Appendix H – Mendota Pool Water Quality Response Plan

This page intentionally left blank

DRAFT

Mendota Pool Water Quality Response Plan

February 1, 2011

1.0 Background

Water quality conditions in the Mendota Pool depend on inflows from the Delta-Mendota Canal (DMC), groundwater pumped into Mendota Pool by the Mendota Pool Group and San Joaquin River inflows. Water quality measurements for water released from Friant Dam show low electrical conductivity (EC) readings in the range of 0 to 100 micro Siemens per centimeter. Measurements of water from the DMC show higher concentrations of EC (300 – 1000 micro Siemens per centimeter) than water in the San Joaquin River. Water in the DMC receives additional loading from runoff and seepage pumped into the canal. Adjacent landowners pump well water into Mendota Pool. In 2007, these adjacent landowners pumped 7,423 acre-feet (AF) into Mendota Pool (DMC Pump-In EA, February 2010).

Shallow groundwater, high in salinity, is pumped into the DMC from six sumps operated by landowners located near Firebaugh. Agricultural return water flows into the DMC through culverts along its length. Reclamation monitors changes in water quality along the DMC through periodic grab samples at sump locations. Another source of groundwater pump-in, the Mendota Pool Group, pumps groundwater directly into Mendota Pool at the Fresno Slough. The Mendota Pool Group is an unincorporated association, consisting of a group of landowners with groundwater wells that pump groundwater in exchange for Central Valley Project (CVP) water from the DMC that they use or transfer to CVP South-of-Delta water users.

Under most conditions, groundwater pumped into the pool and into the DMC is diluted by better quality water in the DMC. The concentration of selenium in CVP water flowing into Mendota Pool is typically less than 2 parts per billion, the objective for the Grasslands wetlands water supply channels. The salinity of this water is suitable for irrigation.

Under the Exchange Contract, Reclamation can meet obligations at Mendota Pool through San Joaquin River deliveries. Exports that would otherwise meet contract obligations is held in storage or becomes water supply for CVP contractors. The exchange of San Joaquin River inflow reduces inflow from the DMC.

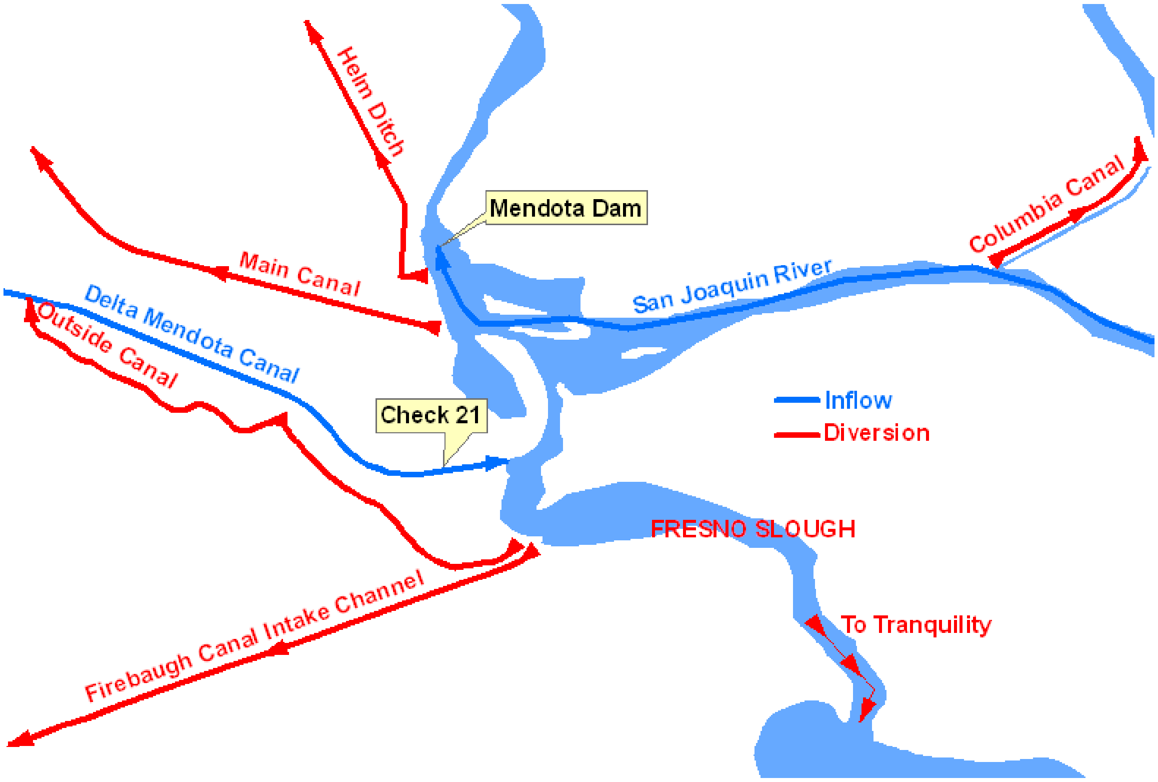

Figure 1: Mendota Pool Normal Operations

Figure 1 shows the location of major canals in the Mendota Pool.

DMC water generally flows into the Pool and backs up 10 miles into Fresno Slough through the Mendota Wildlife Management Area to four water districts near the city of Tranquility. When DMC flows are reduced to recapture Interim Flows at Mendota Pool, the dilution of Mendota Pool pump-in is reduced and salinity levels may increase in Fresno Slough. Although Interim Flows introduce high quality surface water to Mendota Pool, the exchange reduces the assimilative capacity of DMC flows on Mendota Pool pump-in. San Joaquin River water does not thoroughly mix with water in Fresno Slough, and Fresno Slough water increases in salinity, making it not suitable for irrigation purposes.

2.0 Water Quality Monitoring

Water quality monitoring near Mendota Pool includes measurements for EC at canals and in the San Joaquin River. Locations with hourly real-time telemetry of EC include:

- At Gravelly Ford, upstream of Chowchilla Bypass
- Below Chowchilla Bypass
- Check 21 of the Delta Mendota Canal
- Sack Dam

Reclamation collects periodic manual measurements of selenium and EC at the following locations:

- At Gravelly Ford, upstream of Chowchilla Bypass
- Below Chowchilla Bypass (2009)
- DMC Check 21 at Bass Ave.
- Main Canal at Bass Ave.
- Below Mendota Dam
- Firebaugh Wasteway
- At Highway 152, below Sack Dam

Reclamation measurements and real-time monitoring data are reported in the San Joaquin River Restoration Program Annual Technical Report and are available online at www.restoresjr.net/flows/Water%20Quality/WaterQuality.html.

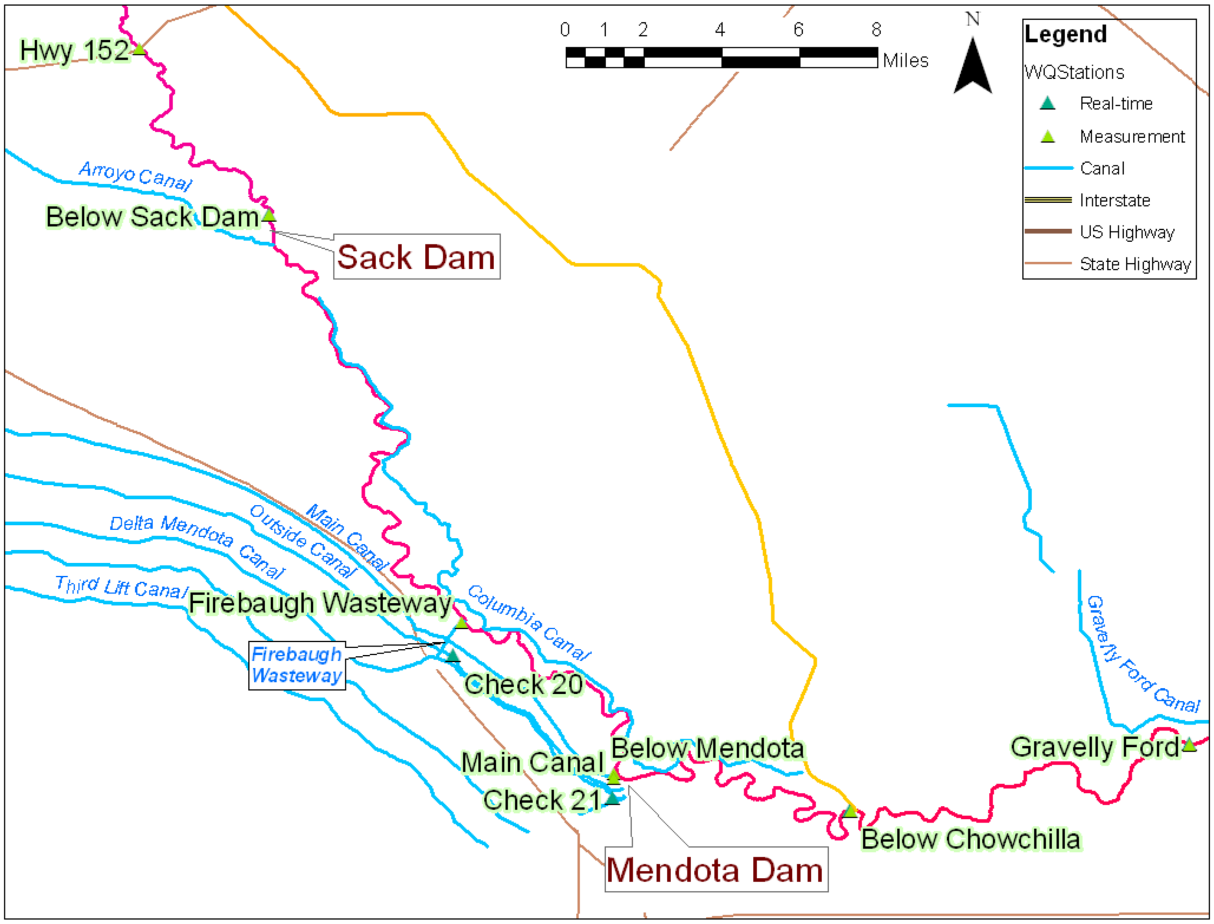

Figure 2: Water Quality Monitoring near Mendota Pool

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) collect daily measurements at the following canal intakes:

- Columbia Canal
- Main Canal
- Outside Canal
- Firebaugh Canal Intake Channel
- Mendota Dam
- Arroyo Canal

3.0 Thresholds

The Two-Year Exchange Agreements and/or Warren Act Contracts for the Conveyance of Non-Central Valley Project (Groundwater) in the Delta-Mendota Canal Environmental Assessment (DMC Pump-in EA) specifies a salinity threshold of 450 parts per million (ppm) total dissolved solids (TDS) in a single day as measured at Check 20 on the DMC. This is approximately equal to 900 micro-Siemens per centimeter (or umhos/cm) of electrical conductivity.

