DRAINAGE PLAN

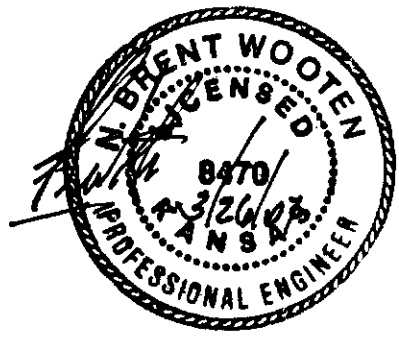
SAVINA 5TH ADDITION

TO

WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY

Baughman
ENGINEERING | SURVEYING | PLANNING
LANDSCAPE ARCHITECTURE



26 MARCH 2007

ENGINEERING | SURVEYING | PLANNING
LANDSCAPE ARCHITECTURE

DRAINAGE PLAN
SAVINA 5TH ADDITION

FINAL REPORT

Prepared by Baughman Company, P.A.
26 March 2007

By N. Brent Wooten, P.E.
Trevor R. Kurth, I.E.
Nicholas H. Jefferson, I.E.

REPORT CONTENTS

Adopted: February 23, 2007

WICHITA

Public Works, Engineering Division
Final Drainage Plan Submittal Checklist

Reviewer: _____ Date: _____

Subdivision Name: SAVINA 5TH Add Location: 33RD & ARKANSAS

Total Land Area Of Ownership: 16.5 Acres

Type: X Residential ____ Commercial ____ Industrial ____ Recreation ____ Municipal ____ Other

Applicant: HABITAT FOR HUMANITY Contact: _____ Phone #: _____

Engineer: BAUGHMAN CO, PA Contact: TREVOR KUPKE Phone # 262-7271

Please check the appropriate box: I = Included; NA = Non-Applicable; R= Required prior to development
(If "NA" is checked, an explanation must be entered)

	Applicant			Engr	
Tab 1. Project Narrative	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Site Location Map, using USGS Map	X				
B. Discussion of development, existing conditions, and proposed impacts on stormwater, wetland, riparian, and flood plain	X				
C. Discussion of offsite conditions	X				
D. Summary of runoff calculations (pre/post development) No increase in peak discharge for all storm series	X				
E. Narrative description of the type and function of the permanent best management practices that are incorporated into the site design	X				
F. Copy of the plat	X				
G. Preliminary grading plan (The final grading plan shall be sealed, signed and dated prior to Engineering receiving the final sanitary sewer plans. One plan sheet and PDF shall be submitted to the Subdivision Engineer.)	X				
H. Professional Engineer seal, signature and date on cover of report	X				
I. CD of drainage plan in PDF format (one file) and one paper copy bound with this checklist included behind the cover		X	Upon Approval, CD will be provided.		

	Applicant			Engr	
Tab 2. Existing Conditions Runoff Calculations	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Copy of applicable orthophoto showing proposed project boundaries (preferable in color)	X				
B. Runoff Method (Rational, Hydrograph Method, or other approved methods by Engineering)	X				
C. Existing topography (no greater than 2-foot contours, 1-foot recommend)	X				
D. Total Site Area and Total Impervious Area (acres)	X				
E. Benchmarks used for site control	X				
F. Streams, creeks, and waterway labeled	X				
G. Predominant soils from USDA soil surveys, and/or on site soil borings	X				
H. Location and boundaries of natural features such as wetlands, lakes, and ponds with the normal water elevation noted	X				
I. Location of existing roads, buildings, parking lots and other impervious areas.	X				

Consulting Engineer Initials TK

J. Location of existing utilities (e.g., water, sewer, gas, electric) and easements	x				
K. Location of existing conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow	x				
L. Flow paths	x				
M. Location and dimensions of existing channels, bridges or culvert crossings	x				
N. Existing conditions hydrologic analysis for runoff rates, volumes and velocities showing methodologies used and supporting calculations (2, 5, 10, 25 & 100 year, 24-hour storm events) or Critical Duration	x				
O. Assumed pre-developed runoff curve numbers	x				
P. Existing time of concentrations used in calculations	x				
Q. Evaluate immediate downstream drainage capacity, not to exceed more than 0.25 miles downstream of site	x				
R. Existing structural elevations (e.g., invert of pipes, manholes, etc.)	x				
S. Cross-section data for open channels	x				
T. Ground water elevations, if applicable		x	NA		

	Applicant			Engr	
Tab 3. Post-Development Hydrologic Analysis	**I**	**NA**	**Explanation / Location in Plan**	**I**	**NA**
A. Proposed (post-development) conditions hydrologic and hydraulic analysis for runoff rates, volumes, HGL, and velocities showing the methodologies used and supporting calculations for all applicable design storms (2, 5, 10, 25 & 100 year, 24-hour storm events)	x				
B. Proposed time of concentrations used in calculations	x				
C. Assumed post-developed runoff curve numbers	x				
D. Proposed contours for detention facilities (to equal area used in outlet rating curves)		x	No detention facilities proposed		
E. Preliminary sizing calculations for stormwater controls including contributing drainage area, storage, and outlet configuration	x				
F. Stage-storage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities		x	No facilities proposed		
G. Final analysis of potential upstream/downstream impact/effects of project, where necessary	x				
H. Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.)	x				
I. Design water surface elevations and normal pool elevation for ponds.		x	No ponds proposed		
J. Typical detail for outlet structures, embankments, spillways, grade control structures, conveyance channels, etc. To include height, width, elevation, and/or diameter.	x				
K. Proposed limits of clearing and grading	x				
L. Location of existing and proposed roads, buildings, parking lots and other impervious areas.	x				
M. Location of existing and proposed utilities (e.g., water, sewer) and easements		x	Proposed utilities on 'Utility Plan'		
N. Location of existing and proposed conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow	x				
O. Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings		x	No modifications expected		

Consulting Engineer Initials TRK

P. Preliminary selection and location of stormwater controls	x				
Q. Emergency overflow structure's flow path	x				
R. Detention facility provides one-foot of freeboard above the HWL and emergency outfall shown (top of berm elevation shown)	x				
S. The 100-year 24-hour HWL delineated on the plan for detention pond	x		HWL for channel is shown.		
T. Lowest opening elevations table on the plat for structures located adjacent to channels or ponds	x				
U. Stormwater Management Facilities located within a Reserve		x	No facilities proposed		
V. Maintenance responsibility of stormwater management facility shall be specified in the platters text. (e.g. HOA, Lot Owners Association, or lot)		x	" "		
W. Off-site drainage easements or agreements required, where necessary	x				

	Applicant			Engr	
Tab 4. Floodplain Submittal	I	NA	Explanation / Location in Plan	I	NA
A. Provide source of flood profile	x				
B. Nearest base flood elevations	x				
C. Delineation of pre-developed regulatory floodplain/floodway limits	x				
D. Delineation of post-developed regulatory floodplain and floodway limits	x				
E. Floodplain boundary determination per elevation (project limits shown)	x				
F. Provide source of floodway data table and discharges		x	None available		
G. Provide all hydrologic and hydraulic study information for site-specific floodplain studies, unnumbered Zone A area elevation determinations and flood plain map revisions or required permits	x				
H. Provide regulatory floodway and four natural profile models (10,50,100, and 500-yr) for existing and future watershed conditions		x	FP and FW made in channel banks per HEC-RAS study		
I. Location of floodplain/floodway limits and relationship of site to upstream/downstream properties (floodplain limits to be per elevation and scaled location)	x				
J. Flood plains and floodways located within a Reserve, where necessary		x	FP in channel section, not on property		

	Applicant			Engr	
Tab 5. Federal, State and Local Permits (to be provided prior to construction unless otherwise specified)	I/R	NA	Explanation / Location in Plan	I/R	NA
A. US Army Corps of Engineers - Regulatory program permits (404 water quality certification)	x		Jurisdictional determination will be obtained		
B. Kansas Department of Agriculture - Division of Water Resources Permits (Stream Obstruction, Channel Change, Flood Plain Fill, Levee, Water Appropriations, Dam safety permit, etc.)		x	NO FF will be placed, may need stream obstruction for outlet structure		
C. Federal Emergency Management Agency (FEMA) Letter of Map Changes (LOMA, LOMR, LOMR-f, CLOMR, etc.) Shall be included and approved when project modifies the limits of the floodway.		x	No modification of FW and site not in FP per elevation.		
D. Kansas Department of Transportation		x	None expected		
E. Sedgwick County Right-of-way Permit		x	None expected		

Consulting Engineer Initials TRL

PROJECT NARRATIVE

EXISTING CONDITIONS

The site is located near the intersection of North Arkansas Avenue and 33rd Street North. The site is bounded on the east by the original Chisholm Creek (aka Wichita Drainage Canal) and on the west by residential housing.

The site consists of approximately 6.5 acres of open space and is generally flat. The site appears to drain to the east into the drainage canal.

