

Executive Summary

STORM WATER MASTER PLAN

DRAFT FINAL REPORT

STORM WATER MASTER PLAN NORMAN, OKLAHOMA



FEBRUARY 2009

10275/WH/08

EXECUTIVE SUMMARY

As the county seat of Cleveland County and home of the University of Oklahoma, the City of Norman is a large and diverse community that is proactive on a wide range of issues, including its land and water environments. The City encompasses almost 190 square miles, including almost 30 square miles that has been developed to accommodate its current population of approximately 112,000. As Norman has grown in population and further urbanized many of its watersheds, the resulting impacts on flooding, water quality, and erosion have increased significantly. Of particular concern, Lake Thunderbird's water quality has deteriorated significantly, which is a condition that could directly impact all of Norman's citizens. At the same time, the recreational opportunities offered by the City's waterways have become increasingly apparent and desirable. Given these and other related factors, the City initiated development of a Storm Water Master Plan (SWMP) in late 2005 with its primary goals aimed at reducing flooding dangers, protecting water quality, enhancing the environment, and advancing recreational opportunities. Development of the present SWMP project began in August 2007 and includes all City watersheds. The SWMP incorporates "quality of life" elements for Norman's citizens by outlining measures to manage creek corridors and floodplains in an environmentally sound manner while offering opportunities for increased recreational activities. A Greenway Master Plan is being developed by the City (Halff Associates, Inc. [Halff], 2009) in parallel with the SWMP and is also nearing completion. This greenway plan is being produced in a separate report although opportunities and constraints were shared between the two studies.

The overall approach to development of the SWMP involved the use of existing information and data to the extent possible, building on that base with new information and data, and performing the analyses needed to meet the SWMP goals. Realizing that local public input was a critical component in fulfilling the goals of the SWMP, a Storm Water Task Force was formed to coordinate ongoing project issues and provide guidance on local perspectives. Several meetings with City Council members, the SWMP Task Force, and City staff as well as three public meetings were held to review ongoing study efforts, discuss project progress, and coordinate the SWMP work flow. Plans for a final public meeting are being made for early 2009.

STUDY LEVELS

In order to focus on the primary stream systems and provide detailed evaluations in the areas having the worst problems, analyses associated with watershed/stream assessments, stream flooding, and stream erosion were performed at different "levels" of study detail based on the needs of the City. Generally, Levels 1 and 2 were studied in detail and Levels 3 and 4 were more generally studied. All watersheds in the City were studied in some capacity, but depending on needs some were analyzed in detail while others were considered using more general methods. Exhibit ES-1 identifies the level of study undertaken for respective streams throughout the City. In consideration of the amount of future urbanization projected to occur in the City, data and other useful information were obtained from the Norman 2025 Plan. **In this report, any reference to this plan should be considered to mean the "Norman 2025 Plan and subsequent updates to this comprehensive plan as adopted by the City Council."**

WATERSHED AND STREAM ASSESSMENTS

Assessments were developed for 36 watersheds that carry storm water into, through, and/or within the City of Norman. Although most of the watersheds are located in the City of Norman, several also originate north of the City, flow into the Little River, and ultimately discharge into Lake Thunderbird. Exhibit ES-1 outlines boundaries of the 15 major watersheds that were further subdivided into the 36 assessed watersheds by separating out larger tributaries or simply separating the watersheds into upper, middle, and lower divisions. In order to quantify and spatially locate certain physiographic characteristics within a watershed, GIS datasets collected from various sources were analyzed and used to develop watershed-specific tables and presentation maps that outline descriptive information such as land use, hydrologic soil groups, floodplains, and impervious cover. Stream corridor environments were similarly analyzed to identify conditions such as erosion problem areas, channel type, floodplain vegetation, Federal Emergency Management Agency (FEMA) flood zone type, and number of storm water outfalls.

HYDROLOGIC AND HYDRAULIC MODELING

Three complementary hydrologic and hydraulic modeling approaches were used in the development of design flows for the master plan. The most detailed of the three methods utilized either the USACE HEC-1 (existing models) or HEC-HMS (some existing and all new models) software. The second approach, used for the development of flows for the Stream Planning Corridors, utilized a USGS regression equation. The third approach, used in limited cases for site-specific drainage issues, was the Rational Method per the City of Norman design criteria. Hydrologic analyses were performed for 307 square miles of drainage area that includes the City's 190 square miles within its boundaries. Hydraulic analyses and floodplain mapping were developed for almost 400 stream miles, which included 59 miles along detailed (Level 1 and 2) streams and 333 miles along general (Level 3 and 4) streams.

