City of Round Rock

Stormwater Master Plan

Drainage Section
Volume 3

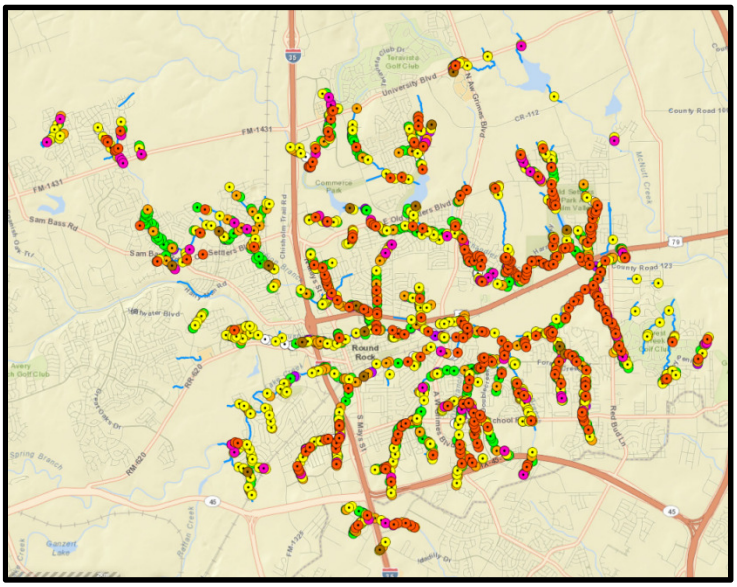
May 2014

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

HALFF
AVO: 29113

City of Round Rock
Storm Water Master Plan

Volume 3
Project Details



Prepared For:
City of Round Rock
Utilities & Environmental Services
Stormwater Management

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

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HALFF

Project Number: R-12-10-11-G11

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Appendix E: Project Details

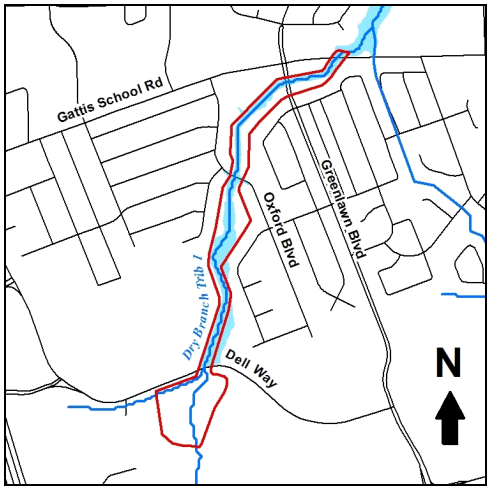
City of Round Rock Project List

Project ID	Project Name	Watershed	CoRR Stream Name	Project Type	Referenced Issues	Project Score	Cost
2013A	Gap Channel	Chandler Branch	Chandler Branch Trib 16C	Channelization			
2013B	Kensington Place - Green Slopes	Dry Branch	Dry Branch Tributary 1	Detention, Channelization, Culvert Modification	DB36, DB69, DB70	393	$750k-$1M
2013C	Sonoma at Brushy Creek	Brushy Creek	Brushy Creek Tributary 44	Channel Stabilization	BC51	266	$250k-750k
2013D	Forest Creek - Harvey Penick	Brushy Creek	Brushy Creek Tributary 48	Resistive Bank Stabilization	BC43	281	<$250k
2013E	Rock Hollow	Chandler Branch	Chandler Branch Tributary 16	Channelization	CB10	310	<$250k
2013F.0	Chisholm Valley	Lake Creek	Lake Creek Tributaries 1 & 2	Modeling - System	LC59-LC64	481	<$250k
2013F.1	Chisholm Valley East-West	Lake Creek	Lake Creek Tributary 2	Regional Detention	LC59, LC60, LC61	309	$1M-$2M
2013F.2	Chisholm Valley North-South	Lake Creek	Lake Creek Tributary 1	Channel Stabilization & Culvert Modification	LC62, LC63, LC64, LC80, LC81	463	$250k-750k
2013G	Old Settlers Blvd. at Dam 14 Trib	Chandler Branch	Chandler Branch Tributary 16	Conveyance	CB11	302	$250k-750k
2013H	Eagle Ridge - Lake Side	Chandler Branch	Chandler Branch Tributary 16	Channel Stabilization	CB19	311	<$250k
2013I.1	The Woods - Oak Hollow	Onion Branch	Onion Branch	Water Quality	OB29	238	<$250k
2013I.2	The Woods - Oak Hollow	Onion Branch	Onion Branch	Floodplain Reduction	OB29	321	$250k-750k
2013J	South Creek	Dry Branch	Dry Branch	Channel Stabilization	DB31	250	$750k-$1M
2013K	Lake Forest	Brushy Creek	Brushy Creek Tributary 44	Channel Stabilization	BC48	274	<$250k
2013L	Sonoma at Forest Creek Drive	Brushy Creek	Brushy Creek Tributary 44A	Channel Stabilization	BC49	261	<$250k
2013M	A.W. Grimes Blvd. at Brushy Creek	Brushy Creek	Brushy Creek	Bridge Scouring	BC54	284	<$250k
2013N	Brushy Slopes	Brushy Creek	Brushy Creek	Residential Flooding	BC56	395	<$250k
2013O	Greenlawn Blvd. at Gilleland Creek	Gilleland Creek	Gilleland Creek	Road Overtopping	GC83	377	<$250k
2013P	Round Rock West	Lake Creek	Lake Creek	Floodplain Reduction			
2013Q	Chisholm Trail at Brushy Creek	Brushy Creek	Brushy Creek	Structure Replacement	BC57	432	$750k-$1M
2013R	Burnet Street at Lake Creek	Lake Creek	Lake Creek	Structure Replacement	WCID		
2013S	Harrell Parkway at Chandler Branch Trib. 23	Chandler Branch	Chandler Branch Tributary 23	Structure Replacement	WCID		
2013T	Harrell Parkway at Chandler Branch	Chandler Branch	Chandler Branch	Structure Replacement	CB06	386	$250k-750k
2013X.1	Major Creek Modeling	Dry Branch	Dry Branch	Modeling - Detention	DB34	212	<$250k
2013X.2	Round Rock West Detention	Lake Creek	Lake Creek Tributary 12	Modeling - Detention	LC58	306	<$250k
2013X.3	Dry Branch Trib. 1 through Windy Park	Dry Branch	Dry Branch Tributary 1 T2	Modeling - Capacity	CoRR		
2013Y.1	Chisholm Trail at Brushy Creek	Brushy Creek	Brushy Creek	Automatic Gating		399	<$250k
2013Y.2	A.W. Grimes Blvd. at Brushy Creek	Brushy Creek	Brushy Creek	Automatic Gating		421	<$250k
2013Z.1	Summit Street at Brushy Creek	Brushy Creek	Brushy Creek	Gating		377	<$250k
2013Z.2	Burnet Street at Lake Creek	Lake Creek	Lake Creek	Gating		377	<$250k
2013Z.3	Park Lane at Lake Creek	Lake Creek	Lake Creek	Gating		377	<$250k
2013Z.4	Nash Street West at Lake Creek Trib 1	Lake Creek	Lake Creek Tributary 1	Gating		377	<$250k
2013Z.5	Harrell Parkway (S) at Chandler Branch	Chandler Branch	Chandler Branch	Gating		404	<$250k

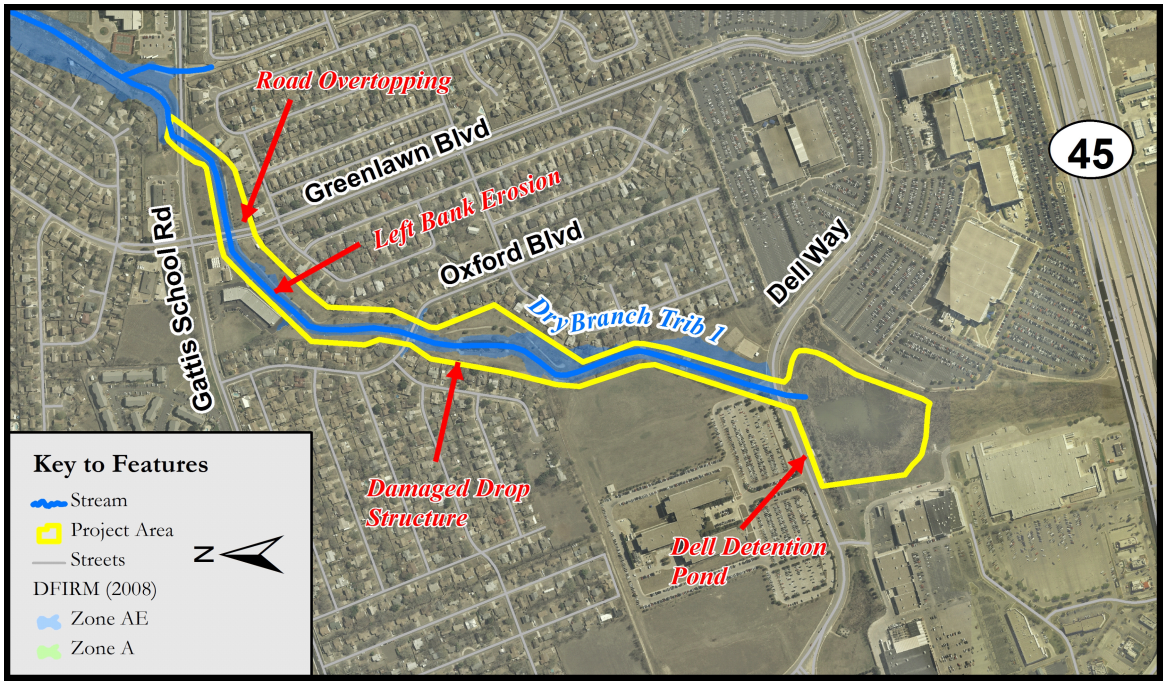
Project: 2013B - Kensington Place - Green Slopes

Dry Branch Tributary 1

Slope and sediment imbalance is causing deposition on the upstream section of Dry Branch Tributary 1 and scour on the downstream section. The concrete grade control structure upstream of Oxford Boulevard is undercut and has water flowing underneath the structure. The lower end of this structure is also cracked and slowly separating from the main body of the structure. Oxford Blvd. overtops 1.9' according to the Upper Brushy Creek WCID models which exceeds the 1' allowable criteria. Downstream of Oxford Blvd. to Greenlawn Blvd. there is scour on the left bank (looking downstream) and instability through the reach which could impact existing infrastructure on the left bank. Greenlawn Blvd. overtops at 0.6' which barely exceeds the 0.5' criteria. However, the overtopping contributes to the intersection flooding at the Gattis School Rd. and Greenlawn Blvd.



Reference Issues: DB36, DB69, DB70



Project: 2013B - Kensington Place - Green Slopes

Dry Branch Tributary 1

Solution

Additional storage at Dell Way Detention Basin could reduce the peak flow through Dry Branch Tributary 1. This increase in storage can come from either increasing the pond volume or decreasing the culvert size at Dell Way. If adequate detention is obtained the overtopping at Oxford Blvd. can be brought within the allowable limit of 1 ft and the overflow into the Gattis School Rd. and Greenlawn Blvd. intersection can be eliminated. The drop structure just upstream of Oxford Blvd. can be replaced with concrete, rock revetment mattress, or loose rock riffle. The rock revetment mattress and the loose rock riffle can provide additional energy dissipation and decrease erosional forces downstream. Construction of resistive bank stabilization on the left bank from Oxford Blvd. to Greenlawn Blvd. is needed to protect the existing infrastructure.

Challenges

- Close coordination with the Private property owner (Dell) will be needed to obtain potential easements.

- The Corps permit requirements should be able to be covered with a Nationwide General Permit. However, the more work that is performed in this reach, a higher level of coordination could be required.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	4	88
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $750k and $1M)	18	3	54
Economic Impact	Economic Development	13	1	13
Environmental Impact	Riparian Corridor Project	13	2	26
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**393**

2013B – Kensington Place – Green Slopes
Dry Branch Tributary 1

Background

- This Project includes Issues DB36, DB69, and DB70.
- This 4300 ft reach extends from Dell Way to Gattis School Road through Kensington Place.
- This reach passes under Dell Way, Oxford Blvd, Greenlawn Blvd, and Gattis School Rd.
- Most of this reach with the exception of the Dell Way detention pond resides in park land.
- FEMA floodplain shows inundated homes along the Tributary while the newer UBCWCID floodplain does not inundate these structures.

Issues

- Slope and sediment imbalance is causing deposition on the upstream section of Dry Branch Trib 1 and scour on the downstream section.
- The concrete grade control structure upstream of Oxford Blvd. is undercut and has water flowing underneath the structure.
- Oxford Blvd overtops 1.9' according to the Upper Brushy Creek WCID models which exceeds the 1' allowable criteria.
- Downstream of Oxford Blvd to Greenlawn Blvd there is scour on the left bank (looking downstream) and instability through the reach which could impact infrastructure on the left bank.
- Greenlawn Blvd overtops at 0.6' which barely exceeds the 0.5' criteria. However, the overtopping contributes to the intersection flooding at the Gattis School Rd. and Greenlawn Blvd.

Candidate Alternatives

1. **Dell Way Detention** – Additional Storage at Dell Way Detention Basin (Cost $250k to $750k)
   - Reduce outflow peak which could reduce overtopping at Oxford and Greenlawn.
   - May need to reduce the Dell way culvert size to increase detention.
   - May need to enlarge the pool.
   - Could be part of a combination project with another alternative.
2. **Oxford Culvert Modification** – Replace existing elliptical CMPs at Oxford Blvd to reduce overtopping to allowable 1'. (Cost $250k-$750k)
   - Replace with two 10' w by 4' h concrete box culverts (cheaper).
   - Replace with precast crownspan or clear span bridge (more expensive but greater reduction in overtopping).
   - Keep the same culvert flowline while replacing the existing culverts or lower only slightly. Lowering the flow line too much will lead to accelerated erosion.
3. **Greenlawn Culvert Modification** – Modification of existing culvert system in order to reduce the overtopping to the 6" allowable (3 – 8' x4' box culverts). (Cost under $250k)
   - Could reduce the spillage into to the intersection with Gattis School Rd.
   - Replace with one 10'x4' box culvert to reduce overtopping.
   - Replace with two 10'x4' box culverts to eliminate overtopping and spillage.
4. **Gattis School Rd Intersection** – Examine the stormwater system at the intersection to see if modifications can be made to reduce the flooding into the intersection from DB Tributary 1. (Cost under $250k)
   - Possibly increase the inlet size at the intersection to handle the additional flow form the overtopping of Greenlawn Blvd (improve the collection system).
   - Add cantilever wings to the existing inlets to increase the flow into the existing inlet.
   - Examine the tailwater downstream of the stormwater system.

- Increase the pipe size if needed to accommodate the flow (improve the conveyance system).

5. **Drop Structure Repair/Replacement** – Replace (long term) or repair (short term) the cracked and broken drop structure just upstream of Oxford Blvd. (Cost under $250k)
   - Examine the "equilibrium slope" in this reach.
     - Replace the structure at the same grade.
     - Lower the new drop structure slightly in order to increase sediment transport and reduce silting upstream.
   - Examine short term maintenance solutions to extend the life but not be counter to any longer term replacement options.
   - Replacement – concrete, rock revetment mattress, loose rock riffle.
6. **Channel Stabilization** – Stabilization of left bank from Oxford to Greenlawn to protect infrastructure. (Cost under $250k).
   - The left bank is scouring and approaching infrastructure while the right bank is stable and not encroaching any infrastructure.
   - Left bank stabilization s could consist of one of the following
     - Rock block wall
     - Rock filled Gabion
     - Earth filled Gabion
     - Loose rock rip-rap
     - Living Wall

Alternative Bundles:

- **Alternatives 1, 5 & 6** – if there is ample storage volume at the existing detention basin, then it is possible that the overtopping at Oxford and overtopping at Greenlawn could be solved without the need for any additional infrastructure improvements at those sites. The damaged drop structure would need to be replaced. The need for channel stabilization would still exist. (Cost $750k to $1M)
- **Alternatives 1, 3, 5 & 6** – if there is minimal additional storage at the existing detention basin, then reduced infrastructure improvement will still be needed at Greenlawn. The damaged drop structure would need to be replaced. The need for channel stabilization would still exist. (Cost $1Mk to $2M).
- **Alternatives 3, 5 & 6** – if there is no additional storage at the existing detention basin, then full infrastructure improvement will be needed at Greenlawn. The damaged drop structure would need to be replaced. The need for channel stabilization would still exist. (Cost $250k to $750k).
- **Alternatives 3 & 4** – The focus would be on minimizing the flooding at Greenlawn and Gattis. (Cost $250k to $750k).

Challenges:

- Alternative 1 will require close coordination with the Private property owner to include potential easements.
- The Corps permit requirements should be able to be covered with a Nationwide General Permit. However, the more work that is performed in this reach, a higher level of coordination could be required. It is assumed that it will take 6 months or less.

Notes:

- The current UBCWCID model does not include the Dell Way detention basin.
- Grant Possibilities:
  - TPWD Restitution, Education, trail connection, habitat, riparian vegetation.
  - TCEQ 319. WQ Lift. Examine possible CORPs nationwide permits.
- Current UBCWCID hydrologic model does not include Dell Way detention basin.
- Impact of flooding down Gattis School Rd caused by Greenlawn Blvd overtopping was not analyzed.

Project: 2013B
Name: Kensington Place
Issue: DB36, DB69, DB70
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

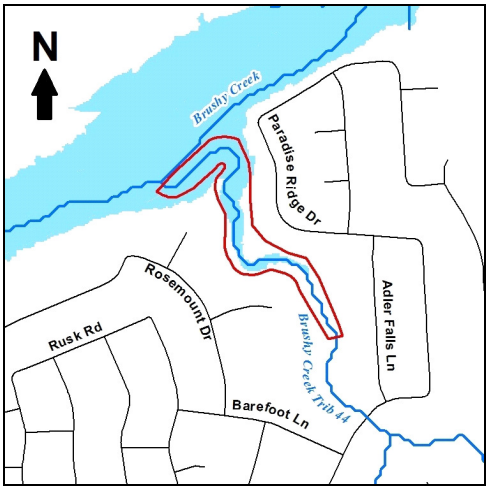
				Alternative 1 Dell Way Detention		Alternative 2 Oxford culvert modification		Alternative 3 Greenlawn culvert modification		Alternative 4 Gattis School Rd interscction		Alternative 5 Drop structure repair/replace		Alternative 6 Channel stabilization Oxford to Greenlawn		Bundle A Alternatives: 1+5+6		Bundle B Alternatives: 1+3+5+6		Bundle C Alternatives: 3+5+6		Bundle D Alternatives: 3+4	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100	PREPARING ROW (Clear and Grubb)	LS	$10,000	1	$10,000		$0		$0		$0		$0		$0	1	$600,000	1	$600,000	1		1	
0100	PREPARING ROW (REMOVE one run of 8x4 box culverts)	LS	$10,000	1	$10,000		$0	1	$10,000		$0		$0		$0	2		2		2		2	
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000	1	$5,000	1	$5,000		$0		$0		$0		$0	3		3	$250,000	3	$250,000	3	$250,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0	350	$14,000		$0		$0	400	$16,000		$0	4		4		4		4	$150,000
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0	120	$1,800	60	$900	160	$2,400		$0		$0	5	$100,000	5	$100,000	5	$100,000	5	
0110 2001	EXCAVATION (Roadway)	CY	$35		$0	267	$9,333	267	$9,333	111	$3,889		$0		$0	6	$200,000	6	$200,000	6	$200,000	6	
110	EXCAVATION (Channel)	CY	$20	8,067	$161,333		$0		$0		$0	533	$10,667	1,111	$22,222								
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0	267	$10,667	267	$10,667		$0		$0		$0								
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2	5,556	$11,111	111	$222		$0		$0		$0		$0								
0162 2002	BLOCK SODDING	SY	$8		$0	111	$889		$0	40	$320	133	$1,067		$0								
162	REVEGETATION (fast early + long term natives)	SY	$8	5,556	$44,444		$0		$0		$0		$0		$0								
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0	200	$20,000	200	$20,000	40	$4,000		$0		$0								
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0	80	$640	120	$960		$0		$0		$0								
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0		$0		$0		$0								
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60	1,111	$66,667	200	$12,000		$0		$0	400	$24,000	1,111	$66,667								
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0		$0		$0		$0								
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0		$0		$0		$0								
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0	120	$10,200	120	$10,200		$0		$0		$0								
462.00	CONC BOX CULV (modifications to inlet opening size)	LS	$15,000	1	$15,000		$0		$0		$0		$0		$0								
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0	120	$72,000	60	$36,000		$0		$0		$0								
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0		$0		$0		$0								
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0		$0		$0		$0								
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0		$0		$0		$0								
464	RC PIPE (CL III)(48 IN)	LF	$180		$0		$0		$0	400	$72,000		$0		$0								
464	INLET (modifications - cantilver wings)	EA	$5,000		$0		$0		$0		$0		$0		$0								
466	WINGWALL (modification)	EA	$10,000		$0		$0	1	$10,000		$0		$0		$0								
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0	2	$20,000		$0		$0		$0		$0								
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0								
0471 2003	FURNISH AND INSTALL NEENAH FRAME AND GRATE	EA	$1,000		$0		$0		$0		$0		$0		$0								
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0		$0		$0		$0								
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0		$0		$0		$0								
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0		$0		$0		$0								
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$35,300	1	$20,100	1	$12,800	1	$8,800	1	$5,200	1	$9,300								
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000	2	$18,000	1	$9,000	1	$9,000		$0		$0		$0								
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0		$0		$0		$0								
0506 2002	EROSION CONTROL	LS	$1,500		$0	1	$1,500	1	$1,500		$0		$0		$0								
506	EROSION CONTROL	SY	$2	5,556	$11,111		$0		$0		$0		$0	2,000	$4,000								
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0	120	$2,400	40	$800	120	$2,400		$0		$0								
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0	67	$3,000	22	$1,000	67	$3,000		$0		$0								
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0	120	$5,400	120	$5,400		$0		$0		$0								
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0	4	$2,360	4	$2,360		$0		$0		$0								
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0		$0		$0		$0								
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0	60	$180		$0		$0		$0		$0								
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0		$0		$0		$0								
				SUBTOTAL	**$388,000**	**SUBTOTAL**	**$221,000**	**SUBTOTAL**	**$141,000**	**SUBTOTAL**	**$97,000**	**SUBTOTAL**	**$57,000**	**SUBTOTAL**	**$103,000**								
				30% Conting.	$117,000	**30% Conting.**	$67,000	**30% Conting.**	$43,000	**30% Conting.**	$30,000	**30% Conting.**	$18,000	**30% Conting.**	$31,000								
				BASE TOTAL	**$505,000**	**BASE TOTAL**	**$288,000**	**BASE TOTAL**	**$184,000**	**BASE TOTAL**	**$127,000**	**BASE TOTAL**	**$75,000**	**BASE TOTAL**	**$134,000**								
ADDITIVE ALTERNATE																							
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0	3	$18,000		$0		$0		$0		$0								
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0	200	$17,000		$0		$0		$0		$0								
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$35,000**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**								
				CONSTR.	**$505,000**	**CONSTR.**	**$323,000**	**CONSTR.**	**$184,000**	**CONSTR.**	**$127,000**	**CONSTR.**	**$75,000**	**CONSTR.**	**$134,000**								
	Permits/Coord (2%)			**Permit/Coord**	**$11,000**	**Permit/Coord**	**$7,000**	**Permit/Coord**	**$4,000**	**Permit/Coord**	**$3,000**	**Permit/Coord**	**$2,000**	**Permit/Coord**	**$3,000**								
	Design/PM(12%)			**Design/PM**	**$61,000**	**Design/PM**	**$39,000**	**Design/PM**	**$23,000**	**Design/PM**	**$16,000**	**Design/PM**	**$9,000**	**Design/PM**	**$17,000**								
	PROJECT TOTAL			**PROJECT**	**$600,000**	**PROJECT**	**$400,000**	**PROJECT**	**$250,000**	**PROJECT**	**$150,000**	**PROJECT**	**$100,000**	**PROJECT**	**$200,000**	**BUNDLE**	**$900,000**	**BUNDLE**	**$1,150,000**	**BUNDLE**	**$550,000**	**BUNDLE**	**$400,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

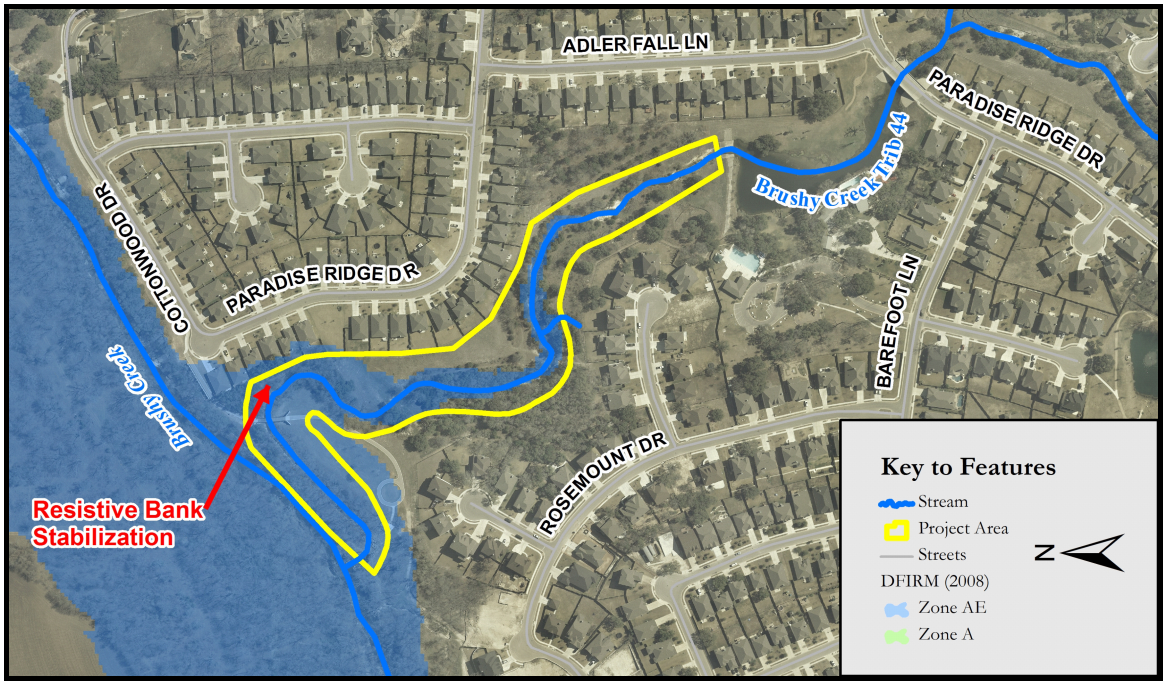
Project: 2013C - Sonoma at Brushy Creek

Brushy Creek Tributary 44

Brushy Creek Tributary 44 experiences vertical bank scour approximately 10 feet tall on both sides of the channel as the tributary approaches Brushy Creek. The right bank is scoured back to the fence line of several homes on Paradise Ridge Drive. If this erosion continues to widen the right bank the homes will begin to lose property and fence lines. Mature hardwood trees on both sides of the eroded channel are at risk. These hardwood trees are most likely keeping the right bank stabilized. If these trees are undermined and lost the right bank erosion could accelerate and threaten the homes.



Reference Issues: BC51



Project: 2013C - Sonoma at Brushy Creek

Brushy Creek Tributary 44

Solution

Installation of resistive bank stabilization on the right bank can protect the eroded right bank from encroaching further on the homes along Paradise Ridge Dr. Longitudinal fill stone toe protection will protect the right bank of the channel while also reclaiming some of the eroded slope. This solution will also move the top of the bank away from the current location right at the fence line of the homes. The resulting filled slope will be gentler than the existing slope and can be armored with the traditional Turf Reinforcement Mat and revegetated. This technique will not require removal of any large trees and can easily work around the existing trees.

Challenges

- Construction access to the area is difficult due to the steep eroded banks and dense vegetation.
- Currently there is no existing hydraulic model for this tributary.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	3	72
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**266**

2013C– Sonoma
Brushy Creek Tributary 44

Background

- This Project includes Issue BC51.
- This reach is near the confluence with Brushy Creek and parallels Paradise Ridge Drive.
- This entire reach exists in City of Round Rock park land.

Issues

- Vertical bank scour approximately 10 feet tall on both sides of the channel as the tributary approaches Brushy Creek.
- Right bank is scoured back to the fence line of the homes on Paradise Ridge Drive.
- Location of private property line. Assume the scoured area is in a drainage easement.
- Mature hardwood trees on both sides of the eroded channel are at risk.