The 2005 Mendota Pool 10-year Exchange Agreement Environmental Impact Statement (Mendota Pool Pump-in EIS) specifies an electrical conductivity at Exchange Contractor canal intakes. The EIS sets a threshold at EC measured 90 umhos/cm or more above the EC of the DMC at Check 20 for three consecutive days.

Coordination with the San Luis and Delta-Mendota Water Authority and the Exchange Contractors during spring 2010 identified consistent electrical conductivities in Mendota Pool above 700 umhos/cm as a level of concern.

4.0 Communication

Daily operations coordination calls will include EC updates by the Exchange Contractors as measured at canal intakes when they near thresholds. San Luis and Delta-Mendota Water Authority will notify the operators at the daily operations call when TDS levels approach 450 ppm at Check 20. Once a threshold is crossed the responsible party as described in Section 5.0 will take an appropriate response action.

5.0 Actions

Operators will discuss and Reclamation will choose an appropriate action at the daily operations call. Response actions to water quality in Mendota Pool may include the following.

1) Suspend Mendota Pool Group Pump-In

The Mendota Pool Pump-in EIS and the Agreement for the Mendota Pool Transfer Pumping Project requires shutting down Mendota Pool Group pumps when the electrical conductivity at Exchange Contractor's canal intakes is 90 umhos/cm above EC measurements in the DMC for 3 days. If the Mendota Pool Group wells are shut off for this reason, they would not be turned back on until the EC at the canal intakes returns to a level that is no more than 30 umhos/cm above the DMC inflow.

This action is the responsibility of the Exchange Contractors and the Mendota Pool Group. The Exchange Contractors track salinity levels at canal intakes. Exchange Contractors will notify operators at the daily operations call when salinity levels at canal intakes approach this threshold. When notified by the Exchange Contractors, the Mendota Pool Group will shut down pumps.

2) Suspend DMC Pump-In

The DMC Pump-in EA requires shutting off the DMC pump-in program when measured water quality at Check 20 on the DMC exceeds 450 parts per million (ppm) TDS in a single day. The wells may resume pumping after the average TDS is below 450 ppm for 3 days.

This action is the responsibility of the San Luis and Delta-Mendota Water Authority to determine when TDS at Check 20 exceeds 450 ppm, and the responsibility of Two-Year Exchange Agreement and Warren Act Contract holders to shut off pumps.

3) Water Supplies through Firebaugh Wasteway

Another response action involves supplying Exchange Contractor water deliveries through Interim Flows diverted to avoid material adverse flooding or seepage impacts, and supplying downstream Interim Flow targets and/or San Luis Canal Company (SLCC) deliveries through the Firebaugh Wasteway.

This action is the responsibility of Reclamation. Following the application of the preceding response actions, as required in their environmental documentation, the Exchange Contractors will notify Reclamation at the daily operations call if salinity levels continue to exceed thresholds. Reclamation will evaluate salinity levels and determine if a downward trend will put salinity levels below thresholds within the next day. If not, Reclamation will direct SLDMWA to shut down the DMC and push flows through Firebaugh Wasteway. Reclamation will specify the amount of Interim Flows through Firebaugh Wasteway, and flows for SLCC through Firebaugh Wasteway in addition to other accounting as specified in Section 4.0 of the San Joaquin River Restoration Program Interim Flows Operations Plan. Reclamation will also manual sample discharge to the San Joaquin River from the Firebaugh Wasteway during this action, as needed.

Appendix I – Draft San Joaquin River Underseepage Limiting Capacity Analysis

This page intentionally left blank

Attachment

San Joaquin River Underseepage Limiting Capacity Analysis

Draft
Supplemental Hydrologic and Water Operations Analyses Appendix

SAN JOAQUIN RIVER RESTORATION PROGRAM

DRAFT
San Joaquin River Underseepage Limiting Capacity Analysis

March 30, 2011

1. INTRODUCTION

Tetra Tech, Inc., dba Mussetter Engineering, Inc. (Tt-MEI) performed an evaluation of the potential effects of restoration flows on levee underseepage in the 150-mile, mainstem portion of the San Joaquin River Restoration Reach and the Eastside Bypass between Friant Dam and the confluence with the Merced River.

Underseepage issues are most acute when a layer(s) of pervious material occurs below the levee foundation that extends both river- and land-side of the levee (USACE, 2000). These pervious layers allow seepage to occur below the levee structure where it often surfaces along the existing ground adjacent to the levee. This seepage can cause adverse impacts to adjacent landowners due to saturation of the ground surface, and can also lead to instability and failure of the levee.

To evaluate the potential impact of restoration flows on underseepage and saturation adjacent to the levees, elevations of land outside and adjacent to the levees were determined and compared to computed water-surface elevations over a range of flows. The evaluation was conducted using the HEC-RAS 1-D steady-state hydraulic models developed by Tt-MEI for the San Joaquin River Restoration Program (SJRRP), and initially consisted of a preliminary analysis of varying potential capacity thresholds and criteria (Tt-MEI, 2011). Based on the results of the preliminary analysis, a refined set of capacity criteria was established. This work was completed under the River Engineering Services for the San Joaquin River Restoration Program Contract, Task Order 48.

2. METHODOLOGY AND ASSUMPTIONS

The following sections describe the methodology and assumptions that were used in performing the analysis. The analysis specifically focused on identifying the discharge at which the water surface in the river would reach the outside ground elevation (i.e., in-channel flow capacity), and included a determination of the extent of each the reach where outside ground elevations are within 1 foot vertically of the water-surface for the identified in-channel capacity.

2.1. River Reaches

The seepage potential was evaluated for each subreach that is bounded by levees in Reaches 2A, 2B, 3, 4A, 4B2, 5, and the Eastside Bypass (**Figure 1**). As part of the project, new setback levees will be constructed in Reach 4B1 to safely convey the maximum releases under full restoration conditions. As a result, impacts associated with the full restoration releases were not evaluated in this reach. Setback levees will also be constructed in Reach 2B, but because interim-flow releases will be routed through this reach prior to construction, seepage potential along the levees upstream from the direct impacts of Mendota Pool was evaluated.

2.2. Hydraulic Models

Hydraulic models for the study reaches, which were initially developed based on 2-foot contour mapping developed by Ayres Associates (1998 and 1999) for the Sacramento and San Joaquin River Basins Comprehensive Study, have been recently updated using improved modeling techniques and the 2008 LiDAR mapping and bathymetry, where available. The models used for this analysis were further refined and the assumptions were defined as part of the evaluation of potential erosion and stability impacts to the levees associated with the proposed restoration flows (Tt-MEI, 2010). In addition, updates to the estimated pool elevation and rating curve at Mendota Dam that were made based on new information obtained after completion of the levee stability analysis (Tt-MEI, 2010) were incorporated into the Reach 2B hydraulic model.

Water-surface profiles used in the analysis were developed by running the refined models over a series of local discharges that were developed based on Friant Dam releases within the range of the Settlement Agreement Exhibit B flows, and adjusted for infiltration and diversion losses based on the curves used to develop the Exhibit B flows. The local discharges in Reach 3 include an additional 300 cfs to represent the average Arroyo Canal deliveries from Mendota Pool to the Arroyo Canal. These flows are then extracted at Sack Dam at the downstream end of Reach 3.

2.3. Outside Ground Elevations

Elevations of improved agricultural or urban land protected by the levees (outside ground) were identified as part of the levee stability analysis conducted by Tt-MEI (2010) to assess the potential for levee issues to affect land improvements along the reach. Elevations for each location were identified at each model cross section through inspection of the 2008 aerial photography, 2008 contour mapping, and cross-sectional topography. Actual elevations were determined from the topography used to develop the hydraulic model for each part of the reach (i.e., 2008 LiDAR mapping, supplemented with bathymetry from the 1998/1999 Ayres mapping, where necessary).

3. RESULTS

Computed water-surface profiles were compared to the ground elevations adjacent to both the left and right levees. The in-channel flow capacity of each reach was determined to be the highest flow rate through the reach where the water-surface elevation does not exceed the outside ground elevation. Approximate lengths of each site where the outside ground elevations are within 1 foot of the in-channel capacity discharge water-surface elevation were then estimated from the available mapping.

3.1. Reach 2A

Reach 2A is approximately 13 miles long and extends from Gravelly Ford (near the upstream end of the project levees) downstream to the Chowchilla Bypass Bifurcation Structure. Along both levees in Reach 2A, the highest local discharge for which the water surface is at or below the outside ground elevation is 1,060 cfs (**Figure 2**). A total of five locations with a combined length of approximately 1,980 feet were identified where the outside ground elevations are within 1 foot of the in-channel capacity water surface (**Figure 3 and Table 1**).

Table 1. Summary of approximate lengths of each location in each reach where the outside ground elevation is within one foot of the in-channel capacity discharge.

Reach	Site	Capacity Flow (cfs)	Length (ft)
Reach 2A	Site 1	1,060	1,120
Reach 2A	Site 2	1,060	380
Reach 2A	Site 3	1,060	350
Reach 2A	Site 4	1,060	40
Reach 2A	Site 5	1,060	90
Reach 2B	Site 1	810	1,240
Reach 3	Site 1	2,140	1,090
Reach 4A	Site 1	630	510
Reach 4A	Site 2	630	1,620
Reach 4A	Site 3	630	100
Reach 4B2	Site 1	990	510
Reach 4B2	Site 2	990	270
Reach 4B2	Site 3	990	320
Reach 4B2	Site 4	990	590
Reach 4B2	Site 5	990	300
Reach 4B2	Site 6	990	270
Reach 4B2	Site 7	990	370
Reach 4B2	Site 8	990	130
Reach 4B2	Site 9	990	440
Reach 4B2	Site 10	990	400
Reach 4B2	Site 11	990	350
Reach 4B2	Site 12	990	740
Reach 4B2	Site 13	990	540
Reach 5	Site 1	1,690	420
Reach 5	Site 2	1,690	440
Reach 5	Site 3	1,690	830
Eastside Bypass	Site 1	600	540
Eastside Bypass	Site 2	600	2,320
Eastside Bypass	Site 3	600	560

3.2. Reach 2B

Reach 2B is approximately 11 miles long and extends from the Chowchilla Bypass Bifurcation Structure downstream to Mendota Dam. Outside ground elevations along the lower portion of this reach (downstream from approximately Sta 4765+00) are generally lower than the normal pool elevation at Mendota Dam. As a result, Interim Flows will not significantly impact the potential for saturation of the outside ground in this area, and the existing flow capacity was evaluated only for the reach upstream from Sta 4765+00. Along both levees in Reach 2B, the highest local discharge for which the water surface is at or below the outside ground elevation is 810 cfs (**Figure 4**). One location of approximately 1,240 feet in length was identified where the outside ground elevations are within 1 foot of the in-channel capacity water-surface (Table 1 and **Figure 5**).

