

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

(Revised July 2024)

OVERVIEW

Storm runoff accumulates pollutants, sediment, and debris as it flows over the landscape until it reaches a receiving waterway - the Lake of the Ozarks. These pollutants, sediments, and debris include oils and petroleum residues, animal refuse, garbage, organic debris from vegetation, silts, sands, and other objectionable materials. The U.S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources, Water Pollution Control Division, considers these pollutants to have adverse effects upon the human and aquatic life that uses the lake for habitat or recreational needs. The water quality of the Lake of the Ozarks is vital to the health and economic well-being of our residents, visitors, and community.

Storm drainage within the City of Osage Beach falls under regulatory authority of the U.S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MoDNR). The provisions of the U.S. Clean Water Act of 1978, Section 402 mandates the National Pollutant Discharge Elimination System (NPDES) and requires permitting for specific types of non-point pollutant sources under Phase II (Final Rule dated December, 1999) for areas where more than one acre of natural ground cover is disturbed. In addition, it mandates other control measures for designated cities, industries, and locations. The City of Osage Beach is not currently designated as a small city with a separate storm water system (MS4) or required to have a NPDES Permit. Several of the Phase II requirements do apply to the City. It is the policy of the City to reduce the contamination of the Lake of the Ozarks to comply with NPDES Phase II to the extent practicable for the city

The City of Osage Beach complies with these requirements through City Code, Title IV Land Use, Section 410.350 thru 410.380 and the applicable portions of the Osage Beach Design Guidelines.

GOALS AND OBJECTIVES

The goal and objective of the City of Osage Beach's Storm Water Management Plan is to manage storm water drainage within the city limits so as to minimize the pollution of the Lake of the Ozarks and to prevent storm water run-off damage to the maximum extent practicable.

The primary source of visible pollutants during storm runoff is through sediment and debris picked up on construction sites or locations where the natural vegetation has been removed. The major secondary source is through volatile fuels, oils, animal wastes, and refuse picked up by storm runoff as it flows off large parking areas, roofs and over the terrain in route to the lake. These sources of contamination will be addressed separately through the application of a Sediment Control Plan and/or a Storm Drainage Plan.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

Recent developments in the Storm Drainage Compliance area have led to the development of “Best Management Practices” (BMPs) and less emphasis on retention facilities. Also, the trend is toward reduction of contamination by:

- 1) reducing the quantity of storm water runoff
- 2) reducing or removing the contamination of the runoff
- 3) by conveying the storm run-off without further contamination.

Our goal is to reduce the pollution of the lake through public education, awareness, and the application of MoDNR Best Management Practices (BMPs). Our immediate objective is to manage the storm drainage system to reduce collectable sediment or pollutants entering the lake and/or causing damage to adjacent or downstream properties.

The following design guidelines will establish the minimum steps or procedures required to reach these goals and objectives.

EROSION & SEDIMENT CONTROL PLAN

- A. The Erosion and Sediment Control Plan shall be submitted as a part of the building permit process and shall be reviewed and approved by the City Engineer prior to the start of any onsite work for any and all projects involving two or more lots or ½ acre, whichever shall be the smaller.

Note: The MoDNR requires a Land Disturbance Permit for construction disturbance activities of one or more acres. Permitting with MoDNR is the responsibility of the property owner or their representative.

1. The Sediment Control Plan must be prepared by a Registered Professional Engineer in the State of Missouri stating the goals of the plan and depicting the locations and details of the construction of all sediment control devices to be utilized on the project during construction.
2. The plan shall clearly set out the contractor’s schedule and requirements for maintaining the integrity of the plan.
3. The primary goal of the plan is to assure that no visible or measurable sediment or debris is allowed to leave the developed area.
4. The devices and measures utilized shall follow the recommended “Best Management Practices” as described in the publication “Protecting Water Quality” by MoDNR and as directed herein. At the minimum the following shall be required:
 - a. Wire backed silt fencing with steel tee-posts or an approved equal method shall be installed around the downhill edges of the disturbed area.
 - b. Earth berms and swales shall be used to reduce sheet flow volumes and velocities.
 - c. Straw bale check dams, earth berms and other BMPs shall be utilized as necessary to prevent run-off from carrying sediment and debris off site.
 - d. Check dams or other BMPs shall be used to reduce velocities in areas of concentrated flow.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

- e. Approved engineering fabric or erosion control matting shall be used in all drainage courses or ditches where flow velocities exceed 5 fps. Velocities shall be calculated and included with permit submittal.
 - f. All denuded slopes or embankments shall be protected from erosion by the installation of earthen berms, straw bale dikes, or other appropriate BMPs.
 - g. Temporary catch basins, drop inlets and/or storm drains (culverts) shall be utilized as necessary to convey concentrated flow and prevent erosion.
 - h. Temporary sediment basins shall be provided for each drainage area with one or more acres disturbed at one time. Basins shall be maintained until final stabilization is achieved as approved by the City Engineer. Each sediment basin shall be sized, at a minimum, to provide a total storage volume of 4,000 cubic feet per acre of contributing area. The sediment basin shall include an outlet structure designed for the slow release of stored runoff to allow for sedimentation in the basin. A perforated riser wrapped in filter fabric and covered with a mound of clean 2-inch stone is the City's preferred outlet structure.
 - i. Depict existing and proposed contours.
 - j. Clearly depict the entire drainage area effecting the development site including downstream areas that will be affected by storm water run-off or drainage and upstream areas that contribute to the site.
 - k. The installation of all BMPs shall be inspected and approved by the City Engineer and the Engineer of Record prior to commencing land disturbance activities. The Engineer of Record shall provide a letter to the City stating he or she approves the installation of the BMPs. Phased projects may require multiple approvals.
 - l. Where soil disturbing activities on site have ceased either temporarily or permanently and will not resume for a period of 14 calendar days, stabilization shall be initiated immediately and completed within 14 calendar days. All denuded slopes or areas shall be reseeded with appropriate seed, fertilizer, and for final stabilization, approved slope stabilization fabric or stone armoring shall be installed on all slope's steeper than 3:1.
 - m. Phased clearing and grading of sites is encouraged to minimize denuded areas and potential for erosion.
5. In the event that the plan is deficient or inadequate to prevent sediment escaping the jobsite, the Owner/Developer shall immediately take any and all measures necessary to stop and prevent further contamination, and to clean up contaminated areas.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

All calculation necessary for the Erosion and Sediment Control Plan shall be signed and sealed by an Engineer licensed in the State of Missouri and submitted with the permit application for review by the City Engineer. Calculations shall be prepared in a report format.

The City's Standard Erosion and Sediment Control Plan Note Block shall be included on the Plans prior to approval.

STORM DRAINAGE PLAN

- A. A Storm Drainage Plan is required for all new construction sites within the jurisdictional boundaries of the City of Osage Beach in which the construction or clearing for construction disturbs an area exceeding two lots or one-half acre, whichever shall be the smaller.
1. The Storm Drainage Plan shall be prepared by a Registered Professional Engineer in the state of Missouri stating the goals of the plan and depicting the locations and details of construction of all permanent sediment and drainage control devices, and post construction BMPs, to be utilized in the plan. The Storm Drainage Plan shall depict permanent drainage structures and post-construction BMPs.
 2. The plan shall clearly state owners schedule and requirements for maintaining the components of the system.
 3. The devices and measures utilized shall follow the recommended "Best Management Practices" as described in the publication "Protecting Water Quality" by and available through MoDNR, the City of Osage Beach City Code and the City of Osage Beach Design Guidelines
 4. At the minimum the Storm Drainage Plan shall provide the following technical data:
 - a. Clearly depict all permanent drainage structures, conveyance devices, and post construction BMPs.
 - b. Clearly depict the entire drainage area effecting the development site including downstream areas that will be affected by storm water run-off or drainage and upstream areas that contribute to the site.
 - c. Accurately calculate the anticipated storm run-off from a theoretical 25-year storm event. Storm duration shall be calculated to correspond to the time of concentration for the tributary drainage area.
 - d. Determine the anticipated flows and capacities of all channels, culverts and conveyance devices. Conveyance structures shall be designed utilizing the criteria in A.4.c of this Section.
 - e. Clearly identify and provide flow data for all velocity control and/or energy dissipation devices.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

5. At the minimum the Storm Drainage Plan shall provide the following post construction sediment and drainage controls:
 - a. Provide removal or containment of all silt, sediment, and debris carried onto or across the development so as to assure that no silt, sediment, or debris is allowed off the developed area. See Post Construction Water Quality.
 - b. Assure that all storm run-off is controlled such that no damage will occur to adjacent downstream properties or facilities. Stormwater detention requirements are as follows:
 1. The rates (pre-developed and post-developed) of runoff shall be determined for the 2-year, 25-year and 100-year rainfall frequencies. The storm duration shall be calculated to correspond to the time of concentration of the tributary area. Minimum storm duration shall be 20 minutes.
 2. Storm water shall be detained on site or on adjacent property under agreement and released at the rate of an undeveloped site for the above frequencies and minimum duration to prevent possible flooding and erosion downstream.
 3. In the event the natural downstream channel or storm sewer system is inadequate to accommodate the release rate provided above, then the allowable release rate shall be reduced to that rate permitted by the capacity of the downstream channel or storm sewer system.
 4. Detention basin volume and outlet structure will be based on routing each post-developed runoff through the detention facility while not exceeding the pre-developed run-off. The routing computation shall be based on an application of the continuity principle. The discharge rate shall be based on the maximum head conditions in the detention facility.
 5. Project site discharging via right-of-way, easement, or land owned by developer to the Lake of the Ozarks shall be exempt from stormwater detention requirements.
 6. Project sites with a differential runoff of less than 2 cfs for the 25-year event shall be exempt from stormwater detention requirements.
 7. All calculations necessary for stormwater detention design shall be signed and sealed by an Engineer licensed in the State of Missouri and submitted with the permit application for review by the City Engineer. Calculations shall be prepared in report format.
 - c. Where parking areas for more than twenty cars exist provide for removal of oils, grease and volatile wastes to the maximum practicable extent by the use of post construction BMPs.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

- d. Assure that conveyance discharges into the Lake of the Ozarks will have a velocity of less than 5 fps.

