2023 Edition Revisions to the SUDAS Design Manual

To updated your printed manual, print this packet. Then remove the old sheets and place the revised sheets in your manual. Some pages are completely new and do not replace an existing sheet. Also, some pages do not contain revisions, but are included due to changes on the other side or a change in the page number. **PLEASE READ CAREFULLY - PAY ATTENTION TO THE SECTION NUMBER!** Included shading to help distinguish between chapters. Questions can be directed to Beth Richards - brich@iastate.edu. The current edition of the manual, with the latest revisions incorporated, can be found at www.iowasudas.org.

Chapter	***Section***	***pg #***	***Summary of Revision(s)***
Manual introductory info			Updated the Contributors and Acknowledgments page. *Note - if you want to replace the small business card for the spine of your manual, you can print a copy from our website.*
1	Table of Contents	i-ii	Updated table of contents based on changes made to Chapter 1.
	1D-1, H	9-10	Updated Iowa DOT's rail section terminology.
	1D-2	ALL	Revised the "items to be specified" list based on corrections and SUDAS Specifications revisions.
	1D-3	ALL	Updated the "incidental or included items" list based on corrections and SUDAS Specifications revisions.
	1D-4	ALL	Updated the "bid item" list based on corrections and SUDAS Specifications revisions.
2	Table of Contents	iii-iv	Updated table of contents based on changes made to Chapter 2.
	2A-2, A	1-2	Deleted reference to Iowa Drainage Law Manual as it is very old and no longer available.
	2A-3, C	3-4	Added roundabouts to the street classifications related to allowable spread of stormwater.
	2B-2, C	7	Updated the hyperlink.
	2B-4	11-12	In Equation 2B-4.08, F_p should reference Table 2B-4.07.
	2C-3, G, 6	13-14	Added preferred manhole drop of 0.3 feet and maintained minimum of 0.10 feet.
	2D-1, F	3-4	Updated water and sewer separation language based on new Iowa DNR rules.
3	3C-1, G and L	3-8	Updated water and sewer separation language based on new Iowa DNR rules. Revised preferred manhole drop to 0.3 feet.
4	Table of Contents	i	Updated table of contents based on changes made to Chapter 4.
	4C-1, G	3-10	Updated water and sewer separation language based on new Iowa DNR rules; affected pages the followed.
5	Table of Contents	i-iv	Updated table of contents based on changes made to Chapter 5.
	5D-1	ALL	Changed terminology from HMA to asphalt; updated references and other minor corrections.
	5J-1	ALL	Updated section references.
7	7E-29, D	3	In the last sentence, corrected the reference.
13	13A-5	ALL	Updated MnDOT references.

Contributors and Acknowledgments

In 2022, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2023 versions of the SUDAS manuals. These revisions would not have been possible without the efforts of the SUDAS technical committee members. The SUDAS program's success is also due to the dedication of the district committees and Board of Directors. Keeping the SUDAS manuals current is an ongoing, cooperative effort, involving hundreds of people who volunteer their time and expertise. It is not possible to acknowledge each of these volunteers individually, but we appreciate them all.

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Chapter 1 - General Provisions

1A General Information

1B Plan Development

1C Submittal Procedures

1D Detailed Plans for Construction of Public Improvements

1E Public Improvement Contracts

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G. Water Main Plans

The plans for water mains and appurtenances should show all appropriate physical features adjacent to the proposed water mains along with horizontal and vertical controls and hydrant coverage. Other utilities such as sanitary and storm sewers, manholes, etc. should be shown on the plans with horizontal and vertical separation distances. Design details for other utilities that do not affect the water main should not be shown on water main plans.

1. Stationing, location, and type of all fittings, valves, and fire hydrants.

2. Details should be shown for all items that are not standard in the SUDAS Specifications.

3. Plan and profiles of all water lines and the existing and proposed ground line above the water main.

4. Size, length, and grade of water mains in profile.

5. Type of pipe materials and strengths if different from the SUDAS Specifications or if specific materials and fire hydrants are required.

6. Elevations at all structures in profile.

7. Location, size, and type of all water service stubs. Stub locations should be referenced to lot corners.

8. Estimates should include length of pipe stubbed out from valves.

9. Fire hydrants should be identified with numbering system on plan and profile.

10. Class of pipe bedding if different than the SUDAS Specifications.

11. Existing utilities or other underground features that could reasonably affect the construction and maintenance of the water main.

H. Railroad Crossings

If a railroad crossing is within the project limits, the project engineer should notify the railroad with a copy of the plans and specifications a minimum of 4 months prior to the project letting. If the project limits contain construction of railroad facilities that will be performed by the railroad's forces, the project engineer will state this in the contract documents. The contract documents will state the contractor's limits of responsibility and allow sufficient time in the schedule for the work to be accomplished by the railroad; and that the contractor must coordinate its activities with the railroad or any subcontractors the railroad mandates using during construction. The contractor must be made aware of any permit and insurance requirements imposed by the railroad.

The project engineer should notify the railroad of the following, immediately after awarding the contract:

1. Federal Railroad Administration (FRA) crossing number*

2. Jurisdiction project number

3. Contractor's name, mailing information, and phone number

4. Contractor's contact person

5. Anticipated start date

6. Number of working days

7. Number of days it is believed the contractor will impact the railroad.

8. Date of preconstruction meeting

* For help in identifying the FRA number, see Iowa DOT Modal Transportation Bureau, Rail Section's Highway/Railroad Crossing Identifiers webpage.

I. ADA Ramps

1. Ramp design must comply with PROWAG requirements or justification acceptable to the jurisdictional engineer.

2. Delineate all ramp components including ramps, turning spaces, transitions, passing spaces, detectable warning panels, and special shaping areas.

3. Show elevations at top and bottom of ramps, corners of turning spaces and transition areas, and all grade breaks.

4. Show table of slope and distance between all critical points.

Items to be Specified on Plans or in Contract Documents

The SUDAS Specifications specify many items and methods that can be used for the construction of improvements. Following is a list of items in the SUDAS Specifications that are to be noted on the construction drawings and/or in the special provisions whenever there is to be a deviation from the standard requirements of the specifications. This information may include specifying pipe sizes and materials, who is responsible for providing compaction testing, as well as many others.

The project engineer should review the following list and the SUDAS Specifications to make sure all items that are necessary to construct the project are specified on the plans and/or in the special provisions. Please note - this list is not all-inclusive.

Section 2010 - Earthwork, Subgrade, and Subbase

2010, 1.08, D	Specify whenever the depth of cut for stripping and salvaging topsoil is other than 8 inches.
2010, 1.08, E	Specify the class of excavation as Class 10, Class 12, or Class 13.
2010, 1.08, E, 1, b, 2)	When the truck count method is to be used for measuring Class 10 or Class 13 excavation, specify if the shrinkage factor is other than 1.35.
2010, 1.08, E, 4	Specify whenever stripping, salvaging, and spreading 8 inches of topsoil is NOT a pay item and is included in the payment of Class 10, Class 12, or Class 13 Excavation.
2010, 1.08, F, 1	Specify whenever below grade excavation (core out) will NOT be measured and paid as extra work.
2010, 1.08, K, 3	Specify whenever removal of pipe and conduits will include plugging.
2010, 1.08, M	Specify when the Contractor is responsible for compaction testing.
2010, 2.01	Specify use of compost-amended or off-site topsoil if on-site topsoil is NOT to be used.
2010, 2.02, C, 3	Specify the limits of Class 13 excavation.
2010, 2.04, C, 5	Specify whenever Type 2 geogrid is to be used in lieu of Type 1.
2010, 3.02, C	Specify if 8 inches of off-site topsoil is not to be used.
2010, 3.03, B, 2, a	Specify if the removed pavement materials should be processed for re-use.
2010, 3.03, B, 2, b, 2)	Specify if the removed pavement should be delivered and stockpiled.

2010, 3.03, F, 1	Specify the desired depth for removal of unsuitable or unstable materials.
2010, 3.04, D	Specify whenever Type A compaction is to be used in lieu of compaction with moisture and density control.
2010, 3.05	Specify whenever and where unsuitable soils will be allowed in the right-of-way.
2010, 3.06, A	Specify if granular stabilization materials or subgrade treatment is to be used in lieu of select subgrade materials.
2010, 3.07	Specify the type of subgrade treatment (lime, cement, fly ash, asphalt, geogrid, or geotextiles) to be used.
2010, 3.07, A, 1	Specify the depth and rate of incorporation of the subgrade treatment material (lime, cement, fly ash, or asphalt).
2010, 3.07, A, 2	Specify the areas requiring subgrade treatment.
2010, 3.08, B	Specify the type and depth of subbase.
2010, 3.09, A	Specify when the Contractor is responsible for compaction testing.
Figure 2010.102	Specify whenever Type A compaction is desired in lieu of compaction with moisture and density control.

Section 3010 - Trench Excavation and Backfill

3010, 1.08, F	Specify when the Contractor is responsible for trench compaction testing.
3010, 2.04, A, 2	Specify whenever Class V material can be used as other than topsoil.
3010, 2.06, D, 1	Specify if foamed cellular concrete may be substituted for flowable mortar.
3010, 3.05, A, 6, a	Specify if concrete, flowable mortar, CLSM, or foamed cellular concrete is to be used in lieu of other bedding materials.
3010, 3.05, B, 1, a	Specify if granular bedding material is to be used for pressure pipes.
Figure 3010.101	Specify when over-excavation and foundation stone will be required.
Figure 3010.105	Specify when and where to install a waterstop.

Section 3020 - Trenchless Construction

3020, 2.02, A	Specify the wall thickness of casing pipe. See Section 9C-1.
3020, 2.02, C	Specify inside diameter of casing pipe.
3020, 2.05, B	Specify where special fill materials will be used.
3020, 3.04, A, 2, b	Specify the installation deviation tolerances of casing pipe if different than those included.

3020, 3.04, A, 2, b, 2), b) Specify the minimum depth of pressurized pipe.

3020, 3.04, D — Specify when to fill the annular space between the carrier and casing pipe with flowable mortar, CLSM, or foamed cellular concrete.

Section 4010 - Sanitary Sewers

4010, 1.08, A, 1, c — Specify if a pipe lining is to be used.

4010, 1.08, A, 2, c — Specify if a pipe lining is to be used.

4010, 1.08, B, 1, c — Specify if a pipe lining is to be used.

4010, 1.08, B, 2, c — Specify if a pipe lining is to be used.

4010, 1.08, E — Specify the distance beyond the right-of-way line that the sanitary sewer service stub is to extend, if other than 10 feet.

4010, 1.08, H, 3 — For removal of sanitary sewer, specify if capping is required.

4010, 2.01, A, 1 — For solid wall PVC pipe, 8 inch to 15 inch, specify if SDR 35 may be used.

4010, 2.01, C, 2, a — For corrugated PVC, 8 inch to 10 inch, specify if a minimum pipe stiffness of 46 psi may be used.

4010, 2.02, A — Specify when joint restraints for ductile iron pipe force mains are required.

4010, 2.02, B — Specify when restrained joints are required for PVC force mains.

4010, 2.02, F, 2 — Specify the color of plastic post used for tracer wire station.

4010, 3.02, B, 7 — Specify the location for installation of wye or tee service fitting.

4010, 3.05, B, 2 — Specify the location for any installation of a tracer wire station in addition to each end of the force main.

4010, 3.06, A — Specify the locations for installation of sanitary sewer service stub.

4010, 3.06, C — Specify the distance beyond the right-of-way line that the sanitary sewer service stub is to extend, if other than 10 feet.

4010, 3.06, C, 3 — Specify the depth of sanitary sewer service stub at its termination, if other than 10 to 12 feet.

4010, 3.06, C, 5 — Specify method of marking the end of the sanitary sewer service line.

4010, 3.08, B, 2 — Specify when to fill an abandoned sanitary sewer with flowable mortar, foamed cellular concrete, or CLSM.

4010, 3.10 — Specify where to provide sanitary sewer cleanouts.

Section 4020 - Storm Sewers

4020, 1.08, D, 3	Specify if capping is required for removal of storm sewer.
4020, 2.01, A, 3	Specify when to use a rubber O-ring or profile gasket in lieu of a tongue and groove joint wrapped with engineering fabric.
4020, 2.01, B, 3	Specify when to use a rubber O-ring or profile gasket in lieu of a tongue and groove joint wrapped with engineering fabric.
4020, 2.01, C, 3	Specify when to use a rubber O-ring or profile gasket in lieu of a tongue and groove joint wrapped with engineering fabric.
4020, 2.01, G, 1, d	Specify gage of corrugated metal pipe, if other than Iowa DOT Standard Road Plan DR-104.
4020, 2.01, I, 2	Specify gage of coated corrugated metal pipe, if other than Iowa DOT Standard Road Plan DR-104.
4020, 3.04, A	Specify any special linear trench drain installation requirements.
4020, 3.05, B, 2	Specify the use of a rubber O-ring or profile gasket.
4020, 3.06	Specify where to install pipe aprons, apron footings, and apron guards.
4020, 3.09, B, 2	Specify when to fill a line to be abandoned with flowable mortar, foamed cellular concrete, or CLSM.

Section 4030 - Pipe Culverts

4030, 2.01, C, 5	Specify gage of the structural plate culverts, if other than Iowa DOT Standard Road Plan DR-104.
4030, 3.02, A	Specify the locations to install pipe aprons.
4030, 3.02, B	Specify the locations to install apron footings.
4030, 3.02, E	Specify the locations to install apron guards.
Figure 4030.225	Specify when to extend the bottom cross bar through the apron.

Section 4040 - Subdrains and Footing Drains

4040, 1.08, A, 3	Specify the use of engineering fabric.
4040, 1.08, E	Specify the distance beyond the right-of-way that the storm sewer service stub is to extend, if other than 10 feet.
4040, 3.01, A, 1	Excavate trench and provide pipe bedding and backfill as shown on the figures. Install engineering fabric if specified in the contract documents.
4040, 3.02, B	Specify the use of engineering fabric.

4040, 3.03, A	Specify the locations to install footing drain service stubs.
4040, 3.03, C	Specify the distance beyond the right-of-way that the footing drain service stub is to extend, if other than 10 feet.
Figure 4040.231	For Type 1 subdrains, specify Case A, B, or C. For Type 2 subdrains, specify Case D or E and the pipe diameter. When using Case A or Case D, specify the distance from back of curb. For both types, specify when engineering fabric is to be used.
Figure 4040.232	Specify the type of subdrain cleanout to be used.
Figure 4040.233	Specify when to use a CMP outlet.

Section 4050 - Pipe Rehabilitation

4050, 1.07, B	Specify if water will not be provided for cleaning and installation of cured-in-place pipe by the Jurisdiction at no cost.
4050, 1.08	Specify if bypass pumping is not included in the measurement and payment of other bid items. *Applies to C, 1, c; D, 3; E, 1, c; E, 2, c; F, 1, c; F, 2, c; F, 3, c; and F, 4, c.* {Note - 1.08, G is the bid item for bypass pumping}.
4050, 1.08, A, 1, c	Specify if unit price will include disposal and associated costs for all debris removed from sewer.
4050, 1.08, E, 2, a	Specify the length of service pipe to line.
4050, 2.01, C, 2	Specify if the CIPP structural requirements are not fully deteriorated conditions.
4050, 2.01, Table 4050.01	Specify the ovality reduction factor and height of soil above pipe.
4050, 2.02, B	Specify the CIPP point repair liner length.
4050, 2.02, C	Specify if the ovality is a value other than 2%.
4050, 2.03, A, 1	Specify the distance the tube should extend from the sewer main into the service.
4050, 2.03, B, 2	Specify the service liner length.
4050, 2.03, E, 1	Specify if the cured-in-place service liner should be designed following different assumptions than those described in Table 4050.02.
4050, 2.03, Table 4050.02	Specify the depth of cover for each service repair location.
4050, 2.04, C	Specify when to provide a root deterrent chemical to control root regrowth.
4050, 2.07, B	Specify the materials to use for pipe replacement.
4050, 3.01, A, 6	Specify if the Contractor is to pay for disposal fees.
4050, 3.05, B, 1	Specify the length of the CIPP service repair.

4050, 3.06, B, 2	Specify if the length of the service line grouting plug should be a length other than 18 inches.
4050, 3.07, C, 1	Specify the materials to use for the replacement pipe.

Section 4060 - Cleaning, Inspection, and Testing of Sewers

4060, 2.01, B, 3	Specify the type of recording media that will be used to record the inspection.
4060, 3.02, A, 1	Specify whenever video inspection of storm sewers is not desired.

Section 5010 - Pipe and Fittings

5010, 2.01, A, 1, b	Specify the minimum wall thickness for PVC pipe sizes over 24 inches.
5010, 2.01, A, 2	Specify joint type for PVC pipe if other than push-on.
5010, 2.01, B, 1, b	Specify the minimum wall thickness for DIP sizes over 24 inches.
5010, 2.01, B, 4	Specify joint type for DIP if other than push-on.
5010, 2.04, C	Specify when thrust blocks will be used for pipe sizes greater than 16 inches in diameter.
5010, 2.07, B	Specify the materials to use for water service pipe and appurtenances.
5010, 3.01, A, 3	Specify the lines and grades to install pipe with fittings.
5010, 3.01, A, 8	For pipes larger than 16 inches, specify when concrete thrust blocks are required in addition to restrained joints.
5010, 3.05, E	Specify the locations to install ground rods if other than adjacent to connections to existing piping.
5010, 3.07	Specify when the change of piping material is not to be at the outside of the structure wall.
5010, 3.10, A, 1	Specify the valves to close and the valve boxes to remove.
5010, 3.10, B, 1	Specify the valves to close and the valve boxes to remove.
5010, 3.11, A	Specify the valves to close.
Figure 5010.101	Specify when to use the alternate method of thrust blocks at dead ends.

Section 5011 - Fusible PVC and HDPE Pipe

5011, 2.01, A, 1, b	Specify the minimum wall thickness for fusible PVC pipe sizes over 24 inches.
5011, 2.01, B, 2, b	Specify the minimum wall thickness for fusible HDPE pipe sizes over 24 inches.

5011, 3.01, C, 2	Specify when the internal joint bead is to be ground and to what height if other than 0.1 inch.

Section 5020 - Valves, Fire Hydrants, and Appurtenances

5020, 1.08, J, 3	Specify if the fire hydrant assembly is to be delivered to the Contracting Authority.
5020, 1.08, K, 3	Specify if the valve is to be delivered to the Contracting Authority.
5020, 1.08, L, 3	Specify if the valve box is to be delivered to the Contracting Authority.
5020, 2.01, A, 2	Specify whenever the opening direction for valves is clockwise.
5020, 2.01, D, 7	Specify the locations to use tapping valve assemblies.
5020, 2.02, B	Specify allowable manufacturer(s) of fire hydrant assemblies.
5020, 2.02, C, 5	Specify whenever the opening direction for fire hydrant assemblies is clockwise.
5020, 2.02, C, 6	For fire hydrant assemblies, specify the operating nut, pumper nozzle, nozzle threads, and main valve nominal opening sizes.
5020, 2.03, A	Specify the type of flushing device (blowoff) to be used.
5020, 2.03, B, 2	Specify the allowable manufacturer(s) for valve boxes.
5020, 3.02	Specify where to install and how to construct flushing device (blowoff).
5020, 3.03, A	Specify where to place anchor tee and hydrant.
5020, 3.04, D	Specify if exterior of a new fire hydrant barrel section will be painted a color other than matching the existing fire hydrant.

Section 6010 - Structures for Sanitary and Storm Sewers

6010, 1.08, A, 3	Specify if a manhole lining is to be used.
6010, 2.05, B, 2, b	Specify the use of engineering fabric.
6010, 2.06, B	Specify when to use a concentric cone on sanitary sewer manholes.
6010, 2.11, B, 1	Specify if sanitary sewer manhole exterior is to be coated.
6010, 2.11, B, 2	Specify whenever sanitary sewer manhole lining is required.
6010, 2.13, A, 1	Specify if steps are to be provided in manholes or intakes less than or equal to 20 feet deep.
6010, 3.01, D	Specify if intake lids are NOT to be set to match the longitudinal slope of the adjacent street.

6010, 3.01, J	Specify the type of casting to use for manholes and intakes, except for intakes that have a specific casting type identified on the figures. Specify if casting frame is to be attached to the structure with bolts.
6010, 3.02, B, 2	Specify if reinforcing steel is to lap other than 36 diameters.
6010, 3.04, A, 1	Specify when to install casting extension rings.
6010, 3.04, B, 3	Specify when existing casting may be reinstalled for minor adjustment of existing manhole or intake.
6010, 3.04, C, 4	Specify when existing casting may be reinstalled for major adjustment of existing manhole or intake.
6010, 3.05, C, 1, a	Specify whenever a knockout opening is allowed in lieu of a cored opening.
6010, 3.05, C, 1, b	Specify if sanitary sewer service is NOT required to be maintained at all times when connecting a sanitary sewer to existing manhole or intake.
6010, 3.05, C, 3	Specify whenever a knockout opening is allowed in lieu of a cored opening.
6010, 3.07, A	Specify if removal of manhole or intake is other than to a minimum of 10 feet below top of subgrade in paved areas or 10 feet below finished grade in other areas.
6010, 3.07, B, 3	Specify when to fill abandoned pipe line with flowable mortar or controlled low strength material.
Figure 6010.301	Specify when an eccentric flat top is to be used in lieu of an eccentric cone section.
Figure 6010.303	Specify when an eccentric flat top is to be used in lieu of an eccentric cone section.
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Figure 6010.501	Specify when Type Q grate is to be used in lieu of Type R.
Figure 6010.502	Specify when Type Q grate is to be used in lieu of Type R.
Figure 6010.603	Specify when Type Q grate is to be used in lieu of Type R.

Section 6020 - Rehabilitation of Existing Manholes

6020, 2.02, A	Specify the thickness of the in-situ manhole replacement wall.
6020, 2.02, C	Specify whenever the Contractor is required to provide a PVC or PE plastic liner for in-situ manhole replacement.
6020, 3.01, C	Specify when the use of a urethane chimney seal is allowed.
6020, 3.02, B, 3	Specify whenever a plastic liner is to be installed in an in-situ manhole replacement.

Section 6030 - Cleaning, Inspection, and Testing of Structures

6030, 3.04, A, 1	Specify when exfiltration testing is required for sanitary sewer manholes in lieu of vacuum testing.

Section 7010 - Portland Cement Concrete Pavement

7010, 2.01, E	Specify the use of an intermediate aggregate for concrete.
7010, 2.01, L, 2	Specify the type of performed expansion jointing filler or sealer to use if NOT using a resilient filler.
7010, 2.02, A, 1	Specify the type of Class C or Class M mix to use.
7010, 2.02, C, 2	Specify the type and amount of supplementary cementitious material in the mix.
7010, 3.01, C, 1, c	Specify the use of stringless paving.
7010, 3.02, I, 5, a	Specify when a textured finished surface other than an artificial turf or burlap drag is desired (i.e. surface tining).
7010, 3.02, I, 5, b	Specify when surface tining is required. *Note - longitudinal tining is listed as the default.*
7010, 3.02, J, 1, a	Specify when the use of a linseed oil solution is required.
7010, 3.02, K, 1, a	Specify the type and locations for construction of joints.
7010, 3.02, K, 2, i	Specify when to use wet sawing for dust control.
7010, 3.02, K, 3, a	Specify the location of longitudinal and transverse construction joints.
7010, 3.02, K, 4, a	Specify the location of expansion joints.
7010, 3.07, C, 2, a	Specify when the use of a profilograph for pavement smoothness is required.
Figure 7010.101	Specify when to use Detail D-1, D-2, or D-3.

Section 7011 - Portland Cement Concrete Overlays

7011, 2.01, L, 1	Specify the mass per unit area.
7011, 3.02, E, 4, a	Specify the high spots in the existing asphalt surface to be milled.

Section 7020 - Asphalt Pavement

7020, 3.05, B, 1	Specify when the use of profilograph for pavement smoothness is required.
7020, Table 7020.05	Specify if the field laboratory air voids target value is other than 4%.

Section 7021 - Asphalt Overlays

7021, 2.04, A	Specify the asphalt binder grade.
7021, 3.01, A	Specify the milling depth, cross-section, or profile.

Section 7030 - Sidewalks, Shared Use Paths, and Driveways

7030, 1.08, I	Specify whenever the Contractor will be responsible for concrete compression or asphalt density testing.
7030, 2.03, A	Specify color and surface texture of clay brick pavers, or select from samples submitted by the Contractor.
7030, 2.03, B	If concrete pavers are to be used, specify the material requirements.
7030, 2.04, B	Specify the use of a pre-mixed high performance cold mix in lieu of an asphalt setting bed.
7030, 2.06	Specify the use of colored cement for brick/paver joint filler.
7030, 3.01, A-C	Specify removal limits of sidewalks, shared use paths, driveways, bricks, and curbs.
7030. 3.01, E	Specify the locations to grind or saw existing curbs to install sidewalks, shared use paths, and driveways.
7030, 3.04	Specify the line and running slope to construct sidewalks and shared use paths. Specify the cross slope.
7030, 3.04, F, 2, a, 1)	Specify the spacing for transverse joints in shared use paths, if other than equal to the width of the shared use paths.
7030, 3.05	Specify the cross slope.
7030, 3.06, A, 2	Specify the cross-section and patterns to use for brick sidewalks with a concrete base.
7030, 3.11, A	Specify when testing will be the Contractor's responsibility.
Figure 7030.101	Specify the radius for commercial and industrial driveways. Specify when a 'B' joint is to be provided at the back of curb. Specify the driveway width. Specify when a 5 foot sidewalk is to be constructed through the driveway.
Figure 7030.102	Specify the radius for commercial and industrial driveways. Specify the driveway width. Specify when a 5 foot sidewalk is to be constructed through the driveway.
Figure 7030.104	Specify parking grading slope and property slope if different than 4:1.
Figure 7030.201	If a special grade is required for parking slopes, specify the grade. Specify the width of the sidewalk.
Figure 7030.202	Specify one of the curb details for Class A sidewalk.
Figure 7030.203	Specify the brick sidewalk pattern. Specify the jointing of the concrete base.

Figure 7030.205	Specify the use of a BT-3, KT-2, or expansion joint.

Section 7040 - Pavement Rehabilitation

7040, 1.08, K, 3	Specify the use of waterproof bonding material with pavement core replacement.
7040, 2.01, A, 1	Specify if patches are not constructed as standard patches.
7040, 2.01, A, 2	Specify the use of calcium chloride in high early strength patching.
7040, 2.01, B	Specify if an asphalt mixture other than a minimum Low Traffic (LT) mixture is desired.
7040, 2.01, C, 5	Specify the use of soil sterilant for crack and joint filler material.
7040, 2.01, G	Specify if a subbase material other than modified subbase is desired.
7040, 2.01, K	Specify the length and diameter of epoxy coated dowel bars.
7040, 3.01, C	Specify the dimensions of full depth and partial depth patches.
7040, 3.01, F	Specify seeding or sodding the area outside the pavement.
7040, 3.02, A, 1	Specify when a second saw cut is required.
7040, 3.02, C, 6	Specify the locations of joints.
7040, 3.03, B, 2	Specify when to tool the joint.
7040, 3.04, J	Specify when pavement smoothness testing is required.
7040, 3.05, B	Specify the depth to mill the pavement area.
7040, 3.05, D	Specify if materials removed are not the property of the Contractor.
7040, 3.06, B, 3	Specify when to clean wet sawn joints.
7040, 3.06, C, 2	Specify the level to heat, handle, and apply joint filler material.
7040, 3.07, A, 3	Specify when to apply soil sterilant.
7040, 3.07, B, 2	For cracks wider than 1 inch, specify when to utilize additional methods to clean cracks of old crack filler.
7040, 3.07, C, 2	For cracks 1/4 inch to 1 inch in width, specify when to utilize additional methods to clean cracks of old crack filler.
Figure 7040.102	Specify the use of a ‘CD’ joint.
Figure 7040.105	Specify the use of filter fabric. Specify the type of subbase.

Section 7050 - Asphalt Stabilization

7050, 1.02	Specify the crown of the pavement.
7050, 2.01, B	Specify the type of aggregate required.
7050, 3.03, A	Specify the depth of existing roadway surface to reclaim, if other than 4 inches.
7050, 3.07	Specify the type of surface treatment to apply.

Section 7060 - Bituminous Seal Coat

7060, 2.01, A	Specify the cover aggregate size.
7060, 2.01, B	Specify bituminous material if different than CRS-2P.
7060, 3.02, A, 1	Specify when to patch and joint fill hard surfaced streets.
7060, 3.04, B	Specify the application rate for spreading binder bitumen, if other than shown in the table.
7060, 3.04, D	Specify the application rate for spreading cover aggregate, if other than shown in the table.
7060, 3.06, B, 2	Specify the rate for spreading binder bitumen for two course seal coats.
7060, 3.06, B, 3	Specify the size of aggregate and the rate for spreading cover aggregate for two course seal coats.
7060, 3.07	Specify if sweeping of rural pavements is not necessary.

Section 7070 - Emulsified Asphalt Slurry Seal

7070, 1.02, B	Specify the application of fine or coarse slurry mixtures.
7070, 2.01, B	Specify when to use crushed aggregates.
7070, 2.02, A	Specify the amount of asphalt emulsion to blend with the aggregate.
7070, 3.01, B, 1, b	Specify the width of slurry mixture application.
7070, 3.02, A	Specify when to complete pavement patches and joint or crack filling for surface preparation.
7070, 3.02, C	Specify if water flushing for surface preparation is not allowed.
7070, 3.03, C	Specify the rate of applying the slurry seal, if other than 10 to 18 pounds per square yard for fine aggregate and 15 to 22 pounds per square yard for coarse aggregate.
7070, 3.03, F	Specify when to apply a burlap drag.

7070, 3.05, E	Specify if strip slurry treatment is to be placed in two separate operations.

Section 7080 - Permeable Interlocking Pavers

7080, 2.02, A	Specify either slotted or perforated underdrain pipes.
7080, 2.02, B	Specify the size of collector pipe if other than 6 inch diameter is desired.
7080, 2.03, C	Specify the size of lateral pipe if other than 4 inch diameter is desired.
7080, 3.02, A	Specify the elevation and grade for the excavation area.
7080, 3.02, B	Specify the use and location of underdrains.
7080, 3.03, A	Specify the use of engineering fabric over completed subgrade.
7080, 3.04, A, 5	Specify cleanout locations.
7080, 3.04, A, 7	Specify the use of underdrain cleanout pipes and observation wells.
7080, 3.04, B, 1	Specify underdrain lateral pipe locations.
7080, 3.05, A	Specify the thickness of storage aggregate.
7080, 3.05, C	Specify the storage aggregate elevation.
7080, 3.06, C	Specify the need to proof roll the filter aggregate.
7080, 3.09	Specify the installation pattern of the pavers.

Section 7090 - Cold-in-Place Pavement Recycling

7090, 2.02	Specify the required strength of the recycled pavement section.
7090, 3.01, B, 1	Specify the width and depth to mill the existing pavement material.
7090, 3.01, B, 2	Specify the use of an asphalt foaming system.
7090, 3.08, C	Specify if the compacted recycled roadway does not have to be within 6 inches of the established centerline.

Section 7091 - Full Depth Reclamation

7091, 2.02	Specify the required strength of the reclaimed pavement section as specified in the contract documents.
7091, 3.01, B, 1	Specify the width and depth to reclaim.
7091, 3.01, B, 2	Specify the use of an asphalt foaming system.
7091, 3.05, A	Specify if multiple passes are required.

7091, 3.09, C	Specify if the compacted, reclaimed roadway does not have to be within 6 inches of the established centerline.
7091, 3.11	Specify when to complete microcracking.
7091, 3.12	Specify the use of an HMA interlayer.