3.3. Reach 3

Reach 3 is about 22 miles long and extends from Mendota Dam downstream to Sack Dam. Considering both levees, the highest local discharge for which the water surface is at or below the outside ground elevation is about 2,140 cfs (**Figure 6**). The limiting area where the outside ground elevations are within 1 foot of the in-channel capacity flow water surface occurs near the downstream end of the reach near Sta 3385+20, just upstream from Sack Dam, and has an approximate length of 1,090 feet (Table 1 and **Figure 7**).

3.4. Reach 4A

Reach 4A is about 23 miles long and extends from Sack Dam downstream to the Sand Slough Control Structure. The computed water-surface profiles indicate that the highest local discharge for which the water surface is at or below the outside ground elevation is 630 cfs (**Figure 8**). A total of three locations with a combined length of approximately 2,230 feet were identified where the outside ground elevations are within 1 foot of the in-channel capacity water surface (Table 1 and **Figure 9**).

3.5. Reach 4B2

Reach 4B2 extends approximately 12 miles from the Mariposa Bypass downstream to the confluence with Bear Creek. The ground adjacent to the right levee in Reach 4B2 has several significant localized depressions near Sta 1068+30 and Sta 1072+20 (**Figure 10**). These local depressions limit the in-channel capacity discharge to about 190 cfs. However, aerial photographs and contour mapping indicate that these depressions are not on or adjacent to agricultural land, are relatively small, and can contain water even at low flows (Tt-MEI, 2011). If these local depressions are excluded from the analysis, the capacity along the reach increases to about 990 cfs (Figure 10). Based on the discharge of 990 cfs, a total of 13 locations with a combined length of approximately 5,230 feet were identified where the outside ground elevations are within 1 foot of the in-channel capacity water surface (Table 1 and **Figure 11**).

3.6. Reach 5

Reach 5 extends downstream from Bear Creek to the confluence with the Merced River, and along the left side of the river, the levee only exists within the upper portion of the reach (upstream from about Sta 660+00) (**Figure 12**). Along both levees in Reach 5, the highest local discharge for which the water surface is at or below the outside ground elevation is 1,690 cfs

(Figure 12). A total of three locations with a combined length of approximately 1,690 feet were identified where the outside ground elevations are within 1 foot of the in-channel capacity water surface (Table 1 and **Figure 13**). However, since much of the outside ground adjacent to the left levee is undeveloped and contains many local depressions (Tt-MEI, 2011), these results likely represent a conservative estimate of the in-channel discharge capacity in this reach.

3.7. Eastside Bypass

The Eastside Bypass extends downstream approximately 21 miles from the Sand Slough Control Structure to where it joins Bear Creek and then the San Joaquin River. The computed water-surface profiles indicate that the highest local discharge for which the water surface is at or below the outside ground elevation is 600 cfs (**Figure 14**). A total of three locations with a combined length of approximately 3,420 feet were identified where the outside ground elevations are within 1 foot of the in-channel capacity water surface (Table 1 and **Figure 15**).

4. REFERENCES

Tetra Tech (dba Mussetter Engineering, Inc.), 2010. Evaluation of Potential Erosion and Stability Impacts on Existing Levees under Proposed restoration Program, Draft technical memorandum prepared for the California Dept. of Water Resources, Fresno, California, August.

Tetra Tech (dba Mussetter Engineering, Inc.), 2011. San Joaquin River Preliminary Underseepage Limiting Capacity Analysis, Draft technical memorandum prepared for the California Dept. of Water Resources, Fresno, California, March.

U.S. Army Corps of Engineers, 2000. Engineering and Design – Design and Construction of Levees EM 1110-2-1913 April 30.

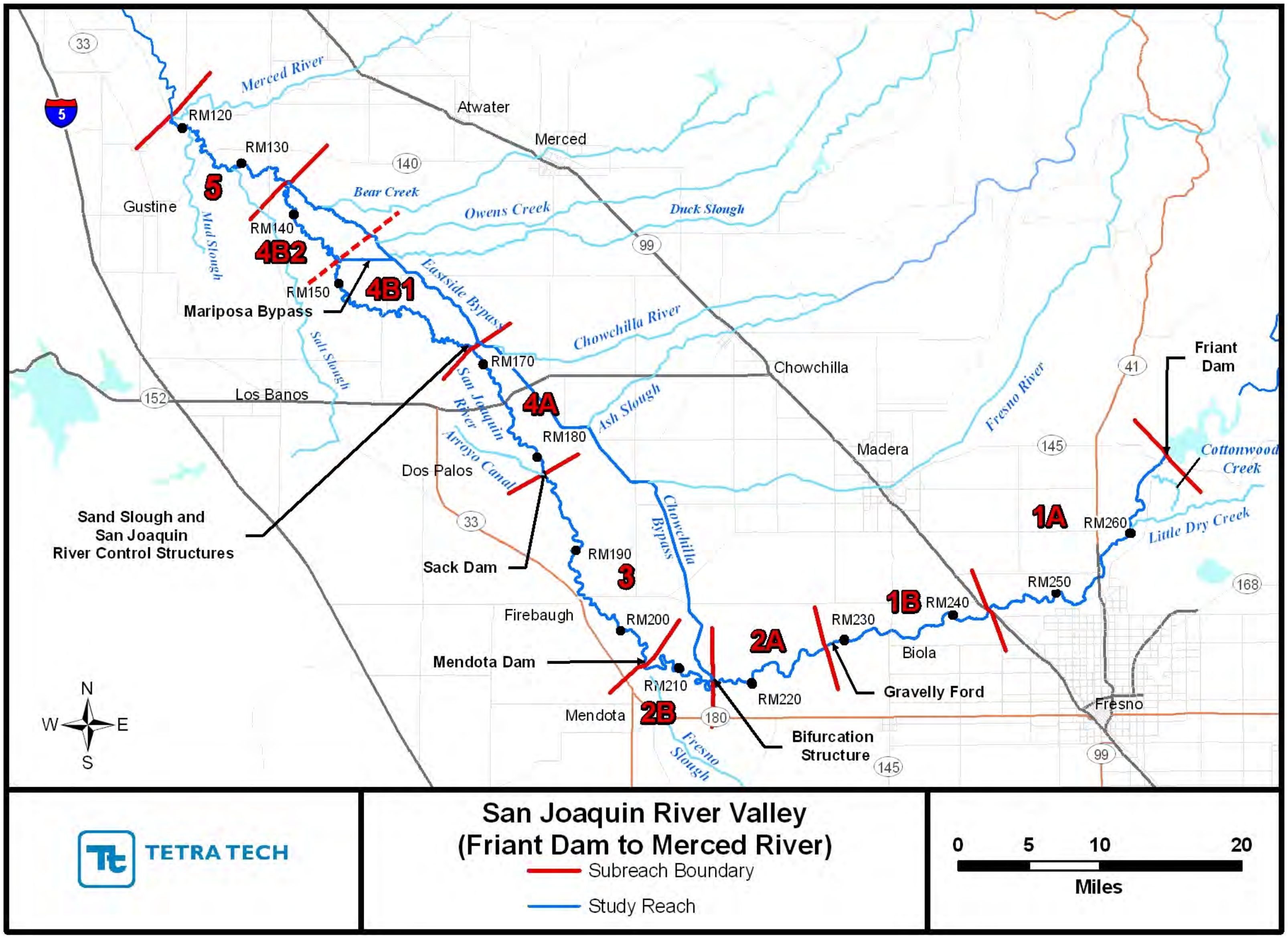

Figure 1. Map of the San Joaquin River Restoration Project Reach showing the subreach boundaries.

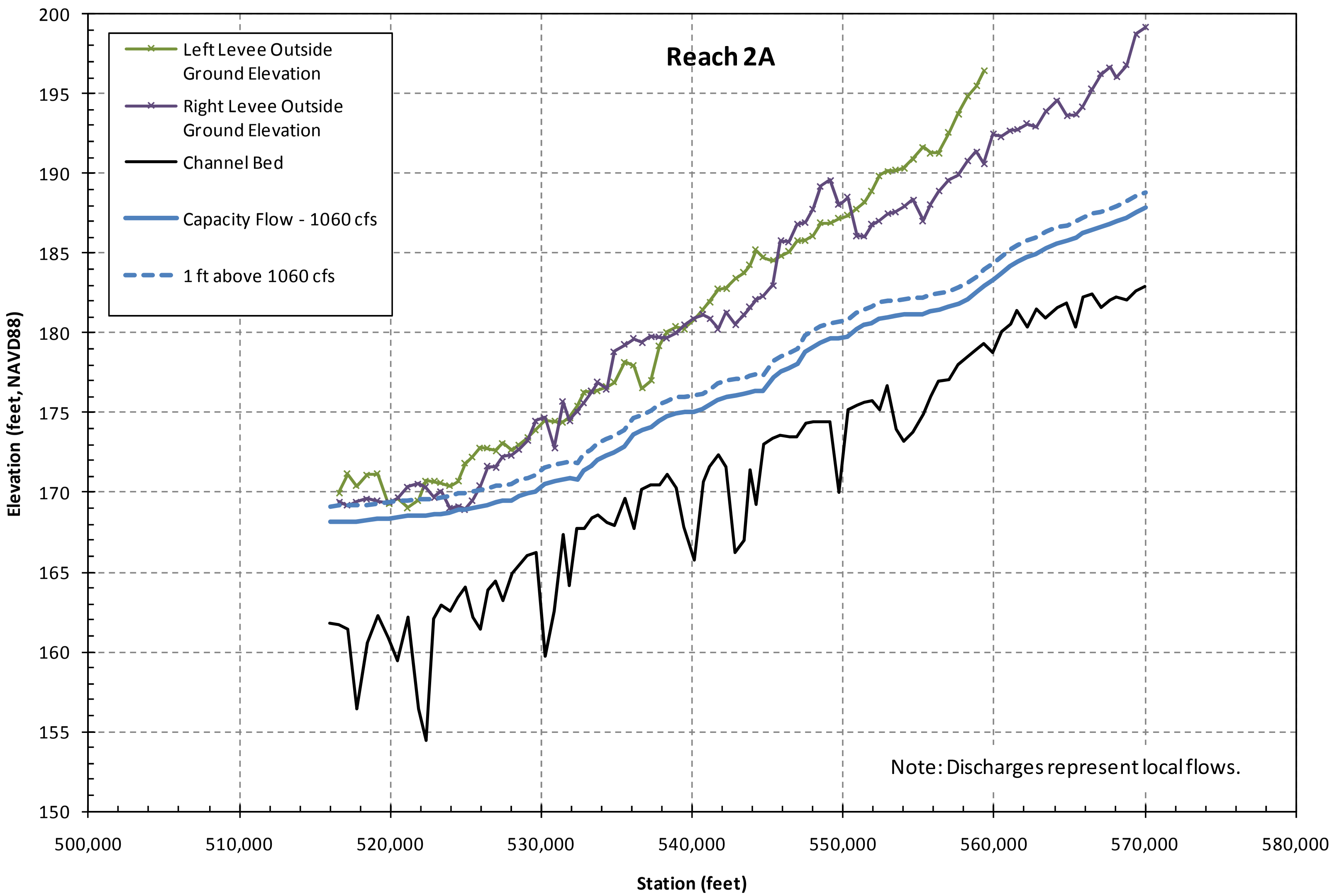

Figure 2. Outside ground elevations and computed water-surface profiles in Reach 2A at and 1 foot above the local discharge of 1,060 cfs.

