Thunderbird Lake Watershed Implementation Project Phase II

FY 11/12 §319(h) C9-996100-16 Project 5

Impediments to Low Impact Development in Lake Thunderbird Watershed

Submitted by

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Introduction

Lake Thunderbird, in central Oklahoma, is a water supply reservoir for the cities of Norman, Del City, and Midwest City, which have a combined population of approximately 178,000. The Lake Thunderbird watershed covers approximately 258 square miles in Oklahoma and Cleveland Counties (Figure 1). The major tributary to Lake Thunderbird is the Little River, and other tributaries include Hog Creek, Clear Creek, Dave Blue Creek, Jim Blue Creek, Rock Creek, Moore Creek, Kitchen Creek, and Elm Creek. In addition, Lake Stanley Draper is located in the watershed.

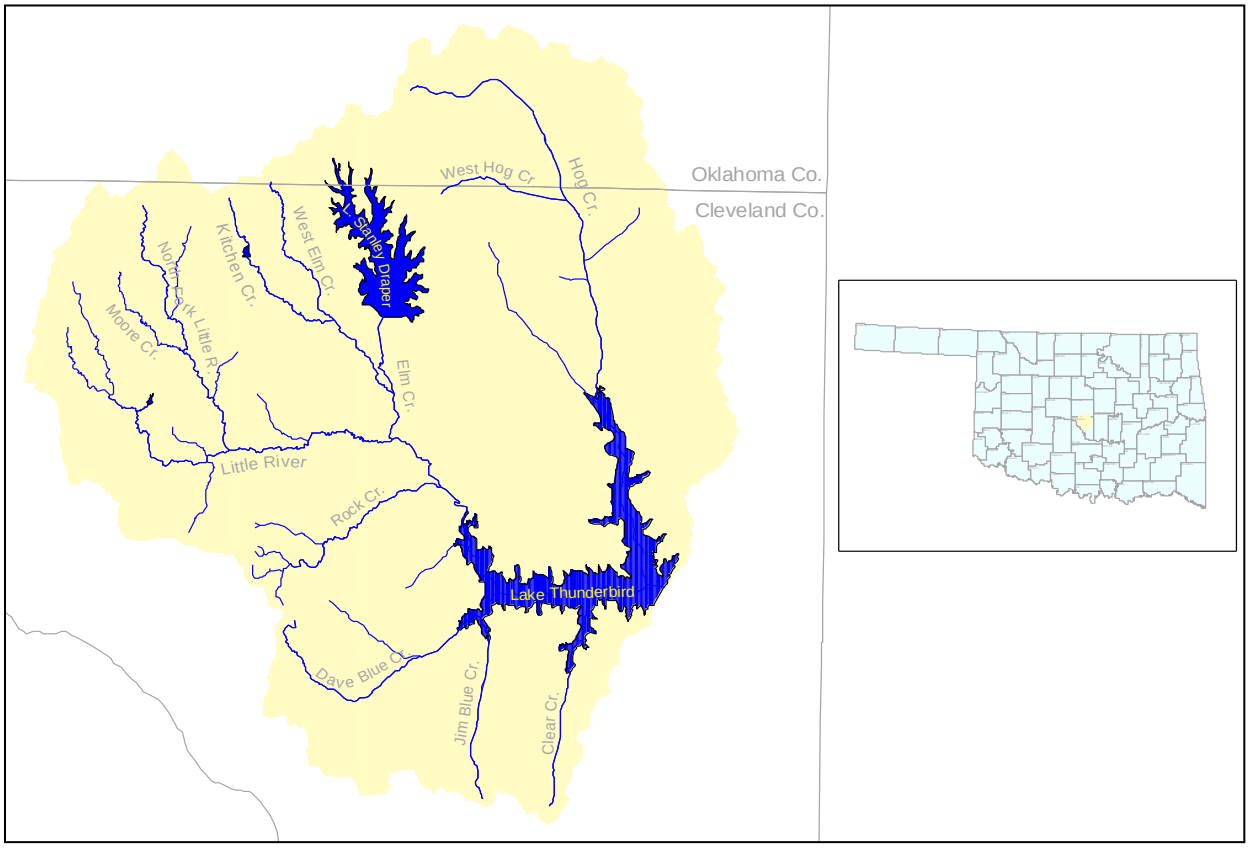

Figure 1. Lake Thunderbird Watershed.

The Lake Thunderbird Watershed in central Oklahoma has a rapidly expanding urban component. The Lake is managed by the Central Oklahoma Master Conservancy District (COMCD), and serves as a water supply for Norman, Del City and Midwest City. The lake is also a major recreational resource for the area. The lake and many of its tributaries are listed on the 303(d) list of impaired water bodies.

The City of Norman and the COMCD are both exploring options to limit water quality pollution to the lake. In 2005, the City of Norman approached the Oklahoma Conservation Commission for assistance with their stormwater master plan and protecting Lake Thunderbird. As part of a 2004 §319 project, OCC worked with Dr. Baxter Vieux of Vieux and Associates and with the University of Oklahoma to model the watershed and recommend load reductions necessary to meet beneficial use support in the lake. Dr. Vieux had previously modeled the watershed and had conducted recent water quality monitoring for the COMCD to help them predict some of the consequences of unregulated growth for the water supply reservoir.

The results of Dr. Vieux's modeling exercises suggest several things. The first of which is that metropolitan areas were well ahead of growth rates predicted in their 2025 plans. Secondly, although all portions of the lake, as represented by OWRB monitoring stations, violate water quality standards at various times, one station in particular is largely responsible for standards exceedances. Nutrient concentration and turbidity values are significantly higher at this station (upper Little River Arm) than in the remainder of the lake. This station is located upstream of a bridge and causeway which partially separate this arm from the main body of the lake.

Potential sources of pollution in the watershed include both agricultural and urban areas. Agriculture in the watershed occurs largely in the form of small, urban ranchettes where landowners own 5-20 acres to keep a few horses or a small herd of cattle. Preliminary results from the Vieux and Associates model suggest that although these areas contribute some to overall loading, the most significant pollutant sources are found in rapidly urbanizing areas of the watershed. In addition, the small acreage size managed by the typical agricultural producer coupled with the respectively large number of small landowners dramatically adds to the difficulty of significantly reducing loading from agricultural areas.

As a result, the Lake Thunderbird project has focused on urban sources of pollution. Although a significant portion of the watershed is still in pasture and urban ranchette agriculture, very little of the watershed is not incorporated. Therefore, reduction of NPS from agricultural sources in the watershed might be best achieved through zoning requirements. This report outlines efforts to evaluate the ordinances in the City of Norman for impediments to low impact development (LID) and make recommendations to allow better development to take place. The City of Norman has already made some positive changes, including the development of a buffer ordinance for part of their jurisdiction, but other practices will help Norman further protect its water resources for future generations.

Impediments to Low Impact Development in Local Codes

Low impact development is an approach to developing or redeveloping properties with the intent of minimizing the negative impact on the environment, in particular local stream water and habitat quality. Usually, this type of development is less costly and provides many additional economic, psychological, and recreational benefits with the only things standing in the way of positive change being old habits….and restrictive local ordinances.

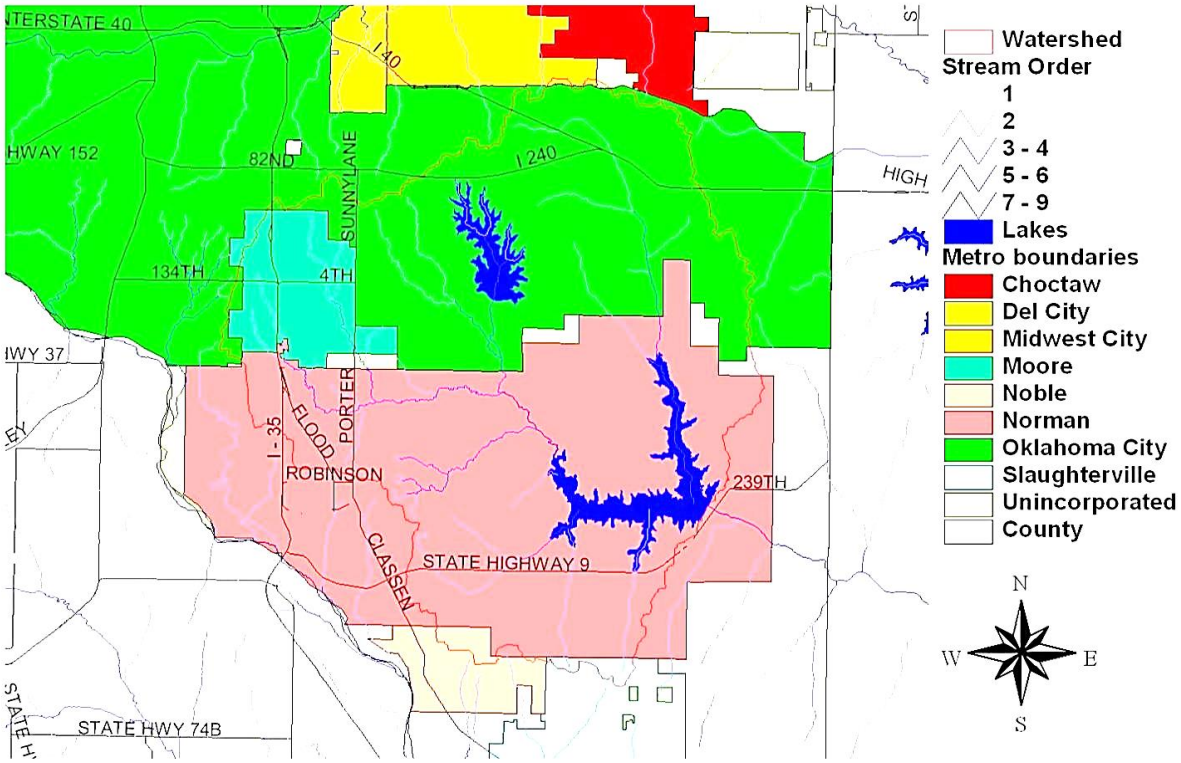

Figure 2. Municipal jurisdictions within the Lake Thunderbird Watershed.

The municipalities that contribute stormwater runoff to Lake Thunderbird are shown in Figure 2. The City of Norman makes up a sizable portion of the watershed. In addition, Lake Thunderbird is the main source of drinking water for Norman, meaning that the city drinks its own stormwater. This important factor has motivated the city to address water quality issues in the watershed and has led to some recent progressive ordinances, including the state's first fertilizer ordinance that regulates the use of fertilizer containing

phosphorus. All of these factors indicate that Norman is a city that would utilize and likely act upon an evaluation of their codes for impediments to LID.

In order to evaluate the City of Norman codes for impediments to low impact development, a handbook established by the Center for Watershed Protection was used. Better Site Design: A Handbook for Changing Development Rules in Your Community (CWP 1998) http://www.cwp.org/online-watershed-library/cat_view/64-manuals-and-plans/82-stormwater-management-manuals-plans-and-guidance is an excellent resource because it not only has a scorecard to compare a municipality's current codes to design benchmarks, it also has several pages of helpful information about each design benchmark to help local managers assess the feasibility of that practice in their local area or to help win over community naysayers.

The Norman codes were evaluated according to the scorecard in this handbook and are included in Appendix A. Despite a number of progressive initiatives in Norman as of late, the total score was 31 out of 100. This low score means that there is room for continued improvement in city codes to remove impediments to LID. The following report, using the Handbook as a guide, gives an overview of conventional practices, recommendations for achieving a lower impact, and what Norman codes allow or require. In most cases the benefits of making those changes are given and ordinances from other parts of the country are offered as a model. These principals and their benefits are covered in much more detail in the Handbook (CWP 1998). The practices are assembled into three groups that are detailed below: Residential Streets and Parking Lots, Lot Development, and Conservation of Natural Areas.

Group 1: Residential Streets and Parking Lots

This group of principles mainly relates to a number of ordinances that dictate the amount of impervious surfaces that are needed for roads and parking lots under

conventional development rules. Recommendations are given for each principal to reduce the runoff or reduce the impact of that runoff before entering a sewer system (and local streams).

Street Width (Principal 1)

In many communities, ordinances require residential streets to be 36 feet wide or more, often making up the single largest percentage of impervious surfaces in a subdivision. Depending on the volume of traffic expected on a street, narrower street widths can safely and effectively serve cars, trucks, fire engines, garbage trucks, and on-street parking, while dramatically reducing the imperviousness of a neighborhood.

Recommendations:

1) Streets should be 18 to 22 feet wide (or even narrower) for streets serving 50 or fewer homes (<500 average daily trips). This recommendation is backed up by the American Association of State Highway and Transportation Officials and the American Society of Civil Engineers and the successful implementation of streets as narrow as 14 feet wide in municipalities across the country.

2) On roads serving slightly higher densities of traffic, queuing streets are recommended (streets where parking lanes can also serve as traffic lanes). Essentially, there is only one lane for traffic moving in either direction. When cars approach one another in the moving lane, one will pull aside in the parking lane and wait for oncoming traffic to pass.

Norman: Although local rural roads can be 22 feet wide, Norman's narrowest allowable (local) urban road is 26 feet. Queuing lanes are presumably allowed given the existence of 26' streets with 2 parking lanes (typically 7 feet each), leaving 12 feet for 2-way vehicle traffic.

Benefits: A reduction in street width would lead to a corresponding reduction in the minimum in runoff volume from these streets and would save a similar percentage in construction cost for the street. A reduction from 26 feet to 22 feet would result in 15% reduction in runoff volume and cost for initial construction.

Model Ordinances: Examples of narrow residential street widths from three locations in the United States are given in Table 1.

Organization, Source	Residential Street Pavement Width	Maximum Average Daily Traffic (trips/day)
State of New Jersey	20' (no parking) 28' (parking on one side)	0-3,500 0-3,500
Boulder, Colorado	20' 20' (no parking) 22' (one side) 26' (both sides) 26'(one side)	150 350-1,000 350 350 500-1,000
Bucks County, PA	12' (alley) 16-18' (no parking) 20'-22'(none) 26' (one side) 28' (one side)	-- 200 200-1,000 200 200-1,000

Note: Street options are influenced by housing density and the need for on-street parking

Table 1: Examples of Narrow Residential Street Widths (after CWP 1998).

Street Length (Principal 2)

Despite the cost of streets and the related infrastructure, street length is seldom a consideration in street layouts for residential developments.

Recommendations:

Increase the number of homes per unit street length by considering a range of street layouts. This practice can be maximized by also reducing frontage distances and side yard setbacks, and allowing smaller lots (discussed later).

Norman: There is no encouragement for optimizing street length in a development.

Benefits: Reducing pavement, curb and gutter, storm sewer, and utilities can add up to significant savings. Also, long term maintenance savings reduce long-term costs for municipalities.

Model Ordinances:

GLOUCHESTER, MASSACHUSETTS: 5.9 Cluster Development

5.9.5 Design Criteria
(a) The Planning Board, in order to grant a special permit for a Cluster Development, must find that the proposed design and layout of the development is superior to a conventional one in preserving open space for conservation and recreation; in preserving natural features of the land; and in allowing more efficient provision of streets, utilities and other public services.

Right-of-Way Width (Principal 3)

Many communities have right-of-way widths of 50-60 feet to accommodate sidewalks and utilities. This practice impedes the ability to create more compact lots and requires more clearing at the time of development.

Recommendations: Allow a narrower right-of-way under 45 feet, and as low as 20-24'. This can be done by the following: 1) narrow the pavement width, 2) narrow sidewalks and/or restrict to one side of the street, 3) reduce the border width between the street and the sidewalk, and 4) install utilities underneath the road. One exception to this recommendation is that using swales for stormwater conveyance is a recommended practice that would require 10-12 feet of right-of-way along one or both sides of the road.

Norman: Norman has a minimum right-of-way width of 50 feet. Utilities are not allowed under the pavement surface.

Benefits: Allows greater flexibility in site design and particularly allows compact residential design to take place.

Model Ordinances: Examples of narrower right-of-way widths from three sources in the United States are given in Table 2.

Source	ROW Width	Pavement Width and Purpose
Portland, Oregon	35' 40	20' residential street 26' residential street
Montgomery County, Maryland	20' 44' 46'-60'	16'; residential alley 20'; residential street 26'; residential streets
ASCE, 1990 (Recommendation)	24-26' 42'-46'	22'-24 residential alley 26' residential street

Table 2: Examples of Narrow Right-of-Way Widths (after CWP 1998).

Cul-de-Sacs (Principal 4)

Dead end streets require a means for large emergency and utility vehicles to exit without backing up. Many communities require a large bulb with 50-60 feet or more radius to allow for this function. These paved surfaces create large impervious surfaces that generate large amounts of runoff.

Recommendations:

1) Reduce the radius of the bulb to less than 45 feet, ideally less than 35 feet (newer vehicles have much better turning radii than in the past).

2) Include landscaped islands in the center of the cul-de-sac to reduce the surface area while maintaining the turning radius.

3) Allow alternative turn arounds, like the "hammerhead" on short streets or low density developments.

Norman: Norman allows cul-de-sacs to have a radius of 41-42 feet (within the recommended range, but could be reduced further). Norman also allows landscaped islands. However, alternative turn arounds are not permitted.

Benefits: Including a landscaped island on a 40 foot radius cul-de-sac will reduce the imperviousness by 12.5%. Reducing the cul-de-sac radius from 40 to 30 feet will reduce imperviousness by 43-44% whether or not they have islands, respectively. Replacing a 40 foot radius cul-de-sac with a 20 foot by 60 foot hammerhead will reduce imperviousness by 75%. Construction and maintenance costs will be reduced as well.

Model Ordinances:

SOUTHWEST HARBOR, MAINE: ROAD DESIGN STANDARDS

C. Dead –end Roads

Standards as listed under paragraph A shall be applicable to dead-end proposed Town Ways. In addition, they shall be constructed with either a turning circle or a hammerhead. A hammerhead may be used for road lengths up to 800'. A road longer than 800' must have a turning circle.

Turning Circle	Hammerhead
Outer edge of pavement 50' radius	Edge of hammerhead 60' across
Inner edge of pavement 30' radium	Edges of hammerhead 20' across

Examples of turning radii for several other locations in the United States are given in Table 3.

Turning radius	Source
35 feet (with approval of fire dept.)	Portland (OR) Office of Transportation
38 feet outside turning radius	Bucks County (PA) Planning Commission
45 feet	Fairfax Co (VA) Fire and Rescue Department
35 feet	Baltimore County (MD) Fire Department
45 feet	Montgomery County (MD) Fire Department
43 feet	Prince Georges County (MD) Fire Department

Table 3: Examples of Cul-de-Sac Turnaround Radii (after CWP 1998).

