Culvert Cost WIG
on the Road to Drainage Asset Management

HydInfra Inspection Manual
Culvert and Storm Drainage Systems

Condition Rating Codes:

- **5** Excellent - like new condition
- **4** Fair - some wear, but structurally sound
- **3** Poor - deteriorated, consider for repair or replacement
- **2** Very Poor - serious deterioration
- **0** Not able to rate, not visible

Simple ratings codes suggest repair needs
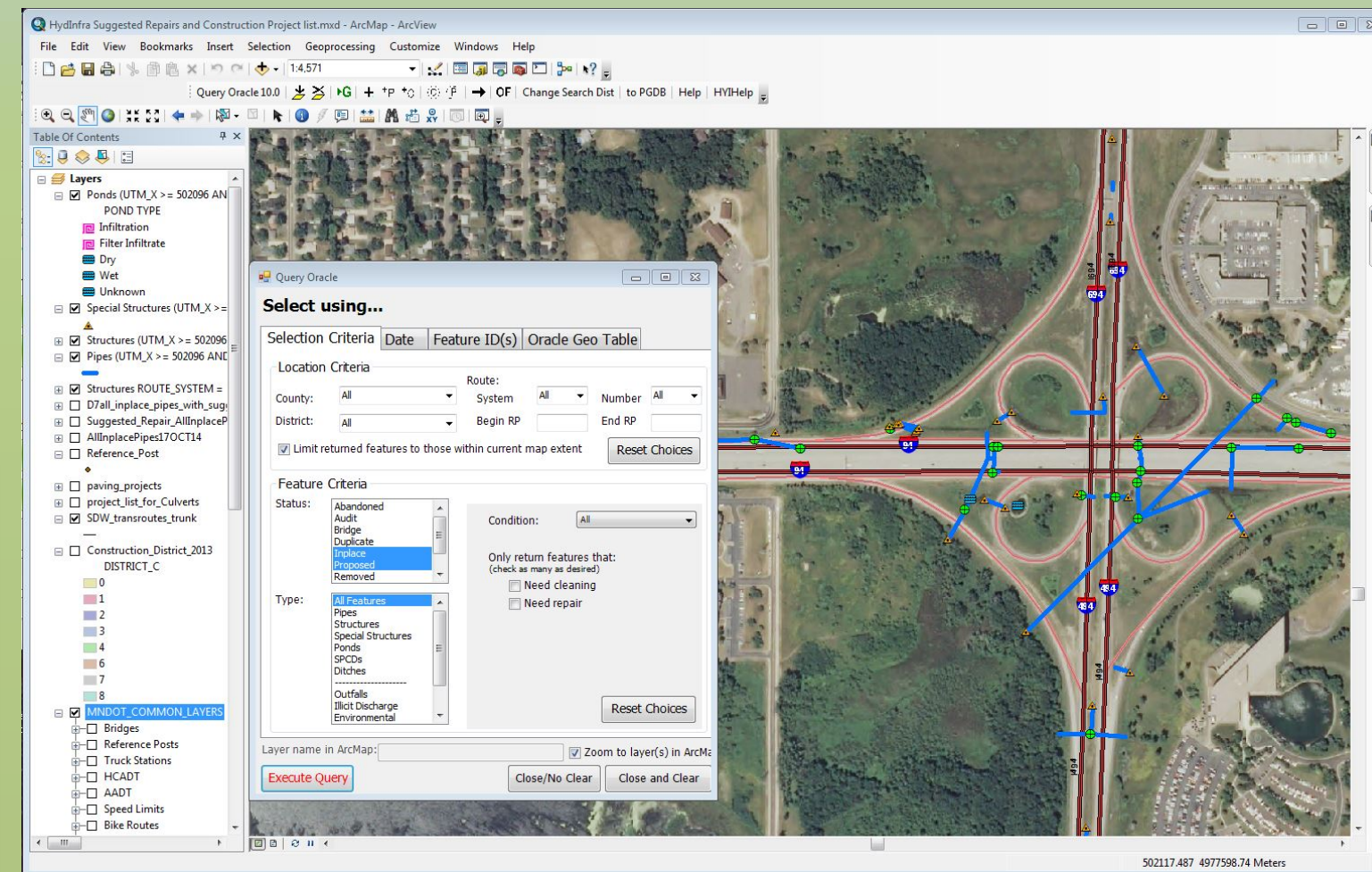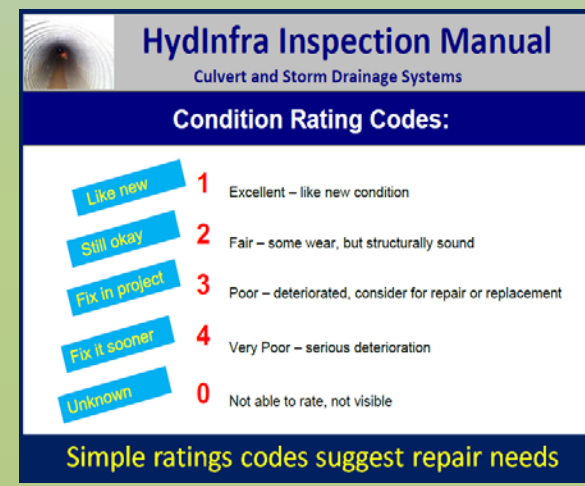
HydInfra - MnDOT's Culvert and Storm Drain Inventory and Inspection System

