

# MPDM CHAPTER 5: SELECTION OF BEST MANAGEMENT PRACTICES



*BWSR MN Public Drainage Manual Broad User Outreach Workshops | April 22, 23, and 25, 2017*



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# DEFINITION



- In the MPDM, a Best Management Practice (BMP) is... a structural or non-structural practice that minimizes water quality and/or quantity (peak flow or volume reduction) impacts within a public drainage system or its watershed and/or downstream.

# TWO KINDS OF BMP



- On-system
- Off-system



# TWO KINDS OF BMP



## ■ On-system

- On-system BMPs are used within a Chapter 103E drainage system and are aligned with the statute based authorities and responsibilities of the drainage authority. These can include any statute-allowed, or required practice.
  - vegetated buffer strips,
  - grade control structures,
  - side inlets,
  - erosion control,
  - multi-stage ditch,
  - water storage,
  - restored wetland,
  - culvert sizing,
  - resloping,
  - tile repair, etc.





# TWO KINDS OF BMP



## ■ Off-system

- Other BMPs are located off the Chapter 103E drainage system, and consequently, not within the traditional purview of the drainage authority. However, as a result of efforts related to Chapter 103E.015, a drainage authority may find that there are practices that can be applied on fields and farms in the watershed of the system which will provide significant benefits downslope to the drainage system.

### ■ Structural

- Water and sediment control basins,
- Grass waterways,
- Grade stabilization structures, and
- Drainage Water Management, etc.

### ■ Non-structural

- Nutrient management,
- Cover crops, and
- Conservation tillage, etc.



# SELECTING A BMP...3 STEPS

STEP 1: OBSERVE  
AND IDENTIFY  
PROBLEMS &  
OPPORTUNITIES



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graph TD; A[STEP 1: OBSERVE AND IDENTIFY PROBLEMS & OPPORTUNITIES] --> B[STEP 2: DETERMINE CAUSE OF PROBLEM]; B --> C[STEP 3: SELECT AN APPROPRIATE BMP SOLUTION];
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STEP 2: DETERMINE  
CAUSE OF PROBLEM

STEP 3: SELECT AN  
APPROPRIATE BMP  
SOLUTION

# SELECTING A BMP...3 STEPS

## STEP 1: OBSERVE AND IDENTIFY PROBLEMS & SYMPTOMS

Based on field observations, and review of inspector or engineer's reports, studies, local water plans or strategies defining what is happening in the watershed of the public drainage system.

Problems/symptoms are the physical issues identified along a public drainage system.

Examples might include:

- a. Headcut on adjacent fields
- b. reduced water quality in nearby or downstream receiving waters
- c. sediment plumes
- d. channel erosion
- e. ditch incision
- f. fish kills
- g. sediment plugged tile
- h. erosion on near-ditch field
- i. high concentrations of pollutants in system waters
- j. failed side slope







# SELECTING A B

STEP 1: OBSERVE  
AND IDENTIFY  
PROBLEMS &  
OPPORTUNITIES



STEP 2: DETERMINE  
CAUSE OF PROBLEM

STEP 2: DETERMINE  
CAUSE OF PROBLEM



## Root River ONE WATERSHED, ONE PLAN

December 2016



Root River Watershed  
ONE WATERSHED ONE PLAN

Prepared For:  
Root River Planning Partnership

Prepared By:  
Houston Engineering, Inc.



Cold Snap Photography

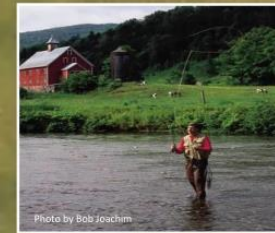


Photo by Bob Joachim

# SELECTING A BMP...3 STEPS

## STEP 2: DETERMINE CAUSE OF PROBLEM



Examples might include:

- a. open tile inlets
- b. lack of buffers
- c. Excessive use of nitrogen fertilizers or manure
- d. lack of cover crops
- e. Excessive phosphorus loss through tile systems creating impaired downstream waterbodies.
- f. altered hydrology due to climate change or man-made changes
- g. excessive phosphorus build-up in the soil
- h. downstream channel straightening or maintenance
- i. Ground subsidence may cause old tile to separate, shift, and plug
- j. excessive bank slope
- k. excessive bottom slope





THE  
MATRIX

# THE BMP MATRIX



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## BMP Table

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### BMP Table

Symptom/Issue To be Addressed	Cause	On-System: Ditch System	On-System: Tile System	Off-System
<b>Erosion</b>	Construction	Stormwater Runoff Control (NRCS CP 570) <ul style="list-style-type: none"> <li><a href="#">MN Stormwater Manual</a></li> <li><a href="#">Practice Standard</a></li> </ul>	Stormwater Runoff Control (NRCS CP 570) <ul style="list-style-type: none"> <li><a href="#">MN Stormwater Manual</a></li> <li><a href="#">Practice Standard</a></li> </ul>	Stormwater Runoff Control (NRCS CP 570) <ul style="list-style-type: none"> <li><a href="#">MN Stormwater Manual</a></li> <li><a href="#">Practice Standard</a></li> </ul>
<b>Excessive Sediment (Aggradation)</b>	Excessive sediment transport from field and upstream ditch bottom and side slopes.	Open Channel (NRCS CP 582) - Natural Channel/Two-stage Channel Design <ul style="list-style-type: none"> <li><a href="#">Factsheet</a> (see page 115 of <a href="#">The Agricultural BMP Handbook for Minnesota</a>)</li> <li><a href="#">Practice Standard</a></li> <li><a href="#">Two-Stage Channel Design Guidance</a> or <a href="#">Part 654: Stream Restoration Design National Engineering Handbook</a></li> </ul>	Tile Replacement (NRCS CP 606) <ul style="list-style-type: none"> <li><a href="#">Practice Standard</a></li> <li><a href="#">Design Guidance</a></li> </ul>	Cover Crops (NRCS CP 340) <ul style="list-style-type: none"> <li><a href="#">Factsheet</a> (see page 36 of <a href="#">The Agricultural BMP Handbook for Minnesota</a>)</li> <li><a href="#">Practice Standard</a></li> <li><a href="#">Practice Information</a></li> </ul>
		Grade Stabilization Structure - Side Inlet (Various Types) (NRCS CP 410) <ul style="list-style-type: none"> <li><a href="#">Factsheet</a> (see page 40 of <a href="#">The Agricultural BMP Handbook for</a></li> </ul>	Alternative Tile Intakes (Perforated Risers, Gravel/rock inlets, dense pattern Tile) (NRCS CP 606)	Grassed Waterways (NRCS CP 412) <ul style="list-style-type: none"> <li><a href="#">Factsheet</a> (see page 84 of <a href="#">The Agricultural BMP</a></li> </ul>



# OFF-SYSTEM BMP GRASSED WATERWAY



CP 412 – Grassed Waterway (Photo Source: USDA NRCS)

