# Metro District
# Office of
# State Aid

## Design Guide
## For
## State Aid Projects

June 2017

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# State Aid for Local Transportation

May 11, 2017

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——— = direct reports
– – – – – = report to others

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# METRO STATE AID WEB SITE

## http://www.dot.state.mn.us/metro/stateaid/home.html

The following information/links can be obtained at the above web site.

1. What's New - State Aid news and bulletins, including training seminar dates.

2. Meet the Staff - Staff Roster with a short explanation of their duties, phone #'s and e-mail addresses.

3. State Aid Training - Up to date information on up-coming training seminars for State Aid, Federal Aid and Cooperative Agreement projects.

4. Downloadable State/Federal Aid Forms - Commonly used State/Federal Aid forms.

5. Municipal Agreement Program - Check out the status of your Cooperative Agreement projects.

6. State Aid Manual and State Aid Rules – provided as a link to SALT.

7. Standard Plates List – A listing of the current Standard Plates.

8. State Aid Contract/Final Estimate Payments - Status of your State Aid payments is at your fingertips.

9. Federal Aid Construction

10. ADA – Metro State Aid ADA Guidelines and links for MnDOT and SALT ADA websites.

Other links of Interest:

1. State Aid for Local Transportation Office (Central Office State Aid). Some information worth checking out at their site is the State Aid Scene, information on their current staff, TRNS*PORT list (downloadable), the current State Aid Rules and the State Aid Manual.
2. Bridge and Design Standard Plans/Provisions, Metro Traffic Engineering, Preliminary Design and Mn/DOT Sample Plan.
3. "Meet the Metro County Engineers". Here you will find the Metro County Engineers names and phone numbers.
4. Metro City Engineer list. Here you will find the Metro City Engineers names and phone numbers.

# ACRONYMS

| | |
|---|---|
| AASHTO | **A**merican **A**ssociation of **S**tate **H**ighway and **T**ransportation **O**fficials |
| ADT | **A**verage **D**aily **T**raffic |
| ATP | **A**rea **T**ransportation **P**artner |
| | |
| CA | **C**ertified **A**cceptance |
| CARS | **C**ontract **A**dministration **R**ecord **S**ystem |
| C&G | **C**urb and **G**utter |
| CIC | **C**apital **I**mprovement **C**ommittee |
| CSA | **C**ounty **S**tate **A**id |
| CSAH | **C**ounty **S**tate **A**id **H**ighway |
| CO | **C**entral **O**ffice |
| COE | **C**orp **O**f **E**ngineers |
| | |
| DBE | **D**isadvantaged **B**usiness **E**nterprise |
| DE | **D**rainage **E**asement |
| DSAE | **D**istrict **S**tate **A**id **E**ngineer |
| | |
| EA | **E**nvironmental **A**ssessment |
| EAW | **E**nvironmental **A**ssessment **W**orksheet |
| EEO | **E**qual **E**mployment **O**pportunity |
| EDS | **E**mployee **D**evelopment **S**pecialist |
| ESAL | **E**quivalent **S**ingle **A**xle **L**oad |
| EVP | **E**mergency **V**ehicle **P**reemption (for Signal Systems) |
| | |
| F&P | **F**unding **A**nd **P**rogramming |
| FBF | **F**ederal **B**ridge **F**unds |
| FHWA | **F**ederal **H**ighway **A**dministration |
| FONSI | **F**inding of **N**o **S**ignificant **I**mpact |
| | |
| GE | **G**ranular **E**quivalent |
| GRR | **G**reat **R**iver **R**oad |
| | |
| ICE | **I**ntersection **C**ontrol **E**valuation |
| ISTEA | **I**ntermodal **S**urface **T**ransportation **E**fficiency **A**ct |
| | |
| LCMR | **L**egislative **C**ommission on **M**inn **R**esources |
| LPA | **L**ocal **P**ublic **A**gency |
| | |
| MEQB | **M**innesota **E**nvironmental **Q**uality **B**oard |
| MMUTCD | **M**innesota **M**anual on **U**niform **T**raffic **C**ontrol **D**evices |
| MnDOT | **M**innesota **D**epartment **O**f **T**ransportation |
| MRP | **M**innesota **R**oad **P**lan |
| MRPC | **M**ississippi **R**iver **P**arkway **C**ommission |
| MSA | **M**unicipal **S**tate **A**id |

# ACRONYMS (cont.)

| | |
|---|---|
| NHS | **N**ational **H**ighway **S**ystem |
| PE | **P**ermanent **E**asement |
| PM | **P**roject **M**emorandum |
| PS&E | **P**lans, **S**pecifications & **E**stimate |
| RFE | **R**eport of **F**inal **E**stimate |
| RSAC | **R**eport of **S**tate **A**id **C**ontract |
| R/W | **R**ight of **W**ay |
| RJR | **R**oundabout **J**ustification **R**eport |
| SA | **S**upplemental **A**greement |
| SALT | **S**tate **A**id for **L**ocal **T**ransportation |
| SAP | **S**tate **A**id **P**roject |
| SBB | **S**tate **B**ridge **B**onds |
| SE | **S**lope **E**asement |
| SP | **S**tate **P**roject (federal funds) |
| SHPO | **S**tate **H**istoric **P**reservation **O**ffice |
| SJL | **S**ignal **J**ustification **L**etter |
| SJR | **S**ignal **J**ustification **R**eport |
| SR | **S**tudy **R**eport |
| STIP | **S**tate **T**ransportation **I**mprovement **P**lan |
| TAB | **T**ransportation **A**dvisory **B**oard |
| TAC | **T**ransportation **A**dvisory **C**ommittee |
| TE | **T**emporary **E**asement |
| TGB | **T**argeted **G**roup **B**usiness |
| TH | **T**runk **H**ighway |
| TIP | **T**ransportation **I**mprovement **P**lan |
| WBE | **W**omen in **B**usiness **E**nterprise |

# Typical Project Time Frame

| Time Frame | Task (responsibility) |
|---|---|
| 1-4 weeks | Plan submittal and log-in, first submittal reviewed by plan reviewer, email with comments to designer (1-2 weeks) **. If the plan has a trunk highway endpoint or crossing, allow an extra 3 weeks for trunk highway routing and comments (3-4 weeks). |
| 1-2 weeks | Corrections made by the designer |
| 1 day-1 week | Final review by plan reviewer, approval or recommendation for approval by the District State Aid Engineer. |
| **3-7 weeks** | **TOTAL PROJECT REVIEW AND APPROVAL TIME** |

**** NOTE: During peak work load periods (January thru June), please allow extra time for initial plan review.**

# PLANS APPROVED AT METRO STATE AID

The following types of plans are currently being approved in the Metro State Aid Office without further Central Office Review:

- Grading and Paving
- Right of Way
- Surfacing
- Overlays
- Seal Coats
- Landscaping
- Signals
- Cooperative Agreements*
- Plans requiring a variance (if variance has been approved and hold harmless resolution submitted)
- Force Account Agreements for all projects
- Turnback Plans*
- Mn/DOT Let Projects*
- Pedestrian Ramp Design

*The State Aid portion of these plans are approved at Metro. The plan still requires the normal Mn/DOT or Cooperative Agreement approval process if Mn/DOT or Cooperative Agreement funds are part of the project.

The following plans must continue to be reviewed by Central Office:

- Bridges and Culverts (eligible for town bridge and bridge bonding)
- State Park Road Account Plans (funding review by CO)
- Plans containing Hydraulic Risk Assessments

# STATE AID PLAN SUBMITTAL

For Review of Plans in the Metro Division State Aid Office

WHAT TO SUBMIT FOR INITIAL REVIEW

Obtain a State Aid Project (S.A.P.) number (request form at http://www.dot.state.mn.us/stateaid/projectdelivery/project-number-request.pdf http://dotapp7.dot.state.mn.us/saasreports/Logon.aspx or by calling Margaret Hylton at 651-234-7767). See pages 13-14 for S.A.P. Number Request form.

When your plan is ready to be delivered to the Metro Division State Aid Office for the first time, please provide the following items to help expedite your plan review.

1. Version of the Plan
    a. Send one electronic copy if the project is MSA or CSAH and does not impact a trunk highway.
    b. If either endpoint is a trunk highway, adjacent to or crosses a Trunk Highway, or a trunk highway drainage area is affected contact our office.
    c. One paper copy if a hydraulics percent split will be needed and you want us to "pre-submit" to State Aid Hydraulics. See #3 below for other drainage submittal information required.
    d. Submit one copy to Dave Conkel, Bridge Office, for bridges 10 feet or longer, except culverts. Obtain bridge numbers from Lisa Hartfiel at 651-366-4557 for all bridges 10 feet or longer.

For reference a checklist of the documents required for submission are listed on page 12 and explanation of each required item is listed below.

2. A **COMPLETED** Plan Review Checklist: Please remember to fill in rule 8820.99XX used on the Design Standard Used line and make sure the City/County has signed the checklist at the bottom of the form.
   State Aid Only - No Bridge
   State Aid Only with Bridge

3. Drainage Area Maps and Hydraulic Computations;
    a. One (1) paper copy if submittal to State Aid Hydraulics is required.
    b. Two (2) copies (one paper, one electronic) if trunk highway endpoint or trunk highway drainage area.

4. If using the R Value Sigma N18 method,
    a. A Soils / Geotechnical Report with the R Value clearly indicated.
    b. ESAL computations bases on ESAL factors from Geotechnical Manual.

5. If using the soil factor HCADT method, and the soil factor in the Needs Report is higher than on the plan, substantiating evidence for the lowered soil factor.

# STATE AID PLAN SUBMITTAL (CONTINUED)

6. If the plan is for Resurfacing (Reconditioning), and vertical and horizontal alignments have not been provided in the plan, copies of as-built plans from previous construction will be needed to verify the design speed. If the roadway was previously constructed with State Aid funds all that is required is a copy of the as built Title Sheet with signatures.

7. Engineers Estimate with cost splits shown. A separate Engineers Estimate for R/W only if reimbursement for R/W costs is part of the plan.

8. Laboratory Testing Services Request Form, Fig. A(1) 5-892.243 of the State Aid Manual can be found at Laboratory Testing & Plant Inspection Services Request. Please make sure to mark all services required including Structural Metal and Fabrication Methods and Fill in the TA98/99 Agreement number.

9. Hydraulic letter/Risk Assessment if applicable (for culverts 3.05m (10ft.)) or greater. (found at Hydraulics Letters and Risk Assessments)

WHAT TO SUBMIT FOR INITIAL REVIEW

10. No Parking Resolutions for the State Aid Route if parking lanes are not provided. For resurfacing or rehabilitation projects, a copy of an inplace resolution is fine.

11. SJR (Signal Justification Report) with signature block for Metro District State Aid Engineer, OR Signal Justification Letter and Warrant Analysis, as applicable. (See Design Guide page 13 for checklist)

12. RJR (Roundabout Justification Report) with signature block from Metro District State Aid Engineer, as applicable.

13. Variance approval letter and Hold Harmless Resolution if a variance is required (variance checklist can be found at: http://www.dot.state.mn.us/stateaid/variance/variance-justification-checklist.pdf ).

14. If your State Aid Project impacts the Trunk Highway Right of Way in any manner, please call Buck Craig (651-234-7911) in the Mn/DOT District Permit Office to obtain a permit to work on Mn/DOT Right of Way.

15. Submit Special Provisions if MnDOT Lab Services are requested

16. Please provide a cover letter with Contact Information including name, phone & email. State any other information pertaining to the review that may assist with the review. Also include the City or County contact information incase specific questions arise. This contact will also be copied on the return of Review Comments.

**PLEASE RETAIN THE SIGNATURE ORIGINALS UNTIL FINAL REVIEW**

# STATE AID PLAN SUBMITTAL (CONTINUED)

WHAT TO EXPECT IN RETURN

1. Plan review in order of turn in date.

2. Routed review if Trunk Highway impacts are possible.

3. Electronic plan review comments will be sent to the designer and the City or County contact will be copied.

4. Hydraulic Eligibility memo and comments if Drainage work is present will be sent separately.

5. List of items needed at final submission with plan.

WHAT TO INCLUDE IN THE FINAL SUBMITTAL

1. The Final Plans with signatures:
    a. Signature original title sheet. (media of Agency's preference)
    b. One (1) electronic copy of the final plan set.

2. Revised submittal material (most often the Engineers Estimate).

3. Documentation of any additions or changes made to the plan other than those changes made due to the comments in the review letter.

# STATE AID SUBMITTAL CHECKLIST 00-000 Plan Year ID

S.A.P. ___-___-___, ___-___-___, ___-___-___, ___-___-___, ___-___-___, ___-___-___, ___-___-___
S.P. ____-___

FIRST PLAN SUBMITTAL DATE 00/00/00 FINAL PLAN SUBMITTAL DATE 00/00/00

PLAN APPROVAL DATE 00/00/00 SEE ELECTRONIC FILES FOR ITEMS Y / N

REQUIRED

□ STATE AID PLAN REVIEW CHECKLIST Rule 8820.99__ Signature Y / N

□ ENGINEERS ESTIMATE (required for al projects)

□ REVISED ENGINEERS ESTIMATE

□ LABORATORY TESTING SERVICES REQUEST FORM (for all projects) TA98/99 □

□ SPECIAL PROVISION IF LAB SERVICES REQUIRED

□ R VALUE DOCUMENTATION (for roadway type projects)

□ ESAL CALCULATIONS (for roadway type projects)

□ PAVEMENT DESIGN CALCULATIONS (for all roadway type projects)

□ PARKING RESOLUTIONS (for roadway type projects that restrict parking)

□ DRAINAGE AREA MAPS/CALCULATIONS (projects which propose storm sewer)

□ HYDRAULIC RISK ASSESSMENT (if applicable)

□ HYDRAULIC MEMO RECEIVED (if applicable) ___ % ELIGIBLE

□ MnDOT PROJECT REQUIRES HYDRAULIC REVIEW

□ SIGNAL JUSTIFICATION REPORT/LETTER (SJR/SJL) (for signal projects) □ SJR/SJL APPROVAL

□ ROUNDABOUT JUSTIFICATION REPORT (for roundabout projects) □ RJR APPROVAL

□ FORCE ACCOUNT PAPERS □ FORCE ACCOUNT APPROVAL

□ VARIANCE APPROVAL LETTER/HOLD HARMLESS RESOLUTION (if applicable) □ VARIANCE APPROVAL

□ BRIDGE REVIEW DATE SENT TO BRIDGE 00/00/00

□ BRIDGE APPROVAL DATE SENT FOR SIGNATURE 00/00/00

□ BRIDGE BOND APPLICATION □ 1601B SPECIAL PROVISION

□ BRIDGE BOND FUNDING APPROVAL LETTER DATE SENT TO PATTI 00/00/00

□ ENGINEER'S ESTIMATE EXCEL FORMAT

□ LRIP APPLICATION DATE SENT TO PATTI 00/00/00

□ LRIP FUNDING APPROVAL LETTER □ 1601B SPECIAL PROVISION

□ TRUNK HIGHWAY REVIEW COMMENTS DUE BACK 00/00/00

□ RAIL REVIEW COMMENTS DUE BACK 00/00/00

# SALT **Request for State Aid Project Number**

Requestor name: _____ Phone: _____

Requestor email: _____

City/County/Agency Name: _____

Funding types (check all that apply):

- ☐ Federal Aid
- ☐ State Aid
- ☐ Turnback
- ☐ Disaster
- ☐ State Park Road

Road System:

