



# Cost of Culvert Repairs

We should have fixed it cheaper, sooner!

APWA 2016 Public Works Expo,  
Minneapolis

Andrea Hendrickson  
MnDOT State Hydraulic Engineer

We all have a stake in **A**  **B**



# MnDOT Maintenance's Culvert Repair Cost Initiative



- ▶ Maintenance crews
  - **cleaned,**
  - **repaired and**
  - **replaced** culverts
- ▶ Record
  - **labor,**
  - **equipment and**
  - **materials**
- ▶ Using mobile iPad app or a PC web app.



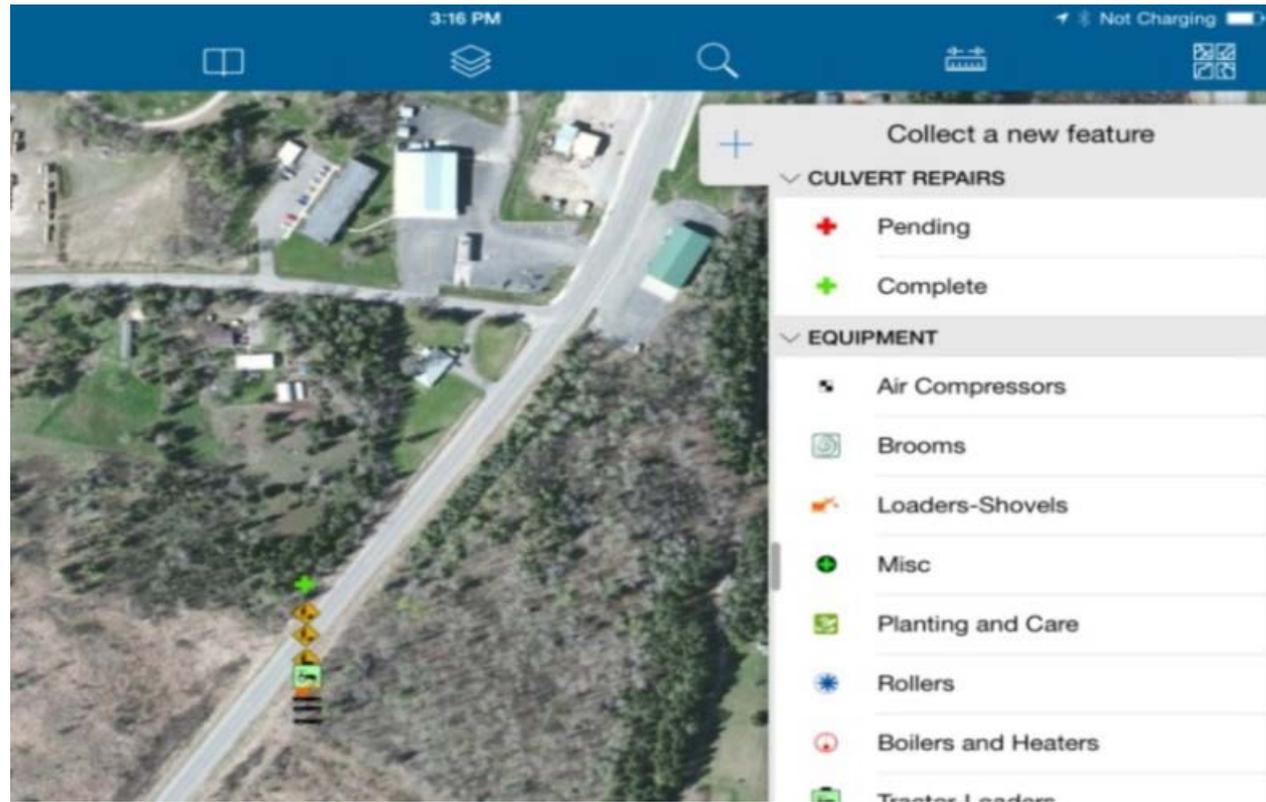
# Use of Culvert Repair Cost Data



- ▶ System planning (funding needs)
- ▶ Maintenance project planning (labor, equipment, materials needs)
- ▶ Identify:
  - most cost effective culvert repairs
  - cost savings



# Maintenance Culvert Repair Costs Recorded Onsite using Arc GIS Mobile App



Rapid App Development took 3-4 months!



# In the office, enter repairs via PC Web App

HOME ▾ CULVERT\_TEST\_V2 NEW MAP CREATE PRESENTATION Culvert ▾

Details Add Edit Basemap Save Share Print Directions Measure Bookmarks Find address or place 🔍

**Add Features**

- CULVERT\_REPAIRS**
  - Final
  - Pending
  - Complete
- EQUIPMENT**
  - Air Compressor
  - Brooms
  - Loaders-Shovels
  - Misc
  - Planting and Care
  - Rollers
  - Boilers and Heaters
  - Tractor-Loaders
  - Trailers-TrailerHouses-BunkHouses
  - Trucks
  - Additional Equip Cost
- LABOR**
  - General Laborer
  - Traffic Control Laborer
  - Additional Labor Cost
- MATERIALS**
  - Additional Material Cost
  - Aggregate Earthwork
  - Apron - Aluminized Safety; Apron - Aluminized
  - Apron - Aluminized Steel Flared