PROPOSED CONDITIONS

The site is proposed to be developed into multi-family detached homes for Habitat for Humanity. The site will also include streets with roll-type curb as well as utilities and drainage structures. The site will drain via storm sewer into the drainage canal. Flumes will be utilized at the end of cul-de-sacs to carry drainage into the existing canal. The north abutting lots to 33rd Street North will drain via the ROW and then to the east into the channel.

OFFSITE CONDITIONS

The site is generally flat and drains to the east. There appears to be offsite drainage encroaching the property from the west. This flow will be accommodated with storm sewer and into the drainage channel. The flow in the drainage channel appears to be from the upstream basin up to the East Fork Chisholm Creek Levees (37th Street North) and the 2-36"x48" HECMP's that pass under the levees to the south. This corresponding flow was calculated to be 800 cfs in the 100-year storm event.

EXISTING CONDITIONS RUNOFF CALCULATIONS

DRAINAGE METHODS & STANDARDS

The following methods and standards, although not a complete list, were used in calculating the existing conditions runoff values.

- STORM SERIES
  - Rational Method utilized for site runoff
  - 24-hour; 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr Storm Events

- OFFSITE FLOW
  - Areas per existing topography and site visits
  - HEC-HMS utilized for upstream offsite flow
  - Time of Concentration using City of Wichita minimum 15 min

SITE CHARACTERISTICS

The proposed site is currently open space with grass cover. A rational 'C' factor of 0.63 was used for these conditions. This was for Urban Lawn Area with slopes less than 1%. The site runoff flows to the east and into the adjacent drainage channel. The existing 33rd Street ROW also flows to the west and drains into the channel via a 24" CMP. A time of concentration of 15 minutes was used. The soil type for the area is Type D (Appendix A).

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

It appears that approximately 0.6 acres drains from the west from the Casa De La Familia Addition. This area generates approximately 3 cfs in the 100-year storm event. There is sheet flow from the remaining properties from the west and will be conveyed in the proposed on-site storm sewer system.
For flow in the existing channel, please see below.

DOWNSTREAM DRAINAGE CAPACITY

As stated above, the site drains into the Wichita Drainage Canal (Chisholm Creek) and flows south. The flow from this site is negligible compared to the basin that feeds the channel.
Due to the area being in a FEMA Unstudied Zone A, no flow data was available for the channel. Based on the USGS Quadrangle as well as aerial photographs, it was determined that the upstream basin to 33rd Street North was approximately 180 acres (0.2828 square miles). This area was modeled in HEC-HMS using the SCS Curve Number Method (CN = 90, 0% impervious area) and the lag time of the basin at 76.75 minutes. Baseflow was also used with Recession Equations and a constant of 0.9. This yields a flow of approximately 380 cfs (Appendix B). There are also 2-36"x48" HECMP's that convey water from the original Chisholm Creek from the north under the levee and into the Wichita Drainage Canal. The flow from these pipes was calculated using HydraFlow Express (Appendix C). When calculating the capacity of the existing pipes, the maximum headwater used was the top elevation of the levee before overtopping into the levee. This yielded a maximum flow capacity of the pipes to be 415 cfs. Therefore, the value used in HEC-RAS modeling was 800 cfs. The modeling can be viewed in Appendix D.

POST-DEVELOPMENT HYDROLOGIC ANALYSIS

DRAINAGE METHODS & STANDARDS

The following methods and standards, although not a complete list, were used in developing the drainage and grading plans.

- STORM SERIES
  - Rational Method utilized
  - 24-hour; 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr Storm Events Modeled

- STORM WATER SEWER PIPES
  - Calculated in HydraFlow StormSewers
  - Developed 'C' = 0.82 (Multi-Unit-Detached)
  - Minimum Tc = 15 min

DETENTION FACILITIES

There is no detention provided on this site. The site will drain to the east and directly into the Wichita Drainage Ditch.
The site will utilize storm sewer systems to convey the site's runoff as well as offsite runoff from the west (Appendix E).

POTENTIAL UPSTREAM/DOWNSTREAM IMPACTS

No potential upstream impacts are expected with this development. The site will convey runoff via storm water sewers into the Wichita Drainage Ditch.

SOURCE OF FLOODPLAIN INFORMATION

The site lies partially within a FEMA Unstudied Zone A. This means, that no Base Flood Elevations (BFE's) are available for this reach. This is per FEMA FIRM Panel 355 of 700 for Sedgwick County, Kansas effective February 2, 2007.

HEC-RAS was utilized in studying the adjacent channel. As stated above, a flow of 800 cfs was used in the channel for the 100-year conditions. This gives a maximum water surface of a 125.4 COW Datum (1312.8 NGVD). The minimum pads on the proposed site will be set at a 129.4. This will give a 3.8' of freeboard to the calculated water surface as well as a 1.0' freeboard to the hypothetical 2000 cfs flow rate.

The FEMA FIRM panel for this area is located in Exhibit 6. No data table or profiles are available at the time of this report.

FEDERAL, STATE, & LOCAL PERMITTING

US ARMY CORPS OF ENGINEERS
The USACOE has been contacted at the time of this report. A jurisdictional determination will be obtained prior to construction.

KANSAS DEPT OF AGRICULTURE - DWR PERMITTING
The calculated floodplain stays within the top banks and does not encroach the property. Therefore, a floodplain fill permit may not be required prior to development. However, if any structures are to be placed below the top bank (ie storm sewer end sections) then a structures permit may be required.

FEMA
An Unstudied Zone A exists on this property. The Base Flood Elevations have been established per HEC-RAS and a minimum pad for the site has been determined. All structures shall conform to floodplain development requirements. At this time, no Letters of Map Change are proposed, as it is not required by State or Federal Law.

KANSAS DEPT OF TRANSPORTATION
There does not appear to be any KDOT permitting needed on the proposed project.

SEDGWICK COUNTY ROW
There does not appear to be any Sedgwick County Permitting on the proposed project.

SUPPORTING CALCULATIONS

APPENDIX A: USGS Soils Survey

APPENDIX B: HEC-HMS
-Offsite Flow Calculations

APPENDIX C: HydraFlow Express
-Capacity of 2-36"x48" HECMP

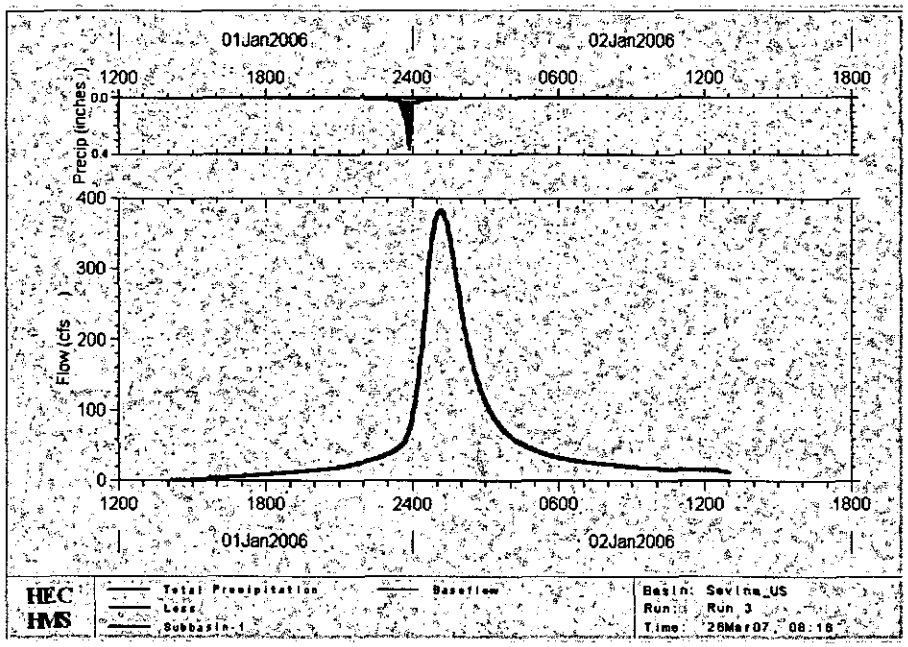
APPENDIX D: HEC-RAS
-Existing Channel Study