Candidate Alternatives

1. **Resistive Bank Stabilization** – Install resistive bank stabilization in order to protect the eroded right bank from encroaching further on the homes along Paradise Ridge Dr. (Cost $250k to $750k).
   - "Resistive" measures are continuous and are applied directly on the bank and toe (or both).
   - Examples include loose rock rip rap, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - **Longitudinal fill stone toe protection**. Create a "pyramid" of larger loose rocks (perhaps four or five feet tall) located approximately 10 feet away from the existing toe. Fill the area behind this longitudinal toe with soil. Reclaim some of the eroded slope. Move the top of the bank away from the current location. Typically the resulting slopes are gentler and can be armored with traditional Turf Reinforcement Mat (TRM) and revegetated. This technique would not require removal of any large trees and can easily work around/with them.
   - Be sure to anchor the toe and install it deeper than the existing flowline.
   - Some systems have geogrid "tails" that extend well behind the face. Concern about encroaching upon the private property boundary.
   - Armor just the right bank and push the creek toward the left gravel bar. Examination of the water surface elevation is needed to avoid constriction.
   - Pay attention to transitions upstream and downstream of the project area. Resistive armament must blend into the native bank.
   - The option needs to be able to work around existing trees. Minimize tree removal which will decrease stability of the bank.

2. **Redirective Bank Stabilization Measure** – Redirect the flow and energy away from the damaged right bank.
   - "Redirective" measures are discontinuous along the bank and must be installed upstream of the problem area.
   - The effectiveness of these features is governed by the channel geometry and the length of the channel upstream of the problem area. In this case there is not enough room to have these features work effectively (narrow channel width and short upstream reach). Although these

opportunities might not be available in this reach, they are included herein so that future evaluations might reconsider this category.

- Redirective measures could include the following:
  - Rock vanes
  - Barbs
  - Bendway weirs
  - Deflectors
  - False point bars
  - Transverse dikes
  - Stone filled dikes
  - Engineered log dams (large wood debris "root wads")

3. **Grade Control** – Add grade control structures downstream of the erosive area. (Cost <$250k).
   - Grade control structures will increase the tailwater elevation and thereby reduce the stream "power" in the problem reach.
   - Create a downstream riffle (or two) with loose rock.
   - Assume the aggressive situation occurs when Brushy Creek is low. The grade control structures would add tailwater to dampen the velocity and shear in the bend.
   - Since the controlling 100-year water surface elevation is determined with the Brushy Creek peak, the addition of these grade control riffles will not affect the BFE at this confluence.
   - Will need to be used in combination with another alternative.

Alternative Bundles

- **Alternative 1 & 3** – Install two rock riffles. Install a longitudinal fill stone to protection. Transition to the existing bank upstream and downstream of the problem area. (Cost $250k to $750k).
- **Alternative 1** - Install a longitudinal fill stone to protection. Transition to the existing bank upstream and downstream of the problem area. (Cost $250k to $750k).

Challenges

- Construction access to the area is difficult due to the steep eroded banks and dense vegetation.
- No existing hydraulic model for the tributary.

Notes

- Additional modeling with SWAT-DEG could help predict the amount of future scour (vertical and horizontal).

Project: 2013C
Name: Sonoma at Brushy Creek
Issue: BC51
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

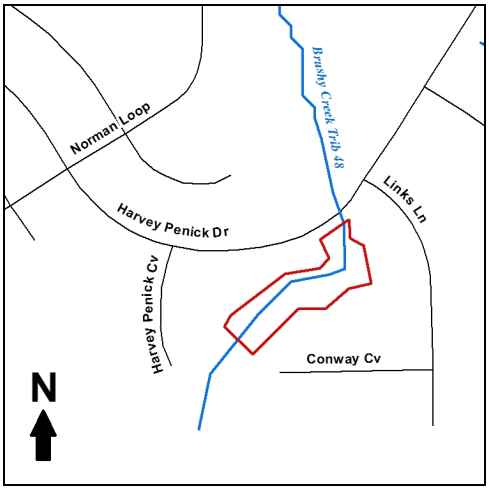
				Alternative 1		Alternative 2		Alternative 3		Bundle A		Bundle B	
				Resistive bank stabilization LFSTP		Redirective bank stabilization none		Grade control		Alternatives: 1+3		Alternatives: 1	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1	$650,000	1	$650,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0	400	$16,000	2		2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3	$125,000	3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0	4		4	
110	EXCAVATION (Channel)	CY	$40	2,222	$88,889		$0	533	$21,333				
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0	5		5	
132	EMBANKMENT (Ordinarly compaction)	CY	$25	3,704	$92,593		$0		$0				
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0	133	$267	6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0	400	$24,000				
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	1,111	$177,778		$0		$0				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$38,400	1	$0	1	$6,200				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0				
506	EROSION CONTROL	SY	$2	2,222	$4,444		$0		$0				
506	EROSION CONTROL (permanent TRM)	SY	$9	2,222	$20,000		$0		$0				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0				
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0				
				SUBTOTAL	**$423,000**	**SUBTOTAL**	**$1,000**	**SUBTOTAL**	**$68,000**				
				30% Conting.	$127,000	**30% Conting.**	$1,000	**30% Conting.**	$21,000				
				BASE TOTAL	**$550,000**	**BASE TOTAL**	**$2,000**	**BASE TOTAL**	**$89,000**				
ADDITIVE ALTERNATE													
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$550,000**	**CONSTR.**	**$2,000**	**CONSTR.**	**$89,000**				
		Permits/Coord (2%)		**Permit/Coord**	**$11,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$2,000**				
		Design/PM(12%)		**Design/PM**	**$66,000**	**Design/PM**	**$1,000**	**Design/PM**	**$11,000**				
		PROJECT TOTAL		**PROJECT**	**$650,000**	**PROJECT**	**$25,000**	**PROJECT**	**$125,000**	**BUNDLE**	**$775,000**	**BUNDLE**	**$650,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

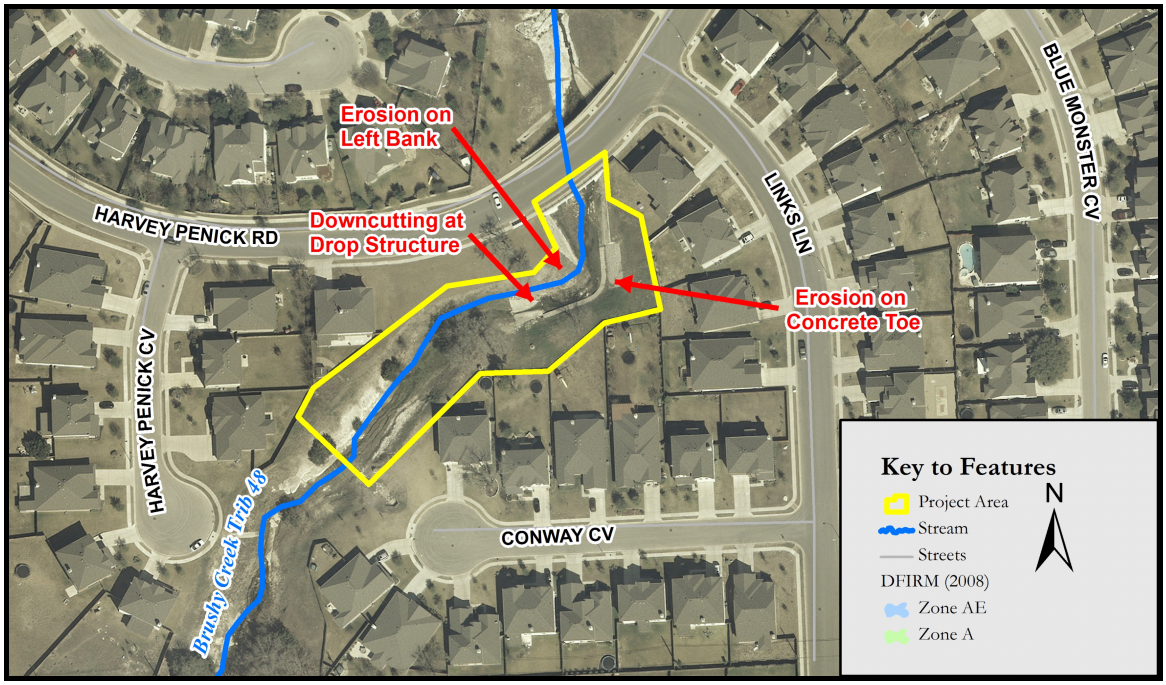
Project: 2013D - Forest Creek - Harvey Penick

Brushy Creek Tributary 48

Brushy Creek Tributary 48 takes a hard left turn (approximately 90 degrees) before going under Harvey Penick Rd. A drop structure just upstream of this turn has approximately 2 feet of downcutting under the downstream toe. An existing 8" wastewater line passes under this drop structure. Further downcutting could lead to undermining and putting this wastewater line at risk. The concrete toe along the outside bend (right bank) has been undercut over 2 feet. The erosion on the outside toe is beginning to undermine the concrete armoring. Erosion has started on the left inside bank which is not armored and is migrating towards Harvey Penick Dr.



Reference Issues: BC43



Project: 2013D - Forest Creek - Harvey Penick

Brushy Creek Tributary 48

Solution

Installation of resistive bank stabilization can protect the eroded right bank. Loose rock rip rap along the sloped right bank will protect the bank from further erosion. The rip rap will need to be toed into the channel in order to insure the rip rap remains in place. The left bank needs to be excavated in order to "round out" the bend to improve the transition angle of the turn. This will reduce the erosive forces on the inside (left) bank. Replacing the existing concrete grade control structure with rock riffle will reduce the velocity in the downstream problem reach. Reducing this velocity will decrease the erosive forces and help the rock rip rap armoring downstream. This rock riffle will also continue to protect the existing 8" wastewater line which crosses the channel in this location.

Challenges

- Construction access to the area is difficult due to the limited work zone area.
- Wastewater line crosses under the upstream concrete drop structure.
- Water line crossing near the Harvey Penick Rd. culvert headwall.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	3	69
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**281**

2013D – Forest Creek
Brushy Creek Tributary 48

Background

- This Project includes Issue BC43
- Existing fortifications include a myriad of materials including concrete, gabions, dry stack blocks, and biaxial geogrid wraps.
- City staff desires a natural and green solution that can integrate into the adjacent residential development.
- The Project area is within existing City of Round Rock Park land.

Issues

- Drop structure has approximately 2 ft. of down cutting under the downstream toe.
- Concrete toe along the right (south) bank has been eroded over 2 ft.
- Erosion has started on the left (north) inside bank. Migrating towards Harvey Penick drive.
- The channel invert appears to be rock. Anticipate minimal down-cutting. Anticipate channel widening.

Candidate Alternatives

1. **Resistive Bank Stabilization** – Install resistive bank stabilization in order to protect the eroded right bank. (Cost under $250k)
   - "Resistive" measures are continuous and are applied directly on the bank and toe (or both).
   - Examples include **loose rock rip rap**, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - Longitudinal fill stone toe protection. Create a "pyramid" of larger loose rocks (perhaps four or five feet tall) located approximately 10 feet away from the existing toe. Fill the area behind this longitudinal toe with soil. Reclaim some of the eroded slope. Move the top of the bank away from the current location. Typically the resulting slopes are gentler and can be armored with traditional Turf Reinforcement Mat (TRM) and revegetated. This technique would not require removal of any large trees and can easily work around/with them.
   - **Round out**. Consider excavation on the left bank to "round out" the bend. Less of a hard left turn.
   - How much removal of the existing armoring infrastructure would be acceptable to the neighborhood? Limit any removal upon the inside bend only. No removal approaching the culvert headwall or on the right bank.
   - Replace some armoring with green gabions?
   - How much vegetation is desired/allowable on the face of the channel?
   - Must anchor the toe and install deeper than the existing flowline.
   - Transitions upstream and downstream of the project area as the resistive armament must blend into the native bank.

2. **Redirective Bank Stabilization Measure** – Redirect the flow and energy away from the damaged right bank.

- "Redirective" measures are discontinuous along the bank and must be installed upstream of the problem area.
- The effectiveness of these features is governed by the channel geometry and the length of the channel upstream of the problem area. In this case there is not enough room to have these features work effectively (narrow channel width and short upstream reach).

- Redirective measures could include the following:
  - Rock vanes
  - Barbs
  - Bendway weirs
  - Deflectors
  - False point bars
  - Transverse dikes
  - Stone filled dikes
  - Engineered log dams (large wood debris "root wads")

3. **Grade Control**. Replace concrete grade control structure with rock riffle to reduce the velocity in the downstream problem reach. (Cost <$250k).

- The rock riffle should arch over the existing wastewater line (as does the existing concrete structure). Consideration could be given to providing a concrete trench cap over the wastewater line before installing the rock riffle (depending upon the various grades involved).
- Use in combination with another alternative.

Alternative Bundles

- **Alternative 1 & 3** – Install one rock riffle over the wastewater line. Install loose rock rip rap along the toe of the right bank armoring. Transition to the existing bank upstream and downstream of the problem area. Excavate on the inside bend and provide for transitions. Minimal modification to the right bank rock wall. No changes within 25 feet of the upstream headwall (and waterline). (Cost <$250k).
- Alternative 1 - Install loose rock rip rap along the toe of the right bank armoring. Transition to the existing bank upstream and downstream of the problem area. Excavate on the inside bend and provide for transitions. Minimal modification to the right bank rock wall. No changes within 25 feet of the upstream headwall (and waterline). (Cost <$250k).

Challenges

- Construction access to the area is difficult due to the limited work zone area.
- Wastewater line crossing could be near (or under) the upstream concrete drop structure.
- Water line crossing near the bridge culvert headwall.

Notes

- No existing detailed hydraulic model.

Project: 2013D
Name: Forest Creek - Harvey Penick
Issue: BC43
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

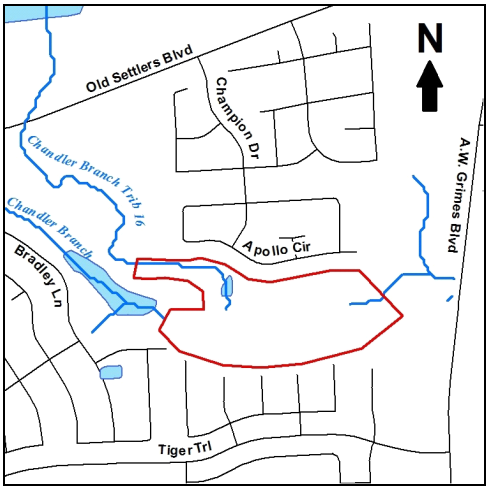
				Alternative 1		Alternative 2		Alternative 3		Bundle A		Bundle B	
				Resistive bank stabilization		Redirective bank stablization		Grade control		Alternatives: 1+3		Alternatives: 1	
				Loose rock rip rap (round out)		none							
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1	$125,000	1	$125,000
0104 2009	REMOVING CONC (RIPRAP, and Stacked rock point)	SY	$40	111	$4,444		$0	200	$8,000	2		2	$25,000
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3	$100,000	3	$100,000
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0				
110	EXCAVATION (Channel)	CY	$40	296	$11,852		$0		$0				
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0				
132	EMBANKMENT (Ordinarly compaction)	CY	$25		$0		$0		$0				
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0				
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0				
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	296	$47,407		$0	267	$42,667				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$7,400	1	$0	1	$5,100				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000	1	$9,000		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0				
506	EROSION CONTROL	SY	$2	667	$1,333		$0		$0				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0				
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0				
				SUBTOTAL	**$82,000**	**SUBTOTAL**	**$1,000**	**SUBTOTAL**	**$56,000**				
				30% Conting.	$25,000	**30% Conting.**	$1,000	**30% Conting.**	$17,000				
				BASE TOTAL	**$107,000**	**BASE TOTAL**	**$2,000**	**BASE TOTAL**	**$73,000**				
ADDITIVE ALTERNATE													
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$107,000**	**CONSTR.**	**$2,000**	**CONSTR.**	**$73,000**				
		Permits/Coord (2%)		**Permit/Coord**	**$3,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$2,000**				
		Design/PM(12%)		**Design/PM**	**$13,000**	**Design/PM**	**$1,000**	**Design/PM**	**$9,000**				
		PROJECT TOTAL		**PROJECT**	**$125,000**	**PROJECT**	**$25,000**	**PROJECT**	**$100,000**	**BUNDLE**	**$225,000**	**BUNDLE**	**$250,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

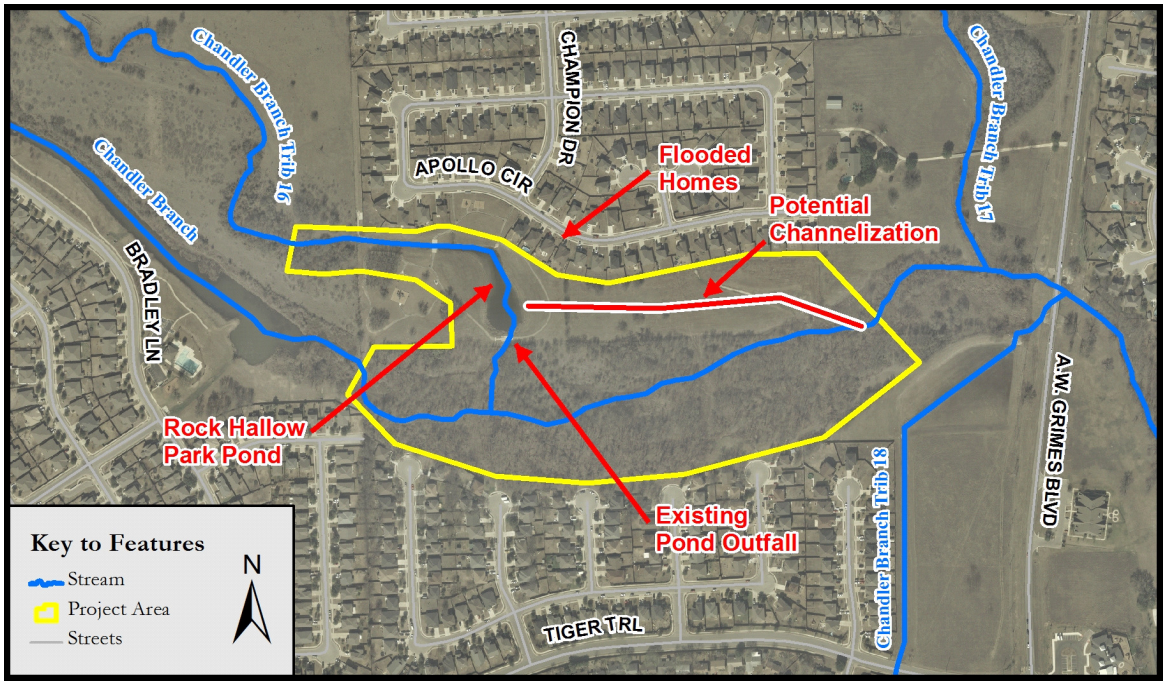
Project: 2013E - Rock Hollow

Chandler Branch Tributary 16

Rock Hallow Park Pond is in line with Chandler Branch Tributary 16 and is just south of Rhodes subdivision. Historical flooding shows that the water surface from the pond has reached over 6 inches up the fence line along several homes directly to the east of the pond. The right embankment of the pond is only slightly higher than the outfall weir of the pond resulting in frequent spilling to the east towards the homes. The pond outfalls into Chandler Branch mainstem which is choked by dense vegetation both upstream and downstream of the outfall. Additional 2-D hydraulic modeling has shown that Chandler Branch backflows into the pond which increases the severity of spilling from the pond to the east.



Reference Issues: CB10



Project: 2013E - Rock Hollow

Chandler Branch Tributary 16

Solution

Channelization from the eastern embankment of the pond and tying into Chandler Branch further downstream can prevent the homes from being flooded. The land along this route is currently owned by the City so no land acquisition is required. The existing pond outfall will need to be raised in order to prevent outflow from the pond and backflow from Chandler Branch. The channelization will also reduce the flow contributing to the choked section of Chandler Branch. The relocation of the existing flowline will also provide additional detention possibilities in the open park land to the east.

Challenges

- The area surrounding the park to the south is located within the Chandler Creek MUD. Therefore, any modification outside of the City Park or drainage easements will require cooperation with the MUD.

- Increases in pond size could potentially lead to water rights issues with the State.

- The impact on FM 1460 (A.W. Grimes Blvd) downstream needs to be considered.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	3	72
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**310**

2013E – Rhodes

Chandler Branch Tributary 16

Background

- This project includes Issue CB10.
- The Project area is on Chandler Branch Tributary 16 near the confluence with Chandler Branch.
- The Project area is within existing City of Round Rock Park land.

Issues

- Historical flooding shows that the water surface from the Rock Hallow Park Pond has reached over 6 inches up the fence line along several homes directly to the east of the pond.
- The right embankment of the pond is only slightly higher than the outfall weir of the pond resulting in frequent spilling to the east towards the homes.
- The outfall of the pond is choked with dense vegetation restricting the outflow.
- Chandler Branch mainstem is choked by dense vegetation both upstream and downstream of the confluence with Dam 14 Trib.
- Overflow from Chandler Branch into the Rock Hallow Park Pond has the potential to take away designed pond capacity. Storm drain outfalls that empty into the pond from the northern residential development may not be able to freely outfall like intended. This could result in street flooding in the residential development upstream from the pond.

Candidate Alternatives

1. **Pond Outfall Modification** –Raise the outfall weir of the pond in order to block overflow from Chandler Branch. (Cost under $250k)
   - Increasing the elevation of the outlet weir will also increase the pond water surface and may cause tailwater issues for the local stormwater outfalls.
   - Does not reduce the flooding of the homes to the east of the pond if the flooding issue is caused by the pond itself and not Chandler Branch.
2. **Raise Eastern Pond Embankment** – Raise the embankment on the eastern side of the pond to prevent spilling. (Cost under $250k)
   - Would increase the storage of the pond before it began to spill out towards the east.
   - Could potentially reduce the severity of the flooding of the parcels to the east of the pond.
3. **Chandler Branch Channel Modification –** Modification to Chandler Branch downstream of the confluence with Dam 14 Trib to decrease the floodplain. (Cost $250k-$750k)
   - Lowering of the water surface of Chandler Brach will reduce the tailwater at the pond outfall and allow the outfall to act more efficiently
   - Could eliminate overflow from Chandler Branch into the pond.
4. **Channelization East of Pond into Chandler Branch** - Channelization from the eastern embankment of the pond and tying in further downstream on Chandler Branch. (Cost under $250k)
   - Could decrease the floodplain to the east and prevent the homes from being inundated.
   - Decrease the flow contributing to the choked section of Chandler Branch.
   - The pond outfall would need to be moved to the eastern embankment.
   - Would need to raise the current pond outfall to prevent Chandler Branch from overflowing into the pond.
5. **Increase in Storage of Rock Hollow Park Pond** – The pond size and storage could be increase by expanding the pond into the open park land to the east. (Cost <$250k)

- An increase in pond size would increase the amount of water stored and stop the water from reaching the homes.
- The current park sidewalk to the east would need to be demolished since the best location for the pond expansion is to the east.

6. **Selective Clearing** – Selective clearing of the thick vegetation along Chandler Branch in order to improve conveyance. (Cost under $250k)
   - Additional conveyance through Chandler Branch could reduce the water surface and prevent backflow into the pond.
   - Clearing of vegetation at ourfall of pond could improve flow and allow the pond to outfall more efficiently.
   - This alternative would require heavy coordination with the Chandler Creek MUD, therefore it is most likely not feasible.

Alternative Bundles

1. **Alternatives 1 & 2** – Raising the pond outfall could reduce the overflow from Chandler Branch into the pond, but the eastern embankment would also need to be raised due to the decreased outflow from the pond. (Cost under $250k)
2. **Alternatives 3, 1, 2** – Channelization of Chandler Branch could potentially lower the water surface enough to prevent back flow into the Rock Hollow Pond. This may need to be combined with raising the existing pond outfall depending on how much the water surface of Chandler Branch can be lowered. (Cost $250k-$750k)
3. **Alternative 4** – Channelization of Chandler Branch could potentially lower the water surface enough to prevent backflow into the Rock Hollow Pond. (Cost under $250k)

Challenges

- The area surrounding the park is within the Chandler Creek MUD. Any modification within these limits will have to be in cooperation with the Chandler Creek MUD.
- As the pond size increases it increases the chance of triggering a water rights issue with the State.
- The impact on FM 1460 (A.W. Grimes Blvd) of any modifications to the existing system must be considered.

Notes:

- This project could be joint funded with City of Round Rock Parks & Recreation Department.
- If the pond was expanded (Alternative 5) it could become a candidate for TPWD to stock fish (Restitution Grant Program).

Project: 2013E
Name: Rock Hollow (Rhodes)
Issue: CB10
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

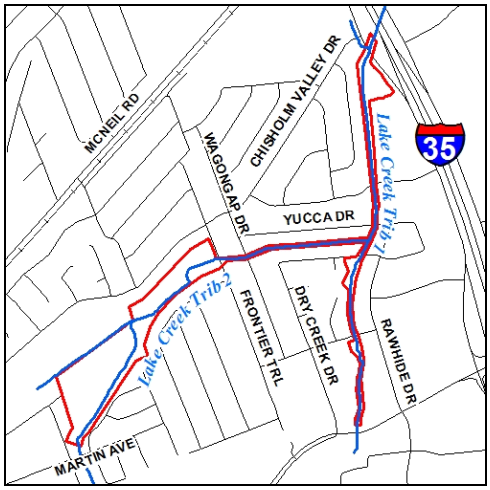
				Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Bundle A		Bundle B		Bundle C	
				Pond outfall modification		Raise eastern pond embankment		Chandler Branch channel modifications		Channelization east of pond into Chandler Branch		Increase storage of Rock Hollow Park pond		Selective clearing		Alternatives: 1+2		Alternatives: 1+2+3		Alternatives: 4	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (clearing trees, grubbing)	LS	$25,000		$0		$0	1	$25,000	0.5	$12,500		$0	1	$25,000	1	$125,000	1	$125,000	1	
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0		$0		$0		$0	2	$75,000	2	$75,000	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0		$0		$0		$0	3		3	$575,000	3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0		$0		$0		$0	4		4		4	$200,000
110	EXCAVATION (Channel)	CY	$15		$0		$0	18,519	$277,778	5,556	$83,333	5,556	$83,333		$0						
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40	1,111	$44,444	741	$29,630		$0		$0		$0		$0	5		5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0		$0		$0		$0	6		6		6	
0162 2002	BLOCK SODDING	SY	$8	1,000	$8,000	667	$5,333		$0		$0		$0		$0						
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0		$0		$0		$0						
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0		$0		$0		$0						
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0		$0		$0		$0						
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0		$0		$0		$0						
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0		$0		$0		$0						
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0		$0		$0		$0						
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0		$0		$0		$0						
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0		$0		$0		$0						
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0		$0		$0		$0						
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0		$0		$0		$0						
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0		$0		$0		$0						
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0						
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0						
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0		$0		$0		$0						
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0		$0		$0		$0						
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0		$0		$0		$0						
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0		$0		$0		$0						
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$6,100	1	$4,100	1	$34,700	1	$11,300	1	$8,300	1	$2,500						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0		$0		$0		$0						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0		$0		$0		$0						
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0		$0		$0		$0						
506	EROSION CONTROL	SY	$2		$0		$0	22,222	$44,444	8,333	$16,667		$0		$0						
506	EROSION CONTROL (TRM, permanent)	SY	$9	1,000	$9,000	667	$6,000		$0		$0		$0		$0						
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0		$0		$0		$0						
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0		$0		$0		$0						
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0		$0		$0		$0						
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0		$0		$0		$0						
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0		$0		$0		$0						
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0		$0		$0		$0						
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0		$0		$0		$0						
				SUBTOTAL	**$68,000**	**SUBTOTAL**	**$46,000**	**SUBTOTAL**	**$382,000**	**SUBTOTAL**	**$124,000**	**SUBTOTAL**	**$92,000**	**SUBTOTAL**	**$28,000**						
				30% Conting.	$21,000	**30% Conting.**	$14,000	**30% Conting.**	$115,000	**30% Conting.**	$38,000	**30% Conting.**	$28,000	**30% Conting.**	$9,000						
				BASE TOTAL	**$89,000**	**BASE TOTAL**	**$60,000**	**BASE TOTAL**	**$497,000**	**BASE TOTAL**	**$162,000**	**BASE TOTAL**	**$120,000**	**BASE TOTAL**	**$37,000**						
ADDITIVE ALTERNATE																					
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0		$0		$0		$0						
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0		$0		$0		$0						
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**						
				CONSTR.	**$89,000**	**CONSTR.**	**$60,000**	**CONSTR.**	**$497,000**	**CONSTR.**	**$162,000**	**CONSTR.**	**$120,000**	**CONSTR.**	**$37,000**						
	Permits/Coord (2%)			**Permit/Coord**	**$2,000**	**Permit/Coord**	**$2,000**	**Permit/Coord**	**$10,000**	**Permit/Coord**	**$4,000**	**Permit/Coord**	**$3,000**	**Permit/Coord**	**$1,000**						
	Design/PM(12%)			**Design/PM**	**$11,000**	**Design/PM**	**$8,000**	**Design/PM**	**$60,000**	**Design/PM**	**$20,000**	**Design/PM**	**$15,000**	**Design/PM**	**$5,000**						
				PROJECT TOTAL	**PROJECT**	**$125,000**	**PROJECT**	**$75,000**	**PROJECT**	**$575,000**	**PROJECT**	**$200,000**	**PROJECT**	**$150,000**	**PROJECT**	**$50,000**	**BUNDLE**	**$200,000**	**BUNDLE**	**$775,000**	**BUNDLE**	**$200,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

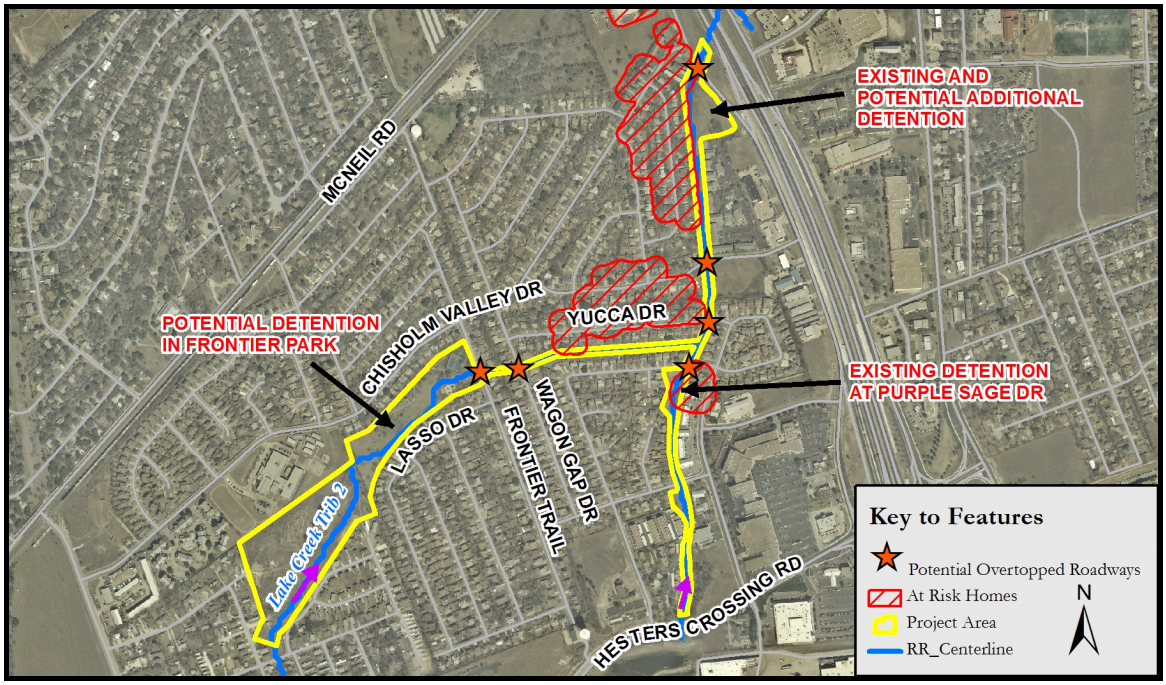
Project: 2013F.0 - Chisholm Valley

Lake Creek Tributaries 1 & 2

Lake Creek Tributary 1 and Tributary 2 run through the Chisholm Valley subdivision. The current WCID models indicate that approximately 98 structures are at risk during the 100-yr storm event along these two reaches. The current models also indicate that 6 roadways crossings exceed the City of Round Rock overtopping criteria for the 100-yr storm event. However, these models do not account for the existing detention at Purple Sage Dr. and at the IH-35 southbound frontage road. The detention outlet structure at Purple Sage Drive is also undersized and causes several structures to be inundated upstream.



