Upper Valley Lake Sunapee Regional Planning Commission

Memorandum

TO: Town of Orford Conservation Commission
FROM: Meghan Butts, GIS Senior Analyst / Transportation Planner
Olivia Uyizeye, GIS Analyst / Assistant Planner
DATE: January 21, 2020
RE: **Town of Orford Culvert Inventory Condition Report**

The attached documents contain the results of a Culvert Inventory project completed between May and November 2019. Culverts on Town roads were assessed using Statewide Asset Data Exchange Systems (SADES) field data collection methodology, data processing and software established in partnership with the UNH Technology Transfer Center (T2), NH Department of Environmental Services (DES), NH Department of Transportation (DOT), NH Fish and Game Department, NH Division of Homeland Security and Emergency Management and the Association of NH Regional Planning Commissions. Drainage structures used the Culvert and Closed Drainage System (CCDS) protocol while structures for streams, wetland and ponds used the Stream Crossing System (SCS) protocol. The 2019 culvert team located and assessed 348 culverts, including 303 drainage, 34 streams, 10 wetlands and 1 pond.

Data Collection

The data collection was completed by driving to each culvert and collecting data based on criteria in the CCDS or SCS field manual. Data was collected using a variety of tools and equipment including a measuring tape, measuring rod, an abney level, waders, boots, and an iPad with ArcGIS Collector App. The criteria for drainage culverts primarily consisted of structural categories to assess the pipe condition, including headwall conditions and sediment buildup. Stream culverts required additional data including: culvert and road elevations, bankfull widths, water depth, wildlife, and erosion and aggradation severity.

Conditions

The overall condition of the culvert and related performance is assessed using a rank-based score tailored for either CCDS or SCS collected variables.

For CCDS scoring, each piece of infrastructure (inlet, outlet, pipe, or drainage structure) was given a score based on its attributes - 'CONDITION' and 'NEEDS MAINTENANCE'. Each assessment was given the following points: CONDITION – Good (0), Fair (1), Poor (2) and 'NEEDS MAINTENANCE' – Yes (1), No (0). This provided a score between 0 and 3 for each piece of infrastructure. These scores were then added together for a maximum of 9 points (very poor) to a minimum of 0 points (excellent). These 'Master' scores can assist in prioritization. See Table 1 for an example. For overall drainage location Master score, the condition was ranked by the method in Table 2.

Table 1. Example: Drainage Location 116 on Strawberry Hill Road

Drainage Structure	**Attribute**	**Assessment**	**Score**
Inlet	Condition	Good	0
	Needs Maintenance	No	0
Pipe	Condition	Poor	2
	Needs Maintenance	Yes	1
Outlet	Condition	Poor	2
	Needs Maintenance	Yes	1
Total Score			**6**

Table 2. Overall Master Score

Master Score	**Overall Condition**
Good	0-3
Fair	4-6
Poor	7-9
*	Needs further assessment by Town

For SCS culverts, the rank score considers seven variables: Structure Clogged, Condition of Pipe, Upstream Condition of Headwall, Downstream Condition of Headwall, Upstream Scour Undermining Structure, Downstream Scour Undermining Structure, and Undersizing of the Structure. These variables were chosen because they best assess the maintenance needs of the culverts. As different variables are collected for different structures, each group of variables (referred to as category) is given a different level of influence on the final rating depending on the structure type, described in Table 3. The categories and sub-scores applied for each variable can be seen in Table 4. The final rating is on a scale of zero to one and given a rating category of Good (0.8 to 1.0), Fair (0.6 to <0.8), Poor (0.5 to <0.6) or Very Poor (<0.5). A lower score means a likely higher priority for maintenance. Those with a Fair rating will likely function for a handful or more years, but require monitoring. Those with a Poor rating require attention within the upcoming season. Those with a Very Poor rating likely need immediate attention.

Table 3. The contribution of variables, grouped into four categories, towards the final rating depending on Upstream water body type and presence of headwall structures.