STORM WATER PROBLEMS AND SOLUTIONS

Storm water problem identification and solution development for the detailed study areas were grouped into stream flooding, stream erosion, water quality, and local drainage to assist in understanding the overall magnitude of such problem types in the City. The identification of problems was accomplished through a variety of means including the review and evaluation of items such as: the City's GIS data; past water quality studies; hydrologic and hydraulic modeling and mapping; watershed and stream assessments; input obtained from the City, various committees, and the SWMP Task Force; and input received from the general public as provided through the City staff and during public meetings. Although existing conditions were reviewed and considered, the identification and evaluation of flooding along major streams primarily focused on future (baseline) full buildout watershed conditions that reflect projected development levels in the City's 2025 Plan and subsequent updates to this comprehensive plan as adopted by the City Council. The identification of stream erosion problems was primarily based on existing conditions consistent with the watershed and stream assessments.

Norman Storm Water Master Plan
Exhibit ES-1
Study Areas



City of Norman
201 West Gray, Bldg. A
Norman, OK 73069



Legend

- Lake
- New Models-Detailed (Level 1)
- Existing Models-Detailed (Level 2)
- Future Detailed (Level 3)
- New General (Level 4)
- Road Centerline

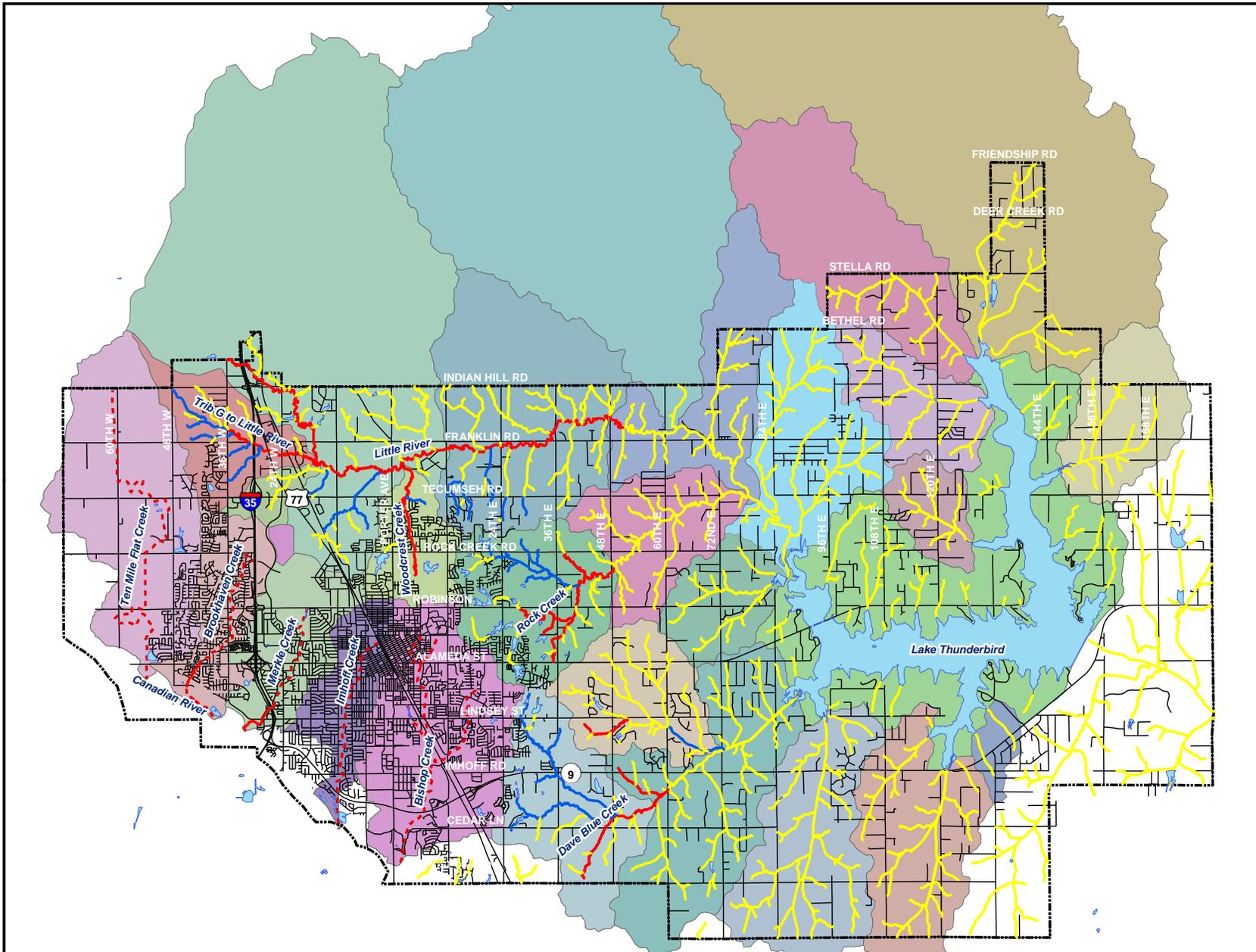
City Watersheds

- Bishop Creek
- Brookhaven Creek
- Direct Lake Thunderbird Runoff
- Imhoff Creek
- Lower Dave Blue Creek
- Lower Little River
- Lower Mid Little River
- Lower Rock Creek
- Merkle Creek
- Ten Mile Flat Creek
- Trib to Dave Blue Creek
- Tributary G to Little River
- Upper Dave Blue Creek
- Upper Rock Creek
- Woodcrest Creek

**Note: Level 3 and Level 4
are Stream Planning Corridors**



0 4,500 9,000
Feet



In developing solutions, considerations were made to incorporate items such as improving and/or protecting stream environmental integrity by using bio-engineering and natural channel design techniques, preserving the historical character of an existing solution type such as the WPA-constructed channels found in the upper Imhoff and Bishop Creek watersheds, improving water quality, and identifying greenway opportunities. Solutions were developed in a way to recognize and respect the conditions and character of the respective watershed in which the problem exists. In addition to considering the opportunities for preserving or enhancing environmental and recreational conditions, the solution development process included the consideration of various possible alternatives or options and review of preliminary findings with City staff as well as the project Task Force to obtain their feedback and guidance.

