**REVISED PER RCWD STAFF COMMENTS** 



	EMO
(External	Correspondence)
Date:	March 7, 2013
To:	Phil Belfiori
Cc:	Tom Schmidt Nick Tomczik

From: Chris Otterness, P.E. Nancy Stowe, P.E.

Through: Mark Deutschman, P.E.

Subject: ARJD 1, Branch 5 Preliminary Culvert Sizing

#### Introduction

In January 2013, the City of Mounds View applied for a District permit to construct street and utility repairs between U.S. Hwy. 10 and County Road 10 (RCWD Permit #13-003). The proposed project includes mill and overlay of two roadways that cross Anoka Ramsey Judicial Ditch 1 (ARJD 1) Branch 5 (Hillview Road and the Greenfield Park access road) and one roadway that crosses the Main Trunk of ARJD 1 (Lois Drive). A cursory review of historical public drainage system records and the District Wide Model indicated that the existing culvert at Lois Drive is at an elevation equal to the "Official Profile" determined by the previous District Engineer in 2005, and is sufficiently sized to convey flood flows. However, the culverts under Hillview Road and the Greenfield Park road in their current condition appeared to be inadequate for flood flow conveyance and possibly higher than the As-Constructed and Subsequently Improved Condition.







The Rice Creek Watershed District Board of Managers authorized HEI in January 2013 to begin preparation of a historical review memorandum of the ARJD 1 public drainage system, including a determination of the As-Constructed and Subsequently Improved Condition. Because it is the interest of both the City of Mounds View and the District to correct inadequacies in the public drainage system while the streets are under construction, the District requested HEI to conduct a accelerated preliminary review of the capacity and function of the ARJD 1 Branch 5 culverts under Hillview Road and the Greenfield Park road and recommend an elevation and size for each culvert to convey flood flows.

#### Existing Conditions<sup>1</sup>

<u>Greenfield Park Access Road:</u> The culvert under the Greenfield Park road consists of a 24" reinforced concrete pipe (RCP), with an 18" corrugated metal pipe (CMP) slipped inside the inlet end and a 12" high-density polyethylene pipe (HDPE) slipped inside the outlet end. It is unknown when the RCP was originally constructed, but a 1986 Mounds View repair plan for ARJD 1 shows the RCP as an existing pipe, at an elevation of 896.42 upstream and 896.33 downstream. Sometime prior to 1994, the CMP and HDPE were added to each end of the pipe (presumably grouted in-place). The current invert elevations of the pipes are 897.03 (upstream) and 897.33 (downstream).

<u>Hillview Road</u>: Hillview Road is less than 100 feet upstream (south) of the Greenfield Park road. There are two side-by-side 24" RCP culverts that convey flow for ARJD 1 under Hillview Road. The lower of these culverts, constructed prior to 1986, is at an elevation of 896.22 (upstream) and 896.07 (downstream), and is at least 80% blocked with sediment. The upper culvert, which was constructed sometime between 1994 and 2005, has invert elevations of 900.42 (upstream) and 898.31 (downstream). A plan and profile of Branch 5 prepared by the Emmons and Olivier Resources (EOR) in 2006 describes the lower culvert as "damaged."

<u>ARJD 1 Upstream Channel and Pond</u>: Upstream of Hillview Road, the ARJD 1 open channel continues south approximately 300 feet, ending at a 36" CMP culvert (with inverts of 897.70 upstream and 897.61 downstream) which serves as the outlet for an open-water wetland complex. (Note: This wetland is not listed in the MnDNR Public Waters Inventory.) This open water complex, which is nearly entirely within a parcel owned by the state of Minnesota, abuts the backyards of residences along Hillview Road and Edgewood Court. Previous modeling indicates the elevation of the 100-year critical duration flood event (10-day snowmelt) to be at an elevation of 904.1. The flooding at this elevation could potentially inundate several homes adjacent to the wetland complex (see **Figure 1**). Because the flood elevation results directly

<sup>&</sup>lt;sup>1</sup> Note: All elevations provided herein have been converted to NAVD 88 vertical datum, unless otherwise noted.





from the hydrologic conditions at Hillview Road and the Greenfield Park road, improving the capacity of these roadway crossings may decrease the risk of flooding in these structures.