- ☐ CSAH
- ☐ MSAS
- ☐ County Road
- ☐ City Street
- ☐ Township Road
- ☐ Trunk Highway
- ☐ Forest Highway
- ☐ Park Road
- ☐ Bikeway
- ☐ Does not apply

Road No.: _____ Road Name: _____

**Project Location** (enter beginning and end of project to know points – not stationing):

From: _____ To: _____

In the City of: _____

If not in a City, enter the distance and direction from the nearest incorporation:

Distance: _____ miles Direction: _____ From: _____

Legal Description (Township-Section-Range): _____

Tied Project Numbers (if any): _____

(project numbers which will be on the same plan or in the same contract as this project)

New Bridge No.: Old Bridge No.: _____

New Bridge No.: Old Bridge No.: _____

**Estimated construction**

**Start date** Month: Year **End date** Month: Year: _____

Additional notes:

**For State Aid Office Use Only** – Assigned State Aid Project No. (SAP/SAP): _____

**Type of work (check all that apply):**

| | **Roadway** | | continued…**Bridge/Culvert** | | continued…**Traffic Control** |
|---|---|---|---|---|---|
| ☐ | Aggregate Base | ☐ | Bridge Replacement | ☐ | Temporary Traffic Signal |
| ☐ | Aggregate Shoulder | ☐ | Bridge Widening | ☐ | Traffic Management System |
| ☐ | Aggregate Surfacing | ☐ | Construction Detour | | Traffic Signal Cab. & Controller |
| ☐ | Bike Lane | ☐ | Culvert Extension | ☐ | Traffic Signal Installation |
| ☐ | Bituminous Base | ☐ | Culvert Replacement | ☐ | Traffic Signal Poles |
| ☐ | Bituminous Crack & Seal | ☐ | Culvert Replacement | ☐ | Traffic Signal Revision |
| ☐ | Bituminous Mill | ☐ | Deck Replacement | ☐ | Traffic Barrier |
| ☐ | Bit. Mill & Overlay | ☐ | Existing Alignment | ☐ | Warning Flasher |
| ☐ | Bituminous Overlay | ☐ | Joint Repair | | **Other Facilities** |
| ☐ | Bit. Pave. Replacement | ☐ | Mechanical Upgrade | ☐ | Aggregate Bike Trail |
| ☐ | Bituminous Surfacing | ☐ | Multiuse Trail Bridge (incl. bike) | ☐ | Bike Lockers |
| ☐ | Bypass Lane | ☐ | Multiuse Trail Underpass (incl. bike) | ☐ | Bike Rack |
| ☐ | Channelization | ☐ | New Alignment | ☐ | Biological Relocation |
| ☐ | Cold Inplace Recycle | ☐ | New Bridge | ☐ | Bituminous Walk |
| ☐ | Con. Crack & Joint Repair | ☐ | New Culvert | ☐ | Building Removal |
| ☐ | Concrete Mill & Overlay | ☐ | Overlay | ☐ | Bus Shelters |
| ☐ | Concrete Overlay | ☐ | Paint | ☐ | Concrete Sidewalk |
| ☐ | Con. Pave. Replacement | ☐ | Pedestrian Bridge | ☐ | Curb Ramps |
| ☐ | Concrete Surfacing | ☐ | Pedestrian Underpass | ☐ | Decorative Ped. Lighting |
| ☐ | Construct Detour | ☐ | Railing Replacement | ☐ | Decorative Roadway Lighting |
| ☐ | Culvert | ☐ | Skyway | ☐ | Erosion Control |
| ☐ | Curb & Gutter | ☐ | Temporary Bridge | ☐ | Exhibits |
| ☐ | Diagonal Parking | | **Non-construction** | ☐ | Fencing |
| ☐ | Drainage/Less 10 ft. Culvert | ☐ | Access Control | ☐ | Historic Building Restoration |
| ☐ | Emergency Repairs | ☐ | Archaeological Study | ☐ | Historic Preservation |
| ☐ | Erosion Repair | ☐ | Areawide Planning | ☐ | Historic Vehicle Restoration |
| ☐ | Existing Alignment | ☐ | Artifact Acquisition | ☐ | Interpretive Facilities |
| ☐ | Grading | ☐ | Construction Engineering | ☐ | Kiosks |
| ☐ | HOV Lane | ☐ | Corridor Management Plan | ☐ | Landscaping |
| ☐ | Median | ☐ | Corridor Study | ☐ | Maintain Building |
| ☐ | Micro Surfacing | ☐ | Design Engineering | ☐ | Miscellaneous Amenities |
| ☐ | New Alignment | ☐ | Develop Training Materials | ☐ | Multiuse Bit. Trail (incl. bike) |
| ☐ | Patching | ☐ | Marketing | ☐ | Noise Abatement |
| ☐ | Reconstruction | ☐ | Preliminary Engineering | ☐ | Other Local Uses |
| ☐ | Roundabout | ☐ | Right of Way Acquisition | ☐ | Other Transp. Facil. Restoration |
| ☐ | Seal Coat | ☐ | Scenic Easement | ☐ | Park and Ride |
| ☐ | Shoulder Paving | ☐ | Tourist Information | ☐ | Parking Lot |
| ☐ | Shoulder Widening | ☐ | Training Conference | ☐ | Pedestrian Lighting |
| ☐ | Slope Flattening | | **Traffic Control** | ☐ | Rest Area |
| ☐ | Storm Sewer | ☐ | Emergency Vehicle Preemption | ☐ | Retaining Wall |
| ☐ | Subgrade Correction | ☐ | Guardrail | ☐ | Scenic Overlook |
| ☐ | Truck Climbing lane | ☐ | Interconnect | ☐ | Street Lighting |
| ☐ | Turn Lane | ☐ | Railroad Crossing Signal | ☐ | Tourist Center |
| ☐ | Widening | ☐ | Railroad Crossing Surfacing | ☐ | Trail Head |
| | **Bridge/Culvert** | ☐ | Ramp Meter | ☐ | Transit Hub |
| ☐ | Approach Panel | ☐ | Signal Lamp Replacement | ☐ | Utility Relocation |
| ☐ | Bridge Rehab | ☐ | Signing | ☐ | Wetland Mitigation |
| ☐ | Bridge Removal | ☐ | Striping | | |

**EMAIL THIS COMPLETE FROM TO YOUR DISTRICT STATE AID OFFICE.**

# PLAN FORMAT ITEMS

Use of these items in a plan presented for review in the State Aid Division will facilitate a quick review.

## TITLE SHEET INFORMATION

1. CONSTRUCTION PLAN FOR _work description_ (Excavation, Agg. Base Class 5, Curb & Gutter, Bituminous Surfacing, R/W Acquisition, Storm Sewer, etc). Use pay item level of detail rather than saying a roadway name or bikeway.

2. SAP ###-###-### LOCATED ON _____ FROM _____ TO _____

3. PROJECT LENGTH showing exceptions if any.
   Length must agree with the stationing shown on the index map. Provide a block for each SAP number, if there is more than one project number in the plan.

4. GOVERNING SPECIFICATION NOTE.
   THE 2016 EDITION OF THE MINESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL APPLY.

5. PLAN PREPARATION CERTIFICATION with License number, printed name and signature of the preparer. Certification is now required by the Board on **EACH** sheet, including Standard Plan sheets where information has been added or deleted. Cross Section sheets do NOT require certification.

6. DESIGN DESIGNATION INFORMATION BLOCK
   a) Show traffic dates in the year the project is to be let and adjust the figures, if appropriate.
   b) Traffic figures should match values shown in the needs. If the proposed roadway is of a lesser width than the amount dictated by the traffic figures in the needs, justification is needed.
   c) Soil factors should match the percentage shown in the needs. If the soil factor shown on the plan provides more stability than the factor shown in the needs, a soils letter and tests or borings supporting the lowered factor are required and needs updated.
   d) Show Exceptions to the Design Speed if less than the design speed allowed by the rules. Include the stations of the exception and the reason allowed.
   *DESIGN SPEED NOT ACHIEVED AT: Sta.____ to Sta.____ (reason)**
   A Stop Condition or lighted sag vertical curve is permitted with no variance.
   If the exception requires a variance include variance note.

# PLAN FORMAT ITEMS CONTINUED

**TITLE SHEET (CONTINUED)**

7. VARIANCE NOTE, if one has been approved for the project, in the following format;
   ** THIS PROJECT HAS BEEN GRANTED A VARIANCE FROM MINNESOTA RULE 8820.__(a)__, DATED FEBRUARY 2013, SO AS TO PERMIT ___(b)___ IN LIEU OF THE REQUIRED ___(c)___. THE VARIANCE WAS SIGNED BY ___(d)___ ON ___(e)___.*

   Complete the blanks in the variance note with;
   - (a) The rule number the variance was granted from, followed by the date of the current rules book.
   - (b) The project roadway width, design speed, R/W width, or condition allowed by the variance.
   - (c) The condition that would have been required by the rules had the variance not been granted.
   - (d) The name and position of the person who signed the variance.
   - (e) The date the signature was affected.

8. MMUTCD NOTE
   The following note should be included on the Title Sheet of all construction plans:
   *All traffic control devices shall conform to the MMUTCD, including "Field Manual for Temporary Traffic Control Zone Layouts"*

9. SIGNATURE BLOCK.
   - a) A County signature will be requested on a City plan when there is any impact on the County Right of Way.
   - b) A City signature will be requested on a County plan when there is any impact on the City Right of Way.

10. <u>ALL</u> PROJECT NUMBERS AND SHEET NUMBERS ON LOWER RIGHT CORNER OF <u>ALL</u> SHEETS.

11. INDEX MAP with print size legible on an 11x17 reduced copy.
    - a) Show major roadways in the general project area.
    - b) Provide leaders from Begin and End Project numbers, with stationing, to the appropriate points on the index map. Length between stations must match Project Length blocks. Provide leaders with station values for any exceptions and equations to the project length.

12. LEGAL DESCRIPTIONS are required on State Aid **<u>RURAL</u>** projects.
    - a) Provide land ties to endpoints of each project.
    - b) Show the distance and direction to the nearest town.

13. INDEX OF SHEETS with the statement *This Plan Contains XX Sheets.* A & B sheets must be listed separately.

14. BAR SCALES for index map, plan, profiles, and cross sections.

15. PLANS SYMBOLS.

# PLAN FORMAT ITEMS CONTINUED

## ESTIMATED QUANTITY SHEET

1. ITEM NUMBERS and UNITS associated with the number that matches the TRNS.PORT list, which can be found for 2016 Spec Book at http://transport.dot.state.mn.us/Reference/refItem.aspx . If item cannot be found in the TRNS.PORT list, replace the item number with a similar item number and use a .6XX extension (refer to sheet 58 for .6XX extension list) and include in the special provisions the method of measurement, payment and construction specifications, of which we would need a copy of.

2. SEPARATE COLUMNS:
   a) For each SAP.
   b) For STORM SEWER a separate column is required for each SAP.
   c) For Local Funds, to pay non-participating items. If local funds are provided from different sources (more than one city or county), a separate column for each source as necessary.
   d) Landscape column for Landscape items.

3. BASIS OF ESTIMATED QUANTITIES SUMMARY.

4. NOTES TO THE PAY ITEMS
   a) Show application rates for tack coat, fertilizer, mulch, and other quantities where the unit is not a total measure.
   b) When Lump Sum items are used, state what the total includes, especially the number of trees in Clearing and Grubbing which are needed to compute the replacement quantity by ratio.

5. TABULATIONS, consider construction location summaries for pay items like: Fence; Trees and Shrubs; Removals; Retaining Walls; Storm Sewer; and Earthwork. All quantities must be verifiable through the use of tabulations or notes on the plan.

6. EARTHWORK SUMMARY, list excavation and embankment quantities so that it is apparent how much material is excess, if the excess is to be disposed of by the contractor or stockpiled, or, if borrow is needed to justify the quantity.

7. Do not show 0 “zero” quantities in the SEQ or Tabulations.

## CONSTRUCTION NOTES

1. Include descriptions of suitable and unsuitable soils and where their placement is allowed or specified.
2. Define tapers through the base material to match an existing roadway.
3. Note if topsoil stripping and stockpiling is expected.
4. Define compaction requirements and methods.

# PLAN FORMAT ITEMS CONTINUED

## STANDARD PLATES

1. FHWA NOTE.
   *THESE STANDARD PLATES AS APPROVED BY THE FHWA SHALL APPLY.*

2. CURRENT LETTER DESIGNATION for each plate number, which can be found at http://standardplates.dot.state.mn.us/StdPlate.aspx.

3. DESCRIPTION matches the one in the manual.

4. USE A BICYCLE SAFE CASTING.

5. PROVIDE ADDITIONAL CONSTRUCTION DETAILS, for items that do not have a MnDOT Standard Plate.

6. IF MULTIPLE SHEETS FOR PLATE, INCLUDE (X SHEETS) AFTER DESCRIPTION.

## TYPICAL SECTIONS

1. INDIVIDUAL LANE WIDTHS for thru lanes, turn lanes, parking lanes, and shoulder widths (rural).

2. G.E. REQUIREMENTS MET. Check total and Bituminous G.E.

3. SHOW RIGHT OF WAY WIDTH.

4. NOTE CLEAR ZONE.

5. SPECIFICATION AND DEPTH OF ROADWAY CONSTRUCTION PAY ITEMS.
   a) Use spec. 2360 Bituminous Quality Management items.

6. Add LABELS for: Pavement Cross Slopes; Inslopes; Ditch Widths; and Backslopes.

7. LABEL THE LOCATION OF THE PROFILE GRADE.

8. Dimension the TOPSOIL DEPTH, and label SEED AND SOD REQUIREMENTS.

9. Illustrate DITCH BOTTOM and BACKSLOPE ROUNDING.

## STANDARD PLAN SHEETS

1. If applicable, include Mn/DOT Standard Plan sheets as details in the plan. Standard Plan sheets are available on our web page http://standardplans.dot.state.mn.us/StdPlan.aspx

2. If changes are made to the Standard Plan sheet or any details are crossed out, a plan certification block must be added to the sheet.

# PLAN FORMAT ITEMS (CONTINUED)

## PEDESTRIAN RAMP DESIGN PLAN SHEETS

1. MnDOT Standard Plans 5-297.250 sheets 1-6 (Most Current Date Version) must be included in plan set. Along with MnDOT Standard Plate 7038. Standard Plate 7035 has been replaced with MnDOT Standard Plans 5-297.254 sheets 1-4.

2. Design guidance for ADA can be found at: http://www.dot.state.mn.us/ada/design.html If you need assistance with Ped Ramp design, please give the ADA office a call and they will help you with your design.

3. Detail drawings for EACH Ped Ramp are preferred for State Aid projects. When the Ped Ramp is within Trunk Highway R/W, details are required and will be reviewed by MnDOT ADA Office.

## PLAN SHEETS

1. HORIZONTAL and VERTICAL CURVE DATA are required to verify design speed. Show superelevation with the horizontal curve data. Plan view of the transition areas or a super chart may be used.