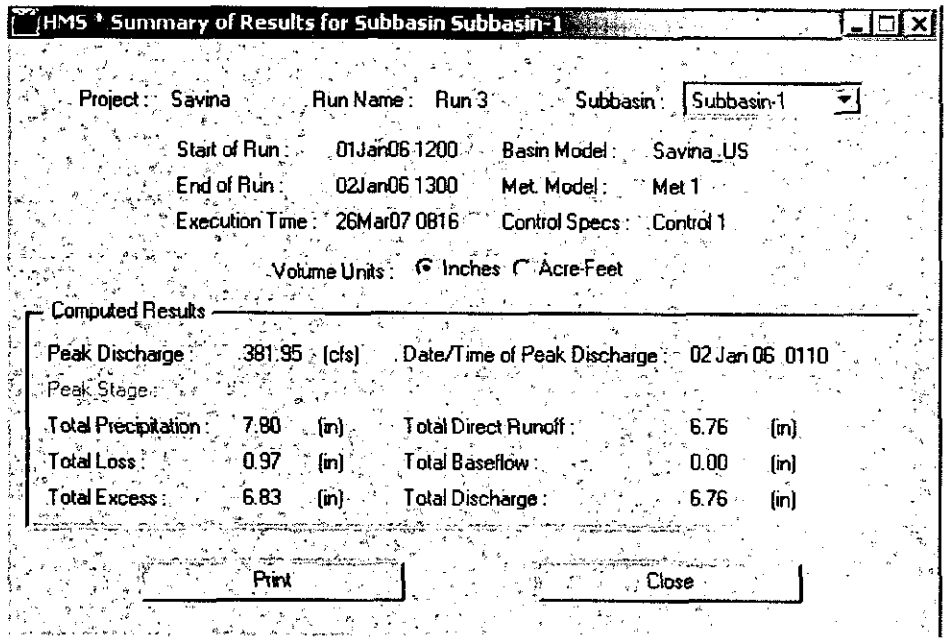
APPENDIX E: HydraFlow Storm Sewers
-SWS System

USGS Soils Survey

HEC-HMS

Offsite Flow Conditions


01Jan2006
02Jan2006
1200
1800
2400
0600
1200
1800
Precip (inches)
0.0
0.4
Flow (cfs)
400
300
200
100
0
01Jan2006
02Jan2006
HEC
HMS
Total Precipitation
Loss
Subbasin-1
Baseflow
Basin: Savina_US
Run: Run 3
Time: 26Mar07 08:18


HMS - Summary of Results for Subbasin Subbasin-1
Project: Savina
Run Name: Run 3
Subbasin: Subbasin-1
Start of Run: 01Jan06 1200
End of Run: 02Jan06 1300
Execution Time: 26Mar07 0816
Basin Model: Savina_US
Met. Model: Met 1
Control Specs: Control 1
Volume Units: Inches Acre-Feet
Computed Results
Peak Discharge: 381.95 (cfs)
Date/Time of Peak Discharge: 02 Jan 06 0110
Peak Stage:
Total Precipitation: 7.80 (in)
Total Loss: 0.97 (in)
Total Excess: 6.83 (in)
Total Direct Runoff: 6.76 (in)
Total Baseflow: 0.00 (in)
Total Discharge: 6.76 (in)
Print
Close

HydraFlow Express

2 - 36"x48" HECMP

Culvert Report

Hydraflow Express by Intelisolve — Friday, Mar 23 2007

Dbl 36x48 HECMP - Levee

Invert Elev Dn (ft)	= 1305.81
Pipe Length (ft)	= 100.00
Slope (%)	= 0.04
Invert Elev Up (ft)	= 1305.85
Rise (in)	= 36.0
Shape	= Ell
Span (in)	= 48.0
No. Barrels	= 2
n-Value	= 0.023
Inlet Edge	= Projecting
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.5

Embankment

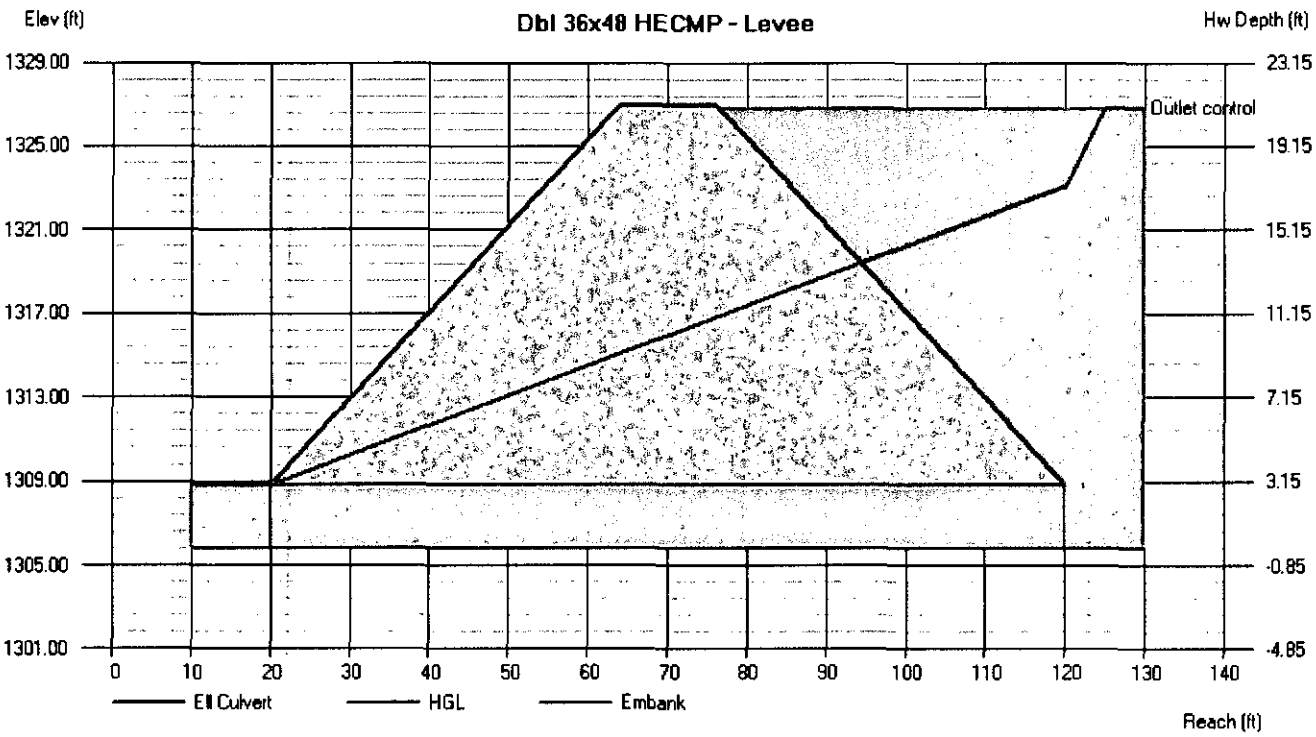
Top Elevation (ft)	= 1327.00
Top Width (ft)	= 12.00
Crest Width (ft)	= 500.00

Calculations

Qmin (cfs)	= 300.00
Qmax (cfs)	= 500.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 415.00
Qpipe (cfs)	= 415.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 22.02
Veloc Up (ft/s)	= 22.02
HGL Dn (ft)	= 1308.81
HGL Up (ft)	= 1323.07
Hw Elev (ft)	= 1326.84
Hw/D (ft)	= 7.00
Flow Regime	= Outlet Control



HEC-RAS

Existing Wichita Drainage Canal Study

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Savina Drainage Canal
Project File : SavDrnCan.prj
Run Date and Time: 3/23/2007 8:11:50 AM

Project in English units

PLAN DATA

Plan Title: Plan 01
Plan File : f:\HYDRO\Projects\Savina 4th\HEC\SavDrnCan.p01

Geometry Title: Exist Geo
Geometry File : f:\HYDRO\Projects\Savina 4th\HEC\SavDrnCan.g01

Flow Title : 100yr_Flow
Flow File : f:\HYDRO\Projects\Savina 4th\HEC\SavDrnCan.f01

Plan Summary Information:
Number of: Cross Sections = 8 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3

Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: 100yr_Flow
Flow File : f:\HYDRO\Projects\Savina 4th\HEC\SavDrnCan.f01

Flow Data (cfs)

River	Reach	RS	Calced 100 yr Flow	PF 2	PF 3
Savina Drainage	1	9940	800	1000	2000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Savina Drainage	1	Calced 100 yr Flow		Normal S = 0.002

GEOMETRY DATA

Geometry Title: Exist Geo
Geometry File : f:\HYDRO\Projects\Savina 4th\HEC\SavDrnCan.g01

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9940

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4951	130	4960	129	4979	122	4983	121	4988	120
4993	119	5000	119	5012	119	5015	120	5018	121
5031	125	5045	130	5051	131	5078	131		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4951	.04	4960	.035	5045	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4960	5045	100	100	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

E.G. Elev (ft)	125.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.12	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.64	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		285.65	
E.G. Slope (ft/ft)	0.000613	Area (sq ft)		285.65	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	63.66	Top Width (ft)		63.66	
Vel Total (ft/s)	2.80	Avg. Vel. (ft/s)		2.80	
Max Chl Dpth (ft)	6.64	Hydr. Depth (ft)		4.49	
Conv. Total (cfs)	32317.8	Conv. (cfs)		32317.8	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		65.66	
Min Ch El (ft)	119.00	Shear (lb/sq ft)		0.17	
Alpha	1.00	Stream Power (lb/ft s)		0.47	
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)		3.38	
C & E Loss (ft)	0.00	Cum SA (acres)		0.90	