Reference Issues: LC59-LC64



Project: 2013F.0 - Chisholm Valley

Lake Creek Tributaries 1 & 2

Solution

Refining of the current hydrologic and hydraulic models for this reach will allow for investigation of alternatives to reduce the number of at risk structures and the risk of road overtoppings in the Chisholm Valley area. Additional detention is available at several locations in this reach and could potentially decrease the number of structures at risk along these two tributaries. Alternative analysis can also determine if modification to the existing detention structures at Purple Sage Dr. and the IH-35 service road could provide additional detention benefits. Examining the hydrologic interactions within this problematic watershed will help to focus upon and generate the most cost effective alternatives.

Challenges

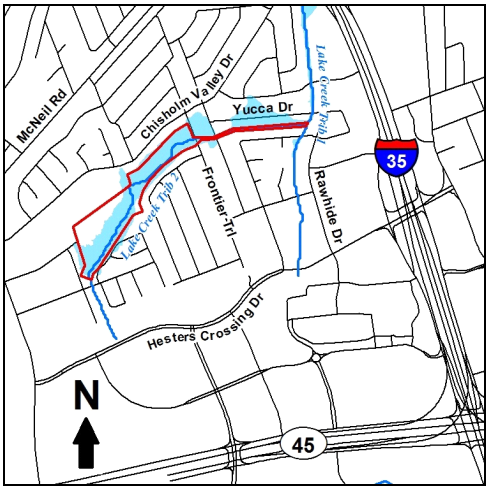
- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	2	44
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**481**

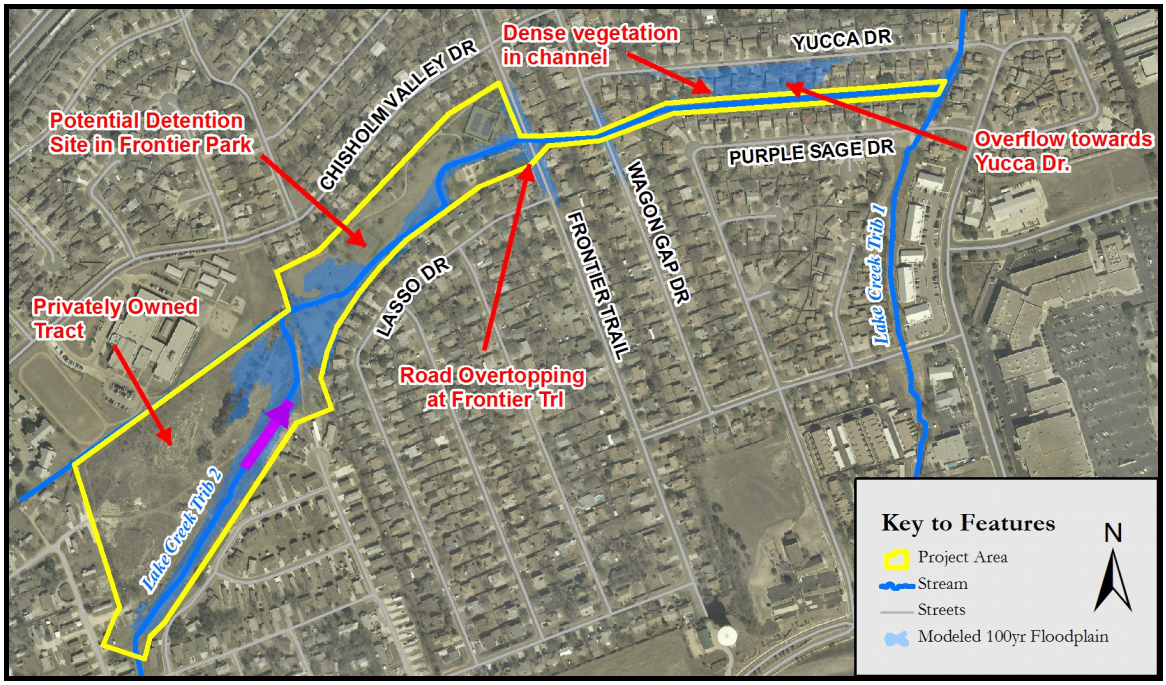
Project: 2013F.1 - Chisholm Valley East-West

Lake Creek Tributary 2

Large mature trees within existing engineered drainage ditch in Lake Creek Tributary 2 between Yucca Dr. and Purple Sage Dr. are "choking' the channel causing a potential increase in the water surface elevation. The capacity of this engineered channel downstream of Wagon Gap Drive is inadequate causing spilling during the 100-yr event between 603 Yucca Drive and 505 Yucca Drive, which inundates 8 homes. This spilling can possibly contribute to additional flooding issues down Yucca Drive. Frontier Trail is overtopped by 0.65 ft exceeding the allowable limit of 6 inches for a nonresidential road during the 100-yr event. Wagon Gap Drive is also overtopped by 0.6 ft during the 100-yr event although it meets the allowable limit of 1 ft.



Reference Issues: LC59, LC60, LC61



Project: 2013F.1 - Chisholm Valley East-West

Lake Creek Tributary 2

Solution

Selective clearing of the dense vegetation and trees in the engineered channel downstream of Wagon Gap Drive will improve conveyance. Several large caliper hardwood trees will need to be cleared, but these trees are within the existing City drainage easement. Construction of a detention facility in Frontier Park can reduce the 100-yr peak flow and potentially prevent the flooding of the 8 homes along Yucca Drive. This detention facility could also prevent Frontier Trial and Wagon Gap Drive from being overtopped. This detention facility could provide further benefits downstream on Lake Creek Tributary and Lake Creek.

Challenges

- The privately owned track upstream of Frontier Park may have to be purchased in order to compensate the Park for the land rededicated to detention.

- An 18" wastewater line parallels the existing stream centerline through Frontier Park. This wastewater line could potentially have to be relocated.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	2	44
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	4	96
Economic Impact	Funding Source	13	3	39
Economic Impact	Project Cost (Between $1M and $2M)	18	2	36
Economic Impact	Economic Development	13	1	13
Environmental Impact	Riparian Corridor Project	13	2	26
Project Timing	Ease of Permitting	13	1	13
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**309**

2013F.1 – Chisholm Valley East-West
Lake Creek Tributary 2

Background

- This project includes Issues LC59, LC60, and LC61
- The Project area is within existing City of Round Rock park land and drainage easements.

Issues

****Observations of water surface and flooding are made from the Upper Brushy Creek WCID hydraulic models with the changes noted in the Notes section.****

- Large mature trees within the existing engineered drainage ditch between Yucca Dr. and Purple Sage Dr. are "choking' the channel causing an increase in the water surface elevation.
- The channel capacity downstream of Wagon Gap Drive is inadequate causing spilling during the 100-yr event between 603 Yucca Drive and 505 Yucca Drive which inundates 8 homes and possibly flooding Yucca Drive.
- Frontier Trail is overtopped by over 0.65 ft exceeding the allowable limit of 6 inches for a nonresidential road during the 100-yr event.

Candidate Alternatives

1. **Selective Clearing** – Selective clearing of trees in engineered channel parallel to Yucca Drive to improve conveyance. (Cost under $250k)
   - Several large caliper hardwood trees will need to be cleared.
   - Trees are in the city drainage easement.
   - Will reduce the floodplain downstream and remove several homes from the 100-yr floodplain.
2. **Channel Modification** - Modification of the existing engineered channel between Yucca Dr. and Purple Sage Dr. (Cost $250k-$750k)
   - Change side slopes to be nearly vertical walls 3 feet inside of the existing stockade fence line.
   - 660 feet starting from the downstream end (half the length of the engineered channel).
   - Will remove all inundated homes along Yucca Dr. from the 100-yr event.
3. **Frontier Trail Culvert Modification –** Replacement of the existing culvert system at Frontier Trail (2 x 54" RCP, 2 x 42" RCP) to reduce overtopping below 6 inches. (Cost under $250k)
   - Replacement of the two 42" RCP with two 54" RCP (4 x 54" RCP)
   - Replacement of the existing culvert system (2 x 54" RCP, 2 x 42" RCP) with two 8' x 4' box culverts.
4. **Regional Detention in Frontier Park** – Construction of a detention facility in an existing City of Round Rock park to reduce flooding downstream. (Cost $1M-$2M)
   - Reduce the peak flow along Lake Creek Trib 6A and subsequently Lake Creek Trib 6.
   - Eliminate overtopping of Frontier Trail and Wagon Gap Drive during the 100-yr event.
   - Remove homes along Yucca Drive from 100-yr floodplain.
   - Possibly purchase private tract from Candidate Alternative 4 in order to compensate the park for lost land.
5. **Regional Detention in Private Tract and Frontier Park** – Construction of detention facilities in both Frontier Park and the privately owned tract just upstream of the park. (Cost $2M-$5M)
   - Offer the benefits of Frontier Park Regional Detention as well as additional reduction of the peak flow.
   - Could provide a solution to issues on Lake Creek Tributary 6.

Alternative Bundles

A. Alternatives 1, 2, & 3 - Removes the homes along Yucca drive from the 100-yr floodplain and reduces the overtopping at Frontier trail below the allowable limit. (Cost $750k-$1M)

B. **Alternative 1 & 4** – Homes along Yucca drive will be removed from the 100-yr floodplain and overtopping at Wagon Gap Dr and Frontier Trail will be eliminated. Could also provide additional benefits downstream of Lake Creek Trib 6A. (Cost $1M-$2M)

C. **Alternative 1 & 5** – All noted issues along Lake Creek Trib 6A will be addressed and additional detention from Private Tract provided further benefits downstream. (Cost $2M-$5M)

Challenges

- The privately owned track upstream of Frontier Park may have to be purchased in order to compensate the Park for the land rededicated to detention.
- An 18" wastewater line parallels the existing stream centerline through Frontier Park. This wastewater line could potentially have to be relocated.

Notes:

****Items noted below are changes made from the current (10-09-2013) UBCWCID hydraulic models during conceptual modeling.****

- Flow from Subbasin LAKT6_020 in the UBCWCID hydrologic model was determined to be improperly distributed along Lake Creek Tributary 6A. Flow distribution was changed to be representative of drainage area.
- Current hydraulic model have a single Manning's n value of 0.09 for single family residential along the engineered channel between Yucca Dr. and Purple Sage Dr. Manning's n values were added to the engineered channel to represent the cobble side slopes and concrete pilot channel.
- The current hydraulic model include Purple Sage Drive as conveyance of the noted engineered pilot channel although water does not spill from the engineered pilot channel onto Purple Sage Dr. Purple Sage Drive was modified to be ineffective flow area.
- The road crossing at Frontier Trail was modeled as four 42" RCP. Field visit data on 11/16/2012 shows that the existing culvert system is made up of two 54" RCP and two 42" RCP.

Project: 2013F.1
Name: Chisholm Valley East-West
Issue: LC59, LC60, LC61
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

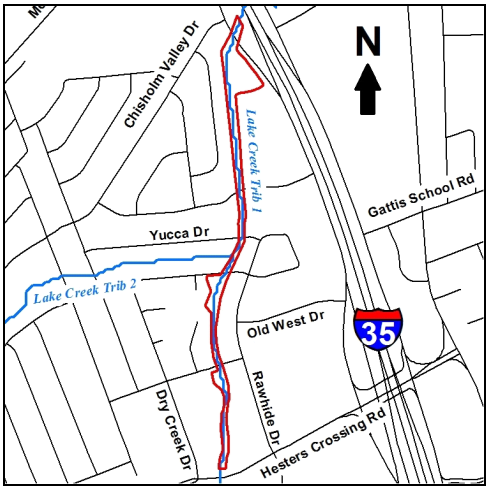
				Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Bundle A		Bundle B		Bundle C	
				Selective Clearing		Channel modification Vertical walls; partial length		Frontier Trail culvert mod. Replacements		Regional detention Frontier Park		Regional detention Private tract and Frontier Park		Alternatives: 1+2+3		Alternatives: 1+4		Alternatives: 1+5	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (clearing trees, grubbing)	LS	$25,000	1	$25,000		$0		$0		$0		$0	1	$50,000	1	$50,000	1	$50,000
0100	PREPARING ROW (clearing trees, grubbing)	AC	$3,500		$0		$0		$0	5	$16,450		$0						
0100	TREE REMOVAL	EA	$250		$0		$0		$0	20	$5,000		$0						
0104	REMOVING EXISTING RCP (42 IN)	LF	$80		$0		$0	160	$12,800		$0		$0						
0104	REMOVING CONC (Basketball court)	SY	$15		$0		$0		$0	540	$8,100		$0	2	$525,000	2		2	
0104	REMOVING CONC (Sidewalk 4")	SY	$15		$0		$0		$0	520	$7,800		$0						
0104	REMOVING HYDRO PAVERS	SY	$15		$0		$0		$0	240	$3,600		$0						
0104	REMOVING WASTEWATER MANHOLE	EA	$3,000		$0		$0		$0	4	$12,000		$0						
0104	REMOVING WASTEWATER LINE (18" PVC)	LF	$40		$0		$0		$0	800	$32,000		$0						
0104	REMOVING STORM DRAIN HEADWALLS	EA	$1,500		$0		$0		$0	3	$4,500		$0						
0104	REMOVING PEDESTRIAIN BRIDGE (wooden)	LS	$4,000		$0		$0		$0	1	$4,000		$0						
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0		$0		$0	3	$250,000	3		3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0	237	$8,296		$0		$0	4		4	$2,100,000	4	
110	EXCAVATION (Channel) (including hauling)	CY	$15		$0	6667	$100,000		$0	59,000	$885,000	135,000	$2,025,000						
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0		$0		$0	5		5		5	$3,500,000
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0		$0		$0						
161	COMPOST MANUF TOPSOIL (BOS) (4")	AC	$3,000		$0		$0		$0	5	$14,100		$0						
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0		$0		$0						
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0	222	$22,222		$0		$0						
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0	80	$640		$0		$0						
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0		$0		$0						
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0	356	$21,333	711	$42,667						
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0		$0		$0						
432	GABION BASKETS (L-shaped wall)	CY	$160		$0	1,333	$213,333		$0		$0		$0						
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0		$0		$0						
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0		$0		$0						
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0		$0		$0						
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0	160	$72,000		$0		$0						
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0		$0		$0						
462.00	PEDESTRIAN BRIDGE	LS	$9,000		$0		$0		$0	1	$9,000		$0						
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0		$0		$0						
464	RC PIPE (CL III)(54 IN)	LF	$200		$0		$0		$0		$0		$0						
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0	1	$10,000		$0		$0						
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0						
0466	HEADWALL (inflow structure)	EA	$10,000		$0		$0		$0	1	$10,000		$0						
0466	HEADWALL (outflow structure)	EA	$15,000		$0		$0		$0	1	$15,000		$0						
0466	HEADWALL (stormdrain)	EA	$2,000		$0		$0		$0	3	$6,000		$0						
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0		$0		$0						
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0		$0		$0						
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0		$0		$0						
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0		$0		$0						
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$2,500	1	$32,000	1	$13,800	1	$119,300	1	$211,700						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0	1	$9,000	2	$18,000	3	$27,000						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0		$0		$0						
0506 2002	EROSION CONTROL (silt fence, check dams, SCE, tree protect)	LS	$25,000		$0		$0		$0	1	$25,000		$0						
506	EROSION CONTROL	SY	$2		$0	3,333	$6,667		$0		$0	11,111	$22,222						
506	EROSION CONTROL (seeding and hydromulch)	AC	$2,000		$0		$0		$0	5	$9,400		$0						
506	EROSION CONTROL (temporary ESC blanket)	SY	$1.50		$0		$0		$0	8,000	$12,000		$0						
506	EROSION CONTROL (irrigation system)	LS	$40,000.00		$0		$0		$0	1	$40,000		$0						
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0	60	$1,200		$0		$0						
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0	33	$1,500	780	$35,100		$0						
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0		$0		$0						
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0		$0		$0						
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0		$0		$0						
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0		$0		$0						
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0		$0		$0						
				SUBTOTAL	**$28,000**	**SUBTOTAL**	**$353,000**	**SUBTOTAL**	**$152,000**	**SUBTOTAL**	**$1,313,000**	**SUBTOTAL**	**$2,329,000**						
				30% Conting.	$9,000	**30% Conting.**	$106,000	**30% Conting.**	$46,000	**30% Conting.**	$394,000	**30% Conting.**	$699,000						
				BASE TOTAL	**$37,000**	**BASE TOTAL**	**$459,000**	**BASE TOTAL**	**$198,000**	**BASE TOTAL**	**$1,707,000**	**BASE TOTAL**	**$3,028,000**						
ADDITIVE ALTERNATE																			
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0	4	$24,000		$0						
510-AW-8" DIA	PIPE, 18" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$120		$0		$0		$0	800	$96,000		$0						
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$120,000**	**ALT.TOTAL**	**$0**						
				CONSTR.	**$37,000**	**CONSTR.**	**$459,000**	**CONSTR.**	**$198,000**	**CONSTR.**	**$1,827,000**	**CONSTR.**	**$3,028,000**						
	Permits/Coord (2%)			**Permit/Coord**	**$1,000**	**Permit/Coord**	**$10,000**	**Permit/Coord**	**$4,000**	**Permit/Coord**	**$37,000**	**Permit/Coord**	**$61,000**						
	Design/PM(12%)			**Design/PM**	**$5,000**	**Design/PM**	**$56,000**	**Design/PM**	**$24,000**	**Design/PM**	**$220,000**	**Design/PM**	**$364,000**						
	PROJECT TOTAL			**PROJECT**	**$50,000**	**PROJECT**	**$525,000**	**PROJECT**	**$250,000**	**PROJECT**	**$2,100,000**	**PROJECT**	**$3,500,000**	**BUNDLE**	**$825,000**	**BUNDLE**	**$2,150,000**	**BUNDLE**	**$3,550,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

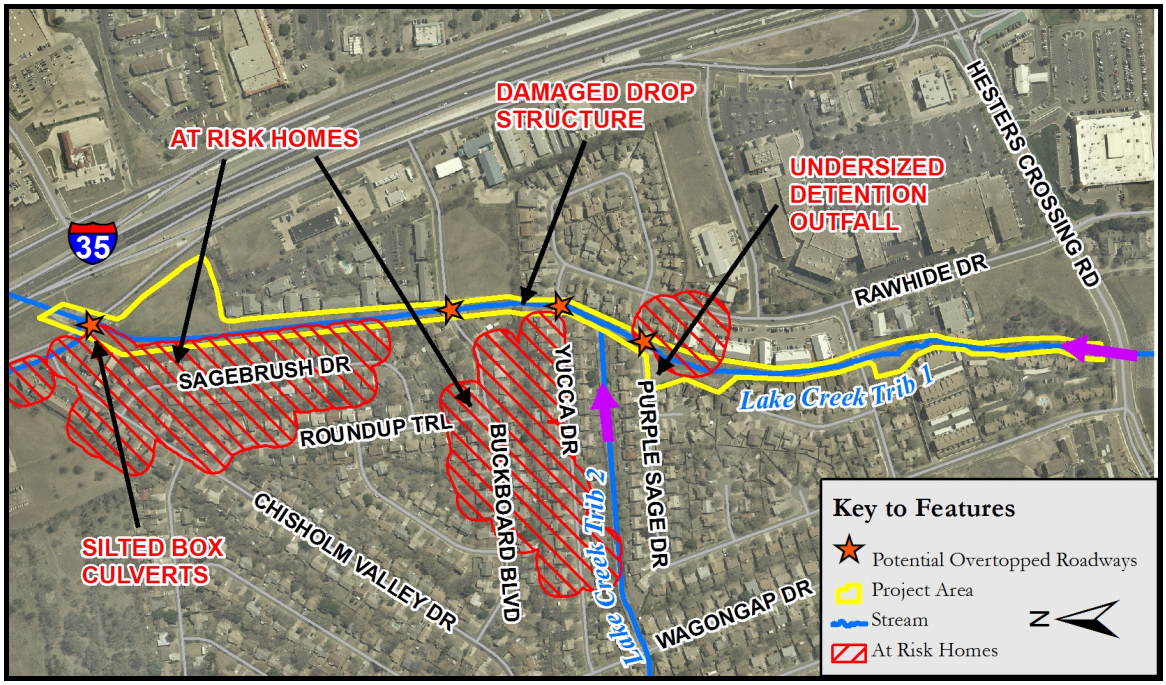
Project: 2013F.2 - Chisholm Valley North-South

Lake Creek Tributary 1

Lake Creek Tributary 1 experiences several issues beginning at Hester's Crossing and ending at the southbound service road of IH-35. The WCID model indicates that the Purple Sage Rd., Yucca Dr., Buckboard Blvd., and IH-35 southbound service road are all overtop by more than 1 ft in the 100-year ultimate storm. The detention pond upstream of Purple Sage Dr. is undersized, and WCID models show that Purple Sage Dr. overtops during the 25-yr event. The WCID model also indicates that over 50 structures are at risk during the 100-yr event along this reach. Just downstream of Yucca Dr. a concrete drop structure is cracked and undermined. The multiple box culverts at the IH-35 southbound frontage road are much wider than the approaching channel, and the outside culverts are showing evidence of siltation. It appears that there is a significant headloss at this expansion point. Additionally, the WCID hydrologic model does not appear to account for the storage at the frontage road and at Purple Sage Dr.



Reference Issues: LC62, LC63, LC64, LC80, LC81



Project: 2013F.2 - Chisholm Valley North-South

Lake Creek Tributary 1

Solution

The existing hydrologic model needs to be revisited to include the detention basin upstream of Purple Sage. It is important to determine if the Purple Sage basin does provide peak flow attenuation at that crossing. The hydrologic model could be modified assuming that one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) is developed. This new basin along with the existing basin at Purple Sage could have significant impacts on reducing the peak flows at Yucca Dr. and Buckboard Blvd. The hydrologic model could be modified assuming some detention at the southbound frontage road of IH-35. Use the information in conjunction in developing some of the other Alternatives. The cracked concrete drop structure downstream of Yucca Drive needs to be replaced with a rock riffle in order to provide additional energy dissipation through the reach.

Challenges

- Discuss grant opportunities with TPWD for development of trails.

- Project 2013F (upstream detention at Frontier Park) could have a major impact on the hydrology in this reach. The resulting hydraulics of reduced flow rates could affect the Alternative solutions.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	2	44
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**463**

2013F.2 – Chisholm Valley North-South Lake Creek Tributary 1

Background

- This Project includes Issue LC62, LC63, LC64, LC80 and LC81.
- The 4,000' reach parallels and is west of IH-35, beginning at Hester's Crossing and ending at the southbound service road of IH-35.
- About half way along this reach is the confluence with Lake Creek Tributary 2.
- This reach has roadway crossings are (from upstream to downstream) Old West Drive, Purple Sage Drive, Yucca Drive and Buckboard Blvd.
- At Purple Sage is a detention basin with four low flow culverts and a fifth culvert with a higher elevation.

Issues

- The WCID model indicates Purple Sage overtops 2' in the 25-year ultimate and 2.4' in the 100-year ultimate.
- The WCID model indicates Yucca Drive overtops 1.2' in the 100-year ultimate.
- The WCID model indicates Buckboard Blvd. overtops 1.4' in the 100-year ultimate.
- The WCID model indicates the southbound frontage road at IH-35 overtops 1.5' in the 100-year ultimate.
- It does not appear that the hydrologic model accounts for the Purple Sage detention basin. The overtopping could be due to this missing computation. The benefit of that basin would diminish moving downstream.
- Just downstream of Yucca Drive is a concrete drop structure. It is cracked and undermined. Adjacent to the right bank is a wastewater manhole that could be in jeopardy.
- The multiple box culverts at the IH-35 southbound frontage road are much wider than the approaching channel. It appears that there is a significant headloss at this expansion point. The outside box culverts are showing evidence of siltation.
- Upstream of the IH-35 south bound frontage road, the right bank of the approach channel has been cut down and widened as if to form another detention basin. It does not appear that the hydrologic model accounts for the additional floodplain storage.

Candidate Alternatives

1. **Additional modeling** – (Cost < $250k).
   - The existing hydrologic model needs to include the detention basin upstream of Purple Sage.
   - It is important to determine if the Purple Sage basin does provide peak flow attenuation at that crossing.
   - The hydrologic model could be modified assuming that one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) is developed. This new basin along with the existing basin at Purple Sage could have significant impacts on reducing the peak flows at Yucca and Buckboard.
   - The hydrologic model could be modified assuming that both of the detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) are developed. These two new basins along with the existing basin at Purple Sage could have significant impacts on reducing the peak flows at Yucca and Buckboard.
   - The hydrologic model could be modified assuming some detention at the southbound frontage road of IH-35. This basin along with one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) and the existing basin at Purple Sage could have significant impacts on reducing the peak flows at the IH-35 frontage road.

- Use the information in conjunction in developing some of the other Alternatives.

2. **Purple Sage Drive** – (Cost $250k-$750k).
   - Should the hydrologic model show the detention basin does provide a benefit, then the outflow structure needs to be modified.
   - Consideration could be given to installing a low height "trash rack" about 10' to 15' upstream of the low flow culverts. The goal would be to collect the trash away from the face of the existing outlet culverts. This would keep them functioning throughout the storm.
   - Should the hydrologic model show the detention basin does not provide a benefit, then the roadway crossing should be replaced with an appropriately sized box culvert (or series of box culverts).
   - Consideration could be given to replacing the structure with a single span concrete arch structure. Removing the adjoining box culverts walls would dramatically reduce the opportunity for trash to collect during a storm.

3. **Yucca Drive** – (Cost < $250k).
   - Examine the hydrologic model assuming that one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) is developed. This new basin along with the existing basin at Purple Sage could have significant impacts on reducing the peak flows at Yucca.
   - Develop a project cost for a culvert replacement.

4. **Buckboard Blvd.** – (Cost < $250k).
   - Examine the hydrologic model assuming that one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) is developed. This new basin along with the existing basin at Purple Sage could have impacts on reducing the peak flows at Buckboard.
   - Develop a project cost for a culvert replacement.

