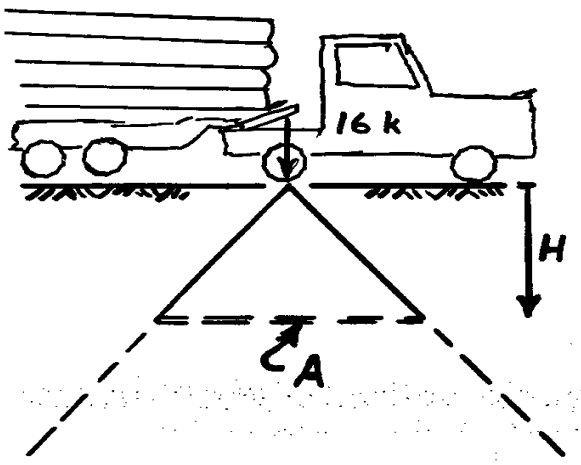
Section 8

Structural Design of Culverts & Pipe Materials



H	A ft²	Approx. P_{LL}	H	Exact P_{LL}	P_{DL}	P_t
0		12,000	0		0	
1	4	4000 ←	1	1800	120	1920
2	16	1000	2	800	240	1040
3	36	400	3	600	360	960
4	64	250	4	400	480	880
⋮			⋮			
8		62	8	100	960	1060
			⋮			
			20	0	2400	2400

8-20

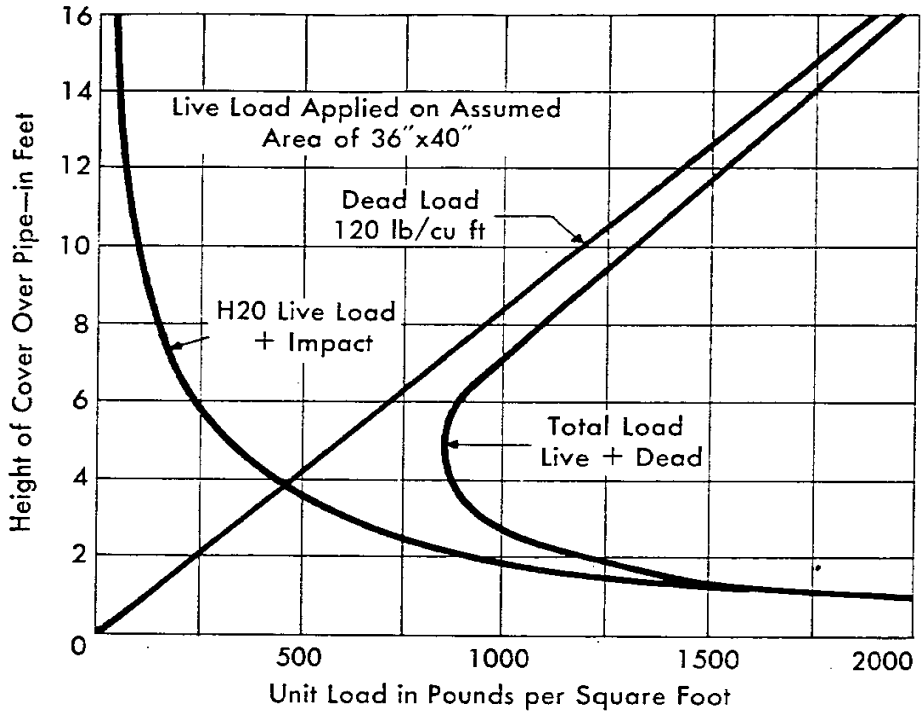
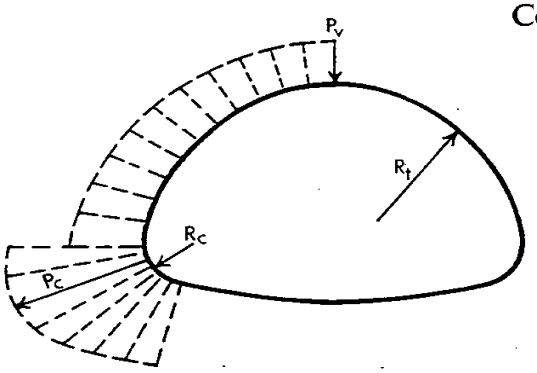


Fig. 3-3. Combined H 20 highway live load and dead load is a minimum at about 5 ft. of cover, applied through a pavement 1 ft thick.



$$\text{Corner Pressure, } P_c = P_v \times \frac{R_t}{R_c} \quad \ldots\ldots (10)$$

where: P_v = Design pressure
R_c = Radius of corner
R_t = Radius of top

Fig. 3-12. The pressures on a pipe-arch vary with location and radius, being greatest at the corners.

