memorandum

date August 18, 2017
to Abigail Fateman, East Contra Costa County Habitat Conservancy
from Eve Pier Kieli and Mark Lindley, Environmental Science Associates
subject Knightsen Wetland Restoration and Flood Protection Project - Assessments and Studies Plan

This memorandum outlines the assessments and studies required to inform the development of restoration alternatives and to help support permitting of the preferred alternative under a future phase of the project. Environmental Science Associates (ESA) worked with Balance Hydrologics, Inc., Nomad Ecology, LLC, and East Contra Costa County Habitat Conservancy (Conservancy) to confirm the overall project goals, the objectives for this initial phase of the project, and to develop an initial project vision. These goals, objectives and vision were used to help inform specific studies and assessments to prioritize for this phase of the project. For each identified study/assessment, objectives, protocols and methods were developed. The studies and assessments are listed below and the plan for each of these studies is described in the attachments.

Project Goals and Objectives
The Knightsen Wetland Restoration and Flood Protection Project site is a 645-acre parcel in East Contra Costa County adjacent to existing slough channels along the western Sacramento/San Joaquin Delta (Figure 1). The restoration project is intended to serve multiple objectives, including:

- Restore a mosaic of wetland and upland habitats for special status species;
- Provide water quality improvements and flood conveyance / attenuation for runoff from the adjacent community of Knightsen; and
- Provide recreation and access to the Delta.

The restoration project will contribute to the conservation goals of the East Contra Costa County Habitat Conservation Plan / Natural Community Conservation Plan (HCP/NCCP). In particular, habitats for special status species such as: giant garter snake, California tiger salamander, California red legged frog, vernal pool fairy shrimp, western pond turtle, tricolored blackbird, Swainson’s hawk, burrowing owl and other species identified in the HCP/NCCP shall be targeted for restoration as appropriate, given the existing site conditions and constraints and the historic ecology.

The site slopes from upland elevations, 16 to 17 feet above mean sea level (MSL), in the southwest corner to tidal wetland elevations at about MSL in the northeast corner of the site. Historically, the ecology of the site supported a mosaic of oak savanna in the higher elevations to the southwest, tidal freshwater wetland with pockets of higher dune habitat to the north and east, and a band of alkali meadow/wetlands between the oak savanna and tidal
wetlands. To the extent practical, restoration alternatives will draw from these historic habitats given the constraints of development adjacent to and on the project site.

The project site also currently receives stormwater runoff from much of the community of Knightsen. Runoff is routed along Delta Road and conveyed through the project site in drainage ditches to a pump discharging to No Name Slough in the southeast corner of the site. Historically the community of Knightsen has been impacted by flooding due to limited conveyance and development (railroad, agriculture, roads, and homes/farmsteads) that intercept and impede the natural path of runoff. Water quality impairment related to agricultural runoff and local flooding has been a problem during wet years. The location of the project site presents opportunities for water quality treatment and flood conveyance and attenuation, while supporting restored habitats such as ponds, channels, wetlands that would offer benefits to several special status species identified in the HCP/NCCP.

The current phase of the project includes initial planning that will ultimately support design and implementation of a restoration project at the project site. The primary objective of this phase of the project is to develop conceptual alternatives for the project site that provide habitat for special status species targeted by the HCP/NCCP while providing flood conveyance and water quality improvements for the community. A number of studies and assessments will be required to inform development of conceptual alternatives and to help support future design and implementation of the project.

Some key objectives of this project phase include:

- Developing a comprehensive understanding of the biological resources onsite and in the surrounding areas to establish baseline conditions.
- Developing a comprehensive understanding of the hydrologic conditions onsite and adjacent to the site, including both groundwater and surface water conditions.
- Understanding the public’s concerns and considerations, in particular understanding how changes to the project site could influence conditions on neighboring properties.

**Restoration Vision**

The project team held a kick off meeting with the Conservancy in late May 2017 to confirm project goals and objectives, and to agree upon an initial vision for the project based on the historic ecology of the site and the habitats that could be restored and enhanced to support special status species covered by the HCP/NCCP.

The restoration vision for habitat creation includes the following goals:

- Discontinue irrigation and all agricultural practices on site;
- Maximize areas of perennial freshwater wetland and alkali seasonal wetland complex;
- Maximize slough channels and adjacent upland basking habitat for giant garter snake;
- Enhance upland habitats including oak savanna and stabilized interior dune;
- Identify potential for restoration of associated habitats suitable to support special status species covered by the HCP/NCCP, including but not necessarily limited to giant garter snake, western pond turtle, silvery legless lizard, vernal pool fairy shrimp, burrowing owl, tricolored blackbird, Swainson’s hawk, brittlescale, and adobe navarretia; and possibly for California tiger salamander and California red legged frog;
- Create on-site stormwater biofiltration swales and shallow wetlands to increase local flood capacity while directing stormwater flows to areas where receiving such flows would be beneficial for target habitats.
The project site is divided into three distinct parcels by Delta Road and the existing utility lines & easements. Figure 2 shows the three distinct parcels on the project site – East, Central, and North parcels. Within each parcel, a range of restoration options specific to each parcel has been identified as described below. The initial vision for restoration options will be further informed by the results of the assessments and studies performed under this initial planning phase of the project to develop conceptual alternatives for consideration in future phases of the project.

