Springfield Planning and Zoning Commission

City Council Chambers (830 Boonville)

Date: July 7th, 2016
Time: 6:30 p.m.

Members: Jason Ray (Chairman), Randall Doennig (Vice-Chairman), Matt Edwards, Melissa Cox, David Shuler, Andrew Cline, King Coltrin, Dee Ogilvy, and Cameron Rose

1. ROLL CALL

2. APPROVAL OF MINUTES

- **June 9th, 2016**

  Documents:

  PZ MINUTES 6-9-2016.PDF

3. COMMUNICATIONS

June 27th, 2016

Documents:

NA06-27-16.PDF

4. UNFINISHED BUSINESS

5. CONSENT ITEMS

(All items may be approved with a single motion without a public hearing, unless removed from the consent agenda)

6. Request To Dispose 517

301 West McDaniel Street, City Utilities

Documents:

DISPOSE 517.PDF

7. PUBLIC HEARINGS

8. Z-9-2016

2420 East Sunshine Street, D.L. Rogers Corp

Documents:

Z-9-2016.PDF

9. Z-10-2016 W/COD #109

2263 East Cherry Street, O'Reilly Automotive Stores, Inc.

Documents:

Z-10-2016 COD 109.PDF

10. Planned Development No. 351

4018 & 4022 South Lone Pine Avenue, Kaonashi, LLC and Lone Projects, LLC

Documents:

PD 351 SR 2.PDF

11. Conditional Use Permit 423

2420 East Sunshine Street, D.L. Rogers Corp

Documents:

UP423.PDF

12. OTHER BUSINESS

13. Initiate Residential Off-Street Parking Surface Amendments

Citywide, City of Springfield

Documents:

INITIATE RESIDENTIAL OFF-STREET PARKING SURFACE AMENDMENTS.PDF

14. ADJOURN

For items for which the public may speak, the Commission Chairperson will invite anyone who wishes to speak to an item after staff makes its presentation. **Please fill out a Speaker Card. When you address Commission, please step to the microphone at the podium and state your name and address.** All meetings are televised live and tape recorded. Please limit your remarks to five (5) minutes unless Commission allows a longer time. In accordance with ADA guidelines, if you need special accommodations when attending any City meeting, please notify the City Clerk's Office at 417-864-1443 at least three (3) days prior to the scheduled meeting.

June 9, 2016
MINUTES OF THE PLANNING AND ZONING COMMISSION
Springfield, Missouri

The Planning and Zoning Commission met in regular session June 9, 2016 in the City Council Chambers. Chairman Jason Ray called the meeting to order.

Roll Call: Present: Jason Ray, (Chair), Randy Doennig (Vice Chair), David Shuler, Andrew Cline, Melissa Cox, King Coltrin, Dee Ogilvy, and Cameron Rose. Absent: Matthew Edwards.

Staff in attendance: Bob Hosmer, Principal Planner, Tom Rykowski, Asst. City Attorney, Nicholas Woodman, Asst. City Attorney, Dawne Gardner, Public Works Traffic Engineer and Chris Dunnaway, Public Works Principal Engineer.

Minutes: The minutes of May 12, 2016 were approved unanimously.

COMMUNICATIONS :

UNFINISHED BUSINESS:

Planned Development 348 Amendment 1
1215 & 1225 North Benton Avenue
Applicant: Historic Patterson House, LLC

Mr. Hosmer states that this is a request to rezone approximately 0.89 acres of property generally located at 1215 and 1225 North Benton Avenue from Planned Development 348 and Mid-Town UCD No. 3 Area E to a Planned Development District No. 348 Amendment 1 and Mid-Town Urban Conservation District No. 3 Area E.

The applicant is proposing to amend PD 348 to add multi-family uses to the existing PD which currently allows for bed and breakfasts, restaurants, and residential uses. The Growth Management and Land Use Plan element of the Comprehensive Plan designates this area as appropriate for medium or high density housing uses. There are two existing structures on the property which are identified as contributing to the Mid-Town National Register Historic District. The Mid-Town Plan states that any institutional expansion in this area should utilize and preserve contributing structures. The PD will allow for the rehabilitation and use of these two properties while preserving the architecturally significant structures and design within the Mid-Town neighborhood. This proposal required a Multi-Family Location and Design Guidelines assessment. The request is consistent with the Multi-Family Development Location and Design Guidelines. Should either the Hawkins House or the Patterson House, or both, be damaged by fire or natural disaster then: 1) Restore to original plans or if it is not possible to repair or rebuild property shall revert to single family and multi-family residential uses. 2) All new construction of multi-family buildings shall meet the Multi-Family Development Location and Design Guidelines. Staff recommends approval.

Mr. Ray opened the public hearing.

Mike Textor, 1215 N. Benton Avenue would have like to use the bed and breakfast concept, however the cost is not feasible at this time and now wants to use and preserve the historic character by allowing multi-family use. We believe it is consistent with appropriate plans and looking forward to moving ahead.

Mr. Ray closed the public hearing.

COMMISSION ACTION:
Mr. Cline motions that we approve Planned Development 348 Amendment 1 (1215 & 1225 North Benton Avenue). Ms. Cox seconded the motion. The motion **carried** as follows: Ayes: Ray, Doennig, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: Shuler (recused himself). Absent: Edwards.

NEW BUSINESS :

CONSENT ITEMS :

Relinquishment of Easement 835
2455 North Glenstone Avenue
Applicant: Tim O'Reilly

Relinquishment of Easement 836
4200 East Division Street
Applicant: Hickory Valley, LLC

COMMISSION ACTION:
Mr. Doennig motions that we approve the consent items (Relinquishment of Easement 835 (2455 North Glenstone Avenue) and Relinquishment of Easement 836 (4200 East Division Street). Mr. Rose seconded the motion. The motion **carried** as follows: Ayes: Ray, Doennig, Shuler, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: None. Absent: Edwards.

PUBLIC HEARINGS:

Redevelopment Plan Amended Patterson House
1225 North Benton Avenue
Applicant: Historic Patterson House, LLC

Mr. Schaefer stated that the Amended Redevelopment Plan conforms with the Springfield-Greene County Comprehensive Plan. The Growth Management and Land Use Element states that the area is designated for medium or high-density housing and is located within the Center City Activity Center. The Mid-Town Neighborhood Plan identifies the area west of the Drury University campus as an appropriate area for the future expansion of institutional uses and suggests any expansion into the 1100 and 1200 blocks of North Benton Avenue utilize existing contributing structures in the Mid-Town National Historic District. The Center City Plan Element mentions the Center City area suffers from physical deterioration and economic obsolescence and that the overall tone of is one of an area that could use revitalization and new investment and the proposed redevelopment is compatible with the vision for Center City outlined in the Center City Element of the Springfield-Greene County Comprehensive Plan. It states,
“Center City will preserve and enhance the public and private historic landmarks and "celebrate the heritage" and history of Springfield.” “Renovation and adaptive re-use of Center City's fine, older buildings will be made a priority. These structures help make Center City special and different, cement the community's emotional attachment to the area, and offer economically attractive spaces for start-up businesses and cultural organizations that cannot be duplicated elsewhere.”

Mr. Ray opened the public hearing

Mike Textor, 1215 N. Benton Avenue noted the blight conditions and looking forward to saving this from and improve the neighborhood.

Mr. Ray closed the public hearing.

COMMISSION ACTION:
Mr. Cline motions that we approve Redevelopment Plan Amended Patterson House (1225 North Benton Avenue). Ms. Cox seconded the motion. The motion **carried** as follows: Ayes: Ray, Doennig, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: Shuler (recused himself). Absent: Edwards.

Z-8-2016
2350 North Clifton Avenue
Applicant: Springfield MO Association of Fire Fighters

Mr. Hosmer states that this is a request to rezone 1.1 acres of property located at 2350 North Clifton Avenue from a LI, Light Industrial District to a IC, Industrial Commercial District.

The Growth Management and Land Use Plan of the Comprehensive Plan identify this as an appropriate area for Low-Density Housing uses. (R-SF, Single-Family Residential uses). However, IC zoning is compatible and consistent with the surrounding Industrial zoning and development in this area along a Primary Arterial roadway (Kearney Street).

Staff recommends approval of this request with the following conditions: A cross access easement shall be approved and recorded which allows for a shared access to Clifton Avenue for the property to the north of the subject property. Dedicate additional right-of-way to meet 30 feet from the established centerline of Clifton Avenue. If the above conditions are not met within two (2) years after City Council's approval, that approval is null and void; and the zoning will remain LI, Light Industrial District.

Mr. Ray opened the public hearing.

Mr. Chad Davis, 1937 N. Trellis Road; Strafford has noted that Public Works have put in a drainage whistle on the south end of the drive that was required and the concrete work will be completed in a few weeks. The north section of the drive will be closed to allow for a drainage ditch.

Mr. Ray closed the public hearing.

COMMISSION ACTION:
Mr. Doennig motions that we approve Z-8-2016 (2350 North Clifton Avenue). Mr. Rose seconded the motion. The motion **carried** as follows: Ayes: Ray, Doennig, Shuler, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: None. Absent: Edwards.

Conditional Use Permit 424
2800 South Fort Avenue
Applicant: National Healthcare Corporation

Mr. Hosmer states that this is a request to allow an existing nursing retirement home built prior to the Zoning Ordinance located at 2800 South Fort within a R-MD, Medium Density Multi-Family Residential District.

Nursing and retirement homes require an use permit in the R-MD, Medium-density Multi-family Residential District. The existing nursing home was built prior to the current Zoning Ordinance (1993). The Growth Management and Land Use Plan an element of the Comprehensive Plan identifies this area as appropriate for Community and Public Land uses. The existing nursing and retirement home and proposed expansion are compatible and consistent with the Plan. The Conditional Use Permit is valid for 18 months or until a building permit or a occupancy permit is issued. The Conditional Use Permit shall adhere to the attached site plan. This application meets the approval standards for a Conditional Use Permit and staff recommends approval.

Mr. Ray opened the public hearing.

Mr. Jared Davis, 2045 W. Woodland available to answer any questions.

Mr. Ray closed the public hearing.

COMMISSION ACTION:
Mr. Doennig motions that we approve Conditional Use Permit 424 (2800 South Fort Avenue). Ms. Cox seconded the motion. The motion **carried** as follows: Ayes: Ray, Doennig, Shuler, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: None. Absent: Edwards.

Preliminary Plat - Major Subdivision Paragon Court
2638 North National Avenue
Applicant: Kenneth Pontious Trust

Mr. Hosmer states that this is a request to approve a 32 lot single-family residential Zero Lot Line/Cluster Subdivision located at 2638 North National Avenue.

The original preliminary plat of Paragon Court was approved by City Council in 2005. It was approved as a zero lot line, cluster subdivision with 33 single-family lots. Public improvement plans were submitted, but never accepted and filed. Therefore, a final plat was never approved or recorded and the preliminary plat expired. The applicant is proposing to subdivide approximately 9.3 acres into a 32 lot single-family residential zero lot/cluster subdivision. A cluster subdivision preserves open space. The lot sizes in a residential cluster subdivision may be reduced from the minimum lot area prescribed for that zoning district (in this case 3,000 sq. ft.). All lot reductions shall be compensated for by an equivalent amount of land in open space or common area to be preserved and maintained for its scenic or historic value, for recreation or conservation purposes. Zero lot line construction allows for single-family residences to have no side or rear yard setback which allows an attached single-family home. All improvements shall be constructed in accordance with the "Design Standards for Public Improvements" of the Public Works Department. All existing streets and other public improvements will have to meet current standards. Staff recommends approval.

Ms. Cox asked about the zero lot line construction and asked if each of the families will have a yard.

Mr. Hosmer stated that each family will have a yard, but will have a common wall. This is unique and the City does not see a lot of these types of designs.

Mr. Ray opened the public hearing.

Mr. David Waln, 2925 East Battlefield stated that they are resurrecting a project from the 2007/2008 economic decline and all the improvements were completed, but never finalized. At this time we believe that it will provide affordable housing. These are basically duplexes with a firewall between them. The yards are actually quite large in addition to the open space requirements.

Mr. Ray closed the public hearing.

COMMISSION ACTION:
Mr. Rose motions that we approve Preliminary Plat - Major Subdivision Paragon Court (2638 North National Avenue). Ms. Cox seconded the motion. The motion **carried** as follows: Ayes: Ray, Doennig, Shuler, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: None. Absent: Edwards.

East West Arterial Mapping
US Highway 65/Riverbluff Boulevard
Applicant: City of Springfield

Mr. Hosmer states that this is a request to approve the East West Arterial Mapping from U.S. Highway 65 and Riverbluff Boulevard to Kissick Avenue (Farm Road 169).

Planning and Zoning Commission approved the East West Arterial Mapping on April 14, 2016. On May 2, 2016 the City Council held a public hearing on the East West Arterial Mapping and decided to remand this item back to the Planning and Zoning Commission. City Council wanted Commission to consider placing a (5) five year time limit on the mapping of the East West Arterial as well as clarify that the mapping is only for properties that are within the City of Springfield. The City Charter (section 11.11) gives the Planning and Zoning Commission the ability to make surveys for the exact location of new streets that have been previously included in the Major Thoroughfare Plan. The general location of the East-West Arterial was

identified as a future primary arterial in the City of Springfield-Greene County Comprehensive Plan Transportation Plan Element which was adopted on June 11, 2001 and updated March 3, 2016. The City Planning and Zoning Commission approved the preparation of preliminary designs for the alignment of the East West Arterial at their meeting on June 4, 2015. A more detailed survey has been completed showing the exact alignment of the East-West Arterial corridor (Attachment 2 and 3). The timing of the street will be limited to 5 years. The adoption of a mapped street shall not, in and of itself, constitute or be deemed to constitute the opening or establishment of any street or the taking or acceptance of any land for street purposes. The City Council may provide by general ordinance that no permit shall be issued for any buildings or structures or any part thereof on any land located between the mapped lines of a street as shown on the official map. The mapped alignment is only for land within the City of Springfield. City Council will consider an ordinance to include the East West Arterial on the City's official map.

Ms. Cox asked about the public meetings the East West Arterial Mapping has taken to date.

Mr. Hosmer stated that it went originally to Planning and Zoning in April and then City Council on May 2 where they had remanded it back the Planning and Zoning Commission for additional action requiring a review of the mapping if the road is not constructed within five years and only pertains to right-of-way segments in Springfield city limits.

Ms. Cox asked if anything has changed on the survey.

Mr. Hosmer stated that nothing has changed on the survey, but only where City Council wants the consideration of the five year term limit and the right-of-way segments within city limits. He also noted that the people who spoke at the April Planning and Zoning meeting have their property in the county and out of the City of Springfield jurisdiction.

Ms. Cox asked to be reminded where Christian and Greene County has there boundaries with regards to the mapping.

Mr. Hosmer went over the boundaries of the area.

Mr. Coltrin noted that the East West Arterial has been part of the Major Thoroughfare Plan available to the public for 10 years or more and that they are only reviewing a more refined centerline.

Mr. Hosmer agreed and noted some of the old alignment and noted the expense of that construction.

Mr. Rose asked about the original right-of-way and the reasoning for the alignment.

Mr. Kirk Juranas, Assistant Director of Public Works noted that none of the property has been purchased and the intent of the original developer was to narrow the right-of-way. The objective at the time was to utilize those areas for development and we don't know if that will be possible. There are significant cuts and fills in the area and the City only owns a small piece of right-of-way at the end of the roundabout and noted that the City does not own the remainder.

Mr. Ray opened the public hearing.

No speakers.

Mr. Ray closed the public hearing.

COMMISSION ACTION:
Ms. Cox motions that we approve East West Arterial Mapping (US Highway 65/Riverbluff Boulevard). Mr. Rose seconded the motion. The motion **carried** as follows: Ayes: Ray, Shuler, Cline, Cox, Coltrin, Ogilvy, and Rose. Nays: None. Abstain: Doennig (recused himself). Absent: Edwards.

OTHER BUSINESS :

Mr. Hosmer welcomed new Planning and Zoning members Dee Ogilvy and King Coltrin.

Noted Agenda City Council Meeting

City Council Chambers
Historic City Hall, 830 Boonville

Robert Stephens, Mayor

Zone Councilmembers	General Councilmembers
Phyllis Ferguson, Zone 1	Jan Fisk, General A
Justin Burnett, Zone 2	Craig Hosmer, General B
Mike Schilling, Zone 3	Kristi Fulnecky, General C
Craig Fishel, Zone 4	Ken McClure, General D

Upcoming Council Meeting Agenda
June 27, 2016 - 6:30 p.m.

Speakers must sign up with the City Clerk to speak to an issue on the agenda. Speakers are to limit their remarks to three to five minutes.

Note: Sponsorship does not denote Council member approval or support.

ROLL CALL.

Approved as Presented

APPROVAL OF MINUTES. June 13, 2016

Approved as Amended

FINALIZATION AND APPROVAL OF CONSENT AGENDAS. CITIZENS WISHING TO SPEAK TO OR REMOVE ITEMS FROM THE CONSENT AGENDAS MUST DO SO AT THIS TIME.

CEREMONIAL MATTERS.

CITY MANAGER REPORT AND RESPONSES TO QUESTIONS RAISED AT THE PREVIOUS CITY COUNCIL MEETING.

SECOND READING AND FINAL PASSAGE. Citizens Have Spoken. May Be Voted On. Except Item No. 7, which was amended at the June 13, 2016 City Council meeting. For Item No. 7, Public Hearing on the Amendment is Being Carried Over. Citizens May Speak To Amendment Only. May Be Voted On.

Persons addressing City Council are asked to step to the microphone and clearly state their name and address before speaking.

All meetings are recorded.

In accordance with ADA guidelines, if you need special accommodations when attending any City meeting, please notify the City Clerk's Office at 864 -1443 at least 3 days prior to the scheduled meeting.

6286 **Amended Council Bill 2016-034. (Schilling) Citizens May Speak To Amendment Only. May Be Voted On.**

A general ordinance amending the Springfield Land Development Code, Section 36-306, Zoning Maps, by rezoning approximately 0.4077 acres of property, generally located at 608 and 614 West Mount Vernon Street, from R-SF, Single-Family Residential District, to R-LD, Low-Density Multi-Family Residential District; establishing Conditional Overlay District No. 103; and adopting an updated Official Zoning Map. (Staff, and Planning and Zoning Commission recommend approval.) (By: Mount Vernon 608, LLC; 608 and 614 West Mount Vernon Street; Z-39-2015 & Conditional Overlay District No. 103.)

Amended and Public Hearing on Amendment Held Over to July 11, 2016

Council Bill 2016-059. (McClure) Tabled at the April 18, 2016 Council Meeting.

A general ordinance amending Chapter 36 of the Springfield City Code, known as the Land Development Code, Article III, Division IV, Subdivision III, Section 36-425(7), Design Requirements, of the COM, Commercial Street District in the Zoning Ordinance to clarify Blaine Street Frontage and new construction requirements.

Failed **Council Bill 2016-120. (Fishel)**

A special ordinance authorizing the issuance of Conditional Use Permit No. 422 to allow a bed and breakfast within an R-SF, Residential Single-family District, generally located at 1755 South National Avenue. (The Planning and Zoning Commission recommend denial, Staff recommends approval.)

26756 **Council Bill 2016-136. (Fishel)**

A special ordinance approving the First Amendment to Sections 3.05 and 3.08 of The Collective Bargaining Agreement Between The City of Springfield, Missouri and Southern Missouri Professional Fire Fighters Local 152 (a/k/a, The International Association of Fire Fighters Local 152) (the “First Amendment”), in conjunction with amending Chapter 2, Administration, Article VI, Finances, Division 4, Policemen’s and Firemen’s Pension Plan, for the fire participants, pursuant to the ordinance adopted by Council Bill 2016-137, by authorizing the City Manager, or his designee, to acknowledge and deliver the First Amendment on behalf of the City of Springfield, Missouri, to the Bargaining Unit; and declaring an emergency.

6287 **Council Bill 2016-137. (Fisk)**

A general ordinance amending the Springfield City Code, Chapter 2, Administration, Article VI, Finances, Division 4, Policemen’s and Firemen’s Pension Plan, by amending the title of Division 4 from “Policemen’s and Firemen’s Pension Plan” to “Police Officers’ and Fire Fighters’ Retirement System,” and by amending Section 2-455, Amount of employee contributions; deductions from salary, of the Springfield City Code, by revising provisions regarding Fire Participants’ Additional Funding Contribution (AFC) and Additional Three-Tenths Percent Multiplier in The Police Officers’ and Fire Fighters’ Retirement Fund; and declaring an emergency.

6288 **Council Bill 2016-138. (Schilling)**

A general ordinance amending Chapter 2, Section 2-92 of the Springfield City Code, known as the Salary Ordinance relating to salary grades for various job titles within the City service as contained in the Professional, Administrative and Technical (PAT) Schedule, the Crafts, Trade and Labor (CTL) Schedule, the Fire Protection Schedule (FPS), and the Law Enforcement Schedule (LES) by making provision for seven (7)

new job titles and deleting four (4) existing job titles; by providing pay adjustments for employees on the PAT, CTL, FPS, and LES pay schedules; by freezing the annual base pay rates for Salary Grades One (1) and Two (2) in the CTL pay schedule; by increasing the annual base rate for the top steps in the CTL pay schedule by $150.00 annually; by deleting the eligibility for educational allowance for Salary Grades Eleven (11) through Thirteen (13) contained in the LES pay schedule; by approving a Memorandum of Understanding between the City and the City Manager; and declaring an emergency.

26757 **Council Bill 2016-139. (Schilling)**

A special ordinance authorizing the City Manager, or his designee, to enter into an On-System Bridge Program Agreement with the Missouri Highways and Transportation Commission for the purpose of funding the Mt. Vernon Street Bridge over Jordan Creek project; and amending the Fiscal Year 2015-2016 budget of the Department of Public Works in the amount of $982,905.

6289 **Council Bill 2016-142. (Ferguson)**

A general ordinance amending various sections of Springfield City Code, Chapter 26, Article III, Dangerous Blighted and Nuisance Building Code, in order to improve enforceability, expand abatement-order authority, and improve the city's cost recovery by clarifying the language of special tax bills and special assessments.

RESOLUTIONS. Citizens May Speak. May Be Voted On.

10273 **Council Bill 2016-159. (Council)**

A resolution authorizing Mayor Bob Stephens and Councilmembers Jan Fisk and Phyllis Ferguson, on behalf of the City of Springfield, to visit our Sister City of Isesaki, Japan in October 2016, to participate in the Thirtieth Anniversary Celebration and to reiterate the City of Springfield’s Sister City relationship.

EMERGENCY BILLS. Citizens May Speak. May Be Voted On.

Tabled **Council Bill 2016-147. (Hosmer)**

A general ordinance amending the Springfield City Code, Section 2-504(b)(14) to limit the insurance requirements for special events held on public property to $1,000,000.00; including a severability clause, savings clause, and declaring an emergency.

PUBLIC IMPROVEMENTS.

GRANTS.

AMENDED BILLS.

COUNCIL BILLS FOR PUBLIC HEARING. Citizens May Speak. Not Anticipated To Be Voted On.

Council Bill 2016-148. (Schilling)

A special ordinance approving the mapping of the East West Arterial, generally located between US Highway 65 and Riverbluff Boulevard to Kissick Avenue, pursuant to Section 11.10 of the City Charter of the City of Springfield, Missouri in

order to preserve right-of-way for future public street improvements for five years. (Planning and Zoning Commission and Staff recommend approval.)

Council Bill 2016-149. (Fishel)

A special ordinance amending the Historic Patterson House Redevelopment Plan and declaring its redevelopment necessary for the preservation of the public peace, prosperity, health, safety, morals, and welfare. (Planning and Zoning Commission, the Land Clearance for Redevelopment Authority and Staff recommend approval.)

Council Bill 2016-150. (Ferguson)

A general ordinance amending the Springfield Land Development Code, Section 36-306, Zoning Maps, by rezoning approximately 0.89 acres of property, generally located at 1215 and 1225 North Benton Avenue, from a Planned Development No. 348 with the Mid-Town Urban Conservation District No. 3 Area E to a Planned Development District No. 348 Amendment 1 with the Mid-Town Urban Conservation District No. 3 Area E; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission recommend approval.) (By: Mike and Hannah Textor; 1215 and 1225 North Benton Avenue; Planned Development 348 Amendment 1.)

Council Bill 2016-151. (Fulnecky)

A general ordinance amending the Springfield Land Development Code, Section 36-306, Zoning Maps, by rezoning approximately 1.1 acres of property, generally located at 2350 North Clifton Avenue, from LI, Light Industrial District, to an IC, Industrial Commercial District; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission recommend approval.) (By: Springfield Mo. Association of Fire Fighters; 2350 North Clifton Avenue; Z-8-2016.)

Council Bill 2016-152. (Schilling)

A special ordinance authorizing the issuance of Conditional Use Permit No. 424 to allow a nursing and retirement home within the R-MD, Medium-density Multi-family Residential District, generally located at 2800 South Fort Avenue. (Staff and Planning and Zoning Commission recommend approval.)

FIRST READING BILLS. Citizens May Speak. Not Anticipated To Be Voted On.

Council Bill 2016-153. (Fulnecky)

A special ordinance approving the plans and bid specifications, and accepting the bid of Landfill Drilling and Piping Specialists, LLC in the amount of $440,925.90 for installation of Phase V of the Gas Collection & Control System Expansion at the Springfield Sanitary Landfill; authorizing the City Manager, or his designee, to enter into a contract with such bidder; and approving a budget adjustment to amend the Fiscal Year 2016-2017 budget of the Environmental Services Department for the Solid Waste Fund in the amount of $485,000 for construction of this project and reimbursement from City Utilities based on a previously approved Memorandum of Understanding #2005-0937.

Moved from Consent Agenda First Reading Bills Tabled to July 11, 2016

29.5 Council Bill 2016-154. (McClure)

A special ordinance authorizing the City Manager, or his designee, to enter into agreements with RSM US LLP, to provide professional auditing services to the City

and to The Police Officers' and Fire Fighters' Retirement System for fiscal years 2016 through 2020.

PETITIONS, REMONSTRANCES, AND COMMUNICATIONS.

NEW BUSINESS.

Recommended

The Mayor recommends the following appointment to the Land Clearance for Redevelopment Authority: Dr. Allen Grymes with term to expire March 1, 2019.

Referred

Refer to the Plans and Policies Committee the issue of a local preference policy and contracts for auditing services.

Referred

Refer to the Plans and Policies Committee the issue of special events insurance liability.

As per RSMo. 109.230 (4), City records that are on file in the City Clerk's office and have met the retention schedule will be destroyed in compliance with the guidelines established by the Secretary of State's office.

UNFINISHED BUSINESS.

MISCELLANEOUS.

CONSENT AGENDA – FIRST READING BILLS. See Item #3.

Moved to First Reading Bills

Council Bill 2016-154. (McClure)

A special ordinance authorizing the City Manager, or his designee, to enter into agreements with RSM US LLP, to provide professional auditing services to the City and to The Police Officers' and Fire Fighters' Retirement System for fiscal years 2016 through 2020.

Council Bill 2016-155. (Fisk)

A special ordinance approving the plans and specifications for the Turner Street Drainage Improvements from Lyon Avenue to Boonville Avenue Project, Plan No. 2014PW0029SWT, accepting the bid of Hartman and Company, Inc. for that project; and authorizing the City Manager, or his designee, to enter into a contract with such bidder.

Removed from Agenda

Council Bill 2016-156. (Ferguson)

A general ordinance amending the Springfield City Code, Chapter 106 – Traffic and Vehicles, Article II – Administration and Enforcement, Division 2 – Violations and Procedure Upon Arrest, to add Section 106-102 – City Agency Towing Authority.

Council Bill 2016-157. (Burnett)

A special ordinance authorizing the Director of Planning and Development to accept the dedication of the public streets and easements to the City of Springfield, Missouri, as shown on the Preliminary Plat of Paragon Court generally located at 2638 North National Avenue, upon the applicant filing and recording a final plat that substantially conforms to the preliminary plat; and authorizing the City Clerk to sign the final plat upon compliance with the terms of this ordinance. (Staff recommends that City Council accept the public streets and easements.)

Council Bill 2016-158. (Burnett)

A special ordinance approving the sale of real property at 711 East Jean Street to Barbara and Grant James for $8,000 and authorizing the issuance of a deed for same.

CONSENT AGENDA – ONE READING BILLS.

CONSENT AGENDA – SECOND READING BILLS. Citizens Have Spoken. May Be Voted On.

26758 **Council Bill 2016-140. (Burnett)**

A special ordinance authorizing the City Manager, or his designee, to enter into an agreement with the Springfield Convention and Visitors Bureau, Inc., that includes the Fiscal Year 2016-2017 budget and marketing plan to promote travel and tourism in the City.

26759 **Council Bill 2016-141. (Fulnecky)**

A special ordinance authorizing the City Manager, or his designee, to enter into an agreement with the Greater Springfield Area Sports Commission, Inc. (Sports Commission), whereby the City will provide the Sports Commission with a share of the City's collection fees from the hotel/motel gross receipts tax to fund the Sports Commission's efforts to promote the hosting of national and regional sporting events to the City.

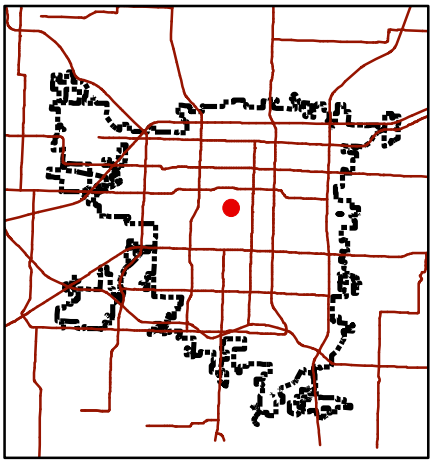
26760 **Council Bill 2016-143. (Schilling)**

A special ordinance approving the plans and specifications for the Bryant Street and Market Avenue project, Plan No. 2015PW0080SWTE; accepting the bid of Hunter Chase & Associates, Inc., for that project, and authorizing the City Manager, or his designee, to enter into a contract with such bidder.

Confirmed Confirm the following reappointments to the Airport Board: Alison George and Colin Brady with terms to expire June 1, 2019.

END OF CONSENT AGENDA.

ADJOURN.



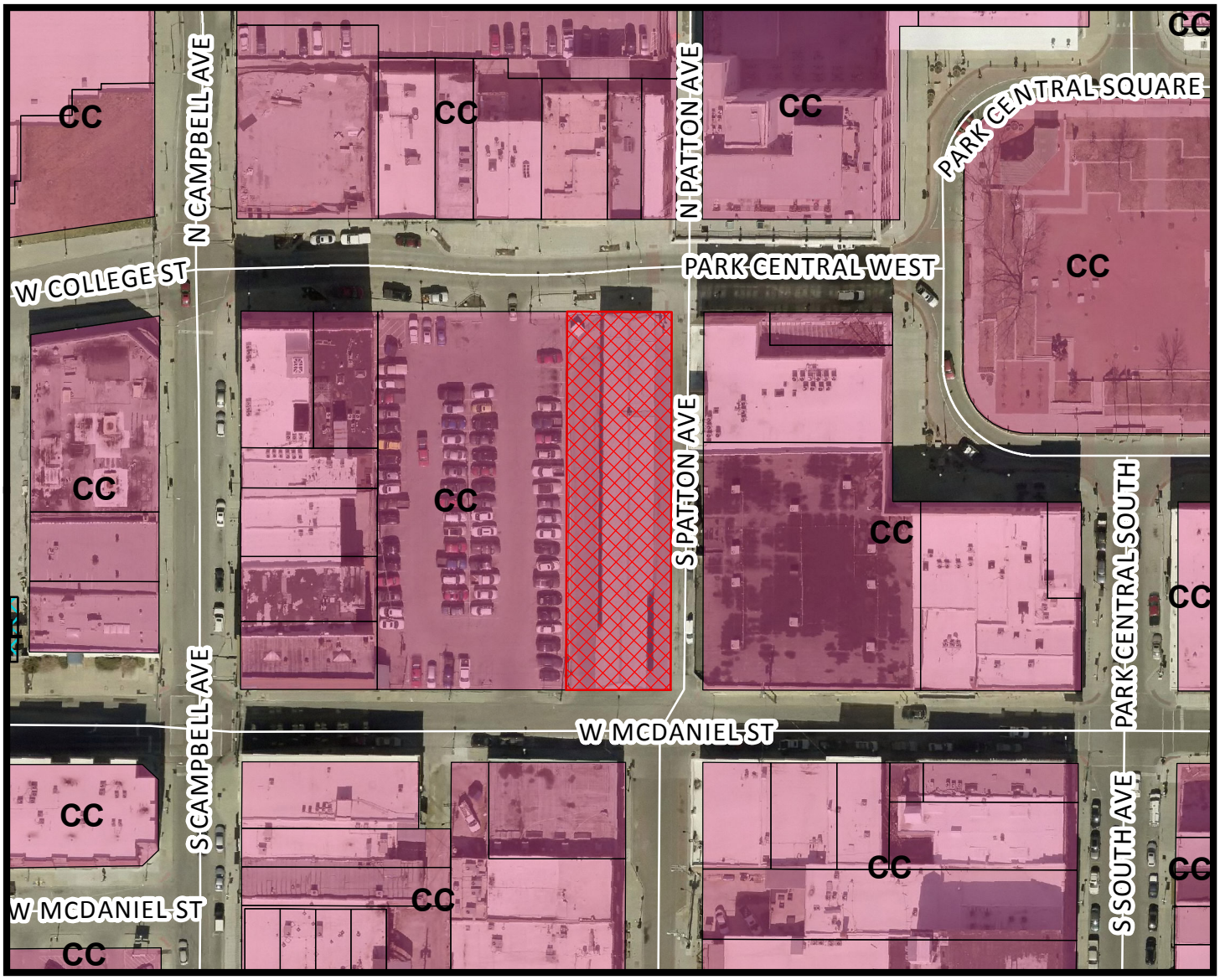
Development Review Staff Report

Department of Planning & Development - 417-864-1031
840 Boonville - Springfield, Missouri 65802

Dispose 517

LOCATION: 301 WEST MCDANIEL STREET
CURRENT ZONING: CC, CENTER CITY
PROPOSED ZONING: NA

LOCATION SKETCH



DEVELOPMENT REVIEW STAFF REPORT
REQUEST TO DISPOSE NO. 517

DATE: June 8, 2016

LOCATION: 301 West McDaniel Street

APPLICANT: City Utilities of Springfield

EXISTING USE: Abandoned City Utilities Bus Transfer Station

RECOMMENDATION: The request be **approved.**

FINDINGS:

1. The subject property is within the City limits of the City of Springfield.
2. The proposed disposal will not adversely affect City Utilities operations.
3. The subject property is no longer useful or necessary as result of the construction of a new transfer station.
4. The proposed disposal will allow City Utilities to surplus the subject property, which includes offering the property to the City of Springfield, which if declined as expected will result in proceeding to public disposition.

STAFF CONTACT PERSON:

Alyssa S. Ahner
Assistant City Planner

ATTACHMENT 1
BACKGROUND REPORT
REQUEST TO DISPOSE NUMBER 517

APPLICANT'S PROPOSAL:

City Utilities proposes to dispose of 0.35 acres of property. It has been determined that the subject property, as result of the construction of a new bus transfer station/terminal, is no longer necessary or useful in the operation of City Utilities to retain the property. The property is proposed to be surplused, which includes offering the property to the City of Springfield, which if denied as expected will result in proceeding to public disposition, subject to approvals as required.

STAFF COMMENTS:

1. The subject property is within the City limits of the City of Springfield.

2. City Utilities purchased the property as three (3) separate parcels. The first parcel was purchased in June 1983, the second parcel in December 1983, and the third parcel in January 1984.

3. City Utilities has constructed a new Bus Transit Center at Main Avenue and College Street, and therefore has no need for the McDaniel property.

4. There is no public sewer on the subject property. It has access to public sewer but there is not record of the connection point. There will be a need to cap sewer service lateral at the property line if the building is to be demolished.

5. The proposed disposal will not adversely affect City Utilities operations.

ATTACHMENT 2
REQUEST TO DISPOSE NUMBER 517
LAND DISPOSAL POLICY

Planning and Zoning Commission adopted the following policy statement for land disposals by public bodies:

1. Where is property located?

   301 West McDaniel Street

2. Please include a copy of the legal description.

   The legal description of the property is attached.

3. Why doesn't city need the property anymore?

   City Utilities has constructed a new Transit Center at Main Avenue and College Street, and therefore has no need for the McDaniel property.

4. When did city purchase property?

   City Utilities purchased the property in three (3) separate parcels. The first parcel was purchased in June 1983, the second parcel in December 1983, and the third parcel in January 1984.

5. Why was property acquired? What did city originally intend to do with the property?

   The property was acquired for the development of a bus transfer station.

6. Who will purchase property?

   The proposed disposal will allow City Utilities to surplus the subject property, which includes offering the property to the City of Springfield, which if declined as expected will result in proceeding to public disposition.

EXHIBIT A
REQUEST TO DISPOSE NUMBER 517
LEGAL DESCRIPTION

ALL OF THE EAST 65 FEET OF LOTS 31 AND 34 OF BLOCK 11 OF THE ORIGINAL TOWN OF SPRINGFIELD, A PLAT RECORDED IN THE GREENE COUNTY RECORDERS OFFICE, SPRINGFIELD, GREENE COUNTY, MISSOURI IN PLAT BOOK "A" AT PAGE 1, BEING MORE PARTICULARLY DESCRIBED AS RECORDED IN BOOK 1811 AT PAGE 1773, BOOK 1826 AT PAGE 1819, AND BOOK 1830 AT PAGE 1819, IN THE RECORDERS OFFICE, SPRINGFIELD, GREENE COUNTY, MISSOURI.

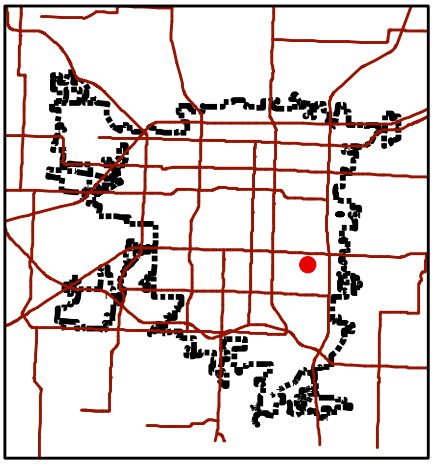
BOOK 1811 PAGE 1773
ALL OF THE WEST 20 FEET OF THE EAST 65 FEET OF THE NORTH 112.5 FEET OF LOT THIRTY-ONE (31), IN BLOCK ELEVEN (11) IN THE ORIGINAL PLAT OF SPRINGFIELD, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI.
ALSO, AN EASEMENT FOR INGRESS AND EGRESS OVER AND ACROSS THE FOLLOWING: BEGINNING AT A POINT 100.6 FEET SOUTH OF THE NORTHEAST CORNER OF LOT 31, BLOCK 11, ORIGINAL TOWN OF SPRINGFIELD; THENCE WEST 45 FEET; THENCE SOUTH 12.3 FEET, THENCE EAST
45 FEET, THENCE NORTH 12.3 FEET TO THE PLACE OF BEGINNING.

BOOK 1826 PAGE 1791
BEGINNING AT THE NORTHEAST CORNER OF LOT THIRTY-ONE (31), IN BLOCK ELEVEN (11) IN THE ORIGINAL TOWN OF SPRINGFIELD, THENCE WEST 23 FEET; THENCE SOUTH 100 FEET; THENCE EAST 23 FEET TO PATTON ALLEY, THENCE NORTH 100 FEET TO THE POINT OF BEGINNING, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI.
ALSO
ALL BEGINNING TWENTY-THREE (23) FEET WEST OF THE NORTHEAST CORNER OF LOT THIRTY-ONE (31), BLOCK ELEVEN (11), ORIGINAL TOWN OF SPRINGFIELD, THENCE WEST TWENTY-TWO (22) FEET, THENCE SOUTH ONE HUNDRED AND SIXTEEN HUNDREDTHS (100.16) FEET, THENCE EAST TWENTY-TWO (22) FEET, THENCE NORTH TO BEGINNING, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI, SUBJECT TO AND FAVORED WITH ALL EASEMENTS OF RECORD.
ALSO
BEGINNING AT THE NORTHEAST CORNER OF LOT 31 IN BLOCK 11 OF THE ORIGINAL PLAT OF THE CITY OF SPRINGFIELD, MISSOURI: THENCE WEST 23 FEET, THENCE SOUTH 100 FEET; THENCE EAST 23 FEET, THENCE NORTH 100 FEET TO THE POINT OF BEGINNING, TOGETHER WITH ALL OF GRANTOR'S RIGHT, TITLE AND INTEREST IN AND TO A CERTAIN EASEMENT OF A TRACT OF LAND TWELVE FEET WIDE AND SOUTH OF THE PROPERTY HERETOFORE DESCRIBED AND AS DESCRIBED IN A WARRANTY DEED FROM
D.C. DADE TO J. McADOO, RECORDED IN BOOK "U" AT PAGE 227 IN THE OFFICE OF THE RECORDER OF
DEEDS, GREENE COUNTY, MISSOURI; EXCEPT THE NORTH 100 FEET AND ALSO SUBJECT TO BUT NONETHELESS CONVEYING ALL OF GRANTORS' RIGHTS IN AND TO ALL COVENANTS, RESTRICTIONS, RESERVATIONS AND EASEMENTS OF

RECORD, AND TOGETHER WITH ALL OF GRANTORS' RIGHT, TITLE AND INTEREST IN AND TO ANY LEASES ON THE ABOVE DESCRIBED PROPERTIES, AND ALSO THE AREA LYING BETWEEN THESE TRACTS AND THE NORTH LINE OF LOT 34, BLOCK 11 AND BEGINNING 23 FEET WEST OF THE NORTHEAST CORNER OF LOT 31, BLOCK 11; THENCE SOUTH 100.16 FEET FOR A POINT OF BEGINNING; THENCE WEST 22 FEET; THENCE SOUTH THIRTEEN FEET; THENCE EAST 22 FEET; THENCE

NORTH TO THE POINT OF BEGINNING, ALSO ANY LAND LYING SOUTH OF THE FOLLOWING TRACT OF LAND AND NORTH OF LOT 34, BLOCK 11 NOT OWNED BY HEER ANDRES INVESTMENT COMPANY; ALL OF THE WEST 20 FEET OF THE EAST 65 FEET OF THE NORTH 112.5 FEET OF LOT THIRTY-ONE (31), IN BLOCK ELEVEN (11) IN THE ORIGINAL PLAT OF SPRINGFIELD, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI. ALSO, AN EASEMENT FOR INGRESS AND EGRESS OVER AND ACROSS THE FOLLOWING: BEGINNING AT A POINT 100.6 FEET SOUTH OF THE NORTHEAST CORNER OF LOT 31, BLOCK 11, ORIGINAL TOWN OF SPRINGFIELD; THENCE WEST 45 FEET; THENCE SOUTH 12.3 FEET, THENCE EAST 45 FEET, THENCE NORTH 12.3 FEET TO THE POINT OF BEGINNING.

BOOK 1830 PAGE 1819
BEGINNING AT THE SOUTHEAST CORNER OF LOT 34, BLOCK 11 ORIGINAL TOWN OF SPRINGFIELD, THENCE NORTH ALONG THE EAST LINE OF LOTS 34 AND 31, ONE HUNDRED TWENTY-TWO (122) TO A POINT, THENCE LEAVING SAID EAST LINE AND RUNNING WEST SIXTY-FIVE FEET (65) TO A POINT, THENCE SOUTH ONE HUNDRED TWENTY-TW0 FEET (122) TO A POINT ON THE SOUTHERLY LINE OF LOT 34, THENCE EAST ALONG THE SOUTHERLY LINE OF SAID LOT 34, SIXTY-FIVE FEET (65) TO THE POINT OF BEGINNING, IN SPRINGFIELD, GREENE COUNTY, MISSOURI, SUBJECT TO ALL RESERVATIONS, RESTRICTIONS, EASEMENTS, PARTY WALL AGREEMENTS AND COMMUNITY CONTRACTS, IF ANY, OF RECORD.



