APPENDIX 9-A

CANAL IMPROVEMENT ASSESSMENT METHODOLOGY

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CANAL IMPROVEMENT ASSESSMENT METHODOLOGY

Organization of the canal condition and capacity data was done by developing a Microsoft Access Database in conjunction with GIS database. These two software packages allow data to be easily stored and manipulated as well as easily viewed. This approach also integrates several sources of information into a single compatible format. The following describes how the databases were organized in addition to the variables used in the analysis. Several examples and figures are used to aid in explanations

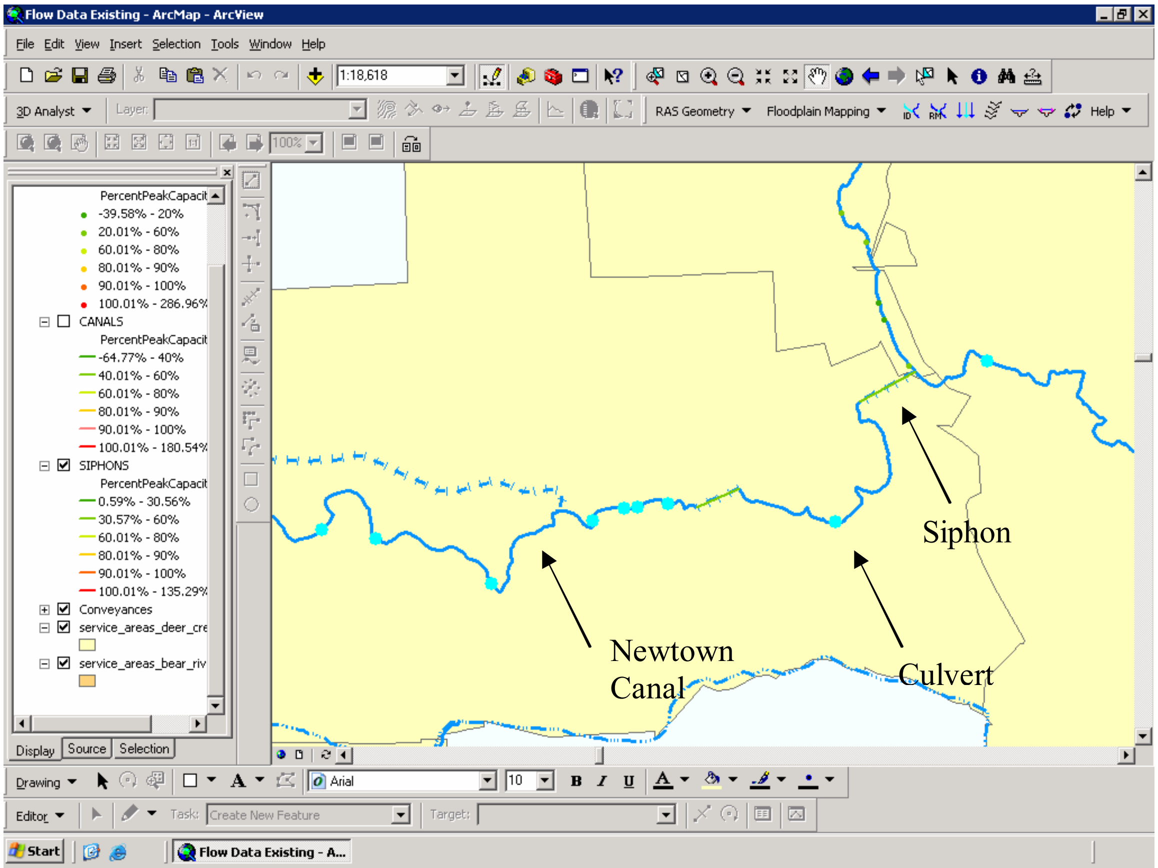
The conveyance structure condition and capacity databases relate the demand analysis (Section 5) to the canal conveyance infrastructure assessment (Section 7). The database system was used to compare the computed canal flows (as displayed on the Flow Schematics) to the limits of flow within the respective canal segments. The projected flow data, which was developed in five year increments, was linked to the GIS database allowing annual flow data to be viewed and queried. The result of this analysis was a listing of all measured reaches with recommended improvements based on the increase in flow demand over time.