It all began in 1996 when Hydraulics/WRE engineers created HydInfra to improve drainage design and maintenance work. HydInfra was built with GIS tools designed so that people new to ArcMap could query for drainage features, make a map and export the data to a spreadsheet. HydInfra's simple condition rating codes based on explicit criteria for different materials, and flags to record defects make it a versatile framework to build asset management on.

Extreme rainfall and floods cause damage to culverts. GIS and HydInfra help recovery.
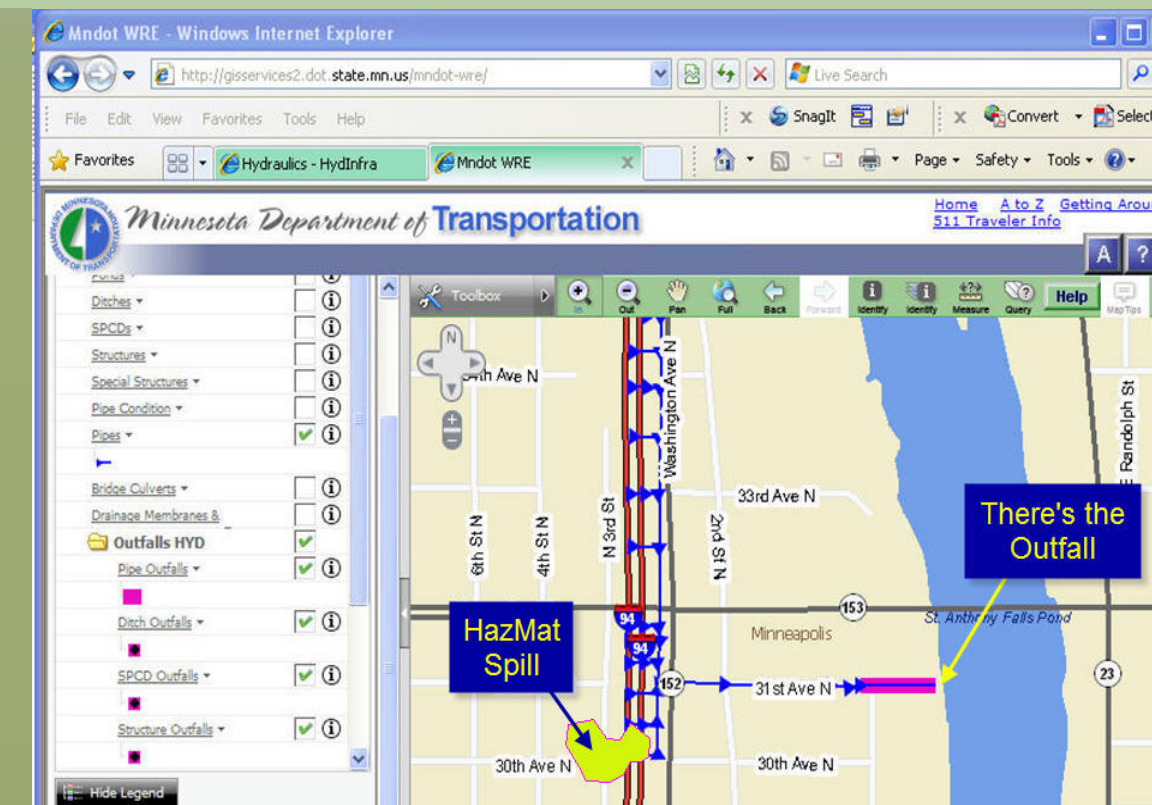
HazMat Spills Response Utility Locations and MS4 Water Quality

