Montana Department of Transportation
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Memorandum

To: Distribution

From: Mark Goodman PE, Hydraulics Engineer

Thru: Paul Ferry PE, Highways Bureau Chief

Date: February 20, 2009

Subject: Special Culvert Installation Guidelines and Details

Attached are Special Culvert Installation Guidelines and the new bedding details for Structural Steel Plate Pipe (SSPP) and Reinforced Concrete Box (RCB) culverts. These documents were developed at the request of the Construction Engineering Service Bureau to specifically address:

- Settlement associated with bedding and backfill that has occurred on several new large culvert installations.
- As a follow up to November 20, 2007 CES Construction Engineering Service Project Review Report lessons learned regarding large pipe and RCB installations.
- To provide an equivalent drawing for SSPP's when alternates are specified between SSPP's and large RCB's.

A committee with representatives from Geotech, Hydraulics, Road Design, and Construction was formed to review the existing drawings, specifications, special provisions, and construction practices on large culvert installations. Because there have been several documented construction issues with these installations, it was determined that modifications to the design/construction process were required. As a result, the new drawings were developed along with guidelines for large culvert installations that include a narrative and flow chart.

The Special Culvert Installation Guidelines will be included in Chapter 17 of the Road Design Manual. The new drawings are not intended to replace Detail Drawings 603-18 and 603-19. They are "Standard Drawings" that are to be included in the plan packages when RCB's or SSPP pipes greater than 10 feet in diameter are specified. The electronic files are located in the Hydraulics directory (HYSTD) on the CADD Standards drive.

As stated in the Special Culvert Installation Guidelines, special backfill or foundation material may be specified depending on the site soil conditions. This issue should be discussed with the Geotechnical Engineer at the Plan in Hand review meeting. If special backfill is anticipated, the quantity will be added to the summary frame on the respective drawing by Hydraulics.

If foundation material is anticipated, the cut off wall will need to be modified to extend 1-foot below the foundation material. The foundation material and geotextile quantities will be shown on the on cross sections and plan summaries as they currently are.

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Distribution w/ attach:

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Special Culvert Installation Guidelines

The following are conditions/parameters where the potential for settlement at or near larger culverts should be evaluated and addressed during the preconstruction phases. These issues could be due to either settlement of the foundation soil below the culvert or where achieving adequate compaction of backfill around the culvert may be problematic (ultimately leading to differential settlement).

If one or more of the following conditions/parameters are present:

1. Large culverts -10 foot diameter (or equivalent arch pipe) or greater (Difficult to obtain compaction below pipe haunches).
2. Low fill heights/cover above the culvert (5 feet or less) measured from top of culvert to top of pavement section.
3. Presence of fine grained soils (silts and clays or AASHTO groups A-4, A-5, A-6, or A-7) that are anticipated for use as culvert backfill.
4. High groundwater table present (within 5 feet of anticipated invert elevation).
5. Locations where culvert is installed through existing PTW (i.e. a widened PTW can lead to differential settlement and/or areas where a vertical trench excavation might be used to install culverts)
6. Double pipe installations (fill area between culverts).
7. Very soft to soft clay or silt foundation soils are present. (long term settlement of foundation soils)

Evaluate alternate culvert installation and backfill techniques.

Note 1: Review Hydraulics and Geotechnical Recommendations..

