



CITY COUNCIL AGENDA REPORT

Meeting Date: March 5, 2020

From: Director of Public Works/city Engineer

Subject: 400 Kings Road Slope Stability Evaluation

Community Goal/Result

Safe Community

Purpose

To receive the Geologic and Geotechnical Evaluation of Slope Stability prepared for the 400 block of Kings Road by Cotton, Shires and Associates.

Recommendation

Provide direction to staff on next steps to be taken.

Background

Notice of the unravelling of the slope on the uphill side vicinity of 400 Kings block was brought to the city's attention in late September 2019. A preliminary geotechnical evaluation was completed the next week, and per the geotech's recommendation, parking was prohibited at the toe of this slope. In mid-November, k-rail was installed as an additional protective measure to prevent loose rocks from migrating out into the travelway.

Concerned citizens from the neighborhood appeared at several council and committee meetings in the following months, expressing their desire for the restoration of the lost parking spaces. At its 11/21/19 meeting, City council approved \$30k for the initial investigation and preliminary design efforts.

Discussion

The attached report incorporates three pages of geologic engineering review that may be best left for study by experts in that field. The salient notes for general consumption are: the minor likely failures that are anticipated will likely be constrained by the currently installed k-rails, and a major seismic event and/or intense rainfall event could result in earth material overflowing the k-rail and blocking the roadway (but would not impact the downhill residences).

The following table discusses options currently reviewed and estimated for the council's consideration:

Option	Cost	Notes
No changes to current condition (leave k-rail in place)	No additional cost. De minimis amounts spent to date – city owned the k-rail, only new purchases were signs and posts	Protects against likely events. Does not protect roadway against seismic events. Does not protect uphill property. Does not restore pre-existing substandard parking & travelway. Protects downhill residences.
Install rock bolt and drapery (leave k-rail in place)	\$80,000*	Protects against likely and seismic events. Does not restore pre-existing substandard parking & travelway. Protects downhill residences.
Install 8-foot high soldier pile and wood lagging wall (remove k-rail)	\$160,000*	Protects against all anticipated events. Without some excavation of existing slope, would only restore a portion of pre-existing substandard parking & travelway. Protects downhill residences.
Grade to a natural, stable slope. (remove k-rail)	\$210,000* (excludes cost of land purchase)	Protects against all anticipated events. Dependent upon quantity of land purchased from uphill properties, could create a wider travelway and parking area. Protects downhill residences.
Shotcrete and soil nail wall (remove k-rail)	\$250,000*	Protects against all anticipated events. Without significant unaccounted for off haul, would only restore pre-existing substandard parking & travelway. Protects downhill residences.

*Note that these costs are very preliminary, and final numbers could and likely will vary significantly. Also note that these numbers are pure construction only, and exclude items such as contractor’s mobilization and demobilization, traffic control, costs to acquire uphill property for the fourth option, etc.

Fiscal Impact

Staff assumes any new work at this point in time would come from the General Fund.

Measure of Success

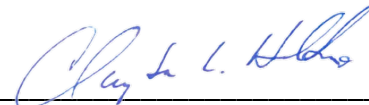
Protection of the public and public infrastructure.

Attachments

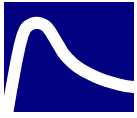
1. Cotton, Shires and Associates letter report dated January 10, 2020



Randy Breault, Public Works Director



Clay Holstine, City Manager



January 10, 2020

E5669

By Email (rbreault@ci.brisbane.ca.us) and by Mail

Randy Breault, P.E.
Director of Public Works
City of Brisbane
50 Park Place
Brisbane, CA 94005

SUBJECT: Geologic and Geotechnical Evaluation of Slope Stability
RE: Kings Road Stability
City of Brisbane, California

Dear Mr. Breault:

Cotton, Shires and Associates, Inc. (CSA) is pleased to provide the City of Brisbane with the results of our evaluation of the slope stability conditions along a segment of Kings Road, east of Beatrice Road. The subject segment of Kings road is approximately 120 feet in length. We understand that Kings Road is a publicly maintained roadway that is approximately 16 to 18 feet wide. We also understand that no development is currently proposed upslope of the subject roadway (i.e., 462 Kings Road). We visited the site on several occasions in December 2019, performed a topographic survey, observed surface conditions, and mapped pertinent geologic features. No subsurface exploration, laboratory testing of samples or installation of monitoring devices was conducted as part of this evaluation.

In the following letter-report, we discuss the purpose and scope of our work, the observed site conditions, our preliminary conclusions, and general recommendations regarding potential slope stability hazards impacting the public roadway and adjacent properties, along with the limitations of our services.

