Mojave National Preserve

U.S. Department of the Interior
National Park Service

Kelso-Cima Road and South Kelbaker Road Rehabilitation
Environmental Assessment - Appendices

March 2025

APPENDIX A:
ISSUES AND IMPACT TOPICS DISMISSED FROM DETAILED ANALYSIS

Air Quality

The 1963 Clean Air Act, as amended (42 USC § 7401 et seq.) requires federal land managers to protect air quality and to meet all federal, state, and local air pollution standards. The Preserve is subject to federal, state, and local air pollution standards. The US Environmental Protection Agency has established National Ambient Air Quality Standards. Current standards are set for sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, particulate matter equal to or less than 10 microns in size, fine particulate matter equal to or less than 2.5 microns in size, and lead. The Preserve is designated as a Federal Class II Airshed under the Clean Air Act, meaning that it is an area that can sustain a moderate increase in air pollutant concentration without significant deterioration of the air quality. Air pollutants are primarily generated in the Preserve from railroads, automobiles, and dust.

Construction activities would generate emissions and fugitive dust through the use of construction vehicles and heavy equipment operation. The effects would be localized and temporary, lasting only for the duration of construction. Best management practices would be implemented to control fugitive dust (e.g., wetting soils to suppress dust, maintaining the existing vegetation to the extent possible, and limiting demolition work in high-wind conditions), and further impacts on air quality would be reduced and would not measurably affect air quality in the Preserve. Therefore, this topic was dismissed from detailed analysis.

Visual Resources

NPS *Management Policies 2006* states that a park's scenery and scenic features are included among the resources and values to be protected and conserved unimpaired for enjoyment by current and future generations. Scenic features, in conjunction with other resources and values, are critical to the visual landscape. Visual impacts from construction activities would be localized and short term. Repair treatments to the existing road in the project area would become permanent features on the landscape, potentially detracting from the scenic resources of the Preserve and affecting visual quality. However, the project would occur in areas where the presence of the road has already altered the natural setting. Furthermore, the road rehabilitation would resemble the existing landscape in color and geological form to minimize visual disturbances. Effects of additional signage in the project area are discussed under "Visitor Use and Experience." Therefore, this topic was considered but dismissed from detailed analysis.

Wilderness

The Wilderness Act of 1964 defines wilderness as: "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." The National Wilderness Preservation System, created by the Wilderness Act, protects federally managed wilderness areas designated for preservation in their natural condition. For the purpose of applying NPS wilderness policy, there are four categories to consider: eligible, proposed, recommended, and designated wilderness. Potential wilderness may be a subset of any of these categories. The five qualities of wilderness character are untrammeled, undeveloped, natural, solitude or a primitive and unconfined type of recreation, and other features of value.

The Preserve has approximately 700,00 acres of designated wilderness. Improvements to road safety associated with the proposed action could facilitate easier access to wilderness areas, resulting in increased visitation and increased human presence in the Mojave wilderness. The proposed action would be consistent with the Preserve's enabling legislation and mission that support increased access to wilderness.

The project would not occur within designated wilderness or directly disturb it. Where wilderness areas are adjacent to a paved road, the boundary is defined as a 100-foot offset from the center of the road.

Construction activities would occur entirely within this 200-foot-wide road corridor and would not directly encroach on any designated wilderness areas within the Preserve. The NPS would stage equipment on disturbed land or on roadway outside wilderness. No public trails would be developed along the project corridor. Noise from the construction would temporarily interrupt visitors' wilderness experience; however, no long- or short-term impacts on wilderness would occur; therefore, this topic was considered but dismissed from detailed analysis.

APPENDIX B:
RESOURCE PROTECTION MEASURES AND BEST MANAGEMENT PRACTICES

GENERAL

- Clearly state all resource protection measures in the construction specifications, and instruct workers to avoid conducting activities outside the project area. Limit disturbances to roadsides and other areas inside the project area. Clearly indicate areas of concern on construction drawings.
- Provide up-to-date road conditions and maps, the status of facilities, hazardous weather conditions and forecasts, and other hazards via the Preserve's website and at the visitor center. Implement warning signs, notifications, and other park communications in advance of upcoming and active construction activities to inform visitors.
- Hold a preconstruction meeting to inform contractors about sensitive areas, including natural and cultural resources, and provide procedures for identifying and addressing any unanticipated discoveries.
- Site staging and storage areas for construction vehicles, equipment, materials, and soils in previously disturbed or paved areas approved by the NPS. Locate these areas outside high visitor use areas and clearly identify them in advance of construction.
- Comply with all legal load restrictions regarding material and equipment hauling. Remove all tools, equipment, barricades, signs, surplus materials, and rubbish from the project work limits upon project completion.
- Provide a copy of all environmental permits to the Preserve Superintendent for the project's decision file.

BIOLOGICAL RESOURCES

- Identify an NPS field contact representative to oversee project compliance and coordination efforts necessary to protect desert tortoise. Field contact representatives should work closely with the USFWS authorized desert tortoise biologist and would be authorized to halt any activity that may harm desert tortoise.
- Require authorized biologists (approved by the NPS and USFWS prior to project initiation), or NPS-designated biological monitors, to handle and/or relocate desert tortoise. Authorized biologists should supervise biological monitors and be available to respond to issues and concerns as they arise. Require biological monitors to be on-site during project activities that occur from March 1 through October 31. The number of biological monitors needed depends on the scale and distribution of work sites. Work sites greater than 250 meters apart require at least one biological monitor each.
- Conduct presence/absence surveys prior to construction, in accordance with the most recent USFWS *Desert Tortoise Monitoring Handbook*, to assess the number of desert tortoises that may be present and to determine the local distribution of desert tortoises. No more than seven days prior to the onset of ground-disturbing activities, have an NPS-approved biologist conduct a pre-activity survey in all work areas within potential desert tortoise habitat, plus an approximately 300-foot buffer. Prominently flag all desert tortoise burrows within the pre-activity survey area at that time so that they may be avoided during work activities. Avoid disturbing desert tortoise burrows to the extent possible; however, excavate burrows if impacted by construction activities. If a potential tortoise burrow must be excavated; the biologist would proceed according to the most recent USFWS guidelines.
- Install proposed tortoise exclusion fencing and tortoise guards prior to road construction activities to keep tortoises off the road right-of-way and minimize habitat fragmentation.

- Coordinate with the field contact representative and the authorized biologist to implement an education program to inform all construction personnel of the general behavior and ecology, protective measures, legal protection, and reporting requirements for the desert tortoise prior to any construction activities. At a minimum, the tortoise education program would cover the following topics: (1) desert tortoise distribution/occurrence, (2) general behavior and ecology, (3) sensitivity of the species to human activities, (4) legal protection, (5) penalties for violation of state or federal laws, (6) reporting requirements, and (7) project protective mitigation measures.
- Require an authorized biologist and designate monitors to conduct clearance surveys to remove desert tortoises from work areas, if needed, prior to the onset of ground-disturbing activities. Such clearance surveys would occur year-round if the work site is in undisturbed habitat. Follow the most recent USFWS guidance for handling, moving, and translocating desert tortoises. In any situation where a desert tortoise places itself in danger (e.g., it enters a work area), an NPS-approved biologist would undertake immediate action to move the desert tortoise from harm's way. Handle any desert tortoise relocated or otherwise removed from areas undergoing reconstruction in accordance with the procedures described in the 2009 USFWS *Desert Tortoise Field Manual*.
- Limit project-related vehicles and equipment to designated roads and areas identified as permanently or temporarily affected by construction within the project area. Limit motor vehicle speeds to not exceed 45 miles per hour along project routes within desert tortoise habitat, and use a biological monitor pilot vehicle to guide groups of three or more large trucks. If extensive haul truck traffic is planned for a given day (greater than 10 deliveries), use a biological monitor to monitor the haul route to determine impacts to tortoises.
- Require all personnel involved in activities to inspect the ground under vehicles immediately before moving when a vehicle or construction equipment is parked in desert tortoise habitat outside areas with desert tortoise fencing. If a desert tortoise is present, it may move of its own accord. If it does not move within 15 minutes, an authorized biologist may remove and relocate the animal to a safe location.
- Implement a litter control program during construction to eliminate the accumulation of trash and food waste to avoid attracting opportunistic predators, such as common ravens, coyotes, and feral dogs that may prey on juvenile desert tortoise.
- Prohibit any personnel involved in activities from bringing pets to the project area.
- Maintain a complete record of contractors completing tortoise education training, time spent monitoring for each biologist, all desert tortoise encounters, and any other notable wildlife encounters (e.g., bird nests, roadkill). Provide these records to the Preserve Wildlife Biologist on a weekly basis.
- Install features along Kelso-Cima Road and South Kelbaker Road to prevent desert tortoise mortality from vehicle strikes and promote habitat connectivity. Features would include tortoise exclusion fencing along the roadway and tortoise crossing structures for the length of the project corridor, approximately every kilometer and/or where existing low-water crossings are located. In total, install approximately 60 to 100 tortoise crossing structures. In addition, place tortoise guards at each secondary road access point to allow uninhibited vehicle traffic and prevent tortoise from accessing the primary roadway.
- Require habitat restoration if construction activities disturb desert tortoise habitat. Habitat restoration would include alleviating soil compaction, collecting seeds for restoration work, replanting, and adding rocks and woody debris to a disturbed area.

- Collect seeds and salvage certain individual plants prior to road construction work. Revegetate areas newly disturbed during construction using soil conserved along the corridor and locally collected plant species (seeds and nursery plants grown from seed collected). Attempt to reconstruct the natural spacing, abundance, and diversity of native plant species.
- Maintain and clean all equipment to avoid the spread of invasive species onto the site from outside areas.
- Implement an on-site environmental educational and awareness program for staff and workers (worker awareness training program). In addition to the focus on special status species, educate workers on how to avoid disturbing bird nests, nesting activity, and nesting areas. To minimize impacts on nesting birds, implement the following measures:
    - To the extent feasible, conduct vegetation removal or disturbance, and/or tree felling outside the nesting season (February 1–July 31).
    - If vegetation removal must occur during the bird nesting season, conduct nest surveys using an NPS-approved biologist to locate active nests before any vegetation removal occurs.
    - Time surveys to maximize the potential to detect nesting birds and do not conduct surveys more than five days in advance of the start of project-related activities that could disturb nests.
    - When nests are located, implement a minimum 500-foot buffer around any active special status species or raptor nests where no disturbance would occur.
    - If an active bird nest of other bird species is found, have an NPS-authorized biologist determine an appropriate no-disturbance buffer based on site-specific conditions, the species of nesting bird, the nature of the project activity, noise level of the project activity, visibility of the disturbance from the nest site, and other relevant circumstances.
    - Prohibit disturbance in the buffer zone until the nest has fledged its young, and/or the nest is no longer active.
    - If establishing a buffer zone without disturbance is not feasible, contact the USFWS for guidance to minimize impacts on nesting birds associated with the proposed project.

GEOLOGICAL FEATURES AND SOILS

- Evaluate new or locally sourced topsoil for nonnative invasive plant infestations. Prohibit the use of infested soil for any construction or post-construction use, including revegetation.
- Implement erosion and sediment control measures that provide for soil stability and prevent movement of soils during rain events (i.e., silt fences and tarps) and minimize soil loss in drainage areas. Use best management practices in the project area for drainage protection to include all or some of the following actions, depending on site-specific requirements:
    - Keep disturbed areas as small as practical to minimize exposed soil and the potential for erosion.
    - Locate waste and excess excavated materials outside drainages to avoid sedimentation.
    - Install silt fences, temporary earthen berms, temporary water bars, sediment traps, stone check dams, or other equivalent measures (including installing erosion control measures around the perimeter of stockpiled fill material) prior to construction.

    - Conduct regular site inspections during the construction period to ensure that erosion control measures were properly installed and are functioning effectively.
- Delineate construction zones outside existing disturbed areas with flagging and confine all surface disturbance to the construction zone.
- Require contractors to properly maintain construction equipment to minimize potential for accidental spills.
- Store, use, and dispose of chemicals, fuels, and other toxic materials appropriately.

CULTURAL RESOURCES

- Conduct cultural resource monitoring in areas identified as containing medium and high cultural sensitivity identified with Cultural Sensitivity Maps. Inspect, from a safe distance, for evidence of culturally sensitive materials or features, at a minimum, within areas designated as medium and high sensitivity. Keep daily logs of construction activities observed and any cultural resource observations. If buried archeological deposits are encountered during the course of monitoring efforts, halt work activities immediately, and erect an exclusion zone around the discovery while the monitor contacts the NPS archeologist, or a designated archeologist/monitor, to determine the appropriate next steps. Following completion of monitoring, summarize the results in a technical report of findings that includes an overview of the monitored areas and activities, a summary of the field methods, results of the monitoring, and recommendations for future studies.
- Identify any cultural resources within the project limits that cannot feasibly be preserved in place and evaluate them for significance according to section 106 of the NHPA. Significance should be based on how well the cultural resource being considered represents one or more of the themes presented in the historic context as well as whether the resource retains integrity and the ability to convey its importance. A qualified cultural resources management professional should evaluate significance.
- Adhere to the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA) (43 CFR Part 10). While the likelihood of encountering items subject to NAGPRA for this project is low, consult with affiliated Tribes and outline a plan of action should archeological materials be exposed during construction. The accepted basic steps for adhering to the updated NAGPRA rule include stoppage of work if archeology items, particularly human remains, are discovered on NPS-administered land. Notify the NPS Superintendent and the NAGPRA coordinator immediately so that notification to Tribes can be met within the time frame outlined in NAGPRA (43 CRF Part 10.5).
- Conduct additional mitigation and minimization measures agreed to through consultation with the public, Tribes, Tribal Historic Preservation Officers, the California SHPO, the NPS, and the contractor.
- Continue to coordinate with the California SHPO and Tribal Historic Preservation Officers throughout the course of the project if unknown cultural resources are discovered as a result of the actions associated with the proposed action.
- Ensure that all contractors and subcontractors are informed of the penalties for illegally collecting artifacts or intentionally damaging archeological sites or historic properties. Instruct contractors and subcontractors on procedures to follow if previously unknown archeological resources are uncovered during construction.

VISITOR USE AND EXPERIENCE

- Meaningly engage with protected populations, visitors, residents, and business owners in the project area in advance of construction activities, including providing detailed construction and detour plans to the public, installing safe and visible directional signage, and working with public information officers to disseminate construction information to the public.
- Implement a traffic control plan and a detailed detour plan during construction.
- Establish provisions for emergency vehicle access through construction zones.
- If recreational opportunities are inaccessible or less accessible during certain phases of construction, provide suggestions for alternative recreational opportunities for visitors on the Preserve website and at the visitor center.
- Provide the public with regular updates about the project's progress and ensure Preserve staff are available to address visitor questions during construction.
- Revegetate the project area following construction to restore the natural viewshed for visitors.
- Use previously disturbed land for construction staging areas and restore staging areas to their previous conditions after construction to protect viewsheds.

WATER RESOURCES

- Comply with all relevant requirements under the Clean Water Act, including management of stormwater-related nonpoint source pollutants under the National Pollutant Discharge Elimination System. Where possible, use sustainable design principles and implement best management practices during and after construction.
- Implement best management practices for drainage and sediment control to prevent or reduce nonpoint source pollution and minimize soil loss and sedimentation in drainage areas. These practices may include silt fencing, filter fabric, temporary sediment ponds, temporary or permanent check dams, and immediate mulching of exposed areas to minimize sedimentation and turbidity impacts from construction activities. Keep erosion control measures in place at the completion of construction to avoid impacts on water and floodplain resources.
- Maintain all equipment in a clean and well-functioning state to avoid or minimize contamination from fluids and fuels. Prior to starting work each day, inspect all machinery for leaks (e.g., fuel, oil, and hydraulic fluid) and make all necessary repairs before commencing work.
- Conduct construction activities with caution to prevent damage to floodplains from equipment, erosion, siltation, or pollutant discharges.
- Limit construction or clearing of vegetation within the floodplains to the greatest extent possible. Restore watershed conditions to preconstruction conditions (or better) to reduce accelerated runoff caused by soil compaction; poor vegetation cover; or the unnatural conveyance of water by roads, ditches, or trails.

APPENDIX C:
ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

The following alternatives were considered in the preliminary planning process but dismissed from further analysis because they were not considered reasonable alternatives (e.g., they did not meet the purpose of and need for the project or were determined not to be technically or economically feasible).

Roadway Realignment and Safety Improvements

The NPS considered an alternative that would realign the roadway at several locations along the project corridor, including:

- A northerly realignment of more than 5 miles of the Kelso-Cima Road segment to correct sight distances and vertical profile dips at low-water crossings.
- A roadway bypass around the Kelso Depot to relocate Kelso-Cima Road to the north of the Kelso Depot area.
- A roadway realignment near the Granite Pass area to remove the existing S-curve in the roadway alignment and improve vertical sight distance for drivers.

This alternative would result in additional environmental impacts to Preserve resources, including impacts to the native landscape, vegetation, and increased habitat disturbance. Therefore, this alternative was considered but dismissed from consideration.

Roadway Rehabilitation and Safety Improvements, Including Installing Box Culverts and Desert Tortoise Crossing Features

The NPS considered an alternative that would include roadway rehabilitation and safety improvements along Kelso-Cima Road and South Kelbaker Road and install box culverts and crossing features for desert tortoises. This alternative would occur primarily within the existing alignment, with adjustments to the vertical profile of the roadway where needed. In addition, it would include pullouts at predefined locations approximately every mile along the project corridor; provide desert tortoise fencing, particularly on the northern and western sides of Kelso-Cima Road and both sides of South Kelbaker Road; and replace existing larger, low-water crossings with box culverts. The proximity of the project to the existing UPRR access and right-of-way could affect the railroad and. this alternative would be cost-prohibitive because constructing the water crossing structures would require a large amount of earthwork and construction to meet the requirements of the Union Pacific Railroad. This alternative also would result in substantially higher environmental impacts to resources in the Preserve. Therefore, this alternative was considered but dismissed from further consideration.

