Module 3 and Module 4
Watershed Analysis and RUSLE Calculation

by

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Presented to:
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Construction Site Erosion Control

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Contents

List of Figures

List of Tables

1.0 Introduction

1.1 Summary

This document describes the practice problem for the watershed delineation as well as the similar analysis for the construction site of Campus Drive Relocation as well as RUSLE calculation for the site.

1.2 Objectives

The objective of this document is to determine the watershed for the construction site and calculate the peak runoff for the storm events. Also using RUSLE equation, determine the soil runoff from the site for each construction phase.

2.0 Watershed analysis for the example problem

2.1 Watershed delineation

Figure 1 describes the watershed for the outlet point in the example problem. Blue straight line shows the flow and the blue dot line shows the channel for the each watershed. Red line describes the watershed boundaries. There are three sub-areas for the site including the sub-area A, sub-area B, and the sub-area C. Blue arrow shows the flow direction.

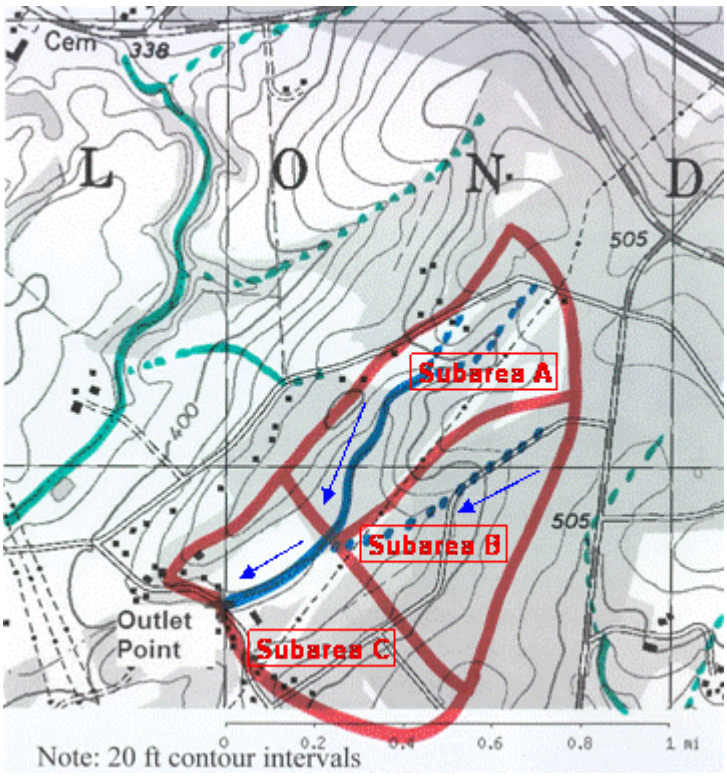

Figure 1: Watershed for the Outlet Point in Example Problem

2.2 Peak runoff rate for the 25 year storm in example problem

All calculations are done by Win TR55 for the peak runoff calculation. Some reasonable assumptions are made for the input data which are: the site is located at Birmingham, the soil for the site is B soils and good wood cover, the flow rate for the channel is 5 ft per second, and the sheet flow for the site is length of 100 ft. Figure 2 describes the plot of hydrographs for the example watershed and the peak runoff is estimated to 438.01 cubic feet per second at 12.47 hrs later. Detail information is attached in Appendix 1.

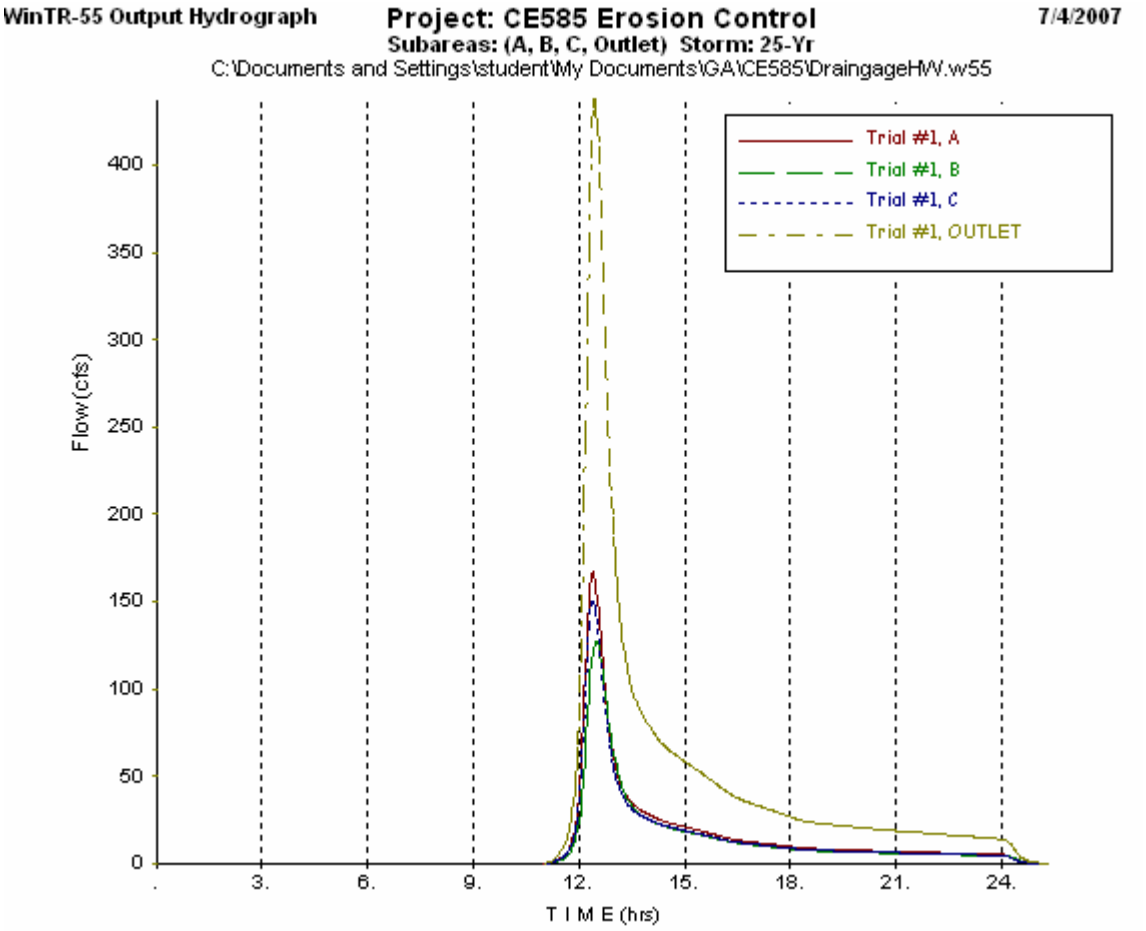

Figure 2: Output Hydrograph (source: WinTR-55)

