MEMO:

TO: Greg Smith, City Manager
FROM: Herbert S. Smith, P.E.
RE: Freedom Park Pond

Greg:

We have completed the hydrology and hydraulic study of the proposed AISD improvements in the Rancho Ditch Watershed. We will submit the HH Study to you on Wednesday, 19 March 2008 for the Council's approval.

As a part of the work on this Study, we refined the overall Rancho Ditch Watershed hydrological study and have the following to report to you.

1 Freedom Park Regional Pond will have a significant benefit to downstream interests once constructed.

2 We had to size the culvert under Downing Road as a part of the analysis involved in preparing a mitigation plan for the proposed AISD improvements. The long range planning for the watershed integrates Freedom Park Regional Pond into the analysis. My analysis assumes that the minimum pond will be built within a reasonable time frame. While the optimum solution is to construct the minimum pond so that it is on line when Downing Road is complete, Council may wish to delay the construction for a very short period and accept the risk of an event occurring without the protection provided by the pond.

Results Summary

Flow Upstream of Freedom Park Pond	Flow After Detention Freedom Park Pond	Water Surface Elevation with Pond and (1) 8' x 6' Box	Water Surface Elevation without Pond and (1) 8' x 6' Box	Water Surface Elevation without Pond and (2) 8' x 6' Boxes
364 cfs	200 cfs	25.10'	26.51'	25.09'

As you can see, the Pond shaves 164 cfs from the hydrograph and allows for the crossing at Downing Road to be 1- 8' x 6' box culvert. This will create a water surface elevation of 25.10' for the 100 year event, which is within the channel. Should we not construct the pond, then with this box the water surface elevation would become 26.51'; almost 18" higher and create unnecessary upstream impacts. Also, you will note that adding a second box culvert brings the water

surface area back to the same elevation as one box culvert working with the Freedom Park Pond.

3 While we are not prepared to provide budget numbers, we can give you "order of magnitude estimates" that might help you determine the instructions you give us.

Price Range for Construction of Minimum Volume Regional Pond at Freedom Park	Cost Range for Installing Second Culvert
$300,000 - $600,000 depending on ratio of force account work to contract work	$90,000 - $125,000 incremental extra (certain costs, such as headwalls will be incurred in both options)

4 The model we used to shave the peak flow from 364 cfs to 200 cfs requires a volume in the Freedom Park Pond of 75 acre feet. The pond is scheduled for 165 acre feet of detention (exclusive of the amenity lake). Council could consider selling the additional 90 acre feet to developers in the watershed. Current prices for purchasing detention in the area range from $8,500 to $12,000 per acre feet. At these prices the owners of the regional pond are expected to excavate the pond, but the purchasers usually truck the dirt to their site for fill. Depending on this and other variables actual profit to the City from the excess detention would range from $2,500 - $7,500 per acre foot ($225,000 - $675,000).

We do not recommend the sale of regional detention. I learned at the FEMA conference that the average home in our country has a 26% chance of suffering flood damage, on average, over the life of a 30 year mortgage when the standard for design of flood protection is the 1% (so called 100 year event) storm. I recommend that the City continue to require on site detention and use the volume available in all regional ponds to reduce this probability of flooding by increasing the level of protection from the 1% event to a less probable event.

RECOMMENDATION

Construct(1) 8' x 6' culvert and the 75 acre foot minimum regional pond at Freedom Park over the next 2 years. Expand the pond as budget allows to the full capacity of 165 acre feet either as a part of the construction of the amenity package or prior to it. If this is not acceptable, then we recommend the hydraulically equivalent design of construction of (2) 8' x 6' box culverts and no immediate construction in the pond. We also recommend that the Regional Pond then be constructed to the full 165 acre feet as the budget allows, to provide for greater protection of downstream interests than the existing condition provides.

Council might choose to install (1) 8' x 6' box culvert and to construct the minimum pond over a longer period. If so, Council should understand that they have accepted the risk that a large event

will occur and the water surface upstream of Downing Road will be 18" higher than need be due to the lack of the pond. We would need a statement from Council, to protect us from liability exposure, that they have chosen to accept the this risk against our advice.