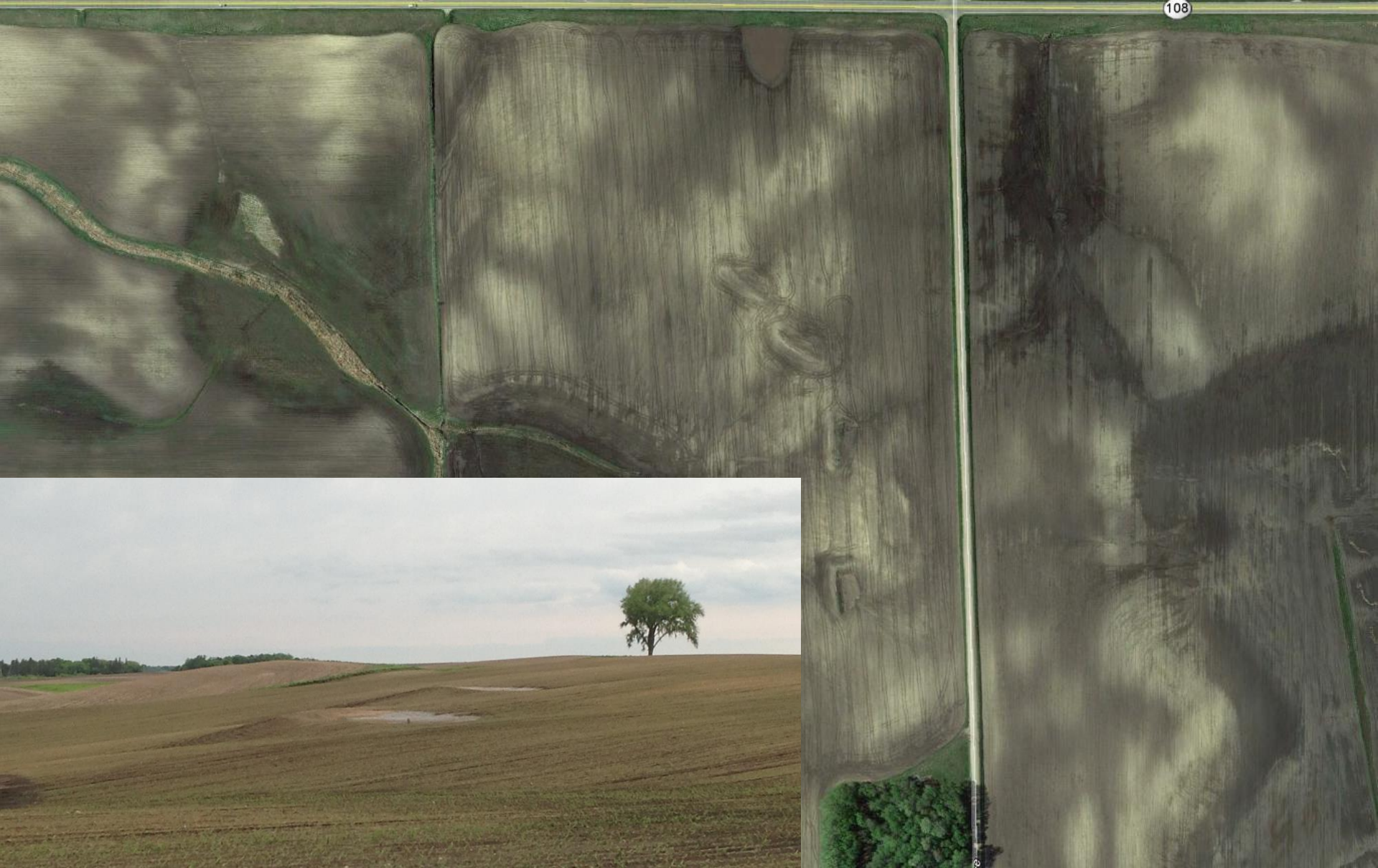


# OFF-SYSTEM BMPs

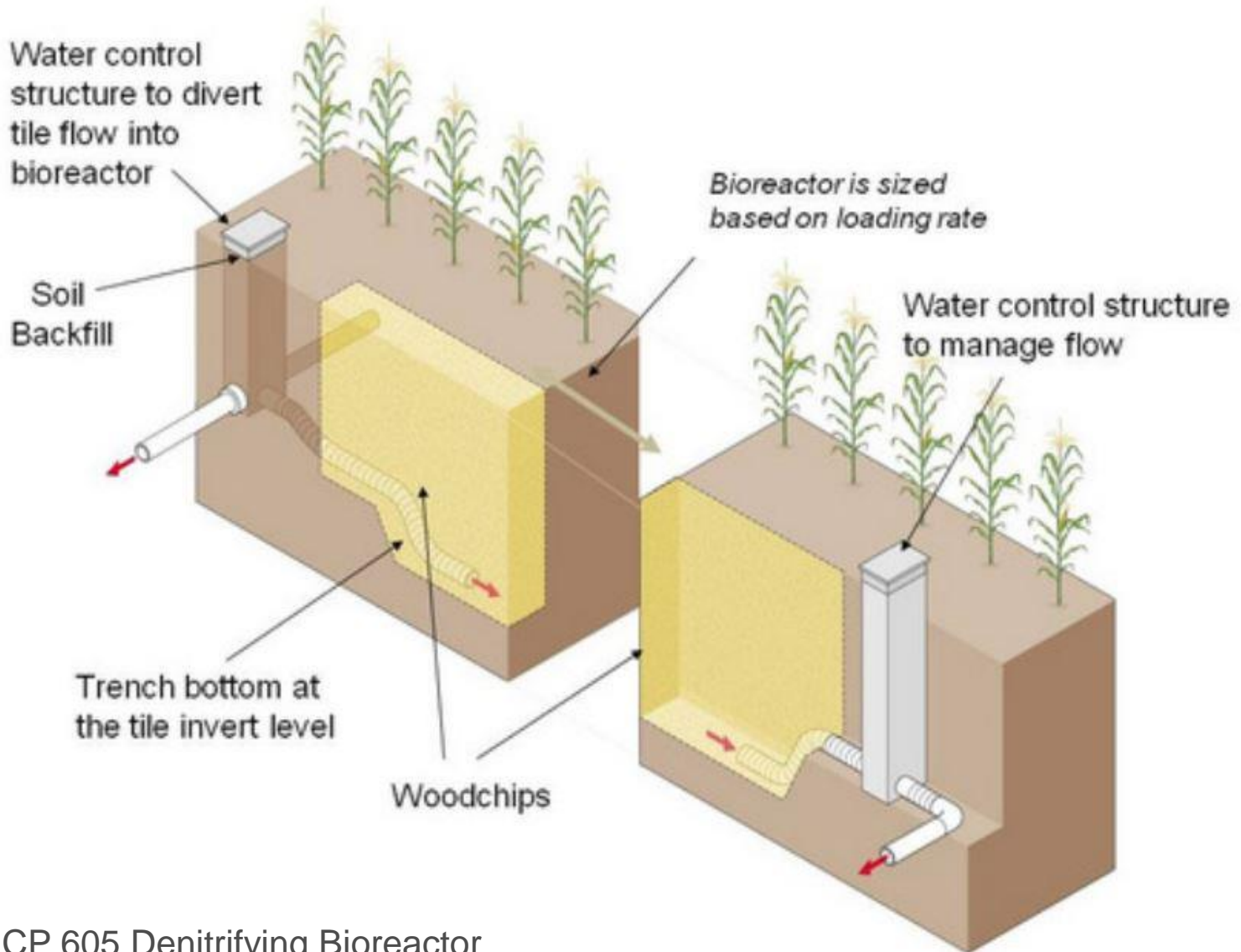




# OFF-SYSTEM BMP WATER & SEDIMENT CONTROL BASINS

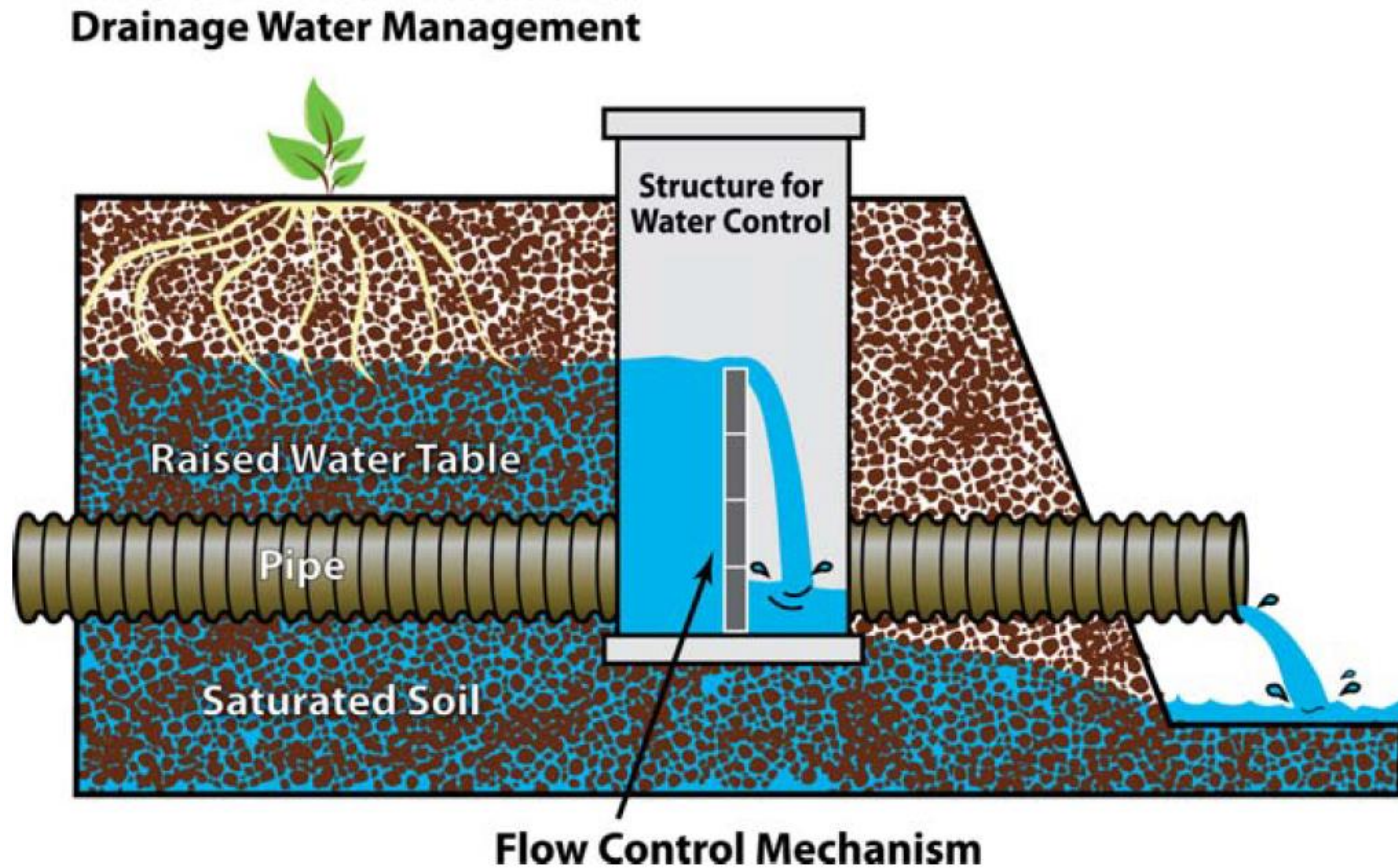


# OFF-SYSTEM BMP DENITRIFYING BIOREACTOR





# OFF-SYSTEM BMP DRAINAGE WATER MANAGEMENT



*DWM is the process of managing the timing and the amount of water that discharges from agricultural drainage systems. A structure for water control is installed in the tile line, which allows for management of the tile outlet elevation.*

# ON-SYSTEM BMP MANDATED BY STATUTE

- Vegetated Buffer





# THE BMP – MANDATED BY STATUTE

## ■ Vegetated Buffer



### Buffer measurement for a public drainage ditch

Buffer Law Implementation

