



2025 Kansas State University Master Plan Update Stormwater System



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SECTION 1

INTRODUCTION

1.1 AUTHORIZATION AND SCOPE

In April of 2012, Kansas State University authorized BG Consultants, Inc. to conduct a Stormwater Master Plan study to supplement the 2025 University Master Plan Update.

This Stormwater Master Plan studies the existing conditions for piping infrastructure 24” diameter and larger for 10-year and 100-year design storm events. The study further includes all existing detention basins and gives particular attention to Campus Creek. The boundaries of the study area are Kimball Ave. on the north, North Manhattan Ave. on the east, Anderson Ave. on the south and College Ave. on the west.

1.2 EXISTING CONDITIONS

Three major drainage basins were identified on the Kansas State University main campus area:

Kansas State Athletics Basin

The *Kansas State Athletics Basin* is approximately 114 Acres and discharges north underneath Kimball Ave. through several drainage structures. This basin includes the area southeast of the intersection of College Ave. and Kimball Ave. where Bill Snyder Family Stadium, Bramlage Coliseum, and the Indoor Practice Facility are located. This area of the basin is approximately 80 Acres and is very urban with large asphalt parking lots and the built environment for the sporting facilities. Average overland slopes range between 1.00-3.50%.

There is also a portion at the southwest quadrant of the N. Manhattan Ave. and Kimball Ave. intersection that drains to the north through drainage structures under Kimball Ave. This area is approximately 34 Acres and includes the Flint Hills Place apartment complex, part of the KSU farms and the NBAF area. This area currently has quite of bit of open space. Average overland slopes are close to 2.00%. Hydraulic analysis of the drainage structures in this area was not performed because they are not KSU owned and maintained.

Campus Creek Basin

The *Campus Creek Basin* is the largest basin at approximately 410 Acres. This basin is really the heart of stormwater drainage on the KSU Campus. The major element of this basin is Campus Creek which carries flow in a southeasterly direction. The common discharge point is a 7’x5’ (WxH) RCB (reinforced concrete box) that crosses N. Manhattan Ave. and joins the City of



Manhattan's 2-5'x4' RCB that runs underneath Bertrand St. taking flow to the east all the way to the Tuttle Creek Blvd. Channel (beautified channel on the east side of Hwy 24). This basin is definitely the most critical due to its size, number of stormwater features and historic flooding issues. The surface conditions are that of a standard college campus built environment. Average overland slopes generally range between 1.00-4.00%.

South Campus Basin

The *South Campus Basin* is approximately 193 Acres and discharges south to the City of Manhattan's large 2-10'x4' RCB structure underneath Anderson Ave. taking flow to the east. Stormwater from as far north as the RV Christian Track and Frank Myers Field travels southeasterly in this drainage basin that follows along the western edge of campus and includes the south half of campus between Claflin Rd. and Anderson Ave. The surface conditions are a little less impervious to the north and present more of a standard college campus built environment to the south. Average overland slopes generally range between 1.00-6.00%.

1.3 HISTORIC OBSERVATIONS

Discussions with KSU Facilities Planning personnel indicate several areas that frequently have flooding issues in larger storm events. Campus Creek is known to overtop Claflin Rd. Old Claflin Rd. and Petticoat Ln. A water depth of approximately 1-1.5' has been observed at Petticoat Ln. Further down Campus Creek, the 7'x5' RCB at N. Manhattan Ave. has been known to overflow. College students have been seen canoeing down N. Manhattan Avenue when this occurs. Capacity problems are likely, however, there is a trash rack at the entrance to the RCB that is also creating debris blockage problems. Staff report no known high water marks on buildings. However, the new Leadership Building may develop high water marks as time goes on. Additionally, it is known that a flooding issue exists at Edwards Hall. There is no underground storm drainage system to intercept water flowing east down Kerr Dr. Runoff in the north curb of Kerr Dr. is known to turn and go down the driveway to Edwards Hall, which has a low finish floor elevation. No other stormwater flooding inside buildings was reported by Facilities staff.



SECTION 2

TECHNICAL METHODS

2.1 GENERAL

The general technical methods to complete this Stormwater Master Plan included surveying the infrastructure according to the KSU Control Datum and performing the existing conditions hydrologic and hydraulic analysis through a model created with the US Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) software. Within HEC-HMS, the SCS Method was utilized to calculate peak runoff flows and volumes. The Muskingham-Cunge Method was utilized for pipe routing. SCS Type II design storms for a 10% and 1% frequency of occurring in any one year were calculated. These design storms are also commonly referred to as 10-year and 100-year events, respectively.

2.2 EVALUATION PROCESS

The evaluation process consisted of the following major components:

1. Survey of all culverts and underground drainage pipes > 24" diameter, existing detention basins, and Campus Creek. Flowlines, pipe size, material and overflow elevation were identified for each culvert. Detention basins that existing data was not available for were topographically surveyed. Data was obtained for the Tecumseh Quivera detention basin south of the indoor practice field which is a City of Manhattan Project and construction plans were used for the Rec Center and NBAF Detention. Cross sections of Campus Creek were obtained. A preliminary field investigation by the engineer occurred concurrently with surveying to familiarize with the drainage structures and patterns that would be modeled.
2. Determine hydrologic characteristics based on field investigation, topography and survey data, including major and minor drainage basins, runoff curve numbers and the time of concentration (lag time) for the SCS Curve Number Method.
3. Research of existing construction documents for confirming existing conditions.
4. Develop US Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) model network.
5. Calibrate and Run HEC-HMS Model for Existing Conditions with a 10-yr and 100-yr SCS Type II design storm. Calibration involved comparing results to historic observations and the results of a previous study conducted for construction of the Leadership Building by Schwab-Eaton.



6. Perform hydraulic analyses by comparing the maximum capacity of all studied drainage pipes with the results of the model analysis to assign an existing Level of Service to each structure.
7. Identify deficiencies, determine recommendations and develop cost estimates. Run model for proposed conditions. (iterative process)

2.3 ASSUMPTIONS AND ANALYSIS CRITERIA

1. Analyzed the maximum capacity of an enclosed system pipe or culvert by comparing inlet and friction control conditions. Overflow elevations were used to determine maximum headwater for these calculations. Overflow elevations included top of rim shots of manholes, area inlet top of grate shots and high point ground shots over a culvert.
2. The City of Manhattan Stormwater Management Master Plan requires that stormwater infrastructure is sized to handle peak flow from a 10-year design storm. For this study, pipes are considered to be deficient when the Level of Service is less than 10. Detention basins were considered deficient when overtopping a 100-year design storm. Therefore, proposed piping recommendations meet 10-year design storm capacity requirements and proposed reservoir improvements meet a 100-year design storm capacity requirement.
3. Properly assigning SCS runoff curve numbers is important to the accuracy of model. Composite curve numbers (CN) were developed taking into account an impervious CN of 98 and pervious CN of 70. Impervious areas were spatially determined utilizing the existing Campus Map in Autocad with Carlson design software.
4. All roof drains were assumed to drain according to the KSU Master Utilities Plan. Engineering judgment was utilized for all roofs and drainage basins without sufficient data for drainage patterns.
5. Campus Creek was modeled as a series of detention basins in the HEC-HMS model.

2.4 RECOMMENDATIONS

The hydrologic and hydraulic analysis was performed for existing conditions only. Future build-out as illustrated in the 2025 Master Plan was not input into the model. However, consideration is given to the projected future build-out for spatially planning capital improvement projects to address existing system deficiencies (i.e. making sure a proposed detention area is not located where a future building is).



2.5 COST ESTIMATING

Cost estimating for recommended capital improvement projects was done utilizing 2012 4th quarter Kansas Department of Transportation bid tabs for Area 1 along with local BG Consultants, Inc. project bid tabs. Utility relocations were not included. A standard 15% construction contingency and 25% design engineering and construction administration contingency were added.



SECTION 3

EXISTING SYSTEM CONDITIONS

3.1 HEC-HMS RESULTS SUMMARY

The existing stormwater system at Kansas State University is in overall fair condition. Many locations have been identified with deficiencies and potential future problems.

The following table is a summary for the results of the HEC-HMS model. Appendix A includes detailed tables for subbasin, pipe and detention basin results for existing conditions. In addition, Figure 1 and 2 maps are located in Appendix D and illustrate the basin boundaries with general overland flow patterns and deficient stormwater elements, respectively.

Table 3.1: Existing Conditions Summary					
Major Basin	Acreage	No. of Subbasins	Pipes >24"	Detention Basins	Deficiencies
Kansas State Athletics	114	13	9	0	3 pipes
Campus Creek	410	89	76	14	31 pipes 5 detention basins
South Campus	193	48	28	1	5 pipes

3.2 KANSAS STATE ATHLETICS BASIN

Three pipes were found to be deficient (33%) in the Kansas State Athletics Basin. There are no detention facilities located in this basin.

Pipe 1-P-02 is a 24" RCP that collects stormwater from the East Stadium Parking Lot at an area inlet located at the NW corner of the lot. Ponding at the area inlet will eventually flow onto Kimball Ave. (west) where it will be intercepted by a sump curb inlet. However, the drainage area to this pipe is estimated at 1.63 Ac. and is largely asphalt pavement (composite CN of 90.4) making 1-P-02 242% over max capacity, therefore, it should be replaced.

Pipe 1-P-06 is a 24" CMP running north-south along the east and south side of Bill Snyder Family Stadium. It is 167% deficient due in large part to the fact that the material is CMP. The existing campus maps seem to indicate that all of the roof top runoff from Bramlage Coliseum is draining to this pipe. Determination of the drainage patterns in this area was challenging. With the construction of the new Basketball Training Facility, this pipe should definitely be monitored



along with 2-P-20 and 2-P-22 located in the South Campus Basin on the east side of the Indoor Practice Facility.

Pipe 1-P-09 is a 30” RCP located at the SE corner of College Ave. and Kimball Ave. It accepts flow traveling north in the concrete channel on the east side of College Ave.

3.3 CAMPUS CREEK BASIN

Since Campus Creek is the largest basin with the oldest infrastructure, it had the most piping deficiencies (41%). Additionally, 5 detention basins are deficient (36%). All of these basins are part of the Campus Creek main line system. All other outlying detention basins performed adequately.

3.3.1 Campus Creek Mainline System

Generally speaking, Campus Creek has capacity problems from the detention basin south of Mosier Hall (2-R-06) travelling southeasterly to the 7’x5’ RCB outlet (2-P-76) at North Manhattan Ave. Campus Creek is modeled as a series of detention basins and all five basins are overtopping in a 100-year design storm. Additionally, two of the basins (2-R-12 and 2-R-14) are overtopping in a 10-year design storm. These are the last two stretches of open channel in the Campus Creek system with overtopping occurring at Petticoat Ln. and N. Manhattan Ave. These two locations were the most memorable areas of overtopping for KSU Facility staff which seems to corroborate the model results showing these two locations overtopping much more frequently.

Reservoir (Creek Sections)		Outlet Structure		Street Overtopping
Model ID	Description	Model ID	Description	
2-R-06	Mosier Hall	2-P-42	(2)4’x4’ RCB	Jardine Dr.
2-R-10	West Mid Campus Dr.	2-P-62	(2)6’x4’ CMAP	Clafin Rd.
2-R-11	International Student Ctr.	2-P-67	9’x6’ RCB	Old Clafin Rd.
2-R-12	Leadership Studies Bldg.	2-P-70	12’x5’ Arch Bridge	Petticoat Ln.
2-R-14	Campus Creek Rd	2-P-76	7’x5’ RCB	N. Manhattan Ave.

The pipe summary tables in Appendix A will show that 2-P-42 and 2-P-67 are adequate, meeting the 10-year design storm requirement. However, as part of the Campus Creek system the capacity must be revisited due to the overtopping condition.

There are also three deficient pipes on the west side of Mid Campus Drive in the Campus Creek system that connect the Mosier Hall Detention to the West Mid Campus Dr. Detention - 2-P-46, 2-P-49, and 2-P-52. Pipe 2-P-46 is a (2)4’x4’ RCB while 2-P-49 and 2-P-52 are (2)6’x4’ CMAP’s.



3.3.2 Rec Complex/Denison Corridor

Stormwater system capacity problems are known to exist at the Rec Complex. Detention in the area of the practice fields has been explored by KSU Facility staff.

The model shows ten deficient pipes in the this system that starts at the area inlet in the parking lot of the Rec Complex and travels down through the tennis courts and across Denison where it turns south and runs down the east side of Denison to the detention south of Mosier Hall.

Table 3.3: Rec Complex/Denison Corridor Deficient Pipes

Model ID	Description
2-P-03	36" RCP
2-P-04	(2) 30"
2-P-05	(2) 24"
2-P-06	42"
2-P-07	4'x3' RCAP
2-P-08	4'x3' RCAP
2-P-09	4'x3' RCAP
2-P-10	4'x3' RCAP
2-P-14	4'x4' RCB
2-P-15	7'x3' RCB

3.3.3 Other Areas

Denison Ave./Jardine Drive Intersection

There are three modeled pipes associated with the curb inlets at the SW, NW and NE corners of the Denison Ave. and Jardine Dr. that show this entire system is deficient. The system discharges into the detention south of Mosier Hall. Pipes 2-P-19 and 2-P-20 are 24" RCP. Pipe 2-P-21 is a 30" RCP. These pipe sizes are simply too small for this rather large drainage area (16.7 Ac. at the first curb inlet).

Inlet to South Pat Roberts Hall Detention

Pipe 2-P-25, a 30" RCP that discharges flow into the South Pat Roberts Hall Detention is deficient. This pipe collects a significant amount of drainage north along Denison Ave.

Serum Plant Rd./Jardine Dr. Intersection

There are four pipes in this area that are deficient. Pipes 2-P-32, 2-P-33, and 2-P-34 are 24" CMP's while 2-P-36 is a 1.83'x2.25' CMAP. This system discharges into the detention area south of Mosier Hall. It is apparent that height constraints exist. The installation of concrete pipe will greatly help. If they could be installed at lower flowlines so more headwater can develop, it would be even better.

Dorm Parking

There are two pipes in the system that collects flow from the dorm parking lots located north of Weber Arena and takes it to the west toward the Mosier Hall detention. Pipe 2-P-38 is a 3.3'x2' CMAP and 2-P-39 is a (2) 2.3'x1.7' CMAP.

Throckmorton to Campus Creek

Four deficient pipes exist in a system that originates near the SE Corner of Throckmorton Hall and travels northeasterly to open channel section of Campus Creek west of Mid-Campus Drive (2-R-10). Pipe 2-P-57 is a 24" RCP, 2-P-58 is a 24" Clay Pipe, 2-P-59 is a 32" RCP and 2-P-61 is a 36" RCP.



South Mid-Campus Drive/Old Claflin Rd. Intersection

Pipe 2-P-68 is a 24" CMP that is deficient and is located just south of the intersection of Mid-Campus Drive and Old Claflin Rd. It collects stormwater from the Waters and Shellenberger Hall area and discharges to Campus Creek just north of the Leadership Studies Bldg.

3.4 SOUTH CAMPUS BASIN

There are 5 deficient pipes (18%) in the South Campus Basin. There is one detention basin, 3-R-01, and it performs adequately. This detention is located at the SE corner of the Indoor Practice Facility and was recently constructed as part of the City of Manhattan's Tecumseh-Quivera project. The analysis showed that the performance of the basin is in line with the original design. This detention basin is designed so that the emergency spillway is active in a 100-year design storm event.

Two of the deficient pipes, 3-P-20 and 3-P-22, are located on the east side of the Indoor Practice Facility and should be monitored along with 1-P-06 on the east side of Bill Snyder Family Stadium. Pipe 3-P-22, in particular, is a 24" CMP showing 216% over max capacity. Pipe 3-P-20 is a 2.25'x1.5' RCAP at 126% max capacity. Again, determination of the drainage patterns in this area was difficult. This analysis may not reflect actual conditions and monitoring is needed before engaging in a capital improvement.

The remaining three pipes are in southern portion of campus and are marginally over max capacity. Pipe 3-P-07 is the 36" pipe running north-south along the west side of the new parking garage south of the Union. It is believed this pipe is fairly new and monitoring is advisable. Pipe 3-P-17 is a 24" RCP and is the last stretch of pipe from a system that wraps around the west side of the Beach Art Museum. It discharges into the city system at Anderson Ave. Pipe 3-P-23 is a 24" CMP located on the north side of the parking that is west of Denison Ave. across from Memorial Stadium.



SECTION 4

RECOMMENDATIONS

4.1 GENERAL

The recommendations presented in this section provide a complete solution for all existing deficient stormwater areas based on the model results. The total cost for all improvements is \$5.1M. Of this total, the Campus Creek mainline system improvement projects are approximately \$2.5M, Project 10 for enclosing the channel for the Vet Med complex is discretionary at \$860,000, and the remaining \$1.7M is for other projects across the KSU campus.

The improvement projects presented upsize capacity deficient pipes and improve the entire Campus Creek mainline system so that overtopping of streets is eliminated. These recommendations should be approached conscientiously. It is recommended that KSU Facility staff continue to monitor the stormwater system in flooding events.

Itemized Estimates of Probable Cost (EOPC's) for all improvements are included in Appendix C. These estimates are based on Kansas Department of Transportation (KDOT) and local bid tabs. The estimates do not include utility relocations.

Figure 3 in Appendix D is a map showing each proposed project. Major projects associated with improving the Campus Creek mainline system are outlined in red. Other piping systems being improved are highlighted.

4.2 STORMWATER POLICY RECOMMENDATION

The stormwater system at Kansas State University already requires many capital improvement projects for attaining adequate existing conditions capacity. Future build-out with increased stormwater flows will expand capacity limitations in a system that already has many, particularly for Campus Creek.

It is recommended that KSU Facilities adopt a stormwater policy to limit developed peak flows to existing conditions for future site development in a manner similar to the City of Manhattan.