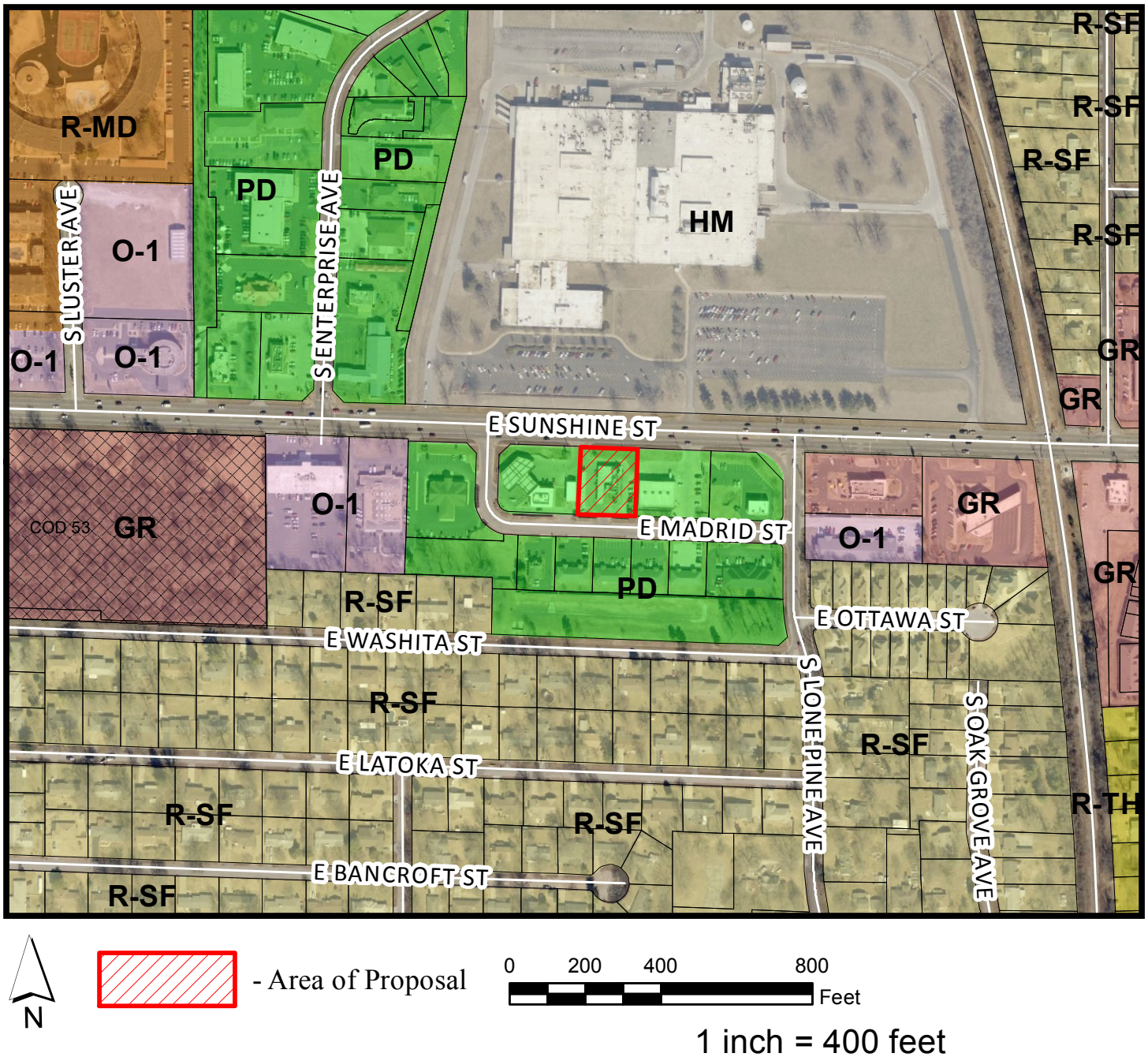
Development Review Staff Report

Department of Planning & Development - 417-864-1031
840 Boonville - Springfield, Missouri 65802

Z-9-2016

LOCATION: 2420 E. Sunshine Street
CURRENT ZONING: Planned Development 136 Amended
PROPOSED ZONING: GR, General Retail District

LOCATION SKETCH



DEVELOPMENT REVIEW STAFF REPORT
ZONING CASE Z-9-2016

PURPOSE: To rezone approximately 0.62 acres of property generally located at 2420 East Sunshine Street from a Planned Development 136 to a GR, General Retail District.

REPORT DATE: June 3, 2016

LOCATION: 2420 E. Sunshine St.

APPLICANT: D.L. Rogers Corporation

TRACT SIZE: Approximately 0.62 acres

EXISTING USE: Restaurant

PROPOSED USE: Automotive service garage

FINDINGS FOR STAFF RECOMMENDATION:

1. The *Growth Management and Land Use Plan* of the *Comprehensive Plan* designates this area along the Sunshine Street corridor as appropriate for medium-intensity retail, office and residential uses. General Retail is one of the zoning districts recommended in these areas.

2. The proposed GR, General Retail zoning is consistent with adjacent commercial zoning and uses that front along Sunshine Street.

3. Approval of this application will facilitate redevelopment of these properties and promote infill development and increased intensity where investments have already been made in public services and infrastructure.

4. Supports the following Field Guide 2030 goal(s): Chapter 6, Growth Management and Land Use Major Goal 4: Develop the community in a sustainable manner. Objective 4a, Increase density in activity centers and transit corridor.

RECOMMENDATION:

Staff recommends **approval** of this request.

SURROUNDING LAND USES:

AREA	ZONING	LAND USE
North	HM	Manufacturing and industrial uses
East	PD 136	Automotive parts store uses
South	PD 136	Office uses
West	PD 136	Convenience store and fueling station uses

COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* of the *Comprehensive Plan* designates this area along the Sunshine Street corridor as appropriate for medium-intensity retail, office and residential uses. General Retail is one of the zoning districts recommended in these areas. The General Retail District is intended for uses that provide community-wide personal and business services, shopping centers and specialty shops. The need for community-wide accessibility dictates that this district be located along or at the intersection of two or more arterial or higher classification streets.

STAFF COMMENTS:

1. The applicant is proposing to rezone the subject property from a Planned Development 136 to a GR, General Retail District. The intent of this application is to rezone the subject property which will facilitate the redevelopment of the site for a new automotive service garage. This use is not currently permitted by the existing PD 136 Amended. A conditional use permit (Use Permit 423) to allow an automotive service garage accompanies this rezoning request.

2. The *Growth Management and Land Use Plan* of the *Comprehensive Plan* designates this area along the Sunshine Street corridor as appropriate for medium-intensity retail, office and residential uses. General Retail is one of the zoning districts recommended in these areas. The General Retail District is intended for uses that provide community-wide personal and business services, shopping centers and specialty shops. The need for community-wide accessibility dictates that this district be located along or at the intersection of two or more arterial or higher classification streets. Staff believes the subject site meets the recommendation of the *Comprehensive Plan* and intent of the General Retail District.

3. A traffic study was not warranted by Public Works Traffic Division since the rezoning from PD 136 Amended to GR will not generate a significant amount of additional traffic.

4. There are no bufferyards required adjacent to PD 136 Amended since the permitted uses are similar to the GR, General Retail District.

5. The proposed rezoning was reviewed by City departments and comments are contained in Attachment 1.

NEIGHBORHOOD MEETING:

The applicant held a neighborhood meeting with property owners, residents and any registered neighborhood association within 500 feet of the subject properties on May 12, 2016. A summary of the meeting is attached (Attachment 2).

PUBLIC COMMENTS:

The property was posted by the applicant or their representative on June 10, 2016 at least 10 days prior to the public hearing. The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet. Nine (9) property owners within one hundred eighty-five (185) feet of the subject property were notified by mail of this request.

CITY COUNCIL MEETING:

July 25, 2016

STAFF CONTACT PERSON:

Daniel Neal
Senior Planner
864-1036

ATTACHMENT 1
DEPARTMENT COMMENTS
ZONING CASE Z-9-2016

BUILDING DEVELOPMENT SERVICES COMMENTS:

Building Development Services does not have any issues with the proposed rezoning to General Retail.

CITY UTILITIES:

No objection to rezoning. All utility services are available.

CLEAN WATER SERVICES COMMENTS:

No objections to rezoning. Public sewer and service lateral available.

MODOT COMMENTS:

No comments.

PUBLIC WORKS TRAFFIC DIVISION COMMENTS:

The City's Transportation Plan classifies Sunshine Street as a Primary Arterial and Madrid Street as a local commercial roadway. Sunshine is a State maintained street. The standard right of way for Madrid Street is 30 feet from the centerline. The most recent traffic count on Sunshine Street is 33,021 vehicles per day. There is no recent traffic count on Madrid Street. There is one existing driveway access points along the property frontage on Sunshine Street and one on Madrid Street. There is a sidewalk along Sunshine Street but no sidewalk along Madrid Street. The existing infrastructure meets current city standards. On-street parking is not allowed along the adjacent streets. There is not a greenway trail in the area. There is one bus stop along Sunshine Street and no bus stops along Madrid Street. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area. There are not any proposed improvements along Sunshine Street or Madrid Street. Staff recommends approval of this rezoning request.

Public Works Traffic Division	Response
Street classification	Sunshine - Primary Arterial; Madrid - Local Commercial
On-street parking along streets	No
Trip generation - existing use	720 trips per day
Trip generation - proposed use	20 trips per day per service bay
Existing street right of way widths	50 feet from centerline for Sunshine (city standards - this is a MoDOT route)

	30 feet from centerline for Madrid
Standard right of way widths	50 feet from centerline for Sunshine (city standards - this is a MoDOT route) 30 feet from centerline for Madrid
Traffic study submitted	Not required
Proposed street improvements	None

STORMWATER COMMENTS:

The property is located in the Galloway Creek drainage basin. The property is not located in a FEMA designated floodplain. Staff is aware of flooding problems in the area. If the project increases the amount of impervious surfacing; detention and water quality is required according to Chapter 96. Buyout in lieu of on-site stormwater detention is not an option. Since the project will be disturbing less than one (1) acre there will not be a land disturbance permit required. There is an existing detention basin and underground storm sewer serving this development. There are no sinkholes on the proposed property.

Public Works Stormwater Division	Response
Drainage Basin	Galloway Creek
Is property located in Floodplain?	No
Is property located on a sinkhole?	No
Is stormwater buyout an option?	No

Attachment 2

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: PD 136 *(existing zoning)* to GR *(proposed zoning)*
2. Meeting Date & Time: May 12, 2016 4 to 6:30pm
3. Meeting Location: Panera Bread, 2924 East Sunshine
4. Number of invitations that were sent: 47
5. How was the mailing list generated: City of Springfield
6. Number of neighbors in attendance (attach a sign-in sheet): 3
7. List the verbal comments and how you plan to address any issues:
(City Council does not expect all of the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

Dan Malachowski telephoned our office with concerns about noise issues. Attached is a letter from Plaza Tire that was given to Mr. Malachowski at the neighborhood meeting in regards to that concern.

8. List or attach the written comments and how you plan to address any issues:

No written comments.

I, Leslie Chrystal *(print name)*, attest that the neighborhood meeting was held on 5/12/16 *(month/date/year)*, and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Leslie Chrystal

Signature of person completing affidavit

Leslie Chrystal

Printed name of person completing affidavit

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

SIGN IN SHEET

Neighborhood Meeting

Thursday, May 12, 2016

Re: Proposed Rezone
With A Conditional Use Permit
2420 East Sunshine
Springfield, Missouri

NAME	ADDRESS	PHONE
Ken Blankenship	2315 E Washita	886-7463
Toni Lightner	2402 E Madrid	883-3235
DAN MALACHOWSKI	2432 E. MADRID	886-1111

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May 12, 2016

Mr. Derek Lee
Lee Engineering
1200 E Woodhurst Dr Bldg D 200
Springfield MO 65804

RE: New Plaza Tire Service, 2420 East Sunshine, Springfield, Missouri

Dear Derek,

Please allow this letter to address concerns about possible noise issues coming from our store operations.

1) All work will be inside the building
2) The bays will be facing west toward Kum & Go.
3) We will use rotary driven compressor not a piston type compressor. This compressor makes noise similar to a residential refrigerator.

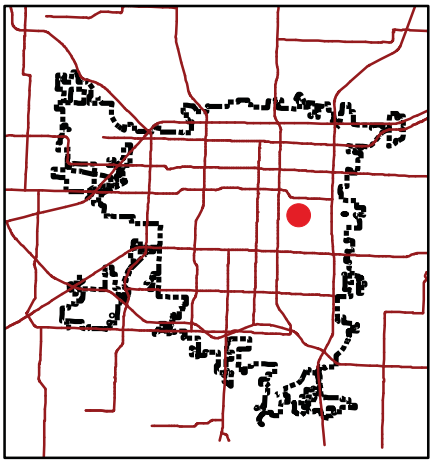
The noise from our operations is typical of retail developments such as Kum & Go or Sonic. We have never had a compliant or violation regarding noise from any of our other 58 stores. Some stores operate within 100' from residential areas. This is our first store in Springfield and we want to be a part of the Springfield community. We will fully comply with the City's noise ordinance (Division 2 Sec. 78-111-114). It is our goal to be a good neighbor and corporate citizen to the City of Springfield.

Sincerely,

Plaza Tire Service, Inc.

Scott M. Rhodes
Vice President
Co-Owner

ESTABLISHED 1966



Development Review Staff Report

Department of Planning & Development - 417-864-1031
840 Boonville - Springfield, Missouri 65802

Z-10-2016 with Conditional Overlay District No. 109

LOCATION: 2263 East Cherry Street
CURRENT ZONING: R-MD, Medium Density Multi-family Residential
PROPOSED ZONING: HM, Heavy Manufacturing with Conditional Overlay District No. 109

LOCATION SKETCH

DEVELOPMENT REVIEW STAFF REPORT
ZONING CASE Z-10-2016 & CONDITIONAL OVERLAY DISTRICT NO. 109

PURPOSE: To rezone approximately 0.41 acres of property generally located at 2263 East Cherry Street from a R-MD, Medium density Multi-family District to an HM, Heavy Manufacturing District and establishing Conditional Overlay District No. 109

REPORT DATE: June 23, 2016

LOCATION: 2263 East Cherry Street

APPLICANT: O'Reilly Automotive Stores, Inc.

TRACT SIZE: Approximately 0.41 acres

EXISTING USE: Vacant Daycare facility

PROPOSED USE: Off-street parking and access drive

FINDINGS FOR STAFF RECOMMENDATION:

1. The requested HM, Heavy Manufacturing District zoning is consistent with the recommendations of the *Growth Management and Land Use Plan* of the *Comprehensive Plan* which recommends General Industry, Transportation and Utilities land uses.

2. The proposed Conditional Overlay District requirements are consistent with the COD of the adjacent property to the west in regards to permitted uses and depth from Cherry Street.

3. Approval of this application will allow for development of this property for additional parking and access drive for a business and will promote development where investments have already been made in public services and infrastructure.

RECOMMENDATION:

Staff recommends **approval** of this request.

SURROUNDING LAND USES:

AREA	ZONING	LAND USE
North	HM	Office Building and parking lot
East	R-MD	Multi-family dwellings
South	R-SF	Single-family residence
West	HM COD #34	Undeveloped land

HISTORY:

City Council, on May 5, 2010, approved Ordinance No. 5872 to rezone the property to the west of the subject property to a HM district & Conditional Overlay District No. 34 which prohibits all other uses except commercial off-street parking lots and structures.

City Council, on May 16, 2016, approved Ordinance No. 6278 to rezone a portion of the property to the west of the subject property to a HM & Conditional Overlay District No. 106 which prohibits all other uses except commercial off-street parking lots and structures and General Office use group. This rezoning maintained the prior Conditional Overlay District No. 34 at a distance of 150 feet North of Cherry Street.

COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* element of the *Comprehensive Plan* identifies this area as appropriate for General Industry, Transportation and Utilities land uses.

STAFF COMMENTS:

1. The applicant is requesting to rezone the subject property from a R-MD, Medium density Multi-family District to an HM, Heavy Manufacturing District with Conditional Overlay District No. 109. The *Growth Management and Land Use Plan* Element of the *Comprehensive Plan* identifies this area as appropriate for General Industry, Transportation and Utilities land uses.

2. The proposed Conditional Overlay District requirements are consistent with the COD of the adjacent property to the west in regards to permitted uses and depth from Cherry Street. The current Conditional Overlay District No. 34 area, subsequent to COD 106, maintained a depth of 150 feet from Cherry Street. This request is consistent with the depth from Cherry Street.

3. Approval of this application will allow for development of this property for additional parking and access drive for a business and will promote development where investments have already been made in public services and infrastructure.

4. The proposed rezoning was reviewed by City departments and comments are contained in Attachment 1.

NEIGHBORHOOD MEETING:

The applicant held a neighborhood meeting on June 13, 2016 regarding the rezoning request. A summary of the meeting is attached (Attachment 2).

PUBLIC COMMENTS:

The property was posted by the applicant at least 10 days prior to the public hearing. The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet. Ten (10) property owners within one hundred eighty-five (185) feet of the subject property were notified by mail of this request.

CITY COUNCIL MEETING:

July 25, 2016

STAFF CONTACT PERSON:

Michael Sparlin
Senior Planner
864-1091

ATTACHMENT 1
DEPARTMENT COMMENTS
ZONING CASE Z-10-2016 & CONDITIONAL OVERLAY DISTRICT NO. 109

BUILDING DEVELOPMENT SERVICES COMMENTS:

No BDS issues with proposed zoning.

PUBLIC WORKS TRAFFIC DIVISION COMMENTS:

The City's Transportation Plan classifies Cherry Street as a Secondary Arterial roadway. The standard right of way width for Cherry Street is 70 feet (35 feet from the centerline). It appears additional right of way is acquired to meet this standard. This is a City maintained street. The most recent traffic count on Cherry Street is 26,588 vehicles per day. There is one existing driveway access point along Cherry Street. This existing access will need to be reconstructed to meet current city standard for a commercial driveway. There is a sidewalk along the property frontage. The existing infrastructure meets current city standards. On-street parking is not allowed along the adjacent streets. There is not a greenway trail in the area. There is one bus stop along Cherry Street. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area. There are proposed improvements along Cherry Street. These are planned for construction in 2018. They include widening to three lanes with curb & gutter, bike lanes and sidewalk. This request will require right of way be dedicated in the amount needed to meet the 35 feet standard from the centerline. A survey is recommended to determine the exact existing right of way.

Public Works Traffic Division	Response
Street classification	Secondary Arterial
On-street parking along streets	No
Trip generation - existing use	180 vehicles per day
Trip generation change - proposed use	39 vehicles per day
Existing street right of way widths	31
Standard right of way widths	35
Traffic study submitted	Not required
Proposed street improvements	None required

Transportation Plan
Growth Management Land Use Plan

FIRE DEPARTMENT COMMENTS:

Fire has no issues.

STORMWATER COMMENTS:

The property is located in the Jordan Creek drainage basin. The property is not located in a FEMA designated floodplain. Staff is aware of flooding problems in the area. If the project increases the amount of impervious surfacing; detention and water quality is required according to Chapter 96. Buyout in lieu of on-site stormwater detention is not an option. Since the project will be disturbing more than one (1) acre there will be a land disturbance permit required. There is an existing channel available for this development to discharge into. There are no sinkholes on the proposed property.

Please note that development of the property will be subject to the following conditions at the time of development:

1. Post development peak run-off rates shall not exceed pre-development peak run-off rates for the 1, 10 and 100 year rain events. Any increase in impervious surfacing will require the development to meet current detention and water quality requirements.
2. Concentrated points of discharge from these improvements will be required to drain into a certified natural surface-water channel, public right-of-way, or a drainage easement.
3. Based upon City data, there is a significant amount of offsite concentrated stormwater crossing the subject property. Although stormwater detention and water quality do not have to be provided for these flows, public improvement plans will be required to convey these flows across the subject property. Drainage easements must be provided for this conveyance.
4. Please keep in mind that more detailed stormwater calculations will have to be submitted before any permits can be approved.

Public Works Stormwater Division	Response
Drainage Basin	Jordan Creek
Is property located in Floodplain?	No
Is property located on a sinkhole?	No
Is stormwater buyout an option?	No

CLEAN WATER SERVICES COMMENTS:

No objection to rezoning. Public sewer is available to tract.

CITY UTILITIES:

No objection to rezoning. All utilities are available.

ATTACHMENT 2
CONDITIONAL OVERLAY DISTRICT PROVISIONS
ZONING CASE Z-10-2016 & CONDITIONAL OVERLAY DISTRICT NO. 109

The requirements of Section 46-433 of the Springfield Zoning Ordinance shall be modified herein for development within this district.

(2) Permitted Uses

(m) Commercial off-street parking lots and structures

Additional Design Requirements

1. Dedicate additional right-of-way to meet 35 feet from the established centerline of Cherry Street.

2. The property shall be combined with the property to the North, 455 South Patterson Avenue.

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: R-MD *(existing zoning)* to HM COD (parking lot) *(proposed zoning)*
2. Meeting Date & Time: June 13, 2016; 4:00 PM to 6:30 PM
3. Meeting Location: 3057 East Cairo Street, Springfield, MO 65802
4. Number of invitations that were sent: 66
5. How was the mailing list generated: City of Springfield, MO Planning Dept.
6. Number of neighbors in attendance (attach a sign-in sheet): 0
7. List the verbal comments and how you plan to address any issues:
   (City Council does not expect all of the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

   No community attendance at Neighborhood meeting.
   4 Phone call messages were received prior to the Neighborhood meeting & attached to this summary as Exhibit A. There were no objections noted in the phone calls. Just questions about what is being proposed.
   Given there are no objections to the re-zoning; there is no issue to address.

8. List or attach the written comments and how you plan to address any issues:

   No written comments received.

I, Paul Engel, PE *(print name)*, attest that the neighborhood meeting was held on 06/13/2016 *(month/date/year)*, and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Signature of person completing affidavit

Paul Engel, PE

Printed name of person completing affidavit

ANDERSON ENGINEERING
EMPLOYEE OWNED

2263 E. Cherry Street Re-Zoning
PLN2016-00185 Neighborhood Meeting
4 PM - 6:30 PM; June 13, 2016

3057 East Cairo Street, Springfield, MO 6580

---Please Print Your Name---

1.	22.
2.	23.
3.	24.
4.	25.
5.	26.
6.	27.
7.	28.
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16.	37.
17.	38.
18.	39.
19.	40.
20.	41.
21.	42.

NO NEIGHBOR OR COMMUNITY ATTENDANCE DURING OPEN TIME OF 4 PM - 6:30 PM ON JUNE 13, 2016.

PAUL ENGEL
6/13/2016 6:31 PM

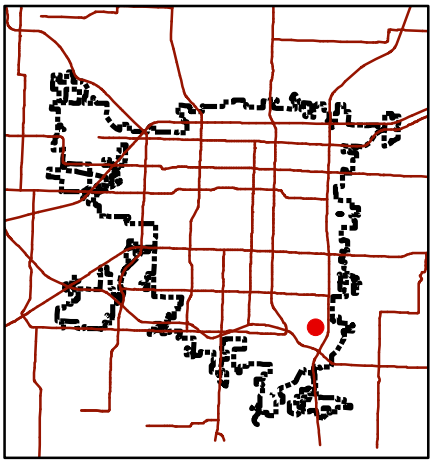
2263 E. Cherry Street Re-Zoning
PLN2016-00185: EXHIBIT A
Phone Call Question Log
to Anderson Engineering

Call #1: 06/03/2016 Goldie Burns (417-869-3534)
Message: Lives near Cherry & Sparks. Asked what is going to be put in.
Anderson called Goldie Burns back on 06/03/2016, ~11 am.
Left message that O'Reilly is wanting to add a drive access and parking lot.
No return call from Goldie Burns.

Call #2: 06/03/2016 Linda Dobbins (417-862-6693)
Left message wanting to know why the property needs to be re-zoned.
Anderson called back and explained that for O'Reilly to construct a parking lot & drive access to Cherry St, the City of Springfield requires the property to be re-zoned.
Linda Dobbins is okay with the parking lot & drive access proposed zoning change.

Call #3: 06/06/2016 Loretta Chilton (417-864-4514)
Message: Lives at 2306 E Cherry. Asked what is going to be built.
Anderson called Loretta Chilton on 06/06/2016, ~1:30 pm.
Left message that O'Reilly is wanting to add a drive access and parking lot.
Loretta Chilton called back (06/06/2016, ~1:50 pm) and said she is okay with the proposed change.

Call #4: 06/08/2016 Celeste - Realtor (417-343-2098)
Message: Client owns property on Sparks but lives in Florida. Question about what is proposed to be built. Anderson said parking lot & access drive. Celeste said that sounds okay & will forward the info to her client.



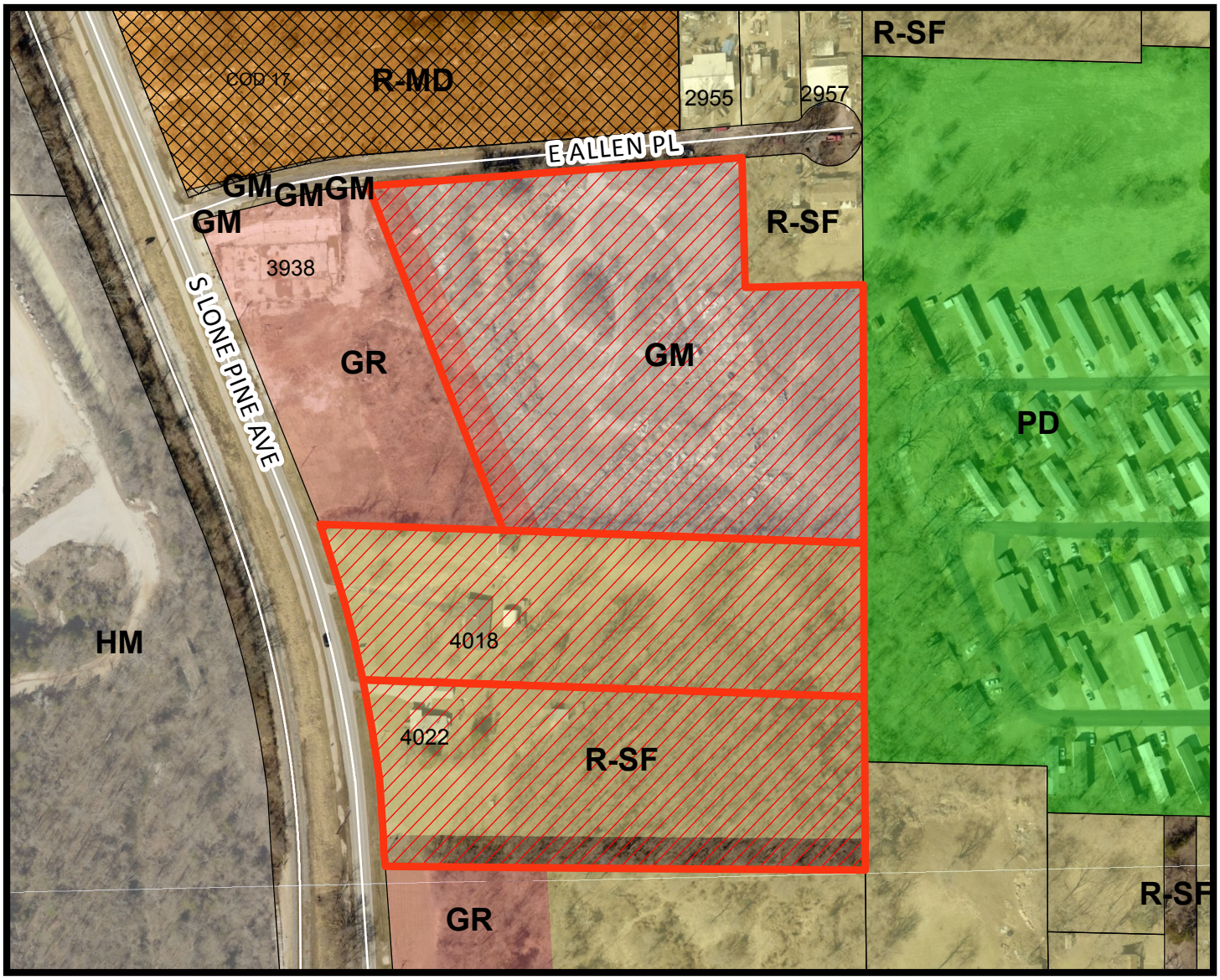
Development Review Staff Report

Department of Planning & Development - 417-864-1031
840 Boonville - Springfield, Missouri 65802

Planned Development 351

LOCATION: 4018 and 4022 Lone Pine Ave
CURRENT ZONING: GR, General Retail District,
GM, General Manufacturing District and
R-SF, Single Family Residential District
PROPOSED ZONING: Planned Development 351

LOCATION SKETCH



N

- Area of Proposal

0 100 200 400
Feet

1 inch = 200 feet

DEVELOPMENT REVIEW STAFF REPORT
PLANNED DEVELOPMENT 351

PURPOSE: To rezone approximately 10.8 acres of property generally located at 4018 and 4022 South Lone Pine Avenue from R-SF, Residential Single-Family District, GR, General Retail District and GM, General Manufacturing District to a Planned Development District No. 351 District.

DATE: June 6, 2016

LOCATION: 4018 and 4022 South Lone Pine Avenue

APPLICANT: Kaonashi LLC and Lone Projects, LLC

TRACT SIZE: Approximately 10.8 acres

EXISTING USE: Three vacant lots

PROPOSED USE: Planned Development for a mixed use development (commercial, office, multi-family and single-family uses).

FINDINGS FOR STAFF RECOMMENDATION:

1. The *Growth Management and Land Use* element of the Comprehensive Plan designates a portion of this area as Medium Intensity Retail, Office or Housing as well as designating some of the area as Low Density Housing.
2. The subject property is within the Redevelopment Plan and Blight Study for the Galloway Redevelopment Area which was adopted by City Council on May 12, 2014. The Redevelopment Plan objectives support the redevelopment of this area to increase investment opportunities in the area.
3. The subject property is also within the *Southeast Springfield Development Study* which recommends retail or services business including offices land uses for this area as well as mixed use developments.
4. The proposed development is within proximity to the US 65/60 Development (Planned Development 330 amended) which is a proposed 500 acre mixed use development approved by City Council in 2011.
5. A traffic study is required based on the proposed uses. Lone Pine Avenue is classified as a secondary arterial which is appropriate roadway for the proposed intensity. Allen Drive is classified as a local street.
6. The subject property is within walking and bicycling distance of the Sequiota Park and Greenway Trail.
7. The Multi-Family Development Location and Design Guidelines were evaluated for this project because of the proposed multi-family development.

The proposed Planned Development meets the standards outlined in the Guidelines.

8. The proposed planned development will mitigate the potential impact between the permitted uses and the adjacent R-SF property to the west with a bufferyard type C which includes plantings and 6 feet wood fence as outlined in Exhibit 1 and Exhibit 2. The proposed Planned Development will not have a significant impact on the surrounding neighborhood.

RECOMMENDATION:

Staff recommends **approval** of this request.

SURROUNDING LAND USES:

AREA	ZONING	LAND USE
North	R-MD COD#17	Multi-Family Apartments
East	PD 276 and R-SF	Manufactured Homes and a residential house
South	GR and R-SF	Commercial and residential uses
West	GR and HM	Vacant land and Ash Grove Mining

COMPREHENSIVE PLAN:

1. The *Growth Management and Land Use* element of the Comprehensive Plan designates this area as Medium Intensity Retail, Office or Housing and Low Density Housing. This area is within Redevelopment Plan and Blight Study for the Galloway Redevelopment Area adopted by City Council May 12, 2014. The Study supports rezoning to increase investments in the area. The Southeast Springfield Development Study accepted by City Council on November 4, 2002 recommended retail or service businesses including offices and mixed land uses for this area.

STAFF COMMENTS:

1. The applicant is proposing a planned development for a mixed use development on 10 acres of property located along South Lone Pine Avenue just south of the Sequiota Park and Greenway Trail.
2. The proposed mixed use planned development will allow for commercial and office uses as well as multi-family and single-family residential uses.
3. The subject property is within the Redevelopment Plan and Blight Study for the Galloway Redevelopment Area adopted by City Council on May 12, 2014. This plan proposed the following objectives;

a. To enhance public health, safety, and welfare of the community by curing blighting conditions and encouraging redevelopment necessary for insuring the Redevelopment Area's future stability,
b. To increase the level and perception of safety and revitalization in the Redevelopment Area which will in turn encourage an influx of new business and residents in the area'
c. To enhance the tax base by including development on the redevelopment area to its highest and best use to benefit taxing districts and to encourage private investment in and around the Redevelopment Area,
d. To increase property values of the Redevelopment Area;
e. To provide development/business opportunities in the Redevelopment Area and surrounding areas;
f. To serve as a catalyst for new multiple-family housing in the Redevelopment Area, and;
g. To stimulate construction and permanent employment opportunities as well as increase demand for goods and services offered by the business within the Redevelopment Area.

4. The Southeast Springfield Development Study accepted by City Council on November 4, 2002 recommended retail or service businesses including office uses within the area. The study states that the City should allow and encourage investments that combine more than one type of use on a site. Mixed-use developments implies a vertical relationship (i.e. offices or housing over shops) while multiple-use development means a side by side positioning. Either case promotes more efficient land uses, reduces auto trips and creates a more interesting urban environment.
5. The proposed planned development is also within proximity to the US Highway 60/65 Planned Development 330 amended. This PD was approved by City Council in 2011 to allow a mixed use development on 500 acres on the east and west sides of U.S. Highway 65 north of Highway 60.
6. The Multi-Family Development Location and Design Guidelines were evaluated for this project because of the proposed multi-family development. The applicant is requesting a maximum density of 12 dwelling units per acre within the development. The site received a total score of 8 points on the assessment, which sets the permitted dwelling units to 11 units per acre. The site scored one out of a potential three points in Land Use Accessibility, one out of a possible five points in the Connectivity Analysis, zero points in Road Network Evaluation and six points for Design Guidelines. There will be additional bonus densities awarded for Green building and mixed use developments per the guidelines to allow 12 dwelling units per acre. A copy of the assessment is attached (Attachment 3).
7. Lone Pine Avenue is classified as a secondary arterial which is appropriate roadway for the proposed intensity. Allen Drive is classified as a local street. A traffic study is required based on the proposed uses and will require a left turn lane to be constructed along Lone Pine Avenue as shown on the Exhibit 2. Sidewalks are required to be constructed along the property frontage along Lone Pine and Allen Drive. Allen Drive must be improved and widened to accommodate on-street parking. The project intends to provide cross access driveways at both the north adjacent property fronting on Lone Pine, as well as the south adjacent property**.** The planned development will allow parking adjacent to a public

right-of-way on private property and will be allowed to back onto a public street. There will be landscaped islands provided within the right-of-way of South Lone Pine Avenue, however, the maintenance will be the responsibility of the developer through a license agreement.

8. The development is permitted to reduce the overall parking by 10% per bicycle parking reduction standards provided in the zoning ordinance. The applicant is requesting to reduce the overall parking requirements by an additional 10%. This additional 10% reduction is requested due to the mixed uses on-site, high pedestrian/bicycle volumes due to the Greenway trail and adjacent residential foot traffic from on-site and from adjacent properties.
9. The project will provide street trees by preserving existing trees along the internal circulating streets and will provide pedestrian connectivity through the site. Trees have been surveyed and documented. Houses, buildings and roads are planned to preserve trees where feasible. A minimum of 5% interior landscaping will be provided and configured to incorporate existing trees where it is reasonably feasible. The project will provide for 30% open space. A box culvert is required to be conveyed for stormwater from this development to the creek on the west side of the BNSF railroad tracks.
10. Approval of this application will facilitate redevelopment of these properties and promote infill development and increased intensity where investments have already been made in public services and infrastructure.

NEIGHBORHOOD MEETING:

The applicant held two neighborhood meetings one on November 19, 2015 and the second meeting was held on May 17, 2016. A summary of theses meetings is attached (Attachment 2).

PUBLIC COMMENT:

The property was posted by the applicant at least 10 days prior to the public hearing. The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet. There are eleven (11) property owners notified by mail of this request within one hundred eighty-five (185) feet of the subject property. Staff has received no objections to date.

CITY COUNCIL MEETING: July 25, 2016

STAFF CONTACT PERSON:

Bob Hosmer, AICP
Principal Planner
864-1834

ATTACHMENT 1
DEPARTMENT COMMENTS
PLANNED DEVELOPMENT 351

TRAFFIC DIVISION COMMENTS:

The City's Transportation Plan classifies Lone Pine Avenue as a secondary arterial and Allen Drive as a local roadway. The standard right of way width for Lone Pine Avenue is 70 feet and for Allen Drive is 60 feet. Both streets are City maintained. The most recent traffic counts on Lone Pine south of Battlefield Road is 5,952 vehicles per day. There is no existing traffic counts on Allen Drive since it is classified as a local street. There are two existing driveway access points along this property frontage on Lone Pine and one along the property frontage on Allen Drive. There is no sidewalk along either street. The existing right of way width on Lone Pine meets current city standard, but the existing right of way along Allen Drive does not. On-street parking is not allowed along the adjacent streets. There is a greenway trail in the area. There are not any bus stops along Lone Pine or Allen. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area. There are no proposed city improvements along Lone Pine or Allen Drive. Staff recommends the following based on the approved Traffic Study and city requirements along Lone Pine Avenue and Allen Drive. A left turn lane will be constructed along Lone Pine Avenue as shown in the Exhibit. Sidewalks are required to be constructed along the property frontage along Lone Pine and along Allen. Allen Drive must be improved and widened to accommodate on-street parking.

Public Works Traffic Division	Response
Street classification	Lone Pine - Secondary Arterial Allen Drive - Local Commercial
On-street parking along streets	No
Trip generation - existing use	48 trips per day
Trip generation - proposed use	720 trips per day/1,000 sf of General Retail space
Existing street right of way widths	Lone Pine - 140 ft Allen Drive - 40 ft
Standard right of way widths	Lone Pine - 70 ft Allen Drive - 60 ft
Traffic study submitted	Yes
Proposed street improvements	Left Turn Lane on Lone Pine Sidewalks on Lone Pine & Allen Drive Widen and Improve Allen Drive

BUILDING DEVELOPMENT SERVICES COMMENTS:

No issues with rezoning to Planned Development

STORMWATER COMMENTS:

The property is located in the Galloway Creek drainage basin. The property is located in a FEMA designated floodplain. Staff is aware of flooding problems in the area. If the project increases the amount of impervious surfacing; detention and water quality is required according to Chapter 96. Buyout in lieu of on-site stormwater detention is preferred based on the information provided. Since the project will be disturbing more than one (1) acre there will be a land disturbance permit required. There is not an existing underground drainage system available for this development to discharge into. The developer is planning to construct downstream stormwater improvements and receive credit towards their stormwater buyout. There are sinkholes on the proposed property.

Please note that development of the property will be subject to the following conditions at the time of development:

1. Any increase in impervious surfacing will require the development to meet current detention and water quality requirements. A fee in lieu of on-site stormwater detention is preferred.
2. Concentrated points of discharge from these improvements will be required to drain into a certified natural surface-water channel, public right-of-way, or a drainage easement.
3. Based upon City data, there is a significant amount of offsite concentrated stormwater crossing the subject property. Public improvement plans will be required to convey these flows across the subject property. Drainage easements must be provided for this conveyance.
4. Please keep in mind that more detailed stormwater calculations will have to be submitted before any permits can be approved.

Public Works Stormwater Division	Response
Drainage Basin	Galloway Creek
Is property located in Floodplain?	Yes
Is property located on a sinkhole?	Yes
Is stormwater buyout an option?	Yes

SANITARY SERVICES COMMENTS:

1. Are the single family residential units going to be condominium lots with common area between each unit? If not, public sewer will need to be extend adjacent to each lot. If they are, maintenance and access rights will need to be defined for the common area in the subdivision covenants.
2. It appears as though these tracts will not be individual properties. It would be preferred that only one connection be made to public sewer for the entire development. The new connection will need to connect into a manhole and would have to be 8 inch minimum. If a new manhole is added to the trunkline, a public improvement plan would be required. It would be preferred that no direct

connections be made to the trunkline. There have been wet weather flow issues along the 24 inch trunkline along Lone Pine. Back flow preventers or holding tanks may be recommended for any new connections to the trunkline.
3. Submit the peak and average flow rates for review to mtaylor@springfieldmo.gov.
4. There needs to be a dedicated sanitary sewer easement across the development to facilitate sewer access for 4059 South Hooper.

CITY UTILITIES COMMENTS:

1. CU has met with Lee Engineering to discuss electric relocations, possible gas conflicts with the parking and installing services to the new development on Tract A. The site plan is acceptable with the understanding that there will be costs involved with relocating facilities required by the development. It should also be understood that there are space requirements for meters, junction boxes, transformer installations etc. These details can be worked out at the development stage, but should be accounted for designing the site plan.
2. The method of extending service to tracts B and C have not been finalized, however there is electric and water facilities on Allen Drive that can be extended in lieu of extending through Tract A.

FIRE DEPARTMENT COMMENTS:

Fire has no issues with the PD. Some of the buildings as drawn will not meet fire code requirements for Fire Access and Fire hydrant proximity. However all the buildings when built will need to meet the following:

1. Where a fire hydrant is located on a fire apparatus access road, the minimum road width shall be 26 feet (IFC D103.1)
2. Make note of the spacing requirements of hydrants for a complex of buildings as required in appendix C of the IFC 2012.
3. Provide required fire load flow calculations for total fire area of the building based on structure building type and square footage. This information needs to include minimum GPM and required minimum number of hydrants. (IFC 507.3)(Appendix tables B105.1 & C105.1) Provide this information on the site plan.
4. Provide available flow data for existing fire hydrants. Hydraulic calculations may be used for new/proposed hydrants. (IFC 507.1) Raw flow data must be input into a hydraulic calculation formula (such as Hazen-Williams) to show maximum flow output at 20 psi residual pressure. Provide this information on the site plan.
5. Show the location of existing and proposed hydrants on site plan; ensure hydrants meet the minimum requirements for spacing of hydrants along apparatus access lanes/roads as well as maximum allowable distances to the structure. (IFC Section 507 & Appendix C). Provide this information on the site plan.
6. Provide a Knox Box for the building in an approved location (IFC 506.1). Typical location is in the immediate vicinity of the main entrance at 5’ above finish floor. Provide this information on the site plan.
7. Show that the minimum Fire Department apparatus access requirements (including road width, proximity to structures, required turn-around, turning radii,

required fire lane marking, 75,000 lb imposed load) are met (IFC 503 & IFC Appendix D). Provide this information on the site plan.

8. Fire apparatus access lanes shall be marked with 4" red striping on either side of the fire lane along the entire length of the lane and "NO PARKING FIRE LANE" shall be stenciled in 12 inch letters every 50 feet in the center of the fire lane (perpendicular to traffic flow and in alternating directions). If a curb is present along one side of the lane the curb should be painted red in place of the 4 inch striping. (IFC 503.3)
9. Specify Knox locking caps for the Fire Department Connection (FDC) (IFC amended 903.3.7.1)
10. Specify Fire Department Connection (FDC) for sprinkler systems and standpipes as 2-1/2” Siamese (13R and 13D systems require 2-1/2” connections as well). (IFC amended 903.3.7.2 & 905.1.2). Provide this information on the site plan. FDC shall be located on address side of the building.
11. Fire Lane will be required in the Residential Single Family area. Bridge over Open Channel Ditch will need to support 75,000 pounds. Possible Future Connection will need to be connected for Fire access. Fire access issues with storage units.

ATTACHMENT 2

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

May 3, 2016

Re: Proposed Rezone
4018 & 4022 S. Lone Pine
3500 Block E. Allen Place
Springfield, Missouri

Dear Property Owner:

A 2nd neighborhood meeting will be held Tuesday, May 17, 2016 to discuss a proposed rezone on the properties listed above. We would like to rezone the properties from R-SF (Residential-Single Family) and GM (General Manufacturing) to a (PD) planned development. The intent is to provide retail along Lone Pine and residential or office uses above and behind the retail along Lone Pine.

The neighborhood meeting will be held at Galloway Baptist Church, 2816 E. Republic Road, Springfield, Mo., in the Fellowship Hall in the basement, between 4:00 and 6:30pm. The entrance will be at the east basement door. The owner's representatives will be present to answer any questions you may have concerning this proposed rezone. Please feel free to come and go between 4:00 and 6:30pm. If you have any questions prior to this meeting, please contact our office at 417-886-9100.

Sincerely,

Leslie K. Chrystal
Office Manager

2nd

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: R-SF, GM & GR *(existing zoning)* to PD 351 *(proposed zoning)*
2. Meeting Date & Time: May 17, 2016 4 to 6:30pm
3. Meeting Location: Galloway Baptist Church, 2816 E. Republic Road
4. Number of invitations that were sent: 48
5. How was the mailing list generated: City of Springfield
6. Number of neighbors in attendance (attach a sign-in sheet): 2 + Lee Eng. Representatives
7. List the verbal comments and how you plan to address any issues:
   (City Council does not expect all of the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

   There were no verbal comments or nor did anyone appose the rezone. The neighbors in attendance stopped by to see the proposed layout of the property and what exactly did the rezone mean and how it would affect them.

8. List or attach the written comments and how you plan to address any issues:

   There were no written comments.

I, Leslie Chrystal *(print name)*, attest that the neighborhood meeting was held on 5/17/2016 *(month/date/year)*, and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Leslie Chrystal

Signature of person completing affidavit

Leslie K. Chrystal

Printed name of person completing affidavit

ATTACHMENT 2

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804

TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

SIGN IN SHEET

2nd Neighborhood Meeting

Tuesday, May 17, 2016

Re: Proposed Rezone
4018 & 4022 S. Lone Pine
3500 Block E. Allen Place
Springfield, Missouri

NAME	ADDRESS	PHONE
MATTHEW LAIR	2936 E BARTON	880-0411
KAREN DECKER	5726 S PINEHURST	860-2220

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

May 18, 2016

City of Springfield
Attn: Bob Hosmer
840 Boonville
Springfield, Mo. 65801

Re: PLN2016-00141

Dear Bob:

We held 2 neighborhood meetings for this proposed rezone. The first meeting being back in November with our intent of submitting the application by the December deadline. However, there were issues that had to be resolved, therefore, we did not submit an application until recently. The second meeting was just held.