3.0 Construction Site Description

3.1 Campus Drive Relocation Project General Information

Campus Derive Relocation Project is planted at the University of Alabama Campus on Campus Drive between Hackberry and Jefferson Avenue. The development and expansion of the northern portion of campus has created a need to improve the current roadway system. The construction is planned to relocate Hackberry Lane between Margaret and Riverside as well as the creation of new loop around Shelby Hall and service road to access facilities. The nearby receiving water, Black Warrior River is located north of the construction site.

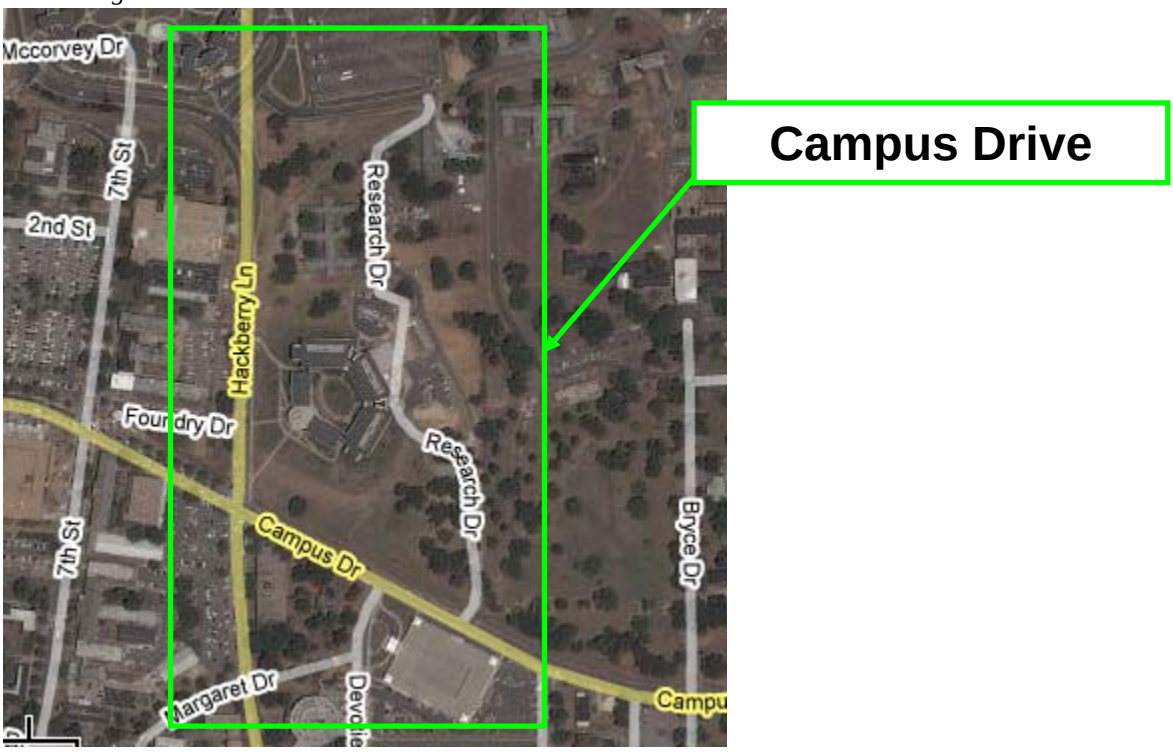

Figure 3: Campus Drive Relocation Project Aerial Image

3.2 Soils

United States Department of Agriculture describes that the 97% of soil in this area is Bama-Urban land complex which is made from loamy marine deposits derived from sedimentary rock. These soils belong to the hydrologic group of B. Other 3% of soils consist of Shatta-Urban land complex which belong to the hydrologic group of C. Lest of 2% soils are hydrologic group B of Smithdale fine sandy loam. Figure 4 describes the soil type of the construction area. Also, Table 1 describes the detail information for the soil which is required for RUSLE calculation.

3.3 Ground Cover

The ground cover over the site ranges from bare soils to matured trees. North side of the construction site is mostly covered by the glasses and small trees as well as the small areas of bare soils. East side is well vegetated and it is covered with relatively large trees and glasses. Shelby Hall is located on west side which has undisturbed ground, covered with small trees and glasses. Major roads and buildings are located at south side which crates a large impervious area.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7	Bama-Urban land complex, 0 to 2 percent slopes	0.3	0.4%
8	Bama-Urban land complex, 2 to 6 percent slopes	59.1	96.6%
31	Shatta-Urban land complex, 0 to 2 percent slopes	0.5	0.8%
33	Smithdale fine sandy loam, 6 to 15 percent slopes	1.3	2.1%
Totals for Area of Interest (AOI)		**61.1**	**100.0%**

Figure 4: Soil Type of the Construction Site (source: USDA Web Soil Survey)

Table 1: Soil Survey

Soil Number	Depth (in)	Hydrologic Soil Group	Permiability (in/hr)	Erodibility Factor K	Tolerable Soil Loss T (tons/ac/yr)
7,8 (Bama Urban land)	0-5	B	0.6-6.0	0.24	5
	5-54		0.6-2.0	0.32	
	54-72		0.6-2.0	0.32	
31 (Shatta Urban land)	0-7	C	0.6-2.0	0.37	3
	7-28		0.2-0.6	0.37	
	28-60		0.06-0.2	0.37	
38 (Smithdale)	0-5	B	2.0-6.0	0.28	5
	5-42		0.6-2.0	0.24	
	42-72		2.0-6.0	0.28	

4.0 Watershed analysis for the Campus Drive Relocation Project

4.1 Watershed delineation

Figure 5 shows sub-drainages for the upslope, down-slope, and on-site areas for the construction site. Red line indicates the watershed area for the site and the pink line subdivides them into upstream (U1-U4), onsite (O1-O5), and downstream (D1) areas. Blue line shows the flow pass for the area. The watershed area has approximately 63 acres.