Vegetated Open Channels (Principal 5)

A majority of urban pollution is typically generated from residential streets, including through deposition (air settling and rainfall), wearing tires/brake pads, runoff from adjacent pervious and impervious areas, etc. Curb and gutter systems, required in most communities, wash this pollution directly to local streams without any chance of cleaning the water. Open drainage that allows some purification of the water is often prohibited.

Recommendations:

1) Where soils, slope, and housing density permit, engineered swales (not roadside ditches) are recommended.

2) Establish criteria for swales that can provide stormwater treatment.

Norman: Norman requires curb and gutters on all new roads except for rural roads and rural estates (with 2 acre lots). There are no engineering criteria for engineered channels that provide stormwater treatment. Regulations state that LID techniques are encouraged, but interested developers are referred to the stormwater manual for Wichita, Kansas.

Benefits: Engineered swales allow for infiltration and filtering of stormwater. This practice results in reduced runoff volumes and cleaner water working its way to local streams. In addition, the cost of an engineered swale costs about a half to a third as much to build as a curb and gutter system.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 179: LOW IMPACT DEVELOPMENT

179.03 LID Site Design Strategies

(C) Site Design Elements.

(d) Grassed Swales: Swales have traditionally been used in rural and suburban areas with low residential densities as a conveyance for runoff from roads and highways. The modern swale as a LID element is utilized as both a method of conveyance and retention, and as an infiltration strategy. Dry swales typically have 2 to 3 feet of permeable soil located above a gravel base allowing stormwater to infiltrate.

Parking Ratios (Principal 6)

Parking ratios usually state the minimum number of parking spaces needed for a given land use, related to the size of the building or number of dwelling units. Often these parking ratios are exceedingly conservative and result in up to 30% extra parking, even at peak times. In addition, some developers worry that they will lose business to a competitor with a bigger parking lot if their parking lot is too small; also, lenders often require extra parking in order to receive a loan. These pressures result in parking lots that are much larger than needed and generate excessive amounts of polluted runoff.

Recommendations:

1) Make sure current parking ratios are in line with the latest national and regional averages, or conduct parking demand studies to determine the best ratios for the municipality.

2) Indicate that parking ratios are a maximum, not a minimum, to prevent oversized parking lot from being produced.

Norman: The parking ratio for professional office buildings and commercial is slightly higher than recommended. The parking ratio for single family homes is within the recommended 2 spaces per home or less. Norman does not set parking ratios as a maximum.

Model Ordinances:

PORTLAND, OREGON: 33.266.115 Maximum Allowed Parking Spaces

A. Purpose. Limiting the number of spaces allowed promotes efficient use of land, enhances urban form, encourages use of alternative modes of transportation, provides for better pedestrian movement, and protects air and water quality.

The maximum ratios in this section vary with the use the parking is accessory to and with the location of the use. These maximums will accommodate most auto trips to a site based on typical peak parking demand for each use. Areas that are zoned for more intense development or are easily reached by alternative modes of transportation have lower maximums than areas where less intense development is anticipated or where transit service is less frequent. In particular, higher maximums are appropriate in

areas that are more than a 1/4 mile walk from a frequently-served bus stop or more than a 1/2 mile walk from a frequently-served light rail or streetcar stop.

B. Maximum number of parking spaces allowed. Regulations in a plan district or overlay zone may supersede the regulations in this subsection.

1. Surface parking. Where more than 25 percent of the parking accessory to a use is on surface parking lots, both the structured and surface parking are regulated as follows. Parking accessory to a use includes accessory parking that is on- and off-site:

a. Generally. The maximum number of parking spaces allowed is stated in Tables 266-1 and 266-2, except as specified in subparagraph B.1.b, below;

b. Exception for sites not well-served by transit. For sites located more than 1/4 mile from a transit stop with 20-minute peak-hour bus service and more than 1/2 mile from a transit stop or station with 20-minute peak-hour light rail or streetcar service, the maximum number of parking spaces allowed is 125 percent of the amount stated in Tables 266-1 and 266-2. Peak hour service is measured on weekdays between 7:00 AM and 8:30 AM and between 4:00 PM and 6:00 PM. Applicants requesting this exception must provide a map identifying the site and all transit stops and stations within 1/2 mile of the site and Tri-met schedules for all transit routes within 1/2 mile of the site.

2. Structured parking. Where 75 percent or more of the parking accessory to a use is in structured parking, both the structured and surface parking are regulated as follows. Parking accessory to a use includes accessory parking that is on- and off-site:

a. Generally. There is no maximum number of parking spaces, except as provided in subparagraph B.2.b, below;

b. Parking accessory to Medical Centers and Colleges. The maximum parking allowed that is accessory to Medical Centers and Colleges is stated in Tables 266-1 and 266-2.

3. Exception in the EG and I zones. In the EG and I zones, there is no maximum number of accessory parking spaces for either structured or surface parking where both B.3.a. and b. is met, and either B.3.c. or d. is met:

a. The site is at least eight acres in area;

b. The site is located more than 1/2 mile from a transit stop or station with 20 minute peak-hour light rail or streetcar service; and

c. At least 700 of the accessory parking spaces are in a structure; or

d. The structured parking is in a structure with at least three floors, and parking is on at least three floors of the structure.

Parking Codes (Principal 7)

Parking ratios can be further reduced based on site conditions, including proximity to mass transit and potential for shared parking arrangements with adjacent establishments.

Recommendations:

1) Reduce parking ratios for proximity to mass transit stops.

2) Reduce parking ratios to encourage shared parking arrangements with adjacent establishments that have different peak parking needs. If so, provide a model shared parking agreement to further encourage the practice.

Norman: Norman does not generally have incentives for mass transit or shared parking. The exception is in the Mixed Use Development (MUD) areas. MUDs promote the interdevelopment of commercial, residential, open space, and other uses in one area to build more walkable and more efficient communities. The city code provides reduced parking ratios for MUDs and essentially provides a formula for determining the number of spaces needed based on the mix of uses that are present.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 172.05 Standards For The Number Of Spaces By Use
(C) Off-street parking.

(3) Reductions. Developments may utilize the following reductions to the required off-street parking ratios listed in Table 3 when the following standards are met:

(a) Transit stops. Properties located within a quarter (0.25) mile radius of a transit stop may further reduce the minimum off street parking requirements by up to fifteen percent (15%).

(b) Motorcycle and scooter spaces. Up to 10% of the required automobile parking spaces may be substituted with motorcycle/scooter parking at a rate of one motorcycle/scooter space for one automobile space.

(c) Bike racks. Up to 10% of required automobile parking may be substituted with bicycle parking at a rate of one additional bicycle rack for one automobile space. This reduction shall be allowed in addition to other variances, reductions and shared parking agreements.

(d) Shared parking. Parking requirements may be shared where it can be determined that the peak parking demand of the existing or proposed occupancy occur at different times (either daily or seasonally). Such arrangements are subject to the approval of the Planning Commission.

(i) Shared parking between developments. Formal arrangements that share parking between intermittent uses with nonconflicting parking demands (e.g. a church and a bank) are encouraged as a means to reduce the amount of parking required.

(ii) Shared parking agreements. If a privately owned parking facility is to serve two or more separate properties, then a “Shared Parking Agreement” is to be filed with the city for consideration by the Planning Commission.

(iii) Shared spaces. Individual spaces identified on a site plan for shared users shall not be shared by more than one user at the same time.

Some communities that allow reduced parking requirements for access to public transportation are shown in Table 4.

Community	Description of Program
Olympia, WA	Allows reduction in required parking in concert with public transportation
Loudoun County, VA	Allows a reduction of up to 20% of the required parking for any use, building or complex within 1,000 feet of any regularly scheduled bus stop
Chicago, IL	Offers reduction in required parking for buildings connected to underground transit stations[1]
Hartford, CT	Reduces minimum required parking in return for developer carpool and transit encouragements)[1]
Montgomery County, MD	Reduces minimum parking requirements in proximity to rail stations [1]
Phoenix, AZ	Allows relaxations in proximity to bus transit [1]
Orlando, FL	Allows payments which support a transportation management program in-lieu of on-site parking [1]

[1]Source: Federal Transit Administration, 1997

Table 4: Communities that Allow Reduced Parking Requirements for Access to Public Transportation (after CWP, 1998).

Parking Lots (Principal 8)

A number of factors other than required parking ratios determine the size of parking lots, including stall dimensions, layout, parking aisles, and other areas such as entrances. Many communities establish a standard stall size that is big enough for the biggest vehicle, rather than considering savings garnered from planning for a large percentage of smaller vehicles. One way parking aisles and special considerations for overflow parking can also improve the overall impact of parking lots.

Recommendations:

1) Consider reducing the standard stall size for new parking lots. Recommended standard stall size is 9 feet or less wide by 18 feet or less long.

2) Require a fixed percentage of parking spaces (15-35%) be designated for compact vehicles with smaller stall dimensions. Thirty percent is recommended as a benchmark.

3) Encourage the use of pervious materials in parking lots, particularly the stalls or in overflow parking areas that receive less use.

Norman: Standard parking stalls in Norman are 8.5 feet wide (within the benchmark standard) and 19 feet long (exceeding the benchmark by a foot). There are no

requirements for a percentage of smaller stalls. Pervious materials are not allowed in regular or overflow parking areas.

Benefits: Stalls designed for compact vehicles can be up to 30% smaller than standard size, resulting in a large reduction in imperviousness, plus reduced construction and maintenance cost.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 172.04 Parking Lot Design Standards

(D) Compact spaces. A maximum of 35% of the total spaces may be compact spaces. Compact spaces shall be marked either by marking on the pavement or by separate marker.

KILL DEVIL HILLS, NORTH CAROLINA: 153.076(A)(7) Off Street Parking and Loading Materials for Driveways and Parking Areas.

(A) Detailed Specifications.

(7) Materials for Driveways and parking lots.

(a) Commercial driveways, parking areas and turn around areas shall be made of asphalt, concrete or permeable blocks, pavements, including porous concrete, porous asphalt, concrete grid pavers, permeable interlocking concrete pavers, and plastic reinforcing grids as defined in153.180(E)(3)(b). No types of temporary materials, such as landing mats and boards, shall be used for the construction of driveways.

(b) Overflow parking areas for commercial sites, in excess of required parking, may utilize grassed or unimproved areas of the site for parking. Parking shall not be allowed in required stormwater, landscaped or wastewater areas. If improvements are made to overflow parking areas standards and materials for required parking areas shall be utilized.

Parking Structures (Principal 9)

Parking structures can vastly decrease impervious surfaces, but the cost benefit is generally only realized for more expensive real estate. Parking structures can cost up to ten times or more the cost of a surface parking lot. Meaningful incentives can help encourage the construction of parking structures. These incentives will not only reduce the impervious area, but can improve the aesthetics of a development, reduce the distance people walk from their cars, and provide protection from the weather.

Recommendations:

1) Encourage multi-level and under-the-building parking with meaningful incentives such as tax credits, stormwater waivers, or density, height, or floor area bonuses.

2) Municipalities should use garages for their own buildings whenever feasible.

Norman: The city has no incentives to developers to provide structured parking.

Model Ordinances:

MILWAUKEE, WISCONSIN: 19.611 PARKING STRUCTURES

The purpose of Section 19.611 is to regulate the design and location of structured parking, and to provide appropriate incentives for the provision of structured parking. Structured parking is allowed to accommodate parking that is required for a specific use, or as a parking facility that is a use by itself.

19.611.4 Incentives for Provision of Structured Parking.

A. An applicant shall be allowed an additional 0.5 sq ft of floor area above the maximum allowed floor area ratio for every 1 sq ft of structured parking provided. The applicant shall meet the other requirements of the development standards for the base zone in which it is located.

B. If structured parking is underground, the applicant shall be relieved from Subsection 19.611.3.C and can locate the underground structure within any part of the setback and yard area. (Ord. 2025 § 2, 2011)

Parking Lot Runoff (Principal 10)

The previous categories included a number of recommendations to reduce parking lot footprints that generate savings in construction costs, for the environment, and for a more aesthetically pleasing environment. Additional water quality and aesthetic benefits can result from detaining (temporary ponding) and treating as much of the generated runoff as possible in vegetated areas within and adjacent to parking lots. Many municipalities already require landscaping within and around parking lots. These areas, often 10-15% of the land area, can be used to treat generated runoff.

Recommendations:

1) Require a minimum percentage of a parking lot to be landscaped.

2) Wherever possible, require onsite treatment of stormwater in vegetated areas within and along the edges of parking lots. Forms of treatment may include a) bioretention – temporary ponding in a landscaped depression, b) dry swales – a grassed channel that filters and treats runoff and discharges it into a storm sewer or nearby creek, c) sand filters – chambers along the edge of a parking lot that allow large particles to settle and

overflow is filtered through sand to treat the water before it is discharged into a storm sewer or stream, and d) filter strips – a large area of land that sheetflow is directed over to settle particles and absorb runoff water that is suitable for small parking lots or remote areas.

Norman: Norman does require parking lots to be landscaped and permanent irrigation to be installed for those areas. There are no requirements in Norman to treat parking lot runoff, although use of the above management practices is "encouraged" and developers are referred to the Wichita Stormwater Manual.

Benefits: The use of onsite stormwater treatment can result in significant runoff volume reductions and stormwater treatment while sometimes, depending on the method, beautifying the area. Plants used in bioretention are often more tolerant of harsh environmental conditions relative to the plants typically used in modern landscaping.

There are increased costs associated with these features. The main cost for these features is often land acquisition. However, landscaping is often already required in and around parking lots, so additional acquisition is usually not an issue. In addition, reducing the size of parking lots with the previous principles will help reduce overall acquisition costs. With onsite treatment, offsite treatment facilities (detention ponds) can be minimized or eliminated. Maintenance for many of these features is not much different than that of existing maintenance for landscaped areas.

Model Ordinances:

PEORIA, ILLINOIS: LOW IMPACT DEVELOPMENT PARKING ORDINANCE

I. Purpose

The purpose of this ordinance is to provide parking lots and landscaping in parking lots that will:

- Maximize the infiltration of storm water runoff;
- Minimize the quantity of storm water runoff generated to be discharged or treated away from the parking area;
- Filter pollutants from storm water runoff to yield cleaner storm water runoff that will improve the water quality of local lakes and streams;
- Maximize the use of native plant species;
- Improve the aesthetics of developed areas;
- Minimize the amount of impervious surfaces;
- Reduce the potential for flooding; and
- Utilize low impact development practices to devise site specific solutions for reducing the quantity and improving the quality of storm water runoff.

III. Design

A. Design Hierarchy

Parking lots shall be designed according to the following hierarchy to utilize low impact development practices to reduce the quantity of storm water runoff generated and improve the quality of storm water runoff. The purpose of this hierarchy is to guide the design of the parking lot. The design of the parking lot shall incorporate each of these steps in order (Step 1 shall be completed, then Step 2 shall be completed, then Step 3 shall be completed, etc.) to the maximum extent practicable:

1. Preserve natural areas such as wetlands and areas that consist of native vegetation and incorporate them into the storm water management system as areas where runoff can be infiltrated or discharged;
2. Maintain natural drainage patterns;
3. Reduce the amount of impervious surface through the use of shared parking and the use of pervious surfaces such as permeable concrete, geoblock porous pavement, and other similar materials;
4. Incorporate landscape features such as vegetated filter strips, sand filters, and other practices that filter pollutants from storm water runoff before runoff infiltrates the ground within the parking area or is conveyed to an area outside of the parking area;
5. Incorporate landscape features such as vegetated swales, bioretention areas, and other practices that infiltrate storm water runoff within the parking area or convey storm water runoff to an area outside of the parking area.

B. Design Standards

The purpose of these design standards is to identify how the parking lot should function.
Parking lots shall be designed to achieve the following standards:
1. Infiltration of storm water runoff shall occur within the parking area to the maximum extent practicable;
2. Filtration of pollutants in storm water runoff shall occur within the parking area to the maximum extent practicable;
3. Native vegetation shall be used as plantings for all landscape features designed to filter pollutants from storm water runoff, infiltrate storm water runoff, and convey storm water runoff to the maximum extent practicable;
4. Storm water runoff shall be conveyed so that pollutants and debris are removed prior to infiltration or conveyance off-site;
5. No untreated storm water runoff shall be discharged directly to a natural wetland, water body, or area outside of the parking area;
6. Landscape features designed to infiltrate storm water runoff and filter pollutants from storm water runoff shall be designed to minimize the need for maintenance and reduce the chances of failure; and
7. The quantity of storm water runoff leaving the parking area shall not be released at a rate greater than the applicable peak release rate listed in Section VIII of the Low Impact Development Storm Water Ordinance.

VII. Landscaping

A. Applicability

The landscaping standards of this chapter shall apply to all off-street parking areas containing a minimum of five (5) off-street parking spaces with the exception of multilevel parking structures.

B. Planting Standards

Parking lot landscaping shall be dispersed throughout off-street parking areas in internal islands, terminal medians, aesthetic landscape treatments, and/or along the perimeter of off-street parking areas in order to facilitate infiltration of storm water runoff and filtration of pollutants that complies with the Design Standards in Section III.B. Offstreet parking areas containing a minimum of five (5) spaces shall provide a minimum of 15 percent of the total parking area as landscaped open space. The interior dimensions of any landscaped area shall be sufficient to protect plant materials and to ensure proper growth.

C. Landscaping Features

Any combination of the following features that meets the Design Standards within Section III. shall be used as parking lot landscaping to filter pollutants from storm water runoff, allow storm water runoff to infiltrate the ground on site, and convey runoff offsite to a receiving area:
1. Vegetated filter strips;
2. Bioretention areas;
3. Infiltration bio-swales;
4. Vegetated swales;
5. Infiltration basins;
6. Infiltration trenches;
7. Sand filters; and
8. Created wetlands.

If other landscape features are proposed to be used in parking areas, the applicant shall submit a written statement explaining why the proposed landscape features are necessary and why the landscaping features identified above in Section VII.C.1-8 are not suitable to be used in the parking area.

