# EXHIBIT 11-A GEOMETRIC DESIGN STANDARDS FOR LOCAL 3R PROJECTS

## GEOMETRIC DESIGN STANDARDS FOR LOCAL 3R PROJECTS

### Table 11-1: Lane and Shoulder Widths Arterial Roads and Streets

| Design Year Volume (ADT) | Design Speed (mph) | Lane Width (feet) | Shoulder Width [a] (feet) | Total Roadway Width (feet) |
|---|---|---|---|---|
| Low Volumes: | | | | |
| 1 - 750 ADT | All | 10 | 2 | 24 |
| High Volumes: | | | | |
| 751 - 2,000 ADT | All | 12 | 2 [b] | 28 [c] |
| Over 2,000 ADT | All | 12 | 6 [b] | 36 [c] |

[a] All shoulders on rural and urban arterials to be paved.

[b] Reduce by 1 foot for highways on mountainous terrain.

[c] Reduce by 2 feet for highways on mountainous terrain.

### TABLE 11-2: LANE AND SHOULDER WIDTHS COLLECTOR ROADS AND STREETS

| Design Year Volume (ADT) | Design Speed [a] (mph) | Lane Width (feet) | Shoulder Width [b] (feet) | Total Roadway Width (feet) |
|---|---|---|---|---|
| Low Volumes: | | | | |
| 1 - 750 ADT | All | 10 | 2 | 24 |
| High Volumes: | | | | |
| 751 - 2,000 ADT | Under 50 | 10 | 2 [c] | 24 [d] |
| | 50 and over | 12 | 2 [c] | 28 [d] |
| Over 2,000 ADT | All | 12 | 4 [c] | 32 [d] |

[a] Highway segments should be classified as “under 50” only if most vehicles have an average speed of less than 50 mph over the length of the segment

[b] All shoulders on collector roads and streets to be paved.

[c] Reduce by 1 foot for highways on mountainous terrain.

[d] Reduce by 2 feet for highways on mountainous terrain.

## TABLE 11-3: LANE AND SHOULDER WIDTHS LOCAL ROADS AND STREETS

| Design Year Volume (ADT) | Design Speed [a] (mph) | Lane Width (feet) | Shoulder Width (feet) | Total Roadway Width (feet) |
|---|---|---|---|---|
| Low Volumes: | | | | |
| 1 - 750 ADT | All | 10 | 2 | 24 |
| High Volumes: | | | | |
| 751 - 2,000 ADT | Under 50 | 10 | 2 [b] | 24 [c] |
| | 50 and over | 12 | 2 [b] | 28 [c] |
| Over 2,000 ADT | All | 12 | 4 [b] | 32 [c] |

[a] Highway segments should be classified as “under 50” only if most vehicles have an average speed of less than 50 mph over the length of the segment

[b] Reduce by 1 foot for highways on mountainous terrain.

[c] Reduce by 2 feet for highways on mountainous terrain.

## TABLE 11-4: LANE WIDTHS URBAN ROADS AND STREETS

| TYPE OF LANE | MINIMUM WIDTH(FEET) |
|---|---|
| Curb Lane | |
| No Parking Anytime [a] | **11** |
| Part-time Use (peak hour/high volume/low speed) | **9** |
| With Parking | **19** |
| Interior Lane | **10** |
| Lane Adjacent to Median | |
| Raised Curb | **10** |
| Painted Median | **10** |
| Left-Turn Lane | |
| One-Way (one lane only) | **10** |
| Two-Way (continuous) | **10** |
| Bicycle Lane (Within Roadway) | |
| One-Way | **4** |
| Bicycle Lane and Parking (One-Way) | **12** |

[a] A 1 foot curb lane, with up to 2 feet wide gutter, may be used at intersections.

### TABLE 11-5: BRIDGES ON ARTERIAL ROADS AND STREETS

| Design Year Volume (ADT) | Minimum Usable Bridge Width [a] |
|---|---|
| 1 - 750 | Width of approach lanes [b] |
| 751 - 2,000 | Width of approach lanes plus 2 feet each side |
| 2,001 - 6,000 | Width of approach lanes plus 4 feet each side |
| Over 6,000 | Width of approach lanes plus 8 feet each side |

[a] If lane widening is planned as part of a 3R project, the usable bridge width should be compared with the planned width of the approaches after they are widened.