#### Historic Condition

When ARJD 1 was established in 1917, the Engineer's Report included a profile of the system, including Branch 5, using an assumed (non-sea level) datum. An inspection report completed for the District in 1994 attempted to correlate this profile to a modern mean sea level datum using elevations from the historic profile and comparing them to existing ground elevations. A subsequent official profile determination completed for the District in 2006 concluded that the 1994 profile determination was in error, and a revised historic profile determination was provided for the Main Trunk and Branch 2 of ARJD 1, but not for Branch 5. Therefore, a conclusive determination of the As-Constructed and Subsequently Improved Condition of Branch 5 has not been completed to date (this analysis will be completed this spring as part of a comprehensive ARJD Historic Review).

The last known repair to be completed on Branch 5 was designed and constructed in 1986 by the City of Mounds View. This repair included excavation of the open channel of Branch 5, using the existing culvert elevations (including the lower culvert currently under Hillview Road) to set the profile of the excavation.

The Wetland Conservation Act (WCA) exempts impacts resulting from repairs to public drainage systems when the drained wetlands have not existed for more than 25 years. It can be concluded that the condition of the public drainage system 25 years ago (in 1988) was similar to the condition at the time of the repair in 1986, and therefore any impacts resulting from repairs to Branch 5 completed to the profile of the 1986 repair project will be exempt from WCA.

#### Analysis

The model of the existing conditions within ARJD 1 was modified to simulate a repaired condition in Branch 5 at Hillview Road and the Greenfield Park road, using three scenarios with culverts ranging from 24" to 36" in diameter. The peak elevations of the 100-year, 24-hour rainfall event and the 100-year, 10-day snowmelt event in the upstream wetland and at each end of the Hillview Road and Greenfield Park road culverts were determined for each scenario (see **Table 1**). The critical duration flood elevation for the upstream wetland was then used to map the floodplain under each scenario (see **Figure 1**).

As requested at a March 5 meeting with City and District staff, an additional scenario (Scenario 4) was analyzed, assuming the two 24" culverts crossing Hillview Road remain in place, and the lower culvert is cleaned out (and maintained). Under this scenario, in order for the lower culvert at elevation 896.22 to function at full capacity, the Greenfield Park Road culvert would be replaced with a 36"





culvert at elevation 896.0, and the sediment within the open channel of Branch 5 be removed to a profile matching the pipe invert elevations (i.e. the 1986 repair profile). This scenario could only be considered after field investigations showing that the culverts are in good condition and do not need to be replaced, and that cleaning the lower pipe without damaging it is practicable. However, given the age of the pipe, the description of the condition of the pipe by EOR, and the extents of the clogging in the pipe, it is unlikely that this alternative is feasible.

The results indicate that flood elevation and flood extent decrease substantially from existing conditions by restoring the culverts and open channels to 1986 conditions (i.e. Scenario 1: a functioning 24" culvert under both Hillview Road and the Greenfield Park road). Scenario 2 (increasing the culvert sizes to 30") and Scenario 4 (existing Hillview culverts and a 36" Greenfield Park road culvert) further decrease the flood elevation. However, replacing the culverts with larger 36" pipes (Scenario 3) will result in a more substantial decrease in the elevation difference (head loss) across both Hillview Road and the Greenfield Park road. This decrease in head loss will coincide with a decrease in velocities, scour, and downstream erosion. The larger open area of the 36" culverts will decrease the likelihood of clogging which is currently problematic in the existing 24" culvert.

#### Recommendation

The City of Mounds View's 2013 Street Improvement Project is an opportune time for the District to consider repairing deteriorating components of ARJD 1 Branch 5 because of the pending City project. To decrease flood elevations in the upstream wetland and improve the long-term sustainability of the public drainage system, we recommend replacement of the two 24" RCP culverts under Hillview Road with a single 36" reinforced concrete pipe, with invert elevations of 896.22 upstream and 896.07 downstream. We recommend replacement of the existing culvert under the Greenfield Park road with a single 36" culvert, with invert elevations of 896.0 upstream and 895.8 downstream.

Replacement with 36" culverts will provide the greatest reduction in flooding risk to upstream properties of any of the scenarios analyzed, and will result in the least amount of future maintenance due to clogging, scour, or erosion. We do not recommend further investigation of the feasibility of Scenario 4 (utilizing the existing culverts in Hillview Road) since the investigation will require substantial work (excavation of the adjacent channel, jetting of the culvert, and televising the culvert), the scenario does not decrease the future likelihood of clogging, and the feasibility of re-using the existing culvert is very unlikely.

