

**Project Summary:**

**Client Contact:**

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**Services Provided:**

- **Geotechnical Studies**
- **Design Recommendations**
- **Laboratory Testing**
- **Geotechnical Consultation**

Cesare, Inc. (Cesare) conducted geotechnical studies and presented design recommendations for 7.6 miles of limited access freeway and 16 bridge structures around the northeast quadrant of the Denver Metropolitan Area. The E-470 Segment IV extends from Interstate 25 to 120th Avenue in Adams County. Design recommendations included bridge foundation systems, embankment construction, pavement design, groundwater drainage, and other construction issues. Unique geotechnical challenges included high groundwater in areas of deep cut, and highly expansive soils and claystone bedrock of the Denver Arapahoe Formations. Over 325 soil borings for roadways, bridge structures, and retaining walls were drilled and sampled. Laboratory testing included typical index property values, R-values, unconfined compressive strength, time consolidation, and direct shear. Recommendations were provided for pavement

sections, pipe and utility trench backfill, drilled pier bridge supports, driven pile bridge supports, spread-footing foundations, lateral loads on retaining walls, mechanically stabilized earth (MSE) wall soil parameters and global stability, and measures for groundwater control. Cesare also provided consultation on geotechnical issues during construction. Drilled straight shaft caissons were used to support the high structural loads of ramp piers and bridge intermediate supports. Caissons are typically 36 to 60 inches in diameter and support loads as high as 900 tons. Driven steel H-piles were used to support the bridge abutments and abutment wing walls. Piles were driven to a refusal criterion based on the results of pile driver analysis (PDA) testing. Cesare initially established a refusal depth at standard penetration test (SPT) N-values of 70 to 80. Actual pile driving records and the results of the PDA tests showed that this criterion was generally valid.

