A (Plate 2-8b)	848+00 to 863+00	70 feet	250-foot-wide seepage berm (+ potential relief wells) and/or cutoff wall	350 feet	326 feet
A:19A, 19B (Plate 2-8b)	863+00 to 878+00	58 feet	200–250-foot-wide seepage berm (+ potential relief wells) and/or cutoff wall	up to 344 feet	up to 286 feet
A:19B (Plates 2-8c through 2-8d)	878+00 to 923+50	52 feet to 83 feet	Cutoff wall and relief wells	80 feet to 103 feet	73 feet to 93 feet
A:19B, 20 (Plate 2-8d)	923+50 to 950+83	60 feet	Cutoff wall and relief wells	125 feet	65 feet

Source: Information from HDR in 2009; compiled by AECOM in 2009

- **Relief Wells.** Relief wells would be constructed in Reach A:16–20 in the O&M access corridor. Relief wells would also be constructed along some of the entrance channels to the landside pump stations. Relief wells would be spaced between 60–100 feet apart and would extend to depths of between 60–80 feet below the ground surface. Relief well discharge would be directed to existing City of Sacramento pumping stations by constructing a pipe system that is parallel to the existing City of Sacramento drainage pipe system, with periodic manhole covers for access. Alternatively, if capacity allows, relief well discharge would be routed directly into existing City of Sacramento drainage pipe systems. The relief well discharge would be contained in the existing O&M corridor.

- **Operation and Maintenance Access/Utility Corridors.** An O&M access corridor would be established adjacent to the toe of the levee or seepage berm. Beyond this corridor, where space is available, a corridor would be established for relocation of power lines and other utility infrastructure. **Plates 2-8a** through **2-8d** show the reach-by-reach configurations of O&M and utility corridors, including widths.

- **Maximum Limit of Flood Damage Reduction Improvements: Table 2-2** shows the proposed footprint of the levee improvements by reach and stationing. The adjacent levee and maximum limit of flood damage reduction improvements are shown on **Plates 2-7a** and **2-7b**, and cross-section dimensions are shown in **Plates 2-8a** through **2-8d**. This footprint is considered a worst-case scenario. Where feasible, the levee and seepage remediation improvements would stop short of existing rights-of-way, such as Wheelhouse Avenue, Marina Glen Way, Avocet Court/Swainson Way, and La Lima Way. However, these rights-of-way may

provide a portion of the O&M corridor for levee inspection and emergency flood fight activities. Installation of retaining walls, which may be employed to limit the landward extent of the footprint, could temporarily affect these roads. However, access to residences along these roads would be maintained during construction.

Construction of the proposed levee improvements would involve the following additional measures:

- **Garden Highway Closures.** In Reach A:16–19A, the landside lane of Garden Highway would be closed for up to 6 months to allow for construction of a cutoff wall. The closed portion of Garden Highway would shift along the levee crown as the cutoff wall is installed. Because of space constraints, in Sacramento River east levee A:Reach 19B–20, the landside lane of Garden Highway would be closed for up to 6 months to allow for construction of a cutoff wall. In addition, because there would be no room for a two-way haul route at the toe of the existing levee, the waterside lane of Garden Highway would be used by haul trucks delivering materials. This lane would only be open to local traffic, with use of traffic controls. Through traffic would be detoured to West El Camino Avenue, SR 160, and Richards Boulevard. Garden Highway would be closed at several locations, including City of Sacramento Pump 160 and RD 1000 Pumping Plant Nos. 1A and 1B, to allow for installation of pipes that need to be raised.

- **Reconstruction of Intersections.** Garden Highway intersections at Orchard Lane and up to 20 additional private parcel ramps would require reconstruction to accommodate the adjacent levee. Where alternate access to the private properties is available, the private ramps would be removed and not replaced. The design would meet Sacramento County or City of Sacramento roadway design criteria, depending on the jurisdiction.

- **Measures to Reduce Impacts to Residences, Businesses, and Heritage Oaks.** Where residences, businesses, and heritage oak trees are located, measures would be employed to reduce the project footprint impacts to these resources, to the extent feasible given levee design and seepage-remediation performance requirements. These measures could include reducing the width of the adjacent levee, seepage berms, and O&M access and utility corridors; and strategically using cutoff walls, seepage relief wells, retaining walls, steeper landside levee slopes; and undergrounding utilities or shifting utilities to the waterside of the levee.

Plates 2-7a and **2-7b** show the Sacramento River east levee improvements in plan view, based on the adjacent levee width and maximum limit of flood damage reduction improvements shown in **Table 2-2**. **Plate 2-23a** shows the parcels within the footprint.

The levee improvements for the Phase 4b Project are anticipated to be constructed between April 15 and November 1. However, construction could extend as late as December 31. Some related activities, such as power pole relocations and demolition or relocation of residential or agricultural structures, may be conducted before April 15, and site restoration and demobilization could extend through January. The construction crew size during its peak would be up to 60 people per shift working two 12-hour shifts. The construction sequence would be divided into several different fronts to meet the proposed schedule. Cutoff wall construction in the generally rural reaches west of the I-80 overcrossing may be conducted 24/7. Sundays would be used to maintain the cutoff wall construction equipment. Cutoff wall construction in the urbanized area east of the I-80 overcrossing would be restricted to daytime hours.

Personnel, equipment, and imported materials would reach the project site primarily by Bryte Bend Road and an off-road haul route parallel to the existing landside levee toe in Reach A:16–20. However, secondary routes may include use of I-5, Powerline Road, El Centro Road, and San Juan Road. The primary corridors where construction activity would take place are off of public roadways, within and through the soil borrow areas and within the adjacent levee alignment and existing dirt roads used for access to the work areas.

Approximately 1,168,000 cubic yards of soil borrow would be required to construct these levee improvements. **Table 2-3** shows the quantity of each fill type needed and the expected source for the Adjacent Levee Alternative (Proposed Action). The levee fill, seepage berm fill, and excavation quantities include a 25% shrinkage factor to account for volume loss during excavation, placement, and compaction. The primary source for this material would be in the South Fisherman's Lake Borrow Area (**Plate 2-7a**). The West Lakeside School Site (**Plate 2-17**)

would be a potential back-up borrow site. The average round-trip distance for truck hauls would be approximately 3.5 miles.

Table 2-3
Quantities of Fill Required for Sacramento River East Levee (Reach A:16–20) – Adjacent Levee Alternative (Proposed Action)

Material Type	Quantity	Source (Average Round-Trip Haul Distance)
Levee fill	505,000 cy	South Fisherman's Lake Borrow Area (4 miles)
Seepage berm fill	663,000 cy	South Fisherman's Lake Borrow Area (4 miles)
Waste material	—	On-site
Aggregate base	15,900 tons	Commercial source (30 miles)
Total	**1,168,000 cy / 15,900 tons**	**NA**

Notes: cy. = cubic yards; NA = not applicable
Source: Data provided by HDR in 2009

Delivery of the materials listed in **Table 2-3** would require up to 900 haul trips per day. Construction in Reach A:16–19A (**Plate 2-7a**) would require an average of 540 truck trips per day based on the following assumptions: (1) construction would take place within a 6-month period, with 140 days available during the 156-day construction season (April 1–November 1), (2) truck capacities would be 14 cubic yards (24 tons), and (3) haul trucks would be used for moving all borrow material from borrow sites. Use of haul trucks for all trips is a conservative assumption because some of these trips could take place off road and may involve the use of elevating scrapers rather than haul trucks.

For construction in Reach A:19B–20 (**Plate 2-7b**), an average of 360 truck trips per day would be required, based on the assumption that hauling would take place over a 45-day period using street-legal haul trucks with a 12 cubic yard capacity (20 tons). Lighter haul trucks would be employed in these reaches because of the increased need to use surface streets in these reaches as a result of limited space for two-way truck traffic along the landside levee toe.

The primary haul route from the South Fisherman's Lake Borrow Area would be Bryte Bend Road and an off-road haul route parallel to the existing landside levee toe in Reach A:16–20. Short sections of Powerline Road, El Centro Road, San Juan Road, West El Camino Avenue, and Gateway Oaks Drive may be used for some trips (**Plate 2-6**). Hauling from West Lakeside School Site would also use off-road haul routes. For Reach A:19B–20, a single lane of Garden Highway from approximately Marina Glen Way to Northgate Boulevard may be used for return trips for haul trucks because landside space may be too limited to provide a two-lane off-road haul route. In this case, use of street-legal haul trucks would be required. Approximately 15,900 tons of aggregate base would be hauled from commercial sources up to 30 miles away, with 10,500 tons to be used in Reach A:16–19A and 5,400 tons to be used in Reach A:19B–20.

Table 2-4 summarizes the types of equipment that may be used throughout the construction sequence, along with an approximation of the duration of each activity.

Table 2-4
Anticipated Equipment Types and Duration of Use for Sacramento River East Levee Reach A:16–20 – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
Mobilization	NA	NA
Site preparation (tree removal, clearing, grubbing, stripping)	Scrapers (6)	27
	Front-end loaders (2)	27
	Crawler/tractors (tree pushers) (2)	27
	Water trucks (2)	27
	Motor graders (2)	27
	Chippers/grinders (4)	27
	Haul trucks (10)	27
Removal of landside structures and other facilities	Excavators (2)	24
	Haul trucks (24)	24
	Front-end loaders (1)	24
Construction of adjacent levee and seepage berms (includes borrow site activities)	Scrapers (5)	140
	Excavators (5)	140
	Front-end loaders (5)	140
	Haul trucks (14 cy) (50)	140
	Bulldozers (5)	140
	Sheepsfoot compactors (2)	140
	Motor graders (2)	140
	Water trucks (2)	140
Cutoff wall construction	Front-end loaders (10)	60
	Bulldozers (20)	60
	Extended-boom pallet loaders (10)	60
	300-kW generators (10)	60
	Slurry pumps (10)	60
	Pickup trucks (8)	60
	Haul trucks (8)	60
	Excavators (6)	60
	Deep soil mix rigs (10)	60
Reconstruction of Garden Highway at intersections	Backhoes (1)	27
	Smooth drum compactors (1)	27
	Asphalt pavers (1)	27
	Haul trucks (3)	27
	Striping trucks (1)	27
	Truck-mounted augers (1)	27
Site restoration and demobilization	Hydroseeding trucks (3)	34
	Water trucks (3)	34
	Haul trucks (2)	34

Notes: cy = cubic yards; kW = kilowatt; NA = not applicable
Source: Data provided by HDR in 2009

The sequence of construction activities would be as follows:

- **Landside Vegetation Removal:** Along the landside of the Sacramento River east levee in Reach A:16–20, approximately 26 acres of vegetation would be removed as needed from the levee improvement footprint, which is a minimum of 15 feet from the levee or seepage berm toe. Vegetation would also be cleared from O&M and utility corridors, as needed. This operation would require removal of some trees and relocation/removal of elderberry shrubs, which occur mostly adjacent to existing roads. Small trees and

elderberry shrubs, where feasible, would be relocated to woodland preservation areas that are part of the Phase 4b Project. A minimal amount of below-ground disturbance would occur.

- **Waterside Vegetation Removal:** No waterside vegetation would need to be removed as part of the levee improvements in Reach A:16–20 of the Sacramento River east levee. In terms of compliance with USACE levee vegetation guidance, it is assumed that, with a variance, construction of an adjacent levee (the Adjacent Levee Alternative [Proposed Action]) would allow the levee to meet USACE vegetation guidance criteria without removal of waterside vegetation.

- **Utilities Relocation:** All utilities (water, sewer, communication, and electrical, including power poles) that currently exist on the landside slope of the levee and at the landside levee toe would need to be relocated and/or rerouted to accommodate the widened levee footprint. A Pacific Gas and Electric (PG&E) Company tower (Reach A:18A, at approximately Station 847+00) is located within the proposed 250-foot-wide seepage berm. The tower would potentially need to be relocated outside of the levee footprint, but all efforts would be made to protect it in place. To the extent feasible, mainline utility infrastructure, such as power poles, would be relocated beyond the landside levee, with the potential of undergrounding some utilities as an option. Should placement of poles be required on top of the seepage berms, raised foundations would be constructed to prevent the poles from penetrating the top of the seepage berm. In Reach A:19A–19B (from Station 863+00 to 923+00), where space on the landside is limited, some utility poles may need to be relocated to the waterside of the existing levee; however, no new power poles would be located on the waterside of the levee in the vicinity of existing waterside residences unless there is no feasible alternative for providing service to these residences. No power poles would be relocated within the new levee prism. Tree pruning would likely be required in some locations to accommodate the power poles and associated wires. The project proponent(s) would conduct the relocations in coordination with the appropriate utility companies and the construction operations.

- **Construction Mobilization:** Mobilization would include setting up construction offices and transporting heavy construction equipment to the work site, and would also include preparation of the borrow sites. The main construction staging areas would be located on a city-owned parcel (Costa Park site) immediately east of the I-80 overcrossing (**Plate 2-7a**). The area would be used for the contractor's and engineer's construction trailers, parking for personnel, storage for machine maintenance tool and parts, water trucks, and storage of fuels and other materials to be used for construction.

- **Site Preparation (Clearing, Grubbing, and Stripping) at the Levee:** Site preparation at the levee would begin with clearing structures and woody vegetation from the landside slope of the existing levee, the footprint of the adjacent setback levee, the seepage berm, and the permanent O&M access and utility corridors. The clearing operation would be followed by grubbing operations to remove stumps, root balls, and below ground infrastructure. This operation would be followed by stripping the top 12 inches of earthen material from the landside slope of the existing levee and the footprint of the adjacent setback levee and seepage berm (unless there are identified cultural artifacts, in which case the area would be mowed and special construction methods would be used to minimize impacts). Excess earthen materials (organic soils and grass from the adjacent levee foundation and excavated material that does not meet levee embankment criteria) would be respread on the surface of the new levee slopes and seepage berms. Debris generated during the clearing and grubbing operations would be hauled off-site to landfills, concrete recycling plants, or cogeneration facilities.

- **Site Preparation (Clearing, Grubbing, and Stripping) at the Borrow Sites:** Site preparation at the borrow sites would begin with clearing structures and woody vegetation from the borrow area. The clearing operation would be followed by grubbing operations to remove stumps, root balls, and below-ground infrastructure. The borrow area would then be disced to chop surface vegetation and mix it with the near-surface organic soils. The discing operation would be followed by stripping the top 12 inches of earthen material from the borrow excavation area and stockpiling this soil at the borrow site. These soils would be respread on the surface of the borrow site following completion of the borrow excavation and grading. Debris generated

during the clearing and grubbing operations would be hauled off-site to landfills, concrete recycling plants, or cogeneration facilities.

- **Removal or Modification of Landside Structures and Other Facilities:** An estimated 15–20 residential and other agricultural structures are located within the footprint of the levee improvements. These structures, and the facilities supporting them, would have to be modified, removed, or relocated out of the project footprint before the start of levee construction in those areas. Irrigation facility conveyance, distribution boxes, wells, and standpipes within the footprint of the project features would be demolished and replaced as needed. Debris from structure demolition, power poles, utility lines, piping, and other materials requiring disposal would be hauled off-site to a suitable landfill. Demolished concrete could be sent to a concrete recycling facility. Wells and septic systems would be abandoned in accordance with the applicable state and county requirements. Existing utilities, pipelines, and appurtenant structures located at the toe of the existing levee will need to be relocated outside of the project footprint. Utilities may include, but not be limited to, water, sewer, and electrical mains servicing both the landside and waterside residential and commercial structures.

- **Construction of Adjacent Levee, Cutoff Walls, and Seepage Berms:** Borrow material from the potential borrow sites would be delivered to the levee construction sites using haul trucks or scrapers where it would be spread by motor graders and compacted by sheepsfoot rollers to build the adjacent levee and seepage berms. In areas of cutoff wall construction, the adjacent levee would initially be built up to approximately 5 feet above existing grade at the toe of the levee to create a working platform. Construction of the cutoff wall downstream of Powerline Road may require closure of one lane of Garden Highway, with one-way traffic maintained to provide access to properties along the work area. Additional material from borrow sites would then be delivered to the project site for construction of the remainder of the adjacent levee and the seepage berms.

- **Installation of Relief Wells:** Where needed, relief wells would be constructed using techniques typically used for drilling water wells. A drill rig would bore a hole into the ground to the required depth of the well, the well casing and well screen sections would be installed, and then the well would be finished by pumping water from it to clean out the bentonite drilling fluid and to consolidate the well's gravel pack. After the solids are settled out, water from the well development operations would be discharged to adjacent fields or drainage ditches.

- **Traffic Control during Construction:** Single-lane traffic control and detours would be required while constructing cutoff walls, reconstructing the landside lane of Garden Highway. Examples of traffic control measures to be considered include use of flaggers to maintain alternating one-way traffic while roadway and utility facility work is proceeding on one-half of the roadway/intersection, use of advance construction signs and other public notices to alert drivers of activity in the area, and use of "positive guidance" detour signing on alternate access roads to reduce inconvenience to the driving public. If detours are required for through traffic, local traffic would be allowed, subject to delays during critical construction operations. Concrete barriers (K-Rail) would be used to separate traffic from the cutoff wall work areas. A moving segment of one lane of Garden Highway would be closed during the entire construction season—up to 6 months. Through traffic would be detoured to West El Camino Avenue, SR 160, and Richards Boulevard.

- **Reconstruction of Garden Highway:** Where cutoff wall construction occurs through the crown of the adjacent levee, some reconstruction work on Garden Highway would be required to restore the landside lane of the roadway. Garden Highway intersections at major roadway ramps would require degrading, rebuilding the embankment, and repaving to accommodate the installation of the cutoff wall and slope flattening. Traffic control and detours would be required during this phase of construction.

- **Site Restoration and Demobilization:** Upon completion of construction activities, the stripped material would be placed on top of the completed seepage berms, and both the levee slopes and the tops of the seepage berms would be hydroseeded. An aggregate base patrol road would be constructed on the crown of the new

levee and on the landside edge of the seepage berm. Any construction debris would be hauled to an appropriate waste facility. Equipment and materials would be removed from the site, and staging areas and any temporary access roads would be restored to preproject conditions. Demobilization would likely occur in various locations as construction proceeds along the project alignment.

- **Postconstruction Site Conditions.** Following construction, the levee slopes, seepage berms, maintenance access rights-of-way, and any previously vegetated areas disturbed during construction would be seeded with a grass mix that meets DFG criteria. To the extent that they do not interfere with flood control inspection and operations, maintenance practices for the areas of grassland cover within the footprint of the levee facilities would be conducted to promote the value of these areas as foraging habitat for Swainson's hawk.

Sacramento River East Levee (Reach B:10–15) – Extension of Levee Raise

The Phase 4a EIS and EIR (USACE 2010 and SAFCA 2009f) analyzed a raised adjacent levee from Reach B:10 through Reach B:12A, with 7–10 waterside drainage outfalls planned north of Powerline Road to drain stormwater to the waterside of the levee. Subsequent engineering analysis indicates that additional levee raising is needed in Reach B:12A–13 to meet height requirements, with the proposed raise extending an additional 4,500 feet, from approximately Station 635+00 to Station 680+00 (see **Plate 2-7a** [inset]). This levee raise extension would be constructed within the previously analyzed (and SAFCA-approved) Phase 4a Project footprint.

From Station 635+00 to Station 662+00, the levee raise would be accomplished by extending the raised adjacent levee for approximately 2,700 feet. From Station 662+00 to Station 680+00, rather than an adjacent levee raise, the existing top of levee, where Garden Highway is located, would be raised in place. The portion of the levee raise from Station 662+00 to Station 680+00 would be constructed as part of the Phase 4b Project; however, as part of the Phase 4a Project, SAFCA would construct from Station 635+00 to Station 662+00 a levee embankment wide enough to accommodate the Phase 4b Project raise through this reach.

The extension of the adjacent levee raise would not require additional waterside drainage outfalls beyond the range 7 to 10 outfalls that was analyzed as part of the Phase 4a EIS and EIR. Therefore, no increase in vegetation removal (estimated 0.5 acres) or additional impacts to water quality would result from these design changes compared to what was analyzed in the Phase 4a EIS and EIR. However, because of the extra length of the highway drainage swale, the spacing of the waterside drainage outfalls would increase. For the extension of the adjacent levee raise from Station 635+00 to 662+00 as part of the Phase 4a Project, one of the outlets would need to be located south of Powerline Road. No additional Garden Highway closures would result from construction of the proposed design modifications. A temporary access road would be provided for the levee segment that would be raised in place (Station 662+00 to Station 680+00). Access to waterside residences in this reach would be maintained at all times.