Section 7092 - Crack and Seat Existing PCC Pavement

7092, 1.08, A, 3	Specify the use of vibration monitoring. Specify the crack and seat pattern.
7092, 1.08, G, 3	Specify if a new grate assembly is required to be furnished and installed. Specify if a new intake top is to be furnished and installed.
7092, 1.08, J, 3	Specify the rock interlayer thickness.
7092, 3.02, C	Specify if subdrains are to be installed.
7092, 3.05, A	Specify if use of existing intake grate assembly is allowed.
7092, 3.05, B	Specify if use of existing intake top is allowed.
7092, 3.09	Specify when notch and runout milling is required.

Section 8010 - Traffic Signals

8010, 1.08, B, 3	Specify if pedestrian equipment is required with temporary traffic signal.
8010, 1.08, C, 3	Specify the location to deliver removed traffic signal materials.
8010, 2.01, A, 1, a	Specify if cable hooks are NOT required.
8010, 2.01, A, 1, c	Specify if a message besides “TRAFFIC SIGNAL” will be required on the handhole cover.
8010, 2.01, B, 3, a, 2)	Specify solvent welded, socket type fittings for use other than PVC conduit and fittings.
8010, 2.01, C, 5, a	Specify the mode type, size, and number of fibers for fiber optic cable required.
8010, 2.01, C, 5, d	Specify the single-mode fiber attributes to follow.
8010, 2.01, C, 5, i	Specify which type of cable to use - dielectric without armoring or armored with corrugated steel tape armor.
8010, 2.01, C, 5, o	Specify the number of fibers to be included in the fiber distribution panel.
8010, 2.01, C, 5, s	Specify the use of fusion splice continuous fiber runs or branch circuit connections in splice enclosures.

8010, 2.02, B, 2, c	Specify the voice message to be used for accessible pedestrian signal push button stations.
8010, 2.02, D, 9	Specify the type of mounting for microwave vehicle detectors.
8010, 2.02, E	Specify the type of wireless magnetic sensor to use for pavement sensor, access points, base stations, and repeaters, if necessary.
8010, 2.03, A	Specify the use of traffic monitoring systems.
8010, 2.03, B	Specify the use of fiber optic hub cabinet.
8010, 2.03, C, 2, b	Specify the location to mount the antenna for a wireless interconnect network, if other than near the top of the signal pole nearest the controller cabinet.
8010, 2.04, A, 2, b	Specify dimensions and type of aluminum cabinet riser to be used.
8010, 2.04, A, 2, c	Specify the ATC cabinet voltage category.
8010, 2.04, A, 2, h	Specify accommodations of phasing and expansibility of cabinet back panel positions.
8010, 2.04, C	Specify the use of emergency vehicle preemption system.
8010, 2.05, A, 1, a	Specify the color of vehicle traffic signal head assembly housing.
8010, 2.05, A, 6, c	Specify the use of high visibility reflective tape on the backplate.
8010, 2.05, A, 7, a	Specify if the rigid mounting hardware should be a natural aluminum finish or match the pole color.
8010, 2.05, B, 1, a	Specify the color of pedestrian traffic signal head assembly housing.
8010, 2.05, B, 2, a	Specify the type of visor - egg crate or tunnel type.
8010, 2.05, C, 1, a	Specify the mast arm length and vertical pole height.
8010, 2.05, C, 1, f	Specify where to use a combination street lighting/signal pole. Specify if the luminaire arm is to be mounted somewhere other than the same vertical plane as the signal arm.
8010, 2.05, D, 1, a	Specify the vertical pole height of the traffic signal pedestal pole.
8010, 2.05, E, 3	Specify the street name sign dimensions, letter height and font, and sheeting.
8010, 3.01, B, 3, c	Specify if boring pits are allowed to be closer than 2 feet to the back of curb.
8010, 3.01, C, 6	Specify the length of fiber optic cable to coil.
8010, 3.01, C, 9, c	Specify if the conduit cables could be pulled through intermediate junction boxes, handholes, pull boxes, pole bases, or any conduit opening.

8010, 3.01, C, 9, g	Specify how much cable slack to provide in each handhole, junction box, and cabinet.
8010, 3.01, C, 9, h	Specify installation of fiber optic accessories.
8010, 3.01, D, 1	Specify the foundation excavation size, shape, and depth.
8010, 3.02, C	Specify the installation of video detection camera system.
8010, 3.03, A	Specify the installation of traffic monitoring system.
8010, 3.03, B	Specify the installation of fiber optic hub cabinet.
8010, 3.04, A, 1	Specify the installation of controller cabinet and auxiliary equipment.
8010, 3.04, B	Specify the installation of controller.
8010, 3.04, C	Specify the installation of UPS battery backup system.
8010, 3.04, D	Specify the installation of emergency vehicle preemption system.
8010, 3.06	Specify construction of temporary traffic signal.
8010, 3.11, C	Specify the removal and disposal of handholes and abandoned conduit.
8010, 3.11, F	Specify the location to deliver salvaged traffic signal material.
Figure 8010.104	Specify the length of rectangular detector loop.
Figure 8010.105	Specify the number of signals, signs, and spacing.

Section 8020 - Pavement Markings

8020, 3.02, A, 3, c	Specify lane widths.
8020, 3.02, B, 2	Specify if pavement surface will not be cleaned with a rotary broom or street sweeper.
8020, 3.02, D	Specify if pavement is to be grooved prior to placing marking tape.
8020, 3.02, G, 2	Specify when to place pavement markings in a groove cut into the pavement surface.

Section 8030 - Temporary Traffic Control

8030, 1.08, A, 3	Specify when to include portable dynamic message signs, temporary barrier rail, temporary flood lighting, and pilot cars in the traffic control lump sum bid item.
8030, 2.04, B	Specify if something other than precast concrete units are to be used for temporary barrier rail.
8030, 3.01, C	Specify the locations to place temporary barrier rail.

Figure 8030.117	Specify the use of auxiliary lighting or audible information devices.
Figure 8030.118	Specify the use of a crash cushion to separate the temporary sidewalk from vehicular traffic.
Figure 8030.119	Specify the use of auxiliary lighting or audible information devices.

Section 8040 - Traffic Signs and Posts

8040, 2.02, C	Specify when to use Type IV high intensity retroreflective sheeting instead of Type XI diamond grade.

Section 9010 - Seeding

9010, 2.01, B	Specify PLS, which shall not be less than the accumulated total.
9010, 2.02	Specify seed mixture in the contract documents.
9010, 2.03, A, 2	Specify if fertilizer is not to be applied for temporary conventional seeding.
9010, 3.01, A	Specify when aerial application of seed and fertilizer is desired.
9010, 3.01, N	Specify the use of a no-till attachment if desired.
9010, 3.04, E, 4, a	Specify if winter dormant seeding is required.
9010, 3.10, B	Specify when a warranty for seeding is required.

Section 9020 - Sodding

9020, 2.04	Specify when contractor is not to provide water and watering equipment.

Section 9030 - Plant Material and Planting

9030, 1.03, E	Specify when the contractor is to submit a schedule of unit prices for each size and variety of tree, shrub, and ground cover plant.
9030, 1.08, A-D	Specify the use of pre-emergent herbicide.
9030, 2.01, A, 4	Specify whenever plants in rows do not need to be matched in form or size.
9030, 2.01, E, 1	Specify where to use bare root plants.
9030, 3.05	Specify when tree drainage wells are needed.
9030, 3.09, A	Specify when tree wrapping is required.
9030, 3.13, B	Specify when a warranty for plants is required.
Figure 9030.102	Specify when tree wrapping is required.

Section 9040 - Erosion and Sediment Control

9040, 1.08, A, 1	Specify if the Contractor will be responsible for the SWPPP preparation.
9040, 1.08, A, 2	Specify if the Contractor will be responsible for the SWPPP management.
9040, 1.08, C, 3	Specify if vegetation should be included with the filter berm.
9040, 1.08, E, 1	Specify the width of temporary RECP.
9040, 1.08, I	Specify if level spreaders are not to be removed.
9040, 1.08, L, 1, c	Specify the use of anti-seep collars.
9040, 1.08, Q, 2, c	Specify the area to hydromulch.
9040, 1.08, S, 3	Specify the slopes to complete surface roughening.
9040, 2.02, B	Specify the use of filter berms or compost blankets.
9040, 2.03	Specify the use of filter material in areas other than filter socks and filter berms.
9040, 2.06, A	Specify diameter for open weave, degradable netting if other than 9 inches is required.
9040, 2.07, A, 2	Specify if using RECP for permeable check dam.
9040, 2.08, A	Specify length of pressure-treated timber for level spreaders.
9040, 2.11, A	Specify class of concrete if not Class C.
9040, 2.11, B	Specify riser diameter for sediment basin outlet structures.
9040, 2.11, C, 1	Specify the number, diameter, and elevation of the holes in the riser of the dewatering device in sediment basin outlet structures.
9040, 2.11, D	Specify barrel diameter of the sediment basin outlet structures.
9040, 2.11, E	Specify riser diameter for anti-vortex device.
9040, 3.02, D	Specify if weekly erosion and sediment control site inspections are not required as a part of SWPPP management.
9040, 3.05, B	Specify depth of compost blankets.
9040, 3.06, A	Specify when the filter berm is not to be installed along the contour.
9040, 3.06, C	Specify when a vegetated berm is required.
9040, 3.07, A, 1	Specify the size and length of filter sock.
9040, 3.07, A, 2	Specify when the filter sock is not to be installed along the contour.

9040, 3.07, B	Specify when to remove the filter sock.
9040, 3.08, A, 2	Specify if placement of seed and fertilizer is to be accomplished before installation of temporary rolled erosion control products.
9040, 3.08, A, 3	Specify if placement of seed and fertilizer is to be accomplished on the anchor trench.
9040, 3.08, B, 1	Specify if placement of seed and fertilizer is to be accomplished before installation of temporary rolled erosion control products.
9040, 3.09, B	Specify when to remove the wattle.
9040, 3.10, A, 2	Specify when to provide an RECP under the check dam.
9040, 3.10, D	Specify when to remove check dams.
9040, 3.12, C	Specify the excavated depth behind the level spreader.
9040, 3.12, E	Specify the minimum depth of depression before accumulated sediment is removed.
9040, 3.15, B, 1	Specify the number, diameter, and configuration of holes in the riser section of sediment basin outlet structures.
9040, 3.17	Specify the size and elevations of sediment traps.
9040, 3.18, A, 1	Specify when the silt fence material is not to be installed along the contour.
9040, 3.19, E	Specify when to install subgrade stabilization fabric prior to placing crushed stone.
9040, 3.19, F	Specify the thickness and dimensions of crushed stone for stabilized construction entrance.
Figure 9040.101	Specify if compost blankets are vegetated or unvegetated.
Figure 9040.102	Specify size of berm if slope is steeper than 3:1. Specify berm placement locations in uncompacted windrow perpendicular to the slope. Specify filter sock diameter.
Figure 9040.105	Specify diameter of wattle. Specify space between wattles.
Figure 9040.107	Specify height between engineering fabric and crest on the rock check dam.
Figure 9040.108	Specify total height of diversion.
Figure 9040.109	Specify excavated depression depth.
Figure 9040.110	Specify the rock thickness (T), width (W), and length (L) for rip rap apron for pipe outlet onto flat ground.

Figure 9040.111	Specify the rock thickness (T), width (W), and length (L) for rip rap apron for pipe outlet into channel.
Figure 9040.112	Specify diameter of pipe for temporary pipe slope drain. Specify A, B, and C anchoring options.
Figure 9040.113	Specify barrel length and diameter for sediment basin without emergency spillway. Specify when anti-seep collars are required.
Figure 9040.114	Specify barrel length and diameter for sediment basin with emergency spillway. Specify when anti-seep collars are required.
Figure 9040.115	Specify elevations and dimensions for sediment basin dewatering device. Specify perforation configurations. Specify diameter of discharge pipe barrel.
Figure 9040.116	Specify riser diameter for anti-vortex device.
Figure 9040.117	Specify when anti-seep collars are required.
Figure 9040.118	Specify width of sediment trap.
Figure 9040.119	Specify spacing of post installation for silt fence.

Section 9050 - Gabions and Revet Mattresses

9050, 1.08, A, 3	Specify PVC coating for gabions.
9050, 1.08, B, 3	Specify PVC coating for revet mattresses.
9050, 2.01	Specify when double twisted wire baskets are not required.
9050, 2.02	Specify when to use welded wire baskets.
9050, 2.05	Specify when to use anchor stakes. Specify the length of anchor stakes.
9050, 3.01, A	Specify when to cut and reshape the area behind a proposed gabion wall to allow for placement of the wall.
9050, 3.01, E	Specify the placement, compaction, and dimensions of granular subbase materials.
9050, 3.04, A	Specify special details of gabion wall installation including height, slope of wall, gabion setback, special backfill materials, and tieback requirements.

Section 9060 - Chain Link Fence

9060, 1.08, A, 3	Specify PVC coating for chain link fence.
9060, 1.08, B, 3	Specify the use of barbed wire for gates.
9060, 2.01, D, 2	Specify the PVC coating color.

9060, 2.02, A, 2	Specify the nominal diameter of fence height for post use, if other than shown in the table.
9060, 2.05, A	Specify the type of arm configuration for barbed wire supporting arms.
9060, 2.07, A	Specify the type, height, and width of gates.
9060, 3.01, A	Specify fence location and height.
9060, 3.01, B, 2, a	Specify post holes dimensions.
9060, 3.01, B, 2, e	Specify the required brace-post assembly.
9060, 3.01, G	Specify when to use barbed wire.
9060, 3.01, G, 1	Specify the installation of barbed wire, if other than 3 parallel wires on each barbed wire supporting arm on the outside of the area being secured.
9060, 3.01, H	Specify the installation requirements for gates.
9060, 3.01, I, 1	Specify the installation of electrical grounds.
9060, 3.02	Specify when all fences, including posts and footings, are not to be removed from within work areas.
9060, 3.03, A	Specify the height of temporary fence.
Figure 9060.101	Specify the fence fabric width. Specify when to install fence on the roadway side of the right-of-way.
Figure 9060.103	Specify the length of the sidewalk.

Section 9070 - Landscape Retaining Walls

9070, 2.01, B	Specify the depth of limestone slabs, if other than 8 inches.
9070, 3.01, B	Specify the excavation line and grade.

Section 9071 - Segmental Block Retaining Walls

9071, 3.01, B	Specify the excavation line and grade.
9071, 3.02, B	Specify leveling pad materials.
9071, 3.02, C	Specify the elevation and orientation.
9071, 3.02, D, 1	Specify the use of subdrains.

Section 9072 - Combined Concrete Sidewalk and Retaining Wall

9072, 2.01, A, 3	Specify the type of expansion joint, if resilient filler is not desired.
9072, 3.01, B	Specify the excavation line and grade.
9072, 3.04	Specify the formation of rustications.

Section 9080 - Concrete Steps, Handrails, and Safety Rail

9080, 2.04, B	Specify when to galvanize handrail and safety rail.
9080, 2.04, C	Specify when to apply powder coat to steel, galvanized steel, or aluminum handrail and safety rail.
9080, 3.02, A, 1	Specify the length of rail.
Figure 9080.103	Specify the field painting of safety rail.

Section 10,010 - Demolition

10,010, 1.07, A	Specify when the use of explosives is allowed.
10,010, 3.08, D	Specify when the removal and disposal of all brush, shrubs, trees, logs, downed timber, and other yard waste on the site is not desired.
10,010, 3.08, E	Specify when the removal of all retaining walls is not desired.
10,010, 3.11	Specify what materials are required to be recycled from the demolition site.

Section 11,010 - Construction Survey

11,010, 1.02	Specify any additional items to be included in construction survey work.
11,010, 3.02, D	Specify if property limits are to be marked.

Section 11,040 - Temporary Sidewalk Access

11,040, 3.02, A	Specify locations to construct temporary granular sidewalks.
11,040, 3.03, B	Specify locations to locate temporary longitudinal channelizing devices.
Figure 11,040.102	Specify when to install orange construction safety fence between the top of the bottom rail and the bottom of the top rail.

Incidental or Included Items

Items that are necessary to properly complete construction, including work and materials, and are not pay items. The following is a list of items in the SUDAS Specifications that are considered incidental to other work unless specified as a pay item on the plans or in the contract documents. Please note - this list is not all-inclusive.

Section 2010 - Earthwork, Subgrade, and Subbase

2010, 1.08, A, 3 — Clearing and Grubbing (by units)
Placement of backfill in area where roots have been removed, and removal and disposal of all materials.

2010, 1.08, B, 3 — Clearing and Grubbing (by area)
Removal and disposal of all materials and placement of backfill in area where roots have been removed.

2010, 1.08, C, 3 — Clearing and Grubbing (by lump sum)
Removing and disposing all materials and furnishing and placing backfill material in area where roots have been removed.

2010, 1.08, D, 1, c — Topsoil, On-site
Stripping and stockpiling topsoil; preparing the topsoil placement area by tillage or ripping; re-spreading the topsoil; additional tillage to address compaction during placement; and removal of clods, roots, stones, and other undesirable materials.

2010, 1.08, D, 2, c — Topsoil, Compost-amended
Preparing the placement area by tillage or ripping and furnishing, transporting, placing, and incorporating compost.

2010, 1.08, D, 3, c — Topsoil, Off-site
Preparing the placement area by tillage or ripping; furnishing, transporting, and spreading the off-site topsoil; completing tillage to address compaction during placement; and removal of clods, roots, stones, and other undesirable materials.

2010, 1.08, E, 3 — Excavation, Class 10, Class 12, or Class 13

a. Site preparation for, and the construction of, embankment, fills, shoulder backfill, and backfill behind curbs.
b. Overhaul.
c. Finishing the soil surface, including roadways, shoulders, behind curbs, side ditches, slopes, and borrow pits.
d. Repair or replacement of any fences that have been unnecessarily damaged or removed.

2010, 1.08, F, 3 — Below Grade Excavation (Core Out)
Equipment, tools, labor, disposal of unsuitable materials, dewatering, drying, furnishing, and placement of foundation materials as required by the Engineer, compaction and finishing of the excavated area, and all incidental work as may be required.

2010, 1.08, G, 3 — Subgrade Preparation
Excavating, manipulating, replacing, compacting, and trimming to the proper grade.

2.01, 1.08, H, 3 — Granular Stabilization
Removal and disposal of unstable material and furnishing, hauling, placing, and compacting granular stabilization material.

2010, 1.08, I, 3 — Subgrade Treatment
Furnishing, placing, and incorporating the subgrade treatment material (cement, asphalt, fly ash, lime, geogrid, or geotextiles).

2010, 1.08, J, 3 — Subbase
Furnishing, placing, compacting, and trimming to the proper grade.

2010, 1.08, K, 1, c — Removal of Structures
Removal and disposal of structures.

2010, 1.08, K, 2, a, 3) — Removal of Known Box Culverts
Removal and disposal of known box culverts.

2010, 1.08, K, 2, c, 3) — Removal of Known Pipe Culverts
Removal and disposal of known pipe culverts.

2010, 1.08, K, 3, a, 3) — Removal of Known Pipes and Conduits
Removal, disposal, and plugging, if specified, of pipes and conduits.

2010, 1.08, L, 1, c — Filling and Plugging of Known Pipe Culverts, Pipes, and Conduits
Furnishing and installing the plug and the flowable mortar as designated by the Engineer.

Section 3010 - Trench Excavation and Backfill

3010, 1.08, A — General

1. Standard trench excavation.
2. Removal and disposal of unsuitable backfill material encountered during standard trench excavation.
3. Removal of abandoned private utilities encountered during trench excavation.
4. Furnishing and placing granular bedding material.
5. Placing and compacting backfill material.
6. Dewatering including, but not limited to, all equipment such as generators, pumps, rock for sump pits, discharge piping, and any extra excavation needed to facilitate dewatering according to stormwater regulations, as applicable.
7. Sheeting, shoring, and bracing.
8. Adjusting the moisture content of excavated backfill material to the range specified for placement and compaction.

3010, 1.08, B, 3 — Rock Excavation
Furnishing the equipment and labor to break up, remove, and properly dispose of rock encountered in the trench.

3010, 1.08, C, 3 — Trench Foundation
Removal and disposal of over-excavated material required to stabilize trench foundation; and furnishing, hauling, and placing stabilization material.

3010, 1.08, D, 3 — Replacement of Unsuitable Backfill Material
Furnishing, hauling, and placing backfill material.

3010, 1.08, E, 3 — Special Pipe Embedment or Encasement
Furnishing and placing all required special pipe embedment or encasement materials.

3010, 1.08, F, 3 — Trench Compaction Testing
All payments associated with retesting resulting from failure of initial tests.

Section 3020 - Trenchless Construction

3020, 1.08 — All items of work contained in this section are incidental to the underground utility pipe being installed and will not be paid for separately.

Section 4010 - Sanitary Sewers

4010, 1.08, A, 1, c — Sanitary Sewer Gravity Main, Trenched
Trench excavation; dewatering; furnishing and installing pipe; pipe lining (if specified); furnishing, placing, and compacting bedding and backfill material; wyes and other fittings; pipe joints; pipe connections; testing; and inspection.

4010, 1.08, A, 2, c — Sanitary Sewer Gravity Main, Trenchless
Furnishing and installing pipe; pipe lining (if specified); trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

4010, 1.08, B, 1, c — Sanitary Sewer Gravity Main with Casing Pipe, Trenched
Furnishing and installing both carrier pipe and casing pipe, pipe lining (if specified); trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, furnishing and installing annular space fill material, casing spacers, pipe connections, testing, and inspection.

4010, 1.08, B, 2, c — Sanitary Sewer Gravity Main with Casing Pipe, Trenchless
Furnishing and installing both carrier pipe and casing pipe; pipe lining (if specified); trenchless installation materials and equipment; pit excavation; dewatering; and placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

4010, 1.08, C, 1, c — Sanitary Sewer Force Main, Trenched
Trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill; wyes and other fittings; pipe joints; testing; and inspection.

4010, 1.08, C, 2, c — Sanitary Sewer Force Main, Trenchless
Furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

4010, 1.08, D, 1, c — Sanitary Sewer Force Main with Casing Pipe, Trenched
Furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

4010, 1.08, D, 2, c — Sanitary Sewer Force Main with Casing Pipe, Trenchless
Furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

4010, 1.08, E, 3 — Sanitary Sewer Service Stub
Trench excavation; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; tap; fittings; testing; and inspection.

4010, 1.08, F, 3 — Sanitary Sewer Service Relocation
Removal of existing pipe, trench excavation, furnishing new pipe and bedding material, placing and compacting bedding and backfill material, connection back to existing service, compaction, testing, and inspection.

4010, 1.08, G, 3 — Sewage Air Release Valve and Pit
Excavation; furnishing, placing, and compacting bedding and backfill material; and testing.

4010, 1.08, H, 3 — Removal of Sanitary Sewer
Removal, disposal, and capping (if specified) of pipe; and furnishing, placing, and compacting backfill material.

4010, 1.08, I, 3 — Sanitary Sewer Cleanout
Plug at the end of the main, fittings, riser pipe, cap with screw plug, casting, and concrete casting encasement.

4010, 1.08, K, 3 — Sanitary Sewer Abandonment, Plug
Trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing and compacting backfill material.

4010, 1.08, L, 3 — Sanitary Sewer Abandonment, Fill and Plug
Trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing and compacting backfill material.

Section 4020 - Storm Sewers

4020, 1.08, A, 1, c — Storm Sewer, Trenched
Trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; joint wrapping; wyes and other fittings; pipe joints; pipe connections; testing; and inspection.

4020, 1.08, A, 2, c — Storm Sewer, Trenchless
Furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

4020, 1.08, B, 1, c — Storm Sewer with Casing Pipe, Trenched
Furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

4020, 1.08, B, 2, c — Storm Sewer with Casing Pipe, Trenchless
Furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

4020, 1.08, C, 3 — Linear Trench Drain
Furnishing and installing the linear trench drain including all appurtenances; furnishing and placement of PCC transition; furnishing, excavation, and backfill of discharge pipe; connection to manhole or intake, if required; installation of apron, if required.

4020, 1.08, D, 3 — Removal of Storm Sewer
Removal, disposal, and capping (if specified) of pipe; and furnishing, placing, and compacting backfill material.

4020, 1.08, F, 3 — Storm Sewer Abandonment, Plug
Trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing and compacting backfill material.

4020, 1.08, G, 3 — Storm Sewer Abandonment, Fill and Plug
Trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing and compacting backfill material.

Section 4030 - Pipe Culverts

4030, 1.08, A, 1, c — Pipe Culvert, Trenched
Trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; connectors; testing; and inspection.

4030, 1.08, A, 2, c — Pipe Culvert, Trenchless
Furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing and compacting backfill material; pipe connections; testing; and inspection.

4030, 1.08, B, 3 — Pipe Apron
Trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; connectors; and other appurtenances.

4030, 1.08, C, 3 Footing for Concrete Pipe Apron
Excavation; dewatering; reinforcing steel; concrete; furnishing and installing apron; furnishing, placing and compacting bedding and backfill material.

4030, 1.08, D, 3 Pipe Apron Guard
Furnishing and installing the apron guard and repairing any damage to the apron from the installation process.

Section 4040 - Subdrains and Footing Drain Collectors

4040, 1.08, A, 3 Subdrain
Trench excavation, furnishing and placing bedding and backfill material, engineering fabric (when specified), connectors, and elbows and tees. The length of elbows and tees of the pipes installed will be included in the length of pipe measured.

4040, 1.08, B, 3 Footing Drain Collector
Trench excavation, pipe, wyes, tap, fittings, and furnishing and placing bedding and backfill material.

4040, 1.08, C, 1, c Subdrain Cleanout
Trench excavation; furnishing cleanout and lid; and furnishing, placing, and compacting bedding and backfill material.

4040, 1.08, C, 2, c Footing Drain Cleanout
Trench excavation; furnishing cleanout and lid; and furnishing, placing, and compacting bedding and backfill material.

4040, 1.08, D, 1, c Subdrain Drain Outlets and Connections
Pipe, non-shrink grout, coupling bands, and rodent guards for pipes 6 inches or smaller.

4040, 1.08, D, 2, c Footing Drain Outlets and Connections
Pipe, non-shrink grout, coupling bands, and rodent guards for pipes 6 inches or smaller.

4040, 1.08, E, 3 Storm Sewer Service Stub
Trench excavation, furnishing bedding material, placing bedding and backfill material, tap, fittings, and plugs.

Section 4050 - Pipe Rehabilitation

4050, 1.08, A, 1, c Pre-Rehabilitation Cleaning and Inspection
Pre-cleaning CCTV inspection, light sewer cleaning, debris removal and transport, post cleaning CCTV inspection for Engineer review, and identification and logging of active service taps. If specified in the contract documents, unit price also includes disposal and associated costs for all debris removed from sewer.

4050, 1.08, A, 2, c Additional Sewer Cleaning
Heavy sewer cleaning; root cutting; deposit cutting; and removing, transporting, disposing, paying associated costs for all debris removed from sewer, and post cleaning CCTV inspection for Engineer review.

4050, 1.08, B, 3	Remove Protruding Service Connections Removal of protruding service connections and debris removal.
4050, 1.08, C, 1, c	CIPP Main Lining Furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, bypass pumping unless otherwise specified, sliding foil, post-lining CCTV inspection, and all costs associated with the public information and notification program.
4050, 1.08, C, 2, c	Building Sanitary Sewer Service Reinstatement Reinstating sanitary sewer service connections, removal of debris, and coordination with service owners.
4050, 1.08, C, 3, c	CIPP End Seal End seal and installation.
4050, 1.08, D, 3	CIPP Point Repair Furnishing and placing point repair liner, bypass pumping unless otherwise specified, sewer cleaning, removal of obstructions, debris removal, pipe preparation, and pre and post repair CCTV inspection.
4050, 1.08, E, 1, c	CIPP Service Pipe, Connection Furnishing and placing service connection liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.
4050, 1.08, E, 2, c	CIPP Service Repair, Partial Pipe Furnishing and installing service repair liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.
4050, 1.08, F, 1, c	Pressure Testing of Mainline Sewer Joints Bypass pumping unless otherwise specified, control testing, and documentation.
4050, 1.08, F, 2, c	Injection Grouting of Mainline Sewer Joints Bypass pumping unless otherwise specified, material testing, pressure testing after grouting, re-grouting of failed joints, and documentation. Unit price does not include the quantity of chemical grout used.
4050, 1.08, F, 3, c	Pressure Testing of Service Connections Bypass pumping unless otherwise specified, and documentation.
4050, 1.08, F, 4, c	Injection Grouting of Service Connections Bypass pumping unless otherwise specified, material testing, pressure testing after grouting, and documentation. Unit price does not include the quantity of chemical grout used.
4050, 1.08, F, 5, c	Chemical Grout Grout additives; root inhibitor; and supplying, mixing, and measurement of chemical grout.

4050, 1.08, G, 3 Bypass Pumping
Development and submittal of the bypassing plan, all staffing, equipment, and appurtenances necessary to accomplish the approved bypassing plan, including reserve equipment.

4050, 1.08, H, 1, c Spot Repairs by Pipe Replacement (by count)
Uncovering and removing existing pipe and furnishing and placing bedding and backfill material for replacement pipe.

4050, 1.08, H, 2, c Spot Repairs by Pipe Replacement (by linear foot)
Furnishing and installing replacement pipe and connections.

Section 4060 - Cleaning, Inspection, and Testing of Sewers

4060, 1.08 Cleaning, inspecting, and testing sanitary sewers, storm sewers, pipe culverts, and rehabilitated pipes (including video inspection) are incidental to other project costs and will not be paid for separately.

Section 5010 - Pipe and Fittings

5010, 1.08, A, 1, c Water Main, Trenched
Trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; tracer system; testing; disinfection; and polyethylene wrap for ductile iron pipe and for fittings.

5010, 1.08, A, 2, c Water Main, Trenchless
Furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; tracer system; testing; and disinfection.

5010, 1.08, B, 1, c Water Main with Casing Pipe, Trenched
Furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

5010, 1.08, B, 2, c Water Main with Casing Pipe, Trenchless
Furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

5010, 1.08, C, 1, c Fitting (by count)
Restrained joints and thrust blocks.

5010, 1.08, C, 2, c Fitting (by weight)
Restrained joints and thrust blocks.

5010, 1.08, D, 3 Water Service Stub (by each)
Water service corporation; service pipe; curb stop; stop box; trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; and installation of tracer wire system for non-metallic service pipe.

5010, 1.08, E, 1, c — Water Service Pipe
Trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; and installation of tracer wire system for non-metallic service pipe.

5010, 1.08, E, 2, c — Water Service Corporation
Trench excavation (if necessary); furnishing and installing the water service corporation; and furnishing, placing, and compacting bedding and backfill material.

5010, 1.08, E, 3, c — Water Service Curb Stop and Box
Trench excavation (if necessary); furnishing and installing the curb stop and box; and furnishing, placing, and compacting bedding and backfill material.

5010, 1.08, F, 3 — Water Main Abandonment, Cap
Trench excavation (if necessary); closing valves; removing valve boxes; installing thrust blocks; cutting pipe; installing MJ caps; and furnishing, placing, and compacting backfill material.

5010, 1.08, G, 3 — Water Main Abandonment, Fill and Plug
Trench excavation (if necessary); closing valves; removing valve boxes; installing thrust blocks; cutting and removing the specified section of pipe; furnishing and pumping flowable material to fill the pipe to be abandoned; installing MJ caps; and furnishing, placing, and compacting backfill material.

5010, 1.08, H, 3 — Water Main Removal
Trench excavation (if necessary); closing valves; installing thrust blocks; cutting pipe; installing MJ caps; removal and disposal of all valves and pipe specified for removal; furnishing, placing, and compacting backfill material.

Section 5011 - Fusible PVC and HDPE Pipe

5011, 1.08, A, 1, c — Fusible Water Main, Trenched
Trench excavation, dewatering, furnishing bedding material, performing fusion jointing, placing bedding and backfill material, tracer system, testing, and disinfection.