I thought an explanation of the reasoning for 2 neighborhood meetings and why they were so far apart was needed. If you have any questions, please contact our office. Thank you.

Sincerely,

Leslie K. Chrystal
Office Manager

1ST

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: R-SF, GM & GR *(existing zoning)* to PD 351 *(proposed zoning)*
2. Meeting Date & Time: November 19, 2015 4 to 6:30pm
3. Meeting Location: Galloway Baptist Church, 2816 E. Republic Road
4. Number of invitations that were sent: 48
5. How was the mailing list generated: City of Springfield
6. Number of neighbors in attendance (attach a sign-in sheet): 9 + Owner & Representative
7. List the verbal comments and how you plan to address any issues:
   (City Council does not expect all of the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

   [ ]

8. List or attach the written comments and how you plan to address any issues:

   Comment Sheets attached.

   The only written comment issue was they did not want to see a Title Loan Business to go in the retail center. At this time, there is no plans to have a Title Loan Business located at this facility.

I, Leslie Chrystal *(print name)*, attest that the neighborhood meeting was held on 11/19/15 *(month/date/year)*, and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Leslie Chrystal

Signature of person completing affidavit

Leslie Chrystal

Printed name of person completing affidavit

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING

1st

I, Leslie Chrystal *(print name)*, attest that the invitation letter to the neighborhood meeting (attached) was mailed ten (10) days prior to the neighborhood meeting on 11/6/15 *(month/date/year)*, the neighborhood meeting is scheduled to be held on 11/19/15 *(month/date/year)*, which is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Exhibit 1: Neighborhood Notification and Meeting Process."

Leslie K Chrystal

Signature of person completing mailings

Leslie K. Chrystal

Printed name of person completing mailings

**NOTE: this affidavit must be submitted by the Friday following the application deadline.*

LEE ENGINEERING AND ASSOCIATES, L.L.C.
CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

SIGN IN SHEET

Neighborhood Meeting

Thursday, November 19, 2015

Re: Proposed Rezone
4018 & 4022 S. Lone Pine
3500 Block E. Allen Place
Springfield, Missouri

NAME	ADDRESS	PHONE
BOB BRADFORD	2850 E. BARTON ST, SPFLD., MO.	883-2355
Matt Blevins	2114 E. Republic Rd Spfd MO	417-848-5572
Randy Mitchell	2957 S Allen " "	350-1267
Jessica Pearson	4062 E Wilshire St	417-849-1333
KRISTI BEATTIE	3750 S. Fremont, Spfd, MO	417-848-0919
LARRY & JOAN CARTER	3016 E BARTON SPFD MO	417 890-4055
STEVE TELSCHER	3750 S. FREMONT SPFD, MO	417-877-9000
[illegible]	4110 S. Hughes Spfd MO 65804	417-881-8912
Barrett Fisk	1918 E. Meadowmere, 2960 E Allen	417-773-3700
Matt O'Reilly	4174 E Canyon Spfd.	417-848-3358
DEREK LEE	2100 WOODHURST	886-9100

LEE ENGINEERING AND ASSOCIATES, L.L.C.
CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

COMMENT SHEET

Neighborhood Meeting

Thursday, November 19, 2015

Re: Proposed Rezone
4018 & 4022 S. Lone Pine
3500 Block E. Allen Place
Springfield, Missouri

NAME	ADDRESS	PHONE
BOB BRADFORD	2850 E. BARTON ST., SPFLD., MO.	883-2355

COMMENTS: I FEEL IT WOULD BE A PLUS FOR THE GALLOWAY AREA.

ATTACHMENT 2

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

COMMENT SHEET

Neighborhood Meeting

Thursday, November 19, 2015

Re: Proposed Rezone
4018 & 4022 S. Lone Pine
3500 Block E. Allen Place
Springfield, Missouri

NAME	ADDRESS	PHONE
R. Mitchell	2957 S Allen	380-1227

COMMENTS:

Allen Dr. Not to be used as access to the properties if possible. Thank you

ATTACHMENT 2

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

COMMENT SHEET

Neighborhood Meeting

Thursday, November 19, 2015

Re: Proposed Rezone
4018 & 4022 S. Lone Pine
3500 Block E. Allen Place
Springfield, Missouri

NAME	ADDRESS	PHONE

COMMENTS:

Business that I would not want... any type of title loan business.

Thank You.

ATTACHMENT 3
MULTI FAMILY DEVELOPMENT LOCATION AND DESIGN GUIDELINES
ASSESSMENT FOR PLANNED DEVELOPMENT 351

The applicant is requesting a maximum density of 12 dwelling units per acre within the development. The site received a total score of 8 points on the assessment, which sets the permitted dwelling units to 11 units per acre. There will be additional bonus densities awarded for Green building and mixed use developments per the guidelines to allow the requested 12 dwelling units per acre. The applicant is requesting 102 multi-family residential units and 22 single family units which equates to approximately 12 dwelling units per acre. Below is an analysis of the four categories used to calculate the Matrix score.

A. Land Use Accessibility (1/3 points)
   Two points were given for land use accessibility. There is a recreational-park/greenway (Sequiota Park and Greenway Trail) as well as a neighborhood retail mixture within 1/4 mile of the subject property.

B. Connectivity Analysis (1/5 points)
   Five out of a maximum of five points were given for connectivity analysis. The proposed development received high scores for its proximity to a greenways, sidewalks, transit and bicycle paths.

C. Road Network Evaluation (0/2 points)
   A maximum of two points were given for the road network evaluation.

D. Design Guidelines (6/6 points)
   Six points were given for design guideline criteria. Below are some of the design considerations that have been incorporated into the proposed development.

   1. Pedestrian Amenities - Pedestrian amenities shall include benches placed near walkways at appropriate locations throughout the development. Pedestrian-scale lighting shall be provided within the development lighting sources or luminaries that do have a cutoff shall not exceed a maximum of 30 feet in height. All lighting shall be glare-free and shielded from the sky and adjacent residential properties and structures, either through external shields or through optics within the fixture. A site lighting and photometric plan shall be submitted conforming to these requirements for building permits.

   2. Building Scale and Articulation - Street facing walls that are greater than 50 feet in length shall be articulated at least each 25 feet with bays, projections or recesses. Articulation means a difference in the vertical place of the building at least 18 inches or more. This project shall be in compliance with the attached site plan and elevations

3. Building Orientation and Interior Landscaping - Building orientation shall address the street and building alignment per submitted site plan. Landscaping and open spaces shown shall be provided with approved ground cover and/or plantings per required city ordinances and zoning requirements. Landscaping islands with plantings shall be located throughout the parking lot. There shall be a 10 feet wide Type C bufferyard buffer yard and fence, shall be located along the western property per site plan. A landscaping plan shall be submitted conforming to these requirements for building permits.

4. Avoidance of Blank Walls along pedestrian circulation areas - Facades that face public streets or connecting pedestrian frontage that are greater than 25 feet in length shall be subdivided and proportioned using at least one or more of the following features windows, entrances, arcades, arbors, awning (over windows or doors), distributed along the façade at least once every 25 feet.

5. Internal Connectivity – Internal sidewalks shall connect internally and to the public sidewalk system.

6. Useable Recreational Area/Facility – Benches will be located throughout the common areas providing for useable tenant amenities. A minimum of 20% usable open space shall be provided in accordance with the attached site plan.

a. Amenity Calculation – There shall be at least 3 amenities provided by the development such as exercise room and/or recreation building, community center, resident clubhouse, swimming pool, picnic area with tables and grills or tot lot will be located on-site.

7. Preservation of Trees –All existing trees of 6” caliper or greater shall be preserved or replaced with 2-inch caliper trees in accordance with the attached site plan and the city ordinance.

8. Water Quality and Detention –The development will use LID, Low Impact Development Best Management Practices in managing its storm water runoff. A box culvert is required to be conveyed for stormwater from this development to the creek on the west side of the BNSF railroad tracks

Density Bonuses:

Mixed Use Developments: Mixed Use developments that contain an equal amount or greater total square footage of residential to non-residential are allowed an increase of 3 dwelling units per acre. Mixed Use developments that contain 50% or more non-residential square footage as residential square footage are allowed an increase of 2 dwelling units per acre.

Green Building: An increase of 1 du/ac for Certified, 1.5 du/ac for Silver, 2 du/ac for Gold and 2.5 du/ac for Platinum as defined by the “Leadership in Energy and Environmental Design” (LEED) Green Building Rating System or similar nationally recognized program as approved by the Planning and Zoning Commission and City Council. An increase of 0.50 du/ac for a rating between 1-50, 1.0 du/ac for a rating between 51-74 and 1.25 du/ac for a rating between 75-100 for EPA Energy Star. An increase of 0.25 du/ac for Bronze, 0.5 du/ac for Silver and 1.0 du/ac for Gold rating of the National Association of Home Builders Green Building Guidelines (see EPA Energy Star and NAHB Green Building guidelines for more information).

Maximum density (du/acre) shall not exceed maximum 12 units per acre per PD 351 zoning as indicated on the attached site plan.

EXHIBIT 1

Requirements and Standards Applicable to
Planned Development District No. 351

A. APPLICATION

Building or other permits may not be issued for development permitted by this planned development nor can any changes be made to this property until the final development plan has been approved in the manner described at the end of this exhibit.

All requirements of the Springfield Zoning Ordinance shall apply unless modified by the requirements and standards that follow.

B. INTENT

To create a modest, tasteful and hip community epicenter that serves the established residential base of the Galloway Corridor within a short radius of the project site while accentuating the unique and charming regional draw of the Galloway Creek and Lone Pine corridor as a destination park, retail and recreational district. The PD will allow mixed uses with a focus on contemporary overlap programming such as Live/Work retail and "small living" high end single family residential.

1. ***To allow single family residential on Tract B.***
2. ***To eliminate the perimeter buffer along Lone Pine. This will allow more of the wooded area on the east side of the property to remain.***
3. ***To reduce parking requirements based on mixed uses. This will allow more of the wooded area on the east side of the property to remain.***
4. ***To allow offsite parking within ½ of a mile of the site to count towards the onsite use. This is consistent with the existing recreational district which serves the green way trails system and Sequiota Park.***
5. ***To allow an LID development where water quality elements can be constructed last and saving existing trees counts towards the City's water quality design standards.***
6. ***To allow a sidewalk system that is integrated into the development's internal pedestrian system.***

C. DEFINITIONS

The definitions contained in the *Zoning Ordinance* shall apply to this ordinance.

D. USES PERMITTED

1. Tract A: All uses allowed in GR, General Retail District
2. Tract B: Single family residential uses.
3. Tract C: All uses allowed in O-1, Office and R-MD, Residential Medium Density District

and self-service storage facilities

E. USE LIMITATIONS

1. All uses shall operate in accordance with the noise standards contained in the *Springfield Zoning Ordinance*.
2. No use shall emit an odor that creates a nuisance as determined by the *Springfield City Code*.

F. INTENSITY OF DEVELOPMENT

Development shall adhere to the following standards.

TRACT A

The intent is to have multi-story buildings with retail and restaurant uses throughout the buildings.

1. The intensity shall be a maximum of 15,000 SF of retail sales group of which 7,000 of the 15,000 SF of the retail sales group can be eating and drinking establishment use group.
2. Office uses shall have a maximum of 13,000 SF dedicated to office use.
3. If offices are located on the first floor, then they count towards the 15,000 SF of retail sales group. If offices are located on the second or third floors, they count towards the 13,000 office maximum.
4. Residential uses shall have a maximum of 13,000 SF dedicated to residential uses above the retail uses (these uses would be substituted for the office uses).

TRACT B

The intent is to have a multiple small unit residential development.

1. The density shall be a maximum of 22 residential units which will be a mixture of single family units or duplex units.

TRACT C

The intent is to have multi-family residential, office buildings and self-storage space. However, the maximum intensity for residential and office space shall not be allowed for both.

1. The density shall be a maximum of 100 multi-family residential units.
2. The intensity shall be a maximum of 10,000 SF of self service storage space.
3. A maximum of 10,000 SF of office space (not including the accessory office use associated with multi-family and self-storage use) can be substituted for residential units based on required parking requirements.

G. BULK, AREA AND HEIGHT REQUIREMENTS

Development shall adhere to the following standards.

1. Maximum structure heights shall be three stories on Tracts A and B. A maximum structure height of four stories shall be permitted on Tract C.

H. DESIGN REQUIREMENTS

The intent of the Planned Development district is to encourage more creative and imaginative design than generally is possible under conventional zoning regulations. In addition, a development plan should be designed to ensure that the following general goals are achieved.

1. The proposed development shall be of such design that it will promote achievement of the stated purposes of the Springfield Comprehensive Plan.
2. The development will efficiently utilize the available land, and will protect and preserve to the extent possible, natural features of the land such as trees, streams and topographic features.
3. The development shall provide for harmonious and coherent site and building design that creates a sense of place.

Both the Multi-family Development Design and Location Guidelines for projects with Multi-family uses (more than 11 dwelling units per acre) and the City's Comprehensive Plan for non-residential uses will apply to this project, unless modified by the requirements and standards that follow:

<u>Section 5.7 Design Guidelines</u>

Encourage Pedestrian Activity:

1. The project will provide pedestrian amenities such as pedestrian scale lighting and non right-of- way street furniture to enhance the pedestrian environment. Lighting sources or luminaries that do not have a cutoff and are used in parking lots and pedestrian ways shall not exceed a maximum of 15 feet in height. Lighting sources or luminaries that do have a cutoff shall not exceed a maximum 30 feet in height. Parking lot lighting and pedestrian lighting should be appropriate to create adequate visibility at night and evenly distributed to increase security. All lighting should be glare-free and shielded from the sky and adjacent residential properties and structures, either through exterior shields or through optics within the fixture. Street furniture may include but is not limited to

benches; shelters; and decorative trash bins. There shall be one (1) street/park bench provided within each multi-family development, thereafter, one (1) park/street bench for every 50 dwelling units.

2. The project will blend the building scale and set back with existing developments that are consistent with these guidelines. Street facing walls that are greater than 50 feet in length must be articulated at least each 25 feet with bays, projections, or recesses. Articulation means a difference in the vertical plane of the building of at least 18 inches or more.

   The project intends to incorporate façade articulation at street-facing walls, both vertically and horizontally with bays, projections, recesses, or material changes. The specific dimensions of articulation will be defined in the final development plan.

3. Buildings adjacent to the street will be situated on the site to provide pedestrian access to the street. Additional interior lot buildings may be oriented toward parking lots or public/common open space. Buildings adjacent to the street shall not have parking lots located between the building and the street. Corner lots may have parking on one street face. Interior areas of parking and vehicular use areas shall contain planting islands every 20 contiguous parking spaces whether double staked or linear. The size of the planting island shall be the equivalent area of one parking space. This shall be used toward satisfying the 5% interior landscaping requirements.

   The project intends to be sensitive to the existing trees and added landscape plantings will be provided to soften the visual impact of paved parking. Existing trees will also be "saved" where reasonably possible and integrated into landscape islands and the parking layout configuration. A minimum of 5% interior landscaping will be provided and configured to incorporate existing trees where it is reasonably feasible.

4. The project will avoid blank walls along pedestrian circulation areas. Facades that face streets or connecting pedestrian frontage that are greater than 25 feet in length shall be subdivided and proportioned using at least one or more of the following features; windows, entrances, arcades, arbors, awnings (over windows or doors), distributed along the façade at least once every 25 feet.

   The project intends to be sensitive to facades along pedestrian circulation areas. Facades shall be subdivided and proportioned using architectural articulation. The specific dimensions of articulation will be defined in the final development plan.

5. The project will avoid tearing down buildings that the Landmarks Board has determined to be historic or architecturally significant.

Provide a Good Circulation System:

1. The project will provide connectivity by including direct vehicular or access easements, pedestrian and bicycle connections between abutting or adjacent developments, including retail centers and bus stops, wherever possible.

2. The project will design streets to consider pedestrian safety and comfort (i.e. sidewalks, bump outs, crosswalks, street trees). All multi-family development site plans proposing multiple buildings shall connect building entrances to one another and to sidewalks on adjacent public and/or private streets via a minimum four (4) foot wide sidewalk separated from vehicular traffic by a four foot wide planting strip (the 4 foot planting strip does not apply to parking lots where the sidewalk is intended to provide access to the parking lot). Public sidewalks may be considered part of the walkway system if they provide convenient movement between structures. Fences, landscaping and other site improvements shall be located so as not to impede safe and convenient pedestrian circulation. On-site sidewalks shall be designed to connect to off-site sidewalks on adjoining properties and public and/or private streets. Sidewalks shall connect parking areas or parking structures that serve the principal multi-family building; community amenities, such as swimming pools, community centers, other recreational facilities, or common open space; and sub-community facilities intended to serve the particular multi-family building, such as mail centers or bike racks.

3. Each multi-family development shall provide pedestrian and bicycle connections to adjacent existing or proposed parks, greenways, bikeways, and trails wherever practical.

4. Provide shared driveways**,** cross access driveways and/or other forms of connectivity and secondary access to existing or future adjacent developments.

   The project intends to provide cross access driveways at both the north adjacent property fronting on Lone Pine, as well as the south adjacent property.

5. Ensure that collector streets align with existing collector streets at thoroughfare intersections to promote safer crossings for pedestrians, cyclists and automobiles.

6. When internal streets are proposed or required design developments around an internal street system with at least one primary street that functions as the vehicular and pedestrian spine of the development:
   a. Include parallel parking, street trees and sidewalks on the primary street(s). (Parking should not be located between the curb and buildings along the street.)

The project will provide street trees by preserving existing trees along the primary internal street. The project will provide pedestrian connectivity through the site. The specific details of pedestrian connectivity will be defined in the Final Development Plan.

b. Provide driveways or secondary streets to function as the main connection between parking lots and the primary street(s).

c. Provide sidewalks on secondary streets, even if they are private streets.

The project will provide pedestrian connectivity through the site. The specific details of pedestrian connectivity will be defined in the Final Development Plan. Due to the "natural environment" design criteria, and intent to preserve as much of the natural environment, secondary streets will not have sidewalks, but pathways will be incorporated to connect site uses to meet the needed pedestrian access.

Respect the Natural Environment:

1. The project will provide a meaningful amount of useable and accessible recreational area/facility. Each multi-family development shall include at least 15% of the total site or premise as a usable recreational area and/or facility. Usable recreational area/facility is defined as an open recreational area or recreational facility which are designed and intended to be used for outdoor living and/or recreation, and/or amenity. Usable open recreational areas shall not include land occupied by buildings, structures, streets, sidewalks, driveways, or parking areas but may include outdoor recreational facilities such as walkways used solely for recreational purposes/connections, swimming pools, sports courts, clubhouse, community center, exercise room or other amenities as defined in these guidelines. The 15% usable recreational area or facility does not reduce the required 20% open space. All common open recreational areas on the site, including recreational facilities, shall be readily accessible to all occupants and should, wherever possible, be physically connected to other common open space areas on and off the site. Generally, usable open recreational areas should have a minimum dimension of thirty (30) feet in any direction and minimum area of nine hundred (900) square feet; however, it is recognized that open recreational areas can be of a smaller minimum dimension or area provided it meets the definition. The usable open recreational area required shall be generally contiguous and moderately level, with an overall gradient not exceeding ten (10%) percent.

2. The project will incorporate functional amenities, in the open space and recreational areas. Multifamily development site shall incorporate recreational amenities or facilities from the list below in the following amounts: Multi-family development site with 20 to 50 dwelling units: 1 amenity; Multi-family development sites with 51 to 100 dwelling units: 2 amenities; and Multi-family development sites with more than 100 dwelling units: 3 amenities. There must be at least two (2) different amenities used for Multi-family development sites with more than 100 units. Allowable recreational amenities:
    a. Swimming pool
    b. Golf course

c. Resident clubhouse
d. One tot lot with a minimum size of nine hundred square feet (900') per tot lot area;
e. Basketball, volleyball, tennis court, handball court or other sports court.
f. One (1) picnic area, with a minimum size of nine-hundred square feet (900') per area, and including a minimum of one (1) picnic table and one (1) barbeque grill/pits per picnic area;
g. Community center (meeting room, assembly hall, etc.);
h. Exercise room and/or recreation building;
i. Par 3 golf course (9 hole minimum);
j. Any proposed amenity found by the City Council to provide recreation or meet the needs of the multi-family development residents to a level similar to that provided by the above

3. The project will address the preservation of steep slopes along perennial streams or adjacent to significant natural landscape features in site plan submittals.
A tree six inches or greater in diameter measured 4 1/2 feet above ground must be preserved or replaced with a tree of at least two inches (2") in diameter—for a maximum total of 7 trees per acre. Trees meeting the landscape requirements in the zoning ordinance may be counted toward this requirement. A tree survey site plan must be submitted with a zoning application in order to assess this requirement. The life of all planted or saved trees shall be guaranteed and maintained for a period of 5 years or shall be replaced with an equal diameter tree. If this is not possible then the total diameter of trees at the time they are lost shall be replaced with an equal diameter amount of trees with no less than 2" in diameter throughout the project area

The project intends to minimize the impact on the existing natural environment. Trees have been surveyed and documented. Houses, buildings and roads are planned to preserve trees where feasible and possible. Common open areas are planned around the core of the residential development and linked to the commercial and mixed use development areas with paths and trails. Additional trees, native plants and shrubs will be incorporated to augment the removal of such needed by the new construction.

Section 5.9 Density Bonus

A density bonus is allowed if a development has met the minimum matrix points for a specified density, at least half the design guidelines are met, and will not exceed 40 dwelling units per acre (du/ac). The total additional bonus dwelling units are as follows;

4. Mixed Use Developments: Mixed Use developments that contain an equal amount or greater total square footage of residential to non-residential are allowed an increase of 3 dwelling units per acre. Mixed Use developments that contain 50% or more non-residential square footage as residential square footage are allowed an increase of 2 dwelling units per acre.

5. Green Building: An increase of 1 du/ac for Certified, 1.5 du/ac for Silver, 2 du/ac for Gold and 2.5 du/ac for Platinum as defined by the "Leadership in Energy and Environmental Design" (LEED) Green Building Rating System or similar nationally recognized program as approved by the

Planning and Zoning Commission and City Council. An increase of 0.50 du/ac for a rating between 1-50, 1.0 du/ac for a rating between 51-74 and 1.25 du/ac for a rating between 75-100 for EPA Energy Star. An increase of 0.25 du/ac for Bronze, 0.5 du/ac for Silver and 1.0 du/ac for Gold rating of the National Association of Home Builders Green Building Guidelines (see EPA Energy Star and NAHB Green Building guidelines for more information).

The project will have up to 102 multi-family and 22 single family dwelling units or 124 units on 10.85 acres which equates to 11.42 du/ac. The project will not exceed 12 du/ac. The project will pursue LEED Silver rating. Pursuant to Section 5.9 Density Bonus, the project is eligible for up to 2 du/ac per Item 5.9.4, and up to an additional 1.5 du/ac for item 5.9.5.

I. OPEN SPACE, LANDSCAPING & SCREENING

1. Required Bufferyards.

   Tract A: No perimeter landscaping or buffer yards required

   Tract B: No perimeter landscaping or buffer yards required.

   Tract C: No perimeter landscaping is required. No bufferyards are required between on-site multi-family residential, office or self storage uses. A 10' foot wide Type C Bufferyard is required on the east side of the subject property adjacent to property zoned PD and R-SF per the site plan.

2. Vehicular use area open space.

   a. Perimeter – no perimeter landscaping is required. The intent of the development is to provide connections to the existing sidewalk system. This will enable outside patios, eating areas and entertainment areas to be close to the street.

   b. Interior – the development shall provide 5% interior green space in parking areas per the zoning ordinance requirements.

3. Open space.

The overall development shall provide a minimum of 30% open space.

4. Screening.

Screening shall be provided in accordance with the zoning ordinance.

5. Water Quality:

Water quality shall be provided in accordance with the City's proposed Chapter 10 Water quality Design guidelines. These guidelines are attached. The City will

allow impervious area from this PD to discharge without water quality if the same amount of impervious area that is coming onto us treated. Specifically water quality can be provided in the residential Tract B area and can treat water from the adjoining trailer park.

6. Detention:

The site discharges directly into a flood plain. Therefore, detention will be bought out and the proceeds will be used to construct a storm pipe under Lone Pine and the Rail Road which will serve this development and the surrounding area.

J. EXTERIOR LIGHTING

The requirements and standards of the *Springfield Zoning Ordinance*, in effect at the time of development shall apply.

K. ACCESS TO PUBLIC THOROUGHFARES

Access to the public street system shown on Exhibit 2 shall be governed by the existing standards of the City of Springfield for the applicable street classification.

L. OFF-STREET PARKING

*T*he *Springfield Zoning Ordinance* in effect at the time of development shall apply. Three exceptions shall be provided to the requirements in the zoning ordinance.

1) Offsite parking may be provided within ½ mile of the site with a cooperative parking agreement.

2) Parking adjacent to Lone Pine Avenue and Allen Drive are permitted as shown on Exhibit 2. The actual parking stalls are not in the right of way.

3) The development is permitted to reduce the overall parking by 10% per the standard bicycle parking reduction provided in the zoning ordinance. The development is also permitted to reduce the overall parking requirements by and additional 10%. This additional 10% reduction is provided to account for mixed uses on site, high pedestrian/bicycle volume due to the green way trail and high adjoining residential foot traffic from on site and the adjoining properties.

M. SIGNS

The *Springfield Zoning Ordinance*, in effect at the time of development shall apply.

N. REQUIRED IMPROVEMENTS

1) One left turn lane for the North entrance will be provided into the property in accordance with the traffic study.

2) A box culvert is required to convey the stormwater from this development to the creek on the West side of the BNSF railroad tracks.

3) Allen Drive must be overlayed with 1-1/2 inches of asphalt from Lone Pine Avenue to the development drive. Allen Drive must be widened to meet parking space standards based on ST-6 standards. This improvement is required when the development takes access to Allen Drive.

O. MAINTENANCE OF COMMON AREAS AND FACILITIES

The maintenance of common areas and facilities within the District shall remain the responsibility of the developer(s) or shall be assumed by a duly constituted property owners association meeting all legal requirements prescribed by the City Attorney. Maintenance of the Lone Pine median vegetation shall be provided by this development.

P. PHASING

A left turn lane on Lone Pine for the North entrance shall be provided prior to obtaining any occupancy permits.

Q. FINAL DEVELOPMENT PLAN

A final development plan, showing conformance with the requirements of this Exhibit, shall be submitted to the Planning and Development Department and approved in the manner described below prior to the issuance of any building permits or prior to the commencement of any of the permitted uses. The final development plan may be submitted in the form of a preliminary plat, provided the plat is prepared in accordance with the requirements, standards, and intent of this Exhibit. Development of this District shall be in accordance with the approved final development plan.

1. The intent of Exhibit 2 is to provide a schematic circulation system and general use guidelines. A final development plan shall be submitted to the ARC to determine conformance with Exhibits 1 and 2 and shall be approved if it is in substantial conformance as defined by 36-405 of the Springfield Zoning Ordinance. If the final development plan is not in substantial conformance than it shall be submitted to the Planning and Zoning Commission for review and recommendation to the City Council for final action, either as a whole or in phases. The Planning and Zoning Commission is hereby authorized, at its discretion, to approve minor adjustments and modifications to the site plan. Such authority shall not, however, be construed to permit:

    A. Any uses within the District other than those specifically prescribed by

the ordinance.

B. Any increase in the intensity of use permitted within the District.

C. Any changes to landscaping and bufferyards.

PLANNED DEVELOPMENT 351 EXHIBIT 2
GALLOWAY VILLAGE
4018 S. LONE PINE AVE.
SPRINGFIELD, GREENE COUNTY, MISSOURI

60 0 30 60 120
(IN FEET)
1 inch = 60 ft.

NOTES:

ALL UTILITIES TO BE PROVIDED BY:
CITY UTILITIES OF SPRINGFIELD
301 E. CENTRAL
SPRINGFIELD, MO 65802
(417)863-9000

TOTAL AREA OF PROPERTY: 10.85 ACRES
MINIMUM OPEN SPACE REQUIRED: 30%
MAXIMUM IMPERVIOUS SURFACE ALLOWED: 70%
PARKING REQUIREMENTS PER ZONING ORDINANCE

TRACT A: GENERAL RETAIL USES

MAXIMUM – 15,000 S.F. RETAIL OF WHICH 7,000 CAN BE RESTAURANTS
MAXIMUM – 13,000 S.F. OFFICE OR
MAXIMUM – 13,000 S.F. RESIDENTIAL
BUILDING HEIGHT: MAXIMUM – 3 STORY
PARKING:

OFFICE	1 SP/350 SF	= 24
RETAIL	1 SP/200 SF	= 30
RESTAURANT	1 SP/80 SF	= 88
RESIDENTIAL	2–4BR 2 SP/UNIT	= 4
TOTAL		= 146
LESS 10% ALLOWED BICYCLE REDUCTION		15
LESS 10% REDUCTION PER PD		15
REQUIRE		116

126 PARKING SPACES PROPOSED

TRACT B: RESIDENTIAL SINGLE FAMILY USES

MAXIMUM – 22 SINGLE FAMILY UNITS OR
BUILDING HEIGHT: MAXIMUM – 2 STORY

RESIDENTIAL 2/UNIT = 44

44 PARKING SPACES PROVIDED BY 2–CAR GARAGE AT EACH RESIDENCE.

LOCATION OF RESIDENTIAL UNITS IS APPROXIMATE AND MAY CHANGE WITH FINAL DESIGN.

TRACT C: RESIDENTIAL MEDIUM DENSITY USES

MAXIMUM – 100 MULTI–FAMILY RESIDENTIAL UNITS (MIXTURE OF 1, 2, AND 3 BEDROOM UNITS)
MAXIMUM – 10,000 S.F. SELF SERVICE STORAGE SPACE
MAXIMUM – 10,000 S.F. OFFICE SPACE (OFFICE SPACE CAN BE SUBSTITUTED FOR THE RESIDENTIAL UNITS BASED ON PARKING REQUIREMENTS).
BUILDING HEIGHT: MAXIMUM – 3 STORY
PARKING:

2–4 BR UNITS	2 SP/UNIT * 56 UNITS+1.5 SP/UNIT * 38 UNITS	= 169
2 FOR SELF–SERVE STORAGE		= 2
TOTAL		171
LESS 10% ALLOWED BICYCLE REDUCTION		17
LESS 10% REDUCTION PER PD		17
REQUIRE		137

137 PARKING SPACES PROPOSED

GENERAL NOTES:

THIS PD EXHIBIT 2 IS INTENDED TO MEET PD GUIDELINES FOR A FINAL DEVELOPMENT PLAN SUBMITTED ADMINISTRATIVELY.

A TEN FOOT BUFFER ZONE IS REQUIRED BETWEEN TRACT C AND THE PROPERTIES OWNED BY BARRET–FISK AND SEQUIOTA. NO OTHER BUFFERS REQUIRED.

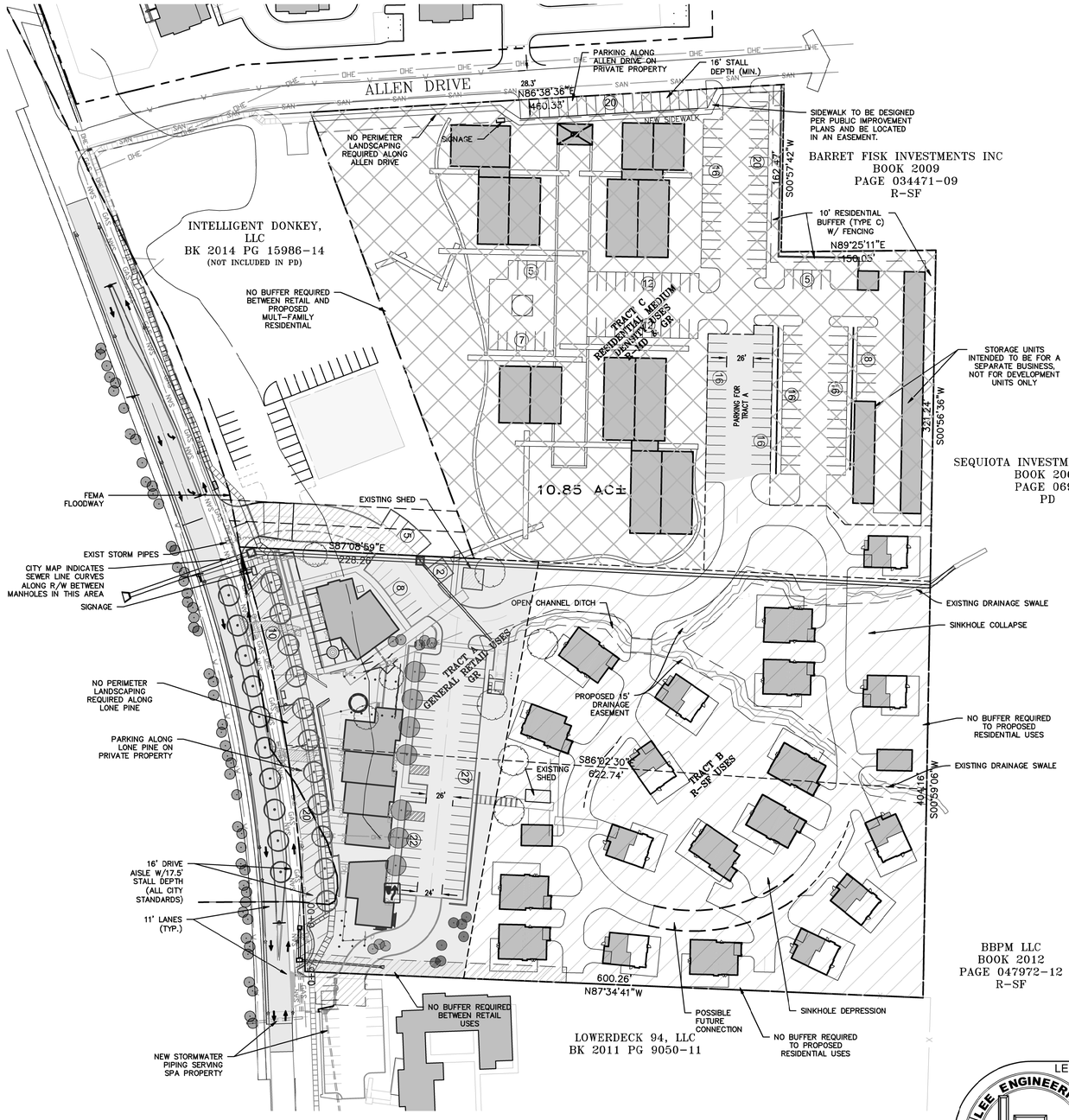
IMPERVIOUS AREA SHALL NOT EXCEED 70% OF DEVELOPMENT.

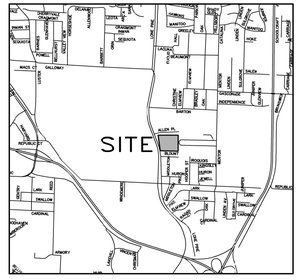
DETENTION & WATER QUALITY NOTES:

DETENTION WILL BE BOUGHT OUT AT THE TIME OF DEVELOPMENT.

WATER QUALITY WILL BE PROVIDED VIA A LID DESIGN AND TREATMENT OF THE SEQUIOTA INVESTMENTS PROPERTY IMPERVIOUS AREA IN LIEU OF GALLAGOWAY VILLAGE IMPERVIOUS AREA.

MISSOURI ONE CALL SYSTEM INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!





VICINITY MAP
NOT TO SCALE

LEGEND

- FOUND IRON PIN (¾" IP UNLESS NOTED)
- SET ⅝" IRON PIN "LSC 2009028050"
- R/W MARKER
- BOUNDARY LINE
- R/W LINE
- EASEMENT LINE
- SETBACK LINE
- (M) MEASURED
- (P) PLAT
- (D) DEED
- (R) RECORD
- LIGHT POLE
- SANITARY SEWER MANHOLE
- SANITARY SEWER CLEANOUT
- SAN — SANITARY SEWER LINE
- UTILITY POLE
- ELECTRIC METER
- OHE — OVERHEAD ELECTRIC
- UGE — UNDERGROUND ELECTRIC
- GUY WIRE
- TELEPHONE/COMMUNICATION MANHOLE
- TELEPHONE PEDESTAL
- CABLE TV RISER
- CATV — CABLE TV LINE
- PHONE — PHONE/COMMUNICATION LINE
- F/O — FIBER OPTIC LINE
- WV — WATER VALVE
- WATER METER
- W — WATER LINE
- FIRE HYDRANT
- GV — GAS VALVE
- GAS METER
- GAS — GAS LINE
- FENCE LINE (AS NOTED)
- ROAD SIGN (STOP, SPEED LIMIT, ETC)

ABBREVIATIONS:

XFMR	TRANSFORMER
ICV	IRRIGATION CONTROL VALVE
CI	STORMWATER CURB INLET

LEE Engineering & Associates, L.L.C.
1200 E. Woodhurst, Suite D200
Springfield, MO 65804
417-886-9100 (phone)
417-886-9336 (fax)
Missouri State Certificate of Authority Engineering #2005015504 Land Surveying #2009028050
dlee@leeengineering.biz
"Engineering with Integrity"

DWG: 536 – Lone Pine PD Sketch Plan 3.dwg
DATE: 05/27/2016
PROJECT NO.: 536

PD 351 EXHIBIT 2
GALLOWAY VILLAGE

4018 S. LONE PINE AVE.
SPRINGFIELD, GREENE COUNTY, MISSOURI

SURVEY BY		DESIGN LEE	SCALES	SHEET 1
FIELD BK		DRAWN RRS	HOR. 1"=60'	OF 1 SHEETS
LEVEL BK		CHECKED LEE	VERT. N/A	FILE NO.

Chapter 10 Water Quality

Table of Contents

1.0 Introduction

Photo 1. Jordan Creek in Springfield, MO.

The potential adverse effects of urban runoff on the physical, chemical, and biological characteristics of receiving waters have been widely documented (NRC, 2008; WEF/ASCE, 1992, 1998; Debo and Reese, 2002; Horner, et al., 1994; Schueler and Holland, 2000). As urbanization occurs, the removal of vegetation, compaction of soils, and addition of impervious surfaces significantly increases the volume of stormwater runoff. Industrial, commercial, and residential sources of pollution also become prevalent with urbanization. Urban runoff picks up pollutants from lawns, streets, parking lots, and industrial and commercial operations. Traditional storm water management focused on moving water away from people, structures, and transportation systems as quickly and efficiently as feasible. This was accomplished by creating conveyance networks of roof drains, street inlets, pipes, and concrete channels, which concentrated runoff discharges to receiving waters. Some of the consequences of this traditional approach on receiving waters include:

- Increased pollutant concentrations and loads, which impact water quality for recreation, drinking water supply, aquatic life protection, and other beneficial uses;
- Stream channel widening and instability, increasing risk of damage to adjacent property and structures;
- Habitat degradation and ecosystem disruption associated with streambed and bank erosion, changes in stream flow, and reduction of both aquatic and terrestrial physical habitats.

Because of the adverse consequences of this traditional approach, storm water management has evolved over the past several decades to focus on minimizing runoff and managing it near the source to address hydrologic and water quality effects of smaller, more frequently occurring events while also providing detention storage to attenuate peak runoff rates from larger events. Smaller, more frequently occurring events carry the bulk of the storm water pollutant load to receiving waters and have the most significant effects on stream stability and geomorphology. Site planning that minimizes disturbance and impervious cover, and preserves soils, vegetation, steep slopes, and natural drainageways is an integral first step in this modern approach of minimizing runoff and managing it near the source. Following site planning, stormwater control measures (SCMs)[1] are designed to manage runoff near the source through infiltration, evapotranspiration, treatment, and harvesting for use (irrigation, toilet-flushing, etc.). Representative practices include rain gardens,

[1] A note on terminology: SCM refers to both non-structural measures (such as preservation of natural areas) and structural controls to manage the quantity and quality of stormwater runoff from development, including SCMs that provide runoff reduction and water quality treatment as well as detention to control peak flows. SCM is used with this meaning in City Code Chapter 96. Nationally, SCM has begun to replace the term Best Management Practice (BMP) when referring to permanent, post-construction practices that provide runoff reduction and water quality treatment. BMP is still commonly used to refer to erosion and sediment controls and other construction site practices to manage runoff of pollutants during construction.

pervious pavement, and vegetated swales, often referred to as Green Infrastructure (GI). This stormwater management approach of preserving natural site hydrology and managing runoff close to its source through the use of GI is called Low Impact Development (LID). It can reduce the volume of storm water runoff that must be managed by the flood control detention and conveyance components of the stormwater drainage system.

This chapter provides design criteria, principles, and standards to protect the health, safety, and welfare of the public through stormwater management that reduces the harmful effects of urban runoff on area waterways and enhances the livability of the community. This chapter focuses on the following objectives:

- Compliance with federal and state requirements under the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) program. The City of Springfield (City) is regulated under this program through its MS4 permit which mandates the City to have criteria and requirements in place to reduce the discharge of pollutants to the MS4 to the Maximum Extent Practicable (MEP) by addressing the post-construction water quality impacts of stormwater runoff from new development and redevelopment.
- Design criteria to most effectively protect water quality by focusing on small, frequently occurring storm events and encouraging a treatment train approach to provide multiple treatment processes and runoff reduction.
- Site planning and design that minimizes and disconnects impervious surfaces and considers preservation of vegetation, soils, natural topography, natural channels, and karst features.
- Design standards for green infrastructure that provides multiple environmental, social, and economic benefits.

In developing this chapter, the following design manuals from other communities were referenced and adapted based on local conditions and experience. Designers may find these resources useful.

- Urban Drainage and Flood Control District (Denver, Colorado) Urban Storm Drainage Criteria Manual Volume 3
- Metropolitan St. Louis Sewer District BMP Toolbox
- American Public Works Association/Mid-America Regional Council (Kansas City, Missouri) Manual of Best Management Practices for Stormwater Quality
- Metro Government of Nashville & Davidson County, Tennessee Stormwater Management Manual
- Minnesota Stormwater Manual

2.0 Water Quality Design Criteria

The water quality design criteria herein apply to new development and redevelopment projects within the city limits of Springfield that disturb 1 acre or greater, including projects less than 1 acre that are part of a larger common plan of development or sale that will disturb 1 or more acres over

the life of the project[2]. Redevelopment means projects that alter the "footprint" of an existing site or building in such a way that there is a disturbance of land. On redevelopment, existing impervious area that is not removed and reconstructed is exempt from the water quality design criteria. For example, overlay of an existing parking lot is exempt but complete removal and reconstruction of an existing parking lot is not exempt. The applicability of the water quality design criteria is based on the City's MS4 permit post-construction program requirements.

New development and redevelopment sites that disturb less than 1 acre and are not part of a larger common plan of development or sale that will disturb 1 or more acres over the life of the project are not required to meet the water quality design criteria herein. However, these small sites are encouraged to implement site design and SCMs that provide some level of water quality treatment and runoff reduction. Often, this can be done through simple site design approaches that minimize directly connected impervious area, such as directing downspouts to grass areas and utilizing flush curbs or curb cuts to allow parking lot runoff to flow into adjacent vegetated areas. Small sites may have detention or landscape requirements that could be designed as dual purpose water quality SCMs, such as parking lot landscape islands designed as rain gardens.

2.1 Water Quality Volume

Storm water systems designed for flood control are typically designed for large, infrequent storm events. In contrast, storm water controls to protect water quality are designed for small, frequent storm events. In Springfield, approximately 90 percent of all rainfall events are 1 inch or less. Studies indicate that most pollutants are washed off in the "first flush," of these small, frequent storms. Therefore, the Water Quality Volume (WQV) is based on the runoff from a 1 inch rainfall. The WQV must be captured using properly designed, approved SCMs that reduce the discharge of pollutants through treatment or runoff reduction.

