



# Condition Assessment Report

**Stormwater, Sanitary  
Sewer, Water and  
Irrigation Systems**

**University at Albany  
(Uptown Campus)**

**Prepared for:**

**The State University  
Construction Fund and the  
University at Albany**

**SUCF Project No. 01834**



709 Westchester Avenue, Suite L2  
White Plains, NY 10604  
1.800.807.4080

COMMITMENT & INTEGRITY DRIVE RESULTS

**November 2008**

## TABLE OF CONTENTS

SECTION	PAGE NO.
Executive Summary .....	E-1
<b>1. SANITARY SEWER SYSTEM .....</b>	<b>1-1</b>
1.1 Method .....	1-1
1.1.1 Pipe Inspections .....	1-1
1.1.2 Visual Inspections.....	1-2
1.2 Inspection Results .....	1-3
1.2.1 Pipe Condition .....	1-3
1.2.2 Manhole Condition.....	1-3
1.3 Discussion of Results .....	1-3
1.3.1 Pipe Conditions by Geographical Area.....	1-3
1.3.1.1 Collins Circle Area.....	1-3
1.3.1.2 Colonial Quad Area .....	1-5
1.3.1.3 Dutch Quad Area.....	1-5
1.3.1.4 Indian Quad and Justice Drive Area .....	1-6
1.3.1.5 North State Quad and Softball Field Area .....	1-7
1.3.1.6 Parking & Mass Transit Area.....	1-8
1.3.1.7 Support Building Area.....	1-9
1.3.1.8 University Field Area .....	1-10
1.3.2 Pipe Condition by Material.....	1-11
1.3.3 Manhole Condition.....	1-12
1.3.4 Capacity Assessment Results .....	1-13
<b>2. STORM SEWER SYSTEM .....</b>	<b>2-1</b>
2.1 Method .....	2-1
2.1.1 Pipe Inspections .....	2-1
2.1.2 Visual Inspections.....	2-2
2.2 Inspection Results .....	2-3
2.2.1 Pipe Condition .....	2-3
2.2.2 Catch Basin, Drainage Manhole, Drain Inlet, Storm Sewer Appurtenance Conditions.....	2-3
2.3 Discussion of Results .....	2-3
2.3.1 Pipe Condition by Geographical Area .....	2-3
2.3.1.1 Business Building Area.....	2-3
2.3.1.2 Colonial Quad Area .....	2-4
2.3.1.3 Dutch Quad Area.....	2-4
2.3.1.4 Humanities and Education Area .....	2-5
2.3.1.5 South State Quad and Fine Arts Area .....	2-6
2.3.1.6 Social Sciences Area.....	2-7
2.3.1.7 Support Building Area.....	2-8
2.3.1.8 University Field Area .....	2-11
2.3.1.9 Hammer Throw Area .....	2-14
2.3.2 Pipe Condition by Material Pipe Condition by Material.....	2-14
2.4 Catch Basin, Drainage Manhole, Drain Inlet, Storm Sewer Appurtenance Conditions.....	2-15
2.5 Retention Pond Condition.....	2-17

<b>3.</b>	<b>WATER SYSTEM .....</b>	<b>3-1</b>
3.1	Method .....	3-1
3.1.1	Water Tower Inspections.....	3-1
3.1.2	Distribution System Investigations.....	3-1
3.2	Inspection Results .....	3-1
3.2.1	Water Tower Inspection Results.....	3-1
3.2.2	Distribution System Investigation Results.....	3-2
3.3	Discussion of Results .....	3-3
3.3.1	Water Tower Results Discussion.....	3-3
3.3.2	Distribution System Investigation Discussion .....	3-4
<b>4.</b>	<b>IRRIGATION .....</b>	<b>4-1</b>
4.1	Method .....	4-1
4.2	Inspection Results .....	4-1
4.2.1	System History .....	4-1
4.2.2	Water Supply .....	4-1
4.2.3	Irrigation Pumps .....	4-1
4.2.4	Controls .....	4-2
4.2.5	Sprinkler Heads .....	4-2
4.2.6	Piping .....	4-2
4.2.7	Condition Summary by Irrigation Zone .....	4-2
4.3	Discussion of Results .....	4-3

## LIST OF TABLES

<b>TABLE</b>	<b>PAGE NO.</b>
Table E-1: Summary of Sanitary Sewer System Condition.....	1
Table E-2: Summary of Storm Sewer System Condition .....	2
Table 1-1: Pipe Condition Determination Criteria.....	1-2
Table 1-2: Collins Circle Sanitary Sewer.....	1-5
Table 1-3: Colonial Quad Sanitary Sewer.....	1-5
Table 1-4: Dutch Quad Sanitary Sewer .....	1-6
Table 1-5: Indian Quad and Justice Drive Sanitary Sewer.....	1-7
Table 1-6: North State Quad and Softball Field Sanitary Sewer .....	1-8
Table 1-7: Parking & Mass Transit Sanitary Sewer.....	1-9
Table 1-8 Support Building Sanitary Sewer .....	1-10
Table 1-9: University Field Sanitary Sewer .....	1-11
Table 1-10: Condition of Manholes .....	1-13
Table 2-1: Pipe Condition Determination Criteria.....	2-2
Table 2-2: Business Building Storm Sewer .....	2-4

Table 2-3: Colonial Quad Storm Sewer .....	2-4
Table 2-4: Dutch Quad Storm Sewer .....	2-5
Table 2-5: Humanities and Education Sanitary Sewer .....	2-6
Table 2-6: South State Quad and Softball Field Storm Sewer .....	2-7
Table 2-7: Social Sciences Storm Sewer .....	2-8
Table 2-8: Support Building Storm Sewer .....	2-9
Table 2- 9: University Field Storm Sewer .....	2-12
Table 2- 10: Hammer Throw Storm Sewer .....	2-14
Table 2-11: Catch Basins .....	2-16
Table 2-12: Drainage Manholes .....	2-16
Table 2-13: Drain Inlets .....	2-17
Table 2-14: Other Appurtenances .....	2-17

## LIST OF FIGURES

FIGURE	PAGE NO.
Figure 1-1: Condition Assessment Area Labels .....	1-4
Figure 1-2: Sanitary Sewer Pipe Material .....	1-12
Figure 2-1: Storm Sewer Pipe Material .....	2-15

## APPENDICES

- Appendix A: Pipe Issue Summary Tables
- Appendix B: All Pipe Conditions
- Appendix C: Manhole, Catch Basin, Drain Inlet and Other Storm Sewer Appurtenance Conditions
- Appendix D: Pipe Inspection Logs
- Appendix E: Campus Irrigation Evaluation Report Prepared by Northern Designs, LLC

## EXECUTIVE SUMMARY

### Overview

In partial fulfillment of SUCF Program Study 01834, Woodard & Curran is submitting this Condition Assessment Report. This report includes a condition assessment of the Sanitary Sewer System, Storm Sewer System, Water System and Irrigation System at University of Albany based on field observations, conversations with University staff, and industry data. This report represents items developed based on our observations as part of this project and does not include any system modifications or changes in condition that have occurred subsequent to our data collection.

### Sanitary Sewer System

The condition of the sanitary sewer system manholes and selected sanitary sewer system pipes was assessed. The sanitary sewer system pipes contained many blockages due to debris, grease, and roots, with several pipe sags and breaks. Much of the sanitary sewer system is composed of vitrified clay pipe, a material not used in modern sanitary sewer construction. Most of the sanitary sewer manholes were in Good to Excellent condition, but a significant number were in Fair condition, and only a few in Poor condition. The inspection results are summarized in Table E-1.

**Table E-1: Summary of Sanitary Sewer System Condition**

Condition	Sanitary Sewer Pipe	Sanitary Sewer Manholes
Excellent	1,088 ft (12.3%)	5 (4.0%)
Good	377 ft (4.3%)	65 (51.6%)
Fair	1,960 ft (22.1%)	48 (38.1%)
Poor	5,430 ft (61.3%)	8 (6.3%)
Total	8,855 ft	126

### Storm Sewer System

The condition of the storm sewer system features (catch basins, manholes, drain inlets and appurtenances) as well as selected storm sewer system pipes was assessed. The storm sewer system pipes contained many blockages due to debris and roots, with several cracks, breaks, and pipe misalignments. Almost half of the inspected storm sewer pipes were rated Fair to Poor. Most of the storm sewer features were in Good to Excellent condition, but a significant number were in Fair condition, and several in Poor condition. The inspection results are summarized in Table E-2.

**Table E-2: Summary of Storm Sewer System Condition**

Condition	Storm Sewer Pipe	Storm Sewer Catch Basins	Storm Sewer Drainage Manholes	Storm Sewer Drain Inlets	Storm Sewer Appurtenances
Excellent	4,026 ft (43.6%)	3 (0.6%)	4 (3.2%)	1 (0.3%)	7 (20.6%)
Good	743 ft (8.0%)	226 (43.5%)	66 (53.2%)	162 (54.4%)	22 (64.7%)
Fair	2,127 ft (23.0%)	232 (44.7%)	47 (37.9%)	78 (26.2%)	4 (11.8%)
Poor	2,335 ft (25.2%)	58 (11.2%)	7 (5.6%)	57 (19.1%)	1 (2.9%)
Total	9,231 ft	519	124	298	34

### Water System

Water tower inspection reports were put together by Schafer Engineering Associates (SEA) and KTA-Tator Engineering Services and reviewed as part of the Condition Assessment of the water tower. The SEA visual inspection of the water tower was conducted on October 31, 2005 and November 1, 2005. The Office of General Services (OGS) reports, conducted on May 31, 2006, were also reviewed. Additional Condition Assessment activities for the water distribution system encompassed conversations with University staff, field observations, and incorporated industry standards for water distribution systems.

The reports on the structure of the water tower showed that the water tower structure and the exposed part of the water tower foundation were determined to be in good condition. Surface corrosion and pitting on welds were found on several structural elements such as gusset plates, braces, triangle stiffener plates, flange plates, tube braces, framed connections, cable braces, turnbuckles and radial beams. Corrosion was also found on exterior non-structural features such as hatches, vent pipes, speaker attachments, conduit and grating. The cables of the tower were reported to have variable tension.

Past reports on the exterior and interior coating of the water tower showed that the exterior water tank face up, to the top of the water tank, and the tank shell coatings, were determined to be in good condition. The coatings on the exterior of the tank roof were determined to be in fair condition with a localized corrosion on 10% of the roof. The coating on the interior of the tank was determined to be in poor condition. The tank's exterior stiffener ribs and bell tower structure were covered by 10% corrosion. The tank's exterior had areas where layers of paint beneath the top coating were exposed consisting of 10% of the total shell. The tank ladders and railings were determined to be non-compliant with OSHA standards.

