Bridge Committee Meeting Agenda

Thursday, August 27, 2020 @ 2:00 PM

In accordance with Gov. Gretchen Whitmer and the Michigan Department of Health and Human Services' recommendations designed to help prevent the spread of Coronavirus Disease 2019 (COVID-19), this will be an online-conference call meeting.

Persons needing accommodations for participating in this meeting should contact Roger Belknap at least 24 hours prior to the start of this meeting: belknapr@michigan.gov Phone: (517) 230-8192

Meeting Telephone Conference Line: 1-248-509-0316 Access Code: 167 665 995 #

Web Meeting Access Link: Join Microsoft Teams Meeting

1. **Welcome - Call to Order – Introduction**

2. **Public Comments on Non-Agenda Items**

3. **Additions or Deletions of Agenda Items**

4. **Consent Agenda *(Action Item)***
   4.1. Approval of the July 23, 2020 Meeting Minutes ***(Attachment 1)***
   4.2. TAMC Budget Update ***(Attachment 2)***

5. **Update Items**
   5.1. 2020 Fall TAMC Virtual Asset Management Conference ***(Memo)***
   5.2. Culvert Activities – *Belknap/Curtis/Gilbertson* ***(Memo Attachment 3)***
      5.2.1. DRAFT Report of 2020 Culvert Activities
      5.2.2. Investigation of Data Exchange Transfer & Load (ETL) Process
      5.2.3. Status of Integrating 2018 Pilot Data into TAMC Dashboards/IMAP
      5.2.4. TAMC DRAFT Policy for the Collection of Culvert Data
      5.2.5. DRAFT FY21 Budget for Culvert Activities
   5.3. Local Agency Bridge Data Cleanup Efforts from IRT – *Esparza/Jennett*
   5.4. Status of Bridge Committee Priorities in TAMC Work Program & 2020 TAMC Strategic Planning Session – *Belknap* ***(Memo Attachment 4)***

6. **Public Comments**

7. **Member Comments**

8. **Adjournment**

Next meeting September 24, 2020 at 2 PM - Location to be determined

MINUTES
TRANSPORTATION ASSET MANAGEMENT COUNCIL
BRIDGE COMMITTEE MEETING
July 23, 2020 at 2:00 p.m.
Meeting was held via Teleconference per Executive Order from Governor Gretchen Whitmer Discontinuing In-Person/Large Meetings Due to the Coronavirus 19 Pandemic
MINUTES

**** Frequently Used Acronyms List attached.**

Committee Members Present:
Christopher Bolt, MAC
Rebecca Curtis, MDOT – Chair
Brian Vilmont, Prein & Newhof
Keith Cooper, MDOT - Vice Chair
Wayne Harrall, KCRC
Brad Wieferich, MDOT

Support Staff Present:
Niles Annelin, MDOT
Jesus Esparza, MDOT
Dave Jennett, MDOT
Bill McEntee, CRA
Roger Belknap, MDOT
Chris Gilbertson, MTU
Tim Lauxman, DTMB/CSS
Gloria Strong, MDOT

Public Present:
None

Members Absent:
Al Halbeisen, OHM Advisers

1. Welcome - Call-To-Order - Introductions:
The meeting was called-to-order at 2:07 p.m. Everyone was introduced and welcomed to the meeting. G. Strong did a roll call to verify attendance.

2. Public Comments on Non-Agenda Items:
None

3. Additions or Deletions of Agenda Items:
None

4. Consent Agenda (Action Item):

4.1. - Approval of the May 28, 2020 Meeting Minutes (Attachment 1)

4.2. – TAMC Budget Update (Memo and Attachment 2)

R. Belknap provided a copy of an updated budget report. All recently received invoices including funds paid to MTU and CSS for their culvert activities are included in the report.

Motion: B. Vilmont made a motion to approve the May 28, 2020 Meeting Minutes; Wayne Harrall seconded the motion. The motion was approved by all members present.

5. Update Items:

5.1. – 2020 Bridge Inspections (Memo Attachment 3)

The Federal Highway Administration has clarified that the National Bridge Inspection standards still stand and that all bridge owners will be inspecting their bridges on time and the data should not be affected by COVID-19 related restrictions. A notice has been sent out to bridge owners.

5.2. – Culvert Activities – R. Curtis/C. Gilbertson/R. Belknap (Memo Attachment 4)

5.2.1. – Survey of 2018 Local Agency Culvert Pilot Project Inventory Participants

C. Gilbertson put together a summary of the culvert survey results. MTU will be doing Culvert Data Collection using Roadsoft and Culvert Condition Evaluations training webinars in September. These trainings may not change much in the future except for possibly the condition evaluation.

MTU did interviews with non-transportation agencies to find out how they may be able to use culvert data. None of them had a high level of use for the culvert data. They were content with the culvert data that they currently have. Huron Pines feels they have most of the data they need. The Southeast Michigan Council of Governments (SEMCOG) was interested in taking a look at the data. Wexford County reached out to non-transportation agencies that have been doing culvert collections to get their data. MTU checked with the Michigan Department of Natural Resources (DNR) on their on-line reporting tool. MTU continues to gather data from different agencies. C. Gilbertson signed up to get access to the DNR database but is not sure if it is necessary for everyone to do that. It appears, SEMCOG may be able to use the culvert data the most.

MTU looked at MDOTs culvert condition assessment system evaluation data. TAMC has been holding off on using funding until we know more about what the needs are from agencies. Transportation agencies may not be ready to do the culvert data collection at this time.

For the Committee to have a full understanding of what to put in the Culvert Data Collection policy, MTU reached out to the culvert pilot project participants. The agencies like the type of culvert information that they collected.

C. Gilbertson showed graphs with the culvert survey data. In the pilot they used point data and most people prefer line data. Other areas reviewed were: simplified ratings, evaluation periods (how often should culverts be surveyed; some people said about every 10 years), how would they use the culvert data from the pilot (60-70 percent were still collecting culvert data after the pilot and they provided comments on how they did the collection); 22 percent said they would find other areas culvert data useful. They had a concern on the quality of the data and how it was collected; 78 percent have no concerns sharing their culvert data in a statewide database and some concern with how the data would be used. For the culvert data to be of any value, there needs to be a need for the data. It does not make sense to do all of this work and there is no use for the culvert data.

If anyone wants the actual survey results from the survey, C. Gilbertson will forward that upon request.

5.2.2. – TAMC Policy for the Collection of Culvert Data – R. Belknap/R. Curtis/ C. Gilbertson

If the Bridge Committee plans to recommend to the full Council to pursue culvert data collection, Bridge Committee needs to show that there is a need and how the culvert data should be collected, what type of information should be gathered, if culvert data collection should be placed on a schedule as required of PASER data collection, if TAMC will need to seek more funding to do the culvert data collections, and how often it should be gathered. If TAMC decides to collect the culvert data, there will need to be a policy. The policy will need to reflect what at a minimum should be done to meet the requirements of the asset management plan per Public Act 325.

For the Culvert Pilot Project MTU provided how to collect the culvert data by using Roadsoft, what to collect, condition evaluation training, and provided a guidebook to evaluate the culvert. C. Gilbertson will check to see if Roadsoft has a section for frequency of culvert data collections.

Once there is a policy, MTU will adapt their trainings towards the policy. The trainings that MTU have scheduled for September 2020 will be the same as the pilot project training. It is felt it may be difficult if it is mandated for some of the smaller agencies to collect the culvert data as they did for the pilot project. They may not have the manpower.

TAMC may not mandate that agencies collect culvert data, but if an agency decides to collect the culvert data, and especially if they use the TAMC funding, everyone will need to be consistent when submitting their data. Therefore, a policy will be needed to provide guidance.

MTU will summarize the survey results and their findings in a report and make a recommendation to full Council as to what they recommend the Council do for culvert data. They will have the final report in draft form no later than the end of September. At the next Bridge Committee meeting in August 2020, C. Gilbertson will provide a draft report to the Bridge Committee. He will then add in anything that comes out of the August Bridge Committee meeting and provide a final draft report in September. Support staff has started to pull together a draft culvert policy outline. They will provide the draft policy outline at the August Bridge Committee meeting. At this time, it looks as if the recommendation to full Council will be to follow the same requirements as used for the Culvert Pilot Project in 2018, with some minor changes.

The Bridge Committee will calendarize the process so everyone knows what the plan is for culverts and creating the culvert policy and keep everyone involved on track. This would then be shared with the full Council. The Committee is currently on schedule for what was previously discussed. This plan will dictate on how the money will be spent. There is an ability to amend contracts to add culvert work.

MTU recently billed towards the remaining culvert funds for the survey. There is currently $472,863.51 in the remaining culvert funds. The original allocation was $2,000,000.00. MTU has provided a list of the number of agencies and number of culverts they inventoried. R. Belknap and C. Gilbertson will work on a draft budget for the remaining 2018 Culvert Pilot Project funds and present that at the August Bridge Committee meeting.

Action Item: MTU will provide a draft of its culvert findings with a recommendation of action for culvert data collection based on their findings to the Bridge Committee at the August 2020 meeting. A final draft will be submitted to full Council in September 2020.

Action Item: C. Gilbertson will check to see if Roadsoft has a section for frequency of culvert data collections.

Action Item: Support staff will provide a draft culvert policy outline at the August Bridge Committee Meeting.

Action Item: R. Belknap and C. Gilbertson will work on a draft budget for the remaining 2018 Culvert Pilot Project funds and present the budget at the August Bridge Committee meeting.

5.2.3. - Status of Integrating 2018 Pilot Data into TAMC Dashboards/IMAP – R. Belknap

This is currently in the UAT testing stage and is expected to go live in 2 – 3 weeks. R. Belknap gave a brief demonstration of the dashboards and interactive maps.

5.3. - Local Agency Bridge Data Cleanup Efforts from IRT – J. Esparza/D. Jennett/ B. McEntee

J. Esparza and D. Jennett have been working on cleaning up contact information and cost for bridge projects of $100 or less. The City of Grand Rapids, Muskegon County Road Commission and Oakland County Road Commission have updated their information. J. Esparza and D. Jennett have sent out a second request to different contacts that could possibly update the needed information. There are a few projects entered that have zero-dollar projects. In the future, these will need to be discussed, especially when doing an estimation of costs. Some agencies need to update their bridge projects in the IRT. It is recommended that once the projects are open to traffic the agencies report the project in the IRT. Bridge projects in ADARS do not populate into the IRT. The agency would need to enter them in.

5.4. - Status of Bridge Committee Priorities in TAMC Work Program & 2020 TAMC Strategic Planning Session – Belknap (Memo Attachment 5)

The Bridge Committee's tasks in the TAMC Work Program were discussed and updated at their last meeting. The work plan will provide a good snapshot of the Bridge Committee's goals and objectives at the September Strategic Planning Session. R. Belknap will provide a final draft to the committee at their August 27th meeting.

6. Public Comments:

None

7. Member Comments:

None

8. Adjournment:

Motion: K. Cooper made a motion to adjourn the meeting; W. Harrall seconded the motion. The motion was approved by all members present. The meeting adjourned at 3:58 p.m.

The next TAMC Bridge Committee meeting is scheduled for August 27, 2020, via Microsoft Teams Meeting.

TAMC FREQUENTLY USED ACRONYMS:

AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
ACE	ADMINISTRATION, COMMUNICATION, AND EDUCATION (TAMC COMMITTEE)
ACT-51	PUBLIC ACT 51 OF 1951-DEFINITION: A CLASSIFICATION SYTEM DESIGNED TO DISTRIBUTE MICHIGAN'S ACT 51 FUNDS. A ROADWAY MUST BE CLASSIFIED ON THE ACT 51 LIST TO RECEIVE STATE MONEY.
ADA	AMERICANS WITH DISABILITIES ACT
ADARS	ACT 51 DISTRIBUTION AND REPORTING SYSTEM
BTP	BUREAU OF TRANSPORTATION PLANNING (MDOT)
CFM	COUNCIL ON FUTURE MOBILITY
CPM	CAPITAL PREVENTATIVE MAINTENANCE
CRA	COUNTY ROAD ASSOCIATION (OF MICHIGAN)
CSD	CONTRACT SERVICES DIVISION (MDOT)
CSS	CENTER FOR SHARED SOLUTIONS
DI	DISTRESS INDEX
ESC	EXTENDED SERVICE CONTRACT
FAST	FIXING AMERICA'S SURFACE TRANSPORTATION ACT
FHWA	FEDERAL HIGHWAY ADMINISTRATION
FOD	FINANCIAL OPERATIONS DIVISION (MDOT)
FY	FISCAL YEAR
GLS REGION V	GENESEE-LAPEER-SHIAWASSEE REGION V PLANNING AND DEVELOPMENT COMMISSION
GVMC	GRAND VALLEY METRO COUNCIL
HPMS	HIGHWAY PERFORMANCE MONITORING SYSTEM
IBR	INVENTORY BASED RATING
IRI	INTERNATIONAL ROUGHNESS INDEX
IRT	INVESTMENT REPORTING TOOL
KATS	KALAMAZOO AREA TRANSPORTATION STUDY
KCRC	KENT COUNTY ROAD COMMISSION
LDC	LAPTOP DATA COLLECTORS
LTAP	LOCAL TECHNICAL ASSISTANCE PROGRAM
MAC	MICHIGAN ASSOCIATION OF COUNTIES
MAP-21	MOVING AHEAD FOR PROGRESS IN THE 21ST CENTURY (ACT)
MAR	MICHIGAN ASSOCIATION OF REGIONS
MDOT	MICHIGAN DEPARTMENT OF TRANSPORTATION
MDTMB	MICHIGAN DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
MIC	MICHIGAN INFRASTRUCTURE COMMISSION
MITA	MICHIGAN INFRASTRUCTURE AND TRANSPORTATION ASSOCIATION
MML	MICHIGAN MUNICIPAL LEAGUE
MPO	METROPOLITAN PLANNING ORGANIZATION
MTA	MICHIGAN TOWNSHIPS ASSOCIATION
MTF	MICHIGAN TRANSPORTATION FUNDS
MTPA	MICHIGAN TRANSPORTATION PLANNING ASSOCIATION
MTU	MICHIGAN TECHNOLOGICAL UNIVERSITY
NBI	NATIONAL BRIDGE INVENTORY
NBIS	NATIONAL BRIDGE INSPECTION STANDARDS
NFA	NON-FEDERAL AID
NFC	NATIONAL FUNCTIONAL CLASSIFICATION
NHS	NATIONAL HIGHWAY SYSTEM
PASER	PAVEMENT SURFACE EVALUATION AND RATING

PNFA	PAVED NON-FEDERAL AID
PWA	PUBLIC WORKS ASSOCIATION
QA/QC	QUALITY ASSURANCE/QUALITY CONTROL
RBI	ROAD BASED INVENTORY
RCKC	ROAD COMMISSION OF KALAMAZOO COUNTY
ROW	RIGHT-OF-WAY
RPA	REGIONAL PLANNING AGENCY
RPO	REGIONAL PLANNING ORGANIZATION
SEMCOG	SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS
STC	STATE TRANSPORTATION COMMISSION
STP	STATE TRANSPORTATION PROGRAM
TAMC	TRANSPORTATION ASSET MANAGEMENT COUNCIL
TAMCSD	TRANSPORTATION ASSET MANAGEMENT COUNCIL SUPPORT DIVISION
TAMP	TRANSPORTATION ASSET MANAGEMENT PLAN
TPM	TRANSPORTATION PERFORMANCE MEASURES
UWP	UNIFIED WORK PROGRAM