**East Parcel** – Historically, this area primarily supported tidal marsh, with alkali meadow/seasonal wetlands complex in the southeast portion of this parcel. Given the location adjacent to No Name Slough and the existing soils and topography, this parcel is ideally suited for restoration of tidal wetlands through the excavation of a tidal slough channel network and some minor grading. The slough channel network could be designed to enhance potential giant garter snake habitat, including channels with suitable adjacent upland habitats. Higher areas could be converted to alkali meadow/seasonal wetlands with minor grading, planting, and the reintroduction of periodic inundation on extreme high tide events. Restoration to tidal marsh would require construction of a new flood control levee with drainage and a pump station on the dry side of the levee to limit potential hydrologic impacts to the neighboring Veale Tract. Depending on input from the public and adjacent property owners, a muted tidal marsh restoration and/or seasonal wetlands controlled through culverts and gates to limit water levels could be a potential restoration alternative.

**Central Parcel** – The main parcel south of Delta Road and including areas west of the utility corridor offers the potential to support a mosaic of habitats including oak savanna, alkali meadow and seasonal wetlands, tidal marsh or seasonal wetlands, and shallow swales and wetlands for water quality treatment/flood storage. This parcel slopes down from elevations that would support upland habitats to the southwest where alkali meadow and seasonal wetlands may be supported in the central portion, to areas suitable for tidal wetlands or deeper seasonal wetlands in the north east corner, just south of Delta Road. Oak savanna and alkali meadow/wetlands habitats could support Swainson’s hawk and burrowing owl within the uplands and potentially support California tiger salamander, California red legged frog, vernal pool fairy shrimp, western pond turtle, and tricolored blackbird within and adjacent to shallow seasonal wetlands.

One key constraint that will influence potential restoration actions on this parcel is the existing utility corridor. Creating tidal wetlands and including tidal channels across existing (overhead) power lines and (below ground) gas lines can be challenging and expensive, requiring extensive coordination with easement holders and potentially relocation or alteration of utilities infrastructure. If it is feasible to route tidal channels across these easements, we envision that the northeast portion of this parcel would support restoration of historic emergent freshwater tidal wetlands habitats to this area. If tidal channels and/or wetlands cross these easements, board walks may be required to provide access along the power lines. Underground gas lines may need to be lowered or otherwise protected to allow for tidal channels to cross the corridor.

An alternative to excavation of channels and creation of tidal wetlands across the easements could be to restore the area to muted tidal wetlands and/or seasonal wetlands connected to the East Parcel via pipes with gates to control water flows to and from this parcel. These muted tidal wetlands could be designed to support giant garter snake by including shallow channels and adjacent suitable upland habitats. Seasonal wetlands and ponds could support habitat for other special status species as described above.

The Central Parcel is also ideally situated to support water quality and flood control facilities for the community of Knightsen. Stormwater is currently conveyed to the parcel via the existing drainage ditch along Delta Road, and we anticipate that the community of Knightsen will install new culvert(s) crossing Byron Highway to deliver stormwater to the western end of the site. Stormwater could be directed to support shallow swales and seasonal wetlands that would provide water quality benefits and conveyance for flood waters, while supporting restored habitats. To the extent possible, shallow swales and wetlands would be located at elevations above tidal marsh to allow stormwater to flow to the adjacent wetlands via gravity, limiting the need for pump stations or actively
managed structures. This would also expand potential wetland habitats onsite by creating some wetlands above tidal elevations and allowing the tidal hydrology and groundwater to help support additional wetlands at lower elevations on the parcel.

**North Parcel** – This area historically supported sand dunes surrounded by tidal marsh. Given the distance from No Name Slough, more hydrologically isolated location north of Delta Road, and the existence of seasonal alkali wetland habitats under current conditions we currently envision this area could be restored to a mosaic of dune habitat with interspersed seasonal wetlands. This restoration could include some limited grading to enhance seasonal wetlands and/or vernal pools and native plantings to help reestablish dune ecology which has been significantly impacted by agriculture and development. Depending on the constraints related to the existing utility easements, it may be possible to introduce additional water via water control structures (culverts with gates) crossing Delta Road.