In addition to the findings of past reports, additional water system condition assessment activities included observations during Woodard & Curran field visits, conversations with University staff, a review of water industry guidance, and general observations regarding the quality of water supplied to the University system. While not subject to the same level of inspection performed on the buried infrastructure in the sanitary sewer and storm sewer systems, some older fire hydrants were observed during Woodard & Curran field visits. Some of these older hydrants were observed to minimally require some service to correct issues such as broken operating nuts or leaks. Conversations with University staff indicate that the water tank may overflow during decreased demand periods. Using water industry guidance, it was determined that the water mains on campus are approximately 50% through their expected lifespan. While the water supplied by the City of Albany to the University is generally of good quality,

some deterioration of water quality could occur in the University's distribution system given the additional length of pipe that the water needs to pass through.

### Irrigation System

The condition of the irrigation system features (sprinkler heads, control systems, pumps, and piping) as well as its water supply were assessed. The water for the system is supplied by an on-site lake, the potable water supply from the University's building water supply, and two wells. These supply sources appear to be adequately meeting current demands.

There is no central control system, and therefore the operation of the systems zones is partly manual and partly automated. Some of the sprinkler heads are clogged or throwing water onto pavement, and in certain areas sprinklers are poorly spaced resulting in losses of water and irregular spray coverage.

Newer piping and lateral piping appear to be in good condition, however, the older main piping has significant leakage. Consequently, the irrigation pumps need to cycle frequently to maintain the system pressure. The age of the system, lack of appropriate valving and modern system controls, complicate system trouble-shooting, making areas of water loss difficult to locate.

The existing irrigation system installed at University Field, Intramural Fields, Practice Fields and Baseball Fields is outdated and inefficiently designed. The existing irrigation system installed at the Boor Sculpture Studio, Life Sciences, Science Library, University Hall, University Police, Artificial Turf Fields (Lacrosse & Field Hockey) and Empire Commons although functional should each be audited for water conservation.

## **1. SANITARY SEWER SYSTEM**

### **1.1 METHOD**

#### **1.1.1 Pipe Inspections**

Camera inspections of selected sanitary sewer pipes were conducted to determine their physical condition. The camera inspections of pipes began on July 18, 2007 and were completed on July 31, 2007 by Savin Engineers, PC, of Pleasantville, New York.

A pan-and-tilt color camera was used to conduct the camera inspections, allowing the operator to rotate, raise and lower the camera head to provide the optimum view of the interior of the pipes. The camera was stopped at each service connection and lateral, and rotated to allow the inspection of the interior of each connection. All video was recorded in MPEG-1 format and stored directly on labeled DVDs. The log information for each pipe segment included street location, manhole and catch basin numbers, pipe size, pipe material, line items for each comment and defect, and a schematic diagram of the manhole-to-manhole observations. The defects that were noted included broken pipe, cracks, offset joints, root intrusions, grease accumulation, infiltration, pipe obstructions, and catch basin covers that could not be opened.

The following areas of the sanitary sewer pipe system were inspected: the stretch of pipe from the northwestern corner of the Colonial Quad to the northeastern corner of the State Quad, a length of pipe along the east side of the Colonial quad, and the pipe along the east side of the State Quad which continues north to Washington Avenue. Also part of this inspection was the length of pipe beginning at the southwestern corner of the Dutch Quad and ending near the intersection of Justice Drive and University Drive East, and the main laterals of this pipe. There were also sanitary sewer pipes inspected in the area northeast of the Indian Quad, and in the area around the Support Buildings. The following report is an analysis of the results of the sanitary and storm sewer pipe inspections.

Each pipe was assigned a condition by Woodard & Curran using the categories of “excellent,” “good,” “fair,” and “poor.” These conditions were assigned based on the presence of cracks/breaks, pipe blockages, grease, sags or fine roots. Table 1-1 summarizes how the criteria were applied to the determination of pipe conditions based on the camera inspection data.



**Table 1-1: Pipe Condition Determination Criteria**

Condition Evaluation	Determination Criteria
Excellent	No cracks or breaks No pipe blockages No grease No pipe sags No fine roots
Good	No cracks or breaks May contain pipe blockages up to 5% No grease May contain pipe sags up to 5% May contain fine roots
Fair	No cracks or breaks May contain pipe blockages up to 30% May contain grease up to 10% May contain pipe sags up to 25% May contain fine roots
Poor	May contain cracks or breaks May contain pipe blockages greater than 30% May contain grease greater than 10% May contain pipe sags greater than 25% May contain fine roots

This report represents items developed based on our observations as part of this project. The actual condition and capacity of the pipes may have changed since the time of our investigations.

### 1.1.2 Visual Inspections

The visual inspections of the condition of manholes were conducted between June 12, 2007 and August 14, 2007 by Woodard & Curran. The structural condition, amount of sediment and hydraulic condition were evaluated for each manhole. Other qualities that were noted about each manhole were the flow volume, flow contents, debris and odor. Each manhole was then assigned an overall condition of "excellent," "good," "fair," or "poor" during the visual inspection.

This report represents items developed based on our observations as part of this project. The actual condition and capacity of the manholes may have changed since the time of our investigations.

## **1.2 INSPECTION RESULTS**

### **1.2.1 Pipe Condition**

During the inspections, approximately 8,855 ft of sanitary sewer pipe were inspected. During the inspections, approximately 561 ft of pipe could not be inspected due to conditions such as pipe blockages. All of the inspected pipes were 8, 10 or 12 inches in diameter. Of the inspected pipes, approximately 90% (8069 ft) were vitrified clay pipe. The remaining approximately 786 ft of pipe consisted of cast iron, PVC, and asbestos cement pipe.

Of the pipe inspected in the sanitary sewer camera inspection, approximately 1,088 ft of pipe (12.3%) was determined to be in excellent condition, approximately 377 ft (4.3%) was determined to be in good condition, approximately 1,960 ft (22.1%) was determined to be in fair condition, and approximately 5,430 ft (61.3%) was determined to be in poor condition. The diameter of the pipes did not correlate closely with the condition of the pipes.

The inspected portion of the sanitary sewer system contained 3 breaks, 5 cracks, 1 hole and 1 fracture. There were 39 partial pipe blockages including intruding roots, a pipe misalignment, an intruding tap, a brick, and a tennis ball. Pipe blockages ranged from 10%-90%. There were also several instances of fine roots. While fine roots do not require immediate attention, they should be inspected and maintained regularly. There were 11 instances of grease ranging from 5%-35%. The inspected portion of the sanitary sewer system also contained 39 pipes with sagging ranging from 10-75%. There were also 3 pipes in the inspected portion of the sanitary sewer system that contained issues causing the abandonment of the inspection of the pipe, including water and a siphon. See Appendix A for a summary of pipe issues and Appendix B for a table of all pipe conditions.

### **1.2.2 Manhole Condition**

During the field inspection, 125 on-campus manholes were inspected. Of these manholes, 4 were determined to be in excellent condition, 65 were determined to be in good condition, 48 were determined to be in fair condition, and 8 were determined to be in poor condition. See Appendix C for a table of all manhole conditions.

## **1.3 DISCUSSION OF RESULTS**

### **1.3.1 Pipe Conditions by Geographical Area**

Pipes were grouped into twelve geographical areas, as shown in Figure 1-1: Condition Assessment Area Labels. Below are summaries of the pipe conditions in each area. During the inspections, 8,854.6 ft of sanitary sewer pipe were inspected. See Appendix D for pipe inspection logs.

#### **1.3.1.1 Collins Circle Area**

Three sanitary sewer pipe segments were inspected in the Collins Circle Area. They ranged in condition from poor to fair. All of the pipe segments in this area contained 5% grease. All of the pipes in this area also contained sags, ranging from 15-25%. The pipe between MH135 and MH137 contained a 70% blockage from a root ball. The 2 outer pipes of the Collins Circle pipe length also contained fine roots just outside of the sidewalk around Collins Circle. In summary, the average condition of the pipes in this area is fair.

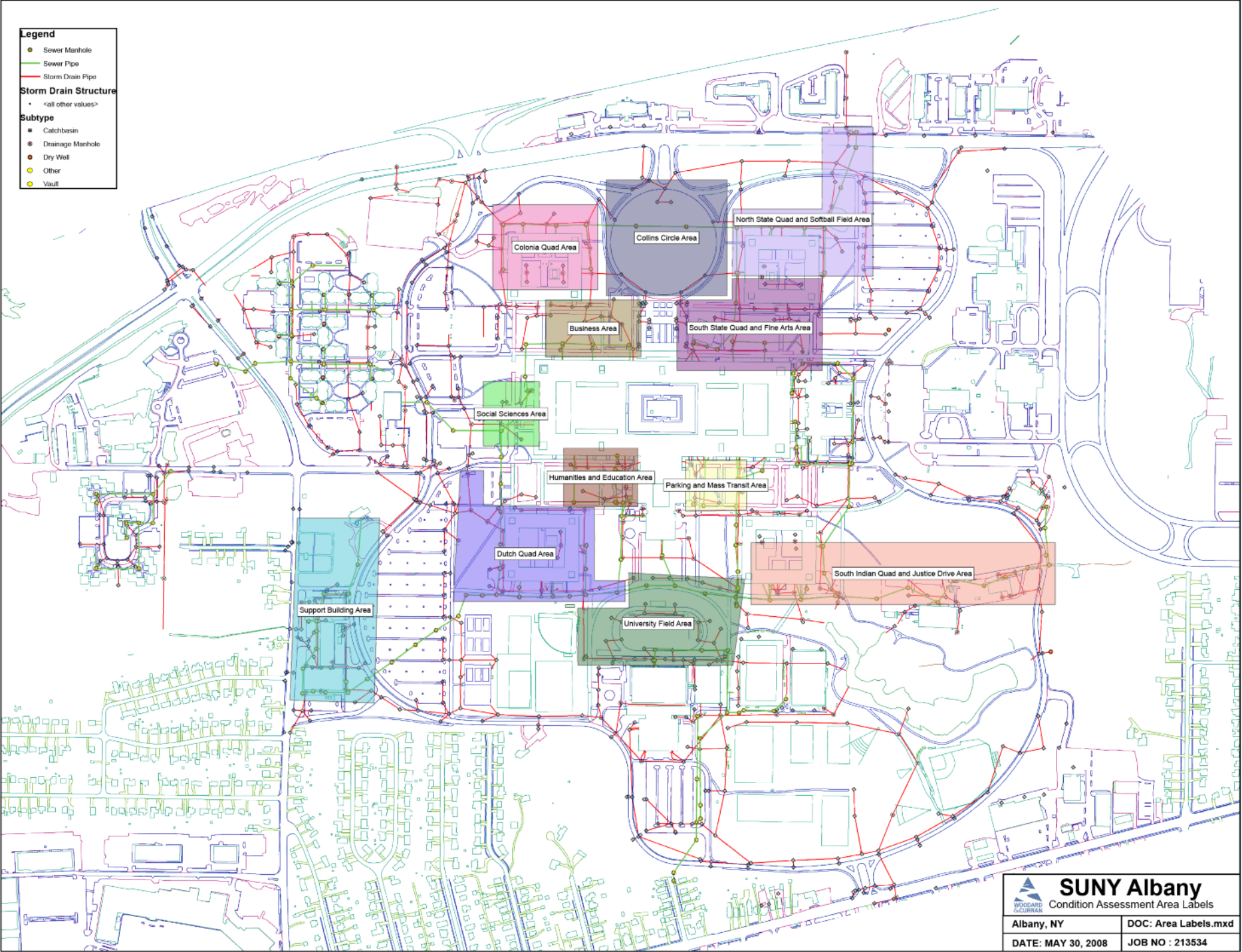


Figure 1-1: Condition Assessment Area Labels

**Table 1-2: Collins Circle Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH137	MH138	E09_sMH02	E09_sMH03	46			5	15		Fair
MH135	MH137	E09_sMH01	E09_sMH02	45		70	5	20	Y	Poor
MH138	MH139	E09_sMH03	F10_sMH01	47			5	25	Y	Fair

### 1.3.1.2 Colonial Quad Area

Four sanitary sewer pipe segments were inspected in the Colonial Quad Area. They ranged in condition from poor to fair. Two of the pipes in poor condition contained cracks, and the pipe in poor condition contained a pipe blockage of 70%. The pipe in fair condition was on the verge of qualifying as being in poor condition because it contained 20% blockages, 5% grease, 20% sags, and fine roots. Half of the pipes contained 5% grease, 2 of the pipes contained 20% sags, 3 of the pipes contained fine roots, and all four pipes contained blockages of 20% or greater. In summary, the average condition of the pipes in this area was poor.