Underground detention (under parking) can provide significant reductions in peak stormwater flows when enough space is not available for conventional detention. Additionally, each site should consider low impact development (LID) techniques to achieve pre-developed peak flows. There are many LID techniques, including buffers, bioretention, green roofs, permeable pavers,



rain barrels and cisterns, etc., and should be coordinated with the recommendations from the Landscaping portion of the Master Plan.

The City of Manhattan will be adopting a post-construction Best Management Practices (BMP) Manual soon to meet the EPA's Municipal Separate Storm Sewer System (MS4) Phase II permitting rules that address water quality issues in stormwater. Kansas State University will not be affected by the requirements of this BMP Manual, which are much more stringent than limiting peak flows to pre-developed conditions. However, the BMP Manual details many of the LID techniques mentioned above for improved water quality and KSU should reference these materials already in place when considering their own policy. For KSU, the LID techniques can be utilized to reduce peak flows while providing a benefit to water quality, though not required. With proper policy and planning, stormwater can be managed in the future build-out of Kansas State University.

4.3 PROJECT 1: REC CENTER DIVERSION AND PAT ROBERTS HALL DETENTION

EOPC: \$240,000

With the new detention ponds constructed for NBAF; 2-R-03, 2-R-04, and 2-R-05, the existing detention facility directly south of Pat Roberts Hall, 2-R-02 is now under-utilized. An analysis was conducted that determined the detention pond south of Pat Roberts could also handle the runoff created from the Rec Complex Practice Fields. Approximately 950 linear feet of 36" RCP would be needed to tie into the existing area inlet located just south of the rec fields. The pipe would run east and cross under Denison Ave. before connecting into the existing detention pond at an estimated slope of 0.60%. Diverting this flow to the Pat Roberts detention does not completely alleviate capacity problems for the downstream Rec Complex/Denison Corridor system, but it certainly helps. Without this improvement, the Rec Complex/Denison Corridor system had 10 deficient pipes (essentially the entire system). With this improvement, the Rec Complex/Denison Corridor System will have 4 deficient pipes. The Pat Roberts Detention will need to be maximized and a spillway installed because the model is currently showing a Q_{100} elevation at the top of bank.

4.4 PROJECT 2: TENNIS COURT DIVERSION

EOPC: \$110,000

Pipe segment 2-P-05 that runs under the tennis courts is a double 24" RCP. It currently severely restricts stormwater flows in the Rec Complex/Denison Corridor system. Pipe 2-P-05 is actually a decrease in size from the upstream pipe 2-P-04, which is double 30" RCP's. As the existing conditions analysis show, the double 24" RCP's are currently 279% over maximum capacity. With Project 1 above, 2-P-05 becomes less stressed but is still 204% over maximum capacity. This project constructs a 30" RCP diversion around the south side of the tennis courts. Pipe 2-P-05 will remain live and an approximate 50/50 flow split should be designed at the area inlet junction box just west of the tennis courts. This project makes replacement of 2-P-05 unnecessary, a very favorable prospect with the recent renovations to the tennis courts.



4.5 PROJECT 3: MOSIER HALL DETENTION FACILITY EXPANSION

EOPC: \$360,000 (min)

The existing detention pond south of Mosier Hall is the largest detention basin on Kansas State University. It has been designated as 2-R-06. When at capacity it can hold approximately 12 ac-ft. of runoff. As shown in the results for existing conditions the pond decreases the peak flows by nearly 33% in a 10-year design storm and 14% in a 100-year event. This detention basin is critical to Kansas State's existing and future infrastructure. It has been determined that this drainage area has the potential for increased storage. By maximizing this detention, the storage can be increased to contain 18 Ac-Ft. of runoff at full capacity.

This proposed detention facility was estimated assuming some type of pilot channel to help low flow conditions, address maintenance issues and improve erosion control. The floor of the basin should be a minimum 2% slope from the toe of the side slopes to the pilot channel. The side slopes of the basin were assumed to be 3:1. For estimating purposes, the pilot channel was assumed to be a 4' flat bottom concrete channel with 3:1 side slopes for 1' of depth. The actual design should verify capacity for a 2-year design storm. This channel can incorporate natural rock lining, permeable pavers or be left as natural as possible. If left natural, the design must carefully consider flow velocities and scouring. The detention basin can also be beautified through retaining walls, incorporate retention similar to the Jardine basin where water is always present, and other landscaping. There is also a pedestrian path in this area that must be considered during design. There are many options here which is why the estimate is presented as a minimum only.

The estimate does not include utility relocations which may be necessary. However, some consideration to utilities was made. The pedestrian path was left in place as it is over an existing steam tunnel and adequate cover was checked for a new high power electrical line known to exist under the basin.

4.6 PROJECT 4: NEW CALL HALL DETENTION

EOPC: \$285,000

As identified in the Figure 3 map, the area directly north of Call Hall has the potential for a new detention facility. Stormwater flow from the dorm parking area north of Weber Hall currently flows through an open channel in this area. To give this detention facility enough capacity to make a difference, it recommended that 2-P-40, currently a (2)4'x2' CMAP crossing Jardine drive and discharging into the detention south of Mosier Hall, be replaced at a lower flowline (approximately 2') with single 36" RCP. There is enough depth available in the Mosier Hall detention basin for this and would be easy to accomplish with Project 3 above. Even without Project 3, it is possible because the downstream structure 2-P-41, a (3)7'x3.4' RCB, is 3.2' lower than the flowline out of 2-P-40. Additionally, the existing upstream pipes 2-P-38 and 2-P-39 that are currently deficient should be replaced as part of this project. Their new sizes will be 3'x2' and (2)3'x2' RCAP's, respectively. Pipe 2-P-38 is underneath the Dorm Parking lot. There will be a significant elevation drop into this new detention facility that can be handled through



pipe replacement with a drop manhole or installing a cascade structure with riprap that would be aesthetically pleasing. The new Call Hall Detention creates approximately 2.5 Ac-Ft of maximum storage volume.

Projects 5-8

Section 3 discussed in detail the deficiencies of the Campus Creek system as a whole. To lessen flooding impacts and prevent overtopping of streets that cross Campus Creek, there are four existing culverts that require upsizing and are presented in Projects 5 through 8. Additionally, the existing 7'x5' RCB under N. Manhattan Ave. should be upsized to a (2)8'x5' RCB to prevent overtopping at N. Manhattan Ave. However, replacement of this structure would be a City of Manhattan project. Discussions with the City revealed that they are aware of the need for more stormwater capacity for the Bertrand system that Campus Creek discharges to but project planning was estimated to be at least 15 years away.

4.7 PROJECT 5: MID CAMPUS DRIVE OPEN CHANNEL

EOPC: \$610,000

Currently this portion of Campus Creek is 805' of (2)4'x4' RCB (2-P-46 and 2-P47) and (2)70"x48" CMAP (2-P-49 and 2-P52). The 2025 master planning documents have a vision for this portion of Campus Creek to be converted into an open channel. The open channel is actually planned to be located further to the east where Mid Campus Drive currently is. This is also a great concept for stormwater hydraulics and gaining needed detention in the Campus Creek system. Existing parking would be removed with this project. The new channel was assumed to have a 10' flat bottom with 3:1 side slopes and adds 3.0 Ac-Ft of storage to the existing downstream open channel section (2-R-10). Pipes 2-P-45 and 2-P-48 require extensions to reach the new open channel. Pipe 2-P-52 can remain in place with partial removal but is now oversized, not being part of the main channel anymore.

This project will also replace existing 2-P-42, a (2)4'x4' RCB, with a (2)5'x4' RCB. This culvert connects the Mosier Hall Detention (2-R-06) to the proposed Mid Campus Drive Open Channel (2-R-10) and is located underneath Jardine Dr.

4.8 PROJECT 6: CLAFLIN RD STRUCTURE REPLACEMENT

EOPC: \$320,000

This project will replace existing 2-P-62, a (2)6'x4' CMAP, with a (2)5'x5' RCB. This culvert connects the proposed Mid Campus Drive Open Channel (2-R-10) to the Campus Creek open channel by the International Studies Ctr. (2-R-11) and is located underneath Claflin Rd.



4.9 PROJECT 7: OLD CLAFLIN RD STRUCTURE REPLACEMENT

EOPC: \$90,000

This project will replace existing 2-P-67, a 9'x6' RCB, with a (2)6'x5' RCB. This culvert connects the Campus Creek open channel by the International Studies Ctr. (2-R-11) to the Campus Creek open channel by the Leadership Studies Bldg. (2-R-12) and is located underneath Old Claflin Rd.

4.10 PROJECT 8: PETTICOAT LN STRUCTURE REPLACEMENT

EOPC: \$140,000

This project will replace existing 2-P-70, a 12'x5' Arch Bridge with a (2)10'x6' RCB. This culvert connects the Campus Creek open channel by the Leadership Studies Bldg. (2-R-12) to the Campus Creek open channel in between Petticoat Ln and Campus Creek Rd. and is located underneath Petticoat Ln.

4.11 PROJECT 9: CAMPUS CREEK RD DETENTION EXPANSION

EOPC: \$400,000

This project maximizes the available detention in the Campus Creek open channel section located between Petticoat Ln and Campus Creek Rd (2-R-14). The flowline to the outlet structure (2-P-76) has a concrete flume that drops 3.42'. By reconstructing this flume and connecting the detention basin inlet and outlet flowlines on a straight grade, a significant amount of storage can be obtained. This project includes a pilot channel with grades similar to that discussed for the expansion of Mosier Hall detention in Project 3. There is a pedestrian path in this area that must be considered during design. By maximizing this detention, the storage can be increased by 7 Ac-Ft at full capacity.

4.12 PROJECT 10: VETERINARY MEDICINE RCB

EOPC: \$860,000

Project 10 is a discretionary project associated with potential build-out for Veterinary Medicine east of Mosier Hall. In preparation for this project, an estimate has been provided at the request of Facilities staff to enclose the stormwater channel located there now. This would require a 1,110' long (2)5'x5' RCB. At the top (north end) of this channel is a 60" RCP from the NBAF detention pond and a 30" RCP from the Pat Roberts Hall detention pond. Because future flows from the NBAF site are unknown, the max capacity of the 60" RCP, 280 cfs, was added to the existing flow in this channel, approximately 115 cfs at the south end, and an allowance was made for increased flows from the Vet Med build-out. The estimated max capacity for the (2)5'x5' RCB is 460 cfs. It is recommended that the conditions from the NBAF site for full build-



out there be completely understood for optimizing the size of this proposed RCB as it is a very significant project both in magnitude and cost.

4.13 PROJECT 11: UPSIZING OTHER EXISTING DEFICIENT PIPES

Recommendations for upsizing of all deficient pipes identified in the existing system analysis are itemized (highlighted) in Appendix B. This includes pipes not previously incorporated into proposed projects 1-10. Additionally, EOPC’s for these areas are included in Appendix C and summarized below.

Table 4.1: Summary of other Upsizing Projects			
Project	Basin	Description	EOPC
11a	1	Kansas State Athletics Basin	\$ 330,000
11b	2	Rec Complex/Denison Corridor	\$ 195,000
11c	2	Denison Ave./Jardine Dr. Intersection	\$ 100,000
11d	2	Serum Plant Rd./Jardine Dr. Intersection	\$ 130,000
11e	2	Throckmorton to Campus Creek	\$ 370,000
11f	2	South Mid-Campus Dr./Old Claflin Rd Intersection	\$ 65,000
11g	3	East Side KSU Indoor Practice Football Facility	\$ 175,000
11h	3	West of KSU Union Parking Garage	\$ 185,000
11i	3	South of Beach Art Museum	\$ 60,000
11j	3	North of Parking Lot West of Memorial Stadium	\$ 85,000
Total:			\$ 1,695,000

It is recommended that all deficient pipes be monitored during heavy rain events to verify potential problems and determine if replacement truly is a priority. The pipes that are over capacity will potentially create some ponding as well as surcharging which may heave manhole lids. Depending on the area, ponding may not create an immediate concern and it will just be an inconvenience until water levels recede. If these pipes in the areas of concern are creating problems such as safety hazards, excessive maintenance or flooding of real property, these improvement projects should be implemented without delay.



APPENDIX A & B

MAP AND TABLE CODING

For a better understanding of the results the three separate basins have been numbered.

Basin 1-Athletics Basin
Basin 2-Camp Creek Basin
Basin 3-South Campus

To assist in accurately identifying the results the following system has been used.

1-D-01
1-R-01
1-P-01

The first number 1 identifies the Basin number 1-D-01.

The letter designation represents a drainage basin, reservoir, or pipe.

“D” Represents Drainage Basin
“R” Represents Reservoir
“P” Represents Pipe
1-D-01

The last number represents the number designated to each entity within that basin.

1-D-01

Therefore the designation 3-D-05 represents a drainage basin within basin 3 with the designation of 5.



APPENDIX A



BASIN #1-KANSAS STATE UNIVERSITY ATHLETICS

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
1-D-01	27.29	93	7	96.0	1451	1.17	21.0	12.58	117.2	171.9
1-D-02	3.51	17	83	74.8	738	3.57	15.4	9.25	9.9	17.6
1-D-03	12.10	90	10	95.2	1010	2.12	12.2	7.31	62.3	91.0
1-D-04	2.11	1	99	70.3	673	1.61	24.2	14.50	4.1	7.9
1-D-05	4.14	66	34	88.5	562	5.95	6.1	3.68	22.2	33.8
1-D-06	5.97	50	50	84.0	560	6.22	7.0	4.22	28.3	45.0
1-D-07	6.55	82	18	93.0	434.44	2.46	6.4	3.85	38.1	55.9
1-D-08	0.66	90	10	95.2	1075	1.93	13.4	8.05	3.3	4.8
1-D-09	4.51	41	59	81.5	1409	0.94	41.1	24.68	10.2	17.2
1-D-10	4.54	60	40	86.8	1244	1.77	22.6	13.56	15.9	25.1
1-D-11	13.20	6	94	71.7	1242	2.21	32.4	19.44	23.9	45.0
1-D-12	21.89	13	87	73.6	1296	4.46	22.3	13.41	50.7	92.5
1-D-13	7.98	21	79	75.9	872	0.1	102.0	61.17	8.3	15.2
TOTAL	114	48.46	51.54	83.6						



BASIN #2-CAMPUS CREEK

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
2-D-01	28.21	8	92	72.2	1148	2.05	31.1	18.67	53.1	99.3
2-D-02	4.56	20	80	75.6	1783	2.45	36.8	22.08	9.0	16.1
2-D-03	0.97	30	70	78.4	223	1.79	7.5	4.51	3.8	6.4
2-D-04	1.58	50	50	84.0	327	4.03	5.7	3.41	7.6	12.1
2-D-05	32.54	50	50	84.0	1790	3.39	24.1	14.48	102.6	166.5
2-D-06	6.40	70	30	89.6	1395	2.51	18.7	11.21	25.8	39.5
2-D-07	0.64	96	4	96.9	466	0.49	12.5	7.48	3.3	4.8
2-D-08	1.85	53	47	84.8	398	1.24	11.6	6.99	7.8	12.4
2-D-09	1.10	45	55	82.6	262	1.25	9.0	5.37	4.7	7.6
2-D-10	15.99	5	95	71.4	1162	8	16.3	9.76	38.5	71.9
2-D-11	4.53	89	11	94.9	566	1.82	8.4	5.03	25.9	37.7
2-D-12	2.85	63	37	87.6	372	3.07	6.3	3.80	15.0	23.0
2-D-13	0.71	92	8	95.8	465	0.47	13.5	8.10	3.6	5.2
2-D-14	2.73	89	11	94.9	516	0.39	16.8	10.10	12.6	18.6
2-D-15	3.27	23	77	76.4	242	7.51	4.2	2.49	13.3	22.8
2-D-16	3.87	60	40	86.8	1055	1.58	21.0	12.58	13.9	21.9
2-D-17	3.98	49	51	83.7	718	0.3	39.4	23.66	9.8	16.2
2-D-18	0.60	22	78	76.2	316	2.99	8.2	4.93	2.1	3.7
2-D-19	3.16	63	37	87.6	410	1.12	11.3	6.80	14.5	22.5
2-D-20	1.11	89	11	94.9	202	0.55	6.7	4.02	6.6	9.6



BASIN #2-CAMPUS CREEK

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
2-D-21	5.96	38	62	80.6	718	5.3	10.4	6.23	23.3	38.6
2-D-22	7.58	40	60	81.2	844	4.37	12.8	7.67	28.2	46.5
2-D-23	6.38	25	75	77.0	1287	7.96	15.1	9.06	19.6	33.8
2-D-24	9.06	24	76	76.7	975	10.42	10.7	6.39	30.9	53.5
2-D-25	21.58	33	67	79.2	2515	4.75	31.2	18.73	52.4	90.0
2-D-26	1.04	99	1	97.7	986	1.71	11.6	6.95	5.6	8.1
2-D-27	29.68	40	60	81.2	1860	2.51	31.7	19.03	76.2	128.2
2-D-28	1.75	57	43	86.0	630	2.29	11.9	7.13	7.6	11.9
2-D-29	1.27	59	41	86.5	336	0.85	11.6	6.94	5.6	8.8
2-D-30	0.93	60	40	86.8	417	1.03	12.4	7.42	4.1	6.4
2-D-31	2.65	78	22	91.8	529	1.71	9.5	5.69	13.9	20.6
2-D-32	5.71	29	71	78.1	639	2.13	16.1	9.67	17.8	30.4
2-D-33	3.10	57	43	86.0	457	3.02	8.0	4.80	35.2	23.5
2-D-34	6.57	32	68	79.0	792	2.97	15.8	9.48	10.9	36.0
2-D-35	0.81	43	57	82.0	542	5.09	8.1	4.85	3.6	5.7
2-D-36	1.01	30	70	78.4	836	4.1	14.3	8.57	8.4	5.6
2-D-37	1.47	66	34	88.5	1106	3.62	13.5	8.10	9.3	10.1
2-D-38	0.90	89	11	94.9	1253	3.19	12.0	7.18	25.2	6.8
2-D-39	1.59	29	71	78.1	431	3.65	9.0	5.39	21.3	10.0
2-D-40	5.14	79	21	92.1	1038	1.58	16.7	10.02	2.2	34.1