This can be accomplished by the use of BMPs, filtration devices, retainage and sedimentation collection basins, filtered curb inlets/manholes or other devices as approved by the City Engineer.

STORM DRAINAGE COMPUTATIONS

- A. The Rational Method shall be used for computation of stormwater run-off.
 1. The base storm event for computation of run-off volumes shall be a 25-year storm event.
 2. The Rational Method of computation shall be used as herein.

$$Q=CIA$$

Where:

- Q = Peak runoff in cubic feet per second (cfs)
I = Rainfall Intensity.¹
A = Area of watershed in acres. This area includes the actual area drained through or in addition to the developed area.
C = Coefficient (weighted by area)²

¹ Storm duration shall be calculated to correspond to the time of concentration for the tributary drainage area.

²Values of C categorized by surface:

<u>Surface Type</u>	<u>Value of C</u>
Impervious (asphalt pavement, concrete pavement, stone/rock surfaces, rooftops, etc.)	0.95
Pervious (greenspace, lawns, unimproved areas)	0.35

If more than one surface type is included in the drainage area, the designer shall calculate the weighted coefficient for use in runoff calculations.

All stormwater calculation shall be signed and sealed by an Engineer licensed in the state of Missouri and submitted with the permit application for review by the City Engineer. Calculations shall be prepared in a report format.

DESIGN OF DRAINAGE STRUCTURES AND DEVICES

- A. Culverts and Storm Drainage Piping Systems shall be designed using the Manning equation for open channel flow. Inlet conditions should be investigated and openings designed to handle the peak runoff condition. In addition, the following conditions shall be met:
1. The minimum pipe size shall be 18-inch diameter.
 2. Bedding shall be installed around the pipe from 6-inches below to 12-inches above the pipe. Bedding shall be crushed rock conforming to MoDOT Type 5 aggregate, Section 1007.
 3. The minimum grade shall guarantee a minimum velocity of 2.0 fps.
 4. Manholes or inlets shall be constructed at not more than 350-foot intervals and at all bends and changes of grade.
 5. All pipe shall be run true to line and grade between manholes or inlets.
 6. Outlets shall have intrusion gates to prevent entry by children or animals.
 7. Outlets shall end in an energy-dissipating device that will reduce the outlet flow velocity to less than 5 fps.
 8. Piping shall be designed to sustain any anticipated loading conditions
- B. Curb Inlets of the “Kansas City Type” are preferred. See Drawing No. IV-11
1. The length of Curb Inlet opening shall be determined as in Chapter IX of the MoDOT Project Development Manual.
 2. Floor of Inlet shall be shaped with invert to provide smooth flow.
 3. Locate manhole ring and cover over outlet.
 4. Each Inlet shall have cast iron steps spaced at 1'-4" centers vertically.
 5. Bevel all exposed edges with 3/4" chamfer or 1/2" tooled edge.
 6. On grade Inlets shall conform to the street grade and sump Inlets shall be level.
 7. The length plus the width shall not exceed 15-feet without special design.
 8. Each Inlet shall be placed on 4-inches compacted aggregate base.
 9. Each Inlet shall have a steel inlet frame.
 10. Each Inlet shall be designed to sustain any anticipated loading conditions. In no case shall materials and design not be sufficient to support an ASHTO HS-20 loading.
 11. Transition curb in 10-feet on the upstream side of inlet and in 5-feet on the downstream side. Transition in 10-feet on both sides for sump inlet. See detail.
- C. Open Channel Design
1. Open Channel Drainage shall be designed using the Mannings Equation for open channel flow. The channel shape maybe trapezoidal, rectangular or circular at the designer's discretion.
 - a. The channel depth shall be designed so that the peak runoff flow will be accommodated at 2/3rd of the channel depth.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

- b. Where channel depth will exceed 1-foot, a trapezoidal section with a maximum of 1:1 side slopes shall be used.
- c. Where flow velocity will exceed 2 fps engineering fabric or erosion mat shall be utilized. Selected fabric or mat shall be rated for the intended application. Velocities shall be calculated and included with permit submittal.
- d. Where velocity will exceed 5 fps riprap shall be installed to eliminate scouring. See Drawing No. IV-7. Velocities shall be calculated and included with permit submittal.

All stormwater calculation shall be signed and sealed by an Engineer licensed in the State of Missouri and submitted with the permit application for review by the City Engineer. Calculations shall be prepared in a report format.

POST CONSTRUCTION WATER QUALITY

- 1. It shall be required that appropriate filtration methods are used in order to assure that silt, sediment, and debris do not get into the conveyed storm drainage flow. Parking areas, roof tops and other similar surfaces (not including single or two family residential), will require the collection and isolation of silts, sediments, debris, oils, and volatile materials. Also see Storm Drainage Plan A.5.c. New developments that disturb less than one acre and are not part of a larger common plan of development that will disturb one or more acres over the life of the project are not required to meet the post construction water quality requirement. Water quality requirements shall not apply to City streets or new constructed streets to be dedicated to the City.

Approved filtering systems are as follows:

- 2. Fabricated Filtration Manholes or Curb Inlets
 - a. Several patented filtration devices are now available that can effectively reduce sediment discharges such as:
 - 1) Treatment systems such as Stormceptor
 - 2) Catch Basin or Curb Inlet inserts such as FloGard manufactured by Hancor, Inc. or Hydro-Kleen manufactured by ACF Environmental.
 - 4) Or several non-patented devices by various highway departments, etc.
- 3. Post Construction Sediment Basin
 - a. Sediment Basin volume, or WQV, shall be based on the following calculation:

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

$$WQV (ft^3) = (P/12)(R_v)(A*43,560)$$

Where

P = rainfall depth = 1 inch

R_v = volumetric runoff coefficient = $0.05 + 0.009I$

I = percent impervious cover (in percent, e.g. 80% = 80)

A = total site area in acres

- b. The inlet should be designed to prevent short-circuiting between entrance and discharge to the maximum extent practicable. This can be accomplished by providing baffles in the channel, turns in the channel, etc.
- c. The shape of the storage basin should allow for easy cleanout of sediment and debris. Proper maintenance is the responsibility of the property owner. Terrain and other site conditions will tend to dictate the shape of the facility. Sediment Basins with water depth greater than 4' shall be fenced for safety.
- d. The sediment basin shall include an outlet structure designed for the slow release of stored runoff to allow for sedimentation in the basin. A perforated riser wrapped in filter fabric and covered with a mound of clean 2-inch stone is the City's preferred outlet structure. Basin shall be designed to prevent permanent standing water.

The details of the design are at the discretion of the designer subject to approval of the City Engineer.

All stormwater calculation shall be signed and sealed by an Engineer licensed in the state of Missouri and submitted with the permit application for review by the City Engineer. Calculations shall be prepared in a report format.

CONSTRUCTION MATERIALS

- A. See Drainage ditches maybe stabilized earth, riprap, concrete, or other durable material.
- B. Retention basin inlets, basin, and outlet structures maybe of any durable material subject to the approval of the City Engineer.
- C. Storm drainage pipe and culvert pipe shall be reinforced concrete, or dual wall polypropylene pipe.
 1. All pipes at a minimum must be capable of sustaining an ASHTO HS-20 loading.
 2. The use of polypropylene pipe for storm drainage at drop inlets or in areas where leaf burning is allowed is prohibited.

Design Guidelines
City of Osage Beach
SECTION 4 - STORM DRAINAGE

D. Curb Inlets

1. Shall be prefabricated or cast-in-place.
 - a. Shall be place on 4-inches compacted aggregate base.
 - b. Reinforcement in footing shall be #4 bars on 6-inch centers both ways.
 - c. Reinforcement in walls shall be #4 bars on 12-inch centers both ways.
 - d. Reinforcement in lid shall be a minimum of six #4 bars placed at 45-degree angle. See detail.
2. Shall have a 10-inch throat galvanized steel inlet frame.
3. Cast iron manhole ring and cover, Neenah R-1537 or approved equal.
4. Cast iron step, Clay & Bailey No. 2101 or approved equal.