**Table 1-3: Colonial Quad Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks (distance from start)	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH132	MH133	D08_sMH01	D08_sMH03	39		70				Poor
MH133	MH134	D08_sMH03	D08_sMH04	41	Circumferential Crack – 63.7 ft.	Y	5		Y	Poor
MH134	MH135	D08_sMH04	E09_sMH01	43		20	5	20	Y	Fair
MH135	MH136	E09_sMH01	E08_sMH02	44	Circumferential Crack – 61.2 ft	25		20	Y	Poor

### 1.3.1.3 Dutch Quad Area

Nine sanitary sewer pipes were inspected in the Dutch Quad Area. They ranged in condition from poor to excellent. The three pipes in poor condition all contain cracks, breaks, or both, and are located near the southeast corner of the Dutch Quad. One break was located just south of the UKids daycare playground, one break was located at the intersection of the sidewalks at the southeast corner of the Dutch Quad, and multiple cracks and breaks were located in the pipe along the south east side of the Dutch Quad. Three of the pipes deemed in fair condition contained

significant sagging (25%), and thus were on the verge of being considered in poor condition. These pipes were all located along the south edge of the Dutch Quad. The other pipe considered in fair condition was flooded with water upon inspection, and may be in poor condition. The other 2 pipes that were deemed in excellent condition were located along the mid-east side of the Dutch Quad. Grease was located in the pipe located parallel and south of the Dutch Quad. Sagging was located in all of the pipes along the south edge of the Dutch Quad. In summary, the average condition of the pipes in this area (besides the two pipes in excellent condition) is poor.

**Table 1-4: Dutch Quad Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH35	MH36	G06_sMH05	H06_sMH01	1				25	Y	Fair
MH36	MH37	H06_sMH01	H06_sMH03	2			10	25		Fair
MH37	MH38	H06_sMH03	H07_sMH01	3	Longitudinal Fracture – 36.2 ft.			30	Y	Poor
MH38	MH39	H07_sMH01	H07_sMH04	4				25		Fair
MH39	MH82	H07_sMH04	H07_sMH05	5	Break – 11.2 ft.			35		Poor
MH37	STUB	H06_sMH03	Dutch Quad	18		Water		15		Fair
MH39	MH40	H07_sMH04	H07_sMH02	19	Circumferential Crack – 30.0 ft. Circumferential Crack – 45.5 ft. Hole – 68.5 ft.				Y	Poor
MH41	MH40	H07_sMH03	H07_sMH02	52						Excellent
MH41	STUB	H07_sMH03	Dutch Quad	53						Excellent

#### 1.3.1.4 Indian Quad and Justice Drive Area

Twelve sanitary sewer pipes were inspected in the Indian Quad and Justice Drive Area. They ranged in condition from poor to excellent. Six of the pipes in poor condition contained sags of 35-45%. One of the other pipes was deemed in poor condition because of its grease content of 20%. The other pipe in poor condition contained a break, a section that was 90% blocked, and a 20% sag. The pipe in fair condition was 25% blocked by deposits. The pipe in good condition contained some fine roots. In summary, all of the pipes in the inspected pipe length between MH88

and MH104 (excluding the pipe section between MH99 and MH101 which was in good/excellent condition) were in poor condition, the pipes to STUB-A and STUB-B were in poor/fair condition, the pipe just south of Building 2 had grease issues, and the pipe just south of Building 1 was in excellent condition.

**Table 1-5: Indian Quad and Justice Drive Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH86	MH87	J08_sMH01	J08_sMH02	14						Excellent
MH87	MH88	J08_sMH02	J08_sMH05	15			20			Poor
MH99	MH100	J09_sMH02	K09_sMH01	16						Excellent
MH100	MH101	K09_sMH01	K09_sMH02	17					Y	Good
MH86	STUB-A	J08_sMH01	Indian Quad	22	Break – 106.2 ft.	90		20		Poor
MH86	STUB-B	J08_sMH01	Indian Quad	23		25				Fair
MH88	MH91	J08_sMH05	J09_sMH01	59				35	Y	Poor
MH91	MH99	J09_sMH01	J09_sMH02	60				35	Y	Poor
MH101	MH102	K09_sMH02	K09_sMH03	61				45		Poor
MH102	MH110	K09_sMH03	K10_sMH01	62				35		Poor
MH110	MH103	K10_sMH01	K10_sMH02	63				45	Y	Poor
MH103	MH104	K10_sMH02	K10_sMH04	64				45	Y	Poor

### 1.3.1.5 North State Quad and Softball Field Area

There were 7 inspected sanitary sewer pipes in the North State Quad and Softball Field Area. Six were in poor condition and one was in excellent condition. The pipe in excellent condition was in the very top right corner of the area at the end of the inspected line. Five of the pipes in poor condition contained sags ranging from 30-50%, 5 of these pipes also contained blockages ranging from 20-85%, and 1 of them also contained a circumferential crack. Four of the poor condition pipes had fine roots. Two pipes in this area also had minor grease issues. In summary, excluding the pipe in excellent condition, the pipes in this area on average were in poor condition for multiple reasons including blockage, grease, cracks, and sagging.

**Table 1-6: North State Quad and Softball Field Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH141	MH142	F10_sMH03	F10_sMH04	50		20	5	45		Poor
MH142	MH144	F10_sMH04	F11_sMH02	55		25		30		Poor
MH145	MH146	F11_sMH03	F11_sMH04	57						Excellent
MH140	MH141	F10_sMH02	F10_sMH03	48		35		30	Y	Poor
MH140	MH139	F10_sMH02	F10_sMH01	54		60	5	50	Y	Poor
MH144	MH145	F11_sMH02	F11_sMH03	56	Circumferential Crack – 4.2 ft.			30	Y	Poor
MH143	MH142	G10_sMH01	F10_sMH04	58		85			Y	Poor

#### 1.3.1.6 Parking & Mass Transit Area

There were 4 inspected sanitary sewer pipes in the Parking & Mass Transit Area. They ranged in condition from poor to fair. The one pipe deemed in fair condition was on the verge of being considered in poor condition for both a 25% sag and 30% of the pipe blocked by roots. The other three pipes were all deemed in poor condition due to root blockages in the pipes ranging from 35-80%. Two of the pipes also contained fine roots. In summary, the pipes in this area are on average in poor condition due to root blockages.

**Table 1-7: Parking & Mass Transit Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH60	MH61	H08_sMH02	H08_sMH04	29		70				Poor
MH189	STUB	H08_sMH03	Physics	33		30		25		Fair
MH60	MH308	H08_sMH02	H08_sMH01	28		35			Y	Poor
MH60	MH189	H08_sMH02	H08_sMH03	31		80			Y	Poor

### 1.3.1.7 Support Building Area

There were 7 sanitary sewer pipes inspected in the Support Building Area. They ranged in condition from poor to excellent. Two of the pipes in poor condition contained root blockages of 75% and 90%. The pipe with the 75% blockage also contained a pipe sag of 25%. The other 2 pipes in poor condition contained pipe sags of 30% and 75%. The pipe with the 30% sag was also 25% blocked. Three pipes in this area also contained fine roots. In summary, half of the pipes were in good condition and half of the pipes were in poor condition. Although the pipes with the worst root problems were grouped at the northeast corner of the area, the rest of the pipes were spread throughout the area independent of condition.



**Table 1-8 Support Building Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH32	MH27	F05_sMH04	G05_sMH03	25		90				Poor
MH14	MH13	G05_sMH02	F05_sMH03	34				75		Poor
MH14	MH15	G05_sMH02	G05_sMH01	35						Excellent
MH20	MH21	G05_sMH05	G05_sMH06	37		25		30		Poor
MH32	MH29	F05_sMH04	F05_sMH02	26		75		25	Y	Poor
MH19	MH20	G04_sMH04	G05_sMH05	36					Y	Good
MH20	MH109	G05_sMH05	G05_sMH04	38					Y	Good

### 1.3.1.8 University Field Area

Nine sanitary sewer pipes were inspected in the University Field Area. They ranged in condition from poor to excellent. One of the pipes in fair condition was 30% blocked by roots. Another one of the pipes in fair condition had a 20% sag. One of the pipes in poor condition contained a 35% sag. The other 2 were rated poor for multiple reasons- one was 40% blocked and contained 35% grease, and the other was 30% blocked and had a 60% sag. There were fine roots in four of the nine pipes. In summary, besides the two pipes in excellent condition, the remaining pipes in this area were on average in fair condition, with the pipes in poor condition having multiple issues.