APPENDIX D:
DRAFT FLOODPLAIN STATEMENT OF FINDINGS

United States Department of the Interior
National Park Service

Mojave National Preserve

Kelso-Cima Road and South Kelbaker Road Rehabilitation

Draft Statement of Findings for Director's Order #77-2: Floodplain Management

March 2025

Draft Statement of Findings for Protection of Floodplains (Executive Order 11988) Kelso-Cima Road and South Kelbaker Road Rehabilitation March 2025

National Park Service Mojave National Preserve

Recommended:

Raymond McPadden, Superintendent, Mojave National Preserve Date

Certification of Technical Adequacy and Servicewide Consistency:

Ed Harvey, Chief, NPS Water Resources Division Date

Approved:

David Szymanski, Director, NPS Regions 8, 9, 10, and 12 Date

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
AMSL	above mean sea level
EA	environmental assessment
EO	Executive Order
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FFRMS	Federal Flood Risk Management Standard=
FSOF	Floodplains Statement of Findings
I	Interstate
LWC(s)	low-water crossing(s)
mph	miles per hour
NEPA	National Environmental Policy Act
NFHL	National Flood Hazard Layer
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resource Conservation Service
Preserve	Mojave National Preserve
UPRR	Union Pacific Railroad
USGS	US Geological Survey

1.0 INTRODUCTION

The National Park Service (NPS) is proposing to rehabilitate Kelso-Cima Road and South Kelbaker Road at Mojave National Preserve (Preserve) in San Bernardino County, California (proposed action). The Federal Highway Administration (FHWA) is a cooperating agency in the National Environmental Policy Act (NEPA) process, providing design details and engineering expertise. The proposed action is located within known floodplains. HDR, on behalf of FHWA, reviewed these areas and prepared an Aquatic Resources Delineation Report (HDR 2024). Construction activities (primarily maintenance and improvement of low-water crossings [LWCs]) would disturb the floodplains associated with aquatic resources, resulting in impacts to the floodplain resources.

Executive Order (EO) 11988, "Floodplain Management," requires the NPS and other federal agencies to evaluate the likely impacts of actions in floodplains. The objectives of EO 11988 are: (1) to avoid, to the extent possible, long-term and short-term, adverse impacts associated with occupancy, modification, or destruction of floodplains; and (2) to avoid indirect support of development and new construction in such areas wherever there is a practical alternative. In addition to EO 11988, the Federal Emergency Management Agency implemented, and the NPS adopted, a Federal Flood Risk Management Standard (FFRMS) for federally funded projects to improve the nation's resilience to floods and to ensure new federal infrastructure would last as long as intended. It is NPS policy to avoid development and construction within the floodplain unless no other practicable alternative exists.

The NPS administers floodplain policy through Director's Order #77-2: *Floodplain Management* and Procedural Manual #77-2: *Floodplain Management* (NPS 2003, 2002). NPS *Management Policies 2006* and Director's Order #77-2 also encourage floodplain preservation, minimization of impacts, and adherence to federal floodplain management law (NPS 2003, 2006). It is the NPS's policy to preserve floodplain functions and values and minimize potentially hazardous conditions associated with flooding, including threats to human health/life, risk to (NPS) capital investment, and impacts on natural and beneficial floodplain values. If a proposed action is found to be in an applicable regulatory floodplain with associated impacts, and relocating the action to a non-floodplain location is not considered a practicable alternative, then a formal Floodplain Statement of Findings (FSOF) must be prepared. The FSOF must (1) describe the rationale for selection of a floodplain site; (2) quantify flood conditions and associated hazards as a basis for management decision-making; (3) disclose the resources and amount of risk associated with the chosen site; and (4) explain flood mitigation plans. The FSOF must be available for public review and comment, generally by including it with applicable NEPA compliance documentation (e.g., environmental assessment [EA]).

This FSOF provides sufficient information for assessing the potential impacts of the proposed action on floodplains and the ability of the proposed action to meet NPS requirements under Director's Order #77-2. This FSOF:

- Quantifies the flood hazard associated with the proposed action.
- Presents the rationale for the proposed development of roadways within the regulatory floodplain of the Preserve.
- Documents potential negative impacts of these improvements on human health/life, capital investment, and floodplain functions and values.
- Describes mitigation measures to reduce potential impacts.

2.0 PROPOSED ACTION

2.1 BACKGROUND

The Preserve is a 1.6-million-acre unit of the national park system established by Congress on October 31, 1994, as part of the California Desert Protection Act. The Preserve protects ecological communities and functions and provides evidence of a 10,000-year history of human connection with the desert. The Preserve is a large expanse of desert lands that represents a combination of Great Basin, Sonoran, and Mojave Desert ecosystems. This combination allows visitors to experience a variety of desert plant life in combinations that exist nowhere else in the United States in such proximity. Of the Preserve's 1.6 million acres, about 700,000 acres are designated wilderness. In addition, about half of the Preserve (including most of the project area) is designated as critical habitat for the desert tortoise (*Gopherus agassizii*), which is listed as a threatened species under the Endangered Species Act (NPS 2013).

Interstates (I)-15 and 40 circle the Preserve's northern and southern boundaries. Preserve roads form a major north–south route that connects Southern California to Las Vegas. The Nevada–California border makes up most of the Preserve's eastern boundary.

The Preserve's roads are heavily traveled, with average daily traffic counts ranging from 400 to more than 1,700 vehicles. Speed limits in the Preserve are up to 55 miles per hour (mph). The roads have a combination of sharp curves, elevation changes, and limited sight distance that can invite unsafe driving from drivers who are not accustomed to the terrain. In addition to the design deficiencies of the roadway, the pavement is generally thin and has exceeded its service life. Although the roadway width is adequate in most locations, it is inconsistent because of shoulder drop-offs, dips, and spalled asphalt pavement. The intersections of Cima Road, Kelso-Cima Road, and Morning Star Mine Road, and the intersection at Kelso Depot with South Kelbaker Road are located near a Union Pacific Railroad (UPRR) grade crossing that blocks motorists' view of the approaching stop signs. These road conditions and design deficiencies have contributed to high accident rates and increased accident severity. As a result, the average accident rate is 31.2 fatal accidents per million vehicle miles traveled, primarily due to excessive speeds on the existing roads (UC Berkeley 2024). Additionally, road mortality is a pervasive issue for wildlife in the Preserve, particularly the federally listed desert tortoise.

2.2 PROPOSED ACTION LOCATION

The proposed action is located along Kelso-Cima and South Kelbaker Roads, encompassing approximately 42 miles of roadway within the Preserve. As shown in Figure 1, the project area spans the intersection of Cima and Kelso-Cima Roads, continuing along Kelso-Cima Road for approximately 19 miles to the intersection of Kelso-Cima and South Kelbaker Roads, where it continues along South Kelbaker Road for approximately 22 miles until it reaches the southern Preserve boundary. The project area encompasses approximately 557 acres and includes two potential construction staging areas, located southwest of the proposed project area limits on South Kelbaker Road and near the intersection of Kelso-Cima and South Kelbaker Roads.

The project area is located between latitude 35.2404133° North, longitude -115.5053298° West at the northern end to latitude 34.7219299° North, longitude -115.6784899° West at the southern end (World Geodetic System 84).

- Approximate project area center coordinates: latitude 35.011950° North, longitude -115.654157° West
- Public Land Survey System:
    - Sections 4, 5, 8, 17, 20, 29, 31, 32 of Township 13 North, Range 14 East
    - Sections 6, 7, 18 of Township 12 North, Range 14 East

- Sections 13, 24, 25, 26, 34, 35 of Township 12 North, Range 13 E
- Sections 3, 4, 8, 9, 17, 18, 19 of Township 11 North, Range 13 East
- Sections 24, 25, 36 of Township 11 North, Range 12 East
- Sections 6, 7, 8, 17, 19, 20, 30, 31 of Township 10 North, Range 13 East
- Sections 6, 07, 08, 17, 20, 28, 29, 33, of Township 9 North, Range 13 East
- Sections 3, 4, 10, 15, 16, 20, 21, 29, 30, 31 of Township 8 North, Range 13 East
- Section 36 of Township 8 North, Range 12 East
- Section 1 of Township 7 North, Range 12 East

- Name of primary downstream waterbodies: Kelso Wash terminating into Soda Lake
- US Geological Survey (USGS) Watershed Hydrologic Units:
  - Marble Mountains (1810010027)
  - Clipper Wash (1810010034)
  - Upper Kelso Wash (1809020819)
  - Town of Ivanpah-Frontal Ivanpah Lake (1606001512)
- USGS Subbasin Hydrologic Units:
  - Southern Mojave (18100100)
  - Mojave (18090208)
  - Ivanpah-Pahrump Valley (16060015)

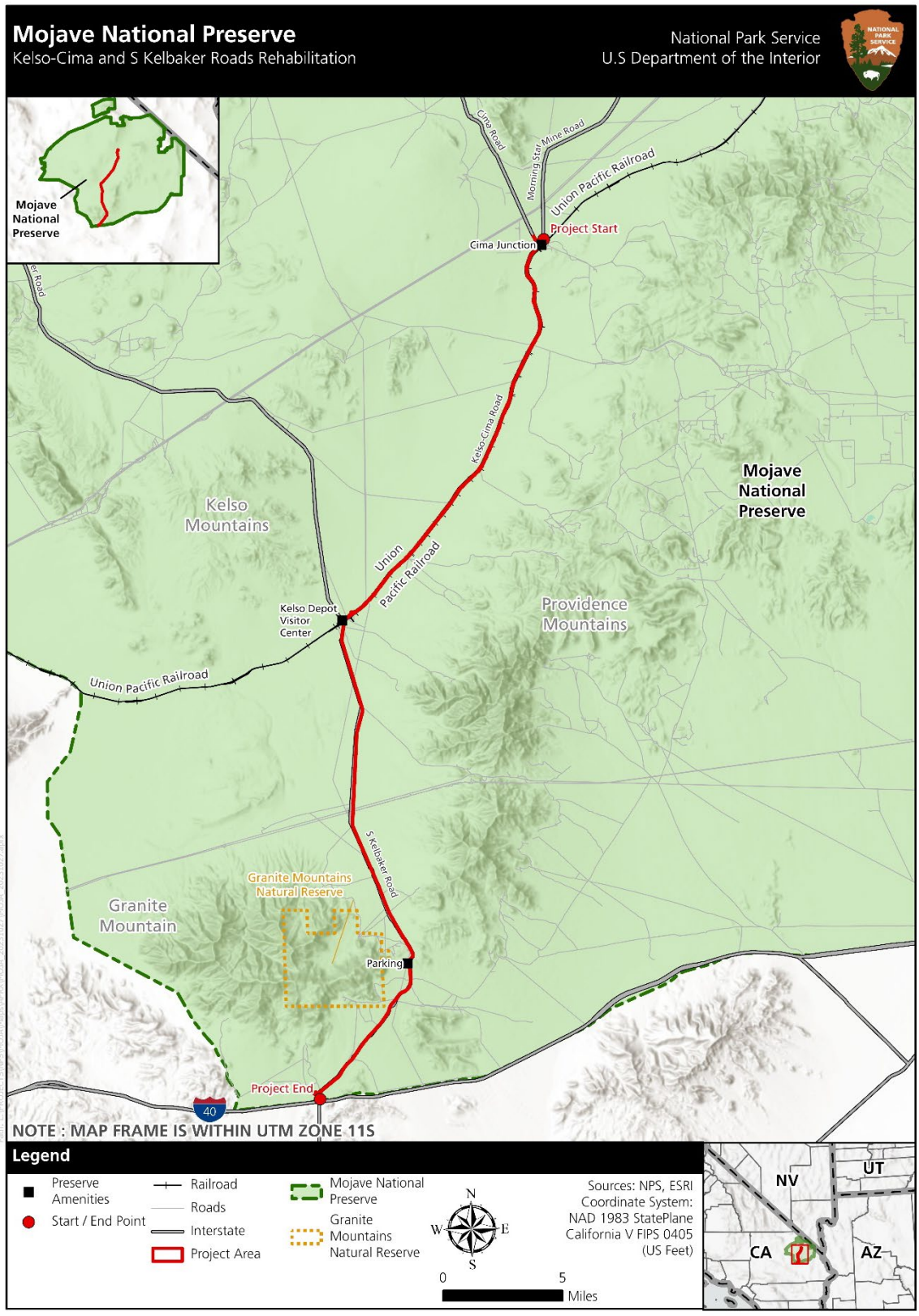

FIGURE 1. PROJECT AREA

2.3 PURPOSE AND NEED

The purpose of the project is to reduce the number and severity of automobile accidents and to improve visitor experience and access within the Preserve by addressing safety concerns and correcting structural and road design deficiencies along 42 miles of major Preserve roadways, while providing additional resource protections and increasing roadway resilience in the Preserve. Other project objectives include:

- Restoring roads to meet current condition standards by resurfacing and correcting design deficiencies.
- Improving road safety.
- Enhancing visitor experience and access with better driving conditions and new amenities, including a welcome area and scenic pullouts.
- Installing exclusion fences to reduce wildlife mortality on Preserve roads.

The proposed action is needed because the existing road system has exceeded its service life and high rates of automobile accidents occur on these roads each year. Current road deficiencies, including sharp turns with poor sightlines, soft shoulders, and degraded asphalt conditions, contribute to avoidable traffic accidents each year. In addition, the project includes protections for desert tortoises to help reduce tortoise deaths in the Preserve.

2.4 PROPOSED ACTION

Under the proposed action, the NPS would rehabilitate and improve safety on Kelso-Cima and South Kelbaker Roads along approximately 42 miles of roadway that bisect the central and southwestern portions of the 1.6-million-acre Preserve. Proposed rehabilitation of the roads would include demolishing and removing the existing road surface, installing a new road base, and reapplying the asphalt road surface. The NPS would maintain the 106 existing LWCs on the roadways (44 LWCs along Kelso-Cima Road, and 62 LWCs along South Kelbaker Road). Thirty of the 44 LWCs on Kelso-Cima would be stabilized based on existing stabilization and/or signs of degradation. On South Kelbaker, 16 of the 62 LWCs would be stabilized. While all crossings were analyzed to develop a peak flow, not all appeared to warrant stabilization. Some of the LWCs appeared to be stable and were perhaps agrading. The NPS would also install features along Kelso-Cima Road and South Kelbaker Road to reduce tortoise mortality and promote habitat connectivity. Additionally, the NPS would improve access and safety at the Granite Pass viewpoint.

The roadway improvements would include treatment options, such as restriping pavement, adding mumble strips,[1] widening shoulders, paving with asphalt concrete, adding fencing for desert tortoises, and installing desert tortoise crossing features adjacent to existing ephemeral drainages. Under the proposed action, the NPS would install speed limit and other traffic signs, radar speed feedback signs or roadway striping and marking as appropriate, and additional signage to address safety issues and improve visitor experience.

At the discretion of the NPS, a variety of native plants would be salvaged; stored in a temporary nursery, which may be located in the Preserve near Kelso Depot or outside the Preserve; and be replanted to reclaimed areas in the Preserve post-construction. Revegetation work would use soil conserved along the corridor and native species from seed collected along each roadway. Revegetation efforts would attempt to reconstruct the natural spacing, abundance, and diversity of native plant species. The areas newly

[1] Mumble strips are used when rumble strips cannot be placed due to noise concerns; mumble strips include an oscillating sine wave pattern to reduce noise outside the vehicle (FHWA n.d.).

disturbed during construction would be revegetated using locally collected seed and nursery plants grown from the collected seed. The following sections describe the various components of the proposed action.

Roadway Improvements

Road rehabilitation activities would primarily maintain the existing roadway alignment with adjustments to the vertical and horizontal profile of the roadway, where needed, to improve safety. The horizontal alignment would be adjusted at three select locations along the project corridor on Kelso-Cima Road, between Cima Junction and Cedar Canyon Road, to improve substandard curves and sight distance. The northernmost adjustment would shift the profile up to 16 feet over a distance of 0.13 miles, and the final two locations would involve shifts of up to 50 feet over 0.2 miles, and up to 15 feet over 0.3 miles The vertical roadway profile would be adjusted, up to approximately 7 feet, approaching approximately 11 LWC locations along the project corridor to improve sight distance and safety. The NPS would also realign Cima Junction to provide continuous travel between Kelso-Cima Road and Cima Road. At Cima Junction, Kelso-Cima Road would be realigned to form a gradual horizontal curve to provide safer driving conditions for through-traffic at the posted speed limit. The proposed realignment would reduce the risk of rear-end collisions by eliminating the existing "T" intersection at Cima Road. The existing vertical road and pavement on Kelso-Cima Road and Cima Road would be excavated, removed, and reclaimed. The existing at-grade crossing on Kelso-Cima Road, for the railroad wye, would be removed, and a new at-grade crossing with pavement markings would be included along the proposed roadway realignment. The proposed speed limit would be reduced throughout the proposed action corridor, except at Kelso Depot, where the proposed speed limit would be reduced to 25 mph.

The NPS, in coordination with UPRR, would decommission and remove the approximately 60-foot guyed wire communications tower located at Cima Junction and install a new self-supporting tower in its place; the new tower would not exceed 65 feet in height. The proposed tower would be positioned on a subterranean mat foundation that would not be visible from the surface, and a fence would be constructed around the ground equipment for safety measures. The proposed fence would measure approximately 45 feet by 50 feet, and the ground equipment may include a generator and an equipment enclosure. Utilities for the proposed self-supporting tower would be determined during final design. Additionally, an access road would be constructed around the proposed self-supporting tower to provide safe access for construction and maintenance activities at the site. The access road would be graded (both vertically and horizontally) to tie into the proposed roadway profile on Kelso-Cima Road. This work would occur entirely within previously disturbed and surveyed areas.