5011, 1.08, A, 2, c — Fusible Water Main, Trenchless
Furnishing and installing pipe; performing fusion jointing, trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; tracer system; testing; and disinfection.

5011, 1.08, B, 1, c — Water Main with Casing Pipe, Trenched
Furnishing and installing both fusible carrier pipe and casing pipe, performing fusion jointing, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, casing spacers, furnishing and installing annular space fill material, tracer system, testing, and disinfection.

5011, 1.08, B, 2, c — Water Main with Casing Pipe, Trenchless
Furnishing and installing both fusible carrier pipe and casing pipe; performing fusion jointing, trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

Section 5020 - Valves, Fire Hydrants, and Appurtenances

5020, 1.08, A, 3 — Valve
All components attached to the valve or required for its complete installation, including underground or above ground operator, square valve operating nut, valve box and cover, valve box extension, and valve stem extension.

5020, 1.08, B, 3 — Tapping Valve Assembly
Tapping sleeve, tapping valve, the tap, valve box and cover, valve box extension, and valve stem extension.

5020, 1.08, C, 3 — Fire Hydrant Assembly
The fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipe, fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

5020, 1.08, D, 3 — Alternate Fire Hydrant Assembly
The fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipes, 90 degree bend; fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

5010, 1.08, E, 3 — Flushing Device (Blowoff)
Trench excavation; furnishing, installing, and removing the flushing device (if designated by the Engineer); and furnishing, placing, and compacting bedding and backfill material.

5020, 1.08, F — Measurement and payment for minor adjustment of an existing valve box by raising or lowering the adjustable valve box is incidental.

5020, 1.08, G, 3 — Valve Box Extension
Furnishing and installing the valve box extension and replacing the valve box lid.

5020, 1.08, H, 3 — Valve Box Replacement
Removal of existing valve box; excavation; furnishing and installing new valve box; backfill; compaction; and all other necessary appurtenances.

5020, 1.08, I, 3 — Fire Hydrant Adjustment
Removal and reinstallation of the existing fire hydrant; furnishing and installing the extension barrel section and stem; and all other necessary appurtenances.

5020, 1.08, J, 3 — Fire Hydrant Assembly Removal
Excavation, removal of the fire hydrant, hydrant valve, thrust block, delivery of the fire hydrant assembly to the Contracting Authority (if specified), capping of the pipe, backfill, compaction, and surface restoration to match the surrounding area.

5020, 1.08, K, 3 Valve Removal
Excavation, removal of each valve, replacing the removed valve with pipe and connections if required or capping the former valve connection, delivery of the valve to the Contracting Authority (if specified), backfill, compaction, and surface restoration to match the surrounding area.

5020, 1.08, L, 3 Valve Box Removal
Excavation, removal of each valve box, delivery of the valve box to the Contracting Authority (if specified), backfill, compaction, and surface restoration to match the surrounding area.

Section 5030 - Testing and Disinfection

5030, 1.08 Testing and disinfection of water systems is incidental to the construction of pipe and fittings.

Section 6010 - Structures for Sanitary and Storm Sewers

6010, 1.08, A, 3 Manhole
Excavation; furnishing and installing pipe; lining (if specified); furnishing, placing, and compacting bedding and backfill material; base; structural concrete; reinforcing steel; precast units (if used); concrete fillets; pipe connections; infiltration barriers (sanitary sewer manholes only); castings; and adjustment rings.

6010, 1.08, B, 3 Intake
Excavation; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; base; structural concrete; reinforcing steel; precast units (if used); concrete fillets; pipe connections; castings; and adjustment rings.

6010, 1.08, C, 1, c Internal Drop Connection
Cutting the hole and installing a flexible watertight connector, providing and installing the receiving bowl, flexible coupler between the bowl and the drop pipe, the PVC drop pipe, pipe brackets and bolts, the bottom elbow, repair of fillet if required, and a splash guard if required.

6010, 1.08, C, 2, c External Drop Connection
The connection to the manhole and all pipe; fittings; concrete encasement; and furnishing, placing, and compacting bedding and backfill material.

6010, 1.08, D, 3 Casting Extension Rings
Furnishing and installing each casting extension ring and reinstalling the casting lid.

6010, 1.08, E, 1, c Manhole Adjustment, Minor
Removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, furnishing and installing new casting, and installing new infiltration barrier (sanitary sewer manholes only).

6010, 1.08, E, 2, c Intake Adjustment, Minor
Removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, and furnishing and installing new casting.

6010, 1.08, F, 1, c — Manhole Adjustment, Major
Removal of existing casting, adjustment rings, top sections, and risers; excavation; concrete and reinforcing steel or precast sections; furnishing and installing new casting; installing new infiltration barrier (sanitary sewer manholes only); placing backfill material; and compaction.

6010, 1.08, F, 2, c — Intake Adjustment, Major
Removal of existing casting, adjustment rings, top sections, and risers; excavation; concrete and reinforcing steel or precast sections; furnishing and installing new casting; placing backfill material; and compaction.

6010, 1.08, G, 1, c — Connection to Existing Manhole
Coring or cutting into the existing manhole or intake, pipe connections, grout, and waterstop (when required).

6010, 1.08, G, 2, c — Connection to Existing Intake
Coring or cutting into the existing manhole or intake, pipe connections, grout, and waterstop (when required).

6010, 1.08, H, 1, c — Remove Manhole
Removal of casting, concrete, and reinforcement; plugging pipes; filling remaining structure with flowable mortar; and placing compacted fill over structure to finished grade.

6010, 1.08, H, 2, c — Remove Intake
Removal of casting, concrete, and reinforcement; plugging pipes; filling remaining structure with flowable mortar; and placing compacted fill over structure to finished grade.

Section 6020 - Rehabilitation of Existing Manholes

6020, 1.08, A, 1, c — Rubber Chimney Seal
All necessary compression or expansion bands and extension sleeves as necessary to complete chimney seal.

6020, 1.08, A, 2, c — Molded Shield
Sealant.

6020, 1.08, A, 3, c — Urethane Chimney Seal
Preparing the surface of the manhole and furnishing and applying primer and urethane chimney seal according to the manufacturer's requirements.

6020, 1.08, B, 3 — In-situ Manhole Replacement, Cast-in-place Concrete
Handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, and testing the manhole upon completion.

6020, 1.08, C, 3 — In-situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner
Handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, sealing at the frame and cover, sealing pipe penetrations as recommended by the manufacturer, and testing the manhole upon completion.

6020, 1.08, D, 3 Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal
Handling of sewer flows during lining operations as required to properly complete the installation, and replacement of the existing casting with a new casting.

Section 6030 - Cleaning, Inspection, and Testing of Structures

6030, 1.08 Cleaning, inspection, and testing of structures are incidental to construction of structures and will not be paid for separately.

Section 7010 - Portland Cement Concrete Pavement

7010, 1.08, A, 3 Pavement, PCC
Final trimming of subgrade or subbase, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness testing.

7010, 1.08, E, 3 Curb and Gutter
Final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

7010, 1.08, F, 3 Beam Curb
Final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

7010, 1.08, G, 3 Concrete Median
Final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

7010, 1.08, H, 3 PCC Railroad Crossing Approach
Excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet or connection to storm sewer, furnishing and installing porous backfill material, furnishing and placing modified subbase material, furnishing and installing reinforcing steel and tie bars, furnishing and placing concrete, furnishing, placing, and compacting asphalt.

7010, 1.08, I, 3 PCC Pavement Samples and Testing
Certified plant inspection, pavement thickness cores, profilograph pavement smoothness measurement (when required by the contract documents), and maturity testing.

7010, 1.08, K, 3 PCC Pavement Widening
Final subgrade/subbase preparation, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness.

Section 7011 - Portland Cement Concrete Overlays

7011, 1.08, A, 1, c — PCC Overlay, Furnish Only
Furnishing the concrete mixture and delivery to the project site.

7011, 1.08, A, 2, c — PCC Overlay, Place Only
Integral curb, bars and reinforcement, joints and sealing, finishing and texturing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness testing.

7011, 1.08, A, 3, c — Surface Preparation for Bonded PCC Overlay
Sandblasting, shot blasting, scarification, and surface cleaning.

7011, 1.08, A, 4, c — Surface Preparation for Unbonded PCC Overlay
Scarification and surface cleaning.

7011, 1.08, A, 5, c — Asphalt Separation Layer for Unbonded PCC Overlay
Asphalt mix, including asphalt binder.

7011, 1.08, A, 6, c — Geotextile Fabric Separation Layer for Unbonded PCC Overlay
Cleaning surface and furnishing, placing, and securing the geotextile fabric separation layer.

7011, 1.08, A, 7, c — Liquid Curing Compound Separation Layer on PCC Surface Patches for Unbonded PCC Overlay
Cleaning PCC surface patches and furnishing and placing the liquid curing compound.

Section 7020 - Asphalt Pavement

7020, 1.08, A, 3 — Pavement, Asphalt (by ton)
Asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

7020, 1.08, B, 3 — Pavement, Asphalt (by square yard)
Asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

7020, 1.08, C, 3 — Asphalt Base Widening (by ton)
Asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

7020, 1.08, D, 3 — Asphalt Base Widening (by square yard)
Asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

7020, 1.08, E, 3 — Asphalt Railroad Crossing Approach
Excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet, furnishing and installing porous backfill material, furnishing and placing modified subbase material, furnishing and applying tack coat, furnishing, placing, and compacting asphalt.

7020, 1.08, I, 3 Asphalt Pavement Samples and Testing
Certified plant inspection, pavement thickness cores, density analysis, profilograph pavement smoothness measurement (when required by the contract documents), and air void testing.

Section 7021 - Asphalt Overlays

7021, 1.08, A, 3 Asphalt Overlay (by ton)
Asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

7021, 1.08, B, 3 Asphalt Overlay (by square yard)
Asphalt mix with asphalt binder, tack coat, construction zone protection, and quality control.

Section 7030 - Sidewalks, Shared Use Paths, and Driveways

7030, 1.08, A, 1, c Removal of Sidewalk
Sawing, hauling, and disposal of materials removed.

7030, 1.08, A, 2, c Removal of Shared Use Path
Sawing, hauling, and disposal of materials removed.

7030, 1.08, A, 3, c Removal of Driveway
Sawing, hauling, and disposal of materials removed.

7030, 1.08, B, 3 Removal of Curb
Hauling and disposal of materials removed.

7030, 1.08, C, 3 Shared Use Path
Subgrade preparation, jointing, sampling, smoothness testing and correction, and testing.

7030, 1.08, D, 3 Special Subgrade Preparation for Shared Use Path
Water required to bring subgrade moisture content to within the required limits.

7030, 1.08, E, 3 Sidewalk, PCC
Minor grade adjustments at driveways and other intersections, subgrade preparation, formwork, additional thickness at thickened edges, jointing, sampling, smoothness testing and correction, and testing.

7030, 1.08, F, 3 Brick/Paver Sidewalk with Pavement Base
Subgrade preparation, pavement base, setting bed, neoprene asphalt adhesive for asphalt setting bed, setting the bricks/pavers, installing weep holes and associated materials, and sand/cement joint filler.

7030, 1.08, G, 3 Detectable Warning
Steel bar supports and manufactured detectable warning panels.

7030, 1.08, H, 1, c Driveway, Paved
Excavation, subgrade preparation, jointing, sampling, and testing.

7030, 1.08, H, 2, c — Driveway, Granular (by square yards)
Excavation and preparation of subgrade.

7030, 1.08, H, 3, c — Driveway, Granular (by tons)
Excavation and preparation of subgrade.

Section 7040 - Pavement Rehabilitation

7040, 1.08, A, 3 — Full Depth Patches
Sawing, removing, and disposing of existing pavement and reinforcing; restoring the subgrade; furnishing and installing tie bars and dowel bars; furnishing and placing the patch material, including the asphalt binder and tack coat; forming and constructing integral curb; surface curing and pavement protection; joint sawing and filling; and placing backfill and restoring disturbed surfaces.

7040, 1.08, B, 3 — Subbase Over-excavation
Removal of existing subbase or subgrade, disposal of materials removed, furnishing and placing subbase material, and any additional excavation required for subbase placement.

7040, 1.08, C, 3 — Partial Depth Patches
Sawing, removing, and disposing of existing pavement; furnishing tack coat or bonding agent; furnishing and placing the patch material; curing; joint filling (PCC patches only); placing backfill; and restoring disturbed surfaces.

7040, 1.08, D, 3 — Crack and Joint Cleaning and Filling, Hot Pour
Furnishing crack and joint filler material and routing, sawing, cleaning, and filling joints or cracks.

7040, 1.08, E, 1, c — Crack Cleaning and Filling, Emulsion
Furnishing emulsified crack filler material, cleaning cracks, placing soil sterilant, and filling cracks.

7040, 1.08, E, 2, c — Asphalt for Crack Filling
Cleaning, applying tack coat, and furnishing and placing asphalt for crack filling.

7040, 1.08, F, 3 — Diamond Grinding
Diamond grinding pavement, testing for smoothness according to the contract documents, and removal of slurry and residue from the project site.

7040, 1.08, G, 3 — Milling
Milling pavement; furnishing water; and salvaging, stockpiling, and removing cuttings and debris.

7040, 1.08, H, 3 — Pavement Removal
Sawing, breaking, removing, and disposing of existing pavement and reinforcing steel.

7040, 1.08, I, 3 — Curb and Gutter Removal
Sawing, breaking, removing, and disposing of existing curb and gutter.

7040, 1.08, J, 3 — Dowel Bar Retrofit
Cutting the slots, preparing the slots, placing and grouting the bars, and curing the surface.

7040, 1.08, K — Core Hole Cutting and Replacement
Cutting the core hole, vacuum excavation, furnishing and placing backfill material and pavement, or replacing the pavement core using waterproof bonding material, if specified.

7040, 1.08, L — Required sampling and testing for pavement repair and rehabilitation work is incidental to other project costs and will not be paid for separately.

Section 7050 - Asphalt Stabilization

7050, 1.08, A, 3 — Asphalt Stabilization
Furnishing and spreading imported material, applying and incorporating asphalt stabilization, blending of the materials, grading and compacting the blended materials, and final clean up.

Section 7060 - Bituminous Seal Coat

7060, 1.08, A, 3 — Bituminous Seal Coat (by area)
Surface preparation including protection of street fixtures; furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts; and final clean up.

7060, 1.08, B, 1, c — Cover Aggregate
Surface preparation including protection of street fixtures; furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts; and final clean up.

7060, 1.08, B, 2, c — Binder Bitumen
Furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts; and final clean up.

Section 7070 - Emulsified Asphalt Slurry Seal

7070, 1.08, A, 3 — Emulsified Asphalt Slurry Seal (by area)
Surface preparation and furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts.

7070, 1.08, B, 1, c — Aggregate
Surface preparation and furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts.

7070, 1.08, B, 2, c — Asphalt Emulsion
Surface preparation and furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts.

Section 7080 - Permeable Interlocking Pavers

7080, 1.08, B, 3 — Engineering Fabric
Placing and securing filter fabric and any overlapped areas.

7080, 1.08, C, 3 — Underdrain
Furnishing and placing pipe, cleanouts, observation wells, and pipe fittings.

7080, 1.08, D, 3 — Storage Aggregate
Furnishing, hauling, placing, and compacting storage aggregate.

7080, 1.08, E, 3 — Filter Aggregate
Furnishing, hauling, placing filter, and compacting aggregate.

7080, 1.08, F, 3 — Permeable Interlocking Pavers
Testing, furnishing and placing bedding course, furnishing and installing permeable interlocking pavers, furnishing and placing joint/opening fill material, refilling joint after 6 months, and pavement protection.

7080, 1.08, G, 3 — PCC Edge Restraint
Final trimming of subgrade or subbase, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, and boxouts for fixtures.

Section 7090 - Cold-in-Place Pavement Recycling

7090, 1.08, A, 3 — Cold-in-Place Recycling
Milling and sizing of existing asphalt layers; protecting street fixtures; development of a job mix formula; adding and mixing recycling agents and additives, if required; supplying and incorporating water; compacting the reclaimed mix; shaping of the mix; completing secondary compaction, if required; removing any loose or excess material; and final clean up.

7090, 1.08, B, 3 — Bituminous Recycling Agents
Furnishing and placing of materials and mixing the agent into the recycled mix.

7090, 1.08, C, 3 — Chemical Recycling Additives
Furnishing and placing of materials and mixing the agent into the recycled mix.

Section 7091 - Full Depth Reclamation

7091, 1.08, A, 3 — Full Depth Reclamation
Pulverizing and sizing of existing asphalt layers; incorporating and mixing of existing underlying materials; protecting street fixtures; development of a job mix formula; adding and mixing stabilizing agents and additives, if required; compacting the reclaimed mix; shaping of the mix; removing any loose or excess material; curing; and final clean up.

7091, 1.08, B, 3 — Mechanical Stabilization Agents
Furnishing and placing of aggregate and blending of the aggregates.

7091, 1.08, C, 3 Bituminous Stabilization Agents
Furnishing and placing of materials and mixing the agent into the reclaimed mix.

7091, 1.08, D, 3 Chemical Stabilization Agents
Furnishing and placing of materials and mixing the agent into the reclaimed mix.

7091, 1.08, E, 3 Microcracking
Furnishing equipment, protecting street fixtures, completing microcracking, and curing.

7091, 1.08, F, 3 Interlayer for Cement Stabilized Base
Surface cleaning, furnishing, and placing of the interlayer (if specified).

Section 7092 - Crack and Seat Existing PCC Pavement

7092, 1.08, A, 3 Crack and Seat of PCC Pavement
Notifying adjacent properties, providing traffic control and no parking signs; vibration monitoring if specified; cracking and seating of the designated PCC pavement to the specified pattern; watering to verify crack pattern; protecting existing fixtures; cleaning of slab prior to overlay; and final project site cleanup.

7092, 1.08, B, 3 Remove and Replace Curb and Gutter
Full depth sawing; removing and disposing removed materials; furnishing and compacting subgrade material to bring to the proper elevation; all form work required; concrete; placing new curb and gutter; and final cleanup and backfill placement behind the new curb.

7092, 1.08, C, 3 Full Depth Saw Cut
Providing a concrete saw or other cutting device that will result in a full depth vertical edge and severing all tie or reinforcing steel.

7092, 1.08, G, 3 Intake Adjustment, Major
Sawing all three sides of the boxout; removing and replacing the boxout; furnishing and installing a new grate assembly or, if specified, removing and re-setting the existing grate assembly; removing existing open-throat intake grate; adjusting intake walls; furnishing and installing new intake grate or, if specified, re-setting existing intake grate; and furnishing, placing, and compacting backfill.

7092, 1.08, H, 3 Joint Control Fabric
Cleaning and preparing the surface, furnishing, placing, and adhering joint control fabric prior to placing surface lift.

7092, 1.08, I, 3 Partial Depth Patch Removal
Provide equipment and removing all designated partial depth patches down to the base PCC, cleaning of the former patch area; and disposal of the patch material.

7092, 1.08, J, 3 Rock Interlayer
Furnishing and placing the rock interlayer to the thickness specified.

Section 8010 - Traffic Signals

8010, 1.08, A, 3 — Traffic Signal
Furnishing and installing all pole foundations, poles, wiring, conduit, heads, signs, detection equipment, traffic signal control equipment (including pedestrian equipment), traffic signal controller and cabinet, and associated appurtenances for a complete, fully operation installation.

8010, 1.08, B, 3 — Temporary Traffic Signal
Furnishing, installing, maintaining, and removing poles; wiring; traffic signal control equipment including pedestrian equipment if specified; implement all modifications of signal timing, signal placement and display due to Contractor initiated changes in the construction staging plan established by the Contracting Authority; relocation of trailer mounted temporary traffic signal systems; placement in another physical location to address changes in construction staging; and all appurtenances.

8010, 1.08, C, 3 — Traffic Signal Removal
Removal of poles, concrete pads, foundations, wiring, traffic signal cabinet and equipment, pedestrian signal equipment, and handholes; delivery of removed materials to the location specified in the contract documents; furnishing, placing, and compacting backfill in all excavations; and restoring disturbed surfaces.

Section 8020 - Pavement Markings

8020, 1.08, B, 3 — Painted Pavement Markings, Solvent/Waterborne
Reflectorizing spheres, layout, surface preparation, and application of marking paint.

8020, 1.08, C, 3 — Painted Pavement Markings, Durable
Layout, surface preparation, and application of marking paint.

8020, 1.08, D, 3 — Painted Pavement Markings, High-Build
Layout, surface preparation, and application of marking paint.

8020, 1.08, E, 3 — Permanent Tape Markings
Layout, surface preparation, and application of marking tape.

8020, 1.08, F, 3 — Wet, Retroreflective Removable Tape Markings
Layout, surface preparation, application, and removal.

8020, 1.08, G, 3 — Painted Symbols and Legends
Layout, surface preparation, and application of each symbol and legend.

8020, 1.08, H, 3 — Precut Symbols and Legends
Layout, surface preparation, and application of each symbol and legend.

8020, 1.08, I, 3 — Temporary Delineators
Installation and removal of delineators.

8020, 1.08, J, 3 — Raised Pavement Markers
Installation and removal of pavement markers.

8020, 1.08, K, 3 Pavement Markings Removed
Pavement marking removal and waste material collection, removal, and disposal.

8020, 1.08, L, 3 Symbols and Legends Removed
Symbol and legend marking removal and waste material collection, removal, and disposal.

8020, 1.08, M, 3 Grooves Cut for Pavement Markings
Layout, cutting grooves, collection and disposal of removed material, and additional groove width and transition length beyond the pavement marking dimensions.

8020, 1.08, N, 3 Grooves Cut for Symbols and Legends
Layout, cutting grooves, and collection and disposal of removed material.

Section 8030 - Temporary Traffic Control

8030, 1.08, A, 3 Temporary Traffic Control
Installation, maintenance, and removal of temporary traffic control; total roadway closures with installation and removal of detour signing as shown in the contract documents; removal and reinstallation or covering of permanent traffic control devices that conflict with the temporary traffic control plan; monitoring and documenting traffic control conditions; and flaggers. When required in the contract documents, the following are also included in traffic control unless a separate bid item is provided: portable dynamic message signs, temporary barrier rail, temporary flood lighting, and pilot cars.

Section 8040 - Traffic Signs and Posts

8040, 1.08, A, 3 Traffic Signs (by each)
The sign blank, application of reflective sheeting, application of screened message, all mounting hardware, and erecting the sign according to the traffic control technician's direction.

8040, 1.08, B, 3 Traffic Signs (by area)
The sign blank, application of reflective sheeting, application of screened message, all mounting hardware, and erecting the sign according to the traffic control technician's direction.

8040, 1.08, C, 3 Wood Posts
Furnishing and erecting the post, including treatment and other details necessary to provide a complete installation.

8040, 1.08, D, 3 Perforated Square Steel Tube Posts
Fabricating, furnishing, and erecting the post and other details required to provide a complete installation.

8040, 1.08, E, 3 U-Shaped Rail Steel Posts
Fabricating, furnishing, and erecting the post and other details required to provide a complete installation.

8040, 1.08, F, 3 — Round Steel Posts
Fabricating, furnishing, and erecting the post and other details required to provide a complete installation.

8040, 1.08, G, 3 — Perforated Square Steel Tube Post Anchors
Furnishing and installing the anchor, coring pavement and filling with concrete, if required, slip base hardware, and other details necessary to provide a complete installation.

8040, 1.08, H, 3 — Round Steel Post Anchors
Furnishing and installing the anchor, coring pavement and filling with concrete, if required, slip base hardware, and other details necessary to provide a complete installation.

8040, 1.08, I, 3 — Remove and Reinstall Traffic Signs
Removing the sign and post, filling the post hole, storing and maintaining the sign and post in good condition, and reinstalling the sign and post. Replacing signs and posts designated for reinstallation that have been damaged is the Contractor's responsibility.

8040, 1.08, J, 3 — Remove and Salvage Traffic Sign Assembly
Removing the sign assembly, removing the post and anchor hardware, filling the post hole, and delivering the traffic sign and post to the site designated by the Contracting Authority. Replacing signs and posts designated for salvage that have been damaged is the Contractor's responsibility.

Section 9010 - Seeding

9010, 1.08, A, 1, c — Conventional Seeding, Seeding
Removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

9010, 1.08, A, 2, c — Conventional Seeding, Fertilizing
Furnishing, applying, and incorporating fertilizer to the area to be seeded.

9010, 1.08, A, 3, c — Conventional Seeding, Mulching
Furnishing, applying, and incorporating mulch to the area to be seeded.

9010, 1.08, B, 3 — Hydraulic Seeding, Seeding, Fertilizing, and Mulching
Removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

9010, 1.08, C, 3 — Pneumatic Seeding, Seeding, Fertilizing, and Mulching
Removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

9010, 1.08, D, 3 Watering
Water, pumps, meters, equipment, water tanker/container, transportation, hoses, and sprinklers.

9010, 1.08, E, 3 Warranty
All work required to correct any defects in the original placement of the seeding for the period of time designated.

Section 9020 - Sodding

9020, 1.08, A, 3 Sod
Preparation of sod and sodbed, stakes, fertilizing, watering, maintenance, and clean-up. Also includes any necessary sod replacements during maintenance period.

Section 9030 - Plant Material and Planting

9030, 1.08, A, 3 Plants (by count)
Delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

9030, 1.08, B, 3 Plants (by count), With Warranty
Delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty periods; and replacements.

9030, 1.08, C, 3 Plants (by lump sum)
Delivery, excavation, installation, watering, placing backfill material, mulching, wrapping, staking or guying, herbicide, maintenance during the establishment period, and replacements.

9030, 1.08, D, 3 Plants (by lump sum), With Warranty
Delivery, excavation, installation, watering, placing backfill material, mulching, wrapping, staking or guying, herbicide, maintenance during the establishment and warranty period, and replacements.

9030, 1.08, E, 3 Tree Drainage Wells
Excavation, furnishing and placing rock, engineering fabric, and placing backfill material.

Section 9040 - Erosion and Sediment Control

9040, 1.07, C When applicable, conduct all operations in compliance with the Iowa DNR NPDES General Permit No. 2. Labor, equipment, or materials not included as a bid item, but necessary to prevent stormwater contamination from construction related sources, are considered incidental. Incidental work related to compliance with the permit may include, but is not limited to: hazardous materials protection, fuel containment, waste disposal, and providing employee sanitary facilities.

9040, 1.08, A, 1, c	SWPPP Preparation Development of a SWPPP by the Contractor meeting local and state agency requirements, filing the required public notices, filing a Notice of Intent for coverage of the project under the Iowa DNR NPDES General Permit No. 2, and payment of associated NPDES permit fees.
9040, 1.08, A, 2, c	SWPPP Management All work required to comply with the administrative provisions of the Iowa DNR NPDES General Permit No. 2; including record keeping, documentation, updating the SWPPP, filing the Notice of Discontinuation, etc. Item also includes weekly inspections required to satisfy the provisions of General Permit No. 2, unless otherwise specified in the contract documents.
9040, 1.08, B, 3	Compost Blanket Furnishing and spreading compost over the designated area.
9040, 1.08, C, 3	Filter Berm Furnishing material and constructing the filter berm, including vegetation if specified.
9040, 1.08, D, 1, c	Filter Sock Anchoring stakes.
9040, 1.08, D, 2, c	Filter Sock, Removal Restoration of the area to finished grade and off-site disposal of filter socks and accumulated sediment.
9040, 1.08, E, 3	Temporary RECP Excavation, staples, anchoring devices, and material for anchoring slots.
9040, 1.08, F, 1, c	Wattle Anchoring stakes.
9040, 1.08, F, 2, c	Wattle, Removal Restoration of the area to finished grade and off-site disposal of wattle and accumulated sediment.
9040, 1.08, G, 1, c	Check Dam, Rock Engineering fabric.
9040, 1.08, G, 2, a, 3)	Check Dam, Manufactured, Installation Anchoring stakes.
9040, 1.08, G, 2, b, 3)	Check Dam, Manufactured, Removal Restoration of the area to finished grade and off-site disposal of manufactured check dam and accumulated sediment.
9040, 1.08, H, 3	Temporary Earth Diversion Structure Removal of the structure upon completion of the project.
9040, 1.08, I, 3	Level Spreader Maintaining the spreader during the period of construction and removal upon completion of the project, unless otherwise specified in the contract documents.

9040, 1.08, J, 3	Rip Rap Engineering fabric.
9040, 1.08, K, 3	Temporary Pipe Slope Drain Excavation, furnishing and installing pipe and pipe aprons, grading, and removal of the slope drain upon completion of the project.
9040, 1.08, L, 1, c	Sediment Basin, Outlet Structure Concrete base, dewatering device, anti-vortex device, outlet pipe, and anti-seep collars (if specified).
9040, 1.08, L, 2, c	Sediment Basin, Removal of Sediment Dewatering and removal and off-site disposal of accumulated sediment.
9040, 1.08, L, 3, c	Sediment Basin, Removal of Outlet Structure Dewatering and off-site disposal of the outlet structure, concrete base, emergency spillway, and accumulated sediment.
9040, 1.08, M, 1, c	Sediment Trap Outlet Engineering fabric.
9040, 1.08, M, 2, c	Sediment Trap Outlet, Removal of Sediment Dewatering and removal and off-site disposal of accumulated sediment.
9040, 1.08, M, 3, c	Sediment Trap Outlet, Removal of Device Dewatering and off-site disposal of sediment trap outlet and accumulated sediment.
9040, 1.08, N, 1, c	Silt Fence or Silt Fence Ditch Check Anchoring posts.
9040, 1.08, N, 2, c	Silt Fence or Silt Fence Ditch Check, Removal of Sediment Anchoring posts.
9040, 1.08, N, 3, c	Silt Fence or Silt Fence Ditch Check, Removal of Device Restoration of the area to finished grade and off-site disposal of fence, posts, and accumulated sediment.
9040, 1.08, O, 1, c	Stabilized Construction Entrance (by Square Yard) Subgrade stabilization fabric.
9040, 1.08, O, 2, c	Stabilized Construction Entrance (by Ton) Subgrade stabilization fabric.
9040, 1.08, P, 1, c	Dust Control, Water Furnishing, transporting, and distributing water to the haul road.
9040, 1.08, P, 2, c	Dust Control Product Furnishing and incorporating the dust control product to the haul road.
9040, 1.08, Q, 1, c	Erosion Control Mulching, Conventional Furnishing and incorporating mulch in the area designated in the contract documents.

9040, 1.08, Q, 2, c — Erosion Control Mulching, Hydromulching
Furnishing mulch and tackifier (if applicable), providing equipment specific to hydromulching, and applying the mulch to the specified area.

9040, 1.08, R, 3 — Turf Reinforcement Mats
Excavation, staples, anchoring devices, and material for anchoring slots.

9040, 1.08, S, 3 — Surface Roughening
Providing equipment to complete directional tracking or grooving/furrowing and completing surface roughening of slopes specified in the contract documents.

9040, 1.08, T, 1, c — Inlet Protection Device
Removal of the device upon completion of the project.

9040, 1.08, T, 2, c — Inlet Protection Device, Maintenance
Removal and off-site disposal of accumulated sediment.

9040, 1.08, U, 3 — Flow Transition Mat
Anchoring devices.

9040, 1.08, V, 3 — End of Season Temporary Erosion Control
Furnishing, placing, and maintaining the end of season temporary erosion control throughout the winter season.

Section 9050 - Gabions and Revet Mattresses

9050, 1.08, A, 3 — Gabions
Furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing gabion stone, engineering fabric, and anchor stakes.

9050, 1.08, B, 3 — Revet Mattresses
Furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing mattress stone, engineering fabric, and anchor stakes.

Section 9060 - Chain Link Fence

9060, 1.08, A, 3 — Chain Link Fence
Posts, fabric, rails, braces, truss rods, ties, tension wire, tension bands, tension bars, grounds, fittings, PVC coating (if specified in the contract documents), excavation of post holes, and concrete encasement of posts.

