



TRANSMITTAL

TO: Vicky Huang, PE COMPANY: City of Wichita ADDRESS: 7 th Floor City Hall CITY/STATE: Wichita, Kansas	FROM: Trevor Kurth DATE: 11-1-07 PROJECT: Mike Stevens Motors Addition PROJECT NUMBER:
--	--

RE:
Mike Stevens Motors Addition Drainage 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	11-1-07	Mike Stevens Motors Addition Drainage 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
SURVEYING
PLANNING
LANDSCAPE
ARCHITECTURE

B a u g h m a n
C o m p a n y , P . A .
315 Ellis Street
Wichita, Kansas 67203
P 316.262.7271
F 316.262.0149

DRAINAGE PLAN
MIKE STEVENS MOTORS
ADDITION
TO
WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY



01 NOVEMBER 2007

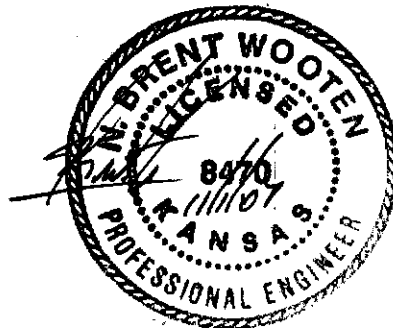


DRAINAGE PLAN MIKE STEVENS MOTORS ADDITION

FINAL REPORT

**Prepared by Baughman Company, P.A.
01 November 2007**

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



REPORT CONTENTS

City of Wichita's Stormwater Subdivision Checklist

Project Narrative

- Existing Conditions
- Proposed Conditions
- Offsite Conditions
- Exhibit 1: Site Location Map
- Exhibit 2: Plat -- Half Scale
- Exhibit 3: Drainage & Grading Plan -- Half Scale

Existing Conditions Runoff Calculations

- Drainage Methods & Standards
- Site Characteristics
- Existing Conditions Hydrologic Analysis
- Downstream Drainage Capacity
- Exhibit 4: Aerial Photo Exhibit with Topography

Post-Development Hydrologic Analysis

- Drainage Methods & Standards
- Detention Facilities
- Detention Summary
- Discharge Points Summary
- Potential Upstream/Downstream Impacts
- Exhibit 5: Drainage & Grading Plan -- Half Scale

Floodplain Submittal

- Source of Floodplain Information
- Exhibit 6: Floodplain Location

Federal, State, & Local Permitting

- US Army Corps of Engineers
- Kansas Dept of Agriculture -- DWR Permitting
- FEMA
- Kansas Dept of Transportation
- Sedgwick County ROW

Appendices: Supporting Calculations

- Appendix A: USGS Soils Survey
- Appendix B: Hydraflow Stormsewer

Plan Sheets

- Drainage & Grading Plan 1:20 Scale



WICHITA

**Public Works, Engineering Division
Final Drainage Plan Submittal Checklist**

Reviewer: _____ Date: _____
 Subdivision Name: MIKE STEVENS MITRES ADD Location: CALHOUN & E. KELLOGG
 Total Land Area Of Ownership: 7.5 Acres
 Type: _____ Residential Commercial _____ Industrial _____ Recreation _____ Municipal _____ Other _____
 Applicant: MICHAEL STEVEN, NEVETS INC Contact: HAROLD JOHNSON Phone #: 652-2277
 Engineer: BAUGHMAN CO. PA Contact: TREVOR KURTH 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)

Tab 1. Project Narrative	Applicant			Engr	
	I	NA	Explanation / Location in Plan	I	NA
A. Site Location Map, using USGS Map	<input checked="" type="checkbox"/>				
B. Discussion of development, existing conditions, and proposed impacts on stormwater, wetland, riparian, and flood plain	<input checked="" type="checkbox"/>				
C. Discussion of offsite conditions	<input checked="" type="checkbox"/>				
D. Summary of runoff calculations (pre/post development) No increase in peak discharge for all storm series	<input checked="" type="checkbox"/>				
E. Narrative description of the type and function of the permanent best management practices that are incorporated into the site design	<input checked="" type="checkbox"/>				
F. Copy of the plat	<input checked="" type="checkbox"/>				
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.)	<input checked="" type="checkbox"/>				
H. Professional Engineer seal, signature and date on cover of report	<input checked="" type="checkbox"/>				
I. CD of drainage plan in PDF format (one file) and one paper copy bound with this checklist included behind the cover	<input checked="" type="checkbox"/>				