[b] Minimum usable bridge width to be 24 feet.

### TABLE 11-6: BRIDGES ON COLLECTOR ROADS AND STREETS

| Design Year Volume (ADT) | Minimum Usable Bridge Width [a] |
|---|---|
| 1 - 750 | Width of approach lanes [b] |
| 751 - 2,000 | Width of approach lanes plus 2 feet each side |
| 2,001 - 6,000 | Width of approach lanes plus 4 feet each side |
| Over 6,000 | Width of approach lanes plus 8 feet each side |

[a] If lane widening is planned as part of a 3R project, the usable bridge width should be compared with the planned width of the approaches after they are widened.

[b] Minimum usable bridge width to be 24 feet.

### TABLE 11-7: BRIDGES ON LOCAL ROADS AND STREETS

| Design Year Volume (ADT) | Minimum Usable Bridge Width [a] |
|---|---|
| 1 - 750 | Width of approach lanes |
| 751 - 2,000 | Width of approach lanes plus 2 feet each side |
| Over 2,000 | Width of approach lanes plus 4 feet each side |

[a] If lane widening is planned as part of a 3R project, the usable bridge width should be compared with the planned width of the approaches after they are widened.

## TABLE 11-8: HORIZONTAL AND VERTICAL ALIGNMENT ARTERIAL ROADS AND STREETS

| Design Speed (mph) | Minimum Stopping Sight Distance (feet) | Minimum Radius of Horizontal Curve (feet) | | Maximum Grade (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Super-Elevation 10% (a) | Super-Elevation 8% (b) | Rural | | | Urban | | |
| | | | | Level | Rolling | Mountains | Level | Rolling | Mountains |
| 30 | 200 | 230 | 250 | ... | ... | ... | 8 | 9 | 11 |
| 40 | 275 | 430 | 470 | ... | ... | ... | 7 | 8 | 10 |
| 50 | 400 | 695 | 765 | 4 | 5 | 7 | 6 | 7 | 9 |
| 60 | 525 | 1,090 | 1,205 | 3 | 4 | 6 | 5 | 6 | 8 |

[a] Generally, superelevation should not exceed 10 percent.
[b] Superelevation should not exceed 8 percent where snow and ice conditions prevail.

## TABLE 11-9: HORIZONTAL AND VERTICAL ALIGNMENT COLLECTOR ROADS AND STREETS

| Design Speed (mph) | Minimum Stopping Sight Distance (feet) | Minimum Radius of Horizontal Curve (feet) | | Maximum Grade (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Super-elevation 10% (a) | Super-elevation 8% (b) | Rural | | | Urban | | |
| | | | | Level | Rolling | Mountains | Level | Rolling | Mountains |
| 20 | 125 | 100 | 105 | 7 | 10 | 12 | 9 | 12 | 14 |
| 30 | 200 | 230 | 250 | 7 | 9 | 10 | 9 | 11 | 12 |
| 40 | 275 | 430 | 470 | 7 | 8 | 10 | 9 | 10 | 12 |
| 50 | 400 | 695 | 765 | 6 | 7 | 9 | 7 | 8 | 10 |
| 60 | 525 | 1,090 | 1,205 | 5 | 6 | 8 | 6 | 7 | 9 |

[a] Generally, superelevation should not exceed 10 percent.
[b] Superelevation should not exceed 8 percent where snow and ice conditions prevail.