Rehabilitation of the roadway would primarily include partial depth reclamation of existing asphalt; however, several sections of the project area would consist of full-depth reclamation. The proposed action would include installation of new asphalt to provide 11-foot-wide travel lanes in each direction, and 2-foot-wide paved shoulders in each direction, for a total pavement width of 26 feet. At Kelso Depot, the replacement roadway would feature 10-foot-wide travel lanes in each direction, paved shoulders of varying widths in each direction, and curb-and-gutter improvements, all within the existing roadway footprint. Additionally, mumble strips would be added along the roadway centerline and roadway shoulders, as needed, to reduce the frequency of roadway departures, while minimizing noise levels in the existing area.

The proposed action would add approximately 37 pullouts at predefined locations, with approximately one pullout location per mile, varying along either side of the corridor. Each pullout would include a 14-foot-wide paved lane with pavement markings and asphalt curbing; pullouts would be approximately 14 feet wide and 200 feet long within previously disturbed areas. The exact number of pullouts would be determined during final design. The pullout locations would provide additional opportunities for visitors to enjoy the scenic vistas, take photographs, rest, and make unplanned emergency stops. The proposed pullouts would also aid law enforcement by providing a safe place for drivers to pull over during traffic stops.

The NPS would improve and stabilize 106 existing LWCs to enhance cross drainage while allowing drivers to maintain a consistent speed and reduce the water surface elevation during heavy rain events. The existing LWCs are unarmored and allow for road undermining and bank erosion during flood events. The proposed, improved LWC structures would use concrete barriers, cut-off walls to resist undermining, and riprap bank protection to prevent damage during flood events. Figure 2 provides a typical LWC cross section from the proposed action design plans.

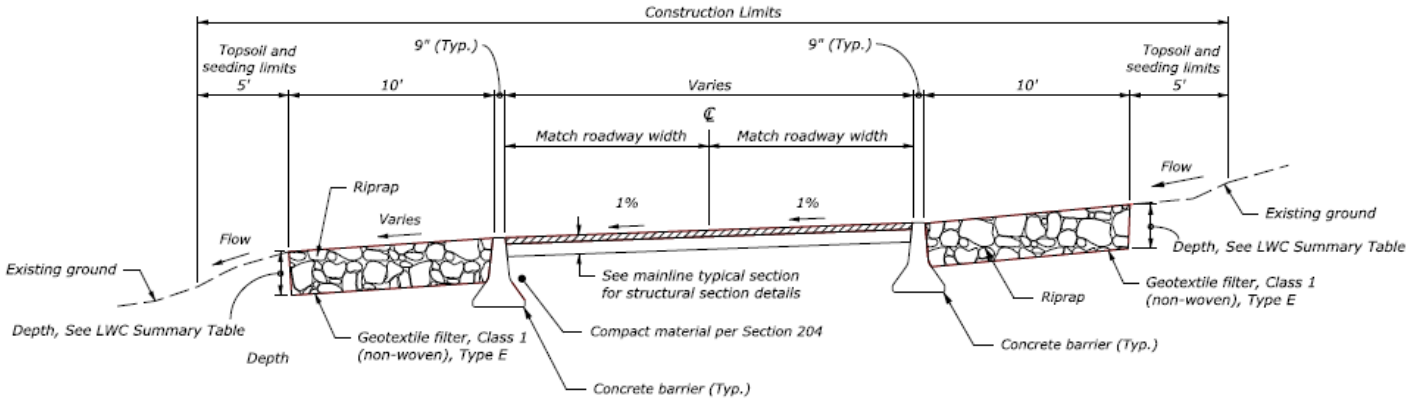

FIGURE 2. TYPICAL LOW-WATER CROSSING CROSS SECTION

Desert tortoise exclusion fencing, following US Fish and Wildlife Service specifications, would be installed along both sides of the roadway in the project area to prevent desert tortoises from accessing the roadway and exposure to potential road mortality. The exclusion fencing would incorporate galvanized 1-inch by 2-inch hardwire mesh material, stand approximately 24 inches tall, and would allow debris to flow under the fence to prevent drainage flow issues. Metal posts, buried to a depth of at least 12 inches, would support the exclusion fence. The tortoise fence would have a U-shaped bend at every fencing terminus to prevent tortoises from entering the roadway. Some portions of the project area, including the western side of Kelso-Cima Road, would use recessed vertical concrete barriers on the downstream side of the LWCs that prevent desert tortoises from accessing the roadway, while allowing other wildlife to escape. The vertical barriers would typically range from approximately 12 to 22 inches in height; approximately 40 to 50 vertical barriers would be constructed along the proposed action corridor.

As part of the proposed action, and where U-shaped fencing termini would not be feasible, the NPS would install approximately several tortoise crossing structures along the length of the proposed action corridor, where existing LWCs are located. The tortoise crossings would feature approximately 2-foot-diameter concrete structures under the roadways to allow safe tortoise passage. The tortoise exclusion fences would tie to the crossing structures under the road to help guide safe desert tortoise passage. While water conveyance is not a primary function of the tortoise crossings, some water may pass through the crossings during large precipitation runoff events.

Visitor Use Improvements

The proposed action would include several improvements along the project corridor related to visitor use and experience, including at Kelso Dunes and Granite Pass, and near the entrance to the Preserve on South Kelbaker Road. The NPS would provide a pullout near the viewpoint at Kelso Dunes to allow visitors to enjoy the scenic vistas, take photographs, rest, and make unplanned emergency stops near the Kelso Dunes. The proposed pullout would be similar to the other proposed pullouts along the project corridor, but the paved area would be approximately 16 feet wider to accommodate parallel parking, and would provide an approximately 6-foot-wide sidewalk with asphalt curbing. The paved area would also incorporate a concrete pad “bump out” (approximately 10 feet by 7 feet) for future interpretive signage.

The area behind the pullout (approximately 4 feet) would need to be graded to tie into the existing ground surface. This work would occur within a previously surveyed area and areas disturbed by roadway construction and maintenance.

At Granite Pass, the NPS would improve the existing parking area, including repaving the parking area and installing pavement markings, installing a concrete pad for future restroom facilities, providing accessibility features, and adding new signs. In addition, the existing viewpoint at Granite Pass would be expanded to improve safety for visitor ingress and egress. This work would occur entirely within previously disturbed areas.

The NPS would also relocate the existing entrance sign for the Preserve to the area near I-40 toward the end of the project area. The entrance sign would be located near the proposed welcome area for visitors that would include a parking area near the Preserve entrance, new pavement and pavement markings, a concrete sidewalk along the perimeter edge, and additional informational signage for visitor use.

Additional signage proposed in the action area would improve traffic safety and hazard communication to travelers (e.g., speed feedback, soft shoulder, winding road, curve ahead, wildlife awareness, "Do Not Enter When Flooded," and "Flash Flood Area"). The NPS would limit the amount of signage proposed throughout the project area, to the extent feasible, to minimize impacts to the landscape. The amount and location of the proposed signage would be determined during final design.

Construction Materials and Disposal

To the extent possible, material delivery and disposal hauling would occur on the main arterial roadways in the region. Contractor hauling operations would comply with legal load limits, and any unsuitable and excess construction materials would be disposed of outside the Preserve in accordance with NPS and FHWA specifications.

The proposed action is expected to generate waste material. To the extent possible, existing on-site demolished materials, such as waste concrete and pulverized asphalt, may be recycled and reused to reduce waste and truck traffic. During final design, the NPS and FHWA would establish parameters for material disposal for the construction contractor.

Staging Areas

All staging areas would be located on previously disturbed areas, existing roadbeds, or disturbed pullouts. No staging would occur on previously undisturbed land. One potential staging area could include an area immediately southwest of the project area limits on South Kelbaker Road, near the southern entrance of the Preserve. The second potential staging area and a transplanted vegetation nursery area could be located near the intersection of Kelso-Cima Road and South Kelbaker Road, near the Kelso Depot visitor center. If used, these sites would be temporarily closed during construction. During construction, the volume of construction vehicle traffic to, from, and through the project area would be higher to accommodate the removal of old road materials and the arrival of new materials for the proposed action. After construction, the NPS would restore staging areas to their previous condition, where feasible, and there would be no change in size or location of the existing areas.

Construction Duration

The NPS anticipates construction would take up to three years to complete, weather permitting. The contractor would determine the proposed action schedule, and the schedule would be carefully coordinated with biological resource protection and other restrictions. Preserve roads provide access for medical, fire, and emergency services for residents who live in the Preserve and visitors of the Preserve. Where feasible, the NPS would provide access to the proposed action area; however, phased roadway closures would help reduce overall construction costs and duration. The length of detours would vary depending on each segment of roadway that would be closed during construction.

3.0 PROJECT AREA DESCRIPTION

3.1 EXISTING CONDITIONS

Topography

Topography within the project area consists of relatively flat, sandy alluvial fans with various undulating sandy hills. Elevation within the project area ranges between approximately 2,090 feet above mean sea level (AMSL) near Kelso at the intersection of Kelso-Cima Road and Kelbaker Road to approximately 4,240 feet AMSL at the northern end of the project area.

The Providence Mountains and Mid Hills are located on the east side of the project area, and the Kelso Dunes, Kelso Mountains, Marl Mountains, and Granite Mountains are located on the west side of the project area. These features primarily direct surface water toward Kelso Wash in the valley west of the project area. There are 116 identified ephemeral stream channels that intersect or flow parallel to the project area (HDR 2024).

Climate

The project area is within the Mojave Basin and Range Major Land Resource Area (USDA 2022). This area receives 2 to 8 inches of annual precipitation; however, higher elevations can receive more than 28 inches of annual precipitation. Most precipitation occurs from rainfall, and snow is uncommon (USDA 2022). Temperatures in the Preserve vary throughout the year. Summer temperatures average 90° Fahrenheit (°F) with highs exceeding 105°F, whereas winter temperatures average approximately 48°F with lows below 40°F (NOAA n.d.).

Hydrology

Most of the project area is located within the Mojave Subbasin (USEPA n.d.). Most of the surface flows in the project area flow into Kelso Wash, which terminates at Soda Lake, approximately 25 miles west of the Kelso-Cima Road and South Kelbaker Road intersection project area near the Preserve visitor center. Because of the project area's confined nature as a closed basin, precipitation falling in the project area does not drain to a relatively permanent or traditional navigable water. Instead, precipitation in this subbasin either evaporates, infiltrates the substrate, or flows into alkali flats. A small portion of the project area near Cima drains northeast into the Great Basin. The ephemeral streams that intersect the project area originate in the surrounding mountains, and water flowing down these streams reaches the valley floor only during heavy flow events. No streams that intersect the project area flow seasonally or throughout the year (i.e., intermittent or perennial). No wetlands were identified within the project area (HDR 2024).

Vegetation

Vegetation within the project area is typical of the Mojave Desert but also include species of the Great Basin and Sonoran Deserts, and even some attributes of the California Coastal Zone (Digital Desert 2024). Vegetation community types are diverse within the Preserve, with five distinct vegetation communities bisecting the project area: creosote scrub covered flats and alluvial fans, Joshua Tree Woodland, Mojave Yucca Scrub, Creosote-Burrobush Desert Scrub, Creosote-Burrobush/Big Galleta Dune Desert Scrub, and numerous desert washes. The project area also supports sensitive biological soil crusts.

The project area encompasses approximately 42 miles of roadway, covering limited vegetated areas. On the north end of the project area, at the intersection of Cima and Kelso-Cima Roads, vegetation adjacent to the roadway consists of perennial herbs and shrubs native to California, including Mojave woodyaster (*Xylorhiza tortifolia*) and branched pencil cholla (*Cylindropunita ramosissima*). Joshua trees (*Yucca jaegeriana*) predominate along Cima Road. Russian thistle (*Salsola kali*), an annual herb not native to California, is the predominant vegetation adjacent to the roadway on the north end of the project area.

Along Kelbaker Road, the predominant species consist of annual and perennial herbs, including the nonnative Saharan mustard (*Brassica tournefortii*), and the native Spanish needle (*Palafoxia arida*), Sonoran sandmat (*Euphorbia micromera*), six weeks grama (*Bouteloua barbata*), and sandpaper plant (*Petalonyx thurberi*) (Calflora 2024). Below 3,800 feet elevation, vegetation transitions to creosote bush (*Larrea tridentata*) and burrobush (*Ambrosia dumosa*). The NPS maintains vegetation in the project area, and the proposed action could require removal of trees and shrubs during road construction and to accommodate construction equipment (HDR 2024).

Geology and Soils

The project area is part of the physiographic region known as the Basin and Range Province and is characterized topographically by mountain ranges that rise steeply and abruptly from the desert floor, interspersed with broad, gently sloping valleys, and faulting. The geologic history of the region is significant, with the oldest exposed rocks dating back 1.7–2.5 billion years (early Proterozoic), including metamorphic rocks derived from sedimentary, volcanic, and igneous (intrusive) rocks. Around 1.4 billion years ago, tectonic activity structurally altered the region, leading to erosion that flattened the landscape. Tectonic activity continued, causing folding and faulting in the sedimentary rocks, and the region became an active margin, developing a volcanic arc during the Jurassic and mid-Cretaceous periods. This activity introduced igneous rocks, primarily granite and batholithic intrusions. Proterozoic and Paleozoic age carbonate rocks, such as limestone and dolostone, are prevalent and resistant to erosion in arid climates. Granitic rocks in the region break down into quartz and feldspar-rich coarse sandy soils (Stoffer 2004). Geologically, the Mojave Desert consists of a complex landscape shaped by tectonic activity, with features such as faults, volcanic fields, alluvial fans, ephemeral streams/drainages, and aeolian dunes.

Many of the valleys and desert flatlands are largely mantled by unconsolidated or poorly consolidated Quaternary surface deposits, sometimes covered by desert pavement or biological soil crusts, and cut by ephemeral streams and washes. Soils with medium textures and with calcium carbonate (e.g., caliche) accumulations are common.

Approximately two-thirds of the survey area consists of soil complexes containing the Arizo, Orwash, and/or the Carrizo series (USDA-NRCS 2024). The Arizo series is present as part of the Arizo-Orwash complex, Yuccabutte-Arizo association as well as Arizo loamy sand. The Orwash series is also present in the Uxo-Orwash complex. The characteristics of these predominant soil series include:

- **The Orwash series** consists of very deep, somewhat excessively drained soils that formed from mixed alluvium derived from granitic sources. Orwash soils are on fan aprons, fan skirts, and alluvial flats. Slope ranges from 2 to 8% in the project area. Mean annual precipitation is about 6 inches, and mean annual temperature is about 59°F (USDA-NRCS 2015a).
- **The Arizo series** consists of very deep, excessively drained soils that formed in mixed alluvium. Arizo soils are on recent alluvial fans, inset fans, fan apron, fan skirts, stream terraces, and floodplains of intermittent streams and channels. Slope ranges from 2 to 15% in the project area. The mean annual precipitation is about 7 inches, and the mean annual temperature is about 62°F (USDA-NRCS 2015b).
- **The Carrizo series** consists of very deep, excessively drained soils formed in mixed igneous alluvium. Carrizo soils are on numerous landforms on floodplains, fan piedmonts, and bolson floors. Slopes range from 2 to 8% in the project area. The mean annual precipitation is about 4 inches, and the mean annual air temperature is about 71°F (USDA-NRCS 2013).

3.2 FLOODPLAINS IN THE PROJECT AREA

Determination of Action Class and Regulatory Floodplain

Following Procedural Manual #77-2, three action classes were considered when evaluating the impacts of the proposed action on floodplains and establishing the regulatory floodplain for this FSOF:

1) Class I Actions (i.e., non-critical actions) include location or construction of administrative, residential, warehouse, and maintenance buildings; non-excepted parking lots; or other human-made features which, by their nature, entice or require individuals to occupy the site, are prone to flood damage, or result in impacts to natural floodplain values.
2) Class II Actions (i.e., critical actions) include any activity for which even a slight chance of flooding is too great such as construction of schools, medical facilities, emergency services, hazardous material storage, and records/collections storage.
3) Class III Actions include any action that involves human occupation or substantial human exposure in high-hazard areas such as drainages subject to flash flooding.

The ephemeral drainages in the survey area are prone to flash flooding and would be considered a Class III Action; however, the action does not involve human occupation or substantial human exposure. Therefore, the proposed action would qualify as a non-critical, Class I Action, as defined in Procedural Manual #77-2. The regulatory floodplain for Class I actions is the FFRMS floodplain.

Determination of Federal Flood Risk Management Standard

Pursuant to NPS policy, federally funded NPS projects must choose one of three methods for establishing a higher vertical flood elevation. Per the FFRMS, the NPS is implementing the *0.2-percent-annual-chance Flood Approach*—using the 0.2-percent-annual-chance flood elevation (also known as the 500-year floodplain) in establishing the FFRMS regulatory floodplain.

Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) data were reviewed for mapped regulatory floodplains within the project area. The project area is located in FEMA Flood Insurance Rate Maps (FIRMs) panel numbers 06071C3025H, 06071C3000H, 06071C3600H, 06071C3575H, 06071C4200H, 06071C4825H, 06071C4850H, and 06071C5475H, in unincorporated areas of San Bernadino County. All pertinent FIRM panels are designated as "Not Printed," and the entire project area is mapped as FEMA Zone D – Area of Undetermined Flood Hazard (FEMA n.d.a). No additional FEMA NFHL data are available for the project area. Additionally, no additional data for the project area within the FEMA Flood Hazard and Data Risk Viewer are available (FEMA n.d.b). The project area is located in San Bernadino County Flood Control District Zone 6. No additional County Flood Zone data are available for the project area.