PURPOSE AND SCOPE OF WORK

The purpose of our slope stability evaluation was to: 1) identify pertinent geologic features at the site; 2) formulate conclusions regarding the potential slope stability hazards that could impact the public roadway and residents; and 3) provide recommendations for future action to address identified hazards.

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The specific scope of work performed for our investigation included the following tasks:

- 1) Review of technical documents and regional maps;
- 2) Conduct a ground-based topographic survey;
- 3) Geotechnical reconnaissance and geologic field mapping;
- 4) Geologic and geotechnical stability evaluations; and
- 5) Preparation of this letter-report.

OBSERVED SITE CONDITIONS

Regional geologic mapping of the site vicinity has identified sandstone and shale bedrock associated with the Franciscan Complex (Bonilla, M.G., 1998). This bedrock has been tectonically deformed, faulted and folded. An anticline fold is regionally aligned sub-parallel to the topographic ridge of San Bruno Mountain which trends approximately northwest-southeast. Reviewed regional maps do not identify landslide deposits in the site vicinity. Locally, the identified bedrock is mapped as dipping down to the northeast at approximately 35 to 50 degrees from horizontal. The subject site vicinity has not been included in state seismic hazard zone mapping efforts for earthquake induced landslides.

Based on the results of our topographic survey, the slope above Kings Road is up to 30 feet in height and is generally inclined at grades of 0.6H:1V to 1H:1V. We assume these precipitous slopes are cut slopes that were excavated during the original construction of Kings Road. Based on a review of historical aerial photographs construction of Kings Road occurred between 1930 and 1941. We observed sandstone and shale bedrock associated with the Franciscan Complex exposed in these cut slopes. The sandstone beds exposed are generally 1 to 2.5 feet thick and typically are bounded by laminated shale beds up to 1 inch thick. The in-place sandstone is moderately weathered and fractured and includes plagioclase feldspar. Roots were observed in open fractures and joints. The in-place shale was fissile, and hand samples easily crumbled. The results of our topographic surveying and geologic mapping are presented on Figure 1, Engineering Geologic Map and on Figure 2, Engineering Geologic Cross Section A-A'.

We measured the orientations of bedrock discontinuities including bedding planes, joints, and fractures. Planar bedding orientations at the site generally paralleled the roadway (strike orientations between 311 and 335 degrees), and were dipping between 43 and 52 degrees to the northeast (towards the roadway). We note that these bedding orientations are inclined shallower than the topography of slope. This geometric configuration is commonly referred to as a "dip-slope condition" where relatively weaker geologic features (e.g., bedding planes) daylight from a slope. This dip-slope condition is illustrated on Figure 2, Engineering Geologic Cross Section A-A'. Conjugate joints were

noted with plane intersections that also trend and plunge out of the slope. It appears that recent minor wedge or slab failures along the slope resulted in blocks of friable/soft weathered bedrock accumulating at the toe of the slope. This slope debris was effectively restrained from entering the roadway by K-rails that we understand were recently installed.

In the vicinity of Beatrice Road, it appeared that a translational slab failure had previously evacuated from the slope along a shale bedding plane (Figure 3). Concrete and steel were observed on the exposed slope that we assume were intended to retain bedrock blocks upslope of the previous failure. This failure was located upslope of the intersection between Beatrice Road and Kings Road. Surficial colluvium and artificial fill earth materials were observed at the top of the cut slope (462 Kings Road) and on portions of the slope inclined approximately 1H:1V (100 percent). Existing foundations were observed at 462 Kings Road in proximity to the top of the cut slope, and we also observed a functioning water spigot located adjacent to an existing foundation footing (Figure 1). It is unclear if this spigot may be damaged and leaking water into the subsurface.

PRELIMINARY CONCLUSIONS AND GENERAL RECOMMENDATIONS

Based on our geotechnical and geologic evaluations it appears that the subject portion of Kings Road is primarily constrained by oversteepened slopes and dip-slope geologic conditions, along with anticipated strong seismic ground shaking. These constraints contribute to a relatively increased potential for future rock-slope failures to impact the roadway. **If no action is taken, the City of Brisbane should anticipate small rock-slope type failures to continue to impact the slope and roadway.** We find that these minor wedge failures resulting from adverse dip-slope conditions or joint orientations will likely be contained by the currently installed K-rails at the toe of the slope, assuming periodic clearing of slope debris if/when a shallow failure or continued raveling occurs. We note that we have not observed surficial geomorphic features or distress suggesting imminent instability beneath the subject portion of Kings Road.