BASIN #2-CAMPUS CREEK

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
2-D-41	1.94	85	15	93.8	560	3.95	6.0	3.58	14.1	16.8
2-D-42	4.54	81	19	92.7	577	5.42	5.5	3.30	3.3	39.0
2-D-43	11.14	50	50	84.0	1142	1.61	24.4	14.67	34.9	56.7
2-D-44	1.36	35	65	79.8	347	2.43	8.8	5.28	5.3	8.9
2-D-45	1.79	85	15	93.8	369	3.79	4.4	2.62	10.6	15.5
2-D-46	1.80	61	39	87.1	462	1.56	10.8	6.47	8.3	12.9
2-D-47	1.57	84	16	93.5	364	4.13	4.2	2.51	9.2	13.5
2-D-48	0.84	31	69	78.7	414	2.04	11.4	6.87	3.0	5.0
2-D-49	4.37	40	60	81.2	602	0.91	21.4	12.82	13.4	22.3
2-D-50	3.60	62	38	87.4	583	0.58	21.1	12.65	13.1	20.5
2-D-51	5.38	64	36	87.9	1221	2.85	16.8	10.10	21.8	33.8
2-D-52	5.90	44	56	82.3	1065	2.77	18.6	11.18	19.8	32.5
2-D-53	2.97	53	47	84.8	414	1.24	12.0	7.21	12.4	19.7
2-D-54	2.18	65	35	88.2	527	3.27	7.9	4.76	11.1	17.0
2-D-55	1.52	67	33	88.8	364	5.59	4.4	2.65	8.7	12.4
2-D-56	0.69	62	38	87.4	225	5.95	3.1	1.84	3.6	5.5
2-D-57	6.93	58	42	86.2	751	2.15	14.0	8.39	28.8	45.3
2-D-58	5.75	30	70	78.4	1404	1.96	31.3	18.77	13.6	23.5
2-D-59	4.74	85	15	93.8	1148	1.43	17.6	10.57	21.2	31.4
2-D-60	1.86	89	11	94.9	346	0.54	10.4	6.23	10.1	14.7



BASIN #2-CAMPUS CREEK

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
2-D-61	0.69	47	53	83.2	530	2.77	10.4	6.22	2.9	4.7
2-D-62	0.41	100	0	98.0	207	5.8	1.8	1.06	2.5	3.6
2-D-63	0.85	94	6	96.3	194	1.65	3.5	2.09	5.2	7.5
2-D-64	1.57	74	26	90.7	268	0.75	8.7	5.23	8.2	12.3
2-D-65	1.52	84	16	93.5	568	2.17	8.3	4.95	8.5	12.5
2-D-66	0.51	97	3	97.2	812	3.17	7.5	4.51	3.0	4.4
2-D-67	9.00	41	59	81.5	825	4.2	12.7	7.61	34.0	55.7
2-D-68	11.26	70	30	89.6	994	2.04	15.8	9.48	48.3	73.7
2-D-69	3.64	68	32	89.0	907	1.87	15.7	9.41	15.5	23.7
2-D-70	6.52	85	15	93.8	897	2.33	11.3	6.80	33.8	49.8
2-D-71	6.36	75	25	91.0	791	4.6	8.3	4.96	34.1	51.0
2-D-72	7.20	67	33	88.8	662	4.95	7.6	4.54	37.9	57.6
2-D-73	0.50	90	10	95.2	959	1	17.0	10.21	2.3	3.4
2-D-74	4.77	46	54	82.9	1024	4.16	14.5	8.68	17.8	29.0
2-D-75	14.29	64	36	87.9	1277	3.01	17.0	10.18	57.7	89.5
2-D-76	7.63	33	67	79.2	757	3.71	13.5	8.11	26.3	44.3
2-D-77	3.66	60	40	86.8	572	3.96	8.1	4.87	18.0	27.9
2-D-78	0.86	83	17	93.2	1427	2.29	17.0	10.20	3.9	5.7
2-D-79	0.72	69	31	89.3	349	2.54	6.2	3.72	3.9	6.0
2-D-80	1.56	81	19	92.7	1449	1.81	19.9	11.92	6.5	9.8



BASIN #2-CAMPUS CREEK

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
2-D-81	1.50	3	97	70.8	330	2	12.1	7.24	4.1	7.6
2-D-82	3.60	70	30	89.6	100	1	3.6	2.16	21.3	29.8
2-D-83	0.91	95	5	96.6	829	3.07	8.0	4.81	5.4	7.8
2-D-84	1.14	7	93	72.0	425	4.29	9.8	5.87	3.3	6.1
2-D-85	0.44	5	95	71.4	263	5.03	6.3	3.75	1.4	2.6
2-D-86	5.54	60	40	86.8	631	2.07	12.1	7.29	24.3	37.8
2-D-87	5.60	40	60	81.2	799	2.29	16.9	10.14	18.9	31.4
2-D-88	1.75	11	89	73.1	290	2.29	9.6	5.74	5.4	9.7
2-D-89	6.46	9	91	72.5	620	5.18	11.9	7.12	18.2	33.1
TOTAL	410	56.54	41.44	84.4						



BASIN #3-SOUTH CAMPUS

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
3-D-01	26.30	40	60	81.2	1809	1.33	42.6	25.57	57.8	97.7
3-D-02	1.01	98	2	97.4	480	2.08	6.0	3.60	6.2	8.9
3-D-03	1.63	73	27	90.4	615	1.95	10.6	6.38	8.1	12.2
3-D-04	1.98	41	59	81.5	441	1.88	11.5	6.89	7.6	12.6
3-D-05	2.16	84	16	93.5	828	1.81	12.2	7.33	10.9	16.1
3-D-06	5.36	76	24	91.3	629	3.51	7.8	4.67	29.3	43.7
3-D-07	8.69	73	27	90.4	1385	2.47	18.1	10.85	36.0	54.8
3-D-08	6.26	65	35	88.2	1652	2.32	23.5	14.10	22.3	34.7
3-D-09	5.71	90	10	95.2	764	1.31	12.4	7.44	29.2	42.7
3-D-10	1.83	49	51	83.7	618	3.57	10.1	6.08	7.9	12.6
3-D-11	1.15	74	26	90.7	420	5.49	4.6	2.77	6.8	10.1
3-D-12	1.38	49	51	83.7	433	6.15	5.8	3.49	6.6	10.5
3-D-13	3.58	35	65	79.8	538	1.62	15.3	9.18	12.0	20.1
3-D-14	3.03	88	12	94.6	572	3.5	6.2	3.71	18.0	26.2
3-D-15	1.51	96	4	96.9	312	0.27	12.2	7.31	7.9	11.5
3-D-16	3.30	46	54	82.9	525	0.63	21.8	13.07	10.6	17.3
3-D-17	6.11	38	62	80.6	1319	3.8	19.9	11.96	18.9	31.7
3-D-18	11.05	20	80	75.6	1032	3.53	19.8	11.88	29.0	51.4
3-D-19	1.40	94	6	96.3	273	3.67	3.1	1.84	8.5	12.3
3-D-20	1.23	82	18	93.0	221	3.16	3.3	1.98	7.2	10.6



BASIN #3-SOUTH CAMPUS

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
3-D-21	8.47	51	49	84.3	1030	0.2	63.2	37.95	16.1	26.7
3-D-22	4.10	74	25	90.0	754	1.09	17.0	10.22	17.3	26.4
3-D-23	3.51	62	38	87.4	960	3.11	13.6	8.14	15.2	23.6
3-D-24	3.90	74	26	90.7	692	5.48	6.9	4.13	21.7	32.4
3-D-25	4.36	44	56	82.3	714	5.21	9.9	5.92	18.2	29.5
3-D-26	1.14	55	45	85.4	329	6.96	4.1	2.48	5.7	8.9
3-D-27	0.33	90	10	95.2	123	0.1	10.4	6.24	1.8	2.6
3-D-28	3.05	53	47	84.8	603	1.8	13.5	8.08	12.4	19.7
3-D-29	1.73	44	56	82.3	366	0.55	17.8	10.68	5.9	9.6
3-D-30	1.29	87	13	94.4	433	0.93	9.7	5.85	7.0	10.2
3-D-31	0.73	86	14	94.1	286	0.7	8.2	4.90	4.1	6.1
3-D-32	2.87	60	40	86.8	612	3.84	8.7	5.22	13.8	21.5
3-D-33	14.47	22	78	76.2	994	2.01	25.0	15.03	35.2	62.3
3-D-34	4.82	65	35	88.2	1003	0.18	56.6	33.96	10.9	17.3
3-D-35	1.11	99	1	97.7	508	0.05	39.8	23.90	3.6	5.3
3-D-36	1.71	99	1	97.7	448	0.28	15.2	9.13	8.4	12.2
3-D-37	3.76	9	91	72.5	671	2.76	17.3	10.39	9.3	17.0
3-D-38	7.13	51	49	84.3	1057	2.36	18.8	11.28	25.2	40.5
3-D-39	5.97	65	35	88.2	1088	1.21	23.3	13.98	21.3	33.2
3-D-40	0.53	32	68	79.0	325	8.71	4.5	2.71	2.2	3.7



BASIN #3-SOUTH CAMPUS

SUB-BASIN RESULTS

SUB-BASIN	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE	FLOW LENGTH (FT)	AVG SLOPE (%)	SCS (TC) MIN	LAG TIME	Q10 (CFS)	Q100 (CFS)
3-D-41	3.38	39	61	80.9	425	3.66	8.1	4.88	14.1	23.2
3-D-42	0.62	53	47	84.8	265	11.61	2.7	1.65	3.3	4.8
3-D-43	3.31	90	10	95.2	737	2.82	8.2	4.92	19.1	27.7
3-D-44	1.50	98	2	97.4	677	2.33	7.5	4.48	9.0	13.0
3-D-45	1.43	99	1	97.7	605	2.03	7.2	4.31	8.7	12.5
3-D-46	2.60	98	2	97.4	1095	2.06	11.7	7.00	14.0	20.1
3-D-47	4.60	85	15	93.8	561	1.99	8.4	5.05	25.7	37.7
3-D-48	6.42	70	30	89.6	1246	5.47	11.6	6.93	30.6	46.6
TOTAL	193	65.94	34.04	88.4						



BASIN #1-KANSAS STATE ATHLETICS

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
1-P-01	RCAP	(2)52 X 34	1096.77	1095.13	75	0.02	0.013	1101.12	190.4	139.9	210.7	<100	73%
1-P-02	RCP	24	1091.39	1084.19	287	0.03	0.013	1095.34	25.6	61.9	90.4	<10	242%
1-P-03	RCB	48 X 48	1084.02	1073.29	116	0.09	0.013	1091.36	177.8	155.2	234.1	<100	87%
1-P-04	RCB	48 X 36	1074.79	1073.64	427	0.00	0.013	1079.48	84.5	84.9	128.0	10	100%
1-P-05	RCB	36 X 30	1075.38	1074.84	216	0.00	0.013	1083.69	83.9	22.1	33.5	>100	26%
1-P-06	CMP	24	1110.1	1074.5	1123	0.03	0.025	1118.43	22.5	37.6	55.0	<10	167%
1-P-07	RCP	24	1117.16	1111.52	861	0.01	0.013	1120.41	19.3	15.8	24.9	<100	82%
1-P-08	RCP	30	1111.36	1108.05	1206	0.00	0.013	1115.48	25.6	24.1	39.0	<100	94%
1-P-09	RCP	30	1099.09	1096.9	85	0.03	0.013	1102.04	26.3	28.5	47.1	<10	108%

DENOTES DEFICIENCIES



BASIN #2-CAMPUS CREEK

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-01	RCP	36	1078.50	1077.91	31	0.02	0.013	1084.55	71.5	53.1	99.3	<100	74%
2-P-02	RCP	42	1077.85	1077.46	57	0.01	0.013	1082.92	79.8	75.2	133.7	<100	94%
2-P-03	RCP	36	1077.46	1077.24	39	0.01	0.013	1082.92	65.9	83.9	144.0	<10	127%
2-P-04	RCP	(2) 30"	1077.29	1076.56	157	0.00	0.013	1081.14	70.0	92.9	157.1	<10	133%
2-P-05	RCP	(2) 24"	1076.51	1074.48	437	0.00	0.013	1080.16	37.9	102.9	170.7	<10	272%
2-P-06	RCP	42	1074.40	1073.87	100	0.01	0.013	1080.51	93.7	102.7	170.5	<100	110%
2-P-07	RCAP	52 X 34	1072.40	1071.41	99	0.01	0.013	1078.63	95.2	109.0	179.6	<100	114%
2-P-08	RCAP	52 X 34	1071.40	1067.00	46	0.10	0.013	1075.88	68.8	112.5	184.4	<10	164%
2-P-09	RCAP	52 X 34	1063.50	1061.71	167	0.01	0.013	1067.92	67.5	122.6	199.6	<10	182%
2-P-10	RCAP	52 X 34	1061.71	1060.88	151	0.01	0.013	1067.76	92.9	125.6	204.2	<10	135%
2-P-11	RCP	27	1064.59	1064.40	15	0.01	0.013	1067.90	26.9	5.6	8.1	>100	21%
2-P-12	RCAP	52 X 34	1061.57	1060.99	40	0.01	0.013	1067.80	43.4	35.0	56.5	>10	81%
2-P-13	RCAP	60 X 36	1061.13	1060.50	67	0.01	0.013	1067.61	116.6	37.8	60.5	<100	32%
2-P-14	RCB	48 X 48	1060.88	1059.59	340	0.00	0.013	1067.29	144.0	162.6	264.0	<10	113%
2-P-15	RCB	84 X 36	1059.59	1057.09	50	0.05	0.013	1063.22	118.6	170.9	276.1	<10	144%
2-P-16	RCB	60 X 36	1059.25	1058.15	165	0.01	0.013	1070.01	232.1	58.7	101.8	>100	25%
2-P-17	RCP	24	1059.43	1059.15	42	0.01	0.013	1063.42	25.7	13.2	20.7	>100	51%
2-P-18	RCP	24	1059.11	1058.97	35	0.00	0.013	1063.50	27.5	17.2	26.9	>100	63%
2-P-19	RCP	24	1061.70	1061.21	42	0.01	0.013	1065.45	24.5	55.9	91.2	<10	228%
2-P-20	RCP	24	1060.96	1059.94	43	0.02	0.013	1065.43	28.0	61.7	100.1	<10	220%

DENOTES DEFICIENCIES



BASIN #2-CAMPUS CREEK

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-21	RCP	30	1059.82	1058.52	123	0.01	0.013	1064.83	45.0	61.6	100.0	<10	137%
2-P-22	RCP	30	1082.08	1079.29	140	0.02	0.013	1086.48	40.8	7.8	12.4	>100	19%
2-P-23	RCP	36	1072.03	1071.63	36	0.01	0.013	1077.19	63.1	12.3	19.8	>100	19%
2-P-24	RCP	48	1071.09	1071.11	74	0.00	0.013	1079.13	145.8	12.2	19.5	>100	8%
2-P-25	RCP	30	1077.17	1073.78	123	0.03	0.013	1080.17	27.0	48.0	75.5	<10	178%
2-P-26	RCP	30	1070.71	1065.36	171	0.03	0.013	1077.71	57.0	31.3	42.0	>100	55%
2-P-27	RCP	48	1104.48	1079.79	223	0.11	0.013	1115.85	188.0	14.0	19.4	>100	7%
2-P-28	RCP	60	1076.02	1075.59	50	0.01	0.013	1087.44	280.0	43.7	120.2	>100	16%
2-P-29	RCP	42	1063.74	1062.66	130	0.01	0.013	1070.81	105.0	73.5	172.3	<100	70%
2-P-30	RCB	(2) 72 X 49	1061.03	1060.96	12	0.01	0.013	1066.85	412.8	81.5	187.0	>100	20%
2-P-31	RCB	(2) 71 X 48	1057.21	1057.05	10	0.02	0.013	1065.10	549.8	93.9	192.3	>100	17%
2-P-32	CMP	24	1075.99	1074.83	20	0.06	0.025	1078.50	16.5	19.5	33.8	<10	118%
2-P-33	CMP	24	1077.60	1074.87	24	0.11	0.025	1080.91	23.1	30.8	53.4	<10	133%
2-P-34	CMP	24	1074.63	1072.42	109	0.02	0.025	1078.06	19.4	49.4	85.4	<10	255%
2-P-35	CMP	24	1073.85	1063.62	280	0.04	0.025	1077.85	23.5	3.3	5.6	>100	14%
2-P-36	CMAP	22 X 27	1072.22	1063.49	252	0.03	0.025	1075.61	22.4	55.4	95.7	<10	247%
2-P-37	CMP	27	1075.50	1070.08	192	0.03	0.025	1079.32	28.5	26.4	38.9	>10	93%
2-P-38	CMAP	40 X 24	1070.04	1068.11	192	0.01	0.025	1074.68	31.5	37.6	55.3	<10	119%
2-P-39	CMAP	(2)28 X 20	1068.03	1065.74	120	0.02	0.025	1071.81	38.1	55.7	82.6	<10	146%
2-P-40	CMAP	(2)44 X 26	1058.94	1057.36	159	0.01	0.025	1062.27	63.1	61.4	92.4	>10	97%