### TABLE 11-10: HORIZONTAL AND VERTICAL ALIGNMENT LOCAL ROADS AND STREETS

| Design Speed (mph) | Minimum Stopping Sight Distance (feet) | Minimum Radius of Horizontal Curve (feet) | | Maximum Grade (%) | | |
|---|---|---|---|---|---|---|
| | | Super-Elevation 10% (a) | Super-elevation 8% (b) | Rural | | |
| | | | | Level | Rolling | Mountains |
| 20 | 125 | 100 | 105 | 8 | 11 | 16 |
| 30 | 200 | 230 | 250 | 7 | 10 | 14 |
| 40 | 275 | 430 | 470 | 7 | 9 | 12 |
| 50 | 400 | 695 | 765 | 6 | 8 | 10 |
| 60 | 525 | 1,090 | 1,205 | 5 | 6 | ... |

[a] Generally, superelevation should not exceed 10 percent.
[b] Superelevation should not exceed 8 percent where snow and ice conditions prevail.

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# EXHIBIT 11-C FOUNDATION INVESTIGATIONS FOR DESIGN

## FOUNDATION INVESTIGATION
## FOR DESIGN

A foundation investigation and report is required for all proposed structure sites. The study and report shall be made by a California licensed Engineering Geologist or Civil Engineer, who specializes in foundations. The report shall, at a minimum, address all "applicable" topics shown in the following Caltrans checklist.

Specific attention is directed to appropriate sections of the *Caltrans Bridge Design Specifications*, Section 4- "FOUNDATIONS." All driven pile support recommendations shall consider the use of Caltrans Standard Class 45 or Class 70 piles using design loads of 45 and 70 tons, respectively.

A Log of Test Borings sheet shall be drafted and included as part of the foundation report, and as part of the structure plans.

## CHECKLIST FOR STRUCTURE FOUNDATION STUDIES
## AND REPORTS

### LOG OF TEST BORINGS SHEET

A log of Test Borings sheet (similar to Caltrans' sheet) shall be included as part of the Foundation Report. Show the location of each boring or test pit in plan view. Logs of all borings shall be shown in an elevation or profile view on the sheet. Information which should be shown on plots of test borings is as follows:

1. Diameter, type, and date of boring.
2. Location of borings with respect to stationing along survey lines for the proposed project.
3. Elevation of the top of each boring, etc.
4. Description of samplers, sampling methods, and in-situ tests.
5. Test results including Standard Penetration Test. Results of the Standard Penetration Test (ASTM D-1586-84) shall be presented so that quick correlation with the Caltrans data base may be made.
6. Soil or rock descriptions and elevations of strata.
7. Groundwater elevation and date of measurement should be shown adjacent to the boring or test pit where taken.
8. Location, description, and elevation or the benchmark used for determining the top-of-hole elevations shown on the Log of Test Borings.
9. Name and position or title of person conducting the field study.
10. Name and position or title of the registered Engineering Geologist or Civil Engineer approving the "Log of Test Boring Sheet."

# WRITTEN REPORT

A written report shall be prepared, which shall contain an interpretation and analysis of the foundation conditions based upon all available sources of data. Data may come form new or previous exploration programs, laboratory testing, and nearby construction experience, performance of nearby structures, etc. A short description of site topography geology should be included. Emphasis should be placed on slope stability of cuts and excavations, unusual groundwater conditions, springs, etc. All sources of information should be cited. The materials and conditions, which may be encountered during construction, shall be discussed. Problems involving design and construction should be anticipated and recommendations made for their solution. The recommendations shall be brief, concise, and definite. Reasons for recommendations and their supporting data shall always be included. Methods used for calculating pile capacities and soil-bearing capacities should be mentioned for ease of review. Extraneous data, which are of no use to the designer or Resident Engineer, should be omitted.

The written report shall be include, but not limited to, information and recommendations regarding applicable items in the following lists:

## 1. TYPING OF FOUNDATION

A. Pile Support (Driven or Cast-In-Drilled-Hole)

1. Method of support (skin friction and/or end bearing) in rock or soil or both.
2. Suitable pile type(s)-reasons for choice and/or exclusion or types. When appropriate, Caltrans' standard piles should be used.
3. Pile tip elevation
   a. Specified (use of "indicator piles" is not acceptable.)
   b. Probable
   c. Need for pre-drilling or jetting
4. Pile Design Load and Ultimate Capacity in compression and tension. Specify the Safety Factor.
5. Reduction of pile capacity due to negative skin friction.
6. Requirement for load test. Specify which portion of the structures' foundation will be controlled by the test.
7. Effects on adjacent existing structures.
8. Corrosion effects of various soils and waters, and possibility of galvanic reaction from stray currents.
9. Scour depth (elevation) and method of determination.