TAMC Budget Financial Reporting - FY18-FY20

8/21/2020

Michigan Transportation Asset Management Council

		FY18 Budget	FY18 Actual		FY19 Budget	FY19 Year to Date		FY20 Budget	FY20 Year to Date	
	(most recent invoice)	$	Spent	Balance	$	Spent	Balance	$	Spent	Balance
I. Data Collection & Regional-Metro Planning Asset Management Progam										
Battle Creek Area Transporation Study	2QTR-20	$ 20,500.00	$ 20,213.36	$ 286.64	$ 20,500.00	$ 15,619.52	$ 4,880.48	$ 20,500.00	$ 6,685.65	$ 13,814.35
Bay County Area Transportation Study	3QTR-20	$ 21,100.00	$ 8,028.84	$ 13,071.16	$ 21,100.00	$ 21,100.00	$ -	$ 19,900.00	$ 9,405.10	$ 10,494.90
Central Upper Peninsula Planning and Development	3QTR-20	$ 47,000.00	$ 47,000.00	$ -	$ 47,000.00	$ 47,000.00	$ -	$ 50,000.00	$ 32,018.85	$ 17,981.15
East Michigan Council of Governments	July	$ 111,000.00	$ 81,559.65	$ 29,440.35	$ 111,000.00	$ 96,962.88	$ 14,037.12	$ 108,000.00	$ 77,397.04	$ 30,602.96
Eastern Upper Peninsula Regional Planning & Devel.	3QTR-20	$ 23,100.00	$ 23,100.00	$ -	$ 23,100.00	$ 23,100.00	$ -	$ 25,000.00	$ 7,859.71	$ 17,140.29
Genesee Lapeer Shiawasse Region V Planning Com.	July	$ 46,000.00	$ 45,954.99	$ 45.01	$ 46,000.00	$ 45,695.89	$ 304.11	$ 46,000.00	$9,325.44	$ 36,674.56
Grand Valley Metropolitan Council	3QTR-20	$ 25,000.00	$ 12,060.69	$ 12,939.31	$ 25,000.00	$ 18,410.63	$ 6,589.37	$ 24,000.00	$ 4,333.28	$ 19,666.72
Kalamazoo Area Transportation Study	3QTR-20	$ 22,000.00	$ 21,588.77	$ 411.23	$ 22,000.00	$ 21,944.89	$ 55.11	$ 22,000.00	$ 7,400.65	$ 14,599.35
Macatawa Area Coordinating Council	3QTR-20	$ 20,200.00	$ 9,575.57	$ 10,624.43	$ 20,200.00	$ 7,271.32	$ 12,928.68	$ 19,000.00	$ 2,109.54	$ 16,890.46
Midland Area Transportation Study	3QTR-20	$ 21,000.00	$ 20,857.81	$ 142.19	$ 21,000.00	$ 19,973.54	$ 1,026.46	$ 21,000.00	$ 2,945.40	$ 18,054.60
Northeast Michigan Council of Governments	June	$ 52,200.00	$ 52,200.00	$ -	$ 46,000.00	$ 46,000.00	$ -	$ 51,000.00	$ 34,950.34	$ 16,049.66
Networks Northwest	2QTR-20	$ 72,000.00	$ 71,915.46	$ 84.54	$ 72,000.00	$ 72,000.00	$ -	$ 75,000.00	$ 10,548.03	$ 64,451.97
Region 2 Planning Commission	2QTR-20	$ 42,000.00	$ 29,362.33	$ 12,637.67	$ 42,000.00	$ 34,881.00	$ 7,119.00	$ 40,000.00	$ 7,290.00	$ 32,710.00
Saginaw County Metropolitan Plannning Commission		$ 22,200.00	$ 22,000.00	$ 200.00	$ 22,200.00	$ 21,012.84	$ 1,187.16	$ 21,000.00		$ 21,000.00
Southcentral Michigan Planning Commission	3QTR-20	$ 57,300.00	$ 37,137.28	$ 20,162.72	$ 57,300.00	$ 57,178.82	$ 121.18	$ 55,000.00	$ 14,702.96	$ 40,297.04
Southeast Michigan Council of Governments	June	$ 174,000.00	$ 174,000.00	$ -	$ 174,000.00	$ 134,547.05	$ 39,452.95	$ 174,000.00	$ 98,646.45	$ 75,353.55
Southwest Michigan Planning Commission	3QTR-20	$ 41,000.00	$ 41,000.00	$ -	$ 41,000.00	$ 40,041.56	$ 958.44	$ 41,000.00	$ 5,417.94	$ 35,582.06
Tri-County Regional Planning Commission	3QTR-20	$ 40,000.00	$ 21,680.54	$ 18,319.46	$ 40,000.00	$ 39,983.00	$ 17.00	$ 40,000.00	$ 18,343.09	$ 21,656.91
West Michigan Regional Planning Commission	Apr	$ 91,000.00	$ 74,351.07	$ 16,648.93	$ 91,000.00	$ 76,853.36	$ 14,146.64	$ 88,000.00	$ 28,239.34	$ 59,760.66
West Michigan Shoreline Regional Development Com.	June	$ 54,000.00	$ 51,333.45	$ 2,666.55	$ 54,000.00	$ 53,996.04	$ 3.96	$ 54,000.00	$ 21,867.08	$ 32,132.92
Western Upper Peninsula Regional Planning & Devel.	2QTR-20	$ 40,000.00	$ 40,000.00	$ -	$ 40,000.00	$ 40,000.00	$ -	$ 42,000.00	$ 6,627.03	$ 35,372.97
MDOT Region Participation	7/31/20	$ 80,000.00	$ 56,032.80	$ 23,967.20	$ 41,440.00	$ 53,614.23	$ (12,174.23)	$ 30,000.00	$ 7,563.11	$ 22,436.89
PASER Quality Review Contract	9/3/19				$ 50,000.00	$ 41,683.39	$ 8,316.61	$ 50,000.00	$ -	$ 50,000.00
Fed. Aid Data Collection & RPO/MPO Program Total		**$ 1,116,400.00**	**$ 960,952.61**	**$ 155,447.39**	**$ 1,127,840.00**	**$ 1,028,869.96**	**$ 98,970.04**	**$ 1,116,400.00**	**$ 413,676.03**	**$ 702,723.97**
III. TAMC Central Data Agency (MCSS)										
Project Management	7/22/20	$ 42,000.00	$ 46,585.00	$ (4,585.00)	$ 60,000.00	$ 76,242.50	$ (16,242.50)	$ 64,200.00	$ 72,225.00	$ (8,025.00)
Data Support /Hardware / Software	7/22/20	$ 68,800.00	$ 67,800.00	$ 1,000.00	$ 55,000.00	$ 17,721.70	$ 37,278.30	$ 37,000.00	$ 19,850.00	$ 17,150.00
Application Development / Maintenance / Testing	7/22/20	$ 114,475.00	$ 115,250.00	$ (775.00)	$ 135,000.00	$ 109,927.04	$ 25,072.96	$ 166,000.00	$ 155,115.00	$ 10,885.00
Help Desk / Misc Support / Coordination	7/22/20	$ 70,200.00	$ 68,200.00	$ 2,000.00	$ 61,900.00	$ 54,227.18	$ 7,672.82	$ 53,250.00	$ 35,285.00	$ 17,965.00
Training	7/22/20	$ 34,950.00	$ 24,850.00	$ 10,100.00	$ 28,660.00	$ 22,071.77	$ 6,588.23	$ 26,000.00	$ 6,600.00	$ 19,400.00
Data Access / Reporting	7/22/20	$ 49,575.00	$ 52,175.00	$ (2,600.00)	$ 38,000.00	$ 30,441.33	$ 7,558.67	$ 28,500.00	$ 36,500.00	$ (8,000.00)
TAMC Central Data Agency (MCSS) Total		**$ 380,000.00**	**$ 374,860.00**	**$ 5,140.00**	**$ 378,560.00**	**$ 310,631.52**	**$ 67,928.48**	**$ 374,950.00**	**$ 325,575.00**	**$ 49,375.00**
IV. MTU Training & Education Program Contract	7/20/20	**$ 235,000.00**	**$ 234,534.14**	**$ 465.86**	**$ 220,000.00**	**$ 219,311.14**	**$ 688.86**	**$ 225,000.00**	**$ 108,743.43**	**$ 116,256.57**
V. MTU Activities Program Contract	7/20/20	**$ 115,000.00**	**$ 114,089.32**	**$ 910.68**	**$ 120,000.00**	**$ 113,588.36**	**$ 6,411.64**	**$ 115,000.00**	**$ 56,588.08**	**$ 58,411.92**
VI. TAMC Expenses										
Fall Conference Expenses	12/10/19	$ 10,000.00			$ 10,000.00			$ 10,000.00		
Fall Conf. Attendence Fees + sponsorship Fees	12/10/19		$ 4,405.00			$ 6,755.00			$ 6,890.00	
Net Fall Conference	12/10/19	$ 14,405.00	$ 7,269.00	$ 7,136.00	$ 16,755.00	$ 7,507.40	$ 9,247.60	$ 16,890.00	$ 6,781.90	$ 10,108.10
Spring Conference Expenses	6/27/19	$ 3,800.00			$ 10,000.00			$ 10,000.00		
Spring Conf. Attendence Fees + sponsorship Fees	6/27/19		$ 8,350.00			$ 9,790.00			$ -	
Net Spring Conference	6/27/19	$ 12,150.00	$ 7,439.36	$ 4,710.64	$ 19,790.00	$ 8,562.18	$ 11,227.82	$ -	$ -	$ 10,000.00
Unallocated / Contingency								$ 10,000.00	$ -	$ 10,000.00
Other Council Expenses (Member Mileage Expenses/Printing/Etc.)	3/12/20	$ 10,000.00	$ 7,301.72	$ 2,698.28	$ 10,000.00	$ 5,073.95	$ 4,926.05	$ 10,000.00	$ 2,046.24	$ 7,953.76
TAMC Expenses Total		**$ 36,555.00**	**$ 22,010.08**	**$ 14,544.92**	**$ 46,545.00**	**$ 21,143.53**	**$ 25,401.47**	**$ 46,890.00**	**$ 8,828.14**	**$ 38,061.86**
Total Program		**$ 1,882,955.00**	**$ 1,706,446.15**	**$ 176,508.85**	**$ 1,892,945.00**	**$ 1,693,544.51**	**$ 199,400.49**	**$ 1,878,240.00**	**$ 913,410.68**	**$ 964,829.32**
Appropriation		**$ 1,876,400.00**		**9.37%**	**$ 1,876,400.00**		**10.53%**	**$ 1,876,400.00**		**51.37%**

VII. Special Projects with Separate Budgets		**FY18 Budget**	**FY18 Actual**		**FY19 Budget**	**FY19 Actual**		**FY20 Budget**	**FY20 Actual**	
MI Local Agency Culvert Inventory Pilot (FY18 HB4320 S-3)		**$**	**Spent**	**Balance**	**$**	**Spent**	**Balance**	**$**	**Spent**	**Balance**
Central Data Agency (MCSS)	5/28/20	$ 15,000.00	$ 9,312.00	$ 5,688.00	$ -	$ -	$ -	$ 25,000.00	$ 12,250.00	$ 12,750.00
MTU Culvert Project Activities & Training Program	7/20/20	$ 172,100.00	$ 172,100.00	$ -	$ -	$ -	$ -	$ 55,011.46	$ 25,859.97	$ 29,151.49
TAMC Administration & Contingency (Unencumbered)	3/2/20	$ 84,438.00	$ -	$ 84,438.00	$ -	$ -	$ -	$ 472,863.51	$ -	$ 472,863.51
Central Upper Peninsula Planning and Development	3 QTR 18	$ 88,641.00	$ 51,909.64	$ 36,731.36	$ -	$ -	$ -	$ -	$ -	$ -
East Michigan Council of Governments	Sept '18	$ 328,607.00	$ 259,229.13	$ 69,377.87	$ -	$ -	$ -	$ -	$ -	$ -
Eastern Upper Peninsula Regional Planning & Devel.	4 QTR 18	$ 5,688.00	$ 5,034.70	$ 653.30	$ -	$ -	$ -	$ -	$ -	$ -
Genesee Lapeer Shiawasse Region V Planning Com.	Sept '18	$ 124,909.00	$ 54,266.60	$ 70,642.40	$ -	$ -	$ -	$ -	$ -	$ -
Grand Valley Metropolitan Council	4 QTR 18	$ 77,782.00	$ 69,733.25	$ 8,048.75	$ -	$ -	$ -	$ -	$ -	$ -
Kalamazoo Area Transportation Study	Sept '18	$ 50,402.00	$ 15,879.65	$ 34,522.35	$ -	$ -	$ -	$ -	$ -	$ -
Northeast Michigan Council of Governments	Sept '18	$ 33,506.00	$ 21,781.96	$ 11,724.04	$ -	$ -	$ -	$ -	$ -	$ -
Networks Northwest	Sept '18	$ 184,513.00	$ 163,641.05	$ 20,871.95	$ -	$ -	$ -	$ -	$ -	$ -
Region 2 Planning Commission	3 QTR 18	$ 54,900.00	$ 22,776.80	$ 32,123.20	$ -	$ -	$ -	$ -	$ -	$ -
Southcentral Michigan Planning Commission	Sept '18	$ 93,456.00	$ 36,137.17	$ 57,318.83	$ -	$ -	$ -	$ -	$ -	$ -
Southeast Michigan Council of Governments	Sept '18	$ 87,644.00	$ 45,757.96	$ 41,886.04	$ -	$ -	$ -	$ -	$ -	$ -
Southwest Michigan Planning Commission	4 QTR 18	$ 101,849.00	$ 67,138.17	$ 34,710.83	$ -	$ -	$ -	$ -	$ -	$ -
Tri-County Regional Planning Commission	4 QTR 18	$ 47,587.00	$ 6,962.44	$ 40,624.56	$ -	$ -	$ -	$ -	$ -	$ -
West Michigan Regional Planning Commission	Sept '18	$ 241,511.00	$ 181,441.39	$ 60,069.61	$ -	$ -	$ -	$ -	$ -	$ -
West Michigan Shoreline Regional Development Com.	Sept '18	$ 144,238.00	$ 89,092.30	$ 55,145.70	$ -	$ -	$ -	$ -	$ -	$ -
Western Upper Peninsula Regional Planning & Devel.	4 QTR 18	$ 63,229.00	$ 46,960.41	$ 16,268.59	$ -	$ -	$ -	$ -	$ -	$ -
Culvert Pilot Project Total		**$ 2,000,000.00**	**$ 1,319,154.62**	**$ 680,845.38**	**$ -**	**$ -**	**$ -**	**$ 552,874.97**	**$ 38,109.97**	**$ 514,765.00**
Total Special Program		**$ 2,000,000.00**	**$ 1,319,154.62**	**$ 680,845.38**	**$ -**	**$ -**	**$ -**	**$ 552,874.97**	**$ 38,109.97**	**$ 514,765.00**
Appropriation		**$ 2,000,000.00**		**34.04%**						**93.11%**

Michigan Transportation Asset Management Council

Memo

To: TAMC Bridge Committee Members

From: Roger Belknap, TAMC Coordinator

Date: August 21, 2020

Re: Culvert Activities Update

Background

The Center for Technology and Training (CTT) has been tasked with providing a report of 2020 Culvert Activities to summarize the findings of this year's efforts, including a survey of 2018 Culvert Pilot Participants, and recommended next steps for the continuation of TAMC's culvert efforts.

TAMC support staff and staff at the Center for Shared Solutions (CSS) have also been working alongside from both the technology, policy and budgetary aspects. Specifically, from a technology perspective, there needs to be recommendations on the Exchange, Transfer and Load (ETL) process by which culvert inventory and condition data can be uploaded into the TAMC database. This would also coincide with TAMC directives for policy and procedures for culvert data collection, for which support staff has also started. Ultimately, there are budgetary aspects to each of these considerations. The meeting will include status reporting on each of these aspects, partnered with CTT's report findings.

Attachments

Attachment 3 is the Draft 2020 Culvert Activities Report from CTT. Policy and Budgetary items will be shared at the meeting.

2020 TAMC Culvert Condition Assessment DRAFT Final Report

Chris Gilbertson, PhD, PE, Associate Director
Center for Technology & Training

Tim Colling, PhD, PE, Director
Center for Technology & Training

Peter Meingast, Research Engineer
Center for Technology & Training

Scott Bershing, Technical Writer
Center for Technology & Training

Michigan Transportation Asset Management Council

Michigan Technological University
Civil and Environmental Engineering

Center for Technology and Training
309 Dillman Hall
1400 Townsend Drive
Houghton, MI 49931

August 21, 2020

ABSTRACT

Content to be added.

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ACKNOWLEDGEMENTS

The Transportation Asset Management Council Bridge Committee and the Center for Technology & Training at Michigan Technological University wish to acknowledge the contribution of all those who contributed to the development of this report through sharing their experiences through surveys and interviews. Their input has been and will continue to be helpful in the development of guidance on the inventory and condition evaluation of culverts in the State of Michigan.

TAMC Bridge Committee Members

Rebecca Curtis, MDOT
Al Halbeisen, OHM Advisors
Brad Wieferich, MDOT
Keith Cooper, MDOT
Wayne Harrall, Kent CRC
Brian Vilmont, Prein & Newhof, Inc.
Christopher Bolt, Jackson CRC

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AOP	Aquatic Organism Passage
CMP	Corrugated Metal Pipe
CRC	County Road Commission
CSS	Center for Shared Solutions
CTT	Center for Technology & Training
DEQ	Department of Environmental Quality
DNR	Department of Natural Resources
DTMB	Department of Technology, Management, and Budget
FAQ	Frequently Asked Questions
FHWA	Federal Highway Administration
GIS	Geographical Information System
GPS	Global Positioning System
GUID	Globally Unique Identification
LDC	Laptop Data Collector
MiBridge	Michigan Web-based Structure Management System
MDOT	Michigan Department of Transportation
MPO	Metropolitan Planning Organizations
NBI	National Bridge Inventory
NCHRP	National Cooperative Highway Research Program
PA	Public Act
TAMC	Transportation Asset Management Council
TAMS	Transportation Asset Management System

EXECUTIVE SUMMARY

In 2018, the Transportation Asset Management Council (TAMC) Bridge Committee was tasked with managing a work plan for a pilot project for the collection of data and the evaluation of culverts owned by local transportation agencies within Michigan. The Center for Technology & Training (CTT) at Michigan Technological University (Michigan Tech) worked with the TAMC Bridge Committee to accomplish their goals for the pilot program and has continued to offer culvert inventory and condition evaluation training since. In 2020, the CTT submitted a work plan to the TAMC consisting of the following tasks:

- Task 1: Conduct Culvert Condition Assessment Training
- Task 2: Evaluate Culvert Data from Combined Sources
- Task 3: Culvert Condition Assessment System Translation

Task 1: Conduct Culvert Condition Assessment Training

CTT staff provided webinar-based culvert data collection and condition evaluation training sessions in March and April, respectively. There are also future webinar-based training sessions scheduled for September, 2020.

Task 2: Evaluate Culvert Data from Combined Sources

In addition to providing training, the CTT have also evaluated culvert data collected and stored from a variety of sources throughout the state. Data from the Michigan Department of Natural Resources (MDNR), the Michigan Department of Transportation (MDOT), and the Transportation Asset Management Council (TAMC) was reviewed and analyzed to determine if it could be easily combined to create a statewide culvert inventory. The most immediate concerns with combining data from different sources is identifying duplicate assets. Another concern included rectifying the different data fields used by each agency. The CTT used data from the Michigan Open GIS portal to gather existing culvert data from both the DNR and MDOT Transportation Asset Management System. They also used TAMC local agency culvert pilot data from the Center for Shared Solutions.

After reviewing sample of data from the three source, the CTT developed generalized process flows for both the DNR and MDOT data sets to assist in identifying duplicate culverts. Processing of the 2230 records in the DNR stream crossing data produced the following results when analyzed with MDOT culvert and bridge data:

- 130 stream crossings were in MDOT's sphere of influence (Step B),
    - Of these, 23 were rejected as ambiguous (step K)
    - 18 were identified as matches (Present in both data sets)

50 were identified as possible previously unidentified MDOT culverts

Processing of the 2230 records in the DNR stream crossing data produced the following results when analyzed with local agency culverts and bridge data:

- 401 stream crossings were within the sphere of influence of local roads (Step B),
    - Of these, 63 were rejected as ambiguous (step K)
    - 25 were identified as matches (present in both data sets)
    - 275 were identified as possible previously unidentified local road culverts.