5. **Southbound Frontage Road at IH-35** – (Cost < $250k).
   - Examine the hydrologic model assuming some detention at the southbound frontage road of IH-35. This basin along with one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) and the existing basin at Purple Sage could have significant impacts on reducing the peak flows at the IH-35 frontage road.
   - Examine some channel modifications upstream of the IH-35 box culverts. Widen and lengthen the transition section. Consider a design that would shed the low flows toward the outer box culvert to help reduce sediment buildup. The transition would then allow the larger flood flows to be presented evenly across all the existing box culverts.
   - Develop a project cost for a culvert replacement.

6. **Existing Drop Structure Downstream of Yucca** – (Cost < $250k).
   - Replace (long term) or repair (short term) the cracked and broken drop structure just downstream of Yucca.
   - Examine the "equilibrium slope" in this reach.
     - Replace the structure at the same grade.
     - Raise the new drop structure slightly in order to decrease sediment transport and reduce scour upstream.
   - Examine short term maintenance solutions to extend the life but not be counter to any longer term replacement options.
   - Replacement – concrete, rock revetment mattress, loose rock riffle.

7. **Upstream bank stabilization items** – (Cost < $250k).
   - Repair (short term) headwall and scoured toe of the gabion lined channel downstream of Hester's Crossing.
   - Examine the "equilibrium slope" in this reach.

8. **Develop trails and educational opportunities** – (Cost < $250k).
   - Consideration could be given to developing a linear nature trail linking several residential neighborhoods.
   - Examine methods to provide educational opportunities along the route.

Alternative Bundles

A. **Alternatives 1, 2, 6, & 7** –Perform additional hydrologic modeling. Reach a better understanding of the performance of the existing detention basin at Purple Sage. Provide either short term stabilization or long term remediation for the existing drop structure and adjacent wastewater MH. Provide bank and headwall stabilization along the upstream reaches of the project. (Cost $250k-$750k).

B. **Alternatives 1 & 3** – Perform additional hydrologic modeling. Reach a better understanding of the performance of the existing detention basin at Purple Sage in conjunction with proposed improvements in Project 2013F and the effects upon Yucca. (Cost $250k-$750k).

C. **Alternatives 1 & 4**– Perform additional hydrologic modeling. Reach a better understanding of the performance of the existing detention basin at Purple Sage in conjunction with proposed improvements in Project 2013F and the effects upon Buckboard. (Cost $250k-$750k).

D. **Alternatives 1 & 5**– Perform additional hydrologic modeling. Reach a better understanding of the performance of the existing detention basin at Purple Sage in conjunction with proposed improvements in Project 2013F and the effects upon SBFR at IH-35. (Cost < $250k).

E. **Alternatives 8** – Provide recreation and educational opportunities along this reach. (Cost < $250k).

Challenges

- Discuss grant opportunities with TPWD for development of trails.

Notes

- Project 2013F (upstream detention at Frontier Park) could have a major impact on the hydrology in this reach. The resulting hydraulics of reduced flow rates could affect the Alternative solutions (and bundles).

Project: 2013F.2
Name: Chisholm Valley North-South
Issue: LC62, LC63, LC64, LC80, LC81
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

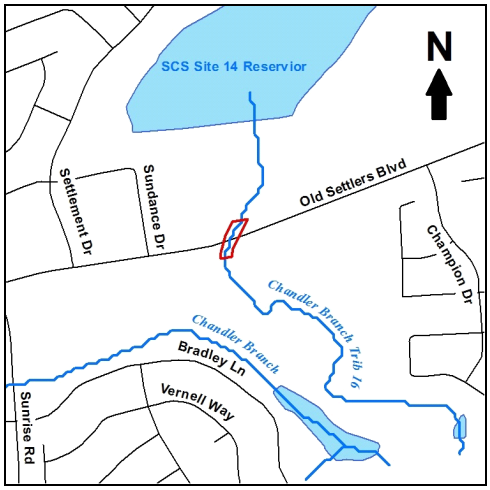
				Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Bundle A		Bundle B		Bundle C		Bundle D		Bundle E	
				Additional modeling		Purple Sage Drive		Yucca Drive		Buckboard Blvd.		SB Frontage Road IH-35		Existing drop structure downstream of Yucca Dr.		Bank stabilization items downstream of Hester's Crossing		Develop trails and educational opportunities		Alternatives: 1+2+6+7		Alternatives: 1+3		Alternatives: 1+4		Alternatives: 1+5		Alternatives: 8	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW	LS	$5,000		$0		$0		$0		$0		$0		$0		$0		$0	1	$50,000	1	$50,000	1	$50,000	1	$50,000	1	
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0		$0		$0	400	$16,000		$0		$0	2	$300,000	2		2		2		2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0	200	$3,000	100	$1,500	100	$1,500		$0		$0		$0		$0	3		3	$275,000	3		3		3	
0110 2001	EXCAVATION (ROADWAY)	CY	$25		$0	889	$22,222	533	$13,333	533	$13,333		$0		$0		$0		$0	4		4		4	$275,000	4		4	
110	EXACAVATION (Channel)	CY	$35		$0		$0		$0		$0	1,778	$62,222	533	$18,667		$0		$0										
132	EMBANKMENT (DG trail)	SY	$50		$0	889	$44,444	533	$26,667	533	$26,667		$0		$0		$0	3,333	$166,667	5		5		5		5	$225,000	5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0		$0		$0		$0		$0		$0	6	$100,000	6		6		6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0		$0		$0	133	$1,067		$0		$0	7	$125,000	7		7		7		7	
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0	267	$26,667	267	$26,667	267	$26,667		$0		$0		$0		$0	8		8		8		8		8	$275,000
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0	80	$640	60	$480	60	$480		$0		$0		$0		$0										
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0		$0		$0		$0		$0		$0										
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0		$0		$0	400	$24,000	1,007	$60,444		$0										
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0		$0		$0		$0		$0		$0										
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0		$0		$0		$0		$0		$0										
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0	160	$13,600	160	$13,600		$0		$0		$0		$0										
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0	80	$48,000	120	$72,000	120	$72,000		$0		$0		$0		$0										
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0		$0		$0		$0		$0		$0										
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0		$0		$0		$0		$0		$0										
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0		$0		$0		$0		$0		$0										
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0		$0		$0										
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0		$0		$0										
0466	HEADWALL (metal trash rack)	LS	$8,000		$0	1	$8,000		$0		$0		$0		$0		$0		$0										
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0		$0		$0		$0		$0		$0										
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0		$0		$0		$0		$0		$0										
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0		$0		$0		$0		$0		$0										
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0		$0		$0		$0		$0		$0										
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$0	1	$17,100	1	$16,300	1	$16,300	1	$12,200		$6,000	1	$6,000	1	$16,700										
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0	1	$9,000	1	$9,000	1	$9,000		$0		$0		$0		$0										
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0		$0		$0		$0		$0		$0										
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0		$0		$0		$0		$0		$0										
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0	200	$4,000		$0		$0		$0	1	$20		$0		$0										
0531 2004	CONC SIDEWALKS (4") (ditch paving)	SY	$45		$0	111	$5,000		$0		$0	1,333	$60,000		$0		$0		$0										
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0		$0		$0		$0		$0		$0										
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0		$0		$0		$0		$0		$0										
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0		$0		$0		$0		$0		$0										
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0		$0		$0		$0		$0		$0										
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0		$0		$0		$0		$0		$0										
				SUBTOTAL	**$1**	**SUBTOTAL**	**$189,000**	**SUBTOTAL**	**$180,000**	**SUBTOTAL**	**$180,000**	**SUBTOTAL**	**$135,000**	**SUBTOTAL**	**$66,000**	**SUBTOTAL**	**$67,000**	**SUBTOTAL**	**$184,000**										
				30% Conting.		**30% Conting.**	$57,000	**30% Conting.**	$54,000	**30% Conting.**	$54,000	**30% Conting.**	$41,000	**30% Conting.**	$20,000	**30% Conting.**	$21,000	**30% Conting.**	$56,000										
				BASE TOTAL	**$1**	**BASE TOTAL**	**$246,000**	**BASE TOTAL**	**$234,000**	**BASE TOTAL**	**$234,000**	**BASE TOTAL**	**$176,000**	**BASE TOTAL**	**$86,000**	**BASE TOTAL**	**$88,000**	**BASE TOTAL**	**$240,000**										
ADDITIVE ALTERNATE																													
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0		$0		$0		$0		$0		$0										
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0		$0		$0		$0		$0		$0										
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**										
				CONSTR.	**$1,000**	**CONSTR.**	**$246,000**	**CONSTR.**	**$234,000**	**CONSTR.**	**$234,000**	**CONSTR.**	**$176,000**	**CONSTR.**	**$86,000**	**CONSTR.**	**$88,000**	**CONSTR.**	**$240,000**										
		Permits/Coord (2%)		**Permit/Coord**	**$1,000**	**Permit/Coord**	**$5,000**	**Permit/Coord**	**$5,000**	**Permit/Coord**	**$5,000**	**Permit/Coord**	**$4,000**	**Permit/Coord**	**$2,000**	**Permit/Coord**	**$2,000**	**Permit/Coord**	**$5,000**										
		Design/PM(12%)		**Design/PM**	**$25,000**	**Design/PM**	**$30,000**	**Design/PM**	**$29,000**	**Design/PM**	**$29,000**	**Design/PM**	**$22,000**	**Design/PM**	**$11,000**	**Design/PM**	**$11,000**	**Design/PM**	**$29,000**										
		PROJECT TOTAL		**PROJECT**	**$50,000**	**PROJECT**	**$300,000**	**PROJECT**	**$275,000**	**PROJECT**	**$275,000**	**PROJECT**	**$225,000**	**PROJECT**	**$100,000**	**PROJECT**	**$125,000**	**PROJECT**	**$275,000**	**BUNDLE**	**$575,000**	**BUNDLE**	**$325,000**	**BUNDLE**	**$325,000**	**BUNDLE**	**$275,000**	**BUNDLE**	**$275,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

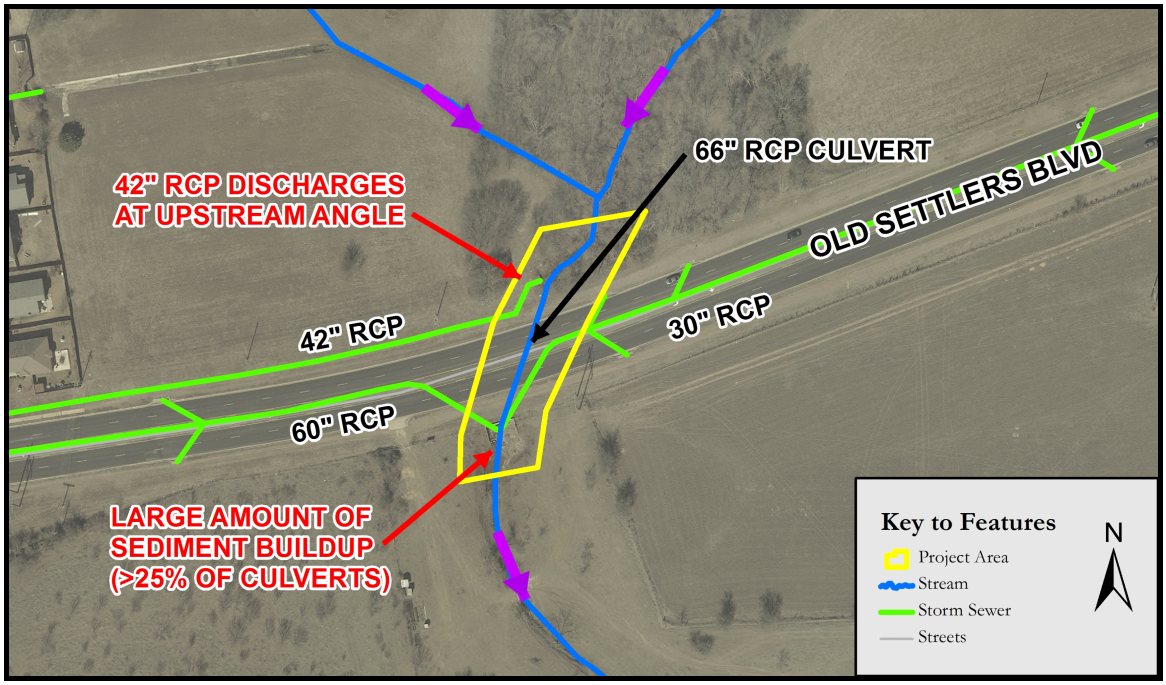
Project: 2013G - Old Settlers Blvd. at Dam 14 Trib

Chandler Branch Tributary 16

Chandler Branch Tributary 16 passes under Old Settlers Blvd. through a 66" RCP. At the upstream headwall of Old Settlers Blvd, a 42" stormwater RCP discharges in the upstream direction, which causes a large amount of head loss and conveyance issues. On the downstream side of Old Settlers Blvd a 60" RCP coming from the west and a 30" RCP coming from the east join with the 66" RCP (under Old Settlers Blvd) and form 3 outlets at the downstream headwall. The grade just downstream of Old Settlers is flat which causes a large amount of sediment buildup on the downstream side of the culvert crossing. The sediment accumulation could also be caused by low velocities through the culvert caused by the head loss from the upstream (42" RCP). This sediment buildup is clogging 50% of all three of the outlet pipes (66", 60", and 30" RCPs) which could cause Old Settlers Blvd to overtop and the inlets of the stormwater pipes to operate inefficiently during a major event.



Reference Issues: CB11



Project: 2013G - Old Settlers Blvd. at Dam 14 Trib

Chandler Branch Tributary 16

Solution

Modification of the existing culvert system can reduce the head loss caused by the 42" RCP stormwater outfall discharging at an upstream angle. Replacement of the 66" culvert with a 6' x 6' box culvert will allow the 42" stormwater outfall to tie in under Old Settler Blvd and discharge at a downstream angle. The two other stormwater outfalls (60" and 30" RCPs) could also tie in under the roadway in order to create a single culvert outlet on the downstream side of Old Settlers Blvd. Allowing these stormwater outfalls to discharge at downstream angles will decrease head loss and increase velocities allowing the sediment to move further downstream. Construction of a sloped concrete apron on the downstream side of the culvert will further reduce the sediment buildup and erosive forces.

Challenges

- The temporary constriction or shutdown of Old Settlers Blvd during modification to the existing culvert system would cause significant traffic issues.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	2	54
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**302**

2013G – E Old Settlers Blvd & Chandler Branch Tributary 16

Background

- This project includes Issue CB11
- The Project area is just downstream of Meadow Lake.
- The current UBCWCID hydraulic models do not include the addition of the flows from the 3 stormwater pipes that outfall at the crossing of Chandler Branch Tributary 16 and Old Settlers Blvd (42", 60", and 30" RCP's).

Issues

- A 42" stormwater RCP discharges at the upstream headwall of the Old Settlers Blvd crossing. This stormwater outfall discharges at an upstream angle causing head loss and conveyance issues for the 66" RCP that passes under Old Settlers Blvd.
- The grade just downstream of Old Settlers Blvd is flat causing a large amount of sediment buildup on the downstream side of the culvert crossing. This sediment buildup is clogging the culvert along with the two stormwater RCP's (60" and 42") which discharge at the downstream headwall.
- This sediment buildup is blocking over 50% of the outfall pipes at the downstream headwall which could cause Old Settlers Blvd to overtop and the inlets of the stormwater pipes to operate inefficient during a major event.
- Noted sediment buildup is causing standing water at the culvert entrance which could lead to a water quality issue.

Candidate Alternatives

1. **Culvert Modification** – Modification of the existing culvert system to reduce the head loss caused by the 42" RCP stormwater outfall discharge upstream. (Under $250k)
   - Replace existing 66" RCP with a 6' x 6' box culvert.
   - Change the outfall point of the 42" RCP to discharge under the roadway into the box culvert at a downstream angle.
   - Would reduce the head loss and increase the velocity which could help alleviate the sediment buildup on the downstream end of the culvert.
   - Could also tie in outfalls from the east and west (60" and 30" RCP's) under the roadway if needed.
2. **Removal of Sediment Buildup** – Removal of large sediment buildup at the culvert outlet to increase conveyance. (Under $250k)
   - Sediment buildup could have been caused by a single event and does not need a more sophisticated solution.
   - Removal of this sediment will lead to increased capacity and conveyance through the culvert and stormwater outfalls. If the sediment returns then look into construction a concrete apron.
   - Monitor to see if sediment deposits return.
3. **Concrete Apron** – Construction of a sloped concrete apron on the downstream side of the culvert to increase velocity and decrease sediment buildup. (Under $250k)
   - Concrete apron will increase grade at the outlet of the culvert under Old Settlers.
   - Could reduce the amount of sediment deposited at the culvert outlet.
   - Tie back into existing grade downstream with appropriate energy dissipation (e.g. loose rock rip rap).

Alternative Bundles

A. Alternatives 1 & 2 – Will reduce the head loss caused by the 42" stormwater outfall and thereby increasing the velocity through the culvert. This increased velocity could prevent any future sediment buildup at the culvert exit once the existing sediment is clear. (Cost $250k-$750k)

B. Alternative 1 & 3 –Changing the 42" stormwater RCP to discharge at downstream angle under the roadway will increase the velocity through the system. Construction of a sloped concrete apron will ensure

that further sediment buildup does not restrict flow on the downstream side of Old Settlers Blvd. ($250k-$750k)

Challenges

- The temporary constriction or shutdown of Old Settlers Blvd during modification to the existing culvert system would cause significant traffic issues.

Notes:

- UBCWCID models have incorrect flows for the 25-yr and 100-yr Ultimate events.
- Increases in the velocity through the culvert system could lead to sediment depositing in Rock Hollow Park Pond downstream.

Project: 2013G
Name: Old Settlers Blvd at Dam 14 Trib.
Issue: CB11
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1 Culvert modification		Alternative 2 Removal of sediment buildup		Alternative 3 Concrete Apron		Bundle A Alternatives: 1+2		Bundle B Alternatives: 1+3	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE RCPs)	LS	$15,000	1	$15,000		$0		$0	1	$225,000	1	$225,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0	2	$75,000	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3		3	$125,000
0110 2001	EXCAVATION (ROADWAY)	CY	$50	356	$17,778		$0		$0	4		4	
0110 2001	EXCAVATION (Channel)	CY	$35		$0	889	$31,111	889	$31,111				
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0	5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0	6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100	133	$13,333		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8	120	$960		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0	93	$37,037				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0				
462.00	CONC BOX CULV (6FT X 6FT)	LF	$450	120	$54,000		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000	2	$20,000		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$13,500	1	$3,100	1	$6,800				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$12,000	1	$12,000		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20	80	$1,600		$0		$0				
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0				
				SUBTOTAL	**$149,000**	**SUBTOTAL**	**$35,000**	**SUBTOTAL**	**$75,000**				
				30% Conting.	$45,000	**30% Conting.**	$11,000	**30% Conting.**	$23,000				
				BASE TOTAL	**$194,000**	**BASE TOTAL**	**$46,000**	**BASE TOTAL**	**$98,000**				
ADDITIVE ALTERNATE													
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$194,000**	**CONSTR.**	**$46,000**	**CONSTR.**	**$98,000**				
	Permits/Coord (2%)			**Permit/Coord**	**$4,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$2,000**				
	Design/PM(12%)			**Design/PM**	**$24,000**	**Design/PM**	**$6,000**	**Design/PM**	**$12,000**				
	PROJECT TOTAL			**PROJECT**	**$225,000**	**PROJECT**	**$75,000**	**PROJECT**	**$125,000**	**BUNDLE**	**$300,000**	**BUNDLE**	**$350,000**

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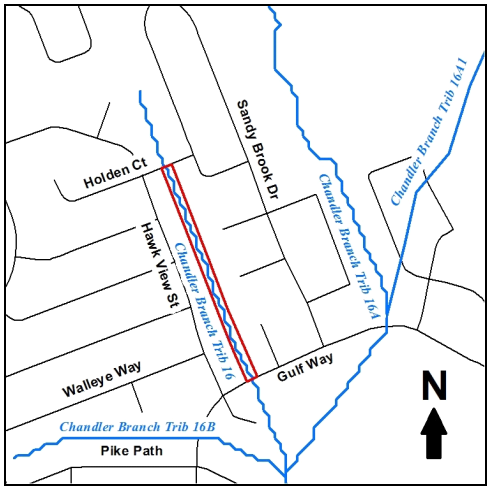
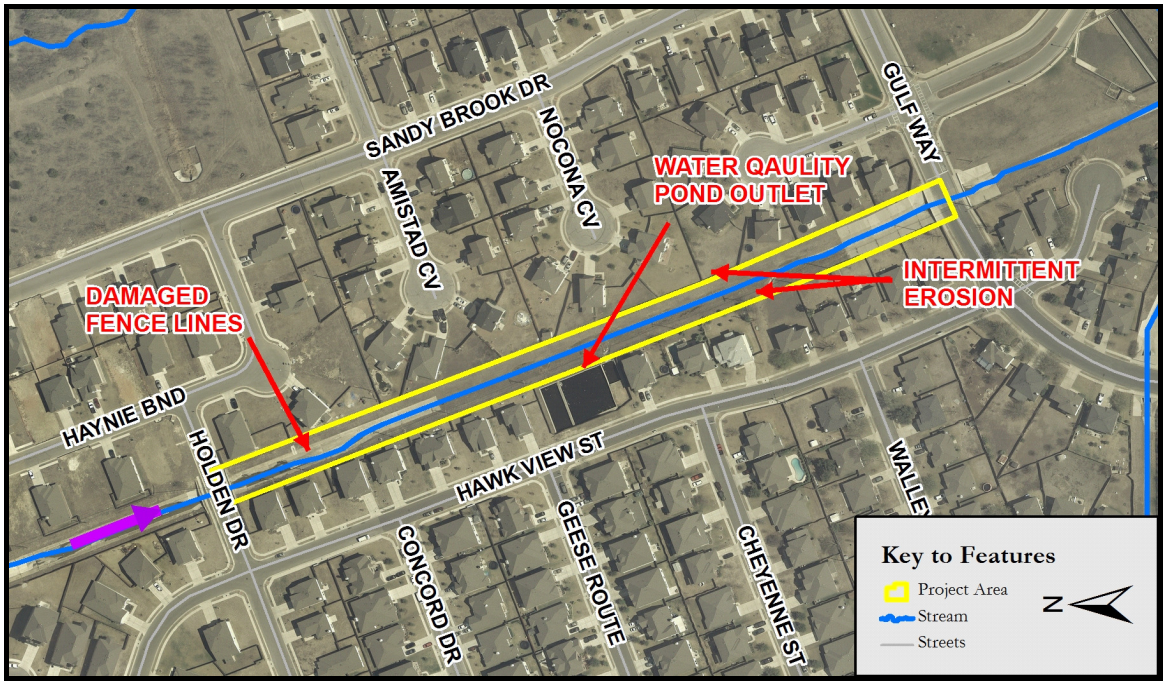
Project: 2013H - Eagle Ridge - Lake Side

Chandler Branch Tributary 16

This 2,400 foot reach is an engineered linear earthen channel with a concrete pilot channel and a slope of 0.8 percent. The earthen channel is subject to intermittent erosion as the water depth gets just higher than the concrete pilot channel. The erosion patterns appear to meander from side to side of the concrete channel. The vegetation on the east side of the channel (gets direct sunlight from the south and west) has not taken hold and the earthen channel is bare. Toward the north end of the reach (toward Holden Dr.) the concrete pilot channel moves toward the west side of the channel leaving the slope of the earthen ditch bank with a steep slope. The wooden privacy fences in this short reach are being undercut and impacted. A water quality basin exists on the west side about half way along the channel. The outlet is regulated with rock rip rap with the outflow moving under the existing wooden fence. The earthen channel is not armored and about two feet of scour has occurred (partially endangering an existing power pole).



Reference Issues: CB19



Project: 2013H - Eagle Ridge - Lake Side

Chandler Branch Tributary 16

Solution

To solve the meandering erosive issue about one foot of a nine foot wide permanent turf reinforcement mat (TRM) could be inserted vertically adjacent to the edge of the concrete pilot channel. The remaining width of TRM could be extended out over the earthen channel then anchor and vegetate. The TRM will provide a transition buffer zone that will dampen the higher velocities of the concrete pilot channel as the stormwater moves laterally out into the rest of the earthen channel. Soil amendments to the left bank (east) of compost or fungi will help support grasses and will allow vegetation to take place without temporary irrigation. The armoring of the water quality basin outlet needs to be extended from the fence line to the concrete pilot channel. The existing scour hole will need to be filled with soil and armored with TRM. This solution would help the riparian corridor by vegetating the banks and improving the soil balance.

Challenges

- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	1	24
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	3	39
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**311**

2013H – Chandler Branch Tributary 16

Background

- This Project includes Issue CB19.
- This 2,400 foot reach is an engineered linear earthen channel with a concrete pilot channel. The north end of the reach is Holden Drive and the south end is Gulfway Drive. The channel is east of and parallels Hawkview Street.
- The elevation difference over this reach is 20 feet for an average channel slope of 0.8%.
- The eastern edge of the entire channel is bounded with a short concrete retaining wall (about 3 feet) with wooden fences at the top.

Issues

- The earthen channel is subject to intermittent erosion as the water depth gets just higher than the concrete pilot channel. The erosion patterns appear to meander from side to side of the concrete channel.
- The vegetation on the east side of the channel (gets direct sunlight from the south and west) has not taken hold and the earthen channel is bare.

Candidate Alternatives

1. **Notched Pilot Channel** – Recess the concrete pilot channel down into the earthen channel about one foot. (Cost < $250k).
   - Would help contain more of the flow before overflow would begin.
   - There could be grade conflicts in the downstream reach as this lowered reach joins other infrastructure that will not have a modified invert elevation.
   - As the flow exceeds this rectangular shape the "meandering erosion patterns" could still take place.
2. **Turf Mat Runners** – Insert about one foot of a nine foot wide permanent turf reinforcement mat (TRM) vertically adjacent to the edge of the concrete pilot channel. Extend the remaining width of TRM out over the earthen channel. Vegetate. Anchor. (Cost < $250k).
   - The TRM will provide a transition buffer zone that will dampen the higher velocities of the concrete pilot channel as the stormwater moves laterally out into the rest of the earthen channel.
   - Without trying to predict the location of the meander pattern back and forth across the concrete pilot channel, simply armoring this buffer zone would provide protection.
   - The entire width of the earthen channel would not require TRM. Just the Turf Mat Runners. It could be possible for a temporary TRM (or a "spray on" flexible growth media" material) to be installed to help get vegetation established on the east bank.
   - Using TRM on the upper slope along a short length of the northern reach would help stabilize the steep sloped earthen banks.
   - This TRM option would help stabilize the transition buffer zone on "opening day" (right after installation) even before any vegetation would grow to further reinforce the mat.
3. **Soil Amendments** – Take two soil samples along the east side of the channel and compare them to two soil samples from the west side of the channel. (Cost < $250k).
   - Determine the type of soil amendments that would help the east side support vegetation.
   - Amendments could include compost or fungi.
   - Create a proper "fungi to bacteria ratio" to help the soil support grasses.
   - Providing good soil texture will help with moisture retention. Vegetation should be able to become established even without temporary irrigation.
   - Selecting a good quickly germinating grass will help. Allow time for some of the other slower grasses to become established. The objective is to have a sustainable short grass overbank channel requiring minimal maintenance.
   - This alternative would help the riparian corridor. For example, both banks would be vegetated. Grasses would be used. Plant health would be improved.

Alternative Bundles

A. **Alternatives 2 & 3** – Stabilizes the meandering erosion along the edge of the concrete pilot channel. Gets the eastern channel bank vegetated. (Cost < $250k).

B. **Alternative 1 & 3** – Reduces but does not eliminate the meandering erosion along the edge of the concrete pilot channel. Gets the eastern channel bank vegetated. (Cost $250k-$750k).

Challenges

-

Notes

- There is no UBC-WCID model for this reach.