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



WICHITA

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	

Tab 3. Post-Development Hydrologic Analysis	Applicant			Engr	
	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 provided		
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 detention provided		
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	x	No detention provided		
I. Design water surface elevations and normal pool elevation for ponds.		x	" " "		
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				



WICHITA

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	No detention facility.		
S. The 100-year 24-hour HWL delineated on the plan for detention pond		x	" "		
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	" "		
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				

Tab 4. Floodplain Submittal	Applicant		Engr	
	I	NA	Explanation / Location in Plan	
A. Provide source of flood profile		x	Project not in/near FEMA SFHA	
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	" "	
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	" "	
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	" "	

Tab 5. Federal, State and Local Permits (to be provided prior to construction unless otherwise specified)	Applicant		Engr	
	I/R	NA	Explanation / Location in Plan	
A. US Army Corps of Engineers - Regulatory program permits (404 water quality certification)		x	Appears to be No Jurisdiction	
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	" "	
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	" "	
D. Kansas Department of Transportation		x	" "	
E. Sedgwick County Right-of-way Permit		x	" "	

PROJECT NARRATIVE

EXISTING CONDITIONS

The site is located on the south side of East Kellogg between Calhoun and Governour Streets. The property consists of approximately 7.5 acres and is currently paved parking for car dealerships. There are two buildings located on the site as well as Whittier Street, which will be vacated with this plat. The site is relatively flat and drains via sheet flow to the east. There are two existing curb inlets in Whittier Street as well as drop inlets on the east portion of the property which conveys runoff to the east.

There is no FEMA SFHA located on this property as of this report.

PROPOSED CONDITIONS

The property is proposed to remain a car dealership with associated buildings and paved parking. Whittier Street, which dissects the (currently) two lots, will be vacated. The east building is expected to be expanded to the west and north. The existing storm water sewer line will need to be removed and re-located to the north in order to continue to convey the Whittier Street drainage to the east. The west building is expected to be razed and replaced with paved parking. The existing runoff conditions are expected to remain the same as proposed conditions as the current site is entirely paved.

OFFSITE CONDITIONS

The site generally drains to the east and utilizes the existing 15" SWS system. This system will continue to be the primary conveyance for the sites storm water. This system will be re-located to the north upon construction and re-connect with the system in Calhoun Street. There does not appear to be any significant amount of drainage encroaching the property.

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
- DRAINAGE AREAS
 - Areas per existing topography
 - HydraFlow Hydrographs utilized for flow calculations
 - Minimum Time of Concentration = 15 min
 - Existing 'C' = 0.91 (Business – Downtown Areas)

SITE CHARACTERISTICS

The proposed site is currently paved parking for a car dealership with associated sales buildings. The site is relatively flat, but paved, and drains via sheet flow to the east. There are existing inlets in Whittier Street as well as drop inlets on the east portion of the property. This system consists of a 15" RCP and connects to curb inlets in Calhoun Street.

The soil type of the site is Type B (loam) and can be viewed in Appendix A with the water depth report. The site is entirely paved and developed, therefore the soil profile is not recommended to be used for engineering purposes. An aerial photograph with existing topography can be viewed in Exhibit 4.

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

The property currently drains to the east and into the existing 15" SWS system. There does not appear to be any offsite drainage encroaching the property. There is currently no FEMA SFHA found on the property.

DOWNSTREAM DRAINAGE CAPACITY

The existing SWS system is to remain and convey the sites runoff to the east. The system consists of curb inlets in the (to be vacated) Whittier Street and drop inlets on the east portion of the property. The system appears to be sized for less than the 2 year storm. This system will be relocated to the north in order for the building expansion and will consist of 15" RCP.

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 for site runoff
 - 24-hour; 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr Storm Events
- DRAINAGE AREAS
 - Areas per existing topography
 - HydraFlow Hydrographs utilized for flow calculations
 - Time of Concentration using City of Wichita minimum 15 min
 - Developed 'C' = 0.91 (Business – Downtown Area)

DETENTION FACILITIES

There are no detention facilities proposed on the property.