The initial restoration vision helps to inform our assessment of the need for studies to further our understanding of the key physical conditions and processes and opportunities and constraints at the site. We envision the areas of investigation will be vital to development of restoration alternatives:

- **Biological Resources** investigations to develop a comprehensive understanding of the existing wetlands, native and non-native plants, and special status species occurring or potentially occurring on the site. Where possible, we will seek to build upon existing native resources by enhancing seasonal wetlands, expanding areas of native plant communities, and avoiding and/or enhancing habitats for special status species.

- **Soils and Hydrologic Resources** studies to characterize existing soil conditions, groundwater and surface water conditions and evaluate how these conditions may influence restoration options. Understanding how groundwater levels would change in response to wetland restoration actions and the interface between surface water and groundwater will be particularly important for developing seasonal wetlands enhancements and to understand the potential for impacts to neighboring properties. Additionally, surface water resources - both stormwater runoff and tidal exchange from No Name Slough will also influence options for wetlands restoration and water quality treatment.

- **Topography** is an additional consideration that ties into both groundwater and surface water hydrology. Key topographic data will be collected to tie groundwater elevations and tidal elevations into the vertical datum at the project site. Proposed studies include using ground surveys to verify available LiDAR elevation data, in particular in areas of varying vegetation cover, as well as surveys within existing drainage features (ditches, sloughs, wetlands) on and adjacent to the site.

- **Public Engagement** will also influence the restoration designs. The team will engage with members of the community to better understand the site history, current water management practices and local effects of stormwater flows across and around the site. Concerns regarding potential impacts of site restoration to neighboring properties will need to be considered and addressed. Additionally, the desire for public access and the Conservancy’s commitment to support access will also influence the restoration alternatives.

- **Cultural Resources** could play a significant role in the formulation of restoration alternatives. Our experience on nearby sites indicates that dunes within former tidal marsh areas often supported Native American habitation sites and/or burial sites. Developing an early understanding of the likelihood of cultural resources at the project site will help to develop restoration alternatives that avoid or accommodate culturally significant areas should they exist at the site.

- **Utility Constraints** will be important to understand in developing restoration alternatives. Taking into account the requirements for access and the limitations on restoration activities along the utility easement will help the Conservancy determine if it is possible and/or cost effective to implement restoration actions within the corridor.
Regulatory Considerations
The East Contra Costa County HCP/NCCP includes habitat conservation, restoration, and creation goals to offset development impacts. The proposed project will be implemented to accommodate these HCP/NCCP goals. Potential impacts on existing habitats at the project site may be pre-authorized under permits issued for the HCP/NCCP, including the Clean Water Act Section 404 Regional General Permit (RGP) issued by the US Army Corps of Engineers (USACE), Clean Water Act Section 401 Certification to be issued by the California Regional Water Quality Control Board (RWQCB), the Federal Endangered Species Act (FESA) Biological Opinion issued by US Fish and Wildlife Service (USFWS), and California Natural Community Conservation Planning Act NCCP permit issued by the California Department of Fish and Wildlife (CDFW). The project may require a California Fish and Game Code Section 1602 Lake or Streambed Alteration Agreement. The Delta Plan is a comprehensive, long-term management plan for the Delta. Required by the 2009 Delta Reform Act, it creates rules and recommendations to further the state’s coequal goals for the Delta: Improve statewide water supply reliability, and protect and restore a vibrant and healthy Delta ecosystem, all in a manner that preserves, protects and enhances the unique agricultural, cultural, and recreational characteristics of the Delta. Pursuant to the Delta Plan, proposed project alternatives will be designed to accommodate these goals, and the Conservancy will consult with the Delta Stewardship Council in selection of the preferred project alternative. On selection of the preferred project alternative, the Conservancy will prepare a determination of the consistency with the Delta Plan.

The following technical evaluations will be implemented to inform the project alternatives development process, support selection of the preferred alternative, and support the regulatory approval process. An explanation for use of each assessment is provided.