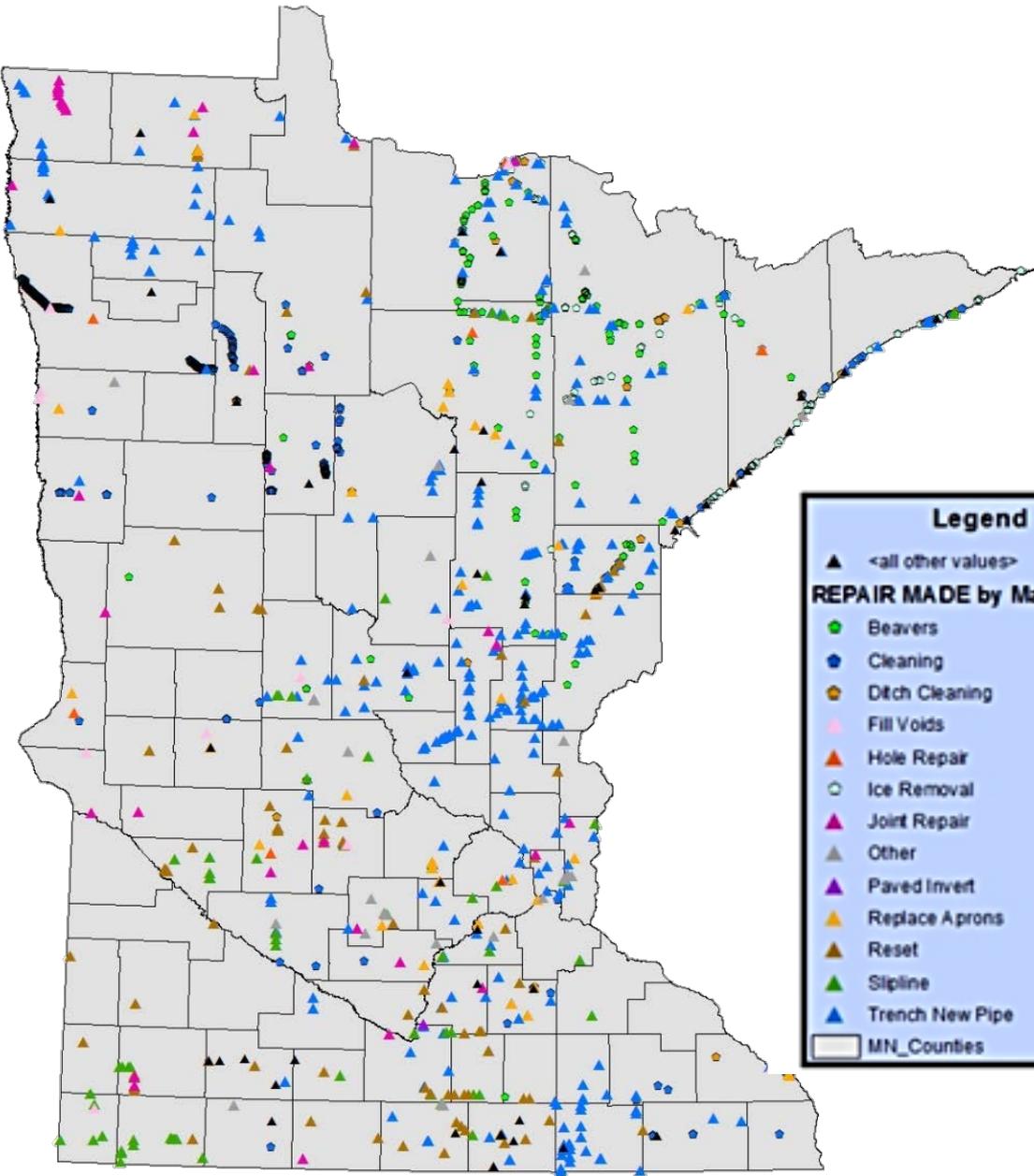
**EQUIPMENT (1 of 7)**

REPAIR ID	10,547
EQUIPMENT CATEGORY	Trucks
EQUIPMENT DESCRIPTION	352 Tandem Axle Truck T - MILE
UNIT COST	2.5500000000000003
QUANTITY	90
TOTAL COST	229.5

DELETE CLOSE



# Map of Repairs by MnDOT Maintenance In 2014 & 2015



**Legend**

- ▲ <all other values>
- REPAIR MADE by Maintenance
- Beavers
- Cleaning
- Ditch Cleaning
- Fill Voids
- Hole Repair
- Ice Removal
- Joint Repair
- Other
- Paved Invert
- Replace Aprons
- Reset
- Slipline
- Trench New Pipe
- MN\_Counties

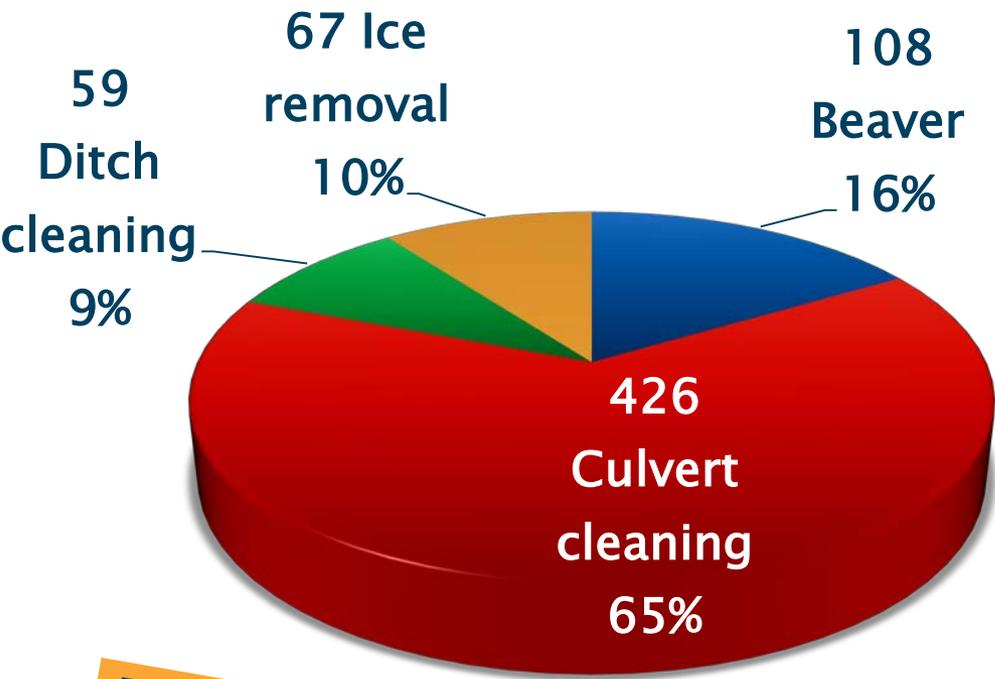


# Types of Culvert Repairs done by Maintenance

Type of Repair	Completed 2014	Completed 2015	Total Both Years	% of Total Repairs
Trench New Pipe	149	165	314	57%
Slipline Pipe	9	38	47	9%
Reset Apron and Pipe	41	25	66	12%
Replace Apron and Pipe	11	41	52	9%
Joint Repair	17	16	33	6%
Pipe Extension	4	11	15	3%
Fix Pipe Hole	2	2	4	1%
Fill Void	1	5	6	1%
Other Repair	5	8	13	2%
<b>Total Repairs</b>	<b>239</b>	<b>311</b>	<b>550</b>	