Group 2: Lot Development

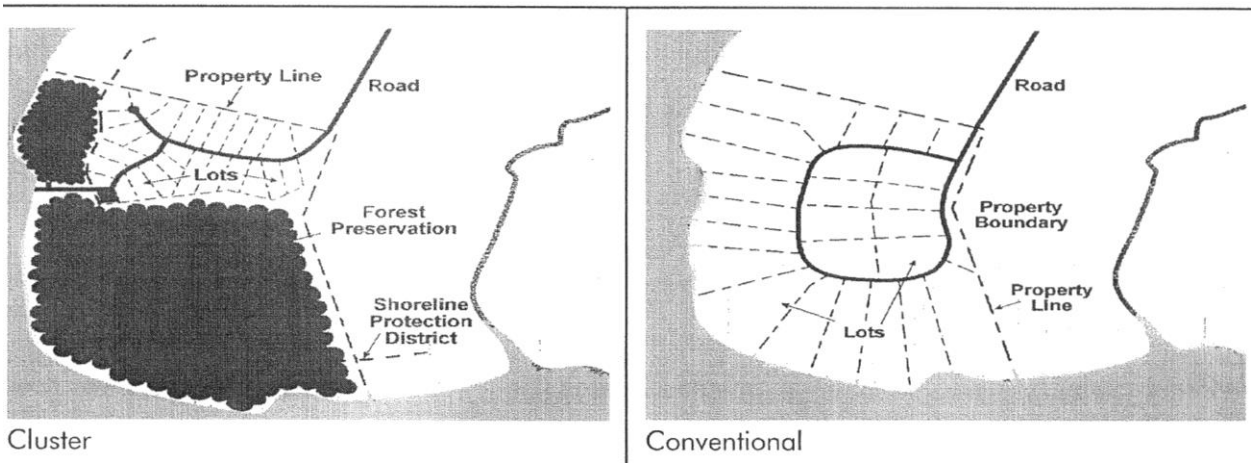

Figure 3: An example of open space development compared to conventional development on a site (after CWP 1998)

This group of principles mainly relates to a number of ordinances that dictate the size shape, and layout of residential lots, the size and layout of sidewalks and driveways, and the management of surface water on lots. Recommendations are given for each principal to reduce the runoff or reduce the impact of that runoff before entering a sewer system (and local streams).

Open Space Design (Principal 11)

In areas where base zoning density is 6 or fewer units per acre, open space development or cluster design allows one portion of a site to be developed more densely in order to leave open space in another portion of a development (Figure 3). Open space development has been promoted for reasons such as community design, preservation of rural character, and affordable housing, as well as more recently for stream protection. Some communities have adopted open space design, but many make it voluntary, rather than mandatory. It often requires special exemptions and procedures (including more studies and closer review) that make this option burdensome for developers.

Recommendations:

1) Allow open space design for new residential developments

2) Where open space design is allowed, make sure the criteria actually encourage reduced runoff and land conservation goals.

3) Make sure that the submittal and review requirements are the same as for conventional development.

4) Make open space design a by-right form of development, one that would not require a zoning variance or special permit exception.

5) Allow flexible site design criteria (setbacks, road width, lot sizes, etc.).

Norman: Open space design for residential development is not allowed in Norman as a by-right form of development.

Mixed Use Development (MUD), with an open space component, is allowed in certain specific areas largely encouraging the development of urban centers that encourage walkable communities with a mix of land uses (i.e. commercial and residential). Twenty percent open space is required for these developments. Seven percent is required to be a central open space for civic community engagement. The rest of the open space must be integrated throughout the community and can include streams, greenways, and detention ponds. Shared parking is allowed as well as flexible site design. Some of the open space may provide some stormwater benefits; however, there is no emphasis on generating stormwater benefits with this zoning.

Planned Unit Developments (PUD) are also allowed in Norman, which are similar to open space design, but generally intended to allow mixed uses on a development. PUDs are intended to allow a mix of uses and greater flexibility with site design criteria. They require 10-15% open space. Up to half of that open space may include open water. Up to ten percent of that may be impervious surfaces used for common recreation, etc. Ten percent of the non-residential component of the development must be landscaped. This type of development has a number of specific requirements and requires multiple steps to complete.

In contrast, open space design (cluster development), focuses on relaxing the lot size requirements of residential zoning areas to allow for conservation of open space, especially to leave swaths of undeveloped land in natural condition.

Benefits: Open space design can reduce impervious cover by 40-60% and similar reductions in stormwater runoff, greater infiltration and recharge of groundwater. With less land converted to maintained lawn or impervious surfaces, water pollution is reduced significantly as well, resulting in 40-80% reductions in nutrients and over 90% reductions in suspended solids (sediment). Additional benefits are dramatically reduced

construction costs, up to 70%, especially due to the reduced need for road construction and stormwater conveyance. Homes are typically highly desirable with a high quality of life. People want to live near preserved open space, and many prefer the smaller lots for the reduced maintenance burden.

Model Ordinances:

GLOUCHESTER, MASSACHUSETTS: 5.9 Cluster Development

5.9.1 Purpose

The cluster development is intended to accomplish all of the following:

(a) Encourage the efficient and creative use of land in harmony with its natural features;
(b) Minimize the consumption of open space by limiting the network of streets and utilities;
(c) Preserve natural topography and wooded areas within developed areas;
(d) Provide usable open space and, where appropriate, recreational facilities;
(e) Preserve the visual character of the neighborhood;
(f) Ensure high-quality design and site planning of developments to enhance the neighborhoods in which they occur and the city as a whole;
(g) Preserve sites and structures of historical importance.

5.9.2 Applicability

The Planning Board may grant a special permit for a Cluster Development on a parcel of land of a size equivalent to five times the minimum lot size in the District, but no less than three acres of contiguous land not separated by a roadway or utility easement at the time of application, in the R-80, R-40, RC-40, R-30, R-20 and R-10 residential districts, subject to Section 5.11 and the following regulations and conditions.

5.9.3 Preliminary Cluster Development Plan

5.9.3.1 Submittal Requirements

To facilitate the review process, applicants are encouraged to submit a Preliminary Cluster Development Plan and application to the Planning Board. Such submittal shall include the following information:
(a) A plan prepared in accordance with the requirements for a preliminary subdivision plan, as described in Section 3.1.2 and 3.1.3 of the Rules and Regulations Governing the Subdivision of Land in Gloucester, whether or not the development constitutes a subdivision, and shall include proposed location, bulk, and height of all proposed buildings and structures.
(b) An evaluation of the open space proposed within the cluster, with respect to size, shape, location, natural resource value and accessibility by residents of the city or of the cluster.

5.9.3.2 Review By Other Boards

Upon its receipt of the Preliminary Cluster Development Plan, the Planning Board shall transmit one copy each to the Board of Health, Conservation Commission, Fire Department and the Building Inspector for review and comment.

5.9.3.3 Approval or Disapproval

The Board shall act on the Preliminary Cluster Development Plan within forty-five (45) days of the date of submission. The Board may approve the Plan, with or without modification, or disapprove it, in

accordance with section 3.1.4 of the Rules and Regulations Governing the Subdivision of Land in Gloucester.

5.9.4 Definitive Cluster Development Plan

5.9.4.1 Submittal Requirements

An applicant seeking approval of a Definitive Cluster Development shall submit a plan and application to the Planning Board. Such submittal shall include the following:

(a) A plan prepared in accordance with the requirements for a definitive subdivision plan, as described in Section 3.2.2, 3.2.3, and 3.2.4 of the Rules and Regulations Governing the Subdivision of Land in Gloucester, whether or not the development constitutes a subdivision, and shall include proposed location, bulk, and height of all proposed buildings and structures.

(b) An evaluation of the open space proposed within the cluster, with respect to size, shape, location, natural resource value and accessibility by residents of the city or of the cluster.

(c) All materials required by Section 3.2.1 of the Rules and Regulations Governing the Subdivision of Land in Gloucester.

(d) A program for the permanent maintenance of all open space.

(e) A development schedule which, at minimum, describes the phases of construction, proposed commencement dates, and the anticipated completion date for all road and utility improvements.

5.9.4.2 Review By Board of Health

At the time of filing the Definitive Cluster Development Plan, the applicant shall also file two copies of the Plan with the Board of Health. In accordance with the requirements of Section 3.3 of the Rules and Regulations Governing the Subdivision of Land in Gloucester, the Board of Health shall, within 45 days of the Plan's filing, report to the Planning Board its approval or disapproval of the Plan.

5.9.4.3 Review By Other City Officials

The Planning Board shall transmit copies of the Definitive Cluster Development Plan to the Department of Public Works, Fire Department, Building Inspector, and the Conservation Commission, in accordance with section 3.4 of the Rules and Regulations Governing the Subdivision of Land in Gloucester.

5.9.4.4 Approval or Disapproval

The Board shall hold a public hearing and act on the Definitive Cluster Development Plan within ninety (90) days of the date of submission, or within one hundred thirty-five (135) days if such Plan did not properly evolve from a Preliminary Cluster Development Plan. The Board may approve the Plan, with or without modification, or disapprove it, in accordance with Sections 3.5 and 3.6 of the Rules and Regulations Governing the Subdivision of Land in Gloucester.

5.9.5 Design Criteria

(a) The Planning Board, in order to grant a special permit for a Cluster Development, must find that the proposed design and layout of the development is superior to a conventional one in preserving open space for conservation and recreation; in preserving natural features of the land; and in allowing more efficient provision of streets, utilities and other public services.

(b) In its consideration of a Cluster Development, the Planning Board shall give particular attention to, and shall use as a basis for its decision, all of the following:

1. Lots, streets, off-street parking, sidewalks, pathways and buildings which achieve the harmonious integration of the proposed development with surrounding properties;
2. The overall layout and design that achieves the best possible relationship between the proposed development and the land;
3. Appropriately sized and configured open spaces for active or passive recreation;

4. Protection of natural features such as streams, mature trees or clusters of trees, rock outcrops, bluffs, slopes, and historic or archeological features;
5. Provision of access to open spaces for the physically handicapped, elderly, and children;
6. Use of open spaces for preserving, enhancing, or providing scenic vistas;
7. Preservation and protection of historic resources;
8. Adequacy of provisions for public safety, protection from fire and flood, and maintenance of public facilities, streets, utilities, and open space.

5.9.6 Allowable Uses

A Cluster Development may include any residential use permitted in that zoning district. The Planning Board may grant special permits required for any such structures located in a Cluster Development. These structures may be situated on separate lots, or situated on a single lot together with open space. Lots created under this provision with more than one dwelling unit under separate ownership thereon shall be in compliance with applicable M.G.L. c. 183A, or with the charter and by-laws of a land trust whose purpose is the provision of affordable housing. Cluster Developments that do not involve the subdivision of land shall comply with all of the design criteria and improvement requirements of the Rules and Regulations Governing the Subdivision of Land in Gloucester, MA.

5.9.7 Development Density

(a) The maximum number of dwelling units allowed in a Cluster Development shall be derived by dividing 90% of the Applicable Land Area by 90% of the required minimum lot area in that district. Applicable Land Area equals the total area encompassed by the Cluster Development, minus land defined as resource areas in Article 12 of the Gloucester Code of Ordinances, and minus land otherwise prohibited from development by other local ordinances or regulations which shall not include any portion of the buffer zone as defined in Article 12 of the Gloucester Code of Ordinances. Applicable Land Area shall be calculated by a registered land surveyor. Such density calculation shall not apply to approved Cluster Development Plans filed within seven (7) months prior to the adoption of this amendment.
(b) Where the Cluster Development includes more than one ownership and/or lies in more than one district, the number of units allowed shall be calculated as above for each district and summed to give an overall allowable total, which may be located on the plan without respect
to allowable subtotals by district or ownership areas.

5.9.8 Density Bonus

The Planning Board may authorize an increase in lots or dwelling units up to 20% above that allowed under Section 5.9.7 of this Ordinance, if either of the following conditions are met:
(a) The applicant deeds to the city or restricts under a conservation restriction a portion of the Applicable Land Area, if that land is determined by the Planning Board to be of critical importance for the public good.
(b) The applicant sets aside a portion of the dwelling units on the site as affordable units, as defined by Section 5.11.4 of this Ordinance. For each affordable unit the applicant shall receive a density bonus of one added lot or dwelling unit for each 1.5 permanently affordable dwelling units built.

5.9.9 Dimensional Requirements

(a) The minimum size of lots in a Cluster Development shall be 10,000 square feet for a single or two-family house, and 20,000 square feet for a multi-family dwelling.
(b) The Planning Board may waive up to fifty percent of the minimum requirements for frontage and/or yard requirements of each lot in the Cluster Development in order to achieve maximum open space area.

(c) More than one single or two-family dwellings may be located on a lot in a Cluster Development, provided that the minimum lot area per dwelling unit is no less than 10,000 square feet.
(d) Clusters of housing shall contain no more than ten single-family or two-family dwellings, and no more than four multi-family dwellings.
(e) The minimum width of open space between clusters of dwellings, and between the Cluster Development and adjacent property, shall be fifty feet in each case.
(f) Except as noted above, each lot in a Cluster Development shall comply with the dimensional requirements of the district within which it is located.

5.9.10 Common Open Space
(a) Common open space is that land so designated by the applicant and approved by the Planning Board.
(b) Common open space shall comprise not less than 30% of the **Applicable Land Area** within the Development Plan.
(c) Such open space may be in one or more parcels of a size and shape appropriate for its intended use as determined by the Planning Board and shall be within easy access to its intended users.
(d) Common open space land shall be used only for the following purposes:
1. Conservancy in its natural, undisturbed state. At least fifty percent of the common open space must be used in this manner;
2. grazing and agriculture;
3. walking, horseback riding and/or bicycle riding;
4. playing fields and courts;
5. swimming pools and other recreational facilities and structures for the use of the owners of the building lots; or
6. any combination of the above.
7. structures and parking specifically for the maintenance and use of the open space, provided that they occupy no more than five percent of said open space.
(e) The common open space shall be conveyed in one of the following ways, as approved by the Board:
1. To a corporation or trust comprising a homeowners association whose membership includes the owners of all lots or units contained in the development. The developer shall include in the deed to owners of individual lots beneficial rights in said open land, and shall grant a conservation restriction to the city of Gloucester over such land to insure that it be kept in an open state and not be built upon for residential use or developed for accessory uses such as parking or roadways.
2. To a non-profit organization, the principal purpose of which is the conservation of open space. The developer or non-profit organization shall grant a conservation restriction as set out above.
3. To the city for park or open space use, subject to the approval of the City Council, for management by the Conservation Commission, with a trust clause insuring that it be maintained as open space.
(f) The removal of material, including groundwater, minerals and trees over four inches basal diameter, except as necessary to comply with conditions of the Planning Board's approval, is prohibited.

5.9.11 Future Change
Any Cluster Development approved by the Planning Board under the provisions of this Section shall incorporate by reference the Cluster Development Plan and development schedule submitted by the developer with application. Minor amendments to such Cluster Development may be approved by the Planning Board, upon application and for good cause shown, but without necessity of public hearing; provided, however, that any of the following shall be considered a major amendment, and shall be acted upon only under the procedures applicable to the initial approval for a Cluster Development:

(a) Reduction in the amount or change in the use of common open space, or any change in the general location of the common open space as provided in the permit; or
(b) Any change in the general layout of the ways as provided in the permit; or
(c) Any increase in the number of lots or dwelling units as provided in the permit; or
(d) Altering the location of any building or structure by more than ten feet.

5.9.12 Changes Not Permitted
Lots and dwelling units created under this provision shall not be modified in any manner other than as indicated in Section 5.9.11.
(Adopted May 27, 1986; amended December 3, 1991; August 22, 2006)

Setbacks and Frontages (Principal 12)

Many communities have strict requirements for front and side setbacks and minimum lot frontages. Front setbacks result in longer driveways. Side setbacks and minimum frontages (often required for on-street parking) lead to longer than needed road systems. Together these constrain developers from reducing the impervious cover of a development. In subdivisions zoned for less density, frontages and setbacks are typically larger, preventing cluster or open space development.

Recommendation:

Reduce setbacks and frontage distances to allow greater flexibility in site design.

Specific benchmarks:

1) Allow irregular lot shapes.

2) Allow 20 feet or less front setback for one half acre lots.

3) Allow 25 feet or less rear setbacks for one half acre lots.

4) Allow 8 feet or less side setbacks for one half acre lots.

5) Allow less than 80 feet frontage distance for one half acre lots.

Norman: It is difficult to judge Norman codes by these benchmarks for a half acre lot because Norman does not have any zoning that allows anything close to half acre lots. Norman has a Residential Estate District with 2 acre lots that exceed all the benchmarks for a half acre lot. The next largest minimum lot size is 6,000 square feet in the Single Family Dwelling District, which is about one third the size of a half acre lot. These more dense developments all meet the benchmarks set for half acre lots, but they are notably smaller. It is worth noting, however, that in this district, despite the density, imperviousness is considered and limited. Here, Norman requires no more

than 65% of the site to be impervious and no more than 50% front yard impervious cover, with a few exceptions allowing up to 75% front yard imperviousness.

Model Ordinances:

Section 5.9.9 in the Glouchester, MA Cluster Development ordinance (in the previous section) allows great flexibility in setbacks and frontages:

5.9.9 Dimensional Requirements
(a) The minimum size of lots in a Cluster Development shall be 10,000 square feet for a single or two-family house, and 20,000 square feet for a multi-family dwelling.
(b) The Planning Board may waive up to fifty percent of the minimum requirements for frontage and/or yard requirements of each lot in the Cluster Development in order to achieve maximum open space area.
(c) More than one single or two-family dwellings may be located on a lot in a Cluster Development, provided that the minimum lot area per dwelling unit is no less than 10,000 square feet.
(d) Clusters of housing shall contain no more than ten single-family or two-family dwellings, and no more than four multi-family dwellings.
(e) The minimum width of open space between clusters of dwellings, and between the Cluster Development and adjacent property, shall be fifty feet in each case.
(f) Except as noted above, each lot in a Cluster Development shall comply with the dimensional requirements of the district within which it is located.

Sidewalks (Principal 13)

Sidewalks are an important part of creating a walkable and desirable community. Sometimes, however, they make up some unnecessary impervious surfaces. In many circumstances, sidewalks may not need to be as wide or may not be necessary on both sides of a street. Small changes in sidewalk considerations may help reduce unnecessary imperviousness.

Recommendations:

1) Require sidewalks to be 3 - 4 feet wide.

2) Allow sidewalks on one side of the street only.

3) Allow sidewalks to drain away from the street

4) Allow alternate pedestrian routes to substitute for sidewalks (trails in common areas, etc.)

Norman: Norman allows sidewalks to be 4 feet wide, but requires sidewalks on both sides of urban residential streets. All sidewalks must slope toward the street. There are no alternatives allowed to substitute for sidewalks.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 171.13 Sidewalk, Driveway And Trail Specifications

(A) Sidewalks.

(2) Minimum width of sidewalks. The minimum width of sidewalks shall follow the guidelines of the Master Street Plan, of the Comprehensive Land Use Plan. In all cases, the effective width of the sidewalk shall be a minimum of 4 feet.

WICHITA, KANSAS: 36-327 Sidewalk Ordinance

SECTION 3. Sidewalks shall be located and installed as herein specified in the manner and at the time prescribed.

