GUIDELINES

For Preparing

DISTRICT PRELIMINARY GEOTECHNICAL REPORTS

VERSION 1.0

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DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

DPGR Outline/ Table of Contents

District Preliminary Geotechnical Report

The District Preliminary Geotechnical Report (DPGR) provides preliminary recommendations to District Project Engineers in Design and Planning, and Environmental Planners to develop the Project Initiation Documents, Environmental Documents, and Project Reports. This report is prepared to document anticipated geotechnical conditions based upon site reconnaissance and available data for the various project alternatives under consideration.

1. **Executive Summary**

   Briefly summarize, in one page where practicable, the proposed project, the purpose of the District Preliminary Geotechnical Report, major geologic hazards, and the preliminary geotechnical conclusions and recommendations presented in the body of the report.

2. **Introduction**

   Identify the proposed project by summarizing the underlying need for the project and presenting the type of facility (new highway alignment, bridge, maintenance facility, widening, etc.) being proposed to meet the need. Identify the project using Caltrans format of District-County-Route-Post Mile limits and Expenditure Authorization. Present a small scale Vicinity Map to help orient the reader to the area of California being discussed.

3. **Pertinent Reports and Investigations**

   Summarize the literature used in researching the geotechnical conditions for this project. The literature may be geologic and/or topographic maps, aerial photographs, previously completed geotechnical reports for this or adjacent projects, reports for the overall geology of the region, or others. Consider including pertinent maps in an appendix.

   Describe the investigations, such as walk-through or aerial site reconnaissance, which may have been conducted for this report by the geotechnical staff. If separate reports or memoranda were prepared describing such investigations, they should be referenced here. Include a short explanation that the information presented in the District Preliminary Geotechnical Report is from surficial reconnaissance, literature study and available subsurface information.

4. Description of Project Alternatives and Existing Facilities

With the aid of a Site Plan, describe the geometric design of the various alternatives considered. Rank, discuss, and evaluate each alternative being proposed.

Describe existing facilities that may be relevant to the proposed project alternatives. For example, describe the heights, slope ratios, constituent materials and performance of existing cut and fill slopes and/or the types, and performance of existing pavements.

5. Physical Setting

5.1 Climate

The ranges of temperatures in the vicinity of the project and average maximum and minimum rainfall in inches should be presented. If possible, specify the months of heavy rain or snow, so the construction can be planned accordingly. Note the potential for frost heave, if appropriate.

5.2 Topography & Drainage

For each alternative, describe the topography and the drainage patterns, as they will be affected by the proposed project. For example, discuss hills and ridges, which will require cuts for given alternatives and the approximate depths of the cuts. Describe valleys to be traversed by embankment and slopes to receive side hill cuts or fills. Note drainage patterns including creeks, intermittent streams, and rivers.

5.3 Prior Land Use

Reference any known environmental site assessments for the project limits or obvious evidence at the surface, such as in-place mitigation units.

5.4 Man-made and Natural Features of Engineering and Construction Significance

At times, proposed alternatives may abut or parallel certain features, which, although outside the proposed right of way, could be adversely affected by the project. Embankment placed upslope of a wall may surcharge the wall, even though the toe of fill is located well back from the wall. As another example, cuts which remove support or which remove confinement from old fills can reduce the

lateral support of structures well outside of the right-of-way. Such conditions should be identified in this part of the report for later consideration. Similarly, features which may require added clearance through steeper, or retained, cut and fill slopes should be identified.

6. Geology

6.1 Regional

Briefly describe the regional geologic setting of the project area including geomorphic province, major geologic features (such as mountain ranges and valleys) and major characteristics such as depth of alluvium over basement rock, geomorphology, basic rock types, etc. as it pertains to the geotechnical aspects of the project.

6.2 Site

Based on a literature search, existing borings and site reconnaissance, describe the site geologic setting as it relates to the project. Include geologic formations, contact locations, and geologic structure. Reference the reports that contain boring information that were used in describing the site geology. For smaller projects, a geologic or soil- profile may be appropriate. Briefly describe known naturally occurring hazardous formations (e.g. methane gas, serpentine, etc) that could affect the project. Include in this discussion the potential for encountering these formations during construction of the project. Also, describe any fossil bearing units that may occur within the project limits. If fossil bearing units do occur within the project limits, an additional paleontological investigation may be required. Relate these features to specific areas of the project. A preliminary geologic map is required.

6.3 Soils

Briefly describe soil types that occur on the project site. Discuss soil type within NRCS Hydrologic Soil Group. Describe infiltration rates, if available. Provide the soil survey mapping designation used and reference (e.g. California Soil/Vegetation Survey, USDA Soil Survey). Provide enough soils information to answer all geotechnical related questions on the Storm Water Data Report.