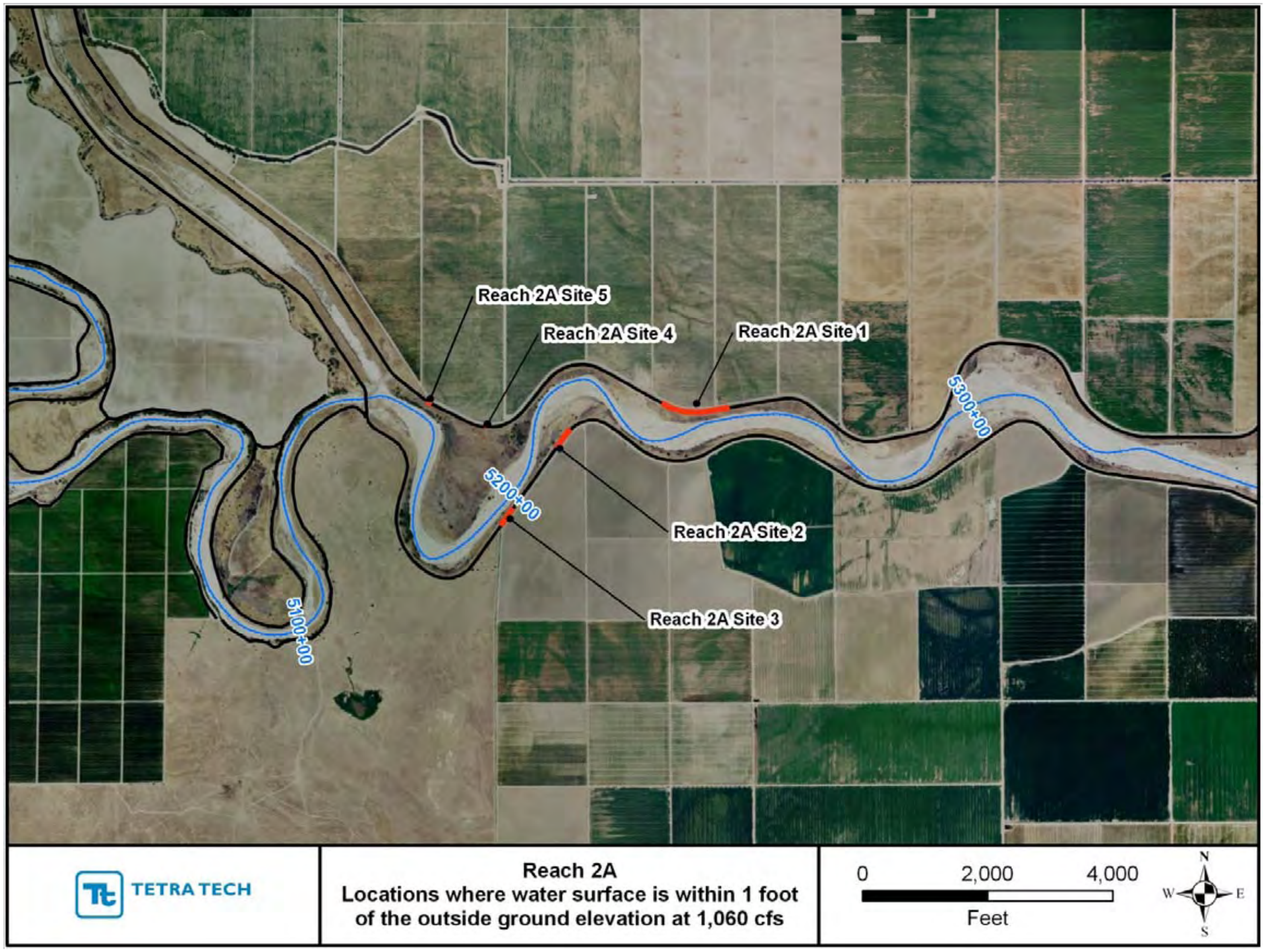

Figure 3. Map showing locations in Reach 2A where the 1,060-cfs water-surface elevation is within 1 foot of the outside ground elevation.

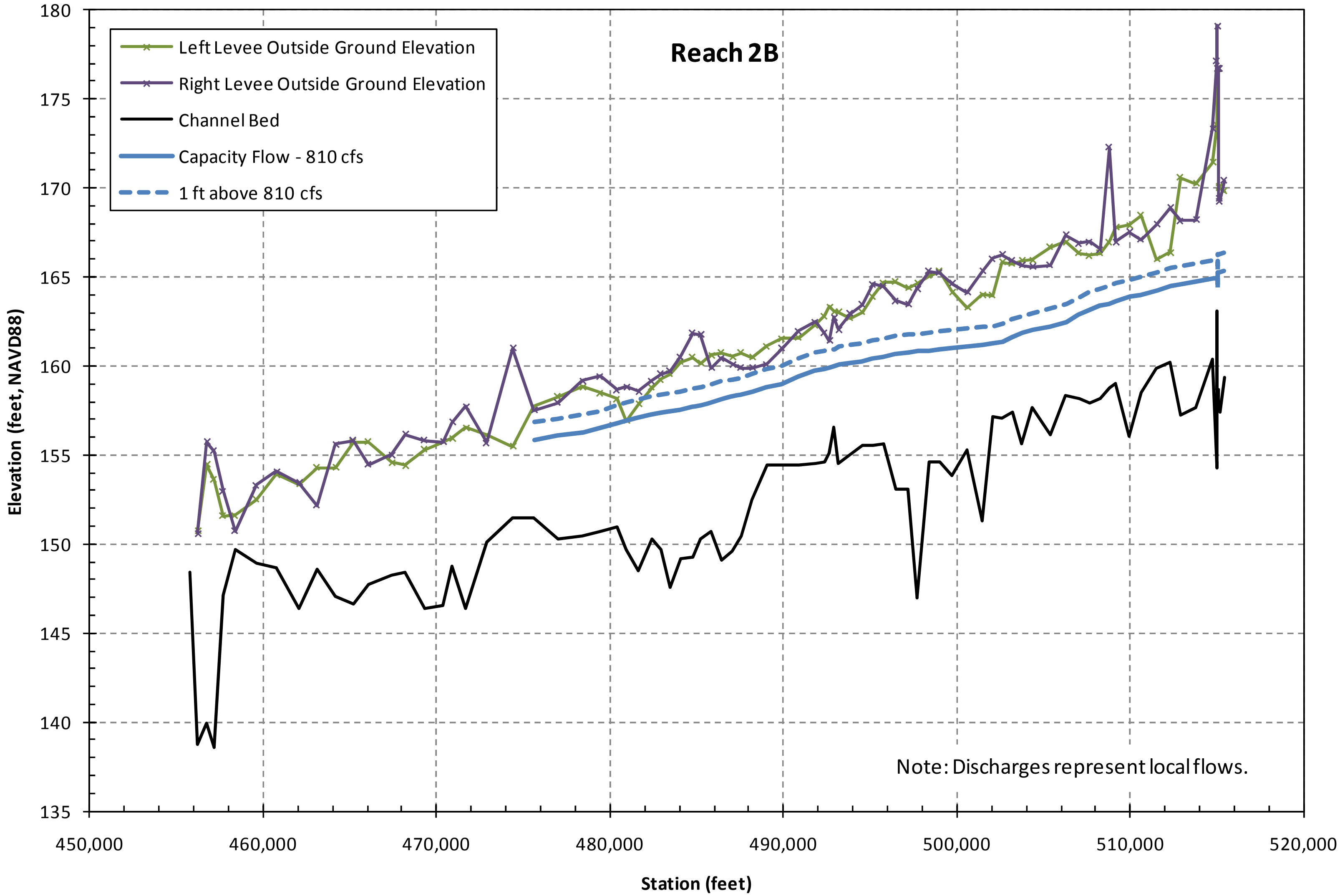

Figure 4. Outside ground elevations and computed water-surface profiles in Reach 2B at and 1 foot above the local discharge of 810 cfs.