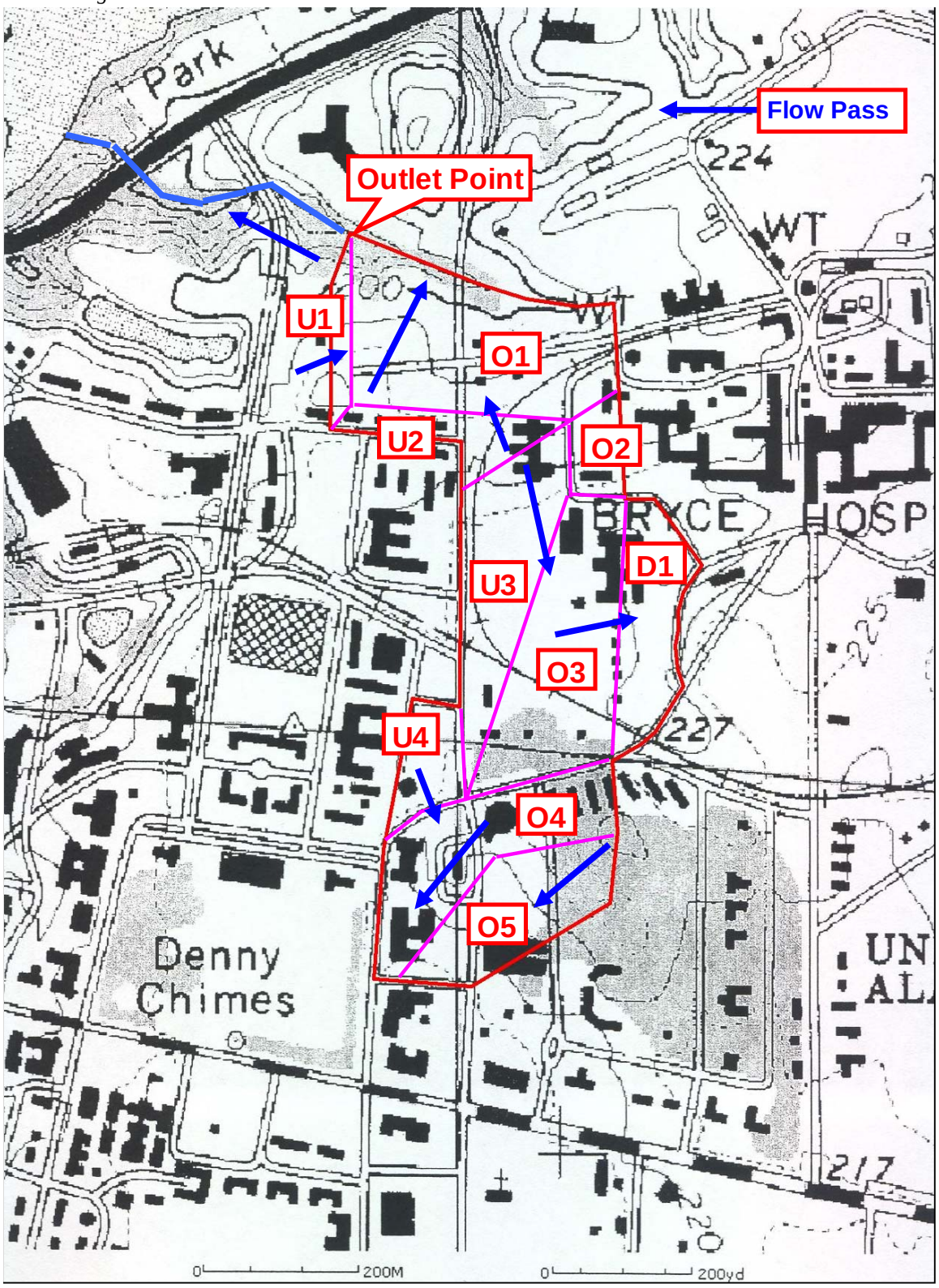

Figure 5: Watershed for the site (source: TerraServer)

4.2 Peak runoff rate for the 25 year storm

All calculations are done by Win TR55 for the peak runoff calculation. Soil type is determined by United States Department of Agriculture Web Soil Survey, described in Table 1 and Figure 4. Figure 6 describes the plot of hydrographs for the construction site and the peak runoff is determined to 241.47 cubic feet per second at 12.20 hrs later for the 25 year storm. Detail information is attached in Appendix 2.