DENOTES DEFICIENCIES



BASIN #2-CAMPUS CREEK

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-41	RCB	(3)84 X 41	1054.17	1054.03	7	0.02	0.013	1062.05	873.8	227.6	365.5	>100	26%
2-P-42	RCB	(2)48 X 48	1051.14	1050.00	100	0.01	0.013	1058.69	357.6	330.9	699.3	>10	93%
2-P-43	RCP	24	1070.86	1062.04	344	0.03	0.013	1075.05	26.7	12.4	19.7	>100	46%
2-P-44	CMP	30	1061.86	1058.50	305	0.01	0.025	1065.77	26.0	17.4	28.0	<100	67%
2-P-45	CMP	30	1058.50	1050.00	297	0.03	0.025	1063.74	39.1	26.3	41.2	<100	67%
2-P-46	RCB	(2)48 X 48	1050.00	1049.00	222	0.00	0.013	1056.89	320.2	341.2	717.6	<10	107%
2-P-47	RCB	(2)48 X 48	1049.00	1047.30	122	0.01	0.013	1057.91	410.1	343.0	720.4	>10	84%
2-P-48	CMP	24	1051.44	1048.00	123	0.03	0.025	1058.46	27.3	11.0	16.9	>100	40%
2-P-49	CMAp	(2)70 X 48	1047.30	1045.76	279	0.01	0.025	1055.54	288.3	354.1	735.8	<10	123%
2-P-50	RCAP	20 X 30	1055.97	1055.17	139	0.01	0.013	1059.71	23.0	21.1	31.2	>10	92%
2-P-51	RCP	24	1055.00	1050.70	210	0.02	0.013	1058.84	25.0	23.2	34.6	>10	93%
2-P-52	CMAp	(2)70 X 48	1045.58	1042.22	182	0.02	0.013	1050.83	240.9	370.6	754.7	<10	154%
2-P-53	RCP	24	1062.81	1061.69	193	0.01	0.013	1078.41	49.1	10.0	14.6	>100	20%
2-P-54	RCP	24	1061.66	1060.79	91	0.01	0.013	1066.37	28.9	12.2	17.7	>100	42%
2-P-55	RCP	30	1060.73	1058.80	83	0.02	0.013	1063.95	29.9	17.0	24.8	>100	57%
2-P-56	RCP	24	1061.26	1060.06	45	0.03	0.013	1067.78	35.9	2.9	4.7	>100	8%
2-P-57	RCP	24	1059.82	1059.07	32	0.02	0.013	1065.6	33.3	60.7	95.6	<10	182%
2-P-58	CLAY	24	1060.87	1060.28	20	0.03	0.015	1066.85	34.0	58.2	91.6	<10	171%
2-P-59	RCP	32	1058.73	1054.89	287	0.01	0.013	1064.19	53.8	107.0	163.6	<10	199%
2-P-60	RCP	28	1060.00	1057.89	102	0.02	0.013	1066.63	48.4	33.7	49.6	<100	70%

DENOTES DEFICIENCIES



BASIN #2-CAMPUS CREEK

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-61	RCP	36	1054.80	1045.50	589	0.02	0.013	1062.77	86.7	113.6	173.3	<10	131%
2-P-62	CMAP	(2)72 X 46	1039.96	1039.23	230	0.00	0.025	1049.77	332.2	490.0	877.5	<10	148%
2-P-63	RCP	24	1047.43	1046.76	66	0.01	0.013	1051.68	26.9	15.4	23.7	>100	57%
2-P-64	RCP	24	1047.58	1046.80	30	0.03	0.013	1051.6	25.9	19.8	32.5	<100	76%
2-P-65	RCP	24	1046.78	1046.46	27	0.01	0.013	1051.64	29.6	21.6	35.2	<100	73%
2-P-66	RCP	24	1042.95	1039.30	171	0.02	0.013	1047.21	27.0	8.4	12.4	>100	31%
2-P-67	RCB	108 X 72	1037.20	1036.50	28	0.03	0.013	1046.49	615.3	499.6	906.7	<100	81%
2-P-68	CMP	24	1045.25	1038.59	197	0.03	0.025	1049.02	22.8	35.4	53.0	<10	155%
2-P-69	RCP	24	1039.43	1035.43	64	0.06	0.013	1043.51	26.4	17.8	29.0	<100	67%
2-P-70	BRIDGE	144 X 58	1033.86	1035.10	35	-0.04	0.013	1042	380.0	521.0	931.9	<10	137%
2-P-71	RCP	30	1105.15	1099.20	203	0.03	0.013	1116.94	78.3	3.3	6.1	>100	4%
2-P-72	RCP	30	1095.58	1094.58	67	0.01	0.013	1105.93	72.5	10.7	17.8	>100	15%
2-P-73	RCAP	45 X 28	1091.34	1090.98	73	0.00	0.013	1101.79	100.3	21.1	34.4	>100	21%
2-P-74	RCP	30	1090.87	1086.45	353	0.01	0.013	1101.69	64.7	20.7	33.9	>100	32%
2-P-75	RCAP	53 X 34	1085.67	1083.19	323	0.01	0.013	1095.13	122.6	24.3	38.3	>100	20%
2-P-76	RCB	84 X 60	1028.77	1028.60	50	0.00	0.013	1036.69	370.0	527.8	926.9	<10	143%

DENOTES DEFICIENCIES



BASIN #3-SOUTH CAMPUS

PIPE RESULTS

PIPE	TYPE	SIZE(WXH)(IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
3-P-01	RCB	48 x 24	1079.16	1076.20	53	0.06	0.013	1083.04	65.3	57.8	97.7	>10	89%
3-P-02	RCP	36	1076.14	1064.34	429	0.03	0.013	1082.71	76.0	61.2	103.3	>10	81%
3-P-03	RCP	36	1064.34	1062.34	189	0.01	0.013	1073.77	96.6	63.7	107.7	<100	66%
3-P-04	RCB	39 X 36	1062.34	1059.57	166	0.02	0.013	1070.05	120.6	82.5	132.6	<100	68%
3-P-05	RCP	24	1066.51	1064.81	202	0.01	0.013	1080.00	51.0	29.1	42.5	>100	57%
3-P-06	RCP	30	1062.14	1052.43	145	0.07	0.013	1077.34	90.8	44.4	66.7	>100	49%
3-P-07	RCP	36	1052.38	1041.00	486	0.02	0.013	1058.44	71.6	74.4	111.6	<10	104%
3-P-08	RCP	24	1047.99	1038.35	195	0.05	0.013	1056.45	42.2	7.8	12.6	>100	18%
3-P-09	RCP	24	1038.35	1032.38	179	0.03	0.013	1044.11	33.2	13.7	21.5	>100	41%
3-P-10	RCAP	30 X 19	1032.38	1028.96	322	0.01	0.013	1037.03	26.7	19.9	31.3	<100	75%
3-P-11	CPP	24	1025.05	1023.43	235	0.01	0.018	1029.35	19.2	13.7	21.3	<100	71%
3-P-12	CPP	30	1023.43	1023.23	118	0.00	0.018	1029.39	40.8	17.4	26.5	>100	43%
3-P-13	RCP	24	1032.53	1031.95	69	0.01	0.013	1042.07	45.1	21.6	32.3	>100	48%
3-P-14	RCP	30	1031.40	1031.65	126	0.00	0.013	1040.23	59.8	21.0	31.4	>100	35%
3-P-15	RCP	30	1031.58	1031.12	93	0.00	0.013	1040.63	66.8	26.6	40.2	>100	40%
3-P-16	RCP	24	1031.00	1030.50	109	0.00	0.013	1036.29	29.4	26.4	39.9	>10	90%
3-P-17	RCP	24	1030.40	1029.88	123	0.00	0.013	1035.10	26.4	27.7	41.9	<10	105%
3-P-18	RCP	24	1098.97	1097.81	34	0.03	0.013	1101.88	19.9	10.9	17.3	>100	55%
3-P-19	RCAP	30 X 19	1097.92	1097.11	137	0.01	0.013	1100.90	20.8	17.6	29.1	>10	85%
3-P-20	RCAP	28 X 18	1097.16	1096.91	115	0.00	0.013	1100.18	15.9	20.1	32.9	<10	126%


 DENOTES DEFICIENCIES



BASIN #3-SOUTH CAMPUS

PIPE RESULTS

PIPE	TYPE	SIZE(WXH)(IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
3-P-21	RCAP	34 X 24	1096.70	1096.54	65	0.00	0.013	1101.65	40.9	29.9	47.5	<100	73%
3-P-22	CMP	24	1096.45	1093.39	430	0.01	0.025	1101.14	13.5	29.1	45.8	<10	216%
3-P-23	CMP	24	1051.59	1049.11	235	0.01	0.025	1055.77	16.0	18.6	27.0	<10	116%
3-P-24	CMP	30	1048.99	1048.05	103	0.01	0.025	1053.68	32.5	27.2	39.4	>10	84%
3-P-25	CMP	30	1047.48	1047.30	30	0.01	0.025	1052.87	44.5	35.7	51.6	>10	80%
3-P-26	RCB	72 X 36	1058.98	1047.25	510	0.02	0.013	1064.43	168.9	30.3	45.9	>100	18%
3-P-27	RCB	60 X 48	1047.25	1047.17	42	0.00	0.013	1053.49	186.1	54.6	82.0	>100	29%
3-P-28	RCAP	43x68	1063.93	1059.08	260	0.02	0.013	1071.57	172.5	30.4	46.3	>100	18%

 DENOTES DEFICIENCIES



BASIN #2-CAMPUS CREEK

DETENTION RESERVOIRS

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION	Q10 STORAGE (AC-FT)	Q10 ELEV	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)
2-R-01	32.1	46.5	1087.50	0.8	1086.50	1.3	1087.10	14.4	24.5
2-R-02	70.4	113.0	1078.50	1.4	1074.00	2.6	1075.30	31.3	42.0
2-R-03	115.1	182.8	1090.90	4.9	1088.80	6.0	1090.00	43.7	120.3
2-R-04	38.5	71.9	1116.90	0.9	1112.00	2.0	1113.80	14.0	19.4
2-R-05	9.0	16.1	1095.90	0.1	1090.90	0.2	1092.40	6.7	14.8
2-R-06	497.5	810.1	1058.69	7.0	1058.10	12.6	1059.50	330.9	699.3
2-R-07	25.9	37.7	1107.30	0.1	1106.40	0.1	1107.00	22.0	33.7
2-R-08	16.1	30.1	1092.50	0.0	1089.90	0.1	1091.50	15.0	21.4
2-R-09	19.8	29.8	1091.50	0.2	1089.10	0.3	1089.90	12.5	17.5
2-R-10	516.1	892.1	1051.70	2.7	1051.70	4.3	1052.50	495.1	883.0
2-R-11	525.4	920.6	1046.49	2.5	1045.20	5.8	1047.70	499.7	906.7
2-R-12	522.8	935.9	1042.04	1.5	1042.70	2.6	1044.00	521.2	932.5
2-R-13	76.2	128.2	1070.00	1.4	1066.80	2.2	1068.10	58.7	101.8
2-R-14	541.5	952.9	1036.69	3.0	1037.60	6.4	1039.00	527.8	926.9


 DENOTES DEFICIENCIES



BASIN #3-SOUTH CAMPUS

DETENTION RESERVOIRS

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION	Q10 STORAGE (AC-FT)	Q10 ELEV	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)
3-R-01	85.1	136.8	1092.50	3.1	1089.80	5.3	1091.50	16.0	44.4

 DENOTES DEFICIENCIES




APPENDIX B



**BASIN #1-KANSAS STATE ATHLETICS
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
1-P-01	RCAP	(2)52 X 34	1096.77	1095.13	75	0.02	0.013	1101.12	190.4	139.9	210.7	<100	73%
1-P-02	RCP	(2)30	1091.39	1084.19	287	0.03	0.013	1095.34	74.7	61.9	90.4	<10	83%
1-P-03	RCB	48 X 48	1084.02	1073.29	116	0.09	0.013	1091.36	177.8	155.1	234.0	<100	87%
1-P-04	RCB	48 X 36	1074.79	1073.64	427	0.00	0.013	1079.48	84.5	84.8	127.9	10	100%
1-P-05	RCB	36 X 30	1075.38	1074.84	216	0.00	0.013	1083.69	83.9	22.1	33.5	>100	26%
1-P-06	RCP	30	1110.1	1074.5	1123	0.03	0.013	1118.43	63.7	37.5	55.0	<10	59%
1-P-07	RCP	24	1117.16	1111.52	861	0.01	0.013	1120.41	19.3	15.8	24.9	<100	82%
1-P-08	RCP	30	1111.36	1108.05	1206	0.00	0.013	1115.48	25.6	24.1	39.0	<100	94%
1-P-09	RCP	36	1099.09	1096.9	85	0.03	0.013	1102.04	31.2	28.5	47.1	<10	91%

 DENOTES IMPROVEMENT



**BASIN #2-CAMPUS CREEK
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-01	Replaced by 36" Rec Field Diversion to Bob Dole Hall Detention (2-R-02)												
2-P-02	RCP	42	1077.85	1077.46	57	0.01	0.013	1082.92	79.8	28.7	43.8	>100	36%
2-P-03	RCP	36	1077.46	1077.24	39	0.01	0.013	1082.92	65.9	39.1	55.5	>100	59%
2-P-04	RCP	(2) 30"	1077.29	1076.56	157	0.00	0.013	1081.14	70.0	52.7	77.0	<100	75%
2-P-05	RCP	(2) 24"	1076.51	1074.48	437	0.00	0.013	1080.16	37.9	31.5	45.7	>10	83%
2-P-06	RCP	42	1074.40	1073.87	100	0.01	0.013	1080.51	93.7	64.3	93.2	100	69%
2-P-07	RCAP	52 X 34	1072.40	1071.41	99	0.01	0.013	1078.63	95.2	70.6	102.8	<100	74%
2-P-08	RCB	54 X 42	1071.40	1067.00	46	0.10	0.013	1075.88	96.2	74.5	108.5	>10	77%
2-P-09	RCB	54 X 42	1063.50	1061.71	167	0.01	0.013	1067.92	96.2	87.5	128.7	>10	91%
2-P-10	RCAP	52 X 34	1061.71	1060.88	151	0.01	0.013	1067.76	92.9	92.0	135.7	10	99%
2-P-11	RCP	27	1064.59	1064.40	15	0.01	0.013	1067.90	26.9	5.6	8.1	>100	21%
2-P-12	RCAP	52 X 34	1061.57	1060.99	40	0.01	0.013	1067.80	43.4	34.9	56.4	>10	80%
2-P-13	RCAP	60 X 36	1061.13	1060.50	67	0.01	0.013	1067.61	116.6	37.8	60.5	>100	32%
2-P-14	RCB	48 X 48	1060.88	1059.59	340	0.00	0.013	1067.29	144.0	125.5	190.0	>10	87%
2-P-15	RCB	120 X 36	1059.59	1057.09	50	0.05	0.013	1063.22	152.5	136.6	206.8	>10	90%
2-P-16	RCB	60 X 36	1059.25	1058.15	165	0.01	0.013	1070.01	232.1	58.7	101.8	>100	25%
2-P-17	RCP	24	1059.43	1059.15	42	0.01	0.013	1063.42	25.7	13.2	20.7	>100	51%
2-P-18	RCP	24	1059.11	1058.97	35	0.00	0.013	1063.50	27.5	17.2	26.9	>100	63%
2-P-19	RCAP	60 X 38	1061.70	1061.21	42	0.01	0.013	1065.45	59.2	55.9	91.2	>10	94%
2-P-20	RCAP	60 X 38	1060.96	1059.94	43	0.02	0.013	1065.43	78.5	61.7	100.1	>10	79%

DENOTES IMPROVEMENT



**BASIN #2-CAMPUS CREEK
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-21	RCAP	60 X 38	1059.82	1058.52	123	0.01	0.013	1064.83	93.1	61.6	100.0	>10	66%
2-P-22	RCP	30	1082.08	1079.29	140	0.02	0.013	1086.48	40.8	7.8	12.4	>100	19%
2-P-23	RCP	36	1072.03	1071.63	36	0.01	0.013	1077.19	63.1	12.3	19.8	>100	19%
2-P-24	RCP	48	1071.09	1071.11	74	0.00	0.013	1079.13	145.8	12.2	19.5	>100	8%
2-P-25	RCP	30 & 36	1077.17	1073.78	123	0.03	0.013	1080.17	82.2	80.2	142.4	<10	98%
2-P-26	RCP	30	1070.71	1065.36	171	0.03	0.013	1077.71	57.0	44.9	61.0	<100	79%
2-P-27	RCP	48	1104.48	1079.79	223	0.11	0.013	1115.85	188.0	14.0	19.4	>100	7%
2-P-28	RCP	60	1076.02	1075.59	50	0.01	0.013	1087.44	280.0	43.7	120.2	>100	16%
2-P-29	Replaced by Vet Med RCB (see below)												
2-P-30	Replaced by Vet Med RCB (see below)												
2-P-31	Replaced by Vet Med RCB (see below)												
2-P-32	RCAP	38 X 24	1075.99	1074.83	20	0.06	0.013	1078.50	20.4	19.5	33.8	>10	96%
2-P-33	RCAP	38 X 24	1077.60	1074.87	24	0.11	0.013	1080.91	31.1	30.8	53.4	>10	99%
2-P-34	RCP	(2) 30	1074.63	1072.42	109	0.02	0.013	1078.06	65.4	49.4	85.4	>10	76%
2-P-35	CMP	24	1073.85	1063.62	280	0.04	0.025	1077.85	23.5	3.3	5.6	>100	14%
2-P-36	RCP	36	1070.00	1056.92	350	0.03	0.013	1075.61	67.6	55.4	95.7	>10	82%
2-P-37	CMP	27	1075.50	1070.08	192	0.03	0.025	1079.32	28.5	26.4	38.9	>10	93%
2-P-38	RCAP	38 X 24	1070.04	1068.11	192	0.01	0.013	1074.68	42.5	37.6	55.3	>10	88%
2-P-39	RCAP	(2) 38 X 24	1068.03	1065.74	120	0.02	0.013	1071.81	71.8	55.7	82.6	>10	78%
2-P-40	RCP	36	1057.00	1055.50	159	0.01	0.013	1062.27	63.1	30.7	47.7	>100	50%