Impacts on AISD Facility Plan:

Because the new facility will connect downstream of the Downing Road crossing of the Rancho Ditch, the options discussed in this memo do not affect the development of the school other than raising the tailwater in Rancho Ditch. The actual volume of detention required is a function of the development of school, not the tailwater in the ditch

Impacts on the upgraded Henderson Road Crossing

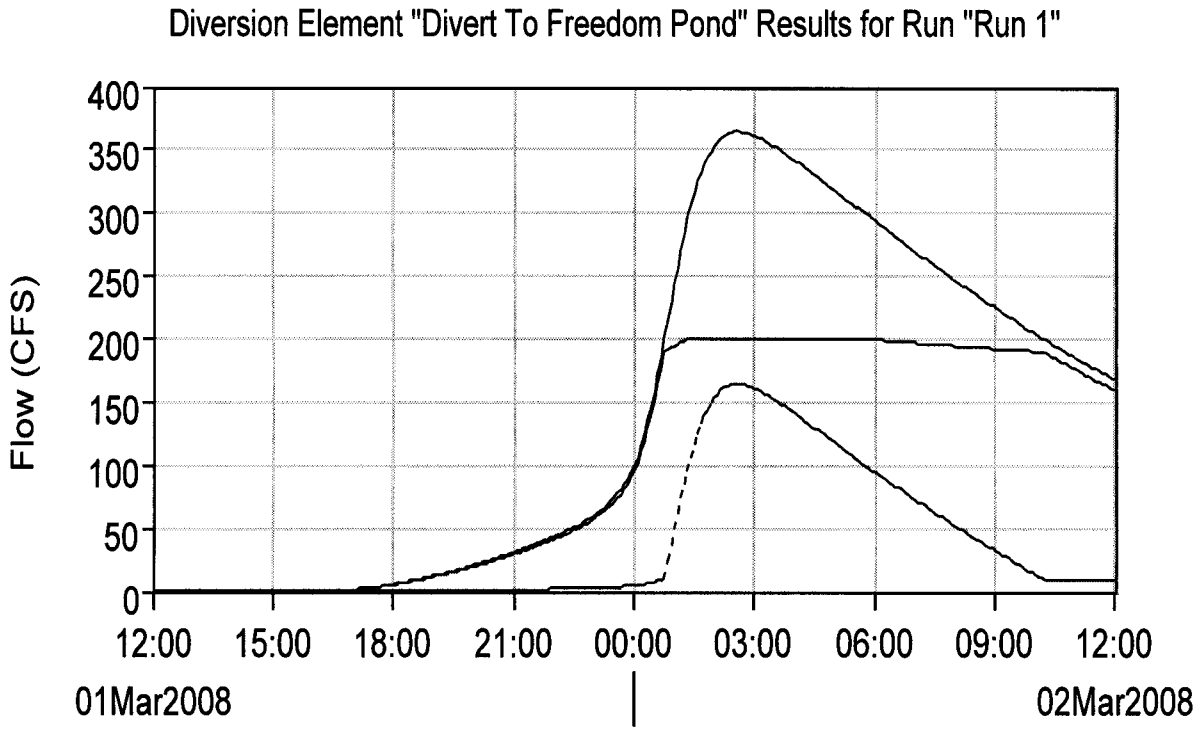
The current planning for Henderson Road crossing at the east side of Good Shepard Church has the Freedom Park Regional Detention Pond in the model. Failure to construct the Pond within the period prior to the construction of the Henderson Crossing will have an impact on that crossing to a greater or lesser extent. The impact will depend on whether Council chooses to build no regional pond, the minimum regional pond or aggressively pursue the construction of the overall pond (the current plan).

Herbert S. Smith, P.E.
City Engineer
City of Angleton, Texas

President
Baker & Lawson, Inc.
Angleton, Texas

cc District Engineer - Angleton Drainage District

17 march 2008.


Diversion Element "Divert To Freedom Pond" Results for Run "Run 1"
Flow (CFS)
400
350
300
250
200
150
100
50
0
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
01Mar2008
02Mar2008
Run:Run 1 Element:DIVERT TO FREEDOM POND Result:Outflow
Run:Run 1 Element:DIVERT TO FREEDOM POND Result:Combined Inflow
Run:Run 1 Element:DIVERT TO FREEDOM POND Result:Diverted Flow