2. Ensure that any VARIANCE PARAMETERS have been met by the plan, if applicable.

3. Add SIGHT DISTANCE OBSTACLES such as trees and walls to the inplace topography.

4. Provide dimensions for INTERSECTION and ENTRANCE RADII.

5. Show RIGHT of WAY and TEMPORARY EASEMENT dimensions.

6. Consider showing DRAINAGE DIRECTION ARROWS.

7. Show inplace and proposed UTILITIES and DRAINAGE SYSTEMS.

8. Provide STATIONING AT CORPORATE LIMITS of municipalities.

9. Add a NORTH ARROW & SCALE to each sheet.

10. LABEL appropriate REMOVAL and CONSTRUCTION ITEMS for quantity verification..

## CROSS SECTION SHEETS

1. RIGHT of WAY, PERMANENT EASEMENT and TEMPORARY EASEMENT LINES are required.

2. Show DRAINAGE PATTERNS and SPECIAL DITCH GRADES.

3. CENTERLINE AND ENTRANCE CULVERTS.

4. Cross section end areas are helpful so that earthwork quantities can be verified more quickly.

# PLAN SIGNATURE BLOCK

Combinations of funding or jurisdiction will require different combinations of signatures.

☆ **FOR COOPERATIVE AGREEMENT PLANS**

☺ **FOR FEDERAL AID PLANS**

● **FOR STATE AID PLANS**

* (Include the appropriate signatures when the project affects Materials, Water Resources, Traffic or Bridge on any portion of the trunk highway right of way.)

☆ ☺ ● _____

Signature

Design Engineer: I hereby certify that this plan was prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

Date: _____ Printed name_____License number _____

☆ ☺ ●Approved _____ 20_____

CITY OF _____ ENGINEER

☆ ☺ ●Approved _____ 20_____

_____COUNTY ENGINEER

☆ Recommended for Approval _____ 20_____

DISTRICT TRANSPORTATION ENGINEER

☆ * Recommended for Approval _____ 20_____

DISTRICT MATERIALS ENGINEER

☆ * Recommended for Approval _____ 20_____

DISTRICT WATER RESOURCES/HYDRAULICS ENGINEER

☆ * Recommended for Approval _____ 20_____

DISTRICT TRAFFIC ENGINEER

☆ Recommended for Approval _____ 20_____

STATE PRE-LETTING ENGINEER

☆ Office of Land _____ 20_____

Management Approval DIRECTOR, LAND MANAGEMENT

☆ Approved _____20_____

STATE DESIGN ENGINEER

☺ _____ 20_____

DISTRICT STATE AID ENGINEER: REVIEWED FOR COMPLIANCE WITH **(1) STATE AND/OR FEDERAL AID** RULES/POLICY

☺ _____ 20_____

APPROVED FOR **(1) STATE AND/OR FEDERAL AID** FUNDING: STATE AID ENGINEER

● _____ 20_____

DISTRICT STATE AID ENGINEER: REVIEWED FOR COMPLIANCE WITH STATE AID RULES/POLICY

● _____ 20_____

APPROVED FOR STATE AID FUNDING: STATE AID ENGINEER

**(1) This portion will be modified when State and/or Federal Aid funds are used for part of the local match.**

For plans that contain ***both*** *Federal Aid and State Aid funding*, use the required Federal Aid signatures shown above.

The City/County Engineer (or approved designee) must sign the plan to approve the use of Federal Aid or State Aid funds.

If a route is shared by more than one City or County, a signature is required from each.

If work will be done on or impacts another agency's right of way, approval by that agency is required.

# STATE AID FUNDING ELIGIBILITY

| ITEM | ELIGIBILITY | | CONDITIONS |
|---|---|---|---|
| | FULL | LIMITED | |
| Bike Paths | X | | --MSA: in permanent R/W or parallel easement<br>--CSA: part of bike path plan & in permanent R/W or parallel easement |
| Culverts | X | | |
| Curb & Gutter | X | | --concrete or bituminous |
| Drain Tile | X | | --as grading expense, not storm sewer |
| Engineering Costs:<br>archaeological surveys<br>pre-design<br>design<br>staking of right of way<br>soils determination<br>construction engineering<br>inspection<br>testing | | MAX 25% | --Actual costs up to 25% of State Aid eligible construction costs |
| Landscaping: | | MAX 5% | Max. 5% of yearly construction allocation |
| decorative handrails<br>ornamental fences & railings<br>brick pavers<br>colored concrete<br>aesthetic surface treatment<br>special surface finish<br>ornamental roadway lighting<br>internally lit street signs | | ** | --decorative treatment on items necessary for transportation purposes<br><br>--standard item costs paid for under grading<br><br>** costs in excess of standard item costs are eligible under 5% landscaping |
| trees | | ** | --when exceeding 2 to 1 replacement<br>--no max dia. |
| shrubs, ground cover, mulch | | ** | |
| irrigation | | ** | --when irrigating eligible landscaping on R/W |
| decorative retaining walls/planters | | ** | --when holding eligible items |
| decorative fences<br>split rail | | ** | |
| pedestrian lighting | | ** | --on R/W |

# STATE AID FUNDING ELIGIBILITY

| ITEM | ELIGIBILITY | | CONDITIONS |
|---|---|---|---|
| | FULL | LIMITED | |
| Lighting(roadway)--standard | X | | --standard poles/fixtures (cobra,shoebox)<br>--criteria:<br>1. 4 or more lanes, or<br>2. at intersection, or<br>3. revision due to reconstruction, or<br>4. within a city,or<br>5. approval of DSAE w/justification |
| Lighting(rdwy)--ornamental | X | ** | --if required by adopted city/county policy<br>** if not--see landscaping |
| Mailbox Supports | X | | |
| Overlays | X | | |
| Pedestrian Ramps | X | | |
| Retaining Walls | X | | |
| Right-of-Way: | | | |
| payment for land | X | | --taken or damaged |
| payment for easements | X | | --temporary or permanent |
| appraisal costs | X | | --owners' & local road authority |
| owners/occ relocation costs | X | | |
| title searches | X | | |
| abstract update | X | | --due to taking (costs necessary for property owner to clear title to make property merchantable are NOT eligible) |
| filing fees: recording of deed satisfaction of mortgage | X | | |
| state deed tax | X | | |
| condemnation costs | X | | |
| payment to utility company | X | | --utility movement required by construction |
| cleanup of contaminated property | X | | --reimbursement by owners/polluters to be paid back to State Aid account |
| Roundabouts | X | | Same as “signal below” |
| Seal Coats | X | | --no time limit |
| Seed/Sod/Mulch | X | | |

# STATE AID FUNDING ELIGIBILITY

| ITEM | ELIGIBILITY | | CONDITIONS |
|---|---|---|---|
| | FULL | LIMITED | |
| Sidewalks<br>incl: bit/conc boulevard | X | | --MSA or CSA, one or both sides<br>--no width limit |
| Signals<br>incl: EVP, Signs<br>Eligibility Sketch: See Next Sheet | | ** | ** if any legs eligible, all public streets under same jurisdiction eligible |
| Signal Interconnect | X | | --either by legs or 100% on mainline |
| Storm Sewer<br>See Tech Memo 96-SA-02 | | ** | ** proportionate share determined by State Aid Hydraulics Engineer |
| Surfacing | X | | |
| Signing/Striping | X | | |
| Trees | X | | --2 to 1 replacement |
| Water/Sanitary Sewer | X | | --only replacement due to construction<br>--upgrades not eligible |

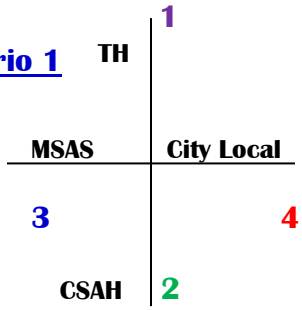
**ITEMS NOT ELIGIBLE**

Parking Meters, incl relocation
Street signs on corners
Work off State Aid R/W (unless approved by DSAE)

# SIGNAL FUNDING OPTIONS

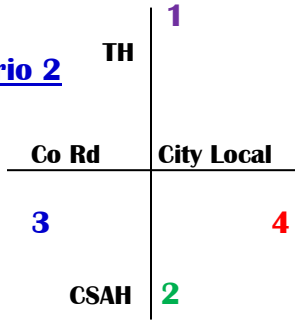
**8820.3100 GENERAL STATE-AID LIMITATIONS. Subp. 5. Traffic control signals.** The extent of state-aid participation in signal installations must be determined by the proportion of the number of approaching routes under the jurisdiction of the county or urban municipality to the total number of approaching routes involved at each installation. When at least one approach is eligible for state-aid participation for a county or urban municipality, then all other approaches under the same jurisdiction are also eligible.

**Scenario 1**



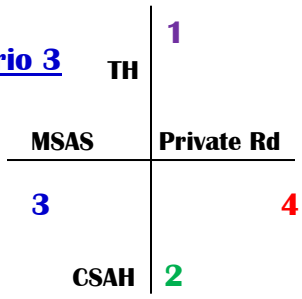

| Approaches | Funding Options |
|---|---|
| 1 | MSAS (offsystem) |
| 2 | CSAH / or MSAS (offsystem) |
| 3 | MSAS |
| 4 | City Local or MSAS |

**Scenario 2**




| Approaches | Funding Options |
|---|---|
| 1 | MSAS (offsystem) |
| 2 | CSAH / or MSAS (offsystem) |
| 3 | County Local or CSAH |
| 4 | City Local or MSAS (offsystem) |

**Scenario 3**




| Approaches | Funding Options |
|---|---|
| 1 | MSAS (offsystem) |
| 2 | CSAH / or MSAS (offsystem) |
| 3 | MSAS |
| 4 | City Local or Private |

# BRIDGE FUNDING ELIGIBILITY

- Federal Bridge Funds (FBF), designated "BR" in the State Transportation Improvement Program (STIP), are available for up to 80% of the "abutment to abutment" costs of eligible bridge rehabilitation or reconstruction work on any publicly owned bridge or culvert longer than 20 feet (clear span as measured along the roadway centerline**). "Abutment to abutment" costs include the 2 foot granular fill or concrete slab above the top of a culvert and all materials under the fill or slab.** Bridges to receive funds are selected by the Area Transportation Partnership (ATP). Federal Funds are provided "in part" are limited to federal funds indicated in the STIP. Funding is dependent on the availability of funds.
    - Bridges, which are deficient under federal criteria **and** have a sufficiency rating less than 50 are eligible for reconstruction.
    - Bridges, which are deficient under federal criteria **and** have a sufficiency rating less than 80 are eligible for rehabilitation.
    - Bridges with sufficiency rating greater than 80 are not eligible for Federal Bridge Funds.

- Minnesota State Transportation Funds, State Bridge Bonding funds (SBB) aka "Fund 29" are available for up to 100% (typically 20% for matching FBF) of the "abutment to abutment" costs of eligible rehabilitation or reconstruction work on any publicly owned bridge or culvert longer than 10 feet (clear span as measured along the roadway centerline), or *roadway in lieu of bridge* work. Work must be done by contract, not local forces.
    - Bridges, which are deficient under federal criteria **and** have sufficiency rating less than 80 are eligible for SBB.
    - *Roadway in lieu of bridge* projects are eligible for SBB, up to the cost of replacing the structure; this includes structure removal, grading, and right-of-way.
    - Bridges that replace structures less than 10 feet long are eligible for SBB.
    - Eligibility for Town Bridge Funds is the same as SBB.

- Items not eligible for FBF and SBB may be eligible for State Aid funding (SA) if on a State-Aid route.

- Town Bridge (Twn Br) funds are available for up to 100% of eligible township bridge rehabilitation, reconstruction, or other necessary work. The County may request 100% funding if the cost is less than $20,000. Items eligible for bridge items is shown the Twn Br column. Approaching grading is eligible after the first $10,000 of local cost (including bridge removal), if requested in writing.

- Turnback funds may be used to replace or repair bridges the Trunk Highway turnback projects. Eligibility is the same as shown in the SA column.

- "Prorated" means the item is partially eligible at the ratio of participating to non-participating items. Traffic control and mobilization are two common examples.

- Decorative or aesthetic items are limited to the estimated cost of the standard items. For example, a chain link fence may be standard, but the designer feels a decorative railing is appropriate in particular situations. The proration rate is the estimated cost for chain link fence, divided by actual unit price of the decorative railing.

| BRIDGE FUNDING ELIGIBILITY | | | | | |
|---|---|---|---|---|---|
| **ITEM** | **ELIGIBILITY** | | | | **CONDITIONS** |
| | **FBF** | **TWN BR** | **SBB** | **SA** | |
| ***GENERAL*** | | | | | |
| Mobilization | X | X | X | X | 100% eligible if approach grading is to the touchdown point. Pro-rated by participating bridge amount if grading goes beyond touchdown point. |
| Structure Excavation | X | X | X | X | |
| Engineering & Surveying | X | X | | X | See Tech Memos 93-SA-05 for eligibility of historic/archaeological review services with federal planning funds. |
| Bridge and Non-Bridge Removals | X | X* | | X | * See note (1) Approach Grading Cost. |
| Salvage | | X* | | X | * See note (1) Approach Grading Cost. |
| Traffic control | X | X | X | X | 100% eligible if approach grading is to the touchdown point. Pro-rated by participating bridge amount if grading goes beyond touchdown point. |
| Right of Way | | X* | X* | X | *May be eligible on road-in-lieu of bridge projects. |
| Utility Work | X | | | X | Whether electrical, gas, telephone not owned by subdivision of the State; or storm, sanitary owned by subdivision of the State. |
| ***BRIDGE STRUCTURES*** | | | | | |
| Granular Backfill for Abutment Drainage System System | X | X | X | X | |
| Granular Bedding | X | X | X | X | |
| Bridge Foundation & Structure | X | X | X | X | Includes piling, beams, joints, rebar, overlays, bearings… |
| Slope Preparation & Paving | X | X | X | X | |

| BRIDGE FUNDING ELIGIBILITY | | | | | |
|---|---|---|---|---|---|
| **ITEM** | **ELIGIBILITY** | | | | **CONDITIONS** |
| | **FBF** | **TWN BR** | **SBB** | **SA** | |
| Concrete Sidewalk on Bridge | X | X(a) | X(a) | X | (a) If existing &/or if urban sidewalk approaching (up to 6' both sides; 8' if only one side). Remaining width may be eligible for FBF, SA, or FA funds; State Aid Manual 5.4.VI |
| Path on Bridge | X | X(b) | X(b) | X | (b) If existing &/or urban path approaching bridge (maximum 8' if only on one side). See sidewalk funding conditions above if on both sides. Remaining width may be eligible for FBF, SA, or FA funds; State Aid Manual 5.4.VI |
| Drainage System | X | X | X | X | On the bridge and/or behind abutments. |
| Lighting Systems (including conduit) | X | X | X | X | If lighting is justified. Ornamental units prorated to standards. |
| Guard Rail | X | X | X | X | |
| Ornamental Metal Rail | X | X | X | X | Prorated to cost of standard railing or chain link fence. |
| Architectural Surface Treatment | X | | | X | Subject to 5% of annual construction allocation cap. See "landscape" guidance. |
| ***CULVERTS*** | | | | | |
| Culvert Pipe & Aprons | X | X | X | X | |
| Culvert Bedding | X | X | X | X | |
| Culvert Backfill Including Granular | X | X | X | X | Eligible to minimum depth of cover required (usually 2'). |
| ***APPROACH WORK*** | | | | | |
| Clearing & Grubbing | X | X* | | X | * See note (1) Approach Grading Cost. |
| Common Excavation for Approaches | X | X* | | X | * See note (1) Approach Grading Cost. |

| BRIDGE FUNDING ELIGIBILITY | | | | | |
|---|---|---|---|---|---|
| **ITEM** | **ELIGIBILITY** | | | | **CONDITIONS** |
| | **FBF** | **TWN BR** | **SBB** | **SA** | |
| Topsoil Borrow | X | X* | | X | * See note (1) Approach Grading Cost. |
| Surfacing | X | X* | | X | Concrete, bituminous or aggregate.<br>* See note (1) Approach Grading Cost. |
| Curb & Gutter | X | X* | | X | * See note (1) Approach Grading Cost. |
| Sidewalks Along Approaches | X | X* | | X | * See note (1) Approach Grading Cost. |
| Channel Excavation | X | X | X | X | To the touchdown point. |
| Approach Panels | X | X* | X* | X | *Eligible if included in the same plan as the bridge construction. |
| ***EROSION CONTROL*** | | | | | |
| Riprap | X | X | X | X | Granular or geo filter incidental. |
| Silt Fence | X | X* | | X | * See note (1) Approach Grading Cost. |
| Turf Establishment | X | X* | | X | * See note (1) Approach Grading Cost. |
| ***OTHER*** | | | | | |
| Water Retention Projects | X | X* | | X | * See note (1) Approach Grading Cost.<br>Needs to replace a deficient bridge. |

(1) Approach grading costs are those costs for grading & surfacing the roadway approaches to the bridge, from the bridge to the point where an alignment that meets design standards can match into the existing alignment. Bridge removal is an approach grading cost. For Town Bridge Funds only, costs in excess of $10,000 are eligible.

