

Multi-Stage Open County Drain Design

Upper Midwest Stream
Restoration Symposium 2015

February 9, 2015



Agenda

1 Background

2 Planning Considerations

3 Design Guidelines

4 Case Studies

Multi-Stage Channel Design

- **Technical guidelines for open drain design in Macomb County**
- **Funded by MI Sea Grant**
- **Partnering with WSU and HRC**



Macomb County, MI

1917 Drain Construction



DRAIN EIGHT FEET BOTTOM WIDTH, EIGHT AND ONE-HALF FEET DEEP, CONSTRUCTED BY DREDGE SHOWN IN PLATE V, IN 1917, AT COST OF \$7.25 PER ROD (ABOUT $\$.08\frac{1}{2}$ PER CUBIC YARD) TO REPLACE SHALLOW TEAM AND SCRAPER DRAIN CONSTRUCTED IN 1914 AT A COST OF \$1.00 PER ROD.

Multi-Stage Channel Design





Integrated Assessment Approach



- **Integrated Assessment Approach**
 - Address particularly challenging problems
 - Regional
 - Transferrable
 - Stakeholder input

“...develop information, tools and partnerships that will help decision makers”

Trapezoidal channel – Utica Drain, Macomb Co.



**Sturgis Drain Macomb County
(Older trapezoidal drain)**



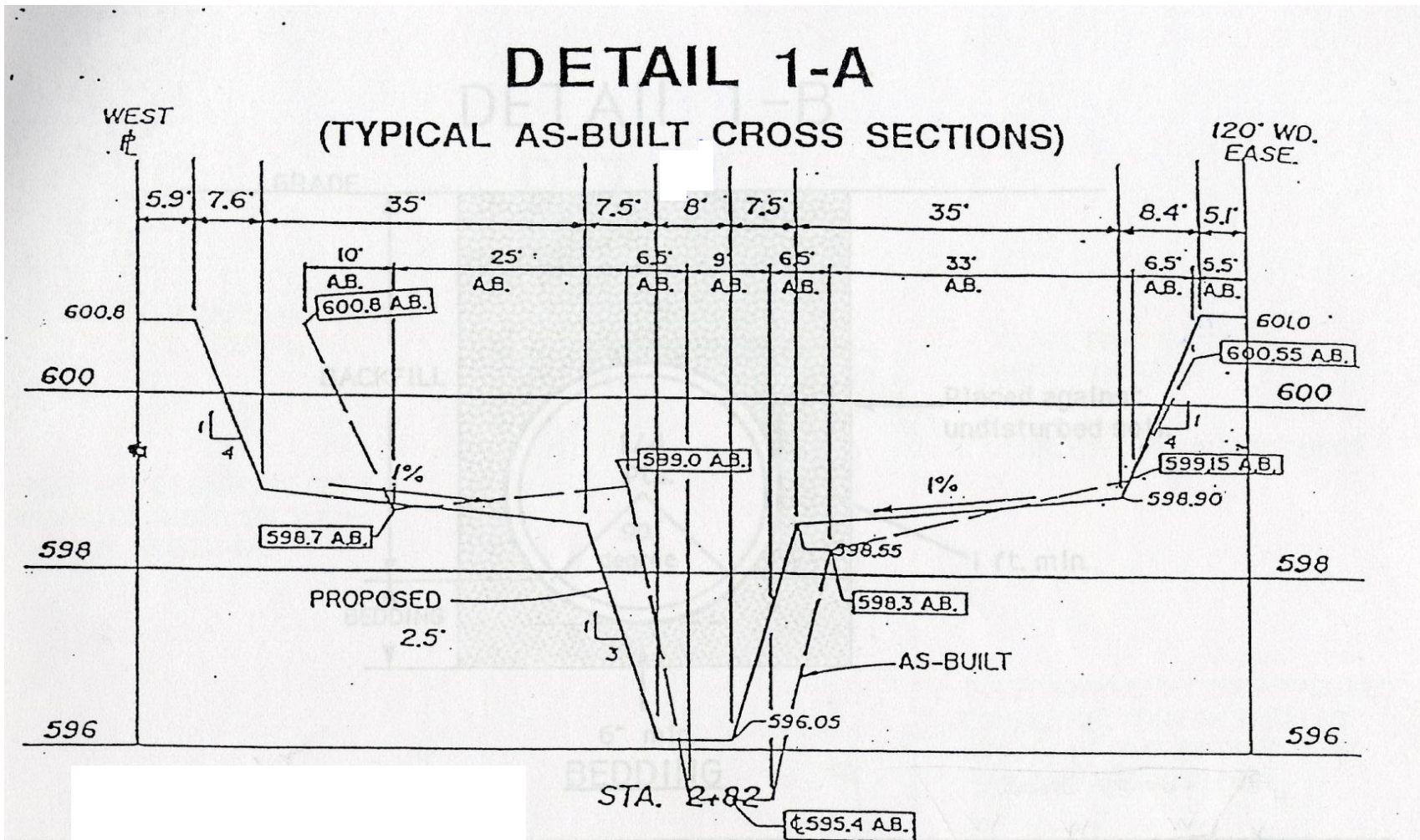


Why change open drain design?