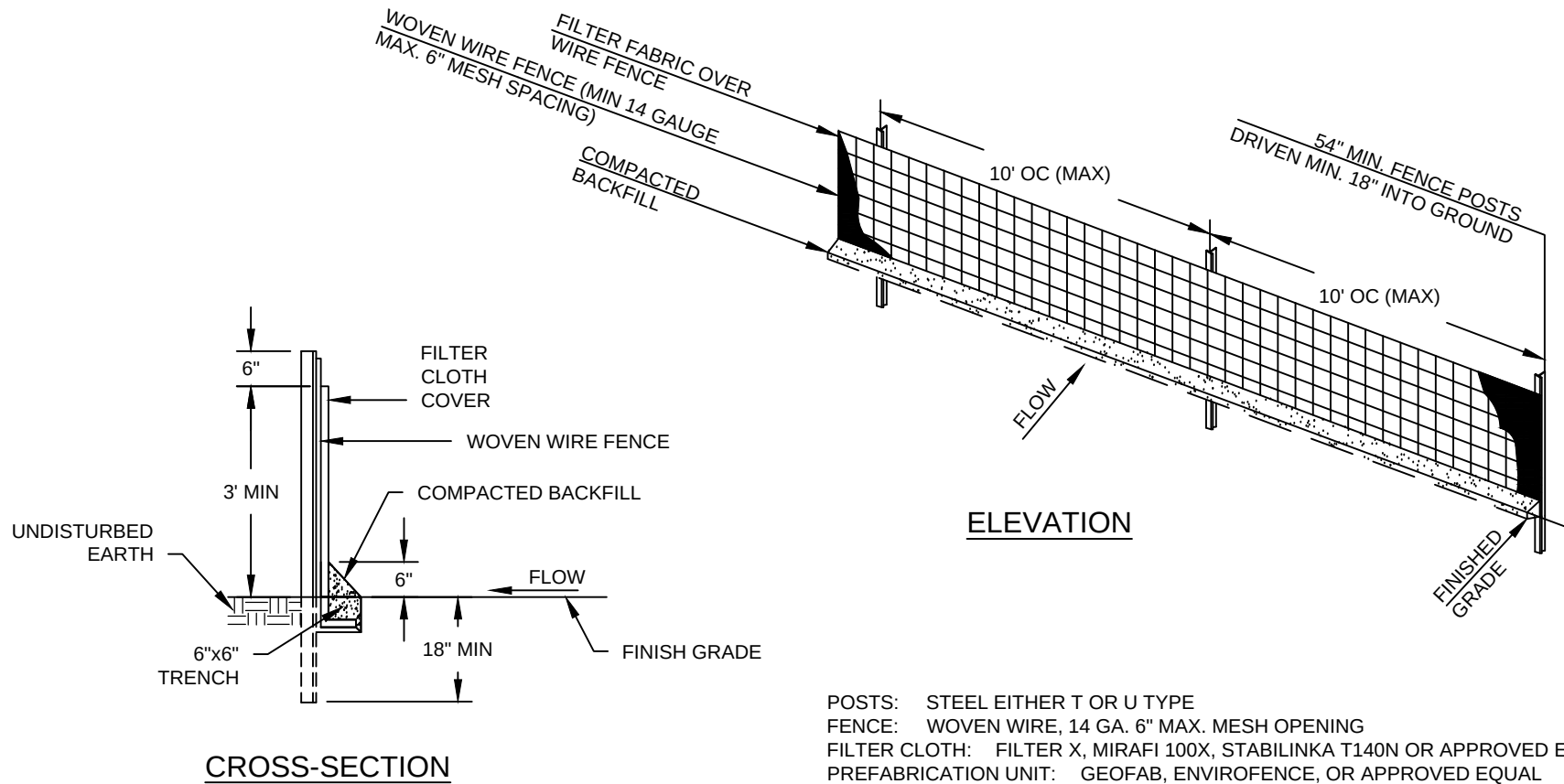
STORM DRAINAGE CONSTRUCTION DETAIL DRAWINGS

Construction details and sketches are attached.

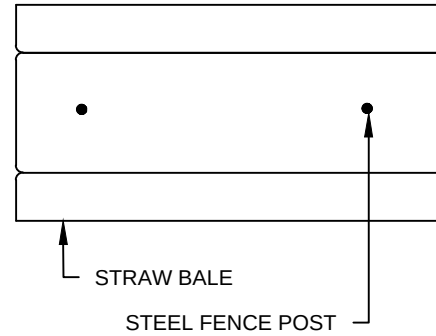
END

NOTES:

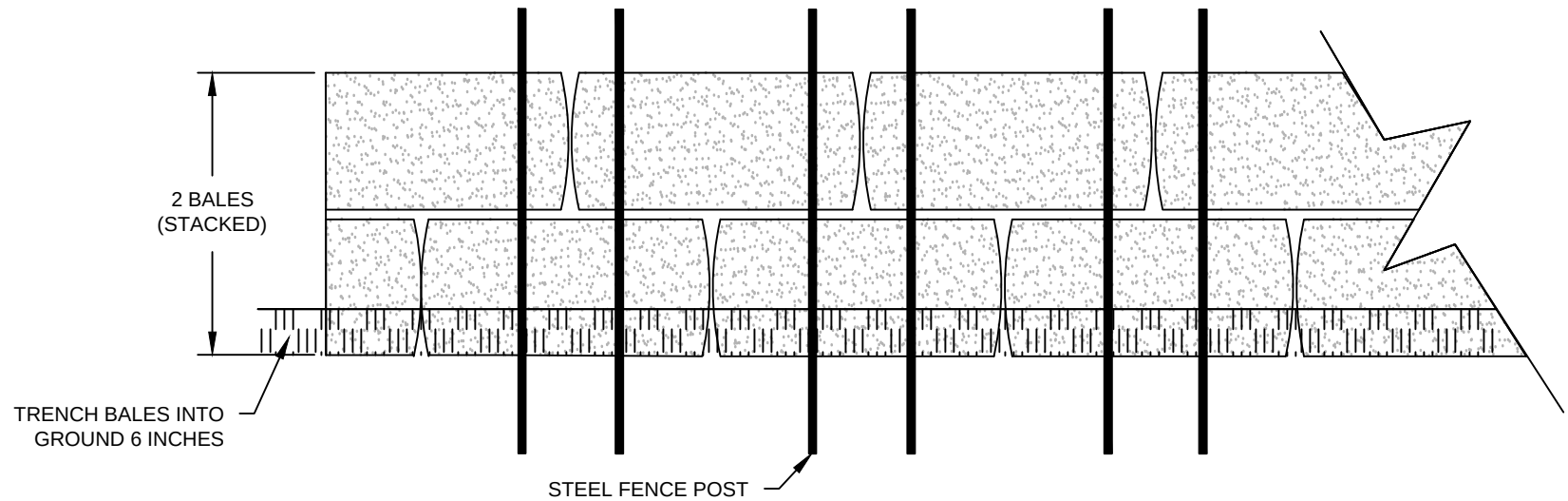
1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER, THEY SHALL BE OVERLAPPED BY 6" AND FOLDED.
4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.



Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL SILT FENCE	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-1