# 660 Cleaning Events Recorded

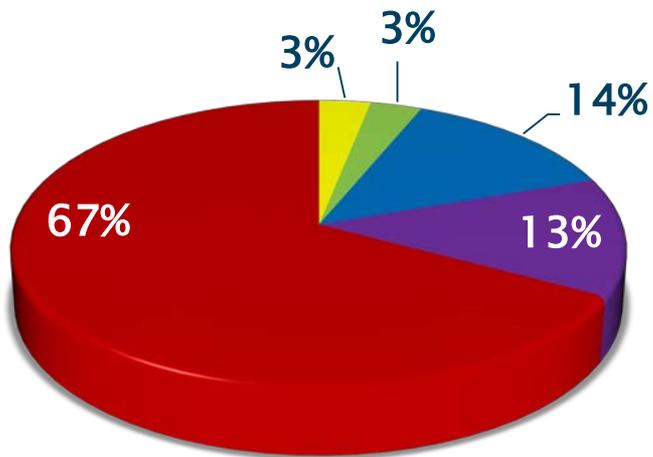


Repetitive maintenance needed?  
Fix drainage vs. regular cleaning.

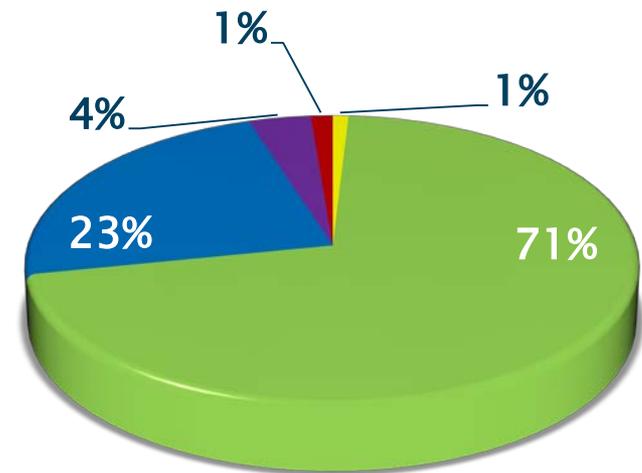


# Changes in Condition Code for All Maintenance Drainage Activities

## Culvert Condition Before Repair



## Culvert Condition After Repair



- 0 - Unknown
- 1 - Like New
- 2 - Fair
- 3 - Poor
- 4 - Very Poor



# Culvert Repair Cost Data

- ▶ Culvert data
- ▶ Labor
- ▶ Equipment
- ▶ Materials



## Culvert Repair Cost - Individual Repair Details Report

Repair ID: 16529  
Culvert Type: County Road  
Repair Made: Reset

Repair Status: Final  
RCA Work Order #:  
Repair Made: Reset

Hydinfra ID:  
Date Completed: 06/11/2015  
Date Started: 06/10/2015

Repaired Length (ft): 24.00	Repaired Material: Concrete	Full Name: Steve Aldrin
Total Length (ft): 100.00	Repaired Shape: Round	District: 1
Clean Done: Major	Inside Height (Inches): 24.00	Route System: IS
Pre-repair Condition: 4 - Very Poor	Inside Width (Inches): 24.00	Route Number: 35
Repaired Condition: 2 - Fair	Fill Over Pipe (ft): 10.00	Route Reference: 213.30
Comment: reset both aprons and first pipe section.		Left or Right: I

Cost Summary	Labor Costs	Equipment Costs	Material Costs	TOTAL COST
	\$ 1,405.88	\$ 1,142.20	\$ 1,187.67	\$ 3,735.75

**Labor**

Labor Classification	Charge Rate		Hours	Labor Cost
	Base Rate	Including Additive		
TA	\$ 25.79	\$ 36.96	12.0	\$443.58
TG	\$ 31.65	\$ 45.36	8.0	\$362.91
TGS	\$ 34.19	\$ 49.00	12.0	\$588.05
Traffic Control TG	\$ 31.65	\$ 45.36	0.3	\$11.34
<b>Total Labor Costs:</b>				<b>\$1,405.88</b>

**Equipment**

Charge Class Description - Units	Charge Rate		Quantity	Equipment Cost
	Base Rate	Including Overhead		
190 Pickup 3/4 Ton - MILE	\$ 0.71	\$ 0.82	50.0	\$40.97
350 57M LB Chassis Cab Tandem Axle Truck - MILE	\$ 2.85	\$ 3.29	80.0	\$263.11
352 Tandem Axle Truck T - MILE	\$ 2.55	\$ 2.94		
480 Semi Type TRLR 20-50T LowBoy ET - HR	\$ 19.79	\$ 22.84	1.0	\$22.84
482 Pull type Trailer 10-25 ton - HR	\$ 35.23	\$ 40.66	1.0	\$40.66
727 Skid Steer Loader 30HP - HR	\$ 38.45	\$ 44.37	3.0	\$133.11
770 Shovels 1/2 C.Y.. or 3/4 C.Y. - HR	\$ 55.59	\$ 64.15	10.0	\$641.51
<b>Total Equipment Costs:</b>				<b>\$1,142.20</b>

**Materials**

Material Description	Charge Rate		Quantity	Materials Cost
	Base Rate	Including Overhead		
Fiber Blanket, Erosion Control - SY	\$ 1.23	\$ 1.52	200.0	\$303.39
Geotextile Fabric - SF	\$ 1.40	\$ 1.73	320.0	\$552.52
Pipe Ties - EA	\$ 30.00	\$ 37.00	8.0	\$295.99
Seed Mix - LB	\$ 2.90	\$ 3.58	10.0	\$35.77
<b>Total Materials Costs:</b>				<b>\$1,187.67</b>

