US Army Corps of Engineers
Los Angeles District

SANTA ANA RIVER 1 LEVEE SYSTEM

ORANGE COUNTY, CALIFORNIA
NLD SYSTEM ID # 3805010039

PERIODIC INSPECTION REPORT NO 1
GENERALIZED EXECUTIVE SUMMARY

FINAL SYSTEM RATING: MINIMALLY ACCEPTABLE
FINAL RATING DATE: OCTOBER 23, 2014

PERIODIC INSPECTION REPORT PREPARED BY TETRA TECH
FOR THE U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT

SUBMITTED: APRIL 2014
INSPECTED: JUNE 17-19 , 2013 AND NOVEMBER 12-14, 2013

EXECUTIVE SUMMARY

This Executive Summary provides an introduction to the periodic inspection (PI), an overview of the Santa Ana River 1 (SAR1) Levee System, a summary of the major findings of the periodic inspection, and the overall rating for the system.

1.1 Scope and Purpose of Periodic Inspections

The purpose of the SAR1 Levee System periodic inspection is to identify deficiencies that pose hazards to human life or property. The inspection is intended to identify the issues in order to facilitate future studies and associated repairs as appropriate.

This assessment of the general condition of the SAR1 Levee System is based on available data and visual inspections. Detailed investigation and analysis involving hydrologic design, topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of this levee system inspection.

1.2 System Summary

The Santa Ana River 1 Levee System is located on the right/west bank of the Santa Ana River in the state of California, in Orange County, in the cities of Santa Ana, Fountain Valley, and Huntington Beach. The SAR1 Levee System was federally authorized and subsequently constructed by the U.S. Army Corps of Engineers, Los Angeles District (USACE). Construction of the SAR1 Levee System was completed in September 1995 (USACE). The SAR1 Levee System is now entirely operated and maintained by Orange County Flood Control District (OCFCD), which is administered by Orange County Public Works (OCPW) staff. The National Levee Database Number (NLD No.) for the SAR1 Levee System is 3805010039. The SAR1 Levee System has a levee embankment, a trapezoidal channel lined with either reinforced concrete, grouted riprap, or riprap, a rectangular channel lined with reinforced concrete, reinforced concrete floodwalls, reinforced concrete retaining walls, concrete masonry unit (CMU) retaining walls, 28 side-drainage structure pipes, 18 discharge pipes, two side-drain junction structure pipes, four pump stations, numerous utility crossings, 20 bridge crossings, and 14 access ramps.

The SAR1 Levee System extends from immediately upstream of Interstate 5 (I-5) (Station 631+00) to slightly downstream of the Pacific Coast Highway (Station 13+40), a distance of approximately 61,760 feet (11.7 miles).

Figure 1 shows the SAR1 Leveed Area.

1.3 Summary of Major Deficiencies Found

The periodic inspection of the SAR1 Levee System was conducted on June 17-19, 2013 and November 12-14, 2013 and OCPW staff was present. OCPW refers to the SAR1 Levee System as Reach 1, Reach 2, Reach 3, Reach 4, Reach 5, and part of Reach 6. During the inspection of the levee system, deficiencies were noted for which remedial actions are required. The following main deficiencies of the project features were noted during the periodic inspection:

- Levee Embankment:
  - Non-Compliant Vegetation Growth: Significant vegetation growth including trees with trunks larger than 2-inches in diameter, shrubs, large rocks, and an irrigation system were present within the vegetation-free zone. The vegetation-free zone extends from 15 feet

beyond the landward toe to 15 feet beyond the riverward toe of the levee. Except for along the Riverview Golf Course, the vegetation was planted as part of the USACE LAD "Esthetic Treatment and Erosion Control Plan" (USACE LAD 1993b, 2006, and 2007).