As part of this task, the CTT also conducted interviews with four non-transportation related agencies that were identified as having an interest in culvert data, as well as one county road commission that was interested in using data that had been collected by other agencies. These agencies included Huron Pines, the Conservation Resource Alliance, the Southeast Michigan Council of Governments, the Michigan State Hydrography Improvement Pilot, and the Wexford County Road Commission.

In general, the interview process indicated only mild interest in sharing culvert data. While it was expected that each agency would have specific data needs that they would want to collect according to their specifications it was thought that some data, like general inventory and location data, would be of common interest to all agencies. The general consensus was that the data each agency already has is of adequate quality to meet their needs. There was some interest in condition data that might help identify areas of potential partnership for replacement of culverts to the benefit of both local agency and environmental quality. Also some interest in data for areas of expanded interest, either geographically or informationally, where the agency would otherwise be starting from scratch to collect data.

Task 3: Culvert Condition Assessment System Translation

There are currently two culvert condition assessment systems in use in Michigan. Most local agencies use the 2018 TAMC Pilot system which was modified from the 1986 FHWA Culvert Inspection System used in Roadsoft. The TAMC Pilot system added additional deterioration descriptions for specific culvert material types not included in the 1986 FHWA Culvert Inspection System. MDOT has its own condition assessment system used in the Transportation Asset Management System (TAMS). Both systems evaluate specific elements within a culvert system to determine the overall culvert condition. They appear to meet the need of the respective users and each group has a significant investment in historical data. Generally speaking, these systems have the same function, assess similar defects, and have a similar scale direction, however the systems are not identical and therefor pose a potential problem when data is displayed side-by-side or combined. The goal of Task 3 was to create a system for translating MDOT and TAMC culvert data for the purpose of creating dashboards that would

allow comparison between these two condition data sets while maintaining the integrity of each agency's detailed element level collection criteria.

While individual elements may rate differently between the two systems, particularly between fair and poor, it is expected that in general, the TAMC Pilot and MDOT TAMS data sets could be displayed side-by-side when reduced to a Good/Fair/Poor/Severe generalization of the overall controlling condition.

A survey was added to the project work plan as a follow-up to the 2018 pilot. Respondents were asked what data, a year after participating in the pilot, did they continue to find useful. Responses varied on individual data elements, however, none of the inventory or condition evaluation data that was collected as part of the pilot was clearly found to be of no use. Respondents were asked how they used the data they collected from the 2018 pilot. One common response was that the data was used for preparing estimates for road repair, prioritizing maintenance schedules, and developing asset management plans.

67% of respondents continued to collect culvert data after the pilot. Most agencies responding to this indicated they continue to add culverts to the database as new culverts are discovered that had been missed in the initial survey or when new culverts are installed.

Most agencies, 78%, said they would have no concerns sharing their basic culvert data in an open state-wide database. However, only 22% expressed an interest in importing data collected by others such as stream crossing surveys if it meant the data may not be complete and would have to be verified. Those agencies willing to share their data did express some concern over sharing free-form data that may be in memo fields and stressed that the information would need to be field verified by the user and could contain incorrect or missing data.

When asked what resources, if any, an agency would need to actively collect data on their culverts many responded that they would need time and people/funding. Most expressed that they already had all the equipment they would need but some said that investment in the right technology, such as a handheld GPS data collection device, would allow data collection to be more efficient.

The final response in the survey allowed participants to share any additional feedback with the TAMC. Several comments supported a simplified condition rating system consisting of elements related directly to the culvert. One said too much data was collected and they would make decisions based on a follow-up site visit. One responder stated they were glad to be having a state-wide discussion on asset management.

Next Steps

Policy:

- A policy document needs to be created to establish the inspection frequency, condition evaluation system, database and information sharing procedures, and a QA/QC program.
- The AASHTO "Culvert & Storm Drain System Inspection Guide" became available on August 13, 2020. This document replaces the 1986 FHWA Culvert Inspection Manual that was modified for the TAMC Pilot to include modern materials and culvert types.
    - TAMC should decide on adoption of the AASHTO guide either in full or part and any modifications necessary for culvert inspections in Michigan
    - A study should be performed to evaluate if a culvert system translation is needed between AASHTO/TAMC Pilot/MDOT TAMS systems and determine a data handling process moving forward
    - A simplified rating system/guidance will need to be defined for culverts that may be rated using a Good/Fair/Poor/Serious assessment
- If data is to be compiled and used comparatively for culvert systems across the state a QA/QC system needs to be created to ensure an adequate training program is established to help assure that each inspector would assign the same rating to a culvert within an established tolerance.
- If condition data between the TAMC Pilot and MDOT TAMS systems are to be compared a field verification program should be used to verify uniformity between the two systems in their Good/Fair/Poor/Serious assessments due to inspector interpretation of generalized condition descriptions.
- TAMC should develop a data schema to summarize culvert data from the pilot and MDOT TAMS. This would include common denominator fields for materials, shapes, and physical measurements that would make combining data from multiple sources easier and consistent

Training:

- Training should be updated to include the rating system as adopted by TAMC (option to do refresher training that highlights the changes in the updated system for those who already took the TAMC Pilot training)
- QA/QC program should feed back into training to help improve program

Revised Data Collection Pilot:

- A pilot program could be initiated in an effort to 'test' the TAMC policy document while it is in a draft state and raise any issues or highlight changes that may be beneficial.

Data:

- A culvert database should be finalized and if not publically available made accessible to those who own culverts so they can retrieve their data (local or centralized storage).

Protocol should be established to define who has access to this data and how data is managed.

- Using the process identified in Task 2 identify previously un-inventoried MDOT and local agency culverts to better complete those data sets.

BACKGROUND

2018 Pilot Study:

The TAMC Bridge Committee was tasked with managing a work plan for the collection of data and the evaluation of culverts located within Michigan. Culverts, for the purposes of the pilot, were defined as linear drainage conduits underneath a public roadway that were not considered "bridges" by the Federal Highway Administration (FHWA). FHWA's definition of brides includes any structure with a combined span over twenty feet. Culverts are differentiated from storm sewers in that they are straight-line conduits that are open at each end, and do not include intermediate drainage structures (manholes, catch basins etc.). Only culverts found within PA 51 Certified Roads were considered in the collection.

The goal of this pilot was to ensure the TAMC had a strategy that could be used across the state to further streamline and standardize the collection of culvert data and to develop best practices for the asset management of culverts in the state. Obtaining local culvert inventory and condition evaluation data in a representative group of local agencies helped determine the level of effort and cost to advance a similar effort statewide.

2020 TAMC Culvert Initiative Overview:

With the pilot complete, the next steps for the Bridge Committee involved processing the data and lessons learned from the pilot to create a policy for the assessment and evaluation of culverts into the future. This report details CTT's work in four areas to assist in TAMC's culvert initiative.

The CTT was tasked with continuing to provide webinar-based training for local agency inventory and condition evaluation procedures, evaluating data handling procedures for combining data from several sources, and determining if a translation procedure would be needed to relate TAMC Pilot data to MDOT TAMS data.

Training was an important component as many local agencies indicated a strong desire to continue to collect culvert data for their own purposes beyond the pilot. The training helped provide and maintain consistency in that data and allowed new agencies to get involved in asset management of their culverts.

Culvert data is collected by numerous agencies and organizations around the state. Interest in creating a centralized, shared access database was expressed during the pilot. The 2020 work plan sought to identify and interview organizations who may be interested in sharing or using

culvert data. Combining data sets also requires having rules for how this data is combined and which data takes priority. A first step in establishing a data handling procedure was to identify a process for identifying duplicate culverts: those that were inventoried in multiple sources of data.

Culvert condition evaluation was conducted in the pilot, and an overall condition rating was established based on evaluation of individual elements. Condition data exists for both state and locally owned culverts. The ratings were determined using two unique rating systems. In order to display this data publically there needs to be a clear translation between the two data sets; either displaying data to the least common denominator, or noting key differences. This task looked at evaluating the two systems and provided recommendations on how data could be displayed for informational purposes.

Lastly, a survey of participants in the 2018 Culvert Pilot was conducted. The purpose of this survey was to learn what data collected during the pilot has been found useful for the local agencies and what they might do different in the future. This information will be used to help establish culvert inspection and condition evaluation policy for the asset management of culverts.

2020 WORK PLAN TASKS AND RESULTS

Task 1 - Culvert data collection and condition assessment training

This task included presentation of five webinar sessions of approximately two to three-hours each. The training modules provided detailed information on the three primary aspects of collecting culvert inventory and condition data: equipment, data collection, and data validation.

Culvert Data Collection using Roadsoft Webinar

This two-hour webinar provided a visual walkthrough of Roadsoft's Culvert module, focusing on data collection and data handling. Topics for the training included: recommended equipment for culvert data collection; completing data collection with Roadsoft using visual walk-throughs of the software to explain the processes needed to collect each piece of information, and the overall process of data management and quality control.

Culvert Condition Evaluation Webinar

This three-hour webinar provided information to participants on the technical points of assessing culvert condition using the TAMC Pilot condition evaluation system, which was a modification to the FHWA Culvert Inspection System to include additional material types. The training presented example culverts and allowed participants to rate them using the

condition assessment system. The training included at least one example of every major culvert material type along with a variety of culvert conditions. Instructors provided guidance on the correct use of the TAMC Pilot condition evaluation system and discussed each example with reference to the culvert rating table provided as a handout.

Task 1 - Results

Culvert Data Collection using Roadsoft

- March 31st (48 registered attendees)
- September 17th (24 registered attendees)

Culvert Condition Evaluation

- April 7th (59 registered attendees)
- April 9th (18 registered attendees)
- September 24th (9 registered attendees)

Full details of these training events, including demographics of attendees, will be provided in CTT's yearend training report to TAMC.

Task 2 - Evaluate culvert data from combined sources

Regional culvert data is collected and stored locally from a variety of sources throughout the state. Data is known to exist from the Michigan Department of Natural Resources (MDNR), the Michigan Department of Transportation (MDOT), and TAMC. The purpose of this task was to determine if there is a desire by the various parties collecting data to share this data for their combined interests, and if so, if there are any concerns with combining this data. For example, the existence of duplicate culverts – those existing in more than one dataset.

It is clear that culvert data provides important information for road owning agencies trying to manage their assets; however, the value of this data goes far beyond the asset owner, providing benefit to groups involved with stream conservation and habitat improvement activities which all rely on culvert data to determine the suitability of culverts to allow aquatic organism passage (AOP). Accurate culvert data is also valuable to groups involved in macro scale hydraulic and risk modeling. Each of these uses needs basic culvert inventory and location data, along with other more specific information which differs by use.

The MDNR facilitated the collection of culvert data from the perspective of gathering information on aquatic habitat in 2013. MDOT gathered culvert data as part of a pilot study in 2016 and 2017. In 2018 TAMC developed a pilot program for the inventory and condition evaluation of local agency culverts. Each of these studies produced data for very specific purposes: some of this data is potentially of use to other agencies and some may not be. This

task reviewed existing data from the three main sources; MDNR, MDOT, and TAMC, and looked at how this data could be combined to create a statewide culvert inventory.

The largest immediate concern with combining these data sets is the issue of the same (duplicate) culvert appearing in two or more of the datasets since the DNR dataset is not limited by jurisdictional boundaries. Duplicate culverts can be hard to identify simply on spatial information alone, since the error involved in geographical location data may be as much as 30 feet. Additionally, different standards in precision can also make identifying duplicates difficult.

Duplicate culverts may represent one of three real life scenarios which may or may not be relevant:

1) A single culvert located two times respectively in each system where measurement error makes them appear as separate assets. In this case the duplicate should be removed.
2) A single culvert that has been replaced and exists in one or more systems before and after replacement. In this case the older (removed culvert) data should be removed or marked as deprecated.
3) A multiple barrel culvert where each barrel is located separately. This case may need intervention or a case by case review to determine the appropriate action.

In most cases culvert data from transportation agencies can easily be attributed to the jurisdictional owner of the road or trail system where the culvert is present. It is uncommon for road owners to collect data on parts of the road network that they do not own, with the possible exception of roads on jurisdictional boundaries or intersections where jurisdictions meet, which further adds to the differentiation between these two data sets. The Michigan framework basemap provides an accurate map to easily distinguish local roads and their associated culverts, state owned roads, and the culverts managed by MDOT.

The MDNR owns a number of culverts and bridges that relate to state owned recreational facilities, such as trails, state parks, and state owned public land. In many cases these trail systems run parallel to state or local roads, which may make differentiation of their ownership difficult using purely location data. The DNR also has an interest in culverts that are owned by other entities as a source of stream crossing information for analysis of barriers to AOP and for regional hydraulic modeling activity. Culverts in particular are a concern as they can be significant barrier to AOP due to features such as high flow rates or perched outfalls. Michigan DNR routinely collects stream crossing data on culverts and bridges owned by state or local transportation agencies as part of a stream survey collection activity which may contain data from all infrastructure owners along a particular stream.

The DNR stream crossing data can be a useful source of data because it may include assets that have not been inventoried by road owning agencies. Similarly, the DNR may find value in using transportation agency data on culvert locations to augment the work they are doing: however,

combining the data sets provides some challenges. Figure 1 below illustrates some of these challenges. The culvert which has been highlighted by the yellow circle is spatially shown located half way between the recreation trail and the state owned road, so it is unclear if the stream survey data shown as a red dot and is representative of the same culvert shown as a blue line from MDOT's data set, or if there are actually two discrete culverts there, one for the MDOT road and one for the trail. Similarly, in Figure 1 the culvert highlighted in the purple circle may be located on the recreation trail or it may be located on a local agency owned road. Identifying culverts unique to one data set as well as identifying assets that are duplicated is complicated by the location accuracy of the data sets, which varies between sub-meter accuracy, and recreation grade GPS (within 30') for different data sets.

Figure 1: DNR Trail located adjacent to MDOT owned highway and crossing local roads. MDOT culverts shown in blue, DNR Stream crossings (culverts) shown in in red.

This task will attempt to identify duplicate culverts in each of the datasets based on a comparison of other fields in the inventory, collection date, location data, and any other information present. It is expected that this task will help take the first steps at establishing a protocol for sharing culvert data amongst multiple agencies while maintaining individual agency needs, each agency's standards for data collection, and the ability of an agency to update and manage their data with respect to shared data.

Task 2 – Results

Evaluation of culvert data

Objective

This task details a process that will allow state and local road agencies the ability to use data sets from the Michigan DNR stream crossing surveys to identify new culverts which may not be in their inventory. This task will provide a process for combining multi-jurisdictional data sources like MDNR's stream crossing data with data sets maintained by MDOT and local agencies without producing duplicate records for culverts which have been inventoried in multiple data set.

Data Sources Used in Analysis

All data used for the analysis in this task were collected from the Michigan Open GIS portal with the exception of the local agency culvert pilot data, which was received directly from the Center for Shared Solutions (CSS). Data sets from the Michigan Open GIS portal were chosen because they represent an outward facing, reproducible product that is already being distributed. Figure 2 illustrates an example of the range of culvert and bridge data available for this analysis in Houghton County.

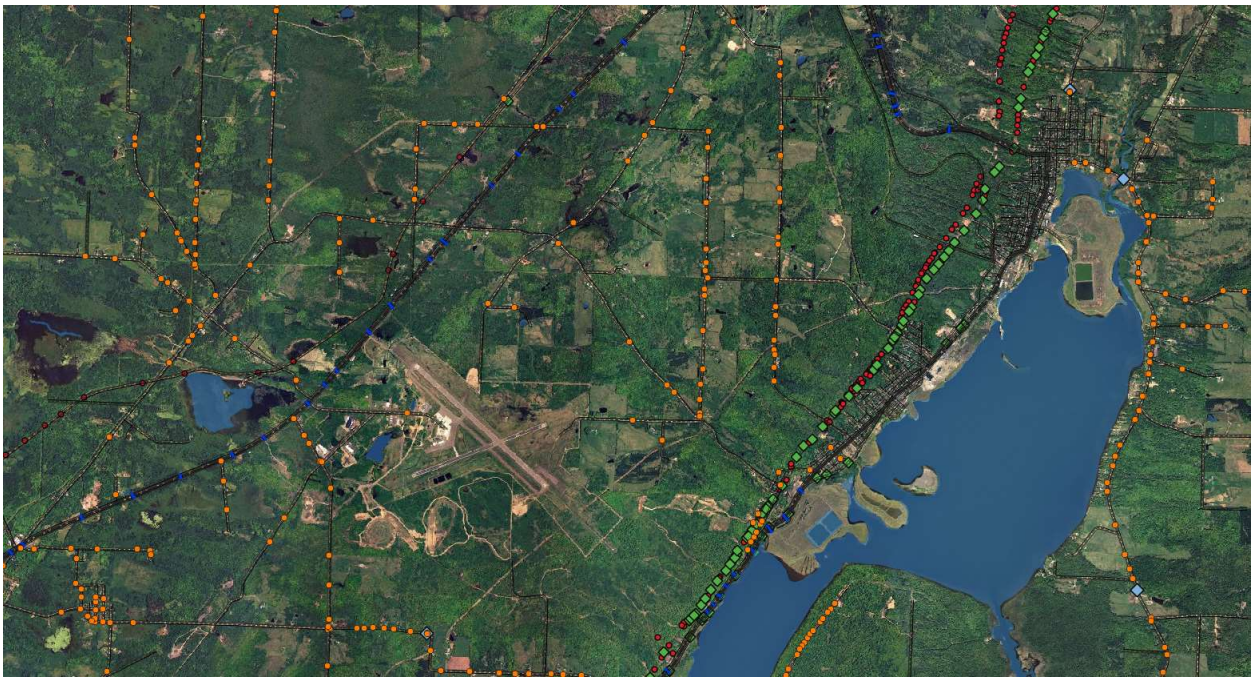


Figure 2: Example bridge and culvert data. Local culverts shown as orange circles, transportation bridges shown as light blue diamonds, DNR owned culverts and bridges shown as green diamonds, DNR stream crossing surveys shown as red circles, MDOT culverts shown as dark blue lines.