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	126.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.		0.035	
W.S. Elev (ft)	126.24	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		325.17	
E.G. Slope (ft/ft)	0.000667	Area (sq ft)		325.17	
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	
Top Width (ft)	66.99	Top Width (ft)		66.99	
Vel Total (ft/s)	3.08	Avg. Vel. (ft/s)		3.08	
Max Chl Dpth (ft)	7.24	Hydr. Depth (ft)		4.85	
Conv. Total (cfs)	38726.1	Conv. (cfs)		38726.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		69.21	
Min Ch El (ft)	119.00	Shear (lb/sq ft)		0.20	
Alpha	1.00	Stream Power (lb/ft s)		0.60	
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)		3.92	0.00
C & E Loss (ft)	0.01	Cum SA (acres)		0.96	0.00

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	128.67	Element	Left OB	Channel	Right OB

Vel Head (ft)	0.27	Wt. n-Val.			0.035	
W.S. Elev (ft)	128.40	Reach Len. (ft)	100.00		100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)			482.89	
E.G. Slope (ft/ft)	0.000893	Area (sq ft)			482.89	
Q Total (cfs)	2000.00	Flow (cfs)			2000.00	
Top Width (ft)	78.91	Top Width (ft)			78.91	
Vel Total (ft/s)	4.14	Avg. Vel. (ft/s)			4.14	
Max Chl Dpth (ft)	9.40	Hydr. Depth (ft)			6.12	
Conv. Total (cfs)	66913.1	Conv. (cfs)			66913.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)			81.89	
Min Ch El (ft)	119.00	Shear (lb/sq ft)			0.33	
Alpha	1.00	Stream Power (lb/ft s)			1.36	
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)			6.09	0.25
C & E Loss (ft)	0.01	Cum SA (acres)			1.12	0.61

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9840

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4951	130	4959	129	4977	122	4979	121	4984	120
4990	119	5000	119	5010	119	5016	120	5019	121
5032	125	5042	128	5114	128				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4951	.04	4959	.035	5042	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4959	5042	100	100	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

E.G. Elev (ft)	125.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.59	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		304.66	
E.G. Slope (ft/ft)	0.000520	Area (sq ft)		304.66	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	66.20	Top Width (ft)		66.20	
Vel Total (ft/s)	2.63	Avg. Vel. (ft/s)		2.63	
Max Chl Dpth (ft)	6.59	Hydr. Depth (ft)		4.60	
Conv. Total (cfs)	35072.9	Conv. (cfs)		35072.9	

Length Wtd. (ft)	100.00	Wetted Per. (ft)	68.23
Min Ch El (ft)	119.00	Shear (lb/sq ft)	0.15
Alpha	1.00	Stream Power (lb/ft s)	0.38
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	2.71
C & E Loss (ft)	0.01	Cum SA (acres)	0.75

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.32				
Vel Head (ft)	0.13	Wt. n-Val.		0.035	
W.S. Elev (ft)	126.19	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		345.51	
E.G. Slope (ft/ft)	0.000574	Area (sq ft)		345.51	
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	
Top Width (ft)	69.75	Top Width (ft)		69.75	
Vel Total (ft/s)	2.89	Avg. Vel. (ft/s)		2.89	
Max Chl Dpth (ft)	7.19	Hydr. Depth (ft)		4.95	
Conv. Total (cfs)	41741.5	Conv. (cfs)		41741.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		71.98	
Min Ch El (ft)	119.00	Shear (lb/sq ft)		0.17	
Alpha	1.00	Stream Power (lb/ft s)		0.50	
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)		3.15	0.00
C & E Loss (ft)	0.01	Cum SA (acres)		0.80	0.00

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.58				
Vel Head (ft)	0.24	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	128.34	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		509.03	24.70
E.G. Slope (ft/ft)	0.000768	Area (sq ft)		509.03	24.70
Q Total (cfs)	2000.00	Flow (cfs)		1987.58	12.42
Top Width (ft)	153.31	Top Width (ft)		81.31	72.00
Vel Total (ft/s)	3.75	Avg. Vel. (ft/s)		3.90	0.50
Max Chl Dpth (ft)	9.34	Hydr. Depth (ft)		6.26	0.34
Conv. Total (cfs)	72162.2	Conv. (cfs)		71714.0	448.2
Length Wtd. (ft)	100.00	Wetted Per. (ft)		84.21	72.34
Min Ch El (ft)	119.00	Shear (lb/sq ft)		0.29	0.02
Alpha	1.08	Stream Power (lb/ft s)		1.13	0.01
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)		4.95	0.22
C & E Loss (ft)	0.01	Cum SA (acres)		0.93	0.53

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9740

INPUT
Description:
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4961	129	4987	120	5000	120	5013	120	5031	126
5049	127	5062	128	5156	128				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4961	.04	4961	.035	5031	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4961	5031	100	100	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

E.G. Elev (ft)	125.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.42	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		227.61	
E.G. Slope (ft/ft)	0.001151	Area (sq ft)		227.61	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	57.94	Top Width (ft)		57.94	
Vel Total (ft/s)	3.51	Avg. Vel. (ft/s)		3.51	
Max Chl Dpth (ft)	5.42	Hydr. Depth (ft)		3.93	
Conv. Total (cfs)	23575.4	Conv. (cfs)		23575.4	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		59.73	
Min Ch El (ft)	120.00	Shear (lb/sq ft)		0.27	
Alpha	1.00	Stream Power (lb/ft s)		0.96	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		2.10	
C & E Loss (ft)	0.01	Cum SA (acres)		0.61	

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	126.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.		0.035	0.000
W.S. Elev (ft)	126.01	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		262.39	0.00

E.G. Slope (ft/ft)	0.001211	Area (sq ft)		262.39	0.00
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	0.00
Top Width (ft)	61.47	Top Width (ft)		61.35	0.11
Vel Total (ft/s)	3.81	Avg. Vel. (ft/s)		3.81	0.03
Max Chl Dpth (ft)	6.01	Hydr. Depth (ft)		4.28	0.00
Conv. Total (cfs)	28734.4	Conv. (cfs)		28734.4	0.0
Length Wtd. (ft)	100.00	Wetted Per. (ft)		63.34	0.11
Min Ch El (ft)	120.00	Shear (lb/sq ft)		0.31	
Alpha	1.00	Stream Power (lb/ft s)		1.19	
Frctn Loss (ft)	0.15	Cum Volume (acre-ft)		2.45	0.00
C & E Loss (ft)	0.01	Cum SA (acres)		0.65	0.00

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	128.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.38	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	128.09	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		396.24	44.27
E.G. Slope (ft/ft)	0.001351	Area (sq ft)		396.24	44.27
Q Total (cfs)	2000.00	Flow (cfs)		1969.77	30.23
Top Width (ft)	192.36	Top Width (ft)		67.36	125.00
Vel Total (ft/s)	4.54	Avg. Vel. (ft/s)		4.97	0.68
Max Chl Dpth (ft)	8.09	Hydr. Depth (ft)		5.88	0.35
Conv. Total (cfs)	54409.2	Conv. (cfs)		53586.7	822.5
Length Wtd. (ft)	100.00	Wetted Per. (ft)		69.69	125.15
Min Ch El (ft)	120.00	Shear (lb/sq ft)		0.48	0.03
Alpha	1.18	Stream Power (lb/ft s)		2.38	0.02
Frctn Loss (ft)	0.17	Cum Volume (acre-ft)		3.91	0.14
C & E Loss (ft)	0.01	Cum SA (acres)		0.76	0.31

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9640

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4963	129	4988	121	4994	120	5000	119.8	5007	120
5015	121	5035	127	5060	128	5080	129	5101	129

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

4963	.04	4963	.035	5035	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4963	5035	95	100	108	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

E.G. Elev (ft)	125.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.19	Reach Len. (ft)	95.00	100.00	108.00
Crit W.S. (ft)		Flow Area (sq ft)		191.19	
E.G. Slope (ft/ft)	0.001867	Area (sq ft)		191.19	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	54.07	Top Width (ft)		54.07	
Vel Total (ft/s)	4.18	Avg. Vel. (ft/s)		4.18	
Max Chl Dpth (ft)	5.39	Hydr. Depth (ft)		3.54	
Conv. Total (cfs)	18516.5	Conv. (cfs)		18516.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		55.49	
Min Ch El (ft)	119.80	Shear (lb/sq ft)		0.40	
Alpha	1.00	Stream Power (lb/ft s)		1.68	
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)		1.61	
C & E Loss (ft)	0.00	Cum SA (acres)		0.48	

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	126.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.76	Reach Len. (ft)	95.00	100.00	108.00
Crit W.S. (ft)		Flow Area (sq ft)		223.04	
E.G. Slope (ft/ft)	0.001908	Area (sq ft)		223.04	
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	
Top Width (ft)	57.75	Top Width (ft)		57.75	
Vel Total (ft/s)	4.48	Avg. Vel. (ft/s)		4.48	
Max Chl Dpth (ft)	5.96	Hydr. Depth (ft)		3.86	
Conv. Total (cfs)	22891.1	Conv. (cfs)		22891.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		59.34	
Min Ch El (ft)	119.80	Shear (lb/sq ft)		0.45	
Alpha	1.00	Stream Power (lb/ft s)		2.01	
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)		1.90	
C & E Loss (ft)	0.00	Cum SA (acres)		0.51	