Based on our visual observations and completed topographic survey we estimate that a significant slope failure could deposit up to 500 to 750 cubic yards of earth material on the roadway. Our estimate is based on a conceptual bedding plane (assumed failure surface) oriented at 45 degrees from horizontal that parallels the roadway and intersects the slope at the roadway elevation. A failure of this nature could 1) occur during a significant seismic event or following prolonged and/or intense rainfall; 2) would significantly impact the upslope property (462 Kings Road); and 3) would likely temporarily block the roadway, because the K-rail will not have the necessary storage capacity or lateral resistance to contain the failure.

It is our recommendation that no development (e.g., building permits or equivalent) should be permitted on the property directly upslope of the subject roadway without an adequate geotechnical investigation and implementation of mitigation measures reviewed and accepted by the City. We understand that the currently installed K-rails block portions of the roadway that were used for parking by neighboring residents. If the City determines that the current level of roadway protection (K-rails blocking portions of the roadway) is insufficient including likely temporary closure of the roadway following significant failures, then alternative mitigation measures should be considered.

In the following section we provide general recommendations and conceptual mitigation measures to improve the relative stability of the slope adjacent to the roadway and reduce the potential risk for adverse impacts from observed geotechnical and geologic conditions. The most significant geotechnical hazard to the roadway and adjacent properties is the dip-slope condition upslope of Kings Road. Our evaluation did not include quantitative slope stability analysis or geotechnical laboratory testing.

General Recommendations

The City of Brisbane should consider the following:

- 1) **Maintained and/or increased containment of anticipated minor slope failures.** This mitigation concept would include maintenance of the current K-rail installation to mitigate the potential for shallow failures or slope debris from entering the functioning roadway. This containment could be improved with further installation of mesh/drapery netting or equivalent on the slope. We find that this level of mitigation (K-rails and netting or equivalent) would appropriately mitigate the potential for minor wedge or block failures along the subject slope.
- 2) **Temporarily shutting off water service from 462 Kings Road** while it remains undeveloped (if possible). We note that water could remain servicing the unoccupied property if a qualified professional concludes that no water is leaking from existing site improvements into the subsurface.
- 3) **Additional mitigation measures (e.g., retaining wall or internal slope reinforcing)** if the potential for roadway closure, the potential for significant failures, or the current level of mitigation is found unacceptable by the City. Internal strengthening could be achieved with a combination of rock bolts and drapery, or rock bolts and shotcrete. Alternatively, the slope could be buttressed by an engineered retaining wall at the toe of the slope. Detailed mitigation concepts and designs would require additional geotechnical investigation and laboratory testing to derive appropriate

geotechnical design recommendations and criteria. This level of mitigation could be designed to resist the potential of larger rock-slope failure and probable seismic conditions.

- 4) **Alternatively**, the City could acquire a portion of the upslope property (462 Kings Road) and grade the slope to a more stable gradient considering the site's dip-slope geologic condition. This alternative may require an extended closure of the roadway to complete grading improvements, would require use of the public roadway to haul excess cut materials off-site, and would restrict the buildable area of 462 Kings Road.

We are available to discuss these general recommendations, and discuss potential further action as needed. Please let us know how we can best be of service moving forward.

LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted engineering geology and geotechnical engineering principles and practices. No warranty, expressed or implied, or merchantability of fitness, is made or intended in connection with our work, by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings.

This report is based solely on a reconnaissance-level evaluation without benefit of subsurface exploration and/or laboratory testing. Such additional work would be necessary to provide final design recommendations.

We trust that this provides you with the information that you need at this time. If you have any questions, or need additional information, please call.

Respectfully submitted,

COTTON, SHIRES AND ASSOCIATES, INC.