**Table 1-9: University Field Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH83	MH84	H07_sMH09	I07_sMH03	8						Excellent
MH82	MH310	H07_sMH05	H07_sMH06	20						Excellent
MH81	MH80	I08_sMH04	I08_sMH02	12				20		Fair
MH73	MH74	I07_sMH04	J07_sMH05	24				20		Fair
MH84	MH85	I07_sMH03	I08_sMH01	9		30			Y	Fair
MH81	MH63	I08_sMH04	--	21					Y	Good
MH81	MH86	I08_sMH04	J08_sMH01	13				35		Poor
MH82	MH83	H07_sMH05	H07_sMH09	6		40	35		Y	Poor
MH85	MH81	I08_sMH01	I08_sMH04	10		30		60	Y	Poor

### 1.3.2 Pipe Condition by Material

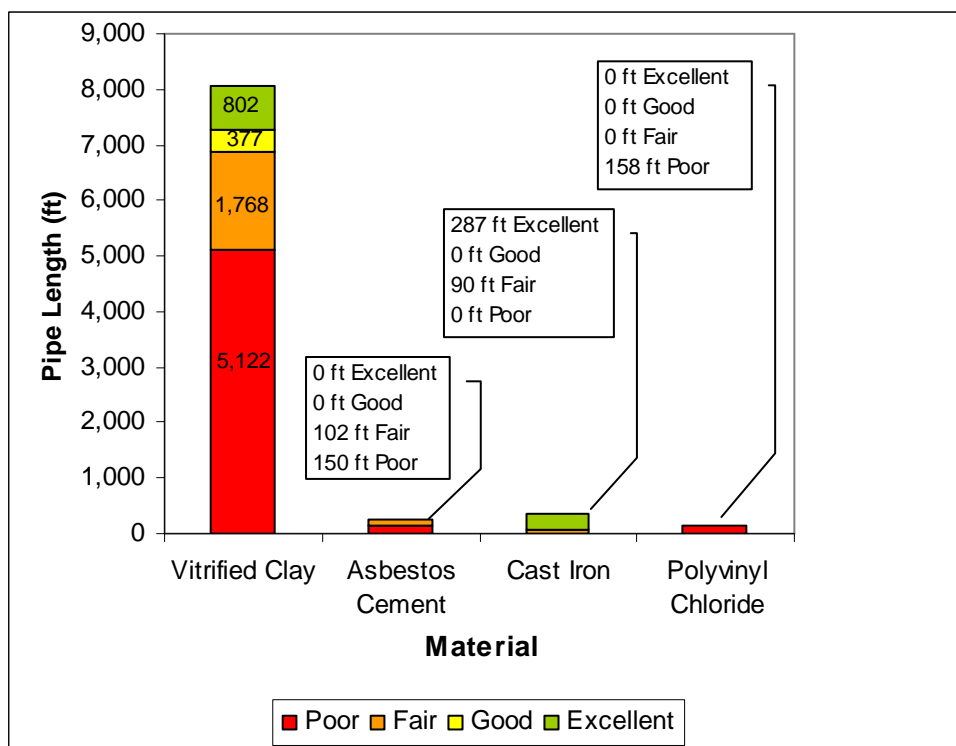
Approximately 91.1% of the inspected pipe (8069 ft) was vitrified clay pipe. Of the pipe, approximately 9.9% (802 ft) was in excellent condition, approximately 4.7% (377 ft) was in good condition, approximately 21.9% (1,768 ft) was in fair condition, and approximately 63.5% (5,122 ft) was in poor condition.

Approximately 4.3% of the inspected pipe (377 ft) was cast iron. Of the inspected cast iron pipe, approximately 76.1% (286 ft) was in excellent condition and approximately 23.9% (90 ft) was in fair condition.

Approximately 2.8% of the inspected pipe (252 ft) was asbestos cement. Of the inspected asbestos cement pipe, approximately 40.4% of this pipe (102 ft) was in fair condition, and the remaining 59.6% of the pipe (150 ft) of the pipe was in poor condition.

The remaining 1.8% (158 ft) of inspected pipe was PVC. All of this pipe was in poor condition.

This information is summarized in Figure 1-2, below.



**Figure 1-2: Sanitary Sewer Pipe Material**

### 1.3.3 Manhole Condition

During the visual inspections of manholes, the structural condition, amount of sediment, and hydraulic condition were evaluated for each manhole. Other qualities that were noted about each manhole were the flow volume, flow contents, debris and odor. Each manhole was then assigned an overall condition.

The structural condition assigned to each manhole was either “good,” “damaged functional” or “damaged non-functional.” Damaged functional manholes contained issues with the structure that did not directly affect their ability to function. The damaged non-functional manholes contained structural issues which prevented the manholes from functioning. On average, the inspected manholes were in good structural condition. Only one manhole was determined to be “damaged non-functional.”

The amount of sediment in each manhole was characterized as either “none,” “partial,” “substantial,” or “full.” On average, the manholes were partially full of sediment. Eighteen of the manholes were rated either “substantial” or “full” with respect to sediment. The remaining manholes were determined to be either “none” or “partial” with respect to sediment.

The hydraulic condition of each manhole was assigned similar to the structural condition with the categories of “good,” “damaged functional,” “damaged non-functional,” and “blocked.” Manholes in the blocked category contained blockages that prevented them from functioning hydraulically. The average hydraulic condition of the manholes was good, with only two manholes determined to be “damaged non-functional” or “blocked.”

An overall condition was assigned to each manhole in the categories of “excellent,” “good,” “fair” or “poor.” The average condition of the inspected manholes was good.

Table 1-10, below, contains a summary of how many of the inspected structures were rated in the individual categories, as well as overall condition.

**Table 1-10: Condition of Manholes**

Structural Condition		Sediment		Hydraulic Condition		Overall Condition	
Good	85	None	25	Good	90	Excellent	5
Damaged Functional	40	Partial	85	Damaged Functional	34	Good	65
Damaged Non-Functional	1	Substantial	15	Damaged Non-Functional	1	Fair	48
		Full	1	Blocked	1	Poor	8

The individual inspection results for each manhole can be found in the Sanitary Sewer Manholes Table in Appendix C. The top section of this table includes the sanitary sewer manholes that were rated “fair” or “poor” in overall condition, had signs of damage which appeared to be affecting the functionality of the manhole, had substantial sediment accumulation, or that had a combination of these issues. The second half of the table includes the remaining inspected manholes. The table is ordered by manhole condition, with the manhole in poorest condition first and ending with the manhole in the best condition.

### 1.3.4 Capacity Assessment Results

For the Capacity Assessment, flow metering was conducted to gather information on pipe flow in four different locations on campus. Location 1 was at MH145 between the northeast softball field and Washington Avenue, and was chosen to characterize the flow at the end of the northern interceptor. Location 2 was at MH103, on the north side of Justice Drive between the University Police Building and University Drive East, and was chosen to characterize the flow at the end of the southern interceptor. Location 3 was at MH86 which is just south of Building 1 in the Indian Quad, and was chosen to characterize the flow contributions upstream of the end of the southern interceptor. Location 4 was at MH46 near Building 15 at the southwest corner of the Dutch Quad and was chosen to characterize the flow contributions at a further upstream location of the southern interceptor. Precipitation was also measured during the period of time that the flow metering took place, because if the precipitation and flows within the system are correlated with each other, this indicates inflow and infiltration. Data was collected between May 16, 2007 and June 14, 2007, and then was analyzed.

One of the results of the analysis was that there was minimal correlation between precipitation and flow, which indicates that there is little infiltration or inflow into pipes. The results also indicated that there were some blockages in the pipes blocking pipe flows. In particular, data indicated that there were blockages in pipes downstream from Location 4, MH46. It also indicated that at each of the four locations there were many instances where there was water in the pipe when there was no flow. This standing water indicates that there may be blockages or sags in the pipes around each of the monitoring locations.

---

## **2. STORM SEWER SYSTEM**

### **2.1 METHOD**

#### **2.1.1 Pipe Inspections**

Camera inspections of selected storm sewer pipes were conducted to determine their physical condition. The pipe inspections began on August 1, 2007 and were completed on August 20, 2007 by Savin Engineers, PC, of Pleasantville, New York. An additional segment of storm sewer was inspected by Lash Contracting, Inc. of Latham, New York on August 12, 2008. This inspection was completed in response to a sinkhole located in the hammer-throw area, near the baseball field in the southeastern portion of campus.

A pan-and-tilt color camera was used to conduct the inspections, which allows the operator to rotate, raise and lower the camera head to provide the optimum view of the interior of the pipes. The camera was stopped at each service connection and lateral, and rotated to allow the inspection of the interior of each connection. All video was recorded in MPEG-1 format and stored directly on labeled DVDs. The log information for each pipe segment included street location, manhole and catch basin numbers, pipe size, pipe material, line items for each comment and defect, and a schematic diagram of the manhole-to-manhole observations. The defects that were noted included broken pipe, cracks, offset joints, root intrusions, grease accumulation, infiltration, pipe obstructions, and catch basin covers that could not be opened.

The following areas of the storm sewer system were inspected: the pipes in the courtyard north of the Business Building that continue north along the Colonial Quad, the pipes to the west of the Social Sciences Building, the pipes just south of the Humanities and Education Buildings, pipes surrounding the Support Buildings, pipes south of University Field, pipes south and west of Dutch Quad, pipes north of the Fine Arts Building, pipes west of State Quad, and pipes between the baseball field and University Drive East. For a full list of inspected pipes, see Appendix A.

The following report is an analysis of the results of the sanitary and storm sewer camera pipe inspections.

After pipe inspection, each pipe was assigned a condition. The four conditions that pipes were divided up into are: excellent, good, fair and poor. These conditions were assigned based on the following five criteria: whether a pipe had cracks/breaks, pipe blockages, grease, sags or fine roots. In order for a pipe to be considered in excellent condition, it could not contain cracks, pipe blockages, grease, pipe sags, or fine roots. In order for a pipe to be considered in good condition, it could contain a pipe blockage up to 5%, a pipe sag up to 5%, and fine roots. For a pipe to be considered in fair condition, it could contain pipe blockages up to 30%, grease up to 10%, and pipe sags up to 25%. Any pipe with cracks, breaks, pipe blockages of 30% or greater, grease greater than 10%, or pipe sags of 25% or greater were considered poor. Table 2-1 below details each condition:

**Table 2-1: Pipe Condition Determination Criteria**

Condition Evaluation	Determination Criteria
Excellent	No cracks or breaks No pipe blockages No grease No pipe sags No fine roots
Good	No cracks or breaks May contain pipe blockages up to 5% No grease May contain pipe sags up to 5% May contain fine roots
Fair	No cracks or breaks May contain pipe blockages up to 30% May contain grease up to 10% May contain pipe sags up to 25% May contain fine roots
Poor	May contain cracks or breaks May contain pipe blockages greater than 30% May contain grease greater than 10% May contain pipe sags greater than 25% May contain fine roots

This report represents items developed based on our observations as part of this project. The actual condition and capacity of pipes may have changed since the time of our investigations.

## 2.1.2 Visual Inspections

The visual inspections of the condition of catch basins, drainage manholes, drain inlets and other storm sewer appurtenances were conducted between June 12, 2007 and August 14, 2007 by Woodard & Curran. The structural condition, amount of sediment and hydraulic condition were evaluated for each of these storm sewer features. Other qualities that were noted about each of these storm sewer features were the flow volume, flow contents, debris and odor. Each feature was then assigned an overall condition of “excellent,” “good,” “fair,” or “poor” during the visual inspection.

This report represents items developed based on our observations as part of this project. The actual condition and capacity of the storm sewer features may have changed since the time of our investigations.