Project: 2013H
Name: Eagle Ridge - Lake Side
Issue: CB19
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1 Notched pilot channel		Alternative 2 Turf mat "runners"		Alternative 3 Soil amendments		Bundle A Alternatives: 2+3		Bundle B Alternatives: 1+3	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1		1	$250,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0	2	$125,000	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3	$50,000	3	$50,000
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0	4		4	
0110 2001	EXCAVATION (Channel)	CY	$45	711	$32,000	178	$8,000		$0				
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0	5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0	8,000	$16,000	6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$14,400	1	$6,700	1	$2,400				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0				
506	EROSION CONTROL	SY	$2	5,333	$10,667	5,333	$10,667		$0				
506	EROSION CONTROL (permanent TRM)	SY	$9		$0	4,800	$43,200		$0				
506	EROSION CONTROL (soil amendments)	SY	$1	5,333	$5,333	5,333	$5,333	8,000	$8,000				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0				
0531 2004	CONC SIDEWALKS (4") (ditch paving)	SY	$45	2,133	$96,000		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0				
				SUBTOTAL	**$159,000**	**SUBTOTAL**	**$74,000**	**SUBTOTAL**	**$27,000**				
				30% Conting.	$48,000	**30% Conting.**	$23,000	**30% Conting.**	$9,000				
				BASE TOTAL	**$207,000**	**BASE TOTAL**	**$97,000**	**BASE TOTAL**	**$36,000**				
ADDITIVE ALTERNATE													
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$207,000**	**CONSTR.**	**$97,000**	**CONSTR.**	**$36,000**				
		Permits/Coord (2%)		**Permit/Coord**	**$5,000**	**Permit/Coord**	**$2,000**	**Permit/Coord**	**$1,000**				
		Design/PM(12%)		**Design/PM**	**$25,000**	**Design/PM**	**$12,000**	**Design/PM**	**$5,000**				
		PROJECT TOTAL		**PROJECT**	**$250,000**	**PROJECT**	**$125,000**	**PROJECT**	**$50,000**	**BUNDLE**	**$175,000**	**BUNDLE**	**$300,000**

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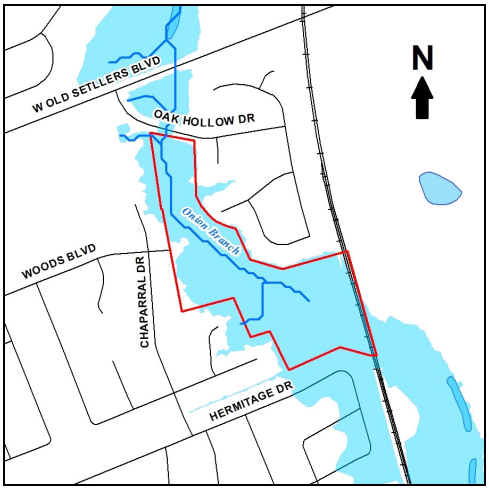
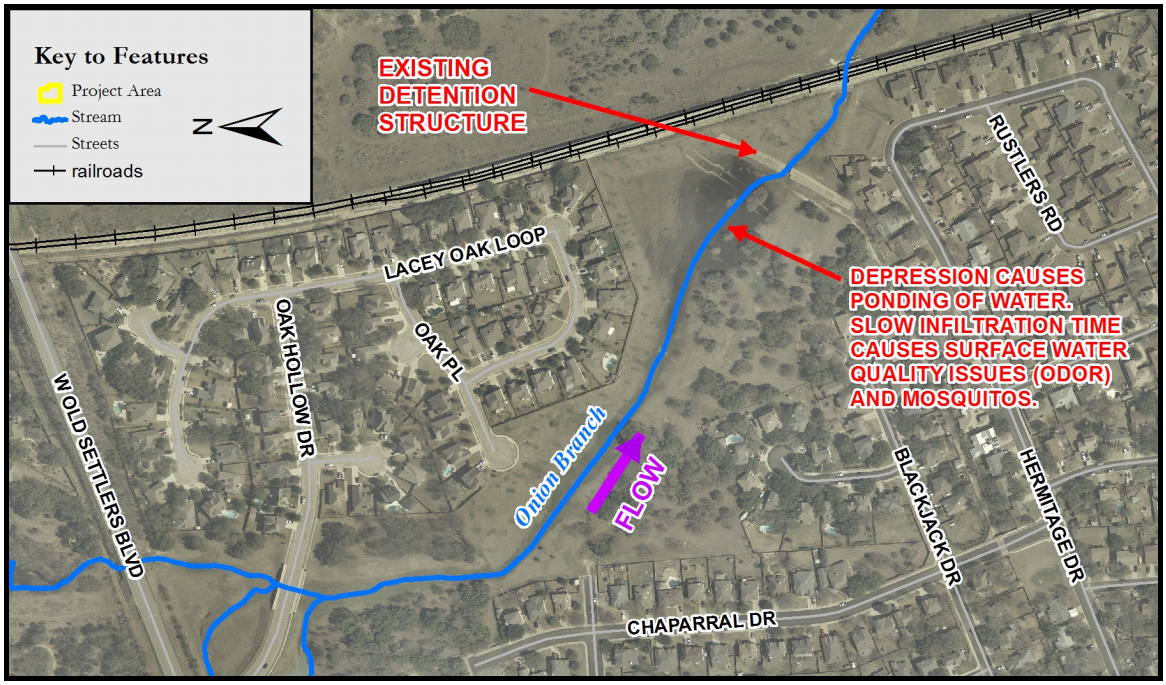
Project: 2013I.1 - The Woods - Oak Hollow

Onion Branch

Onion Branch passes between Oak Hollow and The Woods subdivisions then goes under a Union Pacific Railroad through four 8' x 4' box culverts. There is an existing concrete detention structure just upstream of the railroad crossing. A depression just upstream of the detention structure causes water to pond. This stagnant water contributes to water quality (odor) issues and can provide a breeding ground for mosquitos and other bugs. Additionally, the baffle blocks on the existing detention structure are dense and form a "trash rack" that collects debris and needs frequent maintenance.



Reference Issues: OB29



Project: 2013I.1 - The Woods - Oak Hollow

Onion Branch

Solution

At the detention basin breach the concrete outlet structure and energy dissipation device, but keep the concrete dam crest intact. The existing detention structure is completely inundated by the 100-year storm backwater. This breach would reduce maintenance requirements for trash and storm debris removal at the outlet. The water moves through this area of the reach with a low velocity so the existing energy dissipation is not needed. Specific plants could be added to help minimize standing water by increasing transpiration. The increased transpiration would help reduce the stagnant water and reduce the potential for mosquitos.

Challenges

- Coordination with adjacent HOA regarding the anticipated Level of Effort regarding basin maintenance.
- Coordination with adjacent HOA regarding acceptable plant list.
- This reach is in the Edwards Aquifer Recharge Zone

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**238**

2013I.1 – Onion Branch above the Railroad Trestle

Background

- This Project includes Issue OB29.
- This 2,100' reach is immediately upstream of an existing Railroad Trestle (near Hermitage Dr. and Blackjack Dr.)
- The upstream end of this reach is at Oak Hollow Dr. (just downstream of W. Old Settlers Blvd).
- There is an existing concrete detention structure just upstream of the railroad trestle.
- The crossing under the trestle is made up of four 8'x4' box culverts.
- The backwater from the railroad creates a very flat floodplain slope (essentially a lake) extending upstream to Old Settlers Blvd.
- The natural ground elevation at the east end of Hermitage Dr. is approximately 742 feet.
- The WDIC delineation boundary of the 100-year floodplain is very close to the FEMA delineation.
- The reach is in the Edward's Aquifer Recharge Zone.

Issues

- The railroad trestle is overtopped 2.9 feet in the 25-year event.
- The trestle is overtopped 3.4 feet in the 100-year event with a water surface elevation of 744.4 feet.
- It appears that approximately 10 homes (in the Hermitage Drive area) would become surrounded (or have their access significantly impacted) by the backwater from this railroad trestle overtopping.
- Low spots upstream of the detention structure causes water to pond and become stagnant during minor rain events. This stagnant water provides a breeding ground for mosquitos and raises water quality concerns.

Candidate Alternatives

1. **Leave the existing detention basin in place** – The benefits of keeping this detention basin would be in modifying the lower (more frequent) storm events. (Cost <$250).
   - The existing detention structure is completely inundated by the 100-year storm backwater.
   - Keeping this structure in place could help with groundwater recharge by ponding runoff from the smaller storm events.
   - Specific plants could be added to help minimize standing water (mosquitos) by increasing transpiration.
2. **Modify (breach) the existing detention basin** – Breach the concrete outlet structure and energy dissipation device. Keep the concrete dam crest intact. (Cost <$250).
   - The existing detention structure is completely inundated by the 100-year storm backwater.
   - This would reduce maintenance requirements for trash and storm debris removal at the outlet.
   - Specific plants could be added to help minimize standing water (mosquitos) by increasing transpiration.

Alternative Bundles

A. **Alternatives 2** – Reduce maintenance requirements at the detention basin outlet structure. (Cost <$250k).

B. **Alternatives 1** – Reduce maintenance requirements. (Cost <$250k).

Challenges

- Coordination with adjacent HOA regarding the anticipated Level of Effort regarding basin maintenance.
- Coordination with adjacent HOA regarding acceptable plant list.

Notes

- An UBC-WCID hydraulic model does exist for this reach.

Project: 2013I.1
Name: The Woods - Oak Hollow (drainageway enhancement)
Issue: OB29
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1		Alternative 2		Bundle A		Bundle B	
				Leave existing detention basin in place		Modify (breach) the existing detention basin		Alternatives: 2		Alternatives: 1	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0	1		1	$25,000
0104 2009	REMOVING CONC (RIPRAP Energy Dissipation)	SY	$40		$0	100	$4,000	2	$25,000	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0	3		3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0	4		4	
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0	5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0	6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0				
162	PLANTING (specific "wet footed" native grasses)	LS	$10,000	1	$10,000	1	$10,000				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$1,000	1	$1,400				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0				
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0				
				SUBTOTAL	**$12,000**	**SUBTOTAL**	**$16,000**				
				30% Conting.	$4,000	**30% Conting.**	$5,000				
				BASE TOTAL	**$16,000**	**BASE TOTAL**	**$21,000**				
ADDITIVE ALTERNATE											
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$16,000**	**CONSTR.**	**$21,000**				
	Permits/Coord (2%)			**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**				
	Design/PM(12%)			**Design/PM**	**$2,000**	**Design/PM**	**$3,000**				
	PROJECT TOTAL			**PROJECT**	**$25,000**	**PROJECT**	**$25,000**	**BUNDLE**	**$25,000**	**BUNDLE**	**$25,000**

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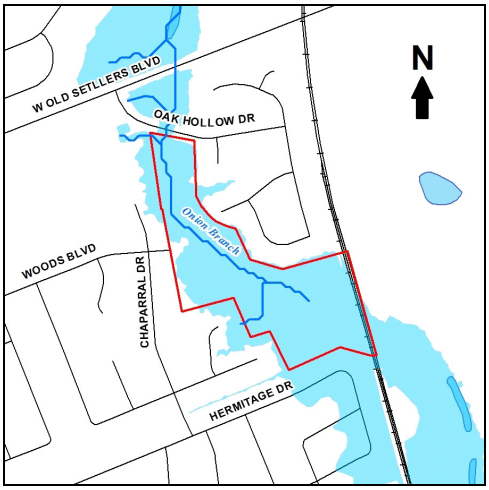
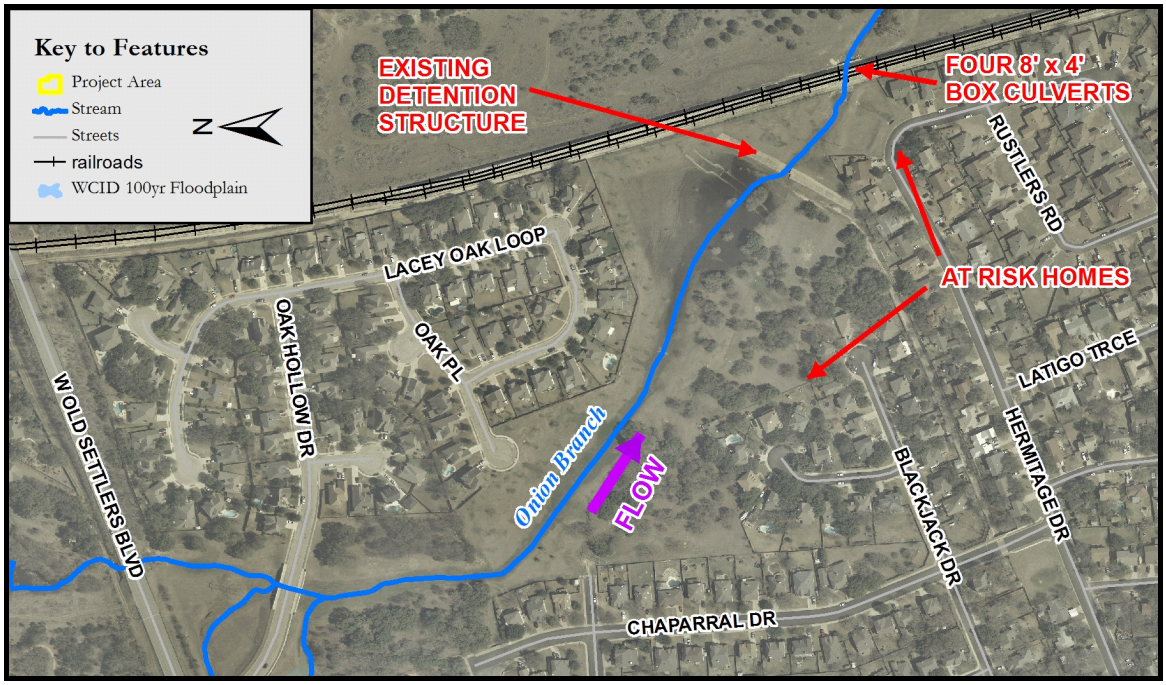
Project: 2013I.2 - The Woods - Oak Hollow

Onion Branch

Onion Branch passes between Oak Hollow and The Woods subdivisions then goes under a Union Pacific Railroad through four 8' x 4' box culverts. There is an existing concrete detention structure just upstream of the railroad crossing. The railroad crossing is overtopped 2.9 feet in the 25-year event and 3.4 feet in the 100-year event according to the WCID ultimate condition models. The backwater from the railroad creates a very flat floodplain slope (essentially a lake) extending upstream to Old Settlers Blvd. It appears that approximately 10 homes (in the Hermitage Drive area) would become surrounded (or have their access significantly impacted) by the backwater from this railroad trestle overtopping.



Reference Issues: OB29



Project: 2013I.2 - The Woods - Oak Hollow

Onion Branch

Solution

Addition of culverts to the railroad crossing can reduce the 25-year WSEL to a degree that the residential roadways would be more passable and the affected homes would be more accessible. Additional concrete pipes could be "jack and bored" through the embankment. The weir flow over the trestle in the 25-year ultimate condition is around 320 cfs. An additional three 48" diameter pipes would help achieve this reduction.

Challenges

- Coordination with the railroad company.
- Length of time to get an agreement with the railroad company.
- Remote chance that the railroad company would participate in the cost of this project.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	5	135
Public Safety	Road Flooding and Mobility	22	1	22
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	1	24
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**321**

2013I.2 – Onion Branch above the Railroad Trestle

Background

- This Project includes Issue OB29.
- This 2,100' reach is immediately upstream of an existing Railroad Trestle (near Hermitage Dr. and Blackjack Dr.)
- The upstream end of this reach is at Oak Hollow Dr. (just downstream of W. Old Settlers Blvd).
- There is an existing concrete detention structure just upstream of the railroad trestle.
- The crossing under the trestle is made up of four 8'x4' box culverts.
- The backwater from the railroad creates a very flat floodplain slope (essentially a lake) extending upstream to Old Settlers Blvd.
- The natural ground elevation at the east end of Hermitage Dr. is approximately 742 feet.
- The WDIC delineation boundary of the 100-year floodplain is very close to the FEMA delineation.
- The reach is in the Edward's Aquifer Recharge Zone.

Issues

- The railroad trestle is overtopped 2.9 feet in the 25-year event.
- The trestle is overtopped 3.4 feet in the 100-year event with a water surface elevation of 744.4 feet.
- It appears that approximately 10 homes (in the Hermitage Drive area) would become surrounded (or have their access significantly impacted) by the backwater from this railroad trestle overtopping.
- Since WCID did not flag this area as having "flooded homes" it is assumed that their FFEs are above 744.4 feet.

Candidate Alternatives

1. **Improve the capacity at the railroad trestle** – The objective of this improvement would be to reduce the 25-year WSEL to a degree that the residential roadways would be more passable and the affected homes would be more accessible. (Cost $250k - $750k).
   - Further modeling would be required to determine just how much additional open area would be required to reduce the 25-year event overtopping by 2.9 feet.
   - Some additional concrete pipes could be "jack and bored" through the embankment.
   - The weir flow over the trestle in the 25-year ultimate condition is around 320 cfs. An additional three 48" diameter pipes would help achieve this reduction.
   - One would think that the railroad would also be interested in pursuing this improvement to reduce the impact upon their rail system.
   - Any alterations of a railroad structure will most certainly take a great amount of coordination with the rail company over an extended period of time.
2. **Improve the capacity at the railroad trestle for the 100-year event** – The objective of this improvement would be to significantly reduce the WSEL in the impacted residential neighborhood. . (Cost $750k-$1M).
   - Further analysis would be required to determine just how much additional open area would be required to reduce the 100-year event overtopping by 3.4 feet.
   - Some additional concrete pipes could be "jack and bored" through the embankment.
   - The weir flow over the trestle in the 100-year ultimate condition is around 1,070 cfs. An additional eight 48" diameter pipes would help achieve this reduction.
   - One would think that the railroad would also be interested in pursuing this improvement to reduce the impact upon their rail system.

- Any alterations of a railroad structure will most certainly take a great amount of coordination with the rail company over an extended period of time.

3. **Buyout the affected homes** – As the cost and coordination time is evaluated in more detail, another option could become more economically viable. That option would be to buyout the 10 affected homes and demolish the structures. The lots could be converted into open space (not necessarily a park). (Cost > $5M).

Alternative Bundles

A. **Alternatives 1** –Reduce the water elevation in the flooded subdivision in an effort to increase mobility and access. (Cost $250k to $750k).

B. **Alternatives 2** –Significantly reduce the water elevation in the flooded subdivision. (Cost $750k-$1M).

C. **Alternative 3** – Remove the affected residential structures. Add open space to the subdivision. (Cost > $5M).

Challenges

- Coordination with the railroad company.
- Length of time to get an agreement with the railroad company.
- Remote chance that the railroad company would participate in the cost of this project.
- Resistance to proceed with the "buyout" alternative.

Notes

- An UBC-WCID hydraulic model does exist for this reach.

Project: 2013I.2
Name: The Woods - Oak Hollow (floodplain reduction)
Issue: OB29
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

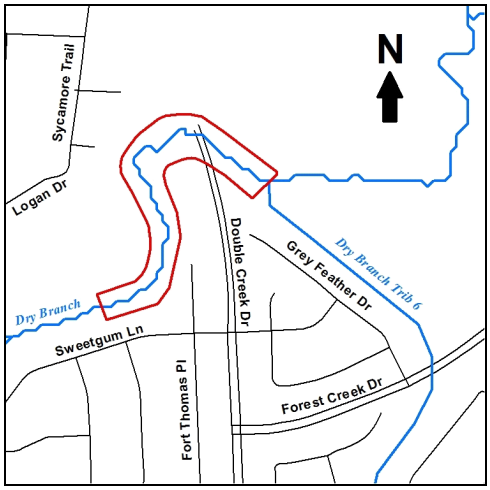
				Alternative 1		Alternative 2		Alternative 3		Bundle A		Bundle B		Bundle C	
				Improve the conveyance at the railroad trestle (25yr)		Improve the connveyance at the railroad trestle (100 year)		Buyout the affected homes		Alternatives: 1		Alternatives: 2		Alternatives: 3	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1	$300,000	1		1	
0100	PREPARING ROW (Buyout homes)	EA	$400,000		$0		$0	10	$4,000,000						
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0	2		2	$1,050,000	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3		3		3	$6,600,000
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0	4		4		4	
110	EXCAVATION (Channel)	CY	$35	200	$7,000	733	$25,667		$0						
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0	5		5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0	6		6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0						
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0						
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0						
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0						
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0						
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0						
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0						
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0						
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0						
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0						
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0						
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0						
464	RC PIPE (CL IV)(48 IN) - (jack and bore)	LF	$400	300	$120,000	1,100	$440,000		$0						
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$7,000	6	$42,000	22	$154,000		$0						
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0						
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0						
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0						
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0						
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0						
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$16,900	1	$62,000	1	$400,000						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0						
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0						
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0						
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0						
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0						
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0						
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0						
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0						
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0						
				SUBTOTAL	**$186,000**	**SUBTOTAL**	**$682,000**	**SUBTOTAL**	**$4,401,000**						
				30% Conting.	$56,000	**30% Conting.**	$205,000	**30% Conting.**	$1,321,000						
				BASE TOTAL	**$242,000**	**BASE TOTAL**	**$887,000**	**BASE TOTAL**	**$5,722,000**						
ADDITIVE ALTERNATE															
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0						
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0						
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**						
				CONSTR.	**$242,000**	**CONSTR.**	**$887,000**	**CONSTR.**	**$5,722,000**						
	Permits/Coord (2%)			**Permit/Coord**	**$5,000**	**Permit/Coord**	**$18,000**	**Permit/Coord**	**$115,000**						
	Design/PM(12%)			**Design/PM**	**$30,000**	**Design/PM**	**$107,000**	**Design/PM**	**$687,000**						
	PROJECT TOTAL			**PROJECT**	**$300,000**	**PROJECT**	**$1,050,000**	**PROJECT**	**$6,600,000**	**BUNDLE**	**$300,000**	**BUNDLE**	**$1,050,000**	**BUNDLE**	**$6,600,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

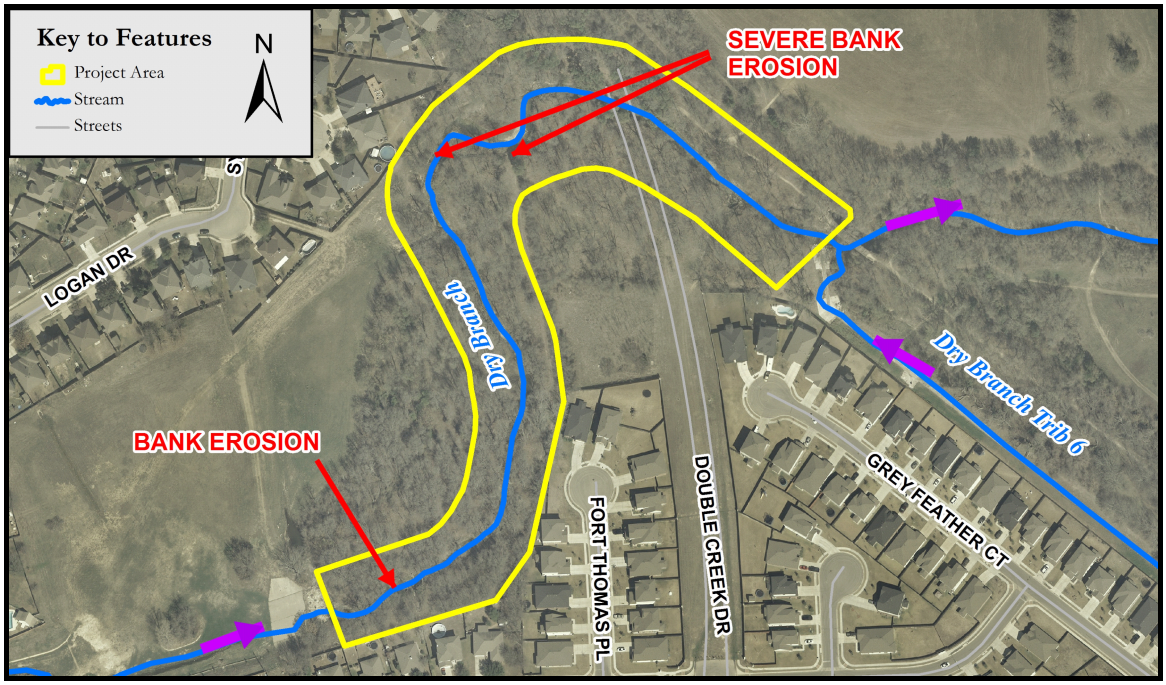
Project: 2013J - South Creek

Dry Branch

This 1700' reach is upstream of the existing railroad trestle located where Double Creek Drive would cross Dry Branch if it were extended. In this reach Dry Branch makes several meander bends each displaying significant bank scour. Several 100 feet of vertical scour with bank heights as much as 10' were observed. WCID hydraulic models indicate velocities upward of 14 fps and water depths of 17 feet in the 100-year event. Unchecked, these meanders may put the homes on Tenanza Cove and Sycamore Trail at risk. The eroded vertical bank is approximately 50' from the fence line of these homes. The land adjacent to this reach is undeveloped open space natural parkland. Although no trails or infrastructure exist in this park, unchecked bank scour certainly diminishes the use of this parkland and might add some risk to the patrons.



Reference Issues: DB31



Project: 2013J - South Creek

Dry Branch

Solution

Installment of longitudinal fill stone toe protection will help protect the outside curves of the meander from encroaching further on the homes along Tenaza Cove and Sycamore Trail. A "pyramid" of larger loose rock approximately 10 feet away from the existing toe will help resist erosive forces. The area behind the toe will be filled in with soil creating a gentler slope, armored with traditional Turf Reinforcement Mat (TRM), and revegetaed. This technique will reclaim some of the eroded bank would not require removal of any large trees. Placement of rock riffle grade control structures downstream and along the erosive area will provide additional energy dissipation. The grade control structures will increase the tailwater elevation and thereby reduce the stream "power" in the problem reach by reducing the slope

Challenges

- Coordination with Parks Department
- This project may need to be timed with the extension of Double Creek Drive.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	2	48
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $750k and $1M)	18	3	54
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	3	39
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**250**

2013J – Dry Branch Channel Stabilization (Double Creek Dr.)

Issues

- This Project includes Issue DB31.
- This 1700' reach is upstream of the existing railroad trestle located where Double Creek Drive would cross Dry Branch if it were extended.
- In this reach Dry Branch makes several meander bends each displaying significant bank scour. Several 100 feet of vertical scour with bank heights as much as 10' were observed.
- WCID hydraulic models indicate velocities upward of 14 fps and water depths of 17 feet in the 100-year event.
- Unchecked, these meanders may put the homes on Tenanza Cove and Sycamore Trail at risk. The eroded vertical bank is approximately 50' from the fence line of these homes.
- The land adjacent to this reach is undeveloped open space natural parkland. Although no trails or infrastructure exist in this park, unchecked bank scour certainly diminishes the use of this parkland and might add some risk to the patrons.
- Improvements in this area could be scheduled to coincide with any future extension of Double Creek Drive to the north over Dry Branch.
- Should this roadway extension be delayed, some interim measures could be required.
- It does not appear that the existing railroad trestle is in any danger from the down cutting or meanders.

Candidate Alternatives

1. **Resistive Bank Stabilization** – Install resistive bank stabilization in order to protect the outside curve of the meander bank from encroaching further on the homes along Tenaza Cove and Sycamore Trail. (Cost $250k to $750k).
   - "Resistive" measures are continuous and are applied directly on the bank and toe (or both).
   - Examples include loose rock rip rap, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - **Longitudinal fill stone toe protection**. Create a "pyramid" of larger loose rocks (perhaps four or five feet tall) located approximately 10 feet away from the existing toe. Fill the area behind this longitudinal toe with soil. Reclaim some of the eroded slope. Move the top of the bank away from the current location. Typically the resulting slopes are gentler and can be armored with traditional Turf Reinforcement Mat (TRM) and revegetated. This technique would not require removal of any large trees and can easily work around/with them.
   - Be sure to anchor the toe and install it deeper than the existing flowline.
   - Some systems have geogrid "tails" that extend well behind the face. Concern about encroaching upon the private property boundary.
   - Armor just the right bank and push the creek toward the left gravel bar. Examination of the water surface elevation is needed to avoid constriction.
   - Pay attention to transitions upstream and downstream of the project area. Resistive armament must blend into the native bank.
   - The option needs to be able to work around existing trees. Minimize tree removal which will decrease stability of the bank.

2. **Redirective Bank Stabilization Measure** – Redirect the flow and energy away from the damaged right bank.

- "Redirective" measures are discontinuous along the bank and must be installed upstream of the problem area.
- The effectiveness of these features is governed by the channel geometry and the length of the channel upstream of the problem area. In this case there is not enough room to have these features work effectively (narrow channel width).
- Redirective measures could include the following:
    - Rock vanes
    - Barbs
    - Bendway weirs
    - Deflectors
    - False point bars
    - Transverse dikes
    - Stone filled dikes
    - Engineered log dams (large wood debris "root wads")

3. **Grade Control** – Add grade control rock riffle structures downstream of and along the erosive area. It appears that this reach is trying to establish a flatter "equilibrium slope" by cutting down the channel invert. Another way to give this reach a flatter slope would be to install natural rock riffles along the entire reach. Additional study of the existing hydraulic model is recommended to determine the desired slope. (Cost $250k to $750k).
    - Grade control structures will increase the tailwater elevation and thereby reduce the stream "power" in the problem reach by reducing the slope.
    - In nature streams typically place riffles at a spacing of 10 to 14 times the bottom width of the channel. Assuming this effective channel width to be around 20' then one would expect a rock riffle to occur every 200' to 280' along the reach. This could equate to six or seven riffles along this entire reach. All of the grade control structures would need to be installed to truly have an effect upon the hydraulics in this reach.
    - Can be used in combination with other alternatives.

Alternative Bundles

A. **Alternatives 1 & 3** – Physically armor the meander bends. Protect existing fences and homes. Reduce the channel side slopes. Stabilize the parkland. Reduce the power in the stream which should lead to reduced requirements (stone size and toe depth) from the armoring structures. . (Cost $750k-$1M).

B. **Alternatives 1** – Physically armor the meander bends. Protect existing fences and homes. Reduce the channel side slopes. Stabilize the parkland. Since the power would not be changed, these armoring structures would have to do all the work by themselves. . (Cost $250k to $750k).

C. **Alternative 3** – Reduce the power in the stream. Slow the attack on the meander banks. The banks would cave in to a stable side slope over time. . (Cost $250k to $750k).

Challenges

- Coordination with Parks Department.
- Coordination with Transportation Department.
- Timing. Wait and do this with any future extension of Double Creek Dr. or proceed at an earlier date as an individual project to keep things from getting worse.