MDOT Culvert Data

MDOT has been aggressively collecting network-wide culvert data for the last several years, and is embarking on an active asset management process to manage ancillary structures such as culverts. Currently, culvert data from MDOT is stored in two separate databases, dependent on the span of the structure. Culverts that are less than ten feet in span (width) are stored in the Transportation Asset Management System (TAMS), while culverts ten feet and over in span are stored in the MI Bridge system, which is the system that stores the federally defined bridge data for all public roads in Michigan. This business process manages culverts relative to the risk and cost to the public by grouping large culverts with bridges. The current culvert data set that is publically available on the State of Michigan Open GIS portal contains data on 47,699 MDOT culverts under ten feet in span. The State of Michigan Open GIS portal Bridge File contains 4,501 MDOT owned bridges and 6,672 local bridges. The MI Bridge data set contains approximately 1,103 MDOT owned culverts that are 10' spans or larger. This data set was not used in the analysis; however, it could easily be integrated into the process by joining it with MDOT's TAMS culvert data set. It is assumed that location data from these files were collected using at least sub meter accurate survey equipment.

Local Agency Culvert Data

Local agency practice for collecting culvert data varies greatly across the state. Some local agencies collect condition and inventory data on a routine cycle while others have not started the process. The largest unified collection effort occurred in 2018 when TAMC completed a local agency culvert collection pilot which collected information on 49,664 local agency owned culverts which are located on local agency owned roads. The primary tool for collecting local agency culvert data is Roadsoft, which provides a unified data schema and process for collection. The data set used for this task was received from CSS and included 43,202 local agency culverts that were collected using Roadsoft during the pilot. It was assumed that all local agency culvert data was located using recreational grade GPS data with an accuracy of +/-30 feet.

DNR Culvert and Stream Crossing Data

The DNR-managed culvert database available on the State of Michigan Open GIS portal contains information on 1201 culverts and bridges managed by the DNR which are primarily located on recreation trails and state park facilities. For the purposes of this task it was assumed that the culverts and bridges in this database were correctly identified as owned by the DNR, and as such were not considered in the evaluation for comparison against the MDOT or Local Agency culvert data sets.

The Michigan DNR maintains a database of stream crossing surveys which have been compiled on culverts and bridges. These stream crossings can be completed by DNR staff, hired consultants, and conservation groups, like Huron Pines Association or Trout Unlimited. Stream crossing surveys are usually collected on a watershed basis so they are likely to collect data on culverts from multiple owners. Stream crossing data can be a valuable source of data for detecting new culverts which may not be in an infrastructure owner's database; however, they also pose a problem since they do not fit into a discrete sphere of influence. The stream crossing data available on Michigan's Open GIS Portal contains stream crossing data representing 2,230 bridges and culverts.

Methods

During the development of the data handling process, DNR stream crossing data sets were compared to the MDOT culvert and bridge data and the Local Agency culvert and bridge data separately. Separating these analysis processes allows the stream crossing data to be matched up with both the MDOT and Local data set without interference between sets, which removes bias in the matching process.

During the development of the process, the project team used the following guiding principles to make decisions on processing data.

a) Each asset owner (MDOT, DNR, Local Agency) has a sphere of influence where their data will have primacy over other users. This ensures that the owner's data will in all cases

remain intact as they have presented it in cases where joining sets is the intent. The sphere of influence varies with the expected width of the road right of way and the total assumed error in location measurement between data sets.

b) Data which occurs at areas where spheres of influence overlap such as parallel right of ways or intersecting roads and trails, will be tested to eliminate duplicates and identify new assets that the road owning agency may have missed. Testing includes finding agreement on critical inventory fields including: length, shape, material, height, and width.

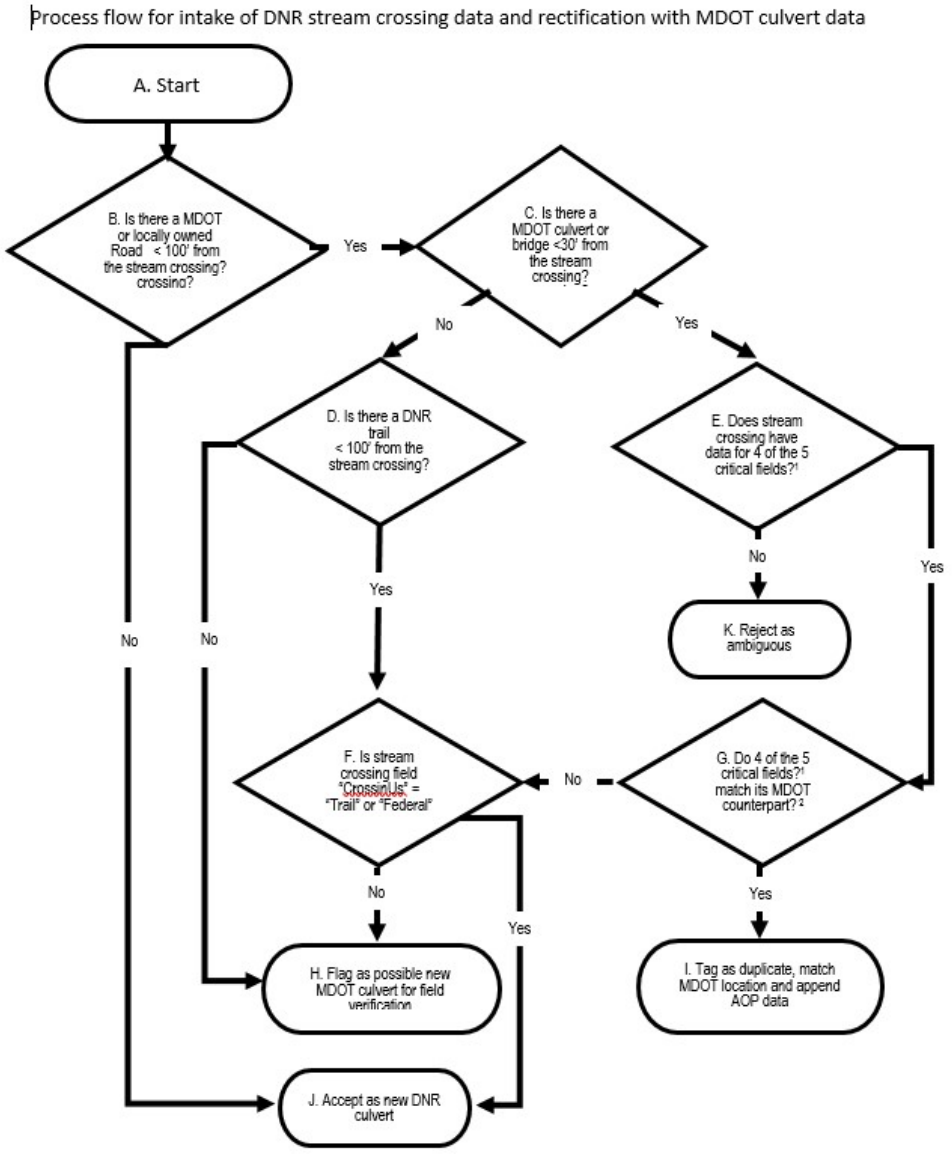
c) Critical inventory fields may be interpreted differently between data sets, so exact matches are not likely and a reasonable buffer or conversion must be provided around the recorded inventory fields to determine a match. For example, some stream crossing data might appear with inventory data such as width or height which were measured literally vs providing the nominal pipe size that culverts are usually classed in. i.e. recorded at 31.4” pipe rather than 30” pipe.

d) Culvert shape and material data needs to be reduced down to the lowest common denominator removing some of the specificity before matches can be determined. For example, “reinforced concrete pipe” and “precast concrete pipe” would be reduced down to “concrete”, and “3 sided box”, “rectangle” and “box” would be reduced to “rectangle”.

e) The goal of the process should be to identify a limited number of locations that can be field verified if data is not present or if a match is not clear, while separating data that is clearly discrete within a set.

A generalized process flow was developed that can be used for analysis of DNR stream crossing data with MDOT and local agency data, with only slight modifications to the two process. Figure 3 below illustrates the process for analyzing DNR Stream crossing data with MDOT culvert data. Both the local agency and MDOT process flow charts, along with GIS process notes, are included in the Appendix.

Figure 3: Process flow chart for matching DNR stream crossing data with MDOT culvert data.



[1]Critical stream crossing fields are: "StructureLength" "StructureWidth" "StructureHeight" "StructureShape" "StructueMaterial"

[2]Matching is defined as within the following tolerances: StructureLength is within 25% of MDOT length, StructureWidth is within 15% if MDOT width or span, StructureHeight is within 15% of MDOT height or rise, StrucutreSshape matches MDOT shape after being transformed, StructureMaterial matches MDOT material after being transformed

Process Narrative:

The first step in the process (Step B) is to separate stream crossings that are outside of MDOT's sphere of influence, which in this case was set at 100 feet from either side of the MDOT centerline as shown on the framework base map. Stream crossings under 100 feet from an

MDOT road are considered for further analysis in Step C to determine if there is a known MDOT bridge or culvert within 30 feet of their location. Thirty feet was chosen to represent the possible inaccuracy of using recreational grade GPS for determining the location of stream crossing data.

Stream crossings that are found to be within 30 feet of an existing MDOT culvert or bridge are evaluated to determine if they are matches with known MDOT culverts or bridges by comparing the critical inventory fields of shape, material, length, height and width in Step E, J, K and I. Stream Crossings that do not have sufficient data in critical fields are marked as ambiguous in Step K, since there is not sufficient data to determine if a match exists. These locations will need to be field verified to determine their ownership and inventory information.

Stream crossings that are in MDOT's sphere of influence but are not within 30 feet of a known bridge or culvert are checked to see if they are located near the crossing point of a DNR trail in Step D. Stream crossings that are not within 100 feet of a DNR trail are considered for possible new MDOT culvert locations which need to be field checked before being included in MDOT's database (Step H). Stream crossings that are not near a trail are evaluated to determine if they have information describing the crossing type. In many cases the crossing type filed is blank; however, when it is listed as "trail" or "federal" the incidence of it being a MDOT owned crossing is low, so the crossing will be processed to Step J where it is added back into the DNR's culvert set.

The process for local agency culvert data is identical to the MDOT process with the exception that the sphere of influence threshold for Step C is increased to 100 feet to account for the presumed lower location accuracy.

Processing of the 2230 records in the DNR stream crossing data produced the following results when analyzed with MDOT culvert and bridge data:

- 130 stream crossings were in MDOT's sphere of influence (Step B),
    - Of these, 23 were rejected as ambiguous (step K)
    - 18 were identified as matches (Present in both data sets)
    - 50 were identified as possible previously unidentified MDOT culverts.

The 23 stream crossings that were marked as ambiguous because they lack critical inventory data are still worth field verification.

The 50 stream crossing that were identified by the process as potential new culverts produced several false positives that can quickly be identified and dismissed by visual inspection of the GIS data. Most of the false positives are located at bridges and are a result of how bridge data is collected using one data point, which is usually located at the abutment. Longer bridges will create false positives since the stream crossing point in many cases will be located at the center

of the creek, which may be over 30 feet from the bridge abutment. These false positives are easy to identify and are relatively few in number, so it does not warrant a change in the collection protocol. Figure 3 and Figure 4 below illustrate these types of false positives.

Figure 3: False positive new MDOT culvert shown by red star icon. MDOT bridge shown as blue diamond, MDOT culverts shown as dark blue lines

Figure 4: False positive new MDOT culvert shown by red star icon. MDOT bridge shown as blue diamond, MDOT culverts shown as dark blue lines.

Figure 5: Potential new MDOT culvert shown as red star. Known MDOT culverts shown as dark blue lines, other stream crossing surveys shown as red circles

Figure 6 Potential new MDOT culverts shown as red stars. Known MDOT culverts shown as dark blue lines, other stream crossing surveys shown as red circles

Figure 7 Possible New MDOT culverts shown as red stars. Existing MDOT culverts shown as dark blue lines, DNR bridges and culverts shown as green diamonds and other stream crossing surveys shown as red circles.

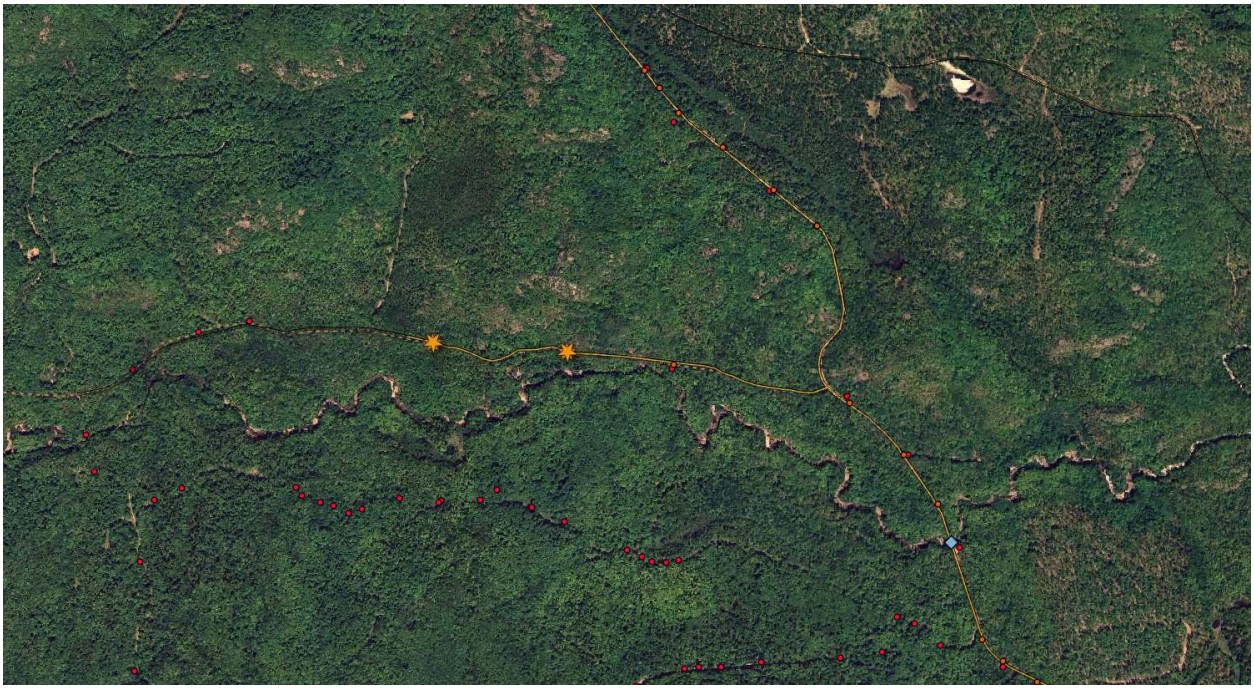


Figure 8: Potential new local agency culverts shown as orange stars, other stream crossings shown as red circles, known local agency culverts shown as orange circles, transportation bridges shown as blue diamonds.

Processing of the 2230 records in the DNR stream crossing data produced the following results when analyzed with local agency culverts and bridge data:

- 401 stream crossings were within the sphere of influence of local roads (Step B),
    - Of these, 63 were rejected as ambiguous (step K)
    - 25 were identified as matches (present in both data sets)
    - 275 were identified as possible previously unidentified local road culverts.

Figure 8 illustrates examples of new local agency culverts identified by the process.

Case Study Interviews

The CTT conducted interviews with agencies identified as having an interest in culvert data outside of the transportation area to determine potential case studies whereby the TAMC Local Agency Pilot data may be of benefit. One local transportation agency was added to the interviews as they had very little self-generated culvert data and desired to reach out to non-transportation agencies who had data in their jurisdiction with the hope of using that data as a start for their collection efforts.

Specific details for each agency interview is presented below. In general, the interview process indicated that there was only a mild interest in sharing culvert data. While it was expected that each agency would have specific data needs that they would want to collect, according to their specifications it was thought that some data, like general inventory and location data, would be of common interest to all agencies. The general consensus was that the data each agency already has is of adequate quality to meet their needs. There was some interest in condition data that might help identify areas of potential partnership for replacement of culverts to the benefit of both the agency and to improve environmental quality. Also, there was some interest in data for areas of expanded interest, either geographically or informationally, where the agency would otherwise be starting from scratch to collect data.

Huron Pines – Gaylord and Alpena

Huron Pines is an organization with a mission to conserve and enhance Northern Michigan's natural resources to ensure healthy water, protected habitat, and vibrant communities. Through strategic partnerships at the federal, state, and local level, Huron Pines influences strategy and vision for the future conservation in Michigan while also executing on-the-ground projects with immediate impacts on environmental quality.

Their main objective is to replace or rehabilitate culverts and dams for the benefit of fish passage. Typically, they are involved with 6 to 10 culverts per year. They generally work with local agencies to achieve this, where Huron Pines works to secure funding for material and then engages a local agency to help provide equipment and labor for the duel benefit of having new culvert that improves on fish passage.

Huron Pines feels they have the data that is most important to them, which includes severity ranking based on stream condition, location, material, and size. Good/Fair/Poor/Severe condition data may be helpful for them to prioritize projects that may be mutually beneficial to their interests and those of the local agencies they work with.

Conservation Resource Alliance – Traverse City

The Conservation Resource Alliance (CRA) is a private, not for profit corporation committed to "sensible stewardship of the land." Their main objective is optimizing stream flow and fish habitat with focus on achieving their goals across an entire watershed while being able to take advantage of opportunities to optimize stream crossings being replaced for other reasons.

They work with local agencies on culvert replacements by securing project funding and then partnering with local agencies to provide equipment and labor. Their interest in culvert data would be to the extent that they could keep an eye on opportunities to improve or replace culverts that would align with their objectives. Culvert cost data would be helpful as they

would like to focus on a cost data-driven approach to culvert replacement – cost of prevention vs cost of emergency response and the value of enhanced habitat.

SEMCOG

The Southeast Michigan Council of Governments (SEMCOG) is working on a project to take a wide approach to infrastructure asset management that includes environmental, flooding, and transportation needs. Their goal is to provide flood consideration input into projects considered for funding. The data SEMCOG is interested in includes location, material, and size as they have found this data to be somewhat lacking. Culvert data related to flood risk, including condition, would be highly valued.