## **2.2 INSPECTION RESULTS**

### **2.2.1 Pipe Condition**

During the storm sewer pipe inspections, approximately 9,231 ft of pipe were inspected, 8,642 ft by Savin Engineers, P.C. and 589 ft by Lash Contracting. Approximately 225 ft of pipe could not be inspected due to conditions such as pipe blockages. Over 95% of the inspected pipes were 15, 18, 21, 30 or 36 inches in diameter. The remaining pipes were 8, 10, 12 or 27 inches in diameter. Over 98% (9,100 ft) of the inspected pipes were reinforced concrete pipe. The remaining approximately 131 ft of pipe consisted of asbestos cement and PVC pipe.

Of the pipe inspected in the storm sewer camera inspection, approximately 4,026 ft of pipe (43.6%) was determined to be in excellent condition, approximately 743 ft (8.0%) was determined to be in good condition, approximately 2,127 ft (23.0%) was determined to be in fair condition, and approximately 2,335 ft (25.2%) was determined to be in poor condition. The diameter of the pipes did not correlate closely with the condition of the pipes.

The inspected portion of the storm sewer system pipes contained a circumferential crack, a circumferential fracture, multiple infiltration drippers, multiple infiltration runners, 22 longitudinal cracks, and 3 locations with multiple cracks. There were 60 partial blockages ranging from 5% to 45%. These blockages included deposits, obstacles, and a pipe misalignment. There were also several instances of fine roots. While fine roots do not require immediate attention, they should be inspected and maintained regularly. There were 2 pipe sags in the inspected pipes of 15% and 20%. There were 2 pipes in the inspected portion of the storm sewer system which could not be inspected due to catch basin covers which could be opened.

### **2.2.2 Catch Basin, Drainage Manhole, Drain Inlet, Storm Sewer Appurtenance Conditions**

During the field inspection, 519 on-campus catch basins were inspected. Of these catch basins, 3 were determined to be in excellent condition, 226 were determined to be in good condition, 232 were determined to be in fair condition, and 58 were determined to be in poor condition. There were also 123 on-campus drainage manholes inspected. Of these drainage manholes, 4 were determined to be in excellent condition, 67 were determined to be in good condition, 46 were determined to be in fair condition, and 6 were determined to be in poor condition. There were also 298 drain inlets inspected. Of these drain inlets, 1 was in determined to be in excellent condition, 157 were determined to be in good condition, 78 were determined to be in fair condition, and 62 were determined to be in poor condition. There were 34 other sewer system appurtenances inspected. Of these features, 7 were determined to be in excellent condition, 22 in good condition, 4 in fair condition and 1 in poor condition.

## **2.3 DISCUSSION OF RESULTS**

### **2.3.1 Pipe Condition by Geographical Area**

Pipes were grouped into 9 geographical areas, as shown in Figure 1-1. Below are summaries of the pipe conditions in each area.

#### **2.3.1.1 Business Building Area**

Six storm sewer pipes were inspected in the Business Building Area. They ranged in condition from good to excellent. The 4 pipes in good condition contained fine roots. In summary, the pipes in this area were in good condition on average.

**Table 2-2: Business Building Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
CB223	CB222	F08_dCB06	F08_dCB07	126					Y	Good
CB223	CB224	F08_dCB06	F08_dCB05	127						Excellent
CB226	CB224	F08_dCB04	F08_dCB05	128					Y	Good
CB226	CB220	F08_dCB04	F08_dCB03	129					Y	Good
CB203	CB220	E08_dCB14	F08_dCB03	130					Y	Good
CB203	MH169	E08_dCB14	E08_dMH05	131						Excellent

### 2.3.1.2 Colonial Quad Area

There was 1 inspected storm sewer pipe in the storm sewer system of the Colonial Quad area. It was deemed to be in good condition because it contained no issues other than fine roots.

**Table 2-3: Colonial Quad Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH169	MH168	E08_dMH05	E08_dMH06	132					Y	Good

### 2.3.1.3 Dutch Quad Area

Seven storm sewer pipes were inspected in the Dutch Quad Area. A portion of them were in poor condition, and the rest were in excellent condition. One of the pipes that was determined to be in poor condition contained an infiltration dripper near the southeastern corner of the Dutch Quad, below the UKids daycare playground, in the same area where there were cracks in the inspected portion of the sanitary system. The other 2 pipes considered to be in poor condition were located between the Dutch Purple lot and Building 16. One contained an infiltration runner (underneath a sidewalk) and the other contained deposits which filled 35% of its cross-sectional area. In summary, over half of the pipes in this area were in excellent shape, and the other pipes were in poor condition.



**Table 2-4: Dutch Quad Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH194	MH52	F07_dMH02	F06_dMH05	73		35				Poor
MH52	MH51	F06_dMH05	G06_dMH01	75						Excellent
MH51	MH49	G06_dMH01	G06_dMH04	76	Infiltration Runner [1/2 GPM] – 10.4 ft.					Poor
MH45	MH47	G06_dMH03	G06_dMH02	101						Excellent
MH47	MH49	G06_dMH02	G06_dMH04	102						Excellent
MH45	MH44	G06_dMH03	H06_dMH01	103						Excellent
MH44	MH43	H06_dMH01	H07_dMH02	104	Infiltration Dripper [1/32 GPM] – 123.4 ft.					Poor

#### 2.3.1.4 Humanities and Education Area

Seven storm sewer pipes were inspected in the Humanities and Education Area. They ranged in condition from poor to excellent condition. The 2 pipes deemed to be in poor condition each had 3 longitudinal cracks, and minor blockages. The pipe in fair condition contained a 20% sag. The pipe deemed to be in good condition contained fine roots. In summary, besides the 2 pipes in this area in poor condition due to cracking, the pipes were in excellent or good condition.

**Table 2-5: Humanities and Education Sanitary Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH155	CB165	G07_dMH04	G07_dCB08	77						Excellent
MH155	MH182	G07_dMH04	G07_dMH06	78	Longitudinal Crack – 20.3 ft.	10				Poor
MH182	MH181	G07_dMH06	G08_dMH01		Longitudinal Crack – 30.1 ft.					
MH181	MH316	G08_dMH01	G08_dMH02		Longitudinal Crack – 43.0 ft.					
MH316	CB77	G08_dMH02	G07_dCB11	79	Longitudinal Crack – 90.8 ft.	5			Y	Poor
CB77	MH58	G07_dCB11	H07_dMH05		Longitudinal Crack – 156.7 ft.					
MH58	CB79	H07_dMH05	H07_dCB05		Longitudinal Crack – 194.0 ft.					

### 2.3.1.5 South State Quad and Fine Arts Area

There were 5 storm sewer pipes inspected in the South State Quad and Fine Arts Area. They ranged in condition from poor to excellent. The pipe in poor condition contained a circumferential crack and the pipe was 20% blocked. The pipes in fair condition all contained blockages of 15-25%. In summary, besides the pipe in excellent condition and the circumferential fracture in 1 pipe, the pipes on average in this area were in fair condition due to pipe blockages.

**Table 2-6: South State Quad and Softball Field Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
CB232	MH172	G09_dCB07	F09_dMH01	123	Circumferential Crack – 94.0 ft.	20				Poor
CB231	CB229	G09_dCB06	G09_dCB05	124		20				Fair
CB231	CB232	G09_dCB06	G09_dCB07	125						Excellent
CB228	CB227	G09_dCB01	F09_dCB23	133		15				Fair
CB228	CB229	G09_dCB01	G09_dCB05	134		25				Fair

### 2.3.1.6 Social Sciences Area

Eleven storm sewer pipes were inspected in the Social Sciences Area. The pipes ranged in condition from fair to excellent condition. The 4 in fair condition contained pipe blockages ranging from 10-25%. These pipes were all located either parallel to, or underneath the sidewalk that exits the Social Sciences building and leads to the Podium West Lot and the Colonial Gold Lot-C. In summary, besides the pipes next to the sidewalk which could use some cleaning, the pipes in this area were in excellent condition.

**Table 2-7: Social Sciences Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
CB162	MH156	F07_dCB10	F07_dMH04	65						Excellent
CB162	CB164	F07_dCB10	F07_dCB09	66		20				Fair
MH154	CB90	F07_dMH03	F07_dCB04	68						Excellent
MH154	MH153	F07_dMH03	F07_dMH01	69						Excellent
MH153	3101	F07_dMH01	F07_dCB01	70						Excellent
3101	CB505	F07_dCB01	F07_dCB03	71						Excellent
CB505	MH194	F07_dCB03	F07_dMH02	72						Excellent
CB91	CB164	F07_dCB05	F07_dCB09	119		10				Fair
CB91	CB90	F07_dCB05	F07_dCB04	120						Excellent
CB93	CB161	F07_dCB06	F07_dCB07	121		15				Fair
CB93	CB90	F07_dCB06	F07_dCB04	122		25				Fair

### 2.3.1.7 Support Building Area

There were 27 storm sewer pipes inspected in the Support Building Area. These pipes ranged in condition from poor to excellent, with 1 pipe whose condition could not be determined. The pipe whose condition could not be determined had catch basins which could not be opened. Four of the pipes in poor condition contained cracks, and 3 also contained blockages of 10-15%. Three of these pipes were in one pipe length stretching from the Support Building A parking lot down to the southwest corner of the Power Plant. The pipes in poor condition without cracks were blocked 40-45% with muck and deposits. Thirteen of the 14 pipes in fair condition were 10-25% blocked with deposits. The other pipe in fair condition had a 15% sag, the only pipe sag in this area. Four of the pipes in this area contained fine roots. In summary, besides the pipes in excellent condition, and the pipe length running along the west side of the Power Plant which contained many cracks, the pipes in this area were on average in fair condition due to a build-up of deposits.

**Table 2-8: Support Building Storm Sewer**

Historic ID		New ID											
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks			Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition	
MH30	CB50	F05_dMH02	F05_dCB14	86								Excellent	
MH9	CB14	G05_dMH04	G05_dCB12	90								Excellent	
MH5	MH4	G04_dMH02	G05_dMH01	96								Excellent	
CB10	MH4	G05_dCB05	G05_dMH01	111								Excellent	
MH31	MH28	F05_dMH04	G05_dMH06	84				20				Fair	
MH9	MH8	G05_dMH04	G05_dMH05	91				20				Fair	
MH8	CB16	G05_dMH05	G05_dCB13	92				15				Fair	
MH8	MH6	G05_dMH05	G05_dMH03	93				10				Fair	
MH6	MH4	G05_dMH03	G05_dMH01	94				15				Fair	
MH8	MH10	G05_dMH05	G05_dMH07	95						15		Fair	
CB4	CB5	F05_dCB10	F05_dCB11	99				25				Fair	
CB6	CB3	G05_dCB01	F05_dCB12	105				15				Fair	
CB6	CB9	G05_dCB01	G05_dCB03	106				15			Y	Fair	
CB8	CB8A	G05_dCB04	--	107				15				Fair	
CB10	CB9	G05_dCB05	G05_dCB03	110				10			Y	Fair	
MH3	1012	F05_dMH03	G05_dCB06	113				10				Fair	
CB15	CB16	G05_dCB14	G05_dCB13	114				10				Fair	
MH28	CB46	G05_dMH06	F05_dCB17	115				10				Fair	
CB51	CB49	F05_dCB13	F05_dCB09	118				20				Fair	
MH7	MH6	G05_dMH02	G05_dMH03	112				5				Good	
MH31	MH49A	F05_dMH04	--	85	Longitudinal Crack – 90.0 ft.							Poor	
					Longitudinal Crack – 114.4 ft.								
					Longitudinal Crack – 118.5 ft.								