Metro WRE and Maintenance partner on MS4 water quality requirements.

Storm drain networking and "Georilla" map service improve response times for hazardous spill capture.

Storm drain networks are also used for Gopher State One Call utility locations.

HazMat Spill

There's the Outfall

Recommended Inspection Frequency for Highway Pipes

Overall Condition	Recommended Inspection Frequency Years	Comments
4	2	Pipes where problem is not under the road
Very Poor	1	Pipes where problem is require a repair under the road
3	4	Most condition 3 pipes
Poor	2	Pipes with Piping or Road Void
1 & 2 Like New and Fair	6	
0 Can't be Rated	2	
Pipes with no inspections		Goal to inspect within 6 years - 2019, many of these are storm drain pipe, so as districts identify pipes as storm drain, these should be reduced

Overall Target: 80% of Highway Pipes meet Recommended Inspection Frequency

Drainage Performance Measure

In 2008, Maintenance Operations chose HydInfra to track their Drainage Performance Measure for highway culvert inventory and inspection. Soon after, the inventory was completed and highway culverts are now inspected on a regular schedule.

GIS map shows year to inspect each culvert in District 8.
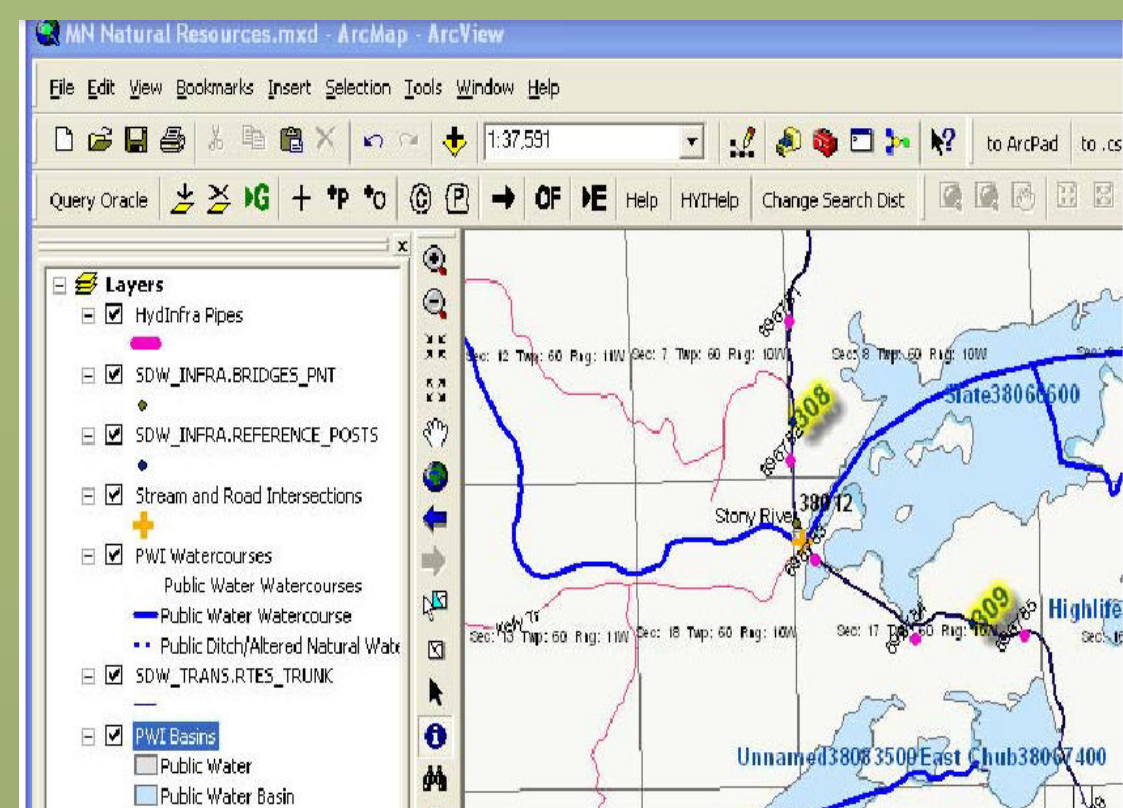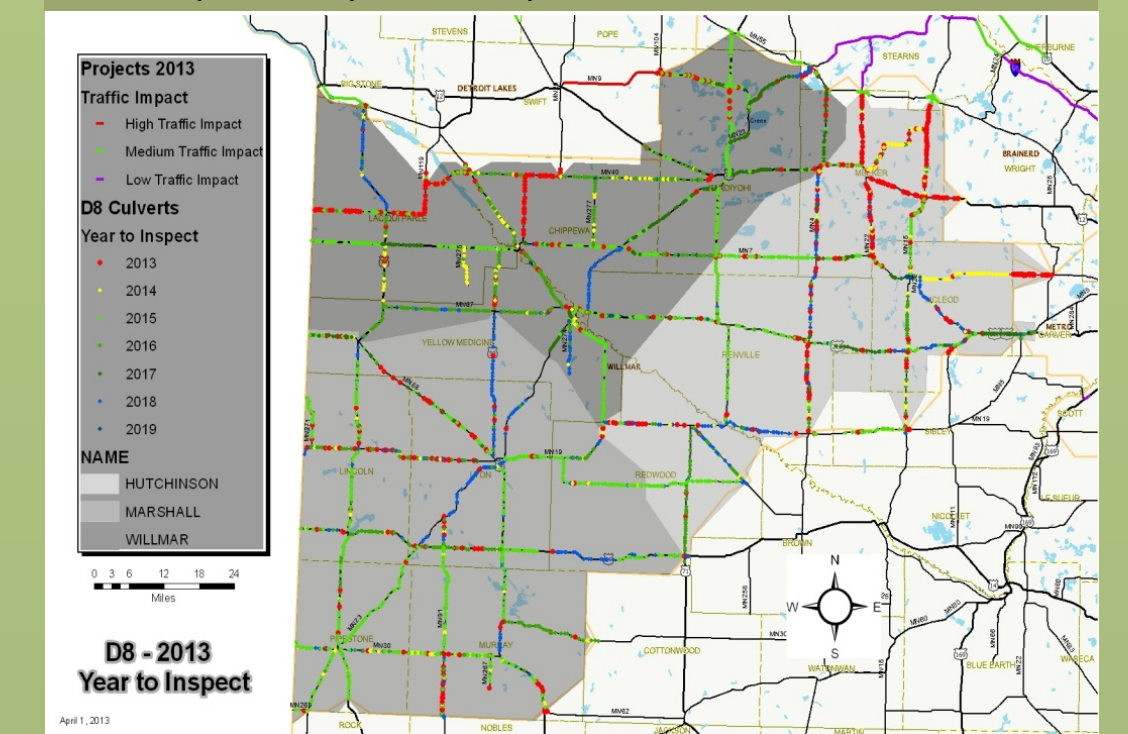
Project Scoping and Predesign