- Biological resources assessment – an evaluation of existing or baseline conditions of the project site is necessary to identify potential project impacts and opportunities for habitat enhancement.
- Aquatic resources delineation – For the project to be accepted under the RGP, delineation of potentially jurisdictional waters of the U.S. is required (RGP Condition 18). Identification of potentially jurisdictional waters on the entire project site is recommended early in the project development stage to evaluate the existing quality and functioning of existing hydrologic features and identify opportunities for habitat enhancement. The delineation process includes review of historic maps, which will further inform the project development process. The survey should be reviewed and verified by the USACE.
- Protocol-level rare plant surveys – The HCP/NCCP does not provide incidental take coverage for plant species that are fully protected under the California Endangered Species Act (CESA). In other words, construction and maintenance of the project must avoid these plant species if present in the project site. Rare plant species are commonly identified during their flowering season only. Multiple rounds of surveys may need to be conducted to complete rare plant surveys for all potentially occurring species.
- Invasive weed mapping – Mapping the existing extent and species composition of invasive non-native plants on the project site will inform development of project alternatives and measures to support the success of restored native habitats after project construction.
- Cultural resources evaluation – a preliminary evaluation to determine whether known cultural resources have been documented at the project will inform development project alternatives and evaluation of potential impacts on those resources. For example, project alternatives may include options to avoid cultural resources or relocate them in cooperation with federal, state, tribal, and historical society representatives. A complete evaluation of cultural resources following guidelines for compliance with NHPA Section 106 report will be prepared later in the project development process to support project permits when the preferred alternative is identified.
Studies & Assessments Plans
Based on our understanding of the initial vision for the project and future permitting requirements we recommend the following studies and assessments be conducted in this initial phase of project planning:

- Biological Resources Assessment
- Aquatic Resources Delineation
- Protocol-level Rare Plant Surveys & Mapping
- Invasive Weed Survey & Map
- Soils and Groundwater and Surface Water Monitoring
- Surface Water Hydrologic Assessment
- Topographic Data Collection
- Utilities Easement Assessment
- Cultural Resources Evaluation

Biological Resources Assessment
Nomad Ecology biologists will perform a background search and literature review of all existing data pertaining to biological resources within the area to generate a list of special-status species and habitats known from the project region. The documentation researched will include, but is not limited to the: (1) California Natural Diversity Database; (2) California Native Plant Society Electronic Rare Plant Inventory; (3) sensitive species or species of concern lists; (4) U.S. Fish and Wildlife Service Website; (5) the East Contra Costa Habitat Conservation Plan/Natural Conservation Plan (HCP/NCCP); other available CEQA documents, biological technical reports, local, state, and federal databases, herbaria records, maps, and photographs.

After the background literature search is complete, a reconnaissance site visit will be conducted to survey the study area for habitats present on site. Biologists will determine what, if any, special-status plant and wildlife species and sensitive habitats known from the region (and documented during the background literature search) have the potential to occur on the project site. Biologists will document all species and habitats observed within the study area. Sensitive or special-status biological resources include: (1) special-status plant and wildlife species (including rare, threatened, endangered, Migratory Bird Treaty Act species, or unique species); (2) wetland/riparian habitats; (3) sensitive plant communities; and (4) other environmentally sensitive habitat areas. The existing Land Cover map for the property will be updated as necessary during this site visit using HCP/NCCP land cover types.

All special-status species identified within the survey area will be mapped using a handheld Global Positioning System device. Attribute data collected for each population will be based on the California Natural Diversity Database Field Survey Form. CNDDB Field Survey Forms will also be completed for all special-status species encountered during the field work and submitted to the CNDDB.

Upon completion of this fieldwork, Nomad will prepare a technical report in a format applicable to meet regulatory requirements. The report will discuss (1) methodologies used for background literature search, biological reconnaissance, and report; (2) results of the background literature search and field reconnaissance; (3) existing biological conditions including plant communities and adjacent land uses; (4) the location, extent, and habitat requirements of any sensitive or special-status biological resources, or wetlands that occur, or will likely occur, on or adjacent to the study area; (5) potential significant impacts that may occur to sensitive or special-status biological resources as a result of the proposed project; (6) recommendations for further focused species surveys if necessary; (7) potential impacts and permitting implications, and meaningful and realistic impact
avoidance and mitigation strategies; and (8) maps of sensitive or special-status biological resources in the study area, including vegetation types and their acreages, within the study area. All report text addressing HCP/NCCP covered species will be consistent with the HCP/NCCP and Planning Survey Report template, so that this information can be put directly into the Planning Survey Report during the project permitting phase. The report will also address all special-status species that are not covered or no-take species in the HCP/NCCP as these species will need to be addressed during CEQA review.

This task does not include the analysis of specific impacts including impact calculations, preparation of mitigation and monitoring plans, conducting preconstruction surveys, other studies not specifically described in the above scope of services, trapping studies, preparation of CEQA documents, initiation or completion of permitting activities, development of detailed or conceptual mitigation plans, agency coordination or obtaining agency approvals. This technical report can be used in support of CEQA, e.g. MND, but it may need to be supplemented by additional focused surveys.

**Aquatic Resources Delineation**

Nomad and ESA will conduct a wetland delineation and preliminary jurisdictional determination in accordance with the U.S. Army Corps of Engineers’ (USACE) 1987 and revised 2008 Guidelines, as well as the Ordinary High Water Mark Field Guide (Lichvar and McColley 2008). The methodology, report and mapping will meet all of the requirements of the Minimum Standards for Acceptance of Aquatic Resources Delineation Reports as specified by the Sacramento District of USACE (2016).