Pipe Diameter mm	Maximum Cover in Meters				
	1.6 mm 16 ga	2.0 mm 14 ga	2.8 mm 12 ga	3.5 mm 10 ga	4.2 mm 8 ga
300	30.5	30.5	30.5	30.5	
450	30.5	30.5	30.5	30.5	
600	30	30.5	30.5	30.5	30.5
750	24	30	30.5	30.5	30.5
900	20	24.5	30.5	30.5	30.5
1050	17	21.5	30	30.5	30.5
1200	15	18.5	26	30.5	30.5
1350		16.5	23	30	30.5
1500			21	27	30.5
1650				24.5	30
1800				22.5	27.5
1950					24.5
2100					21

Minimum Cover: 0.6 meters

Fill Height Table 8-11.3 (Metric)
Corrugated Steel Pipe
68 mm × 13 mm Corrugations
AASHTO M 36M

Pipe Diameter mm	Pipe Wall Thick. mm	Minimum Cover in Meters			
		Plain AASHTO M 86M	Class III AASHTO M 170M	Class IV AASHTO M 170M	Class V AASHTO M 170M
300	50	0.45	0.45	0.30	0.15
450	63	0.45	0.45	0.30	0.15
600	75	0.45	0.45	0.30	0.15
750	88	0.45	0.45	0.30	0.15
900	100	0.45	0.45	0.30	0.15
1200	125		0.45	0.30	0.15
1500	150		0.45	0.30	0.15
1800	175		0.45	0.30	0.15
2100	200		0.45	0.30	0.15

Fill Height Table 8-11.2 (Metric)
Concrete Pipe for Shallow Cover Installations

Pipe Diameter in.	Pipe Wall Thick. in.	Minimum Cover in Feet			
		Plain AASHTO M 86	Class III AASHTO M 170	Class IV AASHTO M 170	Class V AASHTO M 170
12	2	1.5	1.5	1.0	0.5
18	2.5	1.5	1.5	1.0	0.5
24	3	1.5	1.5	1.0	0.5
30	3.5	1.5	1.5	1.0	0.5
36	4	1.5	1.5	1.0	0.5
48	5		1.5	1.0	0.5
60	6		1.5	1.0	0.5
72	7		1.5	1.0	0.5
84	8		1.5	1.0	0.5

Fill Height Table 8-11.2 (English)
Concrete Pipe for Shallow Cover Installations

8-11 Fill Height Tables

Pipe Diameter mm	Maximum Cover in Meters				
	Plain AASHTO M 86M	Class II AASHTO M 170M	Class III AASHTO M 170M	Class IV AASHTO M 170M	Class V AASHTO M 170M
300	5.5	3.0	4.3	6.5	7.9
450	5.5	3.4	4.3	6.5	8.5
600	5.0	3.4	4.6	6.5	8.5
750		3.4	4.6	7.0	9.0
900		3.4	4.6	7.0	9.0
1200		3.7	4.6	7.0	9.0
1500		3.7	4.9	7.5	9.0
1800		3.7	4.9	7.5	9.0
2100		3.7	4.9	7.5	9.0

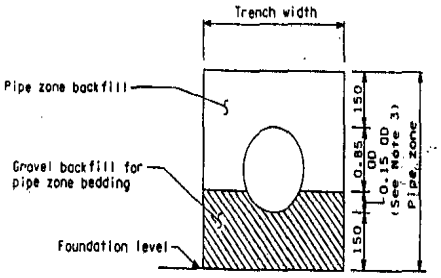
Minimum Cover: 0.6 meters

Fill Height Table 8-11.1 (Metric)
Concrete Pipe

Pipe Diameter in.	Maximum Cover in Feet				
	Plain AASHTO M 86	Class II AASHTO M 170	Class III AASHTO M 170	Class IV AASHTO M 170	Class V AASHTO M 170
12	18	10	14	21	26
18	18	11	14	22	28
24	16	11	15	22	28
30		11	15	23	29
36		11	15	23	29
48		12	15	23	29
60		12	16	24	30
72		12	16	24	30
84		12	16	24	30

Minimum Cover: 2 feet

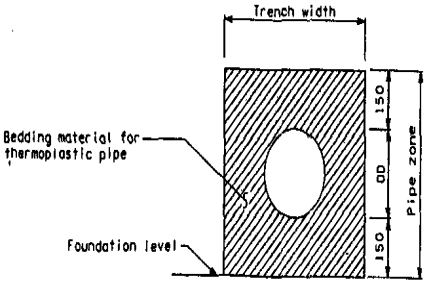
Fill Height Table 8-11.1 (English)
Concrete Pipe



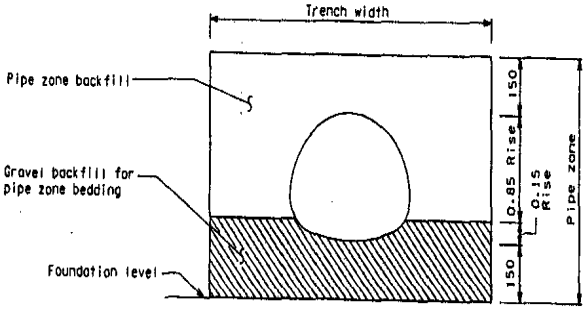
CONCRETE AND DUCTILE IRON PIPE

NOTES:

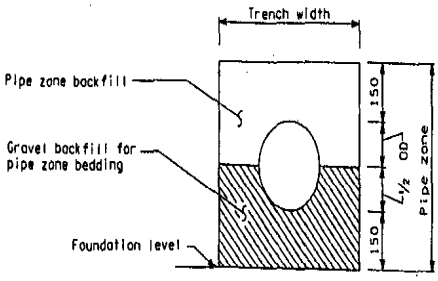
1. See Standard Specifications Section 7-08.3(3) for pipe zone backfill.
2. Trench width shall be as specified in Section 2-09.4 of the Standard Specifications.
3. For sanitary sewer installation, concrete pipe shall be bedded to spring line.