B. Footing Support

1. Elevation of bottom footing.
2. Allowable and ultimate footing pressure (include Safety Factor). Approximate settlement at uniformly distributed allowable load.
3. Brief Description of materials on which the footing is to be placed.
4. Scour depth (elevation).

C. Drilled Shafts/Pier Columns (Mined Shafts)

1. Geologic description of foundation materials
2. Diameter (or dimensions)
3. Design Load, ultimate loads, and safety factor
4. a. Top of shaft elevation
   b. Bottom of shaft elevation
   c. Minimum shaft length into load carrying stratum
   d. Estimate of shaft wall stability and possible shoring requirements
5. Soil or rock weight and strength parameters for determining end bearing capacity, lateral load capacity, and point of shaft/column fixity.

11. APPROACH FILL REQUIREMENTS

1. Predicted amount of settlement and time delay required prior to beginning foundation construction. Predicted post construction settlement. Possibility of negative friction on pile foundations.

2. Special Requirement:
   a. Controlled rates of embankment placement.
   b. Fill height limit on untreated foundation.
   c. Stripping of unsuitable foundation materials.
   d. Use of lightweight fills to reduce amount of settlement.
   e. Use of surcharge, wick drains, or other methods to shorten the required time delay period.
   f. Specify embankment side slopes.
   g. Unusual compaction requirements (i.e. 95% relative compaction) where abutments on spread footings are used.

111. CONSTRUCTION CONSIDERATIONS

1. Water table-seasonal or long term fluctuations, data for possible control in excavations (i.e. pumping, well points, trim seals, amounts of groundwater, etc.).
2. Adjacent structures-protection against damage form excavations, pile driving , etc.
3. Pile driving-difficulties, clearance, overhead or underground utilities, other unusual conditions, etc.
4. Excavation-control of earth slopes including shoring, sheet piles, bracing, and safety requirements.

IV SEISMIC DATA

The foundation report should contain the following information, so that an evaluation of seismicity can be made per the Caltrans Bridge Design Specifications.

1. Maximum credible rock acceleration (from CDMG MS-45*)
2. Magnitude of the maximum credible event.

3. Name of the causative fault and distance from the site.
4. Depth to rock or rock-like material (Vs > 2500 ft/s). Provide supporting evidence for depth (i.e. boring log or geologic reference)
5. Liquefaction potential.
6. Need for “seismic approach slab.

V. REVIEW OF FINAL STRUCTURE PLANS.

The foundation consultant should review the structure plans to ensure that the foundation recommendations have been followed, and provide revised recommendations, if required by design changes, etc.

***MUALCHIN, LALLIANA (1987) CALIFORNIA DIVISION OF MINES AND GEOLOGY MAP SHEET 45, ROCK ACCELERATION FROM MAXIMUM CREDIBLE EARTHQUAKES IN CALIFORNIA.**

# EXHIBIT 11-D PRELIMINARY HYDROLOGIC/HYDRAULIC REVIEW SUMMARY

## PRELIMINARY HYDROLOGIC/HYDRAULIC REVIEW SUMMARY

**Bridge Name** (facility crossed) ______________________________

**State Bridge No.** ____________________ **Road Name** ____________________

**Hydrologic and Hydraulic Data**

1. Size of drainage basin ____________________
2. Design flows and water surface elevations (USGS)
   a. $Q_{10}$ ____________________ elevation ____________________ (culverts only)
   b. $Q_{50}$ ____________________ elevation ____________________
   c. $Q_{100}$ ____________________ elevation ____________________
3. High water marks ____________________ (Elevation/Year)
4. Structure opening size ____________________ Date Constructed
   a. Existing ____________________ ____________________
   b. Upstream ____________________ ____________________
   c. Downstream ____________________ ____________________
5. Description of property risks ____________________
6. Summary of upstream development ____________________
7. Importance of structure ____________________
8. Description of risks to life ____________________
9. Effects of facility on stream environment ____________________
10. Are there any channel restrictions or controlled flow? ____________________
11. Has this basin been studied before? Date of study? Is the Study recognized by Caltrans?
12. Is there a potential debris problem? (describe) ____________________
13. Are there any mining operations within 3000 feet upstream and/downstream? ____________________