Given that no FEMA floodplain data are available for the project area, the approximate 100-year and 500-year floodplains were delineated by generating a FLO-2D hydrologic model using publicly available data to simulate various 100- and 500-year storm events in the hydrologic catchment area that contributes surface flows to the project area. The catchment area for the model encompasses approximately 460 square miles, and the model used a 100-foot by 100-foot grid system for precision. Hydrologic model inputs included:

- USGS elevation data
- Curve numbers using Natural Resource Conservation Service (NRCS) soil types and the USGS National Land Cover Database for land use
- Roughness coefficients represented by Manning's n Values
- Hydrologic Unit Code-10 watershed for model boundary

- National Oceanic and Atmospheric Administration (NOAA) rainfall data

The Hydrologic Model Technical Memorandum in attachment A provides more information regarding the modeling approach, assumptions, data sources, and results. The 100-year and 500-year delineated floodplains and approximate locations of the LWCs, pullouts, and desert tortoise crossings are depicted in the flood flow and velocity figure series included in attachment B.

The 100-year and 500-year delineated floodplains primarily overlap with the various ephemeral drainage channels and wash systems that intersect the project area. Flood depths and velocities are variable within the project area, and the locations of greatest flood depth and velocity are primarily associated with the prominent wash crossings, particularly at Cedar Wash, Winston Wash, Van Winkle Wash, and Kelso Wash (the primary receiving water within the project area). The flow depths (excluding depths less than 1 foot) were used for overall floodplain delineation and acreage calculations, and flow velocities (excluding velocities less than 0.5 foot per hour) were modeled to exhibit all areas of potential surface flows within the modeled catchment area.

3.3 FLOODPLAIN VALUES

Portions of the proposed action would occur within areas predicted to be inundated by 100-year and 500-year storm events, particularly in areas associated with ephemeral drainages and LWCs. The road rehabilitation project would result in temporary and permanent impacts to floodplains. Flooding near the project area typically occurs following substantial amounts of localized rainfall. The risk of flooding during proposed action implementation is possible, but low, due to specific mitigation measures implemented by the Preserve and its contractors. Mitigation measures are described in sections 2.4 and 5.0.

Floodplains in their natural or relatively undisturbed state serve water resource values (e.g., natural moderation of floods, water quality maintenance, and groundwater recharge), climate-regulating values, living resource values (e.g., aquatic invertebrates, wildlife species, plant resources), cultural resource values (e.g., open space, natural beauty, scientific study, outdoor education, and recreation), and cultivated resource values (e.g., agriculture, aquaculture, and forestry) (FHWA 2015). The floodplains in the project area are primarily restricted to the various ephemeral drainages that intersect or flow adjacent to the project area. The drainages are charged by runoff from the surrounding mountains and uplands during heavy precipitation events. The floodplains are seldom active, and surface water generally persists for short periods following storm events.

The ephemeral drainages and their floodplains provide a wide range of functions that are critical to the health and stability of arid watersheds and ecosystems. The drainages and floodplains provide connectivity within the drainage basin, linking tributaries and various ephemeral drainage segments, thereby facilitating the movement of water, sediment, nutrients, and plant seeds and propagules. The drainages and floodplains provide wildlife habitat and connectivity, and support denser, more diverse vegetation communities. For desert tortoise, the floodplains support woody vegetation that provides shade and various vegetative communities, including grasses, leafy plants, and flowers (Bonin, Devaus, and Dupre 2006). After surface flow events, surface water, which is often limited in the Preserve and crucial for survival in the summer, is available for a short period, providing water for tortoises and other wildlife species.

Other floodplain processes include dissipation of energy and movement of sediment and debris. The floodplains in the project area allow flood waters to spread over a large area, reducing flow velocities and allowing surface waters to deposit sediment. Vegetation in the floodplains also slows runoff and reduces potential erosion hazards and further promotes sediment deposition, which may add nutrients to the floodplain. The floodplains and their associated drainage channels direct floodwaters that allow Preserve managers to design roadways and features to minimize public safety hazards and potential infrastructure damage during flood events.

3.4 FLOOD RISK IN PROJECT AREA

Recurrence Interval of Flooding in the Project Area

The project area is, and has been, susceptible to flooding during large storm events, and destructive floods have occurred periodically. The Preserve recently experienced two flood events during a monsoon storm and from Hurricane Hilary after the hurricane made landfall in August 2023. Rain outbursts associated with the storm events produced flash floods that washed out roads or covered them with debris, including both Kelso-Cima Road and South Kelbaker Road. As a result, the NPS temporarily closed many roads in the Preserve for public safety and made temporary repairs to facilitate safe vehicle travel.

Historical weather data within the Preserve are relatively scarce because there are no significant population centers or airports in the vicinity where records are typically maintained.

- The Mitchell Caverns weather station, located at latitude 34.9434° North, longitude -115.5135° West at an elevation of 4,350 feet AMSL, is the nearest weather station, approximately 9 miles southeast of the southern end of the project area. The weather station collected precipitation data from 1958 through 1984. The 100-year, 24-hour precipitation estimate for the Mitchell Caverns weather station is 6.26 inches (with 90% confidence intervals between 4.48 inches to 6.61 inches; NOAA 2017). The 100-year, 24-hour precipitation amount has not been exceeded since recording began in 1958, but the 4.48-inch lower confidence interval has been exceeded three times: in February 1980, in July 1984, and in December 2004 with precipitation amounts of 4.5 inches, 5.6 inches, and 5.1 inches, respectively (NOAA 2024b).
- The Mountain Pass weather station, located at latitude 35.4703° North, longitude -115.5436° East at an elevation of 4,730 feet AMSL, is located approximately 16 miles north of the northern end of the project area. The weather station collected precipitation data from 1957 through 2013. The 100-year, 24-hour precipitation estimate for the Mountain Pass weather station is 4.50 inches (with 90% confidence intervals between 3.66 inches to 5.65 inches; NOAA 2017). The 100-year, 24-hour precipitation amount has not been exceeded since recording began in 1955. The largest 24-hour rainfall event occurred in August 1992, consisting of 3.53 inches of precipitation (NOAA 2024a).
- The Barstow Daggett Airport weather station, located at latitude 34.8536° North, longitude -116.7858° East at an elevation of 1,917 feet AMSL, is located approximately 60 miles west of the project area. The weather station has collected precipitation data since 1943. The 100-year, 24-hour precipitation frequency estimate for the Barstow Daggett Airport weather station is 2.69 inches (with 90% confidence intervals between 2.18 inches to 3.38 inches; NOAA 2017). The 100-year, 24-hour precipitation amount has not exceeded 2.69 inches, but it exceeded the 2.18 confidence interval once in September of 1976 with 2.28 inches of precipitation (NOAA 2017).

Although the 100-year, 24-hour precipitation amounts are rarely exceeded, flash flooding during the late-summer monsoon season occurs frequently. The Preserve Incident Reports, extracted from the NPS Morning Reports/Coalition Reports from 1989 to 2024, report flash flooding and debris flow events causing damage to roads and other infrastructure within the Preserve in August 2005, August 2018, August 2022, and August 2023 (NPS 2023a).

Precipitation recurrence intervals identified for the project area are presented in Table 1. The location used for the NOAA Atlas 14-Point Precipitation Frequency Estimate is located at latitude 35.0279° North, longitude -115.6081° West.

TABLE 1. ESTIMATED PRECIPITATION FREQUENCIES WITHIN THE PROJECT AREA

Annual Exceedance Probability (%)	Return Period (Year)	Inches of Precipitation/ 24 Hours
50	2	1.46
20	5	2.02
10	10	2.51
4	25	3.20
2	50	3.76
1	100	4.36
0.5	200	5.01
0.2	500	5.95

Source: NOAA Atlas 14-Point Precipitation Frequency Estimates (NOAA 2024b)

Hydraulics of Flooding in the Project Area

The project area experiences riverine floods and flash floods/debris flows within the various ephemeral streams that cross and flow adjacent to Kelso-Cima and South Kelbaker Roads. Riverine floods occur when the streams overflow their banks, spilling water into the surrounding low-lying areas, generally resulting from prolonged heavy rainfall associated with major frontal storm events. Flash floods occur when sudden, intense, localized events occur in response to cloudburst rainfall that often accompany convective monsoonal thunderstorms. Because cloudburst storms result from strong convective cells produced by differential atmospheric heating, flash floods are largely a summertime phenomenon in the region. Debris flows occur when flash floods contain large amounts of sediment, ranging in size from clay to boulders. Like flash floods, debris flows are fast moving and are particularly dangerous to life and destructive to property.

The 100-year storm event, which was used to delineate the 100-year floodplain, was modeled using the 100-year, 24-hour storm (4.36 inches of precipitation) and excluded modeled flood depths less than 1 foot. The final model encompasses approximately 61 acres along approximately 6.7 miles of roadway within the constraints of the Kelso-Cima and South Kelbaker Road Rehabilitation Project (project area). The 500-year storm event, which was used to delineate the 500-year floodplain, was modeled using the 500-year, 24-hour storm (5.95 inches of precipitation), excluding modeled flood depths less than 1 foot, encompasses approximately 102 acres along approximately 10.2 miles of roadway within the project area (attachment B). The 100-year and 500-year storm event precipitation data were obtained at the centroid of the modeled catchment area located at latitude 35.0279° North, longitude -115.6081° West (NOAA 2024b).

Hydrologic modeling of the 100- and 500-year, 24-hour rain events generally indicates that areas near Cedar Wash, Winston Wash, Van Winkle Wash, and Kelso Wash would experience floods with the greatest depth and velocity within the project area. It should be noted there is an artificial levee running northeast to southwest along the UPRR track that protects the project area from flood events in the Kelso Wash at the Kelso-Cima Road and South Kelbaker Road intersection near the Kelso Depot visitor center. These wash areas are associated with various ephemeral drainage features that cross the project area. Table 2 provides the general locations of each wash/wash system crossing with the Kelso-Cima and South Kelbaker Roads project area, and the associated maximum flood depth and velocity at each crossing, as determined during hydrologic modeling. Existing LWCs at these wash/wash system crossings are proposed for improvement.

TABLE 2. APPROXIMATE MODELED WASH FLOOD RESULTS WITHIN THE PROJECT AREA

Wash Name	Approximate Project Area Crossing Location (Decimal Degrees)	Approximate Maximum 100-Year, 24-Hour Storm Depth (Feet)	Approximate Maximum 500-Year, 24-Hour Storm Depth (Feet)	Approximate Maximum 100-Year, 24-Hour Storm Velocity (Feet per Second)	Approximate Maximum 500-Year, 24-Hour Storm Velocity (Feet per Second)
Cedar Wash	35.136126°N, -115.530050°W	5–6	6–7	2.0–3.0	4.0–5.0
Winston Wash	34.930458°N, -115.646179°W	2–3	2–3	0.5–1.0	2.0–3.0
Van Winkle Wash	34.769326°N, -115.630847°W	2–3	2–3	1.0–2.0	2.0–3.0
Kelso Wash	35.011942°N, -115.654401°W	3–4	7–8	2.0–3.0	> 5.0

Time Required for Flooding to Occur

Flooding within the project area is generally caused by slow-moving thunderstorms or heavy rains from monsoonal storm events. Floods from these weather events can occur within a few minutes or hours of excessive rainfall, depending on the intensity and duration of the precipitation, topography, soil conditions, and ground cover. Additionally, flooding can occur from rainstorms in the local catchment area up to approximately 8 to 10 miles away from the project area.

Opportunity for Evacuation of the Project Area in the Event of Flooding

NPS personnel use existing roads to evacuate the project area during and immediately after flood events. The Preserve's Kelso Depot visitor center is regularly staffed and is located at the intersection of Kelso-Cima and South Kelbaker Roads. NPS and other emergency personnel can access the project area from both I-15 to the north and I-40 to the south. There are multiple existing pullout locations and additional proposed pullout locations outside the floodplain to allow safe parking for vehicles until evacuation can occur.

Geomorphic Considerations

Flash floods and other forms of desert flooding in the project area can have a significant geomorphic effect on the desert landscape. Flash floods can change the particle size distribution within drainages and on the floodplain, dropping more coarse particles (e.g., boulders, rocks, and pebbles) within and immediately after leaving a consolidated drainage, and dropping finer particles (e.g., gravel and sand) as the flood creates an alluvial fan when the gradient decreases. Additionally, flash floods can significantly alter the shape and level of channel beds due to the sudden, intense rainfall and flooding over sandy, sparsely vegetated environments. Gully erosion processes often occur in narrow channels and can remove the soil to considerable depth over short periods of time. Storm rainfall and morphology (i.e., elevation, slope, curvature, and water catchment) are generally the major contributing factors in driving flash flood erosion (Schepanski, Wright, and Knippertz 2012; Saleem and El-Desouky 2024).

3.5 IMPACTS OF THE PROPOSED ACTION

Potential Risks to Human Health and Safety

The proposed action would mitigate current risks to floodplain values, including human health and safety, because improvement and stabilization of the LWCs would decrease the likelihood of road degradation and damage and decrease the probability of drivers becoming stranded on the road between drainage

crossings during flow events, particularly at the Cedar Wash, Winston Wash, Van Winkle Wash, and Kelso Wash crossing locations. LWC improvements are proposed at each wash crossing location, and pullouts are also proposed in upland areas on either side of the wash crossings.

It should be noted that not all LWCs are perpendicular to surface water flows. Realigning the roadway to have perpendicular flow at all crossings is not practical for this project. Riprap and buried concrete barrier for the LWC would span the entire channel width with additional length to protect the anticipated 'wetted' width of the drainage channels, and the buried concrete barrier would be placed to span the width on the upstream and downstream sides of the LWCs. Additionally, the LWCs at Cedar Wash, Winston Wash, Van Winkle Wash, and Kelso Wash are nearly perpendicular (within approximately 5 to 20 degrees) to the modeled high-velocity, high-depth surface flows, providing additional stability at the high-risk areas.

In the event of substantial 100- or 500-year storm events, the proposed action and maintenance and improvements of the LWCs would reduce the frequency and duration of road closures and potential damage, and the additional roadside pullouts would provide safe areas for vehicles and visitors to wait until floodwaters recede. The proposed additional signage would also improve hazard communication to travelers. Additional signage proposed along the project area would improve traffic safety and hazard communication to travelers, including "Do Not Enter When Flooded," "Flash Flood Area," speed feedback, soft shoulder, winding road, curve ahead, and "Drive Like a Tortoise" signs. The NPS would limit the amount of signage proposed throughout the project area, to the extent feasible, to minimize impacts to the landscape. The amount and location of the proposed signage would be determined during final design.

NPS staff can quickly close roads within the Preserve and provide adequate detours when needed for public safety and to protect road crews. Road access gates are located at the southern end of the project area on South Kelbaker Road and near the railroad crossing at the intersection of Kelso-Cima and South Kelbaker Roads. The Preserve maintains an Emergency Operations Plan that lays out specific communication procedures, internal and external emergency teams, and annual emergency drill requirements to address a variety of different emergency events, including flash floods (NPS 2023b). However, the general lack of road maintenance within the project area has hindered the NPS from providing prompt responses to traffic hazards from flash floods or other surface flow events. The proposed action would improve responsiveness and reduce potential risks to human health and safety.

Potential Risks to Property

The proposed action would reduce the potential risk to property, while the maintenance of the LWCs would allow the ephemeral drainage systems to more effectively transport flood waters across Kelso-Cima Road and South Kelbaker Road, reducing potential downcutting and other erosion issues that contribute to property and infrastructure damage.

Potential Risks to Floodplain Values

The existing road and railroad infrastructure have disturbed floodplains in the project area. Floodplains in the project area would primarily be impacted by improvement and stabilization of the LWCs. Additionally, minor impacts are anticipated for the construction of desert tortoise crossings under the road, generally located outside and adjacent to the various ephemeral drainage channels. Most of the proposed vehicle pullout areas and other construction areas are located outside the modeled 100-year and 500-year floodplains. Construction equipment would be required to access the floodplain to improve the LWCs and install concrete barriers and rock riprap to prevent erosion. Construction equipment would also access floodplains to install the desert tortoise crossings under the roadways at various locations. The desert tortoise crossings are not intended for flow conveyance, and flood waters are intended to continue to wash over the roadway at the improved LWC locations. A number of tortoise crossings are within modeled conveyance flow paths. Though the crossings are not primarily designed to convey water, they

have the capability to transport surface flows under the roadway. Ultimately, improvement and stabilization of the LWCs would enhance floodplain values by promoting more effective flow across the roadway and preventing erosion and infrastructure damage during flood events.

Potential adverse impacts on natural floodplain values would include temporary removal of vegetation during construction activities and soil disturbance from equipment travel. Soil compaction and loss of vegetation are known to diminish floodplain function, which includes loss of flood energy dissipation, loss of shallow groundwater recharge, and loss of sediment and nutrient capture (Opperman et al. 2010). Loss of these functions results in more rapid and energetic runoff responses, and coupled with the destabilizing impacts of the loss of vegetation, temporarily makes the area vulnerable to erosion.

The road rehabilitation would primarily occur within the existing road alignment. Permanent infrastructure proposed to be constructed in floodplains would include concrete barriers, rock riprap, geotextile fiber to support the rock riprap and improve surface water flow conveyance across roadways, and tortoise exclusion fencing and crossing features to improve tortoise movement across roadways and reduce tortoise fatalities. No other permanent infrastructure is expected to be constructed within the existing floodplains. Overall, adverse impacts to floodplain functions and values are expected to be negligible.