THERMOPLASTIC PIPE



PIPE ARCHES



METAL PIPE

CLEARANCE BETWEEN PIPES FOR MULTIPLE INSTALLATIONS		
PIPE	SIZE	MINIMUM DISTANCE BETWEEN BARRELS
CIRCULAR PIPE (DIAMETER)	300 to 600	300
	750 to 2400	DIA/2
	2550 to 4500	1200
PIPE ARCH METAL ONLY (SPAN)	450 to 900	300
	1075 to 3550	SPAN/3
	3700 to 5000	1200

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

PIPE ZONE BEDDING AND BACKFILL

STANDARD PLAN B-11

APPROVED FOR PUBLICATION

STATE DESIGN ENGINEER

DATE

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON

Pipe Materials

WSDOT uses many different types of pipe for many different uses on highway projects. There are 5 categories of pipe that are commonly used, as described below. Additional information on each of the pipe classifications can be found in Chapter 8 of the Hydraulics Manual

Drain Pipe

- Used to carry small amounts of water generated by roadway away from the road
- Does not cross under the main line of a state highway
- Used for: Private road approaches
  Simple slope drains
  Connecting underdrain pipe to storm sewer
- 25 year design life
- No protective treatment required

Underdrain Pipe

- Used to intercept groundwater
- Surrounded by gravel backfill
- Always perforated
- Protective treatment not required

Culvert Pipe

- A conduit used as an artificial channel under a roadway or embankment
- May require a protective coating
- Culverts from 12" to 30" dia are designated as schedule pipe (Standard Plan B-17)
- 50 year design life

Storm Sewer Pipe

- 3 or more pipes connected by inlets, catch basins, or manholes for the purpose of collecting pavement drainage.
- All storm sewers must be pressure tested.
- 50 year design life.
- Protective coatings similar to culvert pipe may be required.

Sanitary Sewer Pipe

- Pipes intended to transport sanitary waste water
- Pressure testing always required
- Generally use material specified by local sewer district

Culvert Pipe

Schedule Culvert Pipe

Pipe Arches

Structural Plate Arches

Private Road Approach and Driveway Culvert

Concrete Box Culverts

Concrete Three-Sided Structures

Culvert Pipe Schedules

Schedule (Fill Height)	Diameter in Inches	Concrete	Steel 2²/₃″ × ¹/₂″	Aluminum 2²/₃″ × ¹/₂″	Thermoplastic PE[1] or PVC[2]
	12, 15, 24	Plain or CI. IV	.064″ (16 Ga.)	.060″ (16 Ga.)	PE or PVC
A	30, 36	Class III	.064″ (16 Ga.)	.060″ (16 Ga.)	PE or PVC
2′ - 15′	42, 48	Class III	.064″ (16 Ga.)	.060″ (16 Ga.)	None
B	12, 15, 24, 30, 36	Class V	.064″ (16 Ga.)	.060″ (16 Ga.)	PVC
> 15′ - 25′	42, 48	Class V	.064″ (16 Ga.)	.060″ (16 Ga.)	None
C	12, 15, 24, 30,				
> 25′ - 40′	36, 42, 48	None	.064″ (16 Ga.)	.060″ (16 Ga.)	None
	12, 15, 24	None	.064″ (16 Ga.)	.060″ (16 Ga.)	None
D	30	None	.064″ (16 Ga.)	.075″ (14 Ga.)	None
	36	None	.064″ (16 Ga.)	.105″ (12 Ga.)	None
> 40′ - 60′	42, 48	None	.079″ (14 Ga.)	.105″ (12 Ga.)	None

1. Corrugated Polyethylene pipe
2. Polyvinyl Chloride pipe

The Contractor shall provide the schedule and diameter of culvert pipe called for on the Plans or Special provisions, and has the option of furnishing any of the acceptable alternates shown in the above table, except when specifically provided otherwise in the plans or special provisions.

8 - 2

Concrete

Plain or reinforced

Advantages	Disadvantages
Corrosion resistant	Limited fill heights
Abrasion resistant	Joints can pull apart/degrade
Low cover applications	Weight
Smooth interior	Hydrogen Sulfide
Rigid	

Corrugated Steel

Galv. or aluminized w/ helical, annular, or spiral rib corrug.

Advantages	Disadvantages
Wide range of sizes and shapes	Corrosion
Fill height	Abrasion
Lighter weight than concrete	Protective coatings
Availability	Roughness
	Pressure Testing

Corrugated Aluminum

Helical, annular, or spiral rib corrugations

Advantages	Disadvantages
Wide range of sizes and shapes	Abrasion
Fill height	Roughness
Light weight	Pressure Testing
Availability	
Corrosion resistant	

PVC

Solid wall or profile wall

Advantages	Disadvantages
Light weight	Size range
Corrosion resistant	Fill height
Abrasion resistant	Cost
Smooth interior	
Excellent joint	

HDPE

High density polyethylene)

Advantages	Disadvantages
Light weight	Size range
Corrosion resistant	Fill height
Abrasion resistant	Joint integrity
Smooth interior	
Cost	