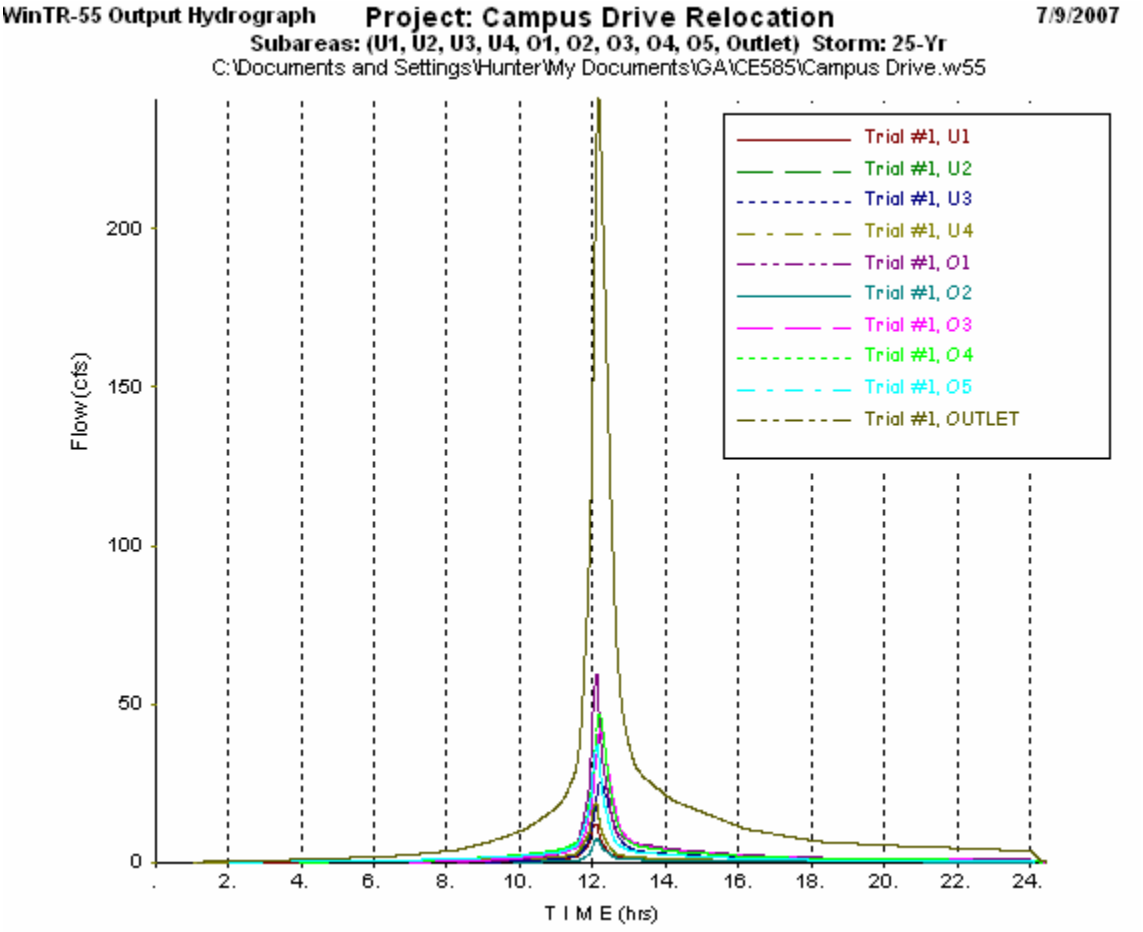

Figure 6: Hydrograph for the Campus Drive Relocation Project (source: WinTR-55)

5.0 Construction Work Phases

5.1 Phase 1 Improvement

The first phase improvement starts from the north of the Hackberry Lane to the intersection of the new campus drive and the existing campus drive. The construction starts from clearing and grubbing, installation of the temporary access and parking to the site, and the demolition of the existing facilities. Erosion control and traffic control are done before the earthwork for the site and the sanitary sewer, storm sewer, water main, electrical line are installed. After that the curb, gutter, and sidewalks are constructed. Then the road is installed starting from the landscaping, base settlement, and paving. Finally striping and road signs are installed. After the completion of the road, parking

lots for the Mcmillan and Environmental Health and Safety are constructed. After the tie-in of North Hackberry intersection, the road is opened for the traffic.

5.2 Existing Campus Drive and Hackberry Lane intersection

This phase is planned to start at the same time with the phase 2 improvement. Intersection of the existing Campus Drive and Hackberry lane are constructed. The work consists of the demolition of the existing facilities and the earth work. Then curb, gutter and sidewalks are installed. The intersection is completed by the paving, striping, and signage.

5.3 Phase 2 Improvement

The second phase improvement starts from the existing campus drive and the new campus drive constructed in the phase 1 improvement. The construction starts from clearing and grubbing, and the demolition of the existing facilities. Erosion control and traffic control are prepared before the earthwork for the site and the storm sewer, water main, and electrical line are installed. After that the curb, gutter, and sidewalks are constructed. Then the road construction is started from the landscaping, base and paving. Then, striping is done and road signs are installed. After the completion of the road, East Engineering Parking Lot is constructed. The road is opened for the traffic and the project is closed with the clean up for the site.

Construction schedule for the site work is as follows:

ID	Task Name	Duration	Start	Finish
1	***PHASE I IMPROVEMENTS***	98 days	Fri 12/15/06	Tue 5/1/07
2	CLEARING & GRUBBING	21 days	Fri 12/15/06	Fri 1/12/07
3	TEMPORARY ACCESS & PARKING	5 days	Mon 12/18/06	Fri 12/22/06
4	DEMOLITION	25 days	Mon 12/18/06	Fri 1/19/07
5	EROSION CONTROL	97 days	Mon 12/18/06	Tue 5/1/07
6	TRAFFIC CONTROL	97 days	Mon 12/18/06	Tue 5/1/07
7	EARTHWORK	15 days	Mon 3/12/07	Fri 3/30/07
8	SANITARY SEWER	16 days	Mon 1/15/07	Mon 2/5/07
9	STORM SEWER SYSTEM	60 days	Mon 1/22/07	Fri 4/13/07
10	WATER MAIN INSTALLATION	52 days	Wed 2/21/07	Thu 5/3/07
11	ELECTRICAL / SITE LIGHTING	30 days	Mon 3/12/07	Fri 4/20/07
12	CURB & GUTTER / SIDEWALKS	15 days	Mon 4/2/07	Fri 4/20/07
13	LANDSCAPING	1 day	Mon 4/23/07	Mon 4/23/07
14	BASE & PAVING	13 days	Mon 4/9/07	Wed 4/25/07
15	STRIPING & SIGNAGE	4 days	Thu 4/26/07	Tue 5/1/07
16	MCMILLIAN & ENV. HEALTH PARKING LOTS	50 days	Mon 2/12/07	Fri 4/20/07
17	NORTH HACKBERRY X-SECTION TIE-IN	13 days	Mon 4/16/07	Wed 5/2/07
18	***OPEN TRAFFIC PHASE I***	1 day	Thu 5/3/07	Thu 5/3/07
19				
20	***CAMPUS & HACKBERRY X-SECTION***	16 days	Mon 5/14/07	Mon 6/4/07
21	DEMOLITION / EARTHWORK	5 days	Mon 5/14/07	Fri 5/18/07
22	CURB & GUTTER / SIDEWALKS	6 days	Fri 5/18/07	Fri 5/25/07
23	BASE & PAVING	8 days	Mon 5/21/07	Wed 5/30/07