The infrastructure assessment used the best available information in regards to the existing conveyance system condition and maximum capacities in conjunction with projected 2027 demands. The databases are intended to be used for planning purposes and general analysis, and not as a definitive engineering guide. Field conditions, alternative routings and variations in growth patterns can and will change in the future. Any listed improvements should be evaluated on an individual basis.

1.0 DATABASE QUERIES

Queries can be made for several different parameters with respect to specific canal segments, level of flows, associated projected flows and specific infrastructure items. As an example on the Newtown canal, the operator could query the database for: *All culverts on the Newtown System greater than or equal to 18 inches in diameter currently* *flowing more than 5 cfs.* This query would produce the following map selection and associated table:

Figure 9-1. Example GIS Query Map



This figure shows a portion of the Newtown canal near the Lester canal flowing north. The highlighted circles (light blue) are locations of culverts that are greater than 18 inches in diameter and are flowing more than 5 cfs. The dashed lines along the canal display locations of siphons whereas the solid line is open canal. In the GIS interface, individual culvert, siphon or canal segment can be queried for any additional information associated with that object.

Every culvert, measured reach and siphon has an independent maximum flow value. This maximum allowable flow is directly tied into the flow demand analysis in five year increments through 2027. Queries were performed for each five year increment to determine what conveyance structures exceed the 90 percent threshold level during a specific time period. Figure 9-2 displays partial results of the sample query showing a listing of all variables associated with each culvert. Similar tables can be developed for canals, siphons or culverts