8-3

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
QUALIFIED PRODUCTS LIST

January, 1997

Contract No:_____

Specification Reference / Material Category / Manufacturer/Supplier - City, State / Product Identification	File No		Accept. Code	Minor Qty Threshold	MQ Code	Last Update
9-05.13 Duct. Iron Sewer Pipe - 4 to 24 Inch Mech. Joint						
Pacific States Cast Iron - Provo, UT	*Bid Items:*					
Ductile Iron Sewer Pipe - 4 to 24 in. Mechanical Jointed. See Std. Plans & Contract Plans.	96-127	CA	2010	25 LF. 10 m	3001	5/1/93
9-05.19 Corrugated Polyethylene Culvert Pipe						
Advanced Drainage Systems,Inc. - Washougal, WA	*Bid Items:*		*Field Verified By:*		*Date:*	
ADS N-12, , meeting the specifications of AASHTO M-294 Type S and Std. Spec. 9-05.19, sizes 12 in. - 36 in.	96-230	A	3001	None	9999	11/28/95
Hancor, Inc. - Findlay, OH	*Bid Items:*		*Field Verified By:*		*Date:*	
Hancor Hi-Q, , meeting the specifications of AASHTO M-294 Type S and Std. Spec. 9-05.19, sizes 12 in. - 36 in.	96-229	A	3001	None	9999	11/28/95
9-05.20 Corrugated Polyethylene Storm Sewer Pipe						
Advanced Drainage Systems,Inc. - Washougal, WA	*Bid Items:*		*Field Verified By:*		*Date:*	
ADS N-12, , meeting the specifications of AASHTO M-294 Type S and Std. Spec. 9-05.20, sizes 12 in. - 24 in.	96-991	A	3001	None	9999	11/28/95
Hancor, Inc. - Findlay, OH	*Bid Items:*		*Field Verified By:*		*Date:*	
Hancor Hi-Q, meeting the specifications of AASHTO M-294 Type S and Std. Spec. 9-05.20, sizes 12 in. - 24 in.	96-987	A	3001	None	9999	6/28/96
9-05.21 Misc. Drainage Str. - Oil Separator						
Boral Cascade Culvert Company - Arlington, WA	*Bid Items:*		*Field Verified By:*		*Date:*	
Fabricated pipe elbows or tees in various sizes to connect to the out-flow pipe. May include a trash screen on the over-flow side.	96-021	A	3001	None	9999	10/15/94
Con-Tech Construction Products - Hillsboro, OR	*Bid Items:*		*Field Verified By:*		*Date:*	
Fabricated pipe elbows or tees in various sizes to connect to the out-flow pipe. May include a trash screen on the over-flow side.	96-047	A	3001	None	9999	10/15/94
Northwest Culvert Company - Spokane, WA	*Bid Items:*		*Field Verified By:*		*Date:*	
Fabricated pipe elbows or tees in various sizes to connect to the out-flow pipe. May include a trash screen on the over-flow side.	96-106	A	3001	None	9999	10/15/94
Oregon Culvert Co., Inc. - Tualatin, OR	*Bid Items:*		*Field Verified By:*		*Date:*	
Fabricated pipe elbows or tees in various sizes to connect to the out-flow pipe. May include a trash screen on the over-flow side.	96-114	A	3001	None	9999	10/15/94

See Appendix "A" for a listing of ACCEPTACE CODES. All products with an acceptance code beginning with "3" requires a "Field Acceptance Report". The report to be completed by WSDOT field personnel prior to use of the materials. New, updated or revisions are noted by Bold Face Dates in the Last Update Column.