9060, 1.08, B, 3 — Gates
Gate rails, fabric, stretcher bars, braces, vertical stay, hinges, latches, keepers, drop bar lock, center gate stop, and barbed wire (if specified).

9060, 1.08, C, 3 — Barbed Wire
Furnishing and installing all necessary strands of barbed wire, anchors, and barbed wire supporting arms.

9060, 1.08, D, 3 Removal and Reinstallation of Existing Fence
Removing vegetation; removing all fence fabric, appurtenances, posts, and gates; removal of concrete encasement from posts; storage of the removed fencing materials to prevent damage; reinstallation of the posts, gates, and fabric, including all appurtenances; and replacement of any fence parts that are not able to be salvaged and reinstalled. Replace items damaged from Contractor's operations with new materials, at no additional cost to the Contracting Authority.

9060, 1.08, E, 3 Removal of Fence
Off-site disposal of fence (including posts, concrete encasement of posts, gates, grounds, and barbed wire) and placing and compacting backfill material in post holes.

9060, 1.08, F, 3 Temporary Fence
Furnishing, installing, and removing posts, fabric, ties, and fittings.

Section 9070 - Landscape Retaining Walls

9070, 1.08, A, 3 Modular Block Retaining Wall
Excavation, foundation preparation, furnishing and placing wall units, geogrid (if necessary), leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, granular backfill material, suitable backfill material, and shoring as necessary.

9070, 1.08, B, 3 Limestone Retaining Wall
Excavation, foundation preparation, furnishing and placing leveling pad, limestone, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

9070, 1.08, C, 3 Landscape Timbers
Excavation, foundation preparation, furnishing and placing leveling pad, landscape timbers, spikes, reinforcing bar, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

Section 9071 - Segmental Block Retaining Walls

9071, 1.08, A, 3 Segmented Block Retaining Wall
Design by a Licensed Professional Engineer in the State of Iowa, excavation, foundation preparation, furnishing and placing wall units, geogrid, leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

9071, 1.08, C, 3 Granular Backfill Material
Furnishing, transporting, placing, and compacting material.

Section 9072 - Combined Concrete Sidewalk and Retaining Walls

9072, 1.08, A, 3 Combined Concrete Sidewalk and Retaining Wall
Excavation; foundation preparation; furnishing and placing concrete and reinforcing steel; joint material; subdrain; porous backfill material; suitable backfill material; finishing disturbed areas; and shoring as necessary.

Section 9080 - Concrete Steps, Handrails, and Safety Rail

9080, 1.08, A, 3 — Concrete Steps
Reinforcement, expansion joint material, and preparation of subgrade.

9080, 1.08, B, 3 — Handrail
Posts, mounting hardware or concrete grout, and finishing (painted, galvanized, or powder coated).

9080, 1.08, C, 3 — Safety Rail
Posts, pickets, mounting hardware, epoxy grout, and finishing (painted, galvanized, or powder coated).

Section 10,010 - Demolition

10,010, 1.08, A, 3 — Demolition Work
Removal of trees, brush, vegetation, buildings, building materials, contents of buildings, appliances, trash, rubbish, basement walls, foundations, sidewalks, steps, and driveways from the site; disconnection of utilities; furnishing and compaction of backfill material; furnishing and placing topsoil; finish grading of disturbed areas; placing and removing safety fencing; removal of fuel and septic tanks and cisterns; seeding; and payment of any permit or disposal fees.

10,010, 1.08, B, 3 — Plug or Abandon Well
Obtaining all permits; plug or abandon private wells according to local, state, and federal regulations.

Section 11,010 - Construction Survey

11,010, 1.08, A, 3 — Construction Survey
The costs of resetting project control points, re-staking, and any additional staking requested beyond the requirements of this section.

11,010, 1.08, B, 3 — Monument Preservation and Replacement
Property research and documentation, locating monuments prior to construction, replacement of disturbed monuments, and preparation and filing of the monument preservation certificate.

Section 11,020 - Mobilization

11,020, 1.07, B — When the proposal form does not include a bid item for mobilization, all costs incurred by the contractor for mobilization are incidental to other work and no separate payment will be made.

11,020, 1.08, A, 3 — Mobilization
The movement of personnel, equipment, and supplies to the project site; the establishment of offices, buildings, and other facilities necessary for the project; and bonding, permits, and other expenses incurred prior to construction.

Section 11,030 - Temporary Services During Construction

11,030, 1.08, A, 3 Maintenance of Postal Service
Coordinating with USPS and erecting and maintaining temporary mailboxes.

11,030, 1.08, B, 3 Maintenance of Solid Waste Collection
Coordinating and maintaining solid waste collection services including establishing alternate collection sites if required.

Section 11,040 - Temporary Sidewalk Access

11,040, 1.08, A, 3 Temporary Pedestrian Residential Access
Supplying and placing granular material, continuous maintenance of granular surface, removal of temporary granular sidewalk, and restoring disturbed surfaces to a condition equal to that which existed prior to construction.

11,040, 1.08, B, 3 Temporary Granular Sidewalk
Excavation, grading, timber edging, supplying and placing granular material, continuous maintenance of granular surface, removal of temporary granular sidewalk, and restoring disturbed surfaces to a condition equal to that which existed prior to construction.

11,040, 1.08, C, 3 Temporary Longitudinal Channelizing Device
Construction, placement, maintenance, and removal of the device.

Section 11,050 - Concrete Washout

11,050, 1.08, A, 3 Concrete Washout
Providing concrete washwater containment, collection, and disposal.

Bid Items

Below is a list of units of measurements/payment and the abbreviations used in the bid item list.

UNITS	Units of Measurement/Payment	UNITS	Units of Measurement/Payment
ACRE	Acres	SF	Square Feet
CY	Cubic Yards	SQ	Squares
EACH	Each	STA	Stations
LB	Pounds	SY	Square Yards
LF	Linear Feet	TON	Tons
LS	Lump Sum	UNIT	Units
MGAL	1,000 Gallons		

A. Standard Bid Items

The following is a list of suggested standard bid items based on the SUDAS Specifications. The four digits first mentioned in the item number below reference the SUDAS Specifications Section; measurement and payment descriptions are included in subsection 1.08. Please note, some of the items below require additional information, such as type, size, width, thickness, etc.

Item No.	Item Description	Unit
Section 2010 - Earthwork, Subgrade, and Subbase		
2010-A	Clearing and Grubbing	UNIT
2010-B	Clearing and Grubbing	ACRE
2010-C	Clearing and Grubbing	LS
2010-D-1	Topsoil, On-site	CY
2010-D-2	Topsoil, Compost-amended	CY
2010-D-3	Topsoil, Off-site	CY
2010-E	Excavation, Class 10, Class 12, or Class 13	CY
2010-G	Subgrade Preparation	SY
2010-H	Granular Stabilization	TON
2010-I	Subgrade Treatment, ____ (Type)	SY
2010-J	Subbase, ____ (Type), ____ (Thickness)	SY
2010-K-1	Removal of Structure, ____ (Type)	EA
2010-K-2-a	Removal of Known Box Culvert, ____ (Type), ____ (Size)	LF
2010-K-2-c	Removal of Known Pipe Culvert, ____ (Type), ____ (Size)	LF
2010-K-3-a	Removal of Known Pipe and Conduit, ____ (Type), ____ (Size)	LF
2010-L-1	Filling and Plugging of Known Pipe Culverts, Pipes, and Conduits, ____ (Type), ____ (Size)	LF
2010-M	Compaction Testing	LS

Item No.	Item Description	Unit
Section 3010 - Trench Excavation and Backfill		
3010-B	Rock Excavation	CY
3010-C	Trench Foundation	TON
3010-D	Replacement of Unsuitable Backfill Material	CY
3010-E	Special Pipe Embedment or Encasement, ____ (Type)	LF
3010-F	Trench Compaction Testing	LS
Section 4010 - Sanitary Sewers		
4010-A-1	Sanitary Sewer Gravity Main, Trenched, ____ (Type), ____ (Size)	LF
4010-A-2	Sanitary Sewer Gravity Main, Trenchless, ____ (Type), ____ (Size)	LF
4010-B-1	Sanitary Sewer Gravity Main with Casing Pipe, Trenched, ___ (Type), ___ (Size)	LF
4010-B-2	Sanitary Sewer Gravity Main with Casing Pipe, Trenchless, ___ (Type), ___ (Size)	LF
4010-C-1	Sanitary Sewer Force Main, Trenched, ____ (Type), ____ (Size)	LF
4010-C-2	Sanitary Sewer Force Main, Trenchless, ____ (Type), ____ (Size)	LF
4010-D-1	Sanitary Sewer Force Main with Casing Pipe, Trenched, ____ (Type), ____ (Size)	LF
4010-D-2	Sanitary Sewer Force Main with Casing Pipe, Trenchless, ____ (Type), ____ (Size)	LF
4010-E	Sanitary Sewer Service Stub, ____ (Type), ____ (Size)	LF
4010-F	Sanitary Sewer Service Relocation	EA
4010-G	Sewage Air Release Valve and Pit	EA
4010-H	Removal of Sanitary Sewer, ____ (Type), ____ (Size)	LF
4010-I	Sanitary Sewer Cleanout, ____ (Size)	EA
4010-K	Sanitary Sewer Abandonment, Plug, ____ (Size)	EA
4010-L	Sanitary Sewer Abandonment, Fill and Plug, ____ (Size)	LF
Section 4020 - Storm Sewers		
4020-A-1	Storm Sewer, Trenched, ____ (Type), ____ (Size)	LF
4020-A-2	Storm Sewer, Trenchless, ____ (Type), ____ (Size)	LF
4020-B-1	Storm Sewer with Casing Pipe, Trenched, ____ (Type), ____ (Size)	LF
4020-B-2	Storm Sewer with Casing Pipe, Trenchless, ____ (Type), ____ (Size)	LF
4020-C	Linear Trench Drain	LF
4020-D	Removal of Storm Sewer, ____ (Type), ____ (Size)	LF
4020-F	Storm Sewer Abandonment, Plug, ____ (Size)	EA
4020-G	Storm Sewer Abandonment, Fill and Plug, ____ (Size)	LF
Section 4030 - Pipe Culverts		
4030-A-1	Pipe Culvert, Trenched, ____ (Type), ____ (Size)	LF
4030-A-2	Pipe Culvert, Trenchless, ____ (Type), ____ (Size)	LF
4030-B	Pipe Apron, ____ (Type), ____ (Size)	EA
4030-C	Footing for Concrete Pipe Apron, ____ (Type), ____ (Size)	EA
4030-D	Pipe Apron Guard, ____ (Type), ____ (Size)	EA
Section 4040 - Subdrains and Footing Drain Collectors		
4040-A	Subdrain, ____ (Type), ____ (Size)	LF
4040-B	Footing Drain Collector, ____ (Type), ____ (Size)	LF
4040-C-1	Subdrain Cleanout, ____ (Type), ____ (Size)	EA

Item No.	Item Description	Unit
4040-C-2	Footing Drain Cleanout, ____ (Type), ____ (Size)	EA
4040-D-1	Subdrain Outlets and Connections, ____ (Type), ____ (Size)	EA
4040-D-2	Footing Drain Outlets and Connections, ____ (Type), ____ (Size)	EA
4040-E	Storm Sewer Service Stub, ____ (Type), ____ (Size)	LF
Section 4050 - Pipe Rehabilitation		
4050-A-1	Pre-Rehabilitation Cleaning and Inspection, ____ (Size)	LF
4050-A-2	Additional Sewer Cleaning	HOUR
4050-B	Remove Protruding Service Connections	EA
4050-C-1	CIPP Main Lining, ____ (Size)	LF
4050-C-2	Building Sanitary Sewer Service Reinstatement	EA
4050-C-3	CIPP End Seal, ____ (Size)	EA
4050-D	CIPP Point Repair, ____ (Size)	EA
4050-E-1	CIPP Service Pipe, Connection, ____ (Size)	EA
4050-E-2	CIPP Service Repair, Partial Pipe, ____ (Size)	EA
4050-F-1	Pressure Testing of Mainline Sewer Joints, ____ (Size)	EA
4050-F-2	Injection Grouting of Mainline Sewer Joints, ____ (Size)	EA
4050-F-3	Pressure Testing of Service Connections, ____ (Size)	EA
4050-F-4	Injection Grouting of Service Connections, ____ (Size)	EA
4050-F-5	Chemical Grout	GAL
4050-G-3	Bypass Pumping	LS
4050-H-1	Spot Repairs by Pipe Replacement, ____ (Type), ____ (Size)	EA
4050-H-2	Spot Repairs by Pipe Replacement, ____ (Type), ____ (Size)	LF
Section 5010 - Pipe and Fittings		
5010-A-1	Water Main, Trenched, ____ (Type), ____ (Size)	LF
5010-A-2	Water Main, Trenchless, ____ (Type), ____ (Size)	LF
5010-B-1	Water Main with Casing Pipe, Trenched, ____ (Type), ____ (Size)	LF
5010-B-2	Water Main with Casing Pipe, Trenchless, ____ (Type), ____ (Size)	LF
5010-C-1	Fitting, ____ (Type), ____ (Size)	EA
5010-C-2	Fitting, ____ (Type), ____ (Size)	LB
5010-D	Water Service Stub, ____ (Type), ____ (Size)	EA
5010-E-1	Water Service Pipe, ____ (Type), ____ (Size)	LF
5010-E-2	Water Service Corporation, ____ (Type), ____ (Size)	EA
5010-E-3	Water Service Curb Stop and Box, ____ (Type), ____ (Size)	EA
5010-F	Water Main Abandonment, Cap, ____ (Size)	EA
5010-G	Water Main Abandonment, Fill and Plug, ____ (Size)	LF
5010-H	Water Main Removal, ____ (Size)	LF
Section 5011 - Fusible PVC and HDPE Pipe		
5011-A-1	Fusible Water Main, Trenched, ____ (Type), ____ (Size)	LF
5011-A-2	Fusible Water Main, Trenchless, ____ (Type), ____ (Size)	LF
5011-B-1	Water Main with Casing Pipe, Trenched, ____ (Type), ____ (Size)	LF
5011-B-2	Water Main with Casing Pipe, Trenchless, ____ (Type), ____ (Size)	LF

Item No.	Item Description	Unit
Section 5020 - Valves, Fire Hydrants, and Appurtenances		
5020-A	Valve, ____ (Type), ____ (Size)	EA
5020-B	Tapping Valve Assembly, ____ (Size)	EA
5020-C	Fire Hydrant Assembly	EA
5020-D	Alternate Fire Hydrant Assembly	EA
5020-E	Flushing Device (Blowoff), ____ (Size)	EA
5020-G	Valve Box Extension	EA
5020-H	Valve Box Replacement	EA
5020-I	Fire Hydrant Adjustment	EA
5020-J	Fire Hydrant Assembly Removal	EA
5020-K	Valve Removal	EA
5020-L	Valve Box Removal	EA
Section 6010 - Structures for Sanitary and Storm Sewers		
6010-A	Manhole, ____ (Type), ____ (Size)	EA
6010-B	Intake, ____ (Type), ____ (Size)	EA
6010-C-1	Internal Drop Connection, ____ (Size)	EA
6010-C-2	External Drop Connection, ____ (Size)	EA
6010-D	Casting Extension Ring	EA
6010-E-1	Manhole Adjustment, Minor	EA
6010-E-2	Intake Adjustment, Minor	EA
6010-F-1	Manhole Adjustment, Major	EA
6010-F-2	Intake Adjustment, Major	EA
6010-G-1	Connection to Existing Manhole	EA
6010-G-2	Connection to Existing Intake	EA
6010-H-1	Remove Manhole	EA
6010-H-2	Remove Intake	EA
Section 6020 - Rehabilitation of Existing Manholes		
6020-A-1	Rubber Chimney Seal	EA
6020-A-2	Molded Shield	EA
6020-A-3	Urethane Chimney Seal	EA
6020-B	In-situ Manhole Replacement, Cast-in-place Concrete	VF
6020-C	In-situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner	VF
6020-D	Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal	VF
Section 7010 - Portland Cement Concrete Pavement		
7010-A	Pavement, PCC, ____ (Thickness), ____ (Mix Type)	SY
7010-E	Curb and Gutter, ____ (Width), ____ (Thickness)	LF
7010-F	Beam Curb	LF
7010-G	Concrete Median	SY
7010-H	PCC Railroad Crossing Approach	SY
7010-I	PCC Pavement Samples and Testing	LS
7010-K	PCC Pavement Widening, ____ (Thickness)	SY

Item No.	Item Description	Unit
Section 7011 - Portland Cement Concrete Overlays		
7011-A-1	PCC Overlay, Furnish Only	CY
7011-A-2	PCC Overlay, Place Only	SY
7011-A-3	Surface Preparation for Bonded PCC Overlay	SY
7011-A-4	Surface Preparation for Unbonded PCC Overlay	SY
7011-A-5	Asphalt Separation Layer for Unbonded PCC Overlay	SY
7011-A-6	Geotextile Fabric Separation Layer for Unbonded PCC Overlay	SY
7011-A-7	Liquid Curing Compound Separation Layer on PCC Surface Patches for Unbonded PCC Overlay	SY
Section 7020 - Asphalt Pavement		
7020-A	Pavement, Asphalt, ____ (Layer), ____ (Aggregate Size), ____ (Binder Grade), ____ (Mix Design Level)	TON
7020-B	Pavement, Asphalt, ____ (Thickness), ____ (Layer), ____ (Aggregate Size), ____ (Binder Grade), ____ (Mix Design Level)	SY
7020-C	Asphalt Base Widening, ____ (Layer), ____ (Aggregate Size), ____ (Binder Grade), ____ (Mix Design Level)	TON
7020-D	Asphalt Base Widening, ____ (Thickness), ____ (Layer), ____ (Aggregate Size), ____ (Binder Grade), ____ (Mix Design Level)	SY
7020-E	Asphalt Railroad Crossing Approach	SY
7020-I	Asphalt Pavement Samples and Testing	LS
Section 7021 - Asphalt Overlays		
7021-A	Asphalt Overlay, ____ (Layer), ____ (Aggregate Size), ____ (Binder Grade), ____ (Mix Design Level)	TON
7021-B	Asphalt Overlay, ____ (Thickness), ____ (Layer), ____ (Aggregate Size), ____ (Binder Grade), ____ (Mix Design Level)	SY
Section 7030 - Sidewalks, Shared Use Paths, and Driveways		
7030-A-1	Removal of Sidewalk	SY
7030-A-2	Removal of Shared Use Path	SY
7030-A-3	Removal of Driveway	SY
7030-B	Removal of Curb	LF
7030-C	Shared Use Path, ____ (Type), ____ (Thickness)	SY
7030-D	Special Subgrade Preparation for Shared Use Path	SY
7030-E	Sidewalk, PCC, ____ (Thickness)	SY
7030-F	Brick/Paver Sidewalk with Pavement Base	SY
7030-G	Detectable Warnings	SF
7030-H-1	Driveway, Paved, ____ (Type), ____ (Thickness)	SY
7030-H-2	Driveway, Granular, ____ (Thickness)	SY
7030-H-3	Driveway, Granular, ____ (Thickness)	TON
7030-I-1	Sidewalk Assurance Testing	LS
7030-I-2	Shared Use Path Assurance Testing	LS
7030-I-3	Driveway Assurance Testing	LS
Section 7040 - Pavement Rehabilitation		
7040-A	Full Depth Patches, ____ (Type), ____ (Thickness)	SY
7040-B	Subbase Over-excavation	TON
7040-C	Partial Depth Patches, ____ (Type)	SF

Item No.	Item Description	Unit
7040-D	Crack and Joint Cleaning and Filling, Hot Pour	LF
7040-E-1	Crack Cleaning and Filling, Emulsion	LF
7040-E-2	Asphalt for Crack Filling	TON
7040-F	Diamond Grinding	SY
7040-G	Milling	SY
7040-H	Pavement Removal	SY
7040-I	Curb and Gutter Removal	LF
7040-J	Dowel Bar Retrofit, ____ (Size)	EA
7040-K	Core Hole Cutting and Replacement	EA
Section 7050 - Asphalt Stabilization		
7050-A	Asphalt Stabilization	SY
Section 7060 - Bituminous Seal Coat		
7060-A	Bituminous Seal Coat	SY
7060-B-1	Cover Aggregate	TON
7060-B-2	Binder Bitumen	GAL
Section 7070 - Emulsified Asphalt Slurry Seal		
7070-A	Emulsified Asphalt Slurry Seal	SY
7070-B-1	Aggregate	TON
7070-B-2	Asphalt Emulsion	GAL
Section 7080 - Permeable Interlocking Pavers		
7080-B	Engineering Fabric	SY
7080-C	Underdrain, ____ (Type), ____ (Size)	LF
7080-D	Storage Aggregate	TON
7080-E	Filter Aggregate	TON
7080-F	Permeable Interlocking Pavers, ____ (Type)	SY
7080-G	PCC Edge Restraint, ____ (Type), ____ (Size)	LF
Section 7090 - Cold-in-Place Pavement Recycling		
7090-A	Cold-in-Place Recycling	SY
7090-B	Bituminous Recycling Agents	GAL
7090-C	Chemical Recycling Additives	TON
Section 7091 - Full Depth Reclamation		
7091-A	Full Depth Reclamation	SY
7091-B	Mechanical Stabilization Agents	TON
7091-C	Bituminous Stabilization Agents	GAL
7091-D	Chemical Stabilization Agents	TON
7091-E	Microcracking	SY
7091-F	Interlayer for Cement Stabilized Base, ____ (Type), ____ (Thickness)	SY
Section 7092 - Crack and Seat Existing PCC Pavement		
7092-A	Crack and Seat of PCC Pavement	SY
7092-B	Remove and Replace Curb and Gutter, ____ (Type), ____ (Size)	LF
7092-C	Full Depth Saw Cut	LF
7092-G	Intake Adjustment, Major	EA

Item No.	Item Description	Unit
7092-H	Joint Control Fabric	LF
7092-I	Partial Depth Patch Removal	SF
7092-J	Rock Interlayer	TON
Section 8010 - Traffic Signals		
8010-A	Traffic Signal	LS
8010-B	Temporary Traffic Signal	LS
8010-C	Traffic Signal Removal	LS
Section 8020 - Pavement Markings		
8020-B	Painted Pavement Markings, Solvent/Waterborne	STA
8020-C	Painted Pavement Markings, Durable	STA
8020-D	Painted Pavement Markings, High-Build	STA
8020-E	Permanent Tape Markings	STA
8020-F	Wet, Retroreflective Removable Tape Markings	STA
8020-G	Painted Symbols and Legends, ____ (Type)	EA
8020-H	Precut Symbols and Legends, ____ (Type)	EA
8020-I	Temporary Delineators	EA
8020-J	Raised Pavement Markers	EA
8020-K	Pavement Markings Removed	STA
8020-L	Symbols and Legends Removed	EA
8020-M	Grooves Cut for Pavement Markings	STA
8020-N	Grooves Cut for Symbols and Legends	EA
Section 8030 - Temporary Traffic Control		
8030-A	Temporary Traffic Control	LS
Section 8040 - Traffic Signs and Posts		
8040-A	Traffic Signs, ____ (Type), ____ (Size)	EA
8040-B	Traffic Signs	SF
8040-C	Wood Posts	LF
8040-D	Perforated Square Steel Tube Posts	LF
8040-E	U-Shaped Rail Steel Posts	LF
8040-F	Round Steel Posts	LF
8040-G	Perforated Square Steel Tube Post Anchors, ____ (Type), ____ (Size)	EA
8040-H	Round Steel Post Anchors, ____ (Type), ____ (Size)	EA
8040-I	Remove and Reinstall Traffic Signs	EA
8040-J	Remove and Salvage Traffic Sign Assembly	EA
Section 9010 - Seeding		
9010-A	Conventional Seeding, Seeding, Fertilizing, and Mulching, ____ (Type)	AC
9010-B	Hydraulic Seeding, Seeding, Fertilizing, and Mulching, ____ (Type)	AC
9010-C	Pneumatic Seeding, Seeding, Fertilizing, and Mulching, ____ (Type)	AC
9010-D	Watering	MGAL
9010-E	Warranty	LS

Item No.	Item Description	Unit
Section 9020 - Sodding		
9020-A	Sod	SQ
Section 9030 - Plant Material and Planting		
9030-A	Plants, ____ (Type) ____ (Size)	EA
9030-B	Plants with Warranty, ____ (Type) ____ (Size)	EA
9030-C	Plants	LS
9030-D	Plants with Warranty	LS
9030-E	Tree Drainage Wells	EA
Section 9040 - Erosion and Sediment Control		
9040-A-1	SWPPP Preparation	LS
9040-A-2	SWPPP Management	LS
9040-B	Compost Blanket, ____ (Thickness)	SF
9040-C	Filter Berm, ____ (Size)	LF
9040-D-1	Filter Sock, ____ (Size)	LF
9040-D-2	Filter Sock, Removal	LF
9040-E	Temporary RECP, ____ (Type)	SY
9040-F-1	Wattle, ____ (Type), ____ (Size)	LF
9040-F-2	Wattle, Removal	LF
9040-G-1	Check Dam, Rock	TON
9040-G-2-a	Check Dam, Manufactured, ____ (Type), ____ (Size)	LF
9040-G-2-b	Check Dam, Manufactured, Removal, ____ (Type)	LF
9040-H	Temporary Earth Diversion Structure, ____ (Type), ____ (Size)	LF
9040-I	Level Spreader	LF
9040-J	Rip Rap, ____ (Type)	TON
9040-K	Temporary Pipe Slope Drain, ____ (Type), ____ (Size)	LF
9040-L-1	Sediment Basin, Outlet Structure, ____ (Size)	EA
9040-L-2	Sediment Basin, Removal of Sediment	EA
9040-L-3	Sediment Basin, Removal of Outlet Structure	EA
9040-M-1	Sediment Trap Outlet	TON
9040-M-2	Sediment Trap Outlet, Removal of Sediment	EA
9040-M-3	Sediment Trap Outlet, Removal of Device	EA
9040-N-1	Silt Fence or Silt Fence Ditch Check	LF
9040-N-2	Silt Fence or Silt Fence Ditch Check, Removal of Sediment	EA
9040-N-3	Silt Fence or Silt Fence Ditch Check, Removal of Device	LF
9040-O-1	Stabilized Construction Entrance	SY
9040-O-2	Stabilized Construction Entrance	TON
9040-P-1	Dust Control, Water	MGAL
9040-P-2	Dust Control, Product	SY
9040-Q-1	Erosion Control Mulching, Conventional	AC
9040-Q-2	Erosion Control Mulching, Hydromulching, ____ (Type)	AC

Item No.	Item Description	Unit
9040-R	Turf Reinforcement Mats, ____ (Type)	SQ
9040-S	Surface Roughening	SF
9040-T-1	Inlet Protection Device, ____ (Type)	EA
9040-T-2	Inlet Protection Device, Maintenance	EA
9040-U	Flow Transition Mat	SF
9040-V	End of Season Temporary Erosion Control	AC
Section 9050 - Gabions and Revet Mattresses		
9050-A	Gabions, ____ (Type)	CY
9050-B	Revet Mattresses, ____ (Type)	CY
Section 9060 - Chain Link Fence		
9060-A	Chain Link Fence, ____ (Type), ____ (Size)	LF
9060-B	Gates, ____ (Type), ____ (Size)	EA
9060-C	Barbed Wire, ____ (Type of Supporting Arm)	LF
9060-D	Removal and Reinstallation of Existing Fence, ____ (Type), ____ (Size)	LF
9060-E	Removal of Fence	LF
9060-F	Temporary Fence, ____ (Type), ____ (Size)	LF
Section 9070 - Landscape Retaining Walls		
9070-A	Modular Block Retaining Wall	SF
9070-B	Limestone Retaining Wall	SF
9070-C	Landscape Timbers	SF
Section 9071 - Segmental Block Retaining Walls		
9071-A	Segmental Block Retaining Wall	SF
9071-C	Granular Backfill Material	TON
Section 9072 - Combined Concrete Sidewalk and Retaining Wall		
9072-A	Combined Concrete Sidewalk and Retaining Wall	CY
Section 9080 - Concrete Steps, Handrails, and Safety Rail		
9080-A	Concrete Steps, ____ (Type)	SF
9080-B	Handrail, ____ (Type)	LF
9080-C	Safety Rail	LF
Section 10,010 - Demolition		
10,010-A	Demolition Work	LS
10,010-B	Plug or Abandon Well	EA
Section 11,010 - Construction Survey		
11,010-A	Construction Survey	LS
11,010-B	Monument Preservation and Replacement	LS
Section 11,020 - Mobilization		
11,020-A	Mobilization	LS
Section 11,030 - Temporary Services During Construction		
11,030-A	Maintenance of Postal Service	LS
11,030-B	Maintenance of Solid Waste Collection	LS

Item No.	Item Description	Unit
Section 11,040 - Temporary Sidewalk Access		
11,040-A	Temporary Pedestrian Residential Access	SY
11,040-B	Temporary Granular Sidewalk	SY
11,040-C	Temporary Longitudinal Channelizing Device	LF
Section 11,050 - Concrete Washout		
11,050-A	Concrete Washout	LS

B. Supplemental Bid Items

When a new bid item needs to be created, the following format is suggested:

1. If the bid item falls within a SUDAS Specifications Section, but is not identified in SUDAS, use the four digit section number, followed by 999, then a letter. For example, if you want to add a new bid item for sanitary sewers, use 4010-999-A.

2. If the bid item generally falls within a SUDAS Specifications Division (broader category), but is not identified as a particular SUDAS Specifications Section, use the division number, followed by 999, then a letter. For example, if you add pipe bursting and want the bid items organized with the other pipe items, use 4999-A. Or if a supplemental specifications section has been created, the first four digits should match the numbers used in the supplemental. In that instance, it is suggested to use the division number as the first digit, followed by a 9, and then the next numbers as you see fit.

3. If the bid item does not fall within a SUDAS Specifications Division or Section, use 0000, followed by 999, then a letter. For example, 0000-999-A.

4. When making modifications to a standard SUDAS bid item, be sure to address such modifications in the estimate reference notes.

2D Storm Sewer Design

2E Culvert Design

2F Open Channel Flow

2G Detention Practices

Stormwater Regulations and Permitting

A. Iowa Drainage Law and Resources

Chapter 468 of the Iowa Code covers a majority of Iowa's drainage law with respect to landowner rights and responsibilities. This chapter covers the establishment and operation of drainage districts as well as laws governing modifying, diverting, or blocking existing drainage ways.

B. Regulated Activities

In Iowa, two agencies administer permit programs for protecting the state's water resources and ensuring their wise use. Some local government agencies have also established permit programs related to land subdivision and land disturbing activities. The primary agencies are:

1. **The Iowa DNR:** Iowa DNR administers permit programs for conserving and protecting Iowa′s water, recreational, and environmental resources, and for the prevention of damage resulting from unwise floodplain development. In addition, Iowa DNR has jurisdiction over sovereign lands and waters, and certain fee title lands of the state, and land below the ordinary high water mark on meandered streams and lakes.

    a. **General Permit No. 2:** For "stormwater associated with industrial activity for construction activities" (land disturbing 1 acre or more). Construction activities that result in the disturbance of 1 acre or more of ground cover are required to obtain an NPDES general permit normally associated with earthwork, grading, or any other non-agricultural land-disturbing activity. The goal of the permit is to reduce the amount of sediment being transported from construction site by stormwater runoff.

    b. **Other Iowa DNR Permits:** (relating to protection of water and recreational sources or adjacent lands):
        1) **Floodplain Construction Permits:** Iowa DNR has authority to regulate construction on all floodplains and floodways in the state. http://www.iowadnr.gov/water/floodplain/index.html. Local governments may have obtained transfer of this jurisdiction from Iowa DNR.
        2) **Construction Permits:** Pursuant to the Iowa Code, no person, association, or corporation can build or erect a pier, wharf, sluice, piling, wall, fence, obstruction, building, or erection of any kind, upon or over any state-owned land or water under the jurisdiction of Iowa DNR, without first obtaining a permit from Iowa DNR. http://www.iowadnr.gov/InsideDNR/RegulatoryAir/ConstructionPermits.aspx.
        3) **Special Permits:** Projects involving a standard recreational boat dock require authorization by Iowa DNR. Permits are also required by commercial operations removing sand or aggregate from meandered streams. http://www.iowadnr.gov/.