Michigan State Hydrography Improvement Pilot

Michigan State University's work on the Hydrography Improvement Pilot is to develop models, scripts, and procedures for realigning hydrology features and flow lines to create a realignment of the National hydrography dataset (NHD) in the state of Michigan. The NHD represents the water drainage network of the United States with features such as rivers, streams, canals, lakes, ponds, coastlines, dams, and stream gages. Their Hydrography Improvement Pilot V2 features the Kalamazoo watershed.

Culverts are an important part of getting these flow lines correct. One of the most important culvert attributes for creating flow lines is location data. The culvert points are collected, then models are created that turn culvert points into channels through barriers. Other useful attributes include skew, length, and diameter of the culverts.

Data was collected from TAMC, MDOT, and counties for the pilot. Several problems arose while processing this data. Those included eliminating duplicates of culverts from different entities, and inaccurate GPS data. Those issues were solved by using spatial selection and a manual review of the culverts. A proposed way to solve the inaccurate GPS data in the future would be to create a standard for GPS collecting units.

Wexford County Road Commission

Wexford County Road Commission would like to create a culvert asset management plan and inventory. Their desire is to be more proactive with budgeting and planning for culvert maintenance activities. They also feel the increased knowledge of their culvert assets would allow for more efficient partnering with resource agencies for mutual benefit. They are currently working with the US Forest Service, DNR, Trout Unlimited, and CTT to gather existing data and import it into Roadsoft. They have found some of the data they received to be helpful – GPS coordinates, length, and diameter; however, other data would be useful but is generally not present from these sources. Examples of other useful data would include condition ratings and pictures of the inlet & outlet.

They would be interested in participating in partner agency training and assist with data collection while on site for other purposes to the extent that the additional time spent would be no more than 5-10 additional minutes per culvert.

They noted some difficulty in gaining access to data from other agencies and expressed concern with importing this data. They also noted the need to have a process to ensure that data considered by the county to be accurate was not potentially overwritten by incoming data from other sources.

Michigan DNR Online Reporting Tool and Knowledge Base

The CTT worked with the Michigan DNR to register for access to their Great Lakes Stream Crossing Inventory data hub. https://great-lakes-stream-crossing-inventory-michigan.hub.arcgis.com/ Site users are encouraged to become involved through training and volunteer opportunities, as well as to contribute data. There is a sign-up for access to the Stream Crossing Collector.

Interactive maps provide crossing locations and information such as the number of crossings, estimated annual erosion tonnage, aquatic passability, stream crossing condition, crossing type, and additional information.

Task 3 - Culvert condition assessment system translation

Two culvert condition assessment systems are currently in use in Michigan; the TAMC Pilot and the MDOT TAMS systems. Both systems evaluate specific elements within a culvert system to determine the overall culvert condition. They appear to meet the need of the respective users and each group has a significant investment in historical data. Generally speaking, these systems have the same function, assess similar defects, and have a similar scale direction; however, the systems are not identical and therefor pose a potential problem when data is displayed side-by-side or combined. The goal of Task 3 was to create a system for translating MDOT and TAMC culvert data for the purpose of creating dashboards that would allow comparison between these two condition data sets while maintaining the integrity of each agency's detailed element level collection criteria.

The FHWA Culvert Inspection System had been incorporated into Roadsoft and has been used by local agencies. The TAMC Pilot system added additional deterioration descriptions for specific culvert types not included in the 1986 FHWA Culvert Inspection System. The TAMC Pilot system allows a numerical ranking from 10 to 1 with 10 being a culvert in excellent condition. The numerical values are divided into the general condition categories of Good (10-8), Fair (7-6), Poor (5-4), and Serious (3-1). A detailed description for each condition state is provided for each numeric rating value specifically intended to address common forms of distress seen in each of the culvert types included in the inspection system; corrugated metal pipe (CMP), concrete pipe, plastic pipe, masonry, slab & abutment, and timber. The TAMC pilot used a

lowest-rating method within Roadsoft to determine the overall culvert condition from individual inspection element ratings.

MDOT has a condition assessment system used in the Transportation Asset Management System (TAMS). This system assigns a numeric rating from 9 to 1 with 9 considered good. The numeric values are summarized as Good (9-8), Fair (7-6), Poor (5-4), and Critical (3-1). A general description of distress associated with the four general categories; good, fair, poor, and critical is provided for each element under consideration. General descriptions for some elements (invert deterioration and corrosion) contain specific descriptions for metal and concrete distress. The MDOT TAMS Asset Collection & Condition Assessment Guide for 1'-<10' Span Culverts (revised June 2018) states that the overall condition rating is based on the lowest rating for the critical attributes (elements).

Figure 9 shows a sample of the rating values, general conditions, and detailed descriptions associated with section deformation for a CMP culvert with a round cross section. Note: the TAMC Pilot system provides a different set of descriptions specific to eight different cross-sectional shapes of CMP and one set of descriptions for plastic pipes. The MDOT TAMS system describes section deformation for all pipes with one set of descriptions, but those descriptions are not broken down into individual numeric rating values. They are instead broken down into the general conditions of good, fair, poor, and critical. Essentially creating a good/fair/poor/serious rating system with the inspector able to indicate better or worse within each bin through their numeric selection.

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Section Deformation (CMP - Round)	New Condition	Good, smooth curvature in barrel. Horizontal diameter (span) dimension within 10% of original design.	Generally good, top half of pipe smooth but minor flattening of bottom. Horizontal diameter (span) dimension within 10% of original design.	Fair, top half has smooth curvature but bottom half has flattened significantly. Horizontal diameter (span) dimension within 10% of original design.	Generally fair, significant distortion at isolated locations in top half and extreme flattening of the invert. Horizontal diameter (span) dimension 10% to 15% greater than original design.	Marginal significant distortion throughout length of pipe, lower third may be kinked. Horizontal diameter (span) dimension 10% to 15% greater than original design.	Poor with extreme deflection at isolated locations, flattening of the crown, crown radius 20 to 30 feet. Horizontal diameter (span) dimension in excess of 15% greater than original design.	Critical, extreme distortion and deflection throughout pipe, flattening of the crown, crown radius over 30 feet. Horizontal diameter (span) dimension more than 20% greater than original design.	Partially collapsed with crown in reverse curvature	Structure collapsed
Section Deformation		None		Slight, perceptible deformation or local buckling		Deformation with longitudinal cracking or crushing in crown, invert, or spring lines		Excessive deformation resulting in extensive infiltration of soil with roadway embankment damage		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 9: Example rating values, general conditions, and detailed descriptions for CMP as used in the TAMC Culvert Pilot

A detailed breakdown between each of the rating systems is discussed in the results section of this report. While both rating systems produce numeric values representative of the overall culvert condition the broad descriptions applied to general conditions within the MDOT TAMS system does not allow for a direct comparison between the two rating systems at a detailed numeric scale level. At the general condition level, all of the associated condition descriptions between the two systems can be compared for general agreement. However, since there is no difference in the description between numeric ratings within a general condition category in the MDOT TAMS system there is not sufficient information to compare at the numeric level.

References are made within this report to numeric values within both systems. These are made for the purpose of discussion and not in suggestion of a direct translation between the two systems.

Results:

Reported Controlling Rating Value:

A summary and comparison of the elements involved in the overall condition rating of each system is shown in Table 1. Elements that appeared to be directly comparable are identified at the top of the table. Because of the difference in element organization some elements were considered to be similar but not necessarily identical between the two systems. For example, Invert Deterioration is defined by the TAMC Pilot system for both closed and open bottom culverts as well as for each of the material types under consideration. The MDOT TAMS system only provided descriptions for metal and concrete invert deterioration. While these are generally comparable there would be some missing guidance specific to other culvert types, plastic or open bottom for example, in the MDOT system. Each system also contained some elements not considered by the other, these were identified as disassociated elements in the table.

TAMC Pilot (Modified FHWA)	MDOT TAMS
Directly Comparable Element Types	
Section Deformation	Section Deformation
Joints/Seams	Joints
Blockage	Sediment
Similar Elements	
Structural Deterioration	Corrosion (metal) Corrosion (concrete)
Invert Deterioration	Invert Deterioration (metal) Invert Deterioration (concrete)
Disassociated Elements	
Scour	
	Road Over
	Embankment
** Note – Category names have been displayed for the TAMC Pilot elements. Individual descriptions of distress are provided for each common culvert type and/or shape.*	

Table 1: Summary and comparison of elements involved condition rating between TAMC Pilot and MDOT TAMS

Rating Elements:

Each rating system consists of individual elements within the culvert system that are rated based on a description of what distress could reasonably be expected to be found associated with that element. The approach and level of detail applied to the TAMC Pilot and MDOT TAMS systems differ. The TAMC Pilot organized the condition evaluation guidance first by culvert type, then by detailed condition descriptions associated with typical distress at each element under consideration for that culvert type. The MDOT TAMS system looked at elements and descriptions more universally where most elements are applicable to all culvert types with some specific elements having been broken down into descriptions based on metal or concrete material type. These differences result in the need for an element by element comparison of distress descriptions in order to determine how closely related the two systems are.

Section Deformation:

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Section Deformation (CMP - Round)	New Condition	Good, smooth curvature in barrel. Horizontal diameter (span) dimension within 10% of original design.	Generally good, top half of pipe smooth but minor flattening of bottom. Horizontal diameter (span) dimension within 10% of original design.	Fair, top half has smooth curvature but bottom half has flattened significantly. Horizontal diameter (span) dimension within 10% of original design.	Generally fair, significant distortion at isolated locations in top half and extreme flattening of the invert. Horizontal diameter (span) dimension 10% to 15% greater than original design.	Marginal significant distortion throughout length of pipe, lower third may be kinked. Horizontal diameter (span) dimension 10% to 15% greater than original design.	Poor with extreme deflection at isolated locations, flattening of the crown, crown radius 20 to 30 feet. Horizontal diameter (span) dimension in excess of 15% greater than original design.	Critical, extreme distortion and deflection throughout pipe, flattening of the crown, crown radius over 30 feet. Horizontal diameter (span) dimension more than 20% greater than original design.	Partially collapsed with crown in reverse curvature	Structure collapsed
Section Deformation		None		Slight, perceptible deformation or local buckling		Deformation with longitudinal cracking or crushing in crown, invert, or spring lines		Excessive deformation resulting in extensive infiltration of soil with roadway/embankment damage.		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 10: Section deformation comparison between the TAMC Culvert Pilot and MDOT TAMS

Section deformation in the TAMC Pilot system contains detailed descriptions for CMP and plastic pipe with CMP further broken down into eight different cross-sectional shapes. Detailed descriptions for round pipe was used for a comparison with the generalized MDOT TAMS description of section deformation. Overall, the general G/F/P/S descriptions appear to be aligned between the two systems with the exception of the TAMC Pilot system ratings of 9 and 8. These rating values allow some cross sectional deformation, though to a small degree. For lack of an apparent allowance in the MDOT TAMS system for slight discrepancies, culverts with those ratings would likely be rated in the fair category (7 or 6) in the MDOT TAMS system.

Joints or Seams:

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Pipe Joints or Seams (CMP & Plastic)	Straight line between sections.	No settlement or misalignment. Tight with no defects apparent.	Minor misalignment at joints. Minor settlement. Distress to pipe material adjacent to joint.	Misalignment of joints but no infiltration. Settlement. Dislocated end section. Extensive areas of shallow deterioration.	Joint open and allowing backfill to infiltrate. Significant cracking or buckling of pipe material. Joint offset less than 3 inches. End sections dislocated and about to drop off from main portion of the structure. Infiltration staining apparent.	Differential movement and separation of joints. Significant infiltration or exfiltration at joints. Joint offset less than 4 inches. Voids seen in fill through offset joints. End sections dropped off at inlet.	Significant openings. Dislocated joints at several locations exposing fill material with joint offsets greater than 4 inches. Infiltration or exfiltration causing misalignment of pipe and settlement or depressions in roadway. Large voids seen in fill through offset joints.	Culvert not functioning due to alignment problems throughout. Large voids seen in fill through offset joints.	Pipe partially collapsed or collapse is imminent.	Total failure of pipe.
Joints		No gaps		Open with minor infil/exfil of water and/or soil		Open or displaced with significant infil/exfil of soil and water. Voids visible		Open or displaced with significant infiltration of soil with accompanying roadway damage		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 11: Joins & Seams rating comparison between the TAMC Culvert Pilot and the MDOT TAMS

The TAMC Pilot system provides a greater level of detail in what to look for in the joints or seams of a culvert and contains additional descriptions for concrete pipes, masonry, and CMP multi-plate systems. Descriptions for CMP or plastic pipes were compared with the MDOT TAMS descriptions and it was determined that ratings could expect to fall within the same G/F/P/S categories for the two systems.

Blockage:

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Blockage	No blockage. Designed condition.	Minor amounts of sediment build-up with no appreciable loss of opening.	Culvert waterway blockage is less than 5% of the cross sectional area of the opening. Bank and channel have minor amounts of drift.	Culvert waterway blockage is less than 10% of the cross sectional area of the opening. Sediment buildup causing flow through 1 of 2 pipes. Silt and Gravel buildup restricts half of the channel. Tree or bush growing in the channel. Fence placed at inlet or outlet. Rock dams in culvert.	Culvert waterway blockage is less than 30% of the cross sectional area of the opening. Tree or bush growing in channel. Fence placed at inlet or outlet. Rock dams in culvert.	Culvert waterway blockage is less than 40% of the cross sectional area of the opening. Occasional overtopping of roadway. Large deposits of debris are in the waterway.	Culvert waterway blockage is less than 80% of the cross sectional area of the opening. Overtopping of roadway with significant traffic delays.	Culvert waterway blockage is 80% or greater of the cross sectional area of the opening. Frequent overtopping of roadway with significant traffic delays.	Culvert waterway completely blocked and causing water to pool. Road closed because of channel failure.	Total failure of pipe.
Sediment		Same condition as initial placement		Additional material has moved into culvert but does not exceed 20% of rise		Sediment exceeds 20% but is less than 50% of rise		Sediment significantly impacting the capacity of culvert		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 12: Blockage rating comparison between the TAMC Culvert Pilot and the MDOT TAMS

When considering blockage or sediment in the pipe, the TAMC Pilot system is likely to have higher G/F/P/S ratings than the MDOT TAMS rating system. For each general condition category, the allowable percent of culvert blocked is lower using the MDOT TAMS system. Culverts rated as 9 or 8 (good) with the TAMC Pilot would be considered 7 (fair) using the MDOT TAMS system. Likewise, 6 and 4 (fair and poor) using the TAMC Pilot system would be considered 5 and 3 (poor and severe) respectively in the MDOT TAMS system. Some good ratings in the TAMC Pilot system would translate to fair in the MDOT TAMS system.

Invert Deterioration (CMP):

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Closed Bottom Invert Deterioration (CMP)	New condition; galvanizing intact; no corrosion.	Discoloration of surface. Galvanizing partially gone along invert. No layers of rust.	Discoloration of surface. Galvanizing gone along invert but no layers of rust. Minor section loss at ends of pipe not located beneath roadway.	Galvanizing gone along invert with layers of rust. Moderate section loss at ends of pipe not located beneath roadway. Moderate section loss: Less than 4% of invert area.	Heavy rust and scale throughout. Heavy section loss with perforations in invert not located under the roadway. Heavy section loss: Up to 10% of invert area.	Extensive heavy rust and scaling throughout. Perforations throughout invert with an area less than 20% of invert area. Overall thin metal, which allows for an easy puncture with chipping hammer.	Extensive heavy rust and scaling throughout. Perforations throughout invert with an area less than 25% of invert area.	Perforations throughout invert with an area greater than 25% of invert area.	Pipe partially collapsed.	Total failure of pipe.
Invert Deterioration (Metal)		Little or no surface rust or coating loss		General corrosion, scaling, or pitting but significant remaining metal section		Perforations visible or easily made by hammer test strike		Significant section loss in invert beyond perforations resulting in work beneath invert and/or roadway/embankment		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 13: Invert Deterioration for CMP rating comparison between the TAMC Culvert Pilot and the MDOT TAMS

Invert deterioration for closed bottom CMP pipe descriptions for the TAMC Pilot ratings were compared against the invert deterioration (metal) description in the MDOT TAMS guide. The TAMC Pilot includes detailed descriptions for plastic and masonry inverts. It is not clear how these materials would be addressed in the MDOT TAMS rating system. A rating of 8 (good) in the TAMC Pilot system could reasonably expect to see a rating of 7 (fair) in the MDOT TAMS system since the description for the TAMC pilot allows minor section loss and the MDOT TAMS description for a general condition of good allows “little or no surface rust or coating loss”. Similarly, due to the allowance for perforations in each system a rating of 6 (fair) in the TAMC Pilot system would rate at 5 (poor) in the MDOT TAMS system.