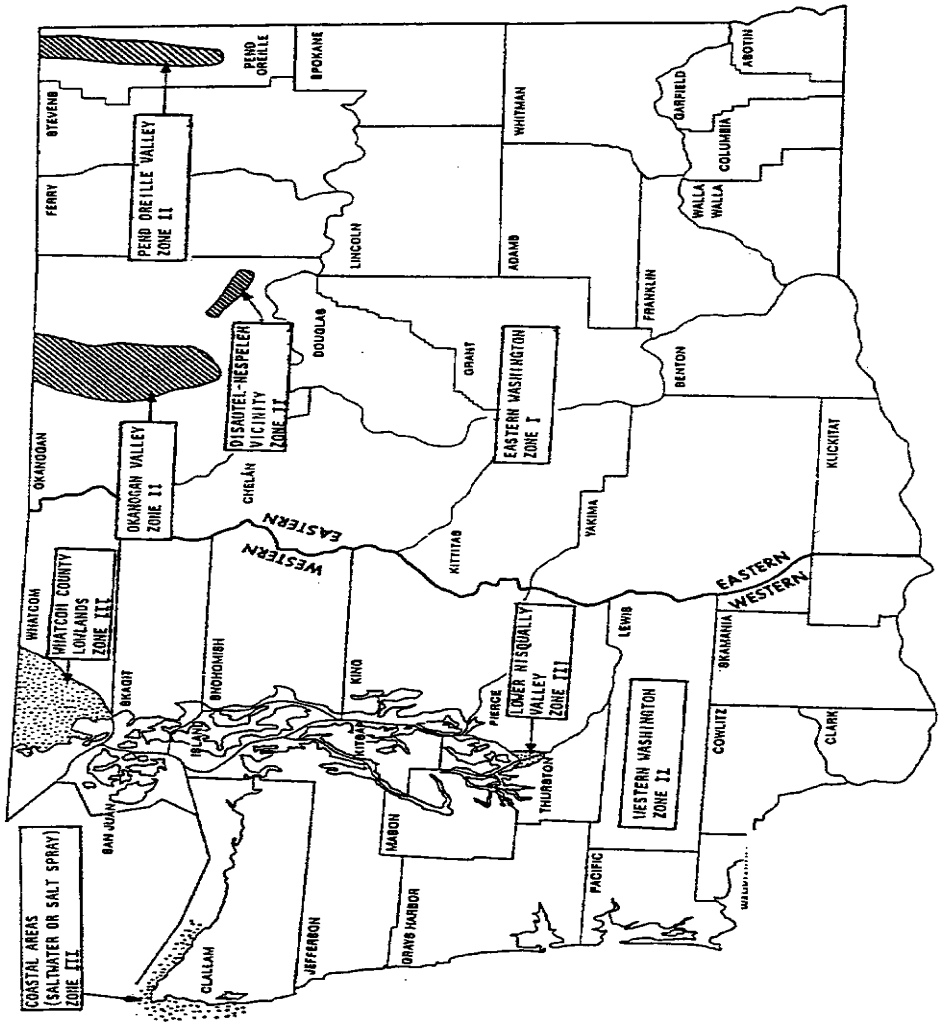


Figure 8-4
Pipe Corrosion Zones

8-5

Corrosion Zones and Protective Coatings

Corrosion Zone I - Most of Eastern WA

Acceptable Materials:
- Plain galvanized steel pipe
- Untreated aluminized steel
- Untreated aluminum alloy
- Concrete pipe
- PVC and HDPE

Corrosion Zone II - Most of Western WA

Acceptable Materials:
- Treated galvanized steel pipe
- Untreated aluminized steel
- Untreated aluminum alloy
- Concrete pipe
- PVC and HDPE

Corrosion Zone III - Coastal areas, bays, marshes, and tide flats

Acceptable Materials:
- Fiber bonded galvanized steel pipe
- Treated aluminized steel
- Aluminum alloy
- Concrete
- Thermoplastic

Metal Pipe Coatings:

Treatment 1: Coated uniformly inside and out with asphalt

Treatment 2: Same as above, but with an asphalt paved invert

Treatment 3: Embeded fibers in conjunction with asphalt coating

Treatment 4: Same as above, but with an asphalt paved invert

Treatment 5: Outside coated with asphalt, inside coated to the top of corrugations

Treatment 6: Same as above, but with embedded fibers

Washington State Department of Transportation

RECEIVED Intra-Departmental Communication

NOV 18 1992

DESIGN OFFICE

Date: November 9, 1992

From: G. Schneider / J. Katzer
Scan 467-6543

Subject: PROJ. NO. OL-0990 SR 97 C.S. 2002
SECTION: Centerville to Goldendale
M.P. 7.53 TO M.P. 13.37 BY J.K.

To: M. Clark / J. Horrocks

LAB # 6713 DATE/TRANS # 11-09-92

DETERMINING MINIMUM RESISTIVITY AND pH OF SOIL AND WATER

TEST SAMPLE			TEST RESULTS				
ITEM	STATION	OFFSET	pH	RESISTIVITY READINGS IN OHMS			
#1	285+00	INLET	6.4	8,000	4,150	3,950	4,000
#2	312+75	24' RT.	6.7	2,400	1,300	1,000	1,400
#3	312+75	24' RT.	7.3	STANDING WATER IN DITCH			
#4	464+70	30'LT.	6.3	4,200	2,700	2,650	2,900

REMARKS: Limitations for these results are found in the Hydraulics Manual under section 8-5.4, 8-5.5. The final Resistivity results are circled.

T-870 (4)
T-871 (3)

Mat'l Files 7365/Oly
Dist. Admin. HEISE X
Proj. Engr. M. Clark 2
Hydraulics KF01/7329X