- **1956 Drain Code**
- **Less risk of failure**
- **Less long-term costs**
- **Reduced maintenance**
- **Nuisance species: mosquitoes, cattails**
- **Property values**



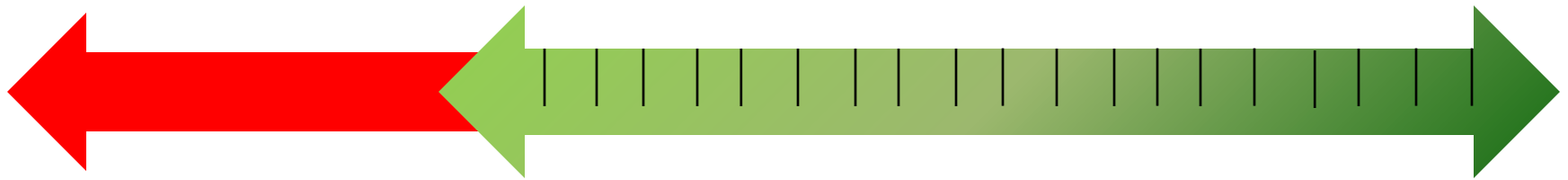
Macomb County (Pre-2008) Standard Drain Detail



Two-Stage Agricultural Ditch Northwest Ohio



Sliding Scale of Project Types



**Entrenched
Trapezoidal
Channel**

- Not Used

**Two-Stage
Ditch**

- Minimum Standard

**Enhanced
Channel**

- Site Constraints
 - WMP Goals

**Natural
Channel
Design**

- Not Required
 - Mitigation?

Two-Stage Ditch (v 2.0)

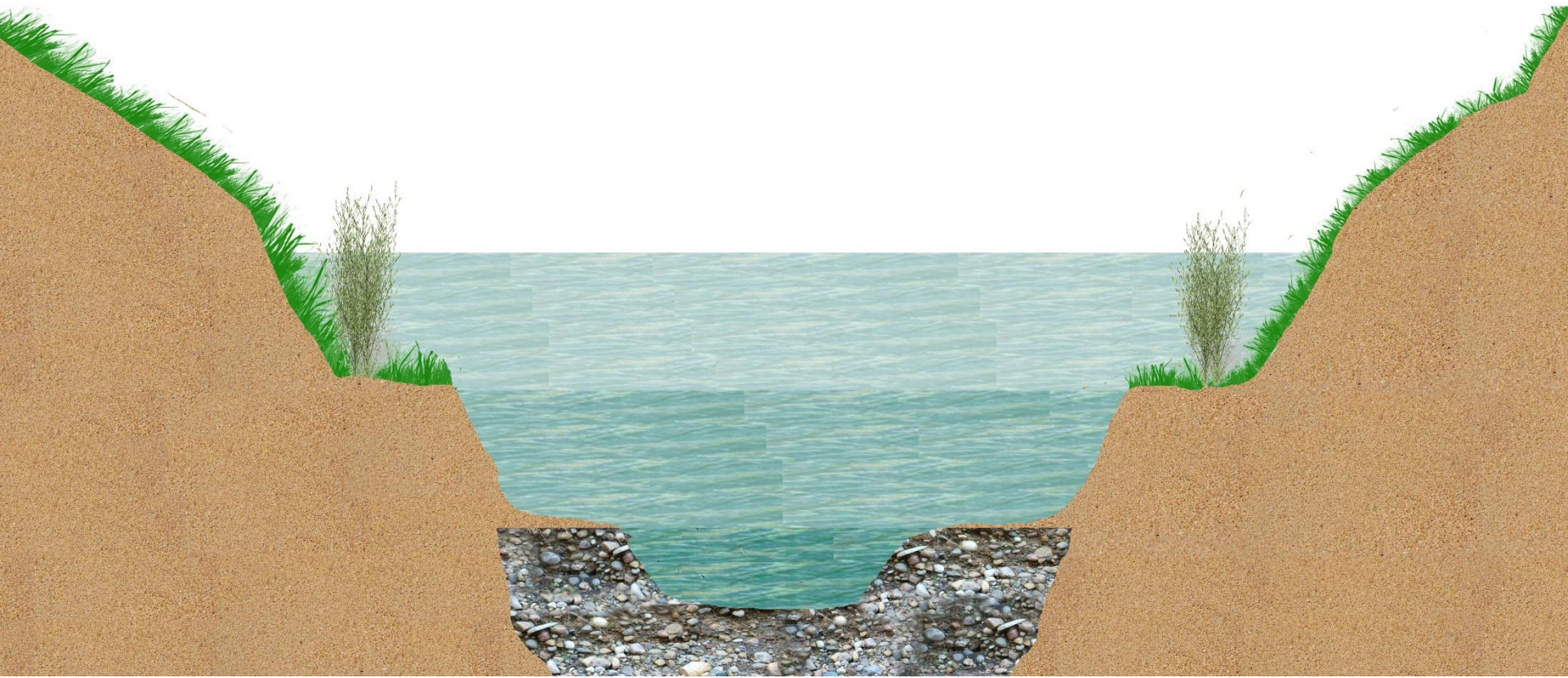
- **Consider sediment transport**
- **Road/stream crossings**
- **Erosion control (RECPs, native veg.)**
- **Manage (native) riparian vegetation for vertical diversity**