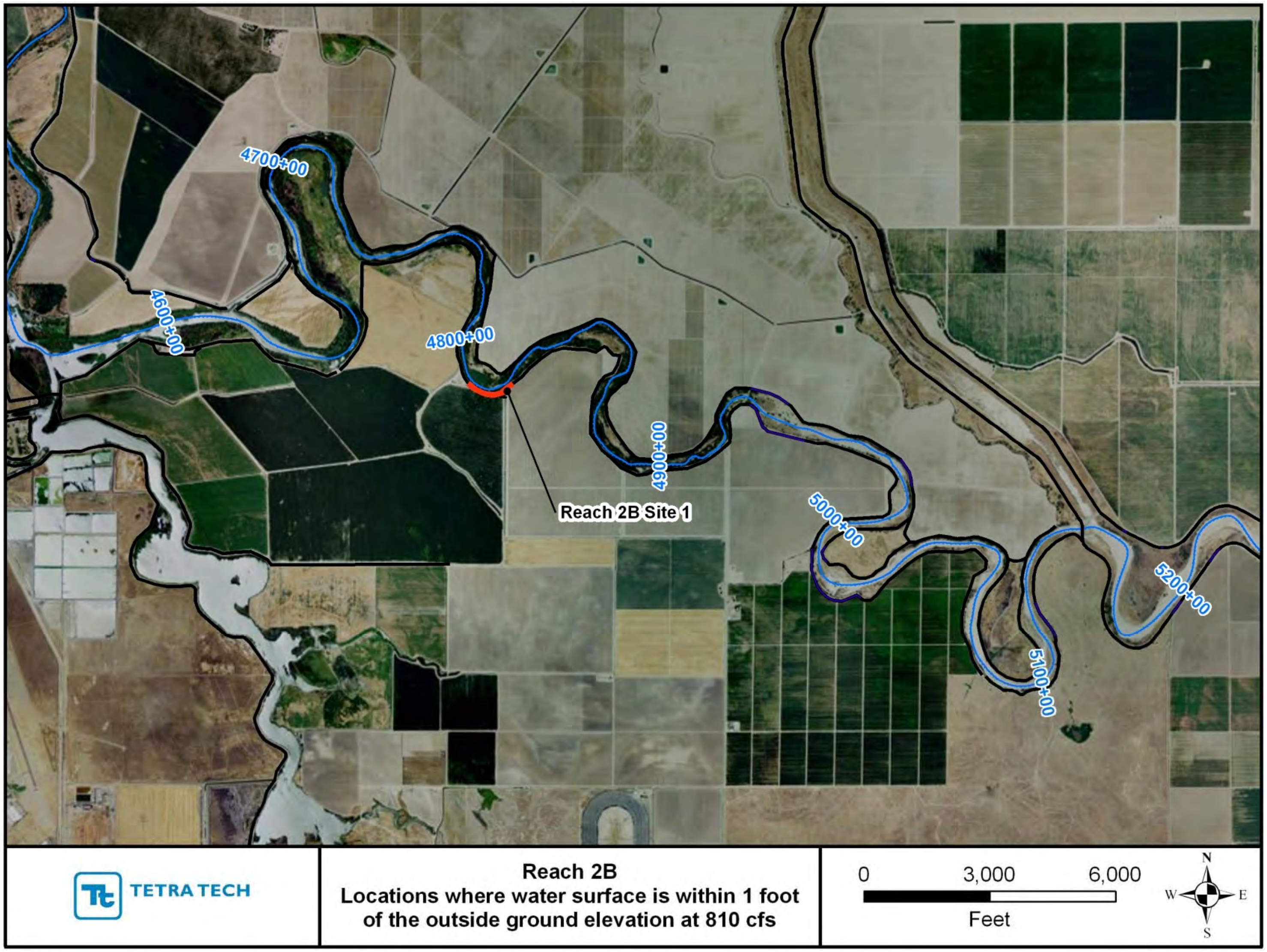

Figure 5. Map showing locations in Reach 2B where the 810-cfs water-surface elevation is within 1 foot of the outside ground elevation.

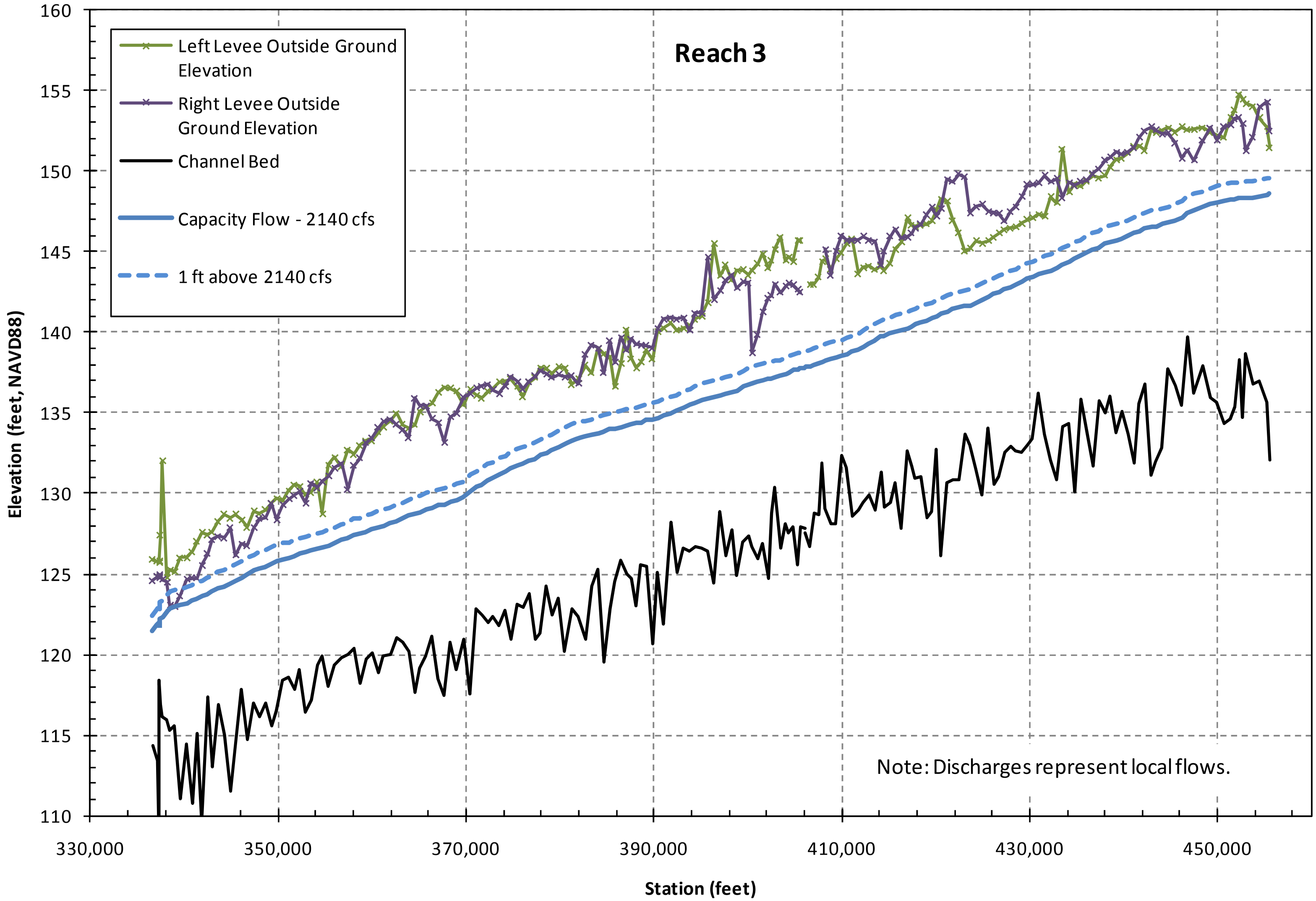

Figure 6. Outside ground elevations and computed water-surface profiles in Reach 3 at and 1 foot above the local discharge of 2,140 cfs.

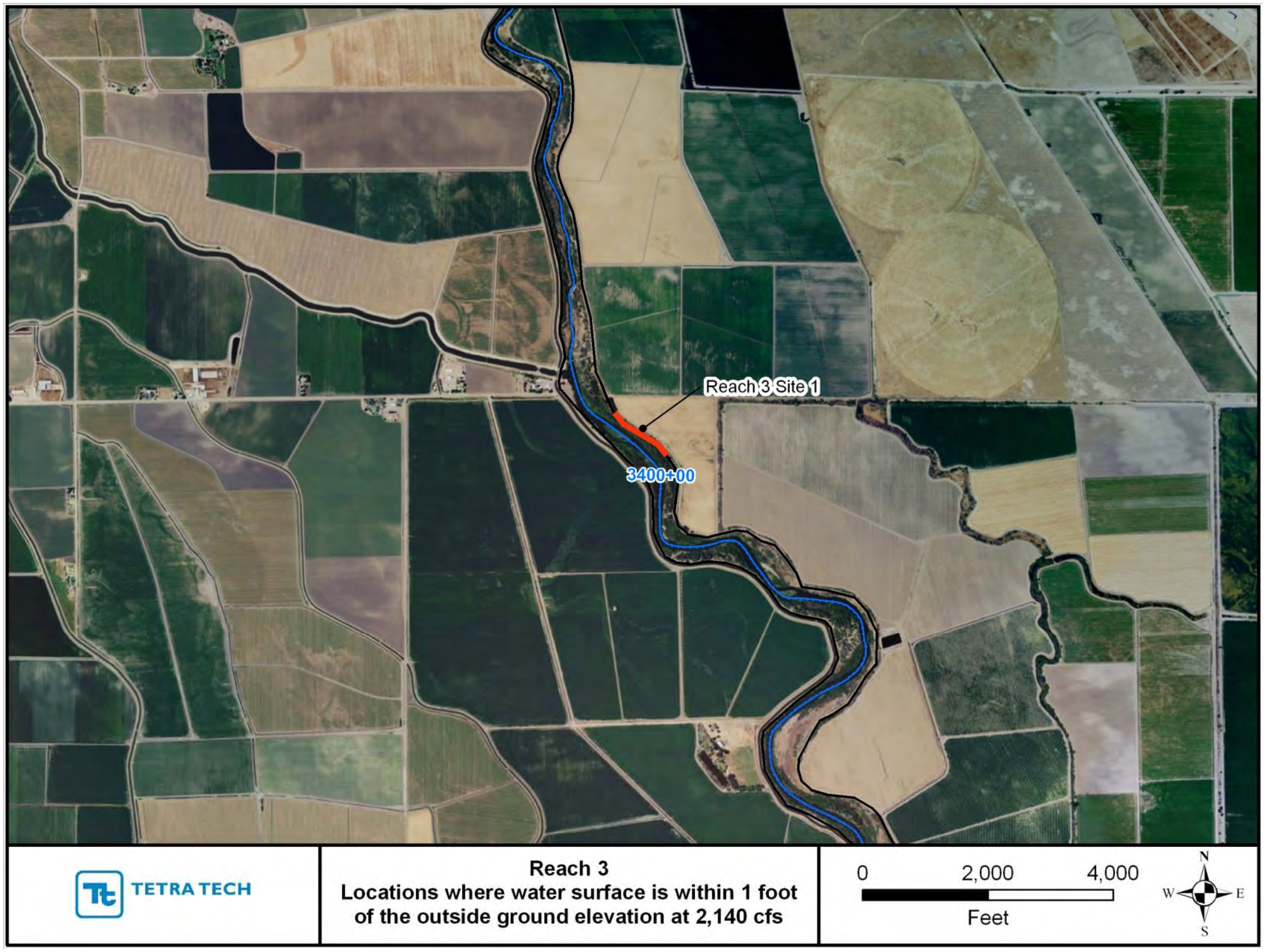

Figure 7. Map showing locations in Reach 3 where the 2,140-cfs water-surface elevation is within 1 foot of the outside ground elevation.