Field work will include sampling field data points, recording data on hydrology, vegetation, and soils, and mapping data points and the extent of potential wetlands and waters. Wetland delineation data that was collected in 2016 by Nomad as part of a wetland assessment of the property will be also be used. Due to the level nature of the site, its proximity to the Delta, and history of modification for agriculture and pasture land, it is anticipated that the wetland delineation will be complicated.

An Aquatic Resource Delineation technical report will be prepared describing the methods used and the existing site conditions, including vegetation, soils, and hydrology. The report will include a summary of all potential wetlands and waters of the U.S. subject to federal regulations, a discussion of permitting implications, and a map of all wetlands and their respective field data forms. The GIS-based maps will show all potentially jurisdictional wetlands and waters as characterized by wetland types, as well as stream length, width, order, and hydrology. As part of this task, we will determine Waters of the State subject to CDFW and RWQCB jurisdictions.

This task includes time to submit all documentation to the USACE for review, attend a single site verification meeting with USACE personnel, revise the map and report, and re-submit the wetland delineation to the USACE for final approval.

**Protocol-Level Rare Plant Surveys**

Based on our familiarity with the rare plant species within the project region and the site, we anticipate the potential for rare plants to occur within the project vicinity, and recommend rare plant surveys be conducted. Nomad will conduct the field work in accordance with California Native Plant Society’s Botanical Survey Guidelines (CNPS 2001), California Department of Fish and Game’s Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (CDFG 2009), and U.S. Fish and Wildlife Service’s Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants (USFWS 2000).

All special-status species identified within the survey area will be mapped using a handheld Global Positioning System device. Attribute data collected for each population will be based on the California Natural Diversity Database Field Survey Form. ArcGIS shapefiles will be submitted to the Conservancy as a deliverable upon
survey completion. These shapefiles will include all attribute data collected in the field represented as either points or polygons depending on the size of the population. Digital photographs will be taken of any special-status species populations observed in the field. California Natural Diversity Database forms for each special-status plant species found will be submitted to the California Department of Fish and Wildlife and voucher specimens will be collected and donated to the Jepson Herbarium at UC Berkeley, pending approval from the Conservancy. The California Native Plant Society’s “Guidelines on Ethics and Best Practices for Collecting Native Plants” will be followed for any voucher collections made.

Upon completion of the protocol-level rare plant surveys, Nomad will prepare a technical report that conforms to agency protocols. The report will include (1) a description of the study methodology; (2) provide an assessment of existing conditions; (3) present the results of protocol-level rare plant surveys for special-status botanical resources including the numbers, size, and condition of all listed species populations observed, potential threats to these populations, and photographs of special-status plant populations encountered; (4) briefly discuss threats posed by non-indigenous plant species; (5) provide recommendation for impact avoidance, minimization, and/or mitigation, as necessary; and (6) include a comprehensive list of all vascular plants observed. The report will include maps that identify the locations of special-status plant species found on site.

**Invasive Weed Mapping**

Nomad prepared a detailed Invasive Weed Map and technical memorandum for the Nunn property in 2016. This existing memorandum provides: (1) relevant Plan goals pertaining to invasive weeds and habitat enhancement; (2) a brief description of the study area; (3) criteria for identification of target invasive weed species; (4) weed mapping methodologies used in the field and aerial imagery analysis; (5) limitations of the survey results; (6) invasive weed survey results; (7) management recommendations for sensitive land cover types and specific invasive weed species; and (8) maps that identify the locations of the weed infestations and sensitive land cover types found on site.

Nomad will update the invasive weed map and technical memorandum as necessary based on one additional site visit under this task as well as on site visits conducted as part of the biological surveys described above. Nomad will review the 2016 invasive weed memorandum and update it as necessary. Nomad will provide additional recommendations for invasive species control as necessary.

**Soils, Groundwater Hydrology, and Surface Water Monitoring**

A number of hydrology-related constraints are currently identified on site:

- A north to south powerline easement divides the site, making it expensive to facilitate and construct wetlands or hydrologic features within the easement. A significant portion of the easement, though, is currently at a low elevation, ponding on-site runoff and stormflows onto the property.

- The once natural, hummocky topography has been uniformly graded with leveling of sand hills and filling of hollows across the property. Current elevations range from about 16 - 17 feet (ft.) at the southwest corner of the property to about 3 ft. at the northeast portions of the site. Low-lying areas on site are easily identified in the 1997 flood photo (Figure 3). Low elevations are found at the northeast corners of the two farm fields along Delta Road, and at the north end of the block east of the powerline easement. The topography of this east block is slightly domed along a south to north axis, bisecting the block into two farm fields, one draining to the northwest and the other to the northeast. The parcel north of Delta Road has a somewhat natural hummocky topography, and ponds water in its hollows, though some sand-hill material was moved across Delta Road to fill a hole at the northeast corner of the property.