#### Purpose and Considerations

This guidance is for local government units charged with implementing and reviewing buffer measurement compliance for proper 103E public drainage ditch.

#### Statutory References

##### Buffer Law

The buffer law requires buffer widths based on the classification Map. The buffer measurement requirement for public drainage law highlighted:

**M.S. §103F.48, Subd. 3. Water resources riparian protection systems.**

- (a) Except as provided in paragraph (b), landowners owning mapped on a buffer protection map must maintain a buffer
- (2) for public drainage systems established under chapter 103E, a buffer as provided in section 103E.021, subdivision 1 maintenance of the ditch.

##### Drainage Law

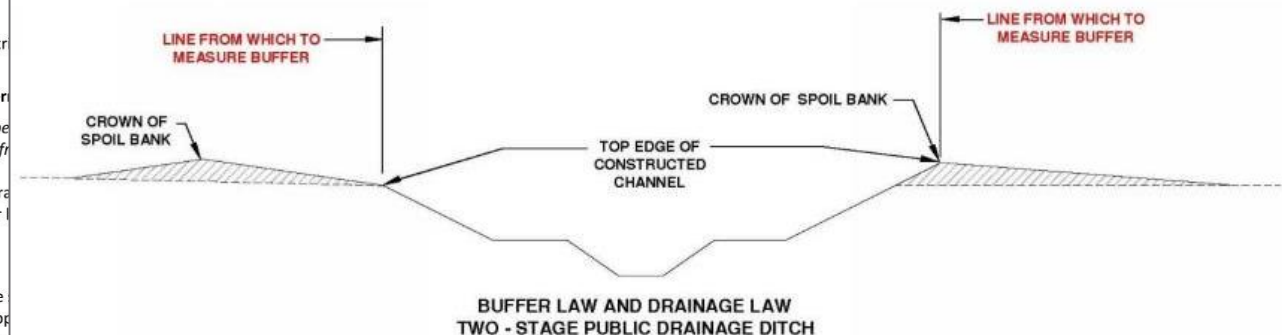
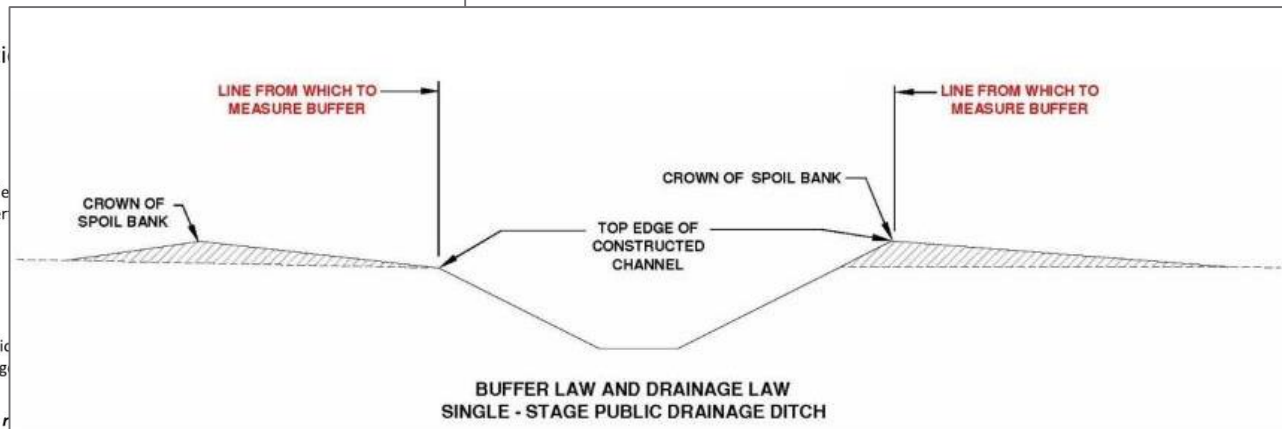
Drainage law includes the following requirement for buffer strip requirement highlighted:

**M.S. §103E.021, Subd. 1. Spoil banks must be spread and permanent.**  
“... The permanent strips of perennial vegetation shall be from the top edge of the constructed channel resulting from the proceeding”

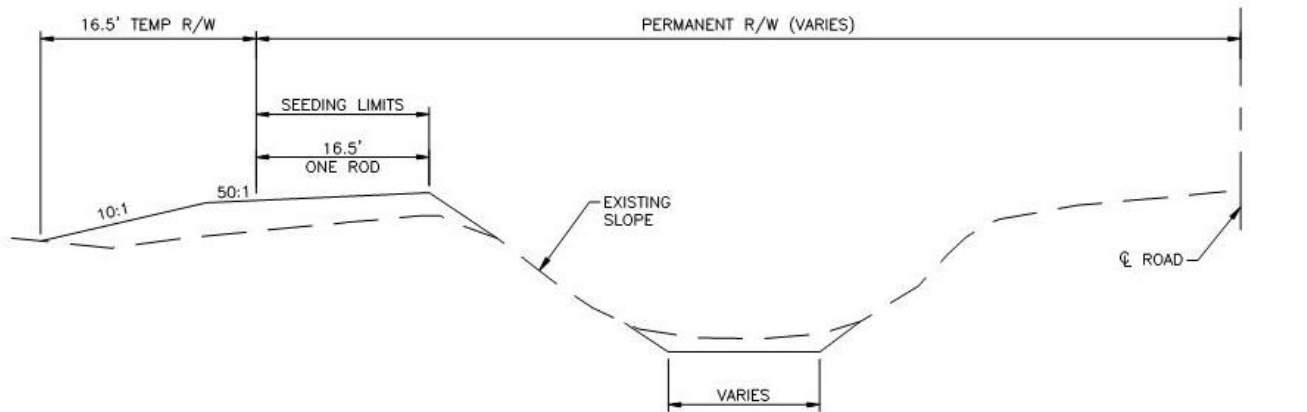
Because the buffer law does not involve “proceedings” like drainage law, “resulting from the proceeding” does not apply for the buffer law.

#### Measuring Buffer Width

The following diagrams provide a visual representation of the buffer strip for a public drainage ditch. These diagrams are approved by Minnesota Statutes, Section 103F.48 (buffer law) and Minnesota Statutes, Section 103E.021 (drainage law).



# ON-SYSTEM BMP GENERAL CHANNEL REPAIR



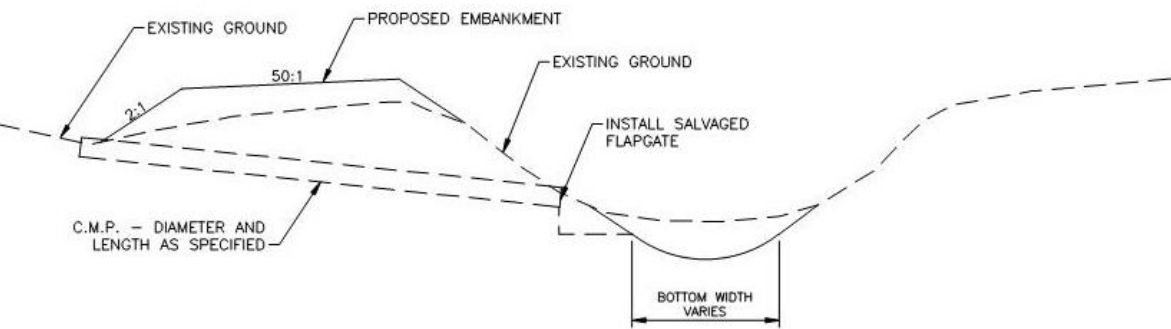
NOTE:  
EXCAVATION TO BE LIMITED TO THE BOTTOM OF THE CHANNEL. NO EXCAVATION TO BE DONE ON SLOPES.