DISCHARGE POINTS SUMMARY

The main discharge this site utilizes is the SWS system which runs to the east and under Calhoun Street. This system has a capacity, up to the Calhoun Street inlet, of approximately 10 cfs. This site currently exceeds that capacity. A portion of the site currently drains to the east and into the Calhoun Street ROW. This portion will be substantially reduced with the re-location of the storm sewer to the north. The amount of runoff is expected to remain the same after the building expansion and storm sewer re-location. It appears that this system is undersized and will lead to standing water in the existing parking lot as well as the vacated Whittier Street.

POTENTIAL UPSTREAM/DOWNSTREAM IMPACTS

No potential upstream impacts are expected with this development. The site is not expected to increase the amount of runoff from existing conditions. However, the existing SWS appears to be undersized to convey its respective drainage basin in the 2-yr storm event.

FLOODPLAIN SUBMITTAL

SOURCE OF FLOODPLAIN INFORMATION

The site lies within a FEMA Zone X. The site is not located within a mapped FEMA SFHA. The location of the property, on FEMA FIRM Panel 367 of 700, map 20173C0367E, is attached as Exhibit 6 (for Sedgwick, effective February 2, 2007).

FEDERAL, STATE, & LOCAL PERMITTING

US ARMY CORPS OF ENGINEERS

There does not appear to be any USACOE permitting needed on the proposed site at this time.

KANSAS DEPT OF AGRICULTURE – DWR PERMITTING

There does not appear to be any DWR permitting needed on the proposed site at this time.

FEMA

There is no mapped floodplain located upon the proposed site. Therefore, no FEMA permitting is expected at this time.

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 discharge into the Sedgwick County ROW as this plat is located totally in the City of Wichita.

