

## STORMWATER MANAGEMENT

Stormwater management is an integral component of an ecologically responsive campus and the long-term sustainability of the University. Implementing best management practices reduces the stormwater load on infrastructure and creates on-site visibility allowing the landscape to be showcased as a productive component of the Campus Framework.

The following recommendations build on the current landuse, topography, ecology, and proposed growth of the University. The stormwater management guidelines have been organized into three overlay zones which reflect the existing conditions and campus connections to surrounding waterways.

### WATERSHED PRIORITY AREAS

These areas are at the high points of the campus watersheds and should include low impact development practices and rainwater harvesting to reduce downstream loading.

### POLLUTION CONTROL AREAS

These are large areas of impervious surfaces, requiring stormwater filtration to improve water quality before discharge.

### STREAM PROTECTION AREAS

These are areas that interface with campus waterways and should include integrated landscape stormwater treatments and green infrastructure to enhance ecosystem function and stream health.

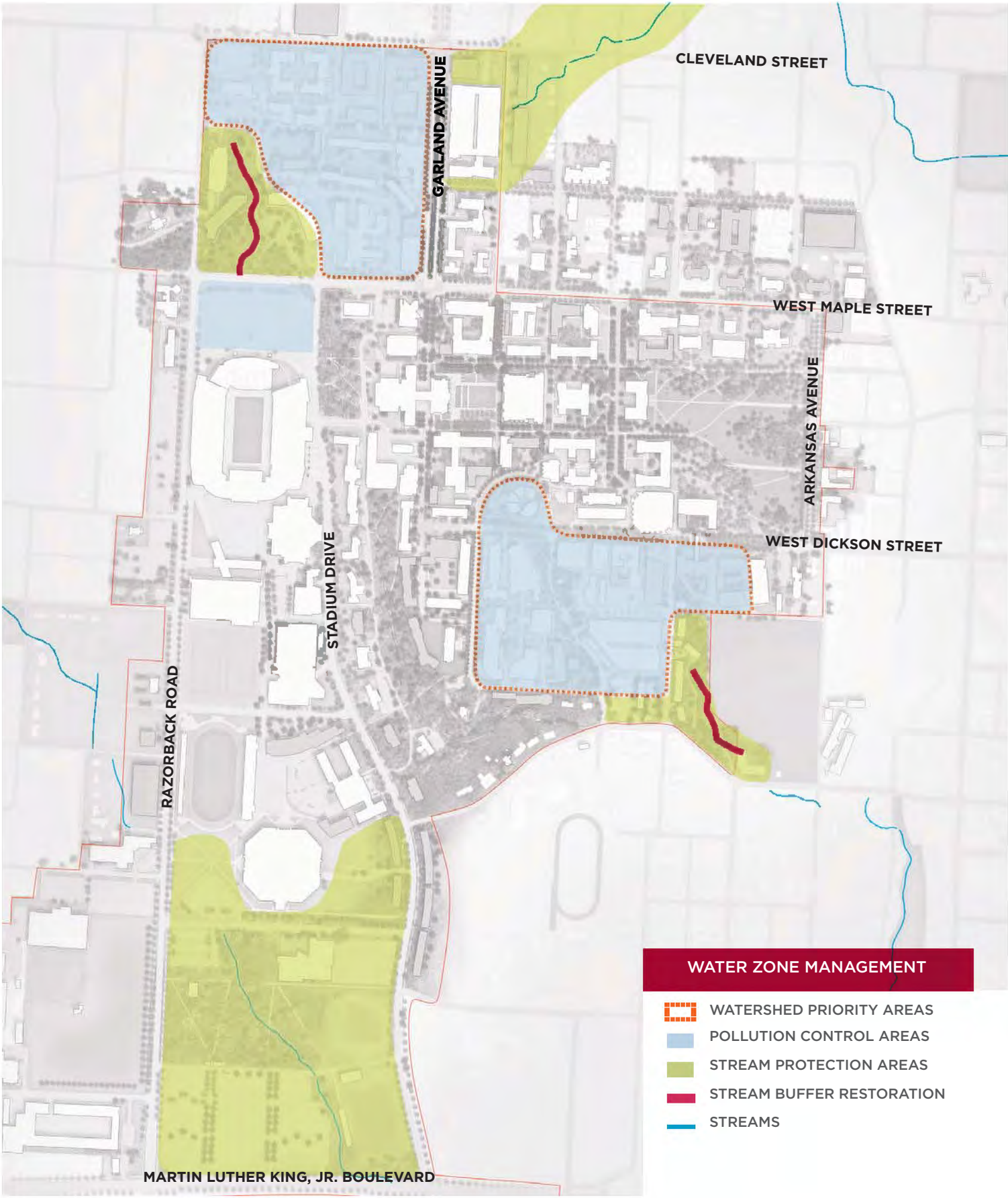
## **WATERSHED PRIORITY AREAS & POLLUTION CONTROL AREAS:**

### WATER QUALITY PROTECTION

- Respond to the natural and topographical context of the landscape in planning for stormwater management measures and re-vegetation.