HEC-RAS Plan: Plan 02 River: Rancho Ditch Reach: Rancho Ditch Profile: 100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Ditch	6202.16	100	364.00	21.00	25.93		25.97	0.000381	1.73	210.02	71.62	0.18
Rancho Ditch	4911.49	100	364.00	21.60	25.31		25.37	0.000595	1.94	187.74	72.57	0.21
Rancho Ditch	4817.02	100	364.00	21.30	25.29		25.32	0.000247	1.37	264.82	88.45	0.14
Rancho Ditch	4641.51	100	364.00	20.88	25.21		25.26	0.000420	1.81	200.88	65.87	0.18
Rancho Ditch	4310.24	100	200.00	20.10	25.18		25.19	0.000072	0.83	240.47	67.57	0.08
Rancho Ditch	4233.31	100	200.00	19.96	25.17		25.18	0.000075	0.85	235.64	65.80	0.08
Rancho Ditch	4135.94	100	200.00	19.80	25.10	21.91	25.17	0.000316	2.05	97.72	68.78	0.17
Rancho Ditch	4042.02		Culvert									
Rancho Ditch	3940.53	100	200.00	19.26	24.65	21.68	24.71	0.000349	2.08	96.12	61.26	0.18
Rancho Ditch	3887.52	100	200.00	19.22	24.67		24.69	0.000095	0.91	220.19	66.34	0.09
Rancho Ditch	3452.92	100	200.00	18.90	24.63		24.65	0.000092	0.90	222.14	66.34	0.09
Rancho Ditch	2793.57	100	200.00	18.50	24.58		24.59	0.000066	0.81	247.53	67.66	0.07
Rancho Ditch	2338.19	100	200.00	18.10	24.55		24.56	0.000075	0.86	233.01	63.92	0.08
Rancho Ditch	2070.40	100	200.00	17.50	24.54		24.55	0.000045	0.70	283.91	70.75	0.06
Rancho Ditch	1929.12	100	200.00	17.80	24.53		24.54	0.000042	0.67	299.98	78.05	0.06
Rancho Ditch	1797.88	100	200.00	17.30	24.53		24.53	0.000036	0.65	307.80	73.25	0.06
Rancho Ditch	1305.40	100	200.00	16.50	24.52		24.52	0.000018	0.50	396.15	82.43	0.04
Rancho Ditch	733.25	100	200.00	15.70	24.51		24.51	0.000011	0.43	467.31	85.02	0.03
Rancho Ditch	284.62	100	200.00	15.20	24.50		24.51	0.000011	0.43	460.86	82.61	0.03
Rancho Ditch	152.71	100	200.00	15.00	24.50		24.51	0.000008	0.39	515.54	88.40	0.03
Rancho Ditch	98.24	100	200.00	14.70	24.50		24.51	0.000009	0.39	506.84	89.45	0.03
Rancho Ditch	48.51	100	200.00	15.40	24.50		24.50	0.000020	0.52	385.83	85.02	0.04
Rancho Ditch	0.00	100	200.00	14.40	24.50	17.23	24.50	0.000017	0.49	410.82	93.18	0.04

HEC-RAS Plan: Plan 02 River: Rancho Ditch Reach: Rancho Ditch Profile: 100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Ditch	6202.16	100	364.00	21.00	26.91		26.94	0.000159	1.28	284.91	79.67	0.12
Rancho Ditch	4911.49	100	364.00	21.60	26.71		26.74	0.000150	1.24	294.33	78.92	0.11
Rancho Ditch	4817.02	100	364.00	21.30	26.71		26.72	0.000075	0.91	398.38	99.75	0.08
Rancho Ditch	4641.51	100	364.00	20.88	26.68		26.71	0.000124	1.20	303.80	73.99	0.10
Rancho Ditch	4310.24	100	364.00	20.10	26.66		26.67	0.000084	1.05	347.35	76.89	0.09
Rancho Ditch	4233.31	100	364.00	19.96	26.65		26.67	0.000087	1.07	338.70	74.03	0.09
Rancho Ditch	4135.94	100	364.00	19.80	26.51	22.65	26.64	0.000424	2.84	128.23	77.50	0.21
Rancho Ditch	4042.02		Culvert									
Rancho Ditch	3940.53	100	364.00	19.26	24.92	22.35	25.12	0.000941	3.56	102.21	63.15	0.29
Rancho Ditch	3887.52	100	364.00	19.22	25.00		25.04	0.000237	1.50	242.49	68.42	0.14
Rancho Ditch	3452.92	100	364.00	18.90	24.90		24.93	0.000244	1.52	239.98	67.75	0.14
Rancho Ditch	2793.57	100	364.00	18.50	24.76		24.79	0.000191	1.40	259.65	68.77	0.13
Rancho Ditch	2338.19	100	364.00	18.10	24.66		24.70	0.000230	1.52	240.11	64.80	0.14
Rancho Ditch	2070.40	100	364.00	17.50	24.62		24.65	0.000139	1.26	289.85	71.25	0.11
Rancho Ditch	1929.12	100	364.00	17.80	24.60		24.63	0.000132	1.19	305.60	78.50	0.11
Rancho Ditch	1797.88	100	364.00	17.30	24.59		24.61	0.000114	1.17	312.29	73.62	0.10
Rancho Ditch	1305.40	100	364.00	16.50	24.55		24.57	0.000059	0.91	399.30	82.62	0.07
Rancho Ditch	733.25	100	364.00	15.70	24.53		24.54	0.000036	0.78	469.19	85.13	0.06
Rancho Ditch	284.62	100	364.00	15.20	24.52		24.52	0.000036	0.79	461.73	82.68	0.06
Rancho Ditch	152.71	100	364.00	15.00	24.51		24.52	0.000027	0.71	516.30	88.45	0.05
Rancho Ditch	98.24	100	364.00	14.70	24.51		24.52	0.000029	0.72	507.50	89.50	0.05
Rancho Ditch	48.51	100	364.00	15.40	24.50		24.52	0.000068	0.94	385.94	85.04	0.08
Rancho Ditch	0.00	100	364.00	14.40	24.50	18.01	24.51	0.000057	0.89	410.82	93.18	0.07