DENOTES IMPROVEMENT



**BASIN #2-CAMPUS CREEK
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-41	RCB	(3)84 X 41	1054.17	1054.03	7	0.02	0.013	1062.05	873.8	201.7	325.1	>100	23%
2-P-42	RCB	(2)60 X 48	1051.00	1049.75	250	0.01	0.013	1060.00	539.5	317.4	473.7	>100	59%
2-P-43	RCP	24	1070.86	1062.04	344	0.03	0.013	1075.05	26.7	12.4	19.7	>100	46%
2-P-44	CMP	30	1061.86	1058.50	305	0.01	0.025	1065.77	26.0	17.4	28.0	<100	67%
2-P-45	CMP	30	1058.50	1050.00	467	0.03	0.025	1063.74	39.1	26.3	41.2	<100	67%
2-P-46	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3:1 side slopes												
2-P-47	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3:1 side slopes												
2-P-48	CMP/RCP	24	1051.44	1048.00	273	0.03	0.025	1058.46	27.3	11.0	16.9	>100	40%
2-P-49	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3:1 side slopes												
2-P-50	RCAP	20 X 30	1055.97	1055.17	139	0.01	0.013	1059.71	23.0	21.1	31.2	>10	92%
2-P-51	RCP	24	1055.00	1050.70	210	0.02	0.013	1058.84	25.0	23.2	34.6	>10	93%
2-P-52	CMP	(2)70X48	1045.58	1042.22	182	0.02	0.013	1050.83	240.9	32.2	47.0	>100	10%
2-P-53	RCP	24	1062.81	1061.69	193	0.01	0.013	1078.41	49.1	10.0	14.6	>100	20%
2-P-54	RCP	24	1061.66	1060.79	91	0.01	0.013	1066.37	28.9	12.2	17.7	>100	42%
2-P-55	RCP	30	1060.73	1058.80	83	0.02	0.013	1063.95	29.9	17.0	24.8	>100	57%
2-P-56	RCP	24	1061.26	1060.06	45	0.03	0.013	1067.78	35.9	2.9	4.7	>100	8%
2-P-57	RCP	36	1059.82	1059.07	32	0.02	0.013	1065.60	69.1	60.7	95.6	>10	88%
2-P-58	RCP	36	1060.87	1060.28	20	0.03	0.013	1066.85	71.0	58.2	91.6	>10	82%
2-P-59	RCP	54	1058.73	1054.89	287	0.01	0.013	1064.19	119.3	107.0	163.6	>10	90%
2-P-60	RCP	28	1060.00	1057.89	102	0.02	0.013	1066.63	48.4	33.7	49.6	<100	70%

DENOTES IMPROVEMENT



**BASIN #2-CAMPUS CREEK
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS
 PIPE RESULTS**


PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE (FT/FT)	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-61	RCP	48	1054.80	1045.50	589	0.02	0.013	1062.77	145.3	113.6	173.3	>10	78%
2-P-62	RCB	(2)5X5	1039.96	1039.23	230	0.00	0.013	1051.10	694.0	492.3	663.9	>100	71%
2-P-63	RCP	24	1047.43	1046.76	66	0.01	0.013	1051.68	26.9	15.5	23.7	>100	58%
2-P-64	RCP	24	1047.58	1046.80	30	0.03	0.013	1051.60	25.9	19.8	32.5	<100	76%
2-P-65	RCP	24	1046.78	1046.46	27	0.01	0.013	1051.64	29.6	21.6	35.2	<100	73%
2-P-66	RCP	24	1042.95	1039.30	171	0.02	0.013	1047.21	27.0	8.4	12.4	>100	31%
2-P-67	RCB	(2)6X5	1037.20	1036.50	28	0.03	0.013	1046.49	741.7	529.7	705.2	>100	71%
2-P-68	RCP	30	1045.25	1038.59	197	0.03	0.013	1049.02	36.0	35.4	53.0	>10	98%
2-P-69	RCP	24	1039.43	1035.43	64	0.06	0.013	1043.51	26.4	17.8	29.0	<100	67%
2-P-70	RCB	(2)10X6	1035.15	1035.10	35	0.00	0.013	1042.00	788.0	561.5	741.1	>100	71%
2-P-71	RCP	30	1105.15	1099.20	203	0.03	0.013	1116.94	78.3	3.3	6.1	>100	4%
2-P-72	RCP	30	1095.58	1094.58	67	0.01	0.013	1105.93	72.5	10.7	17.8	>100	15%
2-P-73	RCAP	45 X 28	1091.34	1090.98	73	0.00	0.013	1101.79	100.3	21.1	34.4	>100	21%
2-P-74	RCP	30	1090.87	1086.45	353	0.01	0.013	1101.69	64.7	20.7	33.9	>100	32%
2-P-75	RCAP	53 X 34	1085.67	1083.19	323	0.01	0.013	1095.13	122.6	24.3	38.3	>100	20%
2-P-76	RCB	(2)96x60	1028.77	1028.60	50	0.00	0.013	1037.00	586.5	564.7	774.6	>10	96%
Rec Field Diversion	RCP	36	1079.00	1074.80	950	0.01	0.013	1084.55	55.2	53.1	99.0	<100	96%
Tennis Ct Diversion	RCP	30	1076.51	1072.40	610	0.01	0.013	1080.16	40.1	32.8	47.6	>10	82%
New Vet Med	RCB	(2)60X60	1065.36	1059.81	1110	.01	.013	1072.40	460.6	98.3	207.7	>100	21%



**BASIN #3-SOUTH CAMPUS
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
3-P-01	RCB	48 x 24	1079.16	1076.2	53	0.06	0.013	1083.04	65.3	57.8	97.7	>10	89%
3-P-02	RCP	36	1076.14	1064.34	429	0.03	0.013	1082.71	76	61.2	103.3	>10	81%
3-P-03	RCP	36	1064.34	1062.34	189	0.01	0.013	1073.77	96.6	63.7	107.7	<100	66%
3-P-04	RCB	39 X 36	1062.34	1059.57	166	0.02	0.013	1070.05	120.6	82.5	132.6	<100	68%
3-P-05	RCP	24	1066.51	1064.81	202	0.01	0.013	1080	51	29.1	42.5	>100	57%
3-P-06	RCP	30	1062.14	1052.43	145	0.07	0.013	1077.34	90.8	44.4	66.7	>100	49%
3-P-07	RCP	42	1052.38	1041	486	0.02	0.013	1058.44	93.5	74.4	111.6	>10	80%
3-P-08	RCP	24	1047.99	1038.35	195	0.05	0.013	1056.45	42.2	7.8	12.6	>100	18%
3-P-09	RCP	24	1038.35	1032.38	179	0.03	0.013	1044.11	33.2	13.7	21.5	>100	41%
3-P-10	RCAP	30 X 19	1032.38	1028.96	322	0.01	0.013	1037.03	26.7	19.9	31.3	<100	75%
3-P-11	CPP	24	1025.05	1023.43	235	0.01	0.018	1029.35	19.2	10.3	16.4	<100	54%
3-P-12	CPP	30	1023.43	1023.23	118	0.00	0.018	1029.39	40.8	16.2	24.9	>100	40%
3-P-13	RCP	24	1032.53	1031.95	69	0.01	0.013	1042.07	45.12	21.6	32.3	>100	48%
3-P-14	RCP	30	1031.4	1031.65	126	0.00	0.013	1040.23	59.8	21.0	31.4	>100	35%
3-P-15	RCP	30	1031.58	1031.12	93	0.00	0.013	1040.63	66.8	26.6	40.2	>100	40%
3-P-16	RCP	24	1031	1030.5	109	0.00	0.013	1036.29	29.4	26.4	39.9	>10	90%
3-P-17	RCP	30	1030.4	1029.88	123	0.00	0.013	1035.1	41.3	27.7	41.9	>10	67%
3-P-18	RCP	24	1098.97	1097.81	34	0.03	0.013	1101.88	19.9	10.9	17.3	>100	55%
3-P-19	RCAP	30 X 19	1097.92	1097.11	137	0.01	0.013	1100.9	20.8	17.6	29.1	>10	85%
3-P-20	RCAP	38 X 24	1097.16	1096.91	115	0.00	0.013	1100.18	23.2	20.1	32.9	>10	87%


 DENOTES IMPROVEMENT



**BASIN #3-SOUTH CAMPUS
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

PIPE RESULTS

PIPE	TYPE	SIZE(WXH) (IN)	INV IN	INV OUT	LENGTH (FT)	SLOPE	MANNINGS	OVERFLOW ELEVATION	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
3-P-21	RCAP	34 X 24	1096.7	1096.54	65	0.00	0.013	1101.65	40.9	29.9	47.5	<100	73%
3-P-22	RCP	30	1096.45	1093.39	430	0.01	0.013	1101.14	39.4	29.1	45.8	>10	74%
3-P-23	RCP	24	1051.59	1049.11	235	0.01	0.013	1055.77	26.2	18.6	27.0	>10	71%
3-P-24	CMP	30	1048.99	1048.05	103	0.01	0.025	1053.68	32.5	27.2	39.4	>10	84%
3-P-25	CMP	30	1047.48	1047.3	30	0.01	0.025	1052.87	44.5	35.7	51.6	>10	80%
3-P-26	RCB	72 X 36	1058.98	1047.25	510	0.02	0.013	1064.43	168.9	30.3	45.9	>100	18%
3-P-27	RCB	60 X 48	1047.25	1047.17	42	0.00	0.013	1053.49	186.1	54.6	82.0	>100	29%
3-P-28	RCAP	43x68	1063.93	1059.08	260	0.02	0.013	1071.57	172.5	30.4	46.3	>100	18%

 DENOTES IMPROVEMENT



**BASIN #2-CAMPUS CREEK
 EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

RESERVOIR RESULTS

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION	Q10 STORAGE (AC-FT)	Q10 ELEV	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)
2-R-01	32.0	46.4	1087.50	0.8	1086.50	1.3	1087.10	14.4	24.4
2-R-02	95.9	167.0	1078.50	3.0	1075.70	6.6	1078.50	44.9	61.0
2-R-03	115.1	182.8	1090.90	4.9	1088.80	6.0	1090.00	43.7	120.3
2-R-04	38.5	71.9	1116.90	0.9	1112.00	2.0	1113.80	14.0	19.4
2-R-05	9.0	16.1	1095.90	0.1	1090.90	0.2	1092.40	6.7	14.8
2-R-06	449.9	722.1	1058.69	8.1	1056.20	18.2	1058.50	290.6	445.8
2-R-07	25.9	37.7	1107.30	0.1	1106.40	0.1	1107.00	22.0	33.7
2-R-08	16.0	29.9	1092.50	0.0	1089.90	0.1	1091.40	14.9	21.3
2-R-09	19.8	29.8	1091.50	0.2	1089.10	0.3	1089.90	12.5	17.5
2-R-10	466.5	710.3	1051.20	1.1	1046.90	3.4	1050.20	458.6	639.3
2-R-11	503.4	708.0	1046.49	1.5	1043.80	3.0	1045.70	494.5	683.9
2-R-12	528.1	723.0	1042.04	0.4	1040.00	0.7	1041.20	527.6	722.9
2-R-13	76.2	128.2	1070.00	1.4	1066.80	2.2	1068.10	58.7	101.8
2-R-14	549.5	796.9	1036.69	4.8	1034.40	7.5	1036.00	532.4	757.4
Call Hall	55.7	82.6	1062.00	1.1	1059.70	1.6	1060.60	27.9	42.8

 DENOTES IMPROVEMENT




**BASIN #3-SOUTH CAMPUS
EXISTING SYSTEM WITH PROPOSED IMPROVEMENTS**

RESERVOIR RESULTS

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION	Q10 STORAGE (AC-FT)	Q10 ELEV	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)
3-R-01	85.1	136.8	1092.50	3.1	1089.80	5.3	1091.50	16.0	44.4



 DENOTES IMPROVEMENT

APPENDIX C



ENGINEER'S OPINION OF PROBABLE COST

PROJECT 1: REC CENTER DIVERSION AND PAT ROBERTS HALL DETENTION					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 15,000.00	\$ 15,000.00
2	Seeding	1	Lump Sum	\$ 7,500.00	\$ 7,500.00
3	Erosion Control	1	Lump Sum	\$ 4,000.00	\$ 4,000.00
4	Detention Expansion	1	Lump Sum	\$ 20,000.00	\$ 20,000.00
5	Emergency Spillway	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
6	Remove and Replace Pavement	46	SY	\$ 100.00	\$ 4,600.00
7	Remove and Replace Sidewalk	25	SY	\$ 80.00	\$ 2,000.00
8	Remove and Replace Curb & Gutter	20	Lin. Ft.	\$ 25.00	\$ 500.00
9	Flowable Fill	65	CY	\$ 80.00	\$ 5,200.00
10	Inlet Structure	1	Each	\$ 7,500.00	\$ 7,500.00
11	Headwall	1	Each	\$ 7,500.00	\$ 7,500.00
12	36" RCP	950	Lin. Ft.	\$ 95.00	\$ 90,250.00
13	Fencing	10	Lin. Ft.	\$ 50.00	\$ 500.00
Subtotal					\$ 169,550.00
Construction Contingency (15%)					\$ 25,432.50
Design Engineering, Construction Admin. (25%)					\$ 42,387.50
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 237,370.00

PROJECT 2: TENNIS COURT DIVERSION					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization		Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding		Lump Sum	\$ 5,000.00	\$ 5,000.00
3	Erosion Control		Lump Sum	\$ 4,000.00	\$ 4,000.00
4	Remove and Replace Sidewalk	10	SY	\$ 80.00	\$ 800.00
5	Inlet Structure	1	Each	\$ 7,500.00	\$ 7,500.00
6	30" RCP	610	Lin. Ft.	\$ 70.00	\$ 42,700.00
7	Connection to Existing Storm Sewer	1	Lump Sum	\$ 7,500.00	\$ 7,500.00
Subtotal					\$ 77,500.00
Construction Contingency (15%)					\$ 11,625.00
Design Engineering, Construction Admin. (25%)					\$ 19,375.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 108,500.00

PROJECT 3: MOSIER HALL DETENTION FACILITY EXPANSION					
Engineer's Opinion of Probable Cost					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 25,000.00	\$ 25,000.00
2	Seeding	1	Lump Sum	\$ 15,000.00	\$ 15,000.00
3	Clearing and Grubbing	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Erosion Control	1	Lump Sum	\$ 12,000.00	\$ 12,000.00
5	Detention Expansion Earthwork	16,000	CY	\$ 10.00	\$ 160,000.00
6	Pilot Channel	1225	SY	\$ 35.00	\$ 42,875.00
Subtotal					\$ 257,375.00
Construction Contingency (15%)					\$ 38,606.25
Design Engineering, Construction Admin. (25%)					\$ 64,343.75
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 360,325.00

ENGINEER'S OPINION OF PROBABLE COST

PROJECT 4: NEW CALL HALL DETENTION					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 20,000.00	\$ 20,000.00
2	Seeding	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
3	Erosion Control	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
4	Detention Expansion Earthwork	3,000	CY	\$ 15.00	\$ 45,000.00
6	Pilot Channel	175	SY	\$ 35.00	\$ 6,125.00
7	Remove and Replace Pavement	280	SY	\$ 100.00	\$ 28,000.00
8	Remove and Replace Sidewalk	10	SY	\$ 80.00	\$ 800.00
9	Remove and Replace Curb & Gutter	40	Lin. Ft.	\$ 25.00	\$ 1,000.00
10	Flowable Fill	375	CY	\$ 80.00	\$ 30,000.00
11	Drop Manhole	1	Each	\$ 7,500.00	\$ 7,500.00
13	36" RCP (2-P-40)	159	Lin. Ft.	\$ 95.00	\$ 15,105.00
14	38" x 24" RCAP (2-P-38 & 2-P-39)	432	Lin. Ft.	\$ 80.00	\$ 34,560.00
Subtotal					\$ 203,090.00
Construction Contingency (15%)					\$ 30,463.50
Design Engineering, Construction Admin. (25%)					\$ 50,772.50
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 284,326.00

PROJECT 5: MID CAMPUS DRIVE OPEN CHANNEL					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 20,000.00	\$ 20,000.00
2	Seeding	1	Lump Sum	\$ 20,000.00	\$ 20,000.00
3	Erosion Control	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
4	Clearing and Grubbing	1	Lump Sum	\$ 40,000.00	\$ 40,000.00
5	Open Channel Earthwork	5,000	CY	\$ 15.00	\$ 75,000.00
6	Aggregate Ditch Lining (6")	1,900	Tons	\$ 50.00	\$ 95,000.00
7	Removal of Existing Structures and Pavement	1	Lump Sum	\$ 65,000.00	\$ 65,000.00
8	30" RCP (Extend 2-P-45)	170	Lin. Ft.	\$ 70.00	\$ 11,900.00
9	24" RCP (Extend 2-P-48)	150	Lin. Ft.	\$ 45.00	\$ 6,750.00
10	2-5'x4' RCB (100' Long) (2-P-42)	1	Lump Sum	\$ 80,000.00	\$ 80,000.00
11	Remove and Replace Pavement	80	SY	\$ 100.00	\$ 8,000.00
12	Remove and Replace Sidewalk	25	SY	\$ 80.00	\$ 2,000.00
13	Remove and Replace Curb & Gutter	55	Lin. Ft.	\$ 25.00	\$ 1,375.00
Subtotal					\$ 435,025.00
Construction Contingency (15%)					\$ 65,253.75
Design Engineering, Construction Admin. (25%)					\$ 108,756.25
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 609,035.00

PROJECT 6: CLAFLIN RD STRUCTURE REPLACEMENT					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 15,000.00	\$ 15,000.00
2	Seeding	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Clearing and Grubbing	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
5	Removal of Existing Structures	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
6	2-5'x5' RCB (230' Long) (2-P-62)	1	Lump Sum	\$ 175,000.00	\$ 175,000.00
7	Remove and Replace Pavement	140	SY	\$ 100.00	\$ 14,000.00
8	Remove and Replace Sidewalk	50	SY	\$ 80.00	\$ 4,000.00
9	Remove and Replace Curb & Gutter	50	Lin. Ft.	\$ 25.00	\$ 1,250.00
Subtotal					\$ 226,750.00
Construction Contingency (15%)					\$ 34,012.50
Design Engineering, Construction Admin. (25%)					\$ 56,687.50
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 317,450.00