Remarks: ______________________________

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# EXHIBIT 11-E CHECKLIST FOR DRAINAGE STUDIES AND REPORTS

## CHECKLIST FOR DRAINAGE STUDIES AND REPORTS

This is a checklist of items to be considered for inclusion in hydraulic studies and reports. For definition of terms see section entitled "*Definitions*" of this chapter.

**1. PRELIMINARY**

a. Review of basic guidelines

1. A floodplain cannot be altered in any way until it has been shown that such alteration will pass the base flood without significant damage to either the floodplain or surrounding property. This requirement is often referred to as "conveyance of the base flood." (Conveyance may be through structures, over the roadway, through escapements, through overflow channels, or any combination of the above.)
2. Approval for actions within a floodplain cannot be given until various options of alignments, grade, and waterway area have been appraised.
3. No bridge abutments or embankment shall encroach on a regulatory floodway.

b. Collect appropriate and readily available published data such as:

1. USGS quadrangle maps
2. NFIP maps - Floodplain maps may be obtained from the National Flood Insurance Program (NFlP), or the Local Caltrans District office
3. Aerial photos - Check with Caltrans
4. Runoff records - USGS water supply papers
5. Rainfall records- Various sources
6. Prior hydrology reports including photos and plans

c. Coordinate with other agencies

1. Determine whether permits are required.
2. Determine how the area is zoned.
3. Investigate possibility of cooperative projects.
4. Determine whether there exist or proposed water resource projects that will influence the design, and summarize details (Watershed area, storage capacity, etc., when pertinent).
5. Determine whether there is ongoing or proposed clearing, construction, land leveling, land development, aggregate mining, etc., that would affect flow in or the stability at the stream.

d. Floodplain Encroachments

1. Executive order 11988 establishes the federal policy on floodplain management. This policy has been implemented by 23 CFR, Part 650A (23 CFR 650A).
2. CFR 650A requires all encroachments and all actions, which affect an area, subject to flooding by flood or tide having a one-percent chance of being exceeded in any given year, to comply with a floodplain management policy. Repairs made to existing facilities with emergency funds (see *Local Programs Manual* which discusses Emergency Relief) during or immediately following a disaster are exempt from this policy.

e. The hydrology and hydraulics report shall:

1. Only be as comprehensive as the conditions warrant. Calculations with short comments are sufficient for a culvert in a well-defined drainage environment. A complete comprehensive document is required for a major stream crossing in an ecological setting.
2. Generally be structured along these guidelines with:
   a. Background data and estimates of future flood.
   b. Calculations to determine velocities, water surface elevations, backwater and scour depth (the lead agency should provide a disk with the data used to run HEC-2 or WSPRO. If a program other than these is used, that program should be provided on a disc along with the data used).
   c. Illustrative photos.
   d. Comments on selection of design flood, conveyance of 100-year flood, channel change, effect on stream stability, and provisions for fish passage.

f. Suggested desirable hydraulic features

1. The following features should be considered in the design of a bridge or culvert:
   a. Use of warped wingwalls
   b. No open vents
   c. No piers in main channel
   d. Use of energy dissipaters
   e. Extending pier walls to edge of deck
   f. No piers in navigable channel

2. **FIELD RECONNAISSANCE --** Should be made by the engineer making the hydrologic and hydraulic analysis

a. Channel stability

1. Estimate the erodability of streambed material.
2. Document bends, meanders, and any eroded areas.
3. Is the existing protection providing adequate erosion control, and if so, is it fragile?
4. Are there signs of aggradations or degradation? Other scour considerations?
5. Are there any upstream or downstream mining operations?