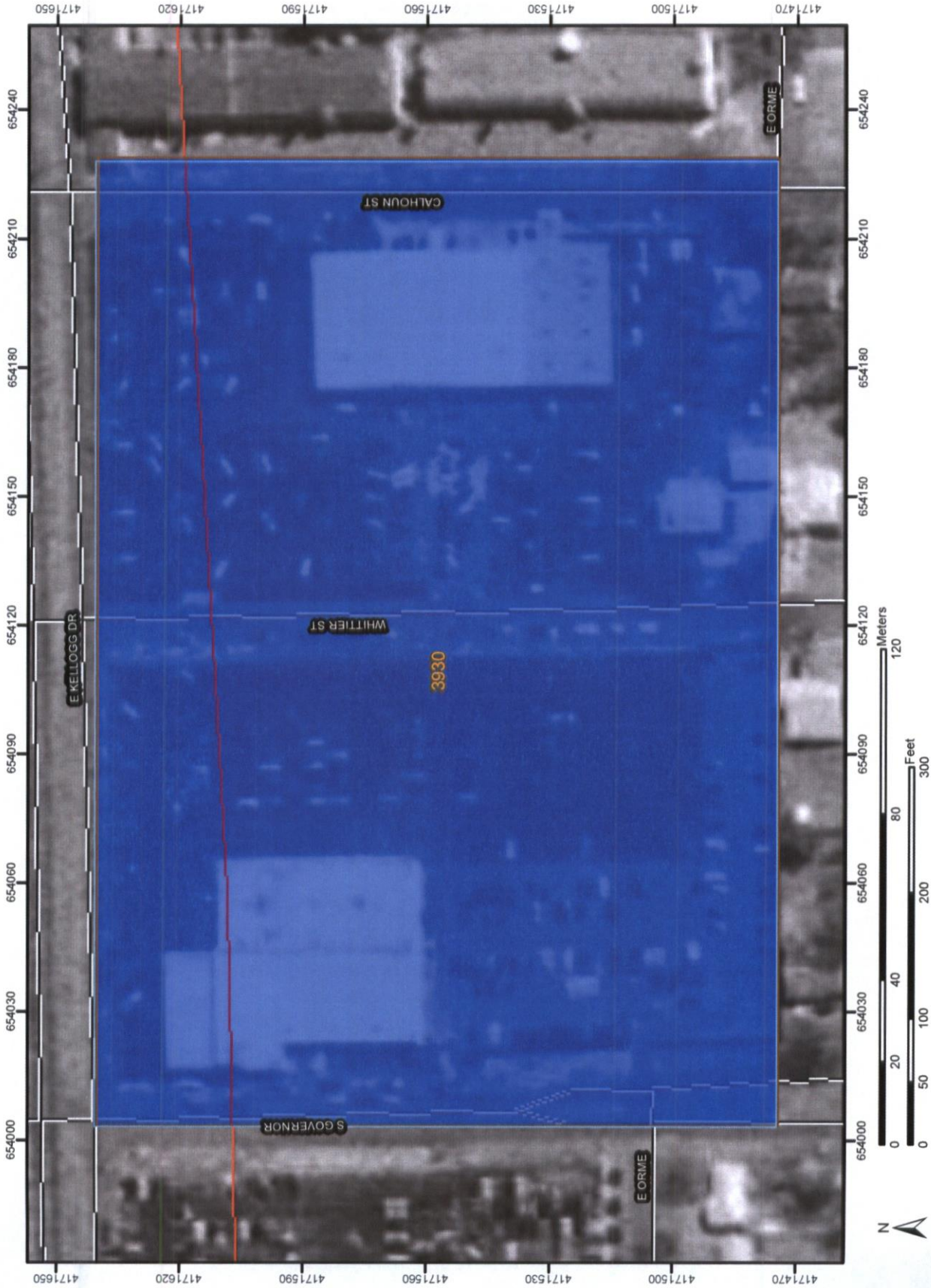
SUPPORTING CALCULATIONS

APPENDIX A: USGS Soils Survey – Water Depth Survey

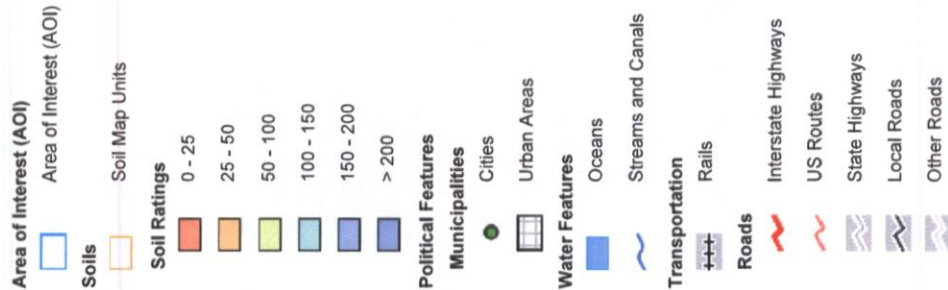
**APPENDIX B: HydraFlow Stormsewer
- 2-yr, 24-hour return period
- Existing & Proposed**

USGS Soils Survey

Depth to Water Table--Sedgwick County, Kansas
(Mike Stevens Motors Addition)



MAP LEGEND



MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 14N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sedgwick County, Kansas
 Survey Area Data: Version 3, Dec 21, 2006

Date(s) aerial images were photographed: 10/1/1991; 3/20/1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Depth to Water Table— Summary by Map Unit — Sedgwick County, Kansas				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
3930	Urban land-Irwin complex, 1 to 3 percent slopes	>200	9.6	100.0%
Totals for Area of Interest (AOI)			9.6	100.0%

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Component" returns the attribute value associated with the component with the highest percent composition in the map unit. If more than one component shares the highest percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher attribute value should be returned in the case of a percent composition tie.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Interpret Nulls as Zero: No

This option indicates if a null value for a component should be converted to zero before aggregation occurs. This will be done only if a map unit has at least one component where this value is not null.