2. **The US Army Corps of Engineers (USACE):** The USACE has authority over public waterways. This includes intrastate lakes, rivers, streams, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, all impoundments of waters and tributaries of waters identified above.

   a. **Clean Water Act Section 404 Permit Program:** Prior to conducting work on or in a regulated water of the U.S., a Section 404 permit must first be obtained from the USACE. Additional information on the 404 program may be found in the Iowa DOT Local Systems I.M. No. 4.130.

   b. **Wetlands:** Wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands have three essential characteristics, all of which must be present for an area to be identified as a wetland. This includes hydrophytic (water-loving) vegetation, hydric soils, and wetland hydrology
      1) **Wetland Delineation:** Identification of Section 404-regulated wetlands requires wetland delineation by the USACE, the EPA, or by submission of a wetland delineation report to the USACE by a qualified wetland specialist. Wetland delineation is often requested or contracted by a property owner who needs to know restrictions on the development or use of the land. In particular, a property owner may need wetland delineation when seeking an individual or general permit.
      2) **Wetland Mitigation:** Every effort should be made at the beginning of a project to avoid or minimize impacts. Any project that does not meet the conditions of any one of the Nationwide Permits must be sent to the USACE and probably will require satisfactory mitigation for the loss of wetlands. Mitigation is defined as wetland restoration, creation, enhancement, or preservation for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be as environmentally beneficial.

3. **Joint Application:** Given the regulatory relationship between the Iowa DNR and the USACE, certain projects require authorization from both agencies before work can commence. Construction, excavation, or filling in streams, lakes, wetlands, or floodplains may require permits from both agencies. Specifically, State Section 401 water quality certification is mandatory for all projects requiring a Federal Section 404 permit. In order to simplify this process, a joint application form has been developed for the permit process for any of the following activities:
   - Cutting the bank of a river or stream
   - Any excavation or dredging in a stream or channel
   - Channel changes or relocations (including stream straightening)
   - Construction of any permanent dock, pier, wharf, seawall, boat ramp, beach, intake, or outfall structure on a stream, river, or lake
   - Placement of any fill, rip rap, or similar material in a stream, river channel, or lake
   - Construction of a dam across any waterway
   - Placement of fill, construction of levees, roadways, and bridges; and similar activities on a floodplain
   - Construction of buildings on a floodplain

   The joint application form and instructions are available on the Iowa DNR website (www.iowadnr.gov); search for "Sovereign Lands Construction Permit."

C. Street Flow Criteria

1. **Street Capacity for Minor Storms:**

   a. Pavement encroachment for minor design storm should not exceed the limitations set forth in Table 2A-3.01.

Table 2A-3.01: Allowable Pavement Encroachment and Depth of Flow for Minor Storm Runoff

Street Classification	Maximum Encroachment[1]
Local/Roundabouts	No curb overtopping. Flow may spread to crown of street.
Collector/Minor Arterial/Roundabouts	No curb overtopping. Flow spread must not encroach to within 8 feet of the centerline of a two-lane street. The flow spread for more than two-lane streets must leave the equivalent of two 12 foot driving lanes clear of stormwater; one lane in each direction. For one-way streets, a single 12 foot lane clear of stormwater is required. For single lane roundabouts, maintain 8 feet clear of stormwater.
Major Arterials/ Roundabouts (4 lanes or greater)	No curb overtopping. Flow spread must not exceed 10 feet from the face of the curb of the outside lane. The flow spread for streets with more than two lanes must leave the equivalent of two 12 foot driving lanes clear of water; one lane in each direction. For multi-lane roundabouts, maintain one 12 foot lane clear of stormwater. For one-way streets, two 12 foot lanes are required. For special conditions, when an intake is necessary in a raised median, the flow spread should not exceed 4 feet from the face of the median curb for an inside lane.

[1] Where no curbing exists, encroachment should not extend past property lines.

   b. The storm sewer system will commence upstream from the point where the maximum allowable encroachment occurs. When the allowable pavement encroachment has been determined, the theoretical gutter carrying capacity for a particular encroachment will be computed using the modified Manning's formula for flow in a small triangular channel as shown in Section 2B-3, Figure 2B-3.01. An "n" value of 0.016 will be used unless special considerations exist.

2. **Street Capacity for Major Storms:** The allowable depth of flow and inundated area for the major design storm should not exceed the limitations set forth in Table 2A-3.02.

Table 2A-3.02: Allowable Pavement Encroachment and Depth of Flow for Major (100 Year) Storm Runoff

Street Classification	Allowable Depth and Ponded Area
Local and Collector/ Roundabouts	The ponded area should not exceed the street right-of-way and the depth of water above the street crown should not exceed 6 inches. There may be situations where other restrictions are necessary.
Major and Minor Arterial/ Roundabouts	A 12 foot lane is the minimum travel lane to be passable in the center of the street.

3. **Cross-street Flow:** Cross-street flow (called cross-pan) can occur by two separate means. One is runoff that has been flowing in a gutter and then flows across the street to the opposite gutter or inlet. The second case is flow across the crown of the street when the conduit capacity beneath the street is exceeded. If the inundated area exceeds the street right-of-way, flow easements must be obtained. The maximum allowable cross-street flow depth based on the worst condition should not exceed the limitation stipulated in Table 2A-3.03.

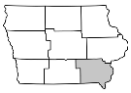
Table 2A-3.03: Allowable Cross-street Flow

Street Classification	Initial Design Storm Runoff	100 Year Design Storm Runoff
Local	6 inch depth at crown or in cross-pan	9 inch depth at crown or in cross-pan
Collector	Where cross-pans are allowed, depth of flow or in cross-pan should not exceed 3 inches	6 inch depth at crown
Arterial	None	3 inch or less over crown

D. References

Flood Plain Development. Title V, Iowa Administrative Code 567. Chapter 71.3.

Table 2B-2.10: Section 9 - Southeast Iowa
Rainfall Depth and Intensity for Various Return Periods

	**Return Period**															
	1 year		***2 year***		***5 year***		***10 year***		***25 year***		***50 year***		***100 year***		***500 year***	
Duration	***D***	***I***	***D***	***I***	***D***	***I***	***D***	***I***	***D***	***I***	***D***	***I***	***D***	***I***	***D***	***I***
5 min	0.38	4.57	0.44	5.33	0.54	6.58	0.64	7.68	0.76	9.22	0.87	10.4	0.97	11.7	1.24	14.8
10 min	0.55	3.34	0.65	3.9	0.80	4.82	0.93	5.62	1.12	6.76	1.27	7.66	1.43	8.60	1.81	10.8
15 min	0.68	2.72	0.79	3.17	0.98	3.93	1.14	4.57	1.37	5.49	1.55	6.23	1.74	6.98	2.21	8.85
30 min	0.95	1.9	1.11	2.22	1.38	2.76	1.61	3.22	1.94	3.88	2.20	4.40	2.46	4.93	3.12	6.25
1 hr	1.23	1.23	1.43	1.43	1.78	1.78	2.09	2.09	2.54	2.54	2.90	2.90	3.28	3.28	4.24	4.24
2 hr	1.51	0.75	1.76	0.88	2.19	1.09	2.58	1.29	3.14	1.57	3.61	1.80	4.10	2.05	5.35	2.67
3 hr	1.68	0.56	1.96	0.65	2.45	0.81	2.89	0.96	3.54	1.18	4.08	1.36	4.66	1.55	6.15	2.05
6 hr	1.99	0.33	2.32	0.38	2.91	0.48	3.44	0.57	4.25	0.70	4.92	0.82	5.63	0.93	7.50	1.25
12 hr	2.31	0.19	2.71	0.22	3.41	0.28	4.03	0.33	4.96	0.41	5.74	0.47	6.56	0.54	8.68	0.72
24 hr	2.68	0.11	3.12	0.13	3.90	0.16	4.59	0.19	5.62	0.23	6.46	0.26	7.35	0.30	9.64	0.40
48 hr	3.12	0.06	3.58	0.07	4.39	0.09	5.11	0.10	6.18	0.12	7.06	0.14	7.98	0.16	10.3	0.21
3 day	3.41	0.04	3.9	0.05	4.73	0.06	5.47	0.07	6.56	0.09	7.45	0.10	8.39	0.11	10.7	0.14
4 day	3.66	0.03	4.16	0.04	5.02	0.05	5.78	0.06	6.88	0.07	7.78	0.08	8.72	0.09	11.0	0.11
7 day	4.33	0.02	4.87	0.02	5.79	0.03	6.59	0.03	7.72	0.04	8.63	0.05	9.57	0.05	11.8	0.07
10 day	4.95	0.02	5.54	0.02	6.54	0.02	7.38	0.03	8.57	0.03	9.51	0.03	10.4	0.04	12.8	0.05

D = Total depth of rainfall for given storm duration (inches)
I = Rainfall intensity for given storm duration (inches/hour)

C. References

Perica, et. al. *NOAA Atlas 14: Precipitation-Frequency Atlas of the United States, Volume 8 Version 2.0: Midwestern States*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, & National Weather Service. 2013. https://www.weather.gov/media/owp/oh/hdsc/docs/Atlas14_Volume8.pdf.

Huff & Angel. *Bulletin 71: Rainfall Frequency Atlas of the Midwest.* Midwestern Climate Center, Illinois State Water Survey. 1992.

Table 2B-4.05: Runoff Curve Numbers for Other Agricultural Lands[1]

Cover Description		**CN's for Hydrologic Soil Group**			
Cover Type	***Hydrologic Condition[3]***	***A***	***B***	***C***	***D***
Pasture, grassland, or range - continuous forage for grazing[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	---	30	58	71	78
Brush - brush-weed-grass mixture with brush the major element[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30[4]	48	65	73
Woods - grass combination (orchard or tree farm)[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Farmsteads - buildings, lanes, driveways, and surrounding lots	---	59	74	82	86

[1] Average runoff condition and I_a=0.2S.
[2] *Poor*: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.
[3] *Poor*: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
[4] Actual curve number is less than 30; use CN = 30 for runoff computations
[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
[6] *Poor*: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed, but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing and litter and brush adequately cover the soil

2. SCS Depth of Runoff: Depth of runoff may be calculated through the SCS Curve Number Method. This method separates total rainfall into direct runoff, retention, and initial abstraction to yield the following equation for rainfall runoff.

$$Q = \frac{(P-I_a)^2}{(P-I_a)+S}$$ **Equation 2B-4.04**

where:

Q = Depth of direct runoff, in
P = Depth of 24 hour precipitation, in. for design year storm (e.g. 10 year, 24 hour)
S = Potential maximum retention after runoff begins, in
I_a = Initial abstraction, in

The initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration during the early part of the storm. Interception and surface depression storage may be estimated from cover and surface conditions, but infiltration during the early part of the storm is highly variable and dependent on such factors as rainfall intensity, soil crusting, and soil moisture. Establishing a relationship for I_a

is not easy. Therefore, I_a is assumed to be a function of the maximum potential retention, S. An empirical relationship between I_a and S is expressed as:

$$I_a = 0.2S$$ **Equation 2B-4.05**

Removing I_a and substituting Equation 2B-4.05 into Equation 2B-4.04 gives:

$$Q = \frac{(P-0.2S)^2}{(P+0.8S)}$$ **Equation 2B-4.06**

The potential maximum (S) is related to the soil cover and conditions of the watershed through the CN as follows:

$$S = \frac{1000}{CN} - 10$$ **Equation 2B-4.07**

After determining the CN and calculating the value for S, the total amount of rainfall, P, for the 24 hour storm with the selected return interval must be determined. Values for total rainfall depth by storm duration and return interval are listed in Section 2B-2. These values are inserted into Equation 2B-4.06 to calculate the total depth of runoff from the watershed.

3. **SCS Peak Runoff:** After the total runoff is determined, the SCS Peak Discharge Method may be utilized to determine the peak rate of discharge from the watershed. The equation for the peak discharge is given as:

$$q_p = q_u A_m Q F_p$$ **Equation 2B-4.08**

where:

q_p = peak discharge, cfs
q_u = unit peak discharge, $ft^3/s/mi^2/in$ (csm)
A_m = drainage area, mi^2
Q = runoff, in (from Equation 2B-4.04 above)
F_p = pond and swamp adjustment factor (Table 2B-4.07)

The unit peak flow is calculated with the following equation (graphical depictions are presented in TR-55):

$$q_u = 10^{[C_0+(C_1)(\log t_c)+(C_2)(\log t_c)^2]}$$ **Equation 2B-4.09**

where:

C_0, C_1, C_2 = Coefficients, listed in Table 2B-4.06. These are a function of the 24 hour rainfall distribution type and Ia/P.
t_c = time of concentration (refer to Section 2B-3)
I_a = Initial abstraction (refer to Equation 2B-4.05), in

Source: HEC-22, FHWA

$$MH_d = \frac{BO_1 + BO_2 + 2CL}{\theta \times \left({}^{\pi}/_{180}\right)}$$ **Equation 2C-3.19**

where:

MH_d = Manhole diameter, in
BO = Blockout diameter, in
CL = Minimum concrete leg length, in (typically 12 inches)
θ = Angle between pipe centerlines, degrees

4) Round the minimum manhole diameter calculated, up to the next standard manhole size (48 inches, 60 inches, 72 inches, 84 inches, 96 inches, 108 inches, or 120 inches).
5) Verify that the manhole diameter calculated is sufficient for the largest pipe diameter (See Table 2C-3.04).

Table 2C-3.04: Minimum Manhole Diameter Required for Pipe Size

Pipe Diameter (inches)	Minimum Manhole Diameter (inches)		
	RCP	***PVC***	***DIP***
8	N/A	48	48
10	N/A	48	48
12	48	48	48
14	N/A	N/A	48
15	48	48	N/A
16	N/A	N/A	48
18	48	48	48
20	N/A	N/A	48
21	48	48	N/A
24	48	48	48
27	*60	48	N/A
30	*60	*60	*60
33	*60	N/A	N/A
36	*60	*60	*60
42	*72		
48	*84		
54	*96		
60	*96		

*48 inch diameter Tee-section manhole may be used for pipes 27 inches and greater.

3. Intake/Manhole Combination: Intake/manhole combinations will be used when the size of the connecting pipes so indicate or when horizontal clearance is necessary behind the back of curb. The Engineer is encouraged to utilize intake/manhole combinations for storm sewers that are parallel to the street. This will prevent storm sewers from being installed under pavement; improving maintenance access without requiring pavement removal.

4. Cleanouts: Lamp holes or cleanout structures are required at the beginning of footing drains and subdrains in street right-of-way. Cleanouts may be allowed in place of a manhole at the end of lines that are less than 150 feet in length. Approval to use cleanouts is required.

5. Access Spacing: Storm sewer structures (manholes, intakes, combination intakes, or cleanouts) in street right-of-way must be located in areas that allow direct access by maintenance vehicles.

Areas outside the street right-of-way will be subject to the approval of the Jurisdictional Engineer.

a. Manhole Spacing: Manholes are to be spaced at intervals not exceeding 400 feet or at intervals not exceeding 500 feet when adequate cleaning equipment is available.

b. Intake Spacing: Locate street intakes upgrade from intersections, sidewalk ramps, and outside of intersection radii. At least one intake is to be installed at the low point of the street grade.

1) First Intake: An intake should be located no further than 500 feet from the street high point.

2) Remaining Intakes: To be spaced at a distance no greater than 400 feet, regardless of gutter flow capacity, in order to meet maintenance needs.

6. Invert Drop: When there is a change in pipe size at a structure, the invert of the smaller sewer must be raised to maintain the same energy gradient. An approximate method of doing this is to place the 0.8 depth point of both sewers at the same elevation. When the outgoing and incoming pipes are the same diameter and when there is a change in alignment between storm sewer of 45 degrees or greater, the suggested drop in the flow line is 0.3 foot and the minimum drop is 0.10 foot.

H. Manhole and Intake Standards

1. Manhole Standards to be Utilized:

Figure No.[1]	Description	Use	
		Main Pipe Size	***Depth Restrictions***
6010.401	Circular Storm Sewer Manhole	12” min. See table on Figure 6010.401 for max. pipe size	N/A
6010.402	Rectangular Storm Sewer Manhole	12” to 54”	8’ max.
6010.403	Deep Well Rectangular Storm Sewer Manhole	12” to 72”	12’ max.
6010.404	Rectangular Base/Circular Top Storm Sewer Manhole	12” to 96”	12’ min. to 22’ max.
6010.405	Tee-section Storm Sewer Manhole	12” or greater	N/A

[1] The figure numbers listed in this table refer to figures from the SUDAS Specifications.

2. Manhole Castings to be Utilized:

Figure No.[1]	Casting Type	Number of Pieces	Ring/ Cover	Bolted Frame	Bolted Cover (Floodable)	Gasket
6010.602	E	2	Fixed[2]	Yes	No	No
6010.602	F	3	Adjustable[3]	No	No	No

[1] The figure numbers listed in this table refer to figures from the SUDAS Specifications.
[2] Typically used with non-paved or flexible surfaces, including HMA, seal coat, gravel, and brick.
[3] Typically used with PCC surfaces, including castings in concrete boxouts.

7. **Minimum Storm Sewer and Footing Drain Grades:**

   a. **Storm Sewer Mains:** Minimum grade is set by the required minimum velocity for storm sewers and footing drain sewers - 3 fps for design storm.

   b. **Cross Runs:** Minimum grade of 1%. Desired minimum velocity of 3 fps for design storm.

   c. **Building Storm Sewer Stubs:** Minimum grade of 1%.

   d. **Subdrains:** Minimum grade of 0.5%.

8. **Intakes:** See Section 2C-3.

9. **Manholes:** See Section 2C-3.

E. Horizontal Alignment

Sewer will be laid with a straight alignment between structures with the following exception: where street layouts are such that straight alignments are difficult to maintain without an increased number of structures, and where the storm sewers are 54 inches in diameter or greater, the sewers may be curved. The curvature will be factory fabricated pipe bends and should be concentric with the curvature of the street. The radius of curvature must not be less than 200 feet. The pipe manufacturer's recommended maximum deflection angle may not be exceeded.

F. Separation of Water Mains from Storm Sewer Mains

The following comply with the Iowa DNR's separation requirements. These requirements do not apply to ditches, culverts, and subdrains.

1. **Horizontal Separation of Gravity Storm Sewers from Water Mains:** Separate storm sewers and water mains by at least 10 feet measured edge to edge unless it is impossible to do so. When not possible to maintain a 10 feet horizontal separation, maintain a minimum separation of 3 feet and utilize one of the following within 10 feet measured edge to edge:
   a. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
   b. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
   c. Construct storm sewer pipe of water main materials.
   d. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

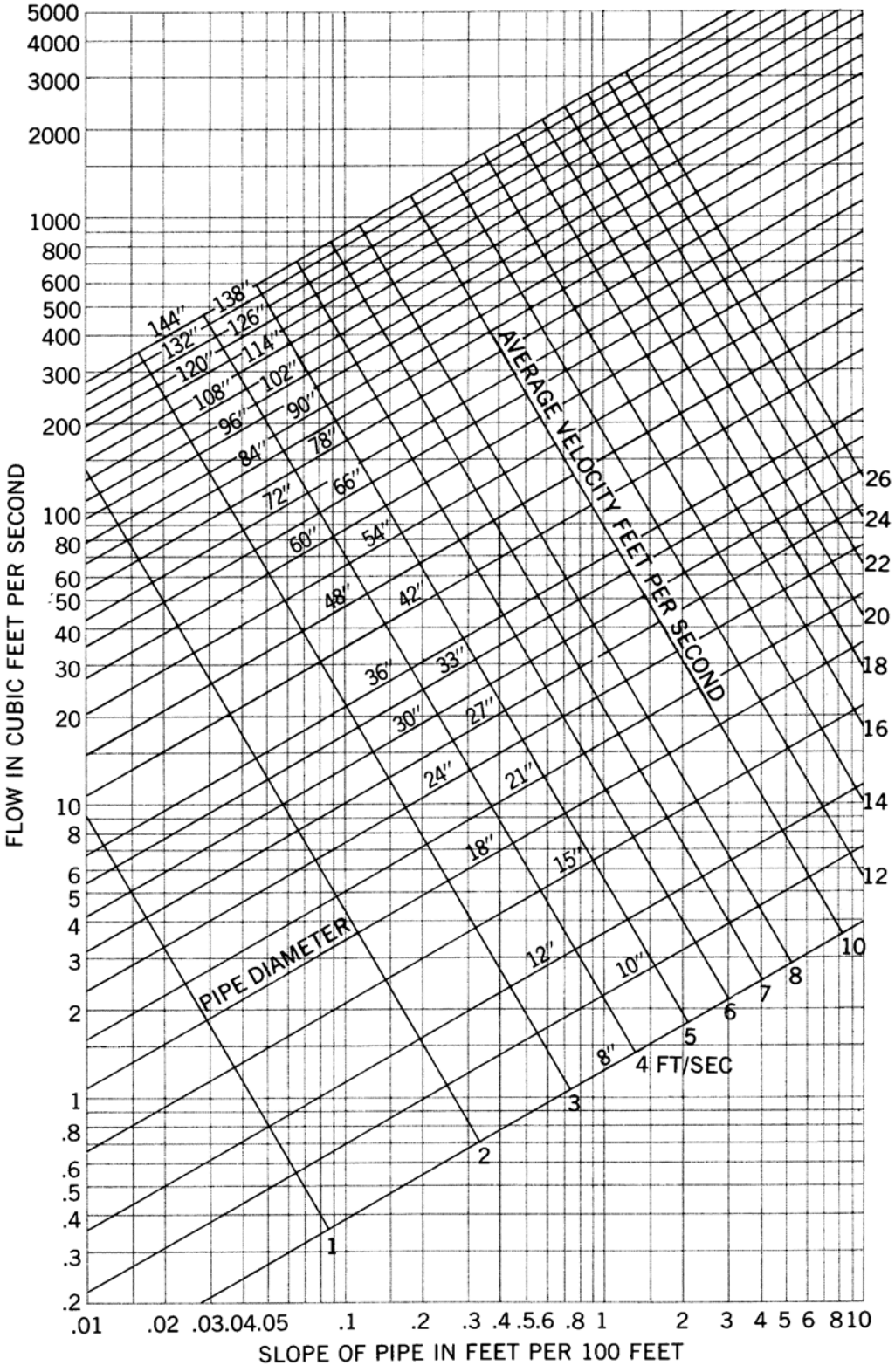
2. **Separation of Storm Sewer Force Mains from Water Mains:** Separate storm sewer force mains and water mains by a horizontal distance of at least 10 feet unless:
   a. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of SUDAS Specifications Section 5010, 2.01, and
   b. The sewer force main is laid at least 4 linear feet from the water main.

3. Vertical Separation of Storm Sewers and Water Main Crossovers:

a. Vertically separate storm sewers from water mains by at least 18 inches measured between the outside edges of the water main and the storm sewer. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

b. When impossible to maintain an 18 inch vertical separation when the water main crosses over the storm sewer, maintain a minimum vertical separation of 6 inches and utilize one of the following within 10 feet measured edge-to-edge centered on the crossing:
   1) Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
   2) Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
   3) Construct storm sewer pipe of water main materials.
   4) Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

Figure 3C-1.01: Flow for Circular Pipe Flowing Full (Based on Manning's Equation n=0.013)



G. Crossings and Clearances

1. **Storm Sewers:** Sanitary sewer crossings of storm sewers should have no less than 6 inches of clearance. Special structural support will be required if there is less than 18 inches clearance. The minimum horizontal clearance should be 5 feet. Clearance refers to the distance from the outside of the sanitary sewer pipe to the outside of the storm sewer pipe.

2. **Protection of Water Supplies:** (from Iowa DNR's Iowa Wastewater Facilities Design Standards, Chapter 12, Section 12.5.8)

   a. **Wells:** Do not lay sewers constructed of standard sewer materials within 75 feet of a public well or 50 feet of a private well. Sewers constructed of water main materials may be laid within 75 feet of a public well and within 50 feet of a private well but no closer than 25 feet to either.

   b. **Horizontal Separation of Gravity Sanitary and Combined Sewers from Water Mains:** Separate sanitary and combined sewers and water mains by at least 10 feet measured edge to edge unless it is impossible to do so. When not possible to maintain a 10 feet horizontal separation, maintain a minimum separation of 3 feet and utilize one of the following within 10 feet measured edge to edge:
      1) the top of a sewer main is at least 18 inches below the bottom of the water main, and
      2) the sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

      When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, construct the sewers of water main materials meeting both a minimum pressure rating of 150 psi and the requirements of SUDAS Specifications Section 5010, 2.01 or enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals. However, provide a linear separation of at least 2 feet.

   c. **Horizontal Separation of Water Mains from Sanitary and Combined Sewer Manholes:** Ensure water pipes do not pass through or come in contact with any part of a sanitary or combined sewer manhole. Maintain a minimum horizontal separation of 3 feet.

   d. **Separation of Sanitary Sewer Force Mains from Water Mains:** Separate sanitary sewer force mains and water mains by a horizontal distance of at least 10 feet unless:
      1) the force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of SUDAS Specifications Section 5010, 2.01 and
      2) the sewer force main is laid at least 4 linear feet from the water main.

   e. **Separation of Sanitary Sewers and Water Main Crossovers:** Vertically separate sanitary sewers crossing under any water main by at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, do not place the sewer closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases.

      When the sanitary sewer crosses over or is less than 18 inches below a water main utilize one of the following within 10 feet measured edge-to-edge horizontally, centered on the crossing: locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main. Ensure the sewer and water pipes are adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

1) Construct sanitary sewer pipe of water main material.
2) Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

f. Exceptions: Should physical conditions exist such that exceptions to b through e above are necessary, the design engineer must detail how the sewer and water main are to be engineered to provide protection equal to that required by these sections.

3. Sewer Crossing Under a Waterway: (from Iowa DNR's Iowa Wastewater Facilities Design Standards, Chapter 12, Section 12.5.11)

The top of all sewers entering or crossing streams shall be at a depth below the natural bottom of the stream bed sufficient to protect the line. One foot of cover over the top of the line is required where the sewer is located in rock or cased and three feet of cover is required in other material. In major streams, more than the three feet of cover may be required.

In paved channels, the top of the sewer line should be placed below the bottom of the channel pavement. Sewer outfalls, headwalls, manholes, gate boxes, or other structures shall be so located that they do not interfere with the free discharge of flood flows of the stream. Sewers located along streams shall be located outside of the stream bed.

Sewers entering or crossing streams shall be constructed of cast or ductile pipe with mechanical joints or shall be so otherwise constructed that they will remain water tight and free from changes in alignment or grade. Sewer systems shall be designed to minimize the number of stream crossings. The stream crossings shall be designed to cross the stream as nearly perpendicular to the stream flow as possible. Construction methods that will minimize siltation shall be employed. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not cause siltation. Upon completion of construction, the stream shall be returned as near as possible to its original condition. The stream banks shall be seeded and planted, or other methods employed to prevent erosion. The design engineer shall include in the project specifications the method or methods to be employed in the construction of sewers in or near streams to provide adequate control of siltation.

4. Aerial Crossings: (from Iowa DNR's Iowa Wastewater Facilities Design Standards, Chapter 12, Section 12.5.12)

Support shall be provided at all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent overturning and settlement.

Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers.

For aerial stream crossings the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 50-year flood.

5. Drainage Courses: Consideration should be given to providing additional depth below the streambed or erosion protection in the case of potentially erodable drainage courses.

H. Depth of Sewer

Gravity sewers should be deep enough to serve basements, assuming a 2% grade plus adequate allowance for pipe fittings on house sewers (absolute minimum of 1%). They should have a minimum depth to the top of pipe of 8 feet unless the sewer can serve existing basements at a lesser

depth. For those structures with no basements or when a high ground water table is encountered, depths less than 8 feet may be allowed. In either case, the sewer should be well below the frost line at all points and lower than any water lines placed in the same street. Insulation should be provided for sewers that cannot be placed at a depth sufficient to prevent freezing. For sewers greater than 12 feet deep as measured at the building line, provide risers on service stubs. Maximum depth of sewer should not exceed depth recommended by the pipe manufacturer.

I. Location of Sanitary Sewers

1. Sanitary Sewers in Street Right-of-way:

a. Sanitary sewers parallel to the right of way may be placed in the center of the street or behind the back of curb. Contact Jurisdiction for allowable location.

b. Sanitary sewers perpendicular to the street should follow Iowa DNR clearance requirements between storm sewer, water mains, and other utilities.

2. Sanitary Sewers Outside of Street Right-of-way:

a. Sanitary sewers will be placed in a sanitary sewer public easement. Public sanitary sewer easements should have a minimum total width of 20 feet or two times the depth of the sewer, whichever is greater, with the sanitary sewer centered in the easement. Additional width may be required by the Jurisdictional Engineer to insure proper access for maintenance equipment.

b. Provisions must be made to provide public access to the sanitary sewer easements from public streets.

J. Alignment of Sewers

Sewers less than 24 inches in diameter should be straight between manholes. Curvilinear alignment may be allowed in sewers 24 inches and greater but must start and end at manholes. Minimum grades must be increased to provide average full flow velocities equivalent to sewers with straight alignment. Submittal of the curvilinear alignment design to the Iowa DNR is required.

K. Sewer Linings for Ductile Iron Pipe

If ductile iron pipe is used for sanitary sewer pipe material, the pipe must be lined for sulfate protection. Allowable linings include calcium aluminate cement, polyethylene, ceramic epoxy, or coal tar epoxy.

L. Manholes

1. Access to Manholes: Manholes in street right of way must be located in areas which allow direct access by maintenance vehicles. Areas outside the street right of way should be subject to the approval of the Jurisdictional Engineer.

2. Standard Manhole: The minimum size for a manhole is 48 inches in diameter. Most Jurisdictions require eccentric manholes with the manhole opening over the centerline of the pipe or on an offset not to exceed 12 inches. The remaining Jurisdictions allow for concentric manholes. Check with Jurisdictional Engineer regarding use of eccentric and concentric manholes and built-in steps.

3. **Special Manholes:** For square or rectangular manholes, the manhole openings should be over the centerline of the pipes or on an offset not to exceed 12 inches. The distance from the centerline of the manhole opening to the face of the inside manhole wall should not exceed 30 inches to better facilitate video inspection and maintenance equipment. This may require more than one manhole opening.

4. **Manhole Locations:**

   a. Manholes should be installed:
      1) at the end of each sewer line
      2) at all changes in pipe size, grade or alignment, and at bends
      3) at all sewer pipe intersections
      4) at intervals not exceeding 400 feet for sewers 24 inches or less or at intervals not exceeding 500 feet when adequate cleaning equipment is available. Spacing of manholes over 500 feet may be permitted in sewers larger than 24 inches if the owner has adequate cleaning equipment.

   b. Cleanouts may be substituted, with Jurisdictional approval, for mains shorter than 150 feet.

5. **Manhole Drop:**

   a. Change in alignment - 0 to 45 degrees - none.

   b. Change in alignment across manhole - greater than 45 degrees - 0.10 feet (minimum), 0.30 feet (preferred).

6. **Dissimilar Pipe Sizes:** Change in pipe size - match eight-tenths full points.