b. Potential problems

1. Consideration of the value of the property that would be damaged by the base flood or overtopping flood.
2. Size and amount of drift.
3. Ice, snow
4. Banks that would erode if flow is accelerated or redirected.
5. Check adequacy of abutment protection.

c. Environmental considerations

1. Beauty of area.
2. Fish habitat and wildlife cover.
3. Will local water supply or sanitation treatment facility be affected?
4. Is it within a park or recreation area?
5. See *Flood Plain Values* (see *Standard Environmental Reference (*SER), Chapter 17, “ Flood Plains”).

d. Alternative sites

1. Locate suitable alternative sites.
2. What are the advantages and disadvantages of the alternative sites?

e. Existing structures (including relief or overflow structures)

1. Locate existing nearby upstream or downstream structures with respect to proposed crossing or encroachment.
2. For each existing nearby structure note the type, number of spans, span lengths, vertical clearance, bent design or pier orientation.
3. For each nearby existing culvert estimate the size and number of cells.

f. Hydraulic data

1. Locate high water marks (give date and elevation).
2. Document both the flood history and source of information.
3. Document the damage to existing structures including abrasion, corrosion, wingwall failure, culvert entrance failure, pier settlement, or excessive aggradations or degradation.
4. Note the use of bank protection, drop structures, or any other sign of corrective work at existing structures.

g. Factors affecting water stage

1. Determine whether flood flow can escape to, or enter from, other watersheds during floods.
2. Determine whether any of the flow can bypass the site.
3. Determine whether backwater or tides affect the flow.
4. Determine what will control an overtopping flood.

**3. ECONOMIC ANALYSIS**

a. Make an economic analysis of all the reasonable alternatives based on construction cost, aesthetic cost, ecological cost, flood damage cost, loss of traffic service, etc.
b. Reject from further considerations those options that are not economically suitable alternatives.

**4. FIELD SURVEY**

a. Obtain topographic data for the suitable site alternatives. Extend limits to include overflows where practicable.
b. Locate, sketch, and record significant features such as buildings, levees, walls, fences, ditches, trees, boulders, etc., and where significant, record elevations.
c. Record water surface elevation, the elevation of the path of greatest depth as in a stream channel (thalweg elevation), and estimate velocity of flow.
e. Obtain channel cross-sections 500 and 1000 feet upstream and downstream where necessary.
f. Obtain data on boat traffic.
g. Take ample photographs at each site to illustrate the hydraulic and ecological features.
h. Take physical measurements of the existing structure and/or any other bridge or culvert with similar characteristics either upstream or downstream.
i. Where possible determine the foundation type (spread footings, piles) and foundation depth of all nearby structures.

## 5. SITE MAP CONSTRUCTION

a. Purpose: For use in estimating flood flow distribution; to locate cross section of stream; to show location of proposed encroachment and structures, alignment of piers, skew of crossing, stream controls, existing encroachments, existing highway structures, etc.

1. A specially prepared site map showing one foot and two feet contours, vegetation, and manmade improvements is normally required. In some cases cross-sections normal to flood flow are acceptable in lieu of the map. A minimum of 3 cross sections is required including one upstream, one at the crossing, and one downstream.
2. The site map should include the limits of the overtopping flood when practical.
3. Where there are two or more suitable alignments, a site map must be prepared for each.

## 6. HYDROLOGIC ANALYSIS

a. Hydrologic considerations

1. Determine drainage area above the proposed encroachment. Subdivide where runoff characteristics are or will be significantly different.
2. List available flood records at the encroachment and/or at nearby hydraulically similar
3. Calculate the flow at the proposed encroachment for the base flood and the design flood, if different. Include any other flow within the floodplain that affects the design of the project. <u>The flood calculations should be made by using at least two widely used methods</u>. Nearby stream gage data may be used, if the data is adequate to furnish the above.
4. Plot the flood frequency curve.
5. Plot the stage discharge curve.

b. Establish the existing flow conditions

1. Determine the distribution of flow and velocities for several discharges or stages in the natural channel for existing conditions. USCE, USGS, FEMA, etc., studies may be used as a general case.
2. Establish the maximum permissible upstream water surface for base flood.

c. Hydraulic design for bridges

1. Compute the water surface profile for various trial bridge lengths and discharges at each of the alternative sites. If alternate alignments are proposed, compute the water surface profile for various trial bridge lengths and discharges at each of the alternative sites.