			Category Contribution (%)			
		# of Headwalls	#1	#2	#3	#4
Structure Type	Drainage	None	100			
		One	80	20		
		Two	60	40		
	Wetland	None	70		30	
		One	50	20	30	
		Two	40	30	30	
	Stream	None	50		30	20
		One	40	15	30	15
		Two	40	30	20	10

Table 4. Variables, grouped into categories, each have range of conditions from the field. These conditions are are given sub-scores that combine with other variables from that category to give a total score for each category.

	Variable	Sub-Score	Variable	Sub-Score
Category 1	Structure Clogged with Sediment • Open • ¼ full • ½ full • ¾ full • entirely full	• 4 • 3 • 2 • 1 • 0	Condition of Structure • Good • Fair • Poor	• 4 • 2 • 0
Category 2	Condition of Headwall (US) • Good • Fair • Poor • NA	• 4 • 2 • 0 • -	Condition of Headwall (DS) • Good • Fair • Poor • NA	• 4 • 2 • 0 • -
Category 3	Scour Undermining Structure (US) • None • Footers • Wing wall • Footers and wing wall • Culvert • Culvert and footers • Culvert and wing wall • Culvert, footers and wing wall • Unknown	• 4 • 3 • 3 • 2 • 2 • 1 • 1 • 0 • -	Scour Undermining Structure (DS) • None • Footers • Wing wall • Footers and wing wall • Culvert • Culvert and footers • Culvert and wing wall • Culvert, footers and wing wall • Unknown	• 4 • 3 • 3 • 2 • 2 • 1 • 1 • 0 • -
Category 4	Undersized Culvert: (Culvert Width ÷ Average Channel Bankfulls) x 100% • Beyond Bankfulls, ≥115% • About the Same, <115% to ≥85% • Slightly Undersized, <85% to ≥55% • Moderately Undersized, <55% to ≥30% • Highly Undersized, <30% • NA	• 4 • 3 • 2 • 1 • 0 • -		

Results

The overall pipe conditions of the culverts were ranked highly. Many newer culverts have plastic piping, which eliminates corrosion and lowers deformation of the pipe. The total number and percentage of drainage locations in each assessment category can be found in Table 5. Similarly, the summary results for structures on streams, wetlands or ponds can be seen in Table 6. Overall the lower scores on drainage culverts were because of sediment buildup (particularly on dirt roads), headwall damage and/or pipe deterioration. On stream, wetland and pond culverts, lower scores were greatly impacted by structure/headwall conditions and, for streams, the undersizing pipes, constricting the natural bankfulls of the system.

Table 5. Summary Results for all Drainage Locations

Assessment Category	**Total Drainage Locations**	**Percentage of Drainage Locations**
Good	218	72%
Fair	58	19%
Poor	12	4%
*Need further assessment	15	5%

Table 6. Summary Results for all Stream, Wetland or Pond Locations

Rating		**# of Culverts**	**% of Culverts**
Good	0.8 to 1.0	19	43%
Fair	0.6 to <0.8	20	45%
Poor	<0.6	5	10%
Insufficient Data		1	2%

Note: It is important to consider seasonal differences in amount of rainfall, sediment and debris that can affect the amount and velocity of stormwater reaching and passing through a culvert. The winter and spring, when there is snowmelt and heavier rainfall, could present different results than drier times like the summer and fall. In contrast, the fall, when there is an abundance of leaf litter, could present its own challenge.

Tabular Report, Maps and Raw Data

The two tabular reports contain all variables contributing to their respective condition rating, location details and additional structure information. A series of maps in a mapbook show the location, condition rating and Town ID of each culvert. The tabular report and mapbook have been created to function in both the field and in meetings. In addition, there is a poster map depicting the location, condition rating and Town ID of each assessed culverts in Orford. This poster has been created for display and group discussions.

The raw data from the assessment has been provided to the Town of Orford. This includes all culvert assessment data, photos, and map packages of the mapbook and poster documents.