- Encroachments: The landward slope of the levee embankment was steepened by the Associated Ready Mixed Concrete operations, which is located adjacent to the levee. In addition, the toe of the landward slope was cut and large concrete blocks have been placed at the cut toe to serve as a retaining wall. OCPW subsequently surveyed the right-of-way along the property and Associated Ready Mixed Concrete has removed the blocks. The landward slope is still pending repair.
- Riprap Revetments and Bank Protection: Erosion has displaced a 50-foot-wide by 6-feet-deep portion of the derrick stone apron at the downstream end of a drop structure; however, the cut-off wall associated with the drop structure was not undermined.
- Underseepage Relief Wells/Toe Drainage Systems: A subdrain cleanout was full of sediment. Records provided by OCPW indicate the vaults associated with the low-flow channel are cleaned once every 5 years. There was no indication that the subdrain pipes have been previously cleaned; however, OCPW is in the process of cleaning inside the pipes.
- Seepage: There was a significant amount of seepage coming into the channel through the joint of two adjacent side panels of the reinforced-concrete low-flow-channel at one location. Seepage through the joints could create voids behind the concrete panels damaging the integrity of those panels; however, none were detected during subsequent geotechnical investigations conducted on the behalf of OCPW (GMU 2014). The seepage may be a result of a cutoff wall at this location that was left in-place due to construction phasing. No water is being discharged from the adjacent subdrainage system, which may indicate that the subdrainage system is clogged.

· Floodwalls:

- Non-Compliant Vegetation Growth: A tree with a trunk larger than 2-inches in diameter was growing next to a reinforced-concrete wingwall. The vegetation-free zone extends from 15 feet beyond the landward side to 15 feet beyond the riverward side of floodwalls.

· Interior Drainage System:

- Vegetation and Obstructions: There was sediment blocking more than 10 percent of the inlet and/or outlet of two drainage structures.
- Encroachments: An 18-inch-diameter RCP side-drainage structure was abandoned, but was not plugged at the outlet.
- Culverts/Discharge Pipes: Significant damage was noted during the video inspection of a side-drainage structure. OCPW is in the process of requesting the property owner to repair the pipe (OCPW 2014a and 2014c).
- Flap Gates: A flap gate was missing at the outlet of a 24-inch-diameter RCP side-drainage structure.

- Trash Racks: A trash rack was missing at the inlet of a 24-inch-diameter RCP side-drainage structure and an 18-inch-diameter RCP side-drainage structure.

· Flood Damage Reduction Channel:

- Shoaling: Shoaling stabilized by saplings, brush, and other vegetation was observed to be diverting flow towards the channel upstream approximate of the line of allowable sediment deposition (OMRRR Manual, USACE 1996). However, shoaling was anticipated at the time of design and freeboard was increased to as much as five feet above the minimum three feet to convey the maximum expected discharge (USACE LAD 1988b). Therefore, while the shoaling should be removed upstream of the approximate line of allowable sediment deposition to be in compliance with the *OMRRR Manual*, shoaling was accounted for along this reach and has not likely reduced the freeboard to below minimum recommended levels.
- Foundation of Concrete Structures: Erosion from local runoff had undermined the upper concrete slope paving at one location.

1.4 Overall Rating

The Levee Safety Out-Brief Meeting was held on February 26, 2014. An engineering determination has concluded that the observed deficiencies would not prevent the system from performing as intended during the next flood event. Therefore, the Levee Safety Officer (LSO), Los Angeles District, has determined the overall system rating to be "Minimally Acceptable."

> *A "Minimally Acceptable" system rating is defined as, "One or more items are rated Minimally Acceptable or one or more items are rated Unacceptable and an engineering determination concludes that the Unacceptable items would not prevent the segment/system from performing as intended during the next significant runoff event."*

The local sponsor will be notified of the overall rating of the levee system by letter with instructions to correct the "Unacceptable" rated items as soon as possible, not to exceed two years, and to correct the "Minimally Acceptable" rated items so that they do not deteriorate further and become "Unacceptable."

Figure 1: Santa Ana River 1 Levee System

US Army Corps of Engineers ®
Los Angeles District

SANTA ANA RIVER 1 LEVEE SYSTEM (UPSTREAM REACH)

ORANGE COUNTY, CALIFORNIA
NLD SYSTEM ID # 3805010039

PERIODIC INSPECTION REPORT NO. 1 GENERALIZED EXECUTIVE SUMMARY

FINAL SYSTEM RATING: MINIMALLY ACCEPTABLE
FINAL RATING DATE: AUGUST 20, 2015

PERIODIC INSPECTION REPORT PREPARED BY TETRA TECH FOR THE U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT

SUBMITTED: JULY 2015
INSPECTED: NOVEMBER 17-19, 2014

EXECUTIVE SUMMARY

This Executive Summary provides an introduction to the Periodic Inspection, an overview of the upstream reach of the Santa Ana River 1 (SAR1) Levee System, which will be referred to as the SAR1 Levee System (Upstream Reach) from hereon, a summary of the major findings of the Periodic Inspection of the SAR1 Levee System (Upstream Reach), and the overall rating for the SAR1 Levee System.