## DITCH CLEAN-OUT TYPICAL SECTION

NOT TO SCALE



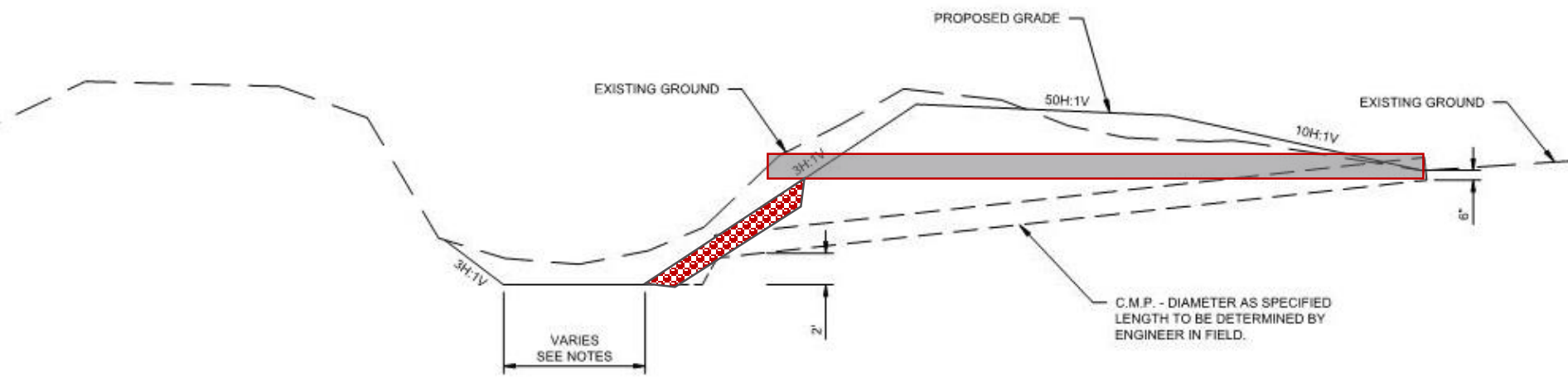
# ON-SYSTEM BMP SIDE INLET STRUCTURE



**TYPICAL SIDE INLET SEDIMENT CONTROL SECTION**

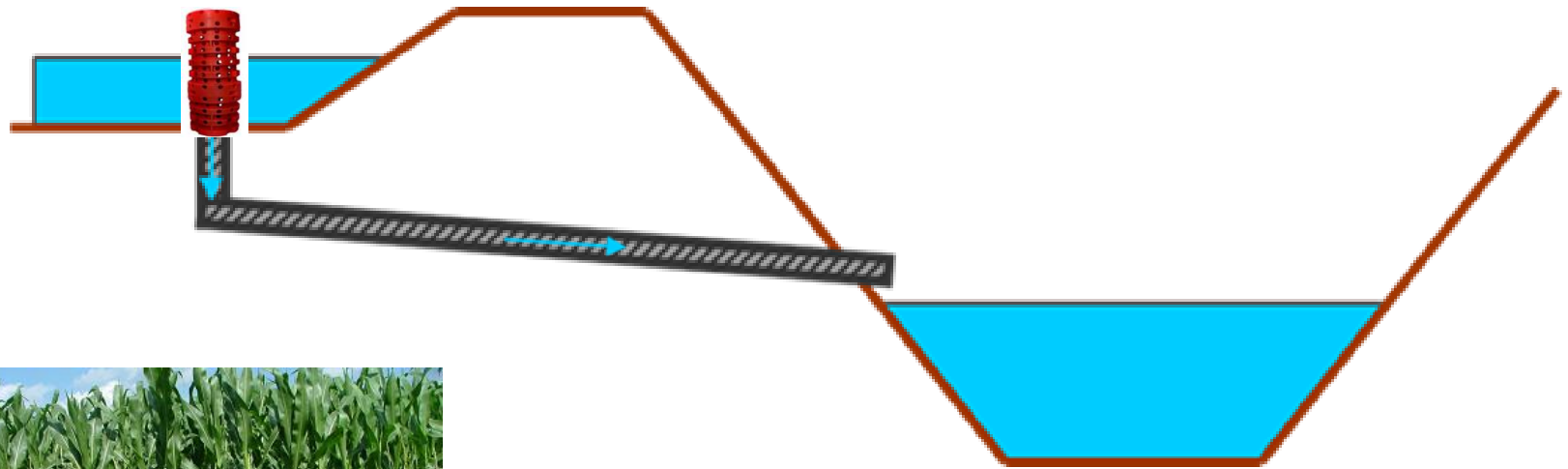
NOT TO SCALE

# ON-SYSTEM BMP SIDE INLET STRUCTURE



**TYPICAL FIELD INLET SECTION**  
NOT TO SCALE

# ON-SYSTEM BMP SIDE INLET STRUCTURE





# ON-SYSTEM BMP SEDIMENT CONTROL





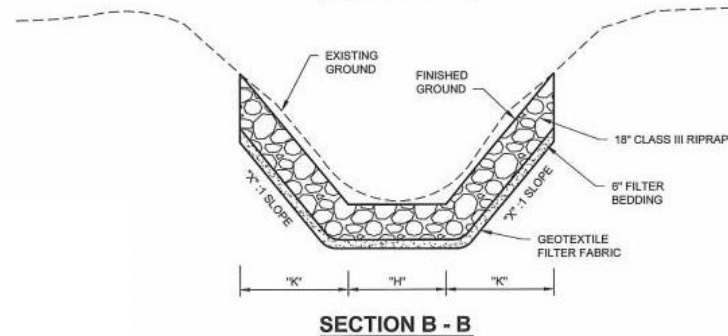
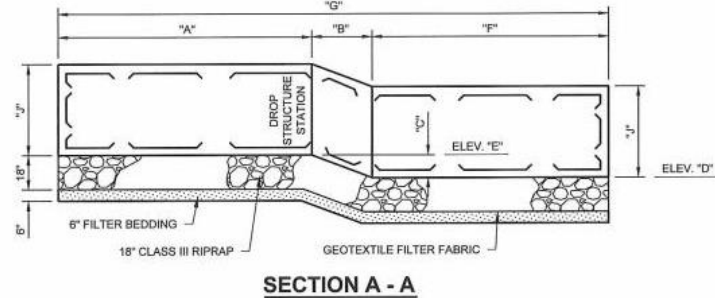
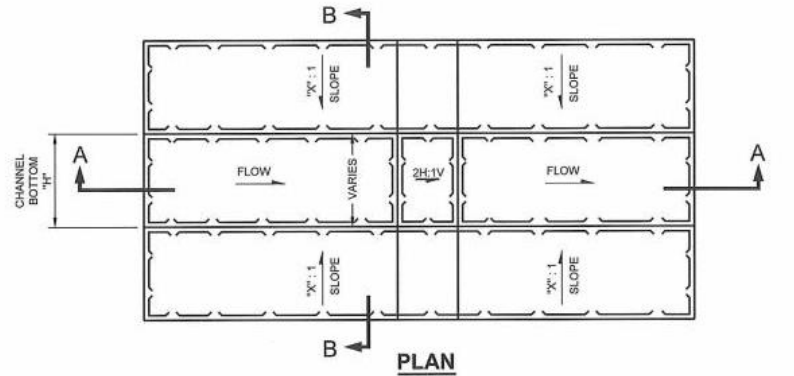
# ON-SYSTEM BMP ALTERNATIVE TILE INLET





# ON-SYSTEM BMP ROCK DROP STRUCTURE

DESIGNATION	DROP STRUCTURE STATION				
	STA. 114+95	STA. 136+85	STA. 174+70	STA. 179+50	STA. 184+50
A	5	5	5	5	5
B	4	4	3	3	3
C	2	2	1.5	1.5	1.5
D	977.09	981.00	985.77	987.65	989.51
E	979.09	983.00	987.27	989.15	991.01
F	20	20	20	20	20
G	29	29	28	28	28
H	15	15	15	15	15
J	5	5	5	5	5
K	15	15	15	15	15
X	3	3	3	3	3
CLASS III RIPRAP	73 cu. Yd	73 cu. Yd	70 cu. Yd	70 cu. Yd	70 cu. Yd
SALVAGED RIPRAP	25 cu. Yd	25 cu. Yd	25 cu. Yd	0 cu. Yd	25 cu. Yd



**NOTES:**

1. REFER TO THE DIMENSION TABLE ON THIS SHEET FOR DIMENSIONS DESIGNATED WITH A LETTER. THESE DIMENSIONS ARE UNIQUE TO EACH DROP STRUCTURE LOCATION.
2. ALL COSTS ASSOCIATED WITH CONSTRUCTION OF THE DROP STRUCTURES WILL BE INCLUDED WITH BID ITEM RANDOM RIPRAP CLASS III.