**Note this list represent the projects that commonly apply for bridge funds. If you have a project replacing a deficient bridge and would like more information on potential bridge funding, contact Patti Loken at 651-366-3803.**

# LOW SPEED URBAN HORIZONTAL CURVE DESIGN

## CURVE RADII FOR VARIOUS DESIGN SPEEDS ON LOW-SPEED URBAN STREETS WITH CURB AND GUTTER BASED ON MAXIMUM URBAN FRICTION FACTORS

| RATE OF SUPER (e) | 20 MPH | 25 MPH | 30 MPH | 35 MPH | 40 MPH |
|---|---|---|---|---|---|
| -0.02 | 96 | 182 | 300 | 454 | 667 |
| 0.02 | 84 | 155 | 250 | 372 | 534 |
| 0.03 | 81 | 149 | 240 | 356 | 508 |
| 0.04 | 79 | 144 | 231 | 341 | 485 |
| 0.05 | 77 | 139 | 223 | 327 | 464 |
| 0.06 | 75 | 135 | 215 | 315 | 445 |

EQUATION FOR DETERMINING RADIUS

$R = V^2 / [ 15 ( e + f ) ]$

WHERE:
- R = RADIUS (ft) AT CENTERLINE
- V = SPEED (mph)
- e = SUPER-ELEVATION
- f = URBAN FRICTION FACTOR

| SPEED (mph) | FRICTION FACTOR (for e = 0.06) |
|---|---|
| 20 | 0.30 |
| 25 | 0.25 |
| 30 | 0.22 |
| 35 | 0.20 |
| 40 | 0.18 |

SUPER-ELEVATION SHALL BE DEVELOPED 2/3 ON TANGENT AND 1/3 ON CURVE.

**SAVED AS FIG D-3 .221**

**Rate of Superelevation and Calculated Length of Runoff for Rural and High-Speed Urban Roadways ($e_{max}$ = 0.06 ft/ft) (S = 0.0025 ft/ft)**

| DEGREE OF CURVE (D) | RADIUS OF CURVE (R) | V=40 mph | | V=45 mph | | V=50 mph | | V=55 mph | | V=60 mph | | V=65 mph | | V=70 mph | | V=75 mph | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | e | L | e | L | e | L | e | L | e | L | e | L | e | L | e | L |
| 0°15’ | 22918 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | NC | 0 |
| 0°30’ | 11459 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | RC | 96.0 | RC | 96.0 | RC | 96.0 |
| 0°45’ | 7639 | NC | 0 | NC | 0 | RC | 96.0 | RC | 96.0 | 0.021 | 100.8 | 0.023 | 110.4 | 0.026 | 124.8 | 0.029 | 139.2 |
| 1°00’ | 5730 | NC | 0 | RC | 96.0 | RC | 96.0 | 0.023 | 110.4 | 0.027 | 129.6 | 0.030 | 144.0 | 0.033 | 158.4 | 0.037 | 177.6 |
| 1°15’ | 4584 | RC | 96.0 | RC | 96.0 | 0.024 | 115.2 | 0.028 | 134.4 | 0.032 | 153.6 | 0.036 | 172.8 | 0.040 | 192.0 | 0.044 | 211.2 |
| 1°30’ | 3820 | RC | 96.0 | 0.024 | 115.2 | 0.028 | 134.4 | 0.032 | 153.6 | 0.037 | 177.6 | 0.041 | 196.8 | 0.046 | 220.8 | 0.051 | 244.8 |
| 1°45’ | 3274 | 0.023 | 110.4 | 0.027 | 129.6 | 0.031 | 148.8 | 0.036 | 172.8 | 0.041 | 196.8 | 0.046 | 220.8 | 0.051 | 244.8 | 0.056 | 268.8 |
| 2°00’ | 2865 | 0.025 | 120.0 | 0.030 | 144.0 | 0.035 | 168.0 | 0.040 | 192.0 | 0.045 | 216.0 | 0.049 | 235.2 | 0.055 | 264.0 | 0.059 | 283.2 |
| 2°15’ | 2546 | 0.028 | 134.4 | 0.033 | 158.4 | 0.038 | 182.4 | 0.043 | 206.4 | 0.048 | 230.4 | 0.053 | 254.4 | 0.057 | 273.6 | 0.060 | 288.0 |
| 2°30’ | 2292 | 0.030 | 144.0 | 0.035 | 168.0 | 0.040 | 192.0 | 0.045 | 216.0 | 0.051 | 244.8 | 0.055 | 264.0 | 0.059 | 283.2 | $D_{max}$=2°15’ | |
| 2°45’ | 2083 | 0.032 | 153.6 | 0.037 | 177.6 | 0.042 | 201.6 | 0.048 | 230.4 | 0.053 | 254.4 | 0.058 | 278.4 | 0.060 | 288.0 | | |
| 3°00’ | 1910 | 0.034 | 163.2 | 0.039 | 187.2 | 0.044 | 211.2 | 0.050 | 240.0 | 0.055 | 264.0 | 0.059 | 283.2 | $D_{max}$=2°45’ | | | |
| 3°15’ | 1763 | 0.036 | 172.8 | 0.041 | 196.8 | 0.046 | 220.8 | 0.052 | 249.6 | 0.057 | 273.6 | 0.060 | 288.0 | | | | |
| 3°30’ | 1637 | 0.038 | 182.4 | 0.043 | 206.4 | 0.048 | 230.4 | 0.054 | 259.2 | 0.058 | 278.4 | $D_{max}$=3°15’ | | | | | |
| 3°45’ | 1528 | 0.039 | 187.2 | 0.045 | 216.0 | 0.050 | 240.0 | 0.055 | 264.0 | 0.059 | 283.2 | | | | | | |
| 4°00’ | 1432 | 0.041 | 196.8 | 0.046 | 220.8 | 0.051 | 244.8 | 0.057 | 273.6 | 0.060 | 288.0 | | | | | | |
| 4°15’ | 1348 | 0.042 | 201.6 | 0.048 | 230.4 | 0.053 | 254.4 | 0.058 | 278.4 | 0.060 | 288.0 | | | | | | |
| 4°30’ | 1273 | 0.043 | 206.4 | 0.049 | 235.2 | 0.054 | 259.2 | 0.059 | 283.2 | $D_{max}$=4°15’ | | | | | | | |
| 4°45’ | 1206 | 0.044 | 211.2 | 0.050 | 240.0 | 0.055 | 264.0 | 0.059 | 283.2 | | | | | | | | |
| 5°00’ | 1146 | 0.046 | 220.8 | 0.051 | 244.8 | 0.056 | 268.8 | 0.060 | 288.0 | | | | | | | | |
| 5°15’ | 1091 | 0.047 | 225.6 | 0.053 | 254.4 | 0.057 | 273.6 | 0.060 | 288.0 | | | | | | | | |
| 5°30’ | 1042 | 0.048 | 230.4 | 0.054 | 259.2 | 0.058 | 278.4 | $D_{max}$=5°15’ | | | | | | | | | |
| 5°45’ | 996 | 0.049 | 235.2 | 0.055 | 264.0 | 0.059 | 283.2 | | | | | | | | | | |
| 6°00’ | 955 | 0.050 | 240.0 | 0.055 | 264.0 | 0.059 | 283.2 | | | | | | | | | | |
| 6°15’ | 917 | 0.051 | 244.8 | 0.056 | 268.8 | 0.060 | 288.0 | | | | | | | | | | |
| 6°30’ | 881 | 0.052 | 249.6 | 0.057 | 273.6 | 0.060 | 288.0 | | | | | | | | | | |
| 6°45’ | 849 | 0.053 | 254.4 | 0.058 | 278.4 | 0.060 | 288.0 | | | | | | | | | | |
| 7°00’ | 819 | 0.053 | 254.4 | 0.058 | 278.4 | $D_{max}$=6°45’ | | | | | | | | | | | |
| 7°15’ | 790 | 0.054 | 259.2 | 0.059 | 283.2 | | | | | | | | | | | | |
| 7°30’ | 764 | 0.055 | 264.0 | 0.059 | 283.2 | | | | | | | | | | | | |
| 7°45’ | 739 | 0.055 | 264.0 | 0.059 | 283.2 | | | | | | | | | | | | |
| 8°00’ | 716 | 0.056 | 268.8 | 0.060 | 288.0 | | | | | | | | | | | | |
| 8°15’ | 694 | 0.057 | 273.6 | 0.060 | 288.0 | | | | | | | | | | | | |
| 8°30’ | 674 | 0.057 | 273.6 | 0.060 | 288.0 | | | | | | | | | | | | |
| 8°45’ | 655 | 0.058 | 278.4 | $D_{max}$=8°30’ | | | | | | | | | | | | | |
| 9°00’ | 637 | 0.058 | 278.4 | | | | | | | | | | | | | | |
| 9°15’ | 619 | 0.058 | 278.4 | | | | | | | | | | | | | | |
| 9°30’ | 603 | 0.059 | 283.2 | | | | | | | | | | | | | | |
| 9°45’ | 588 | 0.059 | 283.2 | | | | | | | | | | | | | | |
| 10°00’ | 573 | 0.059 | 283.2 | | | | | | | | | | | | | | |
| 10°30’ | 546 | 0.060 | 288.0 | | | | | | | | | | | | | | |
| 11°00’ | 521 | 0.060 | 288.0 | | | | | | | | | | | | | | |
| 11°30’ | 498 | $D_{max}$=11°15’ | | | | | | | | | | | | | | | |

KEY TO TABLE

R = Radius of curve, ft
$D_{max}$ = Maximum degree of curve
V = Design speed, mph
e = Superelevation rate, ft/ft
NC = Normal Crown
RC = Remove Crown
L = Calculated length of superelevation runoff, ft
(From adverse crown removed to full superelevation, based on one lane of rotation. L value for RC condition based on normal 0.020 cross slope.)

NOTES:

1. $e_{max}$ = 0.06 ft/ft
1. Tangent runout lengths are in addition to the table runoff lengths
2. Table transition runoff lengths based on:

$$L = \frac{W \times e}{S}$$

Where: S = Longitudinal slope (MnDOT typical $\frac{1}{400}$ or 0.0025 ft/ft )
W = Lane width (12 ft)
e = Superelevation (Table values based on method 5 procedures of AASHTO where superelevation and side friction are in a curvilinear relation with the inverse of the radius of curve)

Where conditions are restrictive, the following absolute minimum longitudinal slopes may be used:

| Design Speed | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
|---|---|---|---|---|---|---|---|
| Slope | 1:170 | 1:185 | 1:200 | 1:215 | 1:230 | 1:240 | |

**Minimum Rates of Superelevation and Calculated Length of Runoff for Low-Speed Roadways in Urban Locations ($e_{max}$ = 0.06 ft/ft) (S = 0.0025 ft/ft)**

| RADIUS OF CURVE (R) | V=20 mph | | V=25 mph | | V=30 mph | | V=35 mph | | V=40 mph | |
|---|---|---|---|---|---|---|---|---|---|---|
| | e | L | e | L | e | L | e | L | e | L |
| 700 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | NC | 0 |
| 600 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | RC | 96.0 |
| 500 | NC | 0 | NC | 0 | NC | 0 | NC | 0 | 0.035 | 168.0 |
| 450 | NC | 0 | NC | 0 | NC | 0 | RC | 96.0 | 0.059 | 283.2 |
| 400 | NC | 0 | NC | 0 | NC | 0 | RC | 96.0 | $R_{min}$=450 | |
| 375 | NC | 0 | NC | 0 | NC | 0 | 0.021 | 100.8 | | |
| 350 | NC | 0 | NC | 0 | NC | 0 | 0.036 | 172.8 | | |
| 325 | NC | 0 | NC | 0 | NC | 0 | 0.054 | 259.2 | | |
| 300 | NC | 0 | NC | 0 | NC | 0 | $R_{min}$=320 | | | |
| 275 | NC | 0 | NC | 0 | RC | 96.0 | | | | |
| 250 | NC | 0 | NC | 0 | RC | 96.0 | | | | |
| 225 | NC | 0 | NC | 0 | 0.046 | 220.8 | | | | |
| 200 | NC | 0 | NC | 0 | $R_{min}$=215 | | | | | |
| 175 | NC | 0 | RC | 96.0 | | | | | | |
| 150 | NC | 0 | 0.026 | 124.8 | | | | | | |
| 140 | NC | 0 | 0.046 | 220.8 | | | | | | |
| 130 | NC | 0 | $R_{min}$=135 | | | | | | | |
| 125 | NC | 0 | | | | | | | | |
| 120 | NC | 0 | | | | | | | | |
| 115 | NC | 0 | | | | | | | | |
| 110 | NC | 0 | | | | | | | | |
| 105 | NC | 0 | | | | | | | | |
| 100 | NC | 0 | | | | | | | | |
| 95 | RC | 96.0 | | | | | | | | |
| 90 | RC | 96.0 | | | | | | | | |
| 85 | RC | 96.0 | | | | | | | | |
| 80 | 0.033 | 158.4 | | | | | | | | |
| 75 | 0.056 | 268.8 | | | | | | | | |
| | $R_{min}$=75 | | | | | | | | | |

KEY TO TABLE

R = Radius of curve, ft
$R_{min}$ = Minimum radius of curve, ft
V = Design speed, mph
e = Superelevation rate, ft/ft
NC = Normal Crown
RC = Remove Crown
L = Calculated length of superelevation runoff, ft
(From adverse crown removed to full superelevation, based on one lane of rotation. L value for RC condition based on normal 0.020 cross slope.)