HEC-RAS Plan: Plan 02 River: Rancho Ditch Reach: Rancho Ditch Profile: 100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Ditch	6202.16	100	364.00	21.00	26.03		26.07	0.000345	1.67	217.41	72.55	0.17
Rancho Ditch	4911.49	100	364.00	21.60	25.50		25.55	0.000474	1.80	202.02	73.45	0.19
Rancho Ditch	4817.02	100	364.00	21.30	25.49		25.52	0.000204	1.29	282.57	90.03	0.13
Rancho Ditch	4641.51	100	364.00	20.88	25.43		25.47	0.000343	1.69	214.97	67.04	0.17
Rancho Ditch	4310.24	100	364.00	20.10	25.35		25.38	0.000210	1.45	251.81	68.71	0.13
Rancho Ditch	4233.31	100	364.00	19.96	25.33		25.36	0.000219	1.48	245.86	66.67	0.14
Rancho Ditch	4135.94	100	364.00	19.80	25.09	22.65	25.30	0.001060	3.74	97.40	68.64	0.31
Rancho Ditch	4042.02		Culvert									
Rancho Ditch	3940.53	100	364.00	19.26	24.92	22.35	25.12	0.000941	3.56	102.21	63.15	0.29
Rancho Ditch	3887.52	100	364.00	19.22	25.00		25.04	0.000237	1.50	242.49	68.42	0.14
Rancho Ditch	3452.92	100	364.00	18.90	24.90		24.93	0.000244	1.52	239.98	67.75	0.14
Rancho Ditch	2793.57	100	364.00	18.50	24.76		24.79	0.000191	1.40	259.65	68.77	0.13
Rancho Ditch	2338.19	100	364.00	18.10	24.66		24.70	0.000230	1.52	240.11	64.80	0.14
Rancho Ditch	2070.40	100	364.00	17.50	24.62		24.65	0.000139	1.26	289.85	71.25	0.11
Rancho Ditch	1929.12	100	364.00	17.80	24.60		24.63	0.000132	1.19	305.60	78.50	0.11
Rancho Ditch	1797.88	100	364.00	17.30	24.59		24.61	0.000114	1.17	312.29	73.62	0.10
Rancho Ditch	1305.40	100	364.00	16.50	24.55		24.57	0.000059	0.91	399.30	82.62	0.07
Rancho Ditch	733.25	100	364.00	15.70	24.53		24.54	0.000036	0.78	469.19	85.13	0.06
Rancho Ditch	284.62	100	364.00	15.20	24.52		24.52	0.000036	0.79	461.73	82.68	0.06
Rancho Ditch	152.71	100	364.00	15.00	24.51		24.52	0.000027	0.71	516.30	88.45	0.05
Rancho Ditch	98.24	100	364.00	14.70	24.51		24.52	0.000029	0.72	507.50	89.50	0.05
Rancho Ditch	48.51	100	364.00	15.40	24.50		24.52	0.000068	0.94	385.94	85.04	0.08
Rancho Ditch	0.00	100	364.00	14.40	24.50	18.01	24.51	0.000057	0.89	410.82	93.18	0.07

Project : Rancho with AISD Developed Simulation Run : Run 1 Diversion: Divert To Freedom Pond

Start of Run :	01Mar2008, 12:00	Basin Model :	AISD w/Freedom
End of Run :	02Mar2008, 12:00	Meteorologic Model :	Met 1
Compute Time :	17Mar2008, 11:40:24	Control Specifications :	Control 1

Volume Units : AC-FT

Computed Results

Peak Inflow :	364.4 (CFS)	Date/Time of Peak Inflow :	02Mar2008, 02:35
Peak Outflow :	200.0 (CFS)	Date/Time of Peak Outflow :	02Mar2008, 01:25
Peak Diversion :	164.4 (CFS)	Date/Time of Peak Diversion :	02Mar2008, 02:35
Total Inflow :	281.4 (AC-FT)		
Total Outflow :	205.9 (AC-FT)	Total Diversion :	75.5 (AC-FT)