Historic ID		New ID											
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks			Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition	
MH30	CB557	F05_dMH02	F05_dCB15	87	Longitudinal Crack – 7.0 ft.			15					Poor
					Circumferential Crack – 20.2 ft.								
					Longitudinal Crack – 28.6 ft.								
					Longitudinal Crack – 44.6 ft.								
					Multiple Cracks – 57.9 ft.								
					Multiple Cracks – 64.7 ft.								
					Longitudinal Crack – 69.7 ft.								
					Longitudinal Crack – 74.5 ft.								
CB557	MH3	F05_dCB15	F05_dMH03	88	Longitudinal Crack – 4.7 ft.			10				Poor	
					Longitudinal Crack – 20.9 ft.								
					Longitudinal Crack – 36.8 ft.								
MH3	MH4	F05_dMH03	G05_dMH01	89	Longitudinal Crack – 41.9 ft.			10				Poor	
					Longitudinal Crack – 98.0 ft.								
					Longitudinal Crack – 160.3 ft.								
MH1	CB4	F05_dMH01	F05_dCB10	97				40			Y	Poor	

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
CB7	CB9	G05_dCB02	G05_dCB03	108		Can't open CBs				Undetermined
CB51	CB52	F05_dCB13	F05_dCB16	116		45			Y	Poor

### 2.3.1.8 University Field Area

There were 24 storm sewer pipes inspected in the University Field Area. Twenty of the pipes were deemed in excellent condition, 1 was deemed in good condition, and 2 were deemed in poor condition. The pipe in the worst condition is located near the northeast corner of the Physical Education building. This pipe contained 2 longitudinal cracks and was also 45% blocked. The other pipe in poor condition was located at the southwest corner of the University Field and was 35% blocked by gravel. There were fine roots in 1 pipe. The rest of the pipes were in excellent shape. In summary, besides the 2 pipes in poor condition, the average condition of the pipe in this area was excellent.

**Table 2- 9: University Field Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH26	MH43	I06_dMH01	H07_dMH02	136						Excellent
MH26	MH113	I06_dMH01	I07_dMH01	137						Excellent
MH113	CB173	I07_dMH01	I07_dCB06	138						Excellent
CB173	MH114	I07_dCB06	I07_dMH02	139						Excellent
MH114	CB359	I07_dMH02	I07_dCB11	140						Excellent
1053	1052	J07_dMH05	J07_dCB11	141						Excellent
1052	1050	J07_dCB11	J07_dCB08	142						Excellent
1050	CB361	J07_dCB08	I07_dCB17	143						Excellent
CB361	MH115	I07_dCB17	I07_dMH03	144						Excellent
MH115	CB360	I07_dMH03	I07_dCB12	145						Excellent
CB360	CB359	I07_dCB12	I07_dCB11	146						Excellent
1053	CB473	J07_dMH05	J07_dCB19	147						Excellent
MH75	MH76	I08_dMH04	I08_dMH05	148						Excellent
MH92	MH76	I08_dMH06	I08_dMH05	149						Excellent
MH92	MH302	I08_dMH06	J08_dMH01	150						Excellent
MH302	OUTFALL	J08_dMH01	J08_dOF01	151						Excellent
1053	CB373	J07_dMH05	J07_dCB14	152						Excellent
CB180	1052	J07_dMH04	J07_dCB11	153						Excellent
CB359	CB358	I07_dCB11	I07_dCB07	155						Excellent
MH113	CB172	I07_dMH01	I07_dCB05	158						Excellent



Historic ID		New ID									
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition	
MH26	CB45	I06_dMH01	I06_dCB05	135					Y	Good	
CB361	CB374	I07_dCB17	J07_dCB06	154	Longitudinal Crack – 16.5 ft.	45				Poor	
					Longitudinal Crack – 19.8 ft.						
MH113	CB362	I07_dMH01	I07_dCB01	156		35				Poor	

### 2.3.1.9 Hammer Throw Area

There were 2 storm sewer pipes inspected in the Hammer Throw Area. These two pipes were inspected by Lash Contracting, Inc. One pipe was deemed to be in fair condition and the other deemed to be in poor condition. Each of these pipes had multiple infiltration drippers and runners, typically in the vicinity of pipe joints, and multiple instances of attached encrustation deposits. The second of the two pipes also had blockages of up to 30% and multiple cracks.

**Table 2- 10: Hammer Throw Storm Sewer**

Historic ID		New ID								
Start Location	End Location	Start Location	End Location	Page Number	Cracks or Breaks	Blockage (%)	Grease (%)	Sags (%)	Fine Roots	Condition
MH97	MH96	L08_dMH02	L08_dMH03		Multiple Infiltration Drippers and Runners	10				Fair
MH97	CB128	L08_dMH02	M07_dCB12		Multiple Cracks; Multiple Infiltration Drippers and Runners	30				Poor

### 2.3.2 Pipe Condition by Material Pipe Condition by Material

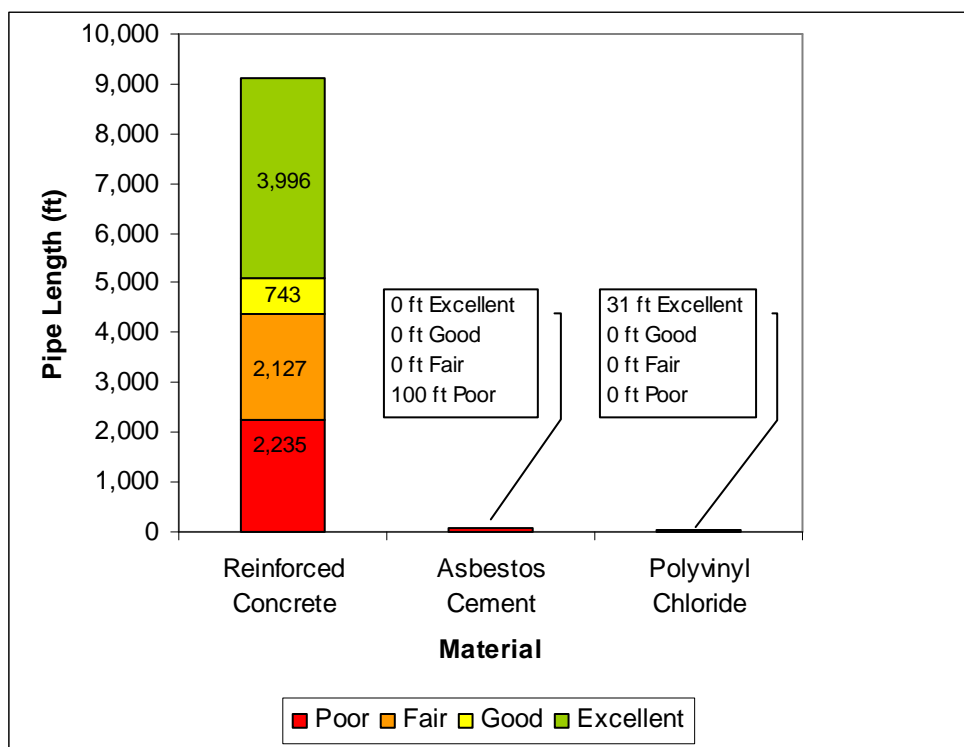
Pipe condition was analyzed by pipe material. Below are summaries of the pipe conditions of pipes of different materials.

Approximately 98.6% of the inspected pipe (9,100 ft) was reinforced concrete pipe. Of this pipe, approximately 43.9% (3,996 ft) was in excellent condition, 8.2% (743 ft) was in good condition, 23.4% (2,127 ft) was in fair condition, and 24.6% (2,335 ft) was in poor condition.

Approximately 1.2% of the inspected pipe (100 ft) was asbestos cement. Of the asbestos cement pipe, 100% (100 ft) was in poor condition.

The remaining 0.4% (31 ft) of inspected pipe was PVC. All of this pipe was in excellent condition.

This information is summarized in Figure 2-1, below



**Figure 2-1: Storm Sewer Pipe Material**

## 2.4 CATCH BASIN, DRAINAGE MANHOLE, DRAIN INLET, STORM SEWER APPURTENANCE CONDITIONS

During the visual inspections of manholes, the structural condition, amount of sediment, and hydraulic condition were evaluated for each catch basin, drainage manhole, drain inlet and storm sewer appurtenance. Other qualities that were noted about each storm sewer feature were the flow volume, flow contents, debris and odor. Each storm sewer feature was then assigned an overall condition.

The structural condition assigned to each storm sewer feature was either “good,” “damaged functional” or “damaged non-functional.” Damaged functional manholes contained issues with the structure that did not directly affect their ability to function. The damaged non-functional manholes contained structural issues which prevented the storm sewer features from functioning. On average, the inspected catch basins, drainage manholes, drain inlets and other appurtenances were in good condition.

The amount of sediment in each manhole was characterized as either “none,” “partial,” “substantial,” or “full.” On average, the manholes were partially full of sediment. Eighteen of the manholes were rated either “substantial” or “full” with respect to sediment. The remaining manholes were determined to be either “none” or “partial” with respect to sediment. On average, the catch basins, drainage manholes and drain inlets were partially full of sediment. Most of the appurtenances had no sediment accumulation.

The hydraulic condition of each storm sewer feature was assigned similar to the structural condition with the categories of “good,” “damaged functional,” “damaged non-functional,” and also “blocked” and “surcharging”. Storm sewer features in the blocked category contained blockages that prevented them from functioning hydraulically. Features in the surcharging category exhibited water exiting the grates because the feature was so full of water. The

average hydraulic condition of the catch basins was damaged functional, with twenty catch basins that were either surcharging, damaged non-functional or blocked. The hydraulic condition of the drainage manholes was split almost evenly between good and damaged functional. The average condition of the drain inlets was good, with thirty-three of the drain inlets that were either surcharging, damaged non-functional or blocked. The other appurtenances were on average in good hydraulic condition.

An overall condition was assigned to each storm sewer feature in the categories of “excellent,” “good,” “fair” or “poor.” The average condition of the inspected catch basins was fair, with 58 catch basins in poor condition. The average condition of the inspected drainage manholes was good. The average condition of the inspected drain inlets was good, although 62 were noted in poor condition. The other appurtenances were on average in good condition.