American River North Levee

Levee improvements would be constructed from Gateway Oaks Drive to Northgate Boulevard, a distance of approximately 2.3 miles. They would include the following components:

- **Levee Slope Flattening.** A new levee slope (3H:1V) would be constructed adjoining the existing American River north levee from Station 0+00 to Station 115+71 (Reach I:1–4) (**Plate 2-9**). The levee typical dimensions are shown in **Plates 2-10a** and **2-10b**. The existing levee already meets height requirements; therefore, the top of the new levee would be no higher than the elevation of the existing levee crown, except at locations where pumping plant discharge pipelines or other utilities must be raised.

- **Cutoff Walls.** Three-foot-wide cutoff walls made of SB, CB, or SCB would be installed either through the existing levee or along the landside toe of the existing levee. Depending on the construction method used, the top of the cutoff walls would be at least 5 feet above existing ground surface (within either the new adjacent setback levee or existing levee) and extend to a depth of 110 feet below ground surface in some areas.

Locations and depths would be determined during engineering design. The total linear extent would be up to 12,000 feet.

- **Seepage Berms.** Seepage berms are not a proposed remediation feature for the American River north levee.
- **Relief Wells.** Relief wells are not a proposed remediation feature for the American River north levee.
- **O&M Access/Utility Corridors.** A 15–30-foot-wide O&M corridor would be established adjacent to the toe of the levee. A 10-foot-wide utility corridor would be located off the landside toe. However, if space is not available, the utility corridor would be adjusted to fit within the available space.
- **Measures to Reduce Impacts to Heritage Oaks.** Where heritage oak trees are located, measures would be employed to reduce the project footprint impacts to these resources, to the extent feasible given levee design and seepage-remediation performance requirements. These measures could include reducing the width of the levee expansion and O&M access and utility corridors, using retaining walls, and potentially undergrounding utilities, where feasible.
- **Garden Highway Closures.** For levee improvements along the American River north levee, Garden Highway/Arden-Garden Connector would be completely closed for up to 6 months between I-5 and Northgate Boulevard. Through-traffic would be detoured to West El Camino Avenue, SR 160, Richards Boulevard, Truxel Road, and Northgate Boulevard. Garden Highway would be closed at several locations, including City of Sacramento Pump 58, to allow for installation of pipes that need to be raised.
- **Reconstruction of Intersections.** Garden Highway intersections at Natomas Park Drive, Truxel Road, Arden-Garden Connector, Northgate Boulevard, and four additional private parcel ramps would require degrading, rebuilding the embankment, and repaving to accommodate the installation of the cutoff wall and slope flattening. The ramps would be reconstructed to the current general ramp and intersection geometry. Where alternate access to the private properties is available, the private ramps would be removed and not replaced. The intersection design would meet City of Sacramento roadway design criteria.

Plate 2-9 shows the levee improvements in plan view. **Plate 2-23a** shows the parcels within the footprint. The width of the real estate acquisition and/or easements would vary between 83 feet and 110 feet from the baseline centerline of the existing levee (up to about 50 feet from the toe of the existing levee in most reaches) (see **Plates 2-10a** and **2-10b** for profile views). In Reach I:2–4, the maximum extent of levee improvements, including the O&M corridor, would end at established property lines.

Approximately 167,000 cubic yards of soil borrow would be required to construct these levee improvements. **Table 2-5** shows the quantity of each fill type needed and the expected source for the Adjacent Levee Alternative (Proposed Action). Fill quantities include a 25% shrinkage factor to account for volume loss during excavation, placement, and compaction. The primary source for this material would be in the South Fisherman's Lake Borrow Area (**Plate 2-7a**). The West Lakeside School Site (**Plate 2-17**) would be a potential back-up borrow site. The average round-trip distance for truck hauls would be approximately 5 miles.

Delivery of the materials listed in **Table 2-5** would require about 120 haul trips per day. These estimates are based on the following assumptions: (1) construction would take place within a 6-month period, with 140 days available during the 156-day construction season (April 1–November 1), (2) truck capacities would be 14 cubic yards (24 tons), and (3) haul trucks would be used for moving all borrow material from the borrow sites. The use of elevating scrapers rather than haul trucks is not possible for the American River north levee improvements. The primary haul route from the South Fisherman's Lake Borrow Area would be Bryte Bend Road. Secondary haul routes may make use of short sections of El Centro Road, San Juan Road, West El Camino Avenue, Natomas Park Drive, Truxel Road, and Northgate Boulevard (**Plate 2-6**). Garden Highway from approximately Marina Glen Way to Northgate Boulevard may be used for return trips for haul trucks because landside space may be too limited to provide a two-lane off-road haul route. Approximately 8,700 tons of aggregate base and approximately

Table 2-5
Quantities of Fill Required for the American River North Levee (Reach I:1–4) – Adjacent Levee Alternative (Proposed Action)

Material Type	Quantity	Source (Average Round-Trip Haul Distance)
Levee fill	167,000 cy	South Fisherman's Lake Borrow Area (5 miles)
Waste material	27,000 cy	On-site
Aggregate base	8,700 tons	Commercial source (30 miles)
Asphalt concrete	1,500 tons	Commercial source (30 miles)
Total	**167,000 cy / 10,200 tons**	

Notes: cy = cubic yards
Source: Data provided by HDR in 2009

1,500 tons of asphalt concrete would be hauled from commercial sources up to 30 miles away. Personnel, equipment, and imported materials would reach the project sites via I-5, Truxel Road, Gateway Oaks Drive, Northgate Boulevard, and Arden-Garden Connector (**Plate 2-6**).

The levee improvements on the American River north levee are anticipated to be constructed between April 15 and November 1. However, construction could extend as late as December 31. Some related activities, such as power pole relocations and demolition or relocation of residential or agricultural structures, may be conducted before April 15, and site restoration and demobilization could extend through January. The construction crew size during its peak is estimated at 60 people per shift working two 12-hour shifts. The construction sequence would be divided into several different headings to meet the proposed schedule.

Table 2-6 summarizes the types of equipment that may be used throughout the construction sequence under the Adjacent Levee Alternative (Proposed Action), along with an approximation of the duration of each activity.

The sequence of construction activities would be as follows:

- **Landside Vegetation Removal:** Along the landside of the American River north levee (Reach I:1–4), approximately 7 acres of vegetation would be removed as needed from the levee improvement footprint, which would be a minimum of 15 feet from the widened levee or new seepage berm toe. The 20-foot-wide proposed utility corridor would also require vegetation removal. This operation would require removal of some trees and relocation/removal of elderberry shrubs, which occur mostly adjacent to existing roads. Small trees and elderberry shrubs, where feasible, would be relocated to woodland preservation corridors that are part of the Phase 4b Project. A minimal amount of below ground disturbance would occur. Because the American River north levee is already relatively wide, and the proposed slope flattening would widen its footprint further, it is expected that vegetation clearing would likely not be required on the waterside of the levee.

- **Waterside Vegetation Removal:** No waterside vegetation would be removed as part of improvements to the American River north levee. In terms of compliance with USACE levee vegetation guidance, the levee (including the section between Northgate Boulevard and the Arden-Garden Connector) may qualify for a variance because it was widened to support construction of the Garden Highway. However, in the event the variance were not granted, it is assumed that the upper two-thirds of the waterside slope would be cleared, resulting in the removal of up to 6 acres of waterside vegetation in a worst-case scenario.

Table 2-6
Anticipated Equipment Types and Duration of Use for Improvements to American River North Levee – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
Mobilization	–	27
Site preparation (tree removal, clearing, grubbing, stripping)	Scrapers (2)	27
	Front-end loaders (2)	27
	Crawler/tractors (tree pushers) (2)	27
	Water trucks (1)	27
	Motor graders (2)	27
	Chippers/grinders (4)	27
	Haul trucks (6)	27
Removal of landside structures and other facilities	Excavators (2)	24
	Haul trucks (8)	24
	Front-end loaders (1)	24
Flattening slope (includes borrow site activities)	Scrapers (2)	140
	Excavators (2)	140
	Front-end loaders (2)	140
	Haul trucks (14 cy) (10)	140
	Bulldozers (2)	140
	Sheepsfoot compactors (2)	140
	Motor graders (2)	140
	Water trucks (1)	140
Cutoff wall construction	Front-end loaders (6)	60
	Bulldozers (12)	60
	Extended-boom pallet loaders (6)	60
	300-kW generators (6)	60
	Slurry pumps (6)	60
	Pickup trucks (6)	60
	Haul trucks (2)	60
	Excavators (2)	60
	Deep soil mix rigs (6)	60
Reconstruction of Garden Highway at four intersections	Backhoes (4)	27
	Smooth drum compactors (4)	27
	Asphalt pavers (2)	27
	Haul trucks (12)	27
	Striping trucks (2)	27
	Truck-mounted augers (2)	27
Site restoration and demobilization	Hydroseeding trucks (3)	34
	Water trucks (3)	34
	Haul trucks (3)	34

Notes: cy = cubic yards; kW = kilowatt
Source: Data provided by HDR in 2009

- **Utilities Relocation:** All utilities (water, sewer, communication, and electrical, including power poles) that currently exist on the landside slope of the levee and at the landside levee toe would need to be relocated and/or rerouted to accommodate the widened levee footprint. To the extent feasible, mainline utility infrastructure, such as power poles, would be relocated beyond the landside levee toe, with the potential option of undergrounding some utilities. Some poles may need to be relocated to the waterside of the existing levee. Tree pruning would likely be required in some locations to accommodate the power poles and associated wires. SAFCA would conduct the relocations in coordination with the appropriate utility companies and the construction operations.

- **Construction Mobilization:** Mobilization would include setting up construction offices and transporting heavy construction equipment to the work site, and would also include preparation of the borrow sites. The main construction staging area would be located adjacent to the working area along the existing Garden Highway alignment and within Discovery Park (**Plate 2-9**). The area would be used for the contractor's and engineer's construction trailers, parking for personnel, storage for machine maintenance tool and parts, water trucks, and storage of fuels and other materials to be used for construction.

- **Site Preparation (Clearing, Grubbing, and Stripping) at the Levee:** Site preparation at the levee would begin with clearing structures and woody vegetation from the landside slope of the existing levee, the footprint of the adjacent setback levee, and the permanent O&M access and utility corridors. The clearing operation would be followed by grubbing operations to remove stumps, root balls, and below-ground infrastructure. This operation would be followed by stripping the top 12 inches of earthen material from the landside slope of the existing levee and the footprint of the adjacent setback levee (unless there are identified cultural artifacts, in which case the area would be mowed and special construction methods would be used to minimize impacts). Excess earthen materials (organic soils and grass from the adjacent levee foundation and excavated material that does not meet levee embankment criteria) would be respread on the surface of the new levee slopes. Debris generated during the clearing and grubbing operations would be hauled off-site to landfills, concrete recycling plants, or cogeneration facilities.

- **Site Preparation (Clearing, Grubbing, and Stripping) at the Borrow Sites:** Site preparation at the borrow sites would begin with clearing structures and woody vegetation from the borrow area. The clearing operation would be followed by grubbing operations to remove stumps, root balls, and below ground infrastructure. The borrow area would then be disced to chop surface vegetation and mix it with the near-surface organic soils. The discing operation would be followed by stripping the top 12 inches of earthen material from the borrow excavation area and stockpiling this soil at the borrow site. These soils would be respread on the surface of the borrow site following completion of the borrow excavation and grading. Debris generated during the clearing and grubbing operations would be hauled off-site to landfills, concrete recycling plants, or cogeneration facilities.

- **Removal or Modification of Landside Structures and Other Facilities:** Multiple facilities or structures would have to be modified, removed, or relocated out of the project footprint before the start of levee construction in those areas. Utility facilities within the footprint of the project features would be demolished and replaced as needed. Debris from structure demolition, power poles, utility lines, piping, and other materials requiring disposal would be hauled off-site to a suitable landfill. Demolished concrete could be sent to a concrete recycling facility. Wells and septic systems would be abandoned in accordance with the applicable state and county requirements.

- **Construction of Slope Flattening Levee and Cutoff Walls:** Borrow material from the potential borrow sites would be delivered to the levee construction sites using haul trucks where it would be spread by motor graders and compacted by sheepsfoot rollers to build the slope flattening levee. In areas of cutoff wall construction, the slope flattening levee would initially be built up to approximately 5 feet above existing grade at the toe of the levee to create a working platform. Construction of the cutoff wall downstream of Gateway Oaks Drive may require closure of one lane of Garden Highway, with one-way traffic maintained to provide access to properties along the work area.

- **Traffic Control during Construction:** Single-lane traffic control and detours would be required while constructing cutoff walls and reconstructing Garden Highway. Examples of traffic control measures to be considered include use of flaggers to maintain alternating one-way traffic while roadway and drainage facility work is proceeding on one-half of the roadway/intersection, use of advance construction signs and other public notices to alert drivers of activity in the area, and use of "positive guidance" detour signing on alternate access roads to reduce inconvenience to the driving public. If detours are required for through-traffic, local traffic would be allowed, subject to delays during critical construction operations. Concrete barriers (K-Rail) would be used to separate traffic from the cutoff wall work areas. A moving segment of the landside lane of Garden Highway would be closed during the entire construction season—up to 6 months.

- **Reconstruction of Garden Highway:** Where cutoff wall construction occurs through the crown of the levee, some reconstruction work of Garden Highway would be required to restore the landside lane of the roadway. Garden Highway intersections at major roadway ramps would require degrading, rebuilding the embankment, and repaving to accommodate the installation of the cutoff wall and slope flattening. Traffic control and detours would be required during this phase of construction. Garden Highway reconstruction would be conducted in compliance with applicable county road standards.

- **Site Restoration and Demobilization:** Upon completion of construction activities, the levee slopes and other disturbed areas would be hydroseeded. Any construction debris would be hauled to an appropriate waste facility. Equipment and materials would be removed from the site, and staging areas and any temporary access roads would be restored to preproject conditions. Demobilization would likely occur in various locations as construction proceeds along the project alignment.

- **Postconstruction Site Conditions:** Following construction, the levee slopes, maintenance access rights-of-way, and any previously vegetated areas disturbed during construction would be seeded with a grass mix that meets DFG criteria. To the extent that they do not interfere with flood control inspection and operations, maintenance practices for the areas of grassland cover within the footprint of the levee facilities would be conducted to promote the value of these areas as foraging habitat for Swainson's hawk.

Natomas East Main Drainage Canal West Levee – Northern Segment

Work along the northern segment of the NEMDC west levee (NEMDC North [Reaches F–G]), located between Elkhorn Boulevard and Sankey Road, would include levee raising, landside slope flattening, and cutoff wall construction (**Plate 2-11**). The total length of this levee segment is 35,690 linear feet. Natomas Road and East Levee Road are located on top of the levee.

The levee height is insufficient from Elkhorn Boulevard to a point approximately 1 mile upstream of Elverta Road. Through this area, the levee would be raised between 1–2 feet. The levee raise would be accomplished by one of two methods:

1) Constructing either a strengthen-in-place levee raise, where the levee is raised by projecting the waterside slope up at a 3H:1V slope to its ultimate height, providing a width necessary to reconstruct the existing Natomas Road/East Levee Road on top of the new levee, and projecting the landside slope back down to existing grade at a 3H:1V slope (**Plate 2-12**, upper illustration); or

2) Leaving Natomas Road/East Levee Road in place and constructing an adjacent levee next to the existing levee to the height required for the appropriate levee height (**Plate 2-12**, lower illustration).

The preferred method would be determined based upon engineering alternatives analyses of the two options. Where levee raising is not required, the levee would be widened landward to provide a theoretical 3H:1V waterside slope, a minimum 20-foot-wide levee crest, and a 3H:1V landside slope. If the levee is strengthened in place, Natomas Road/East Levee Road would be closed to through-traffic for up to 6 months. **Plate 2-11** shows the maximum limit of flood damage reduction improvements that would occur under either option.

Vegetation would be removed as needed from the levee improvement footprint, which is a minimum of 15 feet from the levee or seepage berm toe. The 20-foot-wide proposed utility corridor would also require vegetation removal (see **Plate 2-12**). Power poles that currently exist on the landside slope of the levee and at the landside levee toe would need to be relocated and/or rerouted to accommodate the widened levee footprint. **Plate 2-12** shows the location of the proposed 15-foot-wide utility corridor.

To mitigate for levee underseepage, cutoff walls totaling up to 22,000 linear feet would be constructed 24/7 along the NEMDC North west levee to a depth of up to 80 feet. For an adjacent or widened levee, the cutoff wall would be constructed by placing compacted levee fill to create a cutoff wall working platform at the landside toe of the levee. The platform would be within the prism of the finished widened or adjacent levee, at a height 3–5 feet above the existing grade. For a strengthen-in-place option, the cutoff wall would be constructed at the existing levee centerline, following a one-half degrade of the existing levee. For either option, the cutoff wall would be a SB cutoff wall constructed by the conventional, long-reach excavator method. Once the cutoff wall is constructed and has consolidated, the remaining levee fill would be placed over the cutoff wall and the levee constructed to its final grade. For the full length of the west levee of NEMDC North, the project proponent(s) would acquire easements at least 30 feet wide for levee maintenance and 15 feet wide for existing and future utilities.

The crew size for this phase of the Adjacent Levee Alternative (Proposed Action) during its peak is estimated at 45–55 people working on three fronts, two 12-hour shifts, 6 days a week. Sundays would primarily be used for equipment maintenance. **Table 2-7** lists the anticipated major materials quantities associated with both engineering options. The potential sources of fill material for this work would be the Triangle Properties Borrow Area (**Plate 2-13**) and the Krumenacher borrow site (**Plate 2-14**). Up to 810 truck trips per day would be required to move this material from borrow sites to construction sites. Aggregate material would come from commercial sources up to 30 miles away.

Table 2-7
Anticipated Major Materials Quantities for Natomas East Main Drainage Canal North Cutoff Wall and Levee Widening/Raising Work – Adjacent Levee Alternative (Proposed Action)

Description	Strengthen-in-Place Option	Adjacent Levee Option
Borrow site excavation	830,000 cy	965,000 cy
Levee embankment degrade	240,000 cy	0 cy
Levee embankment fill	1,025,000 cy	965,000 cy
SB cutoff wall	980,000 sf	1,005,000 sf
Class 2 aggregate surfacing	70,000 tons	27,000 tons
Asphalt concrete paving	22,250 tons	0 tons

Notes: cy = cubic yards; sf = square feet
Source: Data provided by Wood Rodgers in 2009

Table 2-8 lists the anticipated equipment and construction durations for this work.

Table 2-8
Anticipated Equipment and Duration for Natomas East Main Drainage Canal North Cutoff Wall and Levee Widening/Raising Work – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Clearing and grubbing/stripping	Elevating scrapers (8)	10
	Water trucks (2)	10
	Front-end loaders (4)	10
	Pickup trucks (5)	10
2. Borrow site preparation (concurrent with no. 1)	Water truck (1)	20
	Scrapers (2)	20
	Tractors with discing equipment (2)	20
3. Working surface construction (follows no. 2)	Water trucks (3)	20
	Vibratory rollers (5)	20
	Scrapers (15)	20
	Excavators (3)	20
4. Cutoff wall construction (follows no. 3)	Hydraulic excavators (6)	85
	Front-end loaders (3)	85
	Extended boom pallet loader (1)	85
	300 kW generators (2)	85
	Slurry pumps (2)	85
	Pickup trucks (5)	85
	Haul trucks (3)	85
	Water trucks (2)	85
5. Levee raising/widening (lags no. 4 by 21 days)	Water trucks (3)	90
	Vibratory rollers (5)	90
	Scrapers (20)	90
	Haul trucks (15)	90
	Motor graders (2)	90
6. Demobilization/cleanup (follows no. 5)	Hydroseeding trucks (2)	12
	Extended boom pallet loader (1)	12
	Haul trucks (2)	12

Note: kW = kilowatt
Source: Data provided by Wood Rodgers in 2009

Pleasant Grove Creek Canal and Natomas East Main Drainage Canal South – West Levee Raise

The Phase 3 EIS and EIR disclosed and analyzed levee improvements at the PGCC west levee (levee raising, slope flattening, levee widening, and installation of a cutoff wall) and southern segment of the NEMDC west levee (installation of a cutoff wall). The Adjacent Levee Alternative (Proposed Action) would build on these improvements and increase the level of flood risk reduction by raising (1–1.5 feet) the west levee of the PGCC and an approximately 500-foot-long section of the west levee of NEMDC South (Reach H) extending south of Elkhorn Boulevard from Station 313+00 to 318+50) to provide 3 feet of levee height (**Plates 2-13** and **2-14**). **Plates 2-13** and **2-14** also show the footprint analyzed as part of the Phase 3 Project. The Phase 4b Project analyzes only the increment change in the footprint and additional material required for construction.