Figure 9-2. Example GIS Query Table

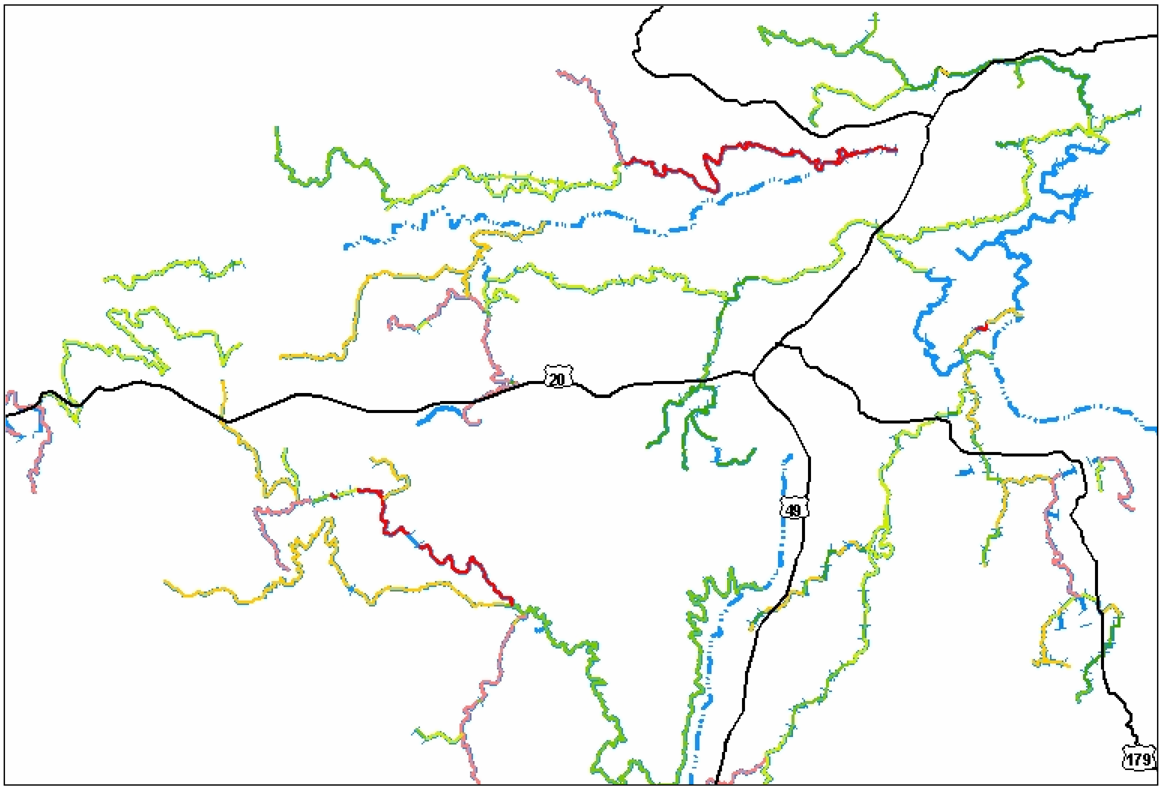
Selected Attributes of CULVERTS

CanalName	Culvert_ID	MaxFlow	PeakExisting	Peak2007	Peak2012	Peak2017	Peak2022
Newtown	NEWT03_01	14.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_16	26.1	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_15	14.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_14	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_13	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_12	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_11	14.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_10	14.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_09	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_08	91.3	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_07	91.3	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_06	91.3	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_05	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_04	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_03	42.4	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT03_02	26.1	11.0	12.0	12.8	14.0	15.3
Newtown	NEWT01_10	6.7	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_09	42.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_08	42.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_07	42.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_06	42.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_05	14.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_04	14.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_03	14.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_02	14.4	15.3	16.4	17.4	18.7	20.2
Newtown	NEWT01_01	42.4	15.3	16.4	17.4	18.7	20.2

Record: 9 Show: All Selected Records (26 out of 924 Selected.) Options

Figure 9-3 displays canal segments throughout Deer Creek which have been color coded dependent on the percentage of maximum allowable flow. This image easily displays which canal segments are considered to be flowing near maximum capacity.

Figure 9-3. Canal Measured Reach Capacities



Note: Dark Green – Sufficient Capacity, Red – Near or Above Capacity

Queries with results similar to those shown above were used to develop tables used in cost estimates and timelines. Improvements were detailed for canals, siphons and culverts from 2007 through to 2027.

2.0 DATABASE APPLICATIONS

The GIS database is intended to be used for planning purposes to quickly determine and organize proposed capital improvement expenditures to the year 2027. Using the model will help to easily locate 'hot-spots' and determine when they will become a priority as the model is directly linked to the flow demand analysis. In addition, the model can be updated and easily viewed when new information on the canal systems becomes available. Should a siphon or a canal segment be replaced or improved, the maximum capacity of the specific component can be adjusted and the model will automatically show a new value. Queries can be made to locate culverts, siphons or canals that are flowing above a certain rate or above a certain percent of maximum capacity. As the District continues to develop, culverts or other features can easily be added to the model for continued analysis.

There are some important limitations with the flow analysis in the GIS model. One of the more important points to note is the way canals model flows in this model. Flows are assigned on a measured reach as displayed in the Flow Schematics. This means that a single flow value is assigned to a length of canal, even though services may be receiving water along its length, thus reducing the actual flow near the end of the measured reach. Structures near the end of canals should be evaluated closely to determine if the stated level of flow from the model is likely to be passing through that specific component.

This also directly ties into the percentage of maximum flow that a canal may be flowing at. Each culvert, canal and siphon has a maximum allowable flow value. Canals may be limited to a certain flow because of one small area of low freeboard or insufficient capacity, but the entire measured reach is shown to be an issue in need of replacement. As the system grows and is updated, these values should be changed to reflect more current field conditions. Similarly, the unit costs for culverts, or the per foot costs for canals and siphons, would be updated. As the updated data is entered into the model, updated expenditure plans can quickly be developed. These costs, assumptions, and output should be evaluated closely. Each structure should be evaluated and designed individually.