Two methods can be used to calculate the WQV - the Short Cut Method and the Small Storm Hydrology Method. According to Claytor and Schueler (1996), these methods are more accurate than other methods for calculating runoff volumes from small storms on urban sites. Use of these methods is also consistent with other Missouri communities. The designer may choose to calculate the WQV using either method. **See Section 3.0 for credits that can be applied when calculating the WQV.**

Short Cut Method - The Short Cut Method (Claytor and Schueler, 1996) is based on the relationship of percent impervious cover and runoff volume. Percent impervious cover should be based on measurement of impervious cover for the site. Where measurement of impervious cover for the site is impractical, the impervious cover should be estimated based on maximum impervious area

[2] The U.S. Environmental Protection Agency provides the following explanation of "larger common plan of development or sale" on their website. "A 'larger common plan of development or sale' is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. For example, if a developer buys a 20-acre lot and builds roads, installs pipes, and runs electricity with the intention of constructing homes or other structures sometime in the future, this would be considered a larger common plan of development or sale. If the land is parceled off or sold, and construction occurs on plots that are less than one acre by separate, independent builders, this activity still would be subject to stormwater permitting requirements if the smaller plots were included on the original site plan…"

per lot allowed by zoning, percent impervious cover of right-of-ways, and other site design factors. The Short Cut Method uses the following equation to calculate the WQV.

$$WQV\ (ft^3) = (P/12)(Rv)(A*43{,}560)$$

Where

P = rainfall depth = 1 inch
Rv = volumetric runoff coefficient = 0.05 + 0.009I
I = percent impervious cover (in percent, e.g. 80% = 80)
A = total site area in acres

Small Storm Hydrology Method - The Small Storm Hydrology Method (Claytor and Schueler, 1996) computes an Rv based on the specific characteristics of the pervious and impervious surfaces of the drainage area. Rv's to be used for each cover type are provided in Table 2. The Small Storm Hydrology Method uses the following equation to calculate the WQV.

$$WQV\ (ft^3) = (P/12)(\text{weighted Rv})(A*43{,}560)$$

Where

P = rainfall depth = 1 inch
Weighted Rv = $[(Rv_1*A_1)+(Rv_2*A_2)+...(Rv_i*A_i)]/A$
Rv_i = volumetric runoff coefficient for cover type *i*
A_i = area of cover type *i* in acres
A = total site area in acres

Table 1. Volumetric runoff coefficients for urban runoff from directly connected impervious areas for a 1 inch rainfall (Claytor and Schueler, 1996; Hirschman, et al., 2008)

Flat roofs and large unpaved parking lots	Pitched roofs and large impervious areas (large parking lots)	Small impervious areas and narrow streets	Urban pervious areas		Forest cover		
			Hydrologic Soil Group B	Hydrologic Soil Groups C & D	Hydrologic Soil Group B	Hydrologic Soil Group C	Hydrologic Soil Group D
0.84	0.97	0.7	0.11	0.21	0.03	0.04	0.05

2.2 Designing for Runoff Reduction and Targeted Pollutants

Development significantly increases the volume of runoff compared to pre-development conditions, contributing to increased pollutant loads and hydrologic stream impacts including erosion and aquatic habitat degradation. To address these impacts, consideration should be given to runoff reduction during site design and SCM selection and design. This can be accomplished through site planning and design techniques such as tree preservation and planting, natural area conservation, and minimizing grading and impervious surfaces, all of which contribute to runoff reduction. SCM selection and design can incorporate moderate to high performing runoff reduction SCMs and/or

use a treatment train approach of more conventional SCMs such as vegetated filter strips, grass channels, and extended detention in series. The runoff reduction and pollutant removal performance of SCMs in series is greater than their use as stand-alone practices. Table 2 gives typical runoff reduction percentages for SCMs. Volume reduction also has economic benefits, including potential reductions in storage requirements for minor and major events, reduced extent and sizing of conveyance infrastructure, and cost reductions associated with addressing channel stability issues. See Sections 5.5 and 5.6 for additional information on runoff volume reduction and the treatment train approach.

SCMs vary in their pollutant removal efficiencies for various pollutants. The majority of Springfield drains to the James River which is categorized as impaired by the Missouri Department of Natural Resources due to excess nutrients that cause algae blooms and reduced water clarity, affecting recreation and other beneficial uses. SCMs for developments in the James River watershed shall be selected and designed to reduce the discharge of nutrients as well as sediment, which is often a carrier of nutrients. The north side of Springfield drains to the Little Sac River which is impaired due to bacteria. SCMs for developments in the Little Sac watershed shall be selected and designed to reduce the discharge of bacteria. In addition to these watershed-specific pollutants, SCM selection and design should also target pollutants specific to the development such as metals associated with industrial facilities. Table 3 gives the typical effectiveness of SCMs for targeted pollutants. See Section 5.3 for additional information about pollutant removal processes.

Table 2. Typical Runoff Reduction Percentages for SCMs (Adapted from Hirschman, et al., 2008)

SCM	Runoff Reduction
Vegetated Filter Strip	
Natural Area	50-75%
Lawn/landscaping (with compost amended soil)	50%
Grass Channel (meeting minimum residence time)	20%
Permeable/Pervious Pavement	
Full Infiltration (no underdrain)	75%
Partial Infiltration (perched underdrain)	45%
No Infiltration (impermeable liner)	0%
Bioretention (Rain Garden)	
Full Infiltration (no underdrain)	80%
Partial Infiltration (perched underdrain)	50%
No Infiltration (impermeable liner)	0%
Extended Detention Basin	15%
Retention Pond	0%
Constructed Wetland Pond	0%
Green Roof	45-60%
Underground/Proprietary SCMs	Based on site specific design
Rainwater Harvesting	40%; May be higher based on site specific design
Natural Area Conservation	% based on calculated WQV credit (see Section 3.1.1)
Natural Area Restoration	% based on calculated WQV credit (see Section 3.1.2)
Tree Preservation	% based on calculated WQV credit (see Section 3.1.3)
Tree Planting	% based on calculated WQV credit (See Section 3.1.3)

Table 3. Typical Effectiveness of SCMs for Targeted Pollutants (Source: UDFCD, 2010)

SCM	Sediment/Solids	Nutrients	Total Metals	Bacteria
Vegetated Filter Strip	Good	Moderate	Good	Poor
Grass Channel	Good	Moderate	Good	Poor
Permeable/Pervious Pavement	Very Good[1]	Good	Good	Unknown
Bioretention (Rain Garden) and Bioswale	Very Good	Moderate	Good	Moderate
Extended Detention Basin	Good	Moderate	Moderate	Poor
Retention Pond	Very Good	Moderate	Moderate	Moderate
Constructed Wetland Pond	Unknown	Unknown	Unknown	
Green Roof[2]	Unknown	Unknown	Unknown	Unknown
Underground/Proprietary SCMs	Variable	Variable	Variable	Variable

[1]Not recommended for drainage areas with high sediment yield (unless pretreatment is provided. [2]Water quality data for green roofs are not yet robust enough to provide meaningful conclusions about pollutant removal. By reducing volume, green roofs have the de facto capability to reduce pollutant loads; however, on a concentration basis, more data is needed to better define effectiveness.

2.3 Water Quality Design Criteria in Floodplains

When developing in or near a floodplain, the bottom of the water quality SCM must be a minimum of 1 foot above the 1-year flood elevation.

3.0 Site Planning and Design Credits

In order to encourage LID site planning and design approaches that preserve and restore natural areas and trees, disconnect impervious surfaces, and utilize vegetated channels rather than pipes or concrete channels for conveyance, the following credits can be used to reduce or meet the WQV.

3.1.1 Natural Area Conservation Credit

A WQV credit can be given for conserving natural areas on a development site, thereby retaining pre-development hydrologic and water quality characteristics. Natural areas include woods or other undisturbed open space that does not have managed turf, including floodplains and stream buffers. Previously disturbed areas are subject to staff review to determine if they qualify as a natural area in their current condition or if restoration would be needed to receive credit under Section 3.1.2. Under the credit, the conserved natural area can be subtracted from total site area when computing the WQV. The Rv is still calculated based on the percent impervious cover for the entire site (Short Cut Method) or based on a weighted Rv that includes the natural area (Small Storm Hydrology Method). An added incentive is that the hydrologic soil group for the conserved area will not have to be adjusted up one level (e.g. from C to D) for calculation of detention volume since the area is not being disturbed. To receive the natural area conservation credit, the following criteria shall be met:

- The natural area shall not be disturbed during or after project construction (e.g. cleared or graded) except for temporary impacts associated with incidental utility work with proper tree protection in place, and forest management activities such as selective cutting to improve forest health.

- The natural area shall be protected by having the limits of disturbance clearly shown on all construction drawings and staked and protected in the field except as provided for above.
- The natural area shall be delineated and included in the approved long-term operation and maintenance plan and agreement required for all SCMs and filed with the Greene County Recorder of Deeds.

Example: A 5 acre site with 3.25 acres of impervious cover (65% impervious composed of pitched roof and large impervious areas), 0.75 acres of urban pervious area (C soil), and 1 acre of conserved forest cover (C soil). The designer may calculate the WQV using either the Short Cut Method or the Small Storm Hydrology Method. For example purposes, both are shown. The WQV is the lesser of the two volumes. In this example, the Short Cut Method produces the lesser volume.

Short Cut Method **(without credit):** WQV = (1/12)(Rv)(A*43,560) where
Rv = 0.05+0.009(65) = 0.64
A = 5 acres
WQV = (1/12)(0.64)(5*43,560) = 11,616 ft^3

Small Storm Hydrology Method **(without credit):** WQV = (1/12)(Rv)(A*43,560) where
Rv = [(0.97*3.25)+(0.21*0.75)+(0.04*1)]/5 = 0.67
A = 5 acres
WQV = (1/12)(0.67)(5*43,560) = 12,161 ft^3

Short Cut Method **(with credit):** WQV = (1/12)(Rv)(A*43,560) where
Rv = 0.05+0.009(65) = 0.64
A = 5 acres - 1 acre conserved area = 4 acres
WQV = (1/12)(0.64)(4*43,560) = 9,292 ft^3

Small Storm Hydrology Method **(with credit):** WQV = (1/12)(Rv)(A*43,560) where
Rv = [(0.97*3.25)+(0.21*0.75)+(0.04*1)]/5 = 0.67
A = 5 acres - 1 acre conserved area = 4 acres
WQV = (1/12)(0.67)(4*43,560) = 9,728 ft^3

3.1.2 Natural Area Restoration Credit

A WQV credit can be given for restoring a minimum contiguous area of 5,000 square feet of the development site as native prairie or urban forest. An area acceptable for restoration can be an area that is currently turf grass, has undergone past disturbance, or a previously developed area. Under the credit, the restored area can be subtracted from total site area when computing the WQV. The Rv is still calculated based on the percent impervious cover for the entire site (Short Cut Method) or based on a weighted Rv that includes the restored area as forest cover (Small Storm Hydrology Method). See the example in Section 3.1.1. An added incentive is that the hydrologic soil group for the restored area will not have to be adjusted up one level (e.g. from C to D) for

calculation of detention volume since the area will be considered undisturbed once restored. To receive the natural area restoration credit, the following criteria shall be met:

- The area shall be restored according to a plan prepared by a qualified landscape architect, licensed forester, or licensed arborist.
- The natural area shall be delineated and included in the approved long-term operation and maintenance plan and agreement required for all SCMs and filed with the Greene County Recorder of Deeds.

3.1.3 Tree Preservation and Planting Credits

Trees reduce runoff through interception, evapotranspiration, and increased infiltration. In recognition of the stormwater benefits of trees, the following volume reduction credits can be applied to the WQ. These credits are based on District of Columbia (2013).

- A volume of 20 ft^3 can be deducted from the WQV for each preserved tree. To receive the credit, preserved trees shall be identified by a licensed forester or arborist as healthy trees that are structurally sound with a minimum current size of 6 inches measured at 4.5 feet above ground level and with an average mature spread of at least 35 feet that can be adequately protected during construction to ensure long-term survival. The natural area conservation credit in Section 3.1.1 or the tree preservation credit can be taken for tree preservation in a given area, but not both.
- A volume of 10 ft^3 can be deducted from the WQV for each planted tree, including trees planted in SCMs such as rain gardens and the bottom of detention basins. No credit will be given for trees required to be planted to meet City Code Sec. 36-482 *Landscaping and Bufferyards* unless the required landscape area where the tree is located is designed as an SCM (e.g. a parking lot landscape island designed as a rain garden or a bufferyard designed as a downspout disconnection or a grass channel). The intent of the credit is to incentivize tree planting beyond zoning requirements and to incentivize the dual use of required landscape areas as SCMs. To receive the credit, planted trees shall have a minimum caliper size of 1.5 inches and an average mature spread of at least 35 feet, or if planted in an SCM in a required landscape area, the planted trees shall meet the criteria in City Code Sec. 36-482. The natural area restoration credit in Section 3.1.2 or the tree planting credit can be taken for tree planting in a given area, but not both.

3.1.4 Vegetated Filter Strip and Grass Channel Credits

SCMs can generally be categorized as conveyance-based versus storage based. Conveyance-based SCMs, which aren't designed based on a storage volume, include vegetated filter strips and grass channels. These simple approaches are an important part of an LID approach to site design and can be used to disconnect and convey runoff from roof downspouts, parking lots, and other impervious surfaces. This section specifies how conveyance-based SCMs can contribute toward meeting the WQV requirement. A vegetated filter strip meeting the full design criteria in Section 8.0 is considered to meet the WQV requirement. Vegetated filter strips can be used as stand-alone SCMs or in series with other SCMs when part of a larger site drainage area. When used in series with other SCMs, the WQV for the area draining to the vegetated filter strip can be subtracted from the

total WQV for the larger site drainage area. Partial credit can also be applied to the WQV for vegetated filter strips that do not meet the full length requirement and are used in series with other SCMs. The vegetated filter strip must be a minimum of 20 feet in length to receive partial credit. The intent of this partial credit is to encourage treatment train approaches that disconnect impervious surfaces. WQV credit is given based on the percentage of the required length provided. For example, the WQV can be reduced by 50% for the drainage area to a vegetated filter strip that is 50% of the required length (minimum 20 foot length). Grass channels are not considered a stand-alone SCM that meets the WQV requirement but can be used in series with other SCMs to reduce the WQV by 20% for the contributing drainage area when designed to meet the criteria in Section 9.0, including minimum residence time.

4.0 Water Quality Design Principles

This section contains fundamental design principles that should be followed when designing a site.

Principle 1: Consider stormwater early. Stormwater site planning and design should be considered early in the concept phase of a development. Site planning is a step that has typically received little attention from a stormwater design perspective. *Low Impact Development Design Strategies: An Integrated Design Approach* (Prince George's County, Maryland, 1999) is recommended as a comprehensive guide for site planning. When considered early, strategies to meet stormwater requirements through low-cost practices that minimize runoff (Principle 2) are most easily achieved and SCM design issues are minimized.

Principle 2: Minimize runoff. The impacts of hydromodification and the total quantity of pollutants transported to receiving waters can be reduced most effectively by minimizing the total runoff volume and the volume of directly connected runoff. This can be achieved by minimizing total and directly connected impervious area, preservation or restoration of trees, natural vegetation and soils, and use of SCMs that provide runoff reduction benefits. Impervious surfaces can be minimized through thoughtful layout that minimizes building footprints and unnecessary street/driveway lengths and parking lot area while still meeting codes. No disturbance zones can be specified in areas where clearing and grading is not necessary for infrastructure or buildings.

Principle 3: Maximize holding and settling time. The most effective SCMs reduce both the runoff peak and volume. By reducing the rate of outflow and increasing the time of detention storage, settling of pollutants and infiltration/evapotranspiration of runoff are maximized.

Principle 4: Maximize contact with vegetation. Contact with vegetation should be maximized to allow for treatment processes, evapotranspiration, and reduced flow velocities for settling of pollutants.

Principle 5: Utilize SCMs in series. Performance monitoring of SCMs throughout the country has shown that the combined effect of several SCMs in series (sometimes called a “treatment train”) can be more effective in reducing the level of pollutants than just providing a single SCM at the point of discharge. To the extent practicable, SCMs should be used in series. For example, a combination of

downspout disconnection, vegetated filter strips, grass channels, and extended detention could be used to reduce and treat the WQV.

Principle 6: Incorporate flood control, water quality, and landscape objectives in designs, where practical. Incorporating both flood control and water quality enhancement into a single storm water management facility (such as an extended detention basin or pervious pavement with subsurface storage) can work well on some sites (see Section 5.9 for more details). Water quality and landscape requirements can also be combined into a single, dual-purpose facility such as parking lot islands designed as rain gardens that meet landscaping requirements and water quality requirements. Combining several objectives maximizes the cost-effectiveness of storm water management facilities.

Principle 7: Use open channels for conveyance. Natural channels should be preserved when feasible, and stabilized if needed according to procedures in Chapter 8. Open, vegetated channels for site conveyance are preferred rather than enclosed or concrete lined channels and can be used to reduce or meet water quality requirements when properly designed. Stream buffer requirements must be met as specified in Chapter 8.

Principle 8: Protect karst features. Sinkholes, springs, caves, and other karst features require special protection to minimize groundwater contamination and instability. Buffer requirements must be met as specified in Chapter 11. Site design and SCM selection should focus on small-scale, distributed practices and sheet flow to avoid concentrating large volumes of runoff which can result in collapses in karst areas.

Principle 9: Design for industrial/high risk runoff and pollutant types. Site specific SCMs should be incorporated into sites with activities or materials that have the potential to discharge significant pollutant loads. Such sites are generally regulated under NPDES industrial stormwater permits and the location and type of potential pollutant sources should be considered during site design and selection of SCMs to aid in NPDES permit compliance. Site and building design should consider specific needs such as materials storage or operations that may require source controls and/or containment or treatment SCMs. Non-NPDES regulated sites may also have specific pollutant types of hot spots such as fueling stations that should be considered when selecting and designing SCMs. Infiltration SCMs such as pervious pavement or bioretention may not be appropriate for sites with higher concentrations of hydrocarbons, metals, or other toxics unless an impermeable liner is provided to design the SCM for filtration only.

5.0 SCM Selection and Design Considerations

The following are general considerations when selecting and designing SCMs. Additional considerations are included in each SCM section.

5.1 Physical Site Characteristics

Physical characteristics of a site should drive the site design and SCM selection, including topography, vegetation, soils, contributing drainage area, groundwater, baseflows, and karst. A fundamental concept of LID is preservation and protection of site features including wetlands,

drainageways, soils that are conducive to infiltration, tree canopy, etc., that provide water quality and other benefits. LID stormwater treatment systems are also designed to take advantage of these natural resources. For example, if a portion of a site is known to have soils with high permeability, this area may be well-suited for rain gardens or permeable pavement. The following are physical site characteristics that should be considered in SCM selection and design:

5.1.1 Soils

Soils with good permeability, most typically associated with Hydrologic Soil Groups (HSGs) A and B provide opportunities for infiltration of runoff and are well-suited for infiltration-based SCMs such as rain gardens, pervious pavement, and bioswales, often without the need for an underdrain system. Even when soil permeability is low, these types of SCMs may be feasible if soils are amended to increase permeability or if an underdrain system is used. In some cases, however, soils restrict the use of infiltration-based SCMs. When soils with moderate to high swell potential are present, infiltration should be avoided to minimize damage to adjacent structures due to water-induced swelling. In some cases, infiltration-based designs can still be used if an impermeable liner and underdrain system are included in the design; however, when the risk of damage to adjacent infrastructure is high, infiltration-based SCMs may not be appropriate. In all cases, consult with a geotechnical engineer when designing infiltration SCMs near structures. Consultation with a geotechnical engineer is necessary for evaluating the suitability of soils for different SCM types and establishing minimum distances between infiltration SCMs and structures.

5.1.2 Vegetation

Preservation of trees and natural vegetation are non-structural SCMs that should be considered during the concept phase of site layout and can reduce the WQV as well as be utilized as vegetated filter strips to meet the WQV requirement. Natural area restoration or reforestation is also an approved SCM that should be considered, especially for larger green space areas.

5.1.3 Topography

Steep slopes may prohibit the use of SCMs such as vegetated filter strips that require sheet flow. Bioswales and rain gardens can be designed for slopes by incorporating check dams. Minimizing disturbance of steep slopes should be considered in site design and can reduce grading and infrastructure costs as well as problems associated with managing flow and erosion.

5.1.4 Watershed Size

The contributing drainage area is an important consideration both on the site level and at the regional level. On the site level, there is a practical minimum size for certain SCMs, largely related to the ability to drain the WQV over the required drain time. For example, it is technically possible to size the WQV for an extended detention basin for a half-acre site; however, designing a functional outlet to release the WQV over a 24-hour drain time is practically impossible due to the very small orifices that would be required. For this size watershed, a rain garden would be more appropriate. At the other end of the spectrum, there must be a limit on the maximum drainage area for a regional facility to assure adequate treatment of rainfall events that may produce runoff from only a portion of the area draining to the SCM. If the overall drainage area is too large, events that produce runoff from only a portion of the contributing area will pass through the SCM outlet (sized for the full drainage area) without adequate residence time in the SCM.

5.1.5 Groundwater

Shallow groundwater on a site presents challenges for SCMs that rely on infiltration and for SCMs that are intended to be dry between storm events. Shallow groundwater may limit the ability to infiltrate runoff or result in unwanted groundwater storage in areas intended for storage of the WQV (e.g., porous sub-base of a permeable pavement system or in the bottom of an otherwise dry facility such as an extended detention basin). Conversely, for some types of SCMs such as constructed wetland basins, groundwater can be beneficial by providing saturation of the root zone and/or a source of baseflow. Groundwater quality protection is an issue that should be considered for infiltration-based SCMs. Infiltration SCMs may not be appropriate for land uses that involve storage or use of materials that have the potential to contaminate groundwater underlying a site (i.e., "hot spot" runoff from fueling stations, materials storage areas, etc.). If groundwater or soil contamination exists on a site and it will not be remediated or removed as a part of construction, it may be necessary to avoid infiltration-based SCMs or use an impermeable liner to prevent infiltration into contaminated areas.

5.1.6 Base Flows

Base flows are necessary for the success of some SCMs such as constructed wetland ponds and retention ponds. Without baseflows, these SCMs will become dry and unable to support wetland vegetation. For these SCMs, a hydrologic budget should be evaluated.

5.1.7 Karst

Disconnection of impervious surfaces with conveyance-based SCMs and small, distributed storage-based SCMs are preferred in karst areas to minimize the risk of collapses due to concentration of large volumes of water. The incidence of collapses is higher in detention basins than in other areas.

5.2 Space Constraints

Space constraints are frequently cited as feasibility issues for SCMs, especially for high-density development and redevelopment sites. In some cases, constraints due to space limitations arise because adequate space for SCMs is not considered early enough in the planning process. This is most common when a site plan for roads, structures, etc., is developed and SCMs are squeezed into the remaining spaces. The most effective and integrated SCM designs begin by determining areas of a site that are best suited for SCMs (e.g., natural low areas, areas with well-drained soils) and then designing the layout of roads, buildings, and other site features around the existing drainage and water quality resources of the site. Allocating a small amount of land to water quality infrastructure during early planning stages will result in better integration of water quality facilities with other site features. Often, green spaces can be dual purpose for meeting zoning green space/landscaping requirements and stormwater management.

5.3 Targeted Pollutants and SCM Processes

SCMs have the ability to remove pollutants from runoff through a variety of physical, chemical and biological processes. The processes associated with a SCM dictate which pollutants the SCM will be effective at controlling. Pollutant load reduction is also affected by hydrologic processes. In addition to pollutant removal capabilities, many SCMs offer channel stability benefits in the form of reduced runoff volume and/or reduced peak flow rates for frequently occurring events. The

International Stormwater BMP Database (www.bmpdatabase.org) provides SCM performance information that is updated periodically. Brief descriptions of several key processes are provided below and listed for each SCM in Table 4.

5.3.1 Hydrologic Processes

- **Flow Attenuation**: SCMs that capture and slowly release the WQV help to reduce peak discharges. In addition to slowing runoff, volume reduction may also be provided to varying extents in SCMs providing the WQV.
- **Infiltration:** SCMs that infiltrate runoff reduce both runoff peak and volume. The extent to which runoff volumes are reduced depends on a variety of factors such as whether the SCM is equipped with an underdrain and the characteristics and long-term condition of the infiltrating media. Examples of infiltrating SCMs include rain gardens and pervious pavements. Water quality treatment processes associated with infiltration can include filtration and sorption.
- **Evapotranspiration**: Runoff volumes can be reduced through the combined effects of evaporation and transpiration in vegetated SCMs. Plants extract water from soils in the root zone and transpire it to the atmosphere. Evapotranspiration is the hydrologic process provided by vegetated SCMs, whereas biological uptake may help to reduce pollutants in runoff.

5.3.2 Pollutant Removal/Treatment Processes

- **Sedimentation:** Gravitational separation of particulates from urban runoff, or sedimentation, is a key treatment process of SCMs that capture and slowly release runoff. Smaller particles under 60 microns in size (fine silts and clays) (Stahre and Urbonas, 1990) can account for approximately 80% of the metals attached or adsorbed along with other contaminants in stormwater and can require long periods of time to settle out of suspension. Extended detention allows smaller particles to agglomerate into larger ones (Randall et al, 1982), and for some of the dissolved and liquid state pollutants to adsorb to suspended particles, thus removing a larger proportion of them through sedimentation. Sedimentation is the primary pollutant removal mechanism for many treatment SCMs including extended detention basins, retention ponds, and constructed wetland basins.
- **Straining**: Straining is physical removal or retention of particulates from runoff as it passes through a SCM. For example, grass channels and vegetated filter strips provide straining of sediment and coarse solids in runoff. Straining can be characterized as coarse filtration.
- **Filtration**: Filtration removes particles as water flows through media such as bioretention soil mix. A wide variety of physical, chemical, and biological mechanisms may occur along with filtration, depending on the filter media. Filtration is a primary treatment process provided by infiltration SCMs. Particulates are removed at the ground surface and upper soil horizon by filtration, while soluble constituents can be absorbed into the soil, at least in part, as the runoff infiltrates into the ground. Site-specific soil characteristics, such as permeability, cation exchange potential, and depth to groundwater or bedrock are

important characteristics to consider for filtration (and infiltration) SCMs. Examples of filtering SCMs include rain gardens and pervious pavements with a sand filter layer.

- **Adsorption/Absorption**: In the context of SCMs, sorption processes describe the interaction of waterborne constituents with surrounding materials (e.g., soil, water). Absorption is the incorporation of a substance in one state into another of a different state (e.g., liquids being absorbed by a solid). Adsorption is the physical adherence or bonding of ions and molecules onto the surface of another molecule. Many factors such as pH, temperature and ionic state affect the chemical equilibrium in SCMs and the extent to which these processes provide pollutant removal. Sorption processes often play primary roles in SCMs such as constructed wetland basins, retention ponds, and rain gardens. Opportunities may exist to optimize performance of SCMs through the use of engineered media or chemical addition to enhance sorption processes.
- **Biological Uptake:** Biological uptake and storage processes include the assimilation of organic and inorganic constituents by plants and microbes. Plants and microbes require soluble and dissolved constituents such as nutrients and minerals for growth. These constituents are ingested or taken up from the water column or growing medium (soil) and concentrated through bacterial action, phytoplankton growth, and other biochemical processes. In some instances, plants can be harvested to remove the constituents permanently. In addition, certain biological activities can reduce toxicity of some pollutants and/or possible adverse effects on higher aquatic species. Unfortunately, not much is understood yet about how biological uptake or activity interacts with stormwater during the relatively brief periods it is in contact with the biological media in most SCMs, with the possible exception of retention ponds between storm events (Hartigan, 1989). Rain gardens, constructed wetlands, and retention ponds are all examples of SCMs that provide biological uptake.

Table 4. Primary, Secondary, and Incidental Treatment Processes Provided by Various SCMs (Adapted from UDFCD, 2010)

SCM	Hydrologic Processes			Treatment Processes				
	Peak	Volume		Physical			Chemical	Biological
	Flow Attenuation	Infiltration	Evapo-transpiration	Sedimentation	Filtration	Straining	Adsorption/ Absorption	Biological Uptake
Grass Channel	I	S	I	S	S	P	S	S
Vegetated Buffer	I	S	I	S	S	P	S	S
Green Roof	P	S	P	N/A	P	N/A	I	P
Permeable/ Pervious Pavement	P	P	N/A	S	P	N/A	N/A	N/A
Bioretention (rain garden)	P	P[1]	S	P	P	S	S[2]	P
Extended Detention Basin	P	I	I	P	N/A	S	S	I
Retention Pond	P	I	P	P	S	S	P	P

P=Primary; S=Secondary, I=Incidental; N/A=Not Applicable

[1]Depending on presence and design of an underdrain.

[2]Depending on soil media.

5.4 Pretreatment

Forebays or other pretreatment is recommended for SCMs including extended detention and rain gardens. The purpose of forebays is to settle out coarse sediment prior to reaching the main body of the facility. It is extremely important that sediment loading be controlled for SCMs that rely on infiltration, including pervious pavement systems and rain gardens. Pretreatment can ensure long-term functionality and reduce maintenance of SCMs.

5.5 Volume Reduction

As specified in Section 2.3, site design and SCM selection and design should consider runoff volume reduction. Infiltration-based SCMs can be designed with or without underdrains, depending on soil permeability and other site conditions. The most substantial volume reductions are generally associated with SCMs that have permeable sub-soils and allow infiltration to deeper soil strata and eventually groundwater. For SCMs that have underdrains, there is still potential for volume reduction although to a lesser degree. As runoff infiltrates through SCM soils to the underdrain, moisture is retained by soils. The moisture eventually evaporates, or is taken up by vegetation, resulting in volume reduction. Runoff that drains from these soils via gravity to the underdrain system behaves like interflow from a hydrologic perspective with a delayed response that reduces peak rates. Although the runoff collected in the underdrain system is ultimately discharged to the surface, on the time scale of a storm event, there are volume reduction benefits.

Although effects of evapotranspiration are inconsequential on the time scale of a storm event, on an annual basis, volume reduction due to evapotranspiration in vegetated SCMs such as bioretention can be an important component of the hydrologic budget. Between events, evapotranspiration lowers soil moisture content, providing additional storage capacity for subsequent events. Volume reduction provided by a particular SCM type will be influenced by site-specific conditions and SCM design features. Table 2 provides typical runoff reduction percentages for SCMs. National research is ongoing with regard to estimating volume reduction provided by various SCM types.

5.6 Treatment Train

The term "treatment train" refers to multiple SCMs in series (e.g., a disconnected roof downspout draining to a grass channel draining to an extended detention basin.) Engineering research over the past decade has demonstrated that treatment trains are one of the most effective methods for management of stormwater quality (WERF 2005). Advantages of treatment trains include:

- **Multiple processes for pollutant removal**: There is no "silver bullet" for a SCM that will address all pollutants of concern as a stand-alone practice. Treatment trains that link together complementary processes expand the range of pollutants that can be treated with a water quality system and increase the overall efficiency of the system for pollutant removal.
- **Redundancy**: Given the natural variability of the volume, rate and quality of stormwater runoff and the variability in SCM performance, using multiple practices in a treatment train can provide more consistent treatment of runoff than a single practice and provide redundancy in the event that one component of a treatment train is not functioning as intended.

- **Maintenance**: SCMs that remove trash, debris, coarse sediments and other gross solids are a common first stage of a treatment train. From a maintenance perspective, this is advantageous since this first stage creates a well-defined, relatively small area that can be cleaned out routinely. Down-gradient components of the treatment train can be maintained less frequently and will benefit from reduced potential for clogging and accumulation of trash and debris.

5.7 Onsite and Regional (Public Improvement) SCMs

SCMs can be onsite, meaning they are located on the lot they are serving or they can be regional, meaning they serve multiple lots. Regional SCMs are also referred to as public improvements. They can be an efficient means of meeting water quality requirements in a common facility that is often maintained by a property owners association. However, a single regional facility may not provide significant runoff volume reduction and does not provide the benefits of a treatment train approach. To achieve these benefits, a regional extended detention basin might be combined with downspout disconnection. Residential subdivisions usually already incorporate disconnection of roof runoff by directing downspouts to lawns. Disconnection of downspouts is an option for commercial buildings as well. Other options include vegetated filter strips for sheet flow from parking lots, grass channels or bioswales to convey runoff to the extended detention basin, and other SCMs such as pervious pavement and rain gardens on the individual lots. This treatment train approach can reduce the WQV and detention volume needed in the regional extended detention basin, while providing volume reduction and a range of water quality treatment processes that will minimize hydromodification and provide better water quality than a stand-alone extended detention basin.

5.8 Integration with Flood Control

In addition to water quality, most projects will require detention for flood control, whether onsite, or in a regional facility that serves multiple lots. It can be efficient to combine water quality and flood control facilities. Examples include extended detention basins and pervious pavement designed to provide the WQV and flood control storage. SCMs can also reduce required detention volume through lower curve numbers and decreased time of concentration.

5.9 Online SCMs and Offsite Drainage

Online refers to locating a SCM such that runoff from upstream of the development flows through it. Generally, on-line SCMs to capture the WQV are strongly discouraged, especially in a natural channel. It is preferable for natural channels to be preserved and SCMs to be located off-line. Online SCMs may require federal and state permits under Section 404 of the Clean Water Act if located in a jurisdictional waterway. Online WQV facilities may be acceptable if the offsite watershed has less impervious area than that of the onsite watershed. There may be situations where SCMs may be located in an area that receives some offsite drainage. This may be acceptable if the offsite drainage is minimal and will not affect the integrity and functionality of the SCM. In these cases, the SCM does not need to be sized for the WQV for the offsite drainage but special design considerations may be needed to ensure the SCM can handle the offsite drainage while still providing the intended water quality treatment or volume reduction for the onsite drainage.

5.10 Land Use, Compatibility with Surroundings, and Safety

SCMs can add interest and diversity to a site, serving multiple purposes in addition to providing water quality functions. Gardens, plazas, rooftops, and even parking lots can become amenities and provide visual interest while performing stormwater quality functions and reinforcing urban design goals for the neighborhood and community. The integration of SCMs and associated landforms, walls, landscape, and materials can reflect the standards and patterns of a neighborhood and help to create lively, safe, and pedestrian-oriented districts. The quality and appearance of SCMs should reflect the surrounding land use type, the immediate context, and the proximity of the site to important civic spaces. Aesthetics will be a more critical factor in highly visible urban commercial and office areas than at a heavy industrial site. The standard of design and construction should maintain and enhance property values without compromising function (WWE et al. 2004).

Public access to SCMs should be considered from a safety perspective. The highest priority of engineers and public officials is to protect public health, safety, and welfare. SCMs must be designed and maintained in a manner that does not pose health or safety hazards to the public. As an example, steeply sloped and/or walled ponds should be avoided. Where this is not possible, emergency egress, lighting and other safety considerations should be incorporated. Facilities should be designed to minimize mosquito breeding, which can be a nuisance and a public health concern (e.g., West Nile virus). The potential for nuisances, odors and prolonged soggy conditions should be evaluated for SCMs, especially in areas with high pedestrian traffic or visibility.

5.11 Maintenance

Maintenance is an important consideration in SCM selection and should be considered early in the planning and design phase. Even when SCMs are thoughtfully designed and properly installed, they can become eyesores, breed mosquitoes, and cease to function if not properly maintained. SCMs can be more effectively maintained when they are designed to allow easy access for inspection and maintenance and take into consideration factors such as property ownership, type of maintenance, visibility, and vehicle and equipment access. An important consideration for a rain garden with plantings is whether the property owner can commit to maintaining it as a landscape feature that requires weeding, watering, and replacement of mulch just like other site landscaping. Selection of pervious pavement should consider whether services are available for periodic vacuum sweeping.

6.0 Plant Selection

Landscaped SCMs are a good choice where landscaping is already required by the zoning ordinance, such as interior and perimeter parking lot landscaping and bufferyard landscaping. Such areas can be designed as rain gardens, vegetated filter strips, grass channels, or bioswales. Turf grass with mulched trees and shrubs is an option that is generally easiest to maintain for most property owners because they will already be mowing other areas. Fully landscaped SCMs with plantings and mulch requires a higher level of commitment to maintain, including weeding and re-mulching. Often times, non-SCM landscape beds gets maintained very well but fully landscaped SCMs get neglected. Fully landscaped SCMs should be designed with a plant palette and mulch that blends in with other landscape beds so that they get maintained equally well. Trees and shrubs are good options for ease of maintenance. When incorporating grasses and perennials, a simple plant palette

of a few easily recognizable species will be easier to maintain. A good resource for plant information is the *Landscape Guide for Stormwater Best Management Practice Design* (Metropolitan St. Louis Sewer District, et. al., 2012). The City of Columbia, Missouri also has a comprehensive list of recommended plant material in their Stormwater Manual. A locally-developed list of tree species for rain gardens is also included in the appendix of this chapter. Trees are highly recommended for SCMs, including rain gardens and the bottom of extended detention basins.

Photo 2. Rain garden with trees, shrubs, grasses, and perennials in the City Government Plaza parking lot.

The following are species of shrubs, grasses, and perennials that the City has found to be good choices for landscaped SCMs in terms of aesthetics and maintenance. These are suggestions; other species may be used. The majority of these species are Missouri natives but a few are native to other nearby U.S. regions. A few cultivars are listed as well. Natives are encouraged due to the other ecological benefits they provide. The Missouri Botanical Garden Plant Finder website is a good resource for characteristics and growing conditions of these species. All of these species have been used on local projects. Trees have also been used in many local projects.

Photo 3. Showy coneflower in a rain garden along Campbell Avenue between Mount Vernon and Elm Streets.

Shrubs:

- Ozark Witch Hazel (Hamamelis vernalis)
- Virginia Sweetspire (Itea virginica)
  - 'Henry's Garnet' - cultivar that is slightly smaller, more vibrant color, and commonly available.
- Shrubby St. johns Wort (Hypericum prolificum)
- Arrowood Viburnum (Viburnum dentatum)
- Buttonbush (Cephalanthus occidentalis)
- Spicebush (Lindera benzoin)
- Strawberry Bush (Euonymous americanus)

Grasses:

- Tussock Sedge (Carex stricta)
- Soft Rush (Juncus effusus)

- Prairie Dropseed (for drier areas) (Sporobolus heterolepis)
- Sideoats Grama (for drier areas) (Bouteloua curtipendula)

Perennials:

- Foxglove Beardtongue (Penstemon digitalis)
- Showy Coneflower (Rudbeckia fulgida var. sullivanti)
- Blazing Star (Liatris spicata)
    - 'Kobold' - shorter, more compact cultivar and commonly available.
- Southern Blue Flag Iris (Iris virginica)
- Indian Pink (Spigelia marilandica)

Photo 4. Indian pink, tussock sedge, and foxglove beardtongue in a rain garden along Campbell Avenue between Mount Vernon and Elm Streets.

7.0 Operation and Maintenance Plan and Agreement

A SCM operation and maintenance plan and agreement is required as a condition for stormwater permitting for construction of SCMs. The SCM operation and maintenance plan and agreement must be prepared using the SCM-specific forms provided by the City, and recorded with the Greene County Recorder of Deeds. Long-term operation and maintenance self-inspections and submittal of a self-inspection report is required annually. Self-inspections and reporting shall be conducted and submitted using the SCM-specific inspection forms provided by the City.

8.0 Vegetated Filter Strip

8.1 Description

Vegetated filter strips are densely vegetated areas that reduce and treat runoff as sheet flow from adjacent impervious and pervious areas. They can be turf grass lawn, landscaping, or conserved/restored natural areas. They require sheet flow to promote filtration/settling of pollutants, infiltration, and evapotranspiration. Lawn or landscaping near buildings can be designed as a vegetated filter strip for roof downspouts. Vegetated filter strips can also be designed for parking lots or other impervious surfaces. Vegetated filter strips differ from grass channels in that they are designed to accommodate sheet flow rather than concentrated or channelized flow. Grass, trees, and shrubs in vegetated filter strips can provide aesthetically pleasing green space, which can be incorporated into a landscaping and bufferyard plan. In addition, their use typically adds little cost to a development when incorporated into the existing green space requirements, and their maintenance should be no different than routine maintenance of onsite landscaping.

Photo 5. Natural conservation area as vegetated filter strip (SEMCOG, 2015).

Photo 6. Turf grass vegetated filter strip.

8.2 Site Selection

Vegetated filter strips can be utilized for a variety of land uses and are typically located adjacent to impervious areas. Because of the amount of space required for filter strips to meet full WQV requirements, additional SCMs are often required. Sites can be designed with a treatment train approach that utilizes vegetated filter strips that provide WQV reduction, in series with storage-based SCMs to provide the remaining WQV. Because the effectiveness of vegetated filter strips depends on having an evenly distributed sheet flow over their surface, the size of the contributing drainage area and the associated volume of runoff must be limited.

8.3 Design Considerations

Design of a vegetated filter strip is based primarily on maintaining sheet flow conditions across a uniformly graded area with a gentle slope and a dense grass cover. Whenever concentrated runoff occurs, it should be evenly distributed across the width of the filter strip via a flow spreader. This may be a pervious pavement strip or another type of structure used to achieve uniform sheet-flow

conditions. When a filter strip is used over unstable slopes, soils or vegetation, formation of rills and gullies that disrupt sheet flow will occur. The resultant short-circuiting will invalidate the intended water quality benefits and must be corrected through maintenance. A rectangular strip is the preferred shape and should be free of gullies or rills that concentrate flow.

Vegetated filter strips should be protected from excessive pedestrian or vehicular traffic that can damage the grass cover and affect uniform sheet-flow distribution. This can be accomplished using slotted curb or other types of barriers. The top of the filter strip should be designed and installed 1 to 3 inches below the adjacent pavement so that growth of vegetation and accumulation of sediment at the edge of the strip does not prevent runoff from entering the filter strip. Alternatively, a sloped edge can be used adjacent to vehicular traffic areas (where vehicle safety would not be impacted). A mixture of grass and trees may offer benefits for slope stability and improved aesthetics, as well as increased runoff reduction.

8.4 Design Procedure and Criteria

A vegetated filter strip meeting the full design criteria in this section is considered to meet the WQV requirement. Vegetated filter strips can be used as stand-alone SCMs or in series with other SCMs when part of a larger site drainage area. When used in series with other SCMs, the WQV for the area draining to the vegetated filter strip can be subtracted from the total WQV for the larger site drainage area. Partial credit can also be applied to the WQV for vegetated filter strips that do not meet the full length requirement and are used in series with other SCMs. The vegetated filter strip must be a minimum of 20 feet in length to receive partial credit. The intent of this partial credit is to encourage treatment train approaches that disconnect impervious surfaces. WQV credit is given based on the percentage of the required length provided. For example, the WQV can be reduced by 50% for the drainage area to a vegetated filter strip that is 50% of the required length (minimum 20 foot length).

The following steps outline the vegetated filter strip design procedure and criteria. Figure 4 is a schematic of a filter strip and its components.

1. **Design Discharge:** Calculate the 2-year peak flow rate, $Q_{2\text{-year}}$ (cfs), of the area draining to the filter strip as described in Chapter 5, Calculation of Runoff.

2. **Minimum Width:** The Width (W), the distance normal to flow of the filter strip, is typically the same as the contributing basin (see Figure VF-2). An exception to this is where flows become concentrated. Concentrated flows require a level spreader to distribute flows evenly across the width of the filter strip. The minimum design width, W_G (ft), (normal to flow) is calculated as:

$$W_G = \frac{Q_{2-year}}{0.05}$$

3. **Length:** The minimum design Length, L_G (ft), along the sheet flow direction, shall meet the minimum length calculated using the following equations for sheet flow or concentrated flow. Concentrated flow includes roof downspouts, pipe discharges or other situations where flow will concentrate (see #5 below).

$L_G = 0.2L_I$ or 20 feet (for sheet flow control)

$L_G = 0.15(A_t / L_t)$ or 20 feet (for concentrated flow control)

In which:

L_I = Flow path length of sheet flow over the upstream impervious surface (ft)

A_t = Tributary area (ft^2)

L_t = Length of the tributary inflow normal to flow spreader (i.e., width of flow spreader) (ft)

4. **Filter Strip Slope:** The vegetated filter strip slope in the direction of flow, S, shall not exceed 4%. Generally, a minimum slope of 2% in turf is adequate to facilitate positive drainage. For slopes less than 2%, consider including an underdrain system to mitigate nuisance drainage.

5. **Flow Characteristics (sheet or concentrated)**: Concentrated flows can occur when the width of the watershed differs from that of the grass buffer. Additionally, when the product of the watershed flow length and the interface slope (the slope of the watershed normal to flow at the grass buffer, see Figure 5) exceeds approximately one, flows may become concentrated. Use the following equations to determine flow characteristics:

   Sheet Flow: FL(SI) ≤ 1

   Concentrated Flow: FL(SI) > 1

   Where:

   FL = watershed flow length (ft)

   SI = interface slope (normal to flow) (ft/ft)

6. **Flow Distribution:** Flows delivered to a vegetated filter strip must be sheet flows. Slotted or flush curbing, pervious pavements, or other devices can be used to spread flows. The filter strip should have relatively consistent slopes to avoid concentrating flows within the filter strip. A level spreader should be used when flows are concentrated. A level spreader can be a slotted drain designed to discharge flow through a slot. The slot openings should be small to encourage frequent flows to overtop the level spreader, but, not so small that it is frequently clogged. A level spreader could also be an infiltration trench filled with gravel, which allows water to infiltrate prior to discharging over a level concrete or rock curb. There are many ways to design and construct a level spreader. They can also be used in series when the length of the filter strip allows flows to re-concentrate. Figure 6 is a schematic of typical level spreader details.

7. **Soil Preparation:** In order to encourage establishment and long-term health of the vegetation and maximize runoff absorption and infiltration, it is essential that soil conditions be properly prepared prior to installation. Following site grading, poor soil conditions often exist. For a constructed filter strip, when possible, stockpile, and reuse on-site topsoil. A minimum of 4 inches of topsoil shall be used. Alternatively, soil can be amended with 2 to 4 inches of compost, tilled to a depth of 6 to 10 inches. Compost shall be derived from the decomposition of

yardwaste as defined by MDNR (2014). Compost derived from animal or poultry manure shall not be acceptable. Compost shall have a C/N ratio <25, indicating a finished compost. Compacted soil should be loosened or tilled. Finish grading to achieve desired elevations and slopes should be performed using tracked equipment to prevent compaction After the topsoil or compost soil amendments are placed, sod or seed the filter strip and cover with suitable erosion control until vegetation is established. Conserved open space used as a buffer should be protected from grading and compaction with fencing or other suitable barriers.