The levee raise would be accomplished by one of two options:

1) Constructing either a strengthen-in-place levee raise, where the levee is raised by projecting the waterside slope up at a 3H:1V slope to its ultimate height, providing a width necessary to reconstruct the existing East Levee Road on top of the new levee, and projecting the landside slope back down to existing grade at a 3H:1V slope (**Plate 2-15**, upper illustration); or

2) Leaving East Levee Road in place and constructing an adjacent levee next to the existing levee (**Plate 2-15**, lower illustration).

The preferred method would be determined based upon further detailed engineering alternatives analyses of the two options.

Vegetation would be removed as needed from the levee improvement footprint, which is a minimum of 15 feet from the levee or seepage berm toe. The 20- to 50-foot-wide proposed utility corridor would also require vegetation removal (see **Plate 2-15**). Power poles that currently exist on the landside slope of the levee and at the landside levee toe would need to be relocated and/or rerouted to accommodate the widened levee footprint. **Plate 2-15** shows the location of the proposed 15- to 20-foot-wide utility corridor.

Table 2-9 lists the total anticipated major materials quantities associated with this work. The primary source of the fill material for work on the PGCC would be the Triangle Area Properties Borrow Area (**Plate 2-13**). The primary source of the fill material for work on the NEMDC South would be the Krumenacher Borrow Site and the Twin Rivers Unified School District Stockpile Site (**Plate 2-14**). Up to 566 truck trips per day would be required to move this material from borrow sites to construction sites. Aggregate material would come from commercial sources up to 30 miles away.

Table 2-9
Anticipated Major Materials Quantities for Pleasant Grove Creek Canal West Levee Raise and Natomas East Main Drainage Canal West Levee Raise – Adjacent Levee Alternative (Proposed Action)

Description	Strengthen-In-Place Option	Adjacent Levee Option
Borrow site excavation	109,000 cy	345,500 cy
Levee embankment fill	87,000 cy	290,000 cy
Class 2 aggregate surfacing	48,300 tons	340 tons
Asphalt concrete paving	11,190 tons	40 tons

Note: cy = cubic yards
Source: Data provided by Wood Rodgers in 2009

Table 2-10 lists the anticipated equipment and construction durations for this work.

Table 2-10
Anticipated Equipment and Duration for Pleasant Grove Creek Canal West Levee Raise and Natomas East Main Drainage Canal West Levee Raise – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Clearing and grubbing/stripping	Elevating scrapers (4)	10
	Water trucks (2)	10
	Front-end loaders (2)	10
	Haul trucks (15)	10
	Pickup trucks (5)	10
2. Borrow site preparation (concurrent with no. 1)	Tractors with scrapers (2)	5
	Water truck (1)	5
3. Levee embankment placement (follows no. 1 and 2)	Elevating scrapers (16)	80
	Hydraulic excavators (2)	80
	Front-end loaders (2)	80
	Pickup trucks (5)	80
	Haul trucks (3)	80
4. East Levee Road/Natomas Road reconstruction (follows no. 3)	Water trucks (2)	30
	Smooth drum rollers (8)	30
	Asphalt concrete pavers (5)	30
	Asphalt delivery trucks (50)	30
5. Cleanup/demobilization (follows no. 4)	Water trucks (2)	12
	Hydroseeding trucks (2)	12
	Extended boom pallet loader (1)	12
	Haul trucks (2)	12

Source: Data provided by Wood Rodgers in 2009

The crew size for this phase of the Adjacent Levee Alternative (Proposed Action) during its peak is estimated at 45–55 people working two 12-hour shifts, 6 days a week. Sundays would primarily be used for equipment maintenance.

Pleasant Grove Creek Canal and Natomas East Main Drainage Canal South Waterside Improvements

Several areas along the waterside slope of the PGCC and NEMDC South (Elkhorn Boulevard to Northgate Boulevard) are currently experiencing erosion or are susceptible to future erosion. Erosion repair and rock slope protection is required at the PGCC and NEMDC South at the locations listed in **Table 2-11** and shown on **Plates 2-13** and **2-14**.

Table 2-11
Rock Slope Protection Areas at PGCC and NEMDC South – Adjacent Levee Alternative (Proposed Action)

Stream Confluence	Location of Rock Slope Protection
PGCC at Curry Creek	PGCC west bank opposite of where creek enters PGCC
PGCC at Pleasant Grove Creek	PGCC west bank opposite of where creek enters PGCC
PGCC at Howsley Road Bridge West Abutment	West abutment of Howsley Road Bridge
PGCC at Pierce-Roberts Drain	PGCC west bank opposite of where creek enters PGCC
NEMDC at Dry Creek	Existing west bank erosion area at confluence of Dry Creek and NEMDC
NEMDC at Arcade Creek	Existing west bank erosion area at confluence of Arcade Creek and NEMDC

Notes: NEMDC = Natomas East Main Drainage Canal; PGCC = Pleasant Grove Creek Canal
Source: Data provided by Wood Rodgers in 2009

The linear extent of the proposed protection on the west bank of the NEMDC at the confluence with Dry Creek is approximately 2,500 feet. Proposed protection would include rock fill to bring the waterside bench up to existing grade, a rock blanket to stabilize the existing 2:1 bank slope below the bench, and a blanket of rock on the waterside toe to help minimize scour (launchable toe). The linear extent of the proposed protection on the west bank of the NEMDC at the confluence with Arcade Creek is approximately 400 feet. Proposed protection would include a variable width bench, a rock riprap blanket on the slope, and a launchable toe.

The bank protection areas on the west bank of the PGCC at Curry Creek, Pleasant Grove Creek, and Pierce-Roberts Drain range from 300–400 feet in length. At Curry Creek and Pleasant Grove Creek, riprap would be placed on the west levee waterside slopes opposite the confluences with Curry and Pleasant Grove Creeks, extending from the waterside toe to the top of slope for about 50 feet upstream and 100 feet downstream of the confluences. The rock would likely be covered with soil and grass. Riprap armoring would also occur opposite the outlet of the Pierce-Roberts Drain. Rock or other protection would be placed along the Howsley Road embankment and along the landside of the PGCC west levee near the Howsley Road gap to prevent erosion from undermining the gap or affecting the landslide slope. Investigations are ongoing to determine if riprap should be placed around the left (west) abutment of the Howsley Road Bridge.

The PGCC west levee and the NCC south levee between SR 99 and Howsley Road also experience a significant problem with beavers and other burrowing animals. To provide low-maintenance mitigation for this concern, a beaver exclusion wall would be constructed at these areas. The wall would be constructed of reinforced concrete or steel or vinyl sheet piling, and would be located at the waterside levee toe at a distance of about 50 feet from the levee centerline. The top of the wall would be located above the ordinary high water mark, and the bottom of the wall would reach as deep as 20 feet.

The NEMDC low-flow channel beneath and downstream of I-80 has been disturbed by the City of Sacramento Pump Station 157 outfall structure. The outfall has caused the low-flow channel to meander towards the west (right) bank of the channel, which could eventually weaken the existing NEMDC west levee. To fix this problem, the low-flow channel would be reconstructed at the middle of the channel. This reconstruction would be accomplished by creating a diversion for the existing stream flow, filling the existing low-flow channel, and excavating a new low-flow channel. The total length of the channel realignment would be approximately 1,000 feet. A rock berm would be placed between the low-flow channel and Sump 157 to minimize the impact of the pump station discharge on the west levee.

Table 2-12 lists the anticipated major materials quantities associated with this work. The sources of fill material for this work would be the Krumenacher Borrow Site and the Twin Rivers Unified School District Stockpile Site (**Plate 2-14**). Aggregate material would come from commercial sources up to 30 miles away.

Table 2-12
Total Anticipated Major Materials Quantities for Pleasant Grove Creek Canal and Natomas East Main Drainage Canal South Waterside Levee Improvement Work – Adjacent Levee Alternative (Proposed Action)

Material Type	Quantity
Rock slope protection	8,600 tons
Beaver exclusion wall	405,800 sf
Excavation	22,250 cy
Backfill	17,800 cy

Notes: cy = cubic yards; sf = square feet
Source: Data provided by Wood Rodgers in 2009

Table 2-13 lists the anticipated equipment and construction durations for this work.

Table 2-13
Anticipated Equipment and Duration for Pleasant Grove Creek Canal and Natomas East Main Drainage Canal South Waterside Levee Improvement Work – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Erosion repair and rock slope protection installation	Front-end loaders (4)	21
	Excavators (3)	21
	Water trucks (2)	21
	Haul trucks (15)	21
	Pickup trucks (2)	21
2. Beaver protection wall installation (independent of item no. 1)	Backhoes (3)	80
	Water truck (1)	80
	Front-end loaders (2)	80
	Light duty crane (1)	80
3. NEMDC low flow channel relocation (independent of item nos. 1 or 2)	Excavator (1)	30
	Vibratory roller (1)	30
	Loaders (2)	30

Source: Data provided by Wood Rodgers in 2009

Erosion repair and rock slope protection installation would require approximately 15 people working a single 8-hour shift, 6 days a week. Installation of the beaver protection wall would require two wall installation fronts with 15 people working one 10-hour shift, 6 days a week. Relocation of the NEMDC low-flow channel would require 12 people working one 10-hour shift, 6 days a week.

Natomas East Main Drainage Canal South – Levee Vegetation Compliance

Along the NEMDC west levee south of the NEMDC Stormwater Pumping Station (Reach G), at a minimum, if a variance request is granted by USACE, vegetation removal would be required for all non-native trees from within the vegetation-free zone, all native trees that have a dbh of four inches or less, and all larger native trees that are

located in the upper 2/3 of the waterside slope, the crown, or within 15 feet of the landside toe (or within the right-of-way, if less than 15 feet). This vegetation removal would total less than 0.6 acre. Under a worst-case scenario, approximately 1.1 acres of vegetation would be cleared on the waterside to within 15 feet of the waterside levee toe. On the landside of NEMDC South, vegetation would be cleared 10 feet from the existing toe.

Pleasant Grove Creek Canal Culvert Remediation

Five existing culverts are located beneath the PGCC west levee and extend under the canal eastward to the east side of the PGCC (**Plate 2-13**). The purpose of these culverts is to drain the area east of the PGCC when the PGCC is experiencing high flows. The Phase 3 Project described these culverts, where they pass beneath the PGCC west levee, as being replaced with pipe materials and pipe closure devices meeting USACE standards for levee penetrations. As an alternative to this upgrade-in-place option, the Phase 4b Project may remove these culverts in their entirety, beneath both the east and west PGCC levees and the PGCC itself. To mitigate for the loss of a drainage outfall area for properties east of the PGCC, five detention basins would be constructed in the area between the PGCC east levee and the Union Pacific Railroad. The basins, which are shown on **Plate 2-13**, would be set back an appropriate distance from the landside toe of the PGCC east levee. To replace the drainage function of these under drains, a combination of the detention basins, drainage channels, new lift pumps, and culverts under tributary streams may be employed. The detention basins and pumping facilities would be sized to handle runoff volumes of a 10-day storm event to protect structures, although temporary flooding of agricultural fields may be allowed during such an event. The detention basins would be returned to rice production, if feasible.

Table 2-14 lists the total anticipated major materials quantities associated with this work.

Table 2-14
Total Anticipated Major Materials Quantities for
Pleasant Grove Creek Canal Culvert Removal Work – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Quantity (cubic yards)
Excavation	4,750
Backfill	5,875

Source: Data provided by Wood Rodgers in 2009

Table 2-15 lists the anticipated equipment and construction durations for this work. The crew size for this phase of the project during its peak is estimated at 35–40 people working 10-hour shifts, 6 days a week.

State Route 99 Natomas Cross Canal Bridge Remediation

The undersides of the SR 99 bridges over the NCC (**Plate 2-16**) would be affected by high river stages in a flood event. The southern abutment for both bridges is supported by the NCC south levee. Preliminary analysis indicates the bridges are stable under this condition; however, a means to prevent the river stage from reaching the landside of the NCC south levee by way of the bridge deck is required.

Providing closure at SR 99 would entail constructing a removable barrier that would be stored off-site and installed across the roadway on the south side of the bridge when the NCC stage reached a pre-established elevation. To support the removable barrier, a permanent structure constructed at and adjacent to the highway would be constructed. The permanent support system would tie into levee raising work completed as part of the project disclosed and analyzed in the Phase 2 EIS and EIR.

Table 2-15
Anticipated Equipment and Duration for
Pleasant Grove Creek Canal Culvert Removal Work – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Culvert removal	Excavators (2)	15
	Vibratory rollers (2)	15
	Water truck (1)	15
	Front-end loaders (2)	15
	Haul trucks (2)	15
	Pickup trucks	15
2. Detention basin area stripping	Elevating scrapers (4)	5
	Loaders (2)	5
	Water trucks (2)	5
3. Detention basin excavation (follows no. 3)	Scrapers (15)	30
	Water trucks (2)	30
	Motor graders (2)	30
4. Demobilization/cleanup (follows no. 3)	Water trucks (2)	12
	Hydroseeding trucks (2)	12
	Haul trucks (2)	12

Source: Data provided by Wood Rodgers in 2009

Construction of the SR 99 removable barrier system would involve lane closures and traffic controls. The northbound and southbound lanes of the NCC Bridge would be closed for 2 weeks (1 week for each direction), with a total of up to 5 weeks to allow for set up and take down of traffic controls and traffic bypasses.

Underseepage mitigation at the bridges would be provided by either a series of relief wells and a relief well discharge collection system, or a SCB cutoff wall constructed by the Deep-Mix Method (DMM) through the highway road section. For a relief well installation, wells would be installed at the levee landside toe adjacent to the Howsley Road undercrossing (located just south of the NCC bridges), just off of the north shoulder of Howsley Road. Discharge from the wells would be collected in a pipe or drainage ditch and conveyed to RD 1000's existing drainage system. Alternatively, the drainage could be addressed by upgrading the existing California Department of Transportation (Caltrans) pump station beneath the Howsley Road overcrossing to accept these flows. In lieu of relief wells, a cutoff wall could be constructed through the centerline of the levee through the SR 99 roadway section to a depth of up to 95 feet. Installation of the cutoff wall would require traffic control on SR 99. Traffic control would include a cross-median detour to route southbound travel to the northbound bridge, which would be divided to allow one lane of travel in each direction. After the cutoff wall through the southbound lanes is installed and cured, the traffic detour would be reconstructed to route northbound traffic to the southbound bridge for installation of the cutoff wall through the northbound roadway. It is anticipated that each cutoff wall section could be constructed over a weekend, with the traffic routing in place at 6 p.m. Friday and removed by 6 a.m. Monday.

Table 2-16 lists the total anticipated major materials quantities associated with this work. Aggregate material would come from commercial sources up to 30 miles away.

Table 2-16
Total Anticipated Major Materials Quantities for State Route 99 Natomas Cross Canal Bridge Cutoff Wall and Closure Structure Work – Adjacent Levee Alternative (Proposed Action)

Material Type	Quantity
Reinforced concrete	50 cy
Aggregate base rock	1,250 tons
Asphalt concrete paving	1,000 tons
Salvage asphalt concrete paving	3,750 sf
SCB cutoff wall by DMM	75,000 sf

Notes: cy = cubic yards; sf = square feet; SCB = soil-cement-bentonite; DMM = Deep-Mix Method
Source: Data provided by Wood Rodgers in 2009

Table 2-17 lists the anticipated equipment and construction durations for this work.

Table 2-17
Anticipated Equipment and Duration for State Route 99 Natomas Cross Canal Bridge Cutoff Wall and Closure Structure Work – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Traffic bypass construction	Motor grader (1)	10
	Water truck (1)	10
	Front-end loader (1)	10
	Asphalt concrete paver (1)	10
	Pickup trucks (2)	10
2. Cutoff wall installation – southbound lanes (follows no. 1)	Deep soil mix rig (1)	6
	Excavator (1)	6
	Loader (1)	6 Days
3. Traffic bypass reconfiguration (Follows 2.)	Motor grader (1)	10
	Water truck (1)	10
	Front-end loader (1)	10
	Asphalt concrete paver (1)	10
	Pickup trucks (2)	10
4. Cutoff wall installation – northbound lanes (follows no. 3)	Deep soil mix rig (1)	6
	Excavator (1)	6
	Loader (1)	6
5. Closure structure construction (follows no. 4)	Pickup trucks (2)	30
	Light duty crane (1)	30
	Concrete trucks (7)	30
	Loader (1)	30
	Backhoe (1)	30

Source: Data provided by Wood Rodgers in 2009

The estimated crew size during the peak of construction would be 25–35 people working two 12-hour shifts, 6 days a week. Cutoff wall construction may be conducted 24/7.

Natomas Cross Canal South Levee – Levee Vegetation Compliance

Along the NCC south levee (Reach D:1–2), at a minimum, if a variance request is granted by USACE, vegetation removal would be required for the upper 1/2 of the waterside levee slope. This vegetation removal would be limited to a few trees. Without a variance, vegetation would also be minimal.

2.3.3.3 IRRIGATION AND DRAINAGE COMPONENTS

West Drainage Canal – Interstate 5 to Fisherman's Lake

The Phase 4b Project would include improvements to the West Drainage Canal from a point south of I-5 to the north end of Fisherman's Lake. The improvements would be designed to provide the following benefits:

- lessen the canal's potential as a wildlife attraction hazard for Airport operations by relocating the western portion of the canal farther away from the airport operations area;
- reduce bank erosion and associated water quality problems caused by the canal's excessively steep sides;
- improve RD 1000's access to maintain the canal by providing expanded rights-of-way for O&M corridors;
- reduce the build-up of aquatic weeds, which require regular removal to avoid loss of channel conveyance capacity; and
- improve the continuity of the canal corridor for movement of giant garter snake between Fisherman's Lake managed wetlands and other managed wetlands and rice fields in the northern part of the Natomas Basin by creating a shoreline band of giant garter snake habitat, a key element of the NLIP conservation strategy.

Plate 2-17 shows the proposed realignment of the westernmost portion of the West Drainage Canal (near Reach B:11A of the Sacramento River east levee), as well as the footprint of proposed improvements to the existing canal east of the portion that would be realigned. The new alignment would abandon and reroute approximately 4,700 feet of the West Drainage Canal. **Plate 2-18** (upper illustration) shows a typical cross-section for the modified West Drainage Canal, which would require a right-of-way of up to 150 feet for approximately 1.2 miles. The realigned section of the canal would have a bottom width of up to 30 feet, stable 3H:1V bank slopes on one or both sides, and a narrow, variable width bench on one side of the canal. A 20-foot-wide maintenance and inspection road would flank each side of the canal and would be slightly elevated above adjacent land to improve an all-weather road condition. Culverts would cross under the patrol road to allow continued drainage into the canal from adjacent fields. The realignment would include rerouting of a small section of the West Drainage Canal (starting at the M10 Drain south of I-5 which leads to RD 1000's Pumping Plant No. 5) to a north-south orientation to improve the management of adjacent agricultural parcels, and to move the canal farther from the Airport Operations Area in the vicinity of the west runway. Regrading of agricultural parcels between the new and old canal alignment may be required for drainage. The normal managed water depth for this reach of the West Drainage Canal would be 6–7 feet in winter and 7–8 feet in summer under both existing and proposed conditions.

Table 2-18 summarizes the proposed improvements to the existing West Drainage Canal east of the portion that would be realigned. No improvements are proposed to the south bank of the canal west of Powerline Road.

Opportunities to improve the existing West Drainage Canal are constrained by the existence of a row of power line poles located on the south side of the West Drainage Canal west of Powerline Road and on the north side of the canal east of Powerline Road. Because the poles are close to the top of the canal bank, canal improvements

would not be feasible on both sides of the canal unless the power line poles were relocated farther away. Therefore, as shown in **Table 2-18** above, improvements would be focused on the north bank of the canal west of Powerline Road (east of the realigned portion) and the south bank of the canal east of Powerline Road. No improvements would be made to the south bank west of Powerline Road, and only a 20-foot-wide right-of-way for a maintenance road would be added to the north bank east of Powerline Road.