Notes

- An UBC-WCID hydraulic model does exist for this reach.
- With parkland improvements (stabilization) it might be possible to nominate this project for TPWD Grant opportunities.

Project: 2013J
Name: South Creek (big M meander)
Issue: DB31
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1		Alternative 2		Alternative 3		Bundle A		Bundle B		Bundle C	
				Resistive bank stabilization LFSTP		Redirective bank stabilization none		Grade control (estimate 6 structures)		Alternatives: 1+3		Alternatives: 1		Alternatives: 3	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1	$425,000	1	$425,000	1	
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0	2		2		2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3	$750,000	3		3	$750,000
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0	4		4		4	
110	EXCAVATION (Channel)	CY	$40	1,389	$55,556		$0	533	$21,333						
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0	5		5		5	
132	EMBANKMENT (Ordinarly compaction)	CY	$25	2,315	$57,870		$0		$0						
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0	6		6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0						
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0						
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0						
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0						
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0						
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	694	$111,111		$0	2,667	$426,667						
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0						
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0						
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0						
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0						
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0						
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0						
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0						
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0						
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0						
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0						
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0						
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0						
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0						
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$24,900	1	$0	1	$44,800						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0						
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0						
506	EROSION CONTROL	SY	$2	2,222	$4,444		$0		$0						
506	EROSION CONTROL (permanent TRM)	SY	$9	2,222	$20,000		$0		$0						
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0						
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0						
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0						
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0						
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0						
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0						
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0						
				SUBTOTAL	**$274,000**	**SUBTOTAL**	**$1,000**	**SUBTOTAL**	**$493,000**						
				30% Conting.	$83,000	**30% Conting.**	$1,000	**30% Conting.**	$148,000						
				BASE TOTAL	**$357,000**	**BASE TOTAL**	**$2,000**	**BASE TOTAL**	**$641,000**						
ADDITIVE ALTERNATE															
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0						
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0						
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**						
				CONSTR.	**$357,000**	**CONSTR.**	**$2,000**	**CONSTR.**	**$641,000**						
		Permits/Coord (2%)		**Permit/Coord**	**$8,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$13,000**						
		Design/PM(12%)		**Design/PM**	**$43,000**	**Design/PM**	**$1,000**	**Design/PM**	**$77,000**						
		PROJECT TOTAL		**PROJECT**	**$425,000**	**PROJECT**	**$25,000**	**PROJECT**	**$750,000**	**BUNDLE**	**$1,175,000**	**BUNDLE**	**$425,000**	**BUNDLE**	**$750,000**

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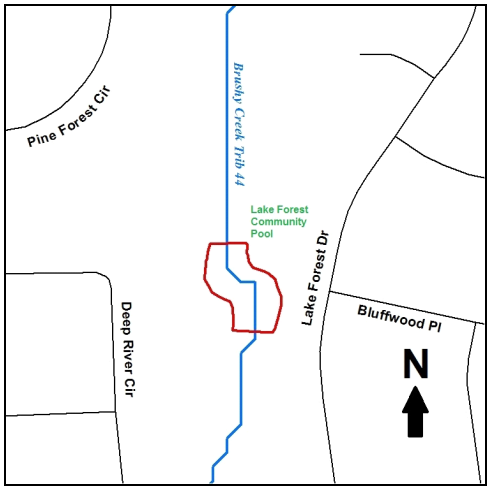
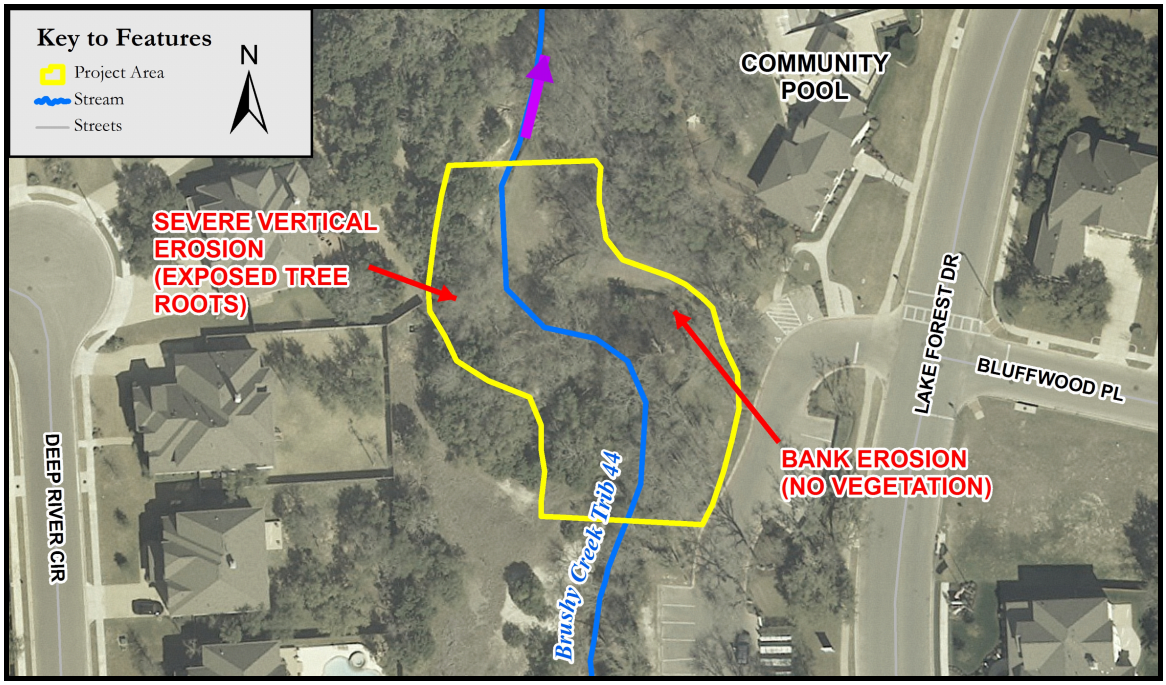
Project: 2013K - Lake Forest

Brushy Creek Tributary 44

A section of Brush Creek Tributary 44 parallels Lake Forest Drive for from Fernspring Drive to Bluffwood Drive. The channel bottom throughout this stretch has a bedrock bottom which creates high velocities in the channel. At the Lake Forest Community Pool, Brushy Creek Tributary 44 enters an S-curve with two approximately 90 degree bends. On the eastern slope of the first bend is a denuded slope with a metal fence on the top of the bank. The scoured slope is nearing the fence and will eventually undermine the fence. This bank also receives western sunlight and cannot support vegetation. The second bend forms a steep bank on the left bank (west). The vertical bank height approaches 10 feet and continued erosion will put several mature trees at risk of falling into the channel bottom.



Reference Issues: BC48



Project: 2013K - Lake Forest

Brushy Creek Tributary 44

Solution

The denuded banks of both bends are in need of resistive bank stabilization to prevent further erosion. Longitudinal fill stone protection (LFSTP) is a "pyramid" of larger loose rocks which will be located 5 to 10 feet from the existing toe. The area behind this longitudinal toe will be filled with soil, reclaiming some of the eroded slope. The resulting slope will be gentler and protected with traditional Turf Reinforcement Mat (TRM) and vegetated. The use of LFSTP will work around existing trees and provide soil that can be revegetated. A soil amendment to the first bend (western) which can include compost or fungi to create a proper "fungi to bacteria ratio" will help with moisture retention and allow vegetation to establish without temporary irrigation.

Challenges

- Close coordination with the Forest Creek HOA will have to be undertaken due to the close proximity to the community pool.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	1	24
Economic Impact	Funding Source	13	2	26
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	3	39
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	4	56
			Project Score	**274**

2013K – Brushy Creek Tributary 44

Background

- This 200' reach parallels Lake Forest Drive and is west of the Bluffwood Place intersection.
- This reach is adjacent to and upstream of the Homeowners Association (HOA) event center and community pool.
- The channel meanders making a hard left turn and then a hard right turn (each of about 90 degrees).
- Storm drainage from Deep River Circle is released into the tributary just before the second bend.
- No WCID hydraulic model is available.

Issues

- This Project includes Issue BC48.
- Entering this S-curve the channel invert is scoured down to the rock. Velocities increase.
- The first bend is a denuded slope. A metal fence has been installed at the top of the bank. The scoured slope is nearing the fence and will undermine it eventually.
- The second bend forms a steep bank on the left bank (looking downstream). Vertical bank heights approach 10 feet.
- With continued erosion several mature trees are in danger of falling into the channel bottom.

Candidate Alternatives

1. **Resistive Bank Stabilization** – Install resistive bank stabilization in order to protect the outside curve of the meander bank from encroaching further on the homes along Tenaza Cove and Sycamore Trail. (Cost < $250k).
   - "Resistive" measures are continuous and are applied directly on the bank and toe (or both).
   - Examples include loose rock rip rap, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - **Longitudinal fill stone toe protection (LFSTP)**. Create a "pyramid" of larger loose rocks (perhaps four or five feet tall) located approximately 10 feet away from the existing toe. Fill the area behind this longitudinal toe with soil. Reclaim some of the eroded slope. Move the top of the bank away from the current location. Typically the resulting slopes are gentler and can be armored with traditional Turf Reinforcement Mat (TRM) and revegetated. This technique would not require removal of any large trees and can easily work around/with them.
   - Any effects from the storm drain outlet from Deep River Circle could be minimized with the use of **loose rock rip rap** in the second bend and blended into the LFSTP.
   - Be sure to anchor the toe and install it deeper than the existing flowline.
   - Some systems have geogrid "tails" that extend well behind the face. Concern about encroaching upon the private property boundary.
   - Armor just the right bank and push the creek toward the left gravel bar. Examination of the water surface elevation is needed to avoid constriction.
   - Pay attention to transitions upstream and downstream of the project area. Resistive armament must blend into the native bank.
   - The option needs to be able to work around existing trees. Minimize tree removal which will decrease stability of the bank.

2. **Redirective Bank Stabilization Measure** – Redirect the flow and energy away from the damaged right bank.
   - "Redirective" measures are discontinuous along the bank and must be installed upstream of the problem area.

- The effectiveness of these features is governed by the channel geometry and the length of the channel upstream of the problem area. In this case there is not enough room to have these features work effectively (narrow channel width).
- Redirective measures could include the following:
    - Rock vanes
    - Barbs
    - Bendway weirs
    - Deflectors
    - False point bars
    - Transverse dikes
    - Stone filled dikes
    - Engineered log dams (large wood debris "root wads

3. Grade Control – Add grade control rock riffle structures downstream of and along the erosive area. It appears that this reach is trying to establish a flatter "equilibrium slope" by cutting down the channel invert. Another way to give this reach a flatter slope would be to install natural rock riffles along the entire reach. Additional study of the existing hydraulic model is recommended to determine the desired slope. (Cost < $250k).
    - Grade control structures will increase the tailwater elevation and thereby reduce the stream "power" in the problem reach by reducing the slope.
    - In nature streams typically place riffles at a spacing of 10 to 14 times the bottom width of the channel. Assuming this effective channel width to be around 20' then one would expect a rock riffle to occur every 200' to 280' along the reach. This reach is only long enough for one riffle which might not provide enough slope modification to be of assistance.
    - Can be used in combination with other alternatives.

4. **Soil Amendments** – Take two soil samples along the east side of the channel and compare them to two soil samples from the west side of the channel. (Cost < $250k).
    - Determine the type of soil amendments that would help the east side support vegetation.
    - Amendments could include compost or fungi to create a proper "fungi to bacteria ratio."
    - Providing good soil texture will help with moisture retention. Vegetation should be able to become established even without temporary irrigation.
    - Selecting a good quickly germinating grass will help. Allow time for some of the other slower grasses to become established. The objective is to have a sustainable short grass overbank channel requiring minimal maintenance.
    - The use of a permanent Turf Reinforcement Mat (TRM) may be required in the first bend.
    - Pedestrian traffic along the eastern bank may need to be modified or curtailed for two years to allow proper vegetation establishment.
    - This alternative would help the riparian corridor. For example, both banks would be vegetated. Grasses would be used. Plant health would be improved.

Alternative Bundles

A. **Alternatives 1 & 4** – Physically armor the meander bends. Protect existing trees and fences. Reduce the channel side slopes. Revegetate denuded slopes. (Cost < $250k)

B. **Alternatives 1** – Physically armor the meander bends. Protect existing trees and fences. Reduce the channel side slopes. (Cost < $250k)

Challenges

- Coordination with HOA.

Notes

- The HOA may be able to provide some cost sharing.

Project: 2013K
Name: Lake Forest (zig zag)
Issue: BC48
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1		Alternative 2		Alternative 3		Alternative 4		Bundle A		Bundle B	
				Resistive bank stabilization LFSTP		Redirective bank stabilization none		Grade control		Soil amendments		Alternatives: 1+4		Alternatives: 1	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0		$0	1	$75,000	1	$75,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0		$0	2		2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0		$0	3		3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0		$0	4	$25,000	4	
110	EXCAVATION (Channel)	CY	$40	111	$4,444		$0	56	$2,222		$0				
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0		$0	5		5	
132	EMBANKMENT (Ordinarly compaction)	CY	$25	167	$4,167		$0		$0		$0				
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0	333	$667	6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0		$0				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0		$0				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0		$0				
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	139	$22,222		$0	46	$7,407		$0				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$3,300	1	$0	1	$1,000	1	$100				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0		$0				
506	EROSION CONTROL	SY	$2	167	$333		$0		$0		$0				
506	EROSION CONTROL (permanent TRM)	SY	$9	167	$1,500		$0		$0		$0				
506	EROSION CONTROL (soil amendments)	SY	$1		$0		$0		$0	333	$333				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0		$0				
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0		$0				
				SUBTOTAL	**$36,000**	**SUBTOTAL**	**$1,000**	**SUBTOTAL**	**$11,000**	**SUBTOTAL**	**$2,000**				
				30% Conting.	$11,000	**30% Conting.**	$1,000	**30% Conting.**	$4,000	**30% Conting.**	$1,000				
				BASE TOTAL	**$47,000**	**BASE TOTAL**	**$2,000**	**BASE TOTAL**	**$15,000**	**BASE TOTAL**	**$3,000**				
ADDITIVE ALTERNATE															
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$47,000**	**CONSTR.**	**$2,000**	**CONSTR.**	**$15,000**	**CONSTR.**	**$3,000**				
		Permits/Coord (2%)		**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**				
		Design/PM(12%)		**Design/PM**	**$6,000**	**Design/PM**	**$1,000**	**Design/PM**	**$2,000**	**Design/PM**	**$1,000**				
		PROJECT TOTAL		**PROJECT**	**$75,000**	**PROJECT**	**$25,000**	**PROJECT**	**$25,000**	**PROJECT**	**$25,000**	**BUNDLE**	**$100,000**	**BUNDLE**	**$75,000**

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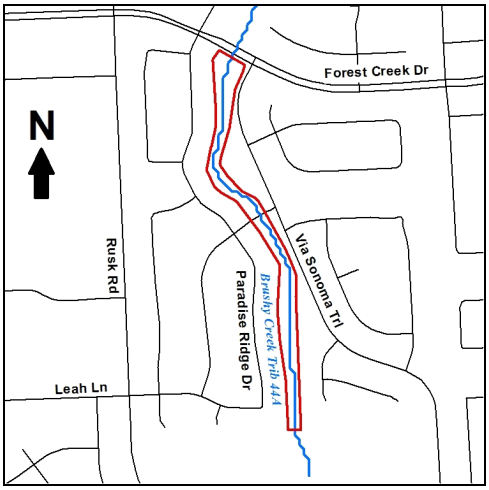
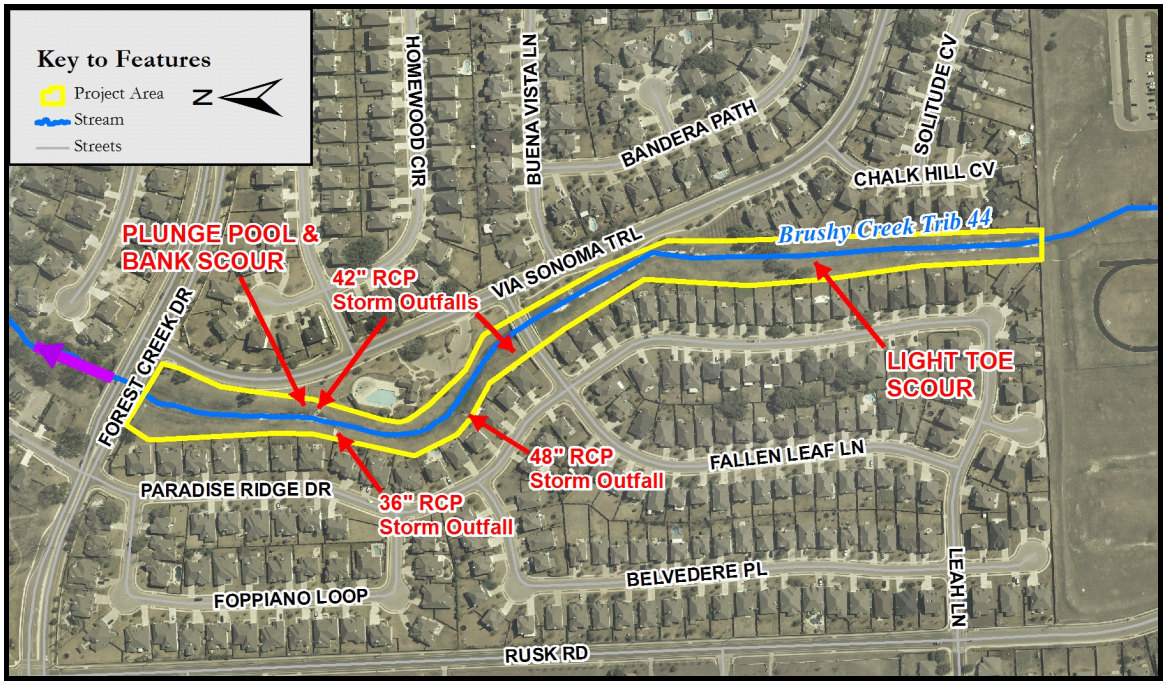
Project: 2013L - Sonoma at Forest Creek Drive

Brushy Creek Tributary 44A

This 2,400' reach parallels Via Sonoma Trail and extends from Leah Lane (southern end) downstream to Forest Creek Drive (northern end). The majority of the channel reach has scoured down to rock. Due to the increased velocity along the rock, the interface with the adjoining bank material is intermittently about one foot in height. Street drainage from Via Sonoma Trail is released into the tributary onto the right (eastern) bank. Although energy dissipation is provided at this headwall, the union with the channel flow has created a plunge pool. Plunge pools are nature's way of creating an energy dissipation feature. The problem at the plunge pool is that the rock-soil interface is being attacked and the banks have been cut roughly six feet deep.



Reference Issues: BC49



Project: 2013L - Sonoma at Forest Creek Drive

Brushy Creek Tributary 44A

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

Solution

Installment of resistive bank stabilization will protect the soil/rock interface at the toe of the channel. In order to slow localized velocities and reduce scour along the rock and soil interface, a thin rock filled gabion wire "revetment mattress" can be placed on top of the irregularly shaped rock invert. The mattress would extend horizontally out into the soil and the soil slopes regarded over the edges of the mattress and revegetated. Loose large rock rip rap can be placed in the "plunge pool" and extended up onto the vegetated soil banks. This would provide additional energy dissipation along with protecting the banks.

Challenges

- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**261**

2013L – Brushy Creek Tributary 44A

Background

- This Project includes Issue BC49.
- This 2,400' reach parallels Via Sonoma Trail and extends from Leah Lane (southern end) downstream to Forest Creek Drive (northern end).
- Overall the earthen channel looks to be in good shape. The side slopes are laid back and vegetated.
- The reach is bounded by park land.

Issues

- The majority of the channel reach has scoured down to rock. Due to the increased velocity along the rock, the interface with the adjoining bank material is scoured in places. The scour extends to about one foot in height.
- Street drainage from Via Sonoma Trail is released into the tributary onto the right/eastern bank (looking downstream). Although energy dissipation is provided at this headwall the union with the channel flow has created a plunge pool. Plunge pools are nature's way of creating an energy dissipation feature.
- The problem at the plunge pool is that the rock-soil interface is being attacked and the banks have been cut roughly six feet deep.

Candidate Alternatives

1. **Resistive Bank Stabilization** – Install resistive bank stabilization in order to protect the soil interface at the toe of the channel. (Cost < $250k).
   - "Resistive" measures are continuous and are applied directly on the bank and toe (or both).
   - Examples include loose rock rip rap, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - Longitudinal fill stone toe protection (LFSTP). Create a "pyramid" of larger loose rocks located away from the existing toe. Fill the area behind this longitudinal toe with soil. Reclaim some of the eroded slope. Move the top of the bank away from the current location. This technique would not require removal of any large trees and can easily work around/with them.
   - The effects from the Via Sonoma Trail storm drain outlet could be minimized with the use of **loose rock rip rap**. The "plunge pool" could be lined with the loose rock and then extend up onto the vegetated soil banks. The energy dissipating depression geometry could generally remain, but the invert and sidewalls would have the benefit of some armoring.
   - **Roughen the rock invert**. The majority of the reach has scoured down to the rock and is now widening slightly. In an effort to slow the localized velocities and reduce the scour along the rock and soil interface, a thin rock filled gabion wire "revetment mattress" could be placed on top of the irregularly shaped rock invert. The mattress would extend horizontally out into the soil. The soil slopes would then be regraded over the top of the mattress and revegetated. The mattress would be "soil choked" and revegetated. Even if the invert did not revegetate, the objective would be to reduce the velocity in the low flow channel such that the short scour ledge at the soil interface would not form.
   - Be sure to anchor the toe and install it deeper than the existing flowline.
   - Pay attention to transitions upstream and downstream of the project area. Resistive armament must blend into the native bank.

2. **Redirective Bank Stabilization Measure** – Redirect the flow and energy away from the damaged right bank.
   - "Redirective" measures are discontinuous along the bank and must be installed upstream of the problem area.
   - The effectiveness of these features is governed by the channel geometry and the length of the channel upstream of the problem area. In this case there is not enough room to have these features work effectively (narrow channel width).
   - Redirective measures could include the following:
     - Rock vanes
     - Barbs
     - Bendway weirs
     - Deflectors
     - False point bars
     - Transverse dikes
     - Stone filled dikes
     - Engineered log dams (large wood debris "root wads")

3. **Grade Control** – Add grade control rock riffle structures downstream of and along the erosive area. It appears that this reach is trying to establish a flatter "equilibrium slope" by cutting down the channel invert. Another way to give this reach a flatter slope would be to install natural rock riffles along the entire reach. Additional study of the existing hydraulic model is recommended to determine the desired slope. (Cost < $250k).
   - Grade control structures will increase the tailwater elevation and thereby reduce the stream "power" in the problem reach by reducing the slope.
   - In nature streams typically place riffles at a spacing of 10 to 14 times the bottom width of the channel. Assuming this effective channel width to be around 10' then one would expect a rock riffle to occur every 100' to 140' along the reach.
   - This alternative would generate shallow pools or water which could be helpful to the habitat along this riparian corridor.
   - Can be used in combination with other alternatives.

Alternative Bundles

A. **Alternatives 1** – Physically armor the plunge pool area. Protect the channel invert. (Cost < $250k)

B. **Alternatives 1 & 3**– Physically armor the plunge pool area. Protect the channel invert. Reduce the low flow velocity along the channel. Provide improved habitat conditions and groundwater recharge opportunities along the reach (Cost < $250k)

Challenges

-

Notes

- This reach passes through park land.

Project: 2013L
Name: Sonoma at Forest Creek Drive
Issue: BC49
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1		Alternative 2		Alternative 3		Bundle A		Bundle B	
				Resistive bank stabilization		Redirective bank stabilization		Grade control		Alternatives: 1		Alternatives: 1+3	
				Loose rock riprap (rough invert)		none							
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1	$75,000	1	$75,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0	2		2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3		3	$25,000
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0	4		4	
110	EXCAVATION (Channel)	CY	$40	200	$8,000		$0	56	$2,222				
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0		$0	5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0	6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0				
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0				
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0				
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0				
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0				
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	200	$32,000		$0	46	$7,407				
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0				
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0				
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0				
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0				
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0				
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0				
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0				
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0				
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0				
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0				
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0				
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0				
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$4,000	1	$0	1	$1,000				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0				
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0				
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0				
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0				
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0				
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0				
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0				
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0				
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0				
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0				
				SUBTOTAL	**$45,000**	**SUBTOTAL**	**$1,000**	**SUBTOTAL**	**$11,000**				
				30% Conting.	$14,000	**30% Conting.**	$1,000	**30% Conting.**	$4,000				
				BASE TOTAL	**$59,000**	**BASE TOTAL**	**$2,000**	**BASE TOTAL**	**$15,000**				
ADDITIVE ALTERNATE													
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0				
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0				
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**				
				CONSTR.	**$59,000**	**CONSTR.**	**$2,000**	**CONSTR.**	**$15,000**				
		Permits/Coord (2%)		**Permit/Coord**	**$2,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**				
		Design/PM(12%)		**Design/PM**	**$8,000**	**Design/PM**	**$1,000**	**Design/PM**	**$2,000**				
		PROJECT TOTAL		**PROJECT**	**$75,000**	**PROJECT**	**$25,000**	**PROJECT**	**$25,000**	**BUNDLE**	**$75,000**	**BUNDLE**	**$100,000**

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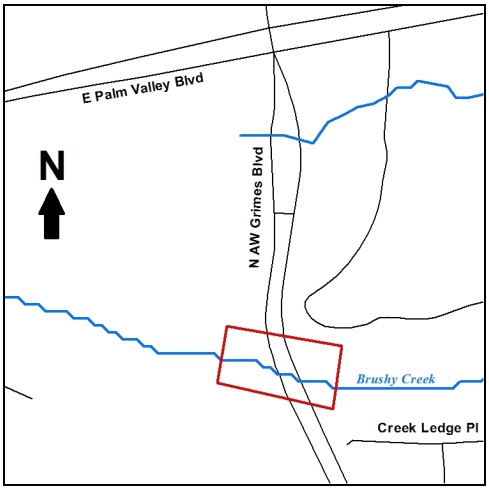
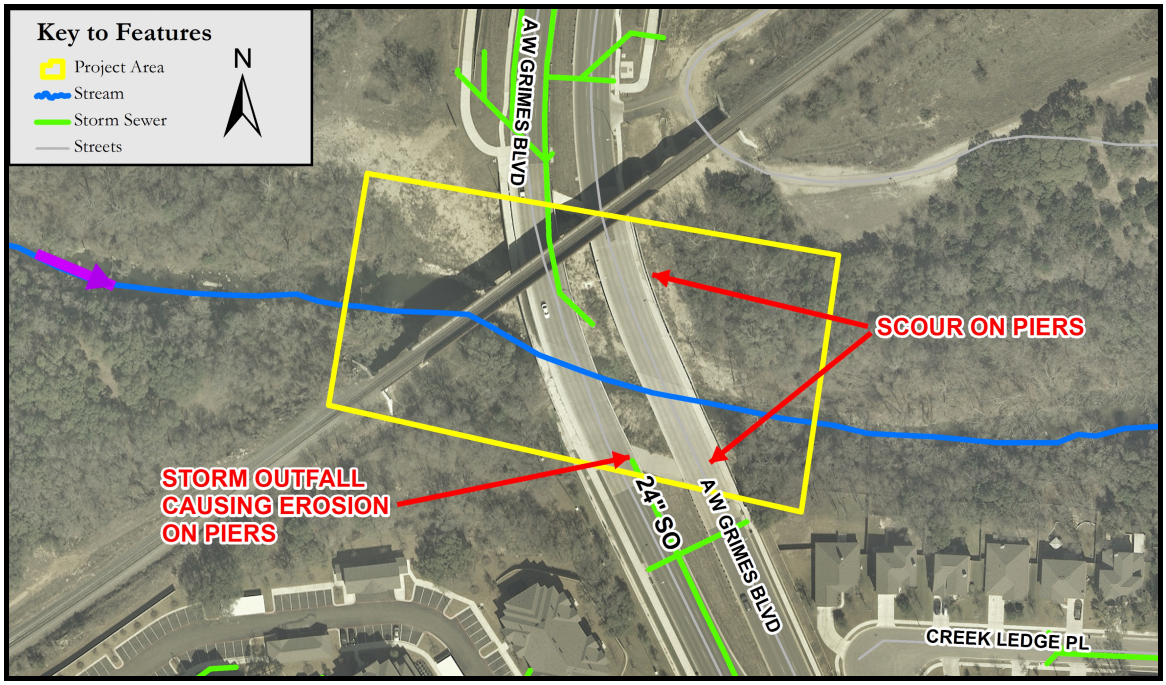
Project: 2013M - A.W. Grimes Blvd. at Brushy Creek

Brushy Creek

High velocities through Brushy Creek are scouring the bridge pears at A.W. Grimes Boulevard. There is no riparian vegetation along the creek banks or in the overbanks underneath the bridge leaving the bare soil susceptible to erosive forces. Additionally, a 24 in storm sewer pipe outfalls on the right (south) bank and is eroding around the adjacent piers to a depth of three to four feet. This storm outfall is also causing a plunge pool to form near the adjacent piers which is accelerating the bank scour. The continued erosion at the bridge piers could lead to foundational problems for the bridge crossing.