Report Date: 6/25/2015 1:43:54PM Page 1 of 1  
Version: 15.06.25





# Culvert Repair Cost Data

## Culvert Repair Cost - Individual Repair Details Report

Hydinfra ID: 482829

Repair ID: 961

Repair Status: Complete

Repair Made: Replace Aprons

Activity: Repair

<b>Labor</b>	<u>Labor Classification</u>	<u>Charge Rate</u>	<u>Sum Hours</u>	<u>Labor Cost</u>
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<b>Equipment</b>	<u>Charge Class - Description - Charge Units</u>	<u>Charge Rate</u>	<u>Quantity</u>	<u>Equipment Cost</u>
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<b>Materials</b>	<u>Material Description</u>	<u>Charge Rate</u>	<u>Quantity</u>	<u>Materials Cost</u>
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	AGGREGATE, SPEC 3138 CLASS 5 SURF BASE - TON	\$9.78	11	\$107.58
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	Concrete Flared Apron 24 Inch - EA	\$546.53	1	\$546.53
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	Reinforced Concrete Pipe 24 Inch - FT	\$30.35	12	\$364.20
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	Pipe Ties - EA	\$40.08	6	\$240.48
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	Select Granular Borrow - TON	\$6.68	67	\$447.56
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	RipRap - all classes - TON	\$26.72	10	\$267.20
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	<b>Total Materials Cost:</b>			<b>\$1,973.55</b>
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<b>Cost Summary</b>	Labor Cost	Equipment Cost	Materials Cost	TOTAL COST
	\$2,616.35	\$1,824.32	\$1,973.55	\$6,414.22

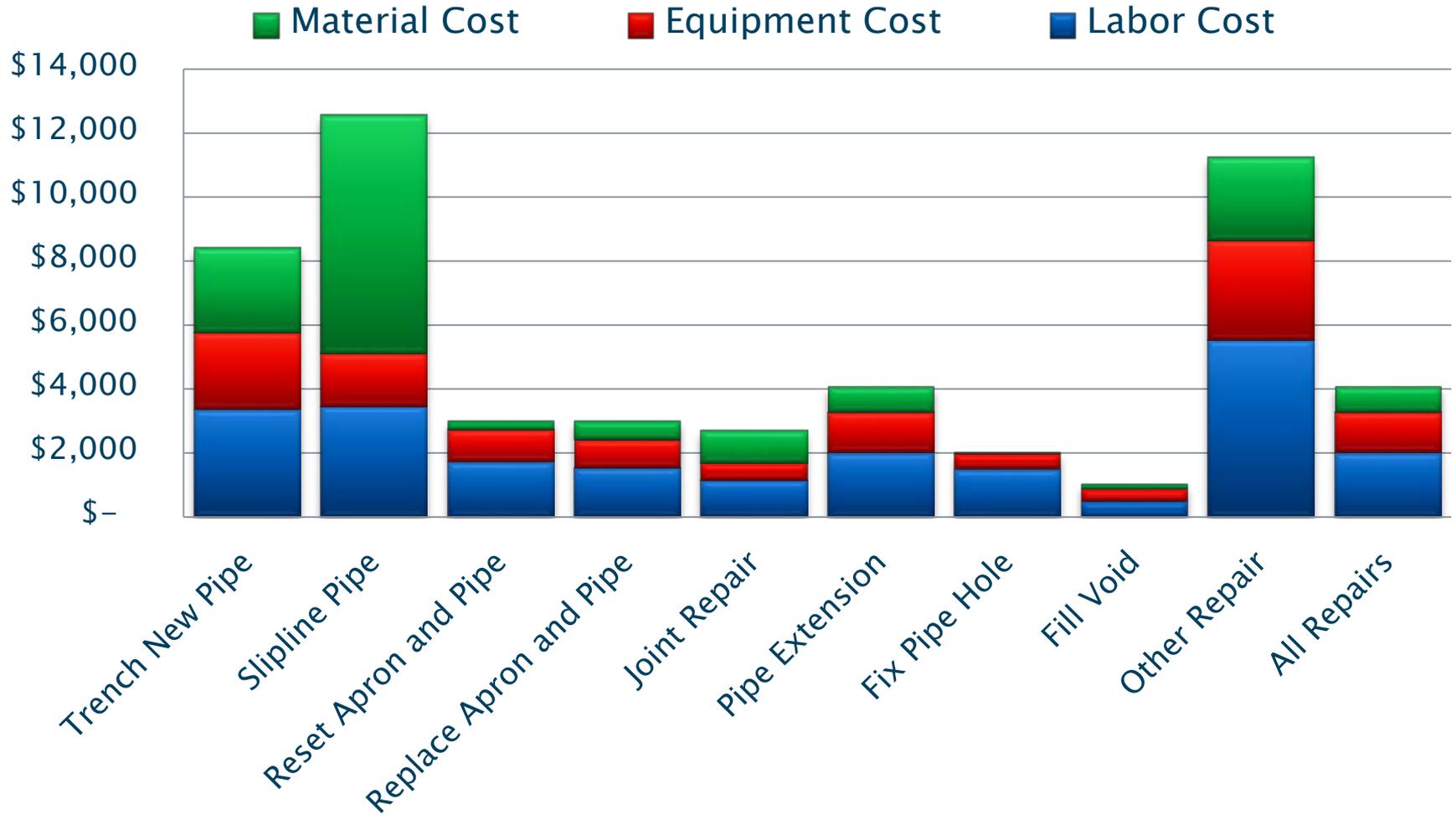
# 2014–2015 Culvert Repair Costs done by MnDOT Maintenance