Invert Deterioration (Concrete):

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Invert Deterioration (Concrete Pipe)	New Condition. Superficial and isolated damage from construction.	Hairline cracking without rust staining or delamination(s). Surface in good condition.	Hairline cracking: Less than 1/16th inch wide parallel to traffic without rust staining. Light scaling: Less than 1/8th inch deep with less than 10% of exposed area. Delaminated or Spalled area: Less than 1% of surface area. Note: cast-in-place box culverts may have a single large crack less than 3/16th inch on each surface parallel traffic direction.	Hairline and map cracking: Cracks less than 1/8th inch parallel to traffic with minor efflorescence or minor amounts of leakage. Scaling: Less than 1/4th inch deep or 20% of exposed area. Spalled areas with exposed reinforcing: Less than 5%. Total delaminated and spalled areas less than 5% of surface area.	Map cracking with hairline cracks less than 1/8th inch parallel to traffic or less than 1/16th inch transverse to traffic with efflorescence, or rust stains, or leakage or all. Scaling 3/16th inch deep on less than 30% of surface area. Spalled areas with exposed reinforcing on less than 10% of surface area. Total delaminated and spalled areas less than 15% of surface area.	Transverse cracks open greater than 1/8th inch with efflorescence and rust staining. Spalling at numerous locations. Extensive surface scaling on invert greater than 1/2 inch. Extensive cracking with cracks open more than 1/8th inch with efflorescence. Spalling has caused exposure of heavily corroded reinforcing steel on bottom or top of slab. Extensive surface scaling on invert greater than 3/4th inch or approximately 50% of culvert invert.	Extensive cracking with spalling, delaminations, and slight differential movement. Scaling has exposed all surfaces of the reinforcing steel in bottom and top slab or invert with approximately 50% loss of wall thickness at invert. Concrete very soft.	Full depth holes. Extensive cracking greater than 1/2 inch. Spalled areas with exposed reinforcing greater than 25%. Over 50% of the surface area is delaminated, spalled, or punky. Reinforcing steel bars have extensive section loss and bar perimeter is completely exposed.	Culvert partially collapsed or collapse is imminent.	The culvert is collapsed.
Invert Deterioration (Concrete)		Little or no abrasion with aggregate exposed		Moderate abrasion and scaling with minor aggregate loss. No exposure of reinforcement		Heavy abrasion and scaling with exposed reinforcement		Holes or section loss with voids beneath and roadway/embankment damage		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 14: Invert deterioration of concrete pipe rating comparison between the TAMC Culvert Pilot and the MDOT TAMS

When considering the invert deterioration of concrete pipes, culverts rated as Fair using the TAMC Pilot approach would likely rate as Poor using MDOT TAMS rating system if the culvert

had exposed rebar. The TAMC Pilot rating system allows exposure of rebar but limits the total surface area exhibiting exposed steel. The MDOT TAMS system suggests any exposed reinforcement would drop rating from Fair to Poor. TAMC Pilot includes detailed descriptions for plastic and masonry inverts. It is not clear how these materials would be addressed in the MDOT TAMS rating system.

Structural Deterioration (CMP):

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Structural Deterioration (Corrosion) (CMP)	New condition. Galvanizing intact. No corrosion.	Discoloration of surface. Galvanizing partially gone. No layers of rust.	Discoloration of surface. Galvanizing gone along invert but no layers of rust. Minor section loss at ends of pipe not located beneath roadway.	Galvanizing gone with layers of rust. Moderate section loss at ends of pipe not located beneath roadway. Moderate section loss: Less than 6 in^2/ft^2.	Heavy rust and scale throughout. Heavy section loss with perforations not located under the roadway. Heavy section loss: Up to 15 in^2/ft^2.	Extensive heavy rust and scaling throughout. Perforations throughout with an area less than 30 in^2/ft^2. Overall thin metal, which allows for an easy puncture with chipping hammer.	Extensive heavy rust and scaling throughout. Perforations throughout with an area less than 36 in^2/ft^2.	Perforations throughout with an area greater than 36 in^2/ft^2 .	Pipe partially collapsed.	Total failure of pipe.
Corrosion (Metal)		Little or no surface rust or coating loss		Minor surface rust and limited pitting		Perforations visible or easily made, conection hardware failing		Significant section loss resulting in extensive oblitteration of soil with roadway/embankment damage		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 15: Structural deterioration of CMP rating comparison between the TAMC Culvert Pilot and the MDOT TAMS

Structural deterioration (corrosion) of CMPs in the TAMC Pilot rating compares with corrosion (metal) in the MDOT TAMS system. A rating of 8 (good) in the TAMC Pilot system could reasonably expect to see a rating of 7 (fair) in the MDOT TAMS system since the description for the TAMC pilot allows minor section loss and the MDOT TAMS description for a general condition of good allows “little or no surface rust or coating loss”. Similarly, due to the allowance for perforations in each system a rating of 6 (fair) in the TAMC Pilot system would rate at 5 (poor) in the MDOT TAMS system.

The TAMC Pilot contains detailed descriptions of structural deterioration in plastic, masonry, and stub & abutment culverts. It is not clear how corrosion of these culverts are addressed within the MDOT TAMS system.

Structural Deterioration (Concrete Pipe):

TAMC Pilot (Modifed FHWA)	Excellent	Very Good	Good	Satisfactory	Fair	Poor	Serious	Critical	Imminent Failure	Imminent Failure
	10	9	8	7	6	5	4	3	2	1
Structural Deterioration (Concrete Pipe)	New Condition. Superficial and isolated damage from construction.	Hairline cracking without rust staining or delamination(s). Surface in good condition.	Hairline cracking: Less than 1/16th inch wide parallel to traffic without rust staining. Light scaling: Less than 1/8th inch deep with less than 10% of exposed area. Delaminated or Spalled area: Less than 1% of surface area. Note: cast-in-place box culverts may have a single large crack less than 3/16th inch on each surface parallel traffic direction.	Hairline and map cracking: Cracks less than 1/8th inch parallel to traffic with minor efflorescence or minor amounts of leakage. Scaling: Less than 1/4th inch deep or 20% of exposed area. Spalled areas with exposed reinforcing: Less than 5%. Total delaminated and spalled areas less than 5% of surface area.	Map cracking with hairline cracks less than 1/8th inch parallel to traffic or less than 1/16th inch transverse to traffic with efflorescence, or rust stains, or leakage or all. Scaling 3/16th inch deep on less than 30% of surface area. Spalled areas with exposed reinforcing on less than 10% of surface area. Total delaminated and spalled areas less than 15% of surface area.	Transverse cracks open greater than 1/8th inch with efflorescence and rust staining. Spalling at numerous locations. Extensive surface scaling on invert greater than 1/2 inch. Extensive cracking with cracks open more than 1/8th inch with efflorescence. Spalling has caused exposure of heavily corroded reinforcing steel on bottom or top of slab. Extensive surface scaling on invert greater than 3/4th inch or approximately 50% of culvert invert.	Extensive cracking with spalling, delaminations, and slight differential movement. Scaling has exposed all surfaces of the reinforcing steel in bottom and top slab or invert with approximately 50% loss of wall thickness at invert. Concrete very soft.	Full depth holes. Extensive cracking greater than 1/2 inch. Spalled areas with exposed reinforcing greater than 25%. Over 50% of the surface area is delaminated, spalled, or punky. Reinforcing steel bars have extensive section loss and bar perimeter is completely exposed.	Culvert partially collapsed or collapse is imminent.	The culvert is collapsed.
Corrosion (Concrete)		Little to no efflorescence		Minor cracking and spalling		Exposed reinforcement		Significant section loss of steel reinforcement that causes pipe deformation, holes, and embankment/roadway damage.		
MDOT TAMS		Good		Fair		Poor		Critical		
		9	8	7	6	5	4	3	2	1

Figure 16: Structural deterioration of concrete pipe rating comparison between the TAMC Culvert Pilot and the MDOT TAMS

Considering the structural deterioration of concrete pipe, culverts rated as Fair using the TAMC Pilot approach would likely rate as Poor using MDOT TAMS rating system if the culvert had exposed rebar. The TAMC Pilot rating system allows exposure of rebar but limits the total surface area exhibiting exposed steel. The MDOT TAMS system suggests any exposed reinforcement would drop rating from Fair to Poor.

Summary:

The two culvert rating systems in use within the state of Michigan, TAMC Pilot and MDOT TAMS, differ in their organizational approach and the level of detail provided in the element level descriptions of distress.

Differences in the organizational structure means the TAMC Pilot system contains culvert-type specific distress descriptions because element level descriptions are specific to a culvert type and in some cases culvert shape. The MDOT TAMS system is more generalized, leaving culvert-type and culvert shape specific considerations to an inspector's interpretation which may be influenced by experience or training. For example, plastic pipes are specifically described in the TAMC Pilot system but an inspector following the MDOT TAMS system would have to conduct their evaluation based on the guidance available for either metal or concrete culverts.

The level of detail provided in the element level descriptions of distress has resulted in the need to make comparisons between the two systems at the level of general conditions; good, fair, poor, serious. In many cases the description provided in the TAMC Pilot system could reasonably fall within the general description of the MDOT TAMS system. Where discrepancies

occurred it was generally in areas where specific measures were made in the MDOT TAMS system. For example, fixed percentages used to describe culvert blockage/sediment or an allowance for a diminutive amount of deterioration or an acceptable range versus an absolute statement on the presence of distress.

For the purposes of comparison between the two systems an absolute adherence to the descriptions provided for element deterioration between the two systems was assumed. In reality an inspector may stray from this, either through experience and personal bias or as a result of clarification provided through training. Without field verification and a comparative study on how inspectors apply the guidance from each system it is impossible to know to what extent an inspector would allow a diminutive amount of deterioration or if they would apply a "representative of the whole" approach to their rating.

A general comparison between the two systems was made using only the descriptions provided for each of the above elements and assuming any amount of distress (when no acceptable range was provided) triggered placement within a respective general category. Under these conditions, it would be reasonable to say that the two systems are generally aligned; however, in some situations the MDOT TAMS system will indicate a lower rating than the TAMC Pilot system. Relationships were established for each of the comparable elements which indicated situations in which a distress described in one category within the TAMC Pilot would fall within a lower category of the MDOT TAMS system. This does not allow for a direct translation to be established, however, as many indicators of distress may be indicated for each rating description and just because one crosses between the general condition categories doesn't mean it would always be present or take priority over the other descriptions.

CONCLUSIONS & GENERAL RECOMENDATIONS

This section provides key points from this study and provides a framework to assist the TAMC with the development and implementation of a strategy that can be used across the state to further streamline and standardize the collection of culvert data assets owned by local agencies throughout Michigan.

Inspection Frequency

Inspection frequency should be established to ensure an agency's data is up-to-date. The follow-up survey was used to gauge participant's thoughts on this subject based on their experience with changes in a culvert's condition over time. Too frequent of an inspection interval results in little to no change between data sets and an inefficient work plan. Too much time between intervals and significant changes could have occurred resulting in missed opportunities for maintenance and potential risk of failure. The survey looked at three variables that may affect the inspection frequency; culvert size, material, and condition. A culvert's size affects the relative risk associated with failure, each material type has a different deterioration profile which would affect the period between inspections, and as a culvert reaches poorer condition states the need to inspect more frequently may increase as well.

Size: The survey indicated, in general, that responders would be comfortable with an inspection frequency of more than six years for culverts 24 inches and smaller and four years for culverts greater than 48 inches. The responses were uniformly distributed for culvert sizes between these two diameters. This would provide between eight and twelve inspections over a typical fifty year culvert service life. Culverts over 48 inches in poor or lower condition should be inspected yearly.

Material: Most survey participants identified a four-year inspection frequency for most of the material types with a potential to inspect concrete culverts at an interval greater than six-years and plastic culverts at a six-year interval.

Condition Rating: The survey responses regarding inspection frequency were fairly clear in identifying a four-six-year frequency on culverts rated good but then lowering the frequency to 4-years when the culvert is rated at fair, two-years at poor, and every year at severe.

The 2018 pilot study conducted a literature review to see what other agencies around the country use for inspection frequency. This varied widely by agency, ranging from annual inspections up to a six-year interval. Size and condition were two factors affecting recommended frequencies. The National Cooperative Highway Research Program (NCHRP) Report 14-26, *Culvert and Storm Drain System Inspection Manual*, recommends establishing an inspection frequency based on both the condition and size of the culvert, but leaves the frequency decision to the agency. Under the recommended system, culverts that span greater

than 10 feet should be inspected every two years regardless of condition, and culverts less than 10 feet should be inspected at intervals depending on their size and last reported condition.

Based on the literature review and survey findings, the CTT would recommend allowing agencies to determine an inspection frequency that best meets their needs, but also set basic parameters to provide consistency across the state. We would recommend allowing up to six-years between inspections for small culverts* and four years for culverts up to 10 feet, and two years for culverts greater than 10 ft. Inspection frequencies should be lowered when the condition reaches poor or severe. Further policy related to material type may create a more complicated system, the committee could leave the decision to alter frequency based on material to an individual agency or provide guidance to allow an exemption for concrete or plastic in good condition.

A data analysis program could be established to monitor changes in condition state over time in an effort to create a more efficient inspection frequency schematic. Rating too often would result in little to no change between inspections, too long and maintenance opportunities will be lost and risk of failure will increase.

* The CTT feels it would be best to be uniform in this specific break-point and establish what constitutes a small culvert by aligning any size related inspection frequency break-point with any change from a detailed condition rating system and a simplified system.

Condition Evaluation

The follow-up survey revealed a mixed reaction to offering a simplified Good/Fair/Poor/Serious rating system for culverts. Approximately 50% of respondents preferred a detailed system and 50% preferred a simplified system.

In a related question, responders were asked to identify a culvert size threshold where they would be most comfortable switching from a simplified system to a detailed one. Most people said 36 inch or smaller could be rated using a simplified approach. Approximately 75% of the respondents indicated a specific size equal to or less than 48 inches.

The literature review from the 2018 pilot study revealed some information regarding changes in the procedures used for culvert inspection by local agencies based on culvert size, but there was no general consensus as to what was practical. Some county road agencies were found to separate culverts by size into categories 2 to 5 feet and below, and 5 to 20 feet. Tuscola County Road Commission (CRC) indicated this was due to different funding sources for maintaining different sized culverts, and Kent CRC indicated this was for inspection frequency: giving priority to the larger culverts. Bay CRC separated culverts into less than 10 feet and 10 to 20 feet. Branch CRC separated culverts into 3 feet and below, 3 to 6 feet, 6 to 10 feet, and 10 to 20 feet. MDOT separated culverts into categories of 1 to <10 feet and 10 to <20 feet.

Subdivision of culverts by size was primarily due to establishing maintenance priorities linked to the condition rating of the culvert for the purpose of asset management practices. Agencies also subdivided culverts by material type to assist with evaluating culvert deterioration and to effectively plan maintenance projects.

The CTT would recommend the TAMC allow (but not require) a simplified rating system for culverts less than or equal to 36 inches. Where the simplified rating system (Good/Fair/Poor/Serious) is based on the detailed approach developed for the 2018 Culvert Pilot so that the general condition states can be compared between the two systems. Since there is no established standard for the size in which condition evaluations may change, the CTT is recommending 36 inches or less because this is reasonably supported by the survey results and, most importantly, culverts of this size and smaller would be difficult to impossible to visually inspect at arms-length without specialized equipment. Therefore, a detailed rating system would not necessarily yield more accurate information than a simplified approach.

Database

The 2018 TAMC Pilot discussed the creation of a centralized database for the storage of culvert inventory and condition evaluation on a statewide basis. The vision for this was to have shared access so that data from a variety of sources beyond transportation agencies could be combined to create a single database with the purpose of avoiding duplicative effort and allowing agencies to focus on collecting only that data relevant to their needs which isn't already in the database. The follow-up survey indicated that only 22% of respondents said it would be beneficial to import stream crossing survey data into a transportation agency database. Interviews with non-transportation agencies with a potential interest in culvert data revealed similar findings indicating that they had the data they needed and could request data exports if the need presented its self. As a result, non-transportation agencies didn't place a great value on creating a single centralize data source. . This is not to say a centralized transportation database would not have value for TAMC, or that there would be no value in periodically checking other data sources to augment its counterpart.

Culvert Matching

The processes shown in Task 2 illustrate methods for utilizing the DNR stream crossing database as a detection method for previously unidentified MDOT and local agency culverts to better complete those data sets. The process can be run using standard GIS tools in a reasonable amount of time. These process can also be used to form a general rule set for software that theCSS has procured (One Spatial) to automate the combination of data sets from numerous sources.

QA/QC & Field Verification

A QA/QC program should be defined if data is made available for public interpretation. The pilot provided a means for local agencies to get involved with inventory and condition assessment of their culverts. A training program was created in an effort to help establish consistency amongst raters, however, there were no QA/QC programs in place to test if two raters would consistently rate the same culvert. The ability to provide a relative ranking to a single agency's culverts can be achieved by having a single inspector and this will meet their asset management needs. However, if data between agencies is to be combined or compared for a larger purpose an appropriate program should exist to ensure the data is consistent between collecting organizations. Feedback between the QA/QC program and training helps ensure, overtime, that consistency is narrowed and maintained.

A QA/QC program is a good way to ensure consistent ratings within a rating system. However, if two separate systems are compared or data is combined or shown together, field verification would help identify the relationship between the two systems. Task 3 showed general agreement between the two systems when compared at a general condition level and assuming absolute adherence to the rating descriptions. Each rating category contains descriptions of multiple kinds of distress associated with that rating. The specific types of distress very between the two systems. Therefore, a translation process could be created, but only if the controlling distress were identified. This would require additional data to be collected. Another option would be to conduct field verification of inspectors using the two systems. This would help identify, statistically, the difference between the two systems. This could allow dashboard-level translation between the two data sets but would not allow a person to translate a rating between the two systems for an individual culvert.

Reporting & Dashboards

A note should be added to dashboards and any other publically available condition rating data that states the two condition ratings systems used within the state are similar in their outcomes when considering the general condition (good, fair, poor, serious) but not identical, some differences in condition rating outcome can be expected, and the current data has not undergone a QA/QC procedure.

Any direct comparison between TAMC Pilot and MDOT TAMS data should also remove any data that is not consistent between the two data sets. For example, the overall controlling condition rating using the TAMC Pilot system does not include ratings based on the condition of the road over the culvert or of the embankment. Likewise, the overall rating from the MDOT TAMS dataset does not include any ratings due to scour. These three condition elements are in one but not both datasets and if they controlled in one system that data should be removed from the comparative dataset.

Inspection frequency must also be considered when making data publically available. There is currently no policy in place that would require condition evaluation or set the inspection frequency. If this information is to be voluntarily submitted at a frequency determined by individual culvert owners, it would be difficult to maintain a condition dashboard unless displayed data is limited to submittals over a relative period of time.