Tables 2-11 through 2-14 below, contain summaries of how many of the inspected structures were rated in the individual categories, as well as overall condition.

**Table 2-11: Catch Basins**

Structural Condition		Sediment		Hydraulic Condition		Overall Condition	
Good	391	None	52	Good	190	Excellent	3
Damaged Functional	123	Partial	281	Damaged Functional	310	Good	226
Damaged Non-Functional	5	Substantial	162	Surcharging	2	Fair	232
		Full	21	Damaged Non-Functional	8	Poor	58
				Blocked	9		

**Table 2-12: Drainage Manholes**

Structural Condition		Sediment		Hydraulic Condition		Overall Condition	
Good	91	None	16	Good	62	Excellent	4
Damaged Functional	32	Partial	87	Damaged Functional	61	Good	67
Damaged Non-Functional	0	Substantial	19	Surcharging	0	Fair	46
		Full	1	Damaged Non-Functional	0	Poor	6
				Blocked	0		

**Table 2-13: Drain Inlets**

Structural Condition		Sediment		Hydraulic Condition		Overall Condition	
Good	250	None	78	Good	162	Excellent	1
Damaged Functional	48	Partial	142	Damaged Functional	100	Good	157
Damaged Non-Functional	0	Substantial	52	Surcharging	1	Fair	78
		Full	26	Damaged Non-Functional	20	Poor	62
				Blocked	15		

**Table 2-14: Other Appurtenances**

Structural Condition		Sediment		Hydraulic Condition		Overall Condition	
Good	32	None	17	Good	26	Excellent	7
Damaged Functional	2	Partial	13	Damaged Functional	3	Good	22
Damaged Non-Functional	0	Substantial	4	Surcharging	0	Fair	4
		Full	0	Damaged Non-Functional	4	Poor	1
				Blocked	1		

Note: Other Appurtenances includes culvert inlets/outlets, drain outlets, drinking fountains, dry wells, gate valves, inlets, outfalls, trenches, and vaults.

The individual inspection results for each catch basin, drainage manhole, drain inlet and other storm sewer appurtenances can be found in Appendix C. The top section of each table includes features which rated “fair” or “poor” in overall condition, which had signs of damage which appeared to be affecting the functionality of the manhole, which had substantial sediment accumulation or which had a combination of these issues. The second half of the table is the remaining inspected features. The table is ordered by condition, with the features in poorest condition first and the features in worst condition last.

## 2.5 RETENTION POND CONDITION

A water quality assessment and sediment survey of the retention pond were conducted in June 2007. The capacity estimates from the sediment survey indicate the existing stormwater retention pond volume is approximately 6.6 million gallons. Using the estimated sediment thickness, approximately 12,200 cubic yards of sediment is present in the pond, the majority of which is characterized as an organic muck. Removal of all sediment accumulated in the pond will add approximately 2.5 million gallons of capacity assuming a one to one ratio of sediment volume and water storage volume. Estimate calculations can be found in the August 7, 2007, Pond Assessment Report prepared by Woodard & Curran.

Sediment sample analyses revealed the presence of semi-volatile compounds and metals above the unrestricted-use soil standards used for Beneficial Use Determinations (BUDs). Exceedences are likely the result of road runoff entering the stormwater system. Given the analytical results, a BUD may not be feasible without sediment treatment.

---

Water quality and sediment exceedances can be found in the August 7, 2007, Pond Assessment Report, Tables 2-1 and 3-1.

### **3. WATER SYSTEM**

#### **3.1 METHOD**

##### **3.1.1 Water Tower Inspections**

Woodard & Curran reviewed the water tower inspection reports developed by Schafer Engineering Associates (SEA) and KTA-Tator Engineering Services. The results from these reports were summarized and are reported below in the 'Results' and 'Discussion of Results' sections. No other inspections of the water tower were conducted by Woodard & Curran.

The SEA visual inspection of the water tower was conducted on October 31 and November 1, 2005. Three technicians rappelled down the face of the water tower and visually inspected the structure, documenting their findings in digital photos and video. Measurements of the tower were taken to cross reference with current CAD drawings. The water tower's exterior surface and the bell tower frame were inspected. During inspection, an electric rotary grinder was used to determine the extent of the corrosion near the ground level of the water tower.

The KTA-Tator Engineering Services inspection was conducted on May 31, 2006, and focused on the exterior and interior coatings of the water tower tank. As part of this inspection, there was a visual inspection of the corrosion (amount and location) on the tank, the coating thickness of the inside and outside of the tank were measured with a Positector 6000 – F1, a Tooke Gage Mark IV was used to detect how many coatings there were and to estimate their corresponding thicknesses, the adhesion was measured with the ASTM D3359 adhesion test, the substrate condition was measured by removing a section of coating to look for under-film corrosion and mill scale, an ultrasonic thickness gage was used to measure the plate thickness, a visual inspection for safety, operations, and structural conditions was completed, and photographs were taken.

The analysis below was developed based on the water tower inspection reports. The actual condition and capacity of the water tower may have changed since the time of the above investigations.

##### **3.1.2 Distribution System Investigations**

During the course of our investigations, we had various conversations with University staff related to the water distribution system. Fire flow testing at selected fire hydrants was conducted by Woodard & Curran and University at Albany staff on March 27, 2008. Additionally, industry references were consulted to provide supplemental information related to system condition.

This report represents items developed based on the above observations. The actual condition and capacity of the distribution system infrastructure items may have changed since the time of our investigations.

#### **3.2 INSPECTION RESULTS**

##### **3.2.1 Water Tower Inspection Results**

The following results section is a summary of the results sections from the SEA and OGS reports. These two reports can be referenced for more detail. Woodard & Curran is not aware of any changes in the condition of the water tower since these two reports.

The water tower was designed and constructed in 1964, and supports both the water tank and the bell tower. The water tower is made primarily of steel panels ranging in thickness from 3/8" to 3/4". Below are the assessments of the water tower's structure, and the exterior and interior coatings based on the SEA and OGS inspections.

- Structure of Water Tower:
  - The structure of the water tower was deemed to be in good condition overall.
  - The exposed part of the water tower foundation was deemed in good condition.
  - The cables, a structural component of the tower, had variable tension.
  - There was surface corrosion and pitting on welds and several structural elements such as gusset plates, braces, triangle stiffener plates, flange plates, tube braces, framed connections, cable braces, turnbuckles and radial beams.
  - There was corrosion on exterior non-structural features of the tank, such as hatches, vent pipes, speaker attachments, conduit, and grating.
  - The vertical ribs were bent clockwise, as much as four inches over three feet where the 'I' shaped beams meet the 'T' shaped beams.
- Exterior Coating of Water Tower:
  - The exterior water tower face up to the top of the water tank was deemed to be in good condition.
  - The coatings on the exterior of the tank roof were deemed to be in fair condition given localized corrosion on 10% of roof.
  - Tank shell coatings were deemed to be in good condition.
  - The tank's exterior stiffener ribs and bell tower structure exhibited 10% corrosion.
  - The tank's exterior had areas where layers of paint beneath the top coating were exposed, consisting of 10% of the total shell.
- Interior Coating of Water Tower:
  - Overall the coating on the interior of the tank was deemed in poor condition, due to coating disbondment from the steel substrate underneath it, corrosion, and coating blisters.
  - The tank ladders and railings were determined to not be in OSHA compliance. The interior tank ladder is damaged due to ice.

### **3.2.2 Distribution System Investigation Results**

Based on our observations, conversations with University personnel, and industry standards, the following are items we noted related to the water distribution system condition:



- While many of the older fire hydrants have been replaced, many still exist and are in varying levels of repair. For example, while conducting fire flow tests, Hydrant 2, was leaking when pressurized. Other older hydrants had loose operating nuts or were buried too deep.
- Several University staff mentioned that the water tank would overflow during the evening or during periods of decreased demand, such as during breaks. While a water overflow weir does exist, the altitude valve should shut off the flow approximately one foot prior the water level reaching the overflow. A high-level alarm should be activated when the water level reaches one-half foot below the overflow.
- Based on industry averages, post-World War II pipes have an average life expectancy of 75 years. The water mains on the campus are approximately 42 years old, or a little more than 50% of their average life expectancy. The short amount of time it took for the water to run clear when performing fire flow testing indicates that there is little accumulation of sediment in the pipe. As a result, the 50% life expectancy remaining is likely a conservative estimate.
- The water supply from the City of Albany is generally of good water quality. Further investigation of water quality within the University's distribution system was not undertaken as part of this project. The additional length of water pipe and water age that results from the water from the City of Albany passing through the University's distribution system could lead to deterioration of water quality before it reaches the end users. While changes in water quality resulting from chemical changes are unlikely, contamination from coliform bacteria could occur either from breaks or leaks in the piping, backflow into the water system, or from biofilm formed on the interior of the piping. The added time it takes water from the City of Albany system to reach the end users at the University, resulting from water in the storage tank or in the piping network, allows more time for disinfection byproducts to form, notably trihalomethanes. The sampled concentrations in the City of Albany's system ranged from 25.8 to 117.4 micrograms per Liter ( $\mu\text{g/L}$ ), between 2004 and 2006, as reported in their Annual Drinking Water Quality Reports. The maximum contaminant level for trihalomethanes is 80  $\mu\text{g/L}$ . Although the average concentrations of trihalomethanes are below the maximum contaminant level in the City of Albany system, additional storage time in the University's system may increase these concentrations. The water source for the City of Albany is a surface water reservoir, which typically has higher trihalomethane formation potential in the summer months, when water temperatures are higher. This time period also correlates with the lowest water usage on campus water, resulting in longer water ages as water sits in the storage tank and distribution system. This combination leads to a higher potential for disinfection byproduct formation during the summer in the University's water distribution system.

### **3.3 DISCUSSION OF RESULTS**

#### **3.3.1 Water Tower Results Discussion**

The following discussion is based on recommendations from the Schafer Engineering Associates (SEA) and the NYS Office of General Services (OGS) reports. Woodard & Curran is not aware of any of the following recommendations which may have already been completed. The SEA and OGS reports both stated that there were no improvement items which demanded immediate attention. However, they both stated that there are a number of improvements which should be completed in the next four years. These recommendations are summarized below.

- Structure of Water Tower:
  - Tension should be properly adjusted in all cables.