8. **Vegetation:** This is the most critical component for treatment with a vegetated filter strip. Select durable, dense, and drought tolerant grasses. Also, consider the size of watershed, as larger watersheds will experience more frequent flows. The goal is to provide a dense mat of vegetative cover. Vegetated filter strip performance falls off rapidly as the vegetation coverage declines below 80% (Barrett el al., 2004). Trees and shrubs are strongly encouraged due to the additional runoff reduction benefits provided and can be compatible with a perimeter or bufferyard landscape plan.

9. **Outflow Collection:** Provide a means for outflow collection. The filter strip can drain to a grass channel, bioswale, storm drain, or street gutter in accordance with design criteria for those facilities. In some cases, the use of underdrains can maintain better infiltration rates and help dry out the filter strip after storms.

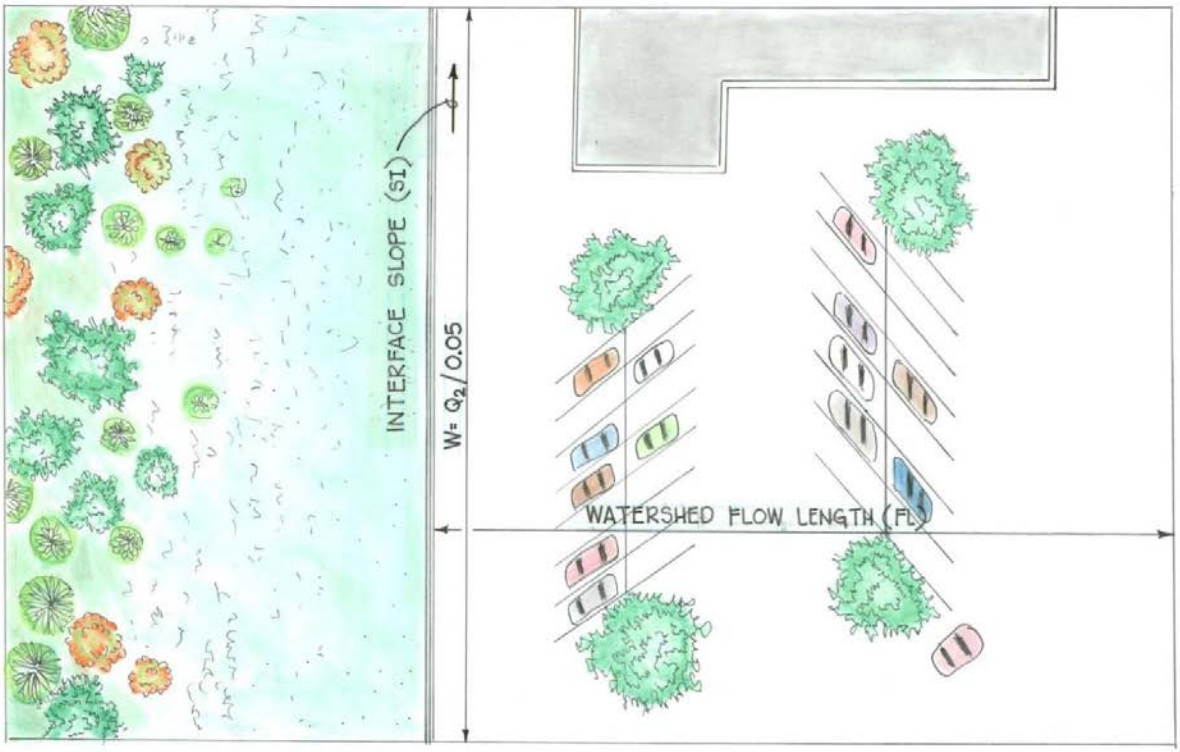


Figure 1. Vegetated filter strip for a parking lot (Source: UDFCD, 2010. Graphic by Adia Davis).

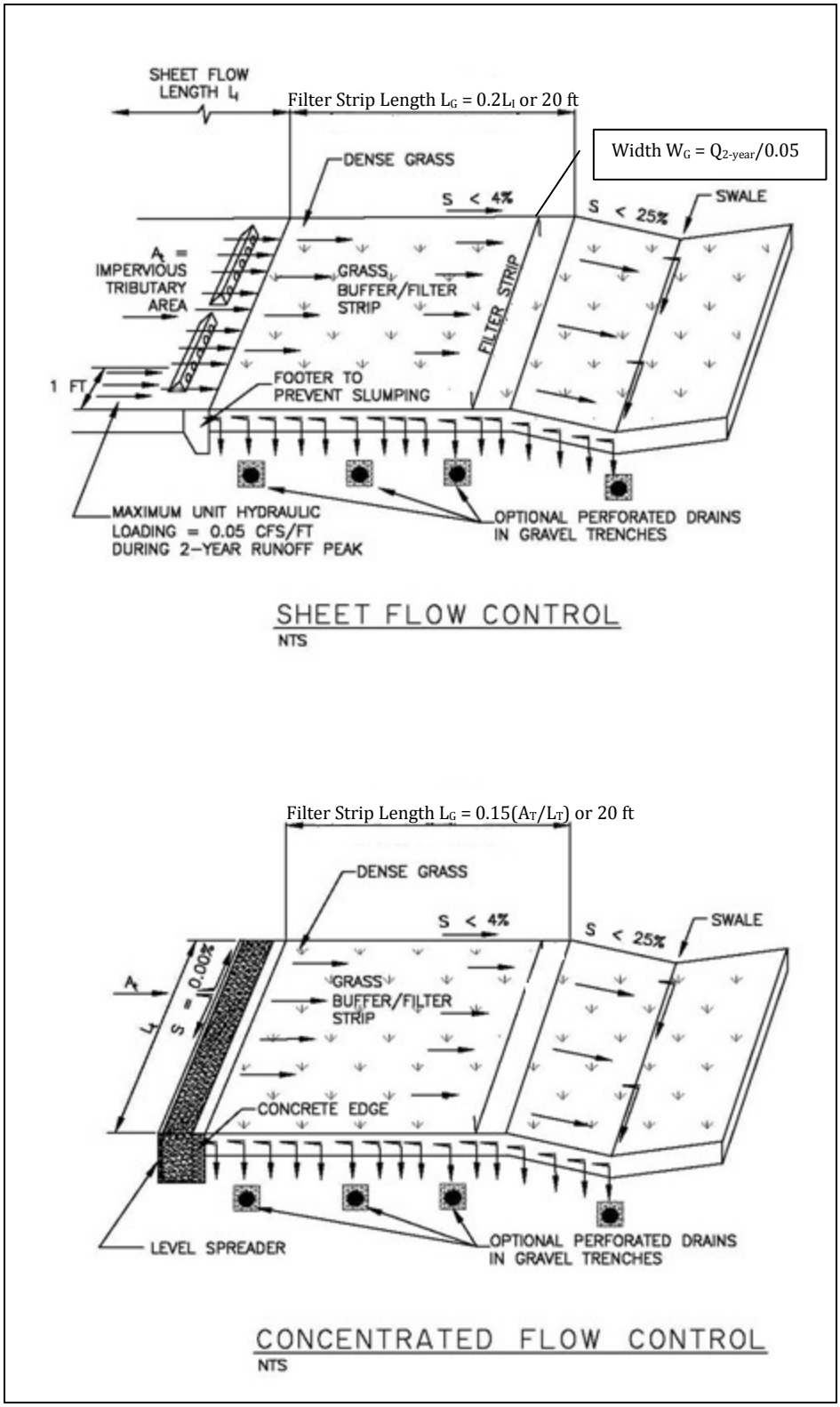


Figure 2. Typical vegetated filter strips for sheet flow and concentrated flow.

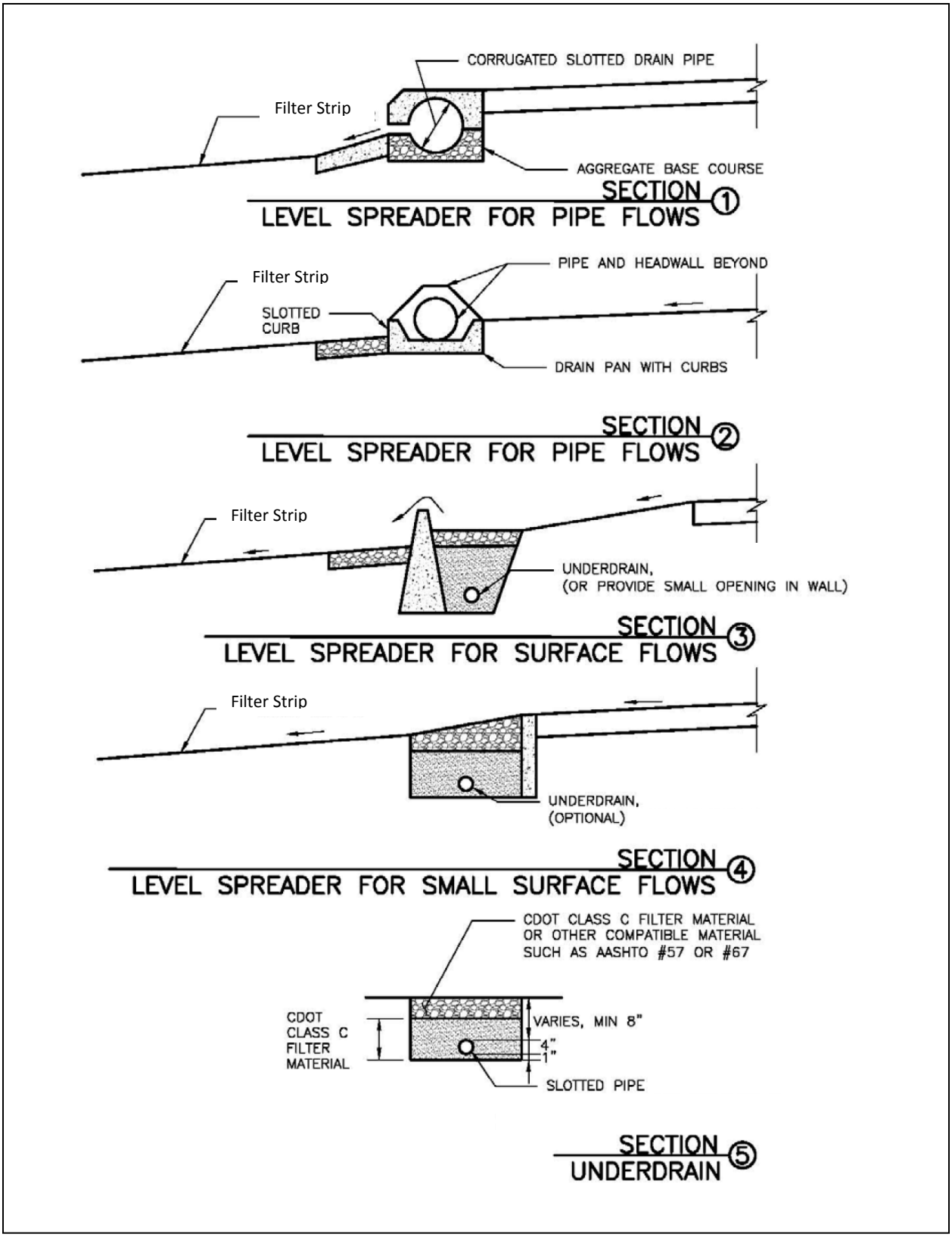


Figure 3. Typical level spreaders (Source: UDFCD, 2010).

8.5 Construction Considerations

Success of a vegetated filter strip depend not only on a good design and long-term maintenance, but also on installing the facility in a manner that enables it to function as designed. Construction considerations include:

- The final grade of the filter strip is critical. Oftentimes, following soil amendment and placement of sod, the final grade is too high to accept sheet flow. The buffer should be inspected prior to placement of seed or sod to ensure appropriate grading.
- Perform soil amending, fine grading, and seeding after tributary areas have been stabilized and utility work crossing the filter strip has been completed.
- When using sod tiles, stagger the ends of the tiles to prevent the formation of channels along the joints. Use a roller on the sod to ensure there are no air pockets between the sod and soil.
- Avoid over-compaction of soils in the filter strip area during construction to preserve infiltration capacities.
- Erosion and sediment control measures on upstream disturbed areas must be maintained to prevent excessive sediment loading to the filter strip.

8.6 As-Built Plan and Certification

Upon completion of the vegetated filter strip, prior to final acceptance, an as-built plan and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following: To Be Determined

9.0 Grass Channel

9.1 Description

A grass channel is a densely vegetated drainageway with gentle side slopes that collects and slowly conveys runoff. Grass channels have low longitudinal slopes and broad cross-sections that convey flow in a slow and shallow manner, thereby facilitating sedimentation and filtering (straining) while limiting erosion and providing some reduction in runoff volumes for small storms through infiltration and evapotranspiration. Grass channels are an integral part of the LID concept as an alternative to pipes or concrete channels, and are generally less expensive to construct. The grass channel should be vegetated with dense grasses that can reduce flow velocities and protect against erosion during larger storm events.

Photo 7. Construction of a grass channel along Erie Street.

Photo 8. Roadside channel with native plants in the Legacy Trails Subdivision.

Grass channels are not considered a stand-alone SCM that meets the WQV requirement; however, they can be used to reduce the required WQV by 20% for the contributing drainage area. To receive the 20% credit towards meeting the WQV requirement, the grass channel must meet all design criteria herein including the minimum residence time. The 20% credit is based on the average runoff reduction benefit of a grass channel (Hirschman, et al., 2008; Nashville & Davidson County, 2012); Grass channels that do not meet the minimum residence time are still beneficial as an alternative to pipes or concrete channels.

9.2 Site Selection

A grass channel can be located to collect overland flows from areas such as parking lots, buildings, roadways and vegetated filter strips. They can also be used to convey runoff from a pipe discharge. A grass channel is well suited for sites with low to moderate slopes.

9.3 Design Considerations

A grass channel is sized to maintain a low velocity during small storms and to collect and convey larger runoff events. A grass channel generally should not be used where site slopes exceed 5

percent. The longitudinal slope of a grass channel should be kept to less than 1 percent in most cases, which often necessitates the use of grade control checks or drop structures. Figure 4 shows trapezoidal and triangular swale configurations. If one or both sides of the grass channel are also to be used as a vegetated filter strip, the design of the vegetated filter strip must follow the requirements in the vegetated filter strip specification.

9.4 Design Procedure and Criteria

The following steps outline the grass channel design procedure and criteria. Figure 4 is a schematic of a grass channel and its components.

1. **Design Discharge:** Calculate the 2-year peak flow rate, Q2-year (cfs), to be conveyed in the grass channel as described in Chapter 5, Calculation of Runoff. For public improvements, the grass channel must meet the criteria given in Chapter 8, Open Channels. For all developments with detention, it must be shown that the channel can convey the maximum design flow to the detention basin and that bypass will not occur.

2. **Hydraulic Residence Time:** Increased hydraulic residence time in a grass channel improves runoff reduction and water quality treatment. Maximize the length of the channel when possible. If the length of the channel is limited due to site constraints, the slope can also be decreased or the cross-sectional area increased to increase hydraulic residence time. Grass channels with a minimum hydraulic residence time of 5 minutes can be used to reduce the WQV by 20% for the contributing drainage area. Grass channels that do not meet the minimum residence time are still beneficial as an alternative to pipes or concrete channels.

3. **Geometry:** The geometry of the cross-section should be either trapezoidal or triangular with side slopes not exceeding 4:1 (horizontal: vertical), preferably flatter.

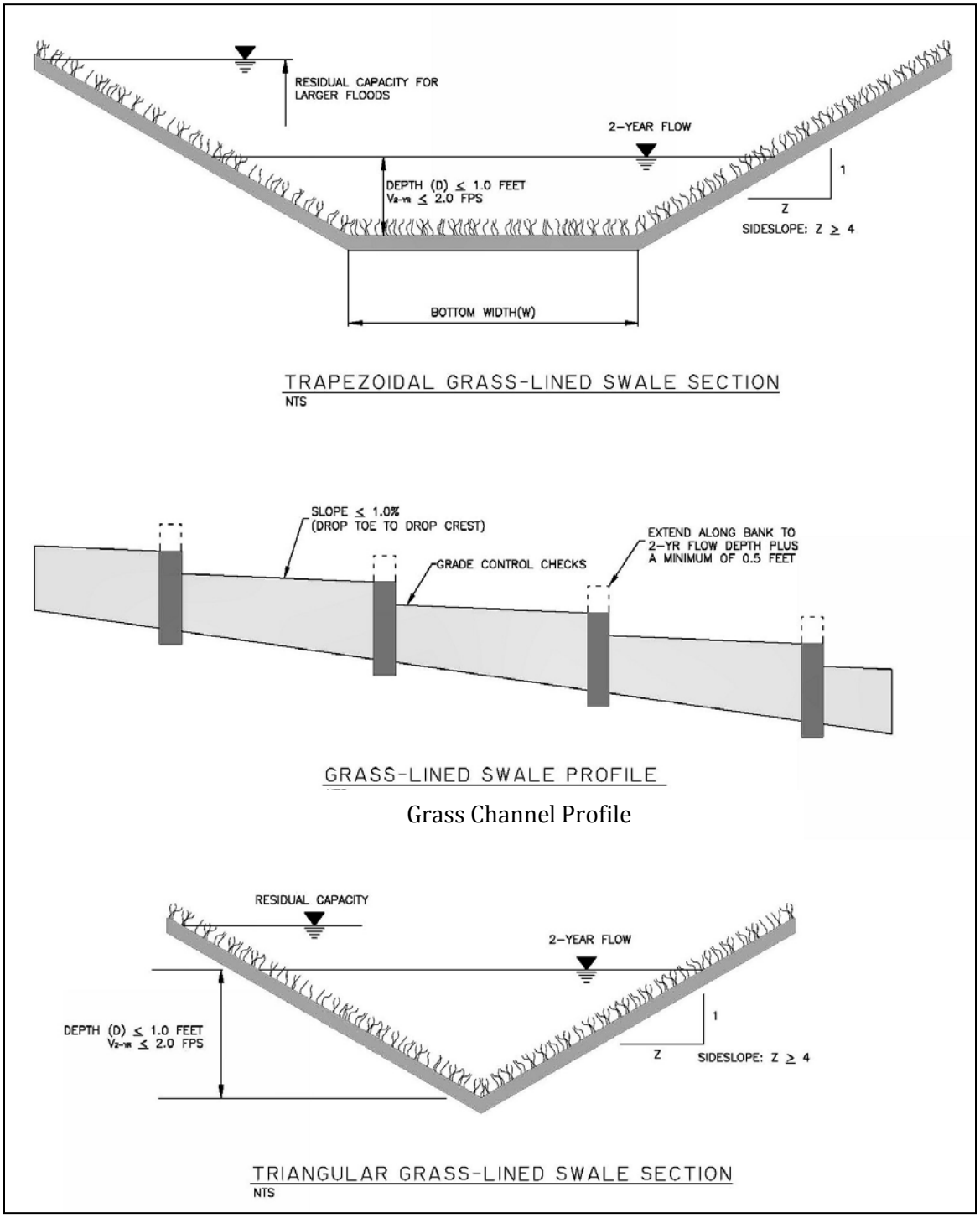
4. **Longitudinal Slope:** The longitudinal slope, So, of the grass channel should be kept to less than 1% in most cases. If the longitudinal slope requirements cannot be satisfied with available terrain, grade-control checks or small drop structures must be incorporated to maintain the required longitudinal slope. (See Chapter 8, Open Channels.)

5. **Velocity and Flow Depth:** To promote sedimentation and water quality treatment, the maximum velocity of the 2-year peak flow shall not exceed 2 feet per second (ft/s) and the maximum flow depth of the same flow shall not exceed 1 foot.

6. **Soil Preparation:** In order to encourage establishment and long-term health of the vegetation and maximize runoff absorption and infiltration, it is essential that soil conditions be properly prepared prior to installation. Following site grading, poor soil conditions often exist. When possible, stockpile, and reuse on-site topsoil. A minimum of 4 inches of topsoil shall be used. Alternatively, soil can be amended with 2 to 4 inches of compost, tilled to a depth of 6 to 10 inches. Compost shall be derived from the decomposition of yardwaste as defined by MDNR (2014). Compost derived from animal or poultry manure shall not be acceptable. Compost shall have a C/N ratio <25, indicating a finished compost. Compacted soil should be loosened or tilled. Finish grading to achieve desired elevations and slopes should be performed using tracked equipment to prevent compaction.

7. **Vegetation:** Select durable, dense, and drought tolerant grasses. Also, consider the size of watershed, as larger watersheds will experience more frequent flows. The goal is to provide a

dense mat of vegetative cover. After the topsoil or compost amendments are placed, sod or seed the grass channel and cover with suitable erosion control until established. Erosion control blanket or turf reinforcement mat may be used.



Grass Channel Profile

Figure 4. Typical grass channel sections.

9.5 Construction Considerations

Success of grass channels depends not only on good design and maintenance, but also on construction practices that enable the SCM to function as designed. Construction considerations include:

- Perform fine grading, soil amendment, and seeding only after upstream areas have been stabilized and utility work crossing the channel has been completed.
- Avoid compaction of soils to preserve infiltration capacities.
- Provide irrigation appropriate to the grass type for establishment.
- If weed control is necessary during establishment, mowing to prevent seeding of weeds and selective spot spraying are preferred methods over wide-spread application of chemical weed control herbicides.
- Protect the channel from other construction activities.

9.6 As-Built Certification

Upon completion of the grass channel for WQV credit, prior to final acceptance, an as-built plan and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following: To Be Determined

10.0 Permeable/Pervious Pavement (General)

10.1 Description

The term permeable or pervious pavement, as used in this manual, is a general term to describe any one of several pavements that allow movement of water into the layers below the pavement surface. Permeable pavement and pervious pavement are often used interchangeably. For simplicity, pervious pavement will be used in this section. Depending on the design, pervious pavements can be used to provide volume reduction, and/or treatment and slow release of the WQV. Use of pervious pavements is a common LID practice used alone or in combination with other SCMs to meet the water quality requirements. Pervious pavement can also be designed with an increased depth of aggregate material in order to provide storage for storm events in excess of the water quality storm event. This requires some additional design considerations which are discussed within this fact sheet. The types of pervious pavement that are considered to have acceptable longevity and are therefore allowed include permeable interlocking concrete pavement (PICP) and pervious concrete. Pervious asphalt, modular block porous pavers and other proprietary pervious pavement systems may be acceptable on a case by case basis and should adhere to manufacturer's specifications and the design considerations and plan notes herein, as applicable.

Photo 10. Installation of pervious concrete at the City Government Plaza.

Photo 9. Permeable interlocking concrete pavers at the City Government Plaza.

10.2 Site Selection

Pervious pavement systems provide an alternative to conventional pavement and are most commonly used in parking lots, pedestrian areas, and lower-traffic vehicle areas. They are not appropriate where sediment-laden runoff could clog the system (e.g., near loose material storage areas, or at sites where vehicles and equipment are likely to track sediment), or where erosive conditions such as steep slopes and/or sparse vegetation drain to the permeable pavement. For sites where land uses or activities can cause infiltrating stormwater to contaminate groundwater, special design requirements are required to ensure no-infiltration from the pavement sections.

When pervious pavement (or other SCMs that allow infiltration) are proposed adjacent to buildings or pavement, protective measures should be implemented to avoid adverse impacts to these structures. Oversaturated subgrade soil underlying a structure can cause the structure to settle or result in moisture-related problems. Wetting of expansive soils or bedrock can cause swelling, resulting in structural movements. A geotechnical engineer should evaluate the potential impact of the pervious pavement on adjacent structures based on an evaluation of the subgrade soil, groundwater, and bedrock conditions at the site. Additional minimum requirements include:

- An underdrain shall be provided whenever possible and shall be designed to divert water away from the structure.
- In locations where potentially expansive soils or bedrock exist, placement of pervious pavement adjacent to structures and conventional pavement should only be considered if the pervious pavement includes an underdrain designed to divert water away from the structure and is lined with an essentially impermeable geomembrane liner designed to restrict seepage.

10.3 General Performance Criteria

To be considered an effective SCM, pervious pavement designs shall meet the following:

- Provide storage equal to the required design volume for water quality, flood control detention, or both.
- Capture and treat the drainage area to meet the required drain time of 12-72 hours.
- Pervious pavement systems must be designed to handle the drainage area to ensure acceptable performance and system longevity, by meeting the ratios in Table 5.
- An underdrain shall be provided whenever possible.
- The thickness of the rock storage shall be a minimum of 6 inches, and thicker if needed to meet storage, drain time, and traffic loads.

Table 5. Pervious Pavement Design Ratios

NRCS Hydrologic Soil Group	Maximum Ratio of Directly Connected Impervious Area to Pervious Pavement Area
D	2:1
C	3:1
B, A	4:1

10.4 Soil and Geotechnical Evaluation

Because of local soil conditions, most pervious pavement sites in Springfield need an underdrain. Partial infiltration through the use of perched underdrains or "internal water storage" (i.e. upturned elbow) is encouraged because it improves pollutant removal and runoff reduction. The requirement for an underdrain may be waived on a case by case basis based on soil evaluation and site specific design considerations.

Either a soil evaluation shall be conducted at all proposed sites for pervious pavement with full or partial infiltration, or the design infiltration rates shown in Table 5 shall be used. A safety factor of 2 shall be applied to infiltration rates determined by a soil evaluation (e.g., an infiltration rate of

1"/hr would be 0.5"/hr after applying a safety factor of 2). If choosing to conduct a soil evaluation, a minimum of two soil evaluations are required per 5,000 square feet of pervious pavement. For sites with multiple separate proposed locations for pervious pavement (such as a parking lot with two separate proposed areas of pervious pavement separated by conventional pavement), a soil evaluation should be conducted at each separate location. Soil evaluation shall consist of one of the following:

- A profile pit soil morphology evaluation as described in 19 CSR 20-3.060(2) and (7). This method of soil evaluation can be used at all sites and is recommended for sites having significant groundwater contamination potential, severe geological limitations or severe limitations relating to restrictive layers.
- A percolation test as described in 19 CSR 20-3.060(2) and determination of depth to bedrock or other restrictive layer in areas where it is known that bedrock may exist at depths less than ten feet (10').

Based on the soil evaluation, the subgrade soil may be modified if needed to provide full or partial infiltration. The recharge bed shall be designed by the Engineer of Record.

The depth to bedrock will not only influence excavation costs, but will also influence the infiltration capabilities of the facility. If near the underlying infiltration zone (subgrade) of the pervious pavement, the bedrock will act as an impermeable layer. It is recommended that the bottom of the infiltration component of the pervious pavement be located at least two feet above the bedrock.

When the groundwater table is close to the infiltration zone, this can inhibit the effective infiltration capacity of the facility. Pervious pavement storage should be located at least two feet above the seasonal high level of the water table. It is recommended to determine the seasonal high water table elevation from taxonomy (e.g., soil borings that indicate certain types of mottling or coloration).

Table 6. Design infiltration rates (Minnesota Pollution Control Agency, 2015)

Hydrologic Soil Group	Infiltration rate (inches/hour)	Soil Textures	Corresponding Unified Soil Classification
A	1.63	Gravel Sandy gravel Silty gravels	GW - well-graded gravels, sandy gravels GP - gap-graded or uniform gravels, sandy gravels GM - silty gravels, silty sandy gravels SW - well-graded gravelly sands
	0.8	Sand Loamy sand Sandy loam	SP - gap-graded or uniform sands, gravelly sands
B	0.45		SM - silty sands, silty gravelly sands
	0.3	Loam, silt loam	MH - micaceous silts, diatomaceous silts, volcanic ash
C	0.2	Sandy clay loam	ML - silts, very fine sands, silty or clayey fine sands
D	0.06	Clay loam Silty clay loam Sandy clay Silty Clay Clay	GC - clayey gravels, clayey sandy gravels SC - clayey sands, clayey gravelly sands CL - low plasticity clays, sandy or silty clays OL - organic silts and clays of low plasticity CH - highly plastic clays and sandy clays OH - organic silts and clays of high plasticity

Note: Select the design infiltration rate based on the least permeable soil horizon within the first 5 feet below the bottom elevation of the infiltration zone. These infiltration rates represent the long-term infiltration capacity of a practice and are not meant to exhibit the capacity of the soils in the natural state.

10.5 General Design Considerations

1. See Sections 12.0 and 13.0 for additional, specific design considerations.
2. Pervious pavement can be excluded from percent impervious area when calculating the WQV using the Short Cut Method and can be considered urban pervious area with HSG C/D soil (Rv = 0.21) when calculating the WQV using the Small Storm Hydrology Method. For calculating detention, pervious pavement can be considered open space in good condition with the actual soil type present on the site.
3. Consideration should be given to the type of traffic loads that the pervious pavement will be required to endure when designing pervious concrete thickness and rock storage thickness. Refer to ACI 330R for parking lots and ACI 325.12R for streets and roads. An engineer with expertise in pavement design should provide input on this aspect early in the design phase.
4. Placing pervious pavement over areas of recent fill or compacted fill is not optimal for infiltration.
5. Consider slopes and velocity of upstream drainage area and length of flow path of permeable pavement to maximize infiltration into permeable pavement and minimize bypass flow over the pervious pavement.
6. When designing grades to ensure drainage to pervious pavement, a minimum of 1% slope is needed and the slope to the pervious pavement should be sufficiently greater than slopes in other directions, taking into account construction and paving accuracy. Sufficient spot elevations should be provided on the plans to ensure grades are constructed as intended.
7. Design gutters to spill onto pervious pavement to prevent runoff from bypassing.
8. Consider where snow is likely to be piled in determining location of pervious pavement. If a mix of pervious and conventional pavement is being used in a parking lot, use conventional pavement where snow is likely to be piled.
9. A geotextile or graded filter should be used between the subbase and subgrade to prevent subgrade soils from entering the subbase voids. If a geotextile is used, a woven fabric

meeting ASTM D4751 and ASTM D4633 is recommended. A geotextile shall be used on the vertical sides of the pervious pavement base to provide separation from adjacent material. An impermeable membrane or barrier may be needed if lateral flow is a concern for adjacent pavement or structures.

10. Consider structural integrity, constructability, and aesthetics when designing the perimeter of pervious pavement. A hard edge such as a curb and gutter or flush concrete band is needed on the perimeter of pervious concrete to prevent crumbling of the edge and on the perimeter of PICP to restrain movement of the pavers. Metal edge may be appropriate for PICP. If pervious pavement is adjacent to asphalt pavement, a concrete band is recommended in between for constructability and aesthetics.
11. The use of pervious pavement on sites whose land use or activity generates higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff requires the use of an impermeable liner and underdrain. Designers should refer to the Permeable Pavement section of the UDFCD *Urban Storm Drainage Criteria Manual* (2013) when designing the impermeable liner system.
12. A perforated or slotted underdrain system should be provided whenever possible. The horizontal and vertical locations shall be determined by the design engineer, depicted on the drawings, and be in general accordance with the pervious pavement details. Horizontal spacing of underdrains shall be a maximum of 20 feet.
13. Infiltration can be accounted for to meet WQV or detention volume by using an acceptable modeling program or methods. Acceptable models include but are not limited to the Stormwater Management Model (SWMM) and the National Stormwater Calculator.
14. To provide an infiltration bed, the primary underdrain system may be perched or configured as internal water storage (upturned elbow) within the subbase rock. The perched height is dependent on the infiltration characteristics of the underlying subgrade and the desired storage. The underdrain system shall not be perched if the underlying soils are plastic or plastic soils that have been stabilized with lime.
15. Provide an overflow system or additional storage to prevent water in the open graded storage bed from rising into the pervious pavement for the 2-yr, 24-hr storm event when designing for water quality only, or the 100-yr critical storm when designing for detention. Any emergency overflow pipes placed within the subbase should discharge only when the storage volume is exceeded. The horizontal and vertical location of all underdrains and overflow systems shall be determined by the design engineer and shown on the plans. Emergency overflow pipes and underdrains systems shall discharge to a stormwater structure or daylight to a stabilized outfall.
16. Observation wells should be provided in low areas within the pervious pavement system, and shall extend to the bottom of the storage bed. Observation wells should also be provided at the end of underdrains to serve as a cleanout. The wells shall consist of a 4-6 inch slotted or perforated pipe with cast iron frame and cover, as shown on the pervious pavement details. The number of wells required on an installation will vary on a site specific basis, and will be determined by the design engineer.
17. The volume in the voids of the open graded base and storage bed shall be considered the total water storage capacity. A void ratio not greater than 40 percent will be used to

calculate storage volume. No storage volume will be allowed in the pervious concrete, PICP or PICP bedding stone layer.

18. A permanent sign shall be posted warning that care should be taken during snow plowing; and prohibit the following: piling of snow and use of deicing materials on pervious pavement if it can be avoided, resurfacing or sealing, the use of sand abrasives for winter tire traction, and the use of power washers.
19. The design of the finished grade of the pavement surface shall take into consideration the Americans with Disabilities Act (ADA) and local code requirements.
20. Subgrade should be flat. Where topography requires, terracing of the subgrade may be needed, and shall be designed as shown in Figure 5. The volume of water stored behind each terrace will be considered part of the infiltration bed.
21. If using pervious pavement in a floodplain, consideration should be given to increased maintenance that may result from sediment/debris clogging from flood inundation.

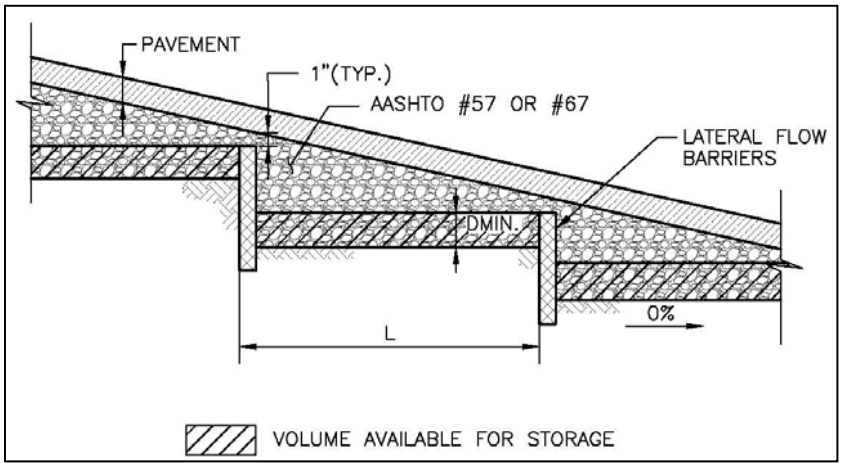


Figure 5. Terraced subgrade under permeable/pervious pavement (Source: UDFCD, 2013).

10.6 General Design Procedure and Criteria

10.6.1 Full Infiltration (No Underdrain)

Use the following steps in the pervious concrete or PICP worksheets:

1. Select design purpose (detention volume, water quality volume, or both).
2. Input pervious pavement and base course properties.
3. Input soil data (hydrologic soil group, and saturated hydraulic conductivity from either in-situ soil evaluation data or from Table 5). For in-situ soil evaluation data, the worksheet applies a safety factor of 2 when calculating the design saturated hydraulic conductivity.
4. Input site data (required volume, directly connected impervious area and pervious pavement area).
5. The worksheet calculates the ratio of DCIA to pervious pavement area and indicates whether the actual design ratio meets the maximum allowable design ratio from Table 5.
6. Input design depth of base course.

7. The worksheet checks that the required volume is met.
8. The worksheet calculates the drain time = design depth ÷ saturated hydraulic conductivity. The drain time shall be 12-72 hours.

10.6.2 Partial Infiltration (Perched Underdrain)

Use the following steps in the pervious concrete or PICP worksheets:

1. Select design purpose (detention volume, water quality volume, or both).
2. Input pervious pavement and base course properties.
3. Input soil data (hydrologic soil group, and saturated hydraulic conductivity from either in-situ soil evaluation data or from Table 5). For in-situ soil evaluation data, the worksheet applies a safety factor of 2 when calculating the design saturated hydraulic conductivity.
4. Input site data (required volume, directly connected impervious area and pervious pavement area).
5. The worksheet calculates the ratio of DCIA to pervious pavement area and indicates whether the actual design ratio meets the maximum allowable design ratio from Table 5.
6. Input design depth of base course.
7. The worksheet checks that the required volume is met.
8. Input depth from top of base course to drain pipe invert.
9. Input underdrain data, including pipe diameter and, if applicable, orifice information (orifice diameter, number of orifices per row, row spacing, number of rows).
10. The worksheet calculates the orifice area based on pipe diameter or orifice information, and the drain time above the underdrain.
11. The worksheet calculates the drain time below the underdrain = depth of base course below the underdrain ÷ design saturated hydraulic conductivity of existing subgrade.
12. The worksheet calculates the total drain time = drain time of underdrain + infiltration drain time. Total drain time must be 12-72 hours.

10.6.3 No Infiltration (Impermeable Liner)

Use the following steps in the pervious concrete or PICP worksheets:

1. Select design purpose (detention volume, water quality volume, or both).
2. Input pervious pavement and base course properties.
3. Input soil data (hydrologic soil group, and saturated hydraulic conductivity from either in-situ soil evaluation data or from Table 5). For in-situ soil evaluation data, the worksheet applies a safety factor of 2 when calculating the design saturated hydraulic conductivity.
4. Input site data (required volume, directly connected impervious area and pervious pavement area).
5. The worksheet calculates the ratio of DCIA to pervious pavement area and indicates whether the actual design ratio meets the maximum allowable design ratio from Table 5.
6. Input design depth of base course.
7. The worksheet checks that the required volume is met.
8. Input depth from top of base course to drain pipe invert.
9. Input underdrain data, including pipe diameter and, if applicable, orifice information (orifice diameter, number of orifices per row, row spacing, number of rows).

10. The worksheet calculates the orifice area based on pipe diameter or orifice information.
11. The worksheet calculates the drain time of the underdrain. Drain time must be 12-72 hours.

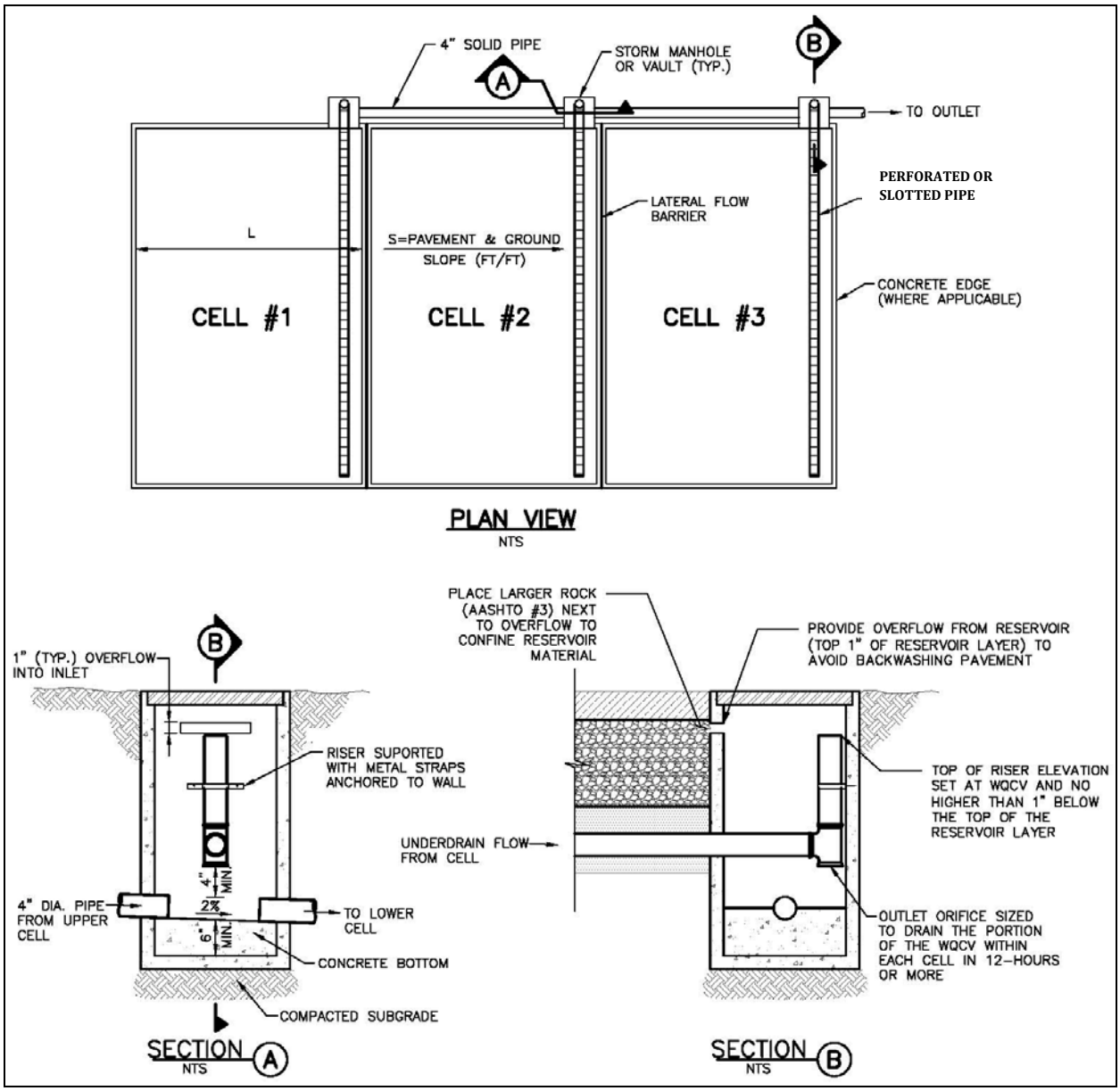


Figure 6. Underdrain system for partial or no infiltration pervious pavement sections (Source: UDFCD, 2013).

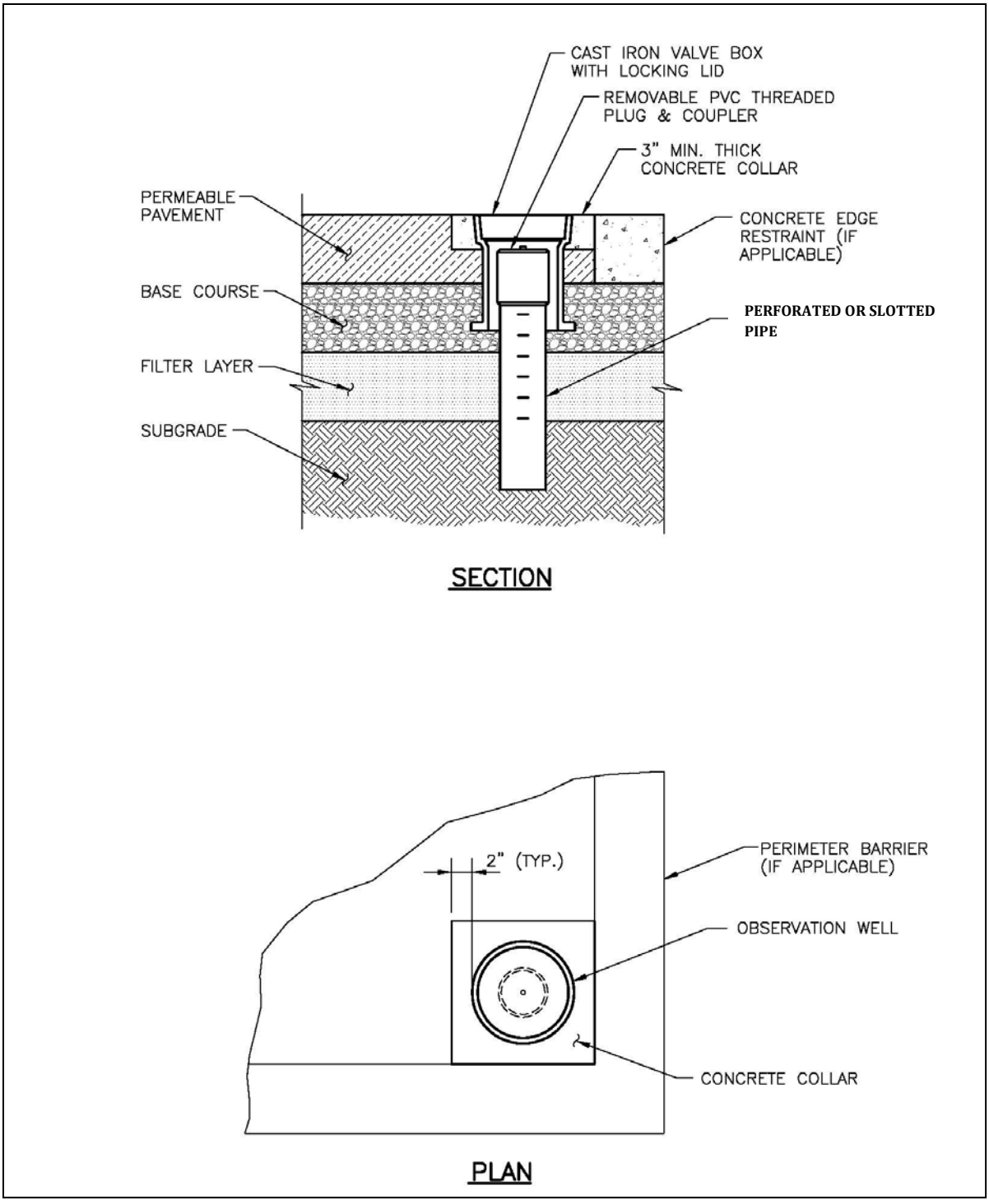


Figure 7. Observation well for pervious pavement (Source: UDFCD, 2013).