NEXT STEPS

Policy:

- A policy document needs to be created to establish the inspection frequency, condition evaluation system, database and information sharing procedures, and a QA/QC program.
- The AASHTO "Culvert & Storm Drain System Inspection Guide" became available on August 13, 2020. This document replaces the 1986 FHWA Culvert Inspection Manual that was modified for the TAMC Pilot to include modern materials and culvert types.
    - TAMC should decide on adoption of the AASHTO guide either in full or part and any modifications necessary for culvert inspections in Michigan
    - A study should be performed to evaluate if a culvert system translation is needed between AASHTO/TAMC Pilot/MDOT TAMS systems and determine a data handling process moving forward
    - A simplified rating system/guidance will need to be defined for culverts that may be rated using a Good/Fair/Poor/Serious assessment
- If data is to be compiled and used comparatively for culvert systems across the state a QA/QC system needs to be created to ensure an adequate training program is established to help assure that each inspector would assign the same rating to a culvert within an established tolerance.
- If condition data between the TAMC Pilot and MDOT TAMS systems are to be compared a field verification program should be used to verify uniformity between the two systems in their Good/Fair/Poor/Serious assessments due to inspector interpretation of generalized condition descriptions.
- TAMC should develop a data schema to summarize culvert data from the pilot and MDOT TAMS. This would include common denominator fields for materials, shapes, and physical measurements that would make combining data from multiple sources easier and consistent

Training:

- Training should be updated to include the rating system as adopted by TAMC (option to do refresher training that highlights the changes in the updated system for those who already took the TAMC Pilot training)
- QA/QC program should feed back into training to help improve program

Revised Data Collection Pilot:

- A pilot program could be initiated in an effort to 'test' the TAMC policy document while it is in a draft state and raise any issues or highlight changes that may be beneficial.

Data:

- A culvert database should be finalized and if not publically available made accessible to those who own culverts so they can retrieve their data (local or centralized storage). Protocol should be established to define who has access to this data and how data is managed.
- Using the process identified in Task 2 identify previously un-inventoried MDOT and local agency culverts to better complete those data sets.

REFERENCES

Arnoult, JD. 1986. Culvert Inspection Manual. Federal Highway Administration (FHWA). IP-86-2. [Available from: https://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=31&id=57]

TAMC. 2018. Michigan Local Agency Culvert Inventory Pilot Evaluation Report. [Available from: https://www.michigan.gov/documents/tamc/TAMC_2018_Culvert_Pilot_Report_Complete_634795_7.pdf]

MDOT. 2018. Asset Collection & Condition Assessment Guide for 1' - <10' Span Culverts. Michigan Department of Transportation (MDOT). [Available from: https://www.michigan.gov/documents/mdot/MDOT_RFP_SS_REQ2435_Tams_Culvert_Colection_616748_7.pdf]

APPENDIX

Follow-up Survey

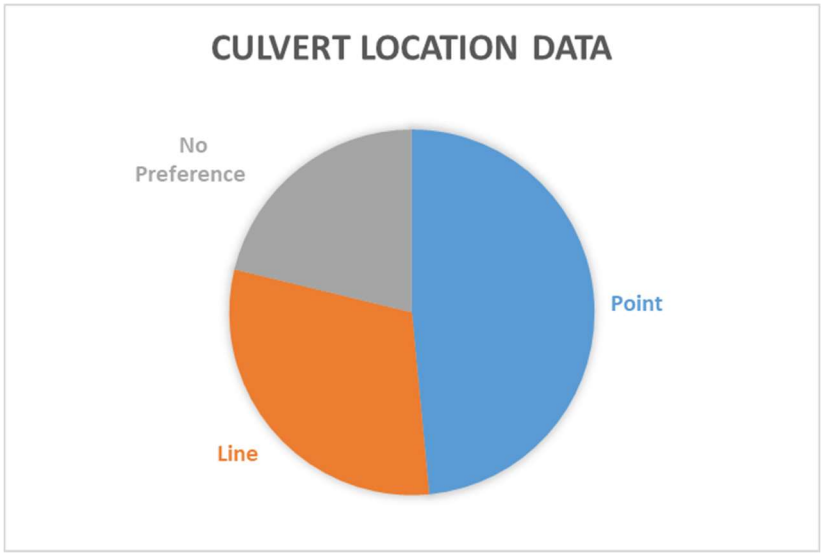
Added to project work plan as a follow-up to the 2018 pilot because CTT had contact list and resources to conduct survey and results would be beneficial to TAMC Bridge Committee for their effort in creating a culvert inspection and condition evaluation policy document.

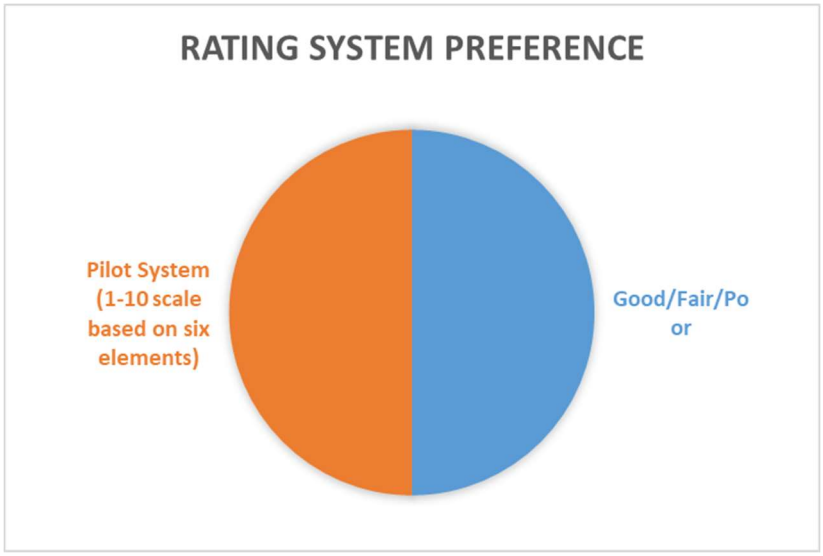
- **Percent of respondents who found pilot data useful one-year after pilot:**

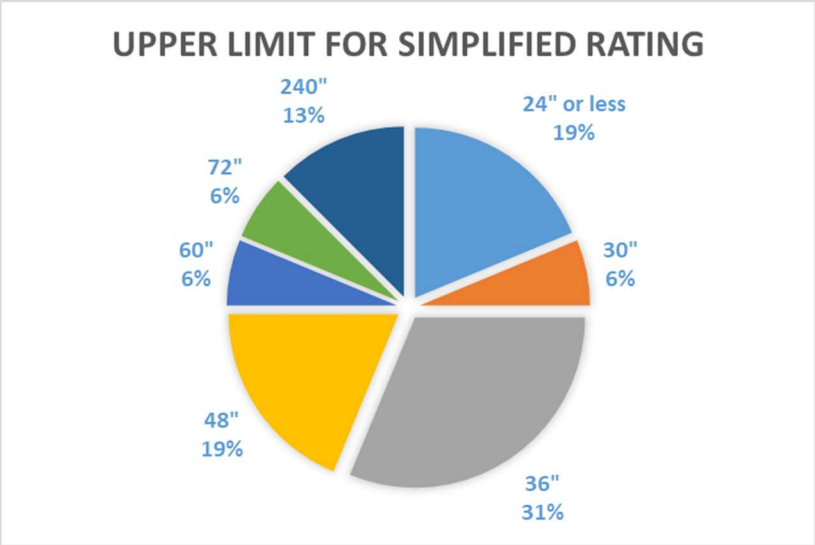
  - Inventory ID (65%)
  - GPS coordinates (85%)
  - Material type (100%)
  - Asset collection date (77%)
  - Shape (100%)
  - Skew angle (74%)
  - Length (100%)
  - Span (width) (100%)
  - Rise (height or diameter) (97%)
  - Depth of cover (90%)
  - Roadway surface type (81%)
  - Culvert Condition (97%)
  - Photographs (optional) (78%)
  - *Additional comments:*
    - *Additional notes specific to culvert or location*
    - *Depth of cover doesn't matter until it is about 5 ft (trench protection) and 10 ft and deeper (larger excavator)*

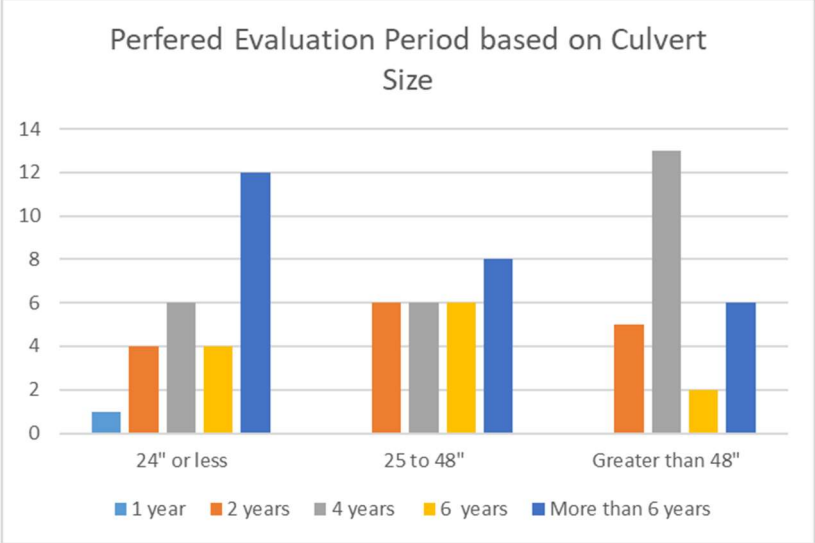
- **Percent of respondents who found pilot condition evaluation data useful:**

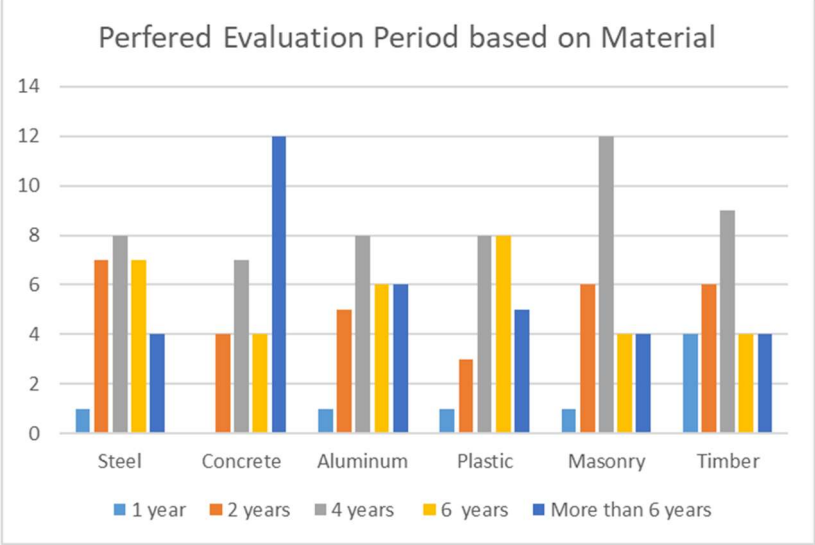
  - Invert deterioration (79%)
  - Structural deterioration (93%)
  - Section deformation (79%)
  - Joint/seam condition (90%)
  - Channel blockage (90%)
  - Scour (86%)
  - *Additional comments:*
    - *These are only useful when it is bad. Still think that a single rating for the pipe and a single rating for the channel & stream would be fine. We are not doing different fixes for all the individual ratings, but basically replace it or not.*

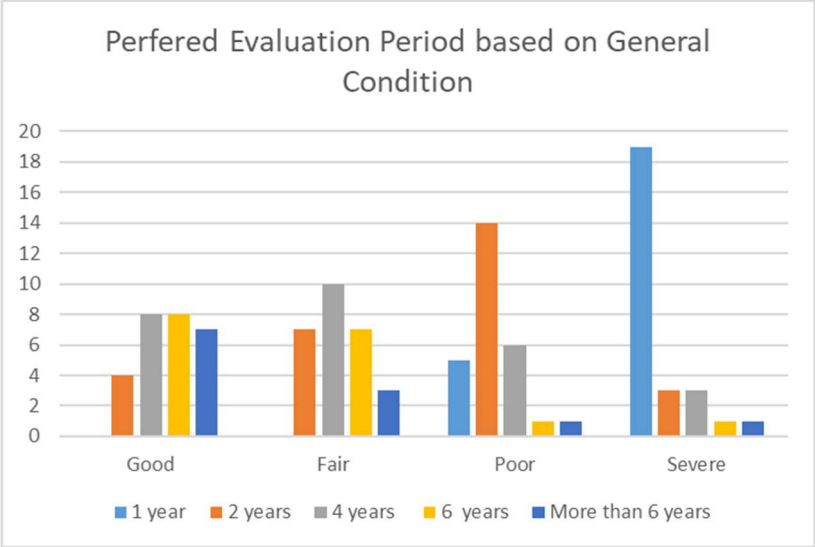

CULVERT LOCATION DATA
No Preference
Point
Line


RATING SYSTEM PREFERENCE
Pilot System (1-10 scale based on six elements)
Good/Fair/Poor


UPPER LIMIT FOR SIMPLIFIED RATING
240"
13%
24" or less
19%
72"
6%
60"
6%
30"
6%
48"
19%
36"
31%


Perfered Evaluation Period based on Culvert Size
14
12
10
8
6
4
2
0
24" or less
25 to 48"
Greater than 48"
1 year
2 years
4 years
6 years
More than 6 years


Perfered Evaluation Period based on Material
14
12
10
8
6
4
2
0
Steel
Concrete
Aluminum
Plastic
Masonry
Timber
1 year
2 years
4 years
6 years
More than 6 years



- **How have you used the culvert data that you collected in the 2018 pilot?**

- Helps when preparing estimates for road repair for identifying before field measuring and for rough estimates of cost
- Look up culvert info from the desk to at least get a good idea of what is there
- Culvert Asset Management program for the county and township
- The City did not have data on all the culverts prior to this pilot program. Since then, all culvert data has been uploaded to GIS for employee use.
- Marked the locations so the crew can locate them
- We provided the township where the pilot was completed data to help with planning of sanitary sewer projects.
- Inventory data and updating database as additional culverts are found and culverts are replaced.
- We used the information to prioritize our maintenance schedule.
- Helps us with estimates on road projects knowing how many culverts are on a segment of road before going into the field to verify.
- Plan maintenance projects
- Incorporated it into Cityworks
- We have used the condition data for our 5 year replacement plan.
- The data has been helpful when we rebuild a roadway corridor to really think carefully about examining the culverts carefully to see if they require attention.
- Used to prioritize replacements, scope resurfacing projects to see if culvert replacements are needed
- Determining culvert replacements and culvert lining on future projects
- To find the location of culverts to replace prior to road construction/maintenance.

- Haven't. Shared the "bad ones" with maintenance foremen, but we don't have the time or money to be proactive. Just fix replace when it fails.

- **67% of respondents have continued collection after the pilot**

- Not on a routine cycle. Catching culverts that were missed in initial survey and updating when repairs or replacements are made.
- New culverts have continually been added
- Collecting locations and rating culverts as they are replaced, and as discovered because some were missed during the pilot. Also, rating culverts at known problem areas, and as time allows.
- Any time our foreman or working foreman come across a new culvert, it gets added by engineering. Every road project we scope and evaluate all culverts in that stretch to make sure that none need to be replaced prior to HMA work occurring. All culverts that get replaced during the year are updated in Roadsoft that following winter/spring, to make sure the data is accurate. We have a close working relationship with the drain commissioner, and have shared the culvert layer data with them in ArcGIS. This has been way easier to view and use then in Roadsoft.
- When possible we are collecting the same data that was collected with the pilot program.
- We filtered out our current database and have been inspecting local road culverts, 4' span and larger. All the primary road culverts have been inspected and our database has been updated.
- Same as in the pilot, currently finishing the initial collection of all culverts with in the county
- We have continued on project by project basis. When we work on a project culverts are reviewed and rated.
- We will still try to evaluate a culvert with the full number of condition categories.
- Every time we replace a culvert we update that info in RoadSoft.
- We have set a 5 year inspection cycle. We have approximately 3200 culverts and ideally would like to inspection 650 per year. In 2019 we fell short of that goal inspecting around 300. So far this year we are at around 800 inspections. The inspectors are verifying the data input from 2018 as well as updating the condition rating. They are also finding a few culverts that were missed during the culvert pilot.
- First, we have completed a draft of our asset management document and often discuss "scope" in terms of the number of culverts we think we own and the overall condition. This data has been helpful in budgetary discussions and formulating plans to manage our risk. The data has slightly shifted the discussion

from "oh this can wait a few more years, to "we better do this now, because there will be other culvert problems waiting, and we must pace ourselves".

- Continue to use the method developed for the pilot project
- Length, width, height, diameter, material type, depth of cover, rating, entrance structure, exit structure, number of culverts, span, rise, waterway sometimes, as well as the memo on the rating.
- Length, depth, material, shape, size, and the pipe condition

- **22% said it would be beneficial to import stream crossing survey data**
- **78% said they have no concerns sharing their basic culvert data in an open, statewide database**

- Everything we share with the state seems to be used against us eventually. But we would do it.
- Yes and no. Any data is subjective, but now you have the fact that in memo fields any data can be entered and then anyone state wide can see it. We had one culvert point that said in the memo best Chinese food in the county. To proof thousands of points would be extremely cumbersome, in addition to the numerous duplicate points that were in the system prior to the TAMC.
- Data could be incorrect or missing pieces.
- Culverts can be in terrible condition visually but with the right amount of cover and supporting soil around it, can last a long time. Sharing data will likely lead to mandated inspections instead of voluntary. Resources are slim so inspections are completed when time permits.
- Could be a liability if a failure occurs prior to repair
- The only concern is that the user needs to field verify all data.
- But must qualify my answer; as long as the state and federal agencies "work with us" cooperatively.