Due to their “non-point source” nature, the identification of water quality problems and related solutions development were evaluated on a citywide scale consistent with procedures used for similarly sized cities throughout the country. This citywide approach to addressing water quality involves a programmatic approach which is now ongoing through the City’s MS4 Program with the potential for expansion due to Canadian River TMDL concerns as well as the Oklahoma Department of Environmental Quality (ODEQ) Watershed Plan that is being developed for the 256-square-mile basin area draining to Lake Thunderbird which includes a large part of Norman.

Fifty-nine problem areas including those characterized by stream flooding, stream erosion and local drainage were identified within the City from the many investigations and evaluations performed. The problems are spread over a large part of the City but all are located along, or west of, 48th Avenue East. Adding to their magnitude, a vast majority of the problems occur on property lacking sufficient drainage easements or rights-of-way requiring that solution costs include the purchase of such easements/rights-of-way. Table ES-1 provides the number of each problem areas in the respective Level 1 and 2 watersheds.

Table ES-1
Summary of Proposed Storm Water Projects

Watershed	Stream Flooding		Stream Stabilization		Local Drainage		Watershed Total Cost	Percent of City Total
	No.	Costs	No.	Costs	No.	Costs		
Bishop Creek	6	\$5,347,808	6	\$1,817,248	5	\$4,720,055	\$11,885,111	14.4
Brookhaven Creek	4	\$2,613,904	4	\$2,106,735	3	\$1,278,962	\$5,999,601	7.3
Clear Creek	---	---	---	---	1	\$1,794,023	\$1,794,023	2.2
Canadian River	---	---	---	---	1	\$400,645	\$400,645	0.5
Dave Blue Creek	2	\$1,786,733	---	---	---	---	\$1,786,733	2.2
Imhoff Creek	9	\$24,439,559	2	\$6,816,509	1	\$12,461,087	\$43,717,155	53.0
Little River	1	\$305,233	1	\$123,682	---	---	\$428,915	0.5
Tributary G to Little River	1	\$992,182	---	---	---	---	\$992,182	1.2
Woodcrest Creek	3	\$3,167,165	1	\$110,965	---	---	\$3,278,130	4.0
Merkle Creek	4	\$8,856,558	---	---	---	---	\$8,856,558	10.7
Rock Creek	3	\$3,136,111	---	---	---	---	\$3,136,111	3.8
Ten Mile Flat Creek	---	---	---	---	1	\$255,326	\$255,326	0.3
Citywide Totals	33	\$50,645,253	14	\$10,975,139	12	\$20,910,098	\$82,530,490	100.0