- Regional stormwater flows east along Delta Road and north along Byron Highway to Delta Road. The culvert at the corner of Delta Road and Byron Highway is said to be undersized. Stormwater continues to flow east along Delta Road to the northeast corner of the property, where the ditch turns south and crosses
the property just east of the powerline easement. At Eagle Lane, the ditch then turns east again and flows to the southwest corner of the property, where water is pumped into No Name Slough. Stormwater and groundwater is also pumped and piped to No Name slough from a shallow wet-well located at the southwest corner of Byron Highway and Ironhorse Road. With restoration, we anticipate redirecting stormwater flow onto the property at two locations: a) southward from Delta Road; and b) eastward from Byron Highway (at the flood-control pump at Ironhorse Road.).

- Tidal slough water is available at No Name Slough along the south property line, east of the powerline easement. Water from No Name Slough is currently pumped onto the property for crop irrigation and distributed across the farm fields by gravity flow.

- Surface water and shallow groundwater elevations are regulated by pumping water off the site at the southeast corner of the property to No Name Slough.

- Depth to groundwater along Byron Highway varies from ground surface when flooded, up to a depth of 8 ft. (PWA, 2002). Locations monitored are shown in the attached Figure 4.

- Surface grab samples on site indicate the clay soils are slightly alkaline (7.5 pH) but not sodic or sodic-saline, and sand or sandy clay loam soils taken from remnant dunes were neutral (7.0 pH) (ESA PWA, 2013).

- On-site historic habitats and project target habitats are generally related to elevation and soil alkali. Alkali affected soils are identified on the 1939 soil survey, noted in the attached Figure 5.

We have prepared the following soil sampling plan and surface water and groundwater elevation monitoring plan based on the objective and known constrains identified above.

**Soils Survey, Piezometer and Surface Water Survey**

The objective of the soil survey is to characterize the surface soils across the site based on field measurements of texture, Munsell color, slurry pH and specific conductance, with an emphasis on identifying the presence buried wetland soils under a veneer of sand. While attempting to sample the prior hummocky landscape, soil sampling will be generally guided by sites every 500 feet along two transects, as shown in Figure 5 (about 15 sites in total). At each site, a surface sample from the upper 1 foot of soil will be collected for field measurements. The surface sample will be collected using a sharpshooter shovel, photographed and texture and color described. Specific conductance and pH of the soil sample slurry will be measured. A GPS waypoint will be taken at each site using a Garmin handheld GPS receiver. Up to eight samples will be sent to A & L Western Agricultural Laboratories for soil salinity analysis.

Eight piezometers will be installed using a direct-push rig (used for soil coring and sampling). The piezometer sites are identified in Figure 4. At each site, continuous cores will be collected, photographed, and the soil texture and color will be logged. A 1.25-inch diameter PVC casing will be installed with a screened section (0.020 inch typical) approximately 4 feet below the water table. Filter pack will be #3 sand with a neat cement backfill grout. A well permit is required by the County for all wells to a depth greater than five feet. In addition, all piezometers installed will require a County exemption for a seal depth less than 10 feet and an annulus .less than 2-inches. Approximately four piezometers will be instrumented with a water-level datalogger (Solinst Levelogger®) and programed to record water level every 60 minutes.

Up to 6 surface water gages are proposed, shown in Figure 4: 1) at the northwest corner of the property in the ditch along Delta Road, a stormwater inflow gage; 2) in the ditch crossing the property from Delta Road; 3) in the ditch at the southeast corner of the property, at the outflow pump; 4) in the ditch on the east property line; 5) in No Name Slough; and 6) in the largest hollow that ponds water north of Delta Road. The surface water gages will consist of USGS Style C staff plate, PVC still well, and water level sensor (Solinst Levelogger®). The leveloggers will be programed to record water level every 15 minutes.
The surface water gaging stations and groundwater piezometers will be monitored for one year. Quarterly hand measurements of depth to water in each piezometer and gage height at each surface water station will be conducted along with field water-quality measurements of specific conductance, temperature, and pH. All leveloggers will also be downloaded during each quarterly site visit. Water level 15-minute records will be calibrated to field measurements and surveyed instrument elevations so that continuous water surface elevation data can be assembled and used to characterize surface-groundwater interactions and groundwater contours over a range of surface water conditions.