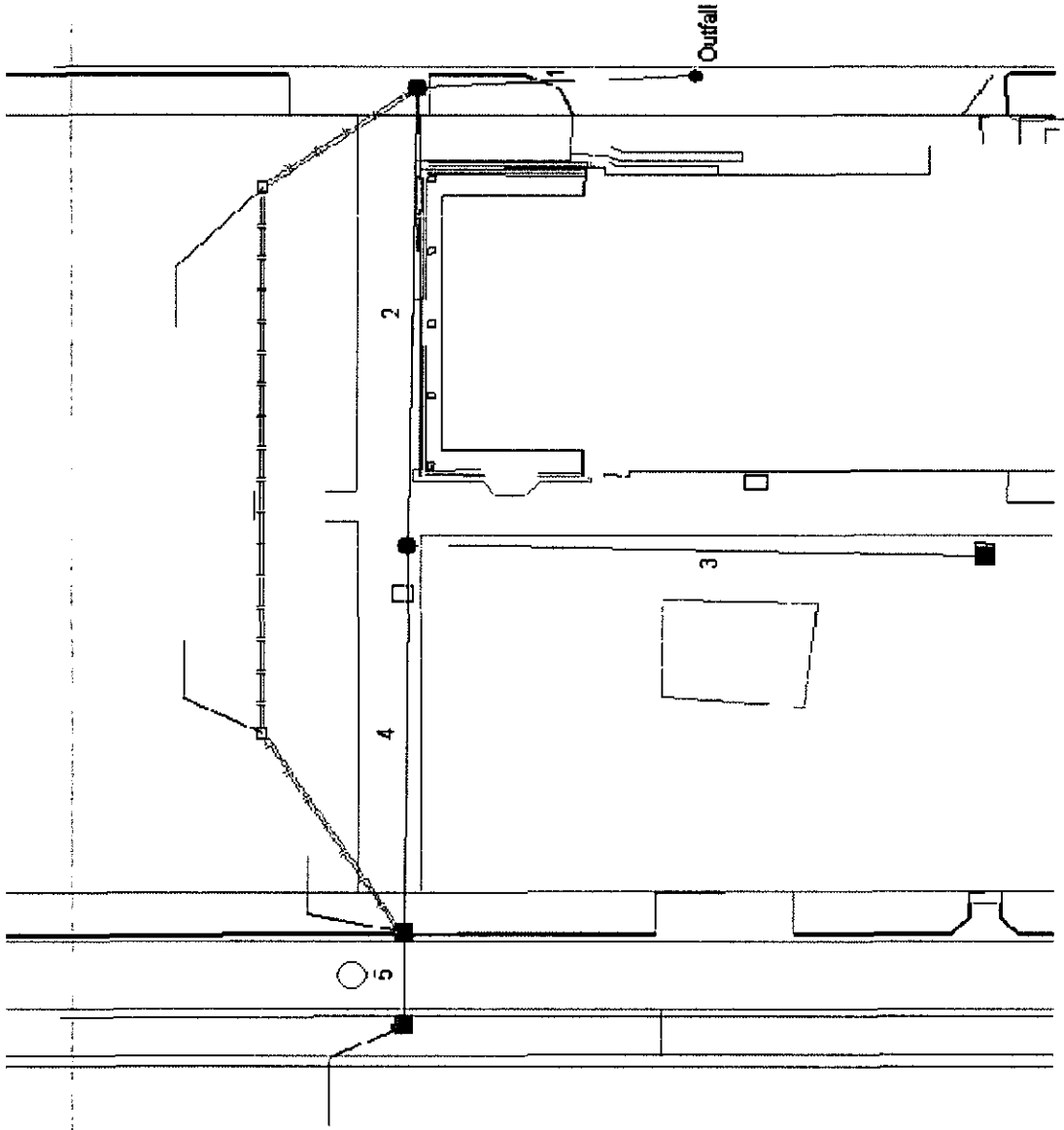
Beginning Month: January

Ending Month: December

HydraFlow Stormsewer

- 2-yr Existing & Proposed

Hydraflow Plan View



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)	Dmg 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)
5	4	31.8	-0.5	Curb	5.00	0.00	0.00	0.0	1338.70	0.63	1338.90	15	Cir	0.013	1.00	1342.60
4	2	133.8	-0.5	Curb	5.00	0.00	0.00	0.0	1337.60	0.82	1338.70	15	Cir	0.013	0.50	1342.30
3	2	184.3	-89.8	DrGr	5.00	0.00	0.00	0.0	1337.60	0.54	1338.60	15	Cir	0.013	1.00	1340.86
2	1	158.0	-86.2	MH	0.00	0.00	0.00	0.0	1336.70	0.57	1337.60	15	Cir	0.013	1.00	1344.30
1	End	88.7	-92.8	MH	0.00	0.00	0.00	0.0	1336.10	0.68	1336.70	15	Cir	0.013	1.00	1339.70