Several Potential Stages

- **Thalweg channel (inner berms)**
- **Inset channel (channel-forming Q)**
- **Terraced side slopes >6-8 ft**
- **100-yr floodplain, setback levees**



Typical Confined Channel



MACOMB COUNTY PUBLIC WORKS OFFICE
OPEN DRAIN DESIGN & TECHNICAL GUIDELINES

Guidelines and not “Drainage Rules”



January 2015

DRAFT

Flexibility based on:

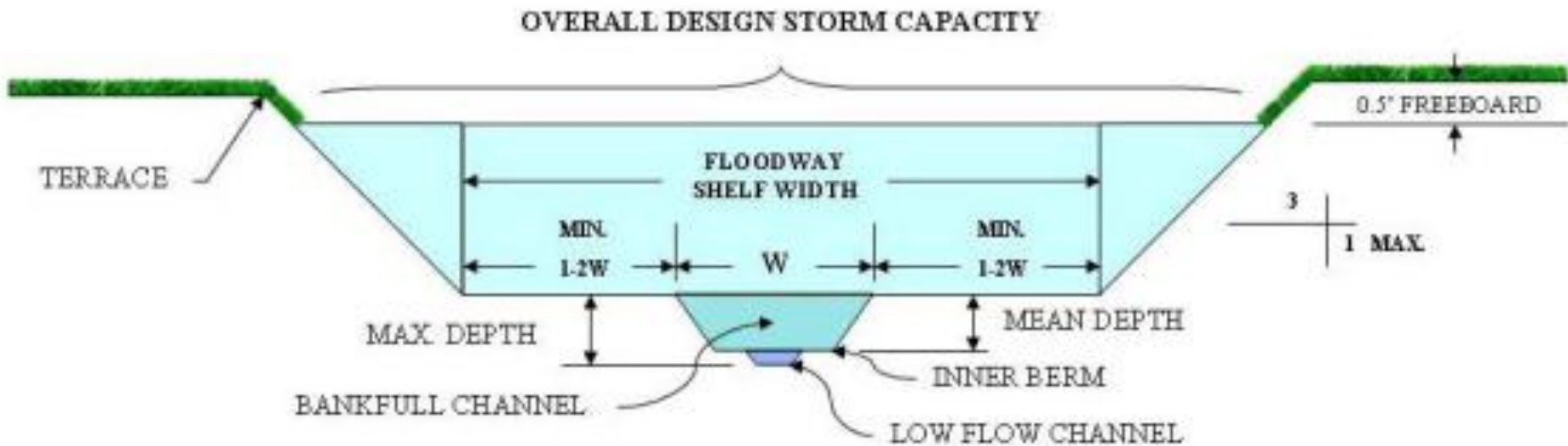
- Valley types
- Stream types
- Stream potential
- Site constraints

Design Considerations

- **Valley type, stream type, materials**
- **Channel incision: Priority 1-3 approach**
- **Alluvial vs. threshold design**
- **Are reference reaches available?**
- **R.O.W. widths, site constraints**
- **Existing vegetation: protect, riparian cut**
- **Erosion control: minimize bank armoring**

Floodway shelf width

- 3-5 x bankfull width (W) std requirement
- $< 3 \times W$ = B3c channel type (higher cost)
- $> 5 \times W$ = tributaries to TMDL or trout stream



Excel Plan Review Checklist

- **Bankfull discharge and cross-sectional area (from ref. reach or curves)**
- **Select width:depth ratio (by stream type)**
- **Determine critical grain size**
- **Enter valley slope, prop. channel slope**
- **Calculates width, depth, velocity, shear stress, power, sediment size moved**

Riparian Vegetation Management

0% Canopy

100% Canopy



No canopy
Cattails/phragmites
Siltation, flooding

Fully shaded
Invasive shrubs
Bare banks underneath



The Goal
50-75% Canopy

Unmaintained Drain - Before



Riparian Improvement Cut



Cattails in Drain with No Canopy



Next steps:

- **Regional adoption (retire the trapezoid)**
- **Standard restoration details (incl. outlets)**
- **Localized regional curves**
- **Dimensionless sediment rating curves**
- **Construction sediment control**
- **Planting lists**
- **Mapping drains and districts**
- **Demonstration projects and monitoring**

Pre-Construction: Is a Priority 1 approach allowable?



Typical Channelized Stream



Floodplain Connectivity Restored





Questions?

<http://www.miseagrant.umich.edu/openchanneldesign>

Comments:

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