Table 2-18
Proposed Improvements to the West Drainage Canal (Eastern Segment) – Adjacent Levee Alternative (Proposed Action)

	West of Powerline Road[1]	East of Powerline Road
North bank	20-foot-wide right-of-way for maintenance Steep banks flattened to 3H:1V slopes 2- to 5-foot-wide tule bench	20-foot-wide right-of-way for maintenance
South bank	No improvements	20-foot-wide right-of-way for maintenance Steep banks flattened to 3H:1V slopes 2- to 10-foot-wide tule bench

[1] East of the portion of the canal that would be realigned
Source: Data compiled by AECOM in 2009

On the north side of the West Drainage Canal west of Powerline Road and the south side of the canal east of Powerline Road, the steep bank would be laid back to a stable 3H:1V slope to prevent ongoing bank slumping and reduce the need for future bank repairs and sediment removal. **Plate 2-18** (lower illustration) shows a typical cross-section for these bank improvements. In these locations, the easement would be expanded between 25 and 35 feet to accommodate flattening of the banks, widening the maintenance road, and adding a 15- to 20-foot-wide setback between the road and adjacent crop fields to place and dry canal sediment and floating debris. Suitable excavated material from laying back the canal bank would be used to elevate an all-weather road above the existing field grade. Besides flattening to a 3H:1V slope, bank improvements would include creating a 2- to 10-foot-wide submerged bench with tule growth to prevent aquatic weeds such as water primrose from attaching to the bank and then expanding across the canal water surface. Bank width would vary depending upon site constraints. Invasive aquatic weeds in the Natomas Basin are known to inhibit the movement of giant garter snake as well as reduce the flow of canal water and cause eutrophic water quality conditions. The tule benches would provide improved habitat for the giant garter snake (see Section 2.3.4.1, "West Drainage Canal Habitat Improvements").

Approximately 323,000 cubic yards of material would be excavated for the new canal and used to backfill the old canal. **Table 2-19** summarizes the types of equipment that may be used throughout the construction sequence under the Adjacent Levee Alternative (Proposed Action), along with an approximation of the duration of each activity.

Riego Road Canal

A portion of an irrigation canal owned by NCMWC would be disrupted by the proposed improvements to the west levee of NEMDC North. The affected portion includes approximately 4,000 feet of irrigation canal, approximately 250 feet of buried irrigation piping and culverts, and several irrigation control turn-out structures. These facilities would be relocated outside of the levee footprint as part of the Phase 4b Project. To prevent disruption of irrigation service, the NCMWC irrigation system would be replaced with in-kind facilities compatible with the new levee footprint. The new canal would be a highline canal with 3H:1V side slopes and a maintenance road on each of the embankments. A right-of-way of up to 100 feet beyond the new levee footprint would be required for the new facility. **Plate 2-11** shows the proposed footprint of the relocated canal. Approximately 46,000 cubic yards of material would be excavated for the new canal and used to backfill the old

canal. **Table 2-20** summarizes the types of equipment that may be used throughout the construction sequence under the Adjacent Levee Alternative (Proposed Action), along with an approximation of the duration of each activity.

Table 2-19
Anticipated Equipment and Duration for West Drainage Canal Realignment and Bank Improvements – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Mobilization, topsoil removal, and canal construction	Service Vehicle (1)	0
	Scrapers (8)	5
	Scrapers (8)	28
	Dump trucks (10)	12
	Dozers (4)	9
	Water trucks (2)	6
	Compactors (2)	4
2. Canal abandonment	Dump trucks (10)	41
	Dozers (4)	32
	Water trucks (2)	20
	Compactors (2)	12
3. Topsoil respread and pipe installation	Loaders (3)	13
	Backhoe (1)	3
	Dozer (1)	1
	Water truck (1)	1
	Compactor (1)	1
4. Restoration	Hydroseed trucks (2)	14
	Water trucks (4)	15
5. Demobilization	Service Vehicle (1)	18

Source: Data provided by Mead & Hunt in 2009

Table 2-20
Anticipated Equipment and Duration for Riego Road Canal Relocation – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Mobilization, topsoil removal, and canal construction	Service Vehicle (1)	9
	Scrapers (2)	7
	Scrapers (2)	2
	Dump trucks (10)	8
	Dozers (2)	12
	Water trucks (2)	4
	Compactors (2)	2
2. Canal abandonment	Dump trucks (10)	6
	Dozers (2)	10
	Water trucks (2)	3
	Compactors (2)	2
3. Topsoil respread and pipe installation	Loaders (3)	6
	Backhoe (1)	1
	Dozer (1)	1
	Water truck (1)	1
	Compactor (1)	1
4. Restoration	Hydroseed truck (1)	4
	Water trucks (2)	4
5. Demobilization	Service Vehicle (1)	9

Source: Data provided by Mead & Hunt in 2009

Private Irrigation

Sacramento River East Levee Reaches B:13–15 and A:16–20

Several private irrigation water wells are located in the vicinity of Bryte Bend Road and Garden Highway. One of these wells at the southeast end of the Riverside Canal (Reach A:18, approximate station of 849+50) adjacent to Bryte Bend Road would be disrupted by the proposed levee improvements and would be relocated as part of the Phase 4b Project (**Plates 2-7a** and **2-7b**). This well discharges directly to the existing Riverside Canal for irrigation service to the adjacent fields for agricultural use. The water well would be relocated outside of the footprint of the levee improvements (by drilling replacement wells and abandoning the existing well) and sited at least 100 feet from the adjacent levee or seepage berm toe. To prevent disruption of service in the fields, the private irrigation well would be replaced with in-kind facilities compatible with the new levee footprint. Well construction would require 24-hour drilling for up to 3 days followed by 24-hour development pumping for up to 2 weeks.

Natomas East Main Drainage Canal

Numerous private irrigation facilities along the NEMDC would be disrupted by the proposed levee improvements and would therefore be relocated as part of the Phase 4b Project. Relocated private irrigation facilities proposed as part of the Phase 4b Project are shown on **Plates 2-11** and **2-14**. These private facilities include nine landside water wells that provide irrigation for cultivation of adjacent fields. The water wells would be relocated outside of the footprint of the levee improvements (by drilling replacement wells and abandoning existing wells) and sited at least 100 feet from the future levee toe. In addition to the wells, approximately 1,500 feet of local field irrigation ditches and approximately 2,500 feet of buried irrigation piping would be relocated. To prevent disruption of service in the fields, the private irrigation systems would be replaced with in-kind facilities compatible with the new levee footprint. Well construction would require 24-hour drilling for up to 3 days followed by 24-hour development pumping for up to 2 weeks.

Pleasant Grove Creek Canal

Numerous private irrigation facilities along the PGCC west levee would be disrupted by the proposed levee improvements and would be replaced as part of the Phase 4a Project (**Plate 2-13**). These private structures, consisting of eight landside water wells and one private river pump, service the adjacent fields for agricultural use. The water wells would be relocated outside of the footprint of the levee improvements (by drilling replacement wells and abandoning the existing wells). The river pump discharge pipes through the levee would be raised and a new positive control valves and an air release/siphon breaker valve would be added. In addition to the wells and river pump, approximately 1,900 feet of local irrigation canals and approximately 2,200 feet of buried irrigation piping would be relocated. To prevent disruption of service in the fields, the private irrigation facilities would be replaced with in-kind structures compatible with the new levee footprint. Some RD 1000 drainage facilities would be relocated prior to PGCC construction, including approximately 5,900 feet of drainage canal and 750 feet of pipe.

Natomas Cross Canal South Levee Ditch Relocations

Along the NCC south levee, between Stations 19+00 to 97+00 (Reach D:2), the Vestal Drain ditch runs parallel to the landside toe of the levee. The geotechnical analyses of the ditch in its present location shows unacceptable seepage gradients at the base of the canal. From Stations 199+00 to 244+00 (Reach D:6), the Morrison Irrigation Canal has similar gradient problems. Both canals would be removed and replaced as part of the Phase 4b Project. (The Northern Main Irrigation Canal, which also parallels the landside toe, does not present the same seepage problems and would remain in place, except as described in the Phase 4a Project.) Replacement canals would be constructed 400 feet from the existing landside toe of slope (**Plate 2-16**). The new canal size would be designed with 3H:1V side slopes. It is anticipated that there would be a balance of fill material available to fill the old canal with the material excavated from the new canal. Approximately 125,000 cubic yards would be excavated for the

new canals and used to backfill the old canals. **Table 2-21** lists the anticipated equipment and construction durations for this work.

Table 2-21
Anticipated Equipment and Duration for Natomas Cross Canal South Levee Ditch Relocations – Adjacent Levee Alternative (Proposed Action)

Construction Activity	Equipment Type and Number	Duration of Use (days)
1. Clearing and grubbing/stripping	Elevating scrapers (4)	15
	Water trucks (2)	15
	Front-end loaders (4)	15
	Pickup trucks (5)	15
2. Channel excavation and backfill (follows no. 1)	Elevating scrapers (8)	30
	Excavators (2)	30
	Water truck (1)	30
3. Demobilization/cleanup (follows no. 2)	Water trucks (2)	12
	Hydroseeding trucks (2)	12
	Extended boom pallet loader (1)	12
	Haul trucks (2)	12

Source: Data provided by Wood Rodgers in 2009

The crew size for this component of the project during its peak would be between 25–35 people working 10-hour shifts, 6 days a week.

Reclamation District 1000 Pumping Plants

Because the Natomas Basin is surrounded by levees, all excess drainage within the Basin must be pumped out. Drainage within most of the Basin is pumped to the Sacramento River and the NEMDC via RD 1000's drainage system and pumping plants. RD 1000 Pumping Plant Nos. A1, 1B, 6, and 8 are within the limits of work for the Phase 4b Project. All three pumping plants would require new discharge pipes and additional modifications to accommodate the new levee criteria and proposed levee improvements. Raising the discharge pipes at Pumping Plant Nos. 1B and 6, which currently cross the levee under Garden Highway and East Levee Road, respectively, would require closure of those roads to through-traffic for up to 60 days, with traffic detours. Raising the discharge pipes at Pumping Plant No. 8 may require a road closure at Northgate Boulevard with a traffic detour and also temporary closure of the bike path on the top of the levee. As design evaluations continue and the design is refined, additional modifications could be required to maintain the plant's current operations or meet underseepage exit gradient criteria in the inlet channels, such as adding relief wells or lining the intake channel with either filter gravel or rock-covered geotextile fabric or sump modifications. In addition, relocating the pump stations away from the levee may be necessary to accommodate the adjacent levee footprint.

Pumping Plant Nos. 1A and 1B

Pumping Plant No. 1A is not included in the NLIP, but is included in a USACE cutoff wall project as part of the Common Features Project. Pumping Plant No. 1A and 1B are located along Garden Highway approximately 1 mile west of I-5. These pumping plants are shown on **Plate 2-7b**.

Pumping Plant No. 1B consists of six pumps, a control-room building, and associated infrastructure for the pumping plant. It is located immediately adjacent to the landside levee toe in Reach A:19B. Each pump for Pumping Plant No. 1B connects to a buried discharge pipe that runs across the existing levee to an outfall structure on the east bank of the Sacramento River. There are a total of six 48-inch pipes. Six air/siphon release valves, one for each pipe, are located close to the crown of the levee in a vault on the waterside of the levee. A metering vault is located on the landside of the levee.

The pumping-plant modifications would include raising and replacing the discharge pipes that extend from Pumping Plant No. 1B across the levee within the confines of the planned levee construction to tie into the existing discharge pipes on the waterside. The air/siphon release valves would be replaced and shutoff valves would be added. The valves would be constructed in a new concrete vault in the waterside shoulder of the levee. The metering vault along with the plant access ramp may also be replaced or relocated. The pumps and motors would also be replaced and/or upgraded to account for the higher head associated with the raised discharge pipes.

To facilitate raising of the pump discharge pipes, Garden Highway would require a local raise of several feet in grade over the pipes. The road raise would transition back down to existing grade upstream and downstream of the local raise. This work would require partial regrading of the waterside slope for the length of the raised Garden Highway. The levee would transition upstream and downstream of this site from an adjacent levee to a raise of the existing levee in place. At this site, the levee would be degraded and reconstructed with engineered fill. Traffic control measures and detours would be required for up to 30 days during pipe removal and replacement under Garden Highway.

Pumping Plant No. 6

Pumping Plant No. 6 is located along the NEMDC, approximately three-quarters of a mile north of Elkhorn Boulevard (**Plate 2-11**). At this location, the existing pump discharge pipelines, which penetrate the west levee, would be reconstructed.

An excavated intake channel connects to the pumping plant. Four pumps, a control-room building, and associated infrastructure for the pumping plant are located immediately adjacent to the landside levee toe. Each pump for Pumping Plant No. 6 connects to a buried discharge pipe that crosses the existing levee and connects to an outfall structure on the NEMDC. These pipes consist of one 42-inch pipe, two 36-inch pipes, and one 30-inch pipe. Four air/siphon release valves, one for each pipe, are located close to the NEMDC on the waterside of the levee.

The pumping plant modifications would include raising and replacing the discharge pipes that extend from Pumping Plant No. 6 across the levee to tie into the existing discharge pipes within the waterside of the levee. The air/siphon release valves would be replaced and shutoff valves would be added. The valves would be constructed in a concrete vault in the waterside shoulder of the levee.

An upgrade to and/or replacement of the pumps, motors, and the electrical service including a new electrical building for Pumping Plant No. 6 would be required to provide the increased horsepower needed to pump over the levee. Use of new pumps could require the excavation of a deeper sump, which may require some associated modifications to the landside intake channel.

To facilitate raising the pump discharge pipes, East Levee Road would require a local raise in grade over the pipes. The road raise would transition back down to existing grade upstream and downstream of the local raise. This work would require partial regrading of the waterside slope for the length of the raised East Levee Road (**Plate 2-11**). The levee would transition upstream and downstream of this site from an adjacent levee to a raise of the existing levee in place. At this site, the levee would be degraded and reconstructed with engineered fill. Traffic control measures and detours would be required during pipe removal and replacement under East Levee Road.

The pipe raise would require a new outfall to comply with the USACE siphon recovery limits criteria, which limit the distance from the top of the apex of the pipe to the top of the outlet pipe. Construction of a new outfall structure would require dewatering a portion of the NEMDC.

Pumping Plant No. 8

Pumping Plant No. 8 is located along the NEMDC, approximately two-thirds of a mile north of I-80 (**Plate 2-14**). An excavated intake channel is located on the west side of Northgate Boulevard, and nine pumps and an equipment building are located immediately adjacent to the pump station on the west side of Northgate Boulevard. Each pump for Pumping Plant No. 8 connects to a buried discharge pipe that runs across the existing levee to an outfall structure on the NEMDC. There are a total of nine pipes, including five 54-inch pipes, three 36-inch pipes, and one 60-inch pipe. Nine air/siphon release valves, one for each pipe, are located close to the NEMDC on the waterside of the levee.

The pumping plant modifications would include raising and replacing the discharge pipes that extend from Pumping Plant No. 8 across the levee to tie into the existing discharge pipes within the waterside bench. The air/siphon release valves would be replaced and shutoff valves would be added. The valves would be constructed in a concrete vault in the waterside shoulder of the levee. The pumps would also be replaced and/or upgraded to account for the higher head associated with the raised discharge pipes.

An upgrade to and/or replacement of the pumps, motors, and the electrical service including a new electrical building for Pumping Plant No. 8 would be required to provide the increased horsepower needed to pump over the levee. Use of new pumps could require the excavation of a deeper sump, which may require some associated modifications to the landside intake channel.

To facilitate raising of the pump discharge pipes, the existing bike trail would require a local raise in grade over the pipes. The trail raise would transition back down to existing grade upstream and downstream of the local raise. This work would require partial regrading of the waterside slope for the length of the raised bike trail. At this site, the levee would be degraded and reconstructed with engineered fill. A detour or closure of the bike trail would be required for up to 30 days. Likewise, the pipes would need to be replaced under Northgate Boulevard. Traffic control measures and detours would be required during pipe removal and replacement under Northgate Boulevard for up to 30 days.

The pipe raise would require a new outfall to comply with the USACE siphon recovery limits criteria, which limit the distance from the top of the apex of the pipe to the top of the outlet pipe. Construction of a new outfall structure would require dewatering a portion of the NEMDC.

City of Sacramento Pumps

The City of Sacramento owns and operates several storm drainage sump pumps to pump residential and urban stormwater out of the Basin. The discharge pipes would be raised and additional modifications would be made to bring all three of the pumping plants into compliance with the new criteria. Raising the discharge pipes at City Sumps 160 and 58 (**Plates 2-7** and **2-9**, respectively), which currently cross the levee under Garden Highway, would require partial closure of the road to through-traffic for up to 30 days, with traffic detours. Raising the discharge pipes at City Sump 102 (**Plate 2-14**) would require a closure of the bike path on the top of the levee. As design evaluations continue and the design is refined, additional modifications could be required to maintain the City Sump 102's current operations. In addition, relocating the pump stations away from the levee may be necessary to accommodate the adjacent levee footprint.

City Sump 160 (Sacramento River East Levee Reach A:19B)

City Sump 160 is located along Reach A:19B of the Sacramento River east levee (**Plate 2-7b**). A 90-inch storm drain carries stormwater drainage from adjacent properties to the pump station. A chainlink fence with slats and

barbed wire is located approximately 30 feet from the landside toe of the levee and, combined with a concrete block wall, surrounds the pump station. Five pumps, an equipment building, and above ground diesel fuel storage tank, and electrical transformers are located behind the fence. Each pump for City Sump 160 connects to a buried steel discharge pipe that runs across the existing levee to an outfall structure on the Sacramento River. There are a total of five pipes, including two 54-inch pipes, two 42-inch pipes, and one 12-inch pipe. Five air/siphon release valves, one for each pipe, are located on the landside of the levee near the top. A concrete pipe support wall is located approximately 100 feet from the outfall on the waterside of the levee.

The pumping plant modifications would include raising the discharge pipes that extend from City Sump 160 across the levee to tie into the existing discharge pipes on the waterside. The air/siphon release valves would be replaced and shutoff valves would be added. The valves would be constructed in a concrete vault in the waterside shoulder of the levee. If necessary, the concrete pipe support wall would be removed and replaced. An upgrade to the pumps and diesel engines for City Sump 160 would likely be required to provide the increased horsepower needed to pump drainage water through the raised pipes.

To facilitate raising the pump discharge pipes, Garden Highway would require a local raise in grade over the pipes. The road raise would transition back down to existing grade upstream and downstream of the local raise. This work would require partial regrading of the waterside slope for the raised Garden Highway. The levee would transition upstream and downstream of this site from an adjacent levee to a raise of the existing levee in place. At this site, the levee would be degraded and reconstructed with engineered fill.

The pipe raise would require a new outfall to comply with the USACE siphon recovery limits criteria, which limit the distance from the top of the apex of the pipe to the top of the outlet pipe. Construction of a new raised outfall structure would require dewatering a portion of the Sacramento River.

City Sump 58 (American River North Levee)

City Sump 58 is located along the American River North Levee approximately 0.4 mile east of Truxel Road (**Plate 2-9**). A 30-inch storm drain carries stormwater drainage from adjacent properties to the pump station. A chainlink fence with slats and barbed wire is located at the landside toe of the levee and surrounds the pump station. Three pumps, an equipment building, trash rack hoist, and electrical transformer are located immediately adjacent to the landside levee toe. Each pump for City Sump 58 connects to a buried discharge pipe that runs across the existing levee to an outfall structure on the NEMDC. There are three pipes, including two 20-inch pipes and one 12-inch pipe. Three air/siphon release valves, one for each pipe, are located close to Garden Highway on the landside of the levee. A concrete cutoff structure located within the pipe trench surrounding the pipes is located on the waterside of the levee.

The pumping plant modifications would include replacing the discharge pipes that extend from City Sump 58 across the levee to tie into the existing discharge pipes on the waterside. The cutoff structure would be removed. The air/siphon release valves would be replaced and shutoff valves would be added. The valves would be constructed in a concrete vault in the waterside shoulder of the levee. An upgrade to the pumps, motors, and the electrical service for City Sump 58 would be required to provide the increased horsepower needed to pump through the raised pipes.

To facilitate raising the pump discharge pipes, Garden Highway would require a local raise in grade over the pipes. The road raise would transition back down to existing grade upstream and downstream of the local raise. This work would require partial regrading of the waterside slope for the length of the raised Garden Highway. At this site, the levee would be degraded and reconstructed with engineered fill.

The pipe raise would require a new outfall to comply with the USACE siphon recovery limits criteria, which limit the distance from the top of the apex of the pipe to the top of the outlet pipe. Construction of a new raised outfall structure would require dewatering a portion of the low-flow channel of the NEMDC within the American River floodway.