David T. Schrier
Principal Geotechnical Engineer
GE 2334



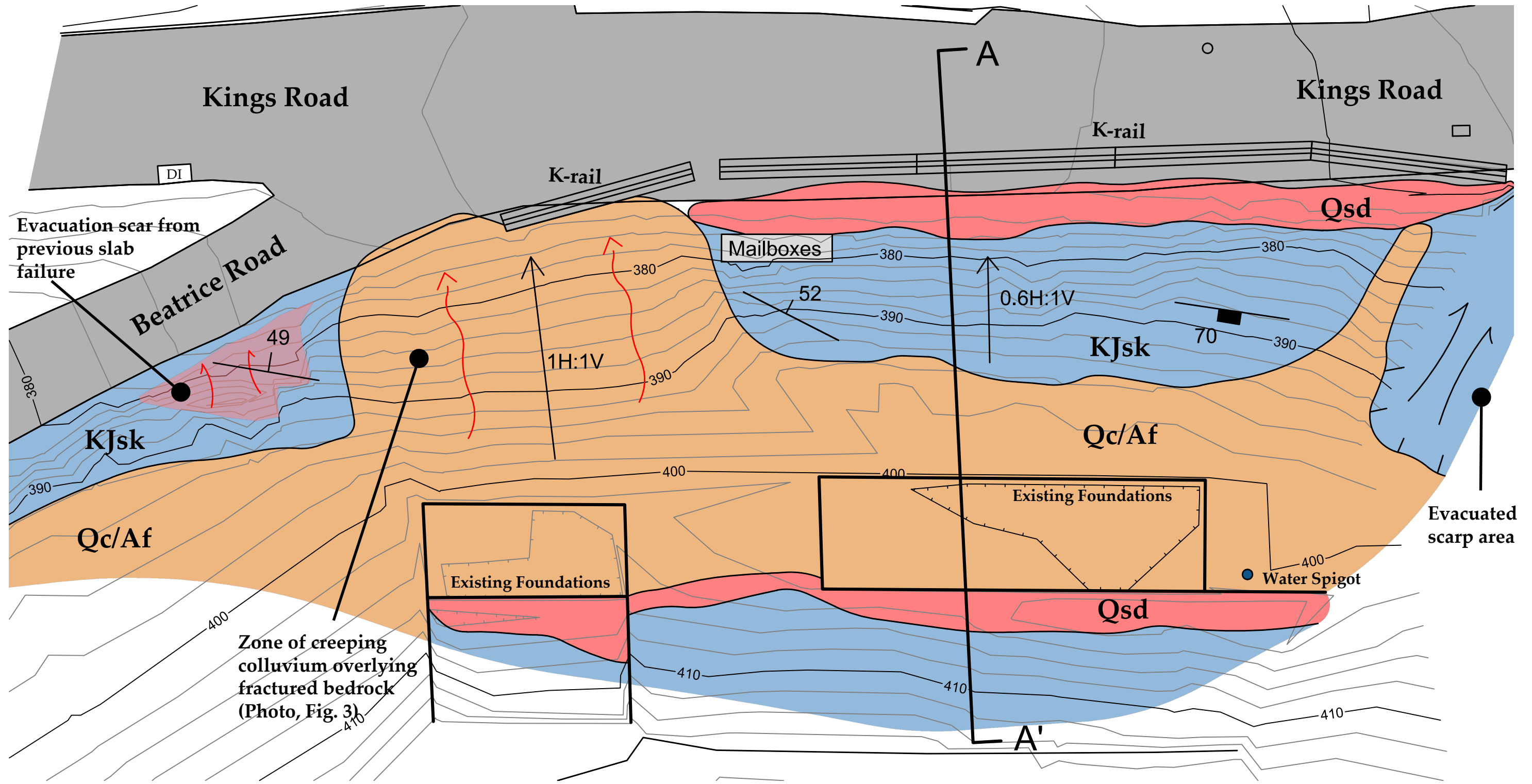
Craig Stewart
Senior Geologist

AM:DTS:CS:st

Attachments:

- 1) Figure 1, *Engineering Geologic Map*
- 2) Figure 2, *Engineering Geologic Cross Section A-A'*
- 3) Figure 3, *Annotated Photograph*

COTTON, SHIRES AND ASSOCIATES, INC.

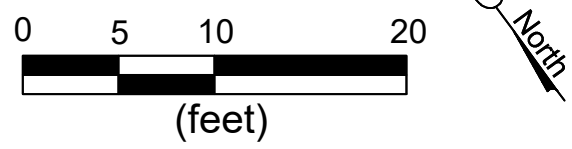


Explanation:

- Qsd Slope debris, including soft blocks of KJsk (up to 1' diameter) and soil
- Qc/Af Colluvium and undocumented fill, soil materials
- KJsk SANDSTONE AND SHALE: See Cross- Section. (Fig. 2)