As indicated in Table ES-1, a variety of conceptual solutions were developed for the 59 flood/drainage-related and stream erosion problems. The estimated costs for each solution were developed and totaled by the respective watersheds and for the City as a whole. Approximately 84% of the problems were located in the urban watersheds of Bishop Creek, Brookhaven Creek, Imhoff Creek, Merkle Creek, and Woodcrest Creek with their solution costs amounting to almost 90% of the City’s \$82.6 million total costs. Stream flooding occurs in several locations in these watersheds with stream erosion also destabilizing the mid and lower reaches of the streams traversing these same watersheds with the exception of Merkle Creek. Certain solutions address overlapping problems, such as stream flooding and stream erosion. The level of protection for most stream flooding solutions varied somewhat although improvements associated with channel capacity and roadway bridge openings used projected 100-year baseline (future) peak discharges while roadway culvert openings used projected 50-year peak flows. Exceptions were made in special cases where 10-year protection was judged to be preferred due to limited space and the costs associated with larger improvements. Such cases included channel improvements and certain roadway crossings along Imhoff Creek, the west-central Imhoff Creek watershed area (including the Lindsey Street-McGee Drive intersection flooding problem), and a few others.

The 59 solutions developed offer resolution and/or mitigation to the problems identified with the following benefits:

- 34 (58% of all solutions) instances of stream flooding mitigation.
 - 26 of the 34 target structure or building flooding.
 - 652 of 830 structures removed from the 100-year baseline floodplain.
 - 29 of the 34 include upgrades to flooded (overtopped) road crossings.
 - 36 out of 36 flood prone road crossings protected to design levels.
 - 12 of the 34 have a structure/parcel buyout component.
 - 62 properties identified as possible buyouts.
- 14 (24% of all solutions) involve stream erosion stabilization.
 - 10,050 ft of eroding streams stabilized.
- 12 (20% of all solutions) represent resolutions of local drainage problems.

Another important aspect of developing solutions for the many problems identified involved prioritization of the solutions. These prioritizations allow for identification of the most critical projects to address the storm water needs in Norman. Further, prioritizations represent an important tool for the City to use along with other information, such as individual project costs, in determining the order that solutions might be implemented or how they might be financed. The prioritization system developed evaluates, scores, and ranks each solution or project in terms of its ability to: solve the problem being considered, provide for public safety, provide sustainability, utilize funding advantages, impart positive impacts on affected neighborhoods and the environment, assist in other important issues like transportation, and present its economic costs versus benefits relationship. Using the evaluation scores, solution (project) rankings were established and organized according to the respective watersheds and ward(s) in which the projects reside as well as within the City as a whole.

KEY ISSUES

During development of the SWMP, several key issues emerged that warranted a considerable amount of attention due to their complexity and the need to have various stakeholder groups offer their guidance on how best to resolve the issues. Numerous discussions with City Council members, the SWMP Task Force, City staff, and other stakeholders produced a variety of approaches and ideas about how to resolve these various issues. As reflected in this executive summary and Section 9 of this report, recommendations on these key issues have been made to assist the City in moving forward toward meeting their storm water management goals. However, it is understood that additional discussion will follow to work out the associated details and exceptions/variances. These key issues are:

- incorporating floodplain or “Stream Planning Corridors” dedications in new developments,
- utilizing structural and non-structural water quality controls in new developments including low impact development techniques,
- providing enhanced maintenance of creeks and storm water detention facilities in existing and new developments,
- acquiring drainage easements and rights-of-way in new and existing developments, and
- providing dam safety throughout the City.

FINANCIAL ANALYSES

Financial analyses were performed to meet the funding needs for the programs and activities associated with this SWMP. The funding needs developed primarily include operations and maintenance costs to meet the City’s current MS4 storm water permit requirements, the upcoming expansion of MS4 permit requirements, the storm water capital improvement program costs, trail construction, and the purchase of critical drainage easements/rights-of-way. Guidance on critical financing decisions was obtained from the mayor and City Council, the SWMP Task Force, City staff, and other stakeholders throughout the process. Key analyses investigated the background and legislative history of storm water utilities, revenue requirements, funding potential associated with a storm water utility as well as general obligation (GO) bonding, and utility rate establishment methods. The proposed utility rate structure developed ensures that: a public purpose will be served, a reasonable relationship exists between the amount of service rendered and the amount of charge to be levied, the rates will not be arbitrary, and the rates will be equally and fairly applied.