In addition, this pump station may need to be relocated as a seepage and stability mitigation measure because of the proximity of the pumps to the toe of the levee. Any landward shift in the levee toe would impact City Sump 58. The reconstructed City Sump 58 would consist of a cast-in-place concrete sump, with a trash rack and operating deck. An enclosure building would be provided to house the electrical, control, and monitoring equipment. The existing storm drain would need to be modified. Related infrastructure, such as access roads and utilities that serve City Sump 58 and are located within the levee footprint, would be relocated outside the footprint.

City Sump 102 (Natomas East Main Drainage Canal at Gardenland Park)

City Sump 102 is located along the NEMDC west levee adjacent to Gardenland Park north of Bowman Avenue (**Plate 2-14**). A 60-inch storm drain carries stormwater drainage from adjacent properties to the pump station. A chainlink fence with slats and barbed wire is located at the landside toe of the levee and surrounds the pump station. Four pumps, trash rack hoist, electrical transformer, and an equipment building are located immediately adjacent to the landside levee toe. Each pump for City Sump 102 connects to a buried discharge pipe that runs across the existing levee to an outfall structure on the NEMDC. There are four pipes, including three 36-inch pipes and one 12-inch pipe. Four air/siphon release valves, one for each pipe, are located on the waterside of the levee near the top of the levee.

The pumping plant modifications would include replacing the discharge pipes that extend from City Sump 102 across the levee to tie into the existing discharge pipes within the waterside bench. The air/siphon release valves would be replaced and shutoff valves would be added. The valves would be constructed in a concrete vault in the waterside shoulder of the levee. An upgrade to the pumps, motors, and the electrical service for City Sump 102 would be required to provide the increased horsepower needed to pump through the raised pipes.

To facilitate raising of the pump discharge pipes, the bike trail would require a local raise in grade over the pipes. The trail raise would transition back down to existing grade upstream and downstream of the local raise. This work would require partial regrading of the waterside slope for the length of the raised bike trail. The levee would transition upstream and downstream of this site from an adjacent levee to a raise of the existing levee in place. At this site, the levee would be degraded and reconstructed with engineered fill.

The pipe raise would require a new outfall to comply with the USACE siphon recovery limits criteria, which limit the distance from the top of the apex of the pipe to the top of the outlet pipe. Construction of a new raised outfall structure would require dewatering a portion of the NEMDC.

In addition, this pump station may need to be relocated as a seepage and stability mitigation measure because of the proximity of the pumps to the toe of the levee. Any landward shift in the levee toe could also require relocation of City Sump 102. The reconstructed City Sump 102 would consist of a cast-in-place concrete sump, with a trash rack and operating deck. An enclosure building would be provided to house the electrical, control, and monitoring equipment. The existing storm drain would need to be modified. Related infrastructure, such as access roads and utilities that serve City Sump 102 and are located within the levee footprint, would be relocated outside the footprint.

2.3.3.4 BORROW SITES

Construction of the Phase 4b Project would use soil borrow material from a combination of sites previously analyzed in NLIP environmental documents and proposed new borrow sites, analyzed in this EIS/EIR (**Table 2-22**). Analyses of previously disclosed borrow sites is summarized in Section 4.1.3, "Summary of Previous NEPA and CEQA Analyses of Borrow Sites."

Table 2-22
Borrow Sources – Adjacent Levee Alternative (Proposed Action)

Borrow Site/Location	Status of Environmental Review	Potential Use
Natomas Boot/Bollinger	Previously analyzed as part of the Fisherman's Lake Borrow Area in the Phase 4a EIS and EIR	Sacramento River east levee Reach A:16–20/American River north levee Reach I:1-4
South Fisherman's Lake Borrow Area	Proposed as part of the Phase 4b Project	Sacramento River east levee Reach A:16–20/American River north levee Reach I:1-4
West Lakeside School Site, Natomas Unified School District	Proposed as part of the Phase 4b Project	Sacramento River east levee Reach A:16–20
Triangle Area Borrow Area	Proposed as part of the Phase 4b Project	PGCC/NEMDC
Krumenacher Borrow Site/Twin Rivers Unified School District Stockpile Site	Previously analyzed in the Phase 3 EIS and EIR	PGCC/NEMDC

Notes: EIR = environmental impact report; EIS = environmental impact statement; NEMDC = Natomas East Main Drainage Canal; PGCC = Pleasant Grove Creek Canal
Source: Data compiled by AECOM in 2009

Table 2-23 lists proposed new borrow sites that are fully analyzed in this EIS/EIR. These sites, which are shown on **Plate 2-6**, would provide material for the proposed levee improvements and modifications to irrigation infrastructure. After excavation of the borrow material, these sites would be reclaimed for postconstruction uses. **Table 2-23** also shows the depth of excavation, depth upon reclamation, and final postreclamation use for the proposed new borrow areas.

Table 2-23
Proposed New Borrow Areas – Adjacent Levee Alternative (Proposed Action)

Borrow Site/Area	Size of Site/Area (acres)	Amount Available for Excavation (acres)[1]	Estimated Average Depth of Excavation (feet)[2]	Current Use	Proposed Postreclamation Use
South Fisherman's Lake Borrow Area – Los Rios Community College Property	105	95	4	Row crops	Row crops
South Fisherman's Lake Borrow Area – 610 South Main, LLC Property	163	150	2	Row crops	Row crops
Triangle Properties Borrow Area	1,100	290	2–6	Rice	Rice or detention basins/grassland
West Lakeside School Site	41	20	2	Fallow	Agriculture or natural habitat

Notes:
[1] Extent of excavation within site.
[2] Depth includes approximately 1 foot of topsoil stripping. Finished elevation would be approximately 1 foot higher after surface material respread, grading, and seeding.
Source: Data provided by Mead & Hunt in 2009 and compiled by AECOM in 2009

South Fisherman's Lake Borrow Area

The South Fisherman's Lake Borrow Area is made up of two properties south of the Bollinger borrow site, which would be analyzed as new borrow sites for the Phase 4b Project. The Los Rios Community College property is directly south of the Bollinger borrow site. The three parcels that make up the 610 South Main, LLC property are south of the Los Rios Community College property. These proposed borrow areas, which are shown on **Plate 2-7a** (along Reach A:15 of the Sacramento River east levee), are currently used for agricultural row crop production. They would be excavated to a depth of 2–4 feet and returned to agricultural production.

Triangle Properties Borrow Area

The Triangle Properties Borrow Area (**Plate 2-13**) is located to the northeast of the Natomas Basin on the east side of the PGCC. It is bordered on the east by the Union Pacific Railroad. Farmland would be excavated to a depth of up to 6 feet and either reclaimed for rice cultivation or converted to detention basins to store PGCC overflow in the event that the PGCC culverts are removed. No demolition of residences or other non-agricultural uses would occur as part of borrow excavation. Excavation sites within the Triangle Properties Borrow Area would be set back at least 100 feet from existing roads, utilities, irrigation ditches, as well as residential and other non-agricultural land uses, such as the Pleasant Grove Cemetery District cemetery. The bridges for Howsley, Fifield, Keys, and Sankey Roads would be used as haul routes to bring the borrow material over the PGCC into the Natomas Basin for the construction of the PGCC and north NEMDC. Alternatively, temporary crossings of the PGCC could be constructed with culverts or bridges over the low-flow channel, to provide for off-road hauling.

West Lakeside School Site

The West Lakeside School Site (**Plate 2-17**) is owned by the Natomas Unified School District and located north of Del Paso Road and east of Fisherman's Lake. The property was historically farmed, but is currently fallow. A portion of the site is planned for the West Lakeside High School/Middle School. The remaining acreage could be shallow-graded for borrow material prior to its development as open space. In the event that the property is not developed as a school site, the shallow-graded portion would be returned to agriculture or natural habitat type appropriate to the setting. Del Paso, El Centro, San Juan, and Bryte Bend Roads could be used as haul routes to transport the material to the Sacramento River east levee construction area. In addition to use as a potential source of soil material for the construction along Sacramento River east levee, the West Lakeside School Site could also be used to provide material for the extension of the Riverside Canal in Reach A:11B (west of Powerline Road), which was previously analyzed in the Phase 4a EIS and EIR (USACE 2010 and SAFCA 2009f). The haul route for this option would be the West Drainage Canal right-of-way (off-road) and Powerline Road.

Borrow Quantities

The borrow sites listed in **Table 2-23** would provide earthen fill material for the proposed levee improvements and modifications to irrigation and drainage infrastructure. **Table 2-24** lists the estimated borrow quantities for each major levee improvement that is proposed. Actual volumes exported from borrow sites would be adjusted to match demands for fill. Estimated excavation volumes are approximated using a 125% of fill volume, to account for shrinkage from fill compaction and other losses.

Borrow Site Construction

The excavation limits on the borrow sites would provide a minimum buffer of 50 feet from the edge of the borrow site boundary or any irrigation or drainage feature. From this setback, the slope from existing grade down to the bottom of the excavation would be no steeper than 3H:1V. Excavation depths for the borrow sites would be as listed in **Table 2-23**. After excavation, disturbed areas would be finish graded in compliance with criteria for drainage of reclaimed land uses.

Table 2-24 Summarize of Fill Material to be Supplied to Proposed Project Features – Adjacent Levee Alternative (Proposed Action)	
Project Feature	Quantity (cubic yards)
Sacramento River east levee Reach A:16–20	1,168,000
American River north levee Reach I:1–4	167,000
NEMDC North Reaches F–G	965,000
PGCC Reach E and NEMDC South Reach H	345,500
Total	**2,645,500**

Notes: PGCC = Pleasant Grove Creek Canal; NEMDC = Natomas East Main Drainage Canal
Source: Data compiled by AECOM in 2009

Excavated soils not used for borrow material, such as the organic surface layer or soils considered unsuitable for levee construction, would be stockpiled and respread on-site after excavation. Any unsuitable borrow material would be stockpiled on-site and graded back into the restored site, which would result in a finish grade elevation somewhat higher than the final design grades. The borrow-site excavation operations would use water for dust control and to maintain proper moisture content in the borrow material. Revegetation activities would include erosion control on excavated slopes (i.e., hydroseeding), application of fertilizer, and seeding. It is anticipated that no unsuitable material would be hauled off-site. Debris encountered during excavation would be hauled off-site.

Employee vehicles and construction equipment would be parked off street, either in the construction staging areas for the levee work, within the borrow site, or in designated parking areas. Construction equipment would be restricted to designated haul routes between the borrow operations and the construction sites. The haul route for the Triangle Properties Borrow Area could include Howsley, Fifield, Keys, and Sankey Roads. Haul Routes for properties identified inside the Basin may include segments of Del Paso, Powerline, El Centro, Bryte Bend, Radio, and San Juan Roads within the immediate vicinity of the borrow sources. Hauling on public roads would occur for short distances as required to transport material to the levee toe. Distribution of material along the levee alignment would take place within the levee footprint. Except for the American River north levee improvements, Garden Highway would not be used either as a haul route or for on-street parking.

2.3.3.5 ENVIRONMENTAL COMMITMENTS FOR BORROW SITES

Although it is assumed that borrow sites listed in **Table 2-22** could supply the required earthen fill material for Phase 4b Project construction, the specific locations of borrow removal are currently unknown because investigations to determine which locations are most suitable are ongoing. Suitable material would be classified as soil based upon geotechnical data. The Phase 4b Project would not excavate material considered to be construction aggregate. This document performs project-level NEPA/CEQA analysis for the entire potential borrow areas, and also provides a checklist in **Appendix B2** to determine if borrow sites selected from within these areas after the approval of the Phase 4b Project would be consistent with identified impacts, and thus can be approved as within the Phase 4b Project and under the NLIP. Any borrow site selected within these areas would be subject to the adopted mitigation measures and other applicable environmental commitments. This approach was used successfully for the Phase 3 and 4a environmental analyses. The project proponent(s) would ensure that the following environmental commitments are met before initiating ground-disturbing activities on these borrow sites, to the extent practicable and feasible:

- minimize land use fragmentation;
- submit a Notice of Intent to the Central Valley Regional Water Quality Control Board (RWQCB), prepare and implement standard Best Management Practices and a storm water pollution prevention plan, and comply with conditions of the National Pollutant Discharge Elimination System permit;
- obtain and comply with applicable regulations and permits or exemptions (e.g., Section 7 of the Federal Endangered Species Act, Section 1602 of the California Fish and Game Code, Section 2081 of the California Endangered Species Act, Section 404 of the Clean Water Act, and California Surface Mining and Reclamation Act);
- complete a wetland delineation, and complete detailed design and habitat creation components and management agreements to ensure compensation for any fill of waters of the United States;
- conduct focused surveys of special-status species and habitats, develop detailed designs to ensure adequate compensation for loss of habitat, and implement all management agreements;
- survey for cultural resources (historic and prehistoric), evaluate identified resources, and develop and implement treatment for historic properties and historical resources subject to adverse effects, as required under the programmatic agreement;
- prepare and implement a traffic safety and control plan for construction-related truck trips and detours;
- implement applicable air quality district–recommended control measures to minimize temporary emissions of reactive organic gases, oxides of nitrogen, and respirable particulate matter with an aerodynamic diameter of 10 micrometers or less during construction;
- implement noise-reducing construction practices, prepare and implement a noise control plan, and monitor and record construction noise near sensitive receptors;
- coordinate with users of irrigation water before and during all modifications to irrigation infrastructure and reduce interruptions of supply;
- verify utility locations, coordinate with utility providers, prepare and implement a service-interruption response plan, and conduct worker training with respect to accidental utility damage;
- complete Phase I and/or Phase II environmental site assessments and implement required measures;
- coordinate work within Perimeter B with Airport operations and restrict night lighting within and near the runway approaches;
- conduct a wildlife-aircraft strike analysis and develop and implement mitigation for earthmoving activities within Perimeter B; and
- prepare and implement a wildfire control and management plan to minimize potential for wildland fires.

Appendix B2 provides a detailed discussion of the criteria that would apply to the selection of borrow sites for the Phase 4b Project.

2.3.4 HABITAT CREATION AND MANAGEMENT

The habitat development and management plan for the NLIP was first introduced at a program level in the Phase 2 EIR and EIS. Since 2007, the ecosystem benefits and conservation strategies of this plan have been refined, and

habitat creation targets and opportunities have been more fully evaluated. The habitat development and management plan is discussed in more detail in Section 4.7, "Biological Resources," under "Natomas Levee Improvement Program Programmatic Conservation Strategy." The habitat development and management components of the Phase 4b Project are intended to compensate for effects on existing habitat from the project's flood damage reduction and canal improvements. Because these components are also meant to further the NLIP's goal to enhance habitat values by increasing the extent and connectivity of Natomas Basin lands managed to provide habitat for giant garter snake, Swainson's hawk, and other special-status species, each component is considered integral to the success of the Basin-wide habitat management plan.

2.3.4.1 WEST DRAINAGE CANAL HABITAT IMPROVEMENTS

Currently, the lower West Drainage Canal is characterized by mostly barren, steep banks with little or no cover or foraging habitat for giant garter snake. This condition extends over several miles of the lower canal system and represents a barrier to giant garter snake movement within the Basin, potentially isolating the species' largest known population found in the Fisherman's Lake area. Improvements to the West Drainage Canal described in Section 2.3.3.3, "Irrigation and Drainage Components," would be designed to enhance giant garter snake corridor habitat compared to the existing poor habitat conditions found on West Drainage Canal south of I-5 and to increase the functional values of the managed wetlands complex on the west side of Fisherman's Lake. The canal abuts the north and east sides of The Natomas Basin Conservancy's (TNBC's) Rosa Preserve for approximately 1.5 miles at the east end of the lower canal.

These habitat features would be designed into the realigned portion of the canal (in the vicinity of Reach B:11A of the Sacramento River east levee) and added to the north bank of the existing canal between the realigned portion of the canal and Powerline Road and to the south bank between Powerline Road and the Fisherman's Lake slough (**Plate 2-17**). These habitat features would consist of:

- 3H:1V sloped banks supporting native sedges and rushes at the shoreline and native perennial grasses at the top; and

- a variable width (2- to 10-foot wide) submerged bench located within the bank, which would support a band of tules.

Flattening the slopes of the canal and planting native vegetation would create more stable banks, improving water quality and overall habitat conditions along the canal. Tules on the submerged bench would typically be inundated during summer. A tule band would preserve channel conveyance capacity by preventing noxious aquatic plants from attaching to the lower bank. Invasive aquatic weeds in the Natomas Basin are known to inhibit the movement of giant garter snake and also reduce the flow of canal water, causing eutrophic water quality conditions. The tule band would also increase available refuge for the snake while not significantly increasing habitat for waterfowl that may be hazardous to Airport operations.

2.3.4.2 WOODLAND COMPENSATION

To compensate for landside impacts to woodland in Reach A:16–20 of the Sacramento River east levee, Reach I:1–4 of the American River north levee, and along the NEMDC west levee, up to 72 acres of woodlands consisting of native riparian and valley oak woodland species would be preserved and created in and around the Natomas Basin. Up to 40 of these acres would be located in Lower Dry Creek, a 420-acre open space area located north of Main Avenue and east of the NEMDC (**Plates 2-14 and 2-19**). This area consists of Hansen Park, owned by the City of Sacramento, and the Coyle Property, which is owned by SAFCA. SAFCA has a conservation easement on Hansen Park (the western portion of the Lower Dry Creek area), and a conservation easement could also be placed on the Coyle property to the east. Existing woodland corridors along Dry Creek channels would be preserved, and additional woodland would be created by filling in gaps and widening these existing riparian corridors. Opportunities to create new woodland corridors may be available on historic stream channels that the

creek has migrated away from over time. In addition, woodland clusters could be created in meadows, providing habitat favorable to raptors. Created woodland would be designed to avoid vernal pools, seasonal wetlands, and relatively permanent water, which are shown on **Plate 2-19**. The balance of woodland compensation would occur by enhancing TNBC preserves and by preserving and creating woodland on other available sites around the Basin.

Mitigation for impacts of the Phase 4b Project to waterside woodlands, including SRA, is addressed in Section 4.7, "Biological Resources."

Woodland groves that would be created would be at least 50 feet wide and several hundred feet long, depending on location constraints. Portions of the created woodlands would be at least 100 feet wide to promote successful nesting by a variety of native birds deeper within the grove canopy, where nest parasitism by crows, cowbirds, and starlings is less of a factor in breeding success. At maturity, stand structure would vary from closed-canopy woodland to valley oak savanna vegetation types, with a native perennial grassland understory.

Planting sites would require suitable soil conditions, irrigation water during a 3- to 5-year establishment phase, reduced risk of wildfire, and minimal depth to seasonally high groundwater or other natural water sources to sustain trees once irrigation ceases. To provide irrigation water, groundwater wells may need to be drilled in the vicinity of the plantings. Drilling of well holes would take 72 hours or more. Because the drilling process must be continuous once started, 24/7 operation of the drill rig would be required. Wells would be located 1,000–1,500 feet from sensitive receptors to minimize the disturbance from 24/7 construction.

A mixture of native riparian and woodland species would be planted, but the predominant species would be valley oak, the primary tree species that would be affected by the proposed improvements to the Sacramento River east levee; and cottonwood, which is a preferred nest tree for Swainson's hawks in the Basin and is faster growing than valley oak. Establishing woody vegetation would likely require more than one technique, including planting nursery stock, live cuttings, and acorn planting in winter, sustained by flood irrigation, drip, or agricultural-scale spray heads. Taking into account predictable and unavoidable mortality within the first 5 years of establishment, the intent is to have an average stem density of approximately 50–100 trees and shrubs per acre within 5–10 years of growth. Wherever possible, groves would be bordered by restricted-access public lands and rights-of-way to reduce the risk of vandalism and other inappropriate uses that may threaten wildlife values or risk wildfires from human sources.

The botanical species composition of individual clusters and rows would mimic vegetation types commonly found along the Sacramento River, including:

- valley oak woodland;
- mixed riparian forest, cottonwood-dominant;
- shallow scrub (at moist soil sites or depressions);
- sycamore and oak savanna (with native perennial grassland); and
- elderberry shrub/scrub.

A monitoring plan with performance criteria would be developed to determine the progress of the woodland habitats towards providing adequate mitigation. The criteria for measuring performance would be used to determine if the conservation component is trending toward sustainability (reduced human intervention) and to assess the need for adaptive management (e.g., changes in design or maintenance revisions). These criteria must be met for the conservation component to be declared successful, both during a particular monitoring year and at the end of the establishment period. These performance criteria, which would be developed in consultation with USFWS and DFG, would include, but are not limited to:

- percent survival of planted trees (from 65–85%),
- percent survival of transplanted trees (from 60–85%), and
- percent relative canopy cover (from 5–35%).