4.0 JUSTIFICATION FOR THE USE OF FLOODPLAINS

4.1 INVESTIGATION OF ALTERNATIVE SITES

During the initial design process, the NPS and FHWA evaluated potential roadway safety improvements within the project area. The following alternatives were considered for project implementation but were dismissed from further analysis.

The NPS considered an alternative that would realign the roadway at several locations along the project corridor, including:

- A northerly off-alignment roadway realignment for over 5 miles on the Kelso-Cima Road segment to correct sight distances and vertical profile dips at LWCs.
- A roadway bypass around the Kelso Depot to relocate Kelso-Cima Road to the north of the Kelso Depot area.
- A roadway realignment near the Granite Pass area to remove the existing S-curve in the roadway alignment and improve vertical sight distance for drivers.

This alternative would result in additional environmental impacts to Preserve resources, including impacts to the native landscape and vegetation and increased habitat disturbance. Therefore, this alternative was dismissed from further consideration.

The NPS also considered an alternative that would include roadway rehabilitation and safety improvements along Kelso-Cima Road and South Kelbaker Road and the installation of box culverts and crossing features for desert tortoises. This alternative would occur primarily on the existing alignment, with adjustments to the vertical profile of the roadway where needed. In addition, it would include pullouts at predefined locations approximately every mile along the project corridor; provide desert tortoise exclusion fencing, particularly on the northern and western sides of Kelso-Cima Road and both sides of South Kelbaker Road; and replace existing larger LWCs with box culverts. Because of the proximity to the project corridor, this alternative could potentially affect the existing UPRR access and right-of-way.

This alternative would be cost-prohibitive because constructing the water crossing structures would require a large amount of earthwork and construction to meet UPPR requirements . This alternative also would result in substantially higher environmental impacts to resources in the Preserve. Therefore, this alternative was dismissed from further consideration.

Under the proposed action, the NPS would mitigate current flood hazards to visitors in the project area and minimize additional impacts to floodplain resources by increasing flow conveyance across the existing roadway and armoring existing LWCs to prevent erosion and road degradation.

4.2 JUSTIFICATION FOR FLOODPLAIN LOCATION

Because the existing roadways are located in the 100-year floodplain and there is not an alternative that would remove them from the floodplain, no other location is available for the proposed action; however, the proposed action would improve the existing LWCs within the floodplain, ultimately mitigating floodplain hazards and lowering risk to human health and property.

5.0 MITIGATION MEASURES

The proposed action would not significantly increase the risk of flooding or increase the hazards to human life and property. Impacts to floodplain values would be minimal along the length of the proposed action. In addition, mitigation would ensure that structures and facilities are designed consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 Code of Federal Regulations Part 60).

Specific mitigation measures that would be applied to minimize impacts to human health and safety, property, and floodplain functions and values include:

- The Preserve would continue to regularly update its website to provide up-to-date road conditions and maps, the status of facilities, hazardous weather conditions and forecasts, and other hazards in the Preserve (NPS 2025).
- Temporary road closure and hazard caution signage would continue to be readily available as needed, and the NPS is proposing to install speed limit and other traffic signs, radar speed feedback signs or roadway striping and marking as appropriate, and additional signage to address safety issues and improve visitor experience.
- Artificial levees that run along Kelso-Cima Road would continue to persist, providing protection from floodwaters for the road and railway infrastructure.
- To help protect life, no inhabitable buildings are currently proposed within the 100-year floodplain in the project area. All road infrastructure would be designed to withstand flood events while impeding flow as little as possible. The NPS would improve and stabilize existing LWCs to enhance cross drainage while allowing drivers to maintain a consistent speed. The proposed LWC structures would use concrete barriers, cut-off walls to resist undermining, and riprap protection in the upstream and downstream channel, as needed, to prevent damage during flood events. Currently, the LWCs are not armored, and erosion occurs after heavy rainfall events.
- All temporary disturbance areas would be restored to preconstruction conditions (or better). Disturbed areas would be revegetated with native plant species that reflect surrounding native vegetation. Native, suitable soils excavated for construction would be reused to restore temporary disturbance areas, as needed, in accordance with the NPS floodplain guidelines and EO 11988.
- At the discretion of the NPS, a variety of native plants may be removed or relocated to reclaimed areas during and following completion of the proposed action. Revegetation work would use soil conserved along the corridor and native species from genetic stock originating in the Preserve. Revegetation efforts would also attempt to reconstruct the natural spacing, abundance, and diversity of native plant species. Areas disturbed during construction would be revegetated using locally collected plant species (seeds and transplants).
- The project would comply with all relevant requirements under the Clean Water Act, including management of stormwater-related nonpoint source pollutants under the National Pollutant Discharge Elimination System. Mitigation to minimize storm damage would include the use of sustainable design principles and implementation of best management practices during and after construction. Contractors would implement best management practices for drainage and sediment control to prevent or reduce nonpoint source pollution and minimize soil loss and sedimentation in drainage areas. These practices may include silt fencing, filter fabric, temporary sediment ponds, temporary or permanent check dams, and immediate mulching of exposed areas to minimize sedimentation and turbidity impacts from construction activities. Erosion control measures would be left in place at the completion of construction to avoid adverse impacts on water and floodplain resources.

- Construction activities would be conducted with caution to prevent damage to floodplains from equipment, erosion, siltation, or pollutant discharges.
- Construction or clearing of vegetation within the floodplains would be limited to the greatest extent possible. Watershed conditions would be restored after temporary impacts to reduce accelerated runoff caused by soil compaction; poor vegetation cover; or the unnatural conveyance of water by roads, ditches, or trails.
- Warning signs, notifications, and other park communications would be implemented during construction activities to warn Preserve visitors of upcoming and active construction activities.
- Ample notice of significant, widespread storms, such as hurricanes and atmospheric rivers, is provided by the National Weather Service. In those cases, the Preserve would have at least one day prior notice to restrict access to the project area from existing road closure gates on either end of Kelso-Cima and South Kelbaker Roads.

6.0 SUMMARY

The NPS finds the proposed action to be consistent with EO 11988 and NPS Director's Order #77-2 for the protection of floodplains, and the NPS has determined that the proposed action would not have significant adverse impacts on floodplains and their associated values and functions.

The NPS has determined that there are no practicable, non-floodplain locations for the proposed action because of the location of the existing road infrastructure. Risks to natural and beneficial floodplain values would be minimal because the permanent net loss of floodplains would be negligeable. After the road construction and improvement of the LWCs are completed, the impacted areas would be restored to natural conditions, and existing floodplain conditions are likely to improve. Additionally, the proposed action would reduce potential hazards to human health and safety, reduce potential erosion and infrastructure degradation from flooding events, and promote water resource and wildlife connectivity.

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ATTACHMENT A – HYDROLOGIC MODEL TECHNICAL MEMORANDUM

HYDROLOGIC MODEL TECHNICAL MEMORANDUM

Project: Kelso-Cima Road and South Kelbaker Road Rehabilitation

Subject: Floodplain Statement of Findings – Hydrologic Modeling

Date: March 24, 2025

Prepared For: US National Park Service – Mojave National Preserve

Prepared By: WSP USA Inc.

This memorandum discusses the approach for determining the approximate floodplain extents along the roadway corridor associated with the Mojave National Preserve Kelso-Cima and South Kelbaker Roads Rehabilitation Project (proposed action).

Overall Approach

WSP USA Inc. (WSP) developed FLO-2D models to simulate rainfall throughout the 460 square mile watershed area that drains to and near the action area. WSP analyzed 100-year, 6-hour and 100-year, 24-hour storm frequencies to establish flow depths and velocities throughout the model boundary. The 6-hour and 24-hour durations were analyzed based on the California Department of Transportation Highway Design Manual Chapter 810 – Hydrology. The 6-hour storm corresponds to drainage areas between 20 and 100 square miles. The 24-hour storm corresponds to drainage areas greater than 100 square miles. Standard SCS Type II distributions were used for the 6-hour and 24-hour scenarios.

The 500-year, 6-hour and 500-year, 24-hour storms were also analyzed to satisfy the 500-year floodplain approach for the Federal Emergency Management Agency (FEMA) Federal Flood Risk Management Standard (FFRMS) to be incorporated into the Floodplain Statement of Findings (FSOF) for the proposed action.

Assumptions

A grid size of 100-feet x 100-feet was used for the model to ensure an acceptable run time and adequate detail given the large size of the model. No hydraulic structures such as existing bridges, culverts, or low water crossings were actively input into the model. Additionally, rainfall depths were obtained at the centroid of the watershed and no reduction factors were used since the two-dimensional model was applied.

Data Sources

Input data for the models were obtained from a variety of publicly available sources. This information is summarized in Table 1.

TABLE 1: DATA SOURCES

Data	Purpose	Source	Format
Elevation	Development of FLO-2D Model	US Geological Survey National Map Viewer Download	Raster
Land Use	Estimating precipitation losses (infiltration)	National Land Cover Database	Raster
Soil Types	Estimating precipitation losses (infiltration)	Natural Resources Conservation Service SSURGO Database	Shapefile
Precipitation	100-year and 500-year precipitation depths	National Oceanic and Atmospheric Administration Atlas 14, Vol. 2	PDF
Aerial Photography	Reference	ArcGIS Map Service	Raster

Results

WSP compared the results for the 6-hour and 24-hour storms to determine the controlling storm scenario along the proposed action corridor. In all instances, the 24-hour storm flow depths were greater than the 6-hour storm flow depths. Therefore, the 24-hour storm controls the flooding area for the proposed action. The anticipated 100-year flow depths and velocities are shown in the figures presented in Appendix B of the FSOF. Note that flow depths less than 1 foot and velocities less than 0.5 foot per second (ft/s) are not shown.

The 500-year floodplain was also determined based on the 24-hour storm flow depths and the extents are included on the flow depth and velocity figures in Appendix B of the FSOF. For the 500-year floodplain determination, flow depths less than 1-foot were excluded which is consistent with standard FEMA practices for floodplain determination.

Conclusion

The floodplain presented in this analysis is based on publicly available data and is intended for informational purposes for use in the Floodplain Statement of Findings. Refer to the FSOF for more information regarding the project.

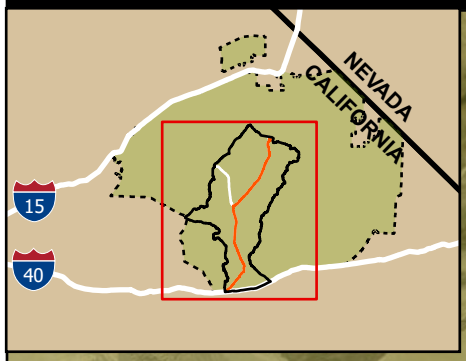
ATTACHMENT B – HYDROLOGICAL MODEL FIGURES

Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

100-Year, 24-Hour Floodplain Analysis: Flow Depth (Full Model)

National Park Service
US Department of the Interior



MID HILLS
MARL MOUNTAINS
KELSO CIMA ROAD
Cedar Wash
Kelso Wash
KELSO MOUNTAINS
WOODS MOUNTAINS
PROVIDENCE MOUNTAINS
Cottonwood Wash
Winston Wash
S KELBAKER ROAD
CLIPPER VALLEY
GRANITE MOUNTAIN
Van Winkle Wash
OLD DAD MOUNTAINS
VAN WINKLE MOUNTAINS
CLIPPER MOUNTAINS
40
40

NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Extent
- ModelBoundary
- Mojave National Preserve

100-Year, 24-Hour Model Results, FD

Depth (ft)

1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | > 10.0

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

0 5 Miles

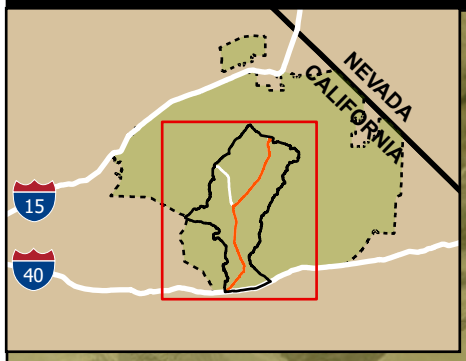
Path: C:\Users\USKM\0923271\OneDrive - WSP

Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (Full Model)

National Park Service
US Department of the Interior



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MARL MOUNTAINS
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NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Extent
- ModelBoundary
- Mojave National Preserve

500-Year, 24-Hour Model Results

Depth (ft)

1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | > 10.0

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

0 5 Miles

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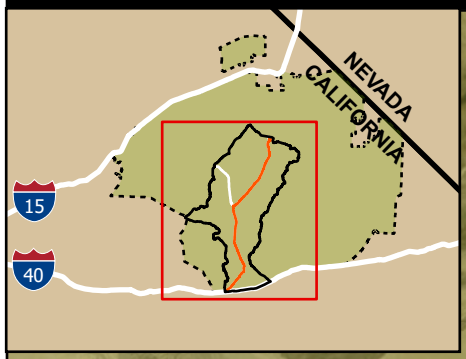
Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

100-Year, 24-Hour Floodplain Analysis: Velocity (Full Model)

National Park Service
US Department of the Interior



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GRANITE MOUNTAIN
Van Winkle Wash
OLD DAD MOUNTAINS
VAN WINKLE MOUNTAINS
CLIPPER MOUNTAINS
40
40

NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Extent
- ModelBoundary
- Mojave National Preserve

100-Year, 24-Hour Model Results

Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | >5.0

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

0 5 Miles

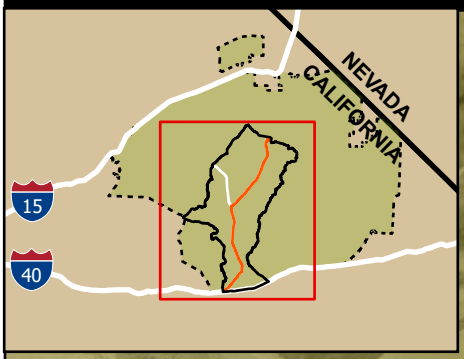
Path: C:\Users\USKM093237\OneDrive - WSP

Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (Full Model)

National Park Service
US Department of the Interior



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Cedar Wash
Kelso Wash
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OLD DAD MOUNTAINS
VAN WINKLE MOUNTAINS
CLIPPER MOUNTAINS
40
40

NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Extent
- ModelBoundary
- Mojave National Preserve

500-Year, 24-Hour Model Results

Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

0 5 Miles

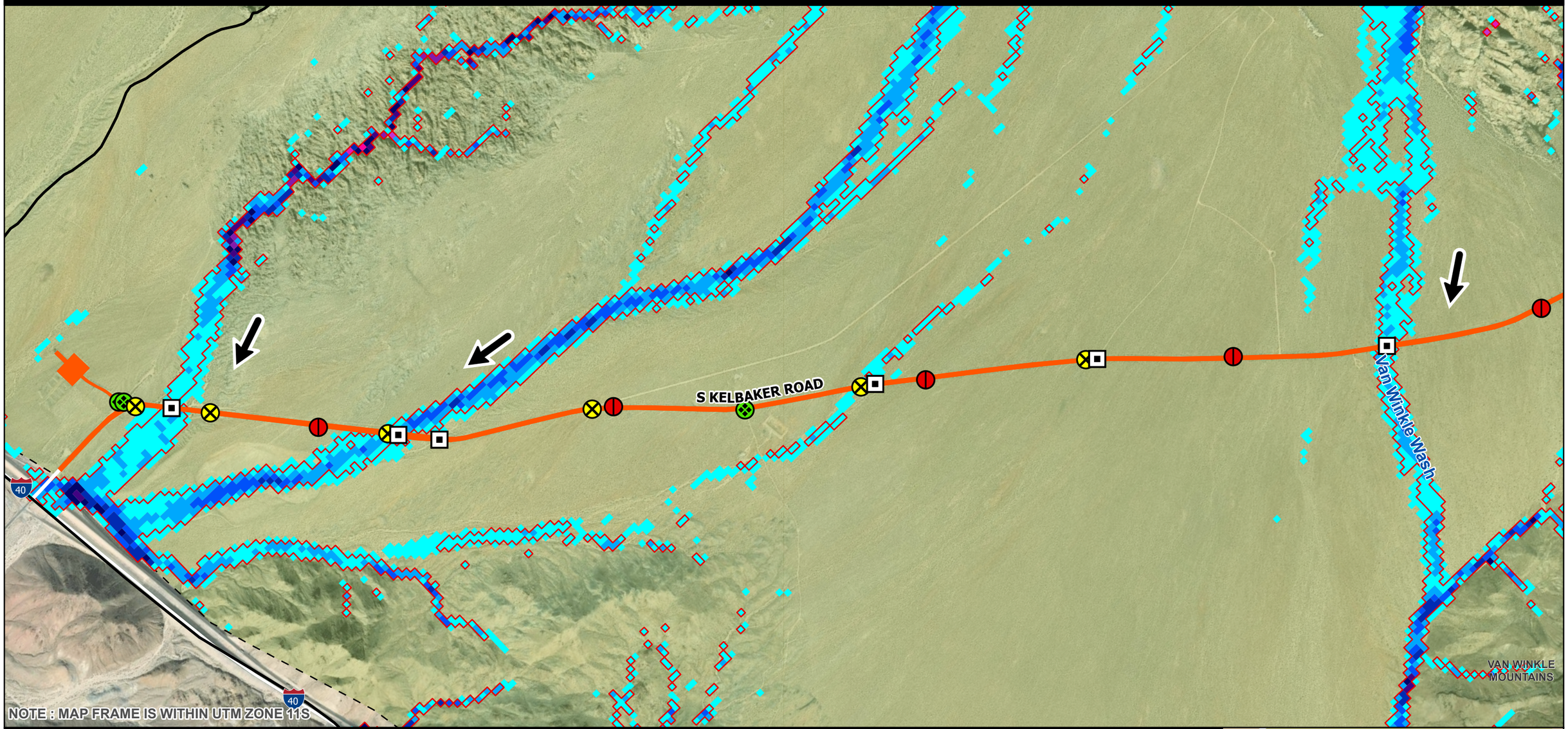
Path: C:\Users\USKM093237\OneDrive - WSP

Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (A)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

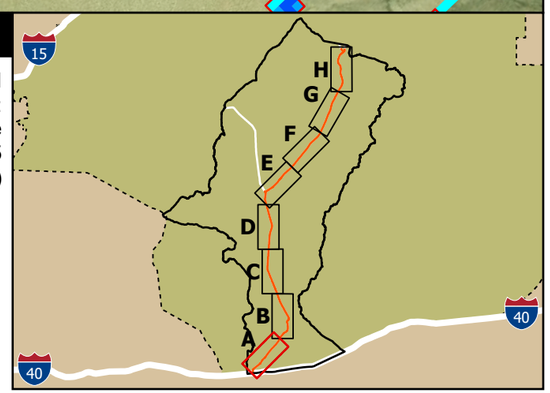
500-Year, 24-Hour Model Results
Depth (ft)

1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | > 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)



Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (B)

National Park Service
US Department of the Interior

S KELBAKER ROAD

NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

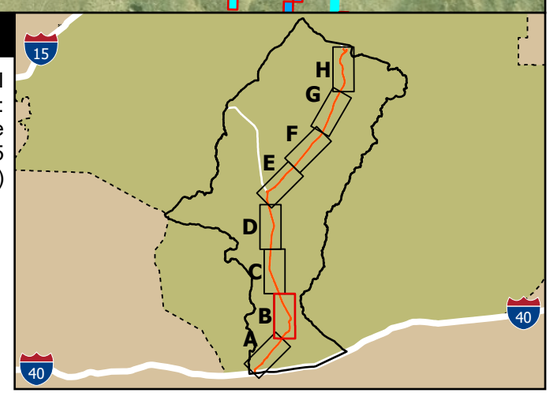
500-Year, 24-Hour Model Results
Depth (ft)

1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
> 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

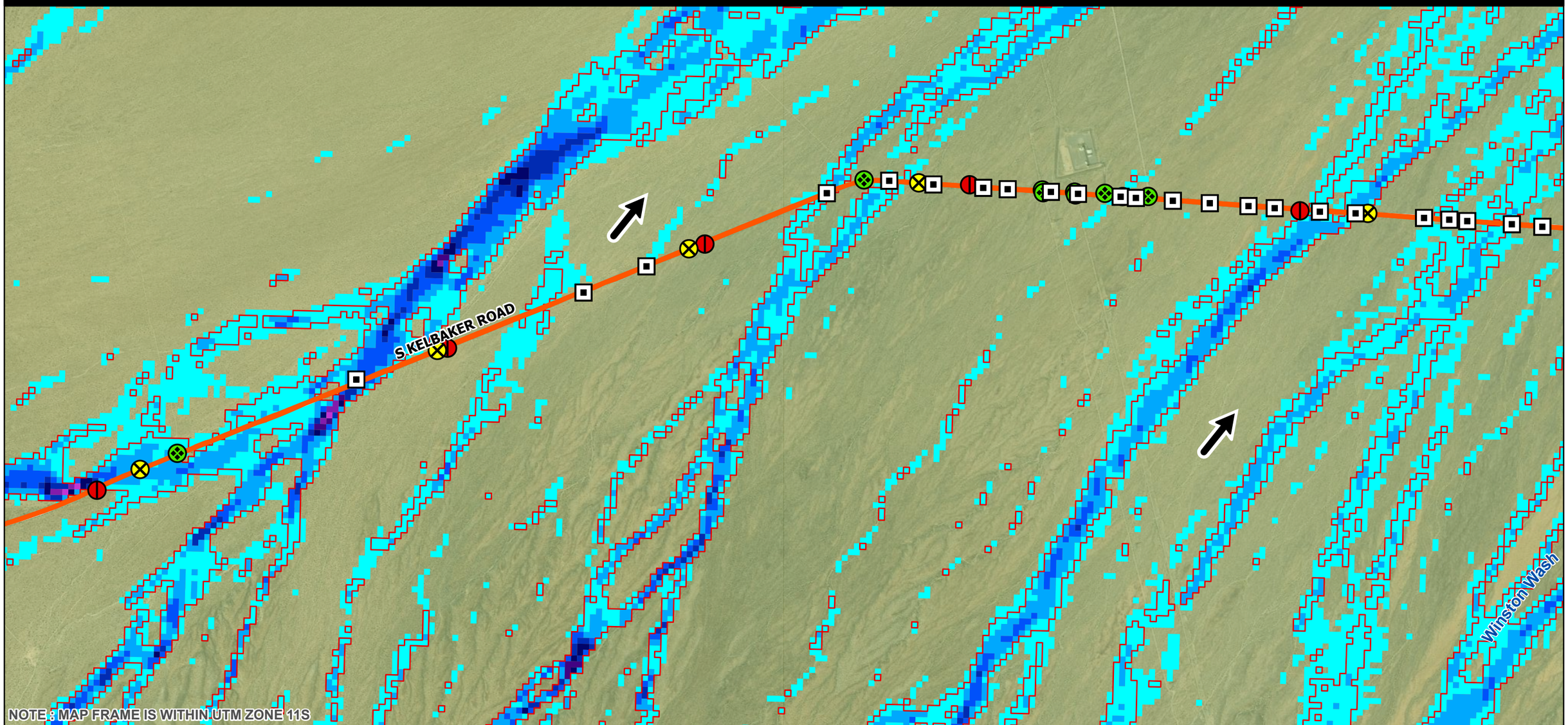


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (C)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

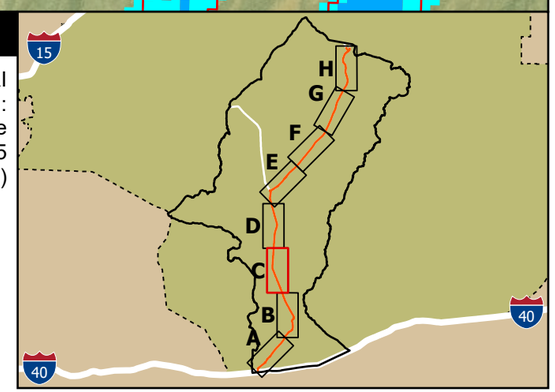
500-Year, 24-Hour Model Results
Depth (ft)

1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
> 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

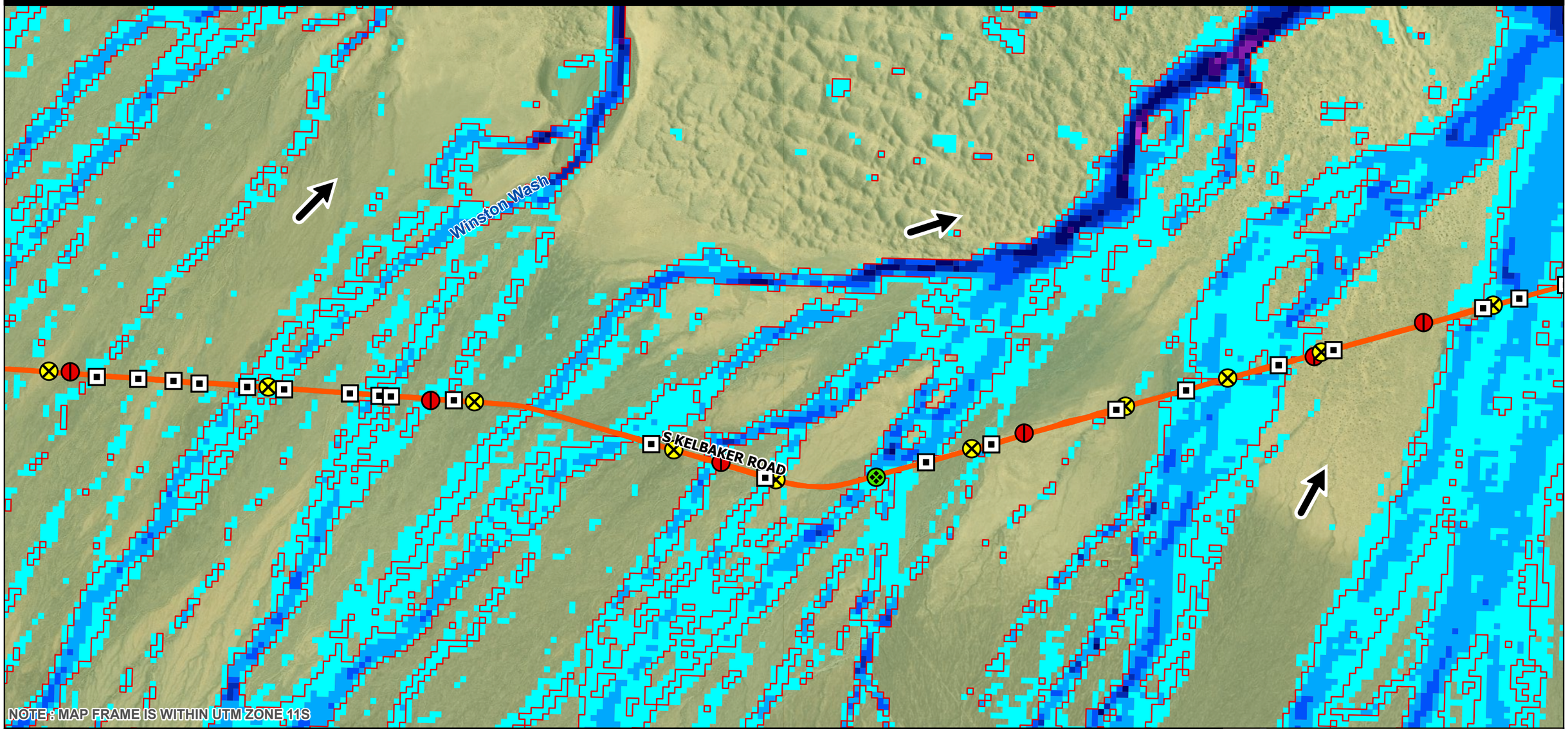


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (D)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

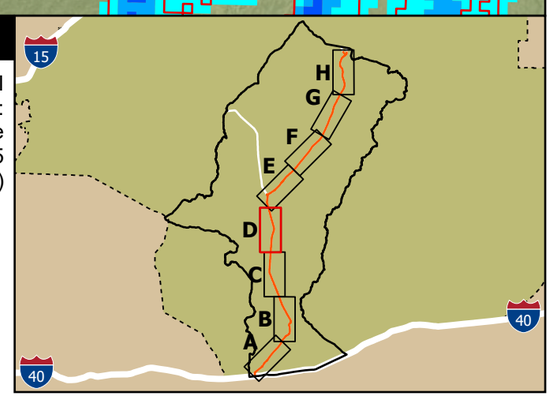
Depth (ft)

1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | > 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

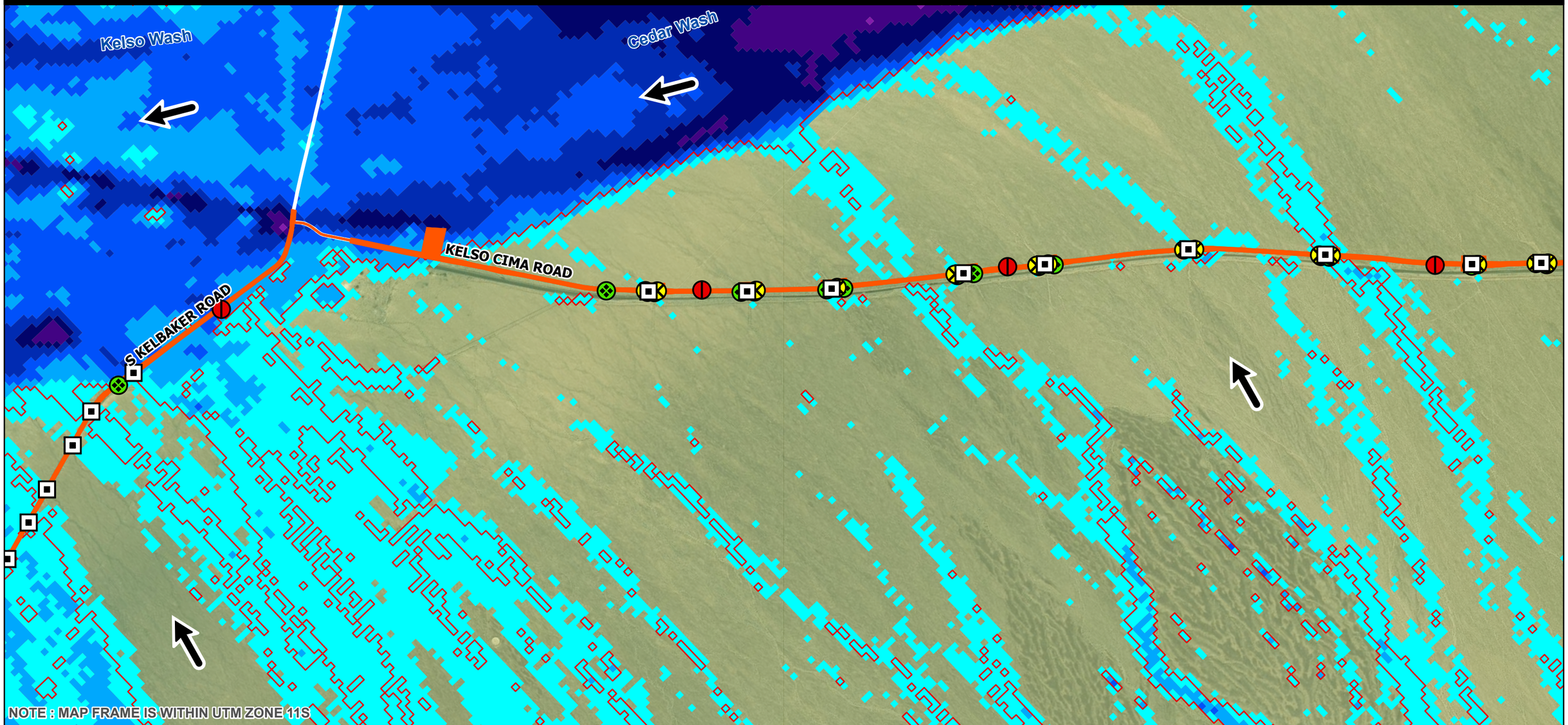


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (E)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

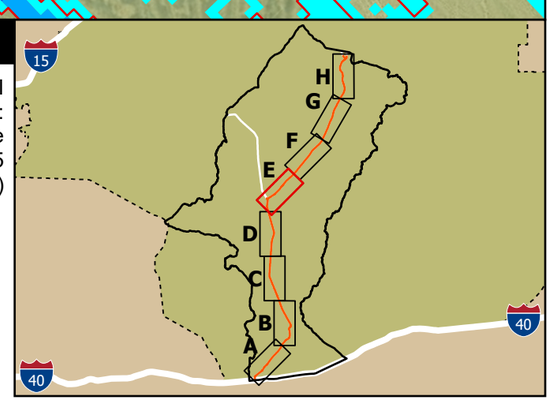
500-Year, 24-Hour Model Results
Depth (ft)

1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
> 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

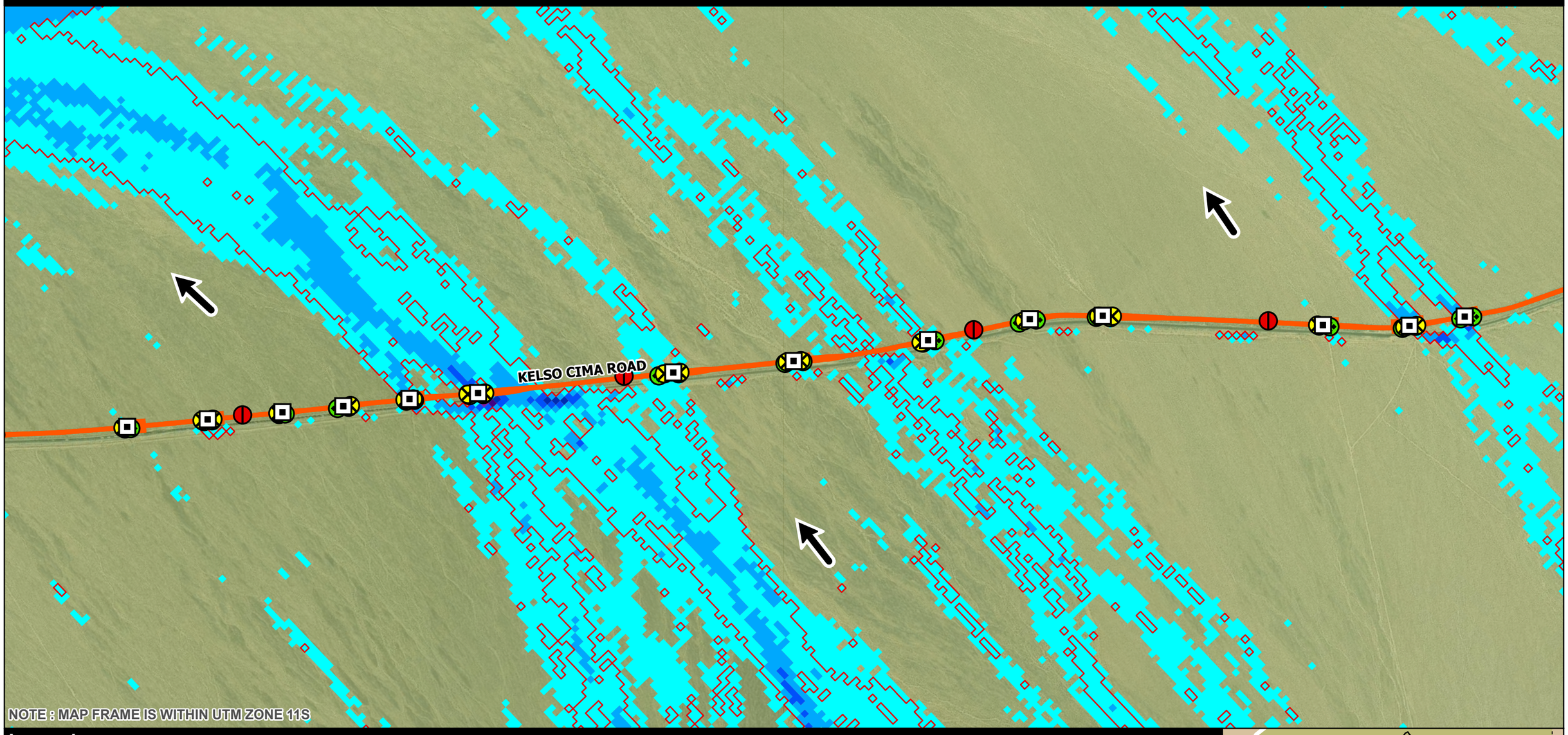


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (F)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