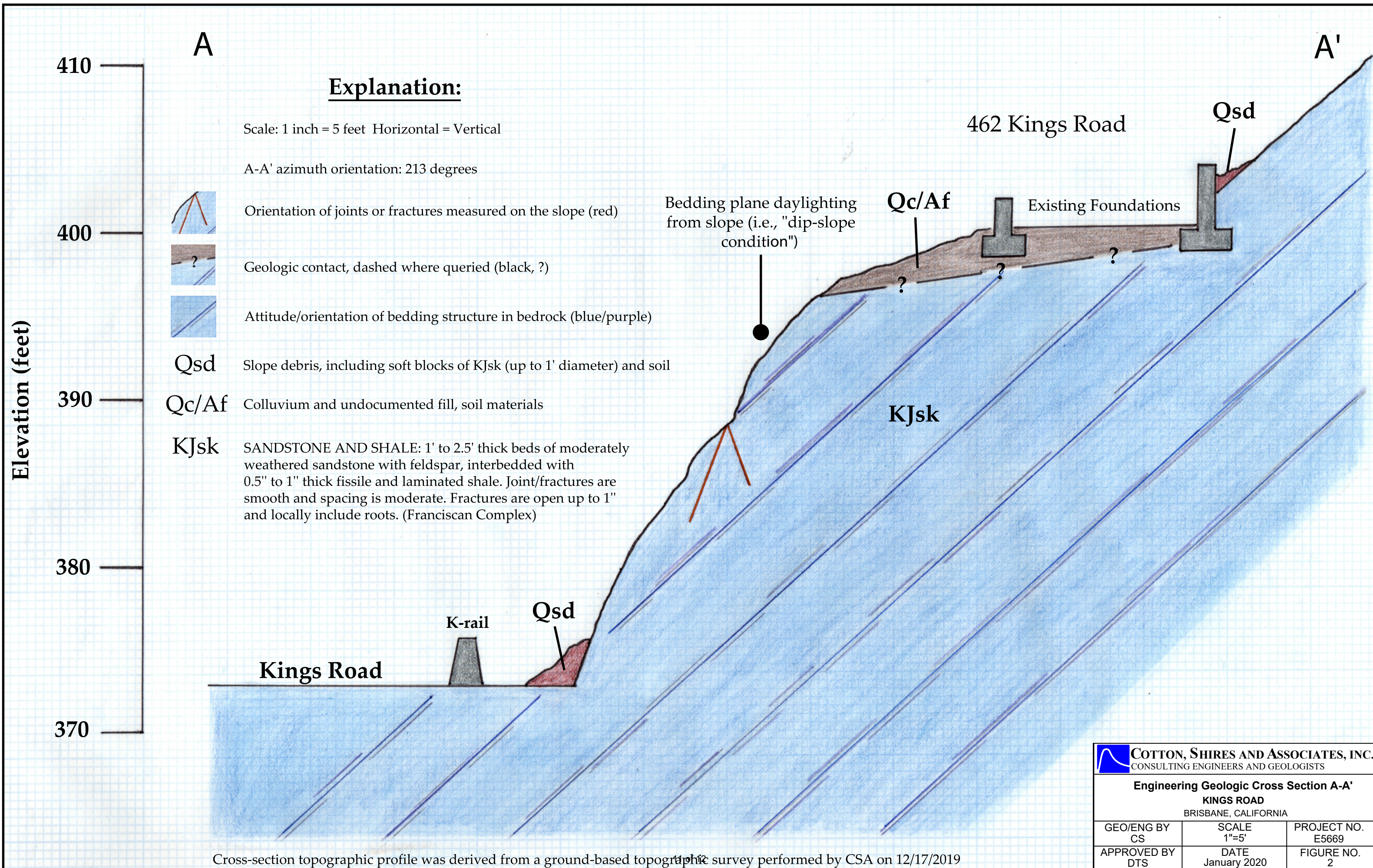
Bedding Attitudes	Joint Orientations
*319, 49 NE	*139, 70 SW
313, 43 NE	209, 64 NW
311, 52 NE	113, 58 SW
*330, 52 NE	226, 54 NW
335, 51 NE	198, 80 W

* measurements plotted on map



Topographic contours were derived from a ground-based topographic survey performed by CSA on 12/17/2019

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ENGINEERING GEOLOGIC MAP KINGS ROAD BRISBANE, CALIFORNIA		
GEO/ENG BY CS/TRH	SCALE 1"=10'	PROJECT NO. E5669
APPROVED BY DTS	DATE January 2020	FIGURE NO. 1



Cross-section topographic profile was derived from a ground-based topographic survey performed by CSA on 12/17/2019


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Engineering Geologic Cross Section A-A' KINGS ROAD BRISBANE, CALIFORNIA		
GEO/ENG BY CS	SCALE 1"=5'	PROJECT NO. E5669
APPROVED BY DTS	DATE January 2020	FIGURE NO. 2



Figure 3: Photograph taken from Beatrice Road facing southeast towards Kings Road. In the fore-ground, fractured sandstone and shale bedrock of the Franciscan Complex is exposed on the slope. It appears that a previous rock-slope failure along a bedding plane (orientation annotated in purple) may have exposed this bedrock outcrop. Colluvial slopes are inclined at grades of approximately 100 percent (1H:1V Slope Gradient).