Figure 7: Construction Schedule

ID	Task Name	Duration	Start	Finish
24	STRIPING & SIGNAGE	1 day	Fri 6/1/07	Sat 6/2/07
25	***OPEN TRAFFIC***	1 day	Mon 6/4/07	Mon 6/4/07
26				
27	***PHASE II IMPROVEMENTS***	61 days	Mon 5/14/07	Mon 8/6/07
28	CLEARING & GRUBBING	10 days	Mon 5/14/07	Fri 5/25/07
29	DEMOLITION	10 days	Mon 5/14/07	Fri 5/25/07
30	EROSION CONTROL	60 days	Mon 5/14/07	Fri 8/3/07
31	TRAFFIC CONTROL	60 days	Mon 5/14/07	Fri 8/3/07
32	EARTHWORK	15 days	Mon 5/28/07	Fri 6/15/07
33	STORM SEWER SYSTEM	28 days	Wed 5/16/07	Fri 6/22/07
34	WATER MAIN INSTALLATION	40 days	Mon 4/30/07	Fri 6/22/07
35	ELECTRICAL / TRAFFIC SIGNALS	28 days	Wed 5/16/07	Fri 6/22/07
36	CURB & GUTTER / SIDEWALKS	20 days	Mon 6/11/07	Fri 7/6/07
37	LANDSCAPING	1 day	Mon 7/9/07	Mon 7/9/07
38	BASE & PAVING	20 days	Mon 7/2/07	Fri 7/27/07
39	STRIPING & SIGNAGE	3 days	Mon 7/30/07	Wed 8/1/07
40	EAST ENGINEERING PARKING IMPROVEMENTS	40 days	Mon 6/4/07	Fri 7/27/07
41	***OPEN TRAFFIC PHASE II***	1 day	Mon 8/6/07	Mon 8/6/07
43				
42	PROJECT CLEAN UP / CLOSE-OUT	5 days	Mon 7/30/07	Fri 8/3/07
44	***PROJECT COMPLETE***	1 day	Mon 8/6/07	Mon 8/6/07

Figure 8: Construction Schedule cont.

5.4 Erosion and Sediment Control for the site

Silt fences have been used at all side slopes and down slope edges of the construction site and existing inlets have been protected by silt fences and wattles. The intersection of the existing road and the new road is closed and protected by two lines of wattles in order to prevent a sediment runoff from the disturbed area. Currently, the project have been completed the Phase 1 improvement and the campus drive and Hackberry intersection. Approximately 20 acres of the site is undergoing active construction and the construction site is surrounded by the silt fences. The construction site is located lower area compared with surroundings, so it has less erosion problem. Final plans for the site cover consist of asphalt road, parking lots, landscaping and sod at the entrance of parking lots as well as the area along with the newly constructed road.

6.0 RUSLE Calculation

6.1 Phase 1 Improvement

The first phase improvement has been started from December 15th 2006 to May 3rd 2007 which includes the 4 active construction areas and 7 undisturbed areas including the site for Phase 2 improvement. The total soil loss on the site for this period was estimated in 3313 tons. The annual rainfall energy R was estimated as 375 and the erosion index of 29% is estimated to affect the erosion considering the location and the period of phase 1 improvement. The credibility factor K is determined from the information of Table 1 considering that at least 5 inch of the top soil will be removed before the construction. The cover factor C has estimated as 0.001 for undisturbed and well protected areas as well as 1.0 for active construction areas. The Table 2 shows the soil runoff for the phase 1 improvement.

Table 2: RUSLE Calculation for December 15, 2006 to May 3, 2007

Phase 1 Improvement Soil Runoff (December 15, 2006-May 3, 2007)										
	Description	Area (ac.)	R for pharse period	K Erodibility Factors	Length of the Slope (ft)	Slope (ft/ft)	LS Sloop Length Factore	C Cover Factor	Unit Area Soil Loss (tons/acres/period)	Total Area Soil Loss (tons/period)
A	Undisturbed	2.01	108.75	0.32	125	0.160	3.21	0.001	0.112	0.22
B	Undisturbed	3.04	108.75	0.32	300	0.067	1.81	0.001	0.063	0.19
C	Undisturbed	9.13	108.75	0.32	475	0.042	2.69	0.001	0.094	0.85
D	Undisturbed	3.14	108.75	0.32	142	0.014	0.23	0.001	0.008	0.03
E1	Active	6.11	108.75	0.24	725	0.1103	6.65	1.000	173.565	1060.48
E2	Active	9.17	108.75	0.32	625	0.096	4.79	1.000	166.692	1528.57
F	Active	2.37	108.75	0.32	375	0.1067	3.99	1.000	138.852	329.08
G	Active	11.59	108.75	0.32	675	0.0291	0.97	1.000	33.756	391.23
H	Phase 2	10.11	108.75	0.32	1325	0.0453	2.55	0.001	0.089	0.90
I1	Phase 2	1.31	108.75	0.37	1175	0.0952	7.02	0.001	0.282	0.37
I2	Phase 2	5.24	108.75	0.32	1050	0.0582	3.3	0.001	0.115	0.60
total		63.220								3312.52

6.2 Phase 2 Improvement and Campus and Hackberry X-section

Site is currently the second phase improvement and it has been started from May 14th 2007 to July 27th 2007 which includes the 4 active construction areas and 7 undisturbed areas including the site completed during the phase 1 improvement. The total soil loss on the site for this period was estimated in 1701 tons. The annual rainfall energy R was estimated as 375 and the erosion index of 26% is estimated to affect the erosion. The credibility factor K is determined from the information of Table 1 considering that at least 5 inch of the top soil will be removed before the construction. The cover factor C has estimated as 0.001 for undisturbed and well protected areas as well as 1.0 for active construction areas. The Table 3 shows the soil runoff calculation result.