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	128.29	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.49	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	127.79	Reach Len. (ft)	95.00	100.00	108.00
Crit W.S. (ft)		Flow Area (sq ft)		352.71	7.87

E.G. Slope (ft/ft)	0.002063	Area (sq ft)	352.71	7.87
Q Total (cfs)	2000.00	Flow (cfs)	1992.83	7.17
Top Width (ft)	88.07	Top Width (ft)	68.23	19.84
Vel Total (ft/s)	5.55	Avg. Vel. (ft/s)	5.65	0.91
Max Chl Dpth (ft)	7.99	Hydr. Depth (ft)	5.17	0.40
Conv. Total (cfs)	44033.6	Conv. (cfs)	43875.8	157.8
Length Wtd. (ft)	100.02	Wetted Per. (ft)	70.32	19.85
Min Ch El (ft)	119.80	Shear (lb/sq ft)	0.65	0.05
Alpha	1.03	Stream Power (lb/ft s)	3.65	0.05
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)	3.05	0.08
C & E Loss (ft)	0.00	Cum SA (acres)	0.61	0.14

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9540

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4962	129	4990	121	4994	120	5000	119.59	5007	120
5016	121	5037	127	5057	128	5062	129	5076	129

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4962	.04	4962	.035	5037	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4962	5037	95	100	105	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

E.G. Elev (ft)	125.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.035	
W.S. Elev (ft)	124.94	Reach Len. (ft)	95.00	100.00	105.00
Crit W.S. (ft)		Flow Area (sq ft)		179.12	
E.G. Slope (ft/ft)	0.002288	Area (sq ft)		179.12	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	53.60	Top Width (ft)		53.60	
Vel Total (ft/s)	4.47	Avg. Vel. (ft/s)		4.47	
Max Chl Dpth (ft)	5.35	Hydr. Depth (ft)		3.34	
Conv. Total (cfs)	16726.3	Conv. (cfs)		16726.3	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		54.91	
Min Ch El (ft)	119.59	Shear (lb/sq ft)		0.47	
Alpha	1.00	Stream Power (lb/ft s)		2.08	
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)		1.19	

C & E Loss (ft)	0.01	Cum SA (acres)	0.35

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	125.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.35	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.51	Reach Len. (ft)	95.00	100.00	105.00
Crit W.S. (ft)		Flow Area (sq ft)		210.65	
E.G. Slope (ft/ft)	0.002293	Area (sq ft)		210.65	
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	
Top Width (ft)	57.57	Top Width (ft)		57.57	
Vel Total (ft/s)	4.75	Avg. Vel. (ft/s)		4.75	
Max Chl Dpth (ft)	5.92	Hydr. Depth (ft)		3.66	
Conv. Total (cfs)	20881.5	Conv. (cfs)		20881.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		59.04	
Min Ch El (ft)	119.59	Shear (lb/sq ft)		0.51	
Alpha	1.00	Stream Power (lb/ft s)		2.42	
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)		1.40	
C & E Loss (ft)	0.01	Cum SA (acres)		0.38	

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	128.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.53	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	127.53	Reach Len. (ft)	95.00	100.00	105.00
Crit W.S. (ft)		Flow Area (sq ft)		340.51	2.78
E.G. Slope (ft/ft)	0.002397	Area (sq ft)		340.51	2.78
Q Total (cfs)	2000.00	Flow (cfs)		1997.92	2.08
Top Width (ft)	80.39	Top Width (ft)		69.85	10.55
Vel Total (ft/s)	5.83	Avg. Vel. (ft/s)		5.87	0.75
Max Chl Dpth (ft)	7.94	Hydr. Depth (ft)		4.88	0.26
Conv. Total (cfs)	40847.1	Conv. (cfs)		40804.7	42.4
Length Wtd. (ft)	100.03	Wetted Per. (ft)		71.80	10.56
Min Ch El (ft)	119.59	Shear (lb/sq ft)		0.71	0.04
Alpha	1.01	Stream Power (lb/ft s)		4.16	0.03
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)		2.26	0.07
C & E Loss (ft)	0.02	Cum SA (acres)		0.45	0.10

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9440

INPUT
Description:

Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4964	128	4989	121	4993	120	5000	119.38	5011	120
5018	121	5038	126	5055	127				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4964	.04	4964	.035	5038	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4964	5038	100	100	100	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

			Left OB	Channel	Right OB
E.G. Elev (ft)	125.03	Element			
Vel Head (ft)	0.27	Wt. n-Val.		0.035	
W.S. Elev (ft)	124.76	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		191.43	
E.G. Slope (ft/ft)	0.002002	Area (sq ft)		191.43	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	57.44	Top Width (ft)		57.44	
Vel Total (ft/s)	4.18	Avg. Vel. (ft/s)		4.18	
Max Chl Dpth (ft)	5.38	Hydr. Depth (ft)		3.33	
Conv. Total (cfs)	17881.6	Conv. (cfs)		17881.6	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		58.66	
Min Ch El (ft)	119.38	Shear (lb/sq ft)		0.41	
Alpha	1.00	Stream Power (lb/ft s)		1.70	
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.76	
C & E Loss (ft)	0.00	Cum SA (acres)		0.23	

CROSS SECTION OUTPUT Profile #PF 2

			Left OB	Channel	Right OB
E.G. Elev (ft)	125.63	Element			
Vel Head (ft)	0.31	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.33	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		225.47	
E.G. Slope (ft/ft)	0.001999	Area (sq ft)		225.47	
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	
Top Width (ft)	61.76	Top Width (ft)		61.76	
Vel Total (ft/s)	4.44	Avg. Vel. (ft/s)		4.44	
Max Chl Dpth (ft)	5.95	Hydr. Depth (ft)		3.65	
Conv. Total (cfs)	22365.3	Conv. (cfs)		22365.3	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		63.13	
Min Ch El (ft)	119.38	Shear (lb/sq ft)		0.45	
Alpha	1.00	Stream Power (lb/ft s)		1.98	
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.90	
C & E Loss (ft)	0.00	Cum SA (acres)		0.24	

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	127.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	127.37	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		363.42	14.73
E.G. Slope (ft/ft)	0.001951	Area (sq ft)		363.42	14.73
Q Total (cfs)	2000.00	Flow (cfs)		1978.37	21.63
Top Width (ft)	88.74	Top Width (ft)		71.74	17.00
Vel Total (ft/s)	5.29	Avg. Vel. (ft/s)		5.44	1.47
Max Chl Dpth (ft)	7.99	Hydr. Depth (ft)		5.07	0.87
Conv. Total (cfs)	45283.3	Conv. (cfs)		44793.5	489.8
Length Wtd. (ft)	100.00	Wetted Per. (ft)		73.47	17.40
Min Ch El (ft)	119.38	Shear (lb/sq ft)		0.60	0.10
Alpha	1.05	Stream Power (lb/ft s)		3.28	0.15
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)		1.45	0.05
C & E Loss (ft)	0.00	Cum SA (acres)		0.29	0.07

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9340

INPUT
Description:
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4961	128	4984	121	4988	120	5000	119.17	5011	120
5015	121	5035	126	5056	127				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4961	.04	4961	.035	5035	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4961	5035	73	73	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

E.G. Elev (ft)	124.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.		0.035	
W.S. Elev (ft)	124.56	Reach Len. (ft)	73.00	73.00	73.00
Crit W.S. (ft)		Flow Area (sq ft)		193.29	
E.G. Slope (ft/ft)	0.001920	Area (sq ft)		193.29	

Q Total (cfs)	800.00	Flow (cfs)	800.00
Top Width (ft)	56.97	Top Width (ft)	56.97
Vel Total (ft/s)	4.14	Avg. Vel. (ft/s)	4.14
Max Chl Dpth (ft)	5.39	Hydr. Depth (ft)	3.39
Conv. Total (cfs)	18258.6	Conv. (cfs)	18258.6
Length Wtd. (ft)	73.00	Wetted Per. (ft)	58.24
Min Ch El (ft)	119.17	Shear (lb/sq ft)	0.40
Alpha	1.00	Stream Power (lb/ft s)	1.65
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	0.32
C & E Loss (ft)	0.00	Cum SA (acres)	0.10