The amount of revenue required for the proposed storm water management activities and improvements outlined in the SWMP can be broken down into needs for operation and maintenance, cash (or storm water fee) financed capital, debt service, and reserve creation less any non-operating revenues such as interest earnings. In addition to a storm water utility, the City decided to propose funding a portion of the storm water capital improvements with general obligation (GO) bonds in order to more quickly provide needed projects in areas of critical storm water needs. Three rate options were developed to fund the storm water capital improvements using the split between GO bonding and storm water utility rates over a 20-year program as defined by the City. As shown in Table ES-2 and consistent with the CIP costs for proposed solutions, the total 20-year capital improvement program needs in 2008–2009 dollars were

Table ES-2
Three Rate Options – FY 2008–2009 Dollars (Uninflated)

Line No.	Item	Option 1	Option 2	Option 3
1	Capital Improvement Program (20-Year Period)	\$83,000,000	\$83,000,000	\$83,000,000
2	Funding Source			
3	General Obligation Bonds	\$30,000,000	\$38,500,000	\$40,000,000
4	Storm Water User Rates (Pay-go) Financing	\$53,000,000	\$44,500,000	\$43,000,000
5	Total	\$83,000,000	\$83,000,000	\$83,000,000
6	Program Period	20	20	20
7	Capital Improvement Projects per Year Funded by Rates	\$2,650,000	\$2,225,000	\$2,150,000

estimated to be approximately \$83 million. To cover these costs, three options for financing this program were developed with varying amounts of general obligation (GO) bonding and storm water utility user fees.

The total storm water revenue requirements were established by incorporating the costs developed during the SWMP project for pertinent items, specifically the eight items listed in Table ES-3 (excluding items on lines 5, 10, and 11). Table ES-3 shows the storm water revenue requirement assumed for the first 5-year period, FY 2009–2010 through FY 2013–2014, under the three rate options. The City chose to implement one rate for the next 5 years and therefore FY 2011–2012 (the midyear in this 5-year period) is used to set rates for this 5-year period. As indicated in line 7 of Table ES-3, the capital improvements program is equivalent to line 7 in Table ES-2 with the exception that the ES-3 values have been adjusted for inflation to reflect FY 2011–2012 dollars, which is the middle year in the 5-year planning period.

Table ES-3
Storm Water Utility Revenue Requirement (FY 2011–2012) Dollars

Line No.	Storm Water Revenue Requirement, FY 2011–2012	Option 1	Option 2	Option 3
1	Operation and Maintenance	\$459,799	\$459,799	\$459,799
2	Shared City Services	\$129,465	\$129,465	\$129,465
3	Minimum Control Measures	\$748,616	\$748,616	\$748,616
4	Reserve Funding	\$265,000	\$265,000	\$265,000
5	Subtotal	\$1,602,880	\$1,602,880	\$1,602,880
6	Enhanced Maintenance (Trails, Detention Ponds, Creeks)	\$1,273,080	\$1,273,080	\$1,273,080
7	Capital Improvements Program	\$2,866,240	\$2,406,560	\$2,325,440
8	Trail Construction	\$1,081,600	\$1,081,600	\$1,081,600
9	Easements and Rights- of- Way	\$265,225	\$265,225	\$265,225
10	Less Interest on Cash Accounts	\$(25,758)	\$(25,758)	\$(25,758)
11	Total Revenue Requirement	\$7,063,267	\$6,603,587	\$6,522,467

Establishment of the utility rates in the proposed storm water utility system will be based on impervious cover of the property owners in Norman, which was developed from data provided by the City of Norman. Table ES-4 displays the impervious cover data in five user classes. The City Council decided to include all impervious parcels as billable parcels after first assessing the impact to rates if exempt parcels (including the University of Oklahoma, churches, schools, Indian land, county, state and federal land, and non-profit land) were excluded.

Table ES-4
Impervious Data Analysis Results

All Parcels	(A)	(B)	(C)	(D)	(E)	(F)
	Parcel Count	Total Area Sq Ft	Imp. Area Sq Ft	% of Total Impervious Area	Avg Impervious Area Sq Ft	% of Total Area that is Impervious
Single Family	26,078	636,195,726	94,245,445	32%	3,614	15%
Multi-family	6,626	193,751,640	42,293,081	15%	6,383	22%
Comm/Indust/Office	2,314	222,531,361	59,935,187	21%	25,901	27%
Agriculture	4,616	3,854,345,991	72,687,230	25%	15,747	2%
University of Oklahoma	199	76,314,671	15,637,104	5%	78,578	20%
Miscellaneous	18	17,709,556	6,827,420	2%	379,301	39%
Total	39,851	5,000,848,945	291,625,467	100%		

The storm water rate, in dollars per square feet (sq ft) of impervious area, was then developed as shown in Table ES-5. The corresponding billing amounts for user classes for each parcel were then determined as shown in Table ES-6 for the first 5-year period and in Table ES-7 for subsequent 5-year periods, assuming Option 1. Table ES-6 also shows the average impervious area and average yearly bill under each of the three options for the three different user classes as well as the University of Oklahoma.