Table 3: RUSLE Calculation for May 14, 2007 to July 27, 2007

Phase 2 Improvement and Campus & Hackberry X-Section Soil Runoff (May 14, 2007-July 27, 2007)										
	Description	Area (ac.)	R for pharse period	K Erodibility Factors	Length of the Slope (ft)	Slope (ft/ft)	LS Sloop Length Factore	C Cover Factor	Unit Area Soil Loss (tons/acres/period)	Total Area Soil Loss (tons/period)
A	Undisturbed	2.01	97.50	0.32	125	0.160	3.21	0.001	0.100	0.20
B	Undisturbed	3.04	97.50	0.32	300	0.067	1.81	0.001	0.056	0.17
C	Undisturbed	9.13	97.50	0.32	475	0.042	2.69	0.001	0.084	0.77
D	Active	3.14	97.50	0.32	142	0.014	0.23	1.000	7.176	22.53
E1	Completed	6.11	97.50	0.24	725	0.075	2.40	0.001	0.056	0.34
E2	Completed	9.17	97.50	0.32	625	0.075	2.21	0.001	0.069	0.63
F	Completed	2.37	97.50	0.32	375	0.035	0.94	0.001	0.029	0.07
G	Completed	11.59	97.50	0.32	675	0.035	1.26	0.001	0.039	0.46
H	Active	10.11	97.50	0.32	1325	0.0453	2.55	1.000	79.560	804.35
I1	Active	1.31	97.50	0.37	1175	0.0952	7.02	1.000	253.247	331.75
I2	Active	5.24	97.50	0.32	1050	0.0582	3.3	1.000	102.960	539.51
total		63.220								1700.79

6.3 After Active Construction and All Land Covered

The soil runoff calculation is for the construction of July 30th 2007 to August 6th 2007. The entire site is covered after the completion of the construction. The total soil loss on the site for this period was estimated in 1.12 tons. The annual rainfall energy R was estimated as 375 and the erosion index of 7% is estimated to affect the erosion. The cover factor C has estimated as 0.001 for undisturbed and well protected areas. Table 4 shows the result.

Table 4: RUSLE Calculation for July 30, 2007 to August 6, 2007

After Active Construction and All Land Covered Soil Runoff (July 30, 2007-August 6, 2007)										
	Description	Area (ac.)	R for pharse period	K Erodibility Factors	Length of the Slope (ft)	Slope (ft/ft)	LS Sloop Length Factore	C Cover Factor	Unit Area Soil Loss (tons/acres/period)	Total Area Soil Loss (tons/period)
A	Undisturbed	2.01	26.25	0.32	125	0.160	3.21	0.001	0.027	0.05
B	Undisturbed	3.04	26.25	0.32	300	0.067	1.81	0.001	0.015	0.05
C	Undisturbed	9.13	26.25	0.32	475	0.042	2.69	0.001	0.023	0.21
D	Completed	3.14	26.25	0.32	142	0.020	0.37	0.001	0.003	0.01
E1	Completed	6.11	26.25	0.24	725	0.075	2.40	0.001	0.015	0.09
E2	Completed	9.17	26.25	0.32	625	0.075	2.21	0.001	0.019	0.17
F	Completed	2.37	26.25	0.32	375	0.035	0.94	0.001	0.008	0.02
G	Completed	11.59	26.25	0.32	675	0.035	1.26	0.001	0.011	0.12
H	Completed	10.11	26.25	0.32	1325	0.035	1.86	0.001	0.016	0.16
I1	Completed	1.31	26.25	0.37	1175	0.035	1.86	0.001	0.018	0.02
I2	Completed	5.24	26.25	0.32	1050	0.075	4.91	0.001	0.041	0.22
total		63.220								1.12

7.0 Temporary and Permanent Erosion Control Plan

7.1 Temporary Erosion Control Plan

The temporary erosion control plans for the site are stabilized construction entrances, silt fences, and sediment traps. Type “A” silt filter fences are used at all side slopes and down slope edges of the construction site. A stone stabilized pad will be installed at entrance and exit for vehicles at the construction site in order to reduce the transport of mud from the construction area onto public roads by motor vehicles and runoff. This pad should consist of an eight inch layer of Alabama Highway Department No. 1 coarse aggregate. It should be 50 feet long and 20 feet in width for the largest construction vehicle at the site. Sediment filters should be installed at the drop inlets and curb inlets in

order to prevent sediment from entering the storm drainage systems during construction and prior to permanent stabilization of the disturbed area. Also, Millet and Rye are suggested by Alabama Soil and Water Conservation Committee as a temporary cover for Central Alabama. Millet can be installed from April 1st to August 15th and Rye will be installed from September 1st to October 15th.

7.2 Permanent Erosion Control Plan

Permanent erosion control plan will be sod. The area for sod should be relatively flat with a slope of 3%. All the area along with the newly constructed road would be suitable for sobbing. Site will be ready for sobbing in August, Bermudagrass or Fescue will be appropriate. The road is located on campus, for landscaping, trees, shrubs and flowers are planted.

Appendix 1

WinTR-55 Current Data Description

--- Identification Data ---

User: Noboru
Project: CE585 Erosion Control
SubTitle:
State: Alabama
County: Jefferson
Filename: C:\Documents and Settings\student\My Documents\GA\CE585\DraingageHW.w55

Date: 7/4/2007
Units: English
Areal Units: Square Miles

--- Sub-Area Data ---

Name	Description	Reach	Area(mi²)	RCN	Tc
A		Reach 1	0.2	55	.489
B		Reach 2	0.17	55	.624
C		Outlet	0.18	55	.492

Total area: .55 (mi²)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.1	5.3	6.1	6.9	7.6	8.4	3.5

Storm Data Source: Jefferson County, AL (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

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Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.1	5.3	6.1	6.9	7.6	8.4	3.5

Storm Data Source: Jefferson County, AL (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

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Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 25-Yr (cfs)
SUBAREAS	
A	**166.90**
B	**127.19**
C	**149.59**
REACHES	
Reach 1	**166.90**
Down	**166.69**
Reach 2	**292.22**
Down	**291.95**
OUTLET	**438.01**

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 25-Yr (cfs) (hr)
SUBAREAS	
A	**166.90** **12.39**
B	**127.19** **12.47**
C	**149.59** **12.37**
REACHES	
Reach 1	**166.90** **12.39**
Down	**166.69** **12.42**
Reach 2	**292.22** **12.46**
Down	**291.95** **12.46**
OUTLET	**438.01**

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Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (mi²)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
A	.20	0.489	55	Reach 1	
B	.17	0.624	55	Reach 2	
C	.18	0.492	55	Outlet	

Total Area: .55 (mi²)

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Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
Reach 1	Reach 2	2400	CHANNEL
Reach 2	Outlet	1680	CHANNEL