Reference Issues: BC54



Project: 2013M - A.W. Grimes Blvd. at Brushy Creek

Brushy Creek

Solution

Placement of large loose rock rip rap along the banks and around the piers will help protect the piers from further erosion. The scour channel and plunge pool formed by the storm outfall could be filled three-fourths of the depth with properly sized loose rock rip rap. Graded filter stone would be placed on the native soil before the larger rock rip rap is placed. This resistive measure will also provide energy dissipation to Brushy Creek.

Challenges

- The loose rock rip rap will have to be carefully sized and gradated to insure it does not wash downstream.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	2	46
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**284**

2013M – A.W. Grimes Blvd. at Brushy Creek

Background

- This Project includes Issue BC54.
- This 200' reach is directly underneath the A.W. Grimes Boulevard crossing of Brushy Creek (just south of Palm Valley Boulevard).
- There is no riparian vegetation along the creek bank or in the overbanks underneath the bridge.

Issues

- The bridge piers along the right bank (looking downstream, southern) are being undermined by flows in Brushy Creek.
- A.W. Grimes goes underneath the railroad at this point and cannot be elevated. Therefore, it is overtopped in the 25-year event as a low water crossing
- The roadway drainage system has an outfall near one of the drilled shaft piers. Sediment has been eroded from around the piers to a depth of three to four feet.

Candidate Alternatives

1. **Resistive Bank Stabilization** – Install resistive bank stabilization in order to protect the outside curve of the meander bank from encroaching further on the homes along Tenaza Cove and Sycamore Trail. (Cost < $250k).
   - "Resistive" measures are continuous and are applied directly on the channel bank, invert or toe.
   - Examples include loose rock rip rap, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - In this case none of the resistive techniques that make use of bioengineered, vegetated solutions will be appropriate due to minimal sunlight under the bridge.
   - Longitudinal fill stone toe protection (LFSTP). Create a "pyramid" of larger loose rocks located away from the existing toe. There is not enough room in the channel for this technique.
   - The effects from the roadway storm drainage system could be minimized with the use of **loose rock rip rap**. The existing scoured channel could be filled three-fourths of the depth with properly sized loose rock rip rap. Graded filter stone would be placed on the native soil before the larger rock rip rap is placed.
   - It would be important to not fill the existing scoured channel completely with rocks and thereby divert the flow into an adjacent pathway that is not armored. Preserving some form of low flow channel is important as the loose rock rip rap is placed.
   - The effects from Brushy Creek scour around the piers could also be minimized with the use of **loose rock rip rap**.
   - Pay attention to transitions upstream and downstream of the project area. Resistive armament must blend into the native bank.

2. **Grade Control** – In lieu of making a continuous armoring treatment, intermittent grade control rock riffle structures could be placed in a "stair step" terrace down the slope. (Cost < $250k).
   - Over time the space between the terrace sills would fill in with sediment.
   - Due to the close proximity of the drilled shafts and the need to completely armor these areas, the intermittent grade control structures are not recommended.

Alternative Bundles

A. **Alternative 1** – Physically armor the plunge pool area by the storm drain outfall. Protect the channel invert. Physically armor the left bank around the bridge piers. (Cost < $250k)

Challenges

- Coordinate with the City's Transportation Department to install low water crossing flashing gates.

Notes

- A WCID model for this reach does exist.
- This Project does not address the overtopping of A.W. Grimes. It just addressed the bridge scour.

Project: 2013M
Name: A.W. Grimes Blvd at Brushy Creek
Issue: BC54
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

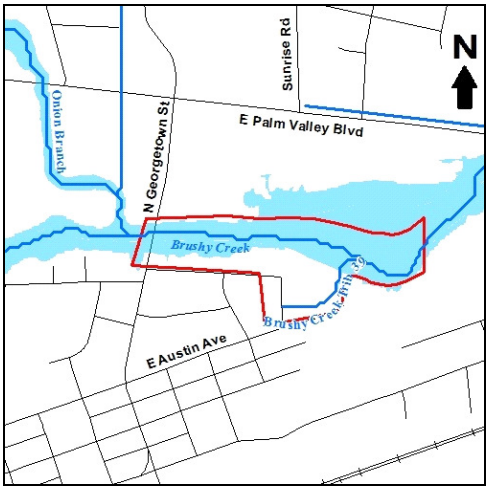
				Alternative 1		Alternative 2		Bundle A	
				Resistive bank stabilization Loose rock riprap		Grade control		Alternatives: 1	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0	1	$25,000
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0	3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0	4	
0132 2006	EMBANKMENT (DENSITY, TYPE C)	CY	$40		$0		$0	5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0	6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	28	$4,444	8	$1,333		
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$400	1	$100		
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		
				SUBTOTAL	**$5,000**	**SUBTOTAL**	**$2,000**		
				30% Conting.	$2,000	**30% Conting.**	$1,000		
				BASE TOTAL	**$7,000**	**BASE TOTAL**	**$3,000**		
ADDITIVE ALTERNATE									
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**		
				CONSTR.	**$7,000**	**CONSTR.**	**$3,000**		
		Permits/Coord (2%)		**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**		
		Design/PM(12%)		**Design/PM**	**$1,000**	**Design/PM**	**$1,000**		
		PROJECT TOTAL		**PROJECT**	**$25,000**	**PROJECT**	**$25,000**	**BUNDLE**	**$25,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

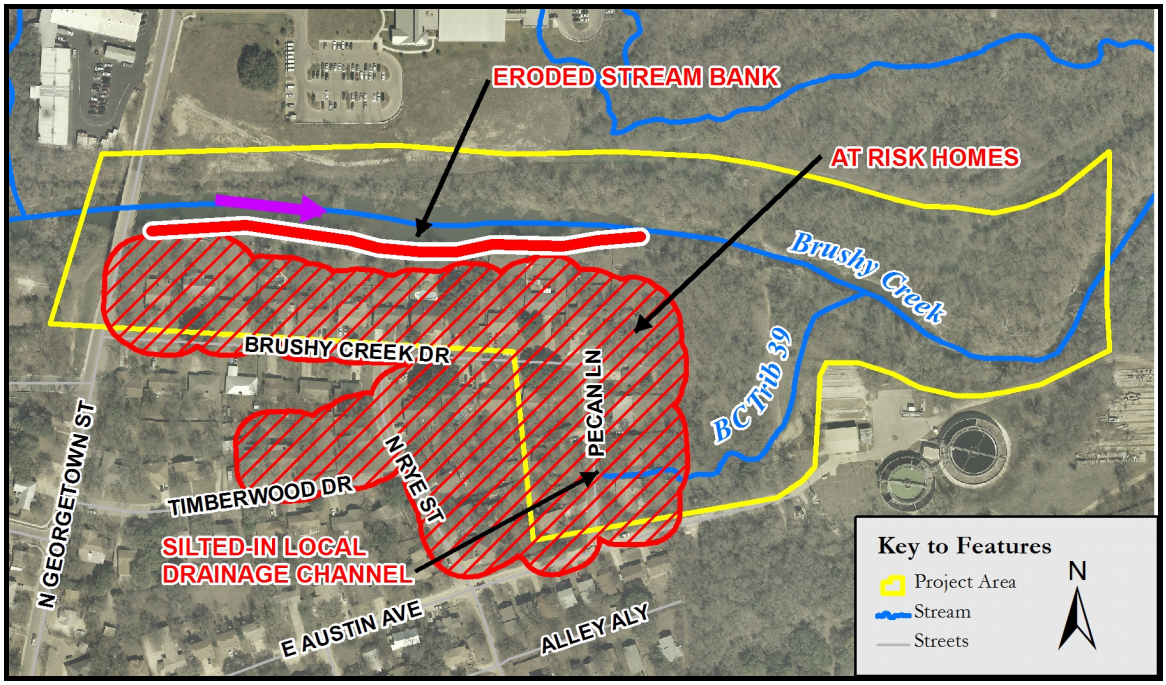
Project: 2013N - Brushy Slopes

Brushy Creek

Just downstream of Georgetown St., Brushy Creek parallels the south side of Palm Valley Blvd. and Brushy Creek Dr. Just downstream of Georgetown St. the right bank of Brushy Creek is experiencing severe bank erosion. Many of the residents along Brushy Creek Drive are losing property and fenclines due to the encroaching bank. Observations from the 10/31/13 flood event show that flow from the tributary upstream of Georgetown St. is pushing against the right bank and causing the vertical bank erosion. Brushy Creek Tributary 39 passes through a residential and drains into Brushy Creek further downstream. An 8' wide shallow local drainage flume had been developed between two homes composed of railroad timbers as vertical sidewalls. Over time silt has been deposited in that open channel such that it only has one foot of depth before it overflows into the adjacent residential lots. The WCID hydraulic models identify 30 structures as being a risk during the 100-yr storm event.



Reference Issues: BC56



Project: 2013N - Brushy Slopes

Brushy Creek

Solution

On the north bank underneath Georgetown Street, clear underbrush and remove "snags" that have formed which redirect flow to the south bank. Install resistive bank stabilization on the right bank just downstream from Georgetown Street. Recommend gabions stacked up to form an "L shaped" wall. All the time having the bank side of the stacked baskets kept in a nearly vertical (battered) line with the creek side being the stepped (terraced) face. The water is deep along this segment of Brushy Creek. Dewatering this right bank area for construction will be costly. The sediment in the residential flume on Tributary 39 needs to be cleaned out. Replacement of the timber flume with a stabilized conveyance channel is needed. A stabilized drop structure composed of a gabion basket is needed to pass flow from the residential flume downstream to Tributary 39.

Challenges

- Lack of drainage easements.
- Steep banks and deep water along Brushy Creek just downstream of Georgetown Street.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	3	81
Public Safety	Road Flooding and Mobility	22	1	22
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	4	56
			Project Score	**395**

2013N –Brushy Creek Tributary 39

Background

- This Project includes Issue BC56.
- The 2400' reach of Brushy Creek parallels the south side of Palm Valley Boulevard and is downstream of Georgetown Street. This project also contains the Brushy Creek Tributary 39 reach.
- Tributary 39 joins Brushy Creek downstream of N. Georgetown Street.
- This Project includes several stormwater issues along Brushy Creek, Tributary 39, and localized areas within the residential subdivision. In this "confluence reach" all the stormwater issues are interrelated.
- A shallow drainage flume had been developed between the homes making use of railroad timbers as vertical sidewalls on the approximately 8' wide channel. Over time silt has been deposited in that open channel such that it only has one foot of depth before it overflows into the adjacent residential lots.
- The cause of the localized sediment deposition appears to be impacted by the heavily overgrown conditions of Tributary 39. The low flow velocity in Tributary 39 appears to be affected by the tailwater from the Brushy Creek floodplain. In this "confluence reach" all the stormwater issues are interrelated.
- The profile of Brushy Creek indicates that a slight "delta" has been developed about 1500' downstream of the Georgetown Street bridge creating a reverse grade (rise) in the stream profile. The delta has naturally formed where the narrow width of the creek has its first opportunity to widen out as a floodplain. This widening reduces the sediment carrying capability and the sediment drops out. Removal of this delta as a part of maintenance would not last since additional sediment will simply be dropped there in the future.
- Vegetation downstream of Tributary 39 has been cleared.
- After the 10/31/13 flood event it appeared that the thalweg of the creek on the upstream side Of the Georgetown Street bridge had the "floating debris line" moving toward the north (left) bank of the creek. However, on the downstream side of the bridge the floating debris path had moved to the south (right) bank. This right bank is the one with the residential properties that are getting eroded. Underneath the structure it appeared that there were some fallen trees or snagged debris on the north bank that was redirecting the flow to the south bank.
- Performing some snagging work on the north bank could help keep some of the velocities on that side of the creek and not redirect them to the south bank.
- On the south bank it would be very helpful to get in a boat and just probe the depth of the water about 5 feet away from the bank (fiberglass survey rod or plastic tape with weighted end). Under the bridge there seemed to be more of a shelf than originally thought.
- Additional resistive options might exist to use gabions stacked up an "L shaped" wall. Three baskets at the base, a couple stacks with two wide and then a couple with one basket width. All the time having the bank side of the stacked baskets kept in a vertical (battered) line with the creek side being the stepped (terraced) face.
- Adding baskets to the south bank would require hydraulic modeling the "removal" of some channel flow area on the north bank (cut back some). Extend the right bank protection along the bank under the bridge and 100 feet or so upstream of the bridge just to anchor in the toe and to also help the right bank scour occurring under the bridge.

Issues

- The localized issues originate with the fact that the stormwater collection and conveyance system in the subdivision is all surface flow. There are no inlets or buried stormwater pipes in the subdivision.
- Surface flow from Timberwood Dr. and N. Rye St. exits the roadway and passes between two homes (309 N. Rye St. and 1101 Brushy Creek Dr.) through a shallow drainage flume making use of railroad timbers as vertical sidewalls on the approximately 8' wide channel. Over time silt has been deposited in that open channel such that it only has one foot of depth before it overflows into the adjacent residential lots.

- On Brushy Creek itself, just downstream of the N. Georgetown Street bridge the right bank (looking downstream) has been scoured and is vertical. The water depth in this reach is about 6 feet deep. The creek is widening and some residential fences are being impacted.

Candidate Alternatives

1. **Tributary 39 – Stabilized Drop Structure** – (Cost < $250k).
   - Create a stabilized drop structure on the bank of Tributary 39 to accept the flow form the residential flume and release the flow at the toe of the slope. The drop structure could make use of gabion basket, loose rock rip rap, or rectangular cut limestone rock blocks.

2. **Residential flume** – (Cost < $250k).
   - Clean out the sediment from the existing timber wall flume.
   - Evaluate the condition of the timber flume and consider replacing with a stabilized conveyance channel form the road to the drop structure. The new structure could be made from gabion baskets, rectangular cut limestone rock blocks, or concrete.
   - Modify the transition from the street into the flume for safety conditions.

3. **Stormwater Infrastructure in the subdivision** – (Cost $250k to $750k).
   - Consider extending a system of inlets and buried pipe from the flume back into the subdivision one or two blocks.
   - Gathering up the surface flow as early as possible into a buried system would help reduce the drainage problems at these two homes.
   - The drainage area upstream from these two houses is approximately 24 acres. Extending the collection and conveyance system would help minimize other drainage related issues that others in the neighborhood are experiencing.

4. **Brushy Creek - Selective clearing** – (Cost < $250k).
   - Thin out the underbrush from the confluence with Tributary 39 downstream 1800' to the existing low water crossing for the Apartment Complex.
   - Leave the large trees and some of the medium sized trees.
   - Revisit the hydraulic model to determine if this clearing will help reduce the water surface elevation in Tributary 39 and help the residential flow to get off of the street.

5. **Brushy Creek - Resistive Bank Stabilization** – Install resistive bank stabilization on the right bank just downstream from Georgetown Street. (Cost $250k to $750k).
   - "Resistive" measures are continuous and are applied directly on the bank and toe (or both).
   - Examples include loose rock rip rap, cut rectangular rock blocks, use of geotextiles and geogrids to create reinforced soil/rock lifts ("burrito wrap"), or green gabion earth filled baskets.
   - A hybrid resistive solution is available combining two or more of these individual components.
   - Be sure to anchor the toe and install it deeper than the existing flowline.
   - The water is deep along this segment of Brushy Creek.
   - Dewatering this right bank area for construction will be costly.
   - All of these resistive measures would include sloping the bank back from the existing location and moving the top of the bank closer to the homes.
   - Further examination would be required to determine if a Longitudinal Fill Stone Toe Protection (LFSTP) technique would work in this reach. Create a "pyramid" of larger loose rocks located away from the existing toe. Fill the area behind this longitudinal toe with soil. Reclaim some of

the eroded slope (or stop the widening). Move the top of the bank away from the current location (toward the creek). This technique would not require removal of any large trees and can easily work around/with them.

- Consideration could be given to installing a vertical sheet piling bulkhead along the right bank. Additional modeling would be required to determine the resulting increase in scour depth at the toe of the piling face.
- Pay attention to transitions upstream and downstream of the project area. Resistive armament must blend into the native bank.

6. **Brushy Creek - Redirective Bank Stabilization Measure** – Redirect the flow and energy away from the damaged right bank.
   - "Redirective" measures are discontinuous along the bank and must be installed upstream of the problem area.
   - The effectiveness of these features is governed by the channel geometry and the length of the channel upstream of the problem area. In this case there is not enough room to have these features work effectively (narrow channel width).
   - Redirective measures could include the following:
     - Rock vanes
     - Barbs
     - Bendway weirs
     - Deflectors
     - False point bars
     - Transverse dikes
     - Stone filled dikes
     - Engineered log dams (large wood debris "root wads")

7. **Buyout the affected homes.**
   - As the cost of alternative bundles is evaluated in more detail, the alternative of "buyout" option could become more economically viable.
   - Tributary 39. That option would be to buyout the five affected homes in the subdivision along Tributary 39 and demolish the structures. The lots could be converted into open space (not necessarily a park). (Cost $1M to $2M).
   - Brushy Creek. Buyout the 13 affected homes on the right bank of Brushy Creek and demolish the structures. The lots could be converted into open space (not necessarily a park). (Cost > $5M).
   - WCID has flagged 30 affected homes within the subdivision and along Brushy Creek.

8. **Develop trails and educational opportunities** – (Cost $250k to $750k).
   - Consideration could be given to developing a linear nature trail linking several residential neighborhoods.
   - Examine methods to provide educational opportunities along the route.

Alternative Bundles

A. Alternatives 1 & 2 – Improve the conveyance of the residential flume. Reduce the maintenance requirement to remove sediment from the flume. Create a stable drop structure into Tributary 39. Increase the flow velocity along a short reach of Tributary 39. (Cost < $250k).

B. **Alternatives 1, 2 & 3** – Improve the conveyance of the residential flume. Reduce the maintenance requirement to remove sediment from the flume. Create a stable drop structure into Tributary 39. Increase the flow velocity along a short reach of Tributary 39. Improve the collection and conveyance capability further into the subdivision. (Cost $750k to $1M).

C. **Alternatives 1, 2 & 4**– Improve the conveyance of the residential flume. Reduce the maintenance requirement to remove sediment from the flume. Create a stable drop structure into Tributary 39.

Increase the flow velocity along a short reach of Tributary 39. Reduce the water surface elevation in Brushy Creek. (Cost <$250k).

D. **Alternative 5**– Stabilize the right bank of Brushy Creek. (Cost $250k to $750k).

E. **Alternative 7 –** Buyout the affected homes in the subdivision drained by Tributary 39. Buyout the homes along Brushy Creek with scour at their rear property line. (Cost >$5M).

F. **Alternative 8** – Develop trails and educational opportunities. (Cost $250k to $750k).

Challenges

- Discuss grant opportunities with TPWD for development of trails.
- Lack of drainage easements.
- Steep banks and deep water along Brushy Creek just downstream of Georgetown Street.

Notes

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Project: 2013N
Name: Brushy Slopes
Issue: BC56
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

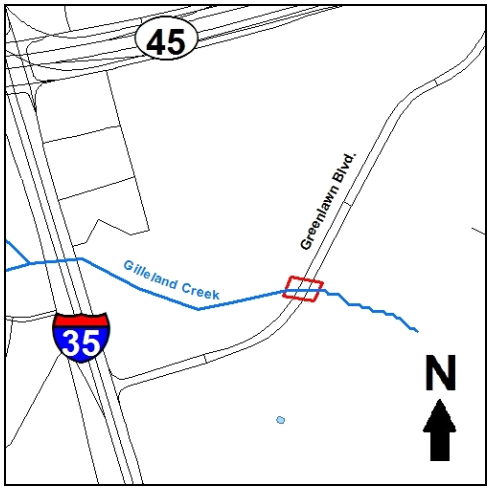
				Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Bundle A		Bundle B		Bundle C		Bundle D		Bundle E		Bundle F	
				Tributary 39 Stabilized drop structure		Residential flume		Stormwater infrastructure into the subdivision		Brushy Creek selective clearing		Brushy Creek - resistive bank Gabion wall (L shaped)		Brushy Creek - redirective none		Buyout the affected homes		Develop trails and educational opportunities		Alternatives: 1+2		Alternatives: 1+2+3		Alternatives: 1+2+4		Alternatives: 5		Alternatives: 7		Alternatives: 8	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (clearing trees, grubbing)	LS	$25,000		$0		$0		$0	2	$50,000		$0		$0		$0		$0	1	$50,000	1	$50,000	1	$50,000	1		1		1	
0100	PREPARING ROW (Buyout homes)	EA	$300,000		$0		$0		$0		$0		$0		$0	13	$3,900,000		$0												
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0		$0		$0		$0		$0		$0	2	$50,000	2	$50,000	2	$50,000	2		2		2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0		$0		$0		$0		$0		$0	3		3	$700,000	3		3		3		3	
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0		$0		$0		$0		$0		$0	4		4		4	$100,000	4		4		4	
110	EXCAVATION (Channel)	CY	$40	22	$889	139	$5,556		$0		$0		$0		$0		$0		$0												
132	EMBANKMENT (DG trail)	SY	$50		$0		$0		$0		$0		$0		$0		$0	5,867	$293,333	5		5		5		5	$750,000	5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0		$0		$0		$0		$0		$0	6		6		6		6		6		6	
0162 2002	BLOCK SODDING	SY	$8	67	$533		$0		$0		$0	2,222	$17,778		$0		$0		$0	7		7		7		7		7	$5,700,000	7	
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0		$0		$0		$0		$0		$0	8		8		8		8		8		8	$500,000
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0		$0		$0		$0		$0		$0												
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0		$0		$0		$0		$0		$0												
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0		$0		$0		$0		$0		$0												
432	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	CY	$160	89	$14,222		$0		$0		$0		$0		$0		$0		$0												
432	GABION BASKETS (filled with ballast rock)	CY	$160		$0		$0		$0		$0	2,667	$426,667		$0		$0		$0												
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0		$0		$0		$0		$0		$0												
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0		$0		$0		$0		$0		$0												
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0		$0		$0		$0		$0		$0												
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0		$0		$0		$0		$0		$0												
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0		$0		$0		$0		$0		$0												
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0		$0		$0		$0		$0		$0		$0		$0												
464	RC PIPE (CL III)(30 IN)	LF	$90		$0		$0	1,200	$108,000		$0		$0		$0		$0		$0												
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0	1,200	$120,000		$0		$0		$0		$0		$0												
0466 2035	WINGWALL (FW-S)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0		$0		$0												
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0		$0		$0		$0		$0		$0												
	CURB INLET (15 FT)	EA	$10,000		$0		$0	20	$200,000		$0		$0		$0		$0		$0												
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0		$0		$0		$0		$0		$0												
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0		$0		$0		$0		$0		$0												
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0		$0		$0		$0		$0		$0												
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0		$0		$0		$0		$0		$0												
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$1,600	1	$1,700	1	$42,800	1	$5,000	1	$44,400	1	$0	1	$390,000	1	$29,300												
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0		$0		$0		$0		$0		$0												
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0		$0		$0		$0		$0		$0												
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0		$0		$0		$0		$0		$0												
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0		$0		$0		$0		$0		$0												
0531 2004	CONC SIDEWALKS (4") (concrete flume pavement)	SY	$45		$0	250	$11,250		$0		$0		$0		$0		$0		$0												
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0		$0		$0		$0		$0		$0												
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0		$0		$0		$0		$0		$0												
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0		$0		$0		$0		$0		$0												
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0		$0		$0		$0		$0		$0												
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0		$0		$0		$0		$0		$0												
				SUBTOTAL	**$18,000**	**SUBTOTAL**	**$19,000**	**SUBTOTAL**	**$471,000**	**SUBTOTAL**	**$56,000**	**SUBTOTAL**	**$489,000**	**SUBTOTAL**	**$1,000**	**SUBTOTAL**	**$4,291,000**	**SUBTOTAL**	**$323,000**												
				30% Conting.	$6,000	**30% Conting.**	$6,000	**30% Conting.**	$142,000	**30% Conting.**	$17,000	**30% Conting.**	$147,000	**30% Conting.**	$1,000	**30% Conting.**	$1,288,000	**30% Conting.**	$97,000												
				BASE TOTAL	**$24,000**	**BASE TOTAL**	**$25,000**	**BASE TOTAL**	**$613,000**	**BASE TOTAL**	**$73,000**	**BASE TOTAL**	**$636,000**	**BASE TOTAL**	**$2,000**	**BASE TOTAL**	**$5,579,000**	**BASE TOTAL**	**$420,000**												
ADDITIVE ALTERNATE																															
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0		$0		$0		$0		$0		$0												
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0		$0		$0		$0		$0		$0												
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**												
				CONSTR.	**$24,000**	**CONSTR.**	**$25,000**	**CONSTR.**	**$613,000**	**CONSTR.**	**$73,000**	**CONSTR.**	**$636,000**	**CONSTR.**	**$2,000**	**CONSTR.**	**$5,579,000**	**CONSTR.**	**$420,000**												
		Permits/Coord (2%)		**Permit/Coord**	**$1,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$13,000**	**Permit/Coord**	**$2,000**	**Permit/Coord**	**$13,000**	**Permit/Coord**	**$1,000**	**Permit/Coord**	**$112,000**	**Permit/Coord**	**$9,000**												
		Design/PM(12%)		**Design/PM**	**$3,000**	**Design/PM**	**$3,000**	**Design/PM**	**$74,000**	**Design/PM**	**$9,000**	**Design/PM**	**$77,000**	**Design/PM**	**$1,000**	**Design/PM**		**Design/PM**	**$51,000**												
		PROJECT TOTAL		**PROJECT**	**$50,000**	**PROJECT**	**$50,000**	**PROJECT**	**$700,000**	**PROJECT**	**$100,000**	**PROJECT**	**$750,000**	**PROJECT**	**$25,000**	**PROJECT**	**$5,700,000**	**PROJECT**	**$500,000**	**BUNDLE**	**$100,000**	**BUNDLE**	**$800,000**	**BUNDLE**	**$200,000**	**BUNDLE**	**$750,000**	**BUNDLE**	**$5,700,000**	**BUNDLE**	**$500,000**

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and that Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit prices are in current dollars and should be adjusted as required when letting schedule for project is determined.

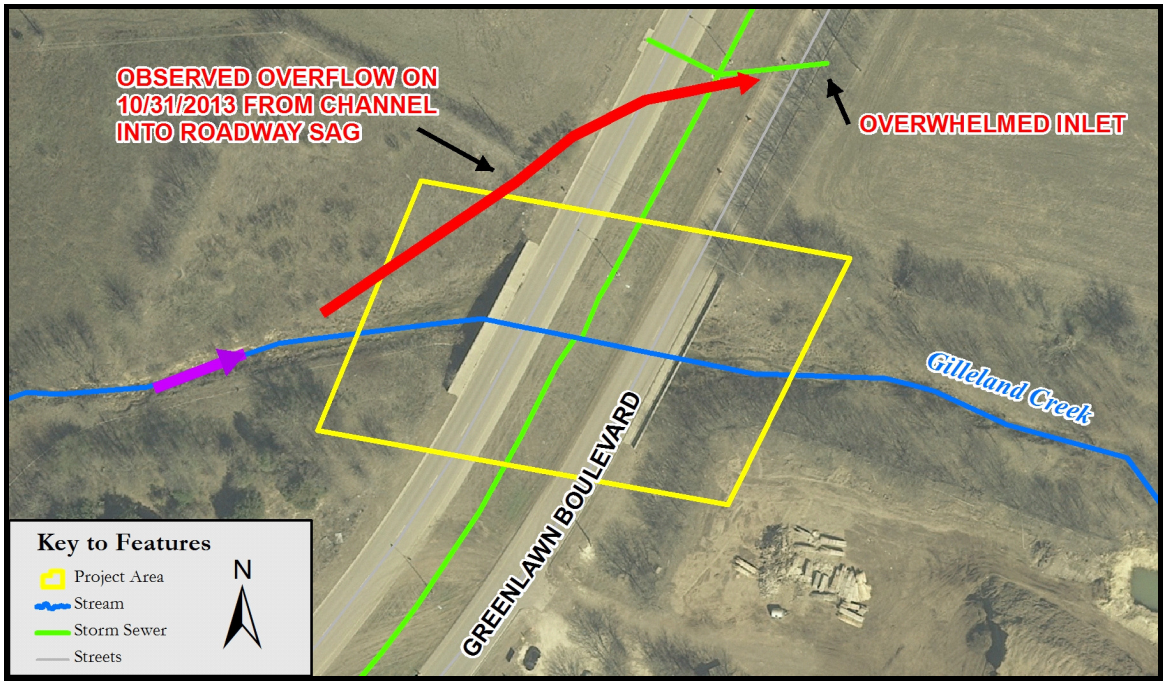
Project: 2013O - Greenlawn Blvd. at Gilleland Creek

Gilleland Creek

This 500' reach encompasses the Greenlawn Boulevard road crossing of Gilleland Creek just east of IH-35. Greenlawn Boulevard is a four lane major arterial roadway. The existing structure has six box culverts. Three of the six boxes (outside ends) have accumulated sediment which restricts their flow carrying capacity. The Gilleland 2009 LOMR (09-06-1966P-481026) indicates Greenlawn Blvd. overtops 4.2' in the 100-year ultimate condition event. The multiple box culverts at Greenlawn Blvd. are much wider than the approaching channel. It appears that there is a headloss at this expansion point. Greenlawn Boulevard has a "sag" or low point in the roadway just north of the Gilleland Creek crossing. Site observations after the October 31, 2013 flood indicated an overflow from the left side of the upstream (west) headwall diagonally across all lanes of the roadway and then exiting the eastern right-of-way near the sag inlet. This overflow created a deep pool causing the roadway to be closed during the flood



Reference Issues: GC83



Project: 2013O - Greenlawn Blvd. at Gilleland Creek

Gilleland Creek

Solution

Extension of the upstream concrete headwall to the north (left bank) along with an earthen (or rock) berm on the left edge of the floodplain would help transition the flow into the culverts. The extend headwall will allow for the hydraulic head to buildup on the upstream side and push more flow through the existing culvert system instead of flowing over the roadway. Consideration may need to be given to "disconnect" the inlet and pipe infrastructure from the culverts and have them work independently to collect and convey the local runoff at the sag to the east in an independent open channel.