- **What Resources, if any, do you need to actively collect data on your culverts?**

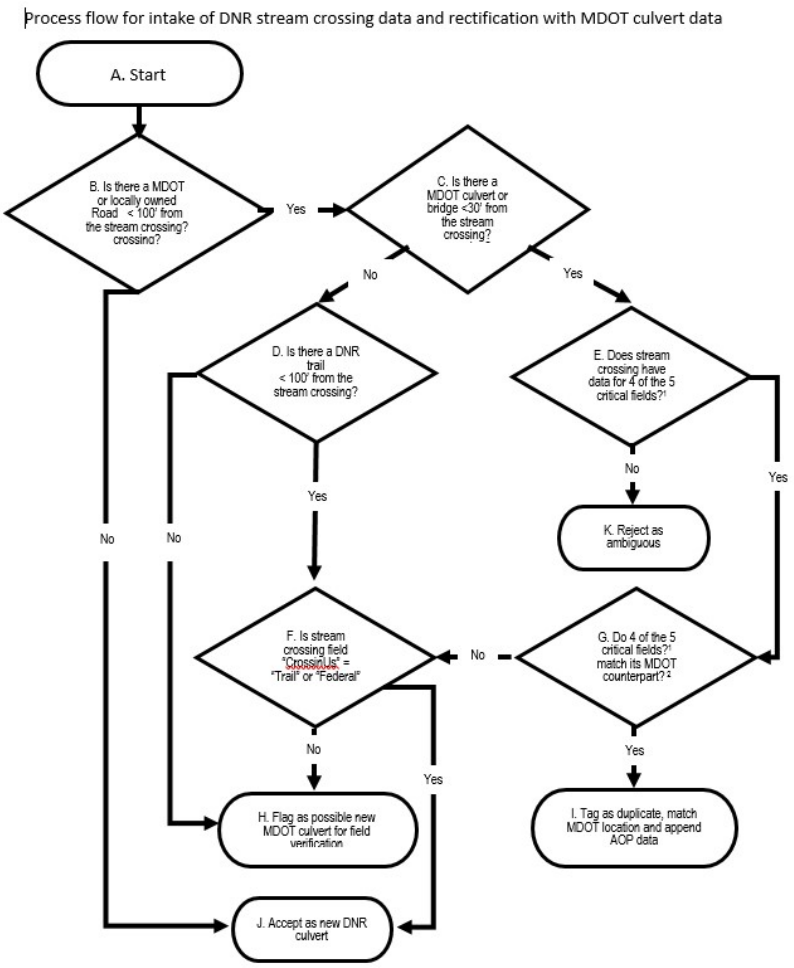
- Time (7 responses)
- People/funding (9 responses)
- The City has all resources needed such as survey/GPS equipment, measuring tape, camera, etc.
- Technology that would allow the data collection to be more efficient.
- I would like a handheld GPS data collector device. The windows tablet is too awkward for field use. Its just as well to use a laptop as the ergonomics of the tablet are not suitable for this activity, when doing solo work.
- GIS support
- Roadsoft, Laptop & GPS

- We have the equipment needed.
- The use of our smarter "summer kids" who where science-based degree seekers, was a good resource in 2018 and I would not hesitate to do that again. With Covid 19, we had a period where we wanted our construction assistants "out of the office" before construction season started. We gave them a tablet and told them "To hit the road" with culvert inspections. This has been successful to date.
- Challenging to do when vegetation gets too high in summer.
- Tape measure, 125' tape, something with a gps is extremely helpful, and a poker to test the bottom of the tubes to get a better idea on what on what to rate the culvert condition itself.
- It would be nice to know which ones are close to failure so maintenance crews can fix before failure.

- **Other feedback for TAMC related to culvert inventory and data collection:**

- Too much data was collected, which isn't needed. Decisions are based on follow up site visit, not based on some inventory years before.
- Work orders. Need a field originated work order process with customizable drop down choices for typical repairs associated with culverts.
- I am glad we are having this state-wide discussion on asset management. It is just the right thing to do fiscally.
- Rating on the condition of the culvert is more important then waterway, channel rating. it should almost be the only rating in all honesty.
- For small culverts, just 1 rating for the culvert in a good fair poor is more than enough. If you want to rate the channel, not opposed, but nothing will happen until the culvert is replaced

Data Process Flowcharts



Step 1: Do Nearest Neighbor Join (NN Join)with DNR Stream Crossing GIS file and MDOT Roads (framework) as Target

Step 2: In joined layer from Step 1, select stream crossing based on join distance from MDOT roads, and save into two layers with join fields removed with the exception of join distance

Select join distance >100 (30.4 M) = Flow Chart Item J

Select join distance <100 (30.4M) = Flow Chart Item C

Step 3: Do NN Join with Flow Chart Item C and MDOT Culverts as target

Step 4: Do NN Join with result of Step 3 and MDOT Bridges as target

Step 5: Select stream crossings from Step 4 based on join distance from MDOT culver and MDOT bridge and save into two layers with join fields, keep all join fields

Select culver or bridge distance >100 (30.4 M) = Flow Chart Item D

Select culver and bridge distance <100 (30.4 M) = Flow Chart Item E

Step 6; Select stream crossings from Flow Chart Item E based on the presence of data in the critical stream crossing fields are: "StructureLength" "StructureShape" "StructueMaterial" and "StructureWidth" or "StructureHeight" and the related fields in the MDOT database

Select does not have data in all 4 fields = Flow Chart Item K

Select does have data in all 4 fields = Flow Chart Item G

Step 7: Do NN Join with Flow Chart Item D and DNR trail layer. May need to add a step to do NN Join with output of this step and USFS roads within national forest boundaries.

Step 8: Select stream crossings from Step 7 based on join distance from DNR trail layer and save into two layers with join fields removed with the exception of join distance

Select join distance >100 (30.4 M) = Flow Chart Item H

Select join distance <100 (30.4M) = Flow Chart Item F

Step 9: Create CSV from Flow Chart Item G stream crossings and check to see if 4 of 5 critical fields match, which is defined as within the following tolerances: StructureL is within 25% of MDOT length, StructureW is within 15% of MDOT width, StructureH is within 15% of MDOT height, StrucutreS matches MDOT shape (after transformed) StructureM matched MDOT material.

If >= 4 fields are in tolerances = Flow Chart Item J

If < 4 field are in tolerances = Flow Chart Item H

Step 10: Join records from Step 8 and Step 9 to create a single set representing Flow Chart Item F

Step 11: Select stream crossings from Step 10 based on "CrossingUse" field and save into two layers with all join fields

Select CrossingUse = Trail or Federal = Flow Chart Item J

Select CrossingUse not = Trail or Federal = Flow Chart Item H

Step 12: Join components of Flow Chart Item H into unified layer and Join components of Flow Chart Item J in unified layer

Results from test run:

Start (Flow Chart Item A and B)

MDOT Culverts = 47,699 records

DNR Stream Crossings = 2,230 records

Flow Chart Item C

130 Stream Crossings

Flow Chart Item D

79 Stream Crossings

Flow Chart Item E

51

Flow Chart Item F

44+10 = 54

Flow Chart Item G

28

Flow Chart Item H

35 +15=50

Flow Chart Item I

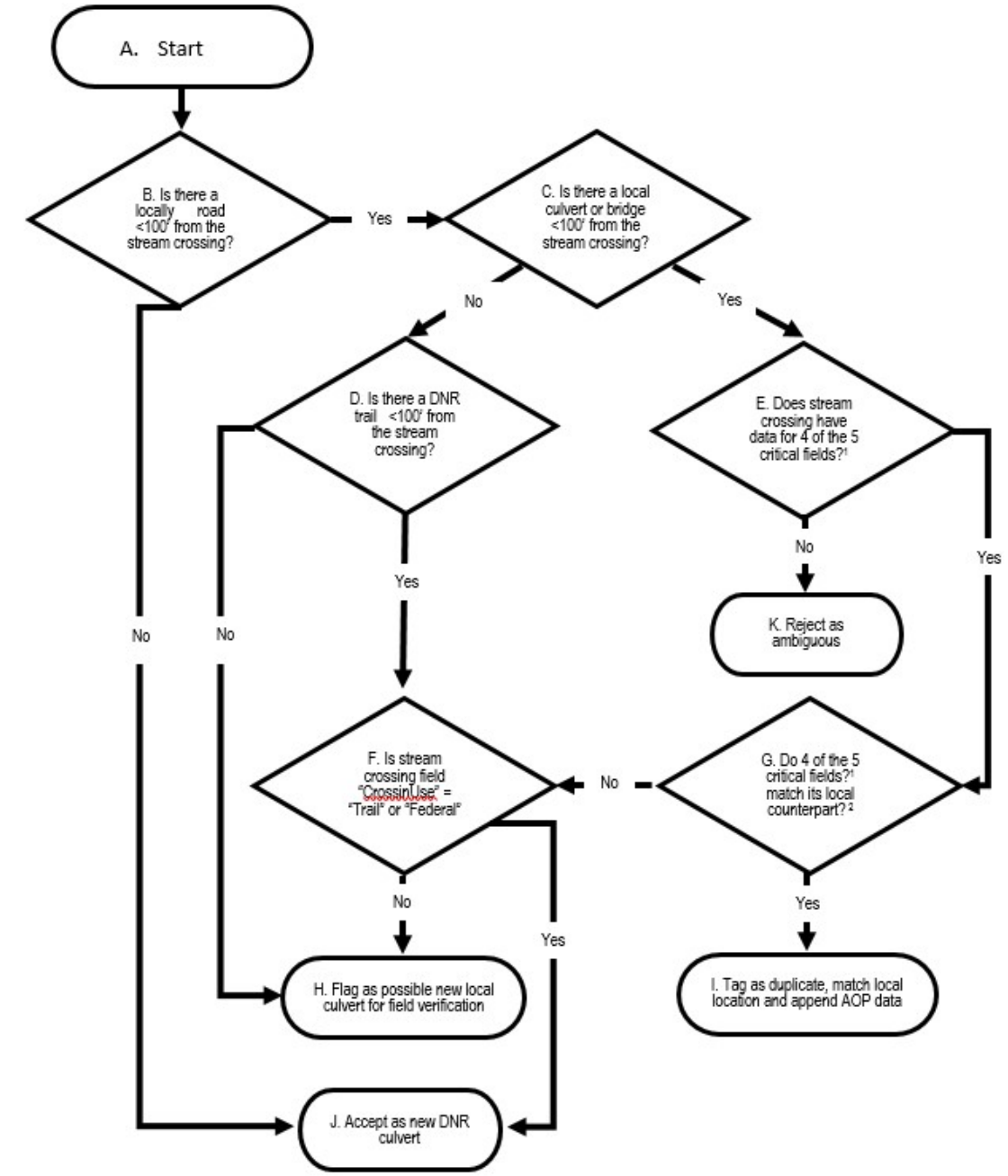
18

Flow Chart Item J

2100+39

Flow Chart Item K 23

Process flow for intake of DNR stream crossing data and rectification with Local Agency culvert data



[1]Critical stream crossing fields are: "StructureLength" "StructureWidth" "StructureHeight" "StructureShape" "StructueMaterial"

Step 1: Do Nearest Neighbor Join (NN Join) with DNR Stream Crossing GIS file and Local Roads (framework) as Target

Step 2: In joined layer from Step 1, select stream crossing based on join distance from local roads, and save into two layers with join fields removed with the exception of join distance

Select join distance >100 (30.4 M) = Flow Chart Item J

Select join distance <100 (30.4M) = Flow Chart Item C

Step 3: Do NN Join with Flow Chart Item C and Local Agency Culverts as target

Step 4: Do NN Join with result of Step 3 and Local Agency Bridges as target

Step 5: Select stream crossings from Step 4 based on join distance from Local Agency culver and MDOT bridge and save into two layers with join fields, keep all join fields

Select culver or bridge distance >100 (30.4 M) = Flow Chart Item D

Select culver and bridge distance <100 (30.4 M) = Flow Chart Item E

Step 6: Select stream crossings from Flow Chart Item E based on the presence of data in the critical stream crossing fields are: “StructureLength” “StructureShape” “StructueMaterial” and “StructureWidth” or “StructureHeight” and the related fields in the local database

Select does not have data in all 4 fields = Flow Chart Item K

Select does have data in all 4 fields = Flow Chart Item G

Step 7: Do NN Join with Flow Chart Item D and DNR trail layer. May need to add a step to do NN Join with output of this step and USFS roads within national forest boundaries.

Step 8: Select stream crossings from Step 7 based on join distance from DNR trail layer and save into two layers with join fields removed with the exception of join distance

Select join distance >100 (30.4 M) = Flow Chart Item H

Select join distance <100 (30.4M) = Flow Chart Item F

Step 9: Create CSV from Flow Chart Item G stream crossings and check to see if 4 of 5 critical fields match, which is defined as within the following tolerances: StructureLength is within 25% of Local length, StructureWidth is within 15% of Local width (unit conversions needed), StructureHeight is within 15% of Local height (unit conversions sometime needed), StrucutreShape matches Local shape (after transformed) StructureMaterial matched Local material. Note: Materials and shapes will need to be transformed to the lowest common denominator, for example: “precast concrete pipe”, “Reinforced concrete pipe” would be transformed to “concrete”; for pipe shape “Box”, “Square open bottom” and “Rectangle” would be transformed to “Rectangle”

If >= 4 fields are in tolerances = Flow Chart Item I

If < 4 field are in tolerances = Flow Chart Item F

Step 10: Join records from Step 8 and Step 9 to create a single set representing Flow Chart Item F

Step 11: Select stream crossings from Step 10 based on “CrossingUse” field and save into two layers with all join fields

Select CrossingUse = Trail or Federal = Flow Chart Item J

Select CrossingUse not = Trail or Federal = Flow Chart Item H

Step 12: Join components of Flow Chart Item H into unified layer, then join components of Flow Chart Item J in unified layer

Results from test run:

Start (Flow Chart Item A and B)

Local Culverts = XXXXX records

DNR Stream Crossings = 4,460 records

Flow Chart Item C

401 DNR Stream Crossings

Flow Chart Item D

258 DNR Stream Crossings

Flow Chart Item E

143 DNR Stream Crossings

Flow Chart Item F

1681 (117+54) DNR Stream Crossings

Flow Chart Item G

76 DNR Stream Crossings

Flow Chart Item H

275 (141+83+51) DNR Stream Crossings

Flow Chart Item I

25 DNR Stream Crossings

Flow Chart Item J

4093 (4059+34) DNR Stream Crossings

Flow Chart Item K

67 DNR Stream Crossings

Michigan Transportation Asset Management Council

Memo

To: TAMC Bridge Committee Members

From: Roger Belknap, TAMC Coordinator

Date: August 21, 2020

Re: TAMC Strategic Planning Session 2020 – UPDATE

Recommendation

A date for the TAMC Strategic Session has been set for September 9, 2020. The meeting will begin at 9 AM and will be held remotely using the Microsoft Teams platform, as we are using with committee meetings. All Bridge Committee members are welcome to attend.

Attachments

Attachment 4 is a draft status update of the 2020-2022 Work Program Goals and Objectives for the TAMC Bridge Committee. If the Bridge Committee is satisfied with these as written, the document will be included with the other committee goals and objectives in the Strategic Session meeting agenda packet.

DRAFT

2020-2022 TAMC Strategic Work Program: Status of Bridge Committee Priorities

7/16/2020

Status color key: Red= No progress/Future Work Yellow= Ongoing Task Green= Completed Task

Goal 1: Ensure TAMC's transportation asset management plan template, policies and training programs are appropriate and optimized for ongoing support of TAMC's bridge data collection and reporting requirements; ensure these programs and policies are well-communicated among partnering agencies and participants.

Objectives

1. Continue review and update of TAMC Policy for the Collection of Bridge Condition Data to accommodate technological updates and in response to changing trends in technology or changes in Federal and State industry reporting standards.

Ongoing; Policy updated 9-6-17

2. Work with TAMC to ensure TAMC Dashboards and Interactive Map applications are compatible with data structure and reporting standards of the Michigan Bridge Inventory System.

Ongoing; preparations of 2019 Michigan Roads and Bridges Annual Report includes ensuring dashboard structure matches reporting formats.

3. Compare and analyze bridge condition data and TAMC Investment Reporting Tool data for planned bridge project data; incorporate TAMC Investment Reporting Tool data into Michigan Department of Transportation's Bridge Forecasting System.

No progress identified at present time

4. Review potential for bridge cost information to be included in the Act 51 Distribution and Reporting System and other applications.

No progress identified at present time

5. Continue to review submitted transportation asset management plans and TAMC asset management plan template for consistency with Federal and State industry standards and findings from previous transportation asset management plan submittals.

No progress identified at present time; very early in the schedule for plan submittals

Goal 2: Continue progress of roadway culvert asset management integration building upon lessons learned from 2018 TAMC Local Agency Culvert Inventory Pilot project as well as culvert data collection efforts performed by Michigan Department of Transportation, other transportation agencies and other stakeholder organizations including Water Asset Management Council, Michigan Department of Environment, Great Lakes and Energy and Michigan Department of Natural Resources.

Objectives

2020-2022 TAMC Strategic Work Program:
Status of Bridge Committee Priorities

Status color key: Red= No progress/Future Work Yellow= Ongoing Task Green= Completed Task

1. Develop data governance and standards for roadway culverts.

Status: Forthcoming following the completion of culvert data migration attempts across jurisdictions; TAMC Bridge Committee to identify key attributes and data format for development of these directives; Survey instrument for obtaining feedback from 2018 participants has been sent out; TAMC Bridge Committee engagement with Center for Shared Solutions and Framework platform for data management has begun; Engagement with other data providers also underway for policy considerations and data modeling.

2. Develop culvert performance metrics for local agency reporting and integration into asset management plans and TAMC technological reporting.

Status: Forthcoming following the completion of culvert data migration attempts across jurisdictions; TAMC Bridge Committee to identify key attributes and data format for development of these directives

3. Establish TAMC Policy for the Collection of Culvert Condition Data to provide guidance and directives for ongoing culvert inventory updates, condition assessment, and data integration procedures.

Status: Forthcoming following the completion of culvert data migration attempts across jurisdictions; TAMC Bridge Committee to identify key attributes and data format for development of these directives

4. Provide tools and training for the ongoing collection of roadway culvert inventory and condition assessment.

Ongoing; CTT has scheduled 5 culvert-related training events for 2020

5. Incorporate culvert inventory and condition data into TAMC Dashboards and Interactive Map applications.

Ongoing; CSS has been provided with the attributes needed for the creation of the culvert dashboards

6. Review other agency's culvert information which can be incorporated into inventory for reduction in duplication of effort among Michigan Department of Environment, Great Lakes and Energy and Michigan Department of Natural Resources and Drain Commissioners, etc.

Ongoing; CTT is in the process of developing external parters to explore data gathering and usage techniques, document case studies on value and procedures of data sharing, and reporting this for future application; some of these examples were to be included in the TAMC Conference program for 2020