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
A							
SHEET	100	0.2000	0.800				0.219
SHALLOW	960	0.0625	0.050				0.066
SHALLOW	864	0.0926	0.050				0.049
CHANNEL	1200					5.000	0.067
CHANNEL	1584					5.000	0.088
					Time of Concentration		.489
B							
SHEET	100	0.2000	0.800				0.219
SHALLOW	768	0.0781	0.050				0.047
SHALLOW	2160	0.0370	0.050				0.193
CHANNEL	2976					5.000	0.165
					Time of Concentration		.624

C

SHEET	**100**	**0.2000**	**0.800**		**0.219**
SHALLOW	**960**	**0.0625**	**0.050**		**0.066**
SHALLOW	**2592**	**0.0463**	**0.050**		**0.207**
				Time of Concentration	**.492**

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (mi²)	Curve Number
A	**Woods**	**(good)**	**B**	**.201**	**55**
	Total Area / Weighted Curve Number			**.2**	**55**
B	**Woods**	**(good)**	**B**	**.173**	**55**
	Total Area / Weighted Curve Number			**.17**	**55**
C	**Woods**	**(good)**	**B**	**.177**	**55**
	Total Area / Weighted Curve Number			**.18**	**55**

Noboru **CE585 Erosion Control**

Jefferson County, Alabama

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	**2400**	**0.013**	**0.0161**	**10**	**4 :1**
Reach 2	**1680**	**0.013**	**0.0476**	**10**	**4 :1**

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	**0.0**	**0.000**	**0**	**10**	**0.0161**
	0.5	**49.180**	**6**	**14**	
	1.0	**170.184**	**14**	**18**	
	2.0	**640.587**	**36**	**26**	
	5.0	**4452.647**	**150**	**50**	
	10.0	**22342.368**	**500**	**90**	
	20.0	**123512.031**	**1800**	**170**	

Reach 2	**0.0**	**0.000**	**0**	**10**	**0.0476**
	0.5	**84.562**	**6**	**14**	
	1.0	**292.624**	**14**	**18**	
	2.0	**1101.460**	**36**	**26**	
	5.0	**7656.122**	**150**	**50**	
	10.0	**38416.671**	**500**	**90**	
	20.0	**212373.245**	**1800**	**170**	

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Appendix 2

WinTR-55 Current Data Description

--- Identification Data ---

User: Noboru
Project: Campus Drive Relocation
SubTitle:
State: Alabama
County: Tuscaloosa
Filename: C:\Documents and Settings\Hunter\My Documents\GA\CE585\Campus Drive.w55

Date: 7/10/2007
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
U1	Upslope	U1 Reach	2.01	98	0.1
U2	Upslope	U2 Reach	3.04	98	.116
U3	Upslope	U3 Reach	9.13	68	.321
U4	Upslope	U4 Reach	3.14	98	0.1
O1	On site	O1 Reach	15.28	71	.117
O2	On site	O2 Reach	2.37	65	.138
O3	On site	O3 Reach	11.59	78	.324
O4	On site	O4 Reach	10.11	89	.281
O5	On site	O5 Reach	6.55	95	.156

Total area: 63.22 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.2	5.4	6.3	7.1	7.8	8.6	3.6

Storm Data Source: Tuscaloosa County, AL (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

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Noboru **Campus Drive Relocation**

Tuscaloosa County, Alabama

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.2	5.4	6.3	7.1	7.8	8.6	3.6

Storm Data Source: Tuscaloosa County, AL (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

Noboru Campus Drive Relocation

Tuscaloosa County, Alabama

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 25-Yr (cfs)	100-Yr (cfs)
SUBAREAS		
U1	11.95	14.49
U2	17.93	21.74
U3	25.46	34.75
U4	18.69	22.66
O1	59.13	78.79
O2	7.48	10.33
O3	42.14	54.54
O4	46.89	58.06
O5	36.88	44.90
REACHES		
U1 Reach	11.95	14.49
Down	11.95	14.49
U2 Reach	17.93	21.74
Down	17.93	21.73
U3 Reach	25.46	34.75
Down	25.45	34.73
U4 Reach	18.69	22.66
Down	18.68	22.64
O1 Reach	241.53	309.65
Down	241.47	309.63
O2 Reach	167.13	212.26
Down	167.13	212.26
O3 Reach	161.17	204.02
Down	161.04	203.83
O4 Reach	99.79	122.28
Down	99.73	122.22
O5 Reach	36.88	44.90
Down	36.87	44.88
OUTLET	241.47	309.63

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Noboru Campus Drive Relocation

Tuscaloosa County, Alabama

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 25-Yr (cfs)	(hr)	100-Yr (cfs)	(hr)
SUBAREAS				
U1	11.95	12.10	14.49	12.10
U2	17.93	12.11	21.74	12.11
U3	25.46	12.24	34.75	12.22
U4	18.69	12.10	22.66	12.10
O1	59.13	12.12	78.79	12.12
O2	7.48	12.13	10.33	12.13
O3	42.14	12.23	54.54	12.22
O4	46.89	12.18	58.06	12.19
O5	36.88	12.12	44.90	12.12
REACHES				
U1 Reach	11.95	12.10	14.49	12.10
Down	11.95	12.11	14.49	12.11
U2 Reach	17.93	12.11	21.74	12.11
Down	17.93	12.12	21.73	12.12
U3 Reach	25.46	12.24	34.75	12.22
Down	25.45	12.26	34.73	12.26
U4 Reach	18.69	12.10	22.66	12.10
Down	18.68	12.13	22.64	12.12
O1 Reach	241.53	12.15	309.65	12.15
Down	241.47	12.16	309.63	12.16

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O2 Reach      167.13    212.26
           12.20     12.20
    Down      167.13    212.26
           12.20     12.20

O3 Reach      161.17    204.02
           12.18     12.18
    Down      161.04    203.83
           12.20     12.20

O4 Reach       99.79    122.28
           12.15     12.15
    Down       99.73    122.22
           12.16     12.16

O5 Reach       36.88     44.90
           12.12     12.12
    Down       36.87     44.88
           12.12     12.13


OUTLET        241.47    309.63
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Noboru Campus Drive Relocation