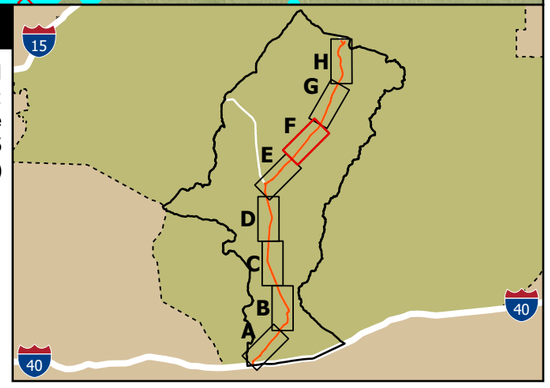
500-Year, 24-Hour Model Results
Depth (ft)

1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | > 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

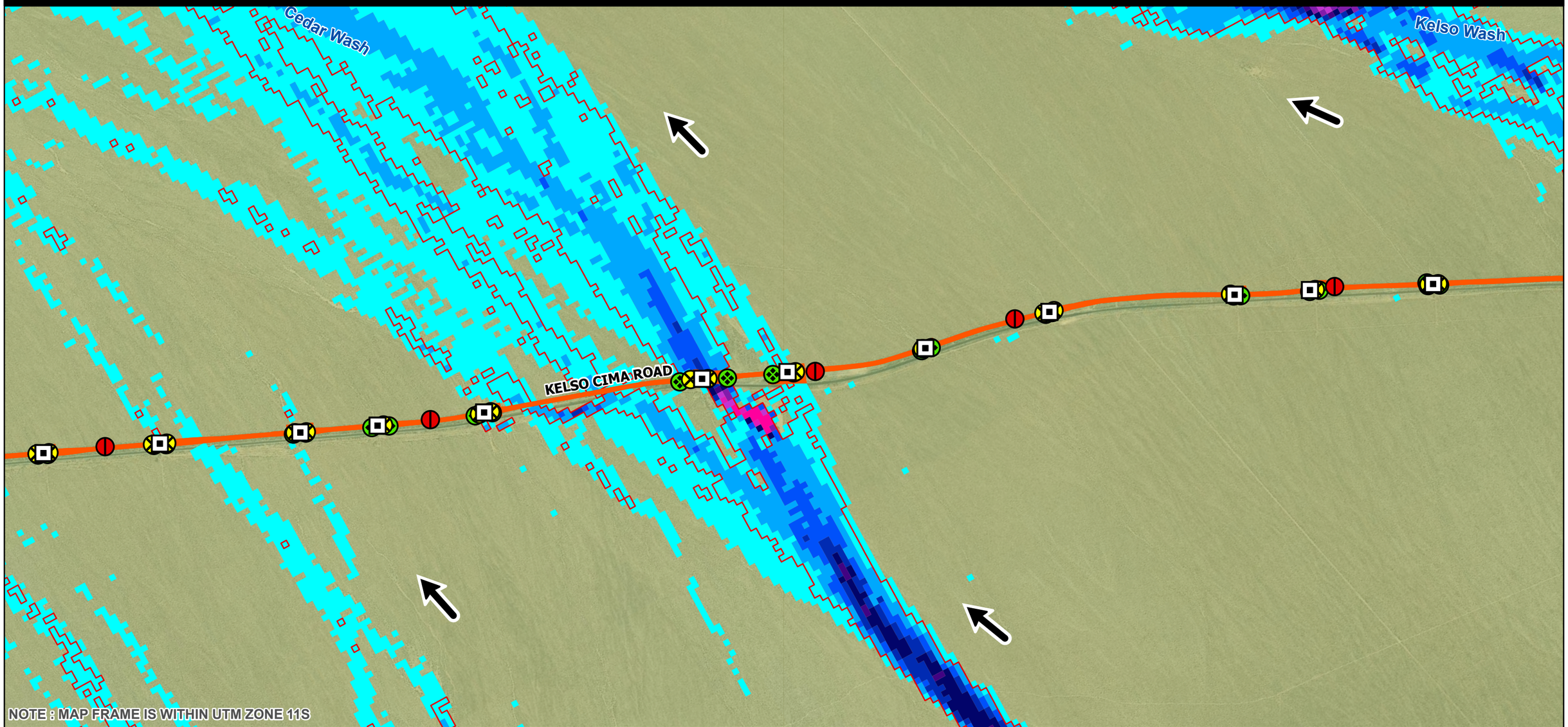


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (G)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

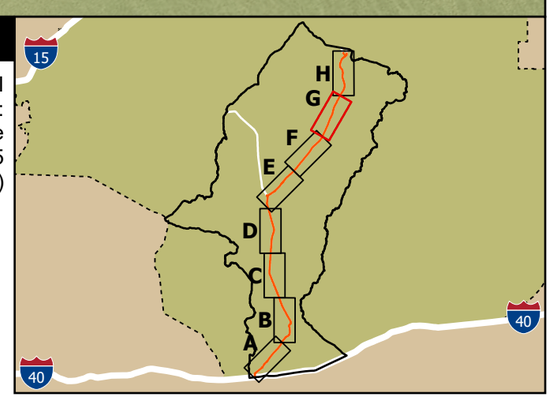
Depth (ft)

1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | 5.0 - 6.0 | 6.0 - 7.0 | 7.0 - 8.0 | 8.0 - 9.0 | 9.0 - 10.0 | > 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

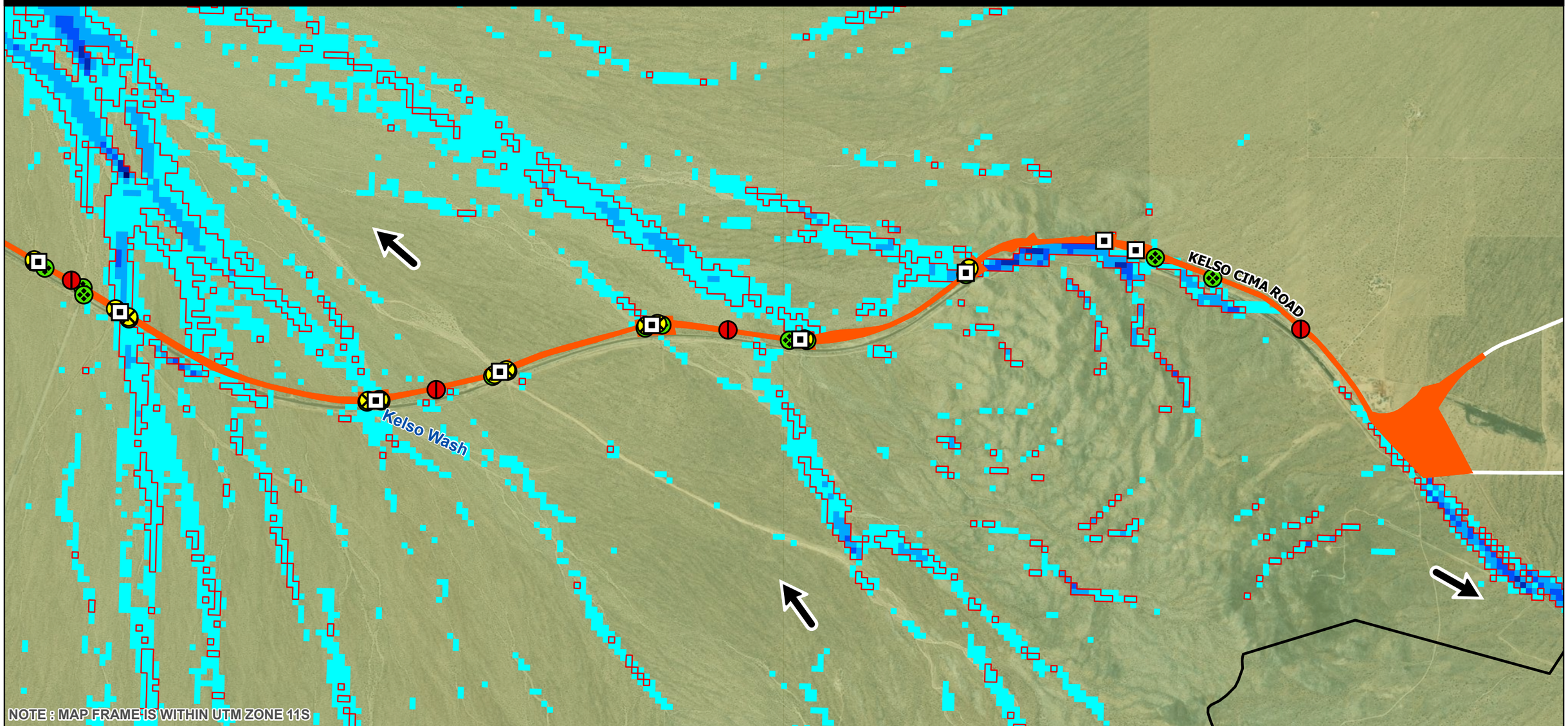


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Flow Depth (H)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

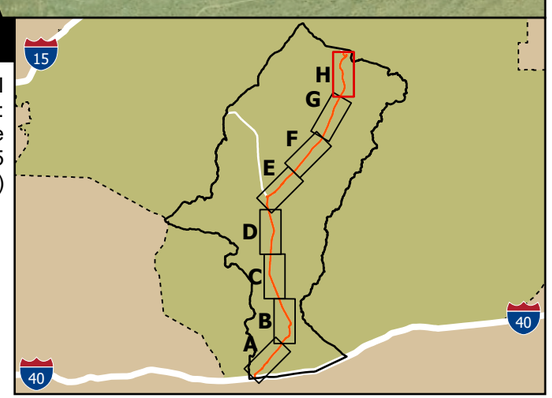
Depth (ft)

1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
> 10.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

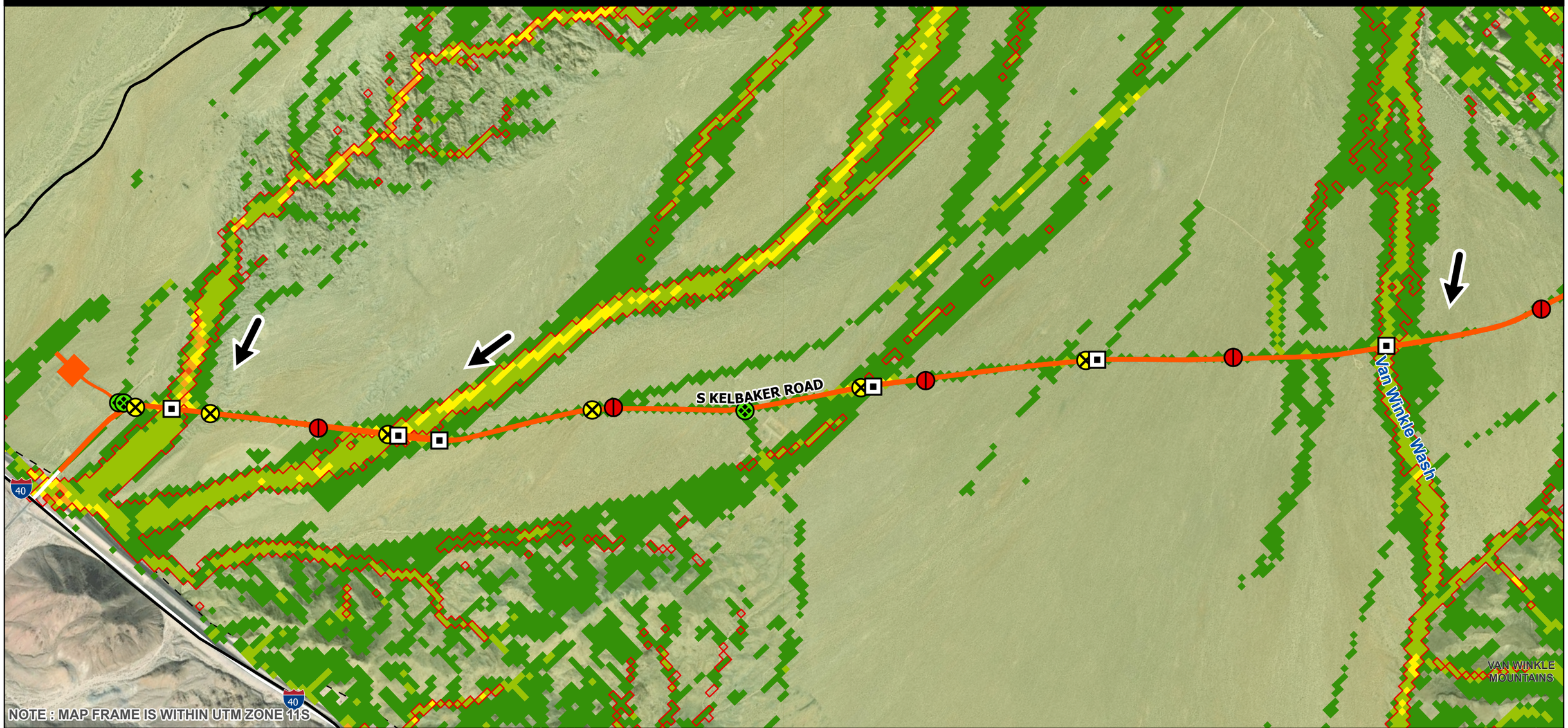


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (A)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

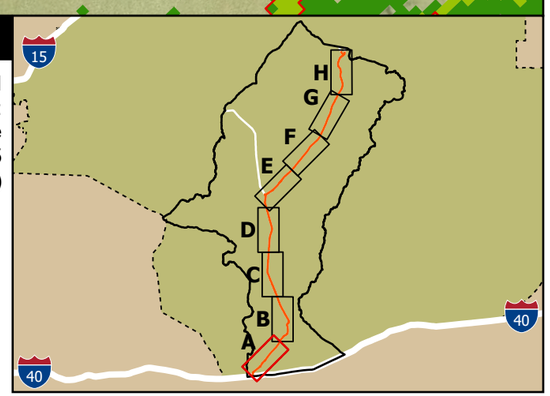
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

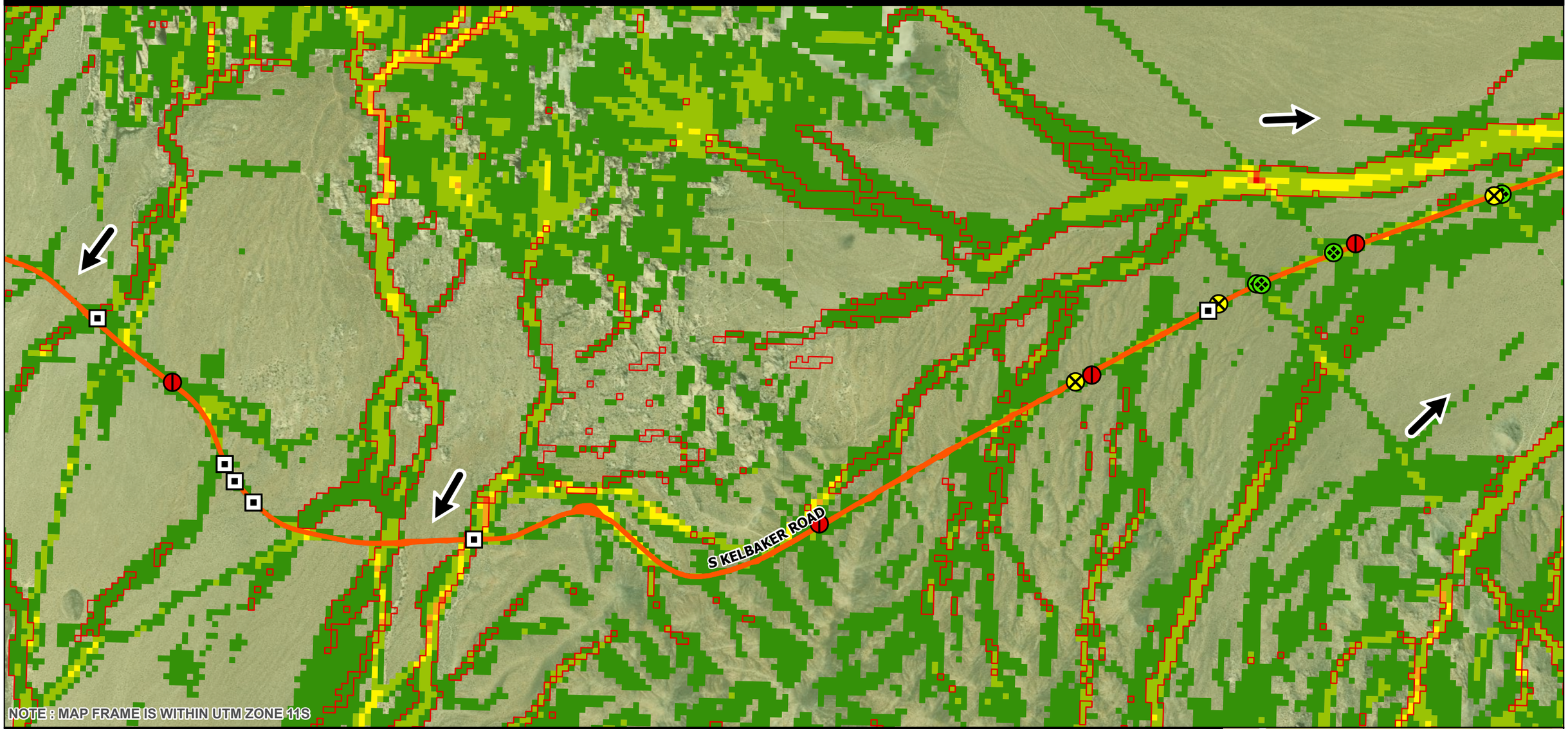


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (B)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