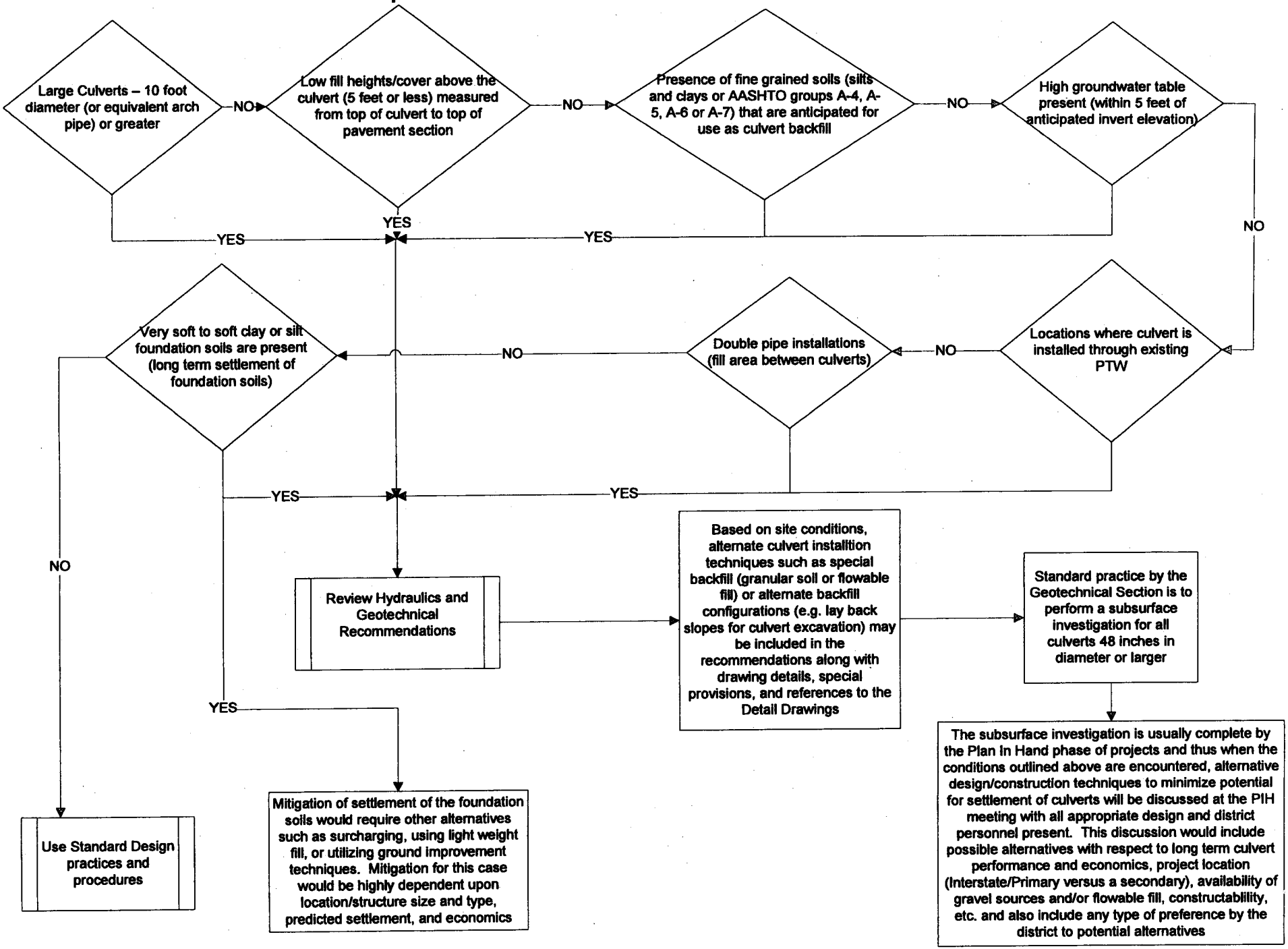
Note2: Based on site conditions, alternate culvert installation techniques such as special backfill (granular soil or flowable fill) or alternate backfill configurations (e.g. lay back slopes for culvert excavation) may be included in the recommendations along with drawing details, special provisions, and references to the Detail Drawings.

Note 3: When No. 7 above is encountered mitigation of settlement of the foundation soils would require other alternatives such as surcharging, using light weight fill, or utilizing ground improvement techniques. Mitigation for this case would be highly dependent upon location/structure size and type, predicted settlement, and economics.

Note 4: Standard practice by the Geotechnical Section is to perform a subsurface investigation for all culverts 48 inches in diameter or larger. As part of the subsurface investigation items 3, 4, and 7 should be identified by the Geotechncial Section. The remaining items will be readily known from the proposed project scope of work, hydraulic design reports, and plans/cross sections.

Note 5: The subsurface investigation is usually complete by the Plan In Hand phase of projects and thus when the conditions outlined above are encountered, alternative design/construction techniques to minimize potential for settlement of culverts will be discussed at the PIH meeting with all appropriate design and district personnel present. This discussion would include possible alternatives with respect to long term culvert performance and economics, project location (Interstate/Primary versus a secondary), availability of gravel sources and/or flowable fill, constructability, etc. and also include any type of preference by the district to potential alternatives.

If none of the 7 conditions/parameters are present.

Go to Standard Design practices and procedures.

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