Tuscaloosa County, Alabama

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
U1	2.01	0.100	98	U1 Reach	Upslope
U2	3.04	0.116	98	U2 Reach	Upslope
U3	9.13	0.321	68	U3 Reach	Upslope
U4	3.14	0.100	98	U4 Reach	Upslope
O1	15.28	0.117	71	O1 Reach	On site
O2	2.37	0.138	65	O2 Reach	On site
O3	11.59	0.324	78	O3 Reach	On site
O4	10.11	0.281	89	O4 Reach	On site
O5	6.55	0.156	95	O5 Reach	On site

Total Area: 63.22 (ac)

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Noboru Campus Drive Relocation

Tuscaloosa County, Alabama

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
U1 Reach	O1 Reach	750	CHANNEL
U2 Reach	O1 Reach	725	CHANNEL
U3 Reach	O3 Reach	1725	CHANNEL
U4 Reach	O4 Reach	1100	CHANNEL
O1 Reach	Outlet	1600	CHANNEL

O2 Reach	O1 Reach	450	CHANNEL
O3 Reach	O2 Reach	1800	CHANNEL
O4 Reach	O3 Reach	1275	CHANNEL
O5 Reach	O4 Reach	250	CHANNEL

Noboru Campus Drive Relocation

Tuscaloosa County, Alabama

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
U1							
SHEET	100	0.2000	0.011				0.007
SHALLOW	125	0.1600	0.025				0.004
CHANNEL	750	0.1333	0.013	0.50	2.50	13.889	0.015
					Time of Concentration		0.1
U2							
SHEET	100	0.2000	0.150				0.057
SHALLOW	125	0.1600	0.025				0.004
SHALLOW	300	0.0667	0.025				0.016
CHANNEL	700	0.0286	0.013	0.50	2.50	6.705	0.029
CHANNEL	350	0.0571	0.013	0.50	2.50	9.722	0.010
					Time of Concentration		.116
U3							
SHEET	100	0.2000	0.240				0.083
SHALLOW	475	0.0421	0.050				0.040
SHALLOW	425	0.0471	0.025				0.027
CHANNEL	1725	0.0232	0.013	0.50	2.50	5.990	0.080
CHANNEL	1875	0.0213	0.013	0.50	2.50	5.723	0.091
					Time of Concentration		.321
U4							
SHEET	100	0.2000	0.011				0.007
SHALLOW	142	0.0141	0.025				0.016
SHALLOW	120	0.1667	0.025				0.004
CHANNEL	425	0.0471	0.013	0.50	2.50	8.433	0.014
CHANNEL	350	0.0571	0.013	0.50	2.50	9.722	0.010
					Time of Concentration		0.1
O1							
SHEET	100	0.2000	0.011				0.007
SHALLOW	725	0.1103	0.025				0.030
SHALLOW	625	0.0960	0.025				0.028
CHANNEL	1625	0.0492	0.013	0.50	2.50	8.681	0.052
					Time of Concentration		.117
O2							
SHEET	100	0.2000	0.240				0.083

SHALLOW	375	0.1067	0.050				0.020
SHALLOW	350	0.1143	0.050				0.018
CHANNEL	300	0.1333	0.013	0.50	2.50	13.889	0.006
CHANNEL	450	0.0889	0.013	0.50	2.50	11.364	0.011
					Time of Concentration		.138

O3

SHEET	100	0.2000	0.240				0.083
SHALLOW	675	0.0296	0.050				0.068
SHALLOW	550	0.0364	0.050				0.050
CHANNEL	1825	0.0110	0.013	0.50	2.50	4.122	0.123
					Time of Concentration		.324

O4

SHEET	100	0.2000	0.011				0.007
SHALLOW	1325	0.0453	0.025				0.085
SHALLOW	1225	0.0490	0.025				0.076
CHANNEL	1050	0.0571	0.013	0.50	2.50	9.409	0.031
CHANNEL	2000	0.0300	0.013	0.50	2.50	6.775	0.082
					Time of Concentration		.281

O5

SHEET	100	0.2000	0.011				0.007
SHALLOW	1175	0.0681	0.025				0.062
SHALLOW	1050	0.0952	0.025				0.047
CHANNEL	1375	0.0582	0.013	0.50	2.50	9.549	0.040
					Time of Concentration		.156

Noboru Campus Drive Relocation

Tuscaloosa County, Alabama

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
U1	Paved parking lots, roofs, driveways	B	2.009	98
	Total Area / Weighted Curve Number		2.01	98
U2	Paved parking lots, roofs, driveways	B	3.042	98
	Total Area / Weighted Curve Number		3.04	98
U3	Open space; grass cover > 75% (good)	B	7.306	61
	Paved parking lots, roofs, driveways	B	1.827	98
	Total Area / Weighted Curve Number		9.13	68
U4	Paved parking lots, roofs, driveways	B	3.142	98

	Total Area / Weighted Curve Number		**3.14**	**98**
			====	**==**
O1	**Open space; grass cover 50% to 75% (fair)**	**A**	**.306**	**49**
	Open space; grass cover 50% to 75% (fair)	**B**	**13.447**	**69**
	Paved parking lots, roofs, driveways	**B**	**1.528**	**98**
	Total Area / Weighted Curve Number		**15.28**	**71**
			=====	**==**
O2	**Open space; grass cover > 75% (good)**	**B**	**2.13**	**61**
	Paved parking lots, roofs, driveways	**B**	**.237**	**98**
	Total Area / Weighted Curve Number		**2.37**	**65**
			====	**==**
O3	**Open space; grass cover 50% to 75% (fair)**	**B**	**8.115**	**69**
	Paved parking lots, roofs, driveways	**B**	**3.478**	**98**
	Total Area / Weighted Curve Number		**11.59**	**78**
			=====	**==**
O4	**Open space; grass cover 50% to 75% (fair)**	**B**	**3.032**	**69**
	Paved parking lots, roofs, driveways	**B**	**7.076**	**98**
	Total Area / Weighted Curve Number		**10.11**	**89**
			=====	**==**
O5	**Open space; grass cover 50% to 75% (fair)**	**B**	**.655**	**69**
	Paved parking lots, roofs, driveways	**B**	**5.24**	**98**
	Paved parking lots, roofs, driveways	**C**	**.655**	**98**
	Total Area / Weighted Curve Number		**6.55**	**95**
			====	**==**