ENGINEER'S OPINION OF PROBABLE COST

PROJECT 7: OLD CLAFLIN RD STRUCTURE REPLACEMENT					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
3	Erosion Control	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
4	Removal of Existing Structures	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
5	2-6'x5' RCB (28' Long) (2-P-67)	1	Lump Sum	\$ 35,000.00	\$ 35,000.00
6	Remove and Replace Pavement	70	SY	\$ 100.00	\$ 7,000.00
Subtotal					\$ 66,000.00
Construction Contingency (15%)					\$ 9,900.00
Design Engineering, Construction Admin. (25%)					\$ 16,500.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 92,400.00

PROJECT 8: PETTICOAT LN STRUCTURE REPLACEMENT					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
3	Erosion Control	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
4	Removal of Existing Structures	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
5	2-10'x6' RCB (35' Long) (2-P-70)	1	Lump Sum	\$ 65,000.00	\$ 65,000.00
6	Remove and Replace Pavement	80	SY	\$ 100.00	\$ 8,000.00
7	Remove and Replace Sidewalk	20	SY	\$ 80.00	\$ 1,600.00
8	Remove and Replace Curb & Gutter	60	Lin. Ft.	\$ 25.00	\$ 1,500.00
Subtotal					\$ 100,100.00
Construction Contingency (15%)					\$ 15,015.00
Design Engineering, Construction Admin. (25%)					\$ 25,025.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 140,140.00

PROJECT 9: CAMPUS CREEK RD DETENTION EXPANSION					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 25,000.00	\$ 25,000.00
2	Seeding	1	Lump Sum	\$ 20,000.00	\$ 20,000.00
3	Clearing and Grubbing	1	Lump Sum	\$ 75,000.00	\$ 75,000.00
4	Erosion Control	1	Lump Sum	\$ 12,000.00	\$ 12,000.00
5	Detention Expansion Earthwork	12,000	CY	\$ 10.00	\$ 120,000.00
6	Pilot Channel	1000	SY	\$ 30.00	\$ 30,000.00
7	Removal of Existing Concrete Flume	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
Subtotal					\$ 287,000.00
Construction Contingency (15%)					\$ 43,050.00
Design Engineering, Construction Admin. (25%)					\$ 71,750.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 401,800.00

PROJECT 10: VETERINARY MEDICINE RCB					
No	Description	Quantity	Units	Unit Price	Total Price
1	Mobilization	1	Lump Sum	\$ 25,000.00	\$ 25,000.00
2	Seeding	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
3	Clearing and Grubbing	1	Lump Sum	\$ 15,000.00	\$ 15,000.00
4	Removal of Existing Structures	3	Each	\$ 1,000.00	\$ 3,000.00
5	Erosion Control	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
6	Detention Tie-in Earthwork	500	CY	\$ 10.00	\$ 5,000.00
7	2-5'x5' RCB (1,110' Long)	1	Lump Sum	\$ 555,000.00	\$ 555,000.00
8	Connect to Existing (60" RCP & 30" RCP)	2	Each	\$ 1,500.00	\$ 3,000.00
Subtotal					\$ 613,000.00
Construction Contingency (15%)					\$ 91,950.00
Design Engineering, Construction Admin. (25%)					\$ 153,250.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 858,200.00

ENGINEER'S OPINION OF PROBABLE COST

PROJECT 11a: UPSIZING OTHER DEFICIENT PIPES					
Kansas State Athletics Basin					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 15,000.00	\$ 15,000.00
2	Seeding	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Clearing and Grubbing	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
5	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
6	Area Inlet	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
7	2 - 30" RCP (1-P-02)	574	Lin. Ft.	\$ 70.00	\$ 40,180.00
8	30" RCP (1-P-06)	1123	Lin. Ft.	\$ 70.00	\$ 78,610.00
9	36" RCP (1-P-09)	85	Lin. Ft.	\$ 95.00	\$ 8,075.00
10	Remove and Replace Pavement	95	SY	\$ 100.00	\$ 9,500.00
11	Remove and Replace Sidewalk	700	SY	\$ 80.00	\$ 56,000.00
12	Remove and Replace Curb & Gutter	30	Lin. Ft.	\$ 25.00	\$ 750.00
13	Flowable Fill	125	CY	\$ 80.00	\$ 10,000.00
Subtotal					\$ 233,115.00
Construction Contingency (15%)					\$ 34,967.25
Design Engineering, Construction Admin. (25%)					\$ 58,278.75
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 326,361.00

PROJECT 11b: UPSIZING OTHER DEFICIENT PIPES					
Campus Creek Basin - Rec Complex/Denison Corridor					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 15,000.00	\$ 15,000.00
2	Seeding	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Clearing and Grubbing	1	Lump Sum	\$ 1,000.00	\$ 1,000.00
5	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
6	5' x 3' RCB (2-P-08)	46	Lin. Ft.	\$ 275.00	\$ 12,650.00
7	5' x 3' RCB (2-P-09)	167	Lin. Ft.	\$ 275.00	\$ 45,925.00
8	9' x 3' RCB (2-P-15)	50	Lin. Ft.	\$ 425.00	\$ 21,250.00
9	Remove and Replace Pavement	197	SY	\$ 100.00	\$ 19,700.00
10	Remove and Replace Sidewalk	18	SY	\$ 80.00	\$ 1,440.00
11	Remove and Replace Curb & Gutter	167	Lin. Ft.	\$ 25.00	\$ 4,175.00
12	Flowable Fill	88	CY	\$ 80.00	\$ 7,040.00
Subtotal					\$ 138,180.00
Construction Contingency (15%)					\$ 20,727.00
Design Engineering, Construction Admin. (25%)					\$ 34,545.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 193,452.00

PROJECT 11c: UPSIZING OTHER DEFICIENT PIPES					
Campus Creek Basin - Denison Avenue/Jardine Drive Intersection					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
5	60"x38" RCAP (2-P-19)	42	Lin. Ft.	\$ 150.00	\$ 6,300.00
6	60"x38" RCAP (2-P-20)	43	Lin. Ft.	\$ 150.00	\$ 6,450.00
7	60"x38" RCAP (2-P-21)	123	Lin. Ft.	\$ 150.00	\$ 18,450.00
8	Remove and Replace Pavement	92	SY	\$ 100.00	\$ 9,200.00
9	Remove and Replace Sidewalk	57	SY	\$ 80.00	\$ 4,560.00
10	Flowable Fill	42	CY	\$ 80.00	\$ 3,360.00
Subtotal					\$ 68,320.00
Construction Contingency (15%)					\$ 10,248.00
Design Engineering, Construction Admin. (25%)					\$ 17,080.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 95,648.00

ENGINEER'S OPINION OF PROBABLE COST

PROJECT 11d: UPSIZING OTHER DEFICIENT PIPES					
Campus Creek Basin - Serum Plant Road/Jardine Drive Intersection					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
5	38"x24" RCAP (2-P-32)	20	Lin. Ft.	\$ 80.00	\$ 1,600.00
6	38"x24" RCAP (2-P-33)	24	Lin. Ft.	\$ 80.00	\$ 1,920.00
7	2 - 30" RCP (2-P-34)	218	Lin. Ft.	\$ 70.00	\$ 15,260.00
8	36" RCP (2-P-36)	350	Lin. Ft.	\$ 95.00	\$ 33,250.00
9	Remove and Replace Pavement	80	SY	\$ 100.00	\$ 8,000.00
10	Remove and Replace Sidewalk	62	SY	\$ 80.00	\$ 4,960.00
11	Remove and Replace Curb & Gutter	110	Lin. Ft.	\$ 25.00	\$ 2,750.00
12	Flowable Fill	26	CY	\$ 80.00	\$ 2,080.00
Subtotal					\$ 89,820.00
Construction Contingency (15%)					\$ 13,473.00
Design Engineering, Construction Admin. (25%)					\$ 22,455.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 125,748.00

PROJECT 11e: UPSIZING OTHER DEFICIENT PIPES					
Campus Creek Basin - Throckmorton to Campus Creek					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 20,000.00	\$ 20,000.00
2	Seeding	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
3	Erosion Control	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
4	Clearing and Grubbing	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
5	Removal of Existing Structures	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
6	36" RCP (2-P-57)	32	Lin. Ft.	\$ 95.00	\$ 3,040.00
7	36" RCP (2-P-58)	20	Lin. Ft.	\$ 95.00	\$ 1,900.00
8	54" RCP (2-P-59)	287	Lin. Ft.	\$ 165.00	\$ 47,355.00
9	48" RCP (2-P-61)	589	Lin. Ft.	\$ 130.00	\$ 76,570.00
10	Remove and Replace Pavement	735	SY	\$ 100.00	\$ 73,500.00
11	Remove and Replace Sidewalk	27	SY	\$ 80.00	\$ 2,160.00
12	Remove and Replace Curb & Gutter	35	Lin. Ft.	\$ 25.00	\$ 875.00
13	Flowable Fill	136	CY	\$ 80.00	\$ 10,880.00
Subtotal					\$ 261,280.00
Construction Contingency (15%)					\$ 39,192.00
Design Engineering, Construction Admin. (25%)					\$ 65,320.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 365,792.00

PROJECT 11f: UPSIZING OTHER DEFICIENT PIPES					
Campus Creek Basin - South Mid-Campus Drive/Old Claflin Road Intersection					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 1,000.00	\$ 1,000.00
3	Erosion Control	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
4	Clearing and Grubbing	1	Lump Sum	\$ 2,000.00	\$ 2,000.00
5	Removal of Existing Structures	1	Lump Sum	\$ 1,000.00	\$ 1,000.00
6	30" RCP (2-P-68)	197	Lin. Ft.	\$ 70.00	\$ 13,790.00
7	Remove and Replace Pavement	107	SY	\$ 100.00	\$ 10,700.00
8	Remove and Replace Sidewalk	13	SY	\$ 80.00	\$ 1,040.00
9	Remove and Replace Curb & Gutter	20	Lin. Ft.	\$ 25.00	\$ 500.00
10	Flowable Fill	18	CY	\$ 80.00	\$ 1,440.00
Subtotal					\$ 43,470.00
Construction Contingency (15%)					\$ 6,520.50
Design Engineering, Construction Admin. (25%)					\$ 10,867.50
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 60,858.00

ENGINEER'S OPINION OF PROBABLE COST

PROJECT 11g: UPSIZING OTHER DEFICIENT PIPES					
South Campus Basin - East Side KSU Indoor Practice Football Facility					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
3	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	38"x24" RCAP (3-P-20)	115	Lin. Ft.	\$ 80.00	\$ 9,200.00
5	30" RCP (3-P-22)	430	Lin. Ft.	\$ 70.00	\$ 30,100.00
6	Remove and Replace Pavement	606	SY	\$ 100.00	\$ 60,600.00
7	Flowable Fill	122	CY	\$ 80.00	\$ 9,760.00
Subtotal					\$ 124,660.00
Construction Contingency (15%)					\$ 18,699.00
Design Engineering, Construction Admin. (25%)					\$ 31,165.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 174,524.00

PROJECT 11h: UPSIZING OTHER DEFICIENT PIPES					
South Campus Basin - West of KSU Union Parking Garage					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
3	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	42" RCP (3-P-07)	486	Lin. Ft.	\$ 110.00	\$ 53,460.00
5	Remove and Replace Pavement	178	SY	\$ 100.00	\$ 17,800.00
6	Remove and Replace Sidewalk	362	SY	\$ 80.00	\$ 28,960.00
7	Remove and Replace Curb & Gutter	220	Lin. Ft.	\$ 25.00	\$ 5,500.00
8	Flowable Fill	107	CY	\$ 80.00	\$ 8,560.00
Subtotal					\$ 129,280.00
Construction Contingency (15%)					\$ 19,392.00
Design Engineering, Construction Admin. (25%)					\$ 32,320.00
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 180,992.00

PROJECT 11i: UPSIZING OTHER DEFICIENT PIPES					
South Campus Basin - Beach Art Museum					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Clearing and Grubbing	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
5	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
6	30" RCP (3-P-17)	123	Lin. Ft.	\$ 70.00	\$ 8,610.00
7	Remove and Replace Sidewalk	22	SY	\$ 80.00	\$ 1,760.00
Subtotal					\$ 40,370.00
Construction Contingency (15%)					\$ 6,055.50
Design Engineering, Construction Admin. (25%)					\$ 10,092.50
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 56,518.00

ENGINEER'S OPINION OF PROBABLE COST

PROJECT 11j: UPSIZING OTHER DEFICIENT PIPES					
South Campus Basin - North of Parking Lot West of Memorial Stadium					
No	Description	Quantity	Units	Unit Price	Total Price/Ft.
1	Mobilization	1	Lump Sum	\$ 10,000.00	\$ 10,000.00
2	Seeding	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
3	Erosion Control	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
4	Clearing and Grubbing	1	Lump Sum	\$ 5,000.00	\$ 5,000.00
5	Removal of Existing Structures	1	Lump Sum	\$ 2,500.00	\$ 2,500.00
6	24" RCP (3-P-23)	235	Lin. Ft.	\$ 55.00	\$ 12,925.00
7	Remove and Replace Pavement	117	SY	\$ 100.00	\$ 11,700.00
8	Remove and Replace Curb & Gutter	210	Lin. Ft.	\$ 25.00	\$ 5,250.00
9	Flowable Fill	39	CY	\$ 80.00	\$ 3,120.00
Subtotal					\$ 57,995.00
Construction Contingency (15%)					\$ 8,699.25
Design Engineering, Construction Admin. (25%)					\$ 14,498.75
Preliminary Engineer's Opinion of Probable Construction Cost					\$ 81,193.00

APPENDIX D

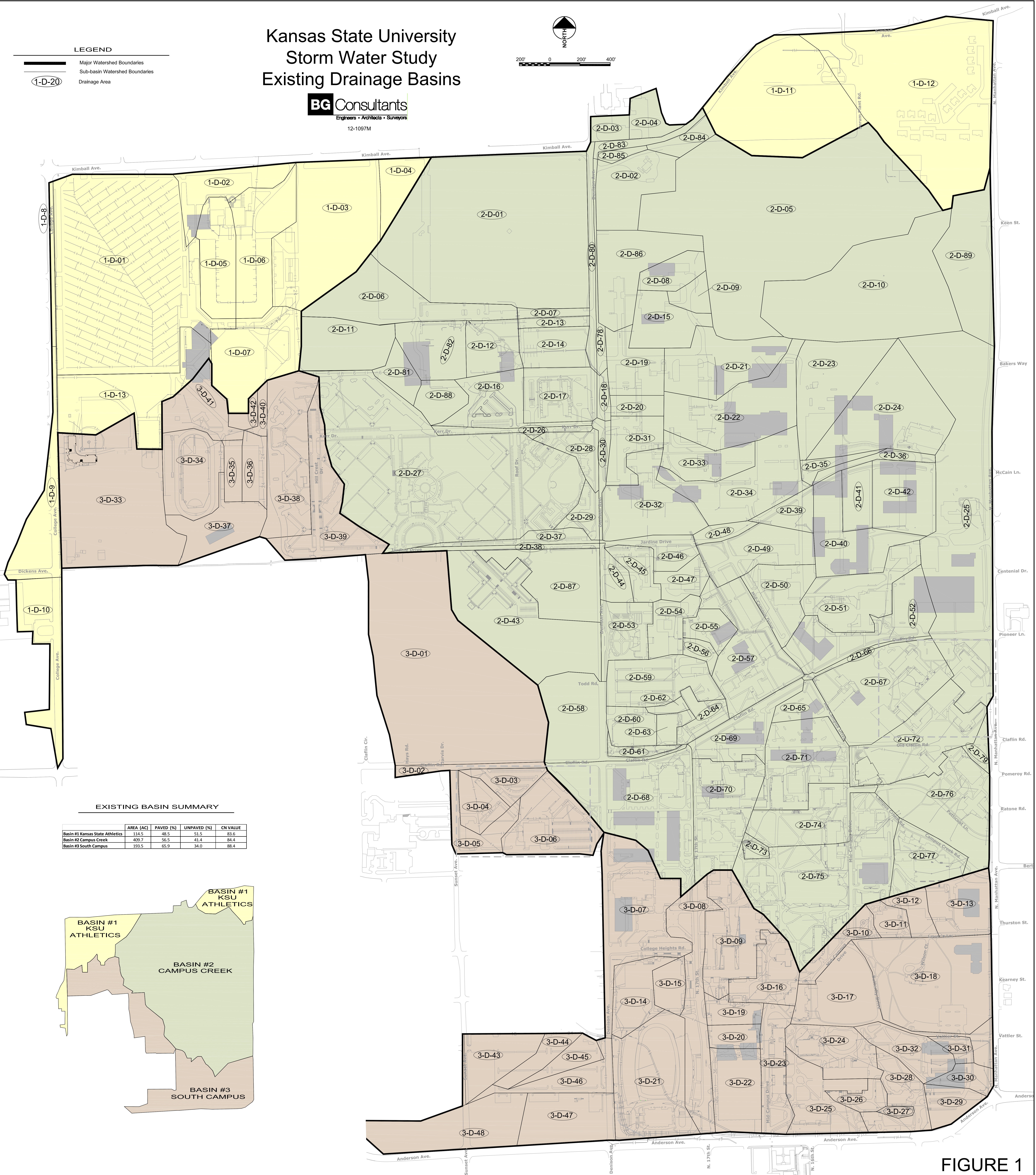
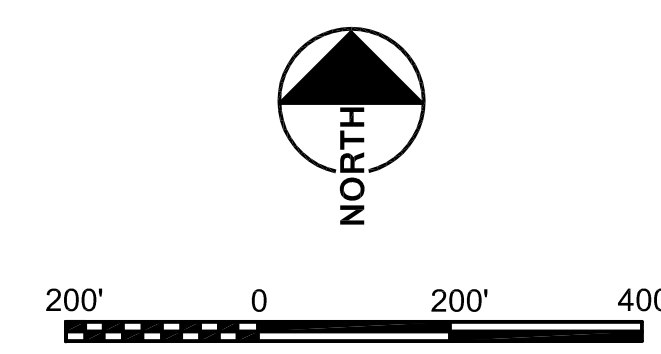