C. New Subdivisions -- Sidewalk improvements shall be determined at the time of preliminary platting and shall be required and installed at the time of street construction in any new subdivision within the City or within three (3) miles of its corporate boundaries, as follows:

1. On both sides of Collector Streets which are so designated at the time of platting.

2. On one side of a continuous street (irrespective of name, resulting in a pattern of through traffic) which is platted to permit 48 or more dwelling units abutting both sides of such street and which street intersects with a designated Collector or Arterial: except A8 Residential Streets (single-family detached and two-family dwelling units) with the majority of lots having frontages over 100 feet or with the majority of lots having an area greater than 20,000 square feet.

3. On either side of a cul-de-sac street or a loop street when either of which intersects with a designated Collector or Arterial and when there are more than 48 dwelling units abutting each such cul-de-sac or loop street. In determining the number of dwelling units on such loop streets outletting on the same street within 800 feet, the total number of dwelling units abutting such loop street shall be multiplied by .6 and the product used to determine if it is greater than 48.

4. On all lots zoned or used for commercial, office or multi-family (not including single-family detached or two-family dwelling units) when such lots are not adjacent to an Arterial Street. When the application of this rule creates a stub extension, such as along a side lot line into a side street, or when complete access control is granted, the Metropolitan

Area Planning Commission may exempt such requirement.

5. On such streets, easements or open space as may be agreed to by the Metropolitan Area Planning Commission and the subdivider at the time of approval of Community Unit Plan (CUP).

6. Along pedestrian easements when connecting existing sidewalks, or sidewalks approved for installation.

7. Adjacent to one side of the street if the sidewalk would connect a required sidewalk on a designated Collector or Arterial Street directly to a publicly owned pedestrian generator, such as a park, elementary school, or similar use. Such extension shall not exceed 800 feet in length.

Driveways (Principal 14)

Driveways can make up to 20% of the imperviousness in subdivisions. Often codes specify the minimum width of driveways and the materials allowed to be used. Front yard setbacks increase the length of driveways as well.

Recommendations:

1) Allow narrower or shorter (setback) driveways (9 feet or less for one lane, 18 feet or less for 2 lanes)

2) Allow use of pervious materials (grass, gravel, pervious pavers).

3) Allow 2 track driveways.

4) Allow shared driveways between two residences.

Norman: Norman requires one lane driveways to be 10 feet wide and made of concrete. Two track driveways are not allowed and shared driveways are not permitted.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 172.11 Driveway And Parking Standards For Four (4) Or Less Parking Spaces

(G) Driveway Standards.

(2) Driveways Beyond the Property Line. Driveways shall be paved from the property line and/or master street plan right-of-way with asphalt, concrete, brick or stone pavers, or other solid surface and shall extend 18 feet (length) into the property unless no parking is provided between the property line and structure.

(3) Driveways Beyond 18 Feet into the Property. Driveways beyond 18 feet into the property may be paved or unpaved and shall be clearly defined by landscaping or edging.

(4) Unpaved Streets. These requirements are waived where the street to which the driveway connects is not paved.

GLOUCHESTER, MASSACHUSETTS: 5.21 COMMON DRIVEWAYS

5.21.1 Purpose

The purpose of this Ordinance is to enhance the safety and welfare of residents of common driveways and to clarify the rights and responsibilities of builders and residents of common driveways, and of the City of Gloucester, in order to improve the public safety along streets by reducing the number of curb cuts, to reduce the negative visual impact of multiple driveways exiting upon a street and to minimize negative impacts on natural resources.

5.21.2 Definition

Vehicular access, extending from a street, serving as a common vehicular access to more than one (1) but not more than four (4) residential lots is a common driveway, built in accordance with standards established in "Rules and Regulations Governing the Subdivision of Land in Gloucester, Massachusetts" where allowed by Special Permit. The driveway will lie entirely within the lots being served.

5.21.3 Prohibition

A common driveway which would serve more than four (4) residential lots is prohibited.

5.21.4 Scope

Common driveways may be allowed by Special Permit and plan approved by the Planning Board for single and two-family residential use only. Where the proposed development constitutes a subdivision under the Subdivision Control Law, MGL, Chapter 41, sec. 81-K et seq., this ordinance shall not apply. All lots associated with the use of a common driveway must provide off-street parking as indicated in Section 4.1 "Off Street Parking". A common driveway shall not become a public or private way. The City of Gloucester shall not be required to provide construction, reconstruction, maintenance, snowplowing, school bus pickup or police patrols along a common driveway, unless by contract duly entered into by the City and all landowners served by the common driveway.

3.5.5 Conditions for Issuance

The Planning Board may authorize the use of common driveways to provide access to no more than four (4) individual lots of land through issuance of a Special Permit (SP) provided the following conditions are met.

(a) Common driveways may not be used to satisfy zoning frontage requirements as defined in Section VI. Each lot served shall have lot frontage on a street which serves to satisfy lot frontage requirements as defined in Section VI.

1. No common driveway shall be extended or connected to any way other than at one point of intersection with a street providing frontage to the development.

(b) All lots to be served by common driveway must meet the requirements of a lot as defined in Section VI. All dimensional requirements, as defined in the Zoning Ordinance, for lots served by a common driveway, including but not limited to, setback and dimension of front, side and rear yards, as measured in relation to the street serving as the legal frontage for the lots, shall be the same as would be required for those lots had they not shared a common driveway.

(c) That common driveways are required to access over approved lot frontage as defined in Section VI.

(d) That each lot having access from an approved common driveway may be improved with no more than two (2) dwelling units and related accessory building and uses.

(e) That if the common driveway provides access to two (2) OR MORE (no more than four) lots, the landowners of all residences served by a common driveway shall be granted a right-of-way. Such right-of-way shall be recorded at the Essex County Registry of Deeds within thirty (30) days of approval by the Planning Board, together with a statement of covenants as follows:

1. The common driveway shall at no time be used to satisfy frontage requirements under the Zoning Ordinance; and

2. the common driveway shall at no time become the responsibility or liability of the City of Gloucester; and,

3. each landowner served by the common driveway shall be liable and responsible in whole for the repair and maintenance of any portion of the common driveway to which they have the exclusive Right of Way, such as a spur serving solely one parcel; and,

4. each landowner served by the common driveway shall be jointly and severally responsible and liable for the repair and maintenance of all portions of the common driveway to which more than one landowner hold a Right of Way.

(f) A covenant shall be entered into between the owner or developer and the City in a form acceptable to the Planning Board prohibiting the sale of lots and erection of building except for lots approved and/or prior to the adoption of this Ordinance, until such time as the common driveway has been constructed in accordance with the approved plan.
(g) Common driveways shall provide access to the lots from the street on which the lots served have their frontage and must observe a twenty-five (25) foot setback from the sideline which the lot of origin shares with a lot not served by the common driveway. The Planning Board may waive this requirement if necessary.
(h) That common driveways be constructed in accordance with the standards established in "Rules and Regulations Governing the Subdivision of Land in Gloucester, Massachusetts".

3.5.6 Procedure for Special Permits

The Planning Board shall follow the procedural requirements for Special Permits as per Massachusetts General Law, Chapter 40A and Section 1.5 of the Gloucester Zoning Ordinance.

(Adopted December 9, 1997)

Open Space Management (Principal 15)

To be particularly effective, open space requirements should be clearly defined. Some communities with open space development lack requirements to consolidate open space into larger units or to maintain some open space in a natural condition. Some community associations left responsible for open space management are ill equipped or financed to handle that management.

Recommendations:

1) Require community associations that manage open space to have mandatory membership and a legal mandate to collect fees. Provide information on open space management for these associations.

2) Require open space to be consolidated into large units.

3) Require that a minimum percentage of open space be maintained in a natural condition.

4) Define allowable and unallowable uses for open space

5) Allow open space to be managed by a third party (conservation easement or land trust).

Norman: Norman does not currently allow open space development.

Benefits: Open space left in a natural state is by far the least expensive and least labor intensive way to manage open space. It will also generate the greatest environmental benefit for water quality and for habitat quality.

Model Ordinances:

The specified recommendations are covered in the Cluster Development Ordinance from Glouchester, Massachusetts listed earlier in this document.

Rooftop Runoff (Principal 16)

Most communities require a minimum slope away from buildings to ensure adequate drainage. Some communities even require that runoff from roofs be piped to the street or other impervious surface to ensure it moves offsite quickly and efficiently. In this manner, the opportunity to maintain water onsite to lessen the load on the stormwater system is lost.

Recommendations:

1) Allow rooftop runoff to run over a pervious surface.

2) Allow temporary ponding of stormwater on front yards or rooftops (green roofs).

Norman: Norman allows rooftop runoff to be discharged onto a pervious surface, but temporary ponding of stormwater is not allowed in new developments.

Benefits: Reversing this practice can decrease annual runoff from sites by up to 50% and significantly decrease the pollutant load on local streams.

Model Ordinances:

MILWAUKEE, WISCONSIN: 225-4. Drainage of Yard Areas and Roofs. (Allows discharge to pervious areas, not ponding)

2. ROOF RAINWATER LEADERS (CONDUCTORS).
a. Discharge to Finished Grade; When Permitted. All buildings, including accessory buildings, may discharge roof rainwater leaders, conductors or downspouts to finished grade provided the discharge to finished grade meets all of the following provisions:
a-1. The point of discharge shall be a minimum of 2 feet from a basement or a foundation wall or alley property line and 5 feet from all other property lines.
a-2. The discharge shall flow parallel to or away from the nearest property line.
a-3. The discharge water shall not discharge to a street, alley or other public way.
a-4. The discharge water shall not create an icy condition on any pedestrian walkways within or adjacent to the subject premises lot lines.
a-5. The downspout hub shall be sealed with a 1" concrete cap or in a manner approved by the commissioner.

CHICAGO, ILLINIOS: Regulations for Sewer Construction and Stormwater Management

C-5 GRADING PLAN

• Show proposed grades and contour lines in bold and existing grades and contour lines to remain in half-tone.
• Existing grade information at property lines.
• Existing grade information should extend at least 10 feet beyond property lines or as required by site design.
• Show curb & gutter, sidewalk, finished floor, pavement, ground, and other elevations necessary to completely define the proposed grading.
• Delineate the limits of ponding for surface detention by indicating the High Water Level (HWL) location and elevation.
• Identify sewer structures with rim elevations.
• Show overflow (overland flood route) location and elevation, typically indicated with large arrows.
• Show direction of surface drainage where needed, typically indicated with small arrows.
• Show a line delineating the limits of construction.
• Identify permeable pavement, drainage swales, bioinfiltration systems, rain gardens, impervious area, landscape area, any other BMPs, etc.
• Provide separate large-scale plan view details of curb ramps, alley returns, and driveways with detailed grading to demonstrate compliance with the latest revision of the CDOT ADA Standards.

3.1.1 DISCONNECTION OF DOWNSPOUTS

In accordance with the plumbing provisions of the Municipal Code, Article XI, Section 18-29-1101.2.3, the disconnection of roof downspouts is encouraged, when feasible. Downspout flow must be directed to the public right-of-way without causing a safety hazard or nuisance to adjacent properties or be collected by an on-site storm water management system, as required. On residential developments where downspout disconnection is proposed, the DWM's affidavit form in support of the disconnection must be signed and submitted with downspout locations shown on the plan. The affidavit form is provided in Appendix II-B.

Group 3: Conservation of Natural Areas

This group of principles mainly relates to a number of ordinances that relate to the preservation of trees and natural vegetation, particularly along streams, and the management of runoff with green infrastructure before entering water bodies. Recommendations are given for each topic to reduce the runoff or reduce the impact of that runoff before entering a sewer system (and local streams).

Buffer Systems and Buffer Maintenance (Principals 17 and 18)

Where communities have stream buffers to restrict development near streams, the buffer averages around 100 feet. Typically, buffers are not extended to specifically encompass the 100 year flood level, wetlands, and steep slopes.

Recommendations:

1) Create a 100 foot buffer around waterways.

2) Extend buffer for

- 100-year floodplain
- Steep slopes (over ~15%)
- Wetlands

Additional recommendations for buffer areas:

- Specify native vegetation for (at least part of) buffer
- Outline allowable uses
- Specify enforcement and education measures

Norman: Norman has recently developed a stream buffer ordinance for part of the city that drains to Lake Thunderbird. The ordinance is well planned and includes a 100 foot minimum buffer, but also includes the 500 year floodplain, and has clearly stated allowable uses and variances.

Benefits: Buffer ordinances provide multiple benefits to the community, including:

- Protect water quality
- Flood protection
- Reduce bank erosion

- Protect aquatic ecosystems
- Serve as wildlife corridors
- Can be valuable recreation systems (Greenbelt)
- Increase value of nearby property (10-30% increases).

Model Ordinances: Norman is a prime example of a municipality with a buffer ordinance (called the Water Quality Protection Zone (WQPZ) ordinance). The ordinance is comprehensive and too long to include within this report. The full ordinance is available in Appendix B and on the City of Norman website: http://www.ci.norman.ok.us/sites/default/files/WebFM/Norman/City%20Manager/O-1011-52%20%20Annotated%20ADOPTED.pdf

Clearing and Grading (Principal 19)

The clearing of entire construction sites is often permitted in municipalities, except for a few limited restrictions. Few communities restrict wholesale clearing and grading of construction sites. Where communities do have restrictions, enforcement is often weak.

Recommendations:

1) Restrict clearing and grading to minimum area needed for:
   - Building footprint
   - Construction Access
   - Safety setbacks

2) Include vegetation "save" areas on Erosion and Sediment Control Plans.

3) Mandate clear posting of limits of disturbance at construction sites.

Norman: Norman has no requirements to limit clearing and grading on construction sites, but does have a protective ordinance for trees not planned to be removed (see below).

Benefits: In areas where natural vegetation is retained, you can retain the natural hydrology with much higher infiltration rates than cleared, compacted soils. With more stable ground, developers can actually reduce the costs for erosion control and earth

movement. In addition, natural vegetation provides habitat for native wildlife and can increase property values in the community.

Model Ordinances:

NORMAN, OKLAHOMA: Standard Specifications and Construction Drawings

2101.3 CONSTRUCTION METHODS
B. Clearing:
1. Tree Removal/Protection: No trees shall be removed, even though listed for removal until specifically marked by the Engineer. Trees to be removed shall be felled in such a manner as not to injure other trees which are to remain, either on the right-of-way or adjacent thereto. Trees or plants which are to remain in place and which may be in danger of injury by construction operations or equipment shall be suitably boxed, fenced or otherwise protected. Boxing and fencing shall be constructed and removed at the direction of the Engineer. The contractor shall repair all injuries to bark, trunk limbs, and roots of remaining trees and shrubs by proper dressing, cutting and painting according to accepted methods, using only accepted tools and materials.

Native Plant and Tree Conservation (Principal 20)

Tree preservation is not often required by municipalities. Where tree preservation is considered, the emphasis is usually on specimen trees that are especially old or rare in the area. Municipalities generally do not encourage the use of native plants for landscaping. Usually, communities have ordinances that restrict the height of vegetation in residential areas that prevent the legal use of native plants to landscape unless they are kept under 8-12 inches high.

Recommendations:

1) Forest Conservation Ordinance – preserve a minimum % of forest on any site (vary with unit density).

2) Allow / promote use of native plant landscaping vs. “weed ordinances” that promote sculpted lawns.

Norman: Norman has no significant tree preservation ordinance (other than the WQPZ ordinance described previously). Norman “encourages” the use of native plants in parking lot landscaped areas, but also enforces an ordinance that regulates the allowable plant height in residential neighborhoods.

Benefits: There are multiple benefits for conserving trees and native vegetation. First, they increase property values: homes with these features sell faster and for higher prices. Trees can lower home cooling costs, use greenhouse gases and control ozone, reduce stormwater flows by holding and allowing infiltration, and reduce sediment erosion. Native plants are adapted to the local climate and local pests, so they

generally do not need fertilizer or pesticides. They also generally do not need supplemental watering. Native trees and other native plants are also hosts for a multitude of wildlife that exotic trees and plants do not attract. Butterflies, in particular, must have specific native plants in order to propagate; their caterpillars must only eat leaves from specific plants. In addition, native plant landscapes typically require much less maintenance than sculpted lawns and do not require the noise pollution and air pollution of small motorized devices to perform the maintenance.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 167.04 Tree Preservation And Protection During Development

(C) Canopy area. In all new Subdivisions, Large Scale Developments, Industrial and Commercial Developments, and all other improvements listed above, trees shall be preserved as outlined in Table 1 under Percent Minimum Canopy, unless the Applicant has been approved for On-Site Mitigation or Off-Site Alternatives as set forth in subsections I. & J. below. The square foot percentage of canopy area required for preservation in new development is based on the total area of the property for which the Applicant is seeking approval, less the right-of-way and park land dedications. An Applicant shall not be required to plant trees in order to reach the Percent Minimum Canopy requirement on land where less than the minimum exists prior to development, unless trees have been removed.

Table 1 Minimum Canopy Requirements

ZONING DESIGNATIONS	PERCENT MINIMUM CANOPY
R-A, Residential - Agricultural (nonagricultural uses)	25%
RSF-.5, Single-family Residential – One Half Unit per Acre	25%
RSF-1, Single-family Residential – One Unit per Acre	25%
RSF-2, Single-family Residential – Two Units per Acre	20%
RSF-4, Single-family Residential – Four Units per Acre	25%
RSF-7, Single-family Residential – Seven Units per Acre	20%
RSF-8, Single-family Residential – Eight Units per Acre	20%
R-O, Residential –Office	20%
RT-12, Two and Three-family Residential	20%
RMF-6, Multi-family Residential – Six Units per Acre	20%

RMF-12, Multi-family Residential – Twelve Units per Acre	20%
RMF-18, Multi-family Residential – Eighteen Units per Acre	20%
RMF-24, Multi-family Residential – Twenty-Four Units per Acre	20%
RMF-40,Multi-family Residential – Forty Units per Acre	20%
NS, Neighborhood Services	20%
C-1, Neighborhood Commercial	20%
CS, Community Services	20%
C-2, Thoroughfare Commercial	15%
UT, Urban Thoroughfare	15%
C-3, Central Business Commercial	15%
DC, Downtown Core	10%
MSC, Main Street Center	10%
DG, Downtown General	10%
NC, Neighborhood Conservation	20%
I-1, Heavy Commercial and Light Industrial	15%
I-2, General Industrial	15%
P-1, Institutional	25%
PZD, Planned Zoning District (HHOD)	25% (30%)

All residential zoning districts and C-1 districts within the Hillside/Hilltop Overlay District shall have their percent minimum canopy requirements increased by 5% to a total requirement of either 30% or 25%.

(D) Prior tree removal.
(1) If trees have been removed below the required minimum within the five (5) years preceding application for development approval, the site must be forested to meet the Percent Minimum Canopy requirements set forth in Table 1, plus an additional ten percent (10%) of the total area of the property for which the Applicant is seeking approval, less the right-of-way and park land dedications. The number of trees required to be planted shall be calculated using the Base Density for High Priority trees.