Table ES-5
Storm Water Rate Calculation for FY 2009–2010 through 2013–2014

	Option 1	Option 2	Option 3
Revenue Requirement	\$7,063,267	\$6,603,587	\$6,522,467
Total Impervious Sq Ft	291,625,467	291,625,467	291,625,467
Yearly Rate (\$/Sq Ft)	\$0.024	\$0.023	\$0.022
Monthly Rate (\$/Sq Ft)	\$0.0018	\$0.0017	\$0.0017

Table ES-6
Average Bill for Each User Class (Based on Mid-Year, 2011–2012, of 2009–2014 Planning Period)

User Class	Average Impervious Surface (Sq Ft)	Option 1		Option 2		Option 3	
		Average Yearly Bill (\$)	Average Monthly Bill (\$)	Average Yearly Bill (\$)	Average Monthly Bill (\$)	Average Yearly Bill (\$)	Average Monthly Bill (\$)
Single Family	3,614	87.53	7.29	81.84	6.82	80.83	6.74
Multi-family	6,383	154.60	12.88	144.54	12.04	142.76	11.90
Commercial/Industrial/Office	25,901	627.33	52.28	586.50	48.88	579.30	48.27
Agriculture	15,747	381.40	31.78	356.58	29.71	352.20	29.35
University of Oklahoma	78,578	1,903.19	158.60	1,779.33	148.28	1,757.47	146.46

Table ES-7
Storm Water Rates for the Subsequent 5-Year Planning Periods (Option 1)

	5-Year Planning Period		
	FY 14/15 to 18/19	FY 19/20 to 23/24	FY 24/25 to 28/29
Revenue Requirement	\$9,596,914	\$11,117,910	\$13,228,877
Total Impervious Sq Ft	291,625,467	291,625,467	291,625,467
Yearly Rate (\$/Sq Ft)	\$0.0329	\$0.0381	\$0.0454
Monthly Rate (\$/Sq Ft)	\$0.0027	\$0.0032	\$0.0038
Average Yearly Single Family Bill	\$118.93	\$137.78	\$163.94
Average Monthly Single Family Bill	\$9.91	\$11.48	\$13.66

As rates were being considered, a nationwide survey was performed to help the City ascertain whether it was common to exempt universities from storm water fees. The results indicated that most universities are not exempt from storm water charges. The City eventually decided to bill all impervious surfaces, both universities and other exempt properties, within the City. The survey taken indicated that in cities which claimed that their fees were fully adequate to fund the storm water utility, monthly utility fees averaged \$9.95 (in 2008 dollars). This compares quite favorably for the City of Norman’s anticipated average fee of approximately \$6.74 to \$7.29 in FY 2011–2012 dollars. As a final output, a long rang financial plan was developed that mapped the financial health of the storm water utility over the 20-year study period.

Table ES-8 shows various bills in 2011–2012 dollars for various impervious cover deciles (i.e., groups of equal frequency). As indicated, approximately 40% of single-family customers have 2,800 square feet of impervious surface or less, which would result in 40% of Norman’s single-family property owners receiving maximum monthly bills of \$5.65, \$5.28, or \$5.22 (probably less depending on each property’s actual impervious amount) for Options 1, 2, and 3, respectively. The median single-family impervious square footage is approximately 3,100 square feet and implies a maximum monthly bill of \$6.26, \$5.85, or \$5.78 (probably less depending on each property’s actual impervious amount) under Options 1, 2, and 3, respectively.

Table ES-8
Bill for Various Impervious Surface Deciles

Single-Family Impervious Surface (sq ft)	Decile – % Properties ≤ sq ft Given	Option 1		Option 2		Option 3	
		Average Yearly Bill (\$)	Average Monthly Bill (\$)	Average Yearly Bill (\$)	Average Monthly Bill (\$)	Average Yearly Bill (\$)	Average Monthly Bill (\$)
2,500	30	60.55	5.05	56.61	4.72	55.91	4.66
2,800	40	67.82	5.65	63.40	5.28	62.62	5.22
3,100	50	75.08	6.26	70.20	5.85	69.33	5.78
3,400	60	82.35	6.86	76.90	6.42	76.04	6.34
3,800	70	92.04	7.67	86.05	7.17	84.99	7.08
4,400	80	106.57	8.88	99.63	8.30	98.41	8.20

RECOMMENDATIONS/IMPLEMENTATION PLAN

Recommendations were developed to cover the range of topics analyzed and evaluated as part of the SWMP development. In certain instances, the recommendations presented should be viewed with the understanding that further meetings, discussions, and considerations will be required. These recommendations covered general items, watershed and stream assessments, hydrologic and hydraulic modeling, drainage criteria manual updates, storm water problems and solutions, key issues, and storm water financing. An overview of the recommendations includes:

Future Meetings and Coordination

- Continue to involve stakeholders in all aspects of the SWMP including implementation.
- Refine storm water and watershed protection goals and needs in the future based on continued public involvement and new studies.
- Develop a formal public outreach campaign or program to further educate citizens about the City’s storm water needs, the importance of obtaining adequate funding to meet those needs, and the general support needed to sustain a viable storm water program throughout the City.