Project File: New.stm

Number of lines: 5

Date: 11-01-2007

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
5		5.00	15 c	31.8	1338.70	1338.90	0.628	1360.01*	1360.20*	0.26	1360.46	4
4		10.00	15 c	133.8	1337.60	1338.70	0.822	1355.51*	1358.72*	0.52	1359.24	2
3		5.00	15 c	184.3	1337.60	1338.60	0.543	1356.28*	1357.39*	0.26	1357.65	2
2		15.00	15 c	158.0	1336.70	1337.60	0.570	1343.37*	1351.90*	2.32	1354.22	1
1		15.00	15 c	88.7	1336.10	1336.70	0.676	1337.34*	1341.94*	n/a	1343.37	End

Project File: New.stm

Number of lines: 5

Run Date: 11-01-2007

NOTES: c = cir; e = ellip; b = box; Return period = 2 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No					
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depth (ft)		Spread (ft)	Depth (ft)	Depr (in)		
5		5.00*	0.00	5.00	0.00	Curb	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.43	7.39	0.54	7.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	4
4		5.00*	0.00	5.00	0.00	Curb	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.43	7.39	0.54	7.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2
3		5.00*	0.00	5.00	0.00	DrGrt	6.0	6.00	2.00	Sag	2.00	0.050	0.050	0.013	0.27	12.72	0.27	12.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2
2		0.00	0.00	0.00	0.00	MH	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	
1		0.00	0.00	0.00	0.00	MH	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Off	

Project File: New.stm

Number of lines: 5

Run Date: 11-01-2007

NOTES: Inlet N-Values = 0.016 ; Intensity = 69.87 / (Inlet time + 13.10) ^ 0.87; Return period = 2 Yrs. ; * Indicates Known Q added