Hydrologic conditions during a large storm (if possible) will be observed to manually measure groundwater and surface water levels and document how stormwater flows onto and across the site. Two samples of runoff will be collected during the storm event: one at the inflow gaging station and the other at the outflow gaging station (see Figure 4). The samples will be sent to a California certified laboratory for the following water quality analyses: general chemistry, trace metals (CAM 17 + boron), volatile organics and semivolatile organics. All information collected will be compiled and interpreted into a comprehensive groundwater, hydrology and soils report for the project site. A draft report will be submitted for review and comments. The final report will be signed and stamped by a California-licensed professional geologist.

**Surface Water Hydrologic Assessment**

The hydrology of the Knightsen restoration site can be broken down into two primary components: 1) rainfall-runoff, and 2) tidal hydrology within No Name Slough at the site boundary. ESA will develop a Surface Water Hydrologic Assessment that examines stormwater runoff that flows onto the site and runoff generated onsite under existing conditions and under conditions anticipated after implementation of the restoration project. Additionally, the Assessment will characterize the tidal hydrology of No Name Slough adjacent to the southeast corner of the site.

Stormwater runoff flowing onto the site will be characterized in the Stormwater Resources Plan that is currently being prepared for the Knightsen Community Services District (CSD). ESA will utilize this information to inform the locations, volumes and flowrates of stormwater runoff flowing onto the project site. Under existing conditions, stormwater runoff is discharged onto the site along Delta Road at the northern boundary of the Central Parcel. Following improvements envisioned by the CSD and Conservancy, we anticipate that runoff will flow onto the Central Parcel both along Delta Road to the north and from Byron Highway near Ironhorse Road to the west. Stormwater flow rates and volumes and the results of stormwater monitoring described above will be used to develop conceptual sizing for swales and depressional seasonal wetlands on the Central Parcel. Additionally, runoff generated onsite will be considered in the conceptual restoration alternatives.

Tidal hydrology of the site was characterized in the 2002 Knightsen Water Quality Wetland Feasibility Assessment (PWA 2002). We will convert that tide signal into NAVD and compare it to other local tide data. We will also investigate more extreme water levels by reviewing the U.S. Army Corps Delta Flood Study to estimate the highest annual tide and 10-, 100-year tide levels in the vicinity of the site. These tidal datums will be important to inform several key details for conceptual restoration options:

1. Tidal datums will be important to identify elevations of emergent marsh and the size and depths of tidal channels designed to support marsh habitat.

2. Highest annual tide and 10-year tide levels will help inform anticipated elevations of alkali meadow/wetland complex habitats.

3. 100-year tide levels will help inform design of flood control levees that will be required for tidal wetlands restoration elements and may be required for muted tidal wetlands elements.
Detailed tide gage deployment will be deferred to a subsequent project phase to inform detailed design following selection of a preferred alternative.

The Surface Water Hydrologic Assessment will be documented in a report that details the assessment methods and results for both stormwater hydrology and tidal hydrology.

**Topographic Assessment**

Recent LiDAR surveys performed by Contra Costa County will be used as the topographic base map for this initial phase of project planning. This mapping will be augmented by limited topographic surveys of the project site:

- The locations and elevations of each piezometer and staff plate installed as described above under the Soils, Groundwater Hydrology, and Surface Water Monitoring study will be surveyed into the project site datum.
- Water surface elevations will be surveyed to help convert tidal data collected at nearby gages to the project site datum. We anticipate surveying in water surface elevations at multiple tide levels across more than one survey day to provide a wide range of conversion points.
- Existing ditches and other key infrastructure that is anticipated to influence the development of conceptual restoration alternatives will be surveyed.
- Key areas of existing wetlands and/or native rare plants will be surveyed to verify LiDAR elevations and assess vertical bias in the LiDAR data.

Topographic data will be incorporated into the base mapping used for Biologic Assessments, Aquatic Habitat Delineation, and Groundwater and Surface Water Monitoring tasks as described above and will be documented as appropriate in the Conceptual Alternatives Report.

**Utility Easement Assessment**

ESA will review Utility Easements and contact easement holders to identify the nature of utilities traversing the project site and develop an understanding of potential constraints to site restoration. Understanding utility constraints at the site will be important to develop viable, cost-effective restoration options. Specifically, the following restoration elements will be influenced by the utility easements:

- High voltage power lines have limitations related to access to towers and lines as well as sag clearance (the minimum distance between the elevation of the lines during extreme high temperatures and ground elevations). These limitations will need to be considered in design of tidal channels and wetlands that could impact access. Additionally, sag clearance could limit the potential for new levees to cross the power line easements which will influence restoration options on the Central Parcel.
- Underground high pressure gas line(s) will likely have limitation regarding cover for tidal channels and/or pipes crossing the lines. Depending upon the depth of the gas line(s), the lines may need to be lowered to accommodate tidal channel and/or pipe crossings.