NOTES:

1. $e_{max}$ = 0.06 ft/ft
2. Tangent runout lengths are in addition to the table runoff lengths
3. Table transition runoff lengths based on:

$$L = \frac{W \times e}{S}$$

Where: S = Longitudinal slope (Mn/DOT typical $\frac{1}{400}$ or 0.0025 ft/ft)

W = Lane width (12 ft)

e = Superelevation rate (Table values based on method 2 procedures of AASHTO where first side friction and then superelevation are increased in inverse proportion to the radius of curve)

Where conditions are restrictive, the following absolute minimum longitudinal slopes may be used:

| Design Speed | 20 | 25 | 30 | 35 | 40 |
|---|---|---|---|---|---|
| Slope | 1:140 | 1:150 | 1:160 | 1:165 | 1:170 |

**Figure B(1) 5-892.211** **Crest Vertical Curves** **October 22, 2004**

Minimum Length of Vertical Curves of "Stopping Sight Distance"

| | V (mph) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A** | **25** | **30** | **35** | **40** | **45** | **50** | **55** | **60** | **65** | **70** | **75** | **80** | |
| **0.8** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | L=3V |
| **0.9** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | |
| **1** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | |
| **1.1** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | |
| **1.2** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | |
| **1.3** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | |
| **1.4** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | **279** | S>L |
| **1.5** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | **381** | |
| **1.6** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | **291** | **471** | |
| **1.7** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | **371** | **551** | |
| **1.8** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | **261** | **441** | **621** | |
| **1.9** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | **324** | **504** | **684** | |
| **2** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | **211** | **381** | **561** | **741** | |
| **2.1** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | **262** | **432** | **612** | **792** | |
| **2.2** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | **309** | **479** | **659** | **839** | |
| **2.3** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | **202** | **352** | **522** | **702** | **882** | |
| **2.4** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | **241** | **391** | **561** | **741** | **921** | |
| **2.5** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | **277** | **427** | **597** | **777** | **959** | |
| **2.6** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | **310** | **460** | **630** | **810** | **998** | |
| **2.7** | 75 | 90 | 105 | 120 | 135 | 150 | **191** | **341** | **491** | **661** | **841** | 1036 | S<L |
| **2.8** | 75 | 90 | 105 | 120 | 135 | 150 | **219** | **369** | **519** | **689** | 872 | 1074 | |
| **2.9** | 75 | 90 | 105 | 120 | 135 | 150 | **246** | **396** | **546** | **716** | 904 | 1113 | |
| **3** | 75 | 90 | 105 | 120 | 135 | 150 | **271** | **421** | **571** | **741** | 935 | 1151 | |
| **3.1** | 75 | 90 | 105 | 120 | 135 | **154** | **294** | **444** | **594** | 766 | 966 | 1190 | |
| **3.2** | 75 | 90 | 105 | 120 | 135 | **176** | **316** | **466** | **616** | 790 | 997 | 1228 | |
| **3.3** | 75 | 90 | 105 | 120 | 135 | **196** | **336** | **486** | **636** | 815 | 1028 | 1266 | |
| **3.4** | 75 | 90 | 105 | 120 | 135 | **215** | **355** | **505** | **655** | 840 | 1059 | 1305 | |
| **3.5** | 75 | 90 | 105 | 120 | 135 | **233** | **373** | **523** | 675 | 864 | 1091 | 1343 | |
| **3.6** | 75 | 90 | 105 | 120 | 135 | **251** | **391** | **541** | 694 | 889 | 1122 | 1381 | |
| **3.7** | 75 | 90 | 105 | 120 | **137** | **267** | **407** | **557** | 713 | 914 | 1153 | 1420 | |
| **3.8** | 75 | 90 | 105 | 120 | **152** | **282** | **422** | 572 | 733 | 938 | 1184 | 1458 | |
| **3.9** | 75 | 90 | 105 | 120 | **167** | **297** | **437** | 587 | 752 | 963 | 1215 | 1497 | |
| **4** | 75 | 90 | 105 | 120 | **181** | **311** | **451** | 602 | 771 | 988 | 1246 | 1535 | |
| **4.1** | 75 | 90 | 105 | 120 | **194** | **324** | **464** | 617 | 790 | 1012 | 1277 | 1573 | |
| **4.2** | 75 | 90 | 105 | 120 | **206** | **336** | **476** | 632 | 810 | 1037 | 1309 | 1612 | |
| **4.3** | 75 | 90 | 105 | 120 | **218** | **348** | **488** | 647 | 829 | 1062 | 1340 | 1650 | |
| **4.4** | 75 | 90 | 105 | 120 | **230** | **360** | 500 | 662 | 848 | 1087 | 1371 | 1688 | |
| **4.5** | 75 | 90 | 105 | **130** | **240** | **370** | 511 | 678 | 868 | 1111 | 1402 | 1727 | |
| **4.6** | 75 | 90 | 105 | **141** | **251** | **381** | 522 | 693 | 887 | 1136 | 1433 | 1765 | |
| **4.7** | 75 | 90 | 105 | **151** | **261** | **391** | 534 | 708 | 906 | 1161 | 1464 | 1804 | |
| **4.8** | 75 | 90 | 105 | **160** | **270** | **400** | 545 | 723 | 925 | 1185 | 1496 | 1842 | |
| **4.9** | 75 | 90 | 105 | **170** | **280** | **410** | 556 | 738 | 945 | 1210 | 1527 | 1880 | |
| **5** | 75 | 90 | 105 | **178** | **288** | **418** | 568 | 753 | 964 | 1235 | 1558 | 1919 | |
| **5.1** | 75 | 90 | 105 | **187** | **297** | 427 | 579 | 768 | 983 | 1259 | 1589 | 1957 | |
| **5.2** | 75 | 90 | 105 | **195** | **305** | 435 | 590 | 783 | 1002 | 1284 | 1620 | 1995 | |
| **5.3** | 75 | 90 | 105 | **203** | **313** | 444 | 602 | 798 | 1022 | 1309 | 1651 | 2034 | |
| **5.4** | 75 | 90 | 105 | **210** | **320** | 452 | 613 | 813 | 1041 | 1333 | 1683 | 2072 | |
| **5.5** | 75 | 90 | **108** | **218** | **328** | 460 | 624 | 828 | 1060 | 1358 | 1714 | 2111 | |
| **5.6** | 75 | 90 | **115** | **225** | **335** | 469 | 636 | 843 | 1080 | 1383 | 1745 | 2149 | |
| **5.7** | 75 | 90 | **121** | **231** | **341** | 477 | 647 | 858 | 1099 | 1408 | 1776 | 2187 | |
| **5.8** | 75 | 90 | **128** | **238** | **348** | 485 | 659 | 873 | 1118 | 1432 | 1807 | 2226 | |
| **5.9** | 75 | 90 | **134** | **244** | **354** | 494 | 670 | 888 | 1137 | 1457 | 1838 | 2264 | |

Minimum Length of Vertical Curves of "Stopping Sight Distance"

| | V (mph) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A** | **25** | **30** | **35** | **40** | **45** | **50** | **55** | **60** | **65** | **70** | **75** | **80** |
| **6** | 75 | 90 | **140** | **250** | 360 | 502 | 681 | 903 | 1157 | 1482 | 1870 | 2302 |
| **6.1** | 75 | 90 | **146** | **256** | 366 | 511 | 693 | 918 | 1176 | 1506 | 1901 | 2341 |
| **6.2** | 75 | 90 | **152** | **262** | 372 | 519 | 704 | 933 | 1195 | 1531 | 1932 | 2379 |
| **6.3** | 75 | 90 | **157** | **267** | 378 | 527 | 715 | 949 | 1215 | 1556 | 1963 | 2418 |
| **6.4** | 75 | 90 | **163** | **273** | 384 | 536 | 727 | 964 | 1234 | 1580 | 1994 | 2456 |
| **6.5** | 75 | 90 | **168** | **278** | 390 | 544 | 738 | 979 | 1253 | 1605 | 2025 | 2494 |
| **6.6** | 75 | 90 | **173** | **283** | 396 | 552 | 749 | 994 | 1272 | 1630 | 2056 | 2533 |
| **6.7** | 75 | 90 | **178** | **288** | 402 | 561 | 761 | 1009 | 1292 | 1655 | 2088 | 2571 |
| **6.8** | 75 | 90 | **183** | **293** | 408 | 569 | 772 | 1024 | 1311 | 1679 | 2119 | 2609 |
| **6.9** | 75 | 90 | **187** | **297** | 414 | 578 | 783 | 1039 | 1330 | 1704 | 2150 | 2648 |
| **7** | 75 | **92** | **192** | **302** | 420 | 586 | 795 | 1054 | 1349 | 1729 | 2181 | 2686 |
| **7.1** | 75 | **96** | **196** | 306 | 426 | 594 | 806 | 1069 | 1369 | 1753 | 2212 | 2725 |
| **7.2** | 75 | **100** | **200** | 310 | 432 | 603 | 818 | 1084 | 1388 | 1778 | 2243 | 2763 |
| **7.3** | 75 | **104** | **204** | 315 | 438 | 611 | 829 | 1099 | 1407 | 1803 | 2275 | 2801 |
| **7.4** | 75 | **108** | **208** | 319 | 444 | 619 | 840 | 1114 | 1427 | 1827 | 2306 | 2840 |
| **7.5** | 75 | **112** | **212** | 323 | 450 | 628 | 852 | 1129 | 1446 | 1852 | 2337 | 2878 |
| **7.6** | 75 | **116** | **216** | 328 | 456 | 636 | 863 | 1144 | 1465 | 1877 | 2368 | 2916 |
| **7.7** | 75 | **120** | **220** | 332 | 462 | 644 | 874 | 1159 | 1484 | 1901 | 2399 | 2955 |
| **7.8** | 75 | **123** | **223** | 336 | 468 | 653 | 886 | 1174 | 1504 | 1926 | 2430 | 2993 |
| **7.9** | 75 | **127** | **227** | 341 | 474 | 661 | 897 | 1189 | 1523 | 1951 | 2462 | 3032 |
| **8** | 75 | **130** | **230** | 345 | 480 | 670 | 908 | 1204 | 1542 | 1976 | 2493 | 3070 |
| **8.1** | 75 | **134** | **234** | 349 | 486 | 678 | 920 | 1220 | 1562 | 2000 | 2524 | 3108 |
| **8.2** | 75 | **137** | **237** | 353 | 492 | 686 | 931 | 1235 | 1581 | 2025 | 2555 | 3147 |
| **8.3** | 75 | **140** | **240** | 358 | 498 | 695 | 942 | 1250 | 1600 | 2050 | 2586 | 3185 |
| **8.4** | 75 | **143** | **243** | 362 | 504 | 703 | 954 | 1265 | 1619 | 2074 | 2617 | 3223 |
| **8.5** | 75 | **146** | **246** | 366 | 510 | 711 | 965 | 1280 | 1639 | 2099 | 2648 | 3262 |
| **8.6** | 75 | **149** | **249** | 371 | 516 | 720 | 976 | 1295 | 1658 | 2124 | 2680 | 3300 |
| **8.7** | 75 | **152** | 252 | 375 | 522 | 728 | 988 | 1310 | 1677 | 2148 | 2711 | 3338 |
| **8.8** | 75 | **155** | 255 | 379 | 528 | 737 | 999 | 1325 | 1696 | 2173 | 2742 | 3377 |
| **8.9** | 75 | **158** | 258 | 384 | 534 | 745 | 1011 | 1340 | 1716 | 2198 | 2773 | 3415 |
| **9** | 75 | **160** | 261 | 388 | 541 | 753 | 1022 | 1355 | 1735 | 2222 | 2804 | 3454 |
| **9.1** | 75 | **163** | 264 | 392 | 547 | 762 | 1033 | 1370 | 1754 | 2247 | 2835 | 3492 |
| **9.2** | 75 | **165** | 266 | 397 | 553 | 770 | 1045 | 1385 | 1774 | 2272 | 2867 | 3530 |
| **9.3** | **78** | **168** | 269 | 401 | 559 | 778 | 1056 | 1400 | 1793 | 2297 | 2898 | 3569 |
| **9.4** | **80** | **170** | 272 | 405 | 565 | 787 | 1067 | 1415 | 1812 | 2321 | 2929 | 3607 |
| **9.5** | **83** | **173** | 275 | 410 | 571 | 795 | 1079 | 1430 | 1831 | 2346 | 2960 | 3645 |
| **9.6** | **85** | **175** | 278 | 414 | 577 | 804 | 1090 | 1445 | 1851 | 2371 | 2991 | 3684 |
| **9.7** | **88** | **178** | 281 | 418 | 583 | 812 | 1101 | 1460 | 1870 | 2395 | 3022 | 3722 |
| **9.8** | **90** | **180** | 284 | 422 | 589 | 820 | 1113 | 1475 | 1889 | 2420 | 3054 | 3761 |
| **9.9** | **92** | **182** | 287 | 427 | 595 | 829 | 1124 | 1491 | 1909 | 2445 | 3085 | 3799 |
| **10** | **94** | **184** | 290 | 431 | 601 | 837 | 1135 | 1506 | 1928 | 2469 | 3116 | 3837 |
| **K** | **12** | **19** | **29** | **44** | **61** | **84** | **114** | **151** | **193** | **247** | **312** | **384** |
| **S** | **155** | **200** | **250** | **305** | **360** | **425** | **495** | **570** | **645** | **730** | **820** | **910** |

V = Design Speed (mph)

S = Sight Distance (ft)

L = Length of Curve (ft)

A = Algebraic Difference of the Grades

Height of Eye = 3.5 feet

Height of Object = 2.0 feet

L minimum = 3V; desirable as per AASHTO

When S > L; Then L = 2S - 2158/A

When S < L; Then L = (AS^2)/2158

When A > 10; Then L = AK

Note: S and K values given above and used in calculations are the rounded "design" values as given in Exhibit 3-76, pg 274 of AASHTO's "A Policy on Geometric Design of Highways and Streets, 2001".