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	125.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.		0.035	
W.S. Elev (ft)	125.13	Reach Len. (ft)	73.00	73.00	73.00
Crit W.S. (ft)		Flow Area (sq ft)		226.92	
E.G. Slope (ft/ft)	0.001933	Area (sq ft)		226.92	
Q Total (cfs)	1000.00	Flow (cfs)		1000.00	
Top Width (ft)	61.11	Top Width (ft)		61.11	
Vel Total (ft/s)	4.41	Avg. Vel. (ft/s)		4.41	
Max Chl Dpth (ft)	5.96	Hydr. Depth (ft)		3.71	
Conv. Total (cfs)	22746.2	Conv. (cfs)		22746.2	
Length Wtd. (ft)	73.00	Wetted Per. (ft)		62.54	
Min Ch El (ft)	119.17	Shear (lb/sq ft)		0.44	
Alpha	1.00	Stream Power (lb/ft s)		1.93	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.38	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	127.63	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	127.17	Reach Len. (ft)	73.00	73.00	73.00
Crit W.S. (ft)		Flow Area (sq ft)		363.68	14.05
E.G. Slope (ft/ft)	0.001942	Area (sq ft)		363.68	14.05
Q Total (cfs)	2000.00	Flow (cfs)		1982.52	17.48
Top Width (ft)	92.27	Top Width (ft)		71.27	21.00
Vel Total (ft/s)	5.29	Avg. Vel. (ft/s)		5.45	1.24
Max Chl Dpth (ft)	8.00	Hydr. Depth (ft)		5.10	0.67
Conv. Total (cfs)	45389.6	Conv. (cfs)		44992.9	396.7
Length Wtd. (ft)	73.00	Wetted Per. (ft)		73.11	21.19
Min Ch El (ft)	119.17	Shear (lb/sq ft)		0.60	0.08
Alpha	1.05	Stream Power (lb/ft s)		3.29	0.10
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.61	0.02
C & E Loss (ft)	0.00	Cum SA (acres)		0.12	0.03

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION

RIVER: Savina Drainage
REACH: 1 RS: 9267

INPUT
Description:
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4957	128	4984	121	4986	120	5000	119.02	5011	120
5015	121	5035	126	5044	127				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4957	.04	4957	.035	5035	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
4957	5035	1	1	.1	.3

CROSS SECTION OUTPUT Profile #Calced 100 yr Fl

			Left OB	Channel	Right OB
E.G. Elev (ft)	124.69	Element			
Vel Head (ft)	0.27	Wt. n-Val.		0.035	
W.S. Elev (ft)	124.42	Reach Len. (ft)			
Crit W.S. (ft)	122.48	Flow Area (sq ft)		192.02	
E.G. Slope (ft/ft)	0.002003	Area (sq ft)		192.02	
Q Total (cfs)	800.00	Flow (cfs)		800.00	
Top Width (ft)	57.84	Top Width (ft)		57.84	
Vel Total (ft/s)	4.17	Avg. Vel. (ft/s)		4.17	
Max Chl Dpth (ft)	5.40	Hydr. Depth (ft)		3.32	
Conv. Total (cfs)	17875.5	Conv. (cfs)		17875.5	
Length Wtd. (ft)		Wetted Per. (ft)		59.14	
Min Ch El (ft)	119.02	Shear (lb/sq ft)		0.41	
Alpha	1.00	Stream Power (lb/ft s)		1.69	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

CROSS SECTION OUTPUT Profile #PF 2

			Left OB	Channel	Right OB
E.G. Elev (ft)	125.29	Element			
Vel Head (ft)	0.30	Wt. n-Val.		0.035	
W.S. Elev (ft)	124.99	Reach Len. (ft)			
Crit W.S. (ft)	122.87	Flow Area (sq ft)		226.33	
E.G. Slope (ft/ft)	0.002000	Area (sq ft)		226.33	

Q Total (cfs)	1000.00	Flow (cfs)	1000.00
Top Width (ft)	62.33	Top Width (ft)	62.33
Vel Total (ft/s)	4.42	Avg. Vel. (ft/s)	4.42
Max Chl Dpth (ft)	5.97	Hydr. Depth (ft)	3.63
Conv. Total (cfs)	22358.4	Conv. (cfs)	22358.4
Length Wtd. (ft)		Wetted Per. (ft)	63.77
Min Ch El (ft)	119.02	Shear (lb/sq ft)	0.44
Alpha	1.00	Stream Power (lb/ft s)	1.96
Frctn Loss (ft)		Cum Volume (acre-ft)	
C & E Loss (ft)		Cum SA (acres)	

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	127.48	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.		0.035	0.040
W.S. Elev (ft)	127.03	Reach Len. (ft)			
Crit W.S. (ft)	124.41	Flow Area (sq ft)		367.56	4.73
E.G. Slope (ft/ft)	0.002000	Area (sq ft)		367.56	4.73
Q Total (cfs)	2000.00	Flow (cfs)		1994.92	5.08
Top Width (ft)	83.24	Top Width (ft)		74.24	9.00
Vel Total (ft/s)	5.37	Avg. Vel. (ft/s)		5.43	1.08
Max Chl Dpth (ft)	8.01	Hydr. Depth (ft)		4.95	0.53
Conv. Total (cfs)	44716.4	Conv. (cfs)		44602.7	113.7
Length Wtd. (ft)		Wetted Per. (ft)		76.06	9.08
Min Ch El (ft)	119.02	Shear (lb/sq ft)		0.60	0.07
Alpha	1.02	Stream Power (lb/ft s)		3.28	0.07
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

SUMMARY OF MANNING'S N VALUES

River:Savina Drainage

Reach	River Sta.	n1	n2	n3
1	9940	.04	.035	.04
1	9840	.04	.035	.04
1	9740	.04	.035	.04
1	9640	.04	.035	.04
1	9540	.04	.035	.04
1	9440	.04	.035	.04
1	9340	.04	.035	.04
1	9267	.04	.035	.04

SUMMARY OF REACH LENGTHS

River: Savina Drainage

Reach	River Sta.	Left	Channel	Right
1	9940	100	100	100
1	9840	100	100	100
1	9740	100	100	100
1	9640	95	100	108
1	9540	95	100	105
1	9440	100	100	100
1	9340	73	73	73
1	9267	1	1	1

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Savina Drainage

Reach	River Sta.	Contr.	Expan.
1	9940	.1	.3
1	9840	.1	.3
1	9740	.1	.3
1	9640	.1	.3
1	9540	.1	.3
1	9440	.1	.3
1	9340	.1	.3
1	9267	.1	.3