Average Estimated Maintenance Cost of Culvert Repair

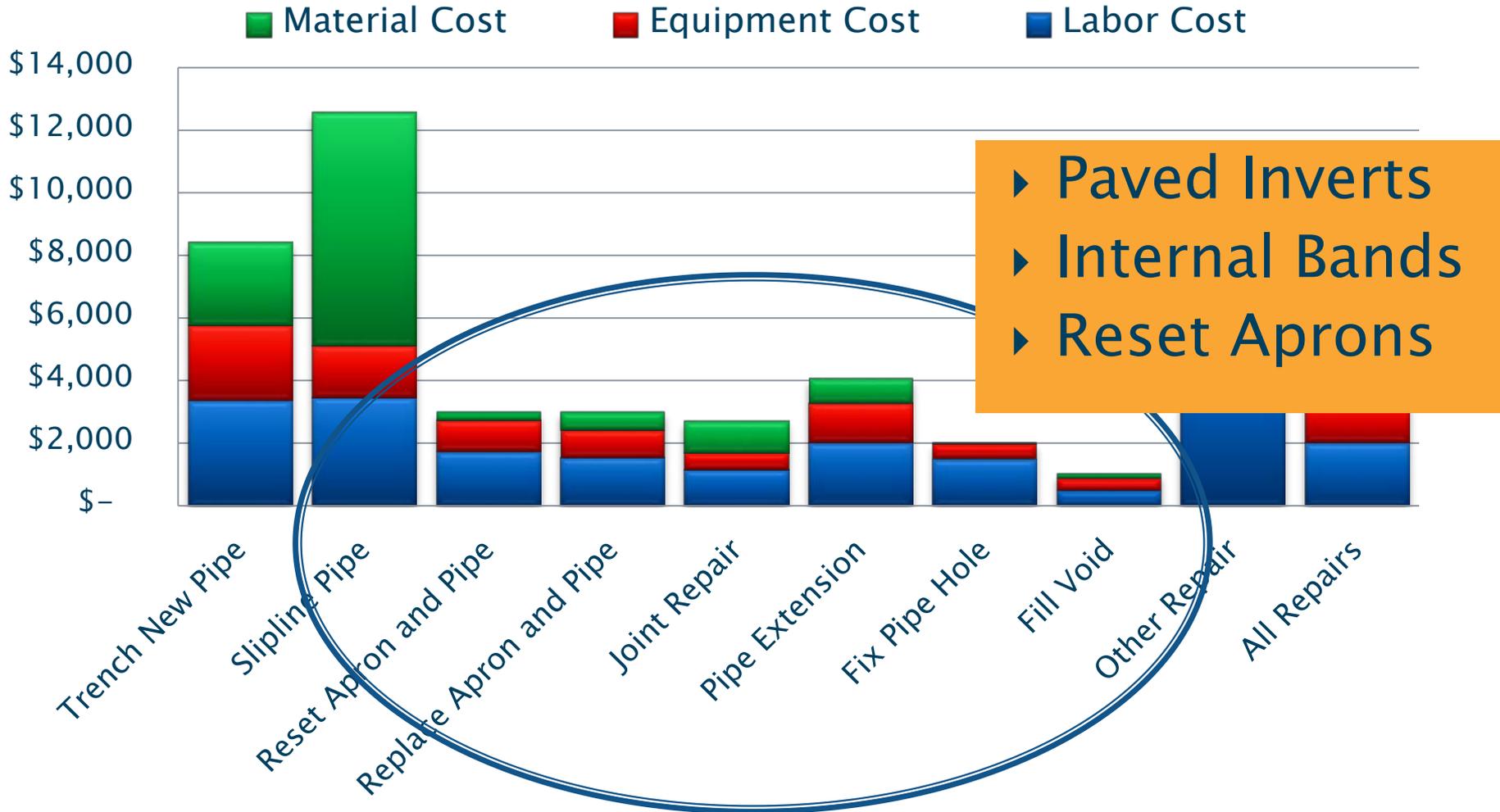
Repair Category	Culvert Categories	Number of Repairs	Average Repair Cost
Trench New Pipe	All	314	\$ 8,430
	Highway <sup>1</sup>		\$32,170
	Side <sup>2</sup>		\$ 9,610
	Entrance <sup>3</sup>		\$ 5,160
Slipline		47	\$12,570
Reset Apron and Pipe		66	\$ 3,000
Replace Apron and Pipe		52	\$ 3,000
Joint Repair		33	\$ 2,710
Pipe Extension		15	\$ 4,060
Hole Repair		4	\$ 2,000
Fill Void		6	\$ 1,020
Other		13	\$11,270
All Culvert Repairs		550	



# Average 2015 Adjusted Cost of Material, Equipment and Labor by Repair Category



# Fixing Small Problem Cheaper than Waiting until Big Problem with Voids



# Safety Aprons Increase Cost

Material Type	Total Cost of a 24" Apron or Pipe	Average % of Material Cost (based on 2014 data)
Metal flared apron	\$113/each galvanized \$249/each aluminized	17%
Metal safety apron	\$580/each galvanized \$880/each aluminized	50%

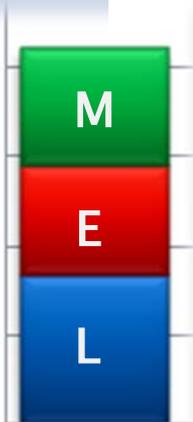
M  
E  
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# Pipe Makes up only 10–15% of Culvert Replacement Costs (trench new pipe)

Material Type	Total Cost of a 24" Apron or Pipe	Average % of Material Cost (based on 2014 data)
Corrugated steel pipe	\$17/L.F.	48%
Aluminized steel pipe	\$19/L.F.	30%
HDPE pipe	\$22/L.F.	58%
Polypropylene	\$24/L.F.	42%
Concrete Pipe	\$30/L.F.	None