Kansas State University Storm Water Study Existing Drainage Basins

BG Consultants
Engineers • Architects • Surveyors
12-1097M

LEGEND

- Major Watershed Boundaries
- Sub-basin Watershed Boundaries
- Drainage Area



EXISTING BASIN SUMMARY

	AREA (AC)	PAVED (%)	UNPAVED (%)	CN VALUE
Basin #1 Kansas State Athletics	114.5	48.5	51.5	83.6
Basin #2 Campus Creek	409.7	56.5	41.4	84.4
Basin #3 South Campus	193.5	65.9	34.0	88.4

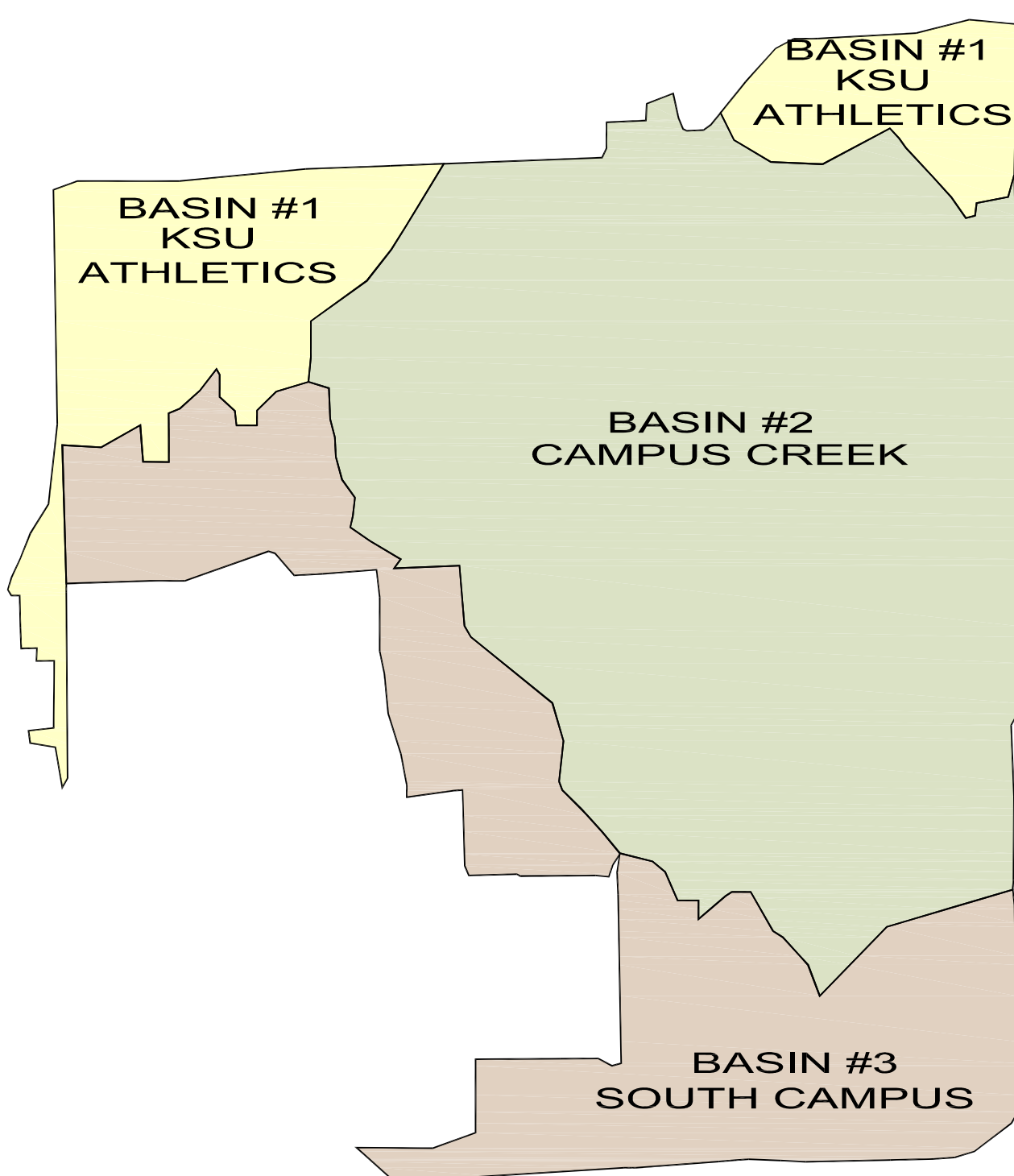


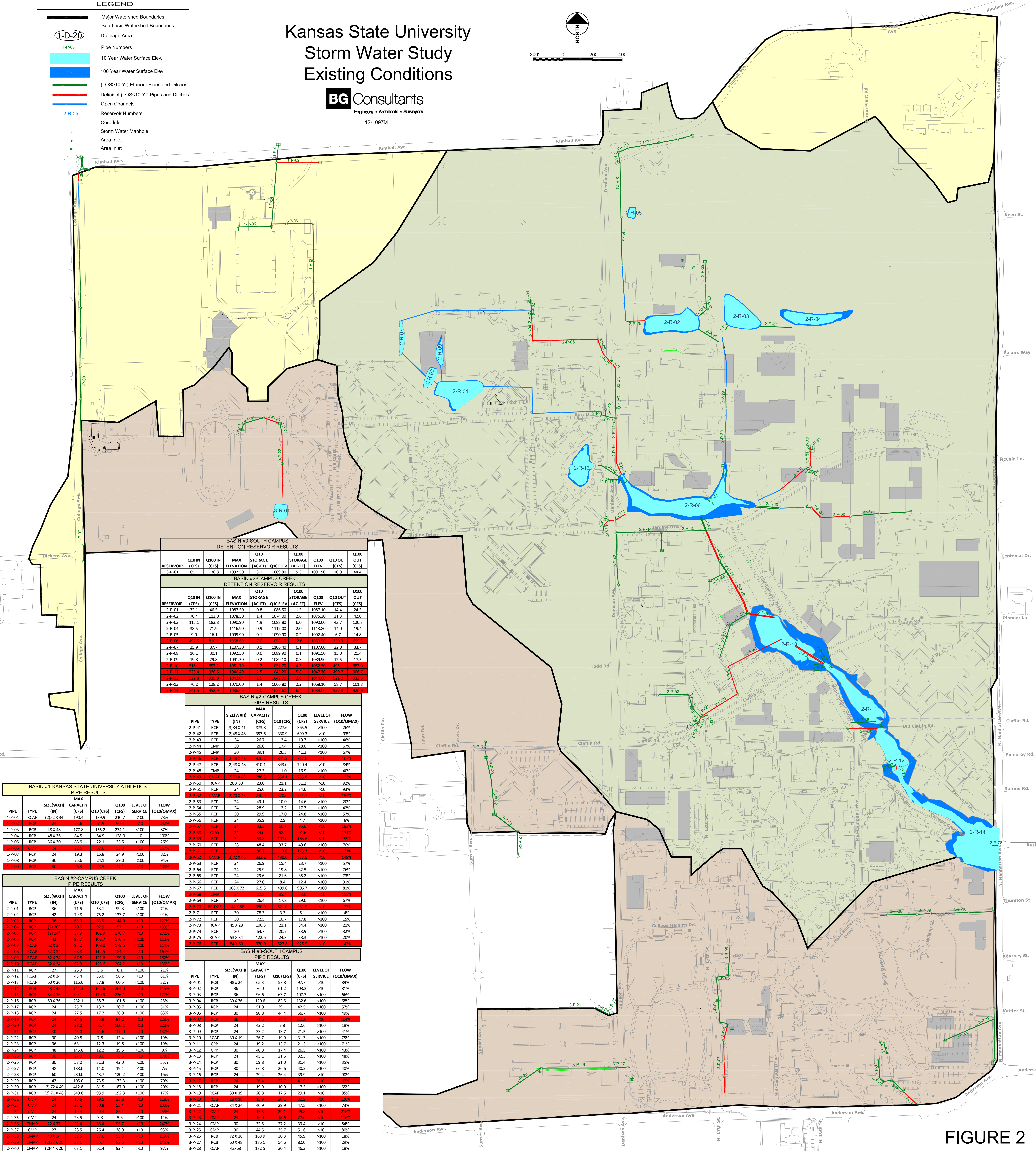
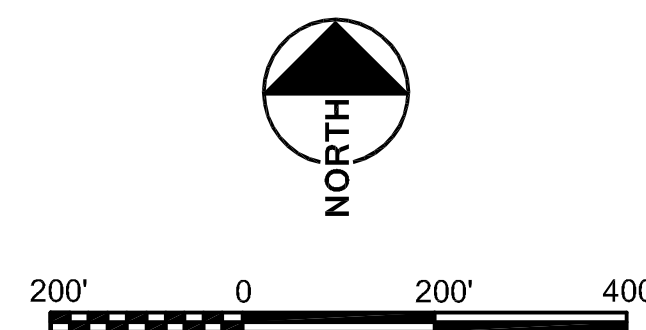
FIGURE 1

LEGEND

- Major Watershed Boundaries
- Sub-basin Watershed Boundaries
- Drainage Area
- Pipe Numbers
- 10 Year Water Surface Elev.
- 100 Year Water Surface Elev.
- (LOS>10-Yr) Efficient Pipes and Ditches
- Deficient (LOS<10-Yr) Pipes and Ditches
- Open Channels
- Reservoir Numbers
- Curb Inlet
- Storm Water Manhole
- Area Inlet
- Area Inlet

Kansas State University Storm Water Study Existing Conditions

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**BASIN #3-SOUTH CAMPUS
DETENTION RESERVOIR RESULTS**

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION	Q10 STORAGE (AC-FT)	Q10 ELEV	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)
3-R-01	85.1	136.8	1092.50	3.1	1089.80	5.3	1091.50	16.0	44.4

**BASIN #2-CAMPUS CREEK
DETENTION RESERVOIR RESULTS**

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION	Q10 STORAGE (AC-FT)	Q10 ELEV	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)
2-R-01	32.1	46.5	1087.50	0.8	1086.50	1.3	1087.10	14.4	24.5
2-R-02	70.4	113.0	1078.50	1.4	1074.00	2.6	1075.30	31.3	42.0
2-R-03	115.1	182.8	1090.90	4.9	1088.80	6.0	1090.00	43.7	120.3
2-R-04	38.5	71.9	1116.90	0.9	1112.00	2.0	1113.80	14.0	19.4
2-R-05	9.0	16.1	1095.90	0.1	1090.90	0.2	1092.40	6.7	14.8
2-R-06	49.4	70.1	1088.49	873.5	1088.49	1068.8	1088.49	29.9	42.0
2-R-07	25.9	37.7	1107.30	0.1	1106.40	0.1	1107.00	22.0	33.7
2-R-08	16.1	30.1	1092.50	0.0	1089.90	0.1	1091.50	15.0	21.4
2-R-09	19.8	29.8	1091.50	0.2	1089.10	0.3	1089.90	12.5	17.5
2-R-10	516.1	892.1	1051.70	2.7	1051.70	4.3	1052.50	495.1	883.0
2-R-11	523.4	920.6	1046.49	2.5	1046.20	5.8	1047.70	499.7	906.7
2-R-12	70.2	128.2	1070.00	1.4	1066.80	2.5	1068.10	58.7	101.8
2-R-13	76.2	128.2	1070.00	1.4	1066.80	2.5	1068.10	58.7	101.8
2-R-14	541.5	953.9	1038.05	3.0	1037.05	6.4	1038.05	527.8	926.8

**BASIN #2-CAMPUS CREEK
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-41	RCB	(3)84 X 41	873.5	227.6	365.5	>100	22%
2-P-42	RCB	(2)48 X 48	357.6	330.9	699.3	>10	93%
2-P-43	RCP	24	26.7	12.4	19.7	>100	46%
2-P-44	CMP	30	26.0	17.4	28.0	<100	67%
2-P-45	CMP	30	39.1	26.3	41.2	<100	67%
2-P-46	RCB	(2)48 X 48	357.6	341.2	717.6	<10	107%
2-P-47	RCB	(2)48 X 48	410.1	343.0	720.4	>10	84%
2-P-48	CMP	30	27.3	11.0	18.9	>100	40%
2-P-49	CMAP	(2)72 X 44	288.3	354.1	755.8	<10	123%
2-P-50	RCAP	20 X 30	23.0	21.1	31.2	>10	92%
2-P-51	RCP	24	25.0	23.2	34.6	>10	93%
2-P-52	CMAP	(2)72 X 48	240.3	370.6	754.7	<10	154%
2-P-53	RCP	24	49.1	10.0	14.6	>100	20%
2-P-54	RCB	24	28.9	17.2	17.7	>100	42%
2-P-55	RCP	30	29.9	24.8	34.9	>100	57%
2-P-56	RCP	24	35.9	2.9	4.7	>100	8%
2-P-57	RCP	24	33.3	60.7	95.6	<10	182%
2-P-58	CLAY	24	34.0	58.2	91.6	<10	171%
2-P-59	RCP	32	53.8	107.0	163.6	<10	199%
2-P-60	RCP	28	48.4	33.7	49.6	<100	70%
2-P-61	CMAP	(2)72 X 46	332.3	490.0	877.5	<10	148%
2-P-63	RCP	24	26.9	15.4	23.7	>100	57%
2-P-64	RCP	24	25.9	19.8	32.5	<100	76%
2-P-65	RCP	24	29.6	21.6	35.2	<100	73%
2-P-66	RCP	24	27.0	8.4	12.4	>100	31%
2-P-67	RCB	108 X 72	613.3	499.6	906.7	<100	81%
2-P-68	RCP	24	26.4	17.8	29.0	<100	67%
2-P-70	BRIDGE	104 X 58	880.0	521.0	941.0	<10	132%
2-P-71	RCP	30	78.3	3.3	6.1	>100	4%
2-P-72	RCP	30	72.5	10.7	17.8	>100	15%
2-P-73	RCAP	45 X 28	100.3	21.1	34.4	>100	21%
2-P-74	RCP	30	64.7	20.7	33.9	>100	32%
2-P-75	RCAP	53 X 34	122.6	24.3	38.3	>100	20%
2-P-76	RCB	64 X 100	130.0	127.3	256.3	<10	143%

**BASIN #2-CAMPUS CREEK
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-01	RCP	36	71.5	53.1	99.3	<100	74%
2-P-02	RCP	42	79.8	75.2	133.7	<100	94%
2-P-03	RCP	36	65.9	83.9	144.0	<10	127%
2-P-04	RCP	(2) 30"	70.0	92.9	157.1	<10	133%
2-P-05	RCP	(2) 24"	37.9	102.9	170.7	<10	272%
2-P-06	RCP	42	93.7	109.7	170.5	<100	110%
2-P-07	RCAP	52 X 34	152.2	110.9	179.6	<100	114%
2-P-08	RCAP	52 X 34	188.8	115.5	184.4	<10	156%
2-P-09	RCAP	52 X 34	67.5	122.6	195.6	<10	182%
2-P-10	RCAP	52 X 34	92.9	125.6	204.2	<10	193%
2-P-11	RCP	27	26.9	5.6	8.1	>100	21%
2-P-12	RCAP	52 X 34	43.4	35.0	56.5	>10	81%
2-P-13	RCAP	60 X 36	116.6	37.8	60.5	<100	32%
2-P-14	RCB	60 X 36	141.3	38.5	60.0	<100	35%
2-P-15	RCB	60 X 36	95.0	170.9	276.1	<10	172%
2-P-16	RCB	60 X 36	232.1	58.7	101.8	>100	25%
2-P-17	RCP	24	25.7	13.2	20.7	>100	51%
2-P-18	RCP	24	27.5	17.2	26.9	>100	63%
2-P-19	RCP	24	24.5	59.9	91.2	<10	228%
2-P-20	RCP	24	28.0	61.7	100.1	<10	229%
2-P-21	RCP	30	45.0	64.5	109.0	<10	235%
2-P-22	RCP	30	40.8	7.8	12.4	>100	19%
2-P-23	RCP	36	63.1	12.3	19.8	>100	19%
2-P-24	RCP	48	145.8	12.2	19.5	>100	8%
2-P-25	RCP	30	27.0	48.0	75.5	<10	178%
2-P-26	RCP	30	57.0	31.3	42.0	>100	55%
2-P-27	RCP	48	188.0	14.0	19.4	>100	7%
2-P-28	RCP	60	280.0	43.7	120.2	>100	16%
2-P-29	RCB	42	105.0	73.5	123.3	<100	70%
2-P-30	RCB	(2) 72 X 49	412.8	81.5	187.0	>100	20%
2-P-31	RCB	(2) 71 X 48	549.8	93.9	192.3	>100	17%
2-P-32	CMP	24	16.5	19.5	33.8	<10	118%
2-P-33	CMP	24	23.1	30.8	53.4	<10	193%
2-P-34	CMP	24	45.0	64.5	109.0	<10	235%
2-P-35	CMP	24	23.5	3.3	5.6	>100	14%
2-P-36	CMAP	22 X 27	22.4	55.4	95.7	<10	219%
2-P-37	CMP	27	28.5	26.4	38.9	>10	93%
2-P-38	CMP	40 X 24	31.5	37.6	55.3	<10	119%
2-P-39	CMAP	(2) 28 X 20	38.1	59.7	82.6	<10	140%
2-P-40	CMAP	(2) 44 X 26	63.1	61.4	92.4	>10	97%