Field assessments of woodland planting areas would be conducted once per year. The timing of these assessments would be adjusted according to annual site-specific conditions, but assessments would generally occur in late summer. To measure percent survival of trees and shrubs, each plant would be inspected and the species of each live plant would be recorded. Qualitative assessments would be recorded to track the health and vigor of each species for adaptive management of the conservation components.

To determine the success of the woodland plantings as a functioning ecosystem, percent canopy would be estimated each fall by recording the extent of woodland habitat on aerial photographs, or using repeat transects or fixed radius plots at ground level. The timing of these assessments would be adjusted according to annual site-specific conditions, but assessments would generally occur in late summer or early fall while trees are still in full foliage. The results of these assessments would also be used to determine where replanting should occur to maintain suitable Swainson's hawk habitat. All monitoring would occur for the full monitoring period or until the performance criteria are met, whichever is longer.

2.3.4.3 MANAGED MARSH CREATION

To compensate for adverse project effects on giant garter snake habitat, up to 200 acres of managed marsh would be created within the Brookfield borrow site, and the adjacent Chappell Ditch and Drain would be improved (**Plate 2-13**). The site is located south of Howsley Road, east of SR 99 and is divided into four approximately equal fields separated by farm roads running east-west. Approximately 160 acres of the 200-acre site was excavated in 2008 and 2009 to approximately 5 feet below existing grade to supply soil material for NCC south levee improvements. Use of this site for borrow was analyzed as part of the Phase 2 Project (SAFCA 2007: 2-9, 2-33). A new irrigation canal was constructed in 2009 along the eastern edge of the lower three fields, which was analyzed as part of the Phase 3 Project (USACE 2009b and SAFCA 2009b). This canal is approximately 3,900 feet long, with 15 foot access roads on either side.

The proposed managed marsh would provide giant garter snake with basking areas, vegetative cover from predators, and foraging habitat. In addition, the managed marsh habitat would compensate for losses of waters of the United States associated with the project. After establishment of the Phase 4b Project marsh, the project proponent(s) would grant TNBC a conservation easement and enter into a stakeholder-specific management agreement with TNBC, ensuring the permanent protection and management of these sites as habitat and open space. Giant garter snakes have been documented in the northwest of the basin; therefore, an additional habitat reserve in that area of the basin would be beneficial to the species. The Natomas Basin Habitat Conservation Plan (NBHCP) suggests that "the primary opportunity for connectivity between reserves is the system of channels maintained and operated by RD 1000 and Natomas Mutual [Natomas Mutual Water Company]." The Brookfield property is adjacent to Natomas Mutual's Chappell Ditch and RD 1000's CH1 Drain. As shown on **Plate 2-13**, drainage improvements are proposed as part of the borrow site marsh design, which would enhance the canals as snake habitat and improve drainage and irrigation to the Brookfield site.

The marsh would consist of a mosaic of aquatic and upland habitats, and an upland buffer between the restoration sites and adjacent roads. This created marsh would maximize habitat edge transitions to provide for shorter distances between burrow, basking, and foraging areas. Marsh design and management would optimize the values of giant garter snake habitat but minimize the attraction to wildlife species (e.g., flocks of waterfowl, starlings, pheasants) considered potentially hazardous to aircraft at low elevations as they approach or depart from runways.

Design of the managed marshes would follow the templates established by TNBC on recent projects, the design of SCAS's Willey mitigation site being developed in the northeast part of the Basin, and the existing SCAS marsh mitigation project at Prichard Lake. These design templates feature a combination of uplands and shallow water bodies, sinuosity of swales, and water control structures to manage target water levels at different times of the year. The marsh would have perimeter fences to control and protect grazing animals, such as goats. Grazing by goats is a management technique successfully used by TNBC to reduce invasions of weedy thatch and exotic plants while retaining sufficient cover for giant garter snake and other semiaquatic species that rely on grassy

uplands adjoining the wetland ponds. An essential component of the managed marsh would be procuring a firm, reliable water supply and good water quality throughout the giant garter snake's active season of April–October.

Currently, the Brookfield site's water supply comes from on-site wells, some of which are located within the footprint of the PGCC levee improvements. To provide irrigation to the site following the marsh creation and to eliminate the need to replace all of the on-site wells, the Chappell Ditch and Drain would be upgraded and extended to provide surface water to the Brookfield marsh and adjacent rice fields to the south and east (see **Plate 2-13**). This improvement would be designed to provide irrigation to approximately 940 acres formerly supplied by groundwater irrigation wells. The Chappell Ditch and Drain would be upgraded for approximately 5,000 feet from Highway 99 east and extended east to the PGCC and south along the PGCC for approximately 6,500 feet, making the total length of improvements approximately 11,500 feet. The Chappell Ditch would have 3H:1V side slopes, a bottom width of 18 feet, a depth of 6 feet, and two 15-foot-wide access roads, one on each embankment. The Chappell Drain, which provides drainage for agricultural fields to the north, would have 3H:1V side slopes, a bottom width of 12 feet, and variable depth. The construction footprint varies in width from 90 to 165 feet, plus a 20-foot temporary construction easement on each side.

In general the Brookfield marsh would flow north to south. A new supply canal would be constructed along the eastern boundary to serve irrigation water to the marsh and a drainage channel would be constructed along the western boundary.

General Construction Plan for the Managed Marsh

After excavation, disturbed areas would be finish graded to allow creation of the marsh habitat. Finish grading and installation of operational facilities and habitat features would take place from August through October. Revegetation activities would include erosion control on excavated slopes (e.g., straw mulch, hydroseeding), application of fertilizer as needed, and seeding of an initial cover crop on the finish grade of the bottom of the borrow site. Marsh plantings would then be installed and the borrow site flooded. It is anticipated that no unsuitable soil material would be hauled off-site. Debris encountered during excavation would be hauled off-site.

Other construction components are as follows:

- **Maintenance and access roads.** All-weather roads up to 15 feet wide would be constructed between the open-water channels and the upland areas in 25-foot-wide maintenance access areas.

- **Water supply and control facilities.** A well to provide a backup source of water would be installed in a location where it could supply water to the network of channels if it is needed to replace or supplement the surface-water supply. Water control facilities, such as riser boards, would be installed at key points in the channels to allow maintenance of desired water levels.

- **Habitat features for giant garter snake.** At points along the channels, clusters of rocks would be installed above the water line to provide basking areas for the snakes. Tule benches would be planted between upland areas and the channels to provide cover for the snakes.

The construction crew size would be up to 10 workers. Construction equipment would include one excavator, one bulldozer, and two backhoes. Employee vehicles and construction equipment would be parked off street, either in the construction staging areas, within the borrow site, or in designated parking areas. Construction equipment would be restricted to designated haul routes between the borrow operations and the construction sites.

2.3.4.4 MONITORING HABITAT COMPONENTS

Overall, after implementation of mitigation components, the mitigation sites would be monitored throughout the year for 3–8 years depending on the type of habitat and as developed in negotiation with the appropriate resource agencies. The project proponent(s) would be responsible for providing success monitoring, which, as required by

the appropriate resource agencies, would be conducted by a qualified ecologist, botanist, or biologist. The monitor would be objective and independent from the installation contractor responsible for site maintenance.

All habitat types and mitigation sites would receive quantitative and qualitative monitoring. Quantitative monitoring would be performed in accordance with the performance criteria described in the following sections (e.g., percent cover). Qualitative monitoring would provide an opportunity to document general plant health, overall plant community composition, hydrologic conditions, damage to the site, infestation of weeds, signs of excessive herbivory, signs of wildlife use, erosion problems, and signs of human disturbance and vandalism. These criteria would be assessed and noted for use in adaptive management of the mitigation sites, but they would not be used to determine project success. In addition, a complete list of all wildlife species encountered would be compiled for each mitigation site during each monitoring visit. Particular attention would be given to looking for evidence, as appropriate, of giant garter snake, valley elderberry longhorn beetle exit holes, and Swainson's hawk.

The project proponent(s) would prepare an annual report in conjunction with the resource managers that would be submitted to USACE (if SAFCA is the project proponent), USFWS, DFG, and the Central Valley RWQCB by December 31 of each year during the success monitoring period, or until the agencies have verified that final success criteria have been met. The report would assess the attainment of or progress toward meeting the success criteria for the mitigation sites.

2.3.4.5 LONG-TERM MANAGEMENT OF HABITAT COMPONENTS

A Phase 4b Project Long-Term Management Plan (LTMP) would be implemented by SAFCA in connection with the Phase 4b Project Mitigation Monitoring Plan (MMP). The LTMP would establish the long-term management practices (post-establishment period success criteria) and land protection mechanisms that would be implemented as each project phase of the NLIP is approved and permitted. Land ownership and management responsibilities would be held by SAFCA, RD 1000, NCMWC, and TNBC.

2.3.4.6 BANK PROTECTION

The Sacramento River Bank Protection Project (SRBPP) has identified 34 sites along the Sacramento River left bank from River Mile (RM) 78.8 to RM 60.2 (Sacramento River east levee Reaches C:1–4B, B:5–15, and A:16–20) where stream bank erosion has the potential to compromise the structural integrity of the levee and/or shorten the seepage path through the levee. However, because an adjacent levee will be constructed in all of these reaches, no erosion protection is needed because the distance from the projected levee slope to the current bank location is sufficient to guarantee that bank erosion will not intrude into the projected levee slope in the near future. Any gradual erosion that might occur would be addressed as a maintenance activity.

The NCC was inspected in 2005 by a SAFCA consultant, who reported minor to moderate erosion issues (Northwest Hydraulics Consultants, Inc. [NHC] 2006). NHC recommended toe protection in the lower 6,600 feet of the approximately 28,700-foot-long reach. The consultant did not develop treatment measures but described the scale of bank protection as minimal because of the low depths involved. The NCC is also inspected annually under the SRBPP, and no erosion sites on the left bank are currently identified.

Along the PGCC and NEMDC, six erosion sites have been identified for levee slope erosion repair, placement of rip rap, and/or channel realignment. All of the locations are at the confluences of tributary streams where the channel of PGCC or NEMDC has migrated to the west and threatens or has damages the right levee. These erosion sites are addressed in Section 2.3.3.2.

2.3.4.7 NATOMAS LEVEE CLASS 1 BIKE TRAIL PROJECT

As part of the Phase 4b Project, a regional Class I (completely separated from traffic) bicycle and pedestrian trail (Natomas Levee Class 1 Bike Trail Project) is proposed to be constructed in an approximately 42-mile loop along

the Natomas Basin levee perimeter in the northwestern portion of the County of Sacramento, southern portion of Sutter County, and a portion of the City of Sacramento (**Plate 2-20**). The exact alignment of the bike trail in terms of its placement in relation to levees and roadways would be determined through a detailed engineering design process. Therefore, this element of the Adjacent Levee Alternative (Proposed Action) is analyzed at a program level. Construction, operation, and maintenance of a recreation trail on the perimeter levee system would require an encroachment permit from the CVFPB with an endorsement by RD 1000. The bike trail would be funded locally, separate from this project.

The proposed recreational trail is intended to provide a bicycle commuter route at the southern and eastern end of the Natomas Basin that would connect to the regional American River Trail system. Although a paved bike trail within the City of Sacramento along the NEMDC provides a connection to the American River Trail system, no separate bikeway facilities are located in the unincorporated area of Sacramento or Sutter Counties. The lack of connection between the southwestern portion of the South Natomas and the American River Trail System discourages use of the commuting and recreational bicycling as well as jogging/walking. By separating vehicles and cyclists, the proposed recreational trail would improve safety conditions for cyclists who use Garden Highway for recreational bicycling, which currently requires them to share the roadway with vehicles. Funding for the trail would likely come from Federal or state grants or through the Metropolitan Transportation Plan (MTP) project priority list maintained by the Sacramento Area Council of Governments (SACOG).

The proposed recreational trail would include a bikeway that would be designed to exceed or meet the minimum standards for a Class I Bikeway (bike trail). Although the trail design is primarily based on bicycle parameters, the trail would also be used for walking, jogging/running, skateboarding, and roller skating/blading. **Plate 20** provides a conceptual illustration of a two-way bike trail on a separate right-of-way. However, because a detailed engineering and constraints analysis has not been conducted, it is unknown at this time whether a Class I bike trail can be achieved on every segment of the 42-mile levee system. Where a Class I bike trail cannot be constructed because of physical constraints, the bikeway would be designed to exceed or meet the minimum standards for a Class II facility (a lane set aside in city/county streets exclusively for bikes). At a minimum, the bike trail would be designed to meet the following criteria as defined in the Highway Design Manual, Chapter 10 (Caltrans 2009):

- **Hours of Use:** The bike trail would be open to the public 24/7. It is expected that the recreational trail would be closed for extended periods during high-water levels, and signage would be posted along the trail system to alert users of the closure. Also, during the regular maintenance by RD 1000, the recreational trail would be temporarily closed with signage posted to alert users of the closure and detour plan.

- **Type of Vehicles Permitted on the Trail:** By state law, motorized bicycles (mopeds) are prohibited on bike trails. Throughout the year, RD 1000 would close the recreational trail as part of levee maintenance activities. During the maintenance, heavy vehicles and/or tractor mowers would be crossing and using the bike trail for access to perform its responsibilities. Also, it is expected that RD 1000 maintenance, parks, and sheriff/police patrol and fire response vehicles and other authorized vehicles would be driving on the recreational trail system on a regular basis to patrol the levee system.

- **Widths:** The minimum paved width for a two-way bike trail would be 8 feet. A minimum 2-foot-wide graded area would be provided adjacent to the pavement (**Plate 2-21**). A 3-foot-wide graded area is recommended to provide clearance from poles, trees, walls, fences, guardrails, or other lateral obstructions. Wherever possible, a wider graded area can also serve as a jogging path.

- **Clearance to Obstructions:** A minimum 2-foot horizontal clearance to obstructions would be provided adjacent to the pavement (**Plate 2-20**). A 3-foot clearance is recommended. Where the paved width is wider than the minimum required, the clearance may be reduced accordingly; however, an adequate clearance is desirable regardless of the paved width. The clear width on structures between railings shall not be less than 8 feet. The vertical clearance to obstructions across the clear width of the trail shall be a minimum of 8 feet. Where practical, a vertical clearance of 10 feet is desirable.

- **Design Speed:** The design speed of the bike trail would be 25 miles per hour.

- **Horizontal Alignment and Super-elevation:** For most bike trail applications, the super-elevation rate would vary from a minimum of 2% to a maximum of approximately 5%. On a straight tangent section a minimum of 2% cross slope is recommended.

- **Signing and Delineation:** For the various types of and placement of signs for the trail, see the Manual on Uniform Traffic Control Devices (MUTCD), Section 9B.01 and the MUTCD and California Supplement Section 9B.01 (Caltrans 2006: 9B-1, 9B-7, and 9B-8). For pavement marking guidance, see the MUTCD, Section 9C.03.

- **Intersections with Highways:** Intersections are a prime consideration in bike trail design. If alternate locations for a bike trail are available, the one with the most favorable intersection conditions should be selected. Where motor vehicle cross traffic and bicycle traffic is heavy, grade separations are desirable to eliminate intersection conflicts. Where grade separations are not feasible, assignment of right-of-way by traffic signals should be considered. Where traffic is not heavy, stop or yield signs for bicyclists may suffice.

- **Separation between Bike Paths and Highways:** A wide separation is recommended between bike trails and adjacent highways (see MUTCD, Figure 1003.1B). Bike trails closer than 5 feet from the edge of the shoulder of an adjacent highway shall include a physical barrier to prevent bicyclists from encroaching onto the highway. Bike trails within the clear recovery zone of freeways shall include a physical barrier separation. Suitable barriers could include chain link fences or dense shrubs.

- **Placement of Bike Trail:** Depending upon the location along the Natomas Basin perimeter levee system, a variety of bike trail placement options would be available and selected through detailed engineering project design. These options, which would be subject to approval by RD 1000, would include placement on the top of levees, adjacent to levee toes, and within O&M corridors. Along Garden Highway, the options would include locating the bike trail next to the highway with a physical separation or locating it adjacent to the highway using its shoulders.

- **Trees:** To comply with levee maintenance policies, trees would not be planted as part of construction of the bike trail. However, where permitted by levee maintenance policies, container trees or other human-made shade structures may be permitted in some locations to provide shade for the trail users.

- **Safety Lighting:** Safety lighting would be provided at the all public street intersections.

- **Call Boxes:** Call boxes would be installed approximately every mile, where needed.

- **Pullout Areas, Shade Shelters, and Water Fountains:** All these features would be provided at a range of every 3 to 5 miles.

- **Pavement/Signage Maintenance:** Sacramento County Department of Transportation (SacDOT) would maintain the signage within the recreation trail easement, paved trail, and its shoulder after the completion within the unincorporated area within the County of Sacramento. It is expected the other jurisdictions would maintain their portions of the recreation trail. The maintenance agreement would be drafted and executed among the partnering jurisdictions to address the timely trail maintenance responsibility in the long run. Overall integrity of the levee structure beyond the influence area of trail easement would be maintained by RD 1000.

- **Trail Patrolling:** On behalf of the Sacramento County, Parks Department staff would patrol the levee on a daily basis. The City of Sacramento and County of Sutter may provide their own patrolling or contract with Sacramento County Parks Department regarding the patrolling for the recreational trail system in their respective jurisdictions. Trail patrolling is necessary to keep SacDOT staff informed of any vandalism, safety

concerns, and maintenance needs on the recreational trail system. Trail users would also report problems. Signage would indicate the contact information to report any issues.

Recreational Trail Construction Activities and Timing

Depending upon the final alignment of the recreational trail, construction would involve grading and paving on top of the new adjacent levee along Garden Highway or other widened levees in the Natomas Basin perimeter levee system. Because of the requirement to have newly constructed levees settle prior to final inspection and certification, trail construction in these areas would not occur until the following year's construction season, at the earliest. In addition, the long lead time in securing funding sources could delay construction for several years after completion of levee construction.

2.3.4.8 AVIATION SAFETY COMPONENTS

The Airport experiences a high rate of aircraft/bird strikes, which poses a substantial hazard to flight safety. In accordance with the Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5200-33B, Hazardous Wildlife Attractants on or Near Airports (FAA 2007), FAA recommends that airports reduce wildlife attractants within Perimeter B, the area within a 10,000-foot radius from Air Operations Area for turbine-powered aircraft. Additionally, the FAA recommends that no land uses deemed incompatible with safe airport operations be maintained in Perimeter C, a radius of 5 miles from the edge of the Airport Operations Area, if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace. Open water and agricultural crops are recognized as being the greatest wildlife attractants in the Airport vicinity, and rice cultivation is considered the most incompatible agricultural crop because of its flooding regime. The following describes the aviation safety components associated with the project:

- Work within Perimeter B would be coordinated with Airport operations and night lighting would be restricted within and near the runway approaches.

- A wildlife-aircraft strike analysis would be conducted and mitigation for earthmoving activities within Perimeter B would be developed and implemented.

2.3.4.9 OPERATIONS AND MAINTENANCE

Whether USACE or SAFCA implement the Phase 4b Project, agencies and organizations that would have management responsibility for proposed Phase 4b Project features are USACE/SAFCA, RD 1000, NCMWC, SCAS, and TNBC, as described below.

U.S. Army Corps of Engineers/Sacramento Area Flood Control Agency

Either USACE or SAFCA, as the project proponent, would be responsible for the design and construction of all levee improvements, maintenance access, inspection roads, rights-of-way, replacement canals, associated drainage and irrigation structures, and habitat creation sites. In addition, the project proponent(s) would be responsible for all necessary land acquisitions and easements to construct the project features and achieve the project objectives. However, once these project features are completed, most of the land or land management responsibilities would be transferred by the project proponent(s) to the other management entities described below. Memoranda of Agreement, land ownership transfers, or management endowments and contracts would be used by the project proponent(s) to transfer land management responsibility to the appropriate public agency or non-profit land management organization. At the end of the project construction period, all project lands would be in public ownership and/or would be under the permanent control of a natural resource conservation entity.