10.7 General Construction Considerations

1. See Sections 12.0 and 13.0 for additional, specific construction considerations.
2. Protect the base aggregate and the pervious pavement from sediment through phasing, runoff diversion, sediment control measures, and keeping the pavement covered as necessary.
3. The subgrade should be stripped of topsoil or other organics and either excavated or filled to the final subgrade level. Unnecessary compaction or over-compaction will reduce the subgrade infiltration rate. However, a soft or loosely compacted subgrade will settle, adversely impacting the performance of the entire pervious pavement system. The following recommendations for subgrade preparation are intended to strike a balance between those competing objectives:
    a. For sites, or portions thereof, requiring excavation to the final subgrade level, compaction of the subgrade may not be needed, provided that loose materials are removed from the excavation, and a firm subgrade is provided for the support of the pavement system. A geotechnical engineer should observe the prepared subgrade. Local soft areas should be excavated and replaced with properly compacted fill. As an alternative to excavating and replacing material, stabilization consisting of geogrid and compacted granular fill material can be used to bridge over the soft area. Fill material should be free draining and have a hydraulic conductivity significantly higher than the subgrade soil. Fill is typically compacted to a level equivalent to 95% Standard Proctor compaction (ASTM D 698). The designer should specify the level of compaction required to support the pavement system.
    b. For sites (or portions thereof), requiring placement of fill above the existing subgrade to reach the final subgrade level, the fill should be properly compacted. Specify the hydraulic conductivity for the material that is to be placed. This should be at least one order of magnitude higher than the native material. If the type or level of compaction of fill material available for construction is different than that considered in design, additional soil evaluation should be performed to substantiate that the design infiltration rate can be met.
    c. Low ground pressure track equipment should be used within the pavement area to limit over-compacting the subgrade. Wheel loads should not be allowed.

10.8 General Plan Notes

1. See Sections 12.0 and 13.0 for additional, specific plan notes.
2. A pre-construction meeting is required prior to any work related to preparation or installation of pervious pavement. Contractor shall schedule pre-construction meeting by contacting the City Public Works Construction Inspection Office at 417-864-1958 at least 48 hours in advance.
3. The subgrade shall be excavated using low ground pressure track equipment to minimize over-compaction of the subgrade. Grading and compaction equipment used in the area of the pervious pavement shall be approved by the engineer prior to use.
4. The pervious pavement area shall not be used for construction staging or materials storage.

5. The contractor shall, at all times during and after installation, prevent sediment and debris from any source from entering the pavement base or the pavement. This may require runoff diversion, sediment controls, traffic barriers, or covers such as plastic.
6. Vehicular traffic shall be prohibited on the pervious pavement until the site is stable to prevent mud from being deposited by vehicles.
7. Stone shall be open-graded, clean, washed and meeting applicable ASTM standards.
8. No product or material substitutions are permitted unless previously approved by the City plan review engineer or by the City inspector assigned to the project. All substitutions shall be presented to the City through the engineer responsible for the design of the pervious pavement.
9. Do not clean the paver surface with high-pressure hoses or abrasives. When cleaning is necessary, a vacuum sweeper should be used alone or in combination with cleaning machines that combine a wet spray and vacuum process.

10.9 As-Built Certification

Upon completion of the pervious pavement, prior to final acceptance, an as-built plan and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following:

- The pervious pavement was built in accordance with the details, dimensions, and materials as approved by the City for this project.
- The pervious pavement was installed by a qualified contractor, and has satisfied all applicable quality control and performance tests.
- The pervious pavement installation was witnessed periodically by the certifying engineer or a representative under their direct supervision.
- Infiltration testing has been conducted per the following applicable ASTM standards, and the infiltration rates are submitted as part of the certification:
    - Pervious concrete: ASTM C1701/C1701M Standard Test Method for Infiltration Rate of In Place Pervious Concrete
    - PICP, concrete grid paving units or clay paving brick: ASTM C1781/C1781M Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems
- Requirement for unit weight test - To Be Determined

11.0 Permeable Interlocking Concrete Pavers

PICP is comprised of a layer of concrete pavers separated by joints filled with small stones. Water enters joints between solid concrete pavers and flows through an "open-graded" base, i.e. crushed stone layers with no small or fine particles. The void spaces among the crushed stones store water and infiltrate it back into the soil subgrade or into an underdrain.

11.1 PICP Design Considerations

1. See Section 10.5 for general design considerations.
2. The design engineer shall reference the following resources published by the Interlocking Concrete Pavement Institute: (1) Permeable Interlocking Concrete Pavements Manual, and (2) Tech Spec 18: Construction of PICP Systems. The Permeable Design Pro software is recommended to aid in the design; all are available at www.icpi.org.
3. The paving units supplied to construct the PICP shall meet the requirements in ASTM C936 and be designed for use as PICP.
4. Consideration should be given to the type of traffic loads placed upon the PICP. An engineer experienced with pavement design shall provide input on this aspect early in the design phase. The minimum pavement section subject to vehicular traffic shall be (from top to bottom) 3 1/8 inch thick paving units, 2-inch thick bedding stone (typically ASTM No. 8 or 9 stone), 4-inch thick layer of base stone (ASTM No. 57 or similar size), and a layer of subbase stone (ASTM No. 2 or similar size). The thickness of the subbase will vary depending on storage and anticipated traffic loads as described in ICPI guidance literature, but shall be a maximum of 36 inches. However, a minimum 6-inch thick subbase will be required for all applications. Alternate paving unit and stone thicknesses may be proposed for residential uses or very light traffic loads. The paver joints shall be filled with aggregate meeting manufacturer's specs, typically ASTM No. 8.

11.2 PICP Design Procedure and Criteria

See Section 11.6 for general design procedure and criteria.

11.3 PICP Construction Considerations

See Section 11.7 for general construction considerations. Bedding, base, and subbase rock shall be compacted per manufacturer's specifications.

11.4 PICP Plan Notes

See Section 11.8 for general plan notes.

11.5 PICP Contractor Qualifications

The PICP installation contractor must have a current Level 1 certificate from the Interlocking Concrete Pavement Institute's concrete paver installer program.

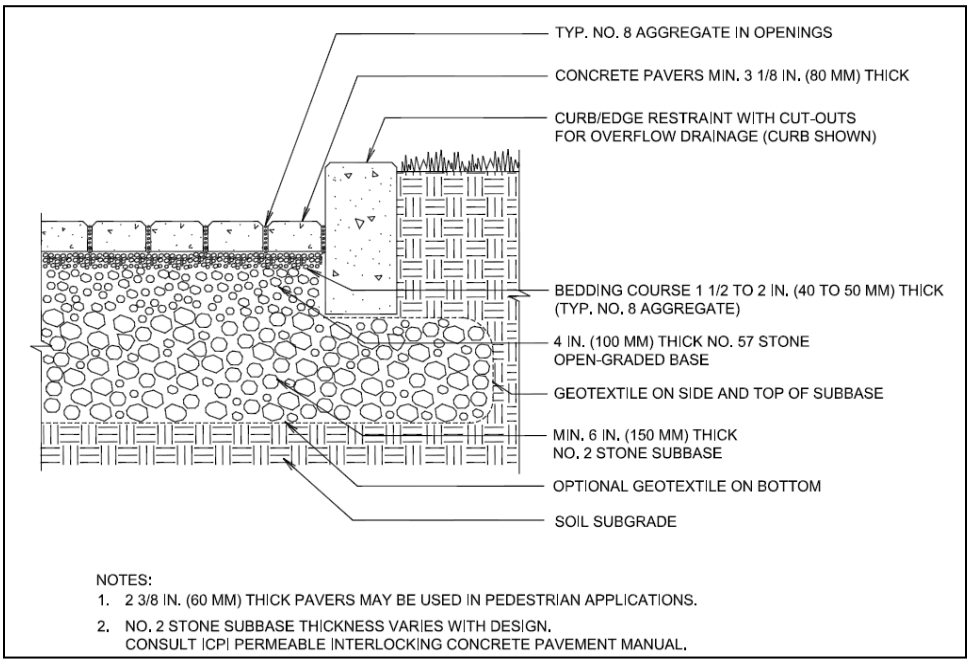


Figure 8. Typical Drawing of PICP with Full Infiltration (Source: ICPI, 2015).

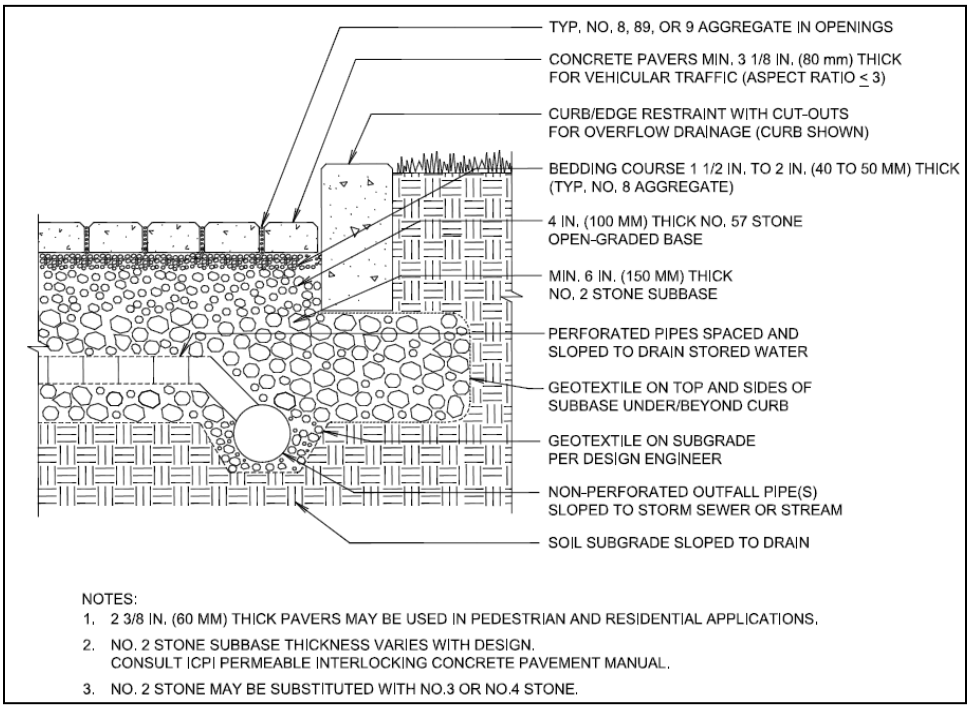


Figure 9. Typical Drawing of PICP with Partial Infiltration (Source: ICPI, 2015).

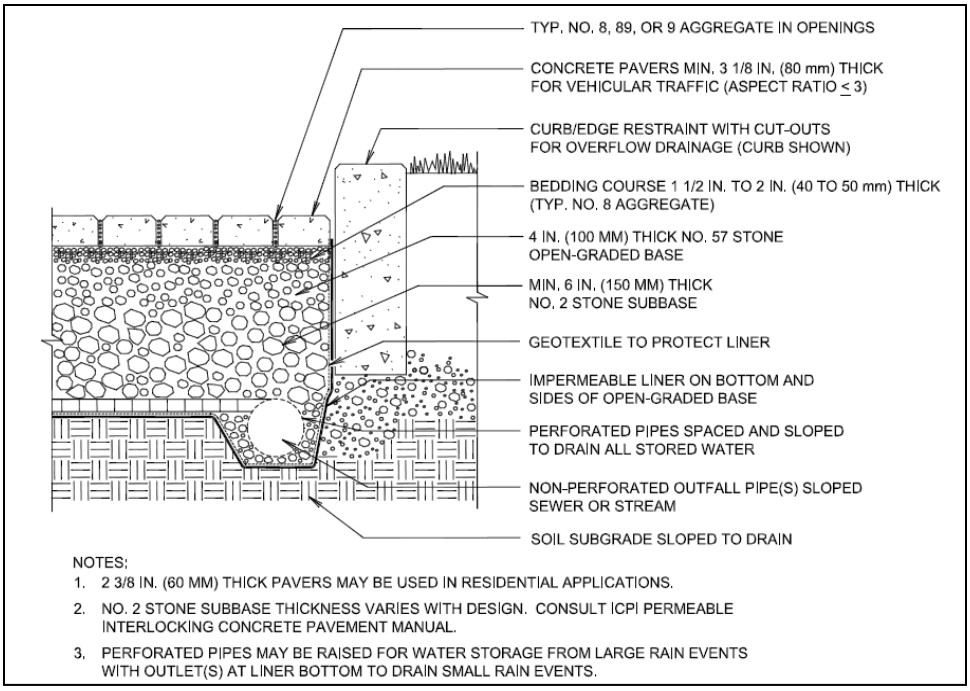


Figure 10. Typical Drawing of PICP with No Infiltration (Source: ICPI, 2015).

12.0 Pervious Concrete

Pervious concrete is a specific mix with carefully controlled amounts of water and cementitious materials that creates a system of permeable, interconnected voids. It has reduced strength compared to conventional concrete mixtures, but sufficient strength for many applications.

12.1 Pervious Concrete Design Considerations

1. See Section 11.5 for general design considerations.
2. The design engineer shall reference ACI 522.1-08, the National Ready Mixed Concrete Association (NRMCA) joint publication EB302.02.
3. A typical pavement section shall be shown on the plans. Designer should reference ACI 522.1-08 and the National Ready Mixed Concrete Association joint publication EB302.02.
4. Typical thicknesses for pervious concrete range from 6-12 inches, depending on the traffic load and other requirements.

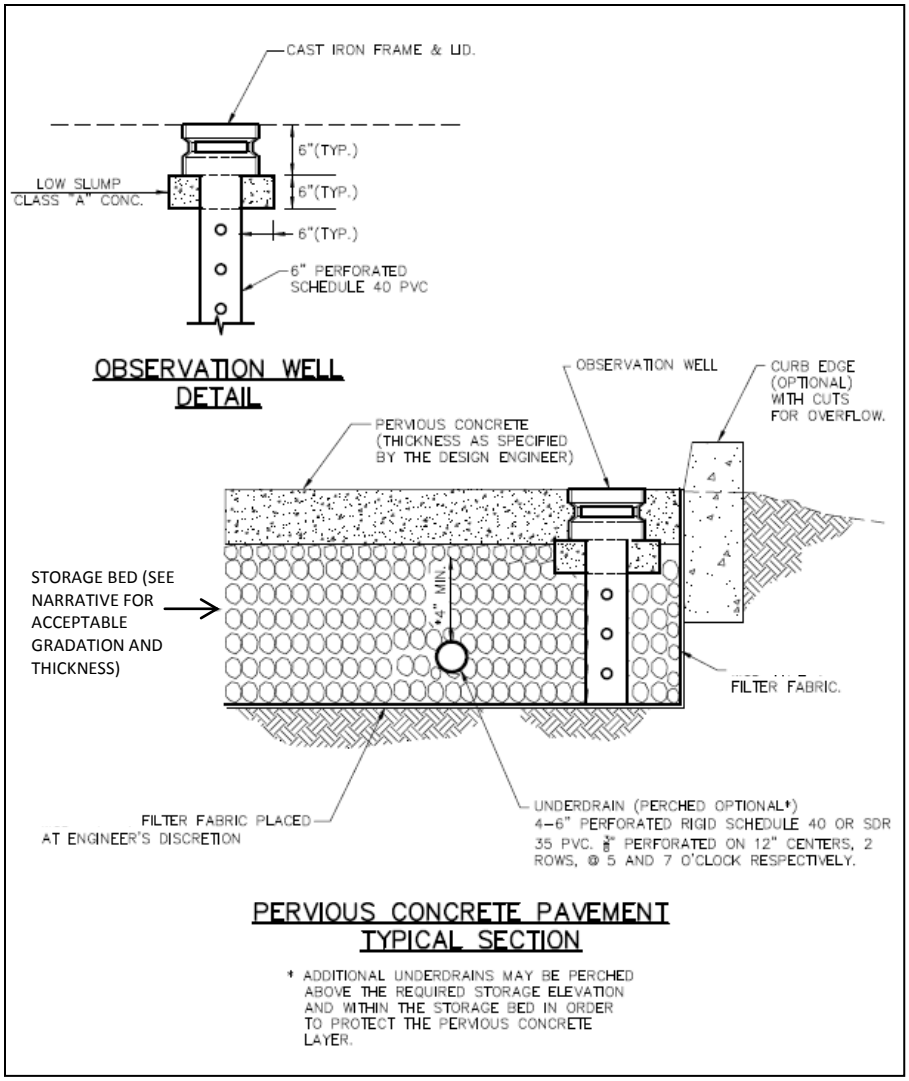


Figure 11. Typical pervious concrete section (Source: St. Louis MSD, 2014).

12.2 Plan Notes:

The following notes shall be included on plans, details, and specifications for pervious concrete pavement designs proposed for plan approval:

1. See Section 11.8 for general plan notes.
2. All pervious concrete construction shall meet the requirements of ACI 522.1-08, The National Ready Mixed Concrete Association joint publication EB302.02, and Chapter 10 of the City's Stormwater Design Criteria Manual.
3. Test panels may be constructed on-site in an area for demolition after test approval, or in an area that may be left in place and included in the completed work.
4. The subgrade shall be constructed to ensure that the required pavement thickness is obtained in all locations. The contractor shall keep all construction traffic off the subgrade area to the maximum extent possible. Regrade the subgrade as required prior to sub base and product installation.

5. Subbase must be moist (without free standing water) prior to placement to prevent water from being removed from the lower portion of the pavement too soon.
6. Pervious Concrete Mix Notes
    a. Pervious Concrete mixture should be discharged completely within one hour after initial mixing. The use of retarding chemical admixtures or hydration stabilizing admixtures may extend the discharge time to one and a half hours or more.
    b. Each load of concrete shall be visually inspected for consistency and aggregate coating.
7. Prior to placement, the subbase preparation and forms should be double-checked. Any irregularities, rutting, or misalignment should be corrected.
8. Placement should be continuous, and spreading and strike off should be rapid. Consolidation should be completed within 15 minutes of placement.
9. Joints shall be placed as specified, and may be placed at the same location along adjoining pavements. Joints shall be made using a rolling jointing tool. The contractor shall submit a joint detail plan to the Engineer providing as-built certification prior to construction.
10. Curing should be started as soon as practical (within 20 minutes is optimal) after placing, compacting, and jointing.
11. Curing is accomplished by fog misting with water and/or an appropriate cure, followed by 4-6 mil minimum poly sheeting anchored to prevent sheeting from blowing off or allowing air to billow under sheeting. The sheeting should remain for at least seven days.
12. Plastic sheeting shall be secured with lumber, rebar, staking or other methods. Avoid the use of sand or dirt as this will clog the pavement.
13. Once installed, the area shall be quarantined from all traffic until site is stable to prevent mud from being deposited.
14. Do not open the pavement to traffic until it has cured for at least seven days and is accepted by Engineer providing as-built certification.

12.3 Concrete Producer Qualifications

The engineer providing as-built certification shall verify that the concrete producer that will supply the pervious concrete has been prequalified by the City and possesses a Pervious Concrete Certification (NRMCA or approved equal).

12.4 Material Certification and Quality Control

Inspection and testing services shall be provided by a testing laboratory under the direction of a full-time employee registered as a Professional Engineer in the State of Missouri. They shall have a minimum of five years of professional engineering experience in inspection and testing of concrete construction, and the technician shall at a minimum be ACI Field Testing Technician as well as NRMCA Pervious Concrete Certified or equal.

The inspection and testing services provider, the engineer providing as-built certification, and the contractor shall establish a quality control and testing program to ensure that the pervious concrete pavement is installed in accordance with the City approved plans and project specifications. ACI 522.1-08 Section 1.6 provides a recommended quality control and testing protocol.

12.5 Pervious Concrete Contractor Qualifications

Contractors installing pervious concrete shall meet the following qualifications:

1. The contractor's past history shall demonstrate their experience and training in installing pervious concrete pavement. If the contractor has insufficient experience (less than three successful jobs), the contractor shall retain an experienced consultant (such as an engineer rated as an ACI Certified Craftsman) to monitor production, handling, and placement operations.
2. The contractor shall meet at least one of the following:
    a. At least one NRMCA Certified Pervious Concrete Craftsman will be on site overseeing each placement crew during all pervious concrete placement, or
    b. At least three NRMCA Certified Pervious Concrete Installers shall be on site installing the pervious concrete, or
    c. At least 2/3 of the placing crew shall be NRMCA Certified Pervious Concrete Technicians.

12.6 Pervious Concrete Mix and Construction Specifications

12.6.1 DESCRIPTION

The concrete described herein shall consist of a mixture of Portland cement, fine aggregate, coarse aggregate, an air-entraining agent and water combined in the proportions as set forth in these specifications. Admixtures may be added as specifically permitted. All pervious concrete mix deigns shall meet testing requirements specified in this specification. Unless otherwise specified, follow the most current revision of the General Conditions & Technical Specification for the City of Springfield, Missouri.

12.6.2 MATERIALS

12.6.2.1 Cement.

Cement shall be Portland Cement Type I or Type II conforming to ASTM C-150 Different brands or different types of cement from the same mill or the same brand or type from different mills shall not be mixed or used alternately in the same item of construction unless authorized by the Engineer. The contractor shall not store cement at the site of the work without prior approval of the Engineer. The right is reserved by the City to sample the cement either at the origin of the shipment or after delivery at the site of the work or the ready-mix concrete plant. Provisional acceptance by the City prior to the completion of tests shall in no way act as a waiver of the right to reject cement which has been shipped and unused, if upon completion of the tests, it fails to meet the requirements of the specifications. Submit a copy of the mill report on the cement and supplementary cementitious materials to be used during the course of the project.

12.6.2.2 Fly Ash.

Fly ash shall conform to ASTM C-618 Class C or Class F.

12.6.2.3 Ground Granulated Blast Furnace Slag (GGBFS).

Ground Granulated Blast Furnace Slag (GGBFS) shall conform to ASTM C 989 and meet the activity performance in Table 1 Grade 100 or grade 120.

12.6.2.4 Blended Hydraulic Cements.

Blended Hydraulic Cement Type IP or Type IS shall conform to ASTM C-595.

12.6.2.5 Water.

Water shall comply with requirements of ASTM C1602, unless specified otherwise.

12.6.2.6 Fine Aggregate.

Fine aggregate shall be natural sand, or manufactured sand that is free from cemented or conglomerated lumps. Fine aggregate shall conform to the requirements of ASTM Designation C-33.

12.6.2.7 Coarse Aggregate.

The coarse aggregate shall consist of crushed stone or crushed gravel. Coarse aggregates shall be of uniform quality and conform to the requirements of ASTM Designation C-33 Class Designation 4S.

12.6.2.8 Admixtures.

Provide admixtures certified by manufacture to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material. Chemical admixtures shall comply with ASTM C-494.

12.6.2.8.1 Air entraining

Air entraining admixture shall conform to the requirements of ASTM C 260.

12.6.2.8.2 Water reducing

Water reducing admixtures shall meet the requirements of ASTM C 494 Type A or Type F.

12.6.2.8.3 Hydration stabilizer

X.2.8.3 Hydration stabilizer admixture shall meet the requirements of ASTM C 494 Type B or D. The admixture's primary function should be as a hydration stabilizer.

12.6.2.8.4 Viscosity modifying

Viscosity modifying admixture shall meet the requirements of ASTM C 494 Type S.

12.6.2.9 Fiber Reinforcement.

Fiber reinforcement shall be used in pervious concrete and shall be either synthetic fiber or a natural fiber.

12.6.2.9.1 Synthetic Fiber.

Fiber shall meet the requirements of ASTM C 1116, Type III, ½ to ¾ inches long.

12.6.2.9.2 Natural Fiber.

Fiber shall meet the requirements of ASTM C 1116, Type IV.

12.6.3 PROPORTIONS OF MATERIALS

12.6.3.1 Cement Content.

Pervious concrete shall contain not less than 600 pounds of cement per cubic yard. Cement content includes weight of supplementary cementitious materials.

12.6.3.1.1 Fly Ash Content.

Pervious concrete may contain fly ash in amounts not to exceed 25% by weight of total cementitious material.

12.6.3.1.2 GGBFS.

Pervious concrete may contain GGBFS in amounts not to exceed 50% by weight of total cementitious material.

12.6.3.2 Water Content.

The water to cementitious material ratio (w/cm), including free surface moisture on the aggregate, shall be in the range of 0.29 - 0.32.

12.6.3.3 Fine Aggregate.

Fine aggregate may be Natural Sand or Manufactured Sand.

12.6.3.3.1 Natural Sands.

Pervious concrete may contain natural sands but shall be limited to a maximum of 8% of total aggregate weight.

12.6.3.3.2 Manufactured Sands.

Pervious concrete may contain manufactured sands but shall be limited to a maximum of 6% of total aggregate weight.

12.6.3.4 Course Aggregate.

Course aggregate shall have a nominal maximum size of 3/8".

12.6.3.5 Admixtures.

Follow manufacturer's instructions and recommendations.

12.6.3.5.1 Total Void Content.

Mix design shall assume a total void content in place of 15% - 35%. Actual void content is a function of the compaction applied during placement. When using total void content for calculating mix design absolute volume, use the total void and air content of 15% (27ft3 x .15).

12.6.3.5.2 Water Reducing Admixtures.

Water reducing admixture shall be included in mix design. Water reducing admixture shall be Type A or Type F. Adjust as needed.

12.6.3.5.3 Hydration Stabilizer.

Hydration Stabilizer admixture is required in the design and production of pervious concrete. A hydration stabilizer admixture is required in the design and production of pervious concrete. (This

admixture suspends cement hydration and delays initial set by forming a protective barrier around the cementitious particles.)

12.6.3.5.4 Viscosity Modifier.

Viscosity Modifier is required in the design and production of pervious concrete. A viscosity modifier is required in the design and production of pervious concrete.

12.6.3.6 Fiber Reinforcement.

Fibers shall be a synthetic or natural fiber uniformly dispersed in concrete mix at manufactures rate, but not less than 1 lb/cu.yd.

12.6.3.7 Mix Water.

Make final adjustment at point of discharge without exceeding design w/cm.

12.6.4 PRE-INSTALLATION REQUIREMENTS

12.6.4.1 Submittals.

Prior or during pre-installation meeting, Contractor shall submit, for review, project specifications, reference publications, drawings, and other contract documents that contain the requirements for concrete materials, proportions, and characteristics. Evidence of satisfactory performance of each material should be provided on request. If a deviation from the specified material is necessary, a full explanation to the Engineer of Record shall be included in the submittal. These documents shall be stamped with approval by the Engineer of Record prior to installation.

12.6.4.1.1 Concrete Materials.

For cement or cementitious materials the source and type of each material proposed for use on the project should be identified and included. Mill test reports, manufacture's certification of compliance, or, both shall be submitted. Proposed concrete mixture proportions shall include all material weights, volumes, density (unit weight), water-to-cement (cementitious) ratio, void content and specific gravity for each material. The concrete mixture proportions expressed in terms of quantity of each component per unit volume of concrete, combined with the freshly mixed concrete properties and the hardened concrete characteristics, shall be included with the submittal. The mass and absolute volume contributed by each material in the mixture should be included in the submittal of the mixture proportions. The quantity of cementitious material added in the powder state should be expressed as pound-mass per cubic yard (lb/yd3).

12.6.4.1.2 Aggregates.

Submit aggregate type, source and individual grading with specific gravity and absorption for each aggregate identified. In accordance with ASTM C-33 and C-330, the combined gradings of the total blended aggregate when combined aggregate concepts are used and should be included for each mixture as described in ACI 301. The fineness modulus of fine aggregate shall be reported. Specific gravity and absorption shall be submitted in accordance with ASTM C-127 and C-128, and dry-rodded unit weight for coarse aggregate per ASTM C-29. In addition, coarse aggregates shall show the size designation (as described in ASTM C-33, or D-448) or the nominal maximum size that is needed. Include service record data indicating absence of deleterious expansion of concrete due to

alkali-aggregate reactivity. All aggregate base material shall require aggregate type, source, individual grading and specific gravity and absorption reported and approved. Provide the void content for aggregate base material used on the project by both the rodding and jigging methods. The quantity of each separately batched size of coarse aggregate and fine aggregate should be expressed as pound-mass per cubic yard.

12.6.4.1.3 Admixtures.

Provide the vendor and type for all admixtures. All admixtures that are proposed for use should be identified in accordance with ASTM C-260, C-494 or another governing standard. These admixtures should be the same type as those used in the trial mixtures from which strength data were obtained. Mill test reports, manufacture's certification of compliance, or, both shall be submitted. If admixtures are to be added at a point other than the concrete batching facilities, the location should be identified. Provide admixture manufactures product data sheet for each product used. Pozzolans that are added in slurry should have their respective solid and water contents expressed as pound-mass per cubic yard. Admixtures dispensed as liquids should be expressed as fluid ounces per cubic yard (fl oz/yd3), the expected dosage range should be stated.

12.6.4.1.4 Water.

The source of mixing water should be identified. Nonpotable water requires evidence of satisfactory use in mortar or concrete in accordance with ASTM C-94, Table 2.

12.6.4.1.5 Fibers, colors pigments, and other additives.

Where the source and type of specific additions are required by the contract, they should be contained in mixtures from with strength data were obtained. Materials identified in the submittal as alternates to products specified by name should include evidence of satisfactory performance and compliance to appropriate material standards. The quantity of any premeasured, prepackaged additives, such as fibers or color pigments, should be expressed in incremental units (sacks, bags, boxes, or tins) and pound-mass per cubic yard.

12.6.4.1.6 Material Certifications.

Provide material certificates signed by manufacture certifying that each material complies with the requirements. From a qualified testing agency, provide, indicate and interpret test results for compliance of the following items; cementitious materials, fiber reinforcement, admixtures, applied finish materials, bonding agent or epoxy adhesive, joint filers.

12.6.4.2 Pre-Construction Meeting.

Owner shall hold a pre-construction meeting one week prior to placement of pervious concrete in which the Contractor, City of Springfield Public Works Inspector, Concrete Supplier, Installers, Owner and anyone else that is involved with the pervious concrete shall attend. This pre-construction meeting shall be used to discuss all aspects of the installation process, site conditions, acceptance or any additional information that is important to the placement and care of pervious concrete. Owner or contractor shall be responsible for notifying the City of Springfield Department of Public Works Inspection Office (417-864-1968) of pre-installation meeting.

12.6.4.3 Quality Assurance

12.6.4.3.1 Contractor Qualifications.

At the time of bid submission, the bidder/contractor shall submit evidence that his company currently has at least 1 in 3 of the crew members in which will be performing the work on the project are certified through the National Ready Mixed Concrete Associate (NRMCA) Pervious Concrete Contractor Certification program or have the ability to become certified through NRMCA prior to installation. The minimum number of certified individuals listed above must be present on each pervious concrete placement, and a certified individual must be in charge of the placement crew and procedures. It is suggested that the contractor is able to supply a minimum 10 member crew for pervious concrete installation. The contractor shall also provide documentation of having performed two successful pervious concrete pavement projects. Information shall include; project name and address, owner name and contact information, and any test result data that was performed (density/unit weight, void content and thickness).

12.6.4.3.2 Manufacturer Qualifications.

Manufacturer of ready-mixed concrete products shall comply with ASTM C 94/C 94M requirements for production facilities and equipment. Manufacturer certified in accordance to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" or shall be NRMCA certified within 90 days from Notice of Award.

12.6.4.3.3 Testing Agency Qualifications.

The Owner shall be responsible for contacting and hiring an independent testing agency to perform the necessary test. The independent testing agency shall be qualified in accordance with ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548. Personnel conducting field test shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01, NRMCA Certified Pervious Concrete Technician or an equivalent certification program. The testing agency shall be able to provide the following test; core samples for density/unit weight, void content and thickness.

12.6.4.4 Site Conditions

12.6.4.4.1 Traffic Control.

Traffic control plan shall be submitted and approved prior to construction activities. Traffic control shall include access for vehicular and pedestrian traffic as required for other construction activities.

12.6.4.4.2 Weather Restrictions.

Pervious concrete pavement shall NOT be installed when the ambient temperature is predicted, by the National Weather Service out of the Springfield-Branson National Airport, to be 40°F or lower during the three days following placement, unless otherwise permitted by the Engineer of Record. If ambient temperature drops below 50°F within the first seven days following placement, concrete shall be covered with an insulated blankets to maintain a temperature of 65°F. Pervious concrete shall not be placed on frozen sub-grade. Pervious concrete shall NOT be installed when the ambient temperature is predicted, by the National Weather Service out of the Springfield-Branson National Airport, to rise above 95°F the day of placement, unless otherwise permitted by the Engineer of Record.

12.6.5 CONSTRUCTION METHODS

12.6.5.1 Forms.

Forms shall be of wood, plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Forms shall be maintained so that the finished concrete will be true to line and elevation will conform to the required dimensions. They shall be designed to withstand the pressure of the concrete, the effect of vibration from a vibratory roller, vibratory truss screed, hand tamping, and all other loads incidental to the construction operations, without distortion or displacement. Oiling both inside and outside surfaces will be required to prevent warping, shrinkage or swelling. Forms shall be constructed and designed so that their removal can be effected without injury to the concrete and may be removed without causing raveling to the concrete surface. Dirt, chips, sawdust, nails, and other foreign matter shall be removed before any concrete is deposited. Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces may be used.

12.6.5.2 Sub-Grade Preparation.

For full or partial infiltration, the subgrade should be uncompacted and scarified. The designer should ensure that the thickness of the base is adequate for structural stability of the pavement based on traffic loads. For no infiltration sections (underdrain not perched), the sub-grade may be compacted by a mechanical vibratory compactor to a minimum density of 95% of the maximum dry density as established by ASTM D 698 or ASHTO T 99. Sub-grade permeability is inversely proportional to compaction so extreme care should be taken to avoid compaction levels that prevent the sub-grade from providing the design infiltration rate. If fill material is required to bring the site to subgrade elevation, it shall be clean and free of deleterious materials. It shall be placed in accordance with the geotechnical engineer's recommendations and/or the engineer of record. Do not place pervious concrete on frozen sub-grade.

12.6.5.3 Sub-Base Preparation.

A geotextile or graded filter should be used between the subbase and subgrade to prevent subgrade soils from entering the subbase voids. If a geotextile is used, a woven fabric meeting ASTM D4751 and ASTM D4633 is recommended. A geotextile shall be used on the vertical sides of the permeable pavement base to provide separation from adjacent material. An impermeable membrane or barrier may be needed if lateral flow is a concern for adjacent pavement or structures.

Base rock shall be a clean open graded stone whose depth and size shall be designed by the Engineer of Record. The base rock shall be compacted but extreme caution should be taken to avoid compaction levels that prevent the sub-base from providing the permeability assumed in the design. It shall be assumed that sub-base shall have 40% ±5% voids in accordance with ASTM C-29. The sub-base shall be firm, compacted, in a moist condition with no mud or standing water. Remove loose material from compacted sub-base and keep sub-base surface wet immediately prior to placing pervious concrete. Maintain consistent elevation of sub-base and continuously rake out any ruts that may occur. In cold weather conditions, keep sub-base protected and warm. Do not place pervious concrete on frozen sub-base.

12.6.5.4 Concrete Border.

A concrete border or concrete strip shall be used when placing pervious concrete. This concrete border shall function as a guide to pour and support pervious, and as a guide to hold and maneuver screeds, and to protect the pervious from various debris sources. The concrete border shall be constructed to a minimum width of 6 inches and to the same depth as the pervious concrete, or as designed by the Engineer of Record. Concrete border shall have control joints spaced a max of 5 feet on center, or as specified by the Engineer of Record.

12.6.5.5 Concrete Placement.

Measure batch and mix, concrete materials and concrete in accordance with ASTM C 94. Provide batch ticket for each batch discharged and used in the work, indicating Project Identification name and number, date, mixture type, mixing time, quantity, and amount of water added. Pervious concrete should be produced, delivered and discharged in accordance with ASTM C 94. Concrete delivery vehicles shall meet the Requirements of ASTM C 94.

During pre-installation meeting, it shall be determined what the mixing and delivery spacing shall be. On the day of installation, adjust mixing and delivery times based on speed of crew and weather conditions. In the event that truck spacing is ten minutes or more, after one truck has been fully discharged, level and cover pervious concrete until next truck is ready for placement. Pervious concrete shall not be left uncovered for more than 20 minutes under any circumstances.

Pervious concrete shall be installed at a maximum width of fifteen (15) feet, unless the contractor can demonstrate competence in constructing wider pavement widths to the satisfaction of the Engineer of Record. It is ideal to place concrete by position the truck down the center of the placement area. Minimize number of chutes and position the truck to discharge at an incline to help with discharge rate. Any ruts that form from concrete truck shall be raked out prior to pervious placement.

12.6.5.5.1 Test Panel.

The test panel shall be used to demonstrate competence in placing pervious concrete and to answer any questions that come with placing pervious concrete. The test panel shall be sized to show that design criteria can be achieved and a satisfactory pavement can be installed.

Test panels will still be subject to standard test methods provided in 6.6.2 Acceptance/Testing and shall meet those requirements. The owner shall approve the pervious concrete visually but the test panel will ultimately be approved by the test results. If the test panel is used in an area to receive pervious pavement and it passes all acceptance test, it may be used as part of the final product.

12.6.5.5.2 Screeding.

Strike-off pervious concrete shall be done with care as to not seal the surface void structure. The equipment to be used shall be limited to the following or as approved by Engineer of Record. Preferred strike-off method include: motorized roller screed, a slipform paver, or spreader machine in the one-step placement method or full width vibratory truss screed in the two-step placement method.

One-step placement method; the pervious concrete is placed, struck off and compacted to the design elevation using a motorized roller screed. The roller screed will accomplish the majority of the compaction and shall have an adequate weight to achieve compaction. While using the roller screed, maintain a consistent head of pervious concrete in front of the screed to fill any gaps. You may add or remove pervious concrete directly in front of screed as necessary for compaction. After roller screeding is complete, a cross roller is used to smooth and for additional compaction. A hand tamper is used to compact all exposed edges and joints.

Two-step placement method; a riser-strip or elevation spacer is attached to the top edge of forms prior to strike-off. This strip or space is set to leave a surface that is ¼" to ¾" higher than the forms. This will allow for excess pervious concrete, the thickness of the strip, to be compacted when cross rolled. The thickness of the strip shall be dictated by the weight and the ability the static roller has to compact the pervious section. After the truss screed has stuck off the excess pervious, the strips or spacers are removed and the static roller is used for final compaction. The static roller shall have sufficient weigh to compact the pervious to the level of the forms.

12.6.5.5.3 Compaction.

A weighted roller or truss screed shall be used to compact and to obtain finished surface grade of the pavement. Caution should be used when compacting pervious concrete, too much compaction can close up the voids and too little compaction can cause raveling. In addition to a weight roller or truss screed a hand roller shall be used to cross roll the pavement. Extra care shall be used to the edges of pervious concrete. A hand tamper shall be used to make sure the weak areas around the edges are compacted. If areas are found to not be at grade, extra pervious may be added but must be tamped into place. Joints, if required shall be installed after compaction is complete.

12.6.5.5.4 Curing and Finishing.

Once all compaction is completed, the pervious shall be prepped for curing. Proper curing will last a minimum of seven (7) days and ideally fourteen (14) days, uninterrupted. In order to achieve proper curing, the pervious concrete will be moist cured and covered in plastic for seven (7) to fourteen (14) days. Curing procedure shall begin immediately but no later than 20 minutes from the time the pervious concrete is discharged from the truck. After the one-step or two-step method is completed, spray the pervious concrete with soybean oil, peanut oil or linseed oil based curing compound. Sprayed-on film-forming curing compound should be avoided for curing pervious concrete pavements. Coat compacted concrete with oil then immediately cover with a minimum 6mil thick polyethylene sheet or approved covering material. The plastic cover shall cover and overlap entire pavement width and be sealed at all edges. The plastic cover shall be tightly secured to prevent wind from uncovering or coming in contact with the surface of the pervious pavement. The polyethylene sheet shall be rolled to help remove any air voids and lock the plastic onto the concrete to help eliminate surface stains and discolorations.

During cold weather placement, 6mil thick polyethylene sheet and insulation blankets shall be used but the insulation blankets shall also be sealed to not allow wind or air to enter between plastic and concrete. During warm weather placement, fogging machines shall be used to help keep moisture and help maintain cool air temperatures. Fogging machines may also be used when wind is in excess of 10 mph or relative humidity represents conditions for high evaporation of moisture. Be

sure to avoid using equipment that will create large droplets of water or using excessive fog as the cement paste may become unstable and can wash off.

12.6.5.5.5 Jointing.

Jointing may also be used during the finishing process. Saw cutting shall not be performed on pervious because the curing sheeting will have to be removed prior to the pervious obtaining enough strength to saw it. A joint roller is an approved jointing method but must be submitted along with jointing plan and jointing layout to be approved by Engineer of Record. The joint roller must meet the following guidelines; joint depth shall be at least ¼" the pavement thickness. The joint roller should be limited to one pass in one direction, placed on opposite end and pulled toward the operator.

12.6.6 ACCEPTANCE/INSPECTION

12.6.6.1 Pre-Construction Inspection.

Inspections by Engineer of record and independent testing agency should determine suitability of the site materials as to the permeability of the soil, material specifications and grade profiles. A survey company may also set grade stakes for the pavement construction.

12.6.6.2 Construction Inspection.

Contractor shall be responsible for contacting the Inspection Office of the Department of Public Works for the City of Springfield 48 hours in advance of pre-construction meeting. The contractor shall contact construction inspector 24 hours in advance of pervious concrete placement. The construction inspector shall be responsible for providing field testing which may include but not limited to: density (unit weight) test, temperature, pervious concrete consistency, and jointing. The owner is responsible for hiring an independent testing agency to do core samples immediately after the curing period has passed. The cores shall pass density (unit weight) test, thickness, infiltration, and percent voids.

12.6.6.3 Acceptance.

The pervious concrete section will be accepted based on the field density (unit weight) and the core sample results. Field density shall be within the range of 115 lbs/cuft and 130 lbs/cuft. Core sample results shall meet the following: density shall be within ±5 lbs/cuft of the field determined density. Thickness shall be within 3/8" of designed pavement thickness. Pervious concrete shall have a void content of 15% - 35%. Pervious concrete shall infiltrate at a rate of 200 in/hr - 1800 in/hr.

13.0 Bioretention (Rain Garden)

13.1 Description

Photo 11. Rain garden on Park Central East and Jefferson.

Bioretention and rain garden are often used interchangeably to refer to an engineered, depressed landscape area designed to filter, uptake, and infiltrate stormwater runoff through the natural processes of plants, microbes, and soil (APWA/MARC, 2012). The term bioretention refers to the ability of the biomass within the rain garden to retain stormwater and remove pollutants (Prince George's County, MD, 2002). In general, bioretention will be used in this chapter to refer to the process and rain garden will be used to refer to the landscape feature itself. Depending on in-situ soil and other design considerations, the rain garden can be designed without an underdrain to allow full infiltration, or with an underdrain to allow partial or no infiltration. During a storm, runoff ponds in the depressed, vegetated surface of the rain garden where a combination of processes occurs that includes evapotranspiration and pollutant uptake by plants and, depending on design, infiltration into the underlying in-situ soil and/or filtration through a porous bioretention soil mix before discharging through an underdrain. Rain gardens are best suited for meeting the water quality volume requirement but may be designed to contribute toward meeting the flood control detention requirement as well if designed properly.

13.2 Site Selection

Rain gardens are intended to be small, distributed practices that manage runoff close to the source for drainage areas of typically one impervious acre or less. Therefore, rain gardens are ideally suited for small installations such as parking lot islands and perimeter landscaping, bufferyards, roof downspout areas, and streetscapes. Managing runoff close to the source reduces the amount of runoff that must be managed further downstream with larger infrastructure. Smaller, distributed rain gardens are also preferred to minimize the potential for karst collapses due to concentrated infiltration of water. Dual use of required landscape areas as rain gardens can be an efficient and cost-effective practice. Following establishment, long-term irrigation requirements can often be reduced by designing landscaping as rain gardens. Rain gardens can be an excellent alternative to extended detention basins for small sites, or used as a companion to extended detention basins to provide runoff reduction and treatment train benefits.