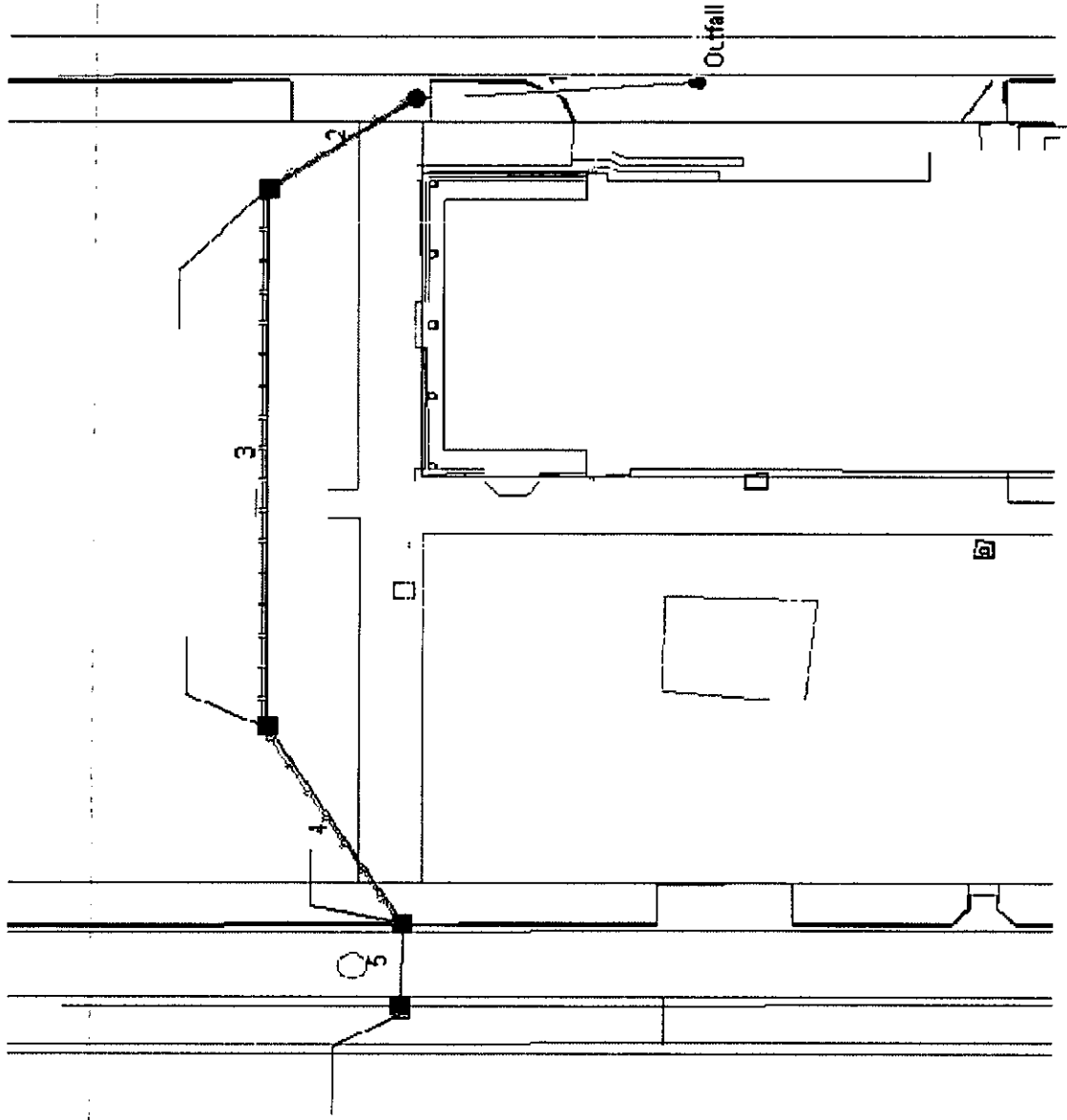
Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream								Len (ft)	Upstream								Check		JL coeff (K)	Minor loss (ft)
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
5	15	5.00	1338.70	1360.01	1.25	1.23	4.08	0.26	1360.27	0.600	31.8	1338.90	1360.20	1.25	1.23	4.07	0.26	1360.46	0.600	0.600	0.191	1.00	0.26
4	15	10.00	1337.60	1355.51	1.25	1.23	8.15	1.03	1356.54	2.399	134	1338.70	1358.72	1.25	1.23	8.15	1.03	1359.75	2.398	2.399	3.210	0.50	0.52
3	15	5.00	1337.60	1356.28	1.25	1.23	4.08	0.26	1356.54	0.600	184	1338.60	1357.39	1.25	1.23	4.07	0.26	1357.65	0.600	0.600	1.105	1.00	0.26
2	15	15.00	1336.70	1343.37	1.25	1.23	12.23	2.32	1345.69	5.398	158	1337.60	1351.90	1.25	1.23	12.22	2.32	1354.22	5.396	5.397	8.527	1.00	2.32
1	15	15.00	1336.10	1337.34	1.24	1.22	12.25	2.33	1339.67	n/a	88.7	1336.70	1341.94	1.25	1.23	12.22	2.32	1344.26	n/a	n/a	2.271	1.00	n/a

General Procedure: Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles. The computed HGL is checked against inlet control.

- Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.
- Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.
- Col. 3 Total flow rate in the line.
- Col. 4 The elevation of the downstream invert.
- Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.
- Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 7 Cross-sectional area of the flow at the downstream end.
- Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).
- Col. 9 Velocity head (Velocity squared / 2g).
- Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).
- Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).
- Col. 12 The line length.
- Col. 13 The elevation of the upstream invert.
- Col. 14 Elevation of the hydraulic grade line at the upstream end.
- Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 16 Cross-sectional area of the flow at the upstream end.
- Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).
- Col. 18 Velocity head (Velocity squared / 2g).
- Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18).
- Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).
- Col. 21 The average of the downstream and upstream friction slopes.
- Col. 22 Energy loss. Average $S/100 \times \text{Line Length}$ (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.
- Col. 23 The junction loss coefficient (K).
- Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Hydraflow Plan View



Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
5		5.00	15 c	29.1	1338.60	1338.90	1.032	1378.16*	1378.34*	0.26	1378.60	4
4		10.00	15 c	82.2	1338.00	1338.70	0.851	1374.49*	1376.46*	0.93	1377.39	3
3		15.00	15 c	189.0	1337.30	1338.00	0.370	1360.95*	1371.15*	2.04	1373.20	2
2		20.00	15 c	57.2	1337.00	1337.30	0.525	1348.37*	1353.86*	5.29	1359.14	1
1		20.00	15 c	91.2	1335.80	1337.00	1.316	1337.05*	1345.60*	n/a	1348.37 i	End
Project File: sws.stm							Number of lines: 5			Run Date: 11-01-2007		
NOTES: c = cir; e = ellip; b = box; Return period = 2 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.												