Reclamation District 1000

The mission and purpose of RD 1000 is to operate and maintain the flood damage reduction levees surrounding the Natomas Basin and operate and maintain the internal drainage system to evacuate agricultural and urban stormwater and incidental runoff. RD 1000 would be responsible for the management of the proposed levee improvements, when complete; the new GGS/Drainage Canal; and its reconfigured pumping plants. Typical activities include mowing grassland along levee slopes and berms, canal banks, and rights-of-way; managing canal bank vegetation, including noxious weeds; maintaining relief wells and other drainage features; periodically removing sediment from drainage canals; and maintaining and repairing canal and levee patrol roads.

Natomas Central Mutual Water Company

NCMWC is a non-profit mutual water company with the primary focus of keeping the water conveyance system functioning to serve the company shareholders. Intensive maintenance to maximize agricultural irrigation services throughout the Basin is generally limited to only 10% annually of the approximately 100 miles in the Natomas Basin canal system operated by NCMWC. NCMWC would be responsible for maintaining and managing the relocated Riego Road Canal and existing irrigation canals. The relocated canals would be maintained in the same manner as the existing canals. Typical maintenance activities include operating and repairing water control structures and barrier gates, periodically removing sediment and noxious aquatic weeds from the canals, repairing canal roads, managing bank vegetation, and mowing grassland along canal and road rights-of-way. However, compared to the existing Riego Road Canal, the relocated canal would have improved embankments, better water control structures, better vegetation cover, and wider roads and rights-of-way. These improvements are expected to ease annual canal management efforts, allowing for a proportionately greater focus on maintenance and operations and less need for repair and dredging.

Sacramento County Airport System

SCAS manages the Sacramento County-owned bufferlands outside the Airport Operations Area. All Phase 4b Project components on land under SCAS management would remain in public ownership and would be managed by SCAS.

The Natomas Basin Conservancy

TNBC acquires and manages land for the purpose of meeting NBHCP objectives. To meet the mitigation goals of the NBHCP, project developers of projects pay a mitigation fee to TNBC when they apply for building permits. TNBC then uses the mitigation fees to acquire, restore, and manage mitigation lands to provide habitat for protected species and maintain agriculture in the Natomas Basin. TNBC owns approximately 30 mitigation properties totaling more than 4,000 acres. Private land acquired by the project proponent(s) and converted to managed marsh, preserved as agricultural uplands (field crops), or used for woodland establishment as part of the Phase 4b Project would be protected by conservation easements conveyed to TNBC. After completion of reclamation activities, the project proponent(s) would contract with TNBC for management of these habitat features.

2.3.4.10 VEGETATION MANAGEMENT

USACE levee guidance requires the removal of vegetation greater than 2 inches in diameter on the levee slopes and within 15 feet of the waterside and landside levee toes (USACE 2000). As shown in **Plate 2-1**, the proposed adjacent levee in Sacramento River east levee Reach A:16–20 is designed to shift the levee prism landward by creating a virtual 3H:1V waterside slope extending from the waterside edge of the designated crown (20 feet wide between the landside and waterside edges) to the extended plane of the landside ground elevation. To meet seepage criteria, this widened levee would be managed to remove and prevent any growth of trees with a drip line that penetrates the landside slope of the widened levee or the projected waterside slope. The intent of this

landward shift in the levee prism is to allow preservation of a large number of trees and important aquatic habitat, including SRA habitat located along the waterside of the Sacramento River east levee without unacceptably impairing the safety, structural integrity, and functionality of the levee. To compensate for landside vegetation removal required for the adjacent levee, a habitat creation plan has been developed to replace this habitat in a manner that has been deemed acceptable by the responsible Federal and State resource management agencies (see Section 2.3.4, "Habitat Creation and Management," above, and Impact 4.7-a, "Loss of Woodland Habitats," in Section 4.7, "Biological Resources").

As noted in Section 2.1.3.4, "Management of Levee Vegetation and Structural Encroachments," along the American River north levee, an extensive number of trees located on and along the current landside slope of the levee would be removed to accommodate the expanded levee footprint, including removal of vegetation within 15 feet of the new landside levee toe. Along the NEMDC west levee south of the NEMDC Stormwater Pumping Station (Reach G), at a minimum, vegetation removal would be required under a variance request for all non-native trees from within the vegetation-free zone, all native trees that have a dbh of four inches or less, and all larger native trees that are located on the waterside slope, the crown, or within 15 feet of the landside toe (or within the right-of-way, if less than 15 feet). Along the NCC south levee, under the variance request, vegetation removal would be required for the upper 1/2 of the waterside levee slope.

2.3.4.11 STRUCTURAL ENCROACHMENTS

USACE levee guidance also requires an assessment of encroachments on the levee slopes, including utilities, fences, structures, retaining walls, driveways, and other features that penetrate the levee prism. Substantial encroachments are present on the Sacramento River east levee with a smaller number of encroachments on the other Natomas Basin levees. One of the objectives of constructing an adjacent levee along the Sacramento River east levee is to facilitate acceptable management of existing vegetation and structural encroachments along the waterside of this levee.

Should any of these existing encroachments be determined to reduce the integrity of the levee, increase flood risk unacceptably, or impede visibility or access to the waterside levee slope, the encroachments would need to be removed. Removal of some waterside slope encroachments may be required by the end of 2010 to ensure that the levee system meets FEMA criteria. Along the landside of the proposed adjacent levee, encroachment removal would typically be accomplished as part of the landside levee improvements. The relocation of power poles located on the existing landside slope of the levee in Sacramento River east levee Reach A:16–20 and American River north levee Reach I:1–4 is anticipated to be conducted as part of the Phase 4b Project to prepare for levee improvement work. Following completion of the proposed levee improvements, USACE, the State, SAFCA, and RD 1000 would inspect and evaluate whether there are any remaining encroachments that would affect levee integrity. To the extent that removal of these identified encroachments may cause potentially significant environmental effects, future, separate NEPA and CEQA compliance and review would be required.

2.3.4.12 LANDS, EASEMENTS, RELOCATIONS, AND RIGHTS-OF-WAY

Several of the project components described above would require substantial land acquisition to accommodate the expanded levee, seepage berm, and canal footprints. In the context of the Phase 4b Project, the acquired lands would support construction of an adjacent levee along the Sacramento River east levee in Reach A:16–19B, flattening the slope of the Sacramento River east levee in Reach A:19B–20, Reach I:1–4 of the American River north levee, NEMDC and PGCC west levees, and the West Drainage Canal. In addition, sufficient land would be acquired to establish O&M access corridor at the landside toes of all the improved levees to prevent encroachment into the levee improvements, and to preserve the land for possible future expansion of levee facilities.

Land would also be acquired for use as borrow areas that would be reclaimed to create or preserve agricultural uplands. Finally, as discussed previously, the Adjacent Levee Alternative (Proposed Action) would require relocation of many existing irrigation and drainage facilities, a number of power poles serving residences along

the levees, several roadway intersections, and several private residential and nonresidential structures. Land ownership in the Phase 4b Project footprint is shown on **Plates 2-22a** through **2-22e**. All or a portion of these parcels may be acquired to construct the Phase 4b Project.

Privately owned lands would be acquired in fee. Easements would be obtained where the project features would be on Airport land (owned by Sacramento County). Where the project footprint would overlie land owned and managed by other agencies (i.e., TNBC), either acquiring the land in fee or obtaining and securing easements would be required.

Real property acquisition and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 United States Code [USC] Section 4601 et seq.) and implementing regulation, 49 Code of Federal Regulations (CFR) Part 24; and California Government Code Section 7267 et seq. Refer to Chapter 6, "Compliance with Federal Environmental Regulations," and Section 3.16, "Socioeconomics, Population, and Housing" for more details regarding these regulations.

2.4 FIX-IN-PLACE ALTERNATIVE

All elements of the Fix-in-Place Alternative would be the same as described for the Adjacent Levee Alternative (Proposed Action) except the method of raising and rehabilitating the Sacramento River east levee, including the extent of levee degradation required to construct cutoff walls, and the extent of encroachment removal along the levee. Differences from the Adjacent Levee Alternative (Proposed Action) are shown in italicized text below. For those elements that are the same as the Adjacent Levee Alternative (Proposed Action), no further discussion of the element is provided.

- **Sacramento River east levee (Reach A:16–20): Levee widening/rehabilitation and seepage remediation**—Same as the Adjacent Levee Alternative (Proposed Action), *except that the levee crown would not be widened by 15 feet, necessitating waterside vegetation removal to comply with USACE guidance criteria.*

- **Sacramento River east levee (Reach B:10–15)**: **Levee raise extension**—Same as the Adjacent Levee Alternative (Proposed Action).

- **American River north levee (Reach I:1–4): Slope flattening and seepage remediation**—Same as the Adjacent Levee Alternative (Proposed Action).

- **NEMDC North (Reaches F–G): Levee raising, slope flattening, and seepage remediation**—Same as the Adjacent Levee Alternative (Proposed Action).

- **PGCC (Reach E) and NEMDC South (Reach H): Levee raising and slope flattening**—Same as the Adjacent Levee Alternative (Proposed Action).

- **PGCC (Reach E) and NEMDC South (Reach H): Waterside improvements**—Same as the Adjacent Levee Alternative (Proposed Action).

- **PGCC (Reach E) culvert remediation**—Same as the Adjacent Levee Alternative (Proposed Action).

- **SR 99 NCC Bridge remediation (Reach D:6)**—Same as the Adjacent Levee Alternative (Proposed Action).

- **West Drainage Canal**—Same as the Adjacent Levee Alternative (Proposed Action).

- **Riego Road Canal (highline irrigation canal) relocation**—Same as the Adjacent Levee Alternative (Proposed Action).

- **NCC south levee ditch relocations**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Modifications to RD 1000 Pumping Plants**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Modifications to City of Sacramento Sump Pumps**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Borrow site excavation and reclamation**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Habitat creation and management**—Same as the Adjacent Levee Alternative (Proposed Action), *except landside woodland compensation would be up to 70 acres.*
- **Infrastructure relocation and realignment**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Landside vegetation removal**—Same as the Adjacent Levee Alternative (Proposed Action), *except maximum extent of removal would be reduced by approximately 1 acre.*
- **Waterside vegetation removal**—Same as the Adjacent Levee Alternative (Proposed Action) for modifications to RD 1000 pump stations and for the NEMDC west levee south of the NEMDC Stormwater Pumping Station. *In Reach A:16–20 of the Sacramento River east levee, it is assumed that because of the uncertainty of how USACE levee vegetation guidance criteria would be applied where the levee is not widened by an additional 15 feet (as under the Adjacent Levee Alternative [Proposed Action]), approximately 19 acres of waterside vegetation would need to be removed from the waterside hinge point of the levee crown to the water's edge as a worst-case scenario.*
- **Bank protection**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Right-of-way acquisition**—Same as the Adjacent Levee Alternative (Proposed Action).
- **Encroachment management**—Same as the Adjacent Levee Alternative (Proposed Action), *except in Reach A:16–20 of the Sacramento River east levee, it is assumed, as stated above, that the levee would not be in compliance with levee vegetation requirements on the waterside.*
- **Natomas Levee Class 1 Bike Trail Project**—Same as the Adjacent Levee Alternative (Proposed Action).

2.4.1 FLOOD RISK REDUCTION COMPONENTS

2.4.1.1 SACRAMENTO RIVER EAST LEVEE

Levee improvements under the Fix-in-Place Alternative would be constructed from the northern end of Reach A:16 through Reach 20 (Station 780+00 to Station 956+82), a distance of approximately 3.3 miles. The improvements would include the following components:

- **Fix-in-Place Levee.** The Sacramento River east levee would be upgraded in place, requiring closure of both lanes of Garden Highway in an approximately 1,000-feet-long segment that would move along the levee as construction is completed. This closure would last for the duration of the construction season—up to 6 months. Local access for homeowners would be provided, while through traffic would be detoured around the construction.

  The fix-in-place levee raise would consist of constructing an embankment from the waterside hinge point of the existing levee. The typical dimensions are shown in **Plates 2-23a** through **2-23d**. Compared to the Adjacent Levee Alternative (Proposed Action), the Fix-in-Place Alternative would reduce the footprint of the

levee improvements on the landside by approximately 15 feet. **Table 2-25** shows the width of the widened levee and the maximum limits of flood damage reduction improvements by reach.

Table 2-25
Maximum Limit of Flood Damage Reduction Improvements by Reach

Reach (Cross-Section Plate)	Stationing	Fix-in-Place Levee	Seepage Remediation	Maximum Limit of Flood Damage Reduction Improvements	
		Approximate Distance from Center Line of Garden Highway		Approximate Distance From Center Line of Garden Highway	Approximate Distance from Existing Levee Toe
A:16 (Plate 2-22a)	780+00 to 799+00	75 feet	300-foot-wide seepage berm and/or cutoff wall	445 feet	395 feet
A:16, 17, 8A (Plate 2-22a)	799+00 to 848+00	75 feet	100-foot-wide seepage berm (+ potential relief wells) and/or cutoff wall	215 feet	160 feet
A:18B, 19A (Plate 2-22b)	848+00 to 863+00	55 feet	250-foot-wide seepage berm (+ potential relief wells) and/or cutoff wall	445 feet	390 feet
A:19A, 19B (Plate 2-22b)	863+00 to 878+00	58 feet	200–250-foot-wide seepage berm (+ potential relief wells) and/or cutoff wall	271 feet to 321 feet	225 feet to 275 feet
A:19B (Plates 2-22c to 2-22d)	878+00 to 923+50	42 feet to 73 feet	Cutoff walls and relief wells	79 feet to 93 feet	79 feet to 93 feet
A:19B, 20 (Plate 2-22d)	923+50 to 950+83	80 feet	Cutoff walls and relief wells	110 feet	90 feet

Source: HDR 2010; compiled by AECOM in 2010

However, because this alternative would not shift the levee prism and encroachment-free zone away from the waterside, as illustrated in **Plate 2-1** (lower illustration), vegetation removal would be required along the Sacramento River within 15 feet of the projected waterside levee toe.

- **Cutoff Walls.** Three-foot-wide cutoff walls made of either CB or SCB would be installed through the existing levee after the existing levee has been degraded by one-third to one-half from its original height. Depending on the construction method used, the top of the cutoff walls would extend from the degraded levee elevation to a depth of 110 feet below ground surface in some areas. Locations and depths would be determined during final engineering design. The total linear extent would be approximately 17,700 feet (in Reach A:16–20).

- **Seepage Berms.** Seepage berm widths would extend up to 100 feet from the fix-in-place levee landside levee toe in Reach A:17–19A and up to 300 feet from the fix-in-place levee landside levee toe in Reach A:16 (**Plate 2-21**). Depending upon width, seepage berms would range 6–7 feet in thickness. All berms would gradually slope downward to about 4 feet thick at the landside edge, with a 3H:1V slope to ground level. A gravel surface patrol road would be constructed near the outside edge of the seepage berms. Precise locations of the seepage berms would be determined during engineering design.

- **Relief Wells.** Relief wells would be constructed at selected locations where berms cannot be wide enough or walls deep enough to meet the required seepage remediation design parameters. Relief wells would also be

constructed along some of the entrance channels to the landside pump stations. Relief wells would be spaced 60–100 feet apart and would extend to depths of 60–80 feet below the ground surface.

- **Levee Slope Flattening.** In Reach A:19B–20, a new landside levee slope (varying from 3H:1V–2H:1V) would be constructed adjoining the existing Sacramento River east levee. The levee typical dimensions are shown in **Plate 2-24**. The existing levee already meets height requirements; therefore, the top of the new levee would be no higher than the elevation of the existing levee crown. With no levee raise, the adjacent levee crown would be graded to drain towards both the waterside and landside as it does now. Therefore, installation of surface drainage outlets across Garden Highway is not required.

- **Operation and Maintenance Access/Utility Corridors.** A 50-foot-wide O&M access corridor would be established adjacent to the toe of the levee or seepage berm. Beyond this corridor, a 20-foot-wide corridor would be established for relocation of power lines and other utility infrastructure. A 20-foot-wide O&M corridor and a 10-foot-wide utility corridor may be used in Reach A:19B–20 and at locations with landside constraints. Where feasible, the levee and seepage remediation improvements would stop short of existing rights-of-way, such as Wheelhouse Avenue, Marina Glen Way, Avocet Court/Swainson Way, and La Lima Way. However, these rights-of-way may provide a portion of the O&M corridor for levee inspection and emergency flood fight activities. Installation of retaining walls, which may be employed to limit the landward extent of the footprint, would temporarily affect these roads. However, access to residences along these roads would be maintained during construction.

- **Garden Highway Closures.** As noted above, both lanes of Garden Highway would be closed in an approximately 1,000-foot-long segment that would move along the levee as construction is completed. This closure would last for the duration of the construction season—up to 6 months. Local access for homeowners would be provided, while through-traffic would be detoured around the construction area.

- **Reconstruction of Intersections.** Garden Highway intersections at Orchard Lane and additional private parcel ramps would require reconstruction to accommodate the fix-in-place levee. Intersecting road embankments would be raised, extending the approach embankment outward from the fix-in-place levee. The design would meet Sacramento County and City of Sacramento roadway design criteria.

The levee improvements for the Phase 4b Project are anticipated to be constructed between April 15 and November 1. However, construction could extend as late as December 31. Some related activities, such as power pole relocations, and demolition or relocation of residential or agricultural structures, may be conducted before April 15, and site restoration and demobilization could extend through January. The construction crew size during peak construction would be up to 60 people per shift working two 12-hour shifts. The construction sequence would be divided into several different fronts to meet the proposed schedule. Cutoff wall construction would be conducted 24/7 only in the reaches west of the I-80 overcrossing. No 24/7 construction would be conducted in the remaining urbanized reaches of the Sacramento River east levee. Sundays would be used to maintain the cutoff wall construction equipment.

Personnel, equipment, and imported materials would reach the project site primarily by Bryte Bend Road and an off-road haul route parallel to the existing landside levee toe in Reach A:16–20. However, secondary routes may include use of I-5, Powerline Road, El Centro Road, and San Juan Road. The primary corridors where construction activity would take place are off of public roadways, within and through the soil borrow areas and within the adjacent levee alignment and existing dirt roads used for access to the work areas.

Approximately 1,097,000 cubic yards of soil borrow would be required to construct these proposed levee improvements. **Table 2-26** shows the quantity of each fill type needed and the expected source for the Fix-in-Place Alternative. The levee fill, seepage berm fill, and excavation quantities include a 25% shrinkage factor to account for volume loss during excavation, placement, and compaction. The primary source for this material

would be in the South Fisherman's Lake Borrow Area (**Plate 2-7a**). The average round-trip distance for truck hauls would be approximately 3.5 miles.

Table 2-26
Quantities of Fill Required Sacramento River East Levee – Fix-in-Place Alternative

Material Type	Quantity	Source (Average Round-Trip Haul Distance)
Levee fill	434,000 cy	South Fisherman's Lake Borrow Area (4 miles)
Seepage berm fill	663,000 cy	South Fisherman's Lake Borrow Area (4 miles)
Waste material	NA	On-site
Aggregate base	63,800 tons	Commercial source (30 miles)
Asphalt concrete	11,100	Commercial source (30 miles)
Total	**1,097,000 cy 74,900 tons**	**NA**

Notes: cy = cubic yards; NA = not applicable
Source: Data provided by HDR in 2009

Delivery of the materials listed in **Table 2-26** would require up to 960 haul trips per day. Construction in Reach A:16–19A would require an average of 510 truck trips per day based on the following assumptions: (1) construction would take place within a 6-month period, with 140 days available during the 156-day construction season (April 1–November 1), (2) truck capacities would be 14 cubic yards (24 tons), and (3) haul trucks would be used for moving all borrow material from borrow sites. Use of haul trucks for all trips is a conservative assumption because some of these trips could take place off-road and may involve the use of elevating scrapers rather than haul trucks.

For construction in Reach A:19B–20, an average of 450 truck trips per day would be required, based on the assumption that hauling would take place over a 45-day period using street-legal haul trucks with a 12 cubic yard capacity (20 tons). Lighter haul trucks would be employed in these reaches because of the increased need to use surface streets in these reaches as a result of limited space for two-way truck traffic along the landside levee toe.

Table 2-27 summarizes the types of equipment that may be used throughout the construction sequence, along with an approximation of the duration of each activity.

- **Landside Vegetation Removal.** For the Fix-in-Place Alternative, vegetation would be removed as needed from the levee footprint, which would be a minimum of 15 feet from the levee waterside toe and between 30 and 190 feet from the existing landside levee toe, depending upon the location. This operation would require removal of some trees and relocation/removal of elderberry shrubs, which occur mostly adjacent to existing roads. Small trees and elderberry shrubs, where feasible, would be relocated to woodland preservation corridors that are part of the Phase 4b Project. A minimal amount of below-ground disturbance would occur.