(2) Waiver. If an applicant is able to demonstrate to the Planning Commission's satisfaction that the trees were removed for a bona fide agricultural purpose, and not with the intent to thwart enforcement of this chapter, the additional 10% reforestation requirement shall be waived.

(E) Tree preservation priorities.
(1) Percent minimum canopy. Proposed designs must meet the percent minimum canopy requirements for the particular zoning designation, emphasizing the preservation and protection of high priority trees on the site. Trees in utility easements shall not be counted toward the percent minimum canopy requirement, and such utilities shall be routed, wherever possible, to avoid existing canopy.

(2) Existing natural features. Each design shall consider the existing natural features of the site, the preservation priorities for the trees, and the impact their proposed removal may have both on and off-site.

(3) Preservation priorities. The list of preservation priorities (See: Table 2) shall guide the review of each development's design. The submittal of designs which do not incorporate preservation priorities for the trees on the site shall result in the denial of the tree preservation plan.

(4) High priority trees. The preservation and protection of high priority trees shall be enforced most stringently to meet the minimum percentage of canopy preservation. The preservation and protection of lower priority trees shall not be substituted for that of high priority trees, except:
(a) When the justification for such a substitution is set forth in the analysis report; and
(b) The substitution is approved by the urban forester.

Table 2 Preservation Priorities

High Priority	Mid-level Priority	Low Priority
Canopied slopes	Contiguous woodlands	Invasive species
Floodways and riparian buffers	Non-native woodlands	Relic orchards
Native woodlands	Use buffers	Less desirable species
Significant trees		

CHICAGO, ILLINIOS: Stormwater Management Ordinance Manual

3.0 Volume Control: Managing Stormwater Onsite

3.3.1 Volume Control BMPs

Natural Landscaping

Natural landscaping involves the planning and implementation of naturalized or native vegetation on permeable soils or prepared soils. Care must be taken to ensure that the proposed vegetation and existing soils are compatible. If existing soils are unsuitable for implementation of native vegetation, alternative landscaping plans should be devised, or a prepared soil should be brought in to the site.

Natural landscaping on prepared soils has a greater capacity to infiltrate stormwater than lawns on heavy soil. As shown on the detention design spreadsheet, areas with natural landscaping on permeable or prepared soils have a lower C-value and can reduce the amount of required detention storage. There is no volume control benefit specifically related to natural landscaping, however, natural landscaping can be an integral part of the design of other BMPs such as vegetated swales, filter strips and bioinfiltration basins.

Trees can also be used for minor volume control benefits and to reduce urban heat island effects. Trees slow down rain from small storms, holding the water on leaves and branches and allowing the water to evaporate. Urban heat island effects are reduced because trees provide shade to impervious surfaces, thereby decreasing the temperature of the surfaces and subsequently the temperature of the surrounding air and of any stormwater that passes over the impervious area. Lowering the temperature of stormwater runoff can be beneficial in improving the water quality of receiving streams. Existing trees located on the development site that are preserved as part of the site plan and proposed trees located on the development site that are planted within 20 feet of on-site impervious areas may count as a deduction of impervious areas on site for volume control calculations. The tree species must be chosen from the approved list provided by the CDOE. New trees planted must be planted within 20 feet of ground level impervious surfaces. New trees must be at least 2-inch caliper at 4.5 feet above ground level to be eligible for the reduction. A 50 sq.-ft. reduction in impervious area is permitted for each new tree. Only 50% of the canopy area of an existing tree of at least 4-inch caliper, within 20 feet of ground level imperviousness, may be credited towards a reduction in impervious area. The 2.1.5 Trees spreadsheet in the Stormwater Spreadsheet Tool shows how to determine the total benefits of providing stormwater trees.

Land Conservation Incentives (Principal 21)

While placing limits on the way development can take place in a community, it is beneficial to also include incentives or bonuses for developers that can help make the changes more agreeable for them. It can be helpful to allow means of recouping some of the expenses of areas restricted from development or to allow some flexibility in the rules to allow desirable communities to be established.

Recommendations:

Provide developers incentives and allow for flexibility in order to increase the acceptability and desirability to implement the above principles. Examples include:

Density Compensation - In exchange for conservation, allow increased density elsewhere onsite.

Transferable Development Rights - Development rights can be transferred to an offsite location

Property Tax Credit (reduce, defer, or exempt) - One example is a credit for a conservation easement (credit applies as long as compliance). There should be a penalty (10-25% of value) if property is taken out of the easement to be developed.

Stormwater Credits – Allow reductions in stormwater fees with adoption of certain practices.

Buffer Averaging – Allow an adjustment of the buffer limit for necessary encroachments by adding proportional buffer width to another portion of the buffer.

Norman: Norman allows buffer averaging and clustering of homes in compensation for the required stream buffer.

Model Ordinances:

OLYMPIA, WASHINGTON: 18.04.080 Residential districts' development standards

A. Maximum Housing Densities.

4. Density Bonuses. The maximum housing densities identified in Table 4.04 may be increased as follows, provided, however, that in the R 4-8 District, TDRs must be obtained (see Section18.04.080(A)(5)(b)

a. Restoration of Critical Areas. At the request of the applicant, the Hearing Examiner may grant a density bonus of up to twenty (20) percent for sites on which damaged or degraded wetlands or stream

corridors (e.g., streams and stream banks within the outer limits of any required buffer) will be restored and maintained according to specifications approved by the City. Sites proposed for this density bonus shall be posted with a notice describing the proposal and opportunities for the public to comment. Property owners within three hundred (300) feet of the site shall be given notice of the proposal and fifteen (15) days to comment. Such notice may be done concurrently with any other notice required by this Code. Prior to taking action on a request for a density bonus, the Hearing Examiner shall consider the public's comments, the expected public benefit that would be derived from such restoration, the probable net effect of the restoration and the increased density on the site, the relative cost of the restoration and the value of the increased density, and the potential impact of increased density on surrounding land uses, traffic, infrastructure, schools, and parks. The City may require the applicant to provide an estimate of the cost of the proposed restoration and other information as necessary to make this determination. This bonus does not apply to site features which were damaged in the course of a current project (e.g., under an active permit) or as a result of an illegal or intentional action by the current property owner or their representative.

FAYETTEVILLE, ARKANSAS: 179 Low Impact Development

179.05 LID Credits
(A) LID systems and structures may be permitted in lieu of conventional stormwater systems including: curb and gutter, storm drain inlets, piping, etc., when supporting data is presented and approved by the City Engineer.
(B) The volume of required retention/detention facilities may be reduced where it is proven that the LID design elements are sufficient to partially accommodate the design storm volume required in the Drainage Criteria Manual.
(C) At such time that a stormwater utility is formed that requires an assessment or a fee then the use of LID systems and structures may reduce or eliminate those fees, in accordance with the enabling ordinance.

Manage Stormwater Before Discharge into Water Bodies (Principal 22)

Following the Principles discussed previously, runoff can be reduced from construction sites by 20-60%. The rest should be treated with green infrastructure rather than discharged directly into streams.

Recommendations:

1) Require that stormwater be treated before being discharged into local water bodies.

2) Establish clear guidance on LID best management practices (including maintenance, inspection, enforcement, and financing).

Norman: Norman has no requirement to treat stormwater before discharge into local water bodies. The WQPZ ordinance (Appendix B) does allow a reduction in the buffer width if LID structural practices are implemented, and LID practices are otherwise "encouraged". As a result, the city has adopted the City of Wichita/Sedgwick County Stormwater Manual, which has specifications for structural LID practices. During the

process, Norman also strongly considered adoption of the City of Austin, Texas manual. These manuals developed in similar climate and soil conditions as the Norman area, indicate the clear applicability of LID structural practices in this area.

A local developer, Richard McKown, has successfully experimented with bioretention in the Norman area. One project in the Trailwoods Neighborhood was completed in cooperation with the Oklahoma Conservation Commission as a part of the Lake Thunderbird Watershed Project, and will be documented in another report. The experimental implementation in Trailwoods was accomplished with variances allowed by City staff.

Model Ordinances:

FAYETTEVILLE, ARKANSAS: 179 Low Impact Development (See Appendix C)

The Way Forward

The design principles outlined in this document are covered in more detail in Better Site Design: A Handbook for Changing Development Rules in Your Community (CWP, 1998). The scorecard for Norman (Appendix A) shows that despite some major accomplishments, there are a number of options Norman could consider to improve the environmental impact of development while continuing to build a city in which people want to live. Norman and other communities should also consider another scorecard developed by the Environmental Protection Agency in 2009, the Water Quality Scorecard (http://www.epa.gov/dced/pdf/2009_1208_wq_scorecard.pdf). This slightly more comprehensive document addresses many of the same issues as the Better Site Design Handbook and more, but with less explanation, statistics, and background information to use when considering these important changes.

On December 9, 2013, the Oklahoma Conservation Commission sponsored a workshop targeted to city officials from municipalities in the Lake Thunderbird Watershed (Figure 2), called the Planning and Building Better Communities Workshop. The principles outlined in this document were covered at the meeting, as well as an in depth discussion of LID structural practices, the City of Norman's new WQPZ ordinance and a progressive fertilizer regulation ordinance, and a look at some structural practices that have been constructed in the Norman area. An ice storm in the Fayetteville, Arkansas area prevented two speakers from coming and sharing the progressive new ordinances that have recently been passed in that city.

In attendance at the workshop were stormwater managers, city engineers, city planners, city council members, and members of municipal citizen Commissions, among others. There was a sizeable contingency from Norman, although many other municipalities within the watershed and elsewhere in the state were represented. The extra time provided by the absence of two speakers led to opportunities for extended discussions during and after each presentation. Everyone at the meeting was supplied with a copy of the Better Site Design Handbook (CWP 1998) to aid their efforts to make changes in their own communities. At the Norman City Council meeting the following day, several city council members mentioned the workshop and their eagerness to work on implementing Low Impact Development in the near future. With the strong support of Mayor Rosenthal and several city council members, changes are expected to take place in the Norman city code in the near future.

Citations

Center for Watershed Protection, 1998, 'Better Site Design: A Handbook for Changing Development Rules in Your Community'. 174 pp.

Appendix A: Handbook Scorecard for the City of Norman, Oklahoma.

Development Feature	*Your Local Criteria*
1. Street Width	
What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 average daily trips (ADT)?	26 feet
*If your answer is between **18-22 feet**, give yourself **4** points* ☞	0
At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?	(YES)/NO
*If your answer is **YES**, give yourself **3** points* ☞	3
2. Street Length	
Do street standards promote the most efficient street layouts that reduce overall street length?	YES /(NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
3. Right-of-Way Width	
What is the minimum right of way (ROW) width for a residential street?	50 feet
*If your answer is **less than 45 feet**, give yourself **3** points* ☞	0
Does the code allow utilities to be placed under the paved section of the ROW?	YES /(NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
4. Cul-de-Sacs	
What is the minimum radius allowed for cul-de-sacs?	41-42 feet
*If your answer is **less than 35 feet**, give yourself **3** points* ☞	1
*If your answer is **36 feet to 45 feet**, give yourself **1** point* ☞	
Can a landscaped island be created within the cul-de-sac?	(YES)/ NO
*If your answer is **YES**, give yourself **1** point* ☞	1
Are alternative turn arounds such as "hammerheads" allowed on short streets in low density residential developments?	YES /(NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
Community Codes and Ordinances Worksheet — *Subtotal Page 15*	5

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Development Feature	*Your Local Criteria*
5. Vegetated Open Channels	
Are curb and gutters required for most residential street sections?	(YES) / NO
*If your answer is **NO**, give yourself **2** points* ☞	0
Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?	YES / (NO)
*If your answer is **YES**, give yourself **2** points* ☞	0
6. Parking Ratios	
What is the minimum parking ratio for a professional office building (per 1000 ft² of gross floor area)?	3.3 spaces
*If your answer is **less than 3.0 spaces**, give yourself **1** point* ☞	0
What is the minimum required parking ratio for shopping centers (per 1,000 ft² gross floor area)?	
*If your answer is **4.5 spaces or less**, give yourself **1** point* ☞ varies	0.5
What is the minimum required parking ratio for single family homes (per home)?	2 spaces
*If your answer is **less than or equal to 2.0 spaces**, give yourself **1** point* ☞	1
Are your parking requirements set as maximum or median (rather than minimum) requirements?	YES / (NO)
*If your answer is **YES**, give yourself **2** points* ☞	0
7. Parking Codes	
Is the use of shared parking arrangements promoted?	YES / (NO)
*If your answer is **YES**, give yourself **1** point* ☞ in MUD only	0
Are model shared parking agreements provided?	YES / (NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
Are parking ratios reduced if shared parking arrangements are in place?	YES / (NO)
*If your answer is **YES**, give yourself **1** point* ☞ in MUD only	0
If mass transit is provided nearby, is the parking ratio reduced?	YES / (NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
Community Codes and Ordinances Worksheet — *Subtotal Page 16*	1.5

Development Feature	*Your Local Criteria*
8. Parking Lots	
What is the minimum stall width for a standard parking space?	8.5 feet
*If your answer is **9 feet or less**, give yourself **1 point*** ☞	1
What is the minimum stall length for a standard parking space?	19 feet
*If your answer is **18 feet or less**, give yourself **1 point*** ☞	0
Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?	YES / (NO)
*If your answer is **YES**, give yourself **1 point*** ☞	0
Can pervious materials be used for spillover parking areas?	YES / (NO)
*If your answer is **YES**, give yourself **2 points*** ☞	0
9. Structured Parking	
Are there any incentives to developers to provide parking within garages rather than surface parking lots?	YES / (NO)
*If your answer is **YES**, give yourself **1 point*** ☞	0
10. Parking Lot Runoff	
Is a minimum percentage of a parking lot required to be landscaped?	(YES) / NO
*If your answer is **YES**, give yourself **2 points*** ☞	2
Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?	YES / (NO)
*If your answer is **YES**, give yourself **2 points*** ☞	0

Community Codes and Ordinances Worksheet — *Subtotal Page 17*: 3

Development Feature *Your Local Criteria*

Time to Assess: Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 15 5 +Subtotal Page 16 1.5 +Subtotal Page 17 3 = **9.5**

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

11. Open Space Design

Are open space or cluster development designs allowed in the community? YES / (NO)

*If your answer is **YES**, give yourself **3** points* ☞ 0

*If your answer is **NO**, skip to question No. 12*

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance? YES / NO

*If your answer is **YES**, give yourself **1** point* ☞ N/A

Are the submittal or review requirements for open space design greater than those for conventional development? YES / NO

*If your answer is **NO**, give yourself **1** point* ☞ N/A

Is open space or cluster design a by-right form of development? YES / NO

*If your answer is **YES**, give yourself **1** point* ☞ N/A

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g, setbacks, road widths, lot sizes) YES / NO

*If your answer is **YES**, give yourself **2** points* ☞ N/A

Community Codes and Ordinances Worksheet *Subtotal Page 18* 0

Development Feature	*Your Local Criteria*
12. Setbacks and Frontages	
Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?	(YES) / NO
*If your answer is **YES**, give yourself **1** point* ☞	1
What is the minimum requirement for front setbacks for a **one half (½) acre** residential lot?	_____ feet
*If your answer is **20 feet or less**, give yourself **1** point* ☞	N/A
What is the minimum requirement for rear setbacks for a **one half (½) acre** residential lot?	_____ feet
*If your answer is **25 feet or less**, give yourself **1** point* ☞	N/A
What is the minimum requirement for side setbacks for a **one half (½) acre** residential lot?	_____ feet
*If your answer is **8 feet or less**, give yourself **1** points* ☞	N/A
What is the minimum frontage distance for a **one half (½) acre** residential lot?	_____ feet
*If your answer is **less than 80 feet**, give yourself **2** points* ☞	N/A
13. Sidewalks	
What is the minimum sidewalk width allowed in the community?	4 feet
*If your answer is **4 feet or less**, give yourself **2** points* ☞	2
Are sidewalks always required on both sides of residential streets?	(YES) / NO
*If your answer is **NO**, give yourself **2** points* ☞	0
Are sidewalks generally sloped so they drain to the front yard rather than the street?	YES / (NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?	YES / (NO)
*If your answer is **YES**, give yourself **1** point* ☞	0
14. Driveways	
What is the minimum driveway width specified in the community?	10 feet
*If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself 2 points* ☞	0
Community Codes and Ordinances Worksheet — *Subtotal Page 19*	3

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Development Feature	*Your Local Criteria*
Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)?	YES / (NO)
*If your answer is **YES**, give yourself **2 points*** ☞	0
Can a "two track" design be used at single family driveways?	YES / (NO)
*If your answer is **YES**, give yourself **1 point*** ☞	0
Are shared driveways permitted in residential developments?	YES / (NO)
*If your answer is **YES**, give yourself **1 point*** ☞	0

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space?	YES/NO
*If your answer is **YES**, give yourself **2 points*** ☞	N/A
Are open space areas required to be consolidated into larger units?	YES / NO
*If your answer is **YES**, give yourself **1 point*** ☞	N/A
Does a minimum percentage of open space have to be managed in a natural condition?	YES / NO
*If your answer is **YES**, give yourself **1 point*** ☞	N/A
Are allowable and unallowable uses for open space in residential developments defined?	YES / NO
*If your answer is **YES**, give yourself **1 point*** ☞	N/A
Can open space be managed by a third party using land trusts or conservation easements?	YES / NO
*If your answer is **YES**, give yourself **1 point*** ☞	N/A

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas?	(YES) / NO
*If your answer is **YES**, give yourself **2 points*** ☞	2
Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?	YES / (NO)
*If your answer is **YES**, give yourself **2 points*** ☞	0

Community Codes and Ordinances Worksheet — *Subtotal Page 20*: 2

Development Feature *Your Local Criteria*

Time to Assess: Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 18 0 +Subtotal Page 19 3 +Subtotal Page 20 2 = 5

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community? (YES) / NO

*If your answer is **YES**, give yourself **2** point* ☞ 2

If so, what is the minimum buffer width? 100 feet

*If your answer is **75 feet or more**, give yourself **1** point* ☞ 1

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required? (YES) / NO

*If your answer is **YES**, give yourself **1** point* ☞ 1

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation? (YES) / NO

*If your answer is **YES**, give yourself **2** points* ☞ 2

Community Codes and Ordinances Worksheet *Subtotal Page 21* 6

- 21 -

Development Feature	*Your Local Criteria*
Does the stream buffer ordinance outline allowable uses?	(YES) / NO
*If your answer is **YES**, give yourself **1 point*** ☞	1
Does the ordinance specify enforcement and education mechanisms?	(YES) / NO
*If your answer is **YES**, give yourself **1 point*** ☞	1
19. Clearing and Grading	
Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?	(YES) / NO
*If your answer is **YES**, give yourself **2 points*** ☞	2
Do reserve septic field areas need to be cleared of trees at the time of development?	YES / (NO)
*If your answer is **NO**, give yourself **1 point*** ☞	1
20. Tree Conservation	
If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?	YES / (NO)
*If your answer is **YES**, give yourself **2 points*** ☞	0
Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction?	YES / (NO)
*If your answer is **YES**, give yourself **1 point*** ☞	0
21. Land Conservation Incentives	
Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)?	YES / NO
*If your answer is **YES**, give yourself **2 points*** ☞	0.5
Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers?	(YES) / NO
*If your answer is **YES**, give yourself **2 points*** ☞	2
22. Stormwater Outfalls	
Is stormwater required to be treated for quality before it is discharged?	YES / (NO)
*If your answer is **YES**, give yourself **2 points*** ☞	0
Community Codes and Ordinances Worksheet — *Subtotal Page 22*	7.5

Development Feature	*Your Local Criteria*
Are there effective design criteria for stormwater best management practices (BMPs)?	(YES) / NO
*If your answer is **YES**, give yourself **1** point* ☞	1
Can stormwater be directly discharged into a jurisdictional wetland without pretreatment?	(YES) / NO
*If your answer is **NO**, give yourself **1** point* ☞	0
Does a floodplain management ordinance that restricts or prohibits development within the 100 year floodplain exist?	(YES) / NO
*If your answer is **YES**, give yourself **2** points* ☞	2

Time to Assess: Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of **24** points available for Principles 17 - 22. What was your total score?