- All turnbuckles should be either tested and cleaned of corrosion, or replaced.
- Welds in poor condition should be repaired.
- Radial beams, braces, gussets, stiffeners, and connections that are heavily corroded should be repaired.
- A maintenance program should be developed to prevent further deterioration of the bell tower's framed connections and non-structural accessories.
- Exterior Coating of Water Tower:
  - The exterior of the tower should be spot-coated in areas with outer shell defects and localized corrosion.
  - The bell tower and balance of the exterior of the tank should be cleaned and overcoated. Water from cleaning may contain lead, and should be contained.
  - The roof of the tank should be cleaned, repaired, and recoated with a coating which is resistant to prolonged periods of saturation.
  - A maintenance program should be developed to prevent further corrosion and pitting of the exterior surface of the water tower and tank.
- Interior Coating of Water Tower:
  - The entire interior coating of the water tower should be completely removed and replaced. A three coat, NSF 61 certified for a potable water, epoxy coating system shall be specified. Since the current coating contains hazardous materials, appropriate safety precautions and containment measures should be taken when the coating is being removed. It is expected that the tank will be out of service for at least twenty weeks while the inside is recoated.
  - The interior ladders of the tank and the railings should be replaced with OSHA compliant ladders and railings of compliant height (42 inches). When the interior ladder is removed, it is recommended that the ladder and support brackets also be removed with care and all remaining weld materials should be ground flush with the tank surface. The access tube ladders should be located so that there is adequate clearance from the outflow pipe.

### 3.3.2 Distribution System Investigation Discussion

Hydrant issues such as leaks, loose operating nuts, and improper installation should be remedied.

Additional investigation relative to the water tower overflow events should be undertaken to better discern the accuracy of this issue. The calibration of the water level meter should be verified, and when overflow events are suspected to be occurring, their occurrence should be verified and documented. Methods of observation may include having a staff member access the top of the tank to visually confirm flow into the overflow, or installing a flow alarm within the overflow pipe. If overflow events are confirmed, action should be undertaken to correct the situation, such as recalibrating or replacing the altitude valve.

---

While we are not aware of any non-ductile iron water distribution piping, PVC water pipes which predate 1977 can leach carcinogenic vinyl chloride into water above recommended levels and should be replaced if they are found.

The University should consider additional sampling for water quality parameters to ensure that the University's distribution system is not deteriorating the quality of water supplied to members of the University community. This sampling should focus on coliform bacteria and disinfection byproducts. Samples should be taken at various times of the year to reflect different water quality conditions and distribution system operating conditions.

## **4. IRRIGATION**

### **4.1 METHOD**

The condition assessment of the irrigation system was conducted by Northern Designs, LLC of North Haven, Connecticut (Northern Designs) and is summarized herein by Woodard & Curran. The full text of the Campus Irrigation System Evaluation prepared by Northern Designs can be found in Appendix E. The assessment consisted of compiling background information on the system, GPS field location mapping of features, and inspection of surface irrigation features including pumping stations, water meters, controls, sensors, valves, and sprinklers. The actual condition and capacity of the infrastructure items may have changed since the time of Northern Design's field investigations.

### **4.2 INSPECTION RESULTS**

#### **4.2.1 System History**

The original system installed in 1970 provided irrigation to the entire campus and can be seen on the Site Utilities drawings dated 4/1/70. The original system comprised manual sprinklers, and steel and copper pipe main lines and lateral pipes. This system now provides irrigation to University Field, Intramural Fields, Practice Fields, Baseball Fields, Artificial Turf Fields, Flag Pole Plaza and Oval at the campus entry. A few areas, such as the Flag Pole Plaza and Practice fields, have been upgraded over time to include automatic valves, gear drive sprinklers and electronic controllers.

The newer irrigation systems include University Hall, Life Science Building, University Police, Boor Sculpture Studio, Artificial Turf Fields (Lacrosse & Field Hockey) Science Library, and Empire Commons. These newer systems generally comprise an automatic electrically controlled pop-up sprinkler system consisting of gear driven rotor sprinklers, pop-up sprinklers, PVC piping and automatic valves for irrigating both the lawn areas and planting beds.

Recently, the Entry Oval irrigation system has been capped in anticipation of future renovations and an irrigation system has been added to the site to the east of University Hall.

#### **4.2.2 Water Supply**

The current water supply, for the Southern University Field, Artificial Turf Fields (Lacrosse & Field Hockey), Practice Athletic Fields and Baseball Fields is the lake north of the Baseball Fields. The Boor Sculpture Studio, Life Sciences, Science Library, University Hall and University Police areas are served by the potable water supply from the building water supply. Empire Commons is supplied by two (2) 50 gpm wells. The existing water supplies, as well as the irrigation pumping station, appear adequate to service the areas they are serving.

#### **4.2.3 Irrigation Pumps**

The current irrigation pumping system consists of 2 - 40hp (600 gpm each) Hayes vertical turbine pumps that produce a system pressure of approximately 100 psi. The pumps are located in a pump house and sit over a wet well with a flume out to the lake. The existing pumps can produce up to 1200 gpm of water to the irrigation system which is enough to irrigate the entire existing campus irrigation system. The pumps are the original pumps and have been recently upgraded with new controls. However, the pumps are starting to show their age. Also, due to the leaks in the main line piping, the pumps cycle on and off frequently.

#### **4.2.4 Controls**

The irrigation systems do not have a central control system, moisture sensors, or sub-metering of flow for each main zone. Several of the main areas serve both lawn and planting bed areas. This results in an inefficient use of water in some places, with over or under-irrigation occurring with respect to varying irrigation requirements of plant materials and responsiveness to weather conditions.

The system did not appear to have adequate manual control valves to isolate areas of the irrigation systems for troubleshooting. In general, the automated valves in the system are in good condition.

#### **4.2.5 Sprinkler Heads**

The sprinkler heads in use in the systems are all of current manufacture. Some landscape sprinklers are clogged, blocked by plant material, or are throwing water onto paved areas. The athletic field sprinkler heads are not spaced to provide an optimal distribution of irrigated water. This results in inefficient distribution of water and susceptibility to wind interference.

#### **4.2.6 Piping**

The older main line piping is buried at depths of three feet (3') or greater below finished grade. The main line piping has many leaks that are difficult to locate and repair. These leaks cause a high rate of cycling by the irrigation pumps to maintain the irrigation main pressure. The more recent installations of PVC main line piping appear to be in good condition. Similarly, the lateral piping constructed of PVC and polyethylene piping appears to be in good condition.

#### **4.2.7 Condition Summary by Irrigation Zone**

University Field - Current system has sprinkler spacing that is inadequate to provide efficient irrigation.

Intramural Fields/Softball Fields - Irrigation zoning is not done properly especially on the softball field. Sprinklers are not located properly to provide efficient irrigation.

Artificial Turf Fields - Did not see manual irrigation system operate, but locations of hydrants and quick couplers are in accordance with current irrigation techniques for synthetic turf fields.

Practice Fields/Baseball Fields - Sprinklers on a portion of the existing practice fields have been automated, but the majority of the sprinklers serving these fields still operate manually. Sprinklers are not located properly to provide efficient irrigation.

Science Library - Existing irrigation system zoning is sufficient. We could not locate water source for the island irrigation.

University Police - Existing irrigation system zoning is sufficient.

Life Science Building - Irrigation zoning appears to be installed according to original planting plan by the Landscape Architect. It appears not all the plant beds were installed (groundcover) as the plan shows, but the irrigation system was.

Boor Sculpture Building - Existing irrigation system is sufficient. There appeared to be a leak in the system near a newly installed tree. A water audit should be performed to provide a more in depth evaluation of the efficiency of the irrigation system.

University Hall - Existing irrigation system is sufficient.

Entry Oval - Not evaluated.

Empire Commons - Existing irrigation system is sufficient, though a large number of spray heads with nozzles are not efficient and there is substantial run-off in pavement areas.

### 4.3 DISCUSSION OF RESULTS

The existing irrigation system installed at University Field, Intramural Fields, Practice Fields and Baseball Fields is outdated and inefficiently designed. The existing irrigation system installed at the Boor Sculpture Studio, Life Sciences, Science Library, University Hall, University Police, Artificial Turf Fields (Lacrosse & Field Hockey) and Empire Commons, although functional, should each be audited for water conservation.

It is Northern Design's recommendation to conduct the following activities to improve the irrigation system:

1. Create a campus wide set of irrigation standards and guidelines.
2. Repair existing irrigation main lines or replace with HDPE piping.
3. Perform hydraulic analysis of existing main line piping distribution to see if it will accommodate possible future irrigation systems, if there are changes required for existing pipe sizes and to determine pumping requirements for a possible master irrigation plan.
4. Install new pump station with higher efficiency pumps and VFDs for speed control. Pump stations today are more efficient and can be connected to the central control system and monitored and controlled centrally.
5. Install irrigation central control system for entire campus. Install flow meters and moisture sensors on individual irrigation systems and connect to central control.
6. Replace existing irrigation controllers with controllers compatible with a new central control system.
7. Install new automatic irrigation system on lower practice fields and baseball fields.
8. Install new automatic irrigation system on intramural fields and softball fields.
9. Install new automatic irrigation system on University Field.
10. Connect existing potable water irrigation (Boor Sculpture Studio, Life Sciences, Science Library, University Hall and University Police) systems to the lake water supply.
11. Install weather station. Weather station could be installed with central control system, but if funding is not available this item could wait while other more important items are completed.
12. Perform a water audit on existing irrigation systems. A water audit is a site specific micro-level evaluation of an irrigation system. This audit reviews sprinkler type, nozzle size, sprinkler spacing and sprinkler system

uniformity, all which when combined provide the end user with a complete profile of the irrigation system and how a more efficient use of water could be achieved.

Zone-specific recommendations are as follows:

University Field - Install new automatic irrigation system with sprinklers properly spaced to provide efficient irrigation.

Intramural Fields/Softball Fields - Install new automatic irrigation system with sprinklers properly spaced to provide efficient irrigation.

Artificial Turf Fields - Existing irrigation system is sufficient.

Practice Fields/Baseball Fields - Install new automatic irrigation system with sprinklers properly spaced to provide efficient irrigation.

Science Library - Existing irrigation system is sufficient; but a water audit should be performed to provide an in depth evaluation of the efficiency of the irrigation system.

University Police - Existing irrigation system is sufficient; but a water audit should be performed to provide an in depth evaluation of the efficiency of the irrigation system.

Life Science Building - Irrigation appears to be installed according to original planting plan by the Landscape Architect. It appears not all the plant beds were installed (groundcover) as the plan shows, but the irrigation was. System should be modified to adjust to the revised plantings. A water audit should be performed to provide an in depth evaluation of the efficiency of the irrigation system.

Boor Sculpture Building - Existing irrigation system is sufficient, though there appeared to be a leak in the system near a newly installed tree. A water audit should be performed to provide an in depth evaluation of the efficiency of the irrigation system.

University Hall - Existing irrigation system is sufficient; but a water audit should be performed to provide an in depth evaluation of the efficiency of the irrigation system.

Entry Oval - A new system is currently planned for the site.

Empire Commons - Existing irrigation system is sufficient; but a water audit should be performed to provide an in depth evaluation of the efficiency of the irrigation system. The system has a large number of spray heads with nozzles that are not efficient. Replacing the existing nozzles with high efficiency nozzles such as MP Rotator by Hunter Industries should be examined.