Rain gardens are best suited for a stabilized drainage area (impervious surfaces or pervious surfaces with good vegetative cover) and land use with minimal sediment load. Pretreatment is recommended for rain gardens that receive parking lot or street runoff and is vital for land uses with higher than typical sediment loads. More information on pretreatment is provided in Section

13.4. The bottom surface of a rain garden should be flat. Terracing can be used in designing rain gardens on a slope.

When rain gardens (or other SCMs that allow infiltration) are proposed adjacent to buildings or pavement, protective measures should be implemented to avoid adverse impacts to these structures. Oversaturated subgrade soil underlying a structure can cause the structure to settle or result in moisture-related problems. Wetting of expansive soils or bedrock can cause swelling, resulting in structural movements. A geotechnical engineer should evaluate the potential impact of the rain garden on adjacent structures based on an evaluation of the subgrade soil, groundwater, and bedrock conditions at the site. Additional minimum requirements include:

- An underdrain shall be provided whenever possible and shall be designed to divert water away from the structure.
- In locations where potentially expansive soils or bedrock exist, placement of a rain garden adjacent to structures and pavement should only be considered if the rain garden includes an underdrain designed to divert water away from the structure and is lined with an essentially impermeable geomembrane liner designed to restrict seepage.

Site selection and rain garden design should also consider all potential maintenance requirements such as mowing (if applicable) and the future need for replacement of the growing medium. Consider the method and equipment for maintenance tasks and ensure adequate space and access to complete these tasks.

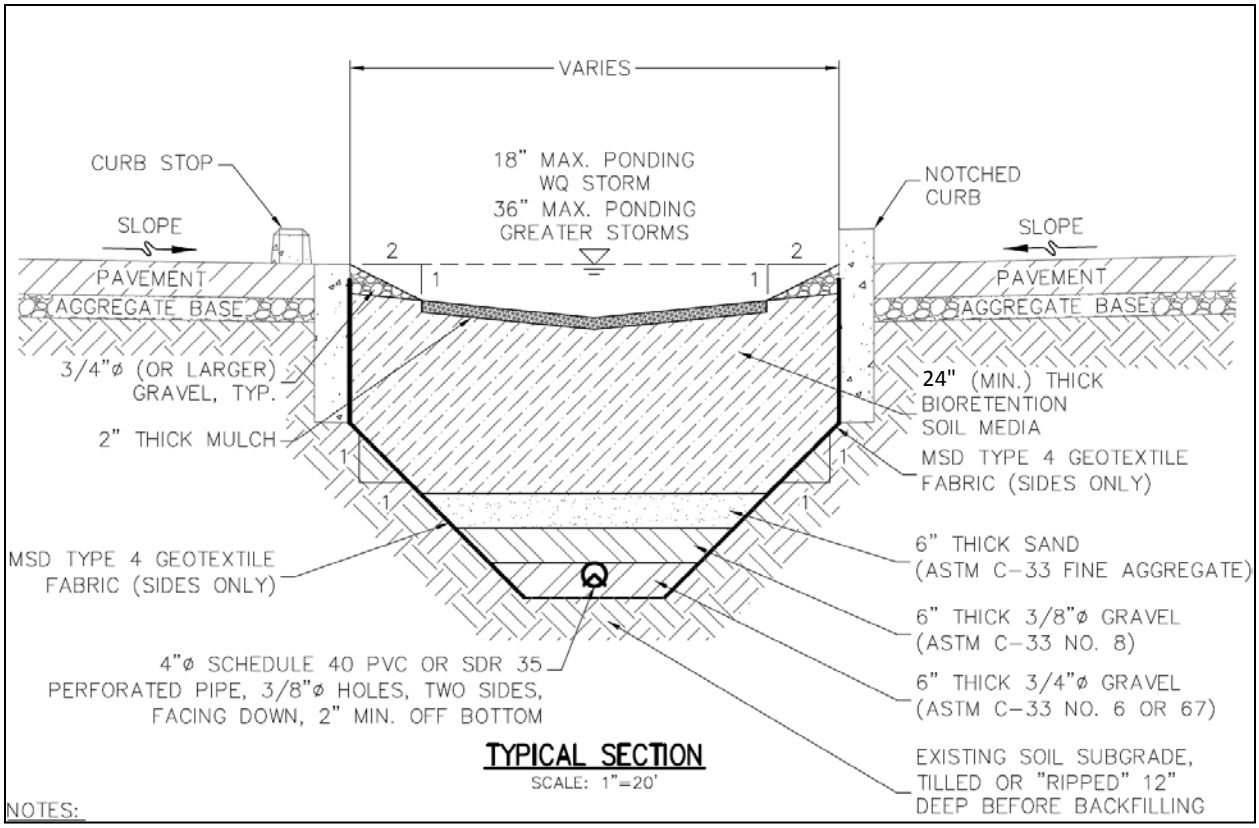


Figure 12. Rain Garden Typical Section (Source: MSD, 2010).

13.3 Design Criteria and Procedure

13.3.1 Soil and Geotechnical Evaluation

Because of local soil conditions, underdrains are often necessary in rain gardens and should be provided if the infiltration rate is slower than 2 times the rate needed to drain the WQV over 12 hours, or where required to divert water away from structures as determined by a professional engineer. Partial infiltration through the use of perched underdrains or "internal water storage" (i.e. upturned elbow) is encouraged because it improves pollutant removal and runoff reduction. The requirement for an underdrain may be waived on a case by case basis based on soil evaluation and site specific design considerations.

Either a soil evaluation shall be conducted at all proposed sites for rain gardens with full or partial infiltration, or the design infiltration rates shown in Table 5 shall be used. A safety factor of 2 shall be applied to infiltration rates determined by a soil evaluation (e.g., an infiltration rate of 1"/hr would be 0.5"/hr after applying a safety factor of 2). Soil evaluation shall consist of one of the following:

- A profile pit soil morphology evaluation as described in 19 CSR 20-3.060(2) and (7). This method of soil evaluation can be used at all sites and is recommended for sites having

significant groundwater contamination potential, severe geological limitations or severe limitations relating to restrictive layers.

- A percolation test as described in 19 CSR 20-3.060(2) and determination of depth to bedrock or other restrictive layer in areas where it is known that bedrock may exist at depths less than ten feet (10').

Based on the soil evaluation, the subgrade soil may be modified if needed to provide full or partial infiltration. The recharge bed shall be designed by the Engineer of Record.

The depth to bedrock will not only influence excavation costs, but will also influence the infiltration capabilities of the facility. If near the underlying infiltration zone (subgrade) of the rain garden, the bedrock will act as an impermeable layer. The City recommends the bottom of the infiltration component of the rain garden be located at least two feet above the bedrock.

When the groundwater table is close to the infiltration zone, this can inhibit the effective infiltration capacity of the facility. Rain garden storage should be located at least two feet above the seasonal high level of the water table. The City recommends determining this seasonal high water table elevation from taxonomy (e.g., soil borings that indicate certain types of mottling or coloration).

Table 7. Design infiltration rates (Minnesota Pollution Control Agency, 2015)

Hydrologic Soil Group	Infiltration rate (inches/hour)	Soil Textures	Corresponding Unified Soil Classification
B	0.45		SM - silty sands, silty gravelly sands
	0.3	Loam, silt loam	MH - micaceous silts, diatomaceous silts, volcanic ash
C	0.2	Sandy clay loam	ML - silts, very fine sands, silty or clayey fine sands
D	0.06	Clay loam Silty clay loam Sandy clay Silty clay Clay	GC - clayey gravels, clayey sandy gravels SC - clayey sands, clayey gravelly sands CL - low plasticity clays, sandy or silty clays OL - organic silts and clays of low plasticity CH - highly plastic clays and sandy clays OH - organic silts and clays of high plasticity

Note: Select the design infiltration rate based on the least permeable soil horizon within the first 5 feet below the bottom elevation of the infiltration zone. These infiltration rates represent the long-term infiltration capacity of a practice and are not meant to exhibit the capacity of the soils in the natural state.

13.3.2 On-line and Off-line Design

Rain gardens can be designed on-line or off-line. On-line rain gardens pass all storms either through the filter bed or the overflow. Rain gardens may be designed as on-line facilities when sized to store the detention volume, or when tributary areas are less than 0.5 acres. On-line rain gardens are required to provide an overflow that safely directs larger storms to other stormwater drainage features. Off-line rain gardens pass the water quality flow rate into the rain garden but bypass higher flows into other stormwater drainage features. This typically is provided using a weir or high-flow/low-flow piping system. Refer to Metropolitan St. Louis Sewer District's Flow Splitting Design Criteria on their BMP Toolbox website. Overflows are recommended for off-line rain gardens. The type of overflow selected should consider potential for re-suspension of trash/pollution, but also the potential for overtopping and availability of a safe overland flow path for large storms.

The design of a rain garden may provide detention for events exceeding the WQV. There are generally two ways to achieve this. The design can provide the flood control volume above the WQV water surface elevation, with flows bypassing the filter usually by overtopping into an inlet designed to restrict the peak flow for a larger event (or events). Alternatively, the design can provide and slowly release the flood control volume in an area downstream of one or more rain gardens. Rain gardens shall be designed so that runoff from storm events greater than the water quality event safely pass through or around the rain garden. If larger events are to pass through the rain garden, the maximum velocity shall be kept below 3 feet per second to avoid erosion of the soil.

13.3.3 Basin Storage Volume

Rain gardens are best suited for meeting water quality requirements. The water quality volume for the drainage area of the rain garden shall be calculated according to Section 2.1. Rain gardens can be used to help meet flood control detention requirements as well if designed properly. Orifices, weirs, and other outlet devices are typically required to release flood control volume from a rain garden. The volume of the rain garden is considered to be the ponding volume above the rain garden surface (including above the filter area and side slopes) and the volume within the bioretention soil mix, also referred to as the filter bed, sand, and gravel. A filter bed maximum porosity of 0.35 may be used for a bioretention soil mix that meets the specification in Section 13.4.3. A higher porosity can be proposed for the gravel.

13.3.4 Basin Geometry

Rain gardens should be designed as shallow as possible. Increasing the depth unnecessarily can create erosive side slopes, limit plant species and survivability, and complicate maintenance. Shallow rain gardens are also more attractive, an important consideration for public acceptance. The preferred ponding depth is 12 inches and the maximum typically allowed is 18 inches. An inlet or other means of overflow shall be provided at this elevation. When used for flood control detention, the maximum ponding depth may be increased to 36 inches if approved based on appropriate location and design considerations, including public acceptance, aesthetics, and plant survivability.

Vertical walls or side slopes can be used to achieve the required volume. Side slopes should be no steeper than 4:1 (horizontal: vertical). The bottom surface of the rain garden, also referred to here as the filter area, should be flat. Sediment will accumulate over time on the filter area. If the filter area is too small, it may clog prematurely. Increasing the filter area will reduce clogging and decrease the frequency of maintenance. The following equation calculates the minimum filter area.

$A = 2/3*V$ where

A = minimum filter area (flat surface area) in ft^2

V = design volume in ft^3

The bioretention soil mix can be limited to only the filter area to minimize cost. If in-situ soil is used outside of the filter area, it should be amended as needed for plant health.

13.3.5 Bioretention Soil Mix

For partial and no infiltration sections, provide a minimum of 24 inches of bioretention soil mix for pollutant removal and plant health. A greater depth may be needed to accommodate trees. For full infiltration sections, bioretention soil mix is optional as needed to meet design volume and drain time requirements. In-situ soils in full infiltration sections may need to be replaced or amended for plant health. Biorention soil mix or other suitable growing medium or amendments may be used to replace or amend in-situ soils in full infiltration sections.

The bioretention soil mix shall be a uniform mix, free of stones, stumps, roots or other similar objects larger than two inches excluding mulch. For best results, it should be free of noxious weed seeds. The composition of the bioretention soil mix is important in balancing the objectives of pollutant removal, plant growth, infiltration rate, local availability, and affordability. The majority of Springfield drains to the James River which is impaired for excess nutrients that cause algae growth and reduced water clarity. The City's MS4 permit requires addressing this impairment by implementing measures that reduce the discharge of phosphorus and nitrogen to the maximum extent practicable. The bioretention soil mix shall meet the criteria in Tables 6 and 7. These criteria are adapted from APWA/MARC (2012), with an increased percentage of sand and a phosphorus index based on Minnesota Pollution Control Agency (2015) to reduce the discharge of phosphorus from the rain garden. This mix is intended to balance the above objectives. Soil mixes that do not meet the criteria in Tables 6 and 7 may be acceptable on a case by case basis. Documentation that the bioretention soil mix meets the criteria in Tables 6 and 7 shall be submitted prior to placement of the mix in the rain garden.

Table 8. Bioretention Soil Mix Composition

Component	Percent by Volume	Reference
Sand	60%	ASTM C33
Planting Soil	25%	See Section 13.4.3.1
Compost	15%	See Section 13.4.3.2

Table 9. Bioretention Soil Mix Testing Criteria

Test Parameter	Criteria[1]	Test Method
pH	6 - 8	Standard[2]
Magnesium	Minimum 32 ppm	Standard[2]
Phosphorus Index	10-30 mg/kg	Mehlich-3 (or equivalent)
Potassium (K_2O)	Minimum 78 ppm	Standard[2]
Soluble Salts	Not to exceed 500 ppm	Standard[2]

[1]If the criteria for pH, magnesium, or potassium are not met, the bioretention soil mix may be amended by uniform mixing with lime, ammonium sulfate, magnesium sulfate, or potash as needed to meet the criteria. [2]Use standard soil test procedures such as those used by MU Extension Soil and Plant Testing Laboratory.

13.3.5.1 Planting Soil

The USDA textural classification of the planting soil component of the bioretention soil mix shall be loamy sand or sandy loam. The planting soil shall be the best available on site material or furnished. Additionally, the planting soil shall be tested and meet the criteria in Tables 7 and 8.

Table 10. Composition of Planting Soil Component of Bioretention Soil Mix

Component	Percent by Weight	Test Method
Sand (2.0-0.050 mm)	50-85%	AASHTO T88
Silt (0.050-0.002 mm)	0-50%	AASHTO T88
Clay (less than 0.002 mm)	2-5%	AASHTO T88
Organic Matter	3-10%	AASHTO T194

Table 11. Textural Analysis of Planting Soil Component of Bioretention Soil Mix

ASTM E11 Sieve Size	Minimum Percent Passing By Weight
2 inch	100
No. 4	90
No. 10	80

13.3.5.2 Compost

Compost is a homogenous and friable mixture of partially decomposed organic matter, with or without soil, resulting from composting, which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase. Compost shall be derived from the decomposition of yardwaste as defined MDNR (2014). Compost derived from animal or poultry manure shall not be acceptable. Additionally, the compost shall have a C/N ratio < 25, indicating a finished compost.

13.3.6 Drain Time and Underdrain System

The required drain time for a rain garden is 12-72 hours. Rain gardens can be designed for full, partial or no infiltration. Full infiltration sections are designed to infiltrate all of the stored water into the subgrade soil. They are appropriate where soil and geotechnical conditions are suitable and meet the required drain time. Partial infiltration sections have an underdrain but do not include an impermeable liner, allowing for some infiltration into the subgrade soil. The underdrain system may be perched or designed for internal water storage (i.e. upturned elbow) to increase the amount of infiltration for improved pollutant removal and runoff reduction. No infiltration sections have an underdrain and impermeable liner that does not allow for any infiltration into the subgrade soil. No infiltration sections (i.e. impermeable liner) are appropriate in the following situations:

- Land use or activities could contaminate groundwater if stormwater is allowed to infiltrate,.
- The rain garden is located over potentially expansive soils or bedrock and is adjacent (within 10 feet) to structures.

When using an underdrain, provide a control orifice sized to drain the design volume in 12-72 hours. Underdrains shall be spaced a maximum of 20 feet on center. Provide cleanouts to enable observation and maintenance of the underdrain. Calculate the diameter of the orifice for a 12-hour drain time using the orifice sizing equation in Section 14 for extended detention basins. Use a minimum orifice size of 3/8 inch to avoid clogging.

The underdrain shall be 4-6" perforated or slotted pipe. Do not put a filter sock on the underdrain. This is not necessary and can clog. The underdrain shall be placed with a minimum 6 inch thick section of 3/4 inch gravel. To separate the underdrain gravel layer from the bioretention soil mix, a

graded filter is preferred instead of a geotextile to reduce the potential for clogging. The graded filter shall consist of a 6 inch thick layer of ASTM-33 sand underlain by a 6 inch thick layer of 3/8 gravel. A geotextile separator fabric may be used on the sides of the rain garden if needed but should not be used between the underdrain gravel layer and the subgrade.

13.3.7 No-Infiltration Impermeable Geomembrane Liner

Designers should refer to the Bioretention section of the UDFCD *Urban Storm Drainage Criteria Manual* (2013) when designing an impermeable liner system for bioretention.

13.3.8 Pretreatment

Pretreatment should be provided for rain gardens with larger (>0.5 acres) drainage areas to prevent erosion of the filter bed and capture trash and coarse sediment that can shorten the life of the filter bed. Pretreatment is recommended for rain gardens with smaller drainage areas as well. The two most common methods of pretreatment are forebays and sheetflow over vegetated or gravel filter strips. For rain gardens with larger drainage areas (>0.5 acres), it is recommended to size the forebay to store 25% of the water quality volume. The forebay floor should be designed to fully drain to the surface of the rain garden filter bed. For smaller rain gardens, forebays can be designed as small sumps with a concrete or rock bottom. A filter strip is typically used when stormwater enters the rain garden as overland flow. A grass filter strip or combination gravel diaphragm and grass filter strip between the diaphragm and filter bed can be used. Hydrodynamic separators or baffle boxes can also be used as pretreatment, particularly if higher loads of solids and floatables are anticipated. Rain barrels can be used as a method for slowing velocities and providing additional storage for roof runoff upstream of a rain garden.

13.3.9 Inlet and Outlet Design

How flow enters and exits the rain garden is a function of the location and overall drainage design for the site. Common inlet designs include curb cuts, curb or grate inlets, trench drains, or small pipe discharges. Flow into the rain garden can also occur as overland flow. The most important aspect of site and inlet design is making sure the runoff from the intended drainage area gets into the rain garden. Runoff bypassing the rain garden is a common problem and can result from inlet design, insufficient slope, tight designs that don't allow for construction and paving tolerances, and inadequate construction staking (Photo 12).

Photo 12. Inadequate construction staking may have contributed to flows bypassing this rain garden (Source: UDFCD, 2010).

The following are specific considerations for inlet design:

- Slope of drainage area toward the rain garden shall be a minimum of 1% and shall be sufficiently greater than slopes in other directions to ensure runoff goes into the rain garden and bypass doesn't occur. Adequate spot elevations shall be provided on the plans to ensure the grades of the drainage area are constructed as intended for drainage into the rain garden.
- Grades shall ensure drainage from the pavement into the gutter occurs upstream of the curb cut. Even when grades are correct, placement of asphalt can create a high spot where the asphalt meets the concrete gutter, which can cause runoff to bypass (Photo 13). Plan notes and proactive communication with the pavement contractor are necessary to prevent these types of issues.
- The slope of the gutter toward the curb cut shall be greater than the longitudinal slope of the gutter.
- The curb cut opening shall be wide enough to ensure the design storm runoff does not bypass the curb cut, depending on velocity and slopes. Curb cuts with 2 ft or 4 ft width are common.

Photo 13. Runoff appears to be bypassing the concrete gutter due to the asphalt elevation increasing where it meets the gutter.

Photo 14. The longitudinal slope appears to be greater than the cross slope, causing some runoff to bypass the curb cuts.

- The gutter shall be designed with a depression or grooves in front of the curb cut opening as needed to ensure runoff does not bypass the opening.
- Provide erosion protection and energy dissipation in the form of rock, or a small concrete sump. The sump may also act as a sediment forebay for pretreatment (see Section 13.4.6).

Careful design is also needed for rain garden outlets. In addition to serving as inlets, curb cuts can also be designed as outlets to release runoff in excess of the design volume. Other common designs for overflow above the design volume include atrium grates and grated inlets. If using a curb inlet outside of the rain garden for bypassing of flows that exceed the design volume, ensure that the design volume of runoff will not short-circuit the rain garden. Rain gardens used in a series, such as on a slope, may be designed to pond and overflow to the next downstream rain garden with a curb cut, weir, level spreader, or outlet structure.

13.3.10 Vegetation

Vegetation is vital for the bioretention processes in the rain garden. Plants uptake pollutants, remove water through evapotranspiration, and improve infiltration through root growth and improved soil structure. Attractive vegetation is also vital for public acceptance of rain gardens. Through careful design and plant selection, rain gardens can blend seamlessly with surrounding landscaping or be a distinct, attractive feature that complements the surrounding design. See Section 6.0 for more information on plant selection.

The surface of the rain garden should be mulched to protect against erosion. Wood mulch or rock mulch is acceptable. Wood mulch provides some benefits over rock mulch for pollutant removal and may be more beneficial in regulating temperature and moisture for plant health. It can also be easier to remove accumulated sediment on wood mulch. However, wood mulch decomposes and need to be replaced periodically. Rock mulch generally only needs to be replaced if removed as part of sediment removal. If using wood mulch, it shall be hardwood mulch to minimize floating of the mulch. The use of wood mulch should also be considered when designing the overflow to minimize clogging. If using rock mulch, a 1 inch diameter decorative rock is common with larger rock at inlet points.

If installing irrigation, design and adjust the irrigation system (temporary or permanent) to provide appropriate water for the establishment and maintenance of the vegetation without over-saturating the soil and reducing the capacity of the rain garden for rain events.

13.3.11 Design Procedure for Full Infiltration (No Underdrain)

Use the following steps in the bioretention (rain garden) worksheet:

1. Indicate whether the bioretention is being used to meet water quality volume, detention volume, or both.
2. Input site data (DCIA, required design volume, soil type and saturated hydraulic conductivity)
3. The worksheet calculates the minimum surface area.
4. Input actual design surface area.
5. Input filter bed thickness, porosity of filter bed, and surface ponding depth.
6. The worksheet calculates the storage volume above the rain garden and the storage volume within the filter bed, and checks that the required design volume is met.

13.3.12 Design Procedure for Partial Infiltration (Perched Underdrain)

Use the following steps in the bioretention worksheet:

1. Indicate whether the bioretention is being used to meet water quality volume, detention volume, or both.
2. Input site data (DCIA, required design volume, soil type and saturated hydraulic conductivity)
3. The worksheet calculates the minimum surface area.
4. Input actual design surface area.
5. Input filter bed thickness, porosity of filter bed, and surface ponding depth.

6. The worksheet calculates the storage volume above the rain garden and the storage volume within the filter bed, and checks that the required design volume is met.
7. Input underdrain data (depth of filter bed below underdrain, distance from maximum ponding elevation to the center of the orifice, underdrain pipe diameter).
8. The worksheet will calculate the orifice diameter for a minimum 12 hour drain time.
9. Input row spacing and number of rows of the perforated pipe.
10. The worksheet calculates the orifice area, drain time of the pipe, the drain time of the subgrade below the pipe, and the total drain time.

13.3.13 No Infiltration (Impermeable Liner)

Use the following steps in the bioretention worksheet:

1. Indicate whether the bioretention is being used to meet water quality volume, detention volume, or both.
2. Input site data (DCIA, required design volume, soil type and saturated hydraulic conductivity)
3. The worksheet calculates the minimum surface area.
4. Input actual design surface area.
5. Input filter bed thickness, porosity of filter bed, and surface ponding depth.
6. The worksheet calculates the storage volume above the rain garden and the storage volume within the filter bed, and checks that the required design volume is met.
7. Input underdrain data (distance from maximum ponding elevation to the center of the orifice, underdrain pipe diameter).
8. The worksheet will calculate the orifice diameter for a minimum 12 hour drain time.
9. Input row spacing and number of rows of the perforated pipe.
10. The worksheet calculates the orifice area and the drain time of the underdrain.

13.4 Construction Considerations

Do not allow machinery on bottom surface of rain garden. If machinery must enter rain garden area, use small, tracked equipment to minimize compaction. Do not allow machinery in the rain garden when the bottom surface of the rain garden is wet as this may smear the soil, greatly reducing infiltration. Start digging at one end and work out so machinery does not track on bottom of finished excavation. Excavation must be flat but not smooth. Do not scrape the bottom smooth since this will reduce infiltration.

13.5 As-Built Certification

Upon completion of the bioretention, prior to final acceptance, an as-built plan and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following: To Be Determined.

14.0 Extended Dry Detention Basin

14.1 Description

An extended dry detention basin (EDB) is a basin designed to provide sedimentation by detaining and slowly releasing stormwater. An EDB is similar to a detention basin used for flood control but is designed with a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal, primarily through sedimentation. An EDB is called "dry" because it is designed not to have a significant permanent pool of water remaining between storm runoff events. It can be used for regional or on-site treatment or as follow-up treatment in series with other SCMs.

An EDB should typically be designed and maintained to pool water for no more than the design drawdown time of 24 to 48 hours. In cases where there is a sufficient distance between the EDB and the nearest residential land use, it may be desirable to allow pools to form and wetland vegetation to grow. These plants generally provide water quality benefits through pollutant uptake, but they often cause public complaints when located near a residential area. In addition, the bottom will be the depository of all the sediment that settles out in the basin. As a result, the bottom can be muddy and may have an undesirable appearance. To mitigate this problem, the designer may provide a small wetland marsh or ponding area in the basin's bottom, which may be considered as part of the design to promote biological uptake of pollutants.

In addition to reducing peak runoff rates and improving water quality, an EDB can be designed to provide other benefits such as recreation, wildlife habitat and open space. As with other SCMs, public safety issues need to be addressed through proper design. EDBs may also be used during land development to trap sediment from construction activities within the tributary drainage area. The accumulated sediment, however, must be removed after upstream land disturbance ceases and before the basin is placed into final long-term use.

14.2 Site Selection

EDBs are best suited for watersheds with at least five impervious acres up to approximately one square mile of watershed. They can be designed for smaller watersheds as long as the outlet structure criteria can be met. Small watersheds can result in orifice sizes that are prone to clogging. Larger watersheds and watersheds with baseflows can complicate the design and reduce the level of treatment provided. EDBs are well suited where flood control detention is incorporated into the same basin.

14.3 Design Considerations

- It is imperative to plan land use correctly to account for an EDB. The land required for an EDB is approximately 0.5 to 2.0 percent of the total tributary development area, depending on directly connected impervious areas and other factors.
- Special consideration must be made when placing an EDB in an area of high groundwater, wet weather springs or areas that otherwise have baseflow. Consideration should be given to constructing an extended wet detention basin or a wetland bottom in those cases. If an

EDB is constructed in this case, a low flow channel shall be constructed to maintain positive drainage to allow mowing and maintenance. Sites with persistent flow typically require a special design by a qualified professional for the unique conditions of the site.

- EDBs should be incorporated into the larger flood control basin whenever possible. In all cases, the embankments and spillway shall be designed to safely pass the 100-year flow as described in Chapter 9, Detention for Flood Control.
- When multiple uses such as recreation or habitat creation are incorporated into a detention basin, a multiple-stage design should be used to limit the frequency of inundation of passive recreational areas. Generally, the area within the WQV is not well suited for active recreation facilities such as ballparks, playing fields, and picnic areas. These are best located above the WQV pool level.
- Soil maps should be consulted, and soil borings may be needed to establish design geotechnical parameters, particularly for larger basins or when bedrock or other sensitive karst features are believed present. A regular concern with storage basins in Springfield is "puncturing" limestone during the course of excavation, thereby providing a conduit for stormwater in the shallow groundwater system.
- Access to critical elements of the pond, such as the inlet, outlet, spillway, and sediment collection areas must be provided for maintenance purposes.

14.4 Aesthetic Design

When an EDB is designed with aesthetics in mind, it becomes an amenity of much greater value to a landowner. Softened and varied slopes, interspersed fields, planting areas and wetlands can all be part of an EDB. The design should be aesthetic whether it is considered to be an architectural or naturalized basin. Architectural basins incorporate design borrowed or reflective of the surrounding architecture or urban forms. An architectural basin is intended to appear as part of the built environment, rather than hiding the cues that identify it as a stormwater structure. A naturalized basin is designed to appear as though it is a natural part of the landscape. The built environment, in contrast to the natural environment, does not typically contain the randomness of form inherent in nature. Constructed slopes typically remain consistent, as do slope transitions. Even dissipation structures are usually a hard form and have edges seldom seen in nature. If the EDB is to appear as though it is a natural part of the landscape, it is important to minimize shapes that provide visual cues indicating the presence of a drainage structure. The following are suggested methods for designing a naturalized basin.

- Create a flowing form that looks like it was shaped by water.
- Extend one side of the basin higher than the other. This may require a berm.
- Shape the bottom of the basin differently than the top.
- Slope of one side of the basin more mildly than the opposing side.
- Vary slope transitions both at the top of the bank and at the toe.
- Use a soft-surface trickle channel if appropriate and approved.
- When using rock for energy dissipation, the rock should graduate away from the area of hard edge into the surrounding landscape. Other non-functional matching rock should

occur in other areas of the basin to prevent the actual energy dissipation from appearing out of context.

- Design ground cover to reflect the type of water regime expected for their location within the basin.

14.5 Design Procedure and Criteria

The following steps outline the design procedure and criteria for an extended dry detention basin. Figure 4 shows a representative layout of an EDB.

1. Calculate the design volume based on the WQV for the drainage area and any reductions or credits based on upstream SCMs.
2. The basin length to width ratio (L:W) should be between 2:1 and 4:1 and the inlets should be as far as possible from the outlet. Maximizing the distance between the inlet and the outlet and shaping the pond with a gradual expansion from the inlet and a gradual contraction toward the outlet will minimize short-circuiting.
3. Basin side slopes should be a maximum of 4H:1V and the use of flatter slopes is encouraged to facilitate maintenance, access, and safety. If steeper side slopes are necessary, 3H:1V is the maximum allowed and must incorporate a flatter upper zone and/or a "safety bench."
4. Determine the preliminary basin geometry necessary to provide the design volume. Select the preferred depth of the basin, then solve for the basin bottom width that will provide adequate storage of the design volume. Assume a trapezoidal pond with the selected L:W ratio, side slopes and basin depth. The EDB design spreadsheet will assist with this calculation. This information is not necessary if detailed stage-area-volume relationships are available for the EDB.
5. Design the outlet structure to release the design WQV over a 24- to 48-hour period. The outlet structure shall consist of a perforated plate with a stainless steel well-screen trash rack. Figure 5 shows details for a perforated plate. The outlet structure shall meet the requirements in Table 6. Use the fewest number of columns possible to maximize the perforation hole diameter. This helps to reduce clogging problems. The EDB design spreadsheet should be used to complete the design.

Table 12. Requirements for Water Quality Outlet Structures

Parameter	Perforated Plate Requirement
Minimum Perforation Diameter	1/2 inch
Maximum Perforation Diameter	2 inches
Minimum Number of Holes Per Row	1
Maximum Number of Holes Per Row	3
Minimum Row Spacing	4 inches
Maximum Row Spacing	12 inches

6. For perforated plates, provide a trash rack of sufficient size to prevent clogging of the primary water quality outlet. Size the rack so as not to interfere with the hydraulic capacity of the outlet. Using the total outlet area (calculated by multiplying the perforation area per row by the number of rows) and the selected perforation diameter, Figure 5 will help to determine the minimum open area required for the trash rack. Use one-half of the total

outlet area to calculate the trash rack's size. This accounts for the variable inundation of the outlet orifices. The EDB design spreadsheet should be used to complete the design.

7. A freeboard of at least 12 inches shall be provided above the 100-year water surface elevation for all EDBs (including facilities that are solely for water quality purposes and allow larger flows to "pass through") and detention areas in accordance with Chapter 9, Detention.
8. A low flow channel should be provided when groundwater or base flow exists in the basin or as required in Chapter 9, Detention.
9. Consideration should be given to the use of native grasses and plants for pond bottoms, berms, and side slopes.
10. Access to the facility shall be provided for maintenance. Grades of the access should not exceed 10 percent, and a stabilized, all-weather driving surface must be provided.
11. Energy dissipation and erosion control should be provided at inlets in accordance with Chapter 9, Detention.
12. A forebay should be considered when the design volume exceeds 20,000 ft^3 or a large sediment, trash or debris load is anticipated due to upstream land use. A forebay provides an opportunity for larger particles to settle out in the inlet area, which has a solid surface bottom to facilitate mechanical sediment removal. The forebay volume for the extended dry detention basin should be between 3 and 5 percent of the design volume. Outflow from the forebay to the basin shall be through a gravel filter designed to be stable under maximum design flow conditions. The top of the gravel filter shall be set equal to the stage of the design volume. The floor of the forebay should be concrete and contain a low flow channel to define sediment removal limits.
13. Combining the water quality facility with a flood control facility is acceptable. Design of the flood control volume may assume the extended dry detention basin is dry at the beginning of the storm. Additional information can be found in Chapter 9, Detention.
14. Plan and design the facility with appearance and neighborhood compatibility as design objectives. Consider naturalized basin design (see Section 13.3).

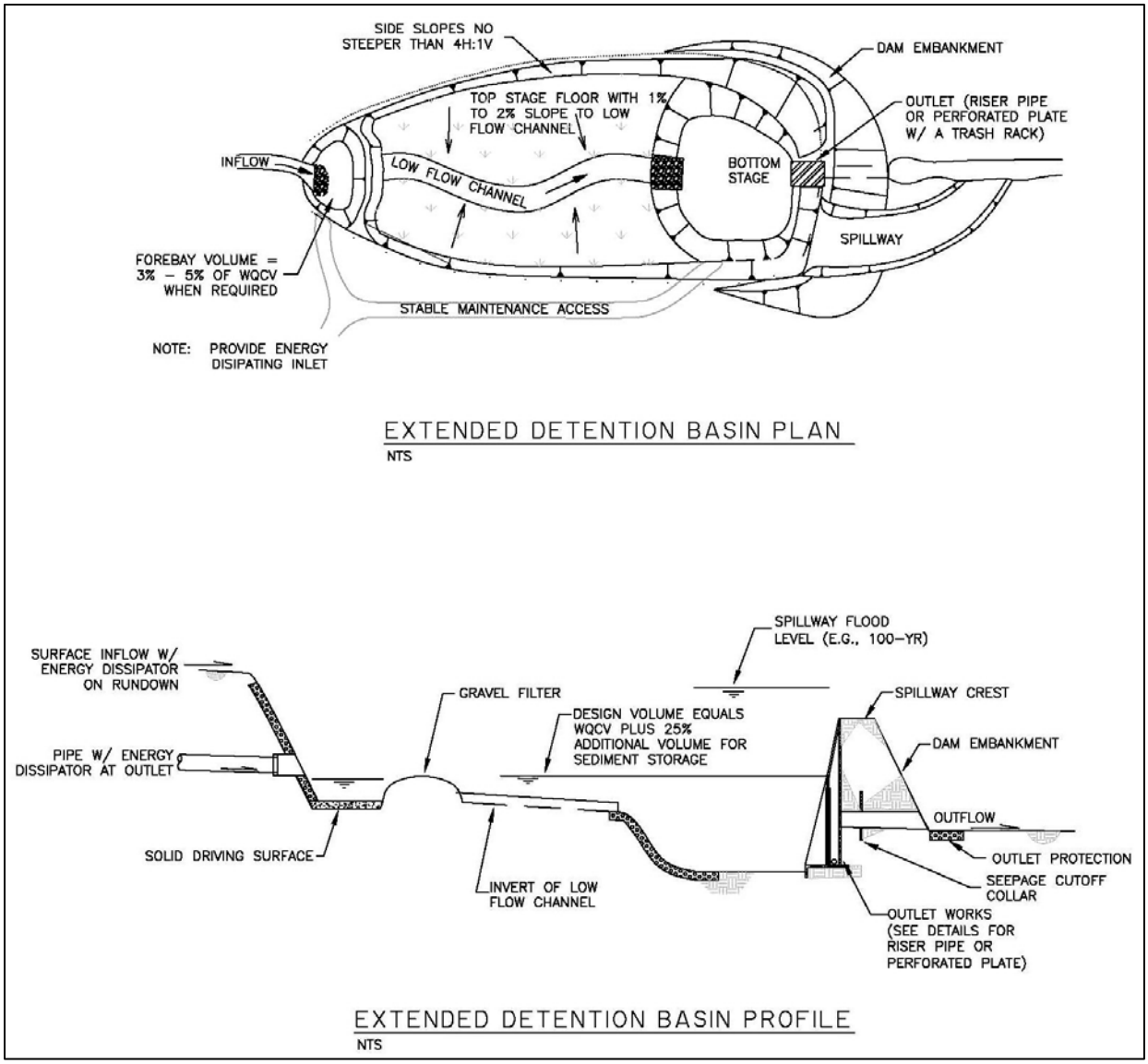


Figure 13. Extended Detention Basin Plan and Profile

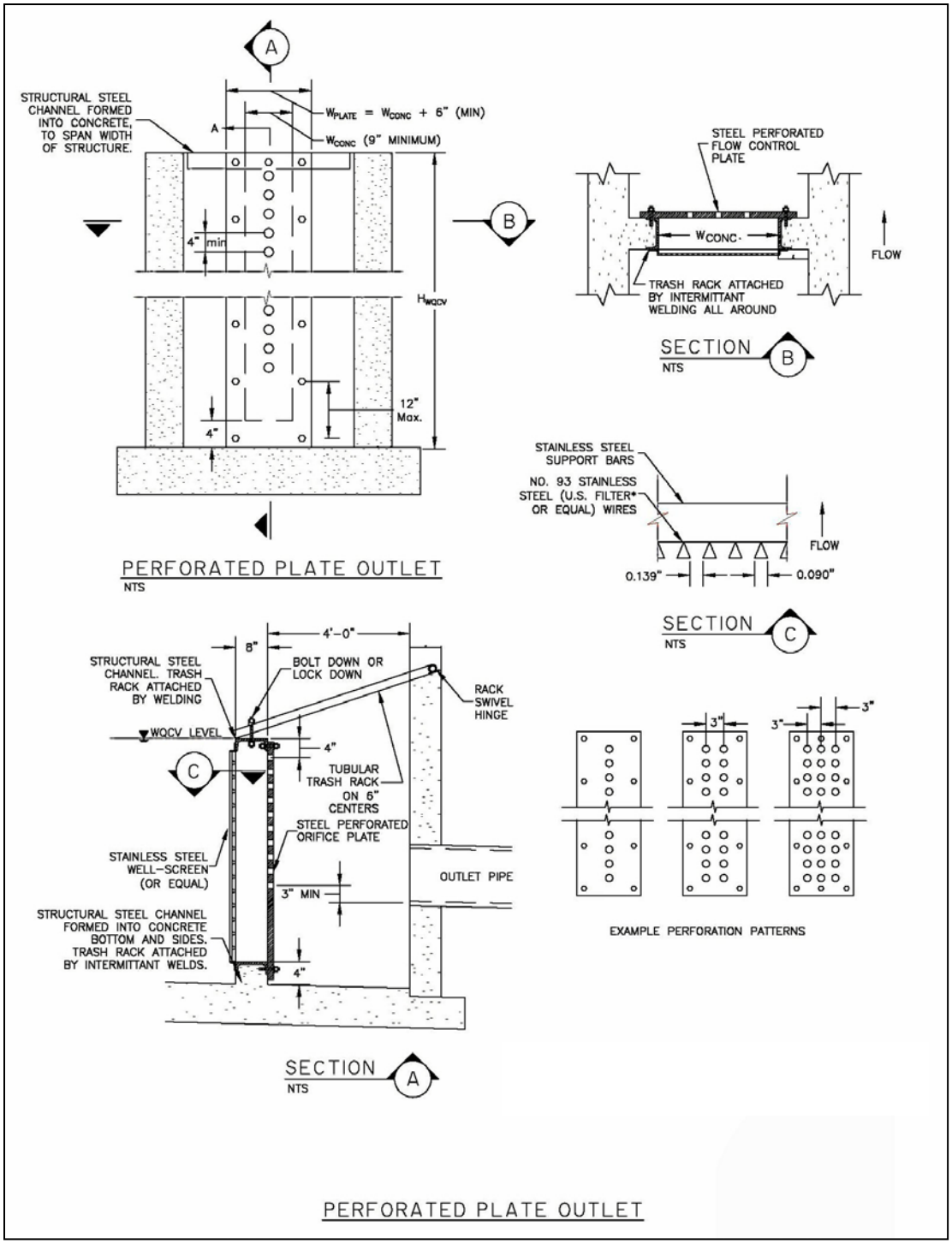


Figure 14. Details for a Perforated Plate and Trash Rack

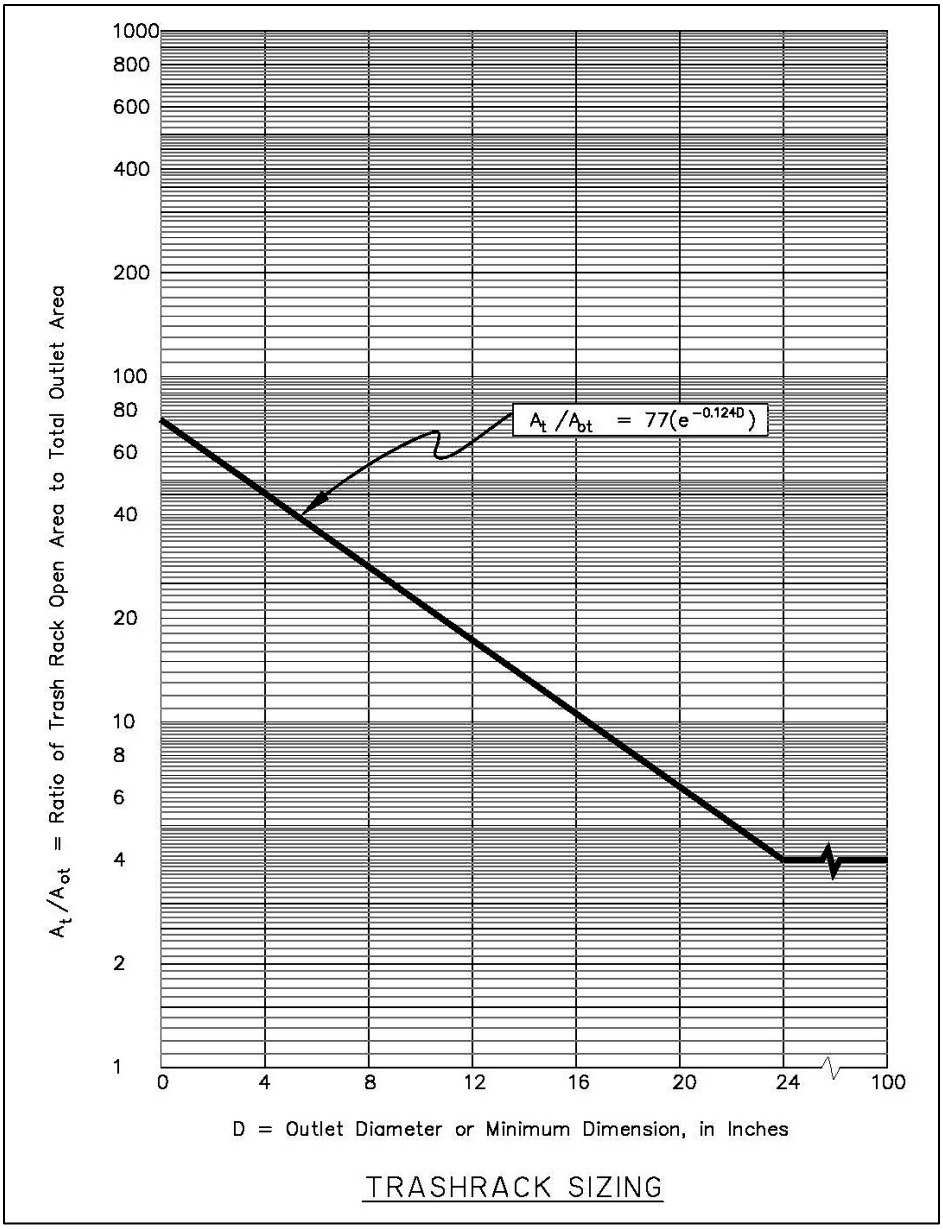


Figure 15. Trash Rack Sizing

14.6 Construction Considerations

14.7 As-Built Certification

Upon completion of the EDB, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following:
To Be Determined

15.0 Extended Wet Detention Basin (Retention Pond)

15.1 Description

Photo 15. Extended wet detention basin.

Similar to an extended dry detention basin, an extended wet detention basin (also sometimes called a retention pond or wet pond) is designed to collect the runoff from smaller, more frequent rainfall events and release the runoff over a longer period of time. The design collects and treats the "first flush" runoff, which typically has a higher concentration of most pollutants found in urban runoff. Like an extended dry detention basin, an extended wet detention basin can be used for regional or on-site treatment or as follow-up treatment in series with other SCMs. Unlike an extended dry detention basin, an extended wet detention basin is designed with a permanent pool, which provides water quality benefits as the influent water mixes with the permanent pool water and most of the sediment deposits remain in the permanent pool zone. An extended wet detention basin provides a similar level (or better due to the permanent pool) of water quality treatment as compared to an extended dry detention basin, but in less time because the outflow occurs above the bottom of the basin and sedimentation continues after the captured surcharge volume is emptied.

An extended wet detention basin should be designed with the WQV above the permanent pool, and the outlet structure should be sized to drain the WQV in approximately 12 to 15 hours. The reduced drain time (when compared to the extended dry basin) is due to the permanent pool. Flood control volume may also be provided above the permanent pool by including modified outlet controls, a 100-year (minimum) overflow spillway and a minimum of 1 foot of freeboard above the 100-year water surface.