Key Issues

- Stream Planning Corridors and 100-year full buildout floodplain dedications as well as structural and non-structural storm water quality controls.
 - Dedicate Stream Planning Corridors (SPCs) and/or the 100-year full buildout floodplains to the City of Norman by easement or title for streams located in the Lake Thunderbird watershed that have a drainage area greater than 40 acres.
 - Prohibit development or significant land disturbance in the SPCs and/or 100-year full buildout floodplain. Exemptions should include items such as, but not limited to, maintenance activities, greenway trails, road crossings, utilities, and stream stabilization measures.
 - Require additional stream-side buffers of 15 feet to each side of streams with drainage areas greater than 40 acres that are located in the Lake Thunderbird watershed and also in Suburban Residential and Country Residential areas as defined in the Norman 2025 Plan including subsequent updates to the comprehensive plan as adopted by the City Council.
 - Require that water quality facilities be constructed to capture and treat runoff from all proposed developments in the City of Norman that exceed 1 acre (or some other size selected by the City) in size. The runoff “capture and treatment volume” should be set to 0.5 inch of runoff from the development area unless specified otherwise for a special condition.
 - Allow very small developments less than 1 acre in size or some other size limit to pay into a regional detention/water quality program in lieu of building very small water quality structures. The City’s present regional detention program should be broadened to include this water quality fee in lieu process.

- Allow and encourage low impact development techniques such as rain gardens and biofilters to provide a portion or all of their storm water quality control requirements subject to the developer providing sufficient technical justification for the techniques.
- For developments that do not dedicate the SPC or full buildout 100-year floodplain by virtue of obtaining a variance, the runoff capture and treatment volume for their development area should be increased to 0.7 inch of runoff.
- Allow limited variances for special conditions/situations that would utilize alternative approaches that could be shown to achieve similar water quality, flood control, and recreational opportunity. In situations where there is a clearly defined riparian corridor of environmental significance and/or flood prone soils, it should be relatively more difficult to obtain such a variance. However, obtaining such variances should be less difficult in situations where a riparian corridor does not exist and the subject waterway flows through an area that has experienced significant past disturbance or change from natural conditions (such as past agricultural activities and/or activities associated with residential, commercial, transportation, or industrial uses).
- Implement nonstructural storm water quality controls in addition to SPCs, including a program to educate the public on fertilizer use, a program to control the overused of fertilizers, a procedure to ensure proper septic system installation and operation, and a continuation of present development density (and impervious cover) limitations in the Lake Thunderbird watershed.
- Require the following compliance measures if development or significant land disturbance occurs within the stream banks of a stream in the City:
 - USACE’s 404 permitting documentation and proof of permit to be submitted to the City prior to plat approval,
 - Riparian stream corridor mitigation will be required (tree replacement, re-vegetation, stream stabilization using bio-engineering techniques, etc.), and
 - Inlet and outlet structures will be provided as needed to incorporate erosion protection.
- Acquisition of drainage easements and rights-of-way along streams and detention facility areas.
 - Develop a plan and begin to obtain drainage easements and/or rights-of-way (as needed) in Level 1 and 2 streams and for storm water detention facilities where access is needed for continuous/routine maintenance activities. For streams, the amount of easement or right-of-way would be as needed based on specific site conditions but, in general, would include a width of stream extending bank to bank plus 10 feet on each side of the stream channel. This can include those areas where storm water CIP projects have been identified if the maintenance need justifies obtaining the easements in advance of designing and constructing the proposed CIP project.
- Enhanced maintenance of creeks and storm water detention facilities.
 - A citywide stream maintenance program should be implemented over the next 2 or 3 years consistent with the acquisition of easements, rights-of-way, rights-of-way, rights-of-entry, and reaches of “no action,” depending on the situation/conditions. Maintenance should focus on those stream reaches and/or detention facility areas where capital improvements are constructed in order to protect those investments. The City should also consider outsourcing some, or all, of the maintenance activities if it is advantageous,

especially while a City's program is ramping up. The City should also focus on detention facilities in which dam maintenance may become a safety issue.