**ROCK DROP STRUCTURE DETAIL**

NOT TO SCALE



# ON-SYSTEM BMP ROCK DROP STRUCTURE





# ON-SYSTEM BMP SHEETPILE DROP STRUCTURE





# ON-SYSTEM BMP CONCRETE DROP STRUCTURE





# ON-SYSTEM BMP OUTLET GRADE CONTROL STRUCTURES





# ON-SYSTEM BMP TOE WOOD SOD MAT

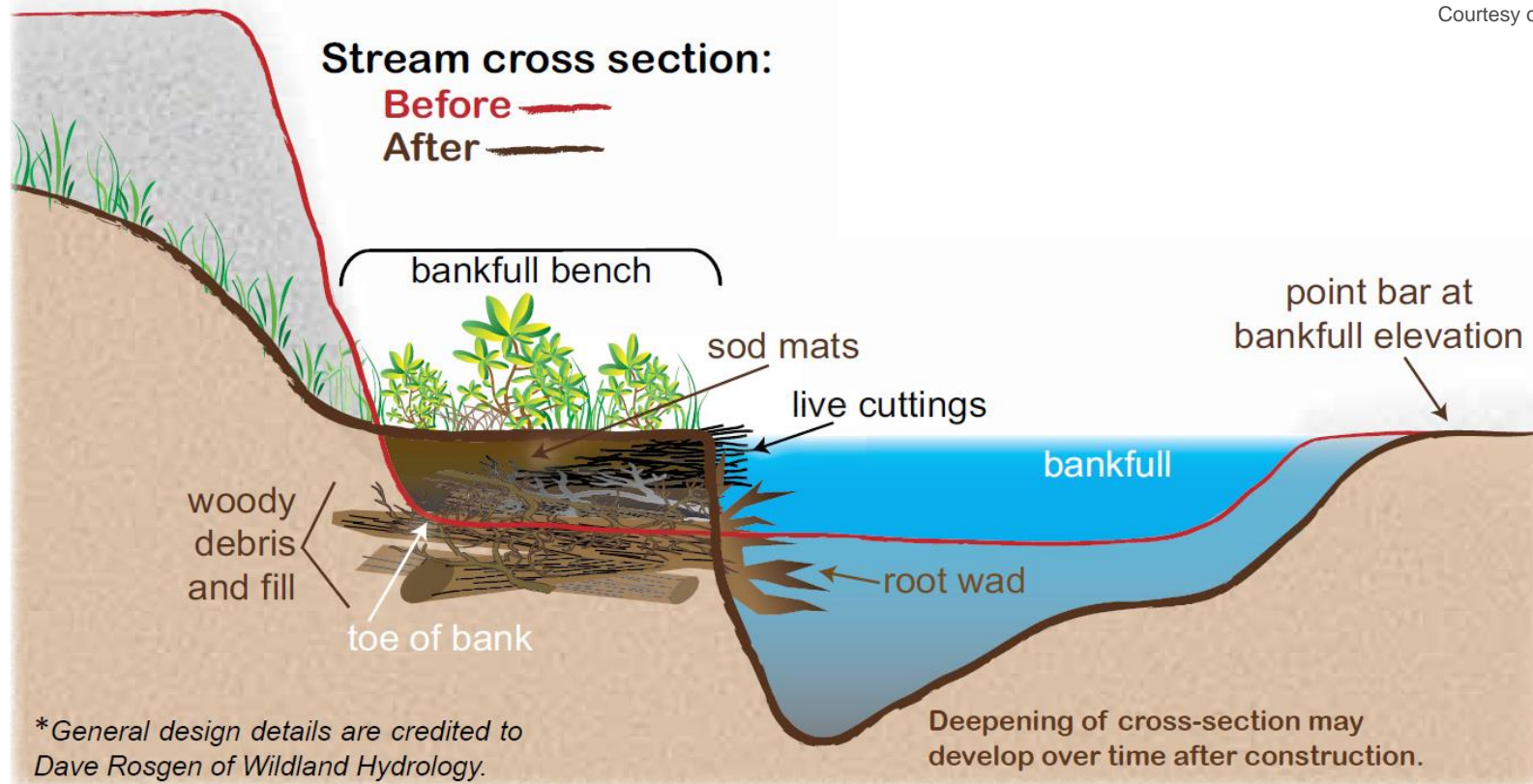


- AKA Wood Debris Bench

Stream cross section:

Before 

After 



Courtesy of MN DNR

*\*General design details are credited to Dave Rosgen of Wildland Hydrology.*

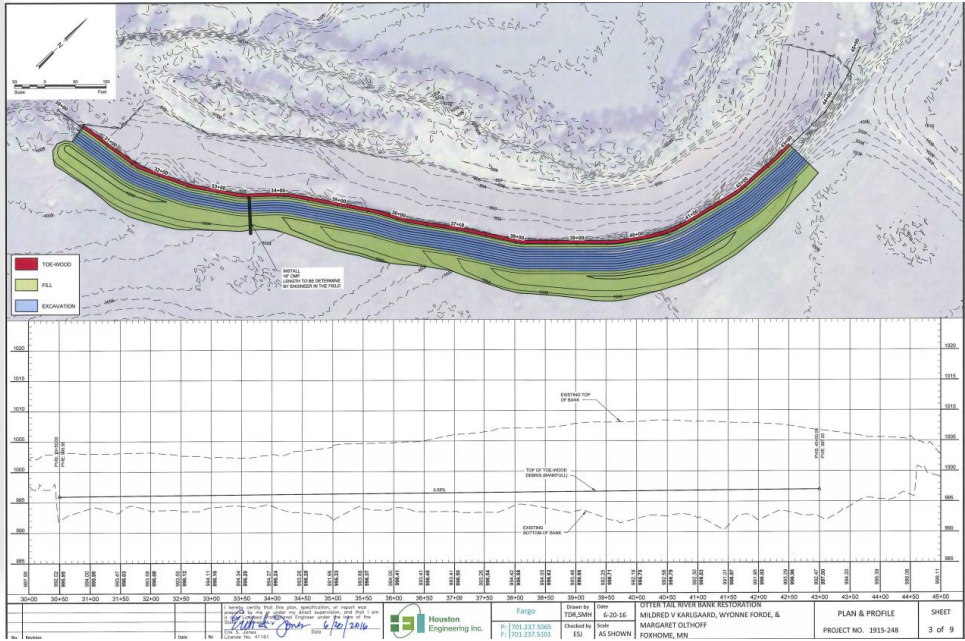


# ON-SYSTEM BMP TOE WOOD SOD MAT





# ON-SYSTEM BMP TOE WOOD SOD MAT



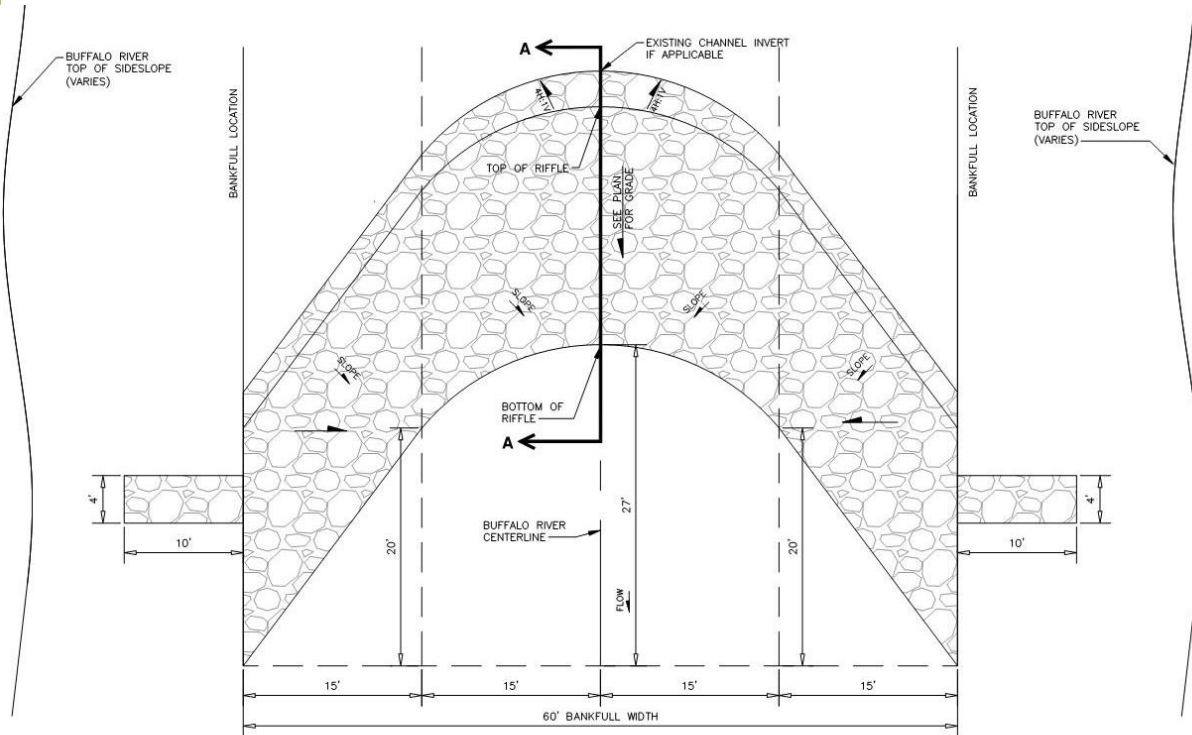
Houston Engineering Inc. 1701.237.5305 1701.237.5301		Fargo Drawn by: TDK/ghb Checked by: EU Date: 6/20/16 Scale: AS SHOWN	SUTTER TAIL RIVER BANK RESTORATION MILDRED V. KARGGAARD, WYONNE FORDE, & MARGARET OLTHOFF FOXHOM, MN	PLAN & PROFILE PROJECT NO. 1515-248	SHEET 3 of 9
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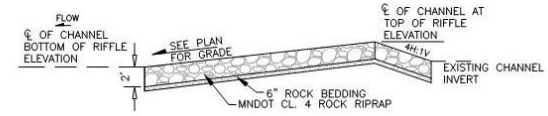




# ON-SYSTEM BMP ROCK RIFFLE GRADE CONTROL

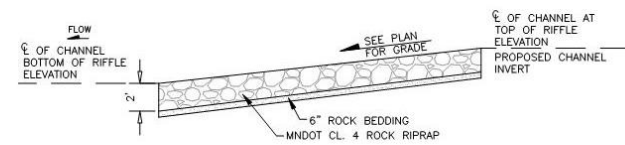


RIFFLE LOCATIONS				
BOTTOM OF RIFFLE STATION	TOP OF RIFFLE STATION	CENTERLINE OF CHANNEL AT TOP OF RIFFLE ELEVATION	CENTERLINE OF CHANNEL AT BOTTOM OF RIFFLE ELEVATION	BANKFULL ELEVATION
50+10	50+30	1127.10	1126.70	1132.10
53+35	53+55	1127.50	1127.10	1132.50
54+95	55+15	1127.80	1127.40	1132.80
57+15	57+35	1128.10	1127.70	1133.10
66+80	67+00	1128.90	1128.40	1133.90
73+80	74+00	1129.40	1128.90	1134.40

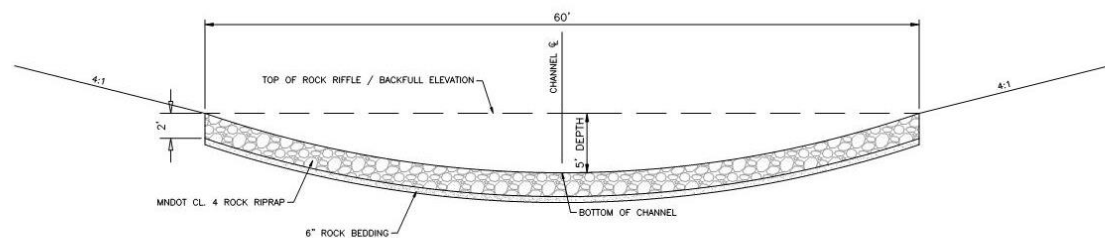


**STA. 67+00 & 75+00**  
**SECTION A - A**  
NOT TO SCALE

NOTE:  
1) PLACE ADDITIONAL ROCK BEDDING MATERIAL AS NECESSARY TO RAISE EXISTING GROUND TO REQUIRED GRADE.