Subtotal Page 21 6 +Subtotal Page 22 7.5 +Subtotal Page 23 3 = **16.5**

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each **Time to Assess**

Principles 1 - 10 (Page 18)	9.5
Principles 11 - 16 (Page 21)	5
Principles 17 - 22 (Page 23)	16.5
TOTAL	**31**

SCORING (A total of **100** points are available):

See Page 10 to determine where your community's score places in respect to the site planning roundtable Model Development Principles:

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Your Community's Score		
90- 100	☞	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	☞	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	☞	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	☞	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	☞	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

Appendix B: Norman Water Quality Protection Zone Ordinance

O-1011-52

AN ORDINANCE OF THE COUNCIL OF THE CITY OF NORMAN, OKLAHOMA AMENDING CHAPTER 19 OF THE CODE OF THE CITY OF NORMAN TO PROVIDE FOR STANDARDS AND REQUIREMENTS FOR A DESIGNATED WATER QUALITY PROTECTION ZONE INCLUSIVE OF THE LAKE THUNDERBIRD WATERSHED; AND PROVIDING FOR THE SEVERABILITY THEREOF.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF NORMAN, OKLAHOMA:

§ 1. That Section 19-210 of Chapter 19 of the Code of the City of Norman shall be amended to read as follows:

Sec. 19-210. Definitions.

The following words and phrases when used in this chapter, shall for the purposes of this chapter, have the meanings respectively ascribed to them in this article, except where the context otherwise requires:

A. *Alley:* A minor right-of-way dedicated to public use, which gives a secondary means of vehicular access to the back or side of properties otherwise abutting a street, and which may be used for public utility purposes.

B. *Best Management Practices (BMP):* An effective integration of storm water management systems, with appropriate combinations of non-structural controls and structural controls which provide an optimum way to convey, store and release runoff, so as to reduce peak discharge, reduce pollutants, enhance water quality, assist in stream and/or stream bank stabilization, prevent property damage due to flooding, and assist in sediment reduction. BMP's include, but are not limited to, the following:

1. Structural controls such as:
   a. Sediment forebay;
   b. Grassed swale;
   c. Enhanced bio-swale;
   d. Voluntary urban nutrient management;
   e. Statutory urban nutrient management;
   f. Wetlands;
   g. Extended detention-enhanced;
   h. Retention basins;

i. Bioretention, surface sand, organic, and similar filters;
j. Soaking trench;
k. Infiltration trench;
l. Storm water pond;
m. Dry extended detention pond; and
n. In-channel detention.

2. Non-structural controls such as:
   a. Landscape conservation;
   b. Reduction in impervious cover;
   c. Schedule of maintenance activities;
   d. Prohibition of practices;
   e. Maintenance procedures.
   f. Street sweeping;
   g. Fertilizer restrictions.

C. *Bicycle lane:* That portion of a roadway set aside and appropriately designated for the use of bicycles.

D. *Bicycle path:* A paved facility physically separating the bicycle from motor vehicle traffic.

E. *Block:* A parcel of land, intended to be used for urban purposes, which is entirely surrounded by public streets, highways, railroad rights-of-way, public walks, parks or greenstrips, rural land or drainage channels or a combination thereof.

F. *Buffer:* A vegetated area, including trees, shrubs, and herbaceous vegetation that exists or is established to protect a stream system, lake or reservoir, reduce pollutants, enhance water quality, assist in stream and/or stream bank stabilization, and assist in sediment reduction.

G. *Building line:* A line parallel to the lot or property line beyond which a structure or building cannot extend, except as specifically provided under the zoning ordinance. It is equivalent to the setback or yard line.

H. *Cluster development:* cluster development is a method of subdividing land which allows the maximum density available within the zoning district while allowing smaller lots than those specified, provided that the land saved is reserved for permanent agricultural use or open space, ideally in common ownership for community use.

I. *Combustible structure:* That which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner and consisting of any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn or will add appreciable heat to an ambient fire.

J. *Degradation:* any condition caused by the activities of humans which result in the prolonged impairment of any constituent of the aquatic environment.

K. *Development:* The erection, construction, or change of use of buildings; or the erection or construction of any additions to existing buildings where outer walls are added or altered as to location, but not including alterations or remodeling of buildings where said outer walls are not added or altered as to location. As it relates to water quality protection, any man-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling, or storage of equipment or materials.

L. *Development committee:* The City of Norman Development Committee shall be comprised of the following staff members: The Director of Public Works (who shall be the chairman), the Director of Planning and Community Development, the Director of Utilities, the City Engineer, the Development Coordinator, and the Manager of Current Planning, or their designees.

M. *Director of Public Works:* The Director of Public Works of the City of Norman, including his or her designee.

N. *Easement:* A grant by the property owner to the public, a corporation, or persons, of the use of an area of land for specific purposes.

O. *Impervious Cover:* Roads, parking areas, buildings, pools, patios, sheds, driveways, private sidewalks, and other impermeable construction covering the natural land surface. This shall include, but not be limited to, all streets and pavement within a subdivision. Vegetated water quality basins, vegetated swales, other vegetated conveyances for overland drainage, areas with gravel placed over pervious surfaces that are used only for landscaping or by pedestrians, and public sidewalks shall not be calculated as impervious cover.

P. *Lot:* A subdivision of a block or other parcel intended as a unit for the transfer of ownership or for development.

Q. *Lot, corner:* A lot which abuts two (2) intersecting streets. The front of a lot is defined by the filed plat of the subdivision, and is addressed accordingly. Although the front door of the house should face the front yard, a house may be oriented towards the side street if the plat was designed to provide two (2) front and rear yards or if there is sufficient room to provide both a new front and rear setback.

R. *Lot, depth:* The average distance from the front property line of the lot adjacent to the street to its rear property line, measured in the general direction of side lines of the lot.

S. *Lot, double frontage:* A lot which runs through a block from street to street and which has frontage on two (2) or more streets, but not including a corner lot.

T. *Lot, reverse frontage:* A corner lot of such size and shape that a building erected on it might logically be designed to face on either adjoining street, thus causing the building to rear on the side line of any abutting lot.

U. *Lot, townhouse:* A lot shown on a townhouse plat and intended as the site of a single attached dwelling unit.

V. *Lot line adjustment:* A relocation of the lot lines of two (2) or more lots included in a plat which is filed of record, for the purpose of making necessary adjustments to building sites.

W. *Low Impact Development (LID):* a comprehensive land planning and engineering design approach to development that can be used to replicate or restore natural watershed functions and/or address targeted watershed goals and objectives.

X. *Non-degradation*: The proper use of BMP's and pollution prevention criteria in activity so as to prevent property damage due to flooding and degradation as defined herein.

Y. *Non-structural controls*: Pollution prevention measures that focus on the management of pollutants by practices and procedures which minimize exposure to runoff, as well as preserve open space and natural systems. Non-structural controls may include riparian buffers,

modified development practices, and regulations on pesticide, herbicide, and fertilizer use.

Z. *Norman 2025 Plan:* The comprehensive development plan for the City of Norman which has been officially adopted to provide long-range development policies for the City in the foreseeable future and which includes, among other things, the plan for land use, land subdivision, traffic circulation and community facilities, utilities, and drainage facilities.

AA. *Person:* Any natural person, corporation, partnership, joint venture, association (including homeowners or neighborhood associations), trust, or any other entity recognized by law.

BB. *Planning Commission:* The City Planning Commission of the City of Norman.

CC. *Plat, final:* A map of a land subdivision giving, in form suitable for filing in the office of the County Clerk, necessary affidavits, dedications, and acceptances, and delineating the layout of such subdivision as required herein.

DD. *Plat, preliminary:* A map of a proposed subdivision showing the character and proposed layout of the tract in sufficient detail to indicate the relationship of the proposed development to topography, existing streets, drainage facilities and utilities, existing easements of record, the Norman 2025 Plan, existing urban development and zoning, and to indicate the nature of the land planning design.

EE. *Pollution:* the contamination or other alteration of the physical, chemical or biological properties of any stream or other water source, or such discharge of any liquid, gaseous or solid substance into any stream or other water source as will or is likely to create a nuisance or render such waters harmful or detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

FF. *Public improvements:* Any utility, structure, or modification of topography which is, or will be, located within, under, or over a right-of-way or easement of record and which is, or will be, owned and/or maintained by other than the individual owner(s) of developed real estate.

GG. *Raised mound septic system:* a soil absorption system that is elevated above the natural soil surface in a suitable fill material. It is a variation of the raised bed utilizing sandy fill material but not requiring a stabilization period prior to the construction of the absorption area.

HH. *Raised septic system:* a wastewater absorption trench system which has been constructed in soil fill material which has been placed on top of the natural soil on a building lot.

II. *Reserve strip:* A strip of land located adjacent to a public easement or right-of-way which has the effect of denying access to adjacent property owners to said public easement or right-of-way.

JJ. *Right-of-way:* Any street, avenue, parkway, highway, boulevard, road, alley, bicycle path or pedestrian walkway reserved and/or dedicated for public or private use chiefly by vehicular or pedestrian traffic. Its width shall be established as the shortest horizontal distance measured between lines delineating the right-of-way.

KK. *Rural and suburban area:* All that part of the incorporated area of the City of Norman which is not classified on the Norman 2025 Plan for urbanization.

LL. *Setback line:* See building line or yard line.

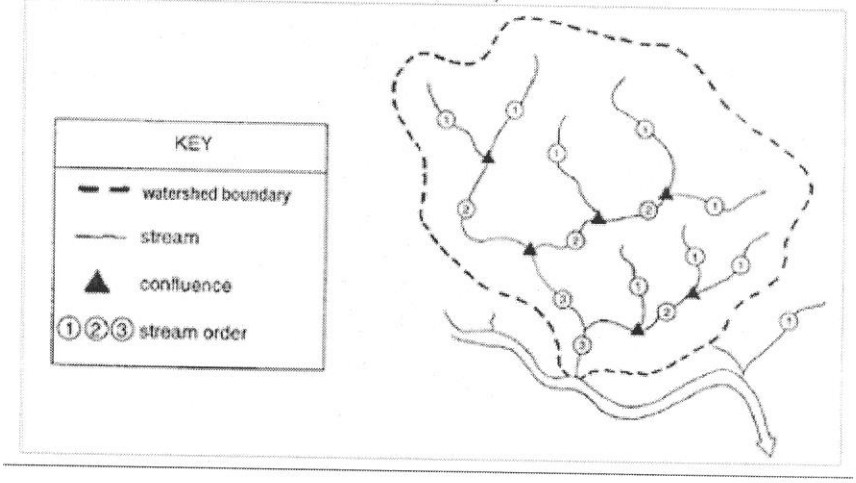
MM. *Site development plan:* A plan drawn at a scale of not less than fifty (50) feet equal one (1) inch which shows the topographic characteristics of the site not more than a one (1) foot contour interval in the urban areas and not more than two (2) feet contour intervals in the rural areasat a contour interval of not less than one (1) foot; the location and dimensions of buildings, yards, courts, landscape, pedestrian and vehicular circulation and parking, fences and screening; service areas and service courts, and other features; the use of each building and area; the height of buildings; adjacent street, alleys, utility, drainage and other easements; and the relationship of the development to adjacent areas which it may affect.

NN. *Streams:* Watercourses that are either identified through site inspection and/or notification by the United States Army Corp of Engineers or by the United States Geological Survey (USGS) 7.5 minute series (topographic) maps drawn at a scale of 1:24,000 or 1 inch = 2000 feet. Perennial streams are those which are depicted on a

USGS map with a solid blue line. Intermittent streams are those which are depicted on a USGS map with a dotted blue line.

OO. *Stream Order:* A method of numbering streams as part of a drainage basin network. Tributaries which have no branches are designated as of the first order, streams which receive two first-order tributaries are of the second order, larger branches which receive two second-order tributaries are designated third order, and so on, the main stream being always of the highest order. Designation of stream order shall be determined utilizing a USGS 7.5 minute series (topographic) map drawn at a scale of 1:24,000 or 1 inch = 2000 feet. See Figure 1 below.

Figure 1: Stream Order (Source: Schueler, 1995)



PP. *Stream Planning Corridor (SPC):* the areas of land designated as an SPC in Exhibit 4-4 to the PBS&J Storm Water Master Plan dated October 2009 along both sides of a stream or natural drainage corridor that encompasses the area projected to be inundated by the one-percent (1%) chance flood event (i.e. the 100-year floodplain) in any given year assuming full build-out watershed conditions (based upon the Norman 2025 Plan and subsequent updates) in those areas with 40 or more acres of drainage area in the Lake Thunderbird watershed.

QQ. *Street:* Any public or private right-of-way which affords the primary means of access to abutting property.

RR. *Street, collector:* A minor street collecting traffic from other minor streets and serving as the most direct route to a major street or community facility.

SS. *Street, cul-de-sac:* A local street having one (1) closed end terminated by a turn-around.

TT. *Street, estate type:* A local street in a Residential Estate (R-E) or Agricultural (A-1, A-2) zone or district.

UU. *Street, frontage or service:* A minor street located adjacent and parallel to a major street for land service to abutting properties and access to adjacent areas and for allowing control of access to the major street.

VV. *Street, local:* A minor street which collects and distributes traffic between parcels of land and collector or arterial streets, with the principal purpose to provide access to abutting property.

WW. *Street, major:* A freeway, principal arterial, or minor arterial designated on the adopted Transportation Plan of the City of Norman.

XX. *Street, minor:* Any street other than one (1) designated as a freeway, principal arterial, or minor arterial on the adopted Transportation Plan of the City of Norman, but not including alleys.

YY. *Street, public:* Any pre-existing county road heretofore annexed by the City of Norman and which forms a part of said City by reason of such annexation, or any street or road granted or dedicated to and accepted by the City of Norman.

ZZ. *Structural controls:* engineered solutions designed to reduce pollution in surface water runoff primarily through five basic mechanisms: infiltration, amelioration, treatment, filtration and detention. In effect, these systems attempt to counteract the opposite tendencies of decreased infiltration, filtration and detention which urbanization imposes upon the land.

AAA. *Subdivider (developer):* Any person, firm, partnership, corporation, or other entity acting as a unit, subdividing or proposing to subdivide or develop land as herein defined.

BBB. *Subdivision:* The division, re-division, or delineation of land by lots, tracts, sites or parcels for the purpose of transfer of ownership, or for urban development, or for the dedication or vacation of a public or private right-of-way or easement.

CCC. *Swale:* A natural depression or wide shallow ditch used to temporarily store, route, or filter runoff and encourage infiltration.

DDD. *Top of bank:* The point along a stream bank where abrupt change in slope is evident, and where the stream is generally able to overflow the banks and enter the adjacent floodplain. The top of bank may be identified from topography maps but must be verified through field inspection. Where no top of bank is discernable by the City Storm Water Engineer or his designee, measurements should be taken from the center line of the stream.

EEE. *Transportation Plan:* The arrangement, character, extent, and width of major streets within the City of Norman as designated on the most currently adopted Land Use and Transportation Plan document.

FFF. *Townhouse:* One (1) of a series of two (2) or more attached dwelling units, separated from one (1) another by continuous, vertical party walls without openings from basement floor to the roof deck and tight against same or through the roof and which are intended to have ownership transferred in conjunction with a platted lot.

GGG. *Urban area:* All that part of the incorporated area of the City of Norman which is designated on the Norman 2025 Plan for urbanization.

HHH. *Water Quality Protection Zone (WQPZ):* A vegetated strip of land that lies along a Stream or Lake Thunderbird and its adjacent wetlands, floodplains or slopes that is comprised of the stream bed and areas adjacent to the stream bed and the distance of which is determined by Section 19-411(B), (C) and (D) herein.

III. *Way:* Any street, avenue, parkway, highway, boulevard, road, alley, bicycle path or pedestrian walkway reserved and/or dedicated for public or private use chiefly be vehicular or pedestrian traffic. Its width shall be established as the shortest horizontal distance measured between lines delineating the right-of-way.

JJJ. *Wetland:* the term, as used herein, shall have the same meaning as set forth in 40 C.F.R. §230.3.

KKK. *Yard line:* An open space at grade between a building and the adjoining lot lines, unoccupied and unobstructed by any portion of a structure from the ground upward except as specifically provided in

Chapters 18 or 22. In measuring a yard for the purpose of determining the width of the side yard, the depth of a front yard, or the depth of a rear yard, the least horizontal distance between the lot line and the main building shall be used.

LLL. *Yard line, front.* A yard extending the full width of a lot between the side property lines and being the minimum horizontal distance between the street side property line and the main building or any projection thereof.

MMM. *Yard line, rear:* A yard extending across the rear of a lot measured between side yard lines and being the minimum horizontal distance between the rear lot line and the rear of the main building or any projections other than steps, unenclosed balconies or unenclosed porches. On corner lots the rear yard shall be considered as parallel to the street upon which the lot has its least dimension. On both corner lots and interior lots the rear yard shall in all cases be at the opposite end of the lot from the front yard.

NNN. *Yard line, side:* A yard between the building and the side line of the lot and extending from the front yard line to the rear lot line and being the minimum horizontal distance between a side lot line and the side of the main building or any projections other than steps.

§ 2. That Section 19-303 of Chapter 19 of the Code of the City of Norman shall be amended to read as follows:

Sec. 19-303. Preliminary Plat: Contents.