GIS layers from many sources give context to drainage design work. DNR layers for Public Waters illustrate areas that need environmental permits. HydInfra layers with drainage feature data help speed scoping and predesign tasks, especially in winter.

Big Storm + bad pipes = wrecked road
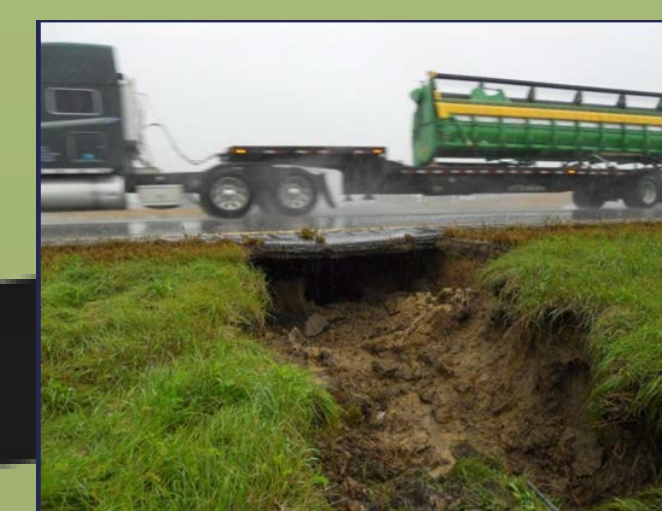
Culvert inspectors record defects that may cause road failure during extreme rainfall events. Pipe defects include road void, piping, and holes.