**BASIN #3-SOUTH CAMPUS
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	MAX CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
3-P-01	RCB	48 X 24	65.3	57.8	97.7	>10	89%
3-P-02	RCP	36	75.0	61.2	103.3	>10	81%
3-P-03	RCP	36	96.6	63.7	107.7	<100	66%
3-P-04	RCB	39 X 36	120.6	82.5	132.6	<100	68%
3-P-05	RCP	24	51.0	29.1	42.5	>100	57%
3-P-06	RCP	30	90.8	44.4	66.7	>100	49%
3-P-07	RCP	36	71.6	74.4	111.6	<10	104%
3-P-08	RCP	24	42.2	7.8	12.6	>100	18%
3-P-09	RCP	24	33.2	13.7	21.5	>100	41%
3-P-10	RCAP	30 X 19	26.7	19.9	31.3	<100	75%
3-P-11	CPP	24	19.2	13.7	21.3	<100	71%
3-P-12	CPP	30	40.8	17.4	26.5	>100	43%
3-P-13	RCP	24	45.1	21.6	32.3	>100	48%
3-P-14	RCP	30	59.8	21.0	31.4	>100	35%
3-P-15	RCP	30	66.8	26.6	40.2	>100	40%
3-P-16	RCP	24	41.7	120.2	191.9	>100	90%
3-P-17	RCP	24	26.4	17.7	11.9	>10	176%
3-P-18	RCP	24	19.9	10.9	17.3	>100	55%
3-P-19	RCAP	30 X 19	20.8	17.6	29.1	>10	85%
3-P-20	RCAP	28 X 18	15.9	20.1	32.9	>10	126%
3-P-21	RCAP	34 X 24	40.9	29.9	47.5	<100	73%
3-P-22	CMP	24	19.4	18.4	26.8	>100	248%
3-P-23	CMP	24	16.0	18.4	27.0	<10	116%
3-P-24	CMP	30	32.5	27.2	39.4	>10	84%
3-P-25	CMP	30	44.5	35.7	51.6	>10	80%
3-P-26	RCB	72 X 36	168.9	30.3	45.9	>100	18%
3-P-27	RCB	60 X 48	186.1	54.6	82.0	>100	29%
3-P-28	RCAP	43x68	172.5	30.4	46.3	>100	18%

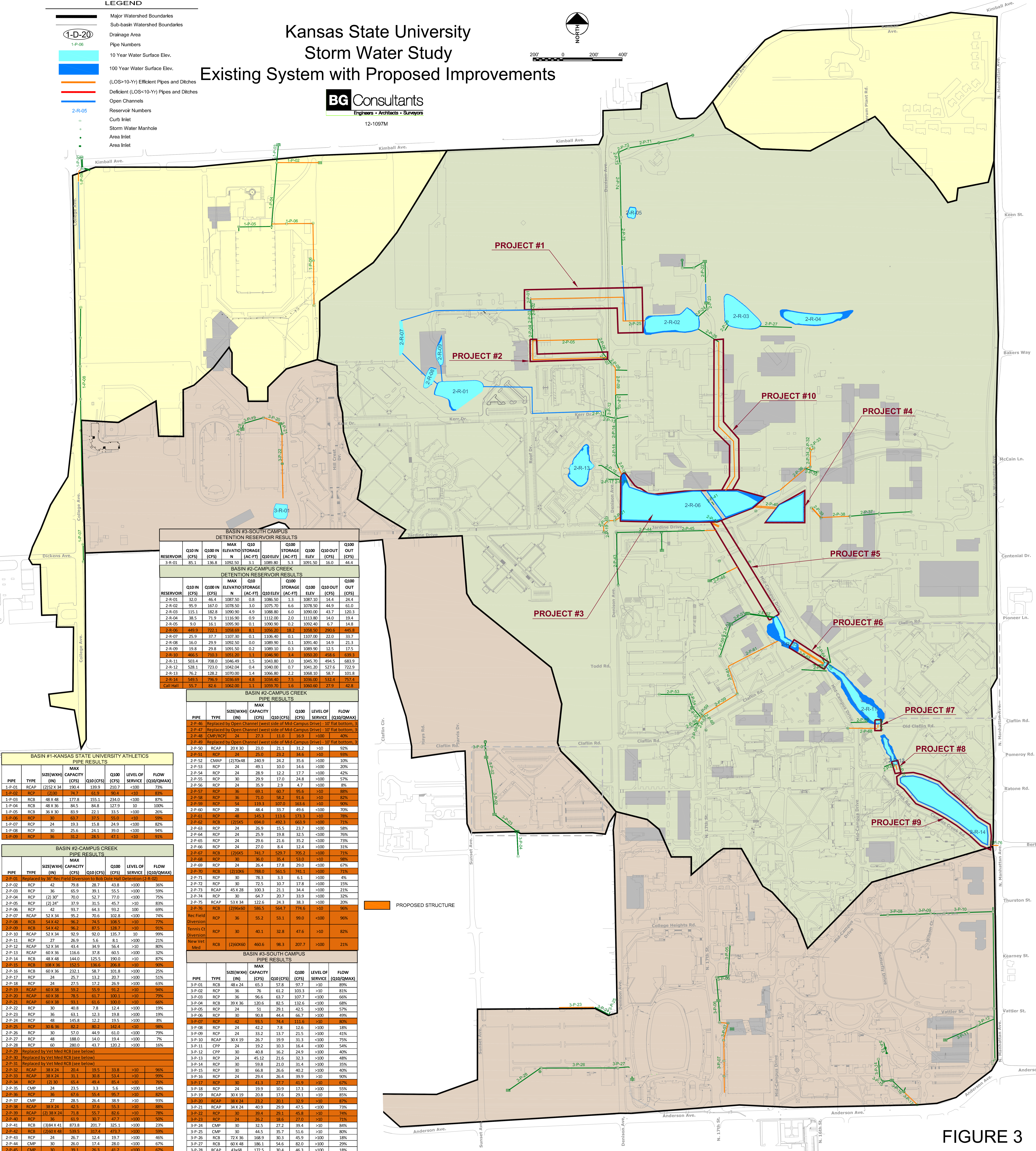
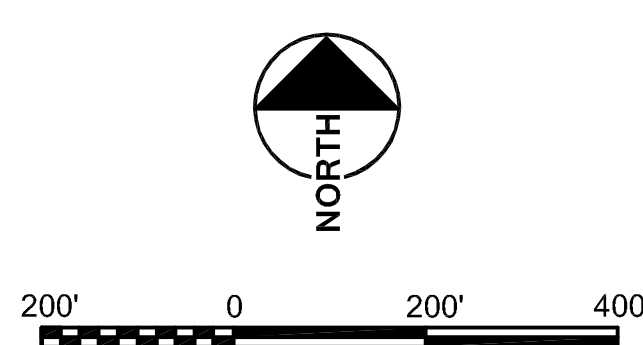
FIGURE 2

LEGEND

- Major Watershed Boundaries
- Sub-basin Watershed Boundaries
- Drainage Area
- Pipe Numbers
- 10 Year Water Surface Elev.
- 100 Year Water Surface Elev.
- (LOS>10-Yr) Efficient Pipes and Ditches
- Deficient (LOS<10-Yr) Pipes and Ditches
- Open Channels
- Reservoir Numbers
- Curb Inlet
- Storm Water Manhole
- Area Inlet
- Area Inlet

Kansas State University Storm Water Study Existing System with Proposed Improvements

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**BASIN #3-SOUTH CAMPUS
DETENTION RESERVOIR RESULTS**

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION (N)	Q10 STORAGE (AC-FT)	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)	
2-R-01	85.1	136.8	1092.50	3.1	1089.80	5.3	1091.50	16.0	44.4

**BASIN #2-CAMPUS CREEK
DETENTION RESERVOIR RESULTS**

RESERVOIR	Q10 IN (CFS)	Q100 IN (CFS)	MAX ELEVATION (N)	Q10 STORAGE (AC-FT)	Q100 STORAGE (AC-FT)	Q100 ELEV	Q10 OUT (CFS)	Q100 OUT (CFS)	
2-R-01	32.0	46.4	1087.50	0.8	1086.50	1.3	1087.10	14.4	24.4
2-R-02	95.9	167.0	1078.50	3.0	1075.70	6.6	1078.50	44.9	61.0
2-R-03	115.1	182.8	1080.50	4.9	1088.80	6.0	1090.00	43.7	120.3
2-R-04	38.5	71.9	1116.90	0.9	1112.00	2.0	1113.80	14.0	19.4
2-R-05	9.0	16.1	1095.90	0.1	1090.90	0.2	1092.40	6.7	14.8
2-R-06	449.9	722.1	1058.69	8.1	1056.20	18.2	1058.50	290.6	445.8
2-R-07	25.9	37.7	1107.30	0.1	1106.40	0.1	1107.00	22.0	33.7
2-R-08	16.0	29.9	1092.50	0.0	1089.90	0.1	1091.40	14.9	21.3
2-R-09	19.8	29.3	1091.50	0.2	1089.10	0.3	1089.80	12.5	17.3
2-R-10	466.5	729.3	1051.24	1.1	1046.90	3.4	1050.20	458.6	698.1
2-R-11	503.4	708.0	1046.49	1.5	1043.80	3.0	1045.70	494.5	683.9
2-R-12	528.1	723.0	1042.04	0.4	1040.00	0.7	1041.20	527.6	722.9
2-R-13	76.2	128.2	1070.00	1.4	1066.80	2.2	1068.10	58.7	101.8
2-R-14	549.5	796.9	1036.69	4.8	1034.40	7.5	1036.00	532.4	757.4
Call Hall	55.7	82.6	1062.00	1.1	1059.70	1.6	1060.60	27.9	42.8

**BASIN #2-CAMPUS CREEK
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)	
2-P-46	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3'			27.3	11.0	16.9	>10	40%
2-P-47	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3'			27.3	11.0	16.9	>10	40%
2-P-48	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3'			27.3	11.0	16.9	>10	40%
2-P-49	Replaced by Open Channel (west side of Mid-Campus Drive) - 10' flat bottom, 3'			27.3	11.0	16.9	>10	40%
2-P-50	RCAP	20 X 30	23.0	21.1	31.2	>10	92%	
2-P-51	RCP	24	25.0	23.2	34.6	>10	93%	
2-P-52	CMAP	(2)70x48	240.9	24.2	35.6	>100	10%	
2-P-53	RCP	24	49.1	10.0	14.6	>100	20%	
2-P-54	RCP	24	28.9	12.2	17.7	>100	42%	
2-P-55	RCP	30	29.9	17.0	24.8	>100	57%	
2-P-56	RCP	24	35.9	2.9	4.7	>100	8%	
2-P-57	RCP	36	69.1	60.7	95.6	>10	88%	
2-P-58	RCP	36	71.0	58.2	91.6	>10	82%	
2-P-59	RCP	54	119.3	107.0	163.6	>10	90%	
2-P-60	RCP	28	48.4	33.7	49.6	<100	70%	
2-P-61	RCP	48	145.3	113.6	173.3	>10	78%	
2-P-62	RCP	(2)6X5	694.0	492.8	663.0	>100	75%	
2-P-63	RCP	24	26.9	15.5	23.7	>100	58%	
2-P-64	RCP	24	25.9	19.8	32.5	>100	76%	
2-P-65	RCP	24	29.6	21.6	35.2	>100	73%	
2-P-66	RCP	24	27.0	8.4	12.4	>100	31%	
2-P-67	RCB	(2)6X5	741.7	529.7	705.2	>100	71%	
2-P-68	RCP	30	36.0	35.4	53.0	>10	98%	
2-P-69	RCP	24	26.4	17.8	29.0	>100	67%	
2-P-70	RCB	(2)10X6	788.0	561.5	741.1	>100	71%	
2-P-71	RCP	30	78.3	3.3	6.1	>100	4%	
2-P-72	RCP	30	72.5	10.7	17.8	>100	15%	
2-P-73	RCAP	45 X 28	100.3	21.1	34.4	>100	21%	
2-P-74	RCP	30	64.7	20.7	33.9	>100	32%	
2-P-75	RCAP	53 X 34	122.6	24.3	38.3	>100	20%	
2-P-76	RCB	(2)9x6x6	586.5	564.7	774.6	>10	96%	
Rec Field Diversion	RCP	36	55.2	53.1	99.0	<100	96%	
Tennis Ct Diversion	RCP	30	40.1	32.8	47.6	>10	82%	
New Vet Med	RCB	(2)60X60	460.6	98.3	207.7	>100	21%	

**BASIN #1-KANSAS STATE UNIVERSITY ATHLETICS
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
1-P-01	RCAP	(2)52 X 34	130.4	139.9	210.7	<100	73%
1-P-02	RCB	48 X 48	147.9	143.9	204.4	>10	85%
1-P-03	RCB	48 X 48	177.8	155.1	234.0	<100	87%
1-P-04	RCB	48 X 36	84.5	84.8	127.9	>10	100%
1-P-05	RCB	36 X 30	83.9	22.1	33.5	>100	26%
1-P-06	RCP	30	63.7	37.5	55.0	<100	59%
1-P-07	RCP	24	19.3	15.8	24.9	<100	82%
1-P-08	RCP	30	25.6	24.1	39.0	<100	94%
1-P-09	RCP	36	31.2	28.5	47.1	<100	91%

**BASIN #2-CAMPUS CREEK
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
2-P-01	Replaced by 36" Rec Field Diversion to Ball Field Detention (2-R-10)						
2-P-02	RCP	42	79.8	28.7	43.8	>100	36%
2-P-03	RCP	36	65.9	39.1	55.5	>100	59%
2-P-04	RCP	(2) 30"	70.0	52.7	77.0	<100	75%
2-P-05	RCP	(2) 24"	37.9	31.5	45.7	>10	83%
2-P-06	RCP	42	93.7	64.3	93.2	>100	69%
2-P-07	RCAP	52 X 34	106.1	70.6	102.8	>100	77%
2-P-08	RCB	54 X 42	96.2	74.5	108.5	>10	77%
2-P-09	RCB	54 X 42	96.2	87.5	128.7	>10	91%
2-P-10	RCAP	52 X 34	92.9	92.0	135.7	>10	99%
2-P-11	RCP	27	26.9	5.6	8.1	>100	21%
2-P-12	RCAP	52 X 34	43.4	34.9	56.4	>10	80%
2-P-13	RCAP	60 X 36	116.5	37.8	60.5	>100	32%
2-P-14	RCB	48 X 48	144.0	125.5	190.0	>10	87%
2-P-15	RCB	108 X 36	152.9	136.6	226.8	>10	90%
2-P-16	RCB	60 X 36	222.1	58.7	101.8	>100	25%
2-P-17	RCP	24	25.7	13.2	20.7	>100	51%
2-P-18	RCP	24	27.5	17.2	26.9	>100	63%
2-P-19	RCAP	60 X 36	59.2	55.9	91.2	>10	94%
2-P-20	RCAP	60 X 36	78.5	61.7	101.1	>10	79%
2-P-21	RCAP	60 X 36	83.1	61.6	100.0	>10	69%
2-P-22	RCP	30	40.8	7.8	12.4	>100	19%
2-P-23	RCP	36	63.1	12.3	19.8	>100	19%
2-P-24	RCP	48	145.8	12.2	19.5	>100	8%
2-P-25	RCP	30 & 36	82.2	80.2	142.4	<100	98%
2-P-26	RCP	30	57.0	44.9	61.0	<100	79%
2-P-27	RCP	48	188.0	43.0	19.4	>100	7%
2-P-28	RCP	60	280.0	43.7	120.2	>100	16%
2-P-29	Replaced by Vet Med RCB (see below)						
2-P-30	Replaced by Vet Med RCB (see below)						
2-P-31	Replaced by Vet Med RCB (see below)						
2-P-32	RCAP	38 X 24	20.4	19.5	33.8	>10	96%
2-P-33	RCAP	38 X 24	31.1	30.8	53.4	>10	99%
2-P-34	RCP	(2) 30"	78.5	49.4	85.4	>10	70%
2-P-35	CMAP	24	23.5	3.3	5.6	>100	14%
2-P-36	RCP	36	67.6	55.4	95.7	>10	82%
2-P-37	CMAP	27	28.5	26.4	38.9	>10	93%
2-P-38	RCAP	38 X 24	42.5	37.6	55.3	>10	88%
2-P-39	RCAP	(2) 38 X 24	71.8	55.7	82.6	>10	78%
2-P-40	RCP	36	63.9	49.7	87.7	>100	59%
2-P-41	RCB	(3)64 X 41	873.8	201.7	325.1	>100	23%
2-P-42	RCB	(2)60 X 48	589.5	317.4	473.7	>100	59%
2-P-43	RCP	24	26.7	12.4	19.7	>100	46%
2-P-44	CMAP	30	26.0	17.4	28.0	<100	67%
2-P-45	CMAP	30	39.1	26.3	41.2	<100	67%

**BASIN #3-SOUTH CAMPUS
PIPE RESULTS**

PIPE	TYPE	SIZE(WXH) (IN)	CAPACITY (CFS)	Q10 (CFS)	Q100 (CFS)	LEVEL OF SERVICE	FLOW (Q10/QMAX)
3-P-01	RCB	48 X 24	65.3	57.8	97.7	>10	89%
3-P-02	RCP	36	76	61.2	103.3	>10	81%
3-P-03	RCP	36	96.6	63.7	107.7	<100	66%
3-P-04	RCB	39 X 36	120.6	82.5	132.6	<100	68%
3-P-05	RCP	30	51	26.1	42.5	>100	57%
3-P-06	RCP	30	90.8	44.4	66.7	>100	49%
3-P-07	RCP	42	93.5	74.4	111.6	>10	80%
3-P-08	RCP	24	42.2	7.8	12.6	>100	18%
3-P-09	RCP	24	33.2	13.7	21.5	>100	41%
3-P-10	RCAP	30 X 19	26.7	19.9	31.3	<100	75%
3-P-11	RCP	24	19.2	10.3	16.4	>100	54%
3-P-12	CPP	30	40.8	16.2	24.9	>100	40%
3-P-13	RCP	24	45.12	21.6	32.3	>100	48%
3-P-14	RCP	30	59.8	21.0	31.4	>100	35%
3-P-15	RCP	30</					