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No	
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depth (ft)		Spread (ft)
5		5.00*	0.00	5.00	0.00	Curb	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.43	7.39	0.54	7.39	2.00	2.00	2.00	0.00	4
4		5.00*	0.00	5.00	0.00	Curb	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.43	7.39	0.54	7.39	2.00	2.00	2.00	0.00	3
3		5.00*	0.00	5.00	0.00	DrGrt	6.0	6.00	2.00	Sag	2.00	0.050	0.050	0.013	0.27	12.72	0.27	12.72	2.00	2.00	2.00	0.00	2
2		5.00*	0.00	5.00	0.00	DrGrt	6.0	6.00	2.00	Sag	2.00	0.050	0.050	0.013	0.27	12.72	0.27	12.72	2.00	2.00	2.00	0.00	1
1		0.00	0.00	0.00	0.00	MH	6.0	6.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	2.00	2.00	2.00	0.00	Off

Project File: sws.stm

Number of lines: 5

Run Date: 11-01-2007

NOTES: Inlet N-Values = 0.016 ; Intensity = 69.87 / (Inlet time + 13.10) ^ 0.87; Return period = 2 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream							Len (ft)	Upstream							Check		JL coeff (K)	Minor loss (ft)		
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)		Sf (%)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)			Ave Sf (%)	Enrgy loss (ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
5	15	5.00	1338.60	1378.16	1.25	1.23	4.08	0.26	1378.42	0.600	29.1	1338.90	1378.34	1.25	1.23	4.07	0.26	1378.60	0.600	0.600	0.174	1.00	0.26
4	15	10.00	1338.00	1374.49	1.25	1.23	8.15	1.03	1375.52	2.399	82.2	1338.70	1376.46	1.25	1.23	8.15	1.03	1377.49	2.398	2.399	1.973	0.90	0.93
3	15	15.00	1337.30	1360.95	1.25	1.23	12.23	2.32	1363.27	5.398	189	1338.00	1371.15	1.25	1.23	12.22	2.32	1373.48	5.396	5.397	10.20	0.88	2.04
2	15	20.00	1337.00	1348.37	1.25	1.23	16.30	4.13	1352.50	9.597	57.2	1337.30	1353.86	1.25**	1.23	16.30	4.13	1357.99	9.593	9.595	5.488	1.28	5.29
1	15	20.00	1335.80	1337.05	1.25	1.23	16.30	4.13	1341.18	n/a	91.2	1337.00	1345.60	1.25**	1.23	16.30	4.13	1349.72	n/a	n/a	4.417	0.57	n/a

Project File: sws.stm

Number of lines: 5

Run Date: 11-01-2007

Notes: ** Critical depth.

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles. The computed HGL is checked against inlet control.

- Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.
- Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.
- Col. 3 Total flow rate in the line.
- Col. 4 The elevation of the downstream invert.
- Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.
- Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 7 Cross-sectional area of the flow at the downstream end.
- Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).
- Col. 9 Velocity head (Velocity squared / 2g).
- Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).
- Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).
- Col. 12 The line length.
- Col. 13 The elevation of the upstream invert.
- Col. 14 Elevation of the hydraulic grade line at the upstream end.
- Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 16 Cross-sectional area of the flow at the upstream end.
- Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).
- Col. 18 Velocity head (Velocity squared / 2g).
- Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18).
- Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).
- Col. 21 The average of the downstream and upstream friction slopes.
- Col. 22 Energy loss. Average $S/100 \times \text{Line Length}$ (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.
- Col. 23 The junction loss coefficient (K).
- Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

PLAN SHEETS

DRAINAGE & GRADING PLAN

Scale 1:40