The preliminary plat shall be drawn at a scale of not more than one hundred (100) feet to the inch, except where impractical and shall show:

A. The scale, north arrow, date and legend;

B. The proposed name of the subdivision;

C. The name and address of the owner of record, the subdivider, the owner's engineer, and the registered land surveyor preparing the plat;

D. Legal description of the proposed subdivision, including the acreage and the number of lots proposed in the subdivision, by type;

E. A key map showing the location of the proposed subdivision referenced to existing or proposed arterial streets or highways and to

government section lines, and including the boundaries and number of acres of the drainage area of which the proposed subdivision is a part;

F. The names, with locations of intersecting boundary lines, of adjoining subdivisions, and the location of the Norman City limits if falling within or immediately adjoining the tract;

G. The land contours with vertical intervals of one foot in the urban areas and two (2) feet in the rural areas referenced to a United States Geological Survey datum (1988) or Coast and Geodetic Survey bench mark or monument;

H. The location of dedicated streets at the point where they adjoin and/or are immediately adjacent; but actual measured distances shall not be required;

I. Important features such as existing permanent buildings; large trees (a minimum eight (8) inch caliber); streams; railway lines; oil and gas line or wells as shown on the records of the Oklahoma Corporation Commission (including abandoned gas or oil wells and dry holes which remain unplugged);

J. The location of all existing easements of record, sanitary and storm sewers, water mains, streets, culverts, power lines, and other surface or subsurface structures within the tract or immediately adjacent thereto, and the proposed location, layout, type, and size of the following structures and utilities:

1. Water mains;

2. Sanitary sewer mains, sub-mains and laterals;

3. Storm sewers; and,

4. Street improvements.

K. The location of all drainage channels and subsurface drainage structures, and the proposed method of disposing of all run-off from the proposed subdivision, and the location and size of all drainage easements relating thereto, whether they be located within or outside of the proposed plat;

L. The length of the boundaries of the tract, measured to the nearest foot, and the proposed location and width of streets, alleys, easements, and setback lines, and the approximate lot dimensions;

M. The existing zoning and proposed changes of zoning in the tract and of the property immediately adjacent thereto;

N. One hundred (100) year flood boundaries;

O. Water Quality Protection Zone boundaries;

P. Preliminary drawings showing compliance with the applicable requirements of this Chapter for structural controls on development;

Q. A topographic map, drawn to a scale of one hundred (100) feet to one inch, or in an appropriate scale. The map should display, according the best information available, topographic information and features (including, but not limited to, faults and fractures along waterways, wetlands, and sinkholes), and the WQPZ. Current limits of the FEMA floodplain and the SPC shall be displayed;

R. Location of all temporary and permanent runoff detention basins, constructed and altered waterways and other physical facilities to be installed to comply with the terms of this ordinance;

S. Location of all existing monitoring stations, sample points or other significant devices used in measuring or assuring water quality;

T. Any technical surveys or studies necessary to support a request for modification of WQPZ boundaries affecting the subject parcel;

U. In the instance where there is one (1) or more active oil and/or gas well(s), lease road(s), tank batteries, flow lines, gas sales lines, dead man anchors or any other related equipment, located within a proposed preliminary plat, any and all such items shall be shown on the submitted preliminary plat. Both existing conditions and any proposed changes to the existing conditions must be indicated on the preliminary plat. The information shall include, but not be limited to well access, size of the well location, including appurtenant equipment, any change in lay out or operations of the well site such as relocation of the lease road or moving of the tank batteries and flow lines, fencing, easements for flow lines, gas sales line, communication cables, and electric power lines. The information must also stipulate the parties responsible for constructing any lease road and approach and fencing. Easements necessary to provide for flow lines, gas sales lines, power

supply lines and communication cables must be designated in writing. All information required must be shown on a site plan that has been reviewed and approved for compliance with oil and gas ordinances. A copy of the site plan shall be provided to the oil and gas inspector to become part of the well records until such time of the plugging and restoration of well location(s) has been completed. Oil well operators shall be notified by the oil and gas inspector of any predevelopment informational meeting(s) as an interested part where a preliminary plat contains a well(s), lease road, tank battery, flow line, gas sales line, dead man anchors, or any other related equipment that they operate. Notice shall be given in the same format as property owners within the required notice area.

§ 3. That Section 19-308(E) of Chapter 19 of the Code of the City of Norman shall be amended to read as follows:

E. In the case of a plat proposing the reserving or dedicating of land or amenities to be used in common by owners of lots in a single-family residential subdivision, or in the case of a plat or Norman Rural Certificate of Survey that contains any portion of the WQPZ, the applicant shall submit evidence acceptable to the City Attorney that all necessary steps have been taken for:

1. The establishment of a mandatory Property Owner's Association ("POA") or establishment of another acceptable arrangement for adequate maintenance of the common elements and any designated non-structural controls for storm water management. All mandatory single-family residential POAs shall submit a Declaration of Covenants, Conditions and Restrictions (the "Declaration") which establishes a minimum framework that provides for the fair and effective administration of the POA and thereby assures the greater likelihood that the interests of the City and its citizens are secure and which include the following provisions:
    a. A list of all common property in the plat, by legal description. A specific description of all of the common elements within the subdivision including any abutting arterial roadways, the uses allowed for each common element and a description of the person responsible for initially constructing or installing each common element and the responsibility for maintaining the common element after initial installation;
    b. In those plats containing any portion of the WQPZ, a list of any non-structural controls located on the property.

* * * * *

§ 4. That Section 19-411 of Chapter 19 of the Code of the City of Norman shall be added to read as follows:

Sec. 19-411. Water Quality Protection Zone Design Standards.

A. The Water Quality Protection Zone (WQPZ) for a stream system shall consist of a vegetated strip of land, preferably undisturbed and natural, extending along both sides of a stream and its adjacent wetlands, floodplains, or slopes. The width shall be adjusted to include contiguous sensitive areas, such as steep slopes, where development or disturbance may adversely affect water quality, streams, wetlands, or other water bodies.

B. The required base width for all WQPZ's shall be equal to:

1. The greater of the following:

a. 100 feet in width, measured from the top of the bank, on either side of the stream; OR

b. The designated Stream Planning Corridor as delineated on Exhibit 4-4 to the Storm Water Master Plan, dated October 2009 and accepted by City Council on November 10, 2009 and as available on the appropriate scale through the Public Works Department, or as indicated by the Applicant's independent engineering analysis ; OR

c. The FEMA Floodplain; OR

2. An alternative width equal to 25 feet in width, measured from the top of the bank, on either side of the stream when a reduction in nitrogen of at least 75% and a reduction in phosphorus of at least 58% is achieved through the use of an engineered process that is certified by a licensed Professional Engineer. A development plan using an alternative width less than the SPC shall also document protection against flooding and bank erosion that would be anticipated during the 1% chance flood event in an given year assuming full build-out watershed conditions in those areas with 40 or more acres of drainage area in the Lake Thunderbird watershed. For the purpose of determining the applicable reduction in the base width of the buffer, the table below may be utilized to determine pollutant removal for a particular structural control,

as long as such control is constructed in accordance with the specifications for said control contained in Wichita/Sedgwick County Stormwater Manual.

Table of Design Pollutant Removal Efficiencies for Storm Water Controls (%)				
Structural Control	Total Suspended Solids	Total Phosphorus	Total Nitrogen	Metals
Storm Water Pond	80	55	30	50
Dry Extended Detention Pond	60	35	25	25
Enhanced Dry Swales	90	50	50	40
Grass Channel	50	25	20	30
Infiltration Trench	90	60	60	90
Soaking Trench	90	60	60	90
Vegetative Filter Strips	50	20	20	40
Surface Sand Filters	80	50	30	50

C. For each portion of any 25 foot segment of the buffer, as set forth in Section 19-411(B), that has a slope over 20%, 25 feet shall be added to the width of the WQPZ. To determine the extent of steep slopes, a cross section of the topography every 100 feet shall be prepared and utilized by the Applicant.

D. In second-order streams with continuous water or in higher order streams, 25 feet shall be added to the base width outlined in Section 19-411 (B) above.

E. Drainage easements, of sufficient size to carry the runoff of a 1% chance flood event from all drainage areas on the Plat greater than forty (40) acres within the WQPZ must be shown on dotted lines on the Preliminary and Final Plats, along with a written legal description of any such easement, all certified by a licensed Professional Engineer. Such easement shall be granted to the City of Norman for the purpose of access for inspecting, repairing, and maintaining drainage channels.

F. For all developments, particularly those containing some portion of the WQPZ, utilization of low impact development strategies are encouraged. For plats or Norman Rural Certificates of Survey that include portions of the WQPZ, the current Engineering Design Criteria may be modified when Low Impact Development strategies are utilized in accordance with City of Wichita/Sedgwick County Stormwater Manual.

G. Water Pollution Hazards. The following land uses and/or activities are designated as potential water pollution hazards and must be set back from the top of the bank of any stream or waterbody by the distance indicated below:

1. Storage of hazardous substances—(300 feet)

2. Aboveground or underground petroleum storage facilities—(300 feet)

3. Drainfields from onsite sewage disposal and treatment systems (i.e., septic systems)—(200 feet)

4. Raised septic systems and raised mound septic systems—(500 feet)

5. Solid waste landfills or junkyards—(600 feet)

6. Subsurface discharges from a wastewater treatment plant—(200 feet)

7. Land application of biosolids—(200 feet)

H. WQPZ Design Restrictions. Except as required for initial construction, there shall be no clearing, grading, construction that disturbs vegetation on any portion of the WQPZ, the width of which is determined by Section 19-411(B), (C) and (D) herein. Any development containing a WQPZ shall not be designed to contain within that zone any permanent structures or portions of septic systems, except for structural controls or other enhancing design features that will further the objectives of this ordinance.

I. All applications for preliminary plats and Norman Rural Certificates of Survey that contain any portion of property within the WQPZ shall also submit a report outlining the Best Management Practices to be employed.

§ 5. That Section 19-514 of Chapter 19 of the Code of the City of Norman shall be added to read as follows:

Sec. 19-514. Water Quality Protection Zone Management and Maintenance.

A. All preliminary plats, final plats, and Norman Rural Certificates of Survey shall clearly:

1. Show the extent of any WQPZ on the subject property.

2. Label the WQPZ.
3. Provide a note to reference any WQPZ stating: "There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by the Director of Public Works unless such disturbance is done in accordance with 19-514(E) of the Norman City Code.
4. Provide a note to reference any protective covenants governing all WQPZ areas stating: "Any WQPZ shown hereon is subject to protective covenants that may be found in the land records and that restrict disturbance and use of these areas."
5. All subdivisions containing a WQPZ area shall ensure maintenance of the non-structural controls/aspects in the WQPZ area by its Property Owners' Association through the filing of a protective covenant, which is required to be submitted to the City Attorney's office for approval. The covenant shall be recorded in the land records and shall run with the land and continue in perpetuity. Any changes to the covenants and restrictions shall be consistent with the provisions herein.

B. An offer of dedication of a WQPZ to the City of Norman does not convey to the general public the right of access to this area unless such a right is explicitly set forth in said dedication. Further, an offer of dedication of a WQPZ is not a mandate for a public trail system or any portion thereof.

C. The Public Works Department shall inspect the buffer annually and following severe storms for evidence of sediment deposition, erosion, or concentrated flow channels and corrective actions taken to ensure the integrity and functions of the WQPZ.

D. Any portion of the WQPZ that is within thirty (30) feet of a combustible structure shall be maintained (regardless of the underlying zoning designation) as provided in Section 10-209.

E. Portions of the WQPZ that are not within thirty (30) feet of a combustible structure may be left undisturbed and natural, and in no event, shall grassy vegetation in this area be mowed or otherwise cut down to less than six (6) inches tall.

§ 6. That Section 19-601 of Chapter 19 of the Code of the City of Norman shall be amended to read as follows:

Sec. 19-601. Variations.

A. Occasionally the tract to be subdivided is of such unusual size or shape or is surrounded by such development or unusual conditions that the strict application of the requirements contained in this chapter would result in substantial hardship or inequity. The City Council may vary or modify, except as otherwise indicated, such requirements of design, but not of procedure or public improvements, so that the subdivider may develop the subject property in a reasonable manner. At the same time, the public welfare and interests of the City must be protected and the general intent and spirit of this chapter are preserved by granting such variance. Such modification may be granted upon written request of the subdivider or the subdivider's engineer, stating the reason for each modification, and may be approved by vote of the regular membership of the City Council, with the recommendation of the Planning Commission, subject to the acceptance of the plat and the dedications thereon by the City Council; provided, however, that a variation based on unique condition(s) shall not be granted when the unique condition(s) was created or contributed to by the subdivider.

B. WQPZ Averaging. The width of the WQPZ may be reduced in some circumstances to accommodate unusual or historical development patterns, shallow lots, stream crossings, or storm water ponds. Any averaging of the WQPZ must be done in accordance with the following:

1. An overall average WQPZ width of at least the base width as determined in 19-411(B) must be achieved within the boundaries of the property to be developed. The WQPZ on adjoining properties cannot be included with buffer averaging on a separate property, even if owned by the same property owner.

2. The average width must be calculated based upon the entire length of stream bank that is located within the boundaries of the property to be developed. When calculating the WQPZ length, the natural stream channel should be followed.

3. WQPZ averaging shall be applied to each side of a stream independently. If the property being developed encompasses both sides of a stream, WQPZ averaging can be applied to both sides of the stream, but must be applied to both sides of the

stream independently, unless the natural topography of the stream makes one side of the stream not conducive to the establishment of a WQPZ and in that event, averaging using both sides may be utilized.

4. WQPZ averaging is prohibited in developments that have, or will have after development areas that have slopes greater than 15% that are located within fifty feet of the stream to be buffered.

5. Appeal from Decision of Public Works Director. If the applicant desires to appeal from the decision of the Public Works Director or his or her designee made in accordance with this subsection, the applicant may file such request, and any documentation supporting said appeal, with the City Clerk. The City Clerk will place the appeal on the agenda of the next available regular City Council meeting. The decision of the Public Works Director, or his or her designee, may be upheld or overturned by vote of the regular membership of the City Council.

C. Whenever infrastructure has been installed that will benefit the full build-out of a Preliminary Plat which was approved within five (5) years prior to the effective date of this ordinance, the Preliminary Plat shall not be deemed expired, for purposes only of the application of this ordinance, even after the passage of three (3) years from the date of approval of the Preliminary Plat, or five (5) years from the date of approval of the Preliminary Plat if a Final Plat has been filed on part of the land embraced in the Preliminary Plat.

§ 7. That Section 19-606 of Chapter 19 of the Code of the City of Norman shall be amended to read as follows:

Sec. 19-606 Exception to allow Norman Rural Certificates of Survey as plats in A-1 and A-2 Zoning Districts.

A. It is the purpose of this exception to allow lots of ten (10) acres or more to be developed and sold adjacent to public or private roadways in the A-1 and A-2 Agricultural Districts; however, private roadways should be constructed and maintained in such a manner that said roadways may be traversed and used by police, fire and other official vehicles of all municipal, county, state and federal agencies. Lots created under this process shall be designated as "Norman Rural Certificate of Survey Subdivisions" and may be permitted under the following procedures (Ord. No. O-0203-34):

* * * * *

2. An accurate survey of the lot, prepared by a land surveyor registered in the State of Oklahoma, and the proposed subdivision thereof shall be submitted to the Public Works Department and shall show the same information required for a preliminary plat as referenced in Section 19-5303, article V, Chapter 19 of this Code, except the ground contours may be drawn at five-foot intervals in such cases where the average ground slope is three (3) percent or greater.

* * * * *

§ 8. If the provisions of any existing section of Chapter 19 conflicts with any section of this Water Quality Protection Zone ordinance, then the provisions of this ordinance O-1011-52 will control and prevail.

§ 9. Severability. If any section, subsection, sentence, clause, phrase, or portion of this ordinance is, for any reason, held invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct, and independent provision, and such holding shall not affect the validity of the remaining portions of this ordinance, except that the effective date provision shall not be severable from the operative provisions of the ordinance.

ADOPTED this _____ day

of _____, 2011

Cindy Rosenthal, Mayor

NOT ADOPTED this _____ day

of _____, 2011.

Cindy Rosenthal, Mayor

ATTEST:
Brenda Hall, City Clerk

Appendix C: Fayetteville, Arkansas Low Impact Development Ordinance

TITLE XV UNIFIED DEVELOPMENT CODE

CHAPTER 179: LOW IMPACT DEVELOPMENT

179.01 Purpose

It is the purpose of this chapter to provide a regulatory basis for site design and development which incorporates Low Impact Development (LID) strategies into land development. This chapter provides techniques for property owners, builders and land developers to integrate site appropriate stormwater management practices while striving to maintain or enhance natural site features. This may reduce or eliminate structural components of a conventional storm water management system.

Some of the existing natural site features typically protected through the use of LID techniques are: wetlands, floodplains, forested areas, hillsides, riparian corridors and existing soils.

There are a variety of LID design alternatives that allow professionals in the land development field the flexibility to implement LID stormwater design elements. The various LID practices can be used alone or in series to maximize benefits to the site. In most cases, some type of structural drainage systems will also be required to be implemented in conjunction with LID element.

(A) *Objectives*. The objectives of this ordinance are:

(1) To establish criteria by which a LID strategy can be measured and implemented.

(2) To strive to maintain and restore natural rainwater absorption and infiltration processes;

(3) To strive to maintain pre-development hydrologic conditions;

(4) To filter pollutants from stormwater runoff thereby improving water quality and positively impacting the region's lakes, streams and groundwater;

(5) To reduce stormwater runoff intensity and velocity;

(6) To preserve riparian banks and beds, and reduce sedimentation that impairs water quality;

(7) To promote the widespread use of LID practices integrated with conventional stormwater engineering;

(8) To protect the safety and welfare of citizens, property owners, and businesses by minimizing the negative impacts of stormwater discharge from land development.

(B) *LID Principles*.

(1) Define and locate critical resource areas during the project planning stage, such as; wetlands, riparian zones and soils with infiltration capacities.

(2) Minimize impervious surfaces such as streets, driveways and parking areas.

(3) Minimize direct connection of impervious areas which convey runoff directly to wetlands or water courses.

(4) Attenuate stormwater flow through a diverse system of collection and infiltration.

(Ord. 5316, 4-20-10)

179.02 Applicability

(A) *Development approval*. The standards and guidelines contained in this chapter shall apply in all cases where a land developer chooses to utilize LID to obtain Administrative, Planning Commission or City Council approval for their project.

(B) *Engineering approval*. The City Engineer, or their designee, will administer this chapter and shall be responsible for final approval of all LID systems and structures. With the approval of the City Engineer, LID systems and structures may be implemented to replace or supplement conventional stormwater management systems. The use of these systems must also be concurrent with other code requirements such as landscaping, fire access, etc. Systems that are approved shall be integrated where their design function dictates.