District 4 pH417
WSDOT TEST METHOD NO. 417

MATERIALS ENGINEER

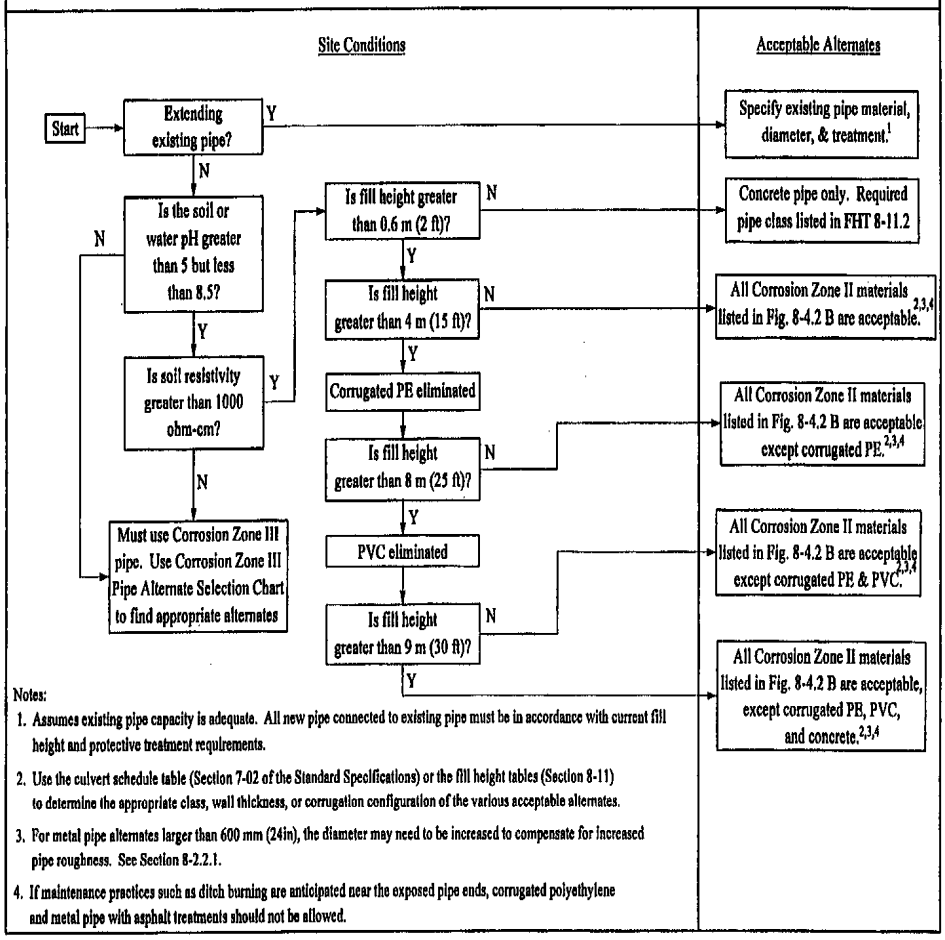
BY Glenn S Schneider

DATE NOV 09 1992

8-7

DOT 700-005 (x) Rev 10/89

Figure 8-4.2 A
Culvert / Storm Sewer Pipe Alternate Selection Chart
Corrosion Zone II



Notes:

1. Assumes existing pipe capacity is adequate. All new pipe connected to existing pipe must be in accordance with current fill height and protective treatment requirements.
2. Use the culvert schedule table (Section 7-02 of the Standard Specifications) or the fill height tables (Section 8-11) to determine the appropriate class, wall thickness, or corrugation configuration of the various acceptable alternates.
3. For metal pipe alternates larger than 600 mm (24in), the diameter may need to be increased to compensate for increased pipe roughness. See Section 8-2.2.1.
4. If maintenance practices such as ditch burning are anticipated near the exposed pipe ends, corrugated polyethylene and metal pipe with asphalt treatments should not be allowed.

8-11

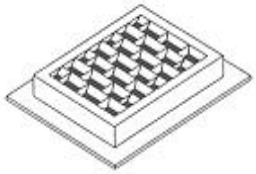
Figure 8-4.2A
Corrosion Zone II
Culvert/Storm Sewer Pipe Alternate Selection Chart Figure

Culverts	Storm Sewers
Schedule Pipe: Schedule____ Culv. Pipe Galvanized Steel alternate shall have Tr. 2 If schedule pipe not selected: ***Concrete:*** • Plain Conc. Culv. Pipe • Cl.____Reinf. Conc. Culv. Pipe ***PVC:*** • Solid Wall PVC Culv. Pipe • Profile Wall PVC Culv. Pipe ***Polyethylene:*** • Corrugated Polyethylene Culv. Pipe ***Steel:*** • Tr. 2 Galvanized Steel Culv. Pipe • Plain Aluminized Steel Culv. Pipe ***Aluminum:*** • Plain Aluminum Culv. Pipe	***Concrete:*** • Plain Conc. Storm Sewer Pipe • Cl.____Reinf. Conc. Storm Sewer Pipe ***PVC:*** • Solid Wall PVC Storm Sewer Pipe • Profile Wall PVC Storm Sewer Pipe ***Polyethylene:*** • Corrugated Polyethylene Storm Sewer Pipe ***Steel:*** • Tr. 5 Galvanized Steel Storm Sewer Pipe • Tr. 2 Galvanized Steel Storm Sewer Pipe with gasketed or welded and remetalized seams • Tr. 5 Aluminized Steel Storm Sewer Pipe • Plain Aluminized Steel Storm Sewer Pipe with gasketed or welded and remetalized seams ***Aluminum:*** • Tr. 5 Aluminum Storm Sewer Pipe • Plain Aluminum Storm Sewer Pipe with gasketed seams ***Steel Spiral Rib:*** • Tr. 5 Galvanized Steel Spiral Rib Storm Sewer Pipe • Tr. 2 Galvanized Steel Spiral Rib Storm Sewer Pipe with gasketed or welded and remetalized seams • Tr. 5 Aluminized Steel Spiral Rib Storm Sewer Pipe • Plain Aluminized Steel Spiral Rib Storm Sewer Pipe with gasketed or welded and remetalized seams ***Aluminum Spiral Rib:*** • Tr. 5 Aluminum Spiral Rib Storm Sewer Pipe • Plain Aluminum Spiral Rib Storm Sewer Pipe with gasketed seams

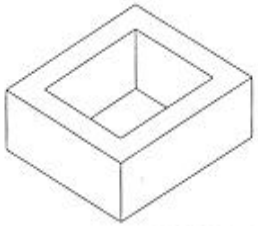
Figure 8-4.2B
Corrosion Zone II
Acceptable Pipe Alternates and Protective Treatments