Provide green zones that reach into the campus fabric, while preserving views and circulation.

- Meet, and exceed where practical, all rainwater regulatory requirements, and set overall campus goals for stormwater management.
- Provide upland treatment practices including parking lot bioretention, and permeable paving for new walkways, hardscape areas, and streets. These practices augment the restoration and treatment practices being employed in the stream protection areas to provide the appropriate level of quantity, rate and quality control.
- Plan and prevent soil erosion from development projects and monitor and enforce these strategies during construction.
- Follow best management practices to prevent increases in nonpoint pollution and minimize pollutants in stormwater runoff from both new development and redevelopment.
- Test and establish baseline data for water quality in receiving waters. Set water quality goals to restore, enhance, and maintain the chemical, physical, and biological integrity of receiving waters to protect public health and enhance domestic, municipal, recreational and other uses of water.
- Target a goal of meeting 100% of the average annual pre-development groundwater recharge volume.



**WATER ZONE MANAGEMENT**

- WATERSHED PRIORITY AREAS
- POLLUTION CONTROL AREAS
- STREAM PROTECTION AREAS
- STREAM BUFFER RESTORATION
- STREAMS

## TREATMENT & CONTROL

- Create and implement visible stormwater BMP's and green infrastructure that promote sustainable on-site stormwater management.
- Daylight water where feasible, integrating hydrologic and natural resource enhancement features into the campus landscape and the daily experience of students and faculty. Incorporate educational signage and integrate research and monitoring opportunities.
- Propose innovative stormwater management into the redevelopment of parking lots, while configuring lots for better circulation of vehicles, pedestrians, and bicycles.
- Create and implement stormwater best management practices in the campus core such as non-mown and conservation areas where habitat, character, plant succession and green infrastructure performance may be studied.
- Use overland flow whenever possible to reduce use of pipes. Use native grass or suitable non-turf alternatives where possible.
- Reduce effective impervious surface by minimizing total impervious cover and disconnecting directly connected impervious areas.
- Provide stormwater quality treatment as close to the generating source as possible, and at a minimum, within the project's limit of disturbance.
- Target zero runoff volume increase for up to a ten year stormwater event compared to existing site conditions.
- Refrain from building in areas subject to localized flooding for less than a ten year storm event.
- Pursue rainwater harvesting strategies for beneficial use purposes such as grey water plumbing or irrigation, as a first consideration for all rooftop runoff.
- Target a 50%-75% reduction in potable water demand for new projects as outlined in the SITES and LEED credits.

## DESIGN GUIDELINES

- Design stormwater features to provide a landscape and/or habitat amenity.
- Protect and enhance on-site water resources and downstream receiving water quality.
- Reduce and disconnect areas of impervious cover.
- Provide depression storage in the landscape.
- Convey rainwater in swales and overland flow to promote infiltration.
- Use biofiltration to provide vegetated and soil filtering.
- Evapotranspire to minimize stormwater discharge. Use engineered soils and vegetation on green roofs or in biofiltration areas to maximize the evapotranspiration potential.
- Infiltrate rainwater using infiltration basins and trenches, and permeable pavement areas.
- Include canopy trees median and perimeter plantings in all surface parking lots.
- Incorporate bioretention in all parking lots for stormwater treatment.
- Avoid internal drainage requirements in new building projects by integrating rainwater capture and infiltration features in the site design. This can be accomplished by green roofs, green canopies, rainwater planters, and cisterns. Green roofs should be considered for those buildings that may have views from other structures. Living walls and green canopies can also be integrated into parking deck design to improve the aesthetic value and create visual connections to neighboring open space.

## PLANT SPECIES

- Enhance existing rainwater best management practices in landscape and parking areas by incorporating native vegetative materials.

## MAINTENANCE

- Plan and implement maintenance activities designed to reduce the exposure of stored materials and possible pollutants to rainwater.

Develop and implement a spill response plan; avoid non-rainwater discharges such as wash water; minimize the use of salt for deicing; and avoid fueling and routine maintenance of construction equipment on-site to reduce pollutant loadings of oils, grease, hydraulic fluids, and other contaminants.