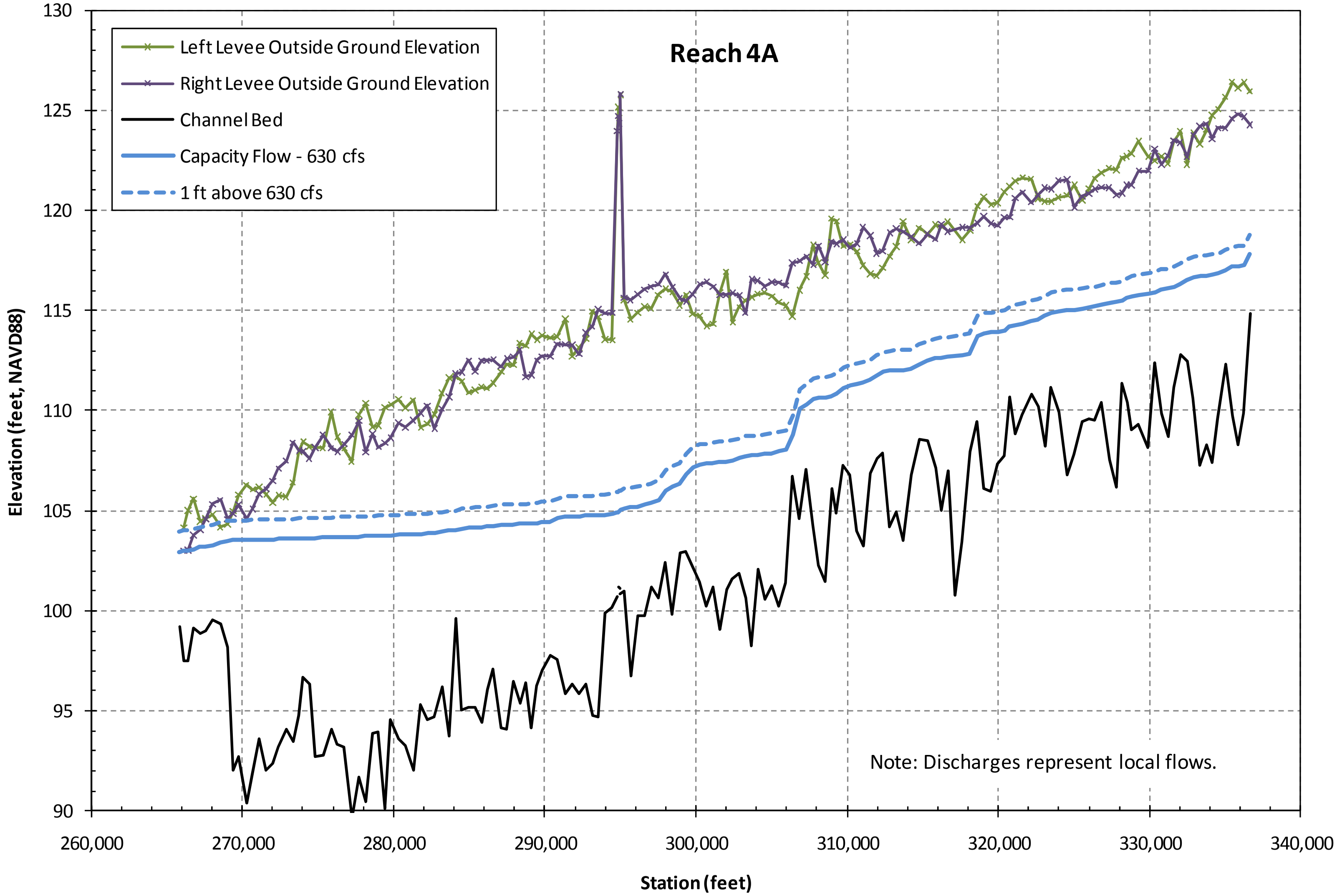

Figure 8. Outside ground elevations and computed water-surface profiles in Reach 4A at and 1 foot above the local discharge of 630 cfs.

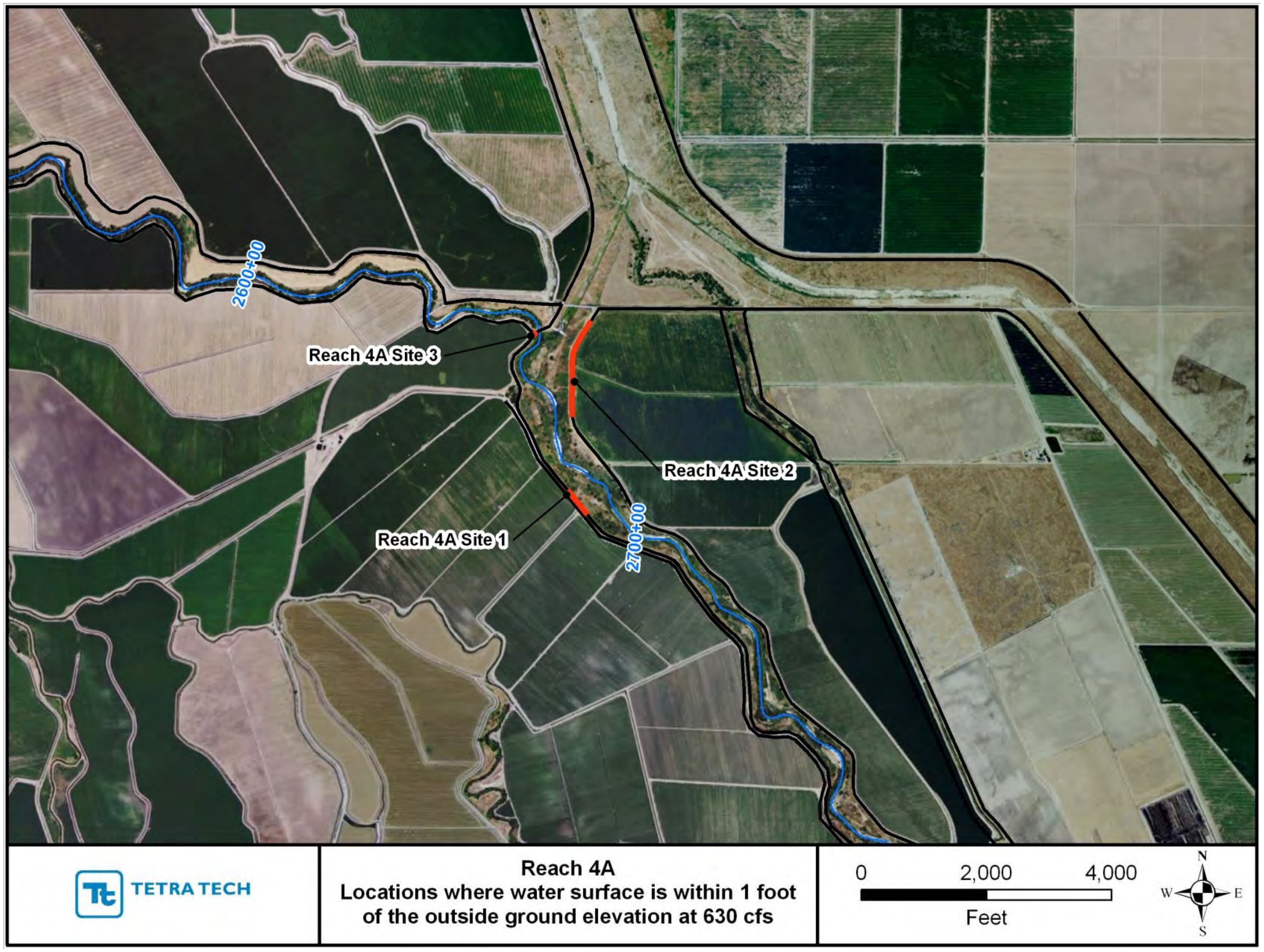

Figure 9. Map showing location in Reach 4A where the 630-cfs water-surface elevation is within 1 foot of the outside ground elevation.

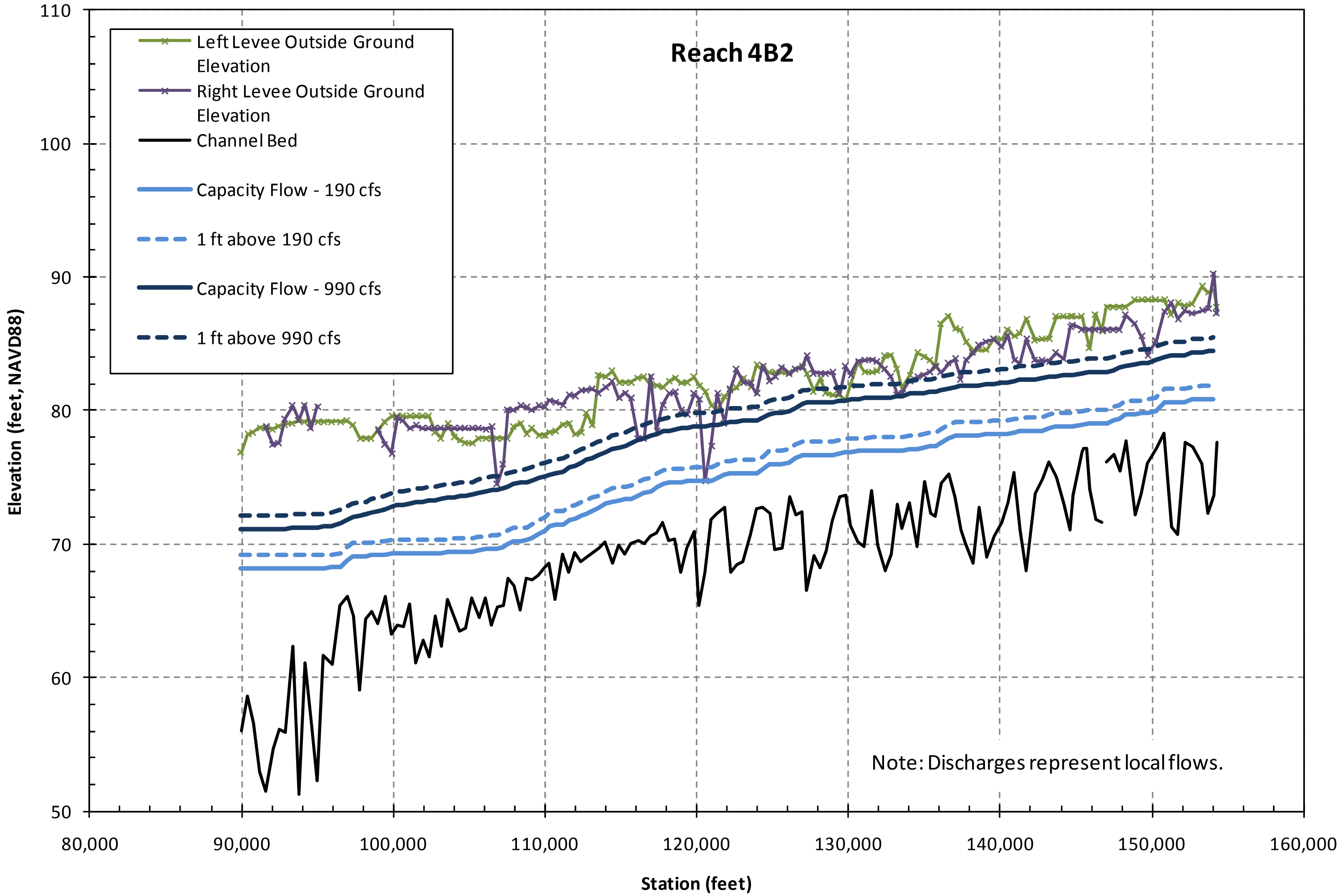

Figure 10. Outside ground elevations and computed water-surface profiles in Reach 4B2 at and 1 foot above the local discharges of 190 and 990 cfs.