\$8,000  
\$6,000  
\$4,000  
\$2,000  
\$-



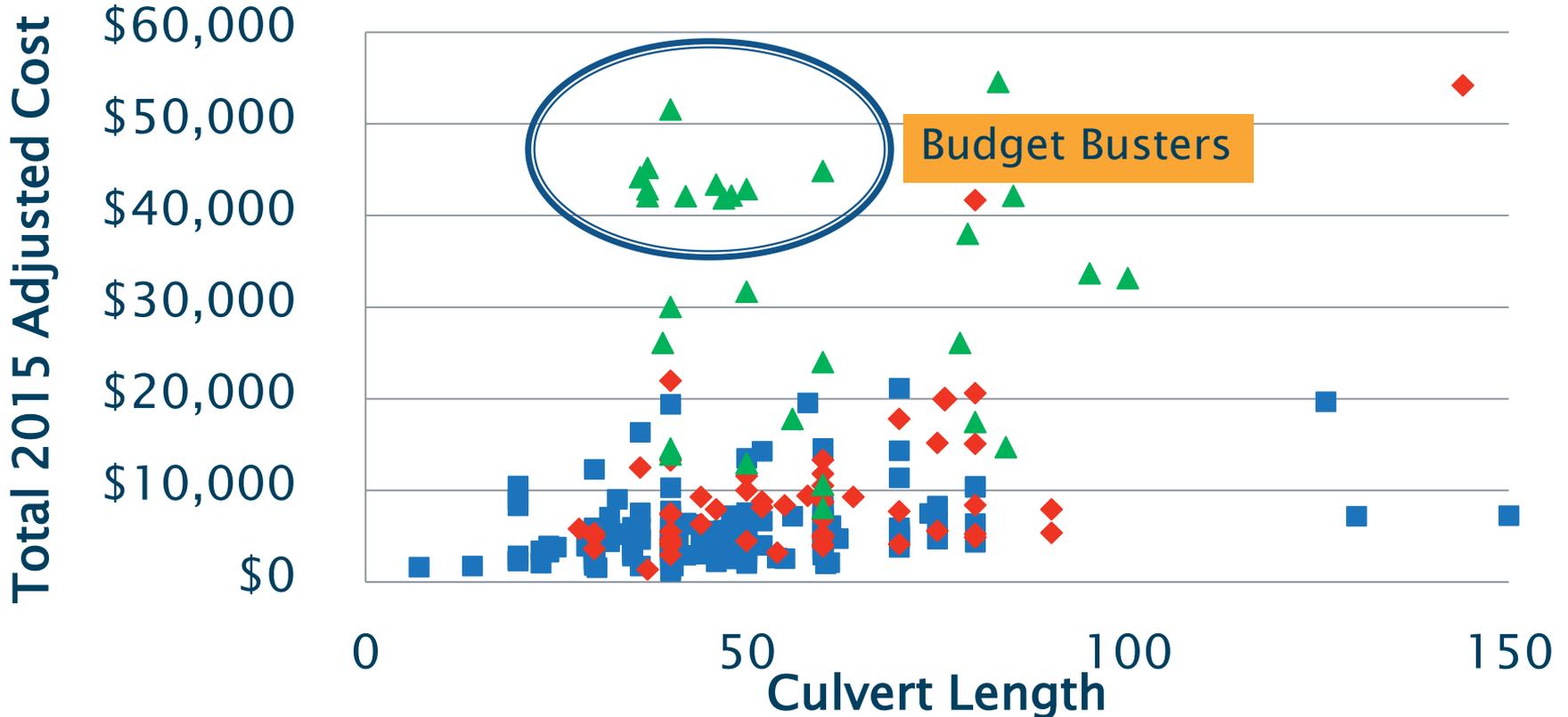
Average Material Cost 30% of Total Cost



# Trench New Pipe by Maintenance

(differences in cover, pavement, earthwork and traffic control influence cost)

■ Entrances    ◆ Side Culverts    ▲ Highway



# Understand Cost Drivers to Prevent Unexpected Budget Busters

Repair Category	Number of Repairs Used	Highway
Average Trench New Highway Pipe	314	\$32,170
Hwy with Standard Trench Width	19	\$26,026
Hwy with Wider Tapered Trench (has 10:1 side slopes)	10	<b>\$43,832</b>



# Slipline Cheaper than New Culvert as Long as Sufficient Hydraulic Capacity

Repair Category	Number of Repairs Used	Highway
Average Trench New Highway Pipe	314	\$32,170
Hwy with Standard Trench Width	19	\$26,026
Hwy with Wider Tapered Trench (has 10:1 side slopes)	10	\$43,832

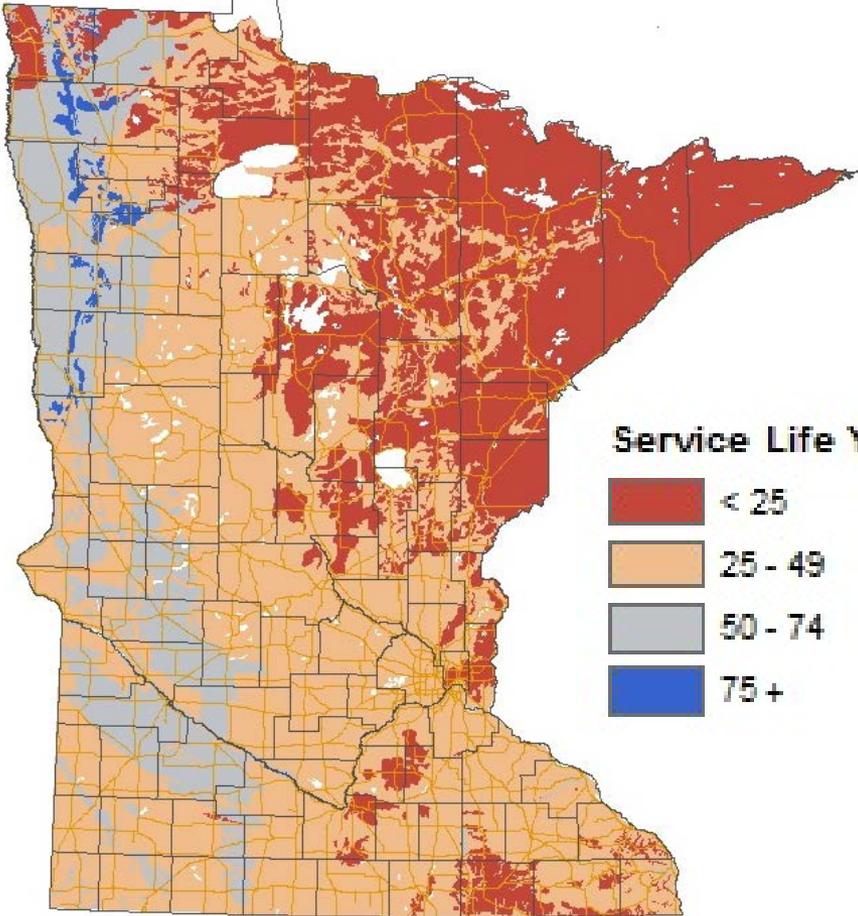
Repair Category	Number of Repairs Used	Highway
Slipline Need to make sure pipe has adequate hydraulic capacity to reduce size by lining	47	\$12,650