1.1 Scope and Purpose of Periodic Inspections

The purpose of the SAR1 Levee System (Upstream Reach) Periodic Inspection is to identify deficiencies that pose hazards to human life or property. The inspection is intended to identify the issues in order to facilitate future studies and associated repairs as appropriate.

This assessment of the general condition of the SAR1 Levee System (Upstream Reach) is based on available data and visual inspections. Detailed investigation and analysis involving hydrologic design, topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of this levee system inspection.

1.2 System Summary

This report is Volume 2 of 2 of the SAR1 Levee System Periodic Inspection Report No. 1. This volume includes the SAR1 Levee System (Upstream Reach). The SAR1 Levee System (Upstream Reach) is located on the right/northwest bank of the Santa Ana River in the state of California, in Orange County, in the cities of Anaheim and Orange (Figure 1). The SAR1 Levee System (Upstream Reach) extends from upstream of Yorba Linda Boulevard/Weir Canyon Road (Station 1214+00) to upstream of the Interstate 5 Freeway (Station 631+00), a distance of approximately 58,300 feet (11.04 miles). The SAR1 Levee System (Upstream Reach) has a levee embankment with a riverward slope lined with either riprap, grouted stone, reinforced-concrete, or shotcrete reinforced with welded wire fabric. Other structures in the SAR1 Levee System (Upstream Reach) include wing walls, retaining walls, a floodwall, drop structures, grade stabilizers, 74 conduits associated with the side-drainage/diversion structures, numerous utility crossings, 16 bridge crossings, and 25 access ramps. The SAR1 Levee System (Upstream Reach) was federally authorized and subsequently constructed by the U.S. Army Corps of Engineers, Los Angeles District (USACE LAD). Construction of the SAR1 Levee System (Upstream Reach) was completed in 1999 (USACE LAD 1999). The SAR1 Levee System (Upstream Reach) is now entirely operated and maintained by Orange County Flood Control District (OCFCD), which is administered by Orange County Public Works (OCPW) staff. The SAR1 Levee System (Upstream Reach) is not included in the National Levee Database (NLD), but will share the same NLD Number as the SAR1 Levee System (Downstream Reach), which is 3805010039, because they share the same leveed area.

Volume 1 of 2 of this report is titled *Santa Ana River 1 Levee System Final Periodic Inspection Report No. 1* (USACE LAD 2014a). This volume included the downstream reach of the SAR1 Levee System, which extended from immediately upstream of Interstate 5 Freeway (Station 631+00) to slightly downstream of the Pacific Coast Highway (Station 13+40), a distance of approximately 61,760 feet (11.7 miles) (Figure 1). The SAR1 Levee System (Downstream Reach) was inspected on June 17-19, 2013 and November 12-14, 2013.

During the next Periodic Inspection scheduled for November 2019, both the upstream and downstream reaches of the SAR1 Levee System will be inspected together. The two reaches

were not inspected together for Periodic Inspection Report No. 1 because the upstream reach was not included in the NLD, and it wasn't until the Periodic Inspection of the downstream reach it was noted there was levee along the upstream reach. The upstream and downstream reaches must be combined into one levee system and share the same NLD number for future Periodic Inspections because they both share the same leveed area.