PLAN



FRONT

CITY OF OSAGE BEACH
TYPICAL DETAIL
STRAW BALE CHECK FENCE

Date Revised:
March, 2014

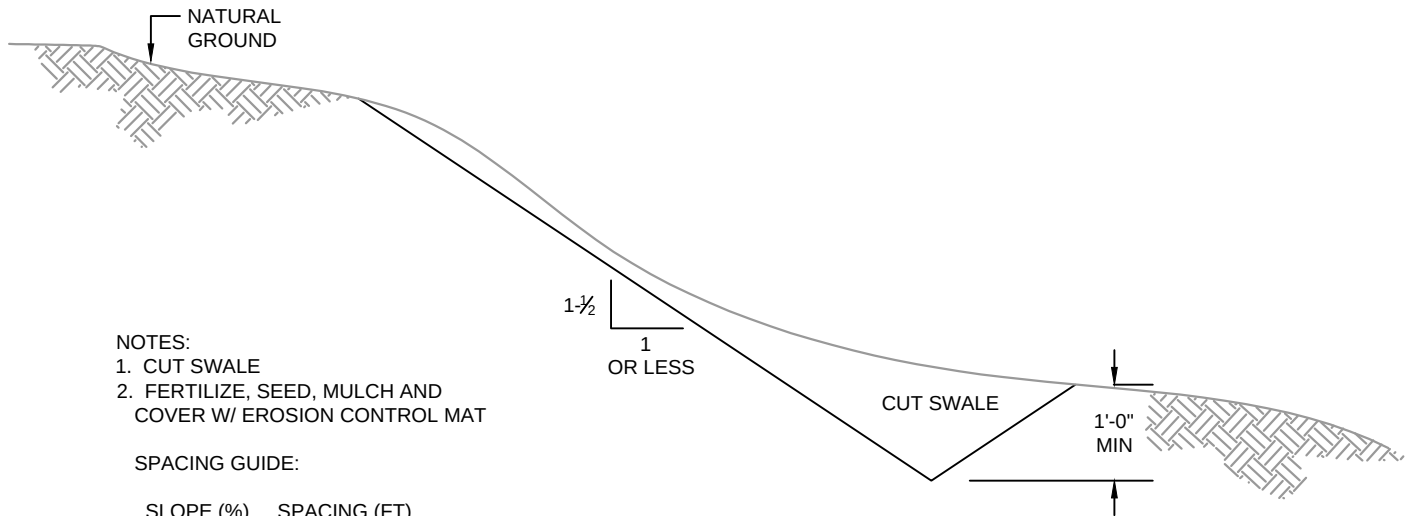
By:
SH

Checked By:
JB

Design Guideline:
SECTION 4

STORM DRAINAGE

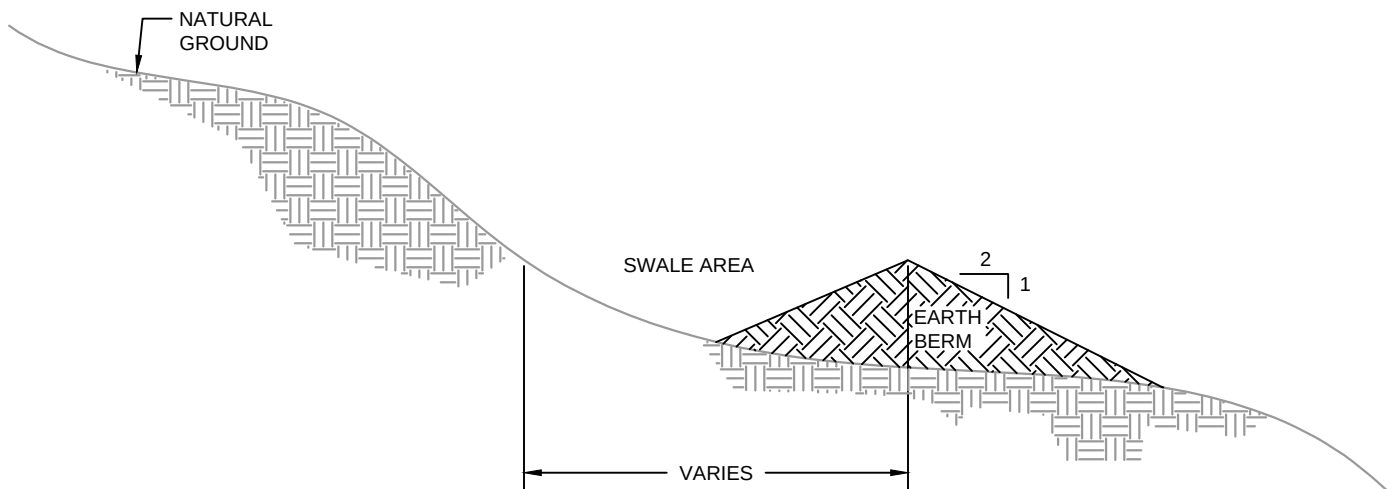
Drawing No:
IV-2



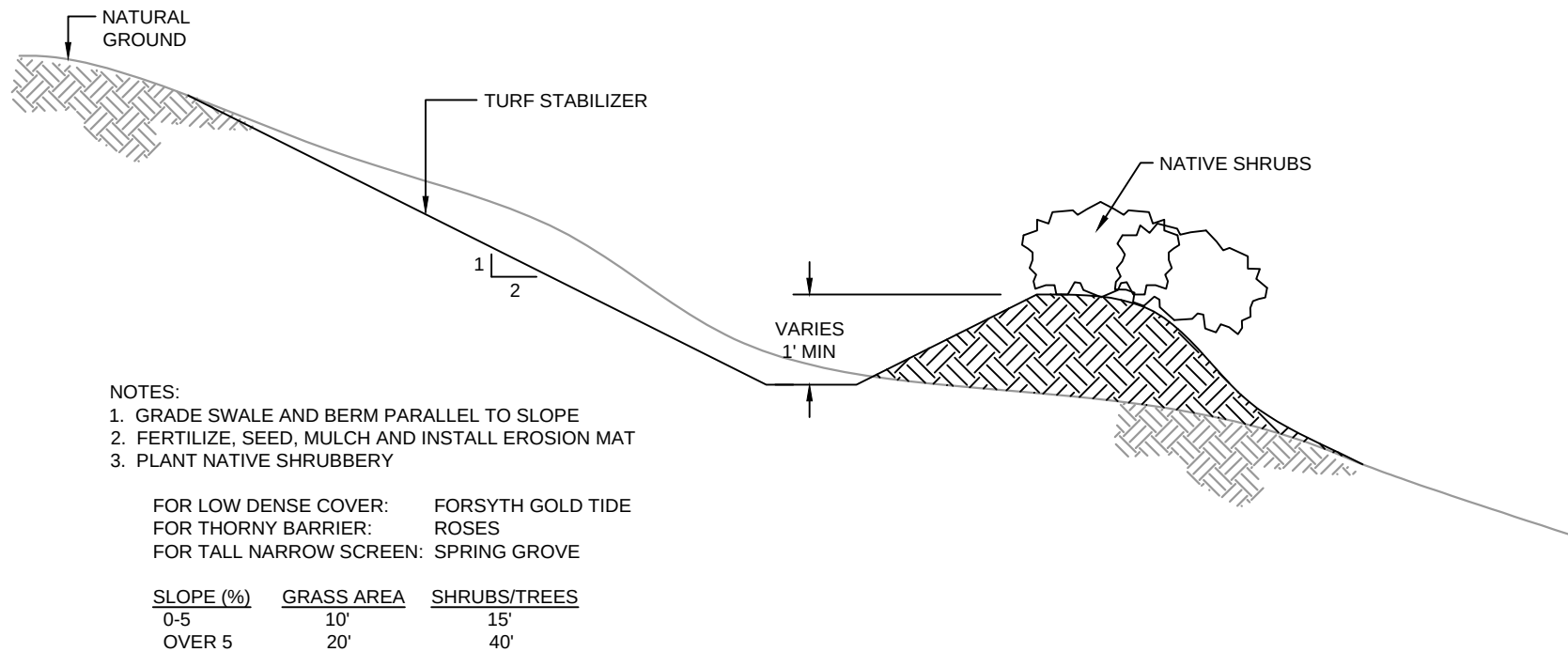
- NOTES:
 1. CUT SWALE
 2. FERTILIZE, SEED, MULCH AND COVER W/ EROSION CONTROL MAT

SPACING GUIDE:

SLOPE (%)	SPACING (FT)
33-50	20
25-33	40
15-25	60
10-15	80
6-10	120
3-6	200

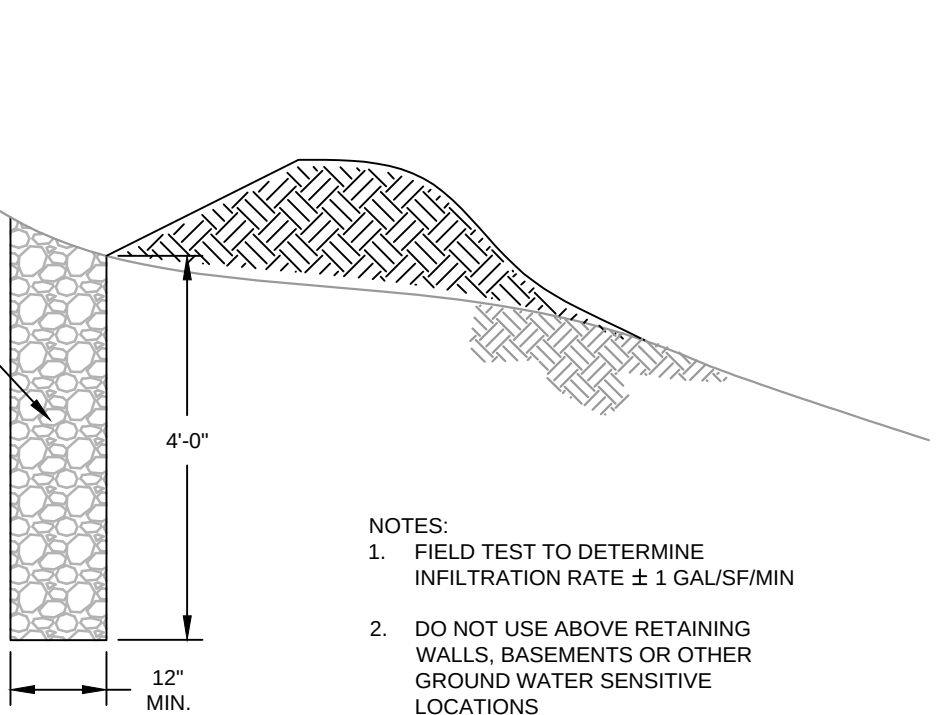


Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL SWALE	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-3



Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL VEGETATION BARRIER & SWALE	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-4

CLEAN $\frac{3}{4}$ " MINUS
AGGREGATE



NOTES:

1. FIELD TEST TO DETERMINE INFILTRATION RATE ± 1 GAL/SF/MIN
2. DO NOT USE ABOVE RETAINING WALLS, BASEMENTS OR OTHER GROUND WATER SENSITIVE LOCATIONS

Date Revised:
March, 2014

By:
SH

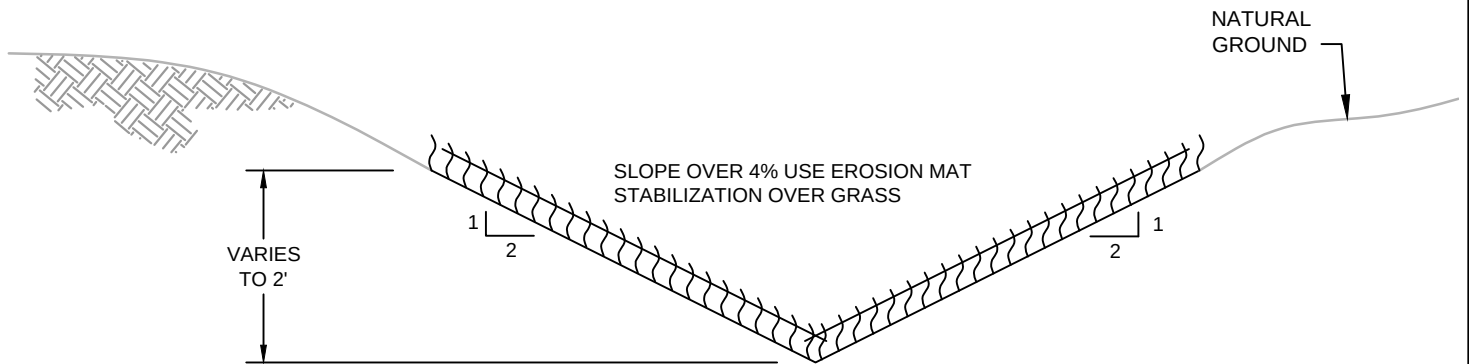
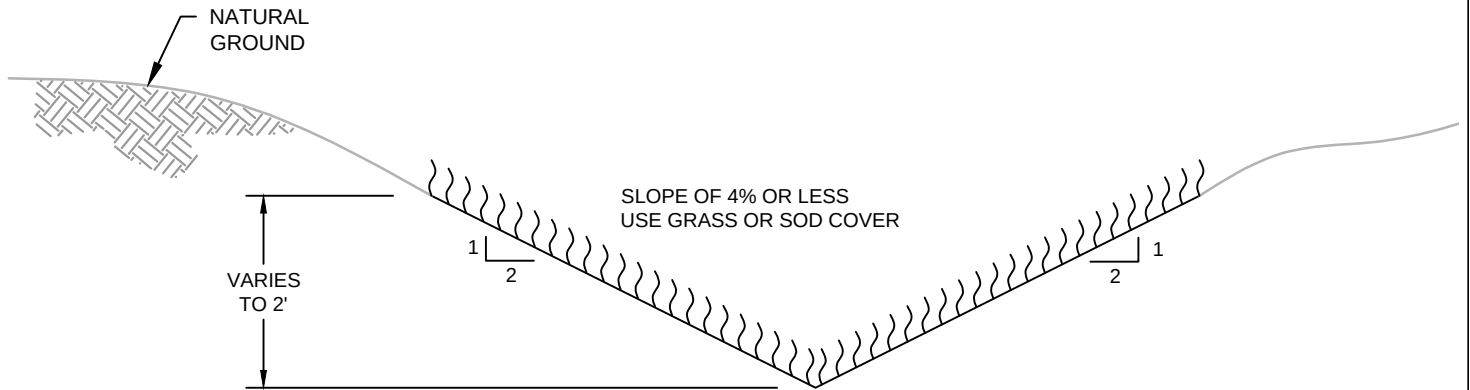
Checked By:
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CITY OF OSAGE BEACH
TYPICAL DETAIL
INFILTRATION TRENCH