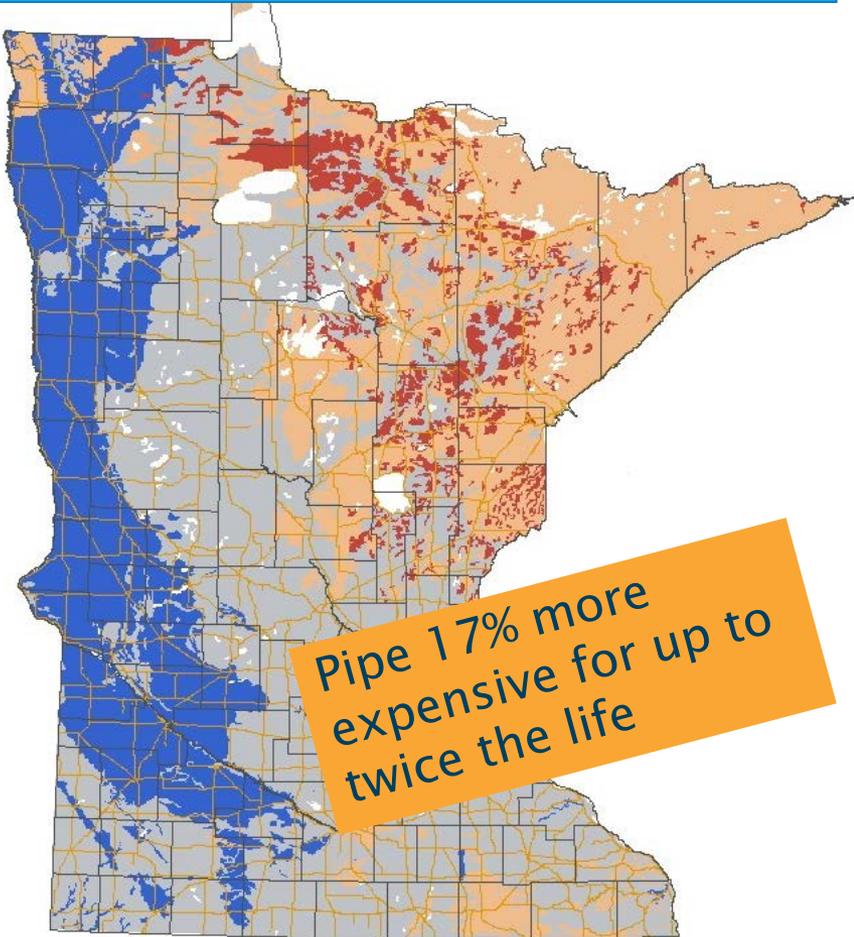
# Minnesota Steel Culvert Pipe Service-Life Research (Make CSP Last Longer)