1.3 Summary of Major Deficiencies Found

The Periodic Inspection of the SAR1 Levee System (Upstream Reach) was conducted on November 17-19, 2014 and OCPW staff was present. During the inspection of the levee system, deficiencies were noted for which remedial actions are required. The following main deficiencies of the project features were noted during the Periodic Inspection:

- Levee Embankment:
  - Non-Compliant Vegetation Growth: Significant vegetation growth including trees with trunks larger than 2-inches in diameter and shrubs were present within the vegetation-free zone. The vegetation-free zone extends 15 feet outward from both the landward and riverward toes of the levee.
  - Encroachments: An unauthorized earthen access ramp on the riverward slope measuring approximately 25 feet wide was observed on top of the grouted stone. This access ramp was not shown on the as-built drawings.
  - Erosion/Bank Caving: Erosion gullies were observed on the landward slope, but outside of the right-of-way, measuring up to 3.5 feet deep and 5 feet wide.
  - Revetments other than Riprap: Shotcrete slope protection was missing at two sections along the riverward slope from top of the levee crown to the junction with riprap that provides toe and lower bank protection.
- Interior Drainage Systems:
  - Vegetation and Obstructions: The outlets or inlets of six of the side-drainage structures, within the right-of-way, were obstructed by vegetation, debris, or sediment by more than 10 percent.
  - Culverts/Discharge Pipes: The majority of the side-drainage/diversion structures could not be visually inspected and have not been video inspected.
- Flood Damage Reduction Channels:
  - Vegetation and Obstructions: Vegetation with diameters larger than 2-inches were observed within a portion of the channel and within 15 feet of the toe of the riverward slope.
  - Encroachments: An unauthorized earthen ramp was observed on top of 11 of the grouted-stone grade stabilizers on the channel invert.

1.4 Overall Rating

The Levee Safety Officer (LSO) Out-Brief Meeting was held on March 13, 2015. An engineering determination has concluded that the observed deficiencies would not prevent the system from performing as intended during the next significant runoff event. Therefore, the Dam and Levee Safety Section Chief, who was acting on the behalf of the LSO, Los Angeles District, has determined the overall rating of the SAR1 Levee System to be "Minimally Acceptable."

> *A "Minimally Acceptable" system rating is defined as, "One or more items are rated Minimally Acceptable or one or more items are rated Unacceptable and an engineering determination concludes that the Unacceptable items would not prevent the segment/system from performing as intended during the next significant runoff event."*

The Local Sponsor will be notified of the overall rating of the levee system by letter with instructions to correct the Unacceptable rated items as soon as possible, and correct the Minimally Acceptable rated items within two years so that they do not deteriorate further and become Unacceptable.

It should be noted that the majority of the inspection observations observed during the Periodic Inspection and rated as Unacceptable were subsequently repaired by OCPW. The repairs are described and photo documented in the OCPW letter titled, "Various Repaired Deficiencies and Video Inspection along Santa Ana River Right Bank and Santa Ana River Left Bank Levee Systems" (OCPW 2015b). In addition, OCPW subsequently video inspected all but six of the side drains along the SAR1 Levee System (Upstream Reach). The pipe inspections are documented in the OCPW report (USACE LAD 2015a) titled, "Santa Ana River Laterals, Condition Assessment Report, Work Order No. 1, December 24, 2014 through February 27, 2015." The two OCPW documents and the repairs were considered in the overall system rating. The repairs will be incorporated into a post-final Periodic Inspection (PI) Report Levee Inspection System (LIS) database to reflect the repairs made by OCPW.

Of all the pipe video inspections (USACE LAD 2015a), the pipe with the worst noted condition was a 24-inch-diameter Corrugated Metal Pipe (CMP). The pipe serves to drain a portion of the Angels Stadium Parking Lot. The CMP was deteriorating and had holes at approximately 20 feet and 46 feet into the pipe. The pipe inspector assigned the structural defects a Pipeline Assessment Certification Program (PACP) grade 5 and high structural risk. The inspector recommended lining the full length of the pipe, which is 85 feet in length.