Research on Pipes and Materials

Research focusing on the projected lifespan of steel pipe is underway. The map below shows roadside pH overlaid on NRCS pH data. Acidity, or low pH, is a factor in steel pipe deterioration rates. The research is being done by Barbara Burkholder Heitkamp, U of M
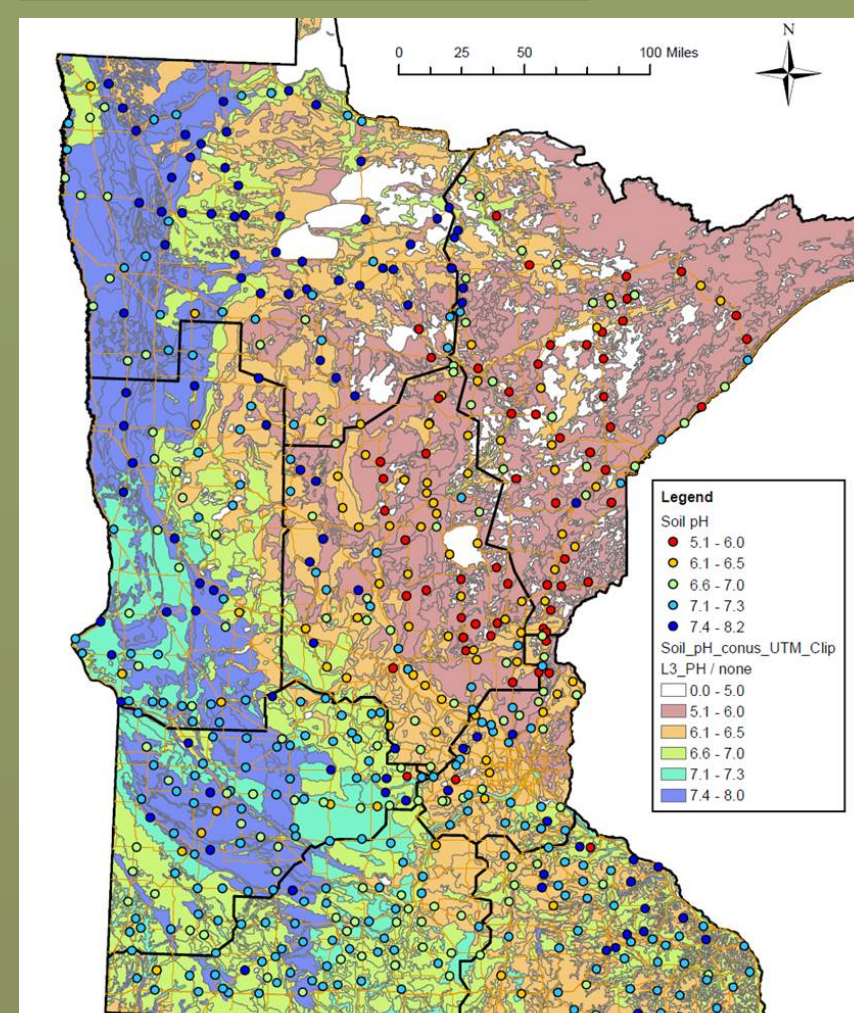
HydInfra data is used in research to look at materials and their failure modes. In this chart, the depth of fill above the pipe is correlated to specific pipe defects.
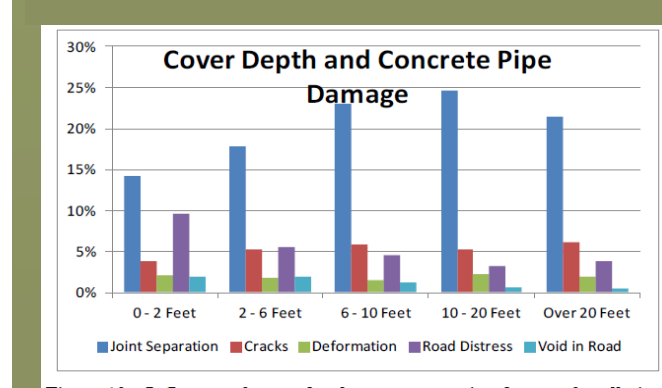
Cover Depth and Concrete Pipe Damage

Figure 13 —Influence of cover depth on concrete pipe damage for all pipes

Culvert Cost WIG

Maintenance crews repair or replace culverts and record the labor, equipment and materials in a mobile app based on ArcGIS Collector software.

Repair data can be entered in the Culvert Cost app while in the field on an iPad, or in the office on a PC.

