BART Agreement Number: 6M8145 **Approval Date:** 1/05/2021

Work Plan: No. B.20-01 – Provide the independent assessment for SVBX

Scope:

2.1 Berryessa Station – Canopy post anchorage Connection

Provide independent seismic evaluation of Berryessa Station Canopy post anchorage connections as follows:

1. Review relevant project specific design criteria, specifications, geotechnical reports.
2. Review relevant as-built drawings, construction submittals.
3. Verify anchor bolt embedment length with non-destructive testing, if necessary.
4. Determine whether the in-situ canopy column anchorage connections meet the project design criteria for operability performance level.
5. Model 3D canopy structure in SAP2000, Risa3D or other appropriate analysis software. Attenuation affects, due to the canopy support structure mass and stiffness, will be accounted for in the seismic analysis.
6. Should connections not meet the original Silicon Valley Berryessa Extension Project Design Criteria, determine if it meets life safety requirements using 2019 California Building Code.
7. Should connections not meet life safety requirements, determine level of earthquake that connections can withstand for life safety performance per 2019 California Building Code.
8. Provide conceptual repair detail recommendations (not the detailed design) for canopy column anchorage connection retrofit, as required.
9. Perform site visits to inspect the column connection and to get information on the site condition and to verify and perform Ultrasonic Testing to confirm embedment length, if required, during blanket hours.

2.2 Ground Motion Development: Seismic Hazard Assessment

1. We will review the available geotechnical data at the project locations to develop idealized shear wave velocity profiles to determine appropriate ground surface Vs30 (time-weighted average shear wave velocity in the upper 30 meters) for the seismic hazard analysis at each project location.
2. Site-specific Probabilistic Seismic Hazard Analysis (PSHA) will be conducted to develop design ground motions according to the project seismic design criteria.
    - For locations 1, 2, and 4 (see Introduction), we understand that the design ground motions correspond to the Safety Evaluation Earthquake (SEE) defined by the Caltrans Seismic Design Criteria (SDC) version 2.0 (Caltrans, 2019). The SEE is defined as the ground motions with 5% probability of exceedance in 50 years (i.e., return period of 975 years) adjusted for near-fault and basin amplification effects.
    - For locations 3 and 5 (see Introduction), we understand that the design ground motions will be developed according to 2019 California Building Code (CBC), which adopted the ground motion requirements of ASCE 7-16. According to ASCE 7-16, the design ground motions correspond to the Risk-Targeted Maximum Considered Earthquake (MCE_R) and Design response spectra. Based on the amplitude of the ground motions expected at the

project locations and assuming a seismic site classification corresponding to Site Class D, Section 11.4.8 of ASCE 7-16 requires a site-specific seismic hazard assessment to estimate the design ground motions.

3. The seismic hazard analysis will be conducted for five (5) locations and for one (1) representative ground surface Vs30 value at each location.
4. The seismic hazard assessment will use the seismic source model and Ground Motion Models (GMM) adopted by the United States Geological Survey (USGS) to develop the 2014 National Seismic Hazard Map Project (NSHMP) (Petersen et al., 2014). The seismic source model corresponds to the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) (Field et al., 2013), and the GMM's correspond to the NGA West 2 models (Bozorgnia et al., 2014). This approach is consistent with Caltrans SDC version 2.0 (Caltrans, 2019), and 2019 CBC.
5. The analysis will include the development of acceleration response spectra for 5% damping for the horizontal and vertical component of shaking. Ground motion directivity effects will be incorporated in the development of the horizontal response spectra if warranted. Vertical response spectra will be developed using published vertical-to-horizontal (V/H) spectral ratios to ensure hazard consistency between the horizontal and vertical components.
6. The analysis will also include the deaggregation of the seismic hazard to evaluate the primary contributions in terms of earthquake magnitude, distance, and epsilon, to the design ground motions.
7. QA/QC: an internal review of the methodology, analyses, and results will be conducted.
8. Data required:
    - Geotechnical information available for the project locations.
9. References:
    - Bozorgnia Y., Abrahamson N.A., Al Atik L., Ancheta T.D., Atkinson G.M., Baker J.W., Baltay A., Boore D.M., Campbell K.W., Chiou B.S.J., Darragh R., Day S., Donahue J., Graves R.W., Gregor N., Hanks T., Idriss I.M., Kamai R., Kishida T., Kottke A., Mahin S.A., Rezaeian S., Rowshandel B., Seyhan E., Shahi S., Shantz T., Silva W., Spudich P., Stewart J.P., Watson-Lamprey J., Wooddell K., Youngs R., 2014. "NGA-West2 Research Project", Earthquake Spectra, Volume 30, No. 3, pages 973-987.
    - Caltrans (2019). "October 2019 Interim Revisions to Caltrans Seismic Design Criteria Version 2.0".
    - Field, E. L., Biasi, G.P., Bird, P., Dawson, T.E., Felzer, K.R., Jackson, D.D., Johnson, K.M., Jordan, T.H., Madden, C., Michael, A.J., Milner, K.R., Page, M.T., Parsons, T., Powers, P.M., Shaw, B.E., Thatcher, W.R., Weldon, R.J., II, and Zeng, Y., 2013. Uniform California earthquake rupture forecast, version 3 (UCERF3)—The time-independent model: U.S. Geological Survey Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, http://pubs.usgs.gov/of/2013/1165.
    - Petersen M. D., Moschetti, M. P., Powers, P. M., Mueller, C. S., Haller, K. M., Frankel, A. D., Zeng, Y, Rezaelian, S., Harmsen, S. C., Boyd, O. S., Field, N, Chen, R., Rukstales, K. S., Luco, N, Wheeler, R. L., Williams, R. A., and Olsen, A. H., 2014. "Documentation for the 2014 Update of the United States National Seismic Hazard Maps," U.S. Geological Survey Open-File Report 2014-1091.

2.3 Project Management and Meetings

- One (1) kickoff meeting with BART
- Twelve (12) biweekly general project check-in meetings via telecommunication conferencing

or in person meeting if the condition permits; attendees will include the project manager, and in specific instances others as required by the agenda topic

- Quality assurance and quality control compliance

2.4 PROJECT QUALITY PLAN

Jacobs will provide the QAQC training to the project team and will submit the Project Quality Plan to BART. For all the projects deliverables, Jacobs will perform the discipline and interdisciplinary quality reviews per the project specific quality plan. Jacobs will provide the summary quality assurance completion at each level of submittal.

Prime: Jacobs

Subconsultant	Amount	DBE (Y/N)	SBE (Y/N)
Furgo	$ 64,593	N	N

Total Work Plan Value: $ 198,868