Abrasion Level	General Site Characteristics	Recommended Invert Protection
Non Abrasive:	• Little or no bed load • Slopes less than 1% • Velocities less than 1 m/s (3 ft/sec)	Generally, the asphalt protective treatments required for corrosion and specified in Section 8-5.3.1 will provide adequate abrasion protection under these conditions.
Low Abrasive:	• Minor bed loads of sands, silts, and clays • Slopes 1% to 2% • Velocities less than 2 m/s (6 ft/sec)	Generally, the asphalt protective treatments required for corrosion specified in Section 8-5.3.1 will provide adequate abrasion protection under these conditions. An additional gauge thickness of metal pipe may be specified if existing pipes in the same vicinity have demonstrated susceptibility to abrasion.
Moderate Abrasive:	• Moderate bed loads of sands and gravels, with stone sizes up to about 75 mm (3 in.) • Slopes 2% to 4% • Velocities from 2 to 4.5 m/s (6-15 ft/sec)	Metal pipe should be specified with asphalt paved inverts or fiber bonded asphalt. The pipe thickness should be increased one to two standard gages, and the designer should consider concrete-lined metal pipe alternatives. Box culverts should be specified with an increased wall thickness.
Severe Abrasive	• Heavy bed loads of sands, gravel and rocks, with stone sizes up to 300 mm (12 in.) or larger • Slopes steeper than 4% • Velocities greater than 4.5 m/s (15 ft/sec)	Asphalt protective treatments will have extremely short life expectancies, sometimes lasting only a few months to a few years. Metal pipe thickness should be increased at least two standard gages, or the pipe invert should be lined with concrete. Box culverts should be specified with an increased wall thickness or an increased concrete compressive strength. Sacrificial metal plates, channels, or rails may need to be installed in the pipe invert to increase the service life. It is recommended that either the Region Hydraulics Section/Contact or the OSC Hydraulics Branch be contacted for additional guidance when designing this type of invert protection. Thermoplastic pipe exhibits better abrasion characteristics than metal or concrete. However, it generally cannot be reinforced to provide additional invert protection and is not recommended in this condition.

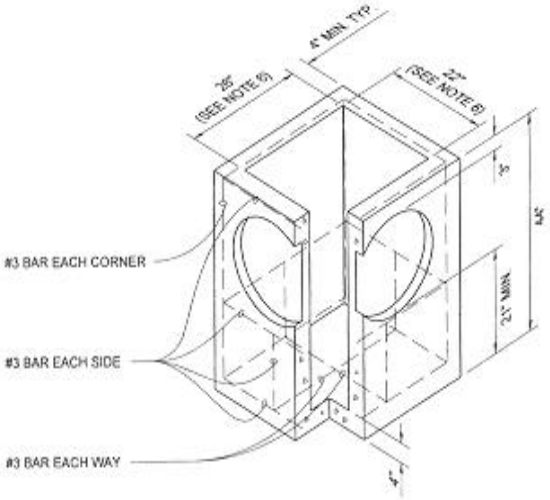
Figure 8.6
Pipe Abrasion Levels



FRAME AND VANED GRATE



RECTANGULAR ADJUSTMENT SECTION



PRECAST BASE SECTION

NOTES

1. As an acceptable alternate to rebar, wire mesh having a minimum area of 0.12 square inches per foot may be used. Wire mesh shall not be placed in knockouts.
2. The knockout diameter shall not be greater than 20". Knockouts shall have a wall thickness of 2" minimum to 2.5" maximum. Provide a 1.5" minimum gap between the knockout wall and the outside of the pipe. After the pipe is installed, fill the gap with joint mortar in accordance with Std. Spec. 9-04.3.
3. The maximum depth from the finished grade to the pipe invert shall be 5'.
4. Frame and grate may be installed with flange down or cast into adjustment section.
5. The precast base section may have a rounded floor and the walls may be sloped at a rate of 1:24 or steeper.
6. Opening shall be measured at the top of the precast base section.

PIPE ALLOWANCES

PIPE MATERIAL	MAXIMUM INSIDE DIAMETER
REINFORCED OR PLAIN CONCRETE	12"
ALL METAL PIPE	15"
CPSSP * (Std. Spec. 9-05.20)	12"
SOLID WALL PVC (Std. Spec. 9-05.12(1))	15"
PROFILE WALL PVC (Std. Spec. 9-05.12(2))	15"

* CORRUGATED POLYETHYLENE STORM SEWER PIPE

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CATCH BASIN TYPE 1

STANDARD PLAN B-1

APPROVED FOR PUBLICATION
Clifford E. Mansfield 9/21/01
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DATE	REVISION	BY

Washington State Department of Transportation

American Public Works Association
Washington State Chapter

Technical Commentary
for
Standard Plan B-1
Catch Basin Type 1

General Information

Background: Catch basins are primarily used to collect pavement runoff and to act as a junction for a storm drain systems. Catch basins differ from manholes in that catch basins are constructed with a sump below the pipe invert. The sump collects sediment and debris entering the catch basin through the grate inlet. The collected material is typically removed by hand or by the use of a vactor truck. Catch basins differ from grate and drop inlets shown in the B-4 series of the Standard Plans in that the B-4 inlets have much larger grates with more flow capacity. Catch basins differ from the concrete inlet shown in Standard Plan B-26 in that the concrete inlet has no sump to catch sediments that may enter through the grate.