   (The Lead Agency should provide a disc with the data used to run the HEC-2 or WSPRO water surface profile computer programs. If a program other than HEC-2 or WSPRO is used that program should be provided on a disc along with the data used.)

   (For the base flood, backwater caused by the encroachment together with that caused by all other man-made obstructions is limited to one foot above the water surface of the base flood.) Design must be in accordance with 23 CFR 650 Subpart A. The local agency must comply with FEMA's regulatory floodplain rules or they may lose their federal flood insurance.

2. Select alignment, grade, bridge type and size waterway openings, etc., on the basis of overall economic calculations and freeboard requirements (see section 10, *Design Standards*).

3. Check "conveyance" of base flood.
4. Calculate scour depth at piers. (Recommended reference HEC-18 *Evaluating Scour at Bridges*, FHWA
5. Design pertinent features such as riprap for bank protection, cross channel stabilizers for streambed control, energy dissipaters to reduce downstream velocities, spur dikes to equalize flow, etc. (Recommended references are HEC - 18 *Evaluating Scour at Bridges* and HEC - 20 *Stream Stability at Highway Structures*).

d. Hydraulic design for culverts (Recommended reference; Caltrans *Highway Design Manual*)

1. Determine allowable headwater elevation.
2. Compute and plot performance curves for trial culvert sizes at alternate alignments.
3. Evaluate erosion, abrasion, and corrosion potentials.
4. Select alignment, grade, and culvert design on the basis of overall economic calculations related to the design standards appropriate to the project.

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e. Hydraulic design for longitudinal encroachments

1. Determine the effect of the proposed encroachment on water surface profile using various roadway design, alternatives, and the base flood.
2. Evaluate the effects on scour and deposition in the channel.
3. Select roadway design on the basis of overall economic calculations.
4. Design pertinent features such as bank protection, etc. (Recommended reference HEC-11 *Design of Riprap Revetment, FHWA and/or Bank and Shore Protection*, Caltrans)

**7. CONTRACT PLANS**

The following data shall be shown on the contract plans, and may be shown in tabular form. List the frequency, magnitude and pertinent water surface elevations for:

a. Minimum Design Flood
c. Base Flood
d. Overtopping Flood
e. Flood of Record, if available

The data used for design must be designated and if different from the above, the data must be shown on the plans.