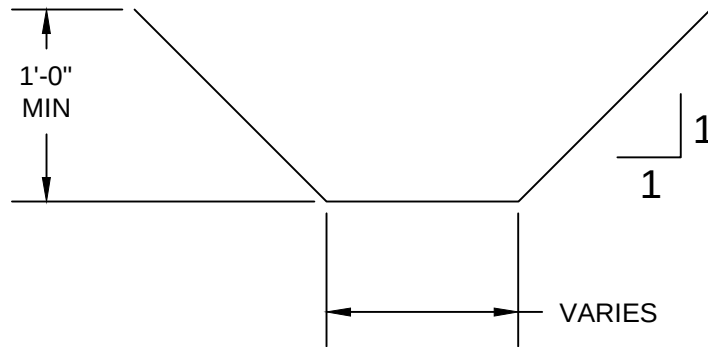
Design Guideline:
SECTION 4

STORM DRAINAGE

Drawing No:
IV-5



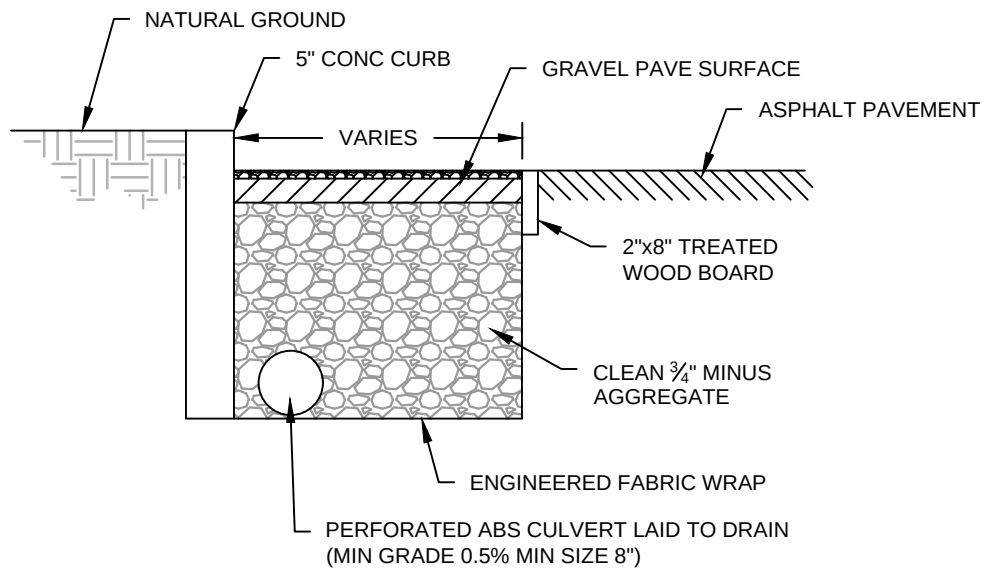
Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL DRAINAGE SWALE-GRASS OR TURF	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-6



NOTES:

1. VELOCITY LESS THAN 2 FPS - GRASS OR TURF
2. VELOCITY 2-5 FPS - TURF AND EROSION MAT
3. VELOCITY OVER 5 FPS - RIP-RAP MIN SIZE 3" SMALLEST DIMENSION

Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL OPEN DRAINAGE CHANNEL	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-7



NOTES:

1. WIDTH VARIES DEPENDENT UPON DRAINAGE AREA (PER MANUFACTURES RECOMMENDATION - 0.25 GPM/SF TARGET VALUE)
2. DIAMETER OF DRAIN DEPENDS ON FLOW
3. DEPTH DEPENDS ON SIZE OF DRAIN - MIN 16"

Date Revised:
March, 2014

By:
SH

Checked By:
JB

**CITY OF OSAGE BEACH
TYPICAL DETAIL
FILTER STRIP**

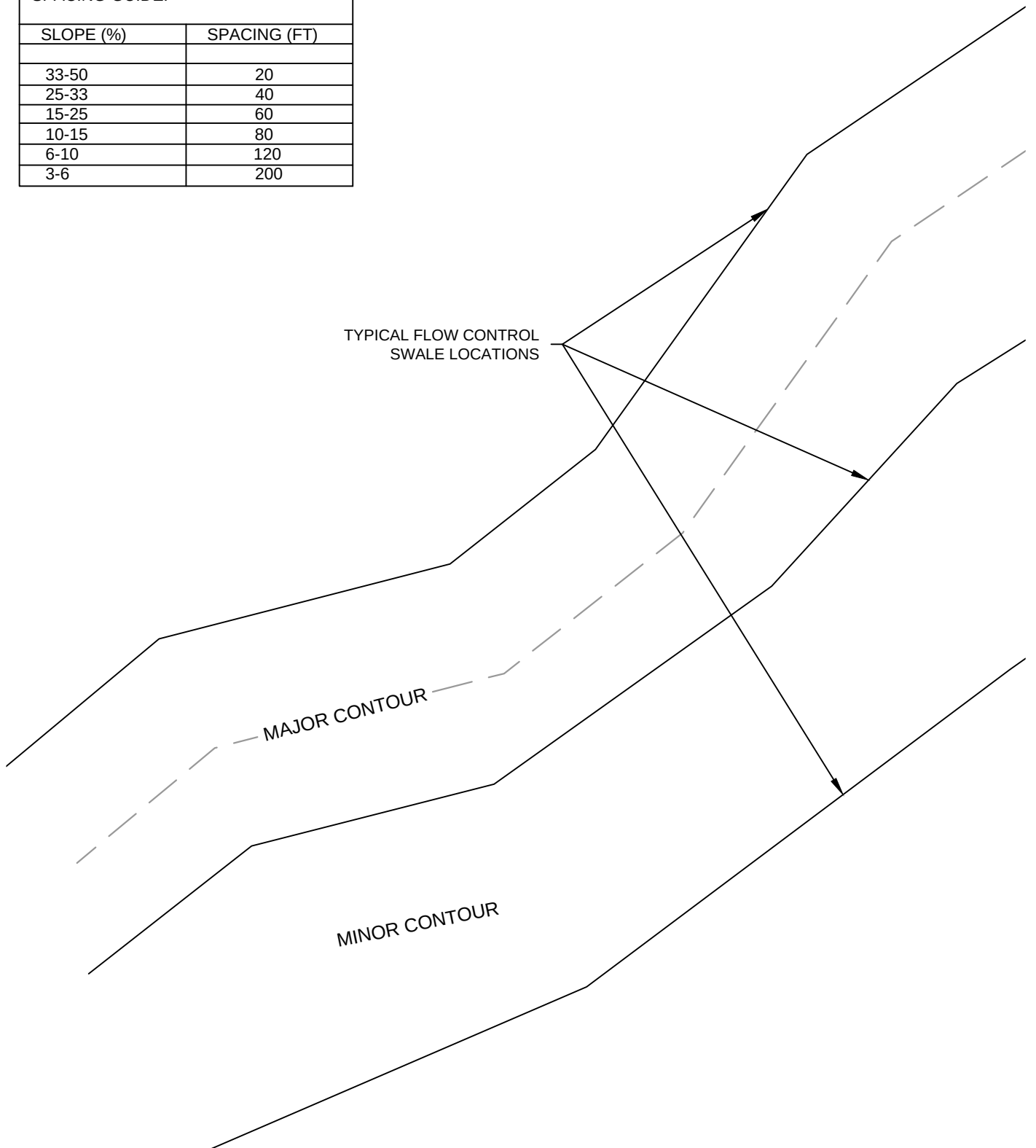
Design Guideline:
SECTION 4

STORM DRAINAGE

Drawing No:
IV-8

SPACING GUIDE:

SLOPE (%)	SPACING (FT)
33-50	20
25-33	40
15-25	60
10-15	80
6-10	120
3-6	200



Date Revised:
March, 2014

By:
SH

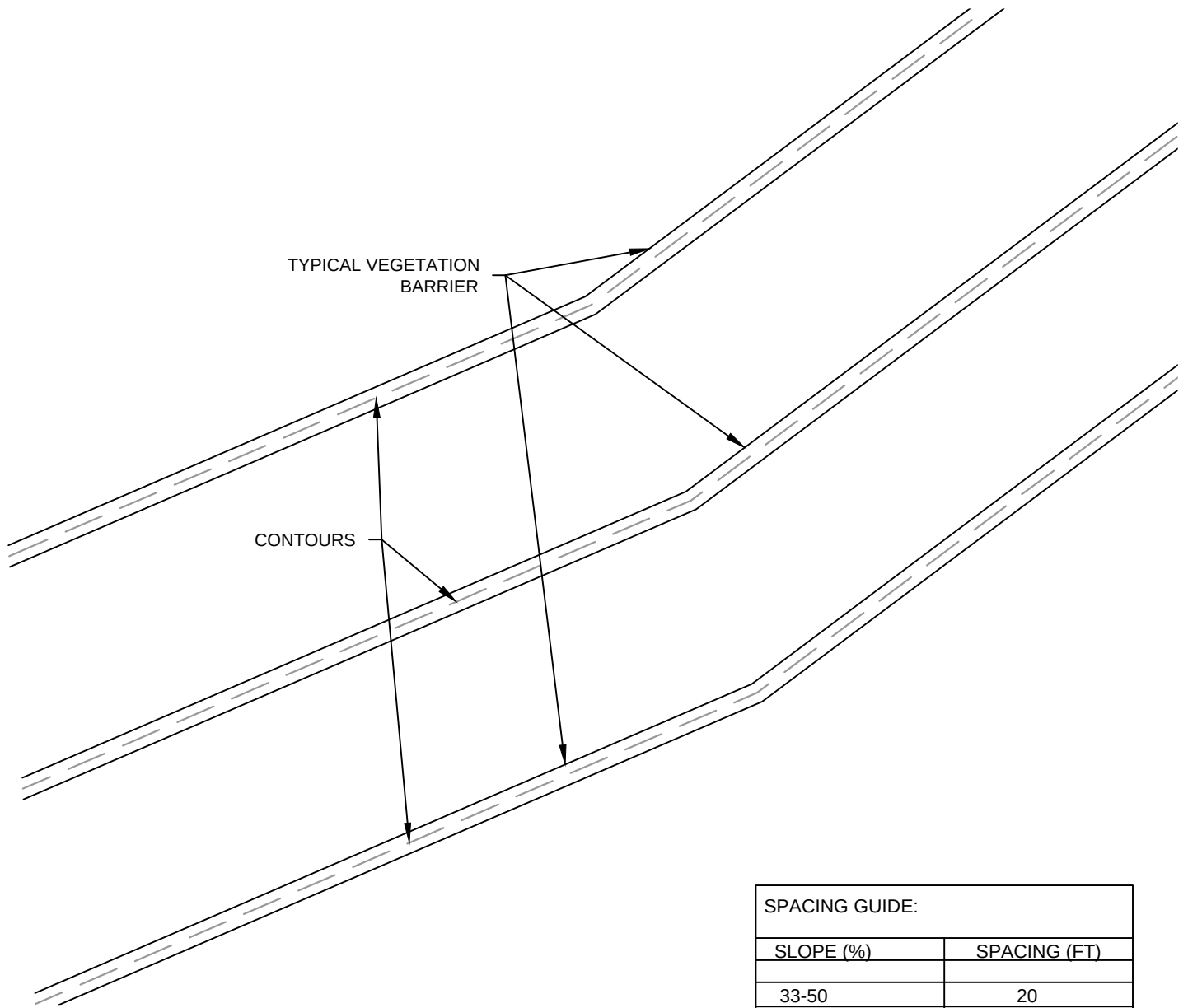
Checked By:
JB

CITY OF OSAGE BEACH
TYPICAL DETAIL
SWALE LOCATION

Design Guideline:
SECTION 4

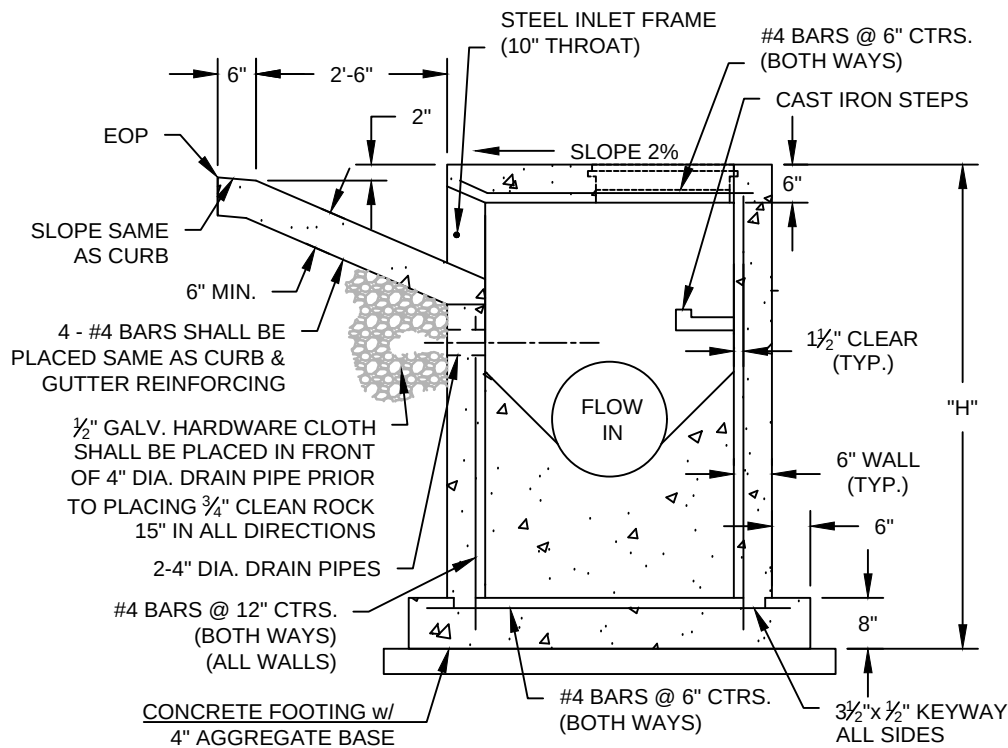
STORM DRAINAGE

Drawing No:
IV-9

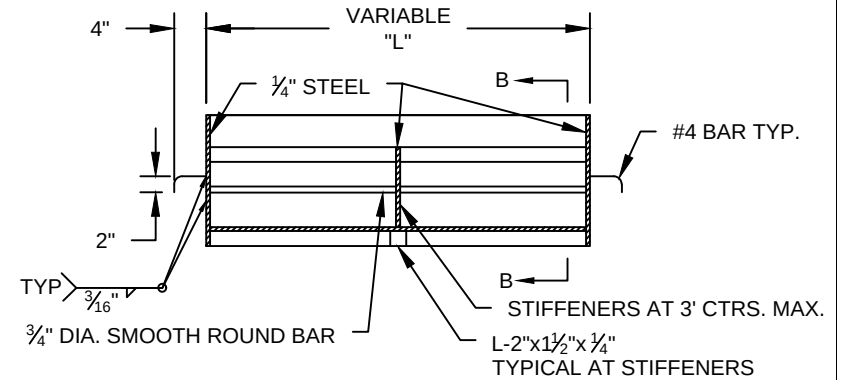


SPACING GUIDE:	
SLOPE (%)	SPACING (FT)
33-50	20
25-33	40
15-25	60
10-15	80
6-10	120
3-6	200

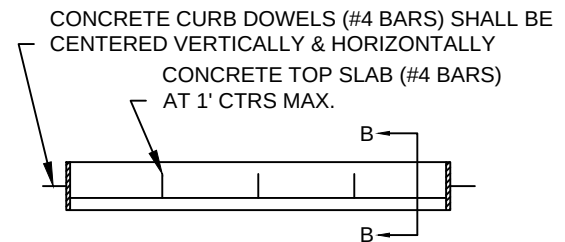
Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL VEGETATION BARRIER LOCATION	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-10



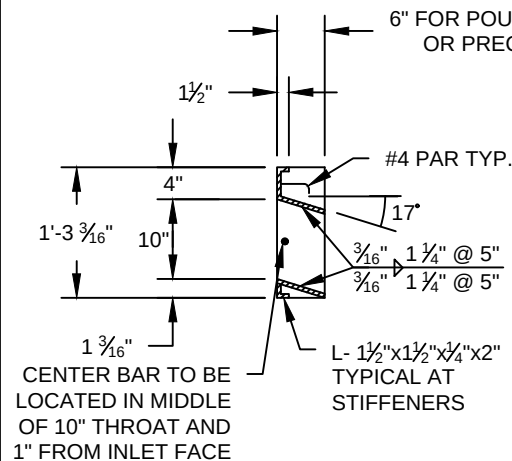
SECTION A-A



FRONT VIEW



TOP VIEW



SECTION B-B

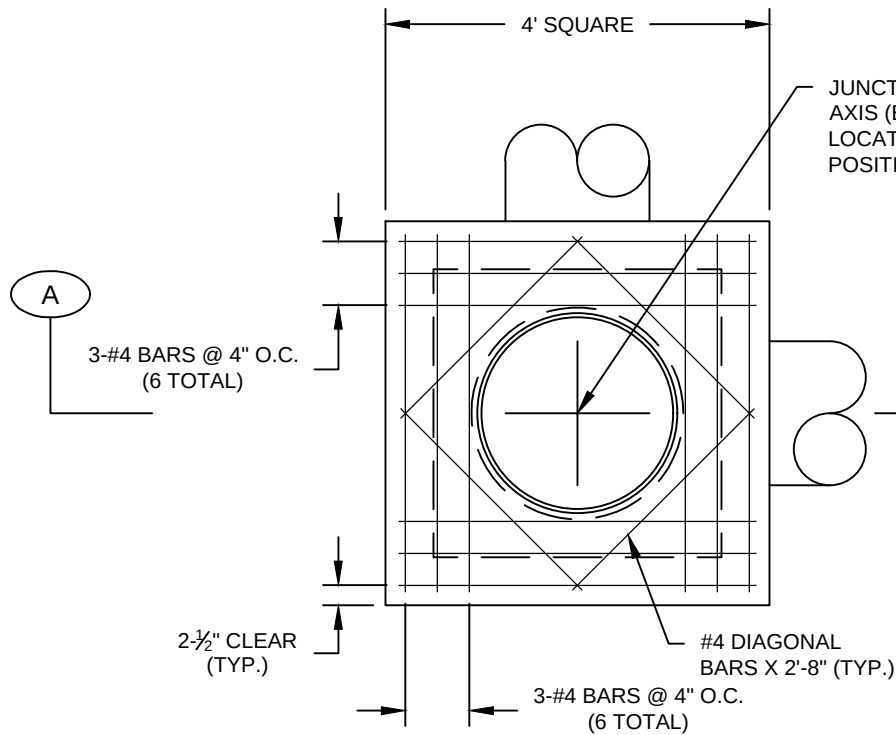
NOTES

1. ALL WELDS SHALL BE PERFORMED IN ACCORDANCE WITH APPROPRIATE AWS SPECIFICATIONS & PROCEDURES.
2. ALL WELDS ON EXPOSED SURFACES SHALL BE DRESSED SO AS TO PROVIDE A PLEASING FINISHED APPEARANCE.
3. THE ENTIRE FRAME SHALL BE GALVANIZED.