Minimum Length of Vertical Curves of "Stopping Sight Distance"

| | V (mph) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **A** | **25** | **30** | **35** | **40** | **45** | **50** | **55** | **60** | |
| **0.8** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | L=3V |
| **0.9** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.1** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.2** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.3** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.4** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.5** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.6** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.7** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.8** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **1.9** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **2** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **2.1** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **2.2** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **2.3** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **2.4** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | |
| **2.5** | 75 | 90 | 105 | 120 | 135 | 150 | 165 | **182** | |
| **2.6** | 75 | 90 | 105 | 120 | 135 | 150 | **170** | **219** | |
| **2.7** | 75 | 90 | 105 | 120 | 135 | **151** | **200** | **253** | S>L |
| **2.8** | 75 | 90 | 105 | 120 | 135 | **176** | **228** | **285** | |
| **2.9** | 75 | 90 | 105 | 120 | **148** | **199** | **255** | **314** | |
| **3** | 75 | 90 | 105 | **121** | **167** | **221** | **279** | **342** | |
| **3.1** | 75 | 90 | 105 | **137** | **185** | **241** | **302** | **367** | |
| **3.2** | 75 | 90 | 105 | **151** | **201** | **260** | **324** | **392** | |
| **3.3** | 75 | 90 | **114** | **165** | **217** | **278** | **344** | **414** | |
| **3.4** | 75 | 90 | **125** | **178** | **232** | **295** | **363** | **436** | |
| **3.5** | 75 | 90 | **136** | **191** | **246** | **311** | **381** | **456** | |
| **3.6** | 75 | **94** | **146** | **202** | **259** | **326** | **398** | **475** | |
| **3.7** | 75 | **103** | **155** | **213** | **271** | **340** | **414** | **493** | |
| **3.8** | 75 | **111** | **164** | **224** | **283** | **353** | **429** | **510** | |
| **3.9** | 75 | **118** | **173** | **234** | **294** | **366** | **443** | **526** | |
| **4** | 75 | **125** | **181** | **243** | **305** | **378** | **457** | **541** | |
| **4.1** | **80** | **132** | **189** | **252** | **315** | **390** | **470** | **556** | |
| **4.2** | **86** | **138** | **196** | **261** | **325** | **401** | **482** | **570** | |
| **4.3** | **91** | **144** | **203** | **269** | **334** | **411** | **494** | 583 | S<L |
| **4.4** | **96** | **150** | **210** | **276** | **343** | **421** | 506 | 597 | |
| **4.5** | **101** | **156** | **217** | **284** | **351** | 431 | 517 | 610 | |
| **4.6** | **105** | **161** | **223** | **291** | **359** | 440 | 529 | 624 | |
| **4.7** | **109** | **166** | **229** | **298** | 367 | 450 | 540 | 638 | |
| **4.8** | **114** | **171** | **234** | **304** | 375 | 459 | 552 | 651 | |
| **4.9** | **118** | **176** | **240** | 311 | 383 | 469 | 563 | 665 | |
| **5** | **122** | **180** | **245** | 317 | 390 | 478 | 575 | 678 | |
| **5.1** | **125** | **184** | 250 | 323 | 398 | 488 | 586 | 692 | |
| **5.2** | **129** | **188** | 255 | 330 | 406 | 498 | 597 | 705 | |
| **5.3** | **132** | **192** | 260 | 336 | 414 | 507 | 609 | 719 | |
| **5.4** | **135** | **196** | 265 | 342 | 422 | 517 | 620 | 733 | |
| **5.5** | **139** | 200 | 270 | 349 | 429 | 526 | 632 | 746 | |
| **5.6** | **142** | 204 | 275 | 355 | 437 | 536 | 643 | 760 | |
| **5.7** | **145** | 207 | 279 | 361 | 445 | 545 | 655 | 773 | |
| **5.8** | **148** | 211 | 284 | 368 | 453 | 555 | 666 | 787 | |
| **5.9** | **150** | 215 | 289 | 374 | 461 | 565 | 678 | 800 | |
| **6** | **153** | 218 | 294 | 380 | 468 | 574 | 689 | 814 | |
| **6.1** | 155 | 222 | 299 | 387 | 476 | 584 | 701 | 828 | |
| **6.2** | 158 | 225 | 304 | 393 | 484 | 593 | 712 | 841 | |
| **6.3** | 161 | 229 | 309 | 399 | 492 | 603 | 724 | 855 | |

## Figure B(2) 5-892.211 Sag Vertical Curves (Cont.) January 14, 2005

Minimum Length of Vertical Curves of "Stopping Sight Distance"

| | V (mph) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 6.4 | 163 | 233 | 314 | 406 | 500 | 612 | 735 | 868 |
| 6.5 | 166 | 236 | 319 | 412 | 507 | 622 | 747 | 882 |
| 6.6 | 168 | 240 | 324 | 418 | 515 | 632 | 758 | 895 |
| 6.7 | 171 | 244 | 328 | 425 | 523 | 641 | 770 | 909 |
| 6.8 | 173 | 247 | 333 | 431 | 531 | 651 | 781 | 922 |
| 6.9 | 176 | 251 | 338 | 437 | 539 | 660 | 793 | 936 |
| 7 | 178 | 255 | 343 | 444 | 547 | 670 | 804 | 950 |
| 7.1 | 181 | 258 | 348 | 450 | 554 | 679 | 816 | 963 |
| 7.2 | 184 | 262 | 353 | 456 | 562 | 689 | 827 | 977 |
| 7.3 | 186 | 265 | 358 | 463 | 570 | 699 | 839 | 990 |
| 7.4 | 189 | 269 | 363 | 469 | 578 | 708 | 850 | 1004 |
| 7.5 | 191 | 273 | 368 | 475 | 586 | 718 | 862 | 1017 |
| 7.6 | 194 | 276 | 373 | 482 | 593 | 727 | 873 | 1031 |
| 7.7 | 196 | 280 | 377 | 488 | 601 | 737 | 885 | 1045 |
| 7.8 | 199 | 284 | 382 | 494 | 609 | 746 | 896 | 1058 |
| 7.9 | 201 | 287 | 387 | 501 | 617 | 756 | 908 | 1072 |
| 8 | 204 | 291 | 392 | 507 | 625 | 766 | 919 | 1085 |
| 8.1 | 206 | 295 | 397 | 513 | 632 | 775 | 931 | 1099 |
| 8.2 | 209 | 298 | 402 | 520 | 640 | 785 | 942 | 1112 |
| 8.3 | 212 | 302 | 407 | 526 | 648 | 794 | 954 | 1126 |
| 8.4 | 214 | 305 | 412 | 532 | 656 | 804 | 965 | 1140 |
| 8.5 | 217 | 309 | 417 | 539 | 664 | 813 | 977 | 1153 |
| 8.6 | 219 | 313 | 422 | 545 | 671 | 823 | 988 | 1167 |
| 8.7 | 222 | 316 | 426 | 551 | 679 | 833 | 1000 | 1180 |
| 8.8 | 224 | 320 | 431 | 558 | 687 | 842 | 1011 | 1194 |
| 8.9 | 227 | 324 | 436 | 564 | 695 | 852 | 1023 | 1207 |
| 9 | 229 | 327 | 441 | 571 | 703 | 861 | 1034 | 1221 |
| 9.1 | 232 | 331 | 446 | 577 | 710 | 871 | 1046 | 1234 |
| 9.2 | 235 | 335 | 451 | 583 | 718 | 880 | 1057 | 1248 |
| 9.3 | 237 | 338 | 456 | 590 | 726 | 890 | 1069 | 1262 |
| 9.4 | 240 | 342 | 461 | 596 | 734 | 900 | 1080 | 1275 |
| 9.5 | 242 | 345 | 466 | 602 | 742 | 909 | 1092 | 1289 |
| 9.6 | 245 | 349 | 471 | 609 | 749 | 919 | 1103 | 1302 |
| 9.7 | 247 | 353 | 475 | 615 | 757 | 928 | 1115 | 1316 |
| 9.8 | 250 | 356 | 480 | 621 | 765 | 938 | 1126 | 1329 |
| 9.9 | 252 | 360 | 485 | 628 | 773 | 947 | 1138 | 1343 |
| 10 | 255 | 364 | 490 | 634 | 781 | 957 | 1149 | 1357 |
| K | 26 | 37 | 49 | 64 | 79 | 96 | 115 | 136 |
| S | 155 | 200 | 250 | 305 | 360 | 425 | 495 | 570 |

# VARIANCES

"Where a local unit of government feels that a variance from the Minnesota Rules for State Aid Operations Chapter 8820 is justified they shall submit a written request, in the form of a resolution, passed by the pertinent political subdivision, to the Commissioner of the Minnesota Department of Transportation. As required in State Aid Operations Rules, Chapter 8820.3300, the resolution shall identify the project by locale and termini, shall cite the specific rule or standard for which the variance is requested and describe the modification proposed."

See the following page for a checklist to aid in formulating a variance request. Requests are due March 1, June 1, September 1, and December 1 of each year. The variance committee will then convene at the ends of those months to hear the requests.

Contact Metro State Aid (Dan Erickson or Julie Dresel) well in advance of the deadline to work through Variance issues. Final Request is due to Central Office as noted above.
Submit variance requests to:

Please send a copy of the request to:
Dan Erickson or Julie Dresel
Metro State Aid
1500 W. County Road B2
Roseville, MN 55113

# Variance Packet information

The planning, scoping, design, implementation, operation, and maintenance of roads should reasonably address the safety and accessibility needs of users of all ages and abilities. The needs of motorists, pedestrians, transit users, and vehicles, bicyclists, and commercial and emergency vehicles moving along and across roads, intersections, and crossings should be consideration in a manner that is sensitive to the local context and recognizes the varying needs in urban, suburban, and rural settings.

A request for a variance to the design elements required by State Aid Operations Rules Chapter 8820 should contain the following as applicable:

1. As required by the Rules: a certified resolution from the responsible city council or county board which identifies the project by location and termini, cites the applicable Rule and chapter, cites the standard for which the variance is requested, and describes what is proposed in lieu of the standard.

   If applicable, cite the relevant guidance provided in the latest edition of “A Policy on Geometric Design of Highways and Streets”, from AASHTO. For projects in urban areas, if applicable, cite the relevant guidance provided in the latest edition of the “Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities” from the Institute of Transportation Engineers.

2. Location map and typical section (in-place and proposed).

3. Describe adjacent land uses (agricultural, residential, commercial, etc).

4. Describe the needs of motorists, pedestrians, transit users, and vehicles, bicyclists, and commercial and emergency vehicles moving along and across roads, intersections, and crossings should be consideration in a manner that is sensitive to the local context. If applicable, cite the relevant guidance provided in the Institute of Transportation Engineers’ “Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities“.

5. Describe effects of designing in accordance to Rule versus proposed non-standard element on adjacent properties, pedestrians, bicycles, motoring public, and emergency vehicles.

6. Define the critical design element involved (i.e. not "Design Speed"): horizontal alignment (radius or degree of curvature), vertical alignment, grades, lane width, shoulder width, bridge width, structural capacity, stopping sight distance (horizontal and vertical), cross slope, super-elevation, clearance (horizontal and vertical).

# Variance Packet information (cont.)

1. Estimate the cost/impacts to construct to the standard, the cost to build to the proposed element, and information that logically explains why the particular proposed design was chosen. For instance, if the radius and sight distance for a horizontal curvature is proposed at 35 mph instead of 55 mph, include cost/impacts for 50 mph and 40 mph radii and sight distance.

2. Include available accident data in detail that indicates the resulting damage (property damage/injury/death), contributing causes, and location.

   The Minnesota Crash Mapping Analysis Tool (MnCMAT) is available thru the SALT Traffic Safety website at: http://www.dot.state.mn.us/stateaid/trafficsafety.html. Note that access to the MnCMAT application requires approval of the city or county engineer. Questions on gaining access or use of the application can be directed to mcmat.dot@state.mn.us.

3. Include existing and projected traffic counts.

4. Include legal, posted, and/or safe speed of abutting roadway sections.

5. Indicate if future improvements are planned on the roadway or on adjacent property.

6. Describe safety mitigation considered, such as signing in accordance with MMUTCD, side-slope flattening, etc.

7. Any other pertinent factors.

# Landscape Items

Metro State Aid Plan and Payment Policy

**Plans**

All plans should show a separate column for landscaping items.

The "Statement of Estimated Quantities" should contain a separate column for landscape items. This column will contain all items that are considered to be decorative landscaping such as wildflowers, shrubs, waste receptacles, etc. By providing an extra landscaping column on the plans, both the Local Partner and Mn/DOT personnel will see the bottom line cost for landscaping at a glance.

Items that are functional but ornamental, such as brick pavers, internally lit street signs, and ornamental fences and railings, will fall into both the roadway and landscaping columns. These items are eligible under the roadway column up to the cost of the average bid price for an equivalent non-ornamental item. The excess cost of these items is considered to be landscaping and will be subject to the 5% annual landscaping reimbursement cap per State Aid Rules 8820.3100, Subpart 10.

To split these items between two columns, State Aid and the Local Partner should develop a mutually agreeable percentage which will reflect what portion of the cost is the state aid eligible roadway cost and what portion is the excess cost for the ornamental product. This percentage will then be applied to the quantity for the item and shown in the roadway and landscaping columns as a quantity, reflecting the percentage split.

For example, brick pavers for sidewalks are eligible up to the usual cost of a regular concrete sidewalk. The excess cost of the pavers over regular concrete is considered a landscape expense and is eligible within the 5% landscaping cap. If the agreed upon percentage for this item was 80% roadway and 20% landscaping (the cost of the pavers was 20% more than the cost of regular concrete sidewalk) the Statement of Estimated Quantities would be shown like this:

| | | | | S.A.P. 123-456-789 | |
|---|---|---|---|---|---|
| Item No. | Description | Unit | Total Estimated Quantity | Roadway | Landscaping |
| 2531.604 | Brick Pavers | SF | 1000 | 800 | 200 |

## Reimbursement

Landscape expenditures will be capped at 5% of the annual construction allocation based on the calendar year of the submittal and the actual payment made to the local partner. The purpose of using the calendar year versus the plan approval year is to simplify the record keeping system, to more efficiently and equitably track expenditures, and to allow the most flexibility for our customers.

For purposes of expenditure tracking, the 5% retainage on landscaping items will be considered payable during the year of finalization, when the local partner actually receives the money, not during the year of the original submittal. The reason for this is to better manage overrun/underrun issues. We need to ensure that the actual dollar amount being spent on landscaping does not exceed the 5% cap for any given calendar year and that the local partner is allowed to fully utilize landscaping funds despite overruns or underruns.

## Tracking Procedure

1. When a Report of State Aid Contract is received for a project which contains landscaping items, a copy of that local partner's current year construction allocation will be obtained and the 5% landscaping cap will be computed.

2. The Landscaping Items paid out on the report (95%) will then be deducted from the Landscaping cap.

3. As the calendar year progresses, all other reports from the same local partner will have any landscaping items deducted from the landscape cap until a zero balance is achieved.

4. If a local partner expends their entire landscaping allotment, they will be advised that they can choose one of the following options: shift the remaining costs into a non-participating status; temporarily shift the landscaping items into non-participating status until the time of final estimate when a new allocation may be available; submit partial requests in subsequent years to recover 100% of the landscaping costs.

5. At the time of the Report of Final Estimate, landscaping costs will be reconciled with previous payments and the 5% retainage and overrun payments will be deducted from the current year's landscaping cap.

# SIGNAL JUSTIFICATION REPORT (SJR)

**WHEN REQUIRED?**

- NEW SIGNAL INSTALLATION (TEMPORARY OR PERMANENT)

- COMPLETE RECONSTRUCTION OF EXISTING SIGNAL
  (Changes affecting number of lanes, relocation of poles, etc.)

# WARRANT ANALYSIS

**WHEN REQUIRED?**

- REVISION TO EXISTING SIGNAL
  (Adding signal heads, pedestrian heads, phasing changes, etc.)