HEC-RAS Plan: Plan 01 River: Savina Drainage Reach: 1

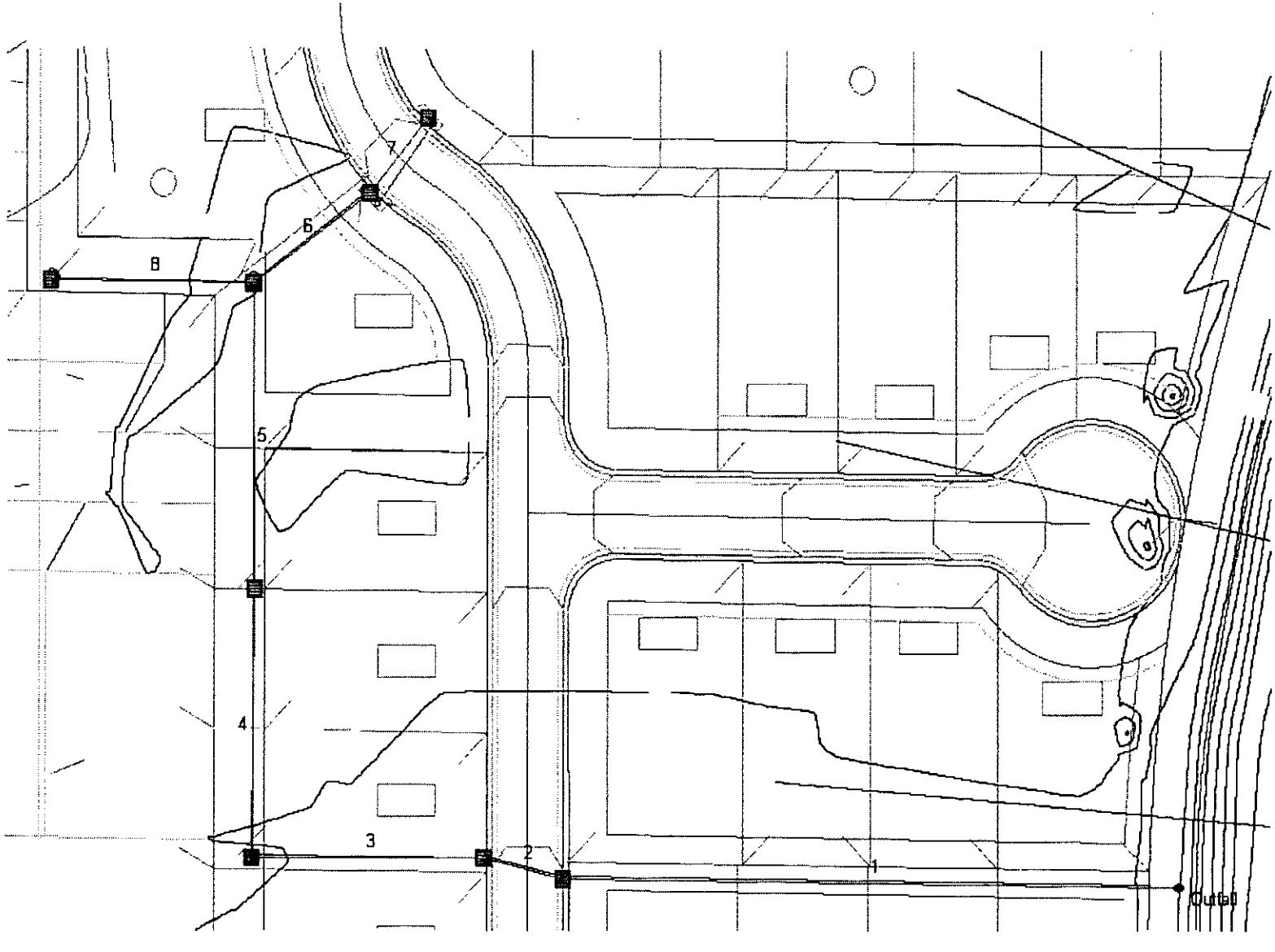
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
1	9940	Calced 100 yr Fl	125.76	125.64	0.12	0.06	0.00		800.00		63.66
1	9940	PF 2	126.39	126.24	0.15	0.06	0.01		1000.00		66.99
1	9940	PF 3	128.67	128.40	0.27	0.08	0.01		2000.00		78.91
1	9840	Calced 100 yr Fl	125.70	125.59	0.11	0.07	0.01		800.00		66.20
1	9840	PF 2	126.32	126.19	0.13	0.08	0.01		1000.00		69.75
1	9840	PF 3	128.58	128.34	0.24	0.10	0.01		1987.58	12.42	153.31
1	9740	Calced 100 yr Fl	125.62	125.42	0.19	0.14	0.01		800.00		57.94
1	9740	PF 2	126.23	126.01	0.23	0.15	0.01		1000.00	0.00	61.47
1	9740	PF 3	128.46	128.09	0.38	0.17	0.01		1969.77	30.23	192.36
1	9640	Calced 100 yr Fl	125.46	125.19	0.27	0.21	0.00		800.00		54.07
1	9640	PF 2	126.07	125.76	0.31	0.21	0.00		1000.00		57.75
1	9640	PF 3	128.29	127.79	0.49	0.22	0.00		1992.83	7.17	88.07
1	9540	Calced 100 yr Fl	125.25	124.94	0.31	0.21	0.01		800.00		53.60
1	9540	PF 2	125.86	125.51	0.35	0.21	0.01		1000.00		57.57
1	9540	PF 3	128.06	127.53	0.53	0.22	0.02		1997.92	2.08	80.39
1	9440	Calced 100 yr Fl	125.03	124.76	0.27	0.20	0.00		800.00		57.44
1	9440	PF 2	125.63	125.33	0.31	0.20	0.00		1000.00		61.76
1	9440	PF 3	127.82	127.37	0.46	0.19	0.00		1978.37	21.63	88.74
1	9340	Calced 100 yr Fl	124.83	124.56	0.27	0.14	0.00		800.00		56.97
1	9340	PF 2	125.43	125.13	0.30	0.14	0.00		1000.00		61.11
1	9340	PF 3	127.63	127.17	0.46	0.14	0.00		1982.52	17.48	92.27
1	9267	Calced 100 yr Fl	124.69	124.42	0.27				800.00		57.84
1	9267	PF 2	125.29	124.99	0.30				1000.00		62.33
1	9267	PF 3	127.48	127.03	0.46				1994.92	5.08	83.24

APPENDIX E

HydraFlow StormSewers

Main SWS System

Hydraflow Plan View



Project File: sws.stm	No. Lines: 8	03-26-2007

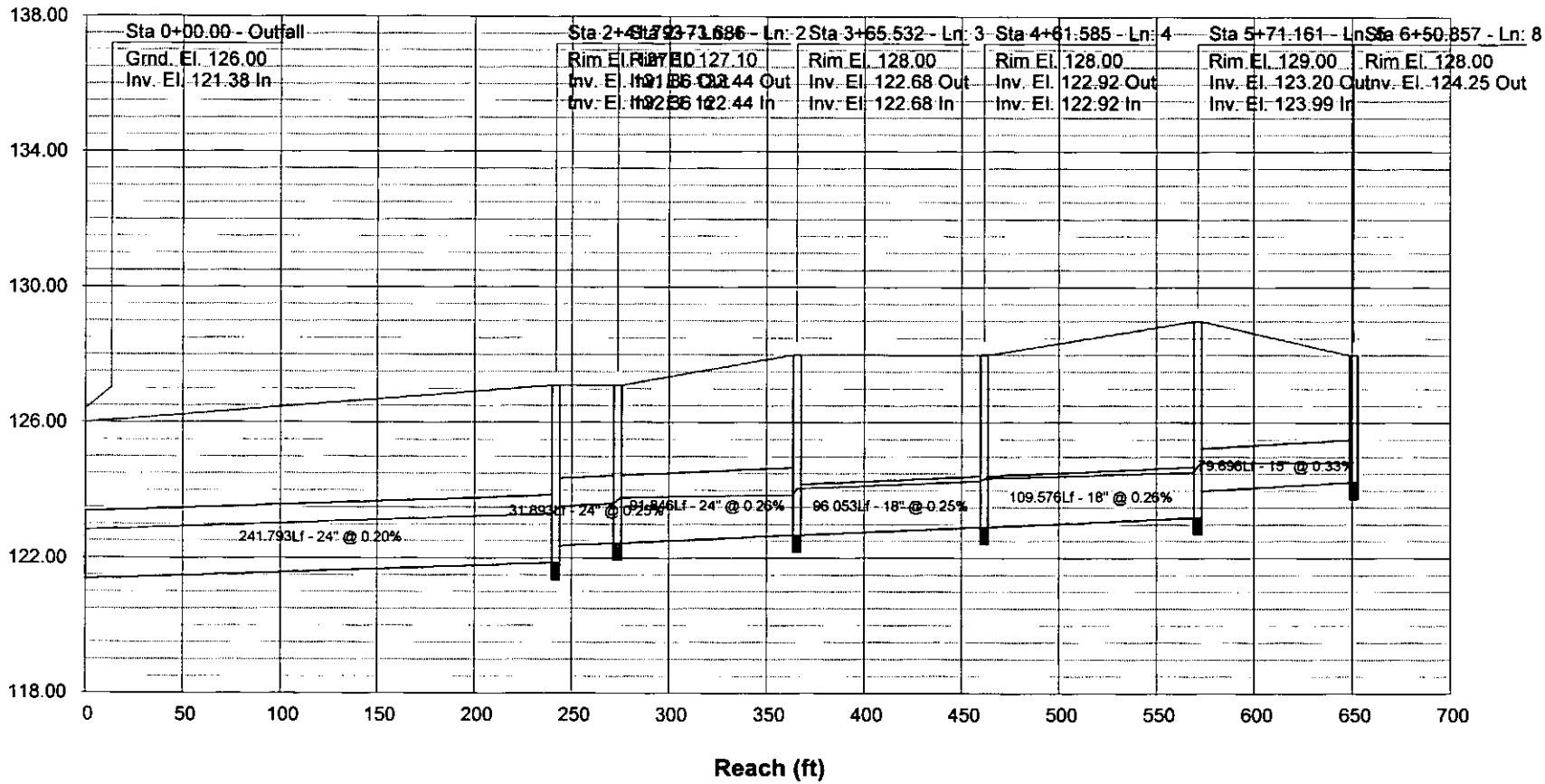
Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
8	5	79.7	-88.9	DrGrt	0.00	0.20	0.82	15.0	123.99	0.33	124.25	15	Cir	0.013	1.00	128.00	
7	6	35.5	-14.8	Curb	0.00	0.60	0.82	15.0	123.63	0.34	123.75	15	Cir	0.013	1.00	127.50	
6	5	56.0	55.6	Curb	0.00	0.60	0.82	15.0	123.45	0.32	123.63	18	Cir	0.013	0.50	127.50	
5	4	109.6	-1.3	DrGrt	0.00	0.10	0.82	15.0	122.92	0.26	123.20	18	Cir	0.013	1.50	129.00	
4	3	96.1	90.8	DrGrt	0.00	0.20	0.82	15.0	122.68	0.25	122.92	18	Cir	0.013	0.50	128.00	
3	2	91.8	-13.1	DrGrt	0.00	0.10	0.82	15.0	122.44	0.26	122.68	24	Cir	0.013	1.50	128.00	
2	1	31.9	12.3	Curb	0.00	0.50	0.82	15.0	122.36	0.25	122.44	24	Cir	0.013	0.50	127.10	
1	End	241.8	-179.3	Curb	0.00	0.50	0.82	15.0	121.38	0.20	121.86	24	Cir	0.013	0.50	127.10	