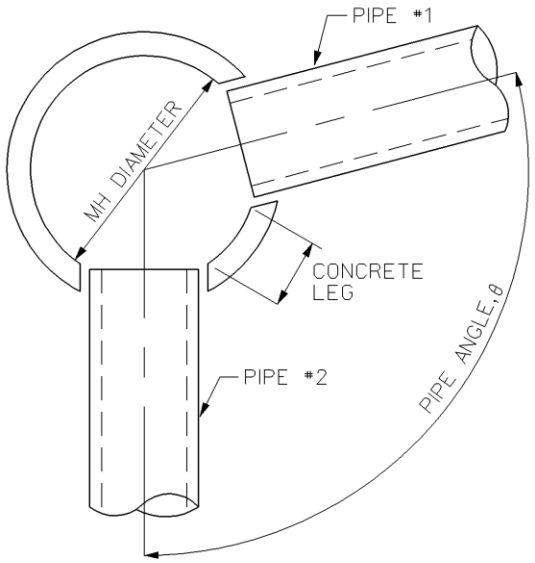
7. **Maximum Manhole Drop:** A drop connection is required when the invert to invert drop is greater than 2 feet, except when the eight-tenths points match exceeds 2 feet.

8. **Manhole Frames and Covers:** Bolt-down covers are required on manholes subject to inundation such as in flood plains, detention areas, and storm water easement areas subject to "major storms." Minimum access diameter of 27 inches is required.

9. **Manhole Coatings:** Exterior waterproof coating (bituminous) is not required unless specified by the Jurisdiction. Interior coatings should be required if sulfate protection is necessary. Drop sections should be coated along with the manhole to protect against sulfate.

10. **Manhole Sizes:** When utilizing circular precast manholes, it is necessary to determine the diameter required to maintain the structural integrity of the manhole. As a general rule, a minimum concrete leg of 6 inches should remain between the manhole blockouts for adjacent pipes. Determining the required manhole diameter to provide this minimum distance may be done as follows:

    a. Determine the diameters of, and the angle between, the two pipes in question. If more than two pipes connect at the manhole, the adjacent pipes with the critical configuration (i.e. smallest angle and largest pipes) should be selected. If the critical configuration is not apparent, calculations may be required for all adjacent pipes.



b. Determine the blockout diameter. The blockout is the opening provided in the manhole for the pipe. Blockout dimensions are based on the outside diameter of the pipe, plus an additional distance to accommodate the integrally cast gasket for sanitary sewer pipe. For storm sewer, a circular or doghouse type opening is provided with additional clearance to allow for the insertion of the pipe and sufficient space to accommodate placement of concrete grout in the opening. Typical blockout dimensions for various pipe sizes and materials are given in Table 3C-1.02.

Table 3C-1.02: Manhole Blockout Sizes

Pipe Diameter (inches)	**Manhole Blockout (inches)**			
	RCP		***PVC***	***DIP***
	Sanitary (gasketed)	***Storm (non-gasketed)***		
8	N/A	N/A	12	12
10	N/A	N/A	14	14
12	24	21	16	16
14	N/A	N/A	16	18
15	26	24	19	N/A
16	N/A	N/A	N/A	20
18	30	28	22	23
20	N/A	N/A	N/A	24
21	35	31	25	N/A
24	38	35	28	29
27	42	38	31	N/A
30	44	42	35	36
33	47	47	N/A	N/A
36	52	48	42	41
42	59	57	N/A	N/A
48	66	64	N/A	N/A
54	72	71	N/A	N/A
60	79	78	N/A	N/A

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Chapter 4 - Water Mains

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D. Valves

1. As a minimum, valves should be located at intersections, such that only one unvalved pipe exists at the intersection. Valves should be equally spaced, if possible, with spacing no more than 800 feet in residential areas and no more than 400 feet in high density residential, commercial, and industrial areas. (See Figures 4C-1.02 through 4C-1.03 for valve locations at intersections).

2. Valves should not be located in the sidewalk line or in driveways.

3. All valves should be installed with valve boxes. Use slide type valve boxes in paved areas and screw type in all other areas. A screw type valve box that is located in an area to be paved should be changed to a slide type valve box as a part of the paving program.

4. No valves (except blowoff valves) should be placed at the end of a dead-end main unless required by a Jurisdiction. A valve should be installed between the existing main and new main when the main is extended. Intermediate valve locations between the end of a dead-end main and last valved street intersection may be required by the Jurisdiction to provide required valve spacing.

5. A tapping sleeve and valve should be used when making a perpendicular connection to an existing main.

6. If the project area has high water pressure, usually exceeding 100 psi, it may be appropriate to install system pressure relief valves as opposed to individual building controls. The potential for using a system pressure reducing valve is limited by the interconnected nature of a distribution system. Check with the Jurisdiction to determine the potential need for use of pressure reducing valves.

E. Fire Hydrants

1. Hydrants should comply with AWWA C502. The connecting pipe between the supply main and the hydrants should be a minimum of 6 inches in diameter and be independently valved. Fire hydrants should not be installed on water mains that do not provide a minimum pressure.

2. Hydrant drains should not be connected to or located within 10 feet of sanitary sewers.

3. Locations of fire hydrants are governed by the rules and regulations of the Iowa DNR and the local Jurisdiction and by the following principles. Satisfy each principle in the order they are listed. See Figures 4C-1.02 through 4C-1.03 for typical hydrant locations.

    a. Locate fire hydrants within 25 feet of each street intersection, measured from an end of a street paving return.

        Locate fire hydrants outside street paving returns. Avoid conflicts with storm sewers, intakes, and sidewalks. Whenever possible, locate fire hydrants at the high point of the intersection.

    b. Locate fire hydrants between street intersections to provide spacings of no more than 450 feet in single family residential districts and no more than 300 feet in all other districts. Coverage radii for structures as noted below should be checked when determining hydrant placement.

        Vary spacings slightly to place fire hydrants on extensions of property lines. When hydrants are required between intersections, they should be located at the high point of the main for air release or at a significant low point for flushing on the downhill side of an in-line valve.

When street curvature or grid patterns places a proposed protected structure at an unusual distance from the fire hydrant, the coverage radius should not exceed 300 feet in single family residential districts and 150 feet in all other districts. The Jurisdiction's fire marshall may have additional private fire protection requirements.

c. On cul-de-sac streets, hydrants should be located at the intersection of the cul-de-sac street and cross-street and the end of the cul-de-sac.

   1) For cul-de-sacs between 300 feet and 500 feet in length, an additional hydrant should be located at the mid-block.

   2) For cul-de-sacs greater than 500 feet in length, hydrants should be placed at near equal spacings, but not exceeding the spacings described above.

d. Hydrants must be located to provide the required fire flows. ISO evaluates fire hydrant locations within 1,000 feet of the test location, measured along the streets as fire hose can be laid, to evaluate the availability of water for fire protection. Hydrant capacity is credited as shown in the following table:

Hydrant Location	Credited Capacity
Within 300’ of location	1,000 gpm
Within 301’ to 600’ of location	670 gpm
Within 601’ to 1,000’ of location	250 gpm

e. Locate fire hydrants to maintain a 3 foot clear space around the circumference of the fire hydrant to create unobstructed access for the fire department.

F. Water Service Stubs

Water service stubs for each building or platted lot should be provided, including corporation stop, service line, and curb stop (shut-off) with box. Check with the Jurisdiction to determine appropriate placement location. In no case should the shut-off be in the sidewalk. Avoid locations where driveway approaches are likely to be constructed in the future.

G. Separation of Water Mains from Sewer Mains

The following comply with the Iowa Department of Natural Resources separation requirements.

1. **Horizontal Separation of Gravity Sanitary and Combined Sewers from Water Mains:** Separate gravity sanitary and combined sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   a. The top of a sewer main is at least 18 inches below the bottom of the water main, and
   b. The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

   Maintain the maximum feasible separation distance in all cases. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, provide a linear separation of at least 2 feet and one of the following:
   a. Construct sanitary and combined sewers of water main materials meeting the requirements of SUDAS Specifications Section 5010, 2.01.
   b. Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

2. **Horizontal Separation of Water Mains from Sanitary and Combined Sewer Manholes:** Ensure water pipes do not pass through or come in contact with any part of a sanitary or combined sewer manhole. Maintain a minimum horizontal separation of 3 feet.

3. **Separation of Sanitary Sewer Force Mains from Water Mains:** Separate sanitary sewer force mains and water mains by a horizontal distance of at least 10 feet unless:
   a. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of SUDAS Specifications Section 5010, 2.01, and
   b. The sewer force main is laid at least 4 linear feet from the water main.

4. **Separation of Sanitary and Combined Sewers and Water Main Crossovers:** Vertically separate sanitary and combined sewers crossing under any water main by at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, do not place the sewer closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

   Where the sanitary sewer crosses over or less than 18 inches below a water main, utilize one of the following within 10 feet measured edge-to-edge horizontally, centered on the crossing:
   a. Construct sewer pipe of water main material.
   b. Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

5. **Horizontal Separation of Storm Sewers from Water Mains:** Separate storm sewers and water mains by at least 10 feet measured edge to edge unless it is impossible to do so. When impossible to maintain a 10 feet horizontal separation, maintain a minimum separation of 3 feet and utilize one of the following within 10 feet measured edge-to-edge:
   a. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
   b. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
   c. Construct storm sewer pipe of water main materials.
   d. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

6. **Vertical Separation of Storm Sewers and Water Main Crossovers:** Vertically separate storm sewers from water mains by 18 inches measured between the outside edges of the water main and the storm sewer. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

   When impossible to maintain an 18 inch vertical separation when the water main crosses over the storm sewer, maintain a minimum vertical separation of 6 inches and utilize one of the following within 10 feet measured edge-to-edge centered on the crossing:
   a. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
   b. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
   c. Construct storm sewer pipe of water main materials.
   d. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

H. Surface Water Crossings

Comply with the Recommended Standards for Water Works, 2007 Edition. Surface water crossings, whether over or under water, present special problems. The reviewing authority should be consulted before final plans are prepared.

1. **Above-water Crossings:** Ensure the pipe is adequately supported and anchored; protected from vandalism, damage, and freezing; and accessible for repair or replacement.

2. **Underwater Crossings:** Provide a minimum cover of 5 feet over the pipe unless otherwise specified in the contract documents. When crossing water courses that are greater than 15 feet in width, provide the following.

    a. pipe with flexible, restrained, or welded watertight joints,

    b. valves at both ends of water crossings so the section can be isolated for testing or repair; ensure the valves are easily accessible and not subject to flooding, and

    c. permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

I. Air Relief Facilities

1. **Air Relief Valves:** At high points in water mains where air can accumulate, provisions should be made to remove the air by means of air relief valves. Automatic air relief valves should not be used in situations where flooding of the manhole or chamber may occur.

2. **Air Relief Valve Piping:**

    a. Use of manual air relief valves is recommended wherever possible.

    b. The open end of an air relief pipe from a manually operated valve should be extended to the top of the pit and provided with a screened, downward-facing elbow if drainage is provided for the manhole.

    c. The open end of an air relief pipe from automatic valves should be extended to at least 1 foot above grade and provided with a screened, downward-facing elbow.

    d. Discharge piping from air relief valves should not connect directly to any storm drain, storm sewer, or sanitary sewer.

J. Valve, Meter, and Blowoff Chambers

Wherever possible, chambers, pits, or manholes containing valves, blowoffs, meters, or other such appurtenances to a distribution system should not be located in areas subject to flooding or in areas of high groundwater. Such chambers or pits should drain to the ground surface or to absorption pits underground. The chambers, pits, and manholes should not connect directly to any storm drain or sanitary sewer. Blowoffs should not connect directly to any storm drain or sanitary sewer.

K. Thrust Blocks and Restrained Joints

Concrete thrust blocks and restrained joints are used to counteract joint movement at points where piping changes directions or at dead-ends.

1. **Thrust Blocks:** Concrete thrust blocks are typically used on pipes 16 inches in diameter or smaller. Thrust blocks may be used on other pipes independently or in combination with restrained joints. Table 4C-1.01 assumes a bearing area of thrust blocks based on 1,000 psf soil pressure and 150 psi water pressure. Where water pressures are higher and/or soil conditions are poor, the designer should design the correct block size using the equation below Table 4C-1.01. No bolts should come into contact with the concrete thrust blocks. If necessary, polyethylene wrap should be wrapped around the pipe, including the bolt circle, before the concrete is placed. Concrete should have a minimum compressive strength of 4,000 psi at 28 days.

Table 4C-1.01: Thrust Block Minimum Bearing Surface (SF)

Pipe Size (inches)	Bends				Tee or Dead-end
	11.25°	***22.5°***	***45°***	***90°***	
4	1.0	1.0	2.0	4.0	3.0
6	1.0	2.0	4.0	8.0	6.0
8	2.0	4.0	7.0	14.0	10.0
10	3.0	6.0	11.0	21.0	15.0
12	4.0	8.0	16.0	29.0	21.0
14	5.0	11.0	21.0	39.0	28.0
16	7.0	14.0	27.0	50.0	36.0
18	9.0	17.0	34.0	63.0	45.0
20	11.0	21.0	42.0	78.0	55.0
24	15.0	31.0	60.0	111.0	78.0
30	24.0	47.0	92.0	171.0	121.0
36	34.0	67.0	132.0	244.0	173.0

Note: Areas based upon water pressure of 150 psi and allowable soil pressure of 1,000 psf.

Required Area, ft^2 = (2) (water pressure, psi)(cross-sectional area of pipe outside diameter, in^2)
(sin(angle of bend / 2))/(allowable soil pressure, psf)

2. **Restrained Joints:**

   a. **For Pipe Diameters 8 inch through 12 inch:** Provide a minimum of 40 feet of restrained pipe in all directions along the pipe from the fitting for pipe diameters 8 inch through 12 inch, depths of bury of at least 5 feet, and a maximum test pressure of 150 psi.

   b. **For Pipe Diameters Greater than 14 inch:** Restrained joints are typically used on pipes larger than 14 inches in diameter. They may be used on other pipe sizes independently or in combination with concrete thrust blocks. See pipe manufacturer's recommendations for determining restrained lengths of pipe required.

L. Crossings

1. **Railroad Crossings:** The regulations of the railroad company involved will govern when a water main is installed under or over any railroad tracks.

2. **Roadway Crossings:** The jurisdiction responsible for the roadway should have regulations for crossing a roadway. For primary and interstate highways, the Iowa DOT is the responsible jurisdiction. For non-primary, federal-aid roadways use the most recent version of the "Policy for Accommodating Utilities on the County and City Non-Primary Federal-Aid System." For all other roadways, contact the responsible jurisdiction.

M. Flushing, Disinfection, and Pressure Tests

Before going into service, all new mains should be adequately flushed, pressure tested, and disinfected according to the rules and regulations of the local Jurisdiction and Iowa DNR. The procedures, once approved by the Jurisdiction, should be conducted under the supervision of the Jurisdiction or designated representative.

1. **Disinfection:** Disinfect the water main according to AWWA C651. Verify requirements and acceptable methods with the Engineer. Three methods of disinfecting new water mains are available. They include the tablet method, the continuous feed method, and the slug method. The tablet method is the most convenient, but the least effective. SUDAS Specifications Section 5030 indicates that the tablet method is not to be used unless approved by the Engineer. The continuous feed method is acceptable for general application. The goal for disinfection is to obtain a concentration in the new main of 25 mg/L free chlorine. The chlorine is to be retained in the pipe for a minimum of 24 hours, but no more than 48 hours.

2. **Flushing:** Once the main has passed the chlorination tests, it is to be flushed according to the requirements of AWWA C651 until the water in the new main is at the same chlorine level as the other sections of the distribution system. The velocity in the main should be at least 2.5 feet per second for adequate flushing. If there is any potential threat the highly chlorinated water will damage the environment, a neutralizing chemical should be added to the water to render it acceptable.

3. **Hydrostatic Pressure Testing:** Pressure test according to AWWA C600. All air must be expelled from the new main. The test pressure should be 1.5 times the working pressure of the system or 150 psi, whichever is greater. The test should continue for a minimum of 2 hours. If the pressure falls by 5 psi or more, additional makeup water must be added to return the pipe to the test pressure. The amount of makeup water used must meet the requirements of SUDAS Specifications Section 5030.

Figure 4C-1.02: Standard Water Main Location at Cul-de-sac

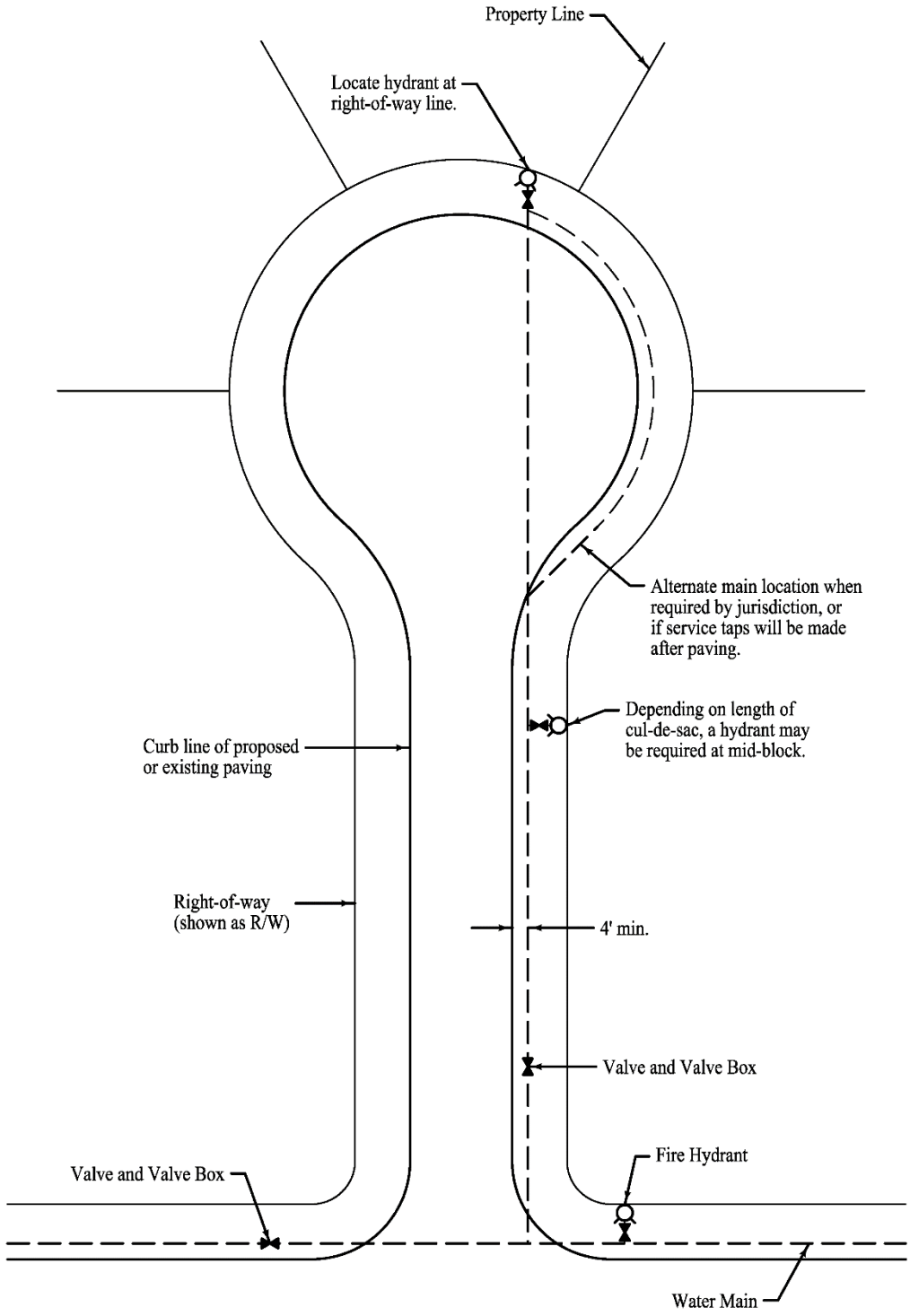
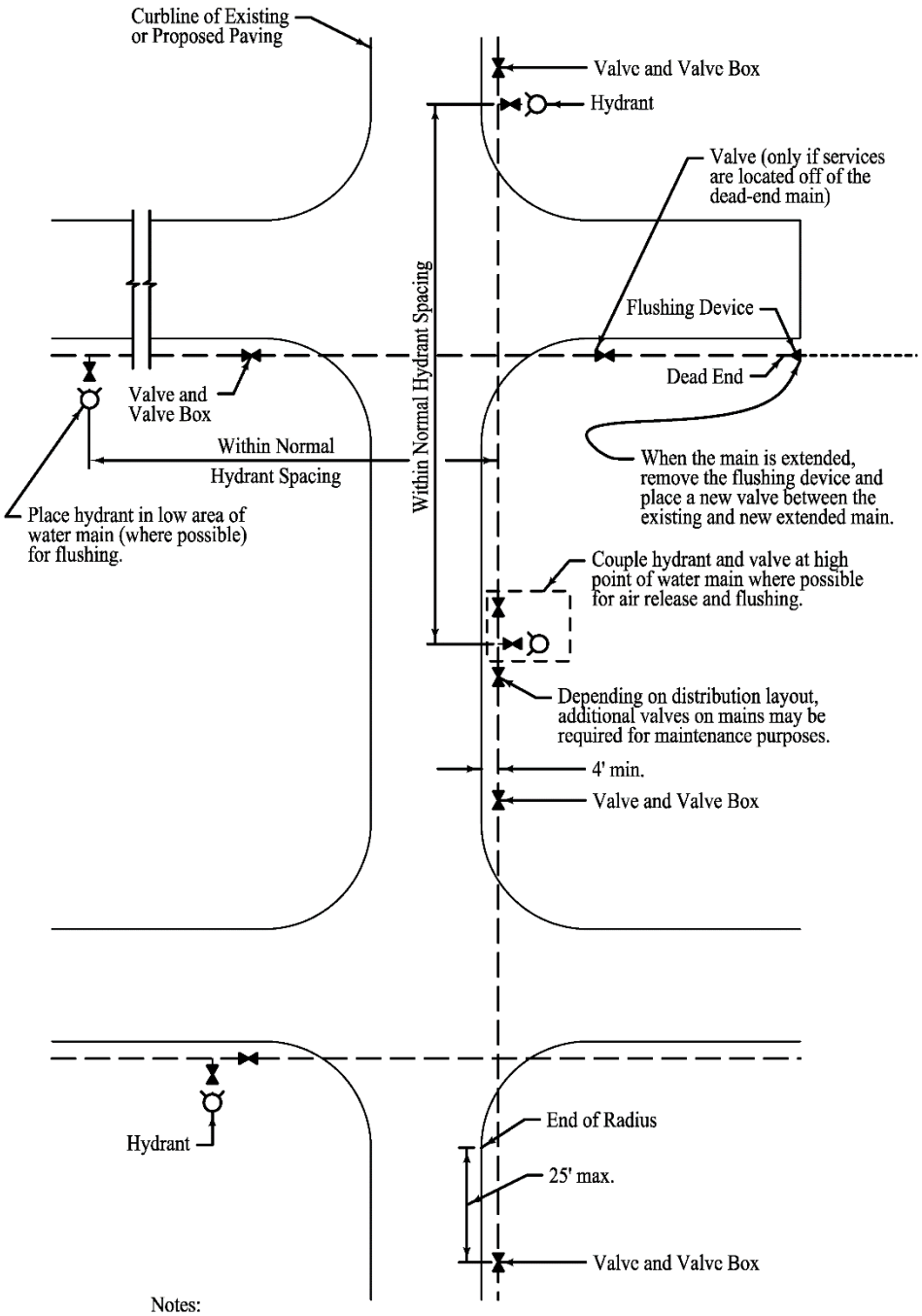


Figure 4C-1.03: Standard Water Main Location



Notes:

1. Install three valves and one fire hydrant at each intersection, except at T-intersections, which will have two valves.
2. Where possible, locate fire hydrant near high point.
3. Locate fire hydrants within 25 feet of intersection return radius, but outside of radius to avoid conflicts with storm sewers and intakes.
4. Where possible, locate fire hydrants on the downhill side of an in-line valve for air release and flusing purposes.

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Asphalt Pavement Mixture Selection

A. Scope

This section is intended for the engineers and technicians who specify asphalt paving material criteria for urban projects, generally ranging from low to medium volume, up to 10M ESALs. Vehicle volumes exceeding 10M $ESAL_{20}$, or projects outside of these design standards, may require more detailed design and/or expert consultation. The section provides a step-by-step process for determining the appropriate mixture criteria and gives the designer additional background information on specific mixture criteria. The section is intended to assist in selecting the mixture criteria that best satisfy the project demands and limitations. Statewide use of this section will improve the standard application of current accepted gyratory mix design technology. According to AASHTO and Iowa DOT Materials I.M. 510, mixture selection involves the use of a 20 year design life whereas pavement thickness design is based on a 50 year design life.

B. Definitions

Equivalent Single Axle Load (ESAL): A standard unit of pavement damage created by a single pass of a vehicle axle.

Car axle = 0.0002 ESAL 18kip truck axle = 1.0 ESAL 24kip truck axle = 3.0 ESAL

$ESAL_{20}$: Estimated cumulative ESALs over a 20 year period.

N: The number of gyratory compaction revolutions at which asphalt mixture properties are measured.

N_{des} represents 20 years of traffic loading.

Gyratory Mix Design: A laboratory process for achieving desired pavement performance by determining the optimum proportions of aggregates and asphalt binder for hot mix asphalt using a SHRP Superpave gyratory compactor.

Lift Designation (Surface, Intermediate, Base): The terms for the lifts in the hot mix asphalt pavement structure. The surface lift is the top lift, about 1 1/2 inches thick. The intermediate lift(s) is one or more lifts placed under the surface lift, generally 2 to 4 inches thick. The base lift(s) is all mixture placed below the intermediate lift, generally limited to full depth construction.

Modified Asphalt Binders: For design traffic levels greater than 1,000,000 ESALs (High, Very High, and Extremely High), the binders may need to be modified and thus may be more costly.

Nominal Maximum Aggregate Size (NMAS): The mixture size designation used for the combined aggregate gradation. Defined as one sieve size larger than the first sieve to retain more than 10%.

Performance Graded (PG): National asphalt binder grading system, developed by AASHTO, based on high and low pavement operating temperatures (°C). A PG binder is identified using a nomenclature of PG XXYY, followed by an ESAL designation (L, S, H, V, E). The XX is the high pavement temperature in degrees Celsius in which the binder should resist rutting. The YY, in negative Celsius, is the low pavement temperature in which the binder should resist cracking. For example, a PG 58-28S should resist rutting to 58 °C and cracking of the pavement to a temperature of -28 °C under standard (0.3 M to 1 M ESALs) traffic loading.

C. Design Checklist

Designers should follow the steps below to ensure that the material criteria selected will best meet the needs of the project and the constraints of the owner agency.

1. **Determine the Level of Traffic Forecasted for the Next 20 Years:** Both current and future traffic levels are needed to determine the appropriate asphalt mixture for the project. Even if the project is not expected to remain in place for 20 years, the material selection levels are based on 20 year values. Common values are average daily traffic (ADT) for the current year, ADT for the 20 year forecast, and percent trucks. In addition to these annualized daily values, the designer should consider potential seasonal high truck volumes, and give particular attention to point sources and future development areas that may generate heavy truck volumes, like quarries, industrial parks, and bus lanes. Seasonal truck volumes may reflect a rate of pavement loading well in excess of the annualized values.

2. **Understand the Pavement Section Design or Rehabilitation Strategy:** In order to make the proper mixture selection, the designer must have knowledge of the proposed pavement construction or rehabilitation and intended pavement performance. The thickness of the pavement will also affect the material and mixture selection. Particular parameters include required structural thickness, existing pavement cross section and condition (dominant distress patterns), traffic patterns and speed, and past maintenance.

3. **Determine the Regional Climate Conditions:** Iowa's 1 day low pavement temperature ranges approximately 5°C from north to south. Adjusted for 98% reliability, the values range from -28 °C to -24 °C. The 7 day high pavement temperature across the state only varies by 3 °C. These values are computed from daily high air temperatures. Adjusted for 98% reliability, the pavement temperature values range from 56 °C to 59 °C. Climate details for a specific location can be obtained from the LTPPB software package available on the FHWA website (https://infopave.fhwa.dot.gov/).

4. **Compute the Anticipated 20 Year Pavement Loading:** The design pavement loading is the starting point for selecting the material and mixture selection criteria. The design pavement loading is measured in ESALs, not ADT. To determine the design ESALs on the project, use the traffic conditions from Step 1 and compute the $ESAL_{20}$. Use the examples outlined in Examples 5D-1.01 and 5D-1.02, for two lane, two way traffic; use Example 5D-1.03 for urban multi-lane situations. Design ESAL levels for asphalt criteria selection are divided into relatively large brackets. While a firm understanding of the traffic and pavement loading is important, good approximations of truck traffic are normally sufficient to determine the design requirements.

5. **Identify Any Special Conditions that Impact the Pavement:** The standard selection process is based on high speed traffic with a broad distribution of vehicle types. There are numerous special conditions that may, through engineering judgement, require changes in the standard pavement materials/mixture selection. These special conditions are outlined below.

    a. **Heavy Trucks:** If the pavement's history has regularly been impacted by heavy trucks, the designer may consider increasing either the binder grade through the designation of a higher design traffic loading, the mix designation (ESAL level), or both. Typical examples of this condition are routes adjacent to quarries, grain elevators, or regional commercial freight distribution centers.

b. Slow/Stop/Turning: Urban roadways normally require slower running speeds and often include signed or signaled intersections. The pavement loading condition significantly increases at slower speeds (less than 45 MPH) and stopped vehicles at intersections. The designer may consider increasing the binder grade through the designation of a higher design traffic loading and/or the percent of crushed aggregate to account for this condition. Economics will determine if the higher grade of binder can be applied to the whole project, or just the impacted length of pavement (i.e. intersection and approaches).

c. Durability: Many low-volume asphalt pavements are more susceptible to failure due to long term aging than to rutting or fatigue. For pavements with good maintenance histories the designer may want to ensure that the mixture selection will provide adequate durability and, if economically necessary, sacrifice some reliability against rutting or fatigue. This can be accomplished through the selection of a lower compaction level and/or the selection of a softer grade of binder.

d. Urban vs. Rural: Separate from the issue of traffic speed, rural projects that pass through urban locations should consider mix sizes (NMAS) that will appeal to the pedestrian traffic. In general, smaller mix sizes will have a better surface appearance than larger mix sizes. The designer can specify smaller mix sizes than those provided in the material selection guide table, but should also consider the availability of the aggregates when making that decision. Similarly, the designer may choose to use a larger mix size on rural sections for the purpose of reducing the asphalt binder content in the mixture.

e. New Construction vs. Rehabilitation: The design guide takes into account the major pavement performance factors including rutting, fatigue, and low temperature cracking. When an overlay is placed directly on a slab to be rehabilitated, the existing pavement distress influences the overlay performance and thus the design. If the underlying pavement is PCC or asphalt with thermocracking, the reflective cracking in the overlay will dominate over low temperature cracking so the design parameters related to low temperature cracking for the overlay become less of a factor in the design. If a stress relief layer is included in the overlay design, low temperature cracking should be considered.

f. Seasonal Traffic: Seasonal traffic occurs over a relatively short period of time and may create pavement damage in excess of the normal traffic. For example, grain harvest, Iowa State Fair, festivals, etc. may generate higher volumes (in terms of ESALs) of traffic for a short period of time. This does not only take into account traffic volumes, but also pavement loads.

g. Mixture Workability: Smaller mixture sizes are easier to use for hand work.

6. Select the Asphalt Mixture Criteria for Each Pavement Layer: Using the information developed in steps 1 through 5, select the PG binder grade, mixture size, mix design level, and aggregate properties.

a. PG Asphalt Binder Grade: Engineers should evaluate the initial costs, traffic loadings, historical experience, and potential maintenance costs when selecting the appropriate binder for a project. The designer should select a binder that nominally satisfies 98% temperature reliability for both the 7 day high pavement temperature and the 1 day low pavement temperature (see 5D-1, C, 3). The 98% reliability level described by LTPP Bind designates the areas that are covered to the most extreme high and low temperatures in Iowa. When evaluating the binder to select, the engineer should balance initial costs for the binder and the likelihood of maintenance requirements caused by rutting/shoving for high pavement temperatures and low temperature cracking during the 1 day cold temperatures. In Iowa, PG 58-28S binders will provide full 98% reliability.