- ADDITION OF EMERGENCY VEHICLE PRE-EMPTION (EVP)

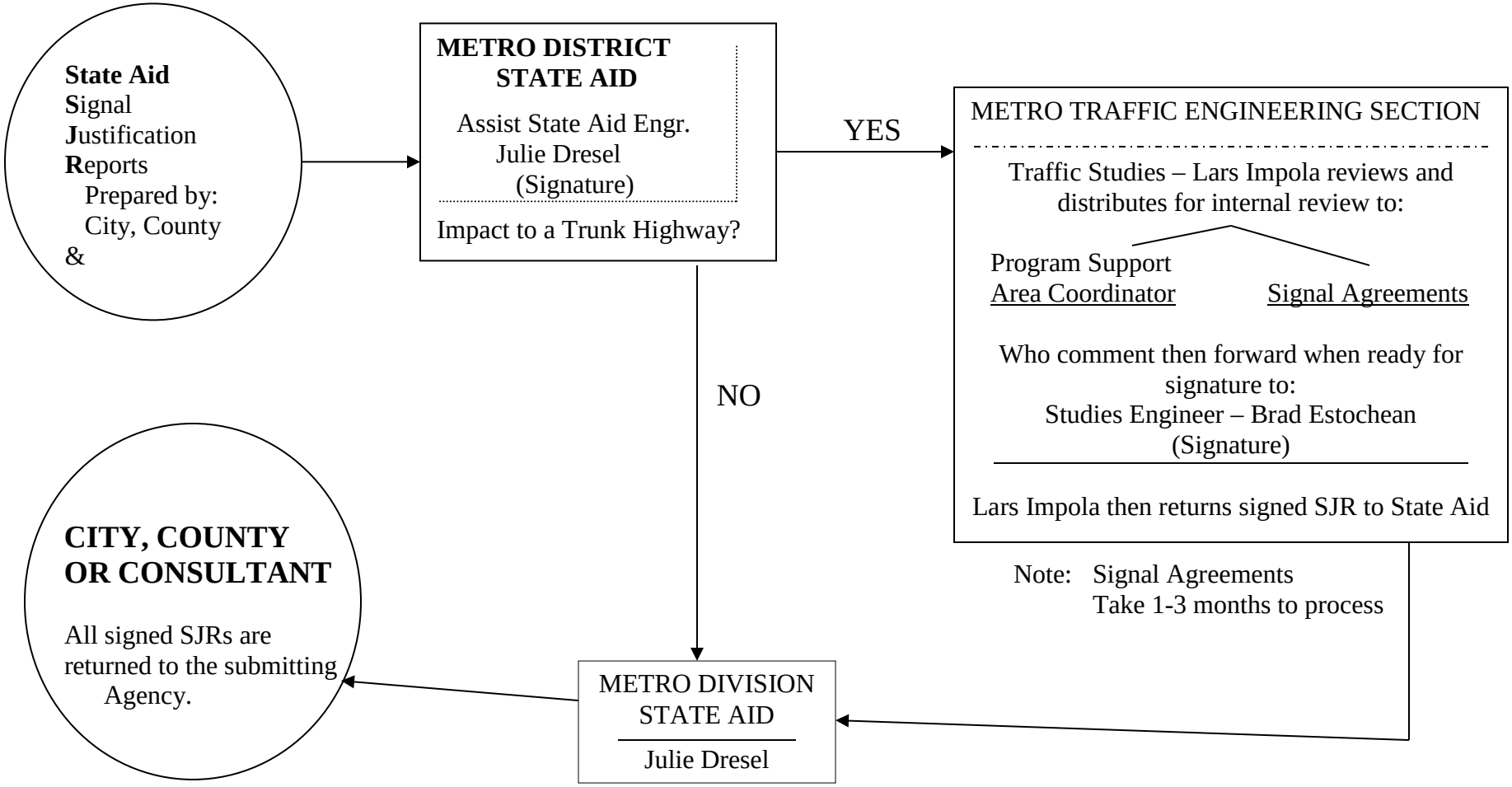
# WHEN ARE NEITHER REQUIRED?

- REPLACEMENT OF LOOPS DUE TO MILLING (ANY APPROACHES)

- OTHER ROADWAY CONSTRUCTION NOT AFFECTING THE APPEARANCE OR OPERATION OF THE SIGNAL SYSTEM.

**NOTE:** **IF SIGNAL ON Mn/DOT R/W (TRUNK HIGHWAY, INTERSTATE, RAMPS, FRONTAGE ROADS), CONTACT LARS IMPOLA (651-234-7820) FOR MN/DOT REQUIREMENTS.**

# Process for SJR Approval on "State Aid Projects"



# SIGNAL JUSTIFICATION REPORT CONTENTS

WHAT IS REQUIRED?

- TITLE/SIGNATURE PAGE
  **see attached example**

- INDEX MAP

- INTERSECTION LAYOUT

  Existing & Proposed conditions

  Show All lanes of approach on all legs of the intersection

- PROJECT DESCRIPTION
  **see attachment for items needed**

- WARRANT ANALYSIS SHEET & WARRANT SUMMARY
  ** see attached examples**

- JUSTIFICATION STATEMENT

- APPENDIX (Data from studies as appropriate):
  Traffic Count Data
  24 or 48 hour vehicle traffic volumes and/or 12 hour turning count
  3 hour AM & PM Peak Vehicle Turning Movement Count
  Pedestrian Count
  Accident History Study/Collision Diagram
  Pedestrian Gap Study
  Delay Study
  Heavy Vehicle Survey
  Projected Traffic Volumes
  Approach Travel Speeds
  Other pertinent information (i.e.: letters)

****EACH PROPOSED INSTALLATION SHOULD HAVE A SEPARATE SJR**

(Title/Signature Page)

# SIGNAL JUSTIFICATION REPORT

FOR

*Roadway Name*

AT

*Roadway Name*

CITY OR COUNTY OF

S.A.P. ____ - ____ - ____

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

_____ _____ _____

Name Reg. No. Date

APPROVED: _____ _____

City of / or ___ County Engineer Date

APPROVED: _____ _____

Metro District – State Aid Engineer Date

(if a Trunk Highway is part of the signalized intersection, include the following)

APPROVED: _____ _____

Metro District – Traffic Engineer Date

# PROJECT DESCRIPTION

*This should be a general description of the existing conditions and the proposed project. the idea is to give the reader as thorough a picture of the intersection and project as possible. The following is a list of information that should be presented:*

1. INTERSECTION LOCATION
   Major & Minor streets
   City & County
   City population
   Project Numbers

2. CHARACTER OF THE SITE
   Function & Importance of the roads
   Number of lanes
   Existing & proposed geometrics
   channelization, grades, parking, speed limits, sight distances, etc.
   Land use: traffic generators, future development
   Existing traffic control
   Adjacent signals
   Proposed coordination

3. TYPE OF WORK
   Signal or beacon
   Temporary or permanent (if temporary, proposed date of removal)
   Phasing
   Scope of project—part of larger project?

4. TIME SCHEDULE
   Proposed letting date
   Anticipated construction date

5. ESTIMATED PROJECT COST
   Type of funding
   Distribution of cost
   Maintenance responsibilities
   Who will operate

# JUSTIFICATION STATEMENT

This section is an explanation of why the signal is being installed. **Traffic signals are not installed because they meet a warrant, but because engineering judgment has determined that they are needed and justified.**

Why is this signal needed?

NOTE: Warrants should be viewed as guidelines, not as hard and fast values. Satisfaction of a warrant is not a guarantee that the signal is really needed. Conversely, the fact that a warrant is not fully satisfied does not constitute absolute assurance that signalization would not serve a useful purpose. The application of warrants is effective only when combined with knowledgeable engineering judgment and awareness of local conditions.

Engineering judgment must be exercised to assure that the traffic signal will not increase the hazard or cause unnecessary delay to the public.

This section should state what studies were conducted, conclusions reached, and the engineering judgment used. It should also state any city, county and citizen concerns that would affect the decision; where did the concern for this intersection originate.

Who wants the signal?

**NOTE: An intersection must meet a signal warrant in order for the traffic signal installation to be eligible for State Aid funding.**

Advance Warning Flashers will need to be justified in this section, if installation is proposed. The criteria set forth in the Technical Memorandum No. 86-22-T-7 "Guidelines for the Installation of Advanced Warning Flashers to Alert Motorists to Traffic Signal Change Intervals" must be met. Include the study and analysis in the appendix.

# WARRANT SUMMARY

(Required)

_____ at_____

This traffic control signal meets the following MMUTCD warrants:

| | |
|---|---|
| **Warrant No. 1 –** Eight Hour Vehicular Volume | met for _____ hours |
| Condition A-Minimum Vehicular Volume | met for _____ hours |
| Condition B-Interruption of Continuous Traffic | met for _____ hours |
| **Warrant No. 2 –** Four Hour Vehicular Volume | met for _____ hours |
| **Warrant No. 3 –** Peak Hour | met for _____ hours |
| **Warrant No. 4 –** Pedestrian Volume | met for _____ hours |
| **Warrant No. 5 –** School Crossing | (met) (does not meet) |
| **Warrant No. 6 –** Coordinated Signal System | (met) (does not meet) |
| **Warrant No. 7 –** Crash Experience | (met) (does not meet) |
| **Warrant No. 8 –** Roadway Network | (met) (does not meet) |

Note: All background supporting data for met warrants is included in the Appendix of this report.

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This flashing beacon meets the following Mn/DOT warrants:

| | |
|---|---|
| **Warrant No. 1 –** Limited Visibility | (met) (does not meet) |
| **Warrant No. 2 –** Accident Rate | (met) (does not meet) |
| **Warrant No. 3 –** School Crossing | (met) (does not meet) |
| **Warrant No. 4 –** Rural Trunk Highway Junctions | (met) (does not meet) |

Note: All background supporting data for met warrants is included in the Appendix of this report.

# ROUNDABOUT JUSTIFICATION REPORT (RJR)

Here are some elements to consider when choosing a roundabout. This information was taken from NCHRP Report 672 Roundabout Guide.

A roundabout feasibility study report may include the following elements:

- Identify why a roundabout is being considered as an improvement alternative at this intersection.
- Identify the current status of traffic operations and safety at the intersection for comparison with expected roundabout performance.
- Identify a conceptual roundabout configuration, which includes the number of lanes on each approach and the designation of those lanes.
- Demonstrate whether an appropriately sized and configured roundabout can be implemented feasibly.
- Identify all potential complicating factors, assess their relevance to the location, and identify any mitigation efforts that might be required.

Where more complete or formal rationale is necessary, the roundabout feasibility study report may also include the following additional considerations:

- Demonstrate institutional and community support, indicating that key institutions (e.g. police, fire department, and schools) and key community leaders have been consulted.
- Give detailed performance comparisons (including delay, capacity, emissions, and/or interaction effects with nearby intersections) of the roundabout with alternative control modes.
- Include an economic analysis indicating that a roundabout compares favorably with alternative control modes from a benefit-cost perspective.
- Include a detailed discussion about potential trade-offs between safety, operations, and design.
- Include detailed appendices containing traffic volume data, signal or all-way stop-control warrant analysis, and so on.

RJR's are similar to ICE reports process so here is a link for ICE process: http://www.dot.state.mn.us/trafficeng/safety/ice/index.html

*RJR requirements are still being discussed and will include more information as it becomes available

# STATE AID STORM SEWER REVIEW

Please submit plans to:

Juanita Voigt
Office of Bridges and Structures
Hydraulics Unit
3485 Hadley Avenue N.
Oakdale, MN 55128
651-366-4469
Fax: 651-366-4497
Email: Juanita.Voigt@state.mn.us

# STORM SEWER SUBMITTAL INFORMATION

Plans will be submitted for Hydraulic review when the project consists of any of the following:

- A mainline pipe is being replaced or a new system is being installed.
- There is work proposed on catch basins and leads (jobs that consist entirely of catch basins and leads will be 100% eligible for State Aid funding).
- When an outlet pipe to an existing or proposed State Aid storm sewer.

If a Hydraulic review is needed, the following should be submitted:

- A drainage area map showing land use and an <u>area to each inlet.</u>
- Drainage calculations
  - Storm sewer computations, including pipe sizing, grades and invert elevations
  - Drainage structure data, including design type, size, invert elevations and type of casting assembly
  - Hydraulic design data, i.e. frequency event, time of concentration, etc.
- Catch basin spread computations
  - Run by, depth at gutter line and width of spread on pavement (reference the State Aid Manual Table A 5-892.605)
- Plan Sheets
  - Title sheet, showing job limits, ADT & design speed.
  - Estimate, with participating storm sewer items <u>in a separate column</u>.
  - Typical Sections with right of way limits, lane and shoulder widths, and slopes shown.
  - Drainage tabulations, notes and details (if other than Standard Plates).
  - Sewer profiles with pipe sizes, lengths, grades and inverts, structure locations, types and elevations, and existing and proposed utilities.
  - Plan view showing proposed and existing sewer lines and pipe lengths, sizes and grades.
- Engineer's Estimate

# PAVEMENT DESIGN

The use of R-values as a basis for pavement design is encouraged in the State Aid Manual because it provides a more economical and appropriate pavement design structure. This method should be used for the design of all 10-ton pavements. The Mn/DOT Geotechnical and Pavement Manual provides information for using this method of pavement design, along with information on computing the ESAL Factor to be used in conjunction with the R-value. The following tables are taken from the Geotechnical Manual to aid you in your design.

Table 4-4.2. Vehicle classification volumes.
Revised February 1, 1997

| VEHICLE CLASS PERCENT OF AADT<br>*Analysis of 1983-1989 Data* | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vehicle Classes | Trunk Highways Greater Minnesota | | | Trunk Highways Mpls/St. Paul Seven County Area | | | Rural CSAH or County Road |
| | Average | Min/Max | 95% of data sites | Average | Min/Max | 95% of data sites | Average |
| Autos, pickups | 89 | | | 93 | | | 94.1 |
| 2 ax, 6 tire SU | 2.7 | .4 / 9.3 | < 4.9 | 2.2 | .8 / 7.6 | < 3.6 | 2.6 |
| 3 + ax SU | 1.5 | 0 / 28.7 | < 4.1 | 1.0 | 0 / 8.9 | < 2.8 | 1.7 |
| 3 ax TST | .1 | 0 / 1.1 | < .3 | .2 | 0 / 1.2 | < .4 | 0.0 |
| 4 ax TST | .2 | 0 / 1.6 | < .6 | .2 | 0 / 1.1 | < .6 | 0.1 |
| 5 + ax TST | 6.1 | 0 / 31.0 | < 15.5 | 3.2 | 0 / 22.6 | < 10.6 | 0.5 |
| Buses, Trucks w/Trailers | .4 | 0 / 3.9 | < 1.2 | .3 | 0 / 2.7 | < .9 | 1.0 |
| Twin Trailers | .1 | 0 / 1.0 | < .3 | .0 | 0 / .4 | < .2 | 0.0 |
| Total Number of Sites | N = 837 | | | N = 239 | | | 1977 County Road Study |

SU = Single Unit Trucks
TST = Tractor Semi-Trailer
ax = axle

Table 4-4.3. Average ESAL factors by vehicle classification from WIM.
Revised February 1, 1997

| Flexible ESAL Factors for the Design-Lane | | | | | | |
|---|---|---|---|---|---|---|
| | | TH 99 | I-494 | I-94 | TH 2 | I-94 |
| Vehicle Class | Default | a | b | c | d | MNROAD |
| Cars, Pick-ups | .0007 | | | | | c |
| 2 ax 6 tire SU | .25 | .26 | .13 | .22 | .26 | .25 |
| **3+ ax SU | .58 | .51 | .63 | .44 | .71 | .61 |
| 3 ax TST | .39 | .26 | .21 | .55 | .36 | .59 |
| 4 ax TST | .51 | .57 | .35 | .47 | .50 | .60 |
| 5+ax TST | 1.13 | .92 | 1.14 | 1.00 | 1.74 | .99 |
| *(6 ax TST) | .78 | .42 | .74 | .64 | .69 | .69 |
| T w/tr, buses | .57 | | | | | |
| MTC buses | 1.25 | | | | | |
| Twin Trailers | 2.40 | .49 | .77 | 2.16 | 1.90 | 3.15 |
| Rigid ESAL factors for the Design-Lane | | | | | | |
| Cars, Pick-ups | .0007 | a | b | c | d | c |
| 2 ax 6 tire SU | .24 | .25 | .12 | .21 | .25 | .24 |
| **3+ ax SU | .84 | .73 | .93 | .62 | 1.09 | .90 |
| 3 ax TST | .37 | .25 | .20 | .53 | .34 | .56 |
| 4 ax TST | .53 | .60 | .35 | .49 | .52 | .63 |
| 5+ax TST | 1.89 | 1.52 | 1.90 | 1.66 | 2.94 | 1.64 |
| *(6 ax TST) | .80 | .51 | .89 | .77 | .83 | .83 |
| T w/tr, buses | .74 | | | | | |
| MTC buses | 1.23 | | | | | |
| Twin Trailers | 2.32 | .47 | .73 | 2.09 | 1.84 | 3.06 |

| Vehicle Classes: | Data Taken From Years: |
|---|---|
| SU = Single Unit Trucks | a = 1985, 1990 |
| TST - Tractor Semi-trailer | b = 1982-1985, 1990 |
| ax = axle | c = 1990 |
| WIM = Weighing-in-Motion (fixed sites) | d = 1984, 1985, 19 |
| T w/tr = Trucks with trailers | |
| MTC = Urban transit buses | |
| * - This vehicle class is not usually considered separately in an ESAL forecast. | |
| **- Use 0.91 if the route is a sugar beet hauling route. | |