6.4 Faulting and Seismicity

Using the Caltrans ARS Online tool[1] and the Caltrans Fault Database[2], provide a map of known active faults in the project vicinity. Also provide a table of these faults including fault type, maximum moment magnitude (**M**Max) earthquake, slip rate, age, and nearest distance from the fault to the site/project (R_{RUP}). The controlling peak ground acceleration (PGA) is based on the upper envelope of the deterministic and probabilistic response spectra as defined in the current Seismic Design Criteria, Appendix B[3]. Estimate PGA using the ARS Online tool. Use the y-intercept at the 0-second period. If a project covers a large area, the estimated PGA may vary significantly (e,g,10% or more) within the project. The controlling fault may be different at one end of the project than it is at the other. Use the ARS tool to estimate PGA at several places in the project, choosing sites as close to active faults as possible within the project limits. If the difference between values is significant, two or more values may be presented.

Using the ARS online tool, determine if any portion of the project site is included in a regulatory California Geological Survey (CGS) Alquist-Priolo Earthquake Fault Zone (AP EFZ) or within 1000 feet of a fault with ruptop=0 but not included in an AP EFZ and active within Holocene time (the past 10-15,000 years) **as** shown in the ARS Online Tool and listed in the Caltrans Fault Database. Include a map showing the project and the fault, using either the AP EFZ map (for a zoned fault) or a screen shot of the ARS online tool printout (for an unzoned fault) showing the site and the fault.

[1]Caltrans ARS Online tool:
http://dap3.dot.ca.gov/ARS_Online/

[2]Caltrans Fault Database:
Caltrans Fault Database V2 (Excel File)

[3] Caltrans Seismic Design Criteria:
Caltrans Seismic Design Criteria, Appendix B

[4]California Geological Survey Alquist-Priolo Earthquake Fault Zones:
http://www.conservation.ca.gov/cgs/rghm/ap/Pages/Index.aspx

7. Geotechnical Conditions

7.1 Groundwater

7.1.1 Groundwater Regime

Describe the general groundwater regime, making note of springs, artesian conditions, perched water, geologist barriers such as faults, and historic depth range.

7.1.2 Groundwater Regime Effects

Discuss the potential for permanent cuts or dewatering installations to lower the water table, hampering use by offsite users or causing settlement to nearby structures. Discuss any existing conditions wherein embankments could reduce aquifer transmissibility causing undesirable springs or seeps upslope, and lowered water table down slope.

7.2 Erosion

Note the performance as it pertains to erosion of existing cut, fill, and natural slopes, describing the slope angle, height, degree of rilling, sloughing and aspect azimuth of problem slopes.

When requested, provide an estimate or range for the soil erodibility factor *k* for soil slopes (based on gradation if no published values are located), and qualitative assessment of rock slopes in terms of erosion potential (e.g., comment on existing talus piles, contact Maintenance to discuss shoulder and ditch clearing frequency). In general, most rock slopes will pose a much lower problem with respect to erosion potential than most soil slopes.

7.3 Seismic Hazards

Using sections 3, 6.4, and literature reviews, discuss the impact of both primary and secondary seismic hazards on the project. Discuss the need for further study, if any, and preferred scheduling of additional work.

7.3.1 Primary Seismic Hazards

The report should identify any seismic studies needed for the design of the entire project.

Identify if a project vicinity is likely to experience strong ground motion (e.g., greater than 0.3 g) (seismic shaking) based on PGA. Ground motion estimation depends on parameters such as fault location and magnitude, VS30, and basin effects. Discuss the reliability of these parameters and if further work is needed to better characterize the parameters. Note that if for example the project is for roadway construction, refinement of ground motion parameters is probably not necessary. However if a bridge is being planned, a detailed study of ground motion may be in order.

Fault rupture should be addressed per Caltrans Memo to Designers 20-10 [5] if any portion of a project is located within an AP EFZ or within 1000 feet of an unzoned fault active within Holocene time (the past 10-15,000 years). For roadways, the scope of work will probably only include a rough estimate of the fault location. For a bridge, a more accurate location than provided on the AP EFZ map or ARS Online is needed and an estimate of displacement is required if there is potential for fault rupture at the bridge. See **Fault Rupture** website[6] for links and more information.

7.3.2 Secondary Seismic Hazards

Depending on the project scope, identify if a project could be affected by secondary seismic hazards including liquefaction, seismically-induced (dry) settlement, seismically-induced slope failure, rock fall and landslides, and seiches and tsunamis. Include a general discussion of the potential for these and any other secondary seismic hazards, possible mitigation measures, and the need for additional study. Information can be obtained from existing borings and reports found in GeoDOG [7], CGS Seismic Hazard Zone Maps[8] if available, or information on groundwater levels and well completion data from the California Department of Water Resources (DWR) [9].