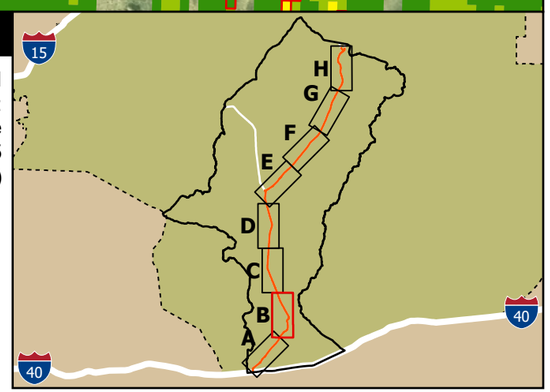
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

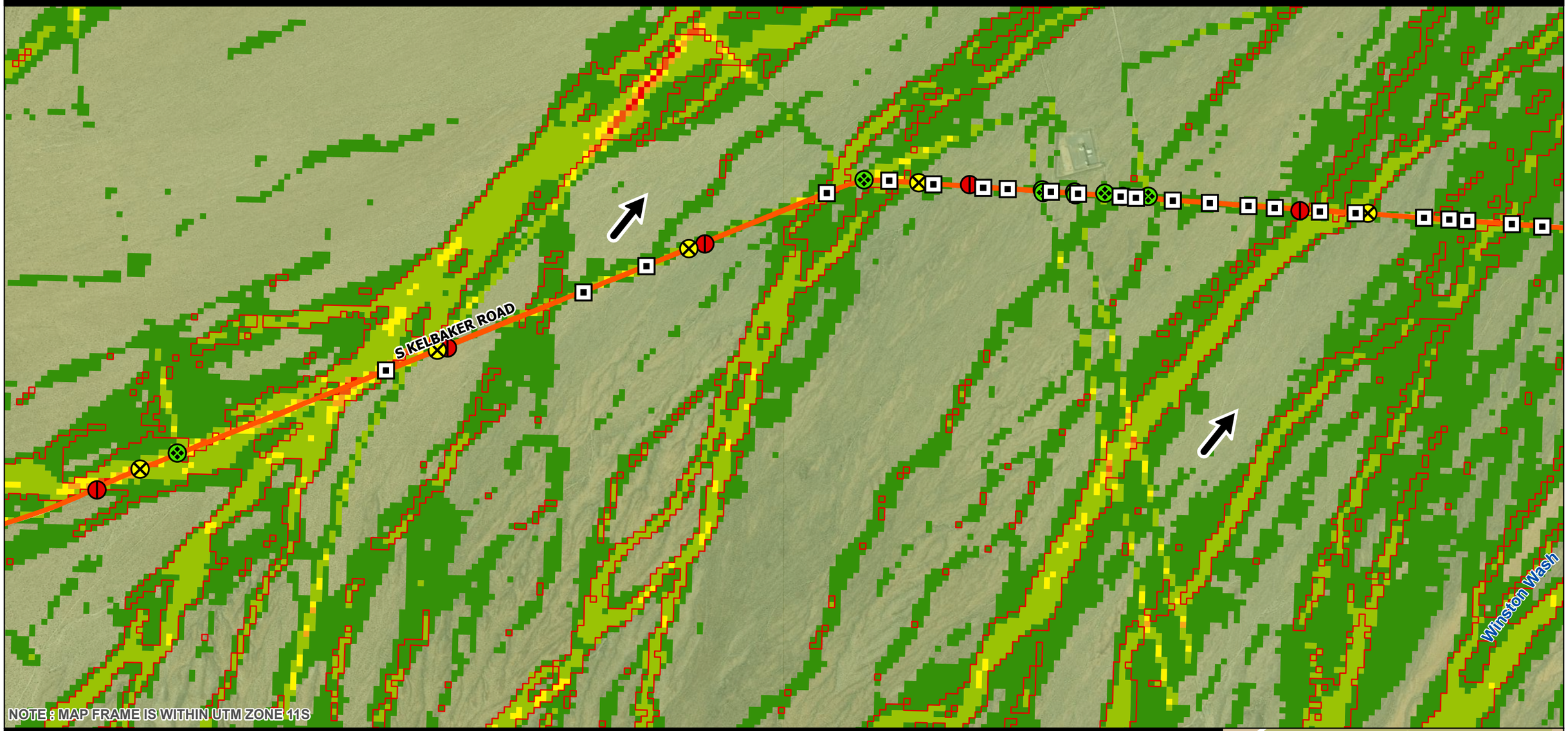


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (C)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

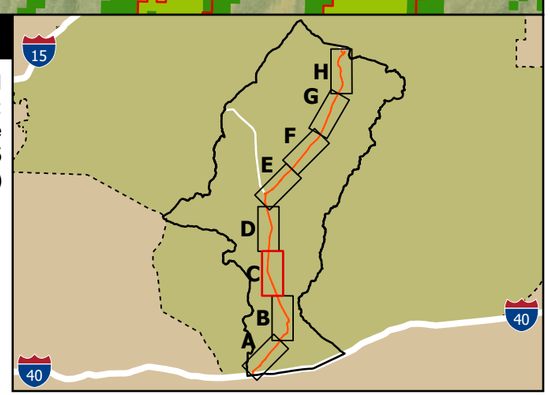
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

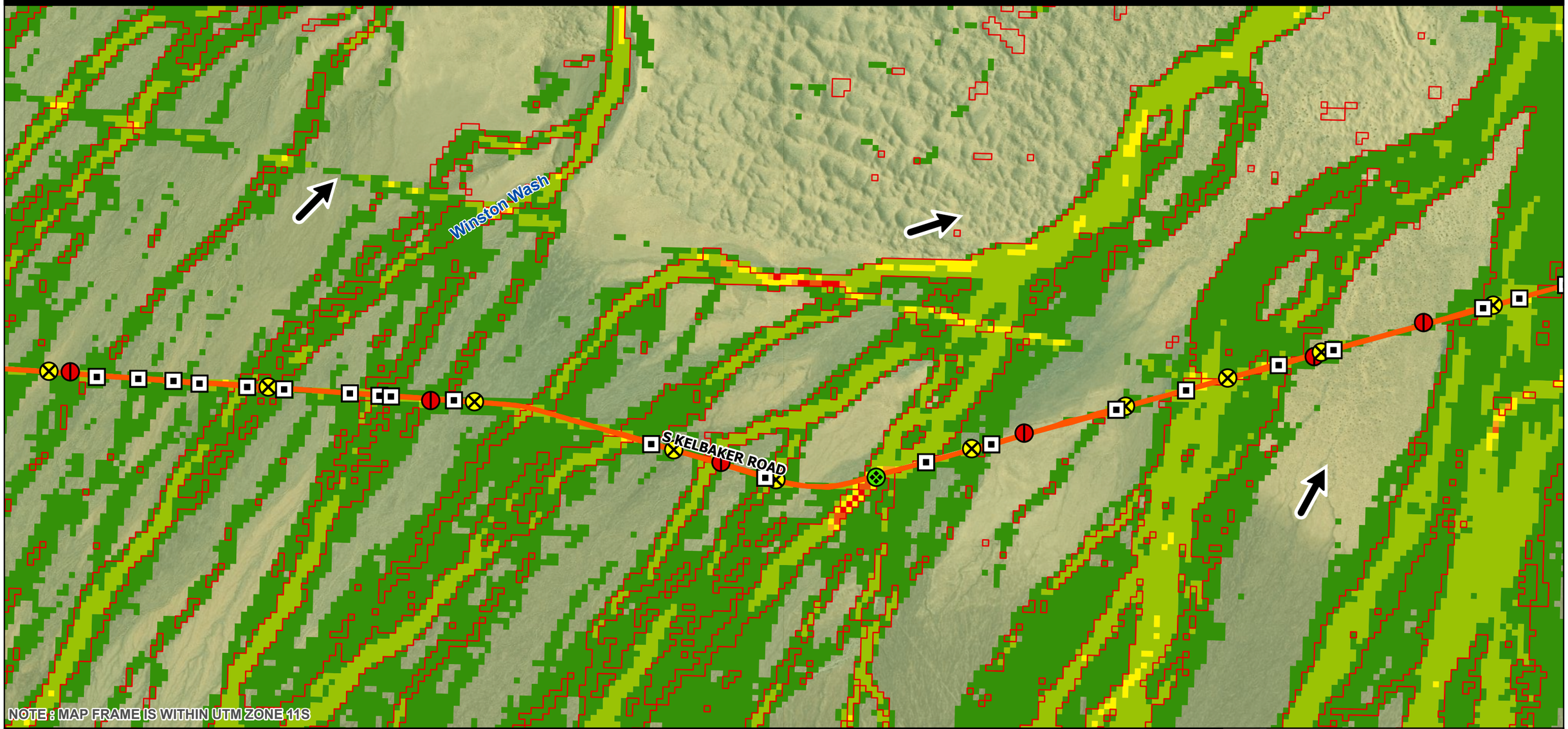


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (D)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

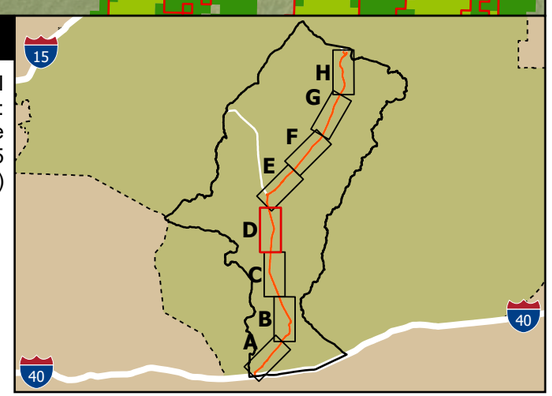
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)



Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (E)

National Park Service
US Department of the Interior

Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

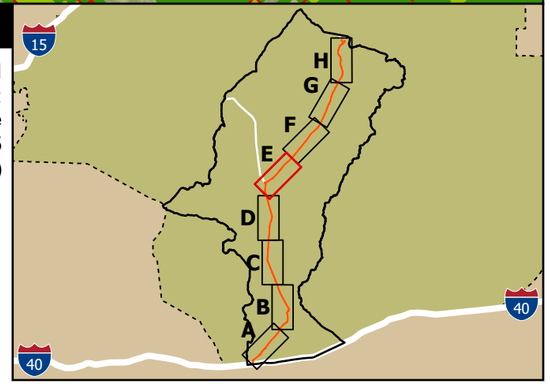
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)



Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (F)

National Park Service
US Department of the Interior

KELSO CIMA ROAD

NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

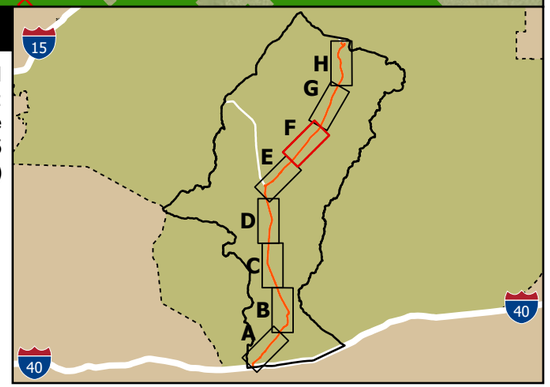
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)



Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (G)

National Park Service
US Department of the Interior

Cedar Wash

Kelso Wash

KELSO CIMA ROAD

NOTE : MAP FRAME IS WITHIN UTM ZONE 11S

Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

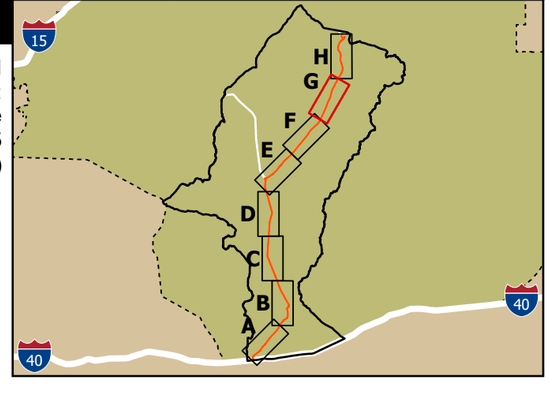
Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)

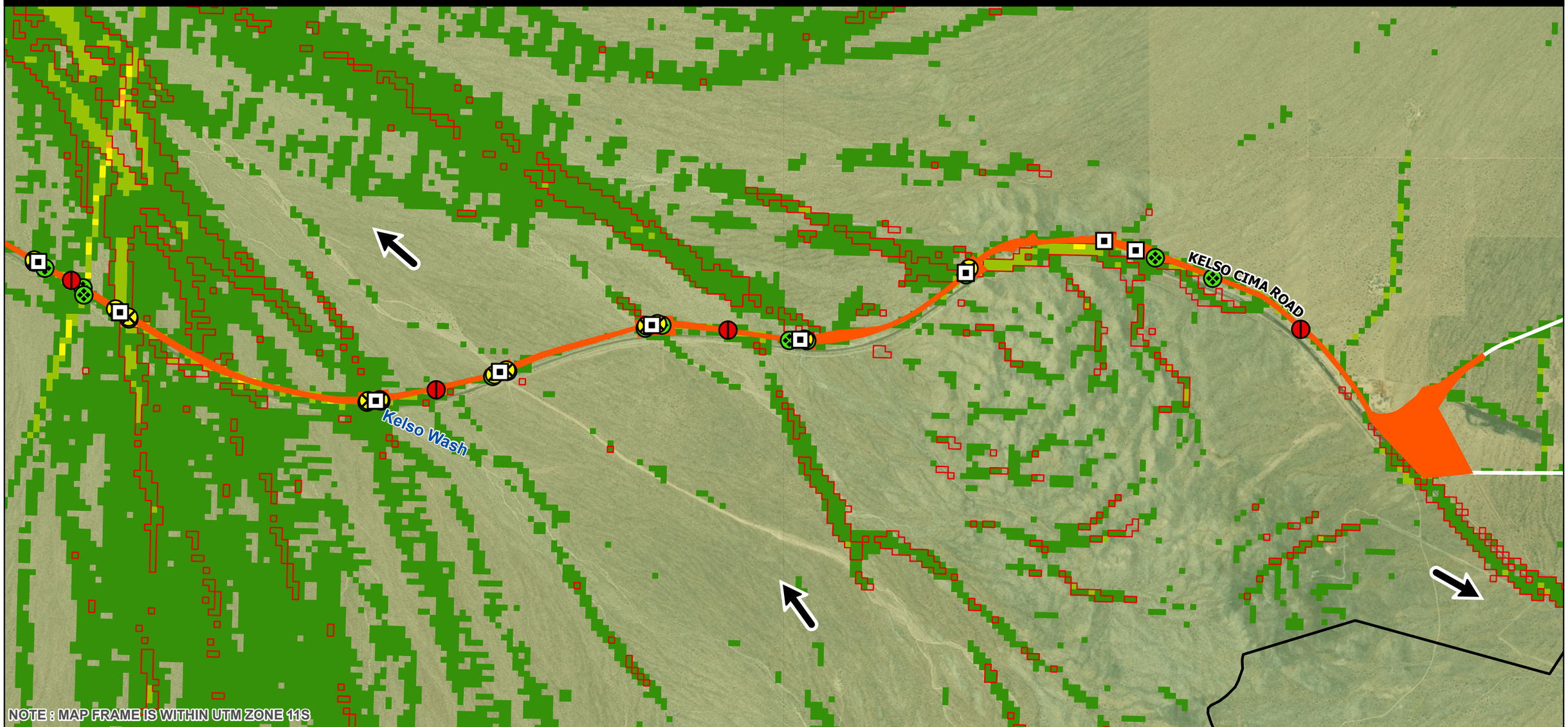


Mojave National Preserve

Kelso-Cima and S Kelbaker Roads Rehabilitation

500-Year, 24-Hour Floodplain Analysis: Velocity (H)

National Park Service
US Department of the Interior



Legend

- Project Area
- Model Boundary
- Mojave National Preserve
- Low Water Crossing
- Tortoise Crossing
- Tortoise Guard
- Pullout

500-Year, 24-Hour Model Results

Velocity (ft/s)

0.5 - 1.0 | 1.0 - 2.0 | 2.0 - 3.0 | 3.0 - 4.0 | 4.0 - 5.0 | > 5.0

- 100-Year Floodplain
- Flow Direction

0 2,000 Feet

Sources: NPS, ESRI
Coordinate System:
NAD 1983 StatePlane
California V FIPS 0405
(US Feet)