Project File: sws.stm | Number of lines: 8 | Date: 03-26-2007

Storm Sewer Profile

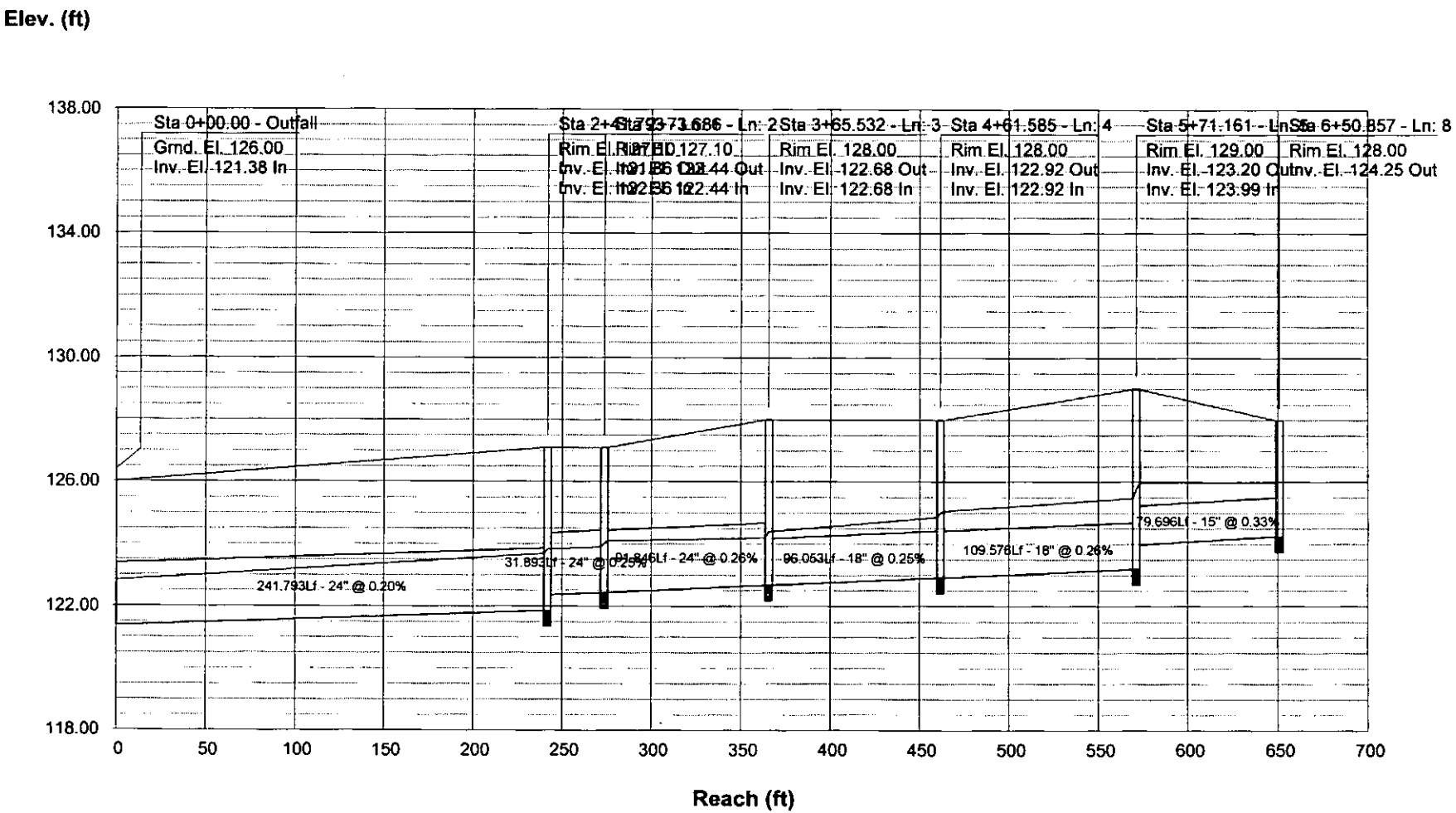
Proj. file: sws.stm



2-YEAR

Storm Sewer Profile

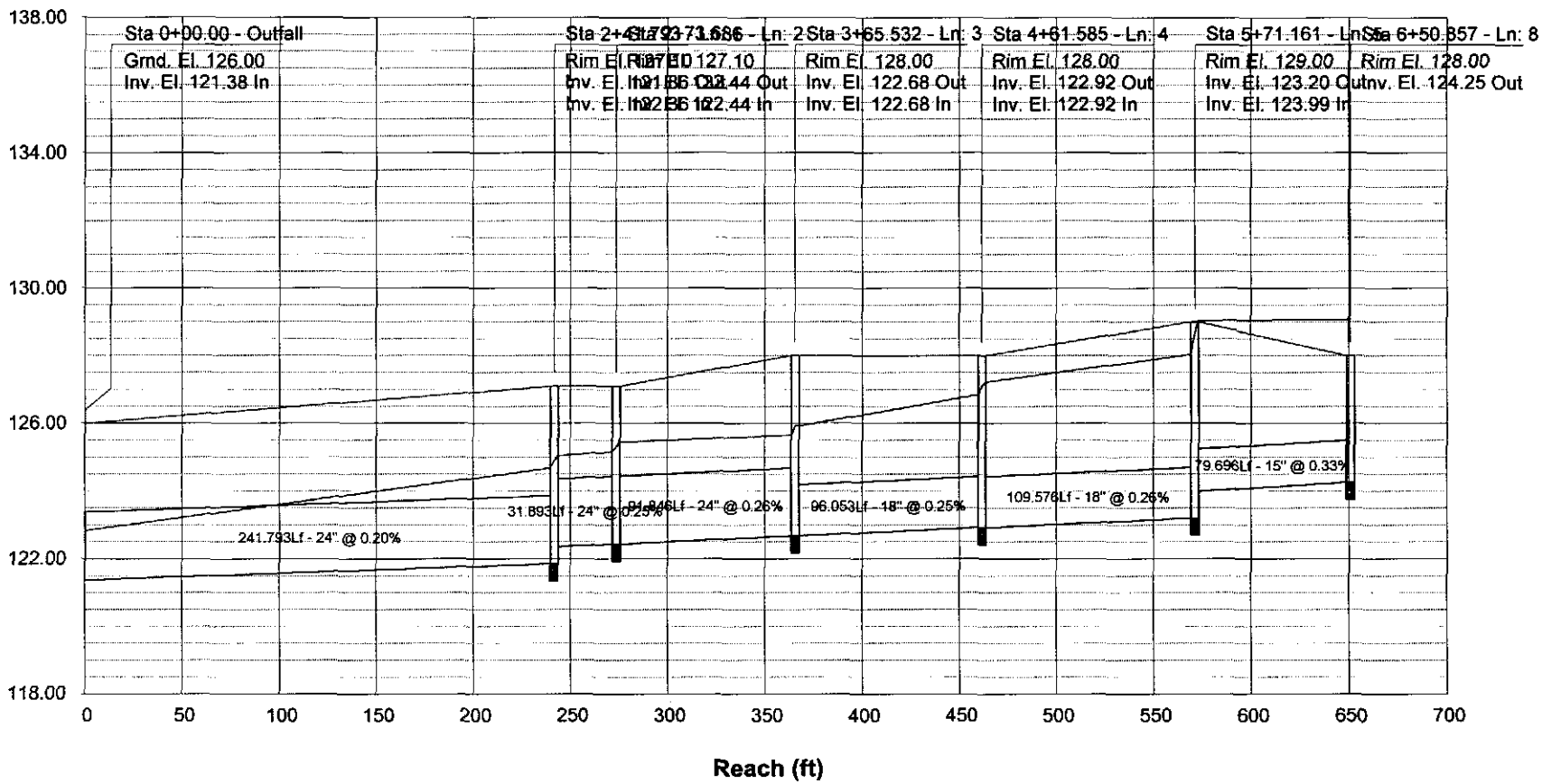
Proj. file: sws.stm



10 - YEAR

Storm Sewer Profile

Proj. file: sws.stm



100-YEAR

DRAINAGE PLAN Scale 1:100

Baughman

TRANSMITTAL

TO:	FROM:
Vicky Huang	Trevor Kurth
COMPANY:	DATE:
City of Wichita	3-26-07
ADDRESS:	PROJECT:
7th Floor City Hall	Savina 5th Addition
CITY/ STATE:	PROJECT NUMBER:
Wichita, Kansas	

RE:
Savina 5th Addition Drainage/Grading Plan

VIA: DELIVERY

We are sending you ☒ ATTACHED ☐ UNDER SEPARATE COVER

☒ PLANS ☐ PRINTS ☐ SHOP DRAWINGS ☐ SAMPLES ☐ SPECS
☐ COPY OF LETTER ☐ CHANGE ORDER ☐ DISK ☐ OTHER

COPIES	DATE	DESCRIPTION
1	3-26-07	Savina 5th Addition Drainage/Grading Plan

☐ URGENT ☒ FOR APPROVAL ☐ FOR YOUR INFO ☒ FOR REVIEW & COMMENT
☐ APPROVED AS NOTED ☐ REVISE AS NOTED ☐ REVISE AND RETURN
☐ AS REQUESTED ☐ PLEASE REPLY ☐ FOR BIDS DUE ☐

NOTES/ COMMENTS:

SIGNED: _____
Trevor R. Kurth, I.E.

Copy: file

ENGINEERING
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