We further recommend that sediment within the open channel of Branch 5 be removed to a profile matching the pipe invert elevations within Branch 5 (i.e. the 1986 repair profile), prior to or immediately after the installation of the new culverts. This work is critical for minimizing the deposition of sediment in the new culverts. It is estimated that sediment removal would be necessary





for approximately 300 feet downstream of Greenfield Park Road, as well as approximately 80 feet between Hillview Road and the Greenfield Park Road and 500 feet upstream (or south) of Hillview Road.

The work described above is not considered an improvement to the public drainage system. It is unlikely that the work will result in any wetland impacts. However, any wetland impacts that would result as part of the project would be considered exempt under WCA.

#### Cost of Recommended Work

We estimate that the cost of restoring drainage function by replacing the culverts under Hillview Road and the Greenfield Park Road with 24" RCP culverts is approximately \$13,000. (Note – the City's Construction Plans currently include replacement of only the Greenfield Park Road culvert, with a 24" diameter RCP). The <u>additional</u> cost of upgrading the culverts to 36" RCP culverts is approximately \$8,500. An additional \$5,500 of work will be required to excavate the ARJD 1 open channel and haul the spoil material adjacent to Greenfield Park offsite.



## Rice Creek Watershed District ARJD1 Historic Review Memo

Greenfield Park

Culverts

### **100 Year Critical Event Floodplain**



Existing Conditions



36" Culverts at Hillview Rd and Park Rd.

30" Culverts at Hillview Rd and Park Rd.

24" Culverts at Hillview Rd and Park Rd.



0	125	250	500
			⊢eet

Source: TLG Imagery: 2012 Twin Cities NGA

Figure 1: Critical Duration Flood Extents											
Scale: AS SHOWN	Drawn by: SMW	Checked by:	Proje 135	ct No.: 5555-202	Date: 2/21/2013	Sheet: 1 of 1					
		louston		Мар							
		ingineering Ind	C.	P: 763.493.4522 F: 763.493.5572							

# TABLE 1Existing and Proposed Modeling ResultsAnoka / Ramsey Judicial Ditch 1, Branch 5

Existing and Proposed 100-Year Peak Elevation in Wetland Upstream of Hillview Road

			Critical
Node	24-Hr	10-Day	Duration
Existing Culverts	902.78	904.01*	10-day
Scenario 1: 24" culverts	902.48	902.55	10-day
Scenario 2: 30" culverts	902.26	902.22	24-hr
Scenario 3: 36" culverts	902.14	902.02	24-hr
Scenario 4: **	902.27	902.20	24-hr

Existing and Proposed Modeling Results for Hillview Road, Park Road, and Berm at Outlet of Wetland - 100-Year, 24-Hour Rainfall

	Existing*			Scenario 1: 24" Culverts			Scenario 2: 30" Culverts			Scenario 3: 36" Culverts				Scenario 4: **						
	Peak Elevation H		Head	Velocity	Peak Elevation		Head	Velocity	locity Peak Elevation		Head	Velocity	Peak Elevation		Head	Velocity	Peak Elevation		Head	Velocity
Road	U/S	D/S	Loss (ft)	(ft/s)	U/S	D/S	Loss (ft)	(ft/s)	U/S	D/S	Loss (ft)	(ft/s)	U/S	D/S	Loss (ft)	(ft/s)	U/S	D/S	Loss (ft)	(ft/s)
Hillview Road	902.61	902.32	0.29	4.6	902.28	901.10	1.18	6.9	901.72	900.89	0.83	6.6	901.21	900.70	0.51	5.9	901.54	900.69	0.85	7.1
Park Road	902.50	900.25	2.25	9.4	901.10	900.32	0.78	6.8	900.89	900.36	0.53	6.5	900.70	900.38	0.32	5.9	900.69	900.38	0.31	4.8
Berm, outlet of Wetland	902.78	902.61	0.17	4.3	902.48	902.29	0.19	4.5	902.26	901.74	0.52	4.7	902.14	901.26	0.88	6.0	902.27	901.58	0.69	4.8

\* Assumes lower culvet under Hillview Road is 100% blocked

\*\* Additional Scenario represents the Existing 2-24" culverts at Hillview (900.42 and 896.22) remaining in place, with the lower culvert cleaned out. Plus 36" culvert at Park Road and removing sediment in ditch to a profile matching the pipe invert elevations, similar to other scenarios.