Engineers may designate an "H" binder, such as PG58-28H, to accommodate higher truck traffic and/or slower stop and go traffic. For the very highest volume roadways, a PG-58-28V should be considered.

For all base and intermediate layers that are 3 to 4 inches below the surface, PG 58-28S is the recommended binder. The surface binders will insulate the lower layers from the severe one day low temperature event. For projects in the central and southern parts of the state that involve overlays, it may be appropriate to use PG 64-22S. If no method is used to retard the reflective cracking, such as an interlayer, rubblization, or crack and seat, the resistance to low temperature cracking is not critical. If there are methods employed to retard the reflective cracking, a PG 58-28S or PG 58-28H should be used.

Agencies in the central and southern part of the state who have had historical success using PG 64-22S may continue use of that binder grade.

Table 5D-1.01: Asphalt Binder for Local Agencies

Asphalt Mixture		**Criteria**			
Design Traffic (1×10^6 ESALs)	**Mix Designation**	**Design Traffic (1×10^6 ESALs)**		**Design Speed (MPH)**	**PG Binder**
≤ 0.3 M	LT	≤ 0.3 M	and	≤ 45	58-28S
0.3 M to 1 M	ST	0.3 M to 1 M	and	> 45	58-28S
0.3 M to 1 M	ST	0.3 M to 1 M	and	15 to 45	58-28S[1]
1 to 10 M	HT	1 to 10 M	and	15 to 45	58-28H
Overlays	LT/ST/HT	≤ 10M	and	15 to 45	64-22S[2] or 58-28S or H

L = Low S = Standard H = High

[1] Use of PG 58-28H should be considered if heavy truck or bus traffic is present.
[2] If methods are used to retard reflective cracking, PG 58-28S or H is recommended.

b. Asphalt Mixture Size: Each mixture size (NMAS) is a function of the available aggregates, project conditions, and lift thickness. Minimum lift thickness is a function of density and mixture constructability. The following table shows the minimum lift thickness for the following mix sizes:

Mix Size	**Minimum Lift Thickness**
3/8"	1"
1/2"	1 1/2"
3/4"	2 1/4"
1"	3"

c. Mix Design Level: Based on the projected $ESAL_{20}$ value, seasonal traffic loading and current pavement distress, the designer must select a mix design level. The boundaries of the design levels are not absolute, so the designer should take into consideration the assumptions used to compute the ESAL value.

d. Aggregate Properties: The mixture design criteria (Table 5D-1.03) is derived from Iowa DOT Materials I.M. 510. Table 5D-1.03 specifies a 15% increase in percent crushed aggregate for surface and intermediate mixes 1 M ESALs and less to account for slow, stop, and turning conditions. This will be a local decision based on past performance and available aggregates. The actual percent crushed needed to achieve the mix design gyratory compaction volumetrics will vary with the quality of the aggregates used. Both the specified percent crushed and the gyratory compaction volumetrics must be satisfied by the asphalt mixture.

7. Check for Availability of Materials to Meet the Mix Design Criteria: Review the mix design criteria selected in step 6 and determine if the binder and aggregates required to meet the mix design criteria are readily available or accessible at a reasonable cost. Contact local producers and/or district materials engineers, if the designer plans to use non-standard criteria. Imported aggregates and modified binders generally cause higher costs. The designer should be ready to justify the mix selection decision.

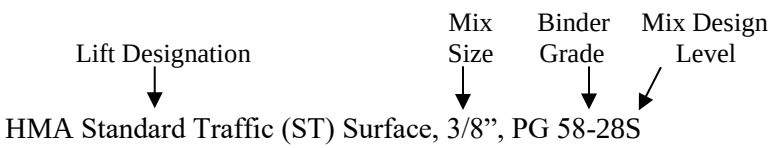
8. Place Mix Criteria in the Project Plans and Proposal: The following information should be placed in the plans and proposal:

a. Traffic and $ESAL_{20}$ Projections: The traffic and $ESAL_{20}$ projections should be listed on the title sheet of the plans. The $ESAL_{20}$ value should coincide with the selected mix design level. If seasonal ESALs are used for design, the title sheet should note that the $ESAL_{20}$ value is based on seasonal loading. The following is an example title sheet.

Traffic	
Current ADT	_____
Future ADT	_____
Present Trucks	_____
$ESAL_{20}$	_____

b. Asphalt Mixture: Each asphalt mixture bid item is defined by the ESAL level, lift designation, and aggregate size. The mixture properties for each mixture level are specified in the specifications and Table 5D-1.03. If the designer specifies a different percent crushed aggregate, this should be identified in the bid item note on the plans. The designer should avoid placing the mix size in additional sections of the plans to minimize errors associated with duplication. The exception to this guide would be a bid item note or tabulation intended to identify locations of different mix sizes for the same lift.

c. Asphalt Binder Grade PG XX -YY: The asphalt binder grade should be specified in the bid item. The designer should avoid placing the binder grade in additional sections of the plans to minimize errors associated with duplication. The exception to this guide would be a bid item note or tabulation intended to identify binder use when multiple binders are specified. The following is an example bid item.



D. Material Properties

1. **Typical PG Grades and Their Application:** PG 58-28S is the common conventional binder used in Iowa.

   Some applications utilize specific binder grades. Use PG 58-34E meeting AASHTO T-321 with a minimum of 100,000 cycles to failure for asphalt interlayer applications. Use PG 58-34E+ meeting AASHTO T-324 with a minimum 90% elastic recovery for high performance thin lift applications.

   When recycled asphalt materials (RAM) are used and they exceed 20% replacement of the total binder, the binder grades may need to be modified. See Iowa DOT Materials I.M. 510.

   If warm mix asphalt (WMA) technologies are utilized, the binder grade selection is based on plant mixing temperatures and the level of field compaction. See Iowa DOT Materials I.M. 510 for information on the appropriate binder grade.

2. **Aggregate Source Properties:** Aggregate source properties are defined in Iowa DOT Specifications Section 4127. The mixture criteria listed in Table 5D-1.03 defines the aggregate type for each mixture level specified for the project. Each individual source of aggregate is expected to meet these criteria. The designer may specify a different aggregate type in the bid item note.

3. **Aggregate Consensus Properties:** Aggregate consensus properties are listed in Table 5D-1.03 for each mixture level. These properties include percent crushed aggregate, fine aggregate angularity, clay content (sand equivalent), and flat and elongated particles. These aggregate properties are measured on the combined aggregate, not individual aggregates.

   If the designer specifies a value different from Table 5D-1.03, the value selected should be based on the local practice and desired pavement performance. The asphalt mixture must satisfy both the percent crushed aggregate and laboratory compaction volumetric criteria. The percent crushed aggregate specified is interdependent on the compaction level and the quality of the aggregate.

E. Use of Mixture Selection Guide and Design Criteria Tables

Two tables in Subsection H are provided to assist designers with the selection of asphalt materials for projects. The Asphalt Mixture Selection Guide (Table 5D-1.02) provides the project designer with a set of standard material selections that will satisfy most projects. The Asphalt Mixture Design Criteria (Table 5D-1.03) is derived from Iowa DOT Materials I.M. 510 and provides the mix designer with the detailed mix criteria for each mixture level. The mixture selection guide and mixture design criteria represent the current understanding of accepted asphalt properties for application on urban routes.

The Asphalt Mixture Selection Guide (Table 5D-1.02) represents commonly used mixture parameters, but does not preclude the project designer from deviating from the "recommended" values. The designer should understand the impact of any modification. The first two columns define the standard mixture levels based on traffic loading. The middle columns establish lift thickness and mix size relationships. It should be noted that Table 5D-1.02 does not address required pavement thickness to meet structural needs (Section 5F-1). The Bid Item Designation column ties the mixture levels to the bid items. The final column gives a general statewide guide for the estimated binder content. Local binder content experience may be more appropriate for project estimated quantities. This table does not address the need for special friction aggregate. In general terms, urban routes do not require special friction aggregate.

As mentioned earlier, the Asphalt Mixture Design Criteria (Table 5D-1.03) is derived from Iowa DOT Materials I.M. 510. However, the table differs from I.M. 510. For the surface and intermediate layers of the LT mixes, the amount of crushed aggregate was increased by 15% and for the ST mixes, all layers have an additional 15% crushed aggregate. A different aggregate type and the percent crushed aggregate may be specified by the designer for the project. These values established in the table are prescribed for each mixture and care should be exercised if altered by the project designer. The designer should only change these values when familiar with the material properties and mixture performance for the local area. The bid item plan note must include these values, if it differs from the value in Table 5D-1.03.

F. Example Plans

1. **Title Page:** The traffic and $ESAL_{20}$ projections should be listed on the title sheet of the plans. The $ESAL_{20}$ value should coincide with the selected mix design level. If seasonal ESALs are used for design, the title sheet should note that the $ESAL_{20}$ value is based on seasonal loading.

2. **Typical Section:** Lift thickness should be shown on the typical section. The lift thickness should match or exceed the recommended lift thickness for the mixture size selected, provided compactive requirements are also achieved. The lift should be designated as surface, intermediate, or base. Mixture size or design $ESAL_{20}$ level should not be added to the typical section (it is specified in the bid item).

3. **Bid Items:** Unless otherwise specified, each bid item covers the mixture and binder grade selected. The corresponding bid item note must specify the minimum percent crushed aggregate, if it differs from the value in Table 5D-1.03.

G. Examples for Determination of Traffic ESALs

Similar to pavement thickness design, the asphalt mixture is designed for the frequency and size of the load applied to the pavement. While it is important to have a good understanding of the traffic, it is possible to select the asphalt paving materials based on reasonable approximations. If the designer has actual traffic data, including a distribution of truck types and loads, the current annual ESAL value can be computed from the AASHTO pavement design tables. For most projects however, the designer will determine estimated values based on a general familiarity with the route. The following examples can be used to approximate the design $ESAL_{20}$ for a project.

Example 5D-1.01: Two Lane, Two Way Traffic, Low Volume Street

Step	Task	Values
1	Given: Current AADT Percent Trucks Percent Annual Growth Rate Design Period	1,000 5% 2% 20 years
2	Base Year Design ESALs *[from Section 5F-1, Table 5F-1.08]*	8,000 ESALs
3	Growth Factor *[from Section 5F-1, Table 5F-1.11]*	24.3
4	Compute $ESAL_{20}$ *[8,000 ESALs x 24.3]*	194,400 ESALs
5	Select mixture design level *[from Table 5D-1.02, Mixture Selection Guide]*	**≤ 0.3 M**

Example 5D-1.02: Two Lane, Two Way Traffic, High Volume Street

Step	Task	Values
1	Given: Current AADT Percent Trucks Percent Annual Growth Rate Design Period	10,000 3% 3% 20 years
2	Base Year Design ESALs *[from Section 5F-1, Table 5F-1.08]*	50,000 ESALs
3	Growth Factor *[from Section 5F-1, Table 5F-1.11]*	26.9
4	Compute $ESAL_{20}$ *[50,000 ESALs x 26.9]*	1,345,000 ESALs
5	Select mixture design level *[from Table 5D-1.02, Mixture Selection Guide]*	**1 to 10 M**

Example 5D-1.03: Four Lane Street

Step	Task	Values
1	Given: Current AADT Percent Trucks Percent Annual Growth Rate Design Period	15,000 5% 2% 20 years
2	Base Year Design ESALs *[from Section 5F-1, Table 5F-1.10]*	75,000 ESALs
3	Growth Factor *[from Section 5F-1, Table 5F-1.11]*	24.3
4	Compute $ESAL_{20}$ *[75,000 ESALs x 24.3]*	1,822,500 ESALs
5	Select mixture design level *[from Table 5D-1.02, Mixture Selection Guide]*	**1 to 10 M**

H. Tables

Table 5D-1.02: Mixture Selection Guide

Design ESAL$_{20}$ (Millions)	Layer Designation	Lift Thickness[3]			Mix Size[1]	Bid Item Designation	Binder Content[2]
		min	*rec*	*max*			
≤ 0.3	Surface	1.5	1.5	2.5	1/2”	Low Traffic (LT)	6.00
	Intermediate	1.5	1.5	3			
	Base	1.5	3	4.5			
0.3 to 1.0	Surface	1.5	1.5	2.5	1/2”	Standard Traffic (ST)	6.00
	Intermediate	1.5	1.5	3			
	Base	1.5	3	4.5			
1.0 to 10.0	Surface	1.5	2	2.5	1/2”	High Traffic (HT)	6.00
	Intermediate	2	2.5	3	3/4”		5.50
	Base	3	4	4.5	1”		5.25

[1] The Common mix size is shown. When other mix sizes are used, the minimum lift thickness also changes (see Section 5D-1, C, 6, b).
[2] These values are for estimating quantities only. The actual asphalt binder content is established in the approved job mix formula.
[3] Some lift thickness values in this guide may conflict with traffic control or allowable compaction criteria.

Table 5D-1.03: Mixture Design Criteria
(derived from Iowa DOT Materials I.M. 510)

Mix	Layer Designation	Gyratory Density		Film Thickness	Aggregate[2]			
		N_{des}	Design % G_{mm} (target)		Quality Type	Crush (min)	FAA (min)	Sand Equivalent (min)
LT	0.3 M S	50	96.0	8.0 - 15.0	A[1]	60[1]	---	40
	0.3 M I							
	0.3 M B		97.0		A[1]	45		
ST	1M S	50	96.0	8.0 - 15.0	A	75[1]	40	40
	1M I				A[1]	60[1]		
	1M B		97.0				---	
HT	10M S	75	96.0	8.0 - 15.0	A	75	43	45
	10M I							
	10M B		96.5		A[1]	60		
For mix design levels exceeding 10M ESALs, see Iowa DOT Materials I.M. 510.								

[1] Requirements differing from Iowa DOT Materials I.M. 510; for base mixes, aggregate quality improved from B to A and percent crushed aggregate increased by 15%.

[2] Flat & Elongated 10% maximum at a 5:1 ratio

Overlays

A. General

Overlays can extend the life of an existing pavement if good selection, design, and construction practices are followed. They can be constructed rapidly and while the roadway is open to traffic if warranted.

In order to achieve successful performance, it is important to choose the correct type of overlay based on the conditions of the existing roadway. This process of evaluation is critical to the success of the pavement and long-term performance. Design practices include thickness design, selection of specific materials, and construction details. Good construction practices include pre-overlay repairs to prepare the existing pavement if required.

B. Concrete Overlays

There are two options for concrete overlays - bonded and unbonded. Bonded overlays are designed as part of the pavement thickness where unbonded overlays are essentially new pavement on a stable base (existing pavement). For complete and detailed guidance on the design and construction of concrete overlays, refer to the *Guide to Concrete Overlays* (hereinafter called *Concrete Overlays*). This guide includes the latest information on the evaluation of the existing pavement, guidance on the overlay selection and managing concrete overlay design and construction. Table 5J-1.01 summarizes the characteristics and applications of the different types of concrete overlay.

1. **Bonded Overlays:** The purpose of a bonded concrete overlay is to add structural capacity and eliminate surface distresses on pavements that are in good to fair structural condition. The new concrete overlay is bonded to the existing pavement and acts as one monolithic unit that increases the structural capacity and provides a means of addressing surface deficiencies or overall ride quality issues. Typically, bonded concrete overlays are relatively thin - typically 2 to 6 inches thick.

   Bonded concrete overlays are not good solutions when any of the following situations exist:
   - Existing concrete pavement has widespread material related deficiencies issues such as ASR or D-cracking, subgrade support is inadequate or non-uniform, or drainage is poor.
   - Existing asphalt or composite pavement exhibits significant structural deterioration, inadequate base or subgrade support or poor drainage condition.

   When the situations discussed above exist, unbonded concrete overlays may be considered.

2. **Unbonded Overlays:** The purpose of the unbonded concrete overlay is to restore the structural capacity of an existing pavement that is moderately to significantly deteriorated. On unbonded concrete overlays, bonding is not needed to reach the desired performance. Unbonded concrete overlays are considered a minor or major rehabilitation strategy depending on the condition of the existing pavement. When the unbonded concrete overlay is placed on an existing concrete pavement, a separation layer is required to prevent bonding and un-necessary stress between the two layers. The separation layer can be provided by either a thin asphalt layer or a nonwoven geotextile fabric. Typically, unbonded concrete overlays are 4 to 11 inches thick.

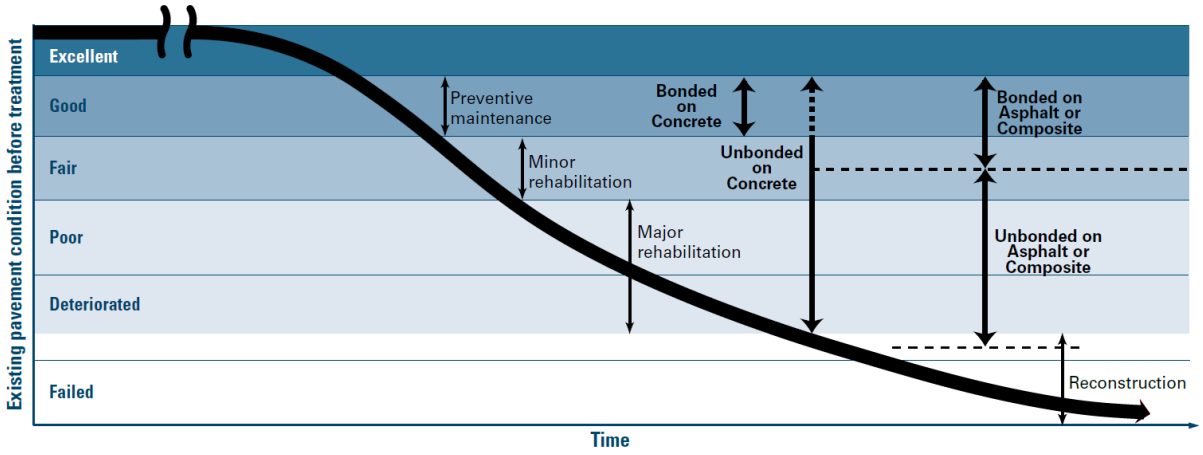
Table 5J-1.01: Concrete Overlay Characteristics and Applications

	Bonded Concrete Overlay	**Unbonded Concrete Overlay**
Purpose	Improve structural capacity & eliminate surface distresses	Restore structural capacity & eliminates surface distresses
Preservation Strategy	Preventative Maintenance	Minor or Major Rehabilitation
Typical Overlay Thickness	2" to 5" (on concrete) 2" to 6" (on asphalt)	4" to 11"
Condition of Existing Pavement	Good to fair structural condition or repaired to that condition	Moderately or significantly deteriorated, must be firm and stable
Special Design/ Construction Considerations	• For bonded concrete overlays of concrete, the coefficient of thermal expansion of the aggregate in the concrete overlay must be similar those of the existing pavement • Existing joints must be in fair to good condition, or repaired • Critical to establish a good bond with existing pavement • Shotblasting or sandblasting may be needed to prepare concrete surfaces • For overlays over existing concrete, joints must match existing spacing and transverse joints sawed through the new overlay plus 0.5", longitudinal joints shall be at least T/2, new overlay joints must match existing concrete pavement joints • The width of the new overlay joint must be equal to or wider than the joint in the existing concrete pavement • Curing should be applied at 2 times the usual application rate. Apply PAMS per manufacturer's recommendation. • Surface distress on existing asphalt pavements may be removed by milling 2" or more of surface distortions (min. 3" asphalt shall remain) • For overlays over asphalt-surfaced pavements, smaller square panel sizes from 3' to 8' is recommended • For bonded overlays on asphalt, water should be sprinkled on the surface when surface temperature is greater than 120 degrees Fahrenheit during overlay placement	• Full-depth repairs may be needed to restore structural integrity of poor deteriorated areas • Surface distress on existing asphalt pavements may be removed by milling 2" or more of surface distortions • Concrete patches in the existing asphalt pavement should be separated with a bond breaker • For unbonded concrete overlays on asphalt, the underlying asphalt surface temperature should be maintained below 120 ˚F; this can be done by sprinkling the asphalt with water prior to the overlay, no standing water shall remain • Shorter panel sizes may be needed to help address curling and warping stresses • Unbonded concrete overlays on concrete require a separation layer of thin asphalt (typically 1") or a non-woven geotextile fabric to provide drainage, separation and minimize reflective cracking • If there are material related distress in the existing concrete or existing composite section, repairs may be needed • For unbonded concrete overlays 6" and thinner, curing should be applied at 2 times the usual application rate. Apply PAMS per manufacturer's recommendation.
Available Design Procedures	ACPA (2014a, 2014b), StreetPave12; AASHTO (1993, 2008, 2015), WinPAS 12; Vandenbossche (2014) BCOA	ACPA (2014b), StreetPave12; AASHTO (1993, 2008, 2015), WinPAS12

Source: Adapted from *Concrete Overlays*

3. **Evaluation:** The evaluation and characterization of the existing pavement is a critical step in determining the suitability of a concrete overlay for the prevailing design conditions. Figure 5J-1.01 shows a typical pavement condition curve with various preservation strategies and the applicability of bonded and unbonded concrete overlays. Table 5J-1.02 summarizes the steps involved in evaluating an existing pavement.

Figure 5J-1.01: Timing of Application of Bonded and Unbonded Concrete Overlays



Source: *Concrete Overlays*

Table 5J-1.02: Pavement Evaluation Process

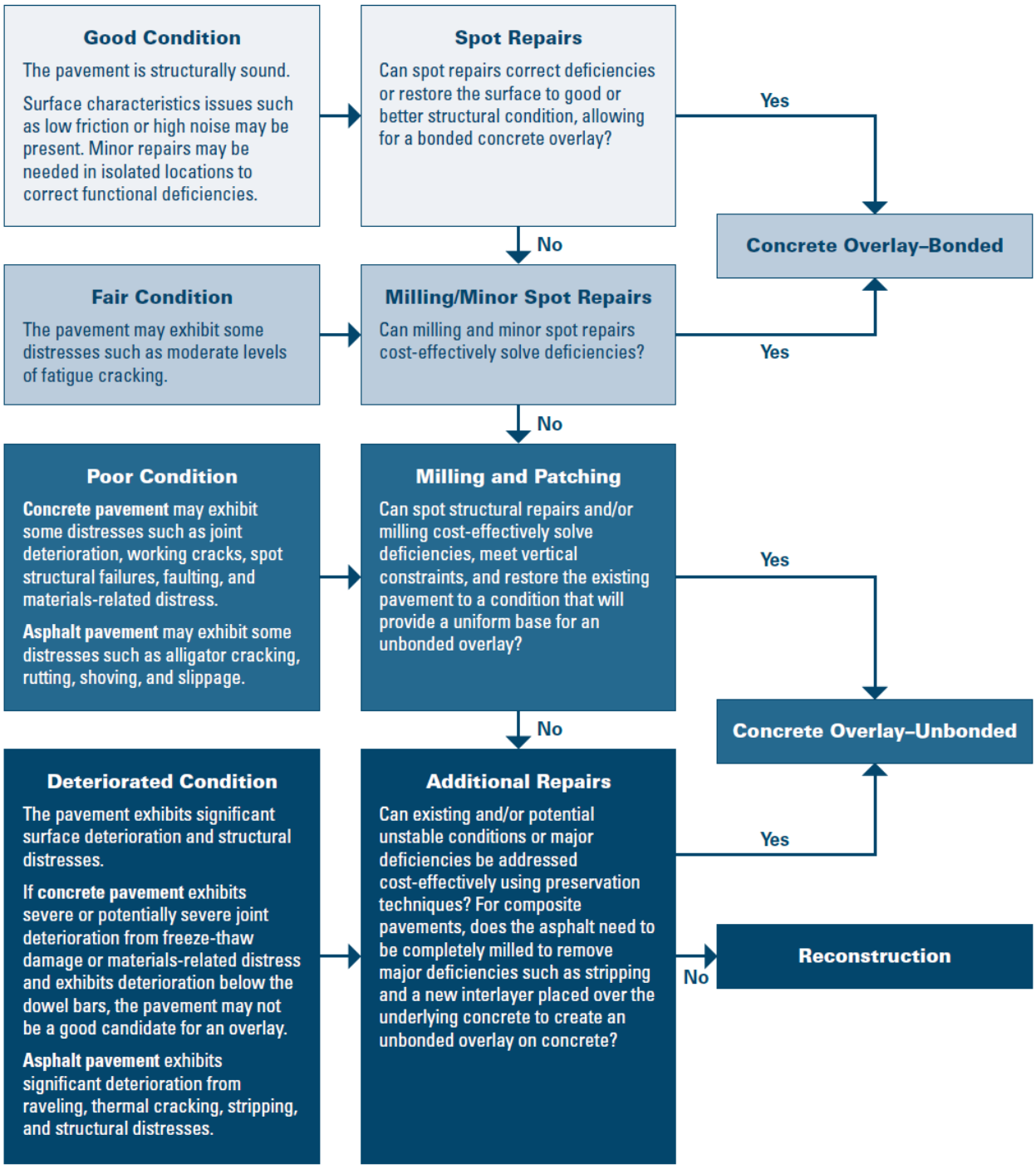
Process	Details
Step 1: Review pavement history and performance goals.	• Pavement design, layer types and thicknesses, length, width, age, drainage system. • Existing traffic and performance level (classification) • Design life and remaining life. • Design traffic and performance requirements. • Existing elevation and grade restrictions. • Other historical information.
Step 2: Perform visual examination of pavement.	• Note visible surface and structural distresses and determine overall condition of pavement (good, fair, poor, deteriorated). PCI may be determined and compared to condition curve.
Step 3: Conduct a thorough examination of pavement structure through core analysis.	• Identify type, extent, and severity of pavement distress. • Verify pavement layer types and thicknesses.

Step 4: Optional Analysis
• Material-related tests (4a)
• Subsurface test (4b)
• Surface texture tests (4c)
	• Material-related tests:
	  ○ Petrographic analysis to identify material-related distress issues and determine quality of air-void system in existing concrete.
	  ○ Determine if asphalt stripping issues exists.
	  ○ Determine aggregate coefficient of thermal expansion for existing concrete.
	• Tests of existing pavement:
	  ○ Falling weight deflectometer testing to determine:
	  ▪ Subgrade/subbase support (k-value) or stiffness.
	  ▪ Subgrade/subbase variability.
	  ▪ Load transfer efficiency of concrete pavements.
	  ▪ Presence of voids.
	  ▪ Concrete flexural strength.
	  ○ Subgrade tests to determine:
	  ▪ Frost heave characteristics.
	  ▪ Shrink-swell characteristics.
	  ▪ Soil strength (dynamic cone penetration or standard penetration test).
	  ○ Surface texture tests: conduct if before/after comparisons of pavement surface friction are needed.

Source: *Concrete Overlays*

After the evaluation, it is necessary to select the type of concrete overlay. Figure 5J-1.02 illustrates the basic steps involved. The process begins by entering the flowchart on the left, based on the condition of the existing pavement, and then following through the chart.

Figure 5J-1.02: Selecting Appropriate Concrete Overlay Solution



Source: *Concrete Overlays*

4. **Construction Materials:** Conventional concrete materials are utilized in concrete overlay construction including cement, supplementary cementitious materials (SCMs), aggregate, water and chemical admixtures. Other conventional materials including steel tie bars, dowel bars, curing compound, and joint sealant are used. The key considerations related to concrete overlay materials and mixtures are summarized in the *Concrete Overlays*.

a. Fibers: Although the use of structural fibers are not normally necessary for most concrete overlays, their use may be warranted in certain situations including those where the overlay thickness is limited, heavier weight traffic loads are expected and increased joint spacing is desirable. Structural fibers improve residual strength of the overlay. Structural fibers can perform the following functions in a concrete mix:

1) Help increase concrete toughness
2) Help control differential slab movement caused by curling and warping, heavy loads, temperatures, etc. (allowing for longer joint spacing)
3) Increase concrete's resistance to plastic shrinkage cracking (enhancing aesthetics and concrete performance)
4) Hold cracks tightly together (enhancing aesthetics and concrete performance)

Additional details on the characteristics and application of fibers in concrete overlays are provided in the *Fiber-Reinforced Concrete for Pavement Overlays: Technical Overview*.

b. Separation Layer Materials: Separation layers for unbonded concrete overlays on concrete may serve three purposes.

- Provide isolation from movement of the underlying pavement. The separation layer is a shear plane that relieves stress, mitigates reflective cracking, and may prevent bonding with the existing pavement
- Provide drainage separation either by use of an impervious material or channel water along the cross slope to the pavement edge
- Provide a cushion or bedding layer to reduce bearing stress and to prevent keying from the underlying pavement

The separation layer may be either a hot mix asphalt or a non-woven geotextile fabric.

1) Asphalt Separation Layer: Conventional HMA mixtures have been used for several years to provide separation for unbonded concrete overlays. Typically, a 1 inch thick layer is used to provide separation from irregularities in the existing pavement, although thicker layers may be used when the irregularities are large enough to impact placement operations.

Poorly drained unbonded concrete overlays under heavy traffic may result in scouring or stripping of the asphalt interlayer. In an effort to reduce scour pore pressure and decreased stability, some agencies increase the porosity of asphalt mixtures. The sand content is reduced and the volume of 0.38 inch chip aggregate is increased. This modified (porous) mixture has a lower unit weight and lower asphalt content, and is comparable in cost to typical surface course mixtures.

2) Nonwoven Geotextile Separation Layer: Nonwoven geotextile interlayers are an alternative to an asphalt interlayer in providing separation, drainage and cushion for an unbonded concrete overlay. The structural condition of the existing concrete pavement must be carefully assessed before geotextile layers are used in lieu of an asphalt interlayer. Leykauf and Birmann (2006) also note that geotextile interlayers are especially recommended for concrete overlays on old concrete pavements.

The fabric is secured to the existing pavement with pneumatic hammers at approximately 6 feet spacing or through the use of adhesives. It is critical that the fabric is free of wrinkles and no more than three edges overlap at one location. The weight of the fabric is dependent on the thickness of the overlay. Recommended weights for nonwoven geotextile fabrics for unbonded concrete overlays are as follows:

Overlays $\leq$ 4 inches – 13.3 oz/yd^2
Overlays $\geq$ 5 inches – 14.7 oz/yd^2

Temperature of the surface upon which the overlay is to be placed is critical to minimize fast drying out and shrinkage cracks in the PCC overlay. One method to assist in keeping the surface cooler is to specify a fabric interlayer that is white or light colored for the hot, summer months. A black or dark fabric interlayer can be used in the cooler spring and fall months.

Specifications for the nonwoven geotextile separation layer are included in SUDAS Specifications Section 7011.

5. **Thickness Design:** There are several design procedures available for determining the thickness of concrete overlays. Designers should reference *Concrete Overlays* for recent guidance. This document provides guidance on the following design procedures, in addition to more recent software design. The following design methodologies are most common:
   - Bonded Concrete Overlays on Asphalt Pavements Mechanical-Empirical Design Guide
   - AASHTO Guide for Design of Pavement Structures
   - StreetPave
   - Unbonded Concrete Overlays on Concrete (UBOL Design)

6. **Construction:** Concrete overlays are constructed using conventional concrete paving equipment and procedures. Construction time for concrete overlays is significantly shorter than reconstruction due to the lack of earthwork required as well as the potential for the paving equipment to move faster due to the thinner layer. Payment for concrete overlays are typically based on square yards of concrete placement and cubic yards of concrete delivered to the site. *Concrete Overlays* provides a detailed discussion of construction consideration items and how they relate to bonded and unbonded concrete overlays.

   Joints are one of the most critical elements for overlay construction. Timing of joint sawing is critical and because of the smaller joint spacing, the sawing operation is likely to determine daily production limits. Joint spacing requires special consideration based on the type of overlay and the type of underlying pavement.