<http://www.dot.state.mn.us/research/TS/2015/201531.pdf>

16 gage Galvanized

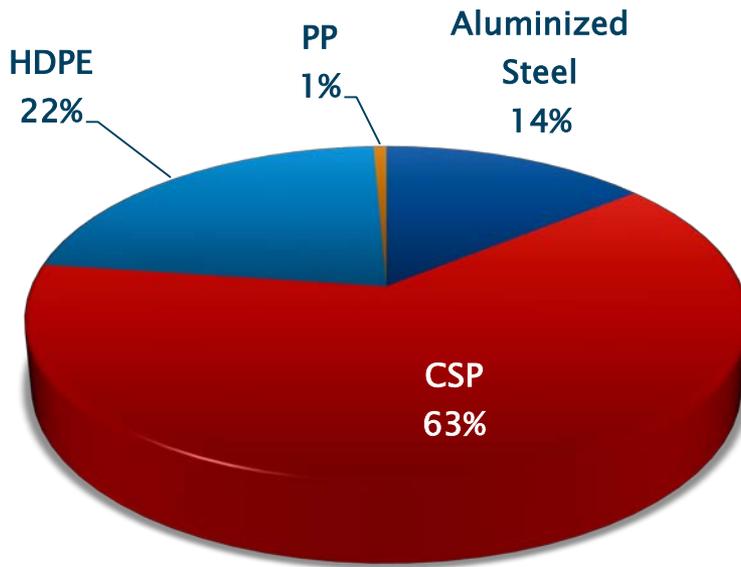


16 gage Aluminized

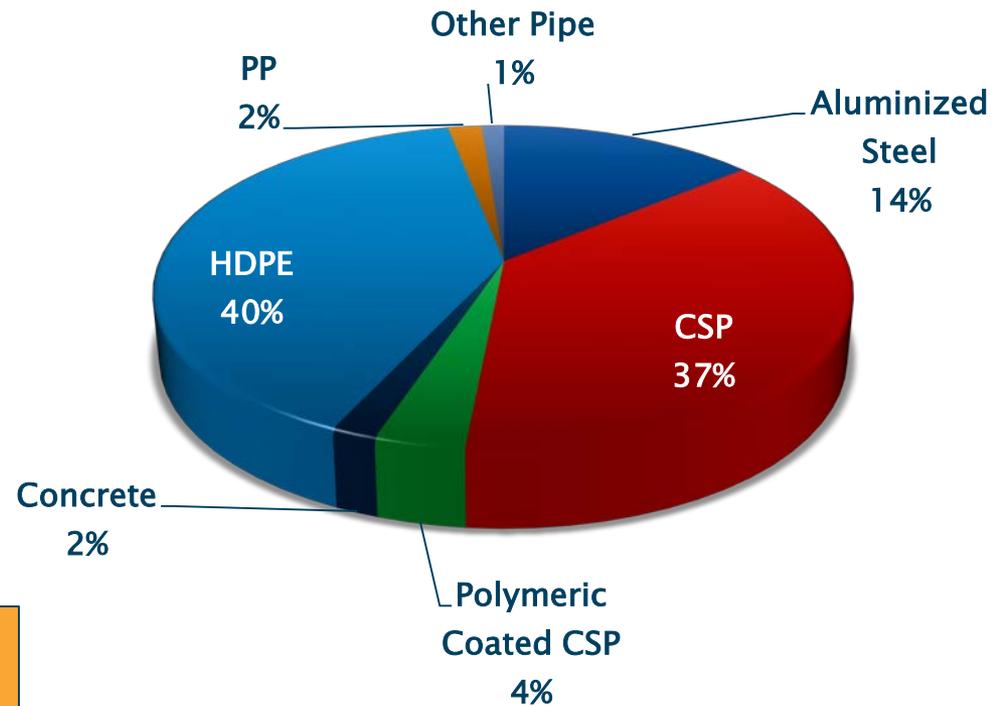


# Changes to Pipe Material Used by MnDOT Maintenance

Installed in 2014



Installed in 2015

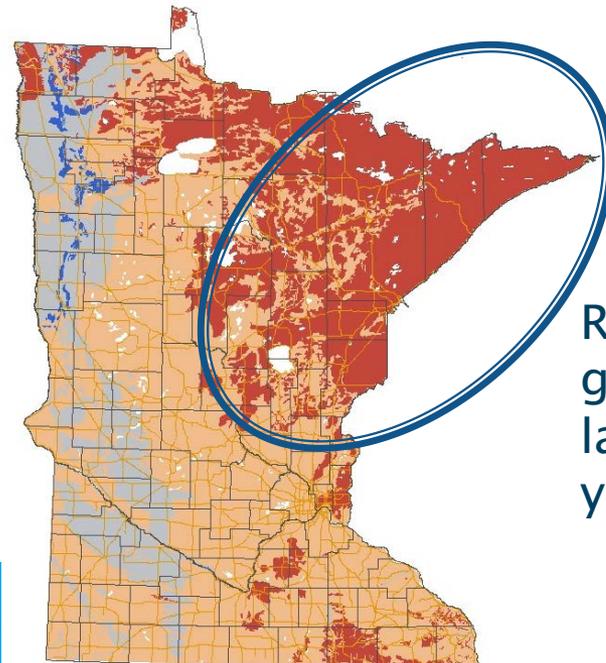
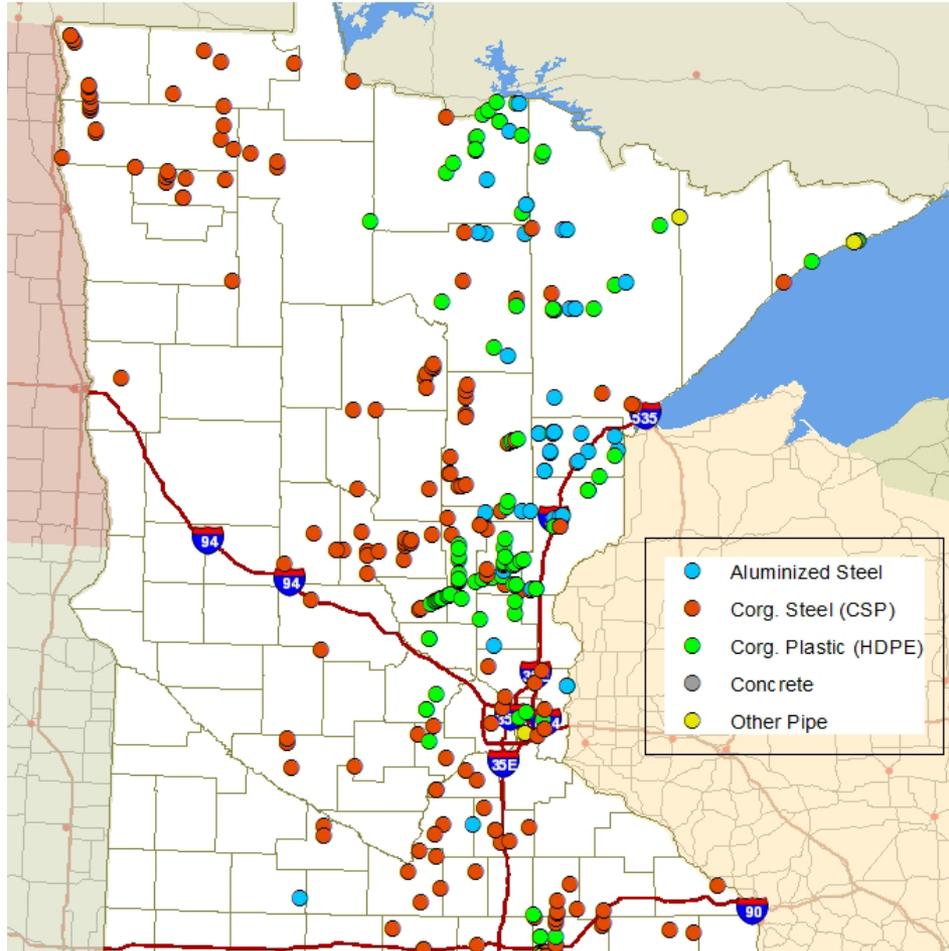


No such thing as a perfect pipe, pick the best for the site conditions.



# Maintenance Selects Culvert Materials to Last

- ▶ Culverts installed by maintenance in 2014 & 2015
- ▶ Material type
  - Red - Galvanized CSP
  - Blue - Aluminized CSP
  - Green - HDPE
  - Yellow - Polymeric coated CSP



Red area  
galvanized  
lasts <25  
year



# Labor = Maintenance Worker Time

(cost includes overhead)

- ▶ Trench new pipe, catch basin repair, cleaning, reset aprons & pipe extensions are labor intensive repairs.
- ▶ Traffic control increases costs
- ▶ Scheduling matters (i.e. travel distance increases hours, size of crew, waiting for...)
- ▶ Don't jump to conclusions
  - Complex or large projects higher labor or needs supervisor on site.



# Save Money, Right Size Equipment

- ▶ Specialty Equipment
  - Size and type to do the job i.e. grout pump or jetter
  - Own vs. rent
- ▶ What size dump truck?
  - Distance matters
  - Charge rates by hour or per mile



# Lessons Learned

- ▶ Use most cost effective pipe repair considering all components of cost, i.e. equipment and labor costs, not just material cost
- ▶ Look for ways to improve culvert repairs,
  - cost drivers and
  - budget busters
- ▶ Cheapest material might not be the best choice
  - Most cost effective over the life of the culvert

<http://www.dot.state.mn.us/bridge/hydraulics/CulvertCost.html>



# Cost of Culvert Repairs?



**Cost of Not  
Doing Repairs!**