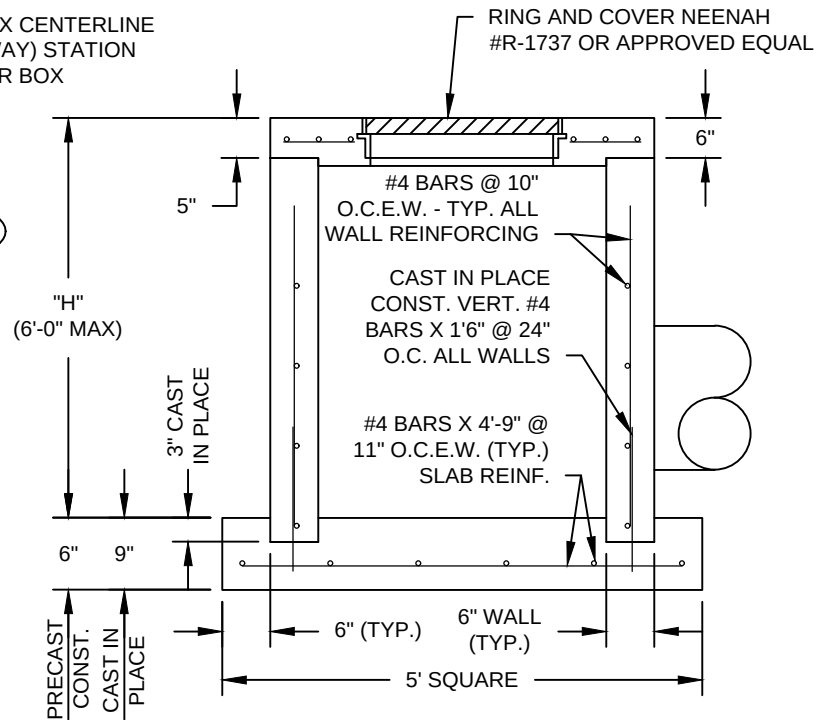
Date Revised:	March, 2014
By:	SH
Checked By:	JB

**CITY OF OSAGE BEACH
TYPICAL DETAIL
CURB INLET DETAILS**

Design Guideline:	SECTION 4
	STORM DRAINAGE
Drawing No:	IV-12

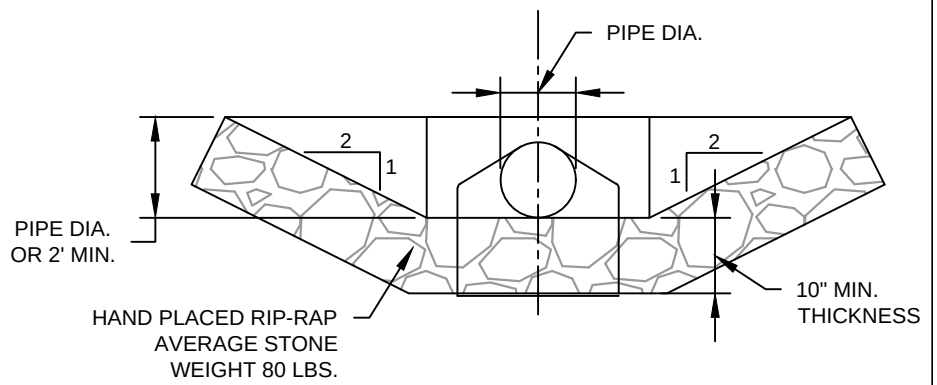


TOP - PLAN

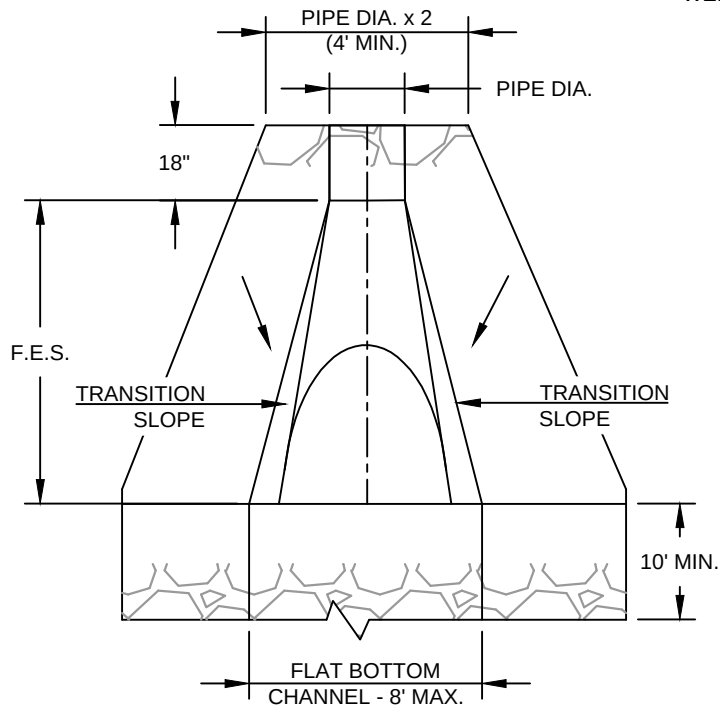


SECTION A-A

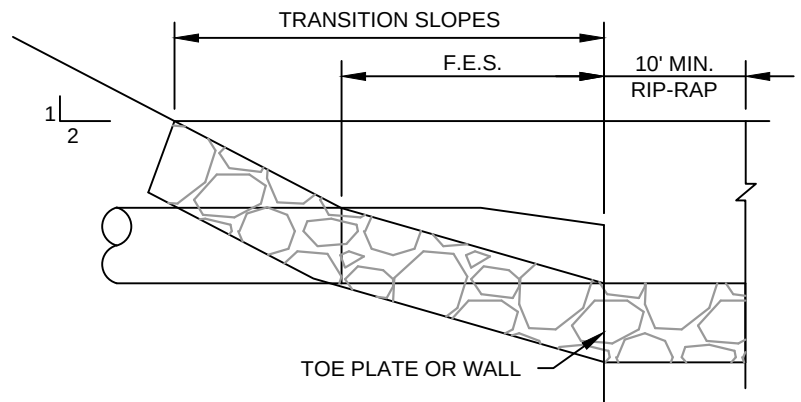
Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL JUNCTION BOX	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-13



END

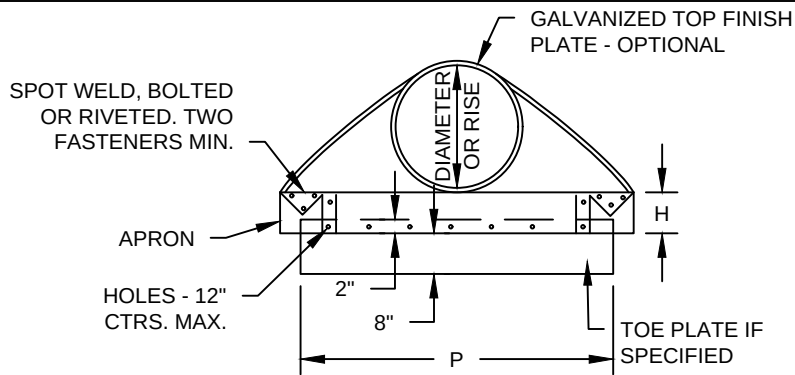


PLAN

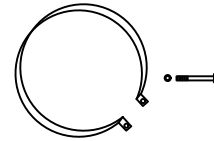


SECTION

Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL FLARED END SECTION w/ RIP RAP	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-14

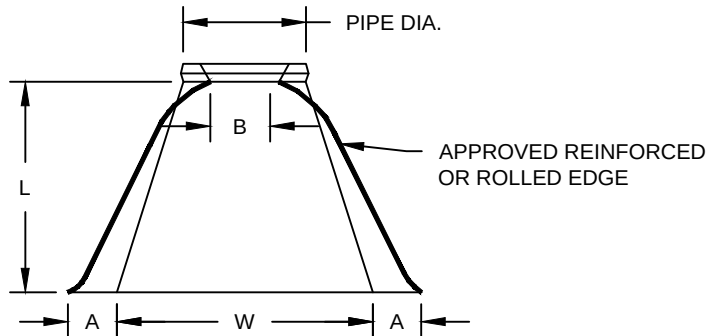


ELEVATION



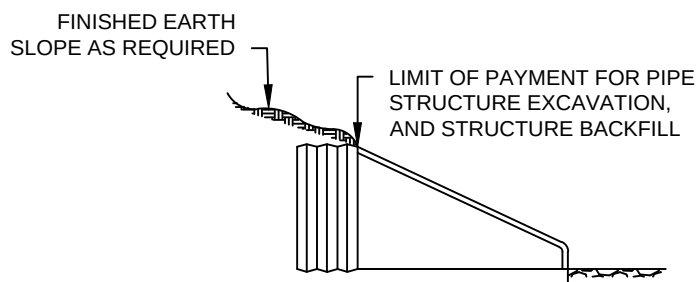
1 INCH WIDE 0.109" THICK CONNECTOR STRAP OF COMMERCIAL QUALITY STEEL. GALVANIZED WITH SAME WEIGHT COATING AS PIPE, AND 6" x 1/2" GALVANIZED BAND BOLT AND NUT. USE AS ALTERNATE ON CONNECTION.