   For bonded overlays over concrete pavement, the joints in the overlay need to match the joints in the underlying pavement. The joints should be cut full depth plus 1/2 inch for transverse joints and T/2 for longitudinal joints. The width of the transverse saw cut must be equal to or greater than the width of the crack at the bottom of the transverse joint in the existing pavement.

   The recommended joint pattern for bonded overlays over asphalt pavement should not exceed 1 1/2 times the overlay thickness. Transverse joints should be sawed to T/3 using conventional saws and not less than 1 1/4 inches using an early entry saw. Longitudinal joints should be cut to T/3.

   For unbonded overlays, it is generally a good practice to mismatch joints or cracks to maximize load transfer from the underlying pavement. Slab dimensions (in feet) should not exceed 1 1/2 times the overlay thickness for overlays less than 6 inches thick, and should not exceed 2 times the thickness with an absolute maximum of 15 feet for overlays greater than 6 inches thick. Transverse saw cuts for conventional saws and longitudinal joints should be T/3. Transverse cuts for early entry saws should be at least 1 1/4 inches deep.

C. Asphalt Overlays

1. HMA Overlays:

a. Conventional: Conventional HMA overlays are typically 2 to 4 inches thick, placed in multiple lifts. Lift thickness varies but are typically 1 1/2 inches to 3 inches thick. The overlay is expected to improve rideability, surface friction, profile, crown, and cross slope. In addition, specific distress types of low severity cracking, raveling, roughness, low severity bleeding, and low severity block cracking are improved. HMA overlays rely on timely compaction to be successful. Typically, HMA overlays are dense-graded but may also be open-graded if a porous mix is desired.

In order for the aggregate in the HMA overlay to properly align itself during compaction and achieve required density, the nominal maximum aggregate size must be no larger than 1/3 the thickness of the overlay. For example, for a 1 1/2 inch thick asphalt lift, nominal aggregate size should be no larger than 1/2 inch. See SUDAS Specifications Section 7020.

b. Thin Lift: Sometimes called thinlays, thin lift overlays generally range from 3/4 inch to 1 1/2 inches thick. With the thin lift overlays, the nominal maximum aggregate size must be no larger than 1/3 the thickness of the overlay. The mix has more asphalt binder (approximately 8%) than a traditional mix in order to cover the surface area. The binder (PG 64-34E+) is formulated to be softer, which helps the mix be more durable and resistant to cracking than traditional mixes.

Because of its nature and the overlay being very thin, it is critical to have a sound underlying pavement for the thin lift overlay to perform properly. In addition to the condition of the underlying pavement, one of the biggest factors for success is cleanliness, especially if milling is involved.

In most cases, milling of the underlying pavement will help improve smoothness as well as remove defects that could reflect through the new thin lift overlay. Milling will roughen the surface, which should improve the bonding and thus the shear resistance. With or without milling, cleaning of the roadway is imperative. Any amount of dust will affect the tack coat. Due to the thin nature, tack failure will lead to debonding and slippage.

The smaller aggregate size used in thin lift overlays can present production and transport challenges. If the air temperatures are cooler and the transport distance long, the mix may lose heat quicker than standard mixes and thus workability and compaction can be compromised. Production temperatures may need to be greater for thin lift overlays because they cool more quickly. Production time for thin lift overlay mixes is generally slower than for standard mixes. Fine aggregates generally retain more moisture than coarse aggregates and thus require more drying time. In addition, the fine aggregates require more asphalt to fully coat the greater surface area they exhibit.

A uniformly applied tack coat is essential to the success of thin lift overlays. Raveling and slipping of the surface course at the interface with the existing pavement are problems when tack coats are insufficient or applied in streaks.

With the thin lift thickness, it is difficult to isolate the density of the overlay from the density of the underlying pavement. Thus, in most cases, a rolling pattern is established. To date, experience has shown that three passes with a vibratory steel-wheeled roller provides appropriate density.

As noted, the performance of thin lift overlays will depend on traffic, climate, underlying pavement quality, surface preparation, materials, and construction quality. In colder climates such as in Iowa, special attention needs to be paid to thermal cracking and damage created by snowplows.

c. Interlayers: HMA interlayers can be placed prior to the HMA overlay to minimize reflective cracking from the underlying pavement. An asphalt interlayer is a specially designed lift of HMA placed over a pavement and under an asphalt overlay. The asphalt interlayer is usually about 1 inch thick and uses a highly polymerized asphalt binder (PG 58-34E), fine aggregates, and a higher than normal asphalt cement content to develop a flexible layer. The interlayer will have the elasticity to resist and partially absorb the tension, shear, and bending exerted on the pavement. The asphalt interlayer assists in retarding reflective cracking of the HMA overlay caused by movement of the underlying pavement. The asphalt interlayer also helps keep additional moisture from penetrating through any cracks that are reflected and thus delaying any further deterioration of the pavement structure.

The condition of the underlying pavement is critical. If an underlying pavement has deteriorated or become unstable, it may be necessary to do removal and patching or placement of a leveling course with standard HMA prior to placement of the interlayer. Due to the higher cost, the asphalt interlayer should not be used as a leveling course.

2. Crack and Seat with Asphalt Overlay: Cracking and seating with asphalt overlay is considered a major rehabilitation. Crack and seat will typically reduce the occurrence and severity of reflection cracks in the asphalt surface overlay. The crack and seat process is best used on structurally good PCC pavements with limited panel movement. Installing a subdrain well in advance, up to a year prior, of the crack and seating operation will enhance the quality of the crack and seat operation because the more stable subgrade/subbase will assist in efficient pavement cracking. The subdrain will also provide improved subgrade support for the new pavement structure. The existing concrete is broken with a segmental type breaker to produce hairline cracks at approximately 1 1/2 to 3 foot spacing. The cracked slabs are then seated by use of a weighted roller to reestablish support between the underlying subbase or subgrade and the existing pavement. The roller is usually a rubber-tired piece of equipment with a minimum gross load of 30 tons. Some streets may not have adequate strength to support a heavy roller. The engineer may designate the use of a lighter roller.

Crack and Seat - Photo courtesy of Antigo Construction

In urban areas, a full depth saw cut along the curbline and also around manholes and utility fixtures, such as water valves, is required prior to conducting crack and seat operations. In addition, a guillotine style breaker should be used with caution where structures are near the roadway. Impacts from the large single breaker can vibrate structures and cause concerns for property and utility owners. A segmental breaker results in lower magnitude vibrations and is recommended for crack and seat projects in urban areas. Informing the public about the project and especially the project schedule will help avoid potential problems. Assuring complete transverse cracking is critical with a segmental breaker. The breaking pattern with the segmental breaker must be varied to avoid developing continuous longitudinal cracks. Crack and seat activities typically produce earth-borne vibrations that are below the level necessary to cause damage, unless the source of the vibrations is very close (< 25 feet). Therefore, these lower intensity vibrations can be considered annoying and may cause people to believe that the building is being damaged, when in reality it is not being damaged. However, there are certain conditions such as close proximity to historical buildings or buildings that house historical or antique

artifacts that may require special attention to avoid damaging the structure or the artifacts in the structure. The following steps should be taken as the project design is progressing:

a. Identify potential problem areas along the project including evaluating the potential for damage to underground utilities.
b. Determine what conditions exist and check for existing damage. Deteriorated sewer systems and aging water mains could be damaged by the vibrations.
c. If allowed by the property owners, take photos of existing conditions prior to construction commencing to establish a baseline.
d. If necessary, provide for monitoring and recording vibrations during the project construction.
e. Be ready to investigate concerns and respond to them.

3. **Modified Rubblization with Asphalt Overlay:** Modified rubblization blends the principles of crack and seat and full rubblization by cracking the roadway to approximately 12 inch to 18 inch pieces. Installation of a longitudinal subdrain prior to initiating the modified rubblization process is strongly recommended. Subdrains will enhance the success of the project because the more stable subgrade/subbase will assist in efficient pavement breaking and provide improved subgrade support for the new pavement structure. This process can be used when softer subgrades prevent use of full rubblization. Seating is accomplished with either a 35 ton rubber tired roller or a 10 ton vibratory roller. A 2 inch to 3 inch rock interlayer of 3/4 inch roadstone may be placed on the rubbilized concrete and rolled prior to placing the asphalt overlay if surface variations remain after initially rolling. The use of the interlayer provides a more stable work platform and enhances the overlay's ability to stop reflective cracking.

   Like rubblization, modified rubblization is not recommended for use in urban areas due to the potential for damage to underground utilities, adjacent properties, and structures.

4. **Rubblizing with Asphalt Overlay:** Rubblizing of an existing concrete pavement and placement of an asphalt overlay is an optional major rehabilitation method. This process includes breaking up the concrete pavement into small pieces and rolling it into place to produce a sound base, which prevents reflective cracking in the asphalt surface. Rubblizing a concrete pavement successfully is predicated on having a stable subgrade so the concrete material does not intermix with the subgrade. Installation of a longitudinal subdrain prior to initiating the rubblization process is recommended and will enhance the success of the project because the drier, more stable subgrade/subbase will assist in efficient pavement cracking. Rubblization has limited uses in areas of soft subgrades, which are often encountered in Iowa. If soft subgrades are encountered during a project, complete failure of the rubblization can result. In urban areas, care must be taken not to damage utilities with minimal cover, as well as the associate utility structures. Rubblization is generally not advised for urban roads. The final surface is an asphalt overlay.

Rubblizing - Photo courtesy of Antigo Construction

   It may be necessary to work with the rubblizing contractor to establish a 100 to 200 foot test section as a means of determining the effectiveness of the rubblization. The goal is to break the existing PCC pavement into pieces with a nominal maximum size of 6 inches. In certain circumstances, the designer may allow larger pieces but they should not exceed 12 inches in size and should only be allowed for a limited area. It may be appropriate to require the contractor to excavate a test pit (4 feet by 4 feet) to assure that the PCC has been fractured throughout its entire thickness and that the bond between any steel and the concrete has been broken.

The displacement of the rubbilized pieces into the subgrade should be minimized. A steel drum vibratory roller having a minimum gross weight of 10 tons is required to compact the rubbilized pavement.

In areas of soft subgrade, it may be necessary to remove the pavement and patch with 2 inch limestone chokestone. Geogrid may be used under the patch rock to add additional support.

A 2 inch to 3 inch rock interlayer of 3/4 inch roadstone may be placed on the rubbilized concrete and rolled prior to placing the asphalt overlay if surface variations remain after rolling. The use of the interlayer provides a more stable work platform and enhances the overlay's ability to stop reflective cracking.

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C. Application

Flotation silt curtains are divided into three types, Type I, Type II, and Type III, based upon the flow conditions within the water body. The information provided here applies to minimal and moderate flow conditions, where the velocity of flow is 5 feet per second or less. For situations where the flow is greater than this, additional investigation is required, and a qualified manufacturer should be consulted.

The three types of silt curtains are differentiated by the strength and flow through rate of the fabric, and the strength of the connecting materials used:

1. Type I curtains are considered light-duty and are intended for areas where there is no current, and where the area is protected from wind and wave action.

2. Type II curtains can be used in areas with moderate running current (up to 3.5 fps), or where wind and water currents can affect the curtain.

3. Type III curtains are used in areas with considerable current (up to 5 fps), or where the curtain is subject to more severe wind and wave action.

D. Maintenance

A decision must be made on how to handle the accumulated sediment. Unless the accumulation is significant, consideration should be given to leaving this sediment in place. The process of removing the sediment can re-suspend the particles. Regardless of whether or not the accumulated sediment is removed, suspended sediment should always be allowed to settle for a minimum of 24 hours prior to removal of the silt curtain.

Once they are suspended in the water, clay and silt particles are difficult to remove by settling methods alone. For waters contaminated with clay or fine silts, the addition of a flocculent to the containment area may be considered prior to removal of the silt curtain. Care must be taken when selecting a flocculent as some are detrimental to water bodies and should not be used. See Section 7E-28 for additional information on flocculents.

E. Time of Year

Sediment curtains should not be left in place during winter months, as ice can cause the curtain to rip or be torn from its shoreline supports.

Traffic Signal Specifications Information

This section provides design information that complements and is organized similar to SUDAS Specifications Section 8010.

The information below provides selective guidance on the specifications.

A. Part 1 - General

1. **Submittals:** There are several key submittals required of the contractor following award of the project. These are described below.

   a. **Schedule of Unit Prices:**
      1) **Document:** Prepared by the traffic signal designer and included within the contract documents or provided to the contractor prior to construction.
      2) **Purpose:** Establish unit pricing for change order work if needed. Used to estimate partial payments.
      3) **Includes:** Identification of major traffic signal items along with an estimate of quantity and units of measurement. Two additional blank columns are provided (unit price, and unit extension).
      4) **Contractor Action:** Within 30 days after award, the contractor is required to submit a completed schedule of unit prices to the contracting authority.
      5) **Engineer Action:** Review the schedule in a timely manner. Check the appropriateness of each unit price, the accuracy of each unit extension calculation, and ensure that the grand total for all unit extensions matches the lump sum bid item for traffic signalization.

   b. **Material and Equipment List:**
      1) **Document:** Prepared by the traffic signal designer or contractor.
      2) **Purpose:** Contracting authority approval of materials and equipment for all major traffic signal items.
      3) **Includes:** Identification of major traffic signal items along with an estimate of quantity and units of measurement. Two additional blank columns are provided (manufacturers name and each item's model number).
      4) **Contractor Action:** Within 30 days after award, the contractor is required to submit a completed list of materials and equipment to the contracting authority for approval.
      5) **Engineer Action:** Review the list in a timely manner. Check the appropriateness of each identified manufacturer and model number. Upon acceptance, sign and date the list and provide a copy to the contractor.

   c. **Contractor Certification:**
      1) **Document:** Prepared by the contractor on company letterhead.
      2) **Purpose:** Contracting authority verification of contractor qualifications.
      3) **Includes:** Name, contact information, and certification of the Level II International Municipal Signal Association (IMSA) Certified Traffic Signal Technician(s) working on the project, along with a copy of their IMSA certificate.
      4) **Contractor Action:** Within 30 days after award, the contractor is required to submit the contractor certification to the contracting authority.
      5) **Engineer Action:** Review the appropriateness of the information provided.

d. Shop Drawings:

1) **Document:** Prepared by the traffic signal pole supplier for the contractor.
2) **Purpose:** Contracting authority review of traffic signal poles, supports, and related hardware.
3) **Includes:** Shop drawing information detailing each traffic signal pole, accompanying parts, and necessary hardware.
4) **Contractor Action:** Within 30 days after award, submit shop drawings to the contracting authority for engineer review.
5) **Engineer Action:** Review the shop drawings in a timely manner. Check the appropriateness of each detail. Upon completion of the review, sign/initial and date the shop drawings and provide a copy to the contractor.

e. Catalog Cuts:

1) **Document:** Prepared by the traffic signal equipment supplier for the contractor.
2) **Purpose:** Contracting authority review of all items within the equipment and materials list as well as for supporting components.
3) **Includes:** Catalog cut information detailing the make, model number, manufacturer, and specific details for all traffic signal equipment.
4) **Contractor Action:** Within 30 days after award, submit catalog cuts to the contracting authority for engineer review.
5) **Engineer Action:** Review the catalog cuts in a timely manner. Check the appropriateness of each item. Upon completion of the review, sign/initial and date the catalog cut documents and provide a copy to the contractor.

2. **Measurement and Payment:** Traffic signal work is typically bid as a lump sum item of which no measurements are made. However, partial payments to the contractor are established through measuring or estimating installed quantities and applying these quantities to the appropriate unit price (see Schedule of Unit Prices above).

B. Part 2 - Products

1. **Underground:**

a. Handhole: Handholes are a critical component to traffic signal design. The designer should verify with the jurisdiction how handhole lids are to be labeled and whether cable hooks should be included in handholes (sometimes not included in fiber optic handholes).

Handholes can come in all shapes and sizes (see SUDAS Specifications Figure 8010.103) and must be specified by the Engineer.

The designer should ensure that the contract documents clearly distinguish between handhole types, sizes, and desired locations. Handholes are typically uniquely numbered on the contract documents.

b. Conduit: The SUDAS Specifications allow both steel and flexible conduit. Steel conduit is typically used on all service risers and plastic PVC or HDPE is used at all other locations. A typical signal installation will use a variety of conduit sizes. Some jurisdictions may request a specific color for fiber optic conduit. When connecting HDPE conduit to PVC conduit, the designer should work with the Contractor to clarify the method or materials to be used.

The following is a conduit checklist to consider during signal design:

- Conduit size and cables listed.
- Correct symbol for in-place conduit.
- Correct symbol for proposed conduit.
- Check for conflict with in place underground utilities.
- Check if conduit fill is less than 40%.
- 3 inch minimum typical size conduit under all public traveled roadways.
- Possible spare conduit stub out of controller cabinet for future use, threaded and capped.
- Conduit runs for interconnect should be as straight as possible.
- No PVC above ground (for example: bridge crossings and wood pole systems).
- Size of bends and elbows in conduit according to National Electrical Code or UL guidelines.
- If conduit is suspended under a bridge, does the distance between supports conform to code, is a hanger detail given in plan, and are expansion fittings called for?

An online resource can be found through MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for considering conduit installation and features.

c. Wiring and Cable: Signalized intersections require a variety of standard wires and cables; however, the number, size, and quantity of extra conductors pulled can vary by agency. The designer should include sufficient details to ensure the clear identification of cable runs by conduit. The inspector should make sure all wires are terminated neatly and in an organized fashion. Cables for vehicle and pedestrian signal heads should be continuous from the pole base to the controller cabinet without splices in underground handholes. Video and emergency vehicle preemption cables should be continuous without splices from the unit to the controller cabinet. All plan terminology should be consistent for example:

- Cable callouts/symbols identifying the number of cables and the number and size of conductors (for example 1-12C#14, 2-5C#14, 2-2C#14, 1-1C#6 Ground, 1-1C#10 Tracer, etc.).
- Ped indications with separate 5/C #14 cables.
- Separate 2/C #14 detector lead-in cable for each group of loop detectors.
- Provide spares for future expansion of system, if necessary, and label them.

d. Foundations: Signalized intersections require footings or foundations for all poles, pad-mounted controller cabinets, and other service cabinets such as fiber optic hubs or electrical service panels. Cabinet footing details are shown on SUDAS Specifications Figure 8010.101. The designer should ensure that the plans reflect any desired future use spare conduit stubs out of the foundation.

Foundation size and depths vary according to pole style, mast-arm length, and pole loadings. The SUDAS Specifications provide figures for both pedestal poles and for mast-arm poles (SUDAS Specifications Figure 8010.102). SUDAS standard Type A mast arm pole foundation in soil designs (SUDAS Specifications Figure 8010.102 and Table 13A-5.01) are based on the following guidelines, parameters, and assumptions:

- Broms' method for lateral resistance (moment/shear design) per AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals*, 6th Edition, 2013 (AASHTO LTS-6), with a safety factor of 2.86, which accounts for the possible under capacity of the soil strength (0.7) and the overload factor for the loadings (2.0).
- Alpha method for torsion design per FHWA-NHI-10-016 *Drilled Shafts: Construction Procedures and LRFD Design Methods*, May 2010, with a safety factor of 1.0.

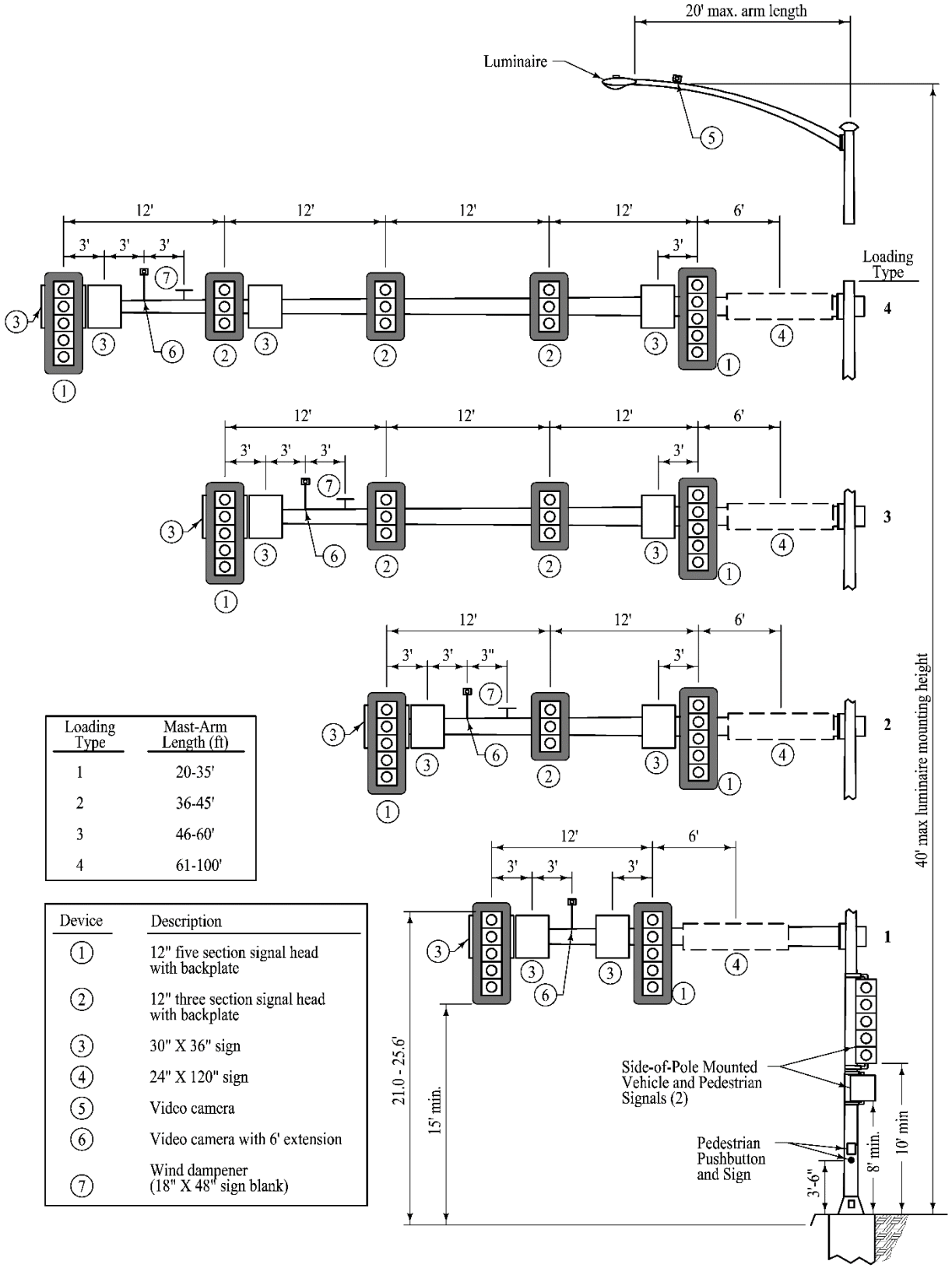
- Disturbed soil due to frost: 2.5 feet for moment/shear design, 5.0 feet for torsion design. Broms' method as presented in AASHTO LTS-6 includes an additional 1.5 diameters of foundation length to be added to the minimum foundation length required. The maximum value of 1.5 diameters or 2.5 feet shall be used when determining the disturbed soil for moment/shear design.
- Groundwater is present for moment/shear and torsion designs.
- Pole loadings as shown in Figure 13A-5.01, with poles designed per AASHTO LTS-6 specifications. Basic wind speed equals 90 mph with a 50 year mean recurrence interval and gust effect factor of 1.14 for strength design. Use Category II for fatigue design. Apply only natural wind gust loads (i.e. do not apply galloping loads, vortex shedding loads, or truck-induced gust loads) for fatigue design. Install vibration mitigation devices on all traffic signal pole mast arms over 60 feet in length as shown in the figures.
- Cohesive soils along the length of the foundation with an average blow count (N60) greater than or equal to 8, which equates to an average unconfined compressive strength (Qu) greater than or equal to 2.0 kips per square foot.
- Reinforced concrete design per AASHTO LTS-6 specifications.

For pole loading conditions greater than shown in Figure 13A-5.01, granular soils, or lower strength soils, special foundation designs will be required. Soil boring testing should be performed prior to construction to verify soil types and strengths if non-typical soils are suspected. If rock is anticipated at the project site and the designer intends to utilize the Type C mast arm pole foundation in rock or a Type B foundation (see SUDAS Specifications Figure 8010.102), determine rock quality through a subsurface investigation completed by a geotechnical engineer licensed in Iowa. If rock is encountered unexpectedly, the contractor may undertake a subsurface evaluation conducted by a geotechnical engineer licensed in Iowa to determine the quality of the rocks encountered. Based on that investigation, the Engineer may approve the use of a Type B or Type C foundation in rock if requested by the contractor.

Table 13A-5.01: Standard Mast Arm Pole Foundation Designs

Loading Type (Figure 13A-5.01)	Maximum Mast Arm Length (feet)
1	35
2	45
3	55
3	60
4	70
4	80
4	90
4	100

Figure 13A-5.01: Mast Arm Pole Loadings for Standard Foundation Designs



Loading Type	Mast-Arm Length (ft)
1	20-35'
2	36-45'
3	46-60'
4	61-100'

Device	Description
1	12" five section signal head with backplate
2	12" three section signal head with backplate
3	30" X 36" sign
4	24" X 120" sign
5	Video camera
6	Video camera with 6' extension
7	Wind dampener (18" X 48" sign blank)

The designer should ensure that foundations:

- Are located in compliance with applicable clear zone requirements (unless breakaway pedestal poles)
- Do not conflict with pedestrian walkways or ramps
- Are at the proper finish grade elevation
- Avoid or minimize conflicts with existing or proposed utilities
- Provide acceptable pedestrian pushbutton locations per MUTCD guidance
- Are located to provide adequate visibility of signal heads

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for foundation types and installation details.

e. Bonding and Grounding: All traffic signal installations must be bonded and grounded according to the National Electrical Code.

Bonding is defined in the Code as the permanent joining of metallic parts required to be electrically connected. In a traffic signal, the term is used to describe the electrical and mechanical connection of conduit, metal poles, cabinets, and service equipment.

Grounding is defined in the Code as a conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conductive body that serves in place of earth.

The designer should ensure that the contract documents include sufficient notation for the traffic signalized intersection to be properly bonded and grounded. This includes placing ground rods at each traffic signal pole and at the controller as well as through use of bonding and grounding jumpers within the handholes.

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for bonding and grounding details.

2. Detection: Detectors provide vehicle and pedestrian inputs to the traffic signal controller. Proper detector installation, operation, and maintenance is critical to the safe and efficient operation of any signalized intersection. An online resource to learn more about detection styles, modes, and typical layouts can be found within MnDOT's Traffic Engineering Manual. Since this document is a PDF, some of the information from this source is provided below.

Detector sizes and locations vary by agency and by location. SUDAS provides standard drawings for typical modified diamond and rectangular detector loops (SUDAS Specifications Figure 8010.104).

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for installation and mounting details.

a. Inductive Loop Vehicle Detector: A common type of vehicle detection device in use today is the inductive loop. This is a loop of wire imbedded in the pavement (saw cut in existing concrete or NMC loop in new concrete) carrying a small electrical current. When a large mass of ferrous metal passes over the loop, the magnetic field is disturbed and generates, or induces, a change in resonant frequency in the wire. This change in frequency is then recognized by the detector amplifier and signals the controller that a vehicle is present.

b. Pedestrian Push Button Detector: There are a number of ways to provide pedestrian actuation at a signalized intersection. The most common equipment used by far is the pedestrian pushbutton detector. Pressing the button provides a contact closure that actuates the call. There are plenty of examples of good and bad pedestrian pushbutton placement; however, part of the problem is getting the pedestrian to use the button. Specific information regarding pedestrian detectors can be found in the MUTCD Section 4E.08 Pedestrian Detectors.

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for style, installation, and mounting details.

c. Video Detection Camera System: Vehicle detection by video cameras is a popular form of vehicle detection within Iowa. The rapid processing of video images provides the detection outputs to the controller. The designer should carefully consider the type of equipment necessary to provide video detection, the maintenance needs of this equipment, and the specific installation and mounting requirements necessary.

Designers should consider relevant manufacturer recommendations and other online resources.

d. Microwave/Radar Vehicle Detector: Microwave/radar detection is often used within Iowa during temporary signal control to provide simple, non-intrusive vehicle detection.

3. Communications: The designer may be required to provide supplemental specifications for these items given the highly proprietary nature of this equipment and the needs of the contracting agency. Generic specifications have been provided in the SUDAS Specifications.

4. Cabinet and Controller: The designer may be required to provide supplemental specifications for the controller, cabinet, and emergency vehicle pre-emption system given the highly proprietary nature of this equipment. Cabinet and controller options include TS1, TS2, ATC, and 2070. The need for controllers to collect high definition data should be considered. Generic specifications have been provided in the SUDAS Specifications; this section also includes references to UPS battery backup system and emergency vehicle preemption system. The designer should carefully consider the cabinet and mounting requirements of the battery back-up system.

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for style, installation, and mounting details.

5. Poles, Heads, and Signs:

a. Vehicle Traffic Signal Head Assembly: Vehicle signal heads must comply with MUTCD Chapter 4D.

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for style, installation, and mounting details.

b. Pedestrian Signal Head Assembly: Pedestrian vehicle signal heads must comply with Chapter 4E of the MUTCD.

c. Traffic Signal Poles and Mast Arms: Signalized intersections require poles and mast arms to achieve proper traffic signal and pedestrian head placement. The default is for the contractor to furnish one-piece poles and mast arms. The designer should include plan note information if two-piece poles and mast arms will be allowed. Mast arm details and typical loadings are shown on Figure 13A-5.01; additional mast arm details are shown SUDAS Specifications Figure 8010.105. The designer should ensure that the plan locations comply with all clear zone, sight restriction, and pedestrian criteria. Vertical clearance to overhead utility lines is a constant issue that designers should take note of during design. Although the minimum height from the pavement to the bottom of the signal housing is 15 feet, the designer should consider the street classification and the volume of large trucks in establishing the signal height above the pavement. However, the top of the signal housing cannot exceed 25.6 feet above the pavement. If the project being designed has specific requirements relative to the elevation of the end of the mast arm in relation to the connecting point on the vertical pole, include those requirements in the plans or special provisions of the contract documents.

An online resource can be found in MnDOT's Lighting and Signal Certification Field Guide, which provides the designer with a photographic resource for style, installation, and mounting details.

d. Traffic Signal Pedestal Poles: Pedestal poles are often used for pedestrian signals and pushbuttons, and are much easier to locate within a tight right-of-way. Pedestal pole details and typical head mounting information are shown on SUDAS Specifications Figure 8010.106.

e. Traffic Signs: The designer must ensure that all signs comply with Iowa DOT standards and the MUTCD.

C. Supplemental Requirements

A summary listing of items within SUDAS Specifications Section 8010 requiring supplemental requirements to be provided by the designer includes, but is not limited to, the following:

- Handholes - specify types, sizes, and lettering.
- Foundations - specify dimensions and any conduit stubs needed for future use.
- Communications - specify all traffic monitoring equipment along with any fiber optic equipment and materials.
- Cabinet, controller, battery backup, vehicle detection, pedestrian detection, PTZ camera, and emergency vehicle preemption - specify all relevant equipment.
- Traffic signal poles and mast arms - specify finish for pole.
- Traffic signs - specify sheeting, sign dimensions, street name sign letter series and sizes, and mounting requirements.

D. Temporary Traffic Signals

When a temporary traffic signal (SUDAS Specifications Figure 8010.107) is included in the work, the designer must address the following items:

- Type of vehicle detection equipment to include, if any.
- Type of emergency pre-emption equipment, if any.
- Number of signal heads for each direction.
- Signal control equipment, including pedestrian equipment if to be included.
- Basic signal timing and any modifications based on construction staging.
- Points for relocation of temporary traffic signal if a trailer mounted unit is specified.