Maximum Pipe Size: The maximum pipe size that can be placed in a Type 1 catch basin is dependent on the maximum knockout size and the outside diameter of the pipe. Type 1 catch basins are provided with a maximum knockout size of 20 inches. It is recommended that a gap of at least 1.5 inches be provided between the knockout wall and the outside of the pipe. The gap facilitates pipe installation into the catch basin. Once the pipe is installed, the gap is filled with concrete grout. Therefore, the maximum pipe outside diameter that should be inserted into the knockout is 17 inches.

The relationship between the inside diameter of the pipe and outside diameter of the pipe varies, depending on the pipe material used. The following table demonstrates the typical outside diameter of various pipe materials accepted by WSDOT for storm sewer applications:

Inside Diameter (in)	Table 1 Typical Outside Diameters of Various Pipe Materials (in.)					
	Concrete[1]	Metal[2] $2^2/_3 \times {}^1/_2$	Metal[2] 3 x 1	HDPE[3]	Profile Wall PVC[4]	Solid Wall PVC[5]
12	17	13	14	15	13.5	12.5
15	21	16	17	18	16.5	16

8-15

1. Reinforced or plain
2. The number refers to the corrugation pitch and depth, and are the same for both steel or aluminum.
3. High density polyethylene Stand Spec. 9-05.20
4. Standard Spec. 9-05.12(1)
5. Standard Spec 9-05.12 (2)

Using 17 inches as the maximum O.D. for pipe that can be installed in a Type 1 catch basin, the maximum allowable pipe inside diameter that should be specified is as follows:

Table 2
Maximum Allowable Inside Pipe Diameter for Type 1 Catch Basins

Concrete	Metal $2^2/_3 \times {}^1/_2$	Metal 3 x 1	HDPE	Profile Wall PVC	Solid Wall PVC
12 in.	15 in.	15 in.	12 in.	15 in.	15 in.

If the inside diameter of the pipe to be used is larger than that shown in Table 2, a larger catch basin, such as a Type 1A or Type 2, must be specified.

Pipe Alternates: Most contracts allow a number of pipe alternates to be used. A Type 1 catch basin should be chosen for use only if it is large enough to accept all of the specified pipe alternates for that location. For example, if a contract called for 12-inch diameter storm sewer pipe and all of the alternates listed in Table 2 were specified, a Type 1 catch basin would be appropriate. However, if the contract called for 15-inch storm sewer pipe and all of the alternates listed in Table 2 were specified, a Type 1 catch basin would not be appropriate. The next largest catch basin, a Type 1L, should be specified.

Maximum Depth: The maximum depth for this structure, as well as the Type 1L and Type 1P catch basins, is specified as 5 feet. The depth is measured from the pipe invert to the finished roadway grade. Division 7-05.3 requires that all catch basins be watertight. In order to meet this requirement, it is often necessary to access the catch basin to regrout the sides of the catch basin or to remortar the joint between the pipe and the catch basin wall. Exceeding the 5-foot depth significantly increases the difficulty in performing these repairs. It is recommended that a Type 2 catch basin be specified when the maximum depth exceeds 5 feet.

The maximum depth is not a concern regarding routine maintenance such as cleaning because catch basins are cleaned with the use of a vactor truck. The vacuum systems on most vactor trucks can effectively draw material from depths up to 15 feet.

Catch Basin Taper: The catch basin is tapered to facilitate removing the catch basin from the forms after it has been fabricated. Often the catch basin is fabricated upside down, which results in the top being larger than the bottom. All thickness and width dimensions are measured at the top of the base section.

Flow Rate Through the Catch Basin: The flow rate through the catch basin is generally controlled by either the grate inlet or the pipes entering or exiting the catch basin. The storage capablity provided by the catch basin is relatively small and should be ignored in storm sewer calculations.

Frame and Grate: The technical commentary for Standard Plan B-2a discusses installing the frame and grate with the flange down or cast into the riser, as described on note 6 of this Standard Plan.

Applicable Specifications

6-02.3	Construction Requirements for Concrete Structures
7-05	Manholes, Inlets, and Catch Basins
9-05.15(2)	Metal Frame, Grate and Solid Metal Cover for Catch Basins or Inlets
9-07.7	Wire Mesh
9-12.4 and 5	Precast Concrete Manholes and Catch Basins

Referenced Standard Plans

B-2a	Metal Frame and Grate for Catch Basin and Inlet
B-2b	Vaned Grate
B-1z	Miscellaneous Catch Basin Details

Other Information

Standard Item Number: 3091
Catch Basin Maintenance - Chapter 7-1.2 WSDOT *Highway Runoff Manual*

This commentary sheet is maintained by the Olympia Service Center Hydraulics Branch. Please send any suggestions for additions or modifications to :

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TRENCHLESS TECHNOLOGY

Common Methods:

Slipline and Grout

Pipe Bursting

Cured In Place

Fold and Form

Spot Repairs

Examples: SR 506 MP 8 2/97
Existing 42" RCP 100' long
Sliplined w/ 36" HDPE SRD 19
Total Cost: $30,000
Time: 2 days, no road closure

Alternative: Remove 3,000 cy of material, replace culvert, rebuild embankment. Staging would be very difficult.

SR 2 MP 37.5
Existing 12", 24" and 30" pipes, each approximately 120' long
Burst the 12", slipline and grout the 24" and 30"
Total Cost (Bid Estimate): $60,000
Time: 4-5 days, no road closures

Alternative: Remove approximately 6,000 cy of material, replace culverts, rebuild embankment. Staging would be very difficult

Manhole Rehabilitation