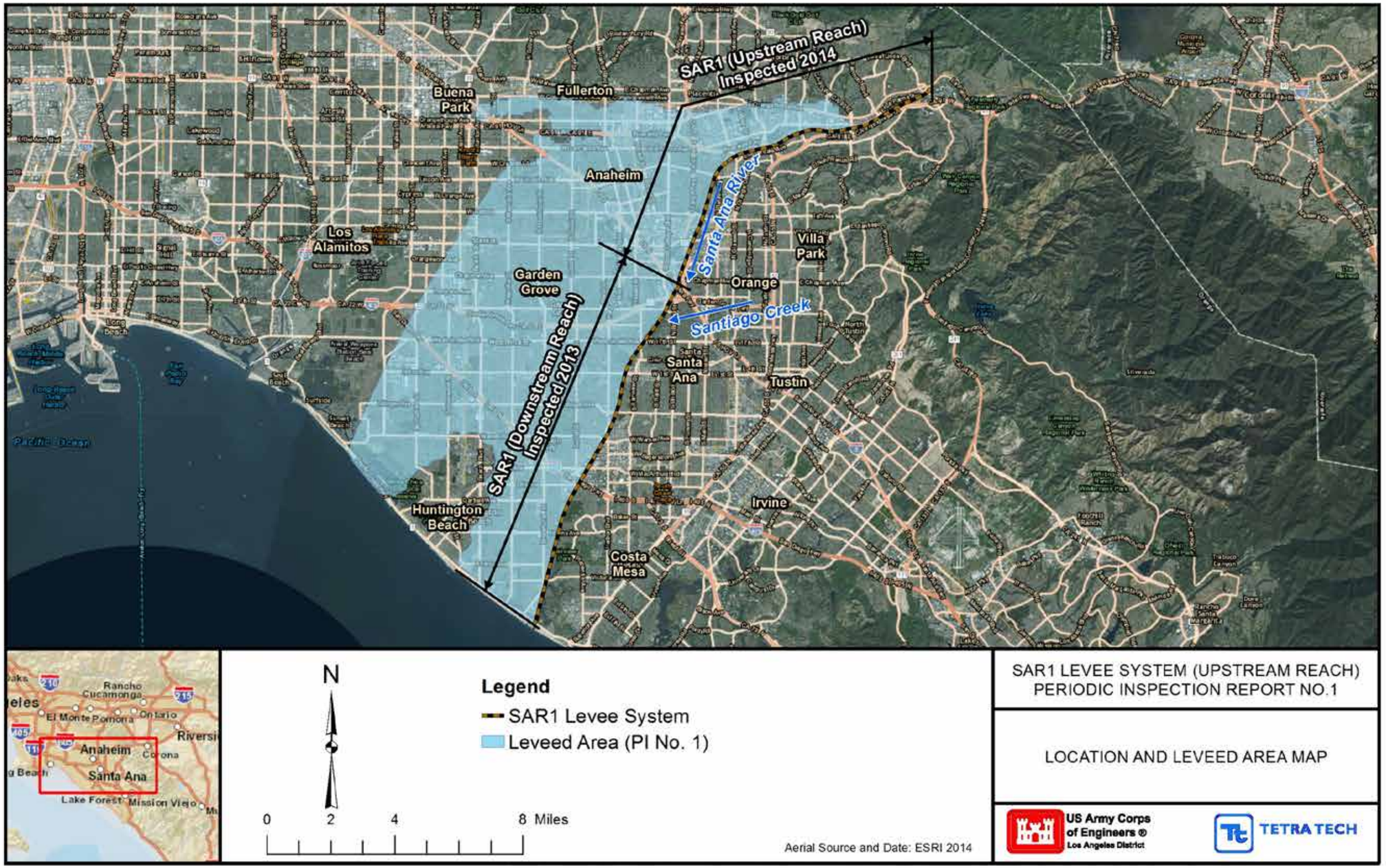
SAR1 (Upstream Reach)
Inspected 2014
SAR1 (Downstream Reach)
Inspected 2013
Buena Park
Fullerton
Anaheim
Los Alamitos
Garden Grove
Villa Park
Orange
Santa Ana River
Santiago Creek
Santa Ana
Tustin
Irvine
Huntington Beach
Costa Mesa
Long Beach
Pacific Ocean
Rancho Cucamonga
El Monte
Pomona
Ontario
Riverside
Corona
Lake Forest
Mission Viejo
N
Legend
SAR1 Levee System
Leveed Area (PI No. 1)
0
2
4
8 Miles
Aerial Source and Date: ESRI 2014
SAR1 LEVEE SYSTEM (UPSTREAM REACH)
PERIODIC INSPECTION REPORT NO.1
LOCATION AND LEVEED AREA MAP
US Army Corps of Engineers
Los Angeles District
TETRA TECH

Figure 1