(Ord. 5316, 4-20-10)

179.03 LID Site Design Strategies

(A) *Definition*. For the purposes of this chapter Low Impact Development (LID) is a stormwater management strategy concerned with maintaining, restoring or replicating the natural hydrologic functions of a site, where possible, by employing a variety and combination of natural and built features that reduce the volume and velocity of stormwater runoff, filter out its pollutants, and facilitate the infiltration of water into the ground.

(B) *Site design strategies*. Generally, site design strategies will address the arrangement of buildings, roads, parking areas, and other

features, and the conveyance of stormwater runoff across the site. LID site design strategies are intended to complement the natural and built environment while minimizing the generation of runoff. Site design strategies should address some or all of the following considerations:

(1) Necessary grading and land disturbance should be designed to encourage sheet flow and lengthen stormwater flow paths.

(2) Natural drainage divides should be maintained to keep flow paths dispersed.

(3) Areas of impervious surfaces should be separated and stormwater should be conveyed across vegetated areas. This assists runoff filtration and encourages infiltration.

(4) Distribute small-scale LID strategies across the development site in order to maximize benefits.

(5) To the maximum extent possible, treat pollutant loads where they are generated.

(6) Preserve naturally vegetated areas and soil types that slow runoff, filter pollutants and facilitate infiltration.

(7) LID systems and structures should be integrated into the natural and built landscape with attention to flow paths, infiltration areas and the use of appropriate native plant materials.

(C) *Site Design Elements*. In addition to water quality impacts, the following LID site design elements when successfully implemented, perform three necessary functions; filtration and infiltration, capture and re-use and reductions in impervious surfaces. Specific site design elements are outlined below:

(1) *Filtration/Infiltration*

(a) Bio-retention and Rain Gardens: Bio-retention is a practice to manage and treat stormwater runoff by using an amended planting soil bed and native planting materials to filter runoff stored within a shallow depression.

Bio-retention Basin / Rain Garden	
Space Required	Minimum surface area range of 50 to 200 square feet (typical)
Soils	Permeable soils recommended – Underdrain may be necessary
Slopes	A design consideration
Water table/Bedrock	2 – 4 ft. clearance above water table recommended (typical)
Proximity to Foundations	Minimum 10 ft. separation from building foundations (typical)
Maximum Depth	2 to 4 ft. depending on soil type (typical)
Maintenance	Low requirement – routine landscape maintenance

(b) Dry Well: A dry well is an excavated pit dug into the native soil and backfilled with aggregate such as pea gravel or crushed stone. Dry wells are utilized for stormwater infiltration from building downspouts and as catch basins for surface runoff.

Dry Well	
Space Required	Minimum surface area range 8 to 20 square feet (typical)
Soils	Permeable soils recommended
Backfill	Clean aggregate surrounded by engineering filter fabric
Slopes	A design consideration – locate downgrade from buildings
Water table/Bedrock	2 – 4 ft. clearance above water table recommended (typical)
Proximity to Foundations	Minimum 10 ft. separation from building foundations (typical)
Maximum Depth	6 to 10 ft. depending on soil type (typical)
Outflow Structures	Overland flow path for runoff exceeding the dry well capacity should be evaluated
Maintenance	Low requirement – routine landscape maintenance

(c) Filter Strips: Filter strips are bands of vegetation, usually grass, planted between a stormwater pollutant source and a downstream receiving waterbody. Filter strips are very effective adjacent to parking lots where sheet flow is designed to travel over the filter strip to a swale or retention area. Filter strips trap sediment and pollutants thereby providing some infiltration while slowing and dispersing stormwater over a larger area.

Filter Strips	
Length and size	A minimum length of 20 feet is recommended (typical)
Flow	Should be used to control overland sheet flow only
Slopes	Minimum slope = 1.0%

	Maximum slope determined by site conditions (typical)
Maintenance	Low requirement – routine landscape maintenance

(d) Grassed Swales: Swales have traditionally been used in rural and suburban areas with low residential densities as a conveyance for runoff from roads and highways. The modern swale as a LID element is utilized as both a method of conveyance and retention, and as an infiltration strategy. Dry swales typically have 2 to 3 feet of permeable soil located above a gravel base allowing stormwater to infiltrate.

Grassed Swales	
Channel Capacity	Swale must be sized to convey the peak discharge of the design storm
Soils	Permeability of the soil will determine whether to use a dry or wet swale
Bottom Width	2 foot minimum 6 foot maximum (typical)
Side Slopes	3:1 or flatter (typical)
Flow Depth	4 inches minimum (typical)
Maintenance	Low requirement – routine landscape maintenance

(e) Infiltration trench: An infiltration trench is an excavated trench that has been back-filled with aggregate or stone to form a subsurface basin. Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, usually over a period of several days. The scale allows for applicability in a variety of small urban drainage areas.

Infiltration Trenches	
Soils	Works best in mid to high permeable soils
Excavation Depth	3 to 12 feet (typical)
Backfill	1.5 to 3 inch clean aggregate (typical)
Outflow Structures	Overland flow path of surface runoff exceeding the capacity of the trench must be identified and evaluated.
Storage Time	Empty within three days. (typical)

(f) Enhanced retention / wet pond: A wet retention pond is designed as a permanent pool of water, often with additional flood control and extended detention storage volume available above the permanent pool. Retention ponds generally hold water for release only through evapotranspiration and infiltration.

Enhanced Retention / Wet Pond	
General Design Considerations	• Size of the watershed • Vegetative cover of the watershed and pond • Seasonal effects and variation • Soil erodibility and infiltration rate • Storm characteristics
Permanent Pool Depth	2-3 ft. minimum (typical) 9-10 ft. maximum (typical) 3-6 ft. average (typical)
Length to Width Ration	3:1 (typical)
Inlet and Outlet	Should be located to maximize flow length
Side Slopes	3:1 maximum (typical)
Erosion Control	Riprap or other suitable erosion control means needed for the inlet and outlet structures
Aquatic Bench	An aquatic bench of a maximum depth of 18 inches extending inward from the normal pool edge for 15 feet is recommended for safety considerations and mosquito control
Vegetation	Appropriate plant materials should be chosen for pollution removal, aesthetics and maintenance requirements
Maintenance	Debris removal from inlet and outlet structures should occur once a month and after significant storm events. Sediment removal will be required periodically.

(2) *Capture and Re-use*

(a) Rain barrels: Rain barrels capture runoff from roof structures for later use primarily to irrigate landscapes and gardens. This low cost and easily maintained retention system can be applicable to both small scale single family residences and larger commercial or industrial sites.

Rain Barrels	
Filtration Screens	Water conveyed by downspouts should be filtered through a screen that can be removed and cleaned
Overflow	An overflow outlet must

	be provided to bypass rainfall from large storm events. Overflow may be channeled through an infiltration ditch or French drain or to a rain garden.
Spigot	A drain spigot with garden hose threading is needed for irrigation.

(b) Cisterns: Cisterns are rainwater capture containers that have the capacity for large rain events on extensive roof areas. They are usually located underground and generally range in capacity from 100 to 1,400 gallons.

Cisterns	
Filtration	Water should be filtered through a screen that can be removed and cleaned
Water re-use	Cisterns have been adapted to provide non-potable water for indoor use.
Design Considerations	Capacity should be determined by the roof area capture for large storm events

(3) *Impervious Surface Reductions*.

(a) Permeable pavement: Permeable pavement refers to any load-bearing surface that has the capability to infiltrate runoff into the underlying base course and soil. Permeable pavement should be limited to use in low volume traffic areas such as parking strips, shoulders and sidewalks.

Permeable Pavement	
Applicability	Permeable pavement should be used only in low volume traffic areas. These systems are difficult to incorporate into retrofit situations where the soils are compacted.
Sub grade Materials and Drainage	Particular care should be given to the permeability of the underlying soil. Soils that do not drain well may be unsuitable for this material. An underdrain system may be required.
Base Course	The type and depth of the reservoir base course should be designed based on the storm event.

(b) Permeable pavers: includes concrete grid and grass pavers, interlocking concrete modules and unit pavers such as brick or stone.

Permeable Pavers	
Applicability	May be used as a crosswalk material with engineering approval in urban situations. Also an appropriate surface for parking areas, excluding drive aisles
Sub grade Materials	Pavers should be set on a crushed stone base that allows for permeability.
Maintenance	Periodically, portions may need to be reset due to settling of the subsurface materials or excessive loads.

(c) Green roofs: Green roofs consist of a layer of soil and vegetation installed on top of a conventional flat or slightly sloped roof. The vegetation captures rainwater allowing evaporation and evapotranspiration processes to reduce the runoff volume. Green roofs work by absorbing rainwater for use by the plant materials.

Green Roofs	
Applicability	Green rooftop area may be limited by structural capacity
Essential Components	• A roof structure capable or supporting the necessary weight loads. • A waterproofing system designed to protect the building. • A drainage layer consisting of porous media capable of water storage for plant uptake. • A geosynthetic layer to prevent fine media from clogging the porous media. • Appropriate soil and plant materials

(4) Additional LID Site Design Elements. Additional LID site elements determined to be beneficial and that meet the site design strategies may be approved by the City Engineer.

(Ord. 5316, 4-20-10)

179.04 Submittal Requirements

(A) *Application Submittal*

(1) Submittal. Projects incorporating LID structures or systems shall submit to the

Development Services Division a LID site design plan sheet, along with all other required site design plan sheets, illustrating the location and type of LID design element(s) being proposed. The City Engineer will require the following information on the LID site design plan sheet:

(a) Names, addresses, zoning and property lines of all property owners adjacent to the exterior boundaries of the project.

(b) Name, address and phone numbers of the owners, developers, and project representatives.

(c) North arrow, scale, date of preparation, zoning classification and proposed use.

(d) Title block in lower right hand corner indicating the name and type of project, scale and firm or individual preparing the drawing, date and revisions.

(e) An accurate legend.

(f) A vicinity map of the project with a radius of 1.5 miles from the project boundaries.

(g) The location of all existing structures.

(h) Show 100 year floodplain and/or floodway and base flood elevations.

(i) Existing and proposed topographic information, with the source noted, at two foot contours for the project site and within 100 ft of the project boundaries.

(j) Delineate all tree canopy to be removed and retained on site.

(k) Delineate the limits of soil disturbance and grading on and off site.

(l) Show existing soil classifications for the site and within 100 feet of the project boundaries.

(m) Provide a note of any known existing erosion problems on site or within 300' downstream of the property.

(n) Show the location of any known or existing water wells, sumps, cesspools, springs, water impoundments and underground structures within the project.

(o) Show the location of all known potentially dangerous areas, including areas subject to flooding, slope settlement, or any previously filled areas and the means of mitigating the hazards.

(p) Show the existing and proposed locations of all utilities, rights-of-way and easements.

(q) Show all existing or proposed LID systems or structures, storm sewer structures, septic systems, water systems, sanitary sewer structures and drainage structures; including locations, types and pipe sizes.

(r) Show the proposed lot layout for any proposed subdivision or development plat.

(s) Show the location of all existing or proposed areas containing impervious surface including rooftops, streets, driveways, sidewalks, and patio areas.

(2) Soils Report. The applicant shall submit a soils report that provides essential technical information regarding the existing and proposed soils. The soils report shall provide all necessary information that supports the incorporation of the proposed conventional and LID stormwater systems and structures.

(3) Drainage Report. The applicant shall submit a drainage report that provides all necessary information that supports the LID design elements within the development, including specifications and technical information for the site specific design details that support the proposed LID systems and structures.

(Ord. 5316, 4-20-10)

179.05 LID Credits

(A) LID systems and structures may be permitted in lieu of conventional stormwater systems including: curb and gutter, storm drain inlets, piping, etc., when supporting data is presented and approved by the City Engineer.

(B) The volume of required retention/detention facilities may be reduced where it is proven that the LID design elements are sufficient to partially accommodate the design storm volume required in the Drainage Criteria Manual.

(C) At such time that a stormwater utility is formed that requires an assessment or a fee then the use of LID systems and structures may reduce or

eliminate those fees, in accordance with the enabling ordinance.

(Ord. 5316, 4-20-10)

179.06 Maintenance Of LID Systems And Structures

(A) *Construction Approval, Timing, and Inspections.* LID systems and structures shall be constructed and installed as follows:

(1) As part of the Grading and Drainage permit approval process, a construction inspection schedule shall be established by the Project Engineer and approved by the City Engineer to address critical project milestones. Under the approved inspection schedule, no work shall proceed until the City Engineer inspects and authorizes work to proceed beyond each scheduled milestone. Any portion of the work that does not comply with the permit conditions shall be specified in writing by the City Engineer and promptly corrected by the responsible entity.

(2) All LID systems and structures that are designed as part of the stormwater conveyance or storage system shall be designed and constructed according to the approved plans.

(3) A final inspection of all LID systems and structures shall be performed prior to final plat or temporary certificate of occupancy approval.

(B) *Dedication.* Those LID structures or systems approved in compliance with this chapter that will function as a part of the stormwater management conveyance system shall be dedicated to the city. All areas and/or structures to be dedicated to the city must be dedicated by plat or separate instrument and accepted by the City Engineer. Final determination of structures or systems to be dedicated shall be made by the City Engineer.

(C) *Perpetual Inspections and Maintenance Agreements.* The City shall require a Stormwater Management Practices Maintenance Agreement of all entities that utilize LID systems and structures in the stormwater management plan for their proposed development. The City shall require the following set of documents and agreements prior to LID stormwater systems and structures approval:

(1) *Agreement of Maintenance Responsibility.* The owner of the property on which the LID systems and structures have been installed shall agree to undergo ongoing inspections, and document maintenance and repair needs.

(2) *Agreement to Maintain LID Systems and Structures.* The owner of the property on which LID systems and structures have been installed shall agree to maintain in good condition and promptly repair and restore all grade surfaces, walls, drains, dams and structures, vegetation, erosion and sedimentation controls, and other protective devices.

(D) *Approved Entities for Perpetual Maintenance Agreements.* All LID structures or systems approved in compliance with this chapter but not dedicated to the city shall have adequate easements to permit the city to inspect and, if necessary to take corrective action should the responsible entity fail to properly maintain the system. Maintenance of all other LID structures or systems approved in compliance with this chapter and not dedicated to the City shall be accomplished by the legal entity responsible for maintenance, which may include an approved entity as identified in the following:

(1) *Special districts and public entities.* An active water control district, drainage district, public utility, or a special assessment district;

(2) *Developer or property owner.* A developer or property owner who provides a bond or other assurance of continued financial capability to operate and maintain stormwater management systems and who executes a binding legal Stormwater Management Practices Maintenance Agreement with the city; or,

(3) *Property owner associations.* Property owner associations able to comply with the following provisions:

(a) The association provides a binding legal Stormwater Management Practices Maintenance Agreement through which it assumes full responsibility for the LID structures or systems operation and maintenance.

(b) The association has sufficient powers to operate and maintain the LID structures or systems, establish rules, assess members, contract for services, exist perpetually and, if dissolved, to provide alternative operation and maintenance services.

(c) The association can provide a bond or other assurances of financial capability

to operate and maintain the LID structures or systems.

(E) *Maintenance Inspections.* All privately owned stormwater management facilities shall be inspected near the end of the first year of operation. Subsequent inspections should be performed once every three years to ensure functionality and compliance. The Stormwater Management Practices Maintenance Agreement shall specify the responsible party for conducting long term inspections. Inspection reports shall be submitted to and maintained by the City Engineer for all LID systems and structures. Inspection reports for LID systems and structures shall include:

(1) The date of the inspection;

(2) The name of the Inspector;

(3) The condition of:

(a) Pretreatment devices.

(b) Vegetation or filter media.

(c) Spillways, valves, or other control structures.

(d) Embankments, slopes or safety benches.

(e) Inlet and outlet channels and structures.

(f) Sediment and debris accumulation in storage and forebay areas.

(g) Underground drainage.

(h) Any other item that could affect the proper function of the LID structures or systems.

(4) Description of the needed maintenance.

(F) *Right-of-Entry for Inspection.* The Stormwater Management Maintenance Agreement shall provide for the City Engineer or designee to enter the property at reasonable times and in a reasonable manner for the purpose of inspecting LID systems and structures.

(G) *Failure to Maintain.* If a responsible person fails or refuses to meet the requirements of the inspection and maintenance agreement the City shall give written notice requesting corrective action. If the conditions described in the Failure to Maintain notice are not corrected within 10 days after such notice is given, the mayor, or his duly authorized representative, is hereby authorized to enter upon the property and do whatever is necessary to correct or remove the conditions described, in the notice. The costs of correcting said conditions shall be charged to the owner or owners of the property and the city shall have a lien against such property for such costs.

(1) *Enforcement of the Lien.* The lien herein provided for may be enforced and collected in either one of the following manners:

(a) The lien may be enforced at any time within 18 months after work has been done, by an action in the chancerycircuit court; or

(b) The amount of the lien herein provided may be determined at a hearing before the City Council held after 30 days written notice by certified mail to the owner or owners of the property, if the name and whereabouts of the owner or owners be known, and if the name of the owner or owners cannot be determined, then only after publication of notice of such hearing in a newspaper having a bona fide circulation in Washington County for one insertion per week for four consecutive weeks; the determination of the City Council shall be subject to appeal by the property owner in the chancery circuit court; and the amount so determined at said hearing, plus ten percent penalty for collection, shall be by the City Council certified to the tax collector of the county, and by him placed on the tax books as delinquent taxes, and collected accordingly, and the amount, less three percent thereof, when so collected shall be paid to the city by the county tax collector.

(c) In case the owner of any lot or other real property is unknown or his whereabouts is not known or he is a nonresident of this state, then a copy of the written notice hereinabove referred to shall be posted upon the premises and before any action to enforce such lien shall be had, the City Clerk shall make an affidavit setting out the facts as to unknown address or whereabouts or non-residence, and thereupon service of the publication as now provided for by law against nonresident defendants may be had, and an attorney ad litem may be appointed to notify the defendant by registered letter addressed to his last known place of residence if same can be found.

(H) *Removal and modification of LID systems and structures*. LID systems and structures may only be modified or removed with the approval of the City Engineer, who shall determine the LID system or structure does not function as a part of the stormwater management system. The applicant may be required to provide supporting data and calculations that justify the removal of the LID systems or structures.

(I) *Exemptions from maintenance agreements and inspections*. LID systems and structures that are not designed as part of a development and are instead utilized on a site by site basis (i.e., use of a rain barrel at a single family home, or individual rain gardens or filter strips on a site) shall not be required to submit a formal maintenance and inspection agreement, unless the function of the LID system or structure is found to be essential to accommodating the stormwater needs of the property or surrounding properties by the City Engineer.

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