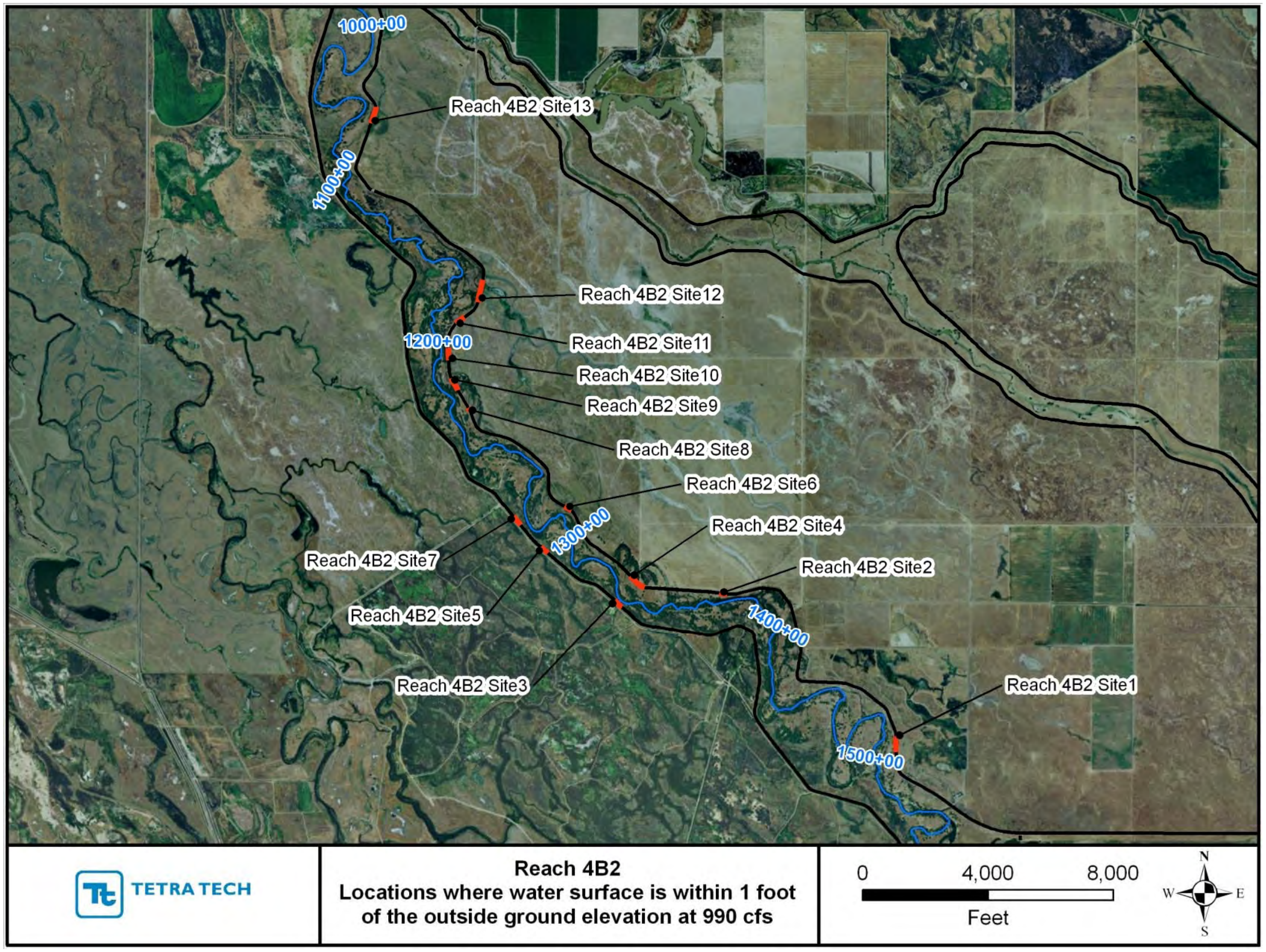

Figure 11. Map showing locations in Reach 4B2 where the 990-cfs water-surface elevation is within 1 foot of the outside ground elevation.

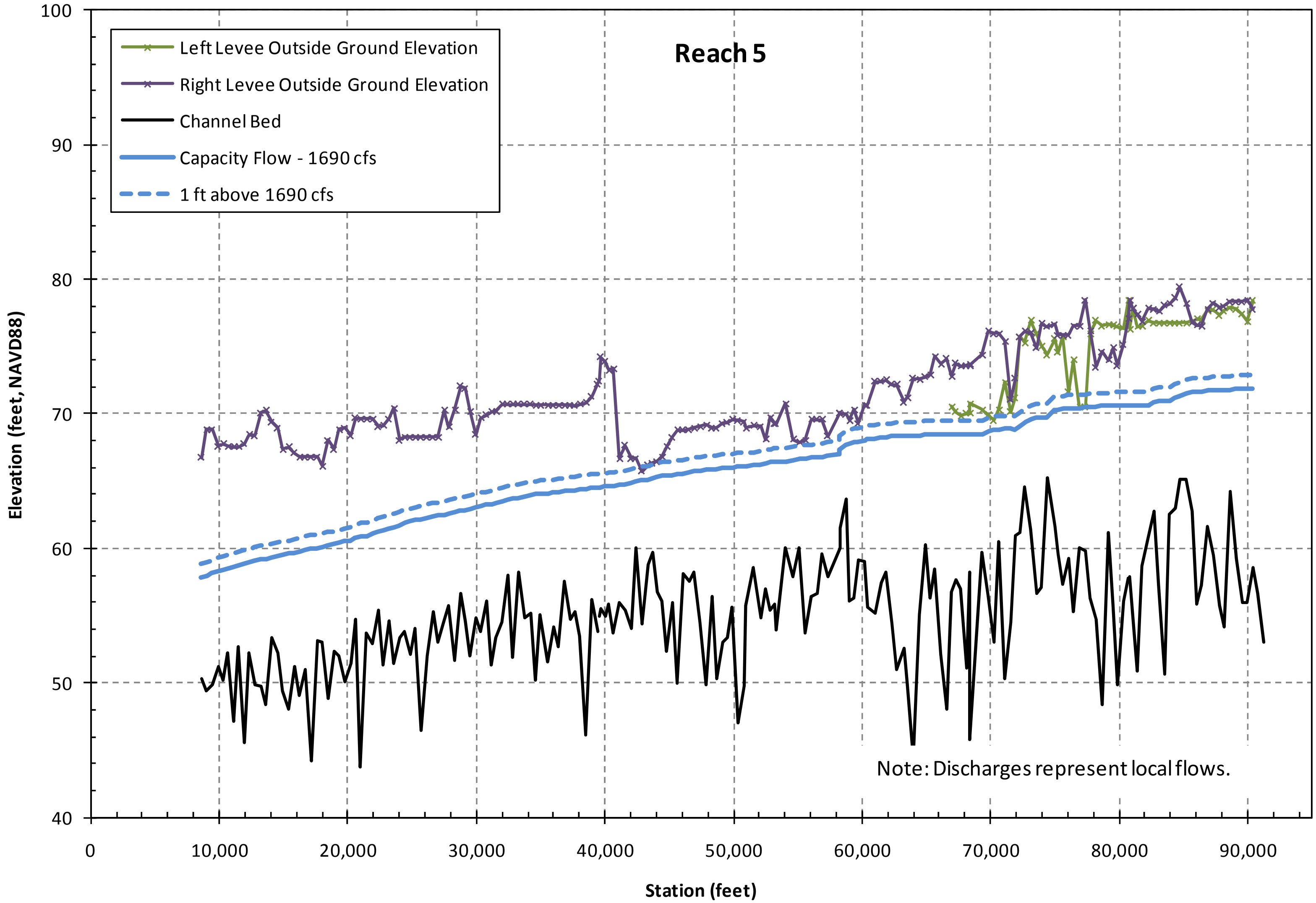

Figure 12. Outside ground elevations and computed water-surface profiles in Reach 5 at and 1 foot above the local discharges of 1,690 cfs.