Table 4-4.4. Sample ESAL calculation.
Revised February 1, 1997

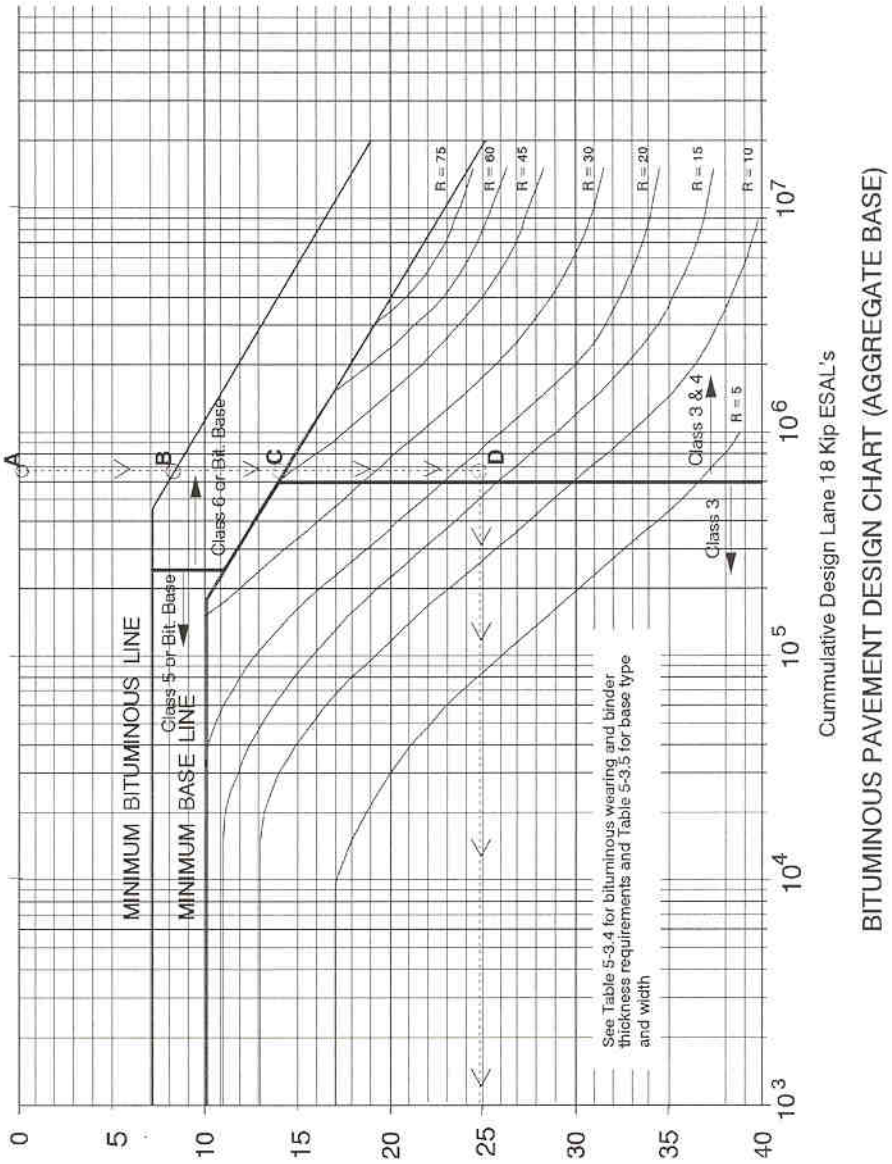
| Example 20-Year Design Lane Cumulative ESAL Calculation (Use only if you do not have access to the MNESALS electronic spreadsheet) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vehicle Classes | Base Year AADT (Two-Way) | | Flexible ESAL Factors | | Base Year ADL | Design Year AADT (Two-Way) | Design Year ADL |
| Cars and Pick-ups | 1207 | x | .0007 | = | .8 | 1690 | 1.2 |
| 2 ax, 6 tire SU | 98 | x | .25 | = | 24.5 | 137 | 34.2 |
| 3 + ax SU | 34 | x | .58 | = | 19.7 | 48 | 27.8 |
| 3 ax TST | 6 | x | .39 | = | 2.3 | 8 | 3.1 |
| 4 ax TST | 8 | x | .51 | = | 4.1 | 11 | 5.6 |
| 5 + ax TST | 120 | x | 1.13 | = | 135.6 | 168 | 189.8 |
| Buses, Trucks w/Trailers | 25 | x | .57 | = | 14.2 | 35 | 20 |
| Twin Trailers | 2 | x | 2.40 | = | 4.8 | 3 | 7.2 |
| TOTAL | 1500 | | | | 206 | 2100 | 288.9 |

ADL = Average Daily Load

(Base Year ADL + Design Year ADL) / 2 = (206 + 288.9) / 2 = 247 (rounded)
Number of days in 20 years x 247 = 7300 x 247 = 1,804,335
Design Lane Factor (if 4 lane) x 1,804,335 = .45 x 1,804,335 = 811,951
Load limit increase factor x 811,951 = 1.12 x 811,951 = 909,385
Cumulative 20-Year Design Lane Flexible ESAL (rounded) = 909,000

Procedures for calculating a cumulative 20-year Design Lane Rigid ESAL are the same as above except rigid ESAL factors are used in place of the flexible ESAL factors.

Figure 5-3.7. Bituminous Pavement Design Chart (Aggregate Base).



**ULTIMATE 10 TON STAGED FLEXIBLE PAVEMENT DESIGN USING SOIL FACTORS 1,5**

Required Gravel Equivalency (G.E. in inches) for various Soil Factors (S.F.)

For new construction or reconstruction use projected ADT or HCADT; for reconditioning projects use present ADT or HCADT

Designs shown here are for an initial 9 Ton pavement structure. Agencies can add pavement structure to increase to 10 Tons in the future

### 9 TON Staged : < 150 HCADT

| S.F. | Minimum Bit G.E. | Total G.E. |
|---|---|---|
| 50 | 7 | 10.3[6] |
| 75 | 7 | 13.9 |
| 100 | 7 | 17.5 |
| 110 | 7 | 19 |
| 120 | 7 | 20.5 |
| 130 | 7 | 22 |

### 9 TON Staged: 151 to 300 HCADT

| S.F. | Minimum Bit G.E. | Total G.E. |
|---|---|---|
| 50 | 7 | 14 |
| 75 | 7 | 17.5 |
| 100 | 7 | 21 |
| 110 | 7 | 22.4 |
| 120 | 7 | 23.8 |
| 130 | 7 | 25.2 |

### 9 TON Staged: 301 to 600 HCADT

| S.F. | Minimum Bit G.E. | Total G.E. |
|---|---|---|
| 50 | 7 | 16 |
| 75 | 7 | 20.5 |
| 100 | 7 | 25 |
| 110 | 7 | 26.8 |
| 120 | 7 | 28.6 |
| 130 | 7 | 30.4 |

### 9 TON Staged: 601 to 1100 HCADT

| S.F. | Minimum Bit G.E. | Total G.E. |
|---|---|---|
| 50 | 8 | 18.5 |
| 75 | 8 | 23.7 |
| 100 | 8 | 29 |
| 110 | 8 | 31.1 |
| 120 | 8 | 33.2 |
| 130 | 8 | 35.3 |

### 9 TON Staged: 1101 to 1500 HCADT[2]

| S.F. | Minimum Bit G. E. | Total G.E. |
|---|---|---|
| 50 | 8 | 20.3 |
| 75 | 8 | 26.4 |
| 100 | 8 | 32.5 |
| 110 | 8 | 35 |
| 120 | 8 | 37.4 |
| 130 | 8 | 39.8 |

| TYPE OF MATERIAL[3] | SPECIFICATION | G.E. FACTOR |
|---|---|---|
| Bituminous Pavement | 2360 | 2.25 |
| Cold-Inplace Recycling (CIR) | 2331 | 1.5 |
| Rubblized Concrete | 2231 | 1.5 |
| Full Depth Reclamation | 2331 | 1 |
| Aggregate Base class 5 & 6 | 3138 | 1 |
| Aggregate Sub-Base class 3 & 4 | 3138 | 0.75 |
| Select Granular Mat'l | 3149.2B2 | 0.5 |

| AASHTO SOIL CLASS | SOIL FACTOR (S.F.) | ASSUMED R-VALUE | GENERAL[4] PLASTICITY |
|---|---|---|---|
| A - 1 | 50 - 75 | 70 - 75 | NP |
| A - 2 | 50 - 75 | 30 - 70 | SP |
| A - 3 | 50 | 70 | NP |
| A - 4 | 100 - 130 | 20 | SP |
| A-5 | 130+ | na | na |
| A - 6 | 100 | 12 | P |
| A - 7 - 5 | 120 | 12 | P |
| A - 7 - 6 | 130 | 8 | P |

Values may not be exact due to rounding

[1]For 10 Ton design see page 31 in Mn/DOT Pavement Manual, July 2007, Chapter 5, Section 3, Figure 5-3-7. Bituminous Pavement Design Chart (Aggregate Base)

[2]For HCADT over 1500 more advanced design procedures should be used; please contact Mn/DOT's Pavement Design Unit

[3]See page 32 in Mn/DOT Pavement Manual, July 2007, Chapter 5, Section 3, Table 5-3.4 - Granular Equivalent (G.E.) factors

[4]General Plasticity: NP = nonplastic; SP= semi-plastic; P = plastic; na = not applicable (An A-5 soil rarely occurs in Minnesota)

5 Safety edge (30° to 35° wedge) are recommended to minimize edge dropoff. See www.dot.state.mn.us/stateaid/sa_safety_edge.html

6 These GE values are for the finished pavement section. During construction additional GE may be warranted for a construction platform.

Origin - 1/10/201

# SPECIAL PROVISIONS

Here is the link for MnDOT Special Provisions where you can download the latest version of Provision for you project.
http://www.dot.state.mn.us/pre-letting/prov/index.html

# Traffic Management Plan (TMP)

http://www.dot.state.mn.us/metro/trafficeng/control_striping.html

# BIKEWAY DESIGN

For Bikeway design please refer to State Aid Rule for On Road and Off Road Bikeway facilities.

For additional design guidelines refer to the MnDOT Bikeway Design Guide. http://www.dot.state.mn.us/bike/design-engineering.html

# .6XX Transport List Extensions

For items that are not on the Transport List please use a similar item number and a .6XX extension according to the correct unit of measure. Refer to the list below for measurement extensions.

| | English | Metric |
|---|---|---|
| .601 | Lump Sum | Lump Sum |
| .602 | Each | Each |
| .603 | Lin Ft | m |
| .604 | Sq Yd | $m^2$ |
| .605 | Acre | ha |
| .606 | Gallon | Lump Sum |
| .607 | Cu Yd | $m^3$ |
| .608 | Pound | kg |
| .609 | Ton | t |
| .610 | Hour | Hour |
| .611 | Day | Day |
| .612 | Week | Week |
| .613 | Unit Day | Unit Day |
| .614 | Structure | Structure |
| .615 | Assembly | Assembly |
| .616 | System | System |
| .617 | Sq Ft/Day | $m^2$ /Day |
| .618 | Sq Ft | |
| .619 | Road Sta | |
| .620 | Yard | |
| .621 | Dollar | Dollar |
| .622 | MBM (Thousand Board Feet) | |
| .623 | MGAL (M Gallons) | |

# General Redline Comments Observed on Plan

General Comments:

- If there is Storm Sewer on a plan, please make sure to include an additional copy of the plan along with Drainage map & calculations for eligibility review.
- If a roadway intersects with a Trunk Highway, please give me a heads up as these reviews take longer and I will let you know if I need extra copies or a pdf of the plan for routing to the functional groups. The number of copies varies depending on the work proposed.
    - Typically a copy is required for:
        - State Aid Review
        - Hydraulics
        - Bridge
        - Unusual Retaining Wall Designs
- If there is a Signal or Signal revisions a SJR or SJL is required.
    - SJR is required when new signals or geometric changes are made to the intersection
    - SJL are for modifications, upgrade to Left Turn Flashing Arrow or Flasher
- Roundabouts require a RJR
- Sometimes a letter of explanation with the final plan submission is helpful to know what changes were made or why something might not have been made.
- If a new person submitting to State Aid, please make sure to include your Name, Phone number and email address.
- On State Aid Check list, please fill in the Rule you are using and do not put "See Table" as I might pick the wrong rule which causes confusion when reviewing the plan and will make my review incomplete until the rule is called out.
- If using MnDOT Lab Services, please submit a hard or electronic copy of the provisions.
- If multiple Agencies on a project and State Aid funds being utilized by one Agency other than lead Agency, then Lead Agency needs to pull a State Aid Project number for tracking purposes.

Title Sheet:

- Specs must be switched over to 2016 at this point for submitted projects, no more 2005 or 2014 Specs.
- A County/City signature is required if work within County/City R/W limits.
- If there is a Trail on a project, make sure to include Trail Design Designation block.

Estimate Quantities/Tabulations:

- No decimals unless quantity is less than 1 or the following items: Drainage Structure heights, sign panel, acres, tons, & Lump Sum splits.
- No 0 Zero quantities in SEQ or Tabs.
- For State Aid projects, items should be in order according to the Transport list (sequential according to XXXX.XXX/XXXXX). If Project that go through MnDOT Central Office Review item must be in order according to Transport list.

# General Redline Comments Observed on Plan Cont.

Estimate Quantities/Tabulations Cont.:

- Check Transport items #'s and descriptions as some have changed from 2014 to 2016 Spec Book.
- If there are Landscaping items, they must be in a separate Landscape column on the SEQ.
- Salvage items must be reinstalled on the project to be eligible for State Aid funds.

Standard Plates:

- In the description please include number of sheets for plate (X sheets).
- Check MnDOT website for latest plate version.
- FHWA Approval note is missing.

Standard Plans:

- There are new Erosion standard plans are out that for current Spec Book.
- ADA Standard Plans make sure you have the latest approval date.
- ADA Standard Plans sheets you must include all 5 sheets in the plan.
- Do not call out ADA Standard Plans 5-297.250 in the plan; they must be included in the plan sheets.
- Please make sure to check MnDOT's website to make sure you have the newest version for a Standard Plan sheet as new versions are now available.

Typicals:

- When you draw a typical, make sure to label and dimension lanes, shoulders, parking, curb reaction, trails, trail clear zones.
- Try not to give a var. label for dimensions giving dimension range is preferred for verification purposes.

Plan Sheets:

- Make sure to include Begin and End of State Aid Project limits on all plans sheets including stationing.