- Dam safety issues.
 - The City should investigate and identify, to the extent possible, the responsible parties for the inspection, maintenance, and overall safety of dams that are judged to be a potential safety hazard. This work should be undertaken beginning with the dams judged to have the greatest public safety risk. An inventory and prioritization method should be developed at the beginning of the investigative work.
 - While stopping short of taking over dam ownership, liability, and routine maintenance from Property Owner Associations (POAs) or other owners, on a case by case basis the City should take over the inspection and maintenance of dams that pose significant safety concerns. POAs should maintain the general/routine mowing and small scale maintenance responsibilities while the City undertakes the more critical inspection and maintenance responsibilities.
 - For any dam for which the City considers taking over certain inspection and maintenance responsibilities, it is recommended that the City first study and determine the prevailing conditions for such dam and its appurtenances. Should the City take over inspection, maintenance, and upgrade responsibilities for the structures, it should first be determined what actions they or the present owners might have to take to bring such structures into state dam safety compliance. Such actions could include determining whether the dam structures, including emergency spillways, require modifications to strengthen them against failure or breach. Another important aspect is whether any of the dams need an emergency action plan to reduce the risk to lives and property that can result from dam failure.

Policy, Ordinances, and Criteria

- Use watershed full buildout peak discharges for new developments and make necessary changes to City policy, the subdivision regulations, and drainage criteria manual.
- Retain the low density development policies outlined in the Norman 2025 plan for the Ten Mile Flat Creek watershed and the areas generally east of the urban core draining to Lake Thunderbird.
- Update the City's Drainage Criteria Manual to include rainfall and runoff methods established in the SWMP.
- Develop a Storm Water Quality Criteria Manual with SWMP findings and recommendations.
- Develop an Erosion Control Manual aimed at preventing erosion problems associated with construction.

General Storm Water Quantity and Quality Management

- To facilitate SWMP improvements implementation, develop a CIP program with staff dedicated to managing the associated design and construction activities. This staff can balance their cyclic work load by using consulting firms and other professionals.
- Inspect and monitor the stream erosion areas identified on a regular schedule (e.g., every 1 or 2 years) until streams are stabilized with adequate improvements.
- Monitor and document conditions associated with the problems identified in the SWMP until CIP improvements solve or mitigate them.

- Incorporate any new problems and possible solutions on a continuing basis.
- Review and update solution prioritizations every few years.
- Continually explore ways to integrate solutions to address multiple problem types and incorporate greenway opportunities.
- Develop collaborative agency partnerships to assist in project funding and cooperation.
- Maintain awareness and knowledge of all water quality monitoring being carried out in watersheds that originate in, or flow through, the City of Norman.
- Meet with the cities of Moore and Oklahoma City to explore ways to improve water quality and preserve Lake Thunderbird's water quality.
- Meet with the Oklahoma Department of Environmental Quality (ODEQ) and get updates on the Lake Thunderbird Watershed Management Plan development and the Canadian River TMDL status. Assign a City coordinator to follow the progress and status of these two programs as well as the MS4 program as compliance activities associated with these three programs will impact water quality in Norman for the foreseeable future.
- Assure compliance with requirements of the City's MS4 OPDES storm water permit, the recently developed Canadian River Bacteria TMDL, and the ODEQ Lake Thunderbird Watershed Management Plan development.

Hydrologic and Hydraulic Modeling

- Update hydrologic and hydraulic models consistent with up-to-date priorities using the data, methods, and findings of the SWMP.
- Develop a hydrologic and hydraulic model management system using an internal City server or a web server to improve user access to the models, facilitate City maintenance and distribution of the models, and to track legitimate updates.
- Submit Letters of Map Revision (LOMRs) to FEMA for the Level 1 streams studied during the SWMP development. When other streams are studied or updated in detail, those studies/updates should be submitted as FEMA LOMRs at that time.

Funding

- Establish long-range funding sources for storm water management such as general obligation bonding and the establishment of a storm water utility.
 - Develop and carry out a strategic work plan for a citizen vote on the proposed storm water utility as described in Section 8. The City must also decide whether establishment of the master account file and other key billing logistics will be worked out before or after the citizen vote (assuming it passes). Regardless, preliminary discussions on billing and administration requirements should begin.
 - Develop and carry out a strategic work plan for a citizen vote on the proposed general obligation bond program as described in Section 8.

SUMMARY STATEMENT

With the results of this SWMP as a solid foundation, the City of Norman will be able to:

- Satisfy their regulatory requirements including the mandated OPDES MS4 storm water quality permitting program.
- Meet the challenges facing the community, including identifying problems and solutions associated with stream flooding, stream erosion, local drainage problems, and water quality.
- Enhance recreational opportunities and protect the environment.
- Obtain input from all stakeholders, receive public input, provide public education on important issues, and maintain public support into the future.