## HYDRAULIC REFERENCES

- *Guidelines for Hydraulic Considerations in Highway Planning and Location, Volume I, Highway Drainage Guidelines, AASHTO, 1999.*
- *Guidelines for Hydrology, Volume II, Highway Drainage Guidelines, AASHTO, 1999.*
- *Highway Hydrology*, HDS No.2, FHWA-SA-96-067, 1996.
- Flood-frequency analysis, such as those of U. S. Geological Survey or other water-resources agencies, for the region in which the structure is located.
- *Highways in the River Environment Hydraulic and Environmental Design Considerations, U.S. Department of Transportation, FHWA,* 1983
- *Stream Stability at Highway Structures, HEC-20, FHWA-0IP-90-014, 1991*
- Bradley, J. N., 1979, *Hydraulics of Bridge Waterways, Hydraulic Design Series No. l, Federal Highway Administration*, U.S. Government Printing Office, Washington, DC, 1978, 111 p.
- *Evaluating Scour at Bridges*, Second Edition, HEC-18, FHWA-IP-90-017, 1993.
- *Highway Research Board, 1979, Scour at Bridge Waterways, National Cooperative Highway Research Program Synthesis 5, Highway Research Board, National Academy of Sciences, 2101 Constitution Avenue, Washington, DC 20418.*
- *Hydraulic Design of Highway Culverts*, September 1985, Hydraulic Design Series No.--, Report No. FHWA-1P-85-15.
- *Circular Memorandum, G. M. Williams, July 21, 1966 Plans for Pipe Culvert Inlet and Outlet Structures, Federal Highway Administration.*
- *Guidelines for Hydraulic Design of Culverts, Volume IV, Highway Drainage Guidelines, AASHTO, 1999.*
- Searcy, J. K., *Design of Roadside Drainage Channels*, 1985, Federal Highway Administration, Hydraulic Design Series No. 4, U.S. Government Printing Office, Washington, DC.
- *Bridge Deck Drainage Systems*, HEC-21, FHWA-SA-92-010, 1993
- *Standard Environmental Reference* (SER), Chapter 17 " Flood Plains"
- *Design of Encroachments on Flood Plains Using Risk Analysis, HEC 17, FHWA-EPD-86-112, 1981*
- For information regarding flood plain delineation studies, write to: Department of Housing and Urban Development, Federal Insurance Administration, Assistant Administrator for Flood Insurance, 451 7th Street, SW, Washington, DC 20410
- *Design of Rip rap Revetment, HEC-11, FHWA-1P-89-016, 1989***.**
- *CALTRANS Highway Design Manual*
- *AASHTO Model Drainage Manual*

Instructions: To be used as guide for Hydraulic Studies and Reports

# EXHIBIT 11-B DESIGN EXCEPTION FACT SHEET

## DESIGN EXCEPTION FACT SHEET

Dist: ______________________________ Date:________________________________

Co:________________________________ Prepared by:__________________________

Rte:________________________________

Project Cost:__________________________

**1. Existing Conditions**

**2. Proposed Work and Non-Standard Features**

**3. Standard for Which Exception is Required**

**4. Accidents** **3-year Period**

Total F F+I Actual Rate Expected Rate

Describe type(s) of accidents that are occurring and what effect the design exception is expected to have on them.

**5. Design Year Traffic Volumes**

**6. Added Cost to Make Standard**

**7. Description of Any Additional Work to Enhance Safety**

**8. Reason for Requesting Exception**

**EXCEPTION APPROVED:____________________________________DATE: _________________**
***PUBLIC WORKS DIRECTOR*** *(OR DELEGATE TITLE)*

# INSTRUCTIONS FOR " DESIGN EXCEPTION FACT SHEET'

**1. Existing Conditions**

Describe existing facility. Number of lanes, median width, shoulder width, etc. Describe width of adjoining sections if that information is relevant, for example on 3R projects.

**2. Proposed Work and Non Standard Features**

Describe work to be done. Resurfacing, shoulder widening, bridge widening, etc. Describe the non-standard design element that required the exception.

**3. Standard for Which Exception is Required**

Be specific. Name the source, i.e., 3R Criteria, *Instructions for AASHTO Green Book Implementation*, or *Highway Design Manual*.

| **4. Accidents** | **3-year Period** | |
|---|---|---|
| Total F F+I | Actual Rate | Expected Rate |

**5. Design Year Traffic Volumes**

If 3R project, use construction year. Otherwise, use design year usually 20-years in the future.

**6. Added Cost to Make Standard**

Show what it would cost to meet the standard for which the exception is being requested. If more than one quadrant is involved in the approach rail design request, cost shall be broken down on a per quadrant basis.

The Fact Sheet should also be accompanied with a detailed drawing of the bridge site along with topographical features (right of way lines, side road widths, physical obstructions, etc.) 30m from beginning and ending of the bridge.

**7. Description of Any Additional Work to Enhance Safety**

Mention any additional work which would qualify for safety enhancement such as median barrier, guardrail upgrade, slope flattening, super correction, elimination of roadside obstacles, additional lane and shoulder width, alignment improvement, etc.

**8. Reason for Requesting Exception**

Be thorough, but brief. These are some, but not all of the reasons exception has been granted in the past: high cost, environmental sensitivity, low accident rates, and postponement of bridgework.