Based on the information collected, ESA will work with the Conservancy to formulate potential options for crossing utility easements for elements of the restoration project. Utility Easement Constraints will be documented in a brief technical memorandum.

**Cultural Resources Study**

The historic ecology at the project site indicates that portions of the site supported dune habitat. Native Americans utilized dune habitat within the Delta for both settlements and burial of their deceased. Human
remains and evidence of historic habitation have been identified on historic dune areas in the vicinity of the project site. These significant cultural resources could influence restoration elements in certain areas of the project site, primarily on the North Parcel.

To determine the cultural resources sensitivity of the Knightsen restoration project area, ESA will complete a limited cultural resources study that includes background research and a surface survey in the project Area of Potential Effects (APE). The study will include a records search at the Northwest Information Center of the California Historical Resources Information System to identify previously recorded cultural resources and studies in the APE. ESA will contact the Native American Heritage Commission to request information on known sacred sites in the project vicinity. ESA will initiate contact through distribution of correspondence to the tribes and individuals identified by the NAHC, but government to government consultation will be conducted between the tribes and the Conservancy, as the lead agency. This coordination will be used in support of Assembly Bill 52 and Section 106 compliance as required.

ESA will complete a cursory one-day surface survey of the APE to identify previously recorded cultural resources and to report on existing site conditions. We anticipate that this one-day survey would be concentrated in areas of historic sand dunes north of Delta Road on the North Parcel. An intensive surface survey to identify previously unrecorded archaeological resources or a subsurface investigation (Extended Phase I survey) to identify buried archaeological resources will not be conducted at this phase of the project.

An intensive Phase I survey and/or an Extended Phase I survey, and if needed, archaeological site evaluation, consisting of Phase II test excavations and special studies such as obsidian hydration or Carbon 14 dating, would be completed during a future phase of the project. At this stage, ESA assumes that there are no architectural resources in the APE that will need to be recorded or evaluated.

ESA will prepare a memorandum that identifies previously recorded cultural resources and assesses the general archaeological sensitivity of the project area. Recommendations for additional work will also be provided, and could include Phase I and/or Extended Phase I archaeological survey, architectural identification, Phase II archaeological site evaluation, cultural resources monitoring during project implementation, and/or actions to follow in the event of an inadvertent discovery of cultural materials or human remains.

**Assessment and Studies Schedule**
Assessments and studies to support the Knightsen Wetland Restoration and Flood Protection Project were initiated in 2016. The schedule for completion of assessments and studies in provided on the following page.
### Assessment and Studies Schedule

#### Knightsen Wetland Restoration and Flood Protection Project

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<tr>
<th>Task No</th>
<th>Task Description</th>
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<th>2018</th>
<th>2019</th>
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<td>Figure 3</td>
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<td>Figure 4</td>
<td>Proposed Piezometer and Surface Water Gage Locations</td>
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<td>Figure 5</td>
<td>Proposed Soil Transects</td>
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Figure 1
Location Map

Knightsen Wetland Restoration and Flood Protection Project. D170045.00

SOURCE: ESRI World Topographic Map
Knightsen Wetland Restoration and Flood Protection Project. D170045.00

Figure 2
Site Map - Restoration Parcels

SOURCE: ESRI World Topographic Map
Figure 3. Local flooding in 1997, Knightsen Wetland and Flood Protection Project, East Contra Costa County, CA. Stormwater is shown to pond at low elevations, primarily in the north and east portions of the property. Photo source: East Contra Costa County Habitat Conservancy
Figure 4. Proposed piezometer and surface-water gage locations, Knightsen Wetland and Flood Protection Project, East Contra Costa County, CA. Irrigation is pumped from No Name Slough into ditches along the south property boundary and distributed onto row crops across the site. Dashed arrows indicate where stormwater has been observed to flow onto the site. Red circles indicate locations of prior groundwater monitoring (PWA, 2002), now not found. Installed piezometer locations are labeled as 17-X series. Photo base: Google Earth. Imagery date: 3/11/2017.
Figure 5. Proposed soil transects, Knightsen Wetland Restoration and Flood Protection Project, East Contra Costa County, CA. Soil transects identified as dashed white lines within the project property boundary (light blue line). Base map: Carpenter, E.J., and Cosby, S.W., 1939, Soil Survey Contra Costa County, USDA Series 1933, No. 26. SoilWeb delineations (yellow lines): Welch, L.E., 1977, Soil Survey of Contra Costa County, USDA SCS. Alkali affected soils boundary (red line on base map) divides historic oak savanna and alkali seasonal wetland habitats on site.
REFERENCES