[5] MTD 20-10: Fault Rupture:
Implementation Memo for MTD 20-10 (Mar. 2013)

MTD 20-10 (Jan. 2013)

[6] Fault Rupture:
Caltrans Fault Rupture Team web site

[7] GeoDOG (Digital Archive of Geotechnical Data):
http://svgcgeodog.dot.ca.gov/

[8]CGS Seismic Hazards Zonation Program:
http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx

[9] DWR Water Data Library:
http://www.water.ca.gov/waterdatalibrary/

7.4 Slope Stability and Rockfall

Describe the potential for rock fall, slope instability, and landslides within the project limits. Investigate the rock fall, landslide, and storm damage history within the project limits and nearby that may pertain to the project. Discuss previous failures, the repairs that were done and how they have performed. Describe geologic structure that could lead to failure e.g. bedding and discontinuity orientations that could lead to rock toppling or translational failures. Note features such as landslide scars or excessive rock/soil debris at the bottom of existing cuts or natural slopes. Note the slope and performance of existing cuts and slopes. Identify areas that will require remediation.

Discuss options for proposed cuts or walls and the impacts of the proposed project on the existing stability of slopes within the project limits.

7.5 Excavation Characteristics

Describe the excavation characteristics of the geologic materials on the site based on literature study, reconnaissance, and local experience. Identify areas where specialized techniques such as blasting or the use of mechanical breaking will be needed to excavate geologic materials. These methods will affect the preliminary cost estimates for earthwork.

7.6 Embankments

7.6.1 Embankment Foundations

Discuss embankment foundation stability, settlement, peat layers, and side hill fill stability. Is the project area known to have a settlement problem? What is the previous settlement experience in the area of the project? Are there underground openings such as tunnels, shafts, caves, etc. that will need backfilling? Where applicable, list the treatments previously used in the area and their performance history. Identify potential treatments for this project. Identify possible impacts that settlement or treatment may have upon the construction schedule, e.g. settlement periods.

7.6.2 Embankment Materials

If sources of embankment material can be tentatively identified, describe their location, availability and suitability of materials including soil classification, compaction characteristics, and need for moisture modification.

7.7 Volumetric Stability of Embankment and Subgrade Materials

Identify, describe, and locate observed distress due to volumetric instability, such as expansive, or collapsible or dispersive soils. Also cite pertinent literature sources.

7.8 Other Potential Geologic Hazards

Describe other potential geologic hazards and geotechnical concerns such as; scour, adverse geologic structures, naturally occurring asbestos, snow avalanches, mineral resources; petrology; tsunamis/seiches; and geothermal activity; that have not been discussed above.

8. Hazardous Waste Potential

Indicate if hazardous waste has been identified on the project and reference existing hazardous waste studies or reports.

9. Preliminary Recommendations and Conclusions

9.1 Future Exploration and Investigations

Describe the timing and extent of field explorations, laboratory testing, and any other investigations needed to complete the Geotechnical Design Report (GDR). Recommend types of exploration needed such as borings, test pits, cone penetrometer studies, geophysical studies, fault studies etc. Note the need for and possible time delays associated with acquiring encroachment permits, environmental permits, rights of entry and any other clearances, and building access roads and drilling pads. A rough estimate of time (in months/weeks/days) needed to produce the GDR should be given.

9.2 Embankments

Present preliminary recommendations for the proposed embankment foundation may need a variety of treatments (e.g., wick drain, geotextiles, stabilization trenches, buttress construction, berms, geotextile reinforcement, wick drains, subexcavation, underdrains and surcharges). These should be mentioned. Preliminary cost data should be included for various alternatives.

9.3 Excavations

Providing preliminary recommendations concerning the slopes of cuts consistent with the geology and geotechnical aspects. If benches are proposed, schematic sections consistent with assumed geotechnical parameters should be presented.

9.4 Retaining Wall Alternatives

Briefly discuss the various preliminary wall types being considered (e.g. Type 1, Type 5, Soldier Pile Ground Anchor, Soil Nail, Mechanically Stabilized Embankment, Secant, etc.).

9.5 Groundwater Control

If dewatering (during construction and long term) is anticipated either due to high ground water table or permanent seeps, recommendations for drawdown tests and other investigative methods should be incorporated during the field exploration for the final GDR. Alternatives to dewatering, if any, which could reduce the cost of the project, should be mentioned.

Discuss potential secondary effects of dewatering, such as settlement of offsite facilities. Discuss the need for underdrains, blanket drains, horizontal drains, transverse cutoff drains at cut/fill contacts, or drainage galleries. Discuss any geotechnical implications to dewatering such as settlement to offsite areas. Discuss the effect of the groundwater table on selection of alignment or profile. If an alternative might extend below the normal groundwater table, discuss the effects of buoyancy on the structural section. Discuss the need for dewatering during construction of wall footing or piers.

9.6 Other Considerations

Add sections and headings for any other recommendations such as slope stability, landslide mitigation, Seismic hazards etc.