- For best management practices, make sure new plantings are cared for during their establishment period with necessary watering and weeding. Aerate lawns and topdress with compost. Confirm water soaks performance is per design specifications. Confirm overflow piping is not clogged. Remove litter and weeds from bioretention features. Mulch planting beds. Develop a management plan that leaves organic matter in place (leaf litter in particular) or adds organic matter on an annual basis to maintain desired soil properties.

## **STREAM PROTECTION AREAS**

### STREAM CHANNELS

- Protect and restore the natural hydrology and flow paths, including landscape recharge areas and depressions.
- Promote the preservation and restoration of existing streams on campus through proactive site planning and design.
- Connect stream projects to the floodplain through channel restoration and enhancement of the native vegetative buffer.
- Stabilize outfalls and stream channels, encouraging groundwater flow for low flows and providing safe conveyance of high flows through practices including plunge pools, step pools, and created wetland areas.



## BUFFERS

- Require de-compaction of soils prior to final grading in the stream buffer zone.
- Protect and restore riparian buffers located on the campus by meeting and exceeding City of Fayetteville Stream Buffer Ordinance requirements for Mullins Creek and Tanglewood Branch (Ordinance No. 11-5390: Streamside Protection - Best Management Practices Manual, Fayetteville 2011).

## PLANT SPECIES

- Prioritize native plant species for all riparian buffer and stream bank plantings.
- Promote biodiversity through a mix of woody and herbaceous species.

## MAINTENANCE

- Regularly monitor and remove invasive species.
- Maintain sufficient stems/acre or “biomass density” in the buffer zone.

## **RAINWATER HARVESTING**

### CISTERNS

Rainwater cisterns associated with new or existing buildings can serve several purposes including harvesting water to meet non-potable demands for irrigation and cooling systems and reducing the overall runoff volume entering the storm drain system. A rule of thumb for the Fayetteville area is to size cisterns between 0.80 and 1.0 gallons per sq. ft. of roof area. Larger cisterns can be used where reuse demands are larger and serve to integrate multiple green infrastructure systems.

### CISTERN SAMPLE CALCULATIONS

- 10,000 sq. ft. of roof area can provide approximately 287,000 gallons of rainwater/stormwater in a single year.
- 3,000 sq. ft. of adjacent landscape with an irrigation demand of 25 inches/year (in addition to natural rainfall) requires approximately 50,000 gallons of irrigation per year.

- A cistern sized at 0.8 gallons of cistern capacity per sq. ft. of roof area, or 8,000 gallons in this example, can reduce annual potable water demands for irrigation by over 80%. Runoff leaving the roof and entering the storm drain system can be reduced by 20%.
- Recycling some of the rainwater to meet cooling water make-up demands can further reduce potable water demand.
  - Cooling demand for a 10,000 sq. ft. building in NW Arkansas climate = 180,000 gallons/year
  - Overall potable water reduction for irrigation & cooling reuse using the 8,000 gallon cistern = 43%.
  - Overall runoff reduction from the rooftop using the 8,000 gallon cistern = 46%.

Note that sizing and flows used in these examples are general and based upon typical conditions for irrigation, cooling demand and rainfall in the Fayetteville, AR area. During the design phase for these systems, the University should generate a detailed monthly or daily ‘water balance’ to understand the potential sources and reuses of rain water.

### CISTERN DESIGN CONSIDERATIONS

Size the cistern based upon total roof area, reuse demand and targeted stormwater reduction goals. A preliminary volume of 0.80 – 1.0 gallons/sq. ft. of roof area is a reasonable starting point for the NW Arkansas region.

Maintaining clean water levels within the cistern reduces overall maintenance and eliminates concerns about vectors (mosquitoes) and odors. Considerations include:

- Include pre-filtration (leaf and solids removal) of rainwater entering the tank to reduce organic loading and potential for odors and biofilms within the cistern. Techniques include first-flush filters, ‘leaf eaters’, vortex filters, basket filters or flat plate filters. The final selection of technology will depend upon the peak flow rates, size of roof, maintenance frequency desired, and budget.
- Install cisterns below grade to maintain cooler temperatures which promote cleaner cistern

conditions. Above-grade cisterns are feasible, but ensure they are totally opaque to minimize algae growth and avoid placing them directly on south-facing sides of the buildings.

- Plumb cisterns to minimize stirring up sediments; techniques include inlet-calming devices and overflow diversion on the inlet pipe prior to entering the cistern.
- Ensure inlet/outlet pipes and vents are either adequately screened or submerged to avoid mosquito populations.

- Provide adequate filtration to prevent irrigation systems from clogging. Reuse of cistern water for interior building use and cooling systems will require disinfection.
- Potable water backup connections should be confirmed with local authorities to determine whether or not a backflow preventor is adequate or if an additional air-gap is warranted. Cross-connections without adequate protection between the rainwater and potable water systems must be avoided.