Repair data is available immediately in web-based reports that repair crews can access from the repair site. Others in MnDOT can find Culvert Cost Reports by searching IHUB for "Culvert Cost".
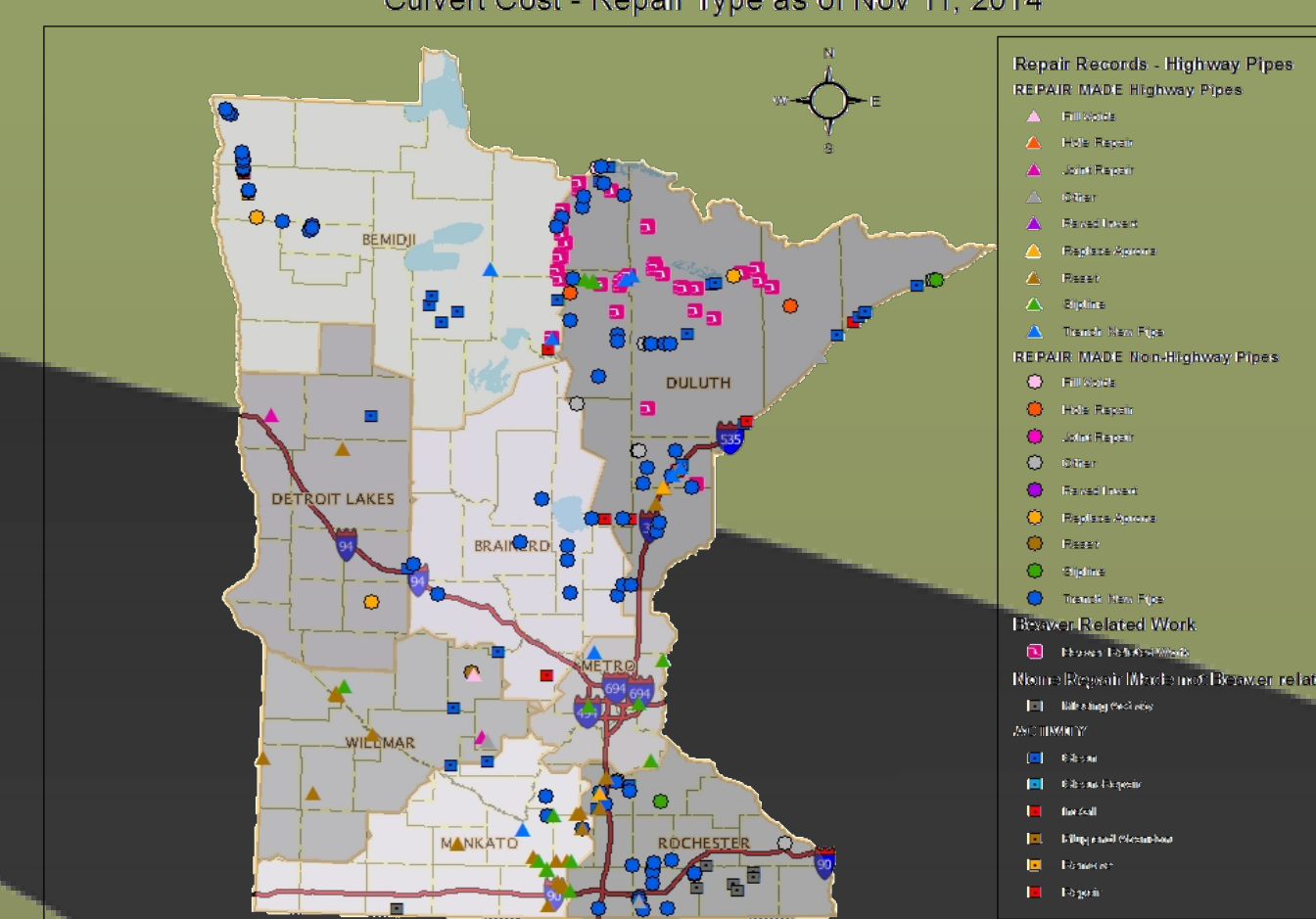
The map shows repairs, cleanings and new installations of culverts recorded in the first season of data collection.
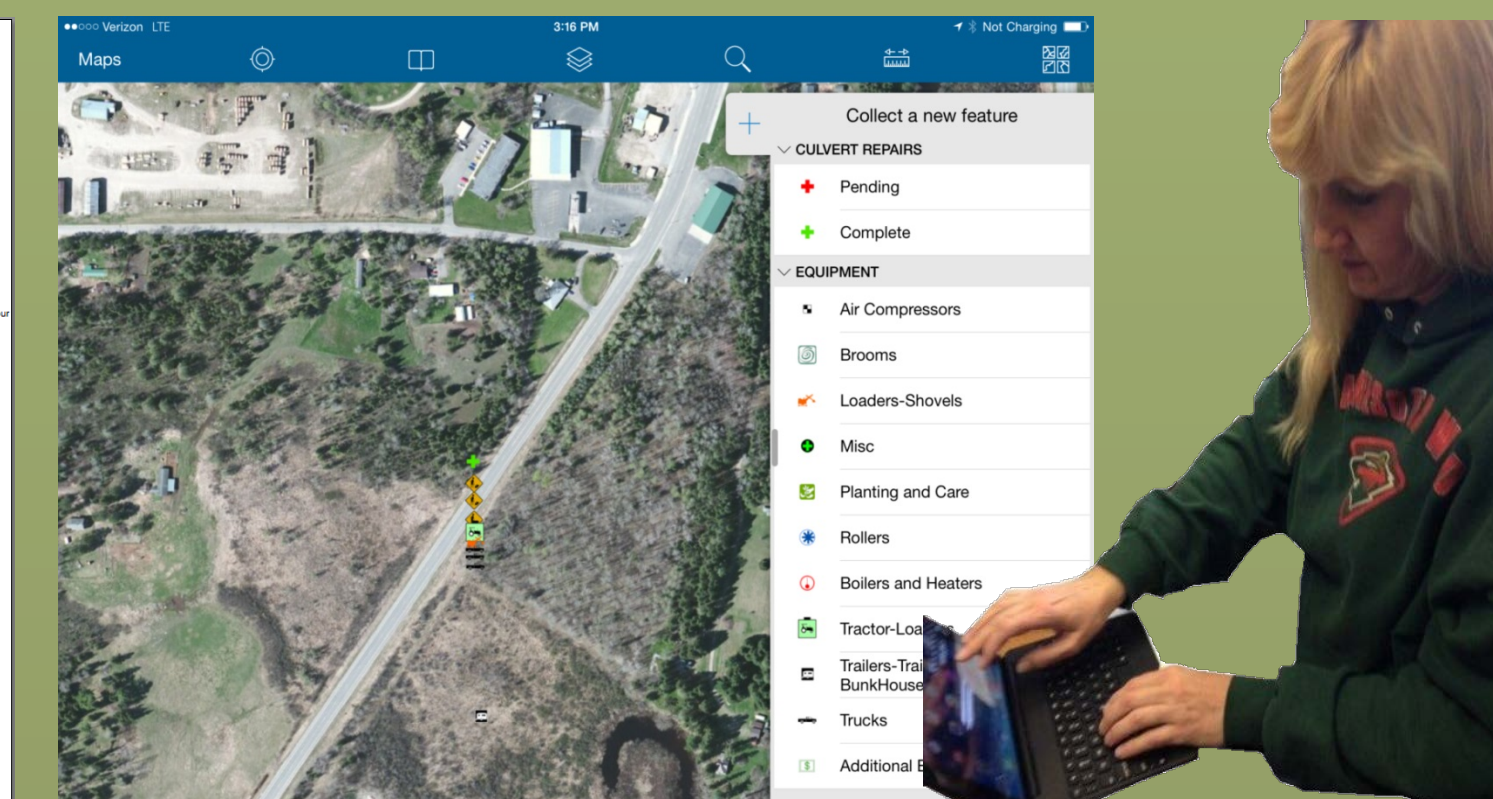
Culvert Cost - Repair Type as of Nov 11, 2014

The Road Ahead to Drainage Lifecycle Cost Analysis

1. Capture construction costs for drainage features from projects by contractors, along with as-built details about the drainage features.
2. Get an Enterprise Asset Management software solution that includes GIS, to merge HydInfra and Culvert Cost databases and to integrate data from MnDOT's many other parts, like Pavement, Traffic and Maintenance Operations' many responsibilities.
3. Inventory and inspect storm drain networks, ponds and other water quality devices and all those other features that are part of the drainage system.
4. Research pipe materials to improve service life predictions.
5. Project Lifecycle Performance to get the most bang for the buck.

Map shows scheduled paving projects overlaid on "Pipe Suggested Repair Method" layer from HydInfra Reports. Cost effective drainage system repair requires coordination with road construction and paving contracts. HydInfra's Pipe Suggested Repair Method uses traits to sort for bad pipes and apply a first-pass repair suggestion.