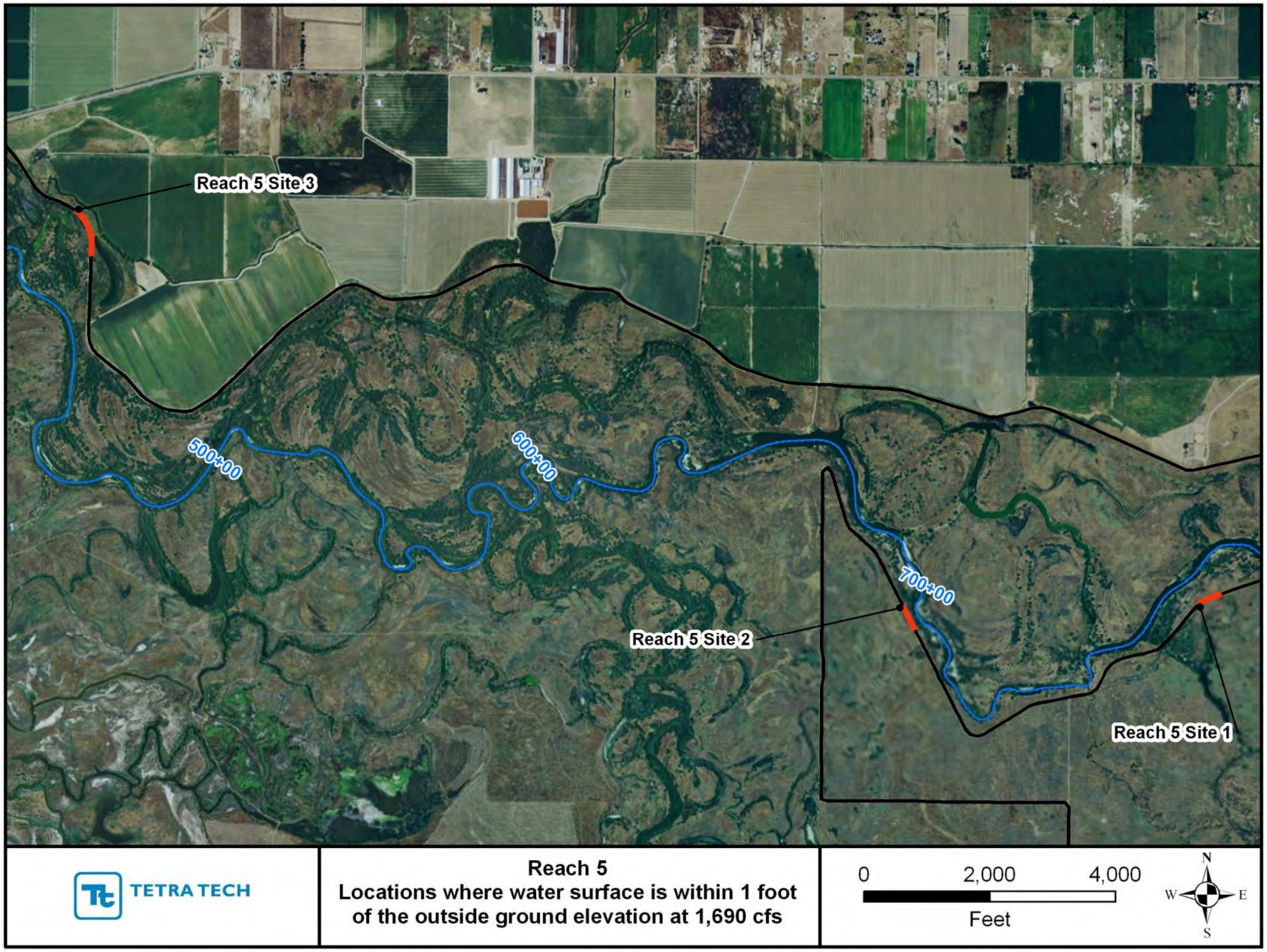

Figure 13. Map showing locations in Reach 5 where the 1,690-cfs water-surface elevation is within 1 foot of the outside ground elevation.

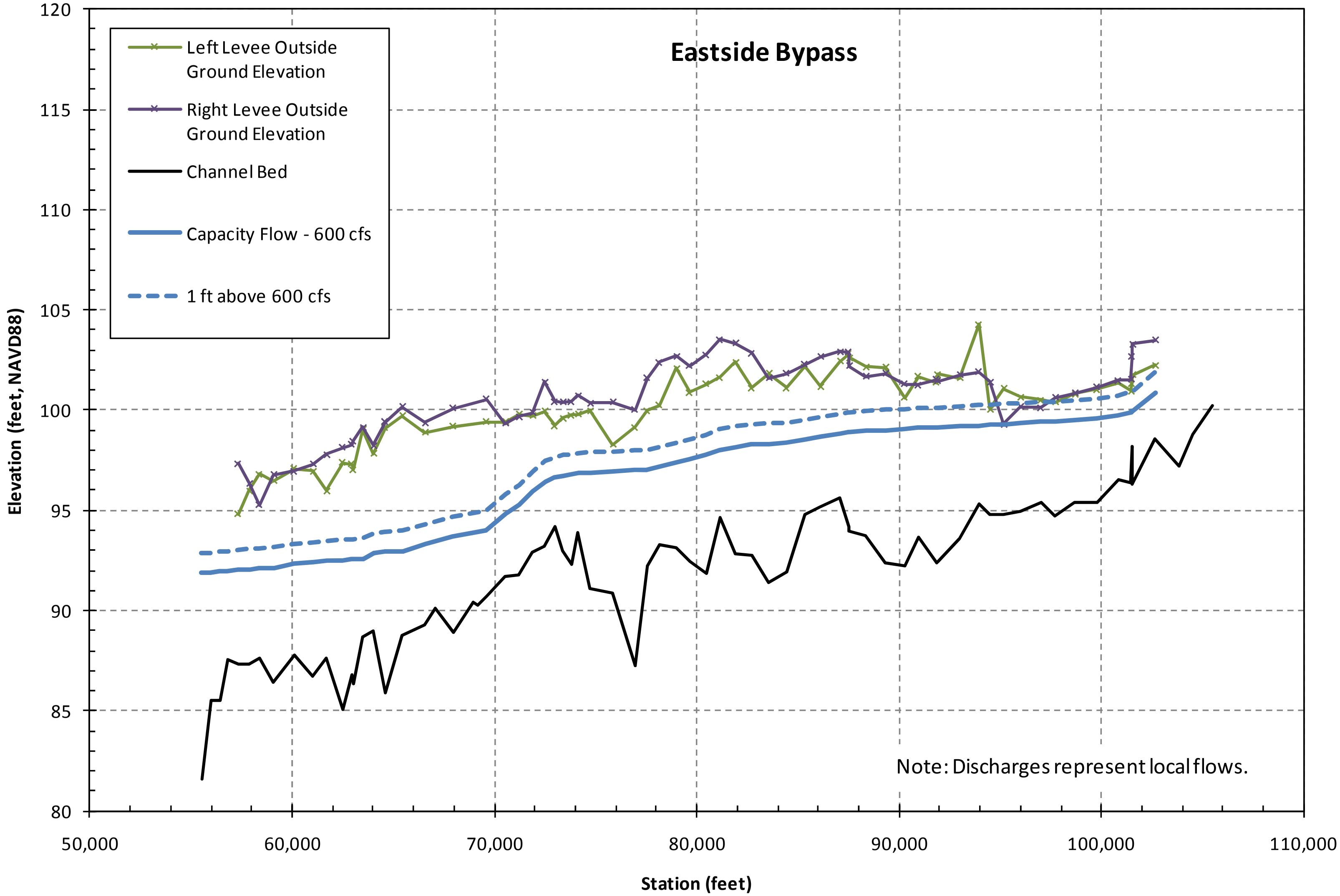

Figure 14. Outside ground elevations and computed water-surface profiles in the Eastside Bypass at and 1 foot above the local discharge of 600 cfs.

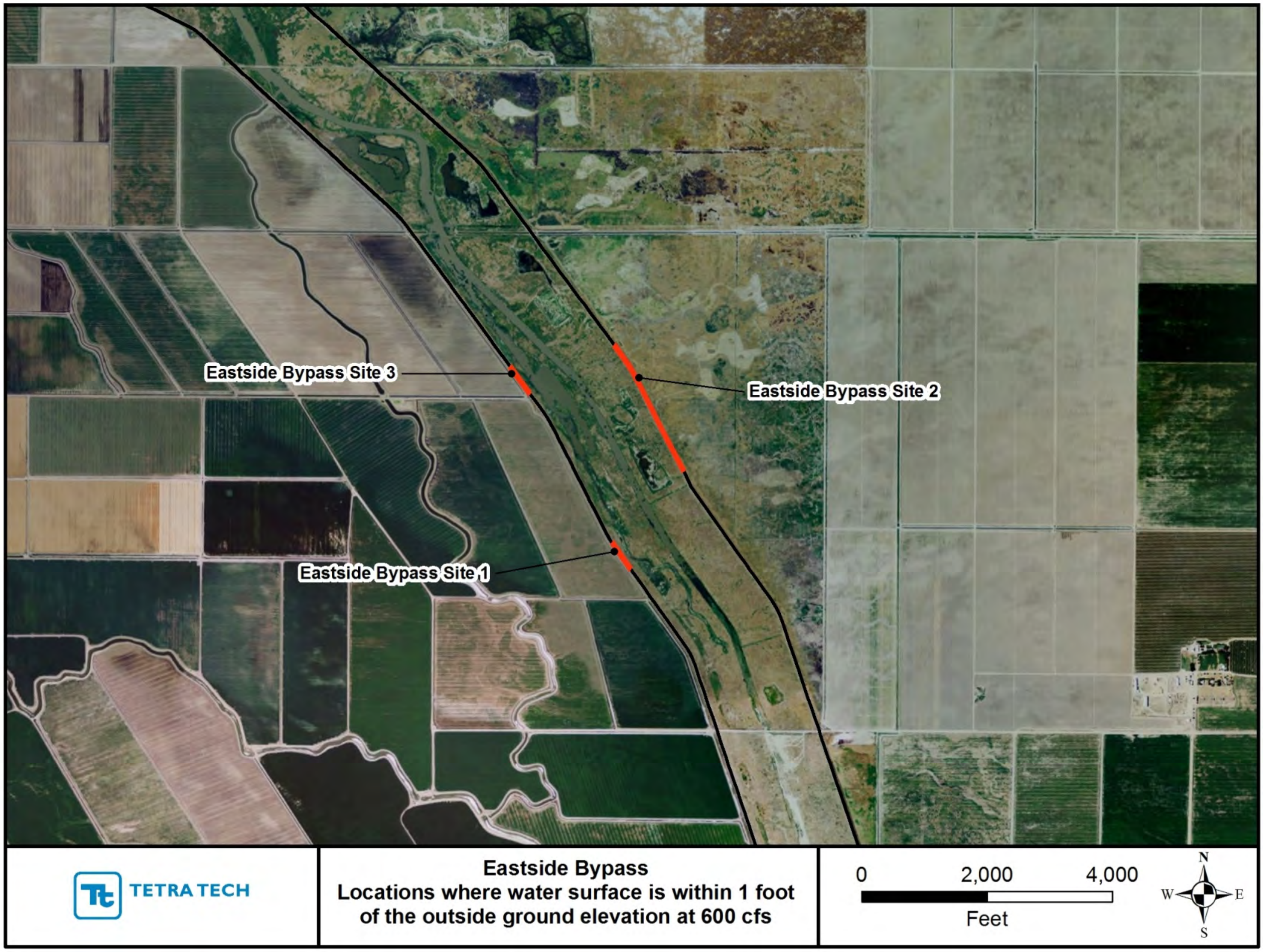

Figure 15. Map showing locations along the Eastside Bypass where the 600-cfs water-surface elevation is within 1 foot of the outside ground elevation.