CONNECTOR STRAP

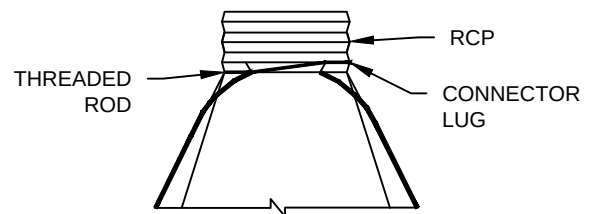


PLAN

END SECTION FOR ROUND PIPE								
PIPE DIA. (IN)	GALV. SHEET THICK (IN)	DIMENSIONS (IN)					APPROXIMATE SLOPE (V:H) (1:SLOPE)	TOE PLATE IF SPECIFIED P (IN)
		A 1" TOL.	B MAX.	H 1" TOL.	L 1-1/2" TOL.	W 2" TOL.		
18	0.064	8	10	6	31	36	2 - 1/2	46
21	0.064	9	12	6	36	42	2 - 1/2	52
24	0.064	10	13	6	41	48	2 - 1/2	58



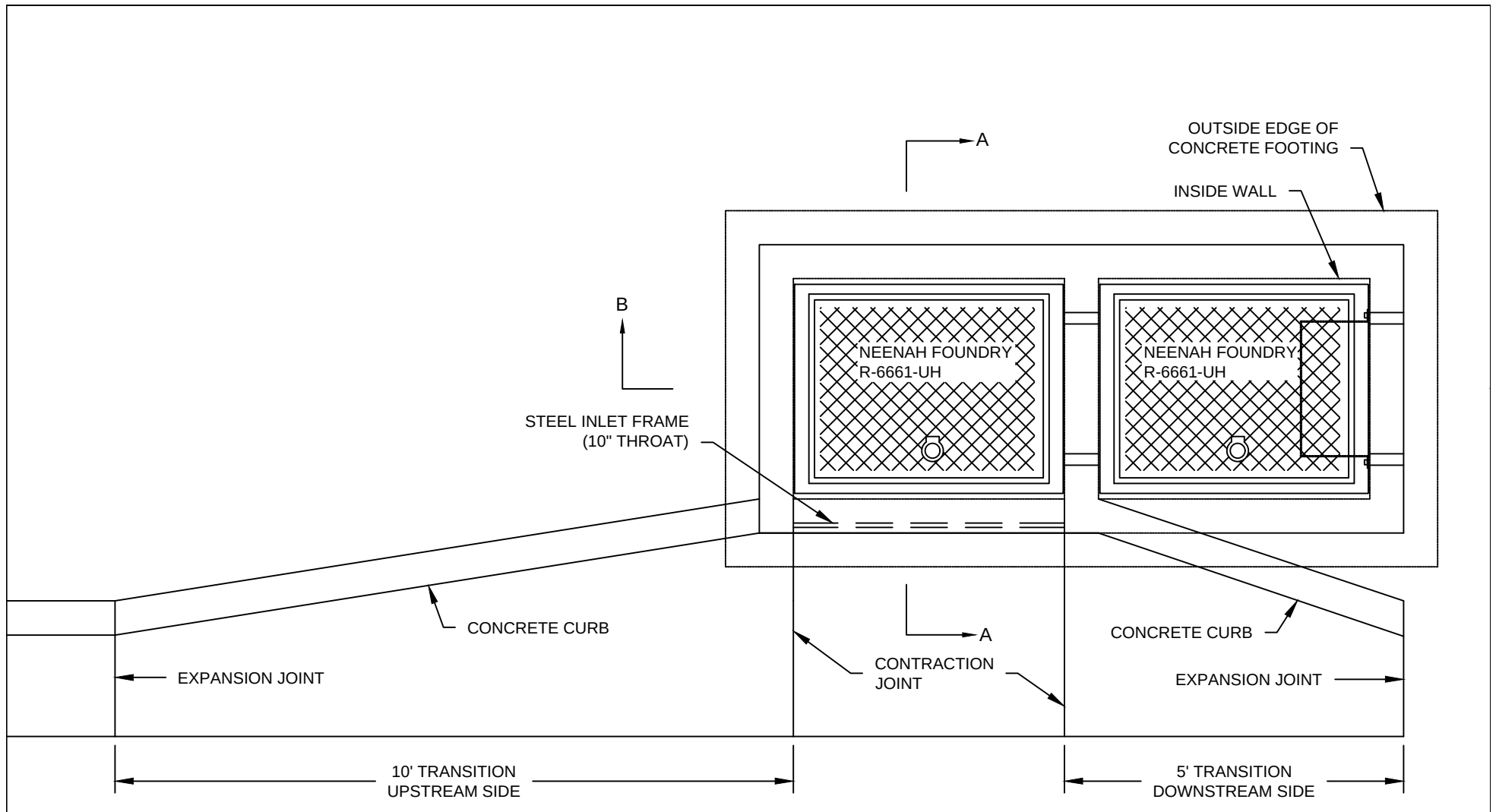
TYPICAL CROSS-SECTION



FOR 12" THRU 24" ROUND PIPE ONLY

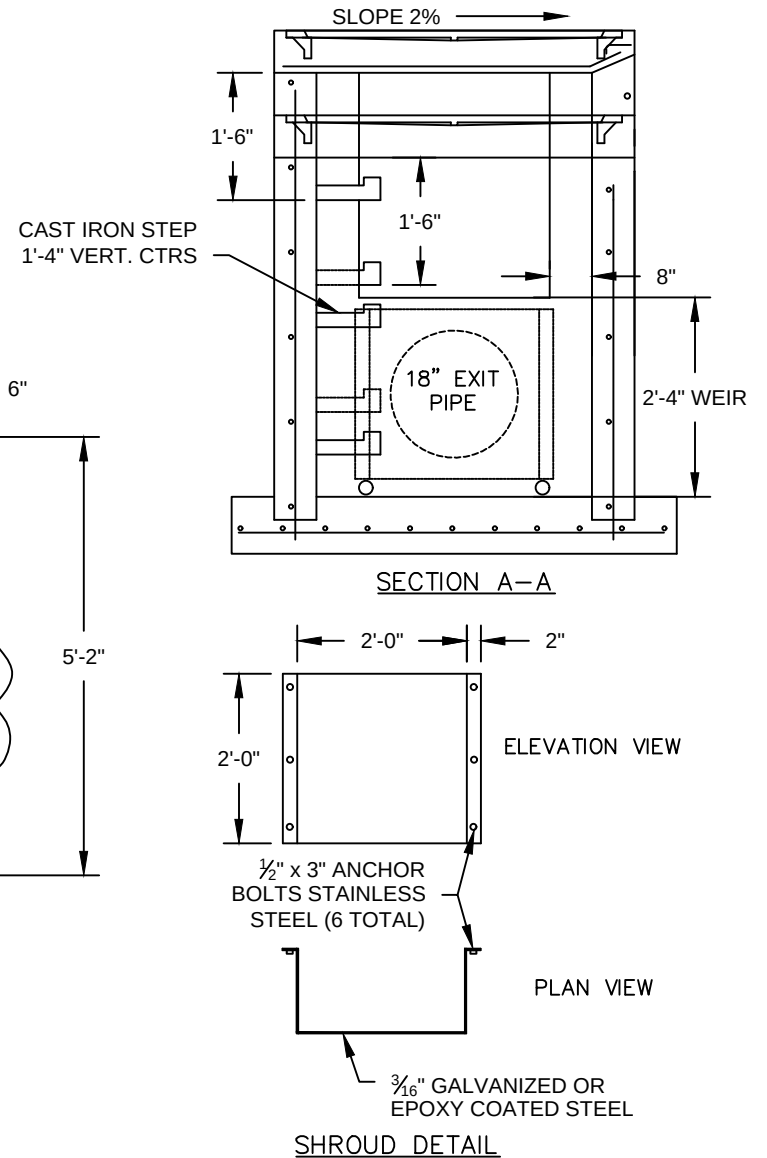
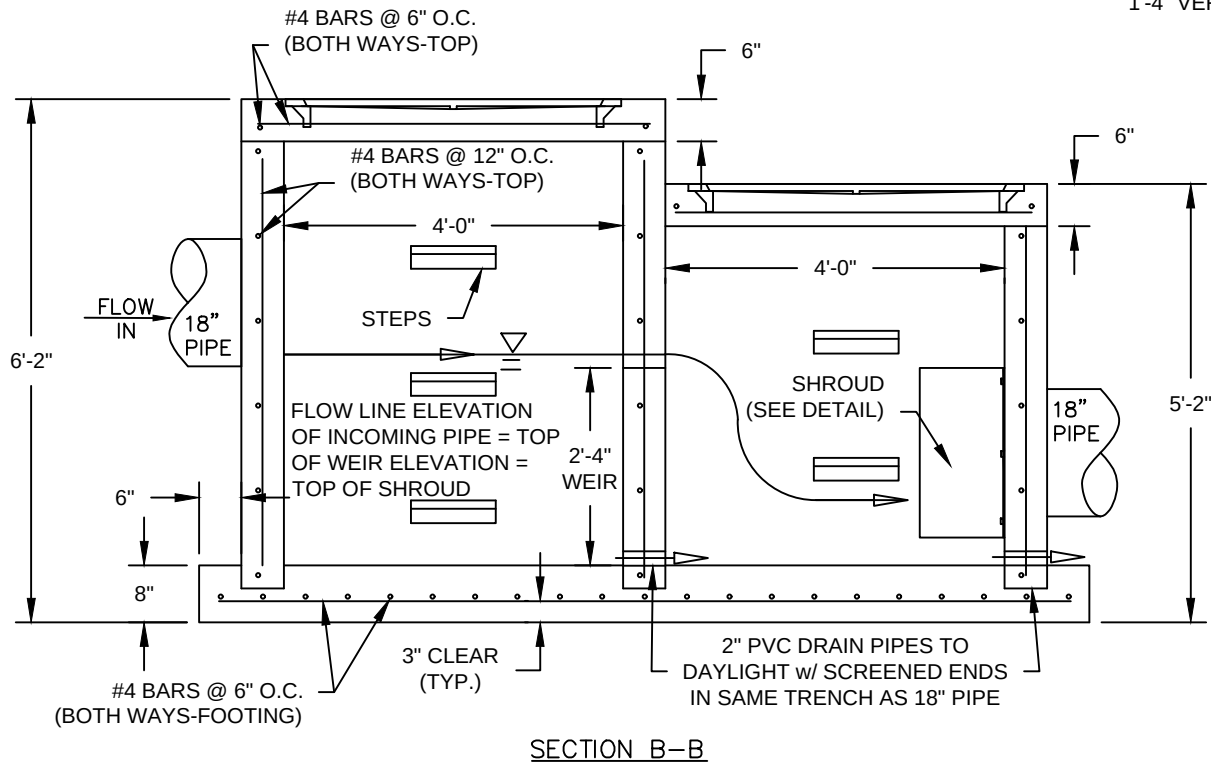
CONNECTION

Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL FLARED END SECTION	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-15



Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL DISSIPATION BOX	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-16

- NOTE:
1. BEVEL ALL EXPOSED EDGES WITH
 $\frac{3}{4}$ " CHAMFER OR $\frac{1}{2}$ " TOOLED EDGE.



Date Revised: March, 2014	CITY OF OSAGE BEACH TYPICAL DETAIL DISSIPATION BOX	Design Guideline: SECTION 4
By: SH		STORM DRAINAGE
Checked By: JB		Drawing No: IV-17