Challenges

- Traffic control during construction.

- Coordination with adjacent land owner regarding the extension of the upstream headwall. The work would be in public ROW, but coordination could be beneficial. Provide for "local drainage" from the adjoining tract into the street ROW.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	4	88
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**377**

2013O –Greenlawn Blvd. & Gilleland Creek

Background

- This Project includes Issue GC83.
- The 500' reach encompasses the Greenlawn Boulevard road crossing of Gilleland Creek just east of IH-35.
- Greenlawn Blvd. is a four lane major arterial roadway.
- The existing structure has six box culverts.
- The Gilleland 2009 LOMR (09-06-1966P-481026) indicates Greenlawn Blvd. overtops 2.2' in the 100-year ultimate condition event.
- The Gilleland Creek channel banks appear to be stable.

Issues

- Three of the six boxes have accumulated sediment which restricts their flow carrying capacity.
- The multiple box culverts at Greenlawn Blvd. are much wider than the approaching channel. It appears that there is a headloss at this expansion point. The outside box culverts are showing evidence of siltation.
- Site observations after the 10/31/13 flood indicated an overflow from the left side of the upstream (west) headwall diagonally across all lanes of the roadway and then exiting the eastern right-of-way near the sag inlet (which is located 100ft or so north of the box culverts).
- The as-built plans need to be reviewed to see if the inlets in the sag actually drain back to the box culverts. Consideration may need to be given to "disconnect" the inlet and pipe infrastructure from the culverts and have them work independently to collect and convey the local runoff at the sag to the east in an independent open channel. Disconnect the hydraulic connection to the box culverts.

Candidate Alternatives

1. **Extend upstream headwall** – (Cost < $250).
   - Extend the upstream concrete headwall to the north (left looking downstream) with a provision to make an earthen (or rock) berm on the left edge of the floodplain to guide (transition) the flow into the culverts.
2. **Replace the box culverts with a bridge** – (Cost $750k-$1M).
   - Replace the existing box culverts with a bridge.
   - The bridge could be built using drilled shafts, bents and spans.
   - The bridge could be built using a precast "bottomless box culvert" span structure.
   - The hydraulic model could be used to evaluate the size of each structure and the relative cost difference between the two.
   - They typically cost about the same per deck area.
   - The precast structure should take less time to install which would help minimize the transportation impact of closing two lanes at a time on Greenlawn Blvd.
3. **Channel modifications** – (Cost < $250k).
   - Examine some channel modifications upstream of the Greenlawn Blvd. box culverts. Widen and lengthen the transition section. Consider a design that would shed the low flows toward the outer box culvert to help reduce sediment buildup. The transition would then allow the larger flood flows to be presented evenly across all the existing box culverts.
   - This alternative should be considered as an interim measure. The root of this problem is indeed a capacity issue, therefore more capacity needs to be provided. However, this measure would help maximize the use of the existing capacity.

Alternative Bundles

A. **Alternative 1** – Eliminate a "short circuit" bypass overtopping. Help the stream flow to get into the box culverts. Reduce the overtopping to a maximum of six inches.(Cost < $250k).

B. **Alternative 2** – Provide additional capacity to the Greenlawn Blvd crossing. Reduce the overtopping to a maximum of six inches. (Cost $750k-$1M).

C. **Alternative 3** – As an interim measure, modify the approach channel to obtain more capacity from the existing box culverts. (Cost < $250k).

Challenges

- Traffic control during construction.
- Coordination with adjacent land owner regarding the extension of the upstream headwall. The work would be in public ROW, but coordination could be beneficial. Provide for "local drainage" from the adjoining tract into the street ROW.

Notes

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Project: 2013O
Name: Greenlawn Blvd. at Gilleland Creek
Issue: GC83
Engineer's Estimate of Conceptual/Planning Construction Cost (alternatives and bundles)
Date: 11-Dec-13

				Alternative 1		Alternative 2		Alternative 3		Bundle A		Bundle B		Bundle C	
				Extend upstream headwall		Replace boxes with bridge		Channel modifications		Alternatives: 1		Alternatives: 2		Alternatives: 3	
PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	QUANTITY	SUB-TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS	ALTERNATE	TOTALS
0100 2002	PREPARING ROW (REMOVE CMPs)	LS	$5,000		$0		$0		$0	1	$100,000	1		1	
0104 2009	REMOVING CONC (RIPRAP)	SY	$40		$0		$0		$0	2		2	$900,000	2	
0104 2022	REMOVING CONC (CURB AND GUTTER)	LF	$15		$0		$0		$0	3		3		3	$150,000
0110 2001	EXCAVATION (ROADWAY)	CY	$35		$0		$0		$0	4		4		4	
110	EXCAVATION (Channel)	CY	$35		$0		$0	2,222	$77,778						
132	EMBANKMENT (earthen berm)	CY	$40	593	$23,704		$0		$0	5		5		5	
0161 2002	COMPOST MANUF TOPSOIL (BOS) (4")	SY	$2		$0		$0		$0	6		6		6	
0162 2002	BLOCK SODDING	SY	$8		$0		$0		$0						
0400 2006	CUT & RESTORING PAVEMENT (base and HMAC)	SY	$100		$0		$0		$0						
0402 2001	TRENCH EXCAVATION PROTECTION	LF	$8		$0		$0		$0						
0432 2002	RIPRAP (CONC) (5 IN)	CY	$400		$0		$0		$0						
0432 2019	RIPRAP (STONE PROTECTION)(D_{50}=18 IN)	SY	$60		$0		$0		$0						
0432 2040	RIPRAP (MOW STRIP)(5 IN)	CY	$400		$0		$0		$0						
0450 2016	RAIL (TY C203)	LF	$125		$0		$0		$0						
0450 2073	RAIL (PEDESTRIAN)	LF	$85		$0		$0		$0						
0462 2011	CONC BOX CULV (10FT X 4FT)	LF	$600		$0		$0		$0						
0462 2011	CONC BOX CULV (8FT X 4FT)	LF	$450		$0		$0		$0						
0462 2011	CONC BOX CULV - SINGLE SPAN (20FT X 6FT)	SF	$90		$0	6,000	$540,000		$0						
0464 2009	RC PIPE (CL III)(36 IN)	LF	$100		$0		$0		$0						
466	WINGWALL (extension)	EA	$25,000	1	$25,000		$0		$0						
0466 2049	WINGWALL (PW)(HW=5 FT)	EA	$10,000		$0		$0		$0						
0471 2003	FURNISH AND INSTALL NEENAH FRAME	EA	$1,000		$0		$0		$0						
0496 2003	REMOV STR (MANHOLE)	EA	$910		$0		$0		$0						
0496 2006	REMOV STR (HEADWALL)	EA	$2,500		$0		$0		$0						
0496 2007	REMOV STR (PIPE)	LF	$15		$0		$0		$0						
0500 2001	MOBILIZATION (assume 10%)	LS	per alternate	1	$5,200	1	$54,000	1	$9,000						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	$9,000		$0		$0		$0						
0502 2001	BARRICADES, SIGNS AND TRAFFIC HANDLING (PHASE 2)	MO	$2,500		$0		$0		$0						
0506 2002	EROSION CONTROL	LS	$1,500		$0		$0		$0						
506	EROSION CONTROL (reveg seeding)	SY	$2	333	$667		$0		$0						
506	EROSION CONTROL (permanent TRM)	LS	$9	333	$3,000		$0	1,333	$12,000						
0529 2004	CONC CURB & GUTTER (TY II)	LF	$20		$0		$0		$0						
0531 2004	CONC SIDEWALKS (4")	SY	$45		$0		$0		$0						
0540 2002	MTL W-BEAM GD FEN (STEEL POST)	LF	$45		$0		$0		$0						
0540 2005	TERMINAL ANCHOR SECTION	EA	$590		$0		$0		$0						
0540 2012	MTL BEAM GD FEN TRANS (TL2)	EA	$1,200		$0		$0		$0						
0542 2001	REMOVING METAL BEAM GUARD FENCE	LF	$3		$0		$0		$0						
0658 2314	INSTL OM ASSM (OM-2X)(WC) GND	EA	$75		$0		$0		$0						
				SUBTOTAL	**$58,000**	**SUBTOTAL**	**$595,000**	**SUBTOTAL**	**$99,000**						
				30% Conting.	$18,000	**30% Conting.**	$179,000	**30% Conting.**	$30,000						
				BASE TOTAL	**$76,000**	**BASE TOTAL**	**$774,000**	**BASE TOTAL**	**$129,000**						
ADDITIVE ALTERNATE															
506 MWW	STANDARD PRE-CAST MANHOLE W/PRE-CAST BASE, 4" DIA.	EA	$6,000		$0		$0		$0						
510-AW-8" DIA	PIPE, 10" DIA. PVC (DR14) INCL EXCAVATION AND BACKFILL	LF	$85		$0		$0		$0						
				ALT.TOTAL	**$0**	**ALT.TOTAL**	**$0**	**ALT.TOTAL**	**$0**						
				CONSTR.	**$76,000**	**CONSTR.**	**$774,000**	**CONSTR.**	**$129,000**						
		Permits/Coord (2%)		**Permit/Coord**	**$2,000**	**Permit/Coord**	**$16,000**	**Permit/Coord**	**$3,000**						
		Design/PM(12%)		**Design/PM**	**$10,000**	**Design/PM**	**$93,000**	**Design/PM**	**$16,000**						
		PROJECT TOTAL		**PROJECT**	**$100,000**	**PROJECT**	**$900,000**	**PROJECT**	**$150,000**	**BUNDLE**	**$100,000**	**BUNDLE**	**$900,000**	**BUNDLE**	**$150,000**

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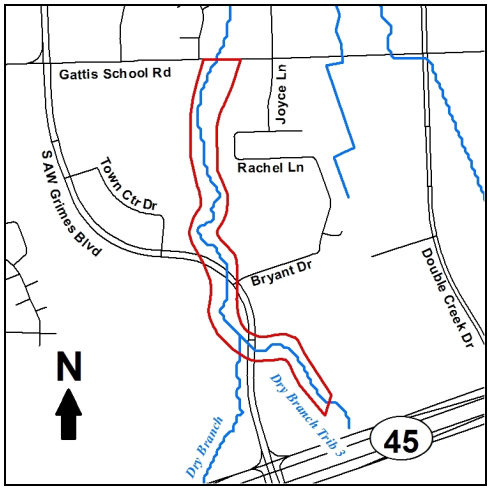
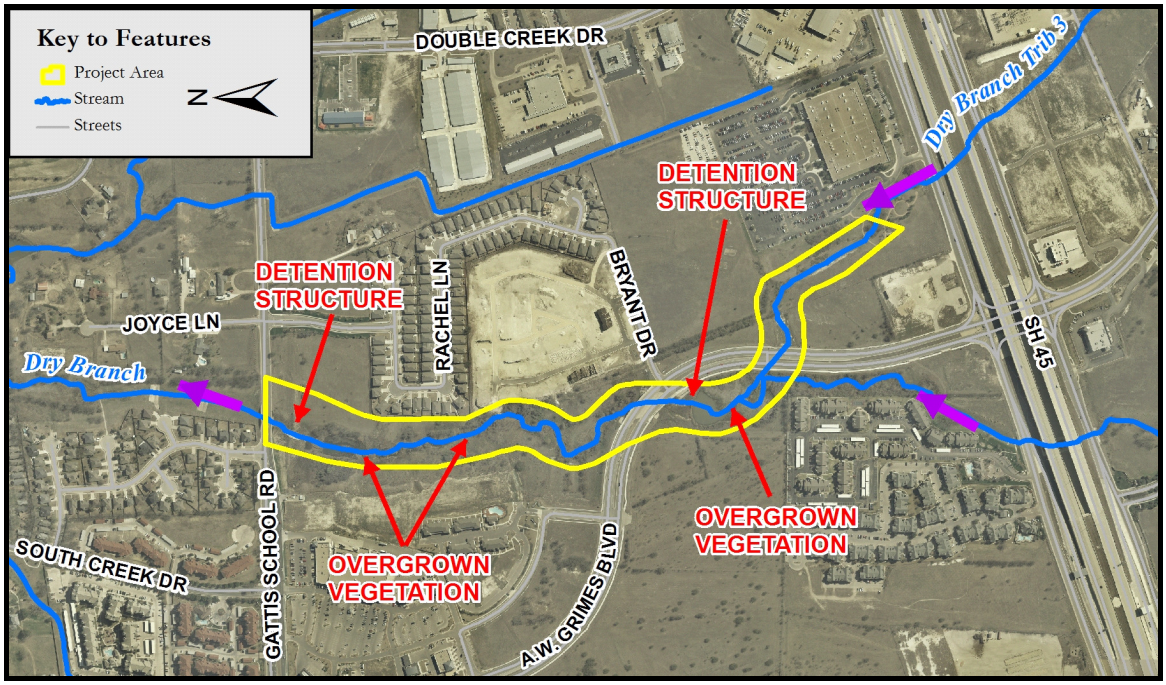
Project: 2013X.1 - Major Creek Modeling

Dry Branch

This 3800 foot reach of Dry Branch is densely vegetated in the overbanks as well as the channel. Although this dense vegetation does restrict the capacity of the channel, it also provided great hydrologic and water quality benefits. The current WCID hydrologic and hydraulic models do not adequately simulate the benefits of this reach. The roughness factor of these two models does not accurately reflect the densely vegetated field conditions of the reach. Additional there are two detention structure that help reduce the peak flow downstream. These two detention benefits are not incorporated into the current WCID hydrologic models.



Reference Issues: DB34



Project: 2013X.1 - Major Creek Modeling

Dry Branch

Solution

A detailed modeling study can help refine the current hydrologic and hydraulic models to reflect the attenuation benefits of the reach. The channel roughness factors can be reviewed to accurately reflect field conditions potentially increasing the storage and travel time through the reach. This potential increase will help reduce the peak flow and water surface downstream. Addition of the existing detention structures in the reach to the existing models will further reduce peak flows downstream and therefore help reduce the floodplain. Revision of the model will help more accurately reflect field conditions and potentially reduce the peak flow and floodplains further downstream on Dry Branch.

Challenges

- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	1	13
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**212**

2013X.1 – Dry Branch Channel Conveyance (A.W. Grimes)

Background

- This Project includes Issue DB34.
- This 3800' reach is upstream of Gattis School Road. This reach crosses A.W. Grimes twice and begins upstream near SH45.
- WCID hydraulic models indicate that no homes are flooded and no roadways are overtopped.

Issues

- This reach has thick vegetation in the channel and overbanks. The hydraulic model could be revisited to reflect a higher roughness coefficient for the channel. The flooding performance could then be reevaluated. Some "selective clearing" could be envisioned along this reach.
- Although this reach is overgrown it could provide some water quality benefits due to the extended time that the urban runoff will have to travel along the reach toward the outlet.
- Another benefit this overgrown reach provides is a form of "linear detention" where the flood peak is attenuated as it moves downstream. The hydrologic model could be revisited and the routing methods could be altered to reflect the storage that is currently taking place along this reach. The current downstream peaks may reflect a more conservative opinion assuming a clear channel and minimal routing attenuation.
- To enhance the linear storage and water quality capabilities along this reach further, consideration could be given to developing "embayments" outside of the main channel to store and treat flood waters that exceed the 2-year storm event.

Candidate Alternatives

1. **Selective Clearing** – Selectively remove invasive species and thick undergrowth while keeping key "riparian function" parameters intact. (Cost < $250k).
   - Some selective clearing would help develop this reach as a "conveyance" reach.
   - Remove the invasive species and revegetate with some lower height native grass species that would not require annual mowing. This could help reduce annual maintenance requirements.
   - Amend the soils to develop a "fungi to bacteria ratio" that would be more conducive to growing grasses and less conducive to the bushes (woody).
   - Insure the streambanks are still stabilized.
   - Insure that some energy dissipation is still occurring through this reach.
   - Insure there are water quality treatment opportunities along the reach.
   - Review the hydraulic model and see what the current roughness assumptions are for this reach. If the model is smoother than the existing conditions, then rerun the model with existing conditions. If the model includes rougher conditions, then determine an acceptable level of roughness reduction without increasing the velocities to a point of scour and erosion.

2. **Review the hydrologic model for "linear detention" benefits** – Determine if the WCID hydrologic model reflects the flood attenuation benefits of this reach. This review could reveal some peak flow reductions to the downstream reaches without having to develop any substantial infrastructure improvements. (Cost < $250k).
   - The alternative to developing this as a "conveyance" reach through selective clearing would be to enhance it as a "flood storage and water quality" reach.

- Minimal selective clearing may still be needed but much less than for the development of a conveyance reach.
- Preserve the existing vegetated overbank's capabilities of storing floodwater for release at a later date to sustain baseflow and help with groundwater recharge.
- Preserve the ability of this reach to dissipate stream energy which helps downstream reaches.
- Preserve the reach's ability to trap sediment and treat urban runoff through extended biological contact.

3. **Embayments** – Enhance the reach's ability to store floodwater, provide enhanced linear detention, and improved water quality treatment by developing embayment depressions along the reach. (Cost < $250k).
   - Embayments are naturally occurring slight depressions on the inside bend of alternating meanders.
   - The stream channel is designed to convey the 2-year storm
   - The embayments would fill with any additional floodwater over the 2-year event.
   - The stormwater would remain in these long, shallow depressions for a couple of days while the waters recede.
   - Larger hardwood trees could be planted in these areas.
   - Should these embayments be developed, then this reach could also have some sort of a trail experience developed along the reach.
   - These features would add value to the riparian corridor.

4. **Trail** – This reach could be developed into a linear trail (not a park). (Cost $250k to $750k).
   - Developing educational experiences for residents can make projects of this type eligible for TPWD grants.
   - Trails like this can help connect residential and commercial developments.
   - Natural trails can provide recreational opportunities to the neighborhoods.

5. **"In-line" detention** – Enhance the reach's ability to store floodwater by developing a more traditional "in-line" detention structure. (Cost $250k to $750k).
   - Additional hydrologic and hydraulic modeling would be required.
   - This reach could lend itself to even a more structural "in-line" detention option due to the length of the reach and the adjacent developments are minimal at this point.
   - Examine possible locations upstream of Gattis School Road as well as A.W. Grimes.
   - The control structures would amount to notched weirs with the invert matching the existing invert of the creek. The key point is that sediment transport would still be allowed through these structures. It would only be as the 2-year event is exceeded would the weir structure begin to block the flow and back a specific amount of water up into these linear detention basins.
   - Consideration would be given to not flood any structures or roadways.
   - Additional detention storage would then help reduce the project needs in the downstream reaches.

Alternative Bundles

A. **Alternatives 1** – A more traditional approach of clearing underbrush to develop a "conveyance channel." Comes with the annual maintenance requirement to preserve the reduced roughness. Establishing low height native grasses could help reduce the annual maintenance requirements. (Cost < $250k).

B. **Alternative 2** – Examine the potential of taking credits for the existing flood attenuation features of this reach. Examine minimal clearing to help minimize annual maintenance requirements. Determine if there are any additional WQ or flood attenuation features that could be added to this reach. (Cost < $250k).

C. **Alternatives 2 & 3** – Should the modeling indicate an opportunity for additional WQ or flood attenuation features that could be added to this reach, then consider the use of embayments. (Cost < $250k).

D. **Alternatives 2, 3 & 4** – Should the use of embayments be considered, then the further addition or a nature trail could also be considered for this reach. (Cost $250k to $750k).

E. **Alternative 5** - Should the modeling indicate an opportunity for additional flood attenuation features for this reach, then consider the use of "in-line" detention structures. (Cost $250k to $750k).

Challenges

- Coordination with Parks Department.
- Coordination with Transportation Department.
- Coordinate with adjacent property owners.

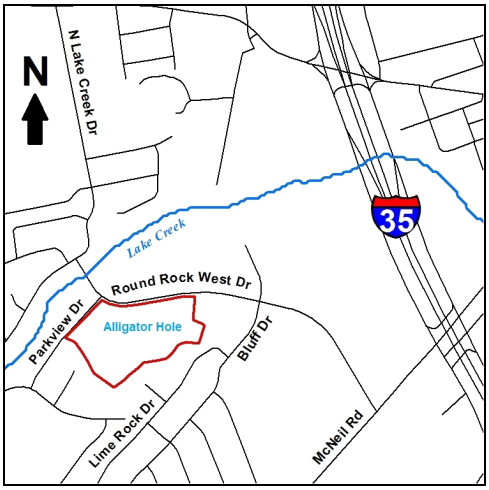
Notes

- An UBC-WCID hydraulic model does exist for this reach.
- With park trails improvements it might be possible to nominate this project for TPWD Grant opportunities.

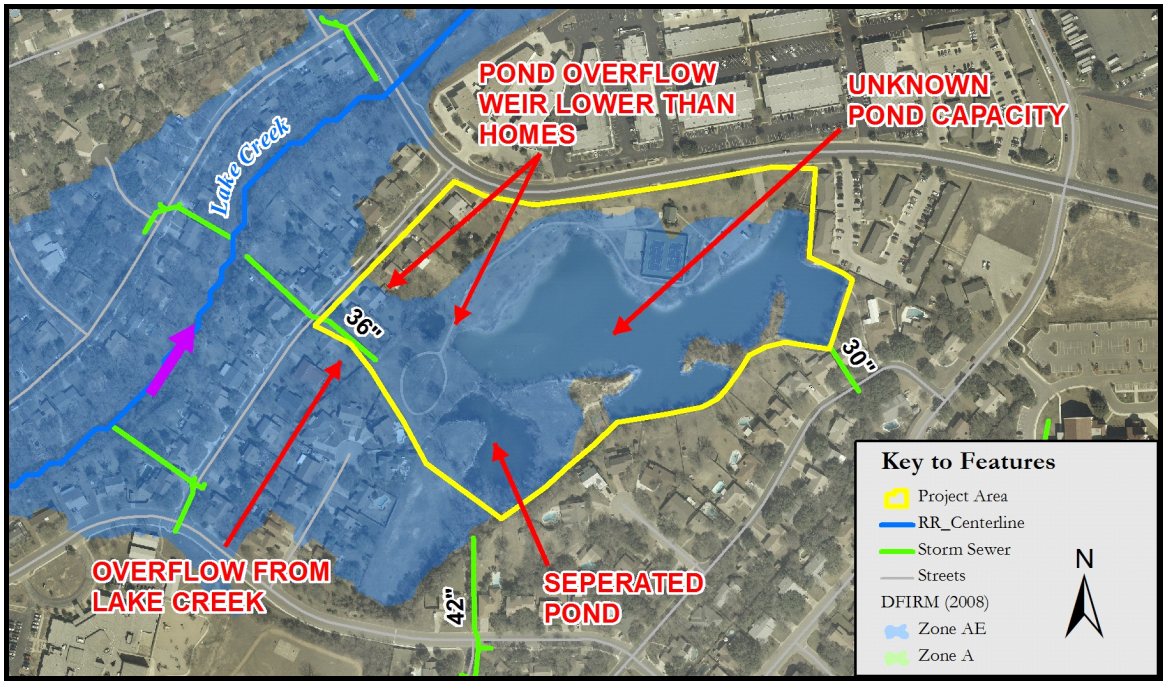
Project: 2013X.2 - Round Rock West Detention

Lake Creek Tributary 12

Round Rock West Lake also known as Alligator Hole is an old quarry that now acts as a retention basin and a park feature. The existing WCID hydrologic model does not reflect the detention benefits of this feature. The current WCID model shows that water flows out of Lake Creek and into Alligator Hole basin during large events. This overflow is not modeled as leaving the Lake Creek reach and detained in Alligator Hole. Since currently there is no elevation-storage information on Alligator Hole the detention benefits and flood risk of the structures surround the feature are unknown.



Reference Issues: LC58



Project: 2013X.2 - Round Rock West Detention

Lake Creek Tributary 12

Solution

A detailed modeling study of Alligator Hole will help define its detention benefits as well as the flood risk for the structures surrounding it. A bathymetric survey would be helpful to determine the storage volume of Alligator Hole. With this information the hydrologic model can be refined to reflect the detention benefits of Alligator Hole as well as the elevation during flood events. This additional detention to the current WCID models can potentially reduce the peak flow and water surface elevations along Lake Creek. A reduction in water surface downstream may remove several structures form the existing floodplain and reduce their flood insurance costs.

Challenges

- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**306**

2013X.2 – Round Rock West – Water Quality (Alligator Hole)

Background

- This Project includes Issue LC58.
- The study area is in the Lake Creek watershed.
- The study area is bounded on the north by Round Rock West Drive and on the west by Parkview Drive.
- The study area is an old quarry site (about 600' by 300') referred to as Alligator Hole.
- The drainage patterns are unique in this location. The adjacent subdivision streets drain into this sump.
- Of interest is that as either the flow from Lake Creek or the local subdivision flow moves from Parkview Drive east toward Alligator Hole, there is a smaller basin that must fill first.
- Another source of inflow to this area is from Lake Creek. As Lake Creek reaches flood stage it appears that the right bank (looking downstream) overflows through the subdivision into Alligator Hole.

Issues

- It does not appear that there is any conveyance infrastructure to evacuate the captured stormwater. It either evaporates or infiltrates.
- This smaller basin is formed by an earthen berm with a hiking trail on top. The elevation of the trail (overflow weir) appears to be higher than the elevation of the backyards of the homes along Parkview Drive.
- After storm events, the smaller basin has standing water and is discolored.
- It appears that the stormwater fills this smaller basin to an elevation that might jeopardize the homes along Parkview Drive.
- The homes along Parkview Drive are already impacted by the Lake Creek floodplain.
- WCID identifies this area as flood prone with many homes flooded.

Candidate Alternatives

1. **Additional information** – (Cost < $250k).
   - Additional topographic survey at the small pond would be very helpful to evaluate the elevation of the trail in comparison to the residential homes, fences and yards.
   - Additional bathymetric survey information would be helpful to determine the storage volume of Alligator Hole.
   - Use the information in conjunction in developing some of the other Alternatives.

2. **Additional modeling** – (Cost < $250k).
   - The existing hydrologic model does include computations for the quarry at the 620 bypass entering Lake Creek from the north.
   - It does not appear that the hydrologic model includes any allowance for a loss of runoff volume into the Alligator Hole basin.
   - It does not appear that there is any attenuation of the peak flow rates due to the existence of this large storage area.
   - See if this storage area will reduce downstream peak flow rates and benefit other Projects.
   - Use the information in conjunction in developing some of the other Alternatives.

3. **Lower the trail elevation** – (Cost < $250k).
   - Should the trail elevation be impacting the adjacent residential lots, then consider lowering the trail elevation.

- Consider installing an automatic level control weir (e.g. Obermeyer) to keep an aesthetically pleasing amount of water in the smaller basin, yet capable of releasing as much water as necessary during a flood event such that harmful backwater elevations are avoided.

4. **Inoculate with bacteria** – (Cost < $250k).
   - Third party products exist that are environmentally safe which help reduce odor from standing water and help clarify the water.
   - Consideration could be given to inoculating the smaller upper basin.
   - The amount of inoculation for the entire Alligator Hole could be investigated, but most likely it would be cost prohibitive.
   - Treatment of Alligator Hole with other biodegradable flocculent materials could help improve the aesthetics of the Hole.
   - Aeration of Alligator Hole could be investigated to help the water quality.

5. **Develop trails and educational opportunities at Alligator Hole** – (Cost < $250k).
   - Consideration could be given to view this area as a valuable resource.
   - Examine methods to provide educational opportunities around the perimeter.
   - If the water quality improved then perhaps this basin could be stocked with fish by the TPWD and developed into a recreational opportunity.
   - Glass bottom boat tours could be possible.
   - Improving the riparian buffer around Alligator Hole could provide a natural remediation plan.

Alternative Bundles

A. **Alternatives 1 & 2** – Gather more information and perform additional hydrologic modeling. (Cost < $250k).

B. **Alternatives 1, 2 & 3**– Gather more information and perform additional hydrologic modeling. Modify the elevation/function of the existing trail. (Cost < $250k).

C. **Alternatives 1, 2, 3 & 4**– Gather more information and perform additional hydrologic modeling. Modify the elevation/function of the existing trail. Improve the water quality of the smaller upper basin. (Cost < $250k).

D. **Alternatives 5** – Discuss trail and education al opportunities with the neighborhoods. (Cost < $250k).

Challenges

- Discuss grant opportunities with TPWD for development of Alligator Hole (trails, fishing, and education).

Notes

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