**STA. 50+30, 53+55, 55+15 & 57+35**  
**SECTION A - A**  
NOT TO SCALE



**BUFFALO RIVER CHANNEL RIFFLE DETAIL "A"**  
NOT TO SCALE



# ON-SYSTEM BMP ROCK RIFFLE GRADE CONTROL





# THE BMP – ON SYSTEM ROCK DROP STRUCTURE





# THE BMP – ON-SYSTEM CHANNEL LINING





# ON-SYSTEM BMP SEDIMENT POND





# ON-SYSTEM BMP DAM (ON-CHANNEL)



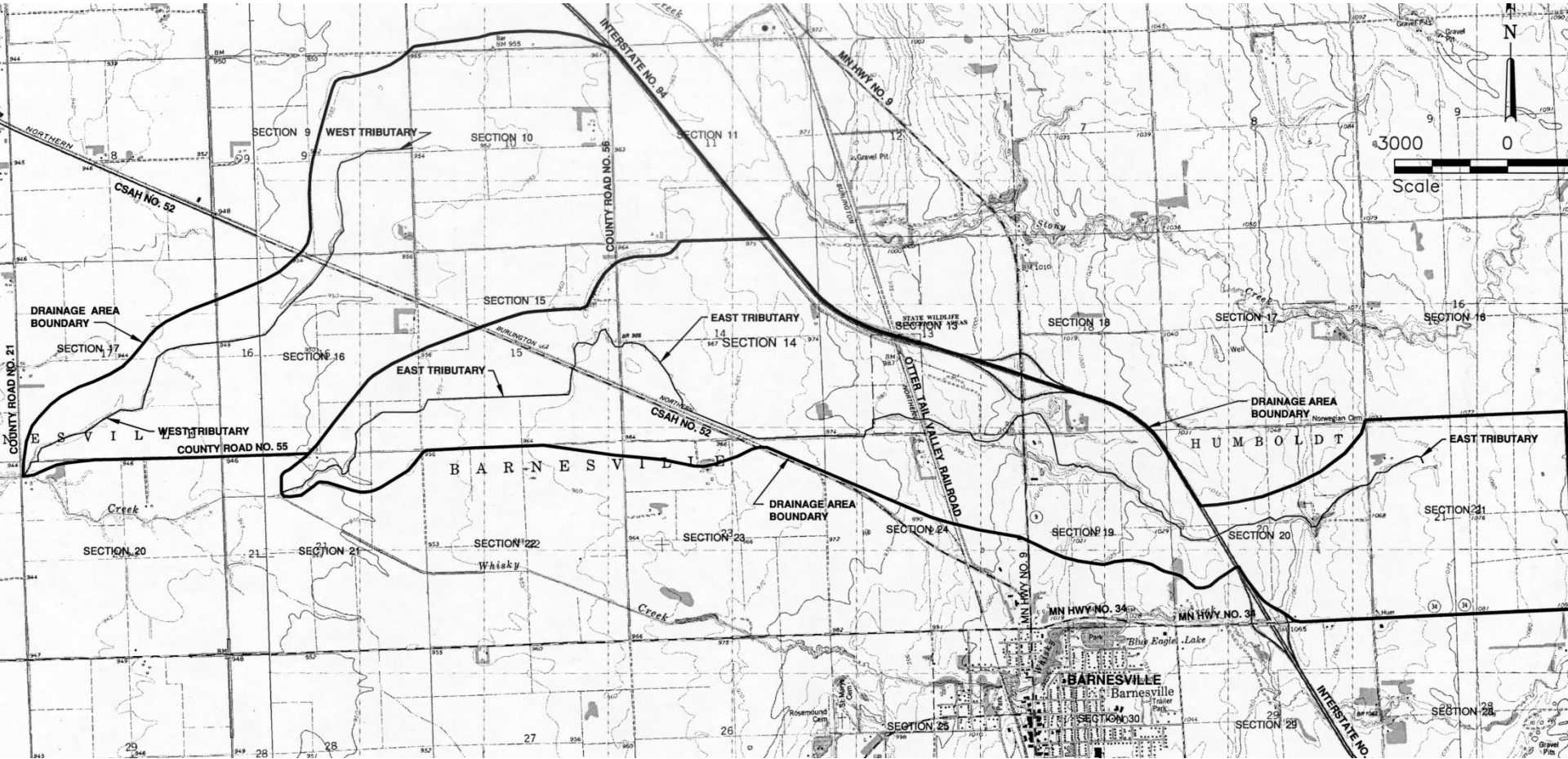


# ON-SYSTEM BMP WETLAND CREATION



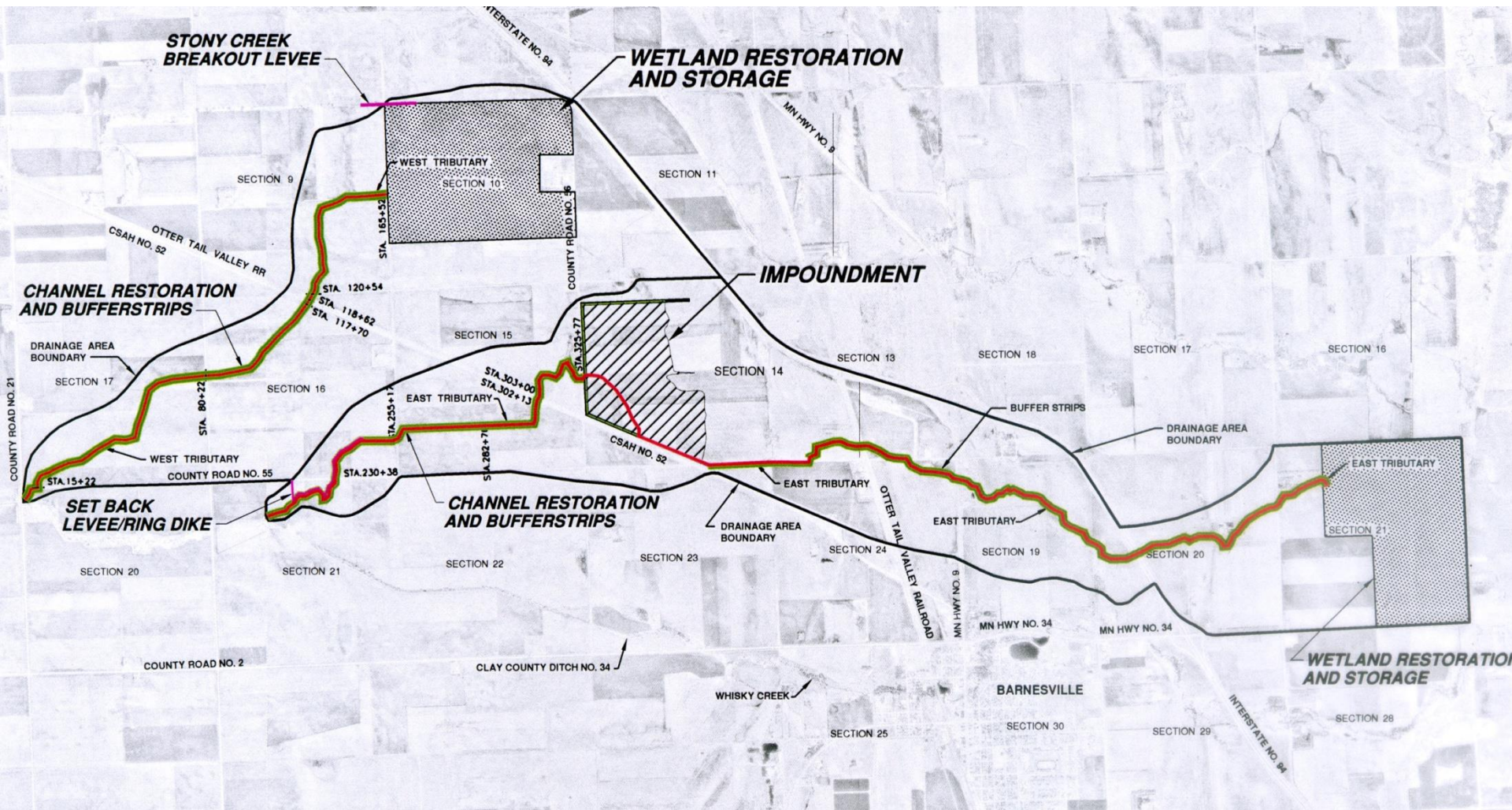


# A TALE OF TWO DITCHES





# A TALE OF TWO DITCHES





# ON-SYSTEM BMP TWO-STAGE/NATURAL CHANNEL



May 4, 2016 Aerial

# BMP SELECTION

- Few Closing Thoughts
  - Ideal Solution May Be A Combination Of On- And Off-system BMPs
  - May Want/Need To Address On-system BMPs
    - Off-system BMPs Can Take More Time To Implement Due To Their Voluntary Nature
  - The MPDM Wiki BMP table Provides Some Guidance
  - The BMP Selected May Open Funding Doors.
- All BMPs Require Professional Judgement

***QUESTIONS?***





**MORE INFORMATION:**  
[drainage.pca.state.mn.us](http://drainage.pca.state.mn.us)  
[houstoneng.com](http://houstoneng.com)

**THANK YOU**