- **Waterside Vegetation Removal.** Under the Fix-in-Place Alternative, because of the uncertainty of how USACE levee vegetation guidance criteria would be applied in Sacramento River east levee Reach A:16–20 where the levee is not widened by an additional 15 feet (as under the Adjacent Levee Alternative [Proposed Action]), it is assumed that waterside vegetation would need to be removed from the waterside hinge point of the existing levee crown to the waterside levee toe plus an additional 15 feet (a total distance of approximately 90 feet from the waterside hinge point of the levee crown.

Table 2-27
Anticipated Equipment Types and Duration of Use for Sacramento River East Levee – Fix-in-Place Alternative

Construction Activity	Equipment Type and Number of Each Type	Duration of Use (days)
Mobilization	NA	NA
Site preparation (tree removal, clearing, grubbing, stripping)	Scrapers (6)	27
	Front-end loaders (2)	27
	Crawler/tractors (tree pushers) (2)	27
	Water trucks (2)	27
	Motor graders (2)	27
	Chippers/grinders (4)	27
	Haul trucks (10)	27
Removal of landside structures and other facilities	Excavators (2)	24
	Haul trucks (24)	24
	Front-end loader (1)	24
Construction of levee and seepage berms (includes borrow site activities)	Scrapers (6)	27
	Front-end loaders (2)	27
	Crawler/tractors (tree pushers) (2)	27
	Water trucks (2)	27
	Motor graders (2)	27
	Chippers/grinders (4)	27
	Haul trucks (10)	27
Cutoff wall construction	Front-end loaders (10)	60
	Bulldozers (20)	60
	Extended boom pallet loaders (10)	60
	300-kW generators (10)	60
	Slurry pumps (10)	60
	Pickup trucks (8)	60
	Haul trucks (8)	60
	Excavators (6)	60
	Deep soil mix rigs (10)	60
Reconstruction of Garden Highway at two intersections	Backhoe (1)	27
	Smooth drum compactor (1)	27
	Asphalt paver (1)	27
	Haul trucks (3)	27
	Striping truck (1)	27
	Truck-mounted auger (1)	27
Site restoration and demobilization	Hydroseeding trucks (3)	34
	Water trucks (3)	34
	Haul trucks (2)	34

Notes: kW = kilowatt
Source: Data provided by HDR in 2009

- **Operation and Maintenance/Utility Corridors.** A 50-foot-wide O&M access corridor would be established adjacent to the levee or seepage berm toe. Beyond this corridor, a 20-foot-wide corridor would be established for relocation of power lines and other utility infrastructure.

- **Garden Highway Drainage.** In Reach A:16–19B with no levee raise, the adjacent levee crown would be graded to drain towards both to the waterside and landside as is does now. Therefore, installation of surface drainage outlets across Garden Highway would not be required.

- **Reconstruction of Intersections.** Garden Highway intersections at Orchard Lane and additional private parcel ramps would require reconstruction to accommodate the adjacent levee. Where alternate access to the private properties is available, the private ramps would be removed and not replaced. Intersecting road embankments would be raised, typically extending the approach embankment approximately 600 feet outward from the adjacent levee. The design would meet Sacramento County and City of Sacramento roadway design criteria.

- **Construction Sequence.** With the exception of the riverbank erosion control, construction activities for the Fix-in-Place Alternative would be similar to those of the Adjacent Levee Alternative (Proposed Action). Construction of the cutoff walls under the Fix-in-Place Alternative would require the temporary removal of Garden Highway and excavation of the top one-third of the levee embankment to provide a suitable working surface to construct the cutoff wall.

- **Utilities Relocation.** All utilities (water, sewer, communication, and electrical, including power poles) that currently exist on the landside slope of the levee and at the landside levee toe would need to be relocated and/or rerouted to accommodate the widened levee footprint. A PG&E tower (Reach A:18A, at approximately Station 847+00) is located within the proposed 250-foot-wide seepage berm. The tower would potentially need to be relocated outside of the levee footprint, but all efforts would be made to protect it in place. To the extent feasible, mainline utility infrastructure, such as power poles, would be relocated beyond the landside levee, with the potential of undergrounding some utilities as an option. Should placement of poles be required on top of the seepage berms, raised foundations would be constructed to prevent the poles from penetrating the top of the seepage berm. In Reach A:19A–19B (from Station 863+00 to 923+00), where space on the landside is limited, some utility poles may need to be relocated to the waterside of the existing levee; however, no new power poles would be located on the waterside of the levee in the vicinity of existing waterside residences unless there is no feasible alternative for providing service to these residences. No power poles would be relocated within the new levee prism. Tree pruning would likely be required in some locations to accommodate the power poles and associated wires. The project proponent(s) would conduct the relocations in coordination with the appropriate utility companies and the construction operations.

2.5 COMPARISON OF THE IMPACTS OF THE ALTERNATIVES

Table 2-28 shows the overall level of significance for each issue area, and provides a comparison of significance determinations among the No-Action Alternative (No Phase 4b Project Construction and Potential Levee Failure) and the two action alternatives (Adjacent Levee Alternative [Proposed Action] and Fix-in-Place Alternative) for each of the 16 environmental issues evaluated in this EIS/EIR. As noted in the table, significance conclusions for this alternatives comparison are the result of the combination of all environmental impacts associated with a particular issue area.

Table 2-28
Comparison of the Environmental Impacts (After Mitigation Implementation) of the Phase 4b Project Alternatives[1]

Environmental Issue Area	Phase 4b Project Alternative			
	No-Action Alternative		Adjacent Levee Alternative (Proposed Action)	Fix-in-Place Alternative
	No Phase 4b Project Construction	Potential Levee Failure		
Agricultural Resources	NI	Too Speculative	**SU**	**SU**
Land Use, Socioeconomics, Population and Housing	NI	Too Speculative	**SU**	**SU**
Geology, Soils, and Mineral Resources	NI	Too Speculative	**SU**	**SU**
Hydrology and Hydraulics	NI	**SU**	LTS	LTS
Water Quality	NI	Too Speculative	LTS	LTS
Biological Resources				
Fisheries	NI	Too Speculative	LTS	LTS
Sensitive Aquatic Habitats	NI	Too Speculative	LTS (B)	LTS (B)
Vegetation and Wildlife	**SU**	Too Speculative	**SU**	**SU**
Special-Status Terrestrial Species	NI	Too Speculative	**SU**	**SU**
Implementation of NBHCP	SU	Too Speculative	LTS	**SU**
Cultural Resources	NI	Too Speculative	**SU**	**SU**
Paleontological Resources	NI	LTS	LTS	LTS
Transportation and Circulation	NI	Too Speculative	**SU**	**SU**
Air Quality	NI	Too Speculative	LTS	LTS
Noise	NI	LTS	**SU**	**SU**
Recreation	**NI**	Too Speculative	SU	SU
Visual Resources	**SU**	Too Speculative	**SU**	**SU**
Utilities and Service Systems	NI	Too Speculative	LTS	LTS
Hazards and Hazardous Materials	NI	Too Speculative	LTS	LTS
Environmental Justice	NI	Too Speculative	LTS	LTS

Notes: B = Beneficial, NI = no impact, LTS = less than significant, S = significant, SU = significant and unavoidable

[1] The overall impact conclusion for each issue area for each alternative was determined as follows: Separate tables were created for each issue area, and within each alternative, the number of appearances of each significance conclusion—LTS, LTS (B), SU—after the implementation of mitigation measures was totaled. The significance conclusion that occurred the greatest number of times within each issue area was determined to be the overall impact conclusion for that alternative. For example, if four impacts were determined to be LTS and two impacts were determined to be SU, the impact conclusion would be LTS. In cases where the numbers were the same (i.e., two impacts determined to be LTS and two impacts determined to be SU), the more severe impact was used; in the case of this example, it would be SU. The No-Action Alternative (for both No Phase 4b Project Construction and Potential Levee Failure) is not subject to mitigation, and often a precise determination of significance was not possible and could be made; therefore, in these cases the impact was determined to be too speculative for meaningful consideration ("Too Speculative").

Source: Data compiled by AECOM in 2010

As shown in **Table 2-28**, no direct construction-related impacts would be associated with the No-Action Alternative (No Phase 4b Project Construction scenario). However, unless a variance is obtained, vegetation clearance would be conducted to comply with USACE levee vegetation guidance, which would cause significant and unavoidable impacts to vegetation, wildlife, and visual resources. In addition, as described in Section 2.2.1, "No-Action Alternative—No Flood Damage Reduction Measures," USACE's evaluation of geotechnical information and other data indicates that without improvements to the Natomas perimeter levee system (i.e., implementation of one of the action alternatives), an approximately 3% per year or greater probability exists that a flood could cause levee failure (Potential Levee Failure scenario). As described in Chapter 4, "Environmental Consequences and Mitigation Measures," under the analyses of the No-Action Alternative: Potential Levee Failure, impacts associated with a potential levee failure are largely unknown and would depend on the location and extent of flooding; therefore, many of these potential impacts are considered too speculative for meaningful consideration.

Although a larger number of significant and unavoidable impacts would result from implementing the Fix-in-Place Alternative than from implementing the Adjacent Levee Alternative (Proposed Action), these impacts would occur as a result of the same mechanisms (e.g., habitat loss, traffic increases).

To further compare and contrast the significant and unavoidable impacts that would result from implementing either action alternative, **Table 2-29** provides a comparison of the quantifiable environmental impacts associated with the action alternatives.

Table 2-29
Summary of Quantifiable Environmental Impacts of the Action Alternatives[1]

Environmental Impact	Adjacent Levee Alternative (Proposed Action)	Fix-in-Place Alternative
Permanent Conversion of Important Farmland	**678**	674
Potential Permanent Loss of Habitat[2]		
Rice	59	59
Canals	23	23
Landside Woodlands	**36**	35
Waterside Woodlands (SRA habitat)	7	**27**
Cropland	**82**	81
Grasslands	**171**	170
Loss of Elderberry Shrub	surveys in progress	surveys in progress
Potential Wetlands Filled		
Temporary	324	324
Permanent	200	200
Potential Temporary Traffic Increases		
Sacramento River east levee Reach A:16–19A	**540**	510
Sacramento River east levee Reach A:19B–20	360	**450**
American River north levee Reach I:1–4	120	120
West levee of NEMDC North (Reaches F–G)	810	810
West levee of PGCC (Reach E)	566	566
Construction-Related Garden Highway Closures	The landside lane of Garden Highway would be closed for up to 6 months, with potential use of the waterside lane for truck hauling.	**Both lanes of Garden Highway would be closed in an approximately 1,000-foot-long segment for up to 6 months.**

Table 2-29
Summary of Quantifiable Environmental Impacts of the Action Alternatives[1]

Environmental Impact	Adjacent Levee Alternative (Proposed Action)	Fix-in-Place Alternative
Potential Temporary Air Pollutant Emissions (total mitigated emissions in 2012, combined Phase 4a and 4b Projects)		
Sacramento County:		
ROG	ROG 78 lb/day	ROG 78 lb/day
NO_X	NO_X 530 lb/day	NO_X 530 lb/day
PM_{10}	**PM_{10} 99 lb/day**	PM_{10} 81 lb/day
Sutter County:		
ROG	**ROG 317 lb/day**	ROG 17 lb/day
NO_X	NO_X 114 lb/day	NO_X 114 lb/day
PM_{10}	PM_{10} 26 lb/day	PM_{10} 26 lb/day

Notes: SRA = shaded riverine aquatic; lb/day = pounds per day; NO_X = oxides of nitrogen; PGCC = Pleasant Grove Creek Canal; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; ROG = reactive organic gases

[1] All values are approximate. Refer to Chapter 4, "Environmental Consequences and Mitigation Measures," for more detail including significance criteria, mitigation measures, and other aspects of the environmental analysis. Some quantifiable environmental impacts are not presented in this table because there is no significant difference between the impacts, or data are not quantifiable. Values in **bold** denote the greater impact.

[2] Acreages represent impact prior to habitat creation and preservation as part of the NLIP programmatic conservation strategy (see Section 4.7, "Biological Resources.")

Source: Data compiled by AECOM in 2010

Implementation of the Phase 4b Project would substantially lessen the probability of a flood in the Basin due to levee failure. However, the Natomas Basin would remain subject to a residual risk of flooding (see Section 2.7, "Residual Risk of Flooding"). All of the action alternatives would have the same residual risk of flooding, with the current risk being reduced from approximately a one-in-three chance of a levee failure in a reach of the Phase 4b Project under the No-Action Alternative, to a 1-in-200 chance under both action alternatives. As described throughout Chapter 4, "Environmental Consequences and Mitigation Measures," the potential environmental impacts of a levee failure, as would occur under the No-Action Alternative, would be significant and unavoidable. Under all action alternatives, SAFCA would be required to maintain an ongoing residual risk management program, as described below.

2.6 ENVIRONMENTALLY SUPERIOR ALTERNATIVE

The State CEQA Guidelines require identification of an environmentally superior alternative from among the proposed project (i.e., Proposed Action) and the alternatives evaluated. If the No-Project Alternative (i.e., No-Action Alternative) is environmentally superior, CEQA requires identification of the "environmentally superior alternative" other than the No-Project Alternative and the alternatives evaluated. Federal NEPA guidelines also recommend that an environmentally preferred alternative be identified; however, under NEPA, that alternative does not need to be identified until the final record of decision is published. Therefore, the discussion in this section of the environmentally superior alternative is intended to satisfy CEQA requirements.

Under the No-Action Alternative (Potential Levee Failure), without improvements to the Natomas perimeter levee system, the risk of a levee failure would remain high, resulting in the potential for multiple unavoidable significant adverse effects on environmental resources (see **Table 2-28**).

Development of the action alternatives included consideration of potential effects on environmental resources (e.g., waters of the United States, woodlands, and habitat). Accordingly, levee improvements were designed to

avoid or minimize such effects where practicable. However, agricultural canals and seasonal wetlands present near the toe of the levees would require filling under either of the action alternatives because of their proximity to the existing levees. Quantification of these and other impacts is provided in **Table 2-29**. Significant impacts on certain environmental issue areas (e.g., noise, cultural resources, visual resources) cannot be quantified, and would result in similar impacts regardless of the action alternative selected.

Based on the conclusions in **Tables 2-28** and **2-29** and from conclusions presented in the previous NLIP environmental documents incorporated by reference, the Adjacent Levee Alternative (Proposed Action) would have the fewest overall environmental impacts, as well as the least environmentally damaging impacts, and therefore would be the environmentally superior alternative under CEQA. The Fix-in-Place Alternative would result in significant and unavoidable effects on SRA habitat function associated with the removal of approximately 26 acres of waterside vegetation to comply with USACE levee vegetation guidance, compared to 7 acres under the Adjacent Levee Alternative (Proposed Action).

SAFCA completed cost estimates for the entire NLIP as part of its Proposition 1E Early Implementation Program NLIP Capital Outlay Grant Application (SAFCA 2009c). The adjacent levee alternative (preferred alternative for the entire NLIP) would have an estimated first cost of $618 million, whereas the raise levee in place with setback alternative (alternative considered for the entire NLIP) would have an estimated first cost of $709.1 million (a difference of $91.1 million or approximately 15% more). These costs apply to the entire NLIP, and are not broken down by project phase; however, an estimate for the Phase 4b Project can be derived as a cost per linear foot.[1] Using this method, the Phase 4b Project Adjacent Levee Alternative (Proposed Action) would have an estimated first cost of $145.6 million[2], whereas the Phase 4b Project Fix-in-Place Alternative would have an estimated first cost of $175.1 million[3] (a difference of $29.5 million or approximately 20% more).

2.7 RESIDUAL RISK OF FLOODING

In recognition of the need to incorporate management of this residual risk into local land use planning efforts, as part of the cost-sharing agreement between the State of California and SAFCA that will facilitate non-Federal funding of the project, SAFCA will be obligated to provide the State with a safety plan that is consistent with recently adopted requirements of State law. Under these requirements, the safety plan, at a minimum, must include all of the following elements:

- a flood preparedness plan that includes storage of materials that can be used to reinforce or protect a levee when a risk of failure exists;
- a levee patrol plan for high-water situations;
- a flood-fight plan for the period before Federal or State agencies assume control over the flood fight;
- an evacuation plan that includes a system for adequately warning the general public in the event of a levee failure, and a plan for the evacuation of every affected school, residential care facility for the elderly, and long-term health care facility;
- a floodwater removal plan; and
- a requirement, to the extent reasonable, that new buildings in which the inhabitants are expected to be essential service providers are either located outside an area that may be flooded or designed to be operable shortly after the floodwater is removed.

[1] Phase 4b Project cost per linear foot = (cost for the Sacramento River east levee portion of the entire NLIP / total linear feet in Reaches 1–20 of the Sacramento River east levee) * Phase 4b Project linear feet in Reaches 10–15 of the Sacramento River east levee.
[2] Phase 4b Project Proposed Action cost per linear foot: ($448.9 million / 96,048 feet) * 31,152 feet = $145.6 million.
[3] Phase 4b Project Fix-in-Place Alternative cost per linear foot: ($540 million / 96,048 feet) * 31,152 feet = $175.1 million.

Moreover, even with these measures in place, SAFCA recognizes that the consequences of an uncontrolled flood would greatly increase over time as planned new development occurs in the Natomas Basin in accordance with the SACOG's regional blueprint. If no additional risk reduction measures are implemented, the result would be a steady rise in expected annual damages that would undermine the risk reduction accomplishments of the project.

To address this potential increase in residual risk, SAFCA has implemented a development impact fee program that applies to all new structures placed anywhere in the 200-year (0.005 AEP) floodplain of SAFCA's capital assessment district, including the Natomas Basin. The objective of this program is to avoid any substantial increase in the expected damage of an uncontrolled flood, as new development proceeds in the floodplain, through a continuing flood risk reduction program for the Natomas Basin and the lower American and Sacramento Rivers that will consist of the measures described below.

- **Waterside Levee Strengthening.** This measure would consist of a long-term program of waterside bank and levee protection improvements along the lower American and Sacramento Rivers, including the Natomas Basin, designed to arrest retreat of the upper bank, preserve waterside berm width, and reduce the potential for destabilization of the adjacent levee foundation due to erosion or ground shaking. In addition, this measure would minimize the long-term loss of mature trees and vegetation located along the affected berms and provide opportunities for expansion of the Central Valley's remnant riparian forest while enhancing the public safety purposes of the levee system.

- **Landside Levee Strengthening.** This measure would focus on improvements to the crown and landside slope of critical segments of the levee system along the NCC, PGCC, and the lower American and Sacramento Rivers to increase the resistance of these levees to overtopping and extended elevated river stages. In the Natomas Basin, these improvements would involve flattening the landside slope of the NCC south levee, the PGCC west levee, and the Sacramento River east levee to a 5H:1V profile. Along the lower American River (outside of the Natomas Basin), these improvements would involve hardening the crown and landside slope of portions of the north and south levees between Howe Avenue and Watt Avenue.

- **Acquisition of Agricultural Preservation Easements.** This measure would focus on acquiring agricultural pre-conservation easements from willing landowners occupying the levee-protected floodplains upstream and immediately downstream of the Fremont Weir located outside of the Natomas Basin. The purpose of these easements would be to compensate the participating landowners for abandoning the development rights associated with their property. These easements would remove the incentive to improve the levees protecting the property beyond the minimum design requirements of the Sacramento River Flood Control Project (SRFCP) and would thus ensure that these levees are not raised above the design of the SRFCP, which is governed by the "1957 profile." This would reinforce the design of the early implementation project and the NLIP as a whole, which assumes that upstream levees are improved to the SRFCP top of levee design and overtop without failing when water surface elevations exceed this design. It is assumed that SAFCA's development impact fee revenue would constitute only a portion of the revenue devoted to this measure, with the balance coming from the Federal and State governments as part of a comprehensive update of the plan of flood damage reduction for the Sacramento Valley (**Plate 1-2**).

- **Improved System Operations.** This measure would focus on opportunities to improve the operation of the SRFCP to reduce water surface elevations in the lower American and Sacramento Rivers and in the drainage channels around the Natomas Basin. These opportunities would include implementing weather forecast–based operations at Folsom Dam and Reservoir and increasing the conveyance capacity of the Yolo and Sacramento Bypass systems. It is assumed that SAFCA's development impact fee revenue would constitute only a portion of the revenue devoted to this measure, with the balance coming from the Federal and State governments as part of a comprehensive update of the plan of flood damage reduction for the Sacramento Valley.