Extended wet detention basins can be very effective in removing pollutants and, when properly designed and maintained, can satisfy multiple objectives such as the creation of wildlife habitats; provision of recreational, aesthetic, and open space opportunities; and inclusion into a larger, regional flood control basin. An extended wet detention basin must be carefully designed and maintained to address safety concerns, bank erosion, sediment removal, and upstream and downstream impacts to waterways. In addition, extended wet detention basins have the potential for floating litter, debris, algae growth, nuisance odors, and mosquito problems. Aquatic plant growth can be a factor in clogging outlet works, and the permanent pool can attract waterfowl, which can add to the nutrient and bacteria loads entering and leaving the pond. Refer to Chapter 9, Detention and Chapter 12, Easements and Maintenance for additional design criteria.

15.2 Site Selection

Retention ponds require groundwater or a dry-weather base flow if the permanent pool elevation is to be maintained year-round. The designer should consider the overall water budget to ensure that the baseflow will exceed evaporation, evapotranspiration, and seepage losses (unless the pond is lined). High exfiltration rates can initially make it difficult to maintain a permanent pool in a new pond, but the bottom can eventually seal with fine sediment and become relatively impermeable over time. However, it is best to seal the bottom and the sides of a permanent pool if the pool is located on permeable soils and to leave the areas above the permanent pool unsealed to promote infiltration of the stormwater detained in the surcharge WQV. Studies show that retention ponds can cause an increase in temperature from influent to effluent. Retention ponds are discouraged upstream of receiving waters that are sensitive to increases in temperature (e.g., fish spawning or hatchery areas).

Use caution when placing this SCM in a basin where development will not be completed for an extended period, or where the potential for a chemical spill is higher than typical. When these conditions exists, it is critical to provide adequate containment and/or pretreatment of flows. In developing watersheds, frequent maintenance of the forebay may be necessary.

15.3 Design Considerations

The total basin volume of an extended wet detention basin facility consists of the permanent pool volume, the WQCV above the permanent pool and, if included, the flood control volume above the WQCV. Care should be taken to assess the complete water budget of the watershed accounting for runoff, baseflow, evaporation, evapotranspiration, seepage, and other losses to assure the permanent pool can be maintained.

Design considerations for an extended wet detention basin in addition to the considerations typically given to an extended dry detention basin include:

- Water balance calculations should be conducted to assure there is adequate flow to maintain a desirable permanent pool and provide adequate flushing through the basin.
- Edge treatments must be considered that will prevent bank erosion.
- To minimize the potential of algae growth, a minimum permanent pool depth of 6 feet must be provided. Other control methods including aeration or upstream SCMs may also be provided.
- Basin lining must be provided to ensure the basin is watertight and a permanent pool will be maintained. Karst features can make this difficult and expensive.
- The embankments must be carefully designed with keys and cutoff collars to prevent seepage and piping that can lead to loss of the permanent pool or dam failure.
- A shorter detention time of 12 to 15 hours may be used due to the inherent sedimentation that occurs in a wet basin.

15.4 Aesthetic Design

When an extended wet detention basin is designed with aesthetics in mind, it becomes an amenity of much greater value to a landowner. Softened and varied slopes, interspersed fields, planting

areas and wetlands can all be part of an EDB. The design should be aesthetic whether it is considered to be an architectural or naturalized basin. Architectural basins incorporate design borrowed or reflective of the surrounding architecture or urban forms. An architectural basin is intended to appear as part of the built environment, rather than hiding the cues that identify it as a stormwater structure. A naturalized basin is designed to appear as though it is a natural part of the landscape. The built environment, in contrast to the natural environment, does not typically contain the randomness of form inherent in nature. Constructed slopes typically remain consistent, as do slope transitions. Even dissipation structures are usually a hard form and have edges seldom seen in nature. If the EDB is to appear as though it is a natural part of the landscape, it is important to minimize shapes that provide visual cues indicating the presence of a drainage structure. The following are suggested methods for designing a naturalized basin.

15.5 Design Procedure and Criteria

The following steps outline the design procedure and criteria for an extended wet detention basin. Figure 7 shows a representative layout for an extended wet detention basin.

1. For large ponds, if the residence time for the permanent pool volume is 24 hours or greater during a 2-year storm event, the surcharge WQV is not required above the permanent pool. The residence time, t (hr), is calculated by dividing the permanent pool volume, V_p (ft^3), by the average inflow rate during a 2-year storm event, $Q_{2yr,\,avg}$ (cfs), as shown in the equation below. The 2-year average inflow rate must be calculated using the appropriate hydrologic analysis method presented in Chapter 5, Calculation of Runoff.

$$t = \frac{V_p}{Q_{2yr-avg} \cdot 3600}$$

2. If the residence time is less than 24 hours, the WQV shall be added above the permanent pool and shall be calculated using the method provided in Section 4.2 of this chapter. The WQV is the surcharge volume above the permanent pool. Generally, an extended wet detention basin should be located away from any offsite drainage crossing the site to ensure proper function. If offsite area is drained through the facility, that area must be included in all volume calculations.
3. The minimum volume required for the permanent pool is a function of the WQV and is calculated using the following equation.

   V_p = 1.2*WQV

   The permanent pool shall have a depth of at least 6 feet (and preferably deeper) to decrease the likelihood of algae growth. An option to improve water quality treatment and minimize bank erosion is to provide a littoral zone 18 inches deep and 10 feet wide for aquatic plant growth along the perimeter of the permanent pool. This also enhances pond safety.

4. The outlet works are to be designed in accordance with requirements set forth in design procedure and criteria for an extended dry detention basin, with the following exceptions:
   a. Design the outlet works to release the WQCV over a 12- to 15-hour period.

   b. Where perforated riser pipes are not encased in gravel, only corrugated metal or ductile iron pipe may be used, and an anti-seep collar must be provided around the outlet.
5. The trash rack is to be designed in accordance with requirements set forth in design procedure and criteria for an extended dry detention basin.
6. The basin length to width ratio should be between 2:1 and 4:1. The minimum allowable ratio is 1:1. Maximizing the distance between the inlet and the outlet will minimize short-circuiting.
7. Basin side slopes above the permanent pool should be no steeper than 4:1, preferably 5:1 or flatter to limit rill erosion and facilitate maintenance and safety.
8. A 4- to 6-inch organic topsoil layer, vegetated with aquatic species, shall be provided on the littoral bench if incorporated.
9. Access to the basin bottom, forebay, and outlet area must be provided for maintenance vehicles. Grades of the access should not exceed 10 percent, and a stabilized, all-weather driving surface must be provided.
10. Provide erosion protection at all inlets to the pond.
11. A forebay should be considered when the design volume exceeds 20,000 ft^3 or a large sediment, trash or debris load is anticipated due to upstream land use. Forebays provide an opportunity for larger particles to settle out at a controlled location where sediment and debris can be more easily removed. Install a solid driving surface on the bottom and sides below the permanent water line to facilitate sediment removal. A berm consisting of rock and topsoil mixture should be part of the littoral bench to create the forebay. The forebay volume within the permanent pool volume should be between 5 and 10 percent of the design WQV.

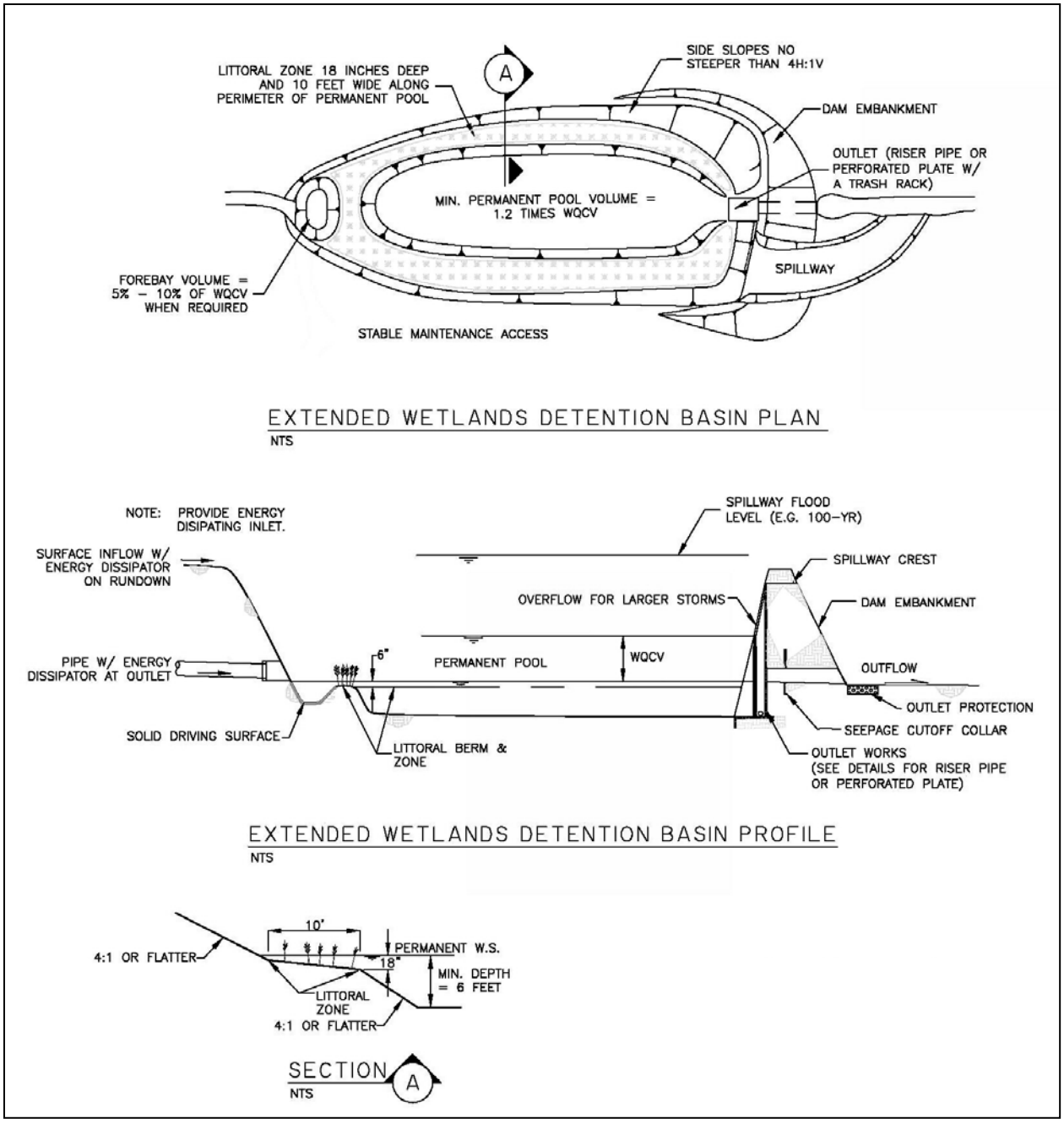


Figure 16. Extended Wet Detention Basin Plan and Profile

15.6 As-Built Certification

Upon completion of the extended wet detention basin, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following: To Be Determined

16.0 Constructed Wetland Pond

16.1 Description

A constructed wetland pond is a shallow extended wet detention basin that requires a perennial base flow to maintain microorganism habitat and to permit the growth of rushes, willows, cattails, and reeds to slow runoff and allow time for sedimentation, filtering, and biological uptake. Constructed wetlands differ from "natural" wetlands, as they are artificial and built to treat stormwater. Do not use existing or natural wetlands for stormwater treatment. Stormwater should be treated prior to entering natural or existing wetlands. Sometimes, small wetlands that exist along ephemeral drainageways can be enlarged and incorporated into a constructed wetland system. Such actions, however, require the approval of federal and state regulators.

Regulations intended to protect natural wetlands recognize a separate classification of wetlands constructed for water quality treatment. Such wetlands generally are not allowed to be used to mitigate the loss of natural wetlands but are allowed to be disturbed by maintenance activities. Therefore, the legal and regulatory status of maintaining a wetland constructed for the primary purpose of water quality enhancement is separate from the disturbance of a natural wetland. Nevertheless, any activity that disturbs a constructed wetland should be cleared through the U.S. Army Corps of Engineers as to whether a 404 permit is needed.

16.2 Site Selection

A constructed wetland pond requires a positive net influx of water to maintain vegetation and microorganisms. This can be supplied by groundwater or a perennial stream. An ephemeral stream will not provide adequate water to support a constructed wetland pond. It is best used as a follow-up SCM in a treatment train, although it can serve as a stand-alone facility. Constructed wetland ponds can also be designed for flood control in addition to capture and treatment of the WQV. Although constructed wetlands can provide an aesthetic onsite amenity, significant algae blooms can occur. The owner should maintain realistic expectations of aesthetics. Algae blooms may be reduced when SCMs that are effective in removing nutrients are placed upstream.

16.3 Design Considerations

When properly designed, a constructed wetland basin can offer several potential advantages, such as natural aesthetic qualities, wildlife habitat, erosion control, and pollutant removal. Additionally, the constructed wetland basin can act as part of a multi-use facility by providing flood control storage above the WQV pool or by providing effective follow-up treatment to onsite and source control SCMs that rely upon settling of larger sediment particles.

The primary drawback of the constructed wetlands basin is the need for a continuous base flow to ensure viable wetland growth. In addition, silt and algae can accumulate and, unless properly designed and built, can be flushed out during larger storms, reducing downstream water quality benefits. Also, in order to maintain healthy wetland growth, the surcharge depth for WQV above the permanent water surface cannot exceed roughly 2 feet.

Development and analysis of a water budget is needed to show the net inflow of water is sufficient to meet all the projected losses (such as evaporation, evapotranspiration, and seepage for each season of operation) and ensure a perennial baseflow. Insufficient inflow can cause the wetland to become saline or die.

Loamy soils are needed in a wetland bottom to permit plants to take root. Exfiltration through a wetland bottom cannot be relied upon because the bottom is either covered by soils of low permeability or because the groundwater is higher than the wetland's bottom. Also, wetland basins require a near zero longitudinal slope, which can be provided using embankments.

During design, consider maintenance access and a means for draining the pond for sediment removal. Along with vegetation management and other routine maintenance, occasional sediment removal will be required when sediment accumulations become too large and affect performance. This may be required whenever sediment accumulation occupies approximately 20 percent of the WQV. Periodic sediment removal is also needed for proper distribution of growth zones and water movement within the wetland.

16.4 Design Procedure and Criteria

The following steps outline the design procedure for a constructed wetland basin. Figure WQ-9 illustrates an idealized constructed wetland basin.

1. Calculate the WQV in cubic feet. The WQV is the surcharge volume above the permanent wetland pool.
2. The volume of the permanent wetland pool shall be no less than 75 percent of the WQV.
3. Proper distribution of wetland habitat is needed to establish a diverse plant community. Distribute pond area in accordance with Table 7.
4. The surcharge depth of the WQV above the permanent pool's water surface shall not exceed 2.0 feet.
5. The outlet works shall be designed in accordance with requirements set forth for extended dry detention basins, with the following exceptions:
    a. Design the outlet works to release the WQV in 22 to 28 hours.
    b. Where perforated riser pipes are not encased in gravel, only corrugated metal or ductile iron pipe may be used, and an anti-seep collar must be provided around the outlet pipe.
    c. Outlet design should consider the elevated potential for wetland vegetation growth and clogging around the outlet.
6. The trash rack shall be designed in accordance with requirements set forth for extended detention basins in Section 5.3.3.
7. Determine whether flood storage or other uses will be provided and design accordingly for combined uses.
8. The basin length to width ratio should be between 2:1 and 4:1. The minimum allowable ratio is 1:1. Maximizing the distance between the inlet and the outlet will minimize short-circuiting.

9. Basin side slopes should be no steeper than 4:1, preferably 5:1 or flatter to facilitate maintenance, safety and access.
10. A net influx of water must be available through a perennial base flow and must exceed the losses. A hydrologic balance should be used to estimate the net quantity of base flow available at a site.
11. Provide energy dissipation at all inlets to limit sediment re-suspension.
12. Forebay design considerations and criteria for extended wet detention basins in Section 5.4.3 shall be followed.
13. Cattails, sedges, reeds, and wetland grasses should be planted in the wetland bottom. Qualified professionals must be utilized to develop the planting plan and to plant the wetland plants. Berms and side-slopes should be planted with native or turf-forming grasses. Initial establishment of the wetland requires control of the water depth. After planting wetland species, the permanent wetland pool should be kept at 3 to 4 inches deep at the plant zones to allow growth and to help establish the plants, after which the pool should be raised to its final operating level.
14. Provide vehicle access to the forebay and outlet area for maintenance and removal of bottom sediments. Maximum grades should not exceed 10 percent, and a stabilized, all-weather driving surface must be provided.

Table 13. Constructed Wetland Pond Design Depths

Components	% of Permanent Pool Surface Area	Water Design Depth
Forebay, outlet and free water surface areas	30% to 50%	2 to 4 feet deep
Wetland zones with emergent vegetation	50% to 70%	6 to 12 inches deep (1/3 to 1/2 of this zone should be 6 inches deep)

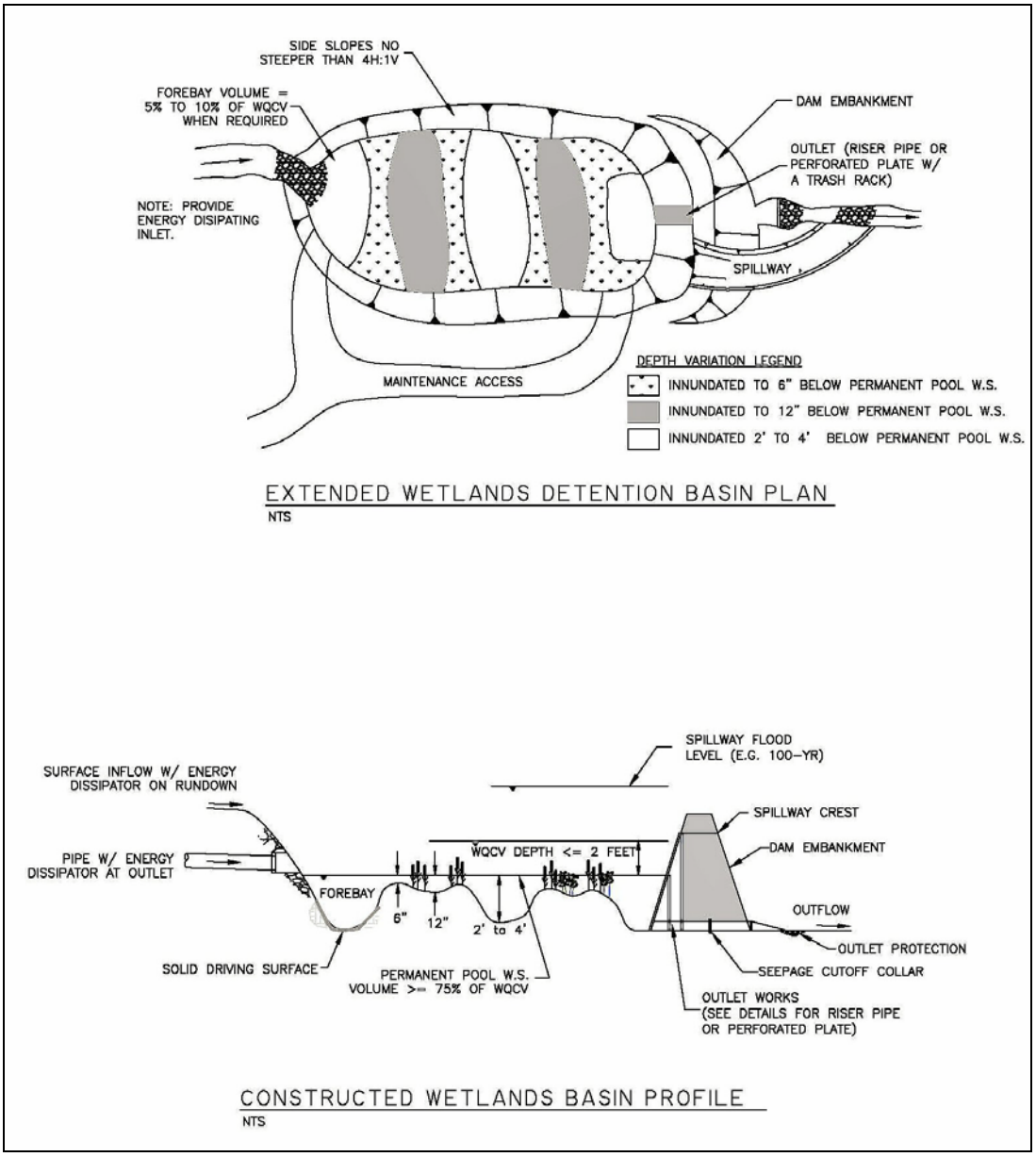


Figure 17. Constructed Wetland Typical Drawings

16.5 As-Built Certification

Upon completion of the green roof, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following: To Be Determined

17.0 Green Roof

17.1 Description

The term green roof refers to a roof partially or completely covered with vegetation underlain with an engineered growing medium, drainage and filter layers, and waterproofing. It provides stormwater volume reduction and flow attenuation benefits by capturing and temporarily storing rainfall before it is conveyed to the roof drainage system. A portion of the captured rainfall evaporates and is taken up by plants. Green roofs can also provide other benefits including extended roof life, increased insulation and energy savings, urban heat island reduction, and social benefits of increased green space.

There are two types of green roofs: extensive and intensive. Extensive green roofs have a shallow depth of growing medium, typically 3-6 inches thick, and are planted with sedums or other plants suitable for the limited root zone. Intensive green roofs have deeper growing medium, typically 6 inches to 4 feet thick, and a wider variety of plants that may include shrubs and trees. Green roofs can be modular trays that contain the necessary drainage layers, growing medium and plants, or each component can be installed separately. The additional weight loading of intensive green roofs may limit their application. Both types of green roofs are acceptable; however, because extensive green roofs are generally more common, this section predominantly focuses on extensive green roof design only. The design of a green roof involves many disciplines in addition to stormwater engineers, including structural engineers, architects, landscape architects, horticulturalists, and others. This section is intended to provide general green roof stormwater design criteria only. Designers should reference other resources for more comprehensive green roof design information, including but not limited to *Standard Guide for Vegetative (Green) Roof Systems* (ASTM, 2014). In addition to this standard guide, ASTM has issued several standards for specific green roof components. Green roof design should generally adhere to ASTM standards.

Photo 16. Extensive green roof on employee balcony of Greene County Public Safety Center.

Photo 17. Extensive green roof on Greene County Public Safety Center.

17.2 Site Selection

Green roofs can be installed on commercial or residential buildings or structures. They can be particularly well-suited for ultra urban areas where space is limited and where they be accessed for enjoyment by building tenants, customers, or employees.

Photo 18. Intensive green roof on Green Circle Shopping Center (Source: Green Circle Shopping Center)

17.3 Design Considerations

The growing medium, plant selection, and irrigation needs and methods are critical factors determining the long-term functionality of a green roof. They should be carefully designed to ensure establishment and minimize maintenance needs such as replanting vegetation. The following are additional considerations when designing a green roof (adapted from Metropolitan Nashville - Davidson County, 2012).

- **Roof Structural Capacity.** The roof must be designed to support the green roof system as well as loads associated with rainfall, snow, people, and equipment. Typically, the roof must be designed to support an additional 15 to 30 pounds per square foot for an extensive green roof. A structural engineer, architect or other qualified professional should be involved with all green roof designs to ensure that the building has adequate structural capacity to support the green roof. Structural capacity should conform to ASTM standards.
- **Roof Pitch.** The volume reduction and flow attenuation benefits of a green roof are maximized when the roof is relatively flat (a pitch of 1 to 2%). Some pitch is needed to promote positive drainage and prevent ponding and/or saturation of the growing medium. Green roofs can be installed on roofs with slopes up to 25% if baffles, grids, or strips are used to prevent slippage of the medium.
- **Access.** Adequate access to the roof must be available to deliver construction materials and perform routine inspections and maintenance. If an underdrain system is used, provide cleanouts as needed for inspection and maintenance. Access in the form of non-vegetated walkways should also be provided to allow for weeding and spot repairs of vegetation.
- **Building Codes.** The green roof design should comply with applicable City building codes.
- **Waterproofing.** Ensure that the waterproofing warranty for the roof will not be voided by a green roof application. A leak test is recommended following installation of the impermeable membrane.

17.4 Design Procedure and Criteria

The WQV shall be provided within the void space of the drainage layer and the growing medium. The drainage layer should be designed to convey the 10-year storm without backing water up into the growing medium. The void space shall be specified by the designer based on the materials selected. If using a proprietary green roof system, designers should consult with the manufacturer for design information and the design shall adhere to manufacturer's specifications. Designers may also design a non-proprietary green roof system in which case they should consult and follow design resources including but not limited to *Standard Guide for Vegetative (Green) Roof Systems*

(ASTM, 2014). Metropolitan Nashville - Davidson County's (2012) "GIP-12 Green Roof" document also contains good information and was referenced in developing this section.

Green roofs are composed of the following basic components which shall be addressed in the design:

- **Roof deck:** The roof deck provides the foundation for the green roof. Concrete decks are generally preferred but other decking materials can be used if appropriately designed. The potential for decking materials to leach metals or chemicals should be considered when choosing decking material.
- **Waterproofing layer**: A wide range of waterproofing materials can be used to prevent water from entering the building. The waterproofing layer must have an expected life span that meets or exceeds the expected life span of the green roof system.
- **Insulation layer (optional):** Green roofs may include an insulation layer that increases the energy efficiency of the building and/or protects the roof deck.
- **Root barrier (optional)**: Root barriers are sometimes used to protect the waterproof membrane from root penetration.
- **Drainage layer and system**: A layer of aggregate or a proprietary product is installed to remove excess water from the root zone. This drainage layer should convey flow to a roof drainage system. The roof drainage system should be designed to be kept free of debris and plant material. Roof drains immediately adjacent to the growing medium should be separated by a barrier such as perforated metal edging filled with gravel (Photo 5). A drainage barrier should also be used at the roof border with the parapet wall and for any joints where the roof is penetrated, or joins with vertical structures. The outlet can be controlled by an orifice or orifices located at one central location or at each roof drain and will be dictated by the overall drainage design.
- **Filter fabric**: A filter fabric is placed between the drainage layer and the growing medium to prevent migration of the growing medium from clogging the drainage layer.
- **Growing medium**: Growing medium is a key issue with regard to plant health, irrigation needs, and potential stormwater benefits. The recommended growing medium for extensive green roofs is composed of approximately 80-90% lightweight inorganic materials such as expanded slates, shales or clays, pumice, scoria or other similar materials. The remaining media should contain no more than 15% organic matter, normally well-aged compost. The percentage of organic matter should be limited to minimize leaching of nutrients and clogging of the filter fabric. The medium should have a maximum water retention capacity of around 30%.
- **Vegetation**: Succulents, grasses, perennials, and shrubs with relatively shallow root depths are possibilities for green roof plantings depending on whether the design is extensive or intensive. An experienced professional should be consulted for plant selection and design. Designers should order plants at least 6 months in advance to ensure supply or consider having plants contract-grown.
- **Irrigation**: The design should include a plan for irrigation during establishment, which generally takes 12 to 18 months. The design should also include a plan for long-term

supplemental irrigation as needed depending on species selection. Even vegetation with low water requirements may require supplemental irrigation.

Photo 19. Separation of the roof drain from the growing media and plants using perforated metal edging and rock (Source: UDFCD, 2010).

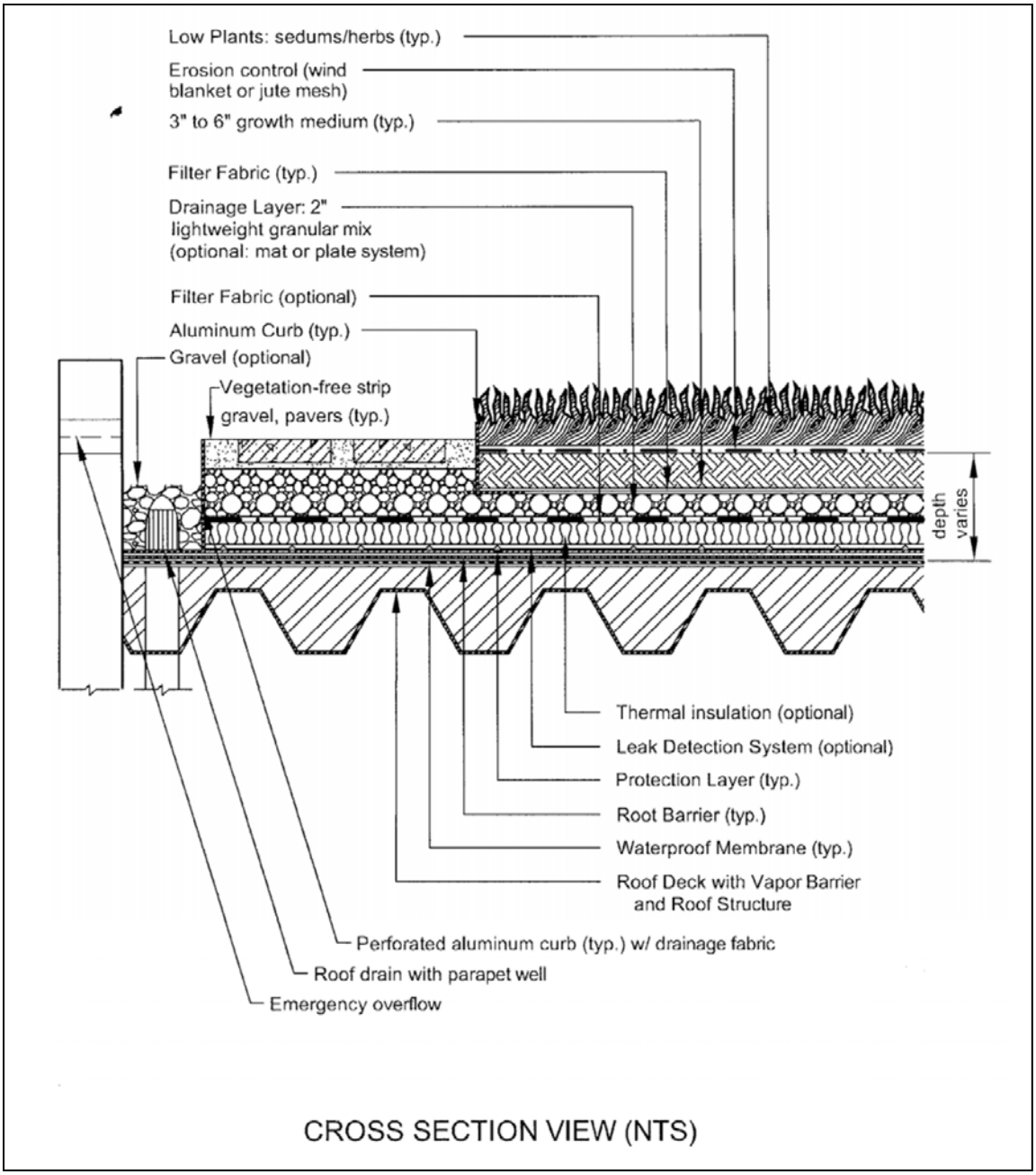


Figure 18. Extensive Vegetated Roof Typical Section (Source: NVRC, 2007).

17.5 Construction Considerations

The following should be considered during construction and plan notes provided as needed.

- Conduct a flood test to ensure the system is water tight by placing at least 2 inches of water over the membrane for 48 hours to confirm the integrity of the waterproofing system.
- Take care not to damage the waterproofing when adding other system components.

- The growing medium should be mixed prior to delivery to the site. It should be spread evenly over the filter fabric surface and covered until planting to prevent weeds from growing. Sheets of exterior grade plywood can be laid over the medium to accommodate foot and wheelbarrow traffic. Foot and equipment traffic should be limited to reduce compaction of the growing medium.
- The growing medium should be moistened prior to planting and the plants watershed immediately after installation and routinely during establishment.
- The construction contract should contain a warranty that specifies a 75% minimum survival after the first growing season and a minimum effective vegetative ground cover of 75% for flat roofs and 90% for pitched roofs.

17.6 As-Built Certification

Upon completion of the green roof, prior to final acceptance, an as-built plan and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following:

1. Protection of vulnerable areas (abutting vertical walls, roof vent pipes, outlets, air conditions units and perimeter areas) from leakage;
2. Profile view of facility including typical cross-sections with dimensions;
3. Growing medium specification including dry and saturated weight;
4. Filter fabric specification;
5. Drainage layer specification;
6. Waterproof membrane specification, including root barriers;
7. Stormwater piping associated with the site, including pipe materials, sizes, invert elevations at bends and connections; and
8. Planting and irrigation plan.

18.0 Rainwater Harvesting

18.1 Description

Rainwater harvesting refers to the collection and storage of roof runoff in tanks, cisterns, or barrels for non-potable uses such as irrigation and toilet flushing. Storage tanks or cisterns can be aboveground or below ground. Rainwater harvesting provides stormwater volume reduction and flow attenuation benefits as well as conserving public drinking water supplies.

Photo 20. Installation of underground cistern at the City Environmental Resource Center.

18.2 Site Selection

Rainwater harvesting can be used for residential, commercial, and industrial applications where the system can be designed for automatic use or owners have adequate buy-in to ensure drawdown and use of the harvested water.

18.3 Design and Construction Considerations and Criteria

Rainwater harvesting shall be from roofs only, and for non-potable interior and exterior uses only. Rainwater harvesting systems for non-residential developments shall adhere to Section 707 Rainwater Collection and Distribution Systems of the International Green Construction Code, as adopted into the Plumbing Code in City Code Sec. 36-622(x). Residential rainwater harvesting systems shall adhere to City Code Sec. 36-1302(y). Designers should refer to Metropolitan Nashville - Davidson County's (2012) "GIP-11 Cistern" specification for additional design considerations and criteria. Where conflicts exist, City Code Sec. 36-622(x) and Sec. 36-1302(y) shall govern.

Photo 21. Installation of underground cistern at the Missouri State University Pinegar Arena.

18.4 As-Built Certification

Upon completion of the rainwater harvesting system, prior to final acceptance, an as-built plan and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be provided certifying the following:

1. Roof plan of the building that will be used to capture rainwater, showing slope direction and roof material.
2. Display downspout leaders from the rooftops being used to capture rainwater.
3. Display the storm drain pipe layout (pipes between building downspouts and the tank) in plan view, specifying materials, diameters, slopes and lengths, to be included on typical grading and utilities or storm sewer plan sheets.
4. Include a detail or note specifying the minimum size, shape configuration and slope of the gutter(s) that convey rainwater.

Photo 22. Aboveground cistern at the Watershed Center at Valley Water Mill.

19.0 Proprietary SCMs - To Be Determined

19.1 Description

19.2 Site Selection

19.3 Design Considerations

19.4 Design Procedure and Criteria

19.5 Construction Considerations

19.6 As-Built Certification

19.7 Maintenance

20.0 References

ASTM International. 2014. ASTM E2777-14, Standard Guide for Vegetative (Green) Roof Systems. ASTM International. West Conshohocken, PA.

American Society of Civil Engineers and Water Environment Federation. 1992. Design and Construction of Urban Storm Water Management Systems. ASCE Manual and Reports of Engineering Practice No. 77 and WEF Manual of Practice FD-20. Alexandria, VA: Water Environment Federation.

Barrett, M., A. Lantin, and S. Austrheim-Smith. 2004. Stormwater Pollutant Removal in Roadside Vegetated Buffer Strips. Prepared for the Transportation Research Board: Washington, DC.

Claytor, Richard A., and Thomas R. Schueler. 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection.

Debo, T. and A. Reese. 2002. Municipal Storm water Management. 2nd Edition. Boca Raton, FL: Lewis Publishers.

Hartigan, J.P. 1989. Basis for Design of Wet Detention Basin SCMs. Design of Urban Runoff Quality Controls. Proceedings Engineering Foundation Conference. American Society of Civil Engineers (ASCE): New York, NY.

Hirschman, David, Kelly Collins, Tom Schueler. 2008. Technical Memorandum: The Runoff Reduction Method. Center for Watershed Protection, Inc.

Horner, R.R., J.J. Skupien, E.H. Livingston, and H.E. Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Intuitional Issues. Washington, DC: Terrene Institute, in cooperation with the U.S. Environmental Protection Agency.

Interlocking Concrete Pavement Institute. Accessed October 15, 2015 from www.icpi.org.

Metcalf and Eddy, Inc. 2003. Wastewater Engineering, Treatment, Disposal and Reuse. Fourth Edition. Revised by G. Tchobanoglous and F.L. Burton. McGraw Hill: New York, NY.

Metropolitan Government of Nashville and Davidson County. June 2012. Stormwater Management Manual Volume 5 - Low Impact Development Manual. "Green Roofs". Nashville, TN.

Metropolitan St. Louis Sewer District. September 2010. Bioretention for Parking Island Typical Section. Accessed from Bioretention Design Details webpage at http://www.stlmsd.com/what-we-do/stormwater-management/SCM-toolbox/stormwater-quality/bioretention/bioretention-design.

Minnesota Pollution Control Agency. Accessed September 30, 2015. Design Criteria for Infiltration Trench - Design Infiltration Rates. http://stormwater.pca.state.mn.us/index.php/Design_infiltration_rates.

National Research Council, 2008. Urban Stormwater Management in the United States. Washington, D.C.: National Academies Press.

Northern Virginia Regional Commission (NVRC). 2007. Low Impact Development Manual. "Vegetated Roofs." Fairfax, VA.

Prince George's County Maryland, 1999. Low-Impact Development Design Strategies: An Integrated Design Approach. Prince George's County, Maryland, Department of Environmental Resources, Programs and Planning Division.

Randall, C.W., K. Ellis, T.J. Grizzard, and W.R. Knocke. 1982. Urban Runoff Pollutant Removal by Sedimentation. Stormwater Detention Facilities. Proceedings of the Engineering Foundation Conference. ASCE: New York, NY.

Rawls, W.J., D.L. Brakensiek, and K.E. Saxton. 1982. Estimation of Soil Water Properties. Transactions of the American Society of Agricultural Engineers (Vol. 25, No.5, pp. 1316-1320 and 1328). St. Joseph, Michigan.

Schueler, T. and H. Holland. 2000. The Practice of Watershed Protection. Ellicott City, MD: The Center for Watershed Protection.

Southeast Michigan Council of Governments (SEMCOG). Accessed September 30, 2015. LID - SEMCOG Low Impact Development Case Studies. Ford Road Outer Drive Vegetated Filter Strip. http://archive.semcog.org/Data/lid.report.cfm?lid=170

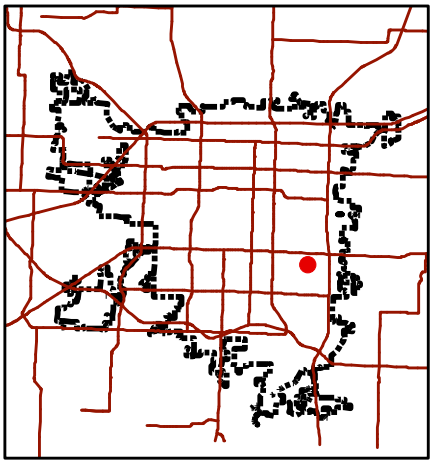
Stahre, P. and B. Urbonas. 1990. Stormwater Detention for Drainage, Water Quality, and CSO Management. Prentice Hall.

Urban Drainage and Flood Control District. 2010 and 2013. Urban Storm Drainage Criteria Manual, Volume 3. Denver, CO: Urban Drainage and Flood Control District.

Water Environment Federation and American Society of Civil Engineers. 1998. Urban Runoff Quality Management. WEF Manual of Practice No. 23 and ASCE Manual and Report on Engineering Practice No. 87. Alexandria, VA: Water Environment Federation.

Water Environment Federation (WERF). 2005. Critical Assessment of Stormwater Treatment Controls and Control Selection Issues. 02-SW-01. WERF: Alexandria, VA: IWA Publishing: London.

Wright Water Engineers, Inc., Wenk Associates, Muller Engineering Company, Inc., Matrix Design Group, and Smith Environmental. 2004. City and County of Denver Water Quality Management Plan. Denver, CO



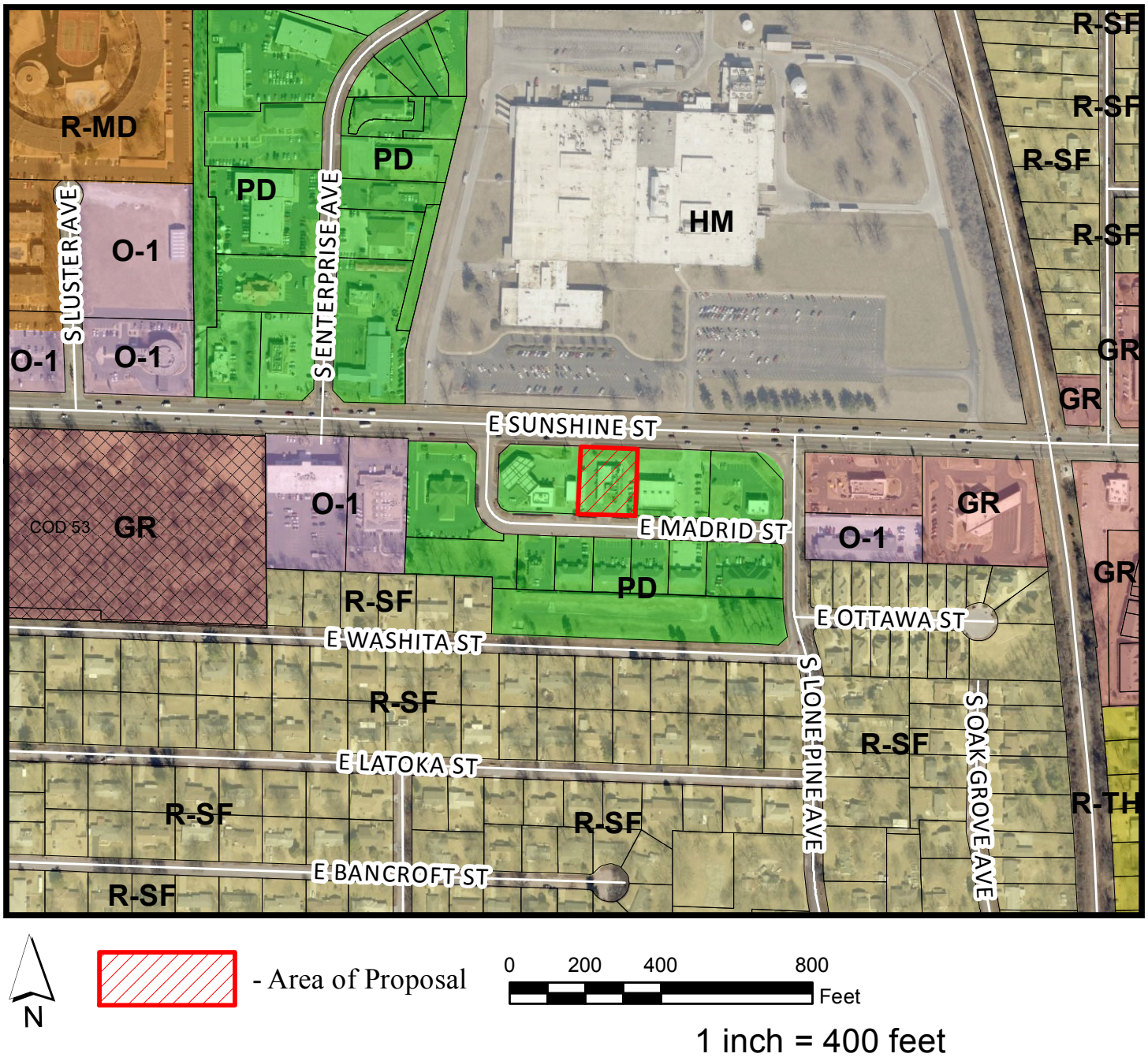
Development Review Staff Report

Department of Planning & Development - 417-864-1031
840 Boonville - Springfield, Missouri 65802

Use Permit 423

LOCATION: 2420 E. Sunshine Street
CURRENT ZONING: Planned Development 136 Amended
PROPOSED ZONING: GR, General Retail District
PROPOSED USE: Automotive Service Garage

LOCATION SKETCH



DEVELOPMENT REVIEW STAFF REPORT
CONDITIONAL USE PERMIT 423

PURPOSE: To allow an automobile service garage within a GR, General Retail District generally located at 2420 East Sunshine Street

REPORT DATE: June 9, 2016

LOCATION: 2420 E. Sunshine St.

APPLICANT: D.L. Rogers Corporation

TRACT SIZE: Approximately 0.62 acres

EXISTING USE: Restaurant

PROPOSED USE: Automotive service garage

FINDINGS FOR STAFF RECOMMENDATION:

1. The *Growth Management and Land Use Plan* of the *Comprehensive Plan* identifies this property as an appropriate area for medium intensity retail, office or housing. This land use category would accommodate a variety of commercial uses.

2. Approval of this request will provide for the productive use of the subject property which is already served with public infrastructure and services and is not expected to adversely impact the surrounding properties.

3. This application meets the approval standards for a Conditional Use Permit and is in conformance with the *Comprehensive Plan,* which identifies this area as appropriate for a variety of commercial uses.

4. Supports the following Field Guide 2030 goal(s): Chapter 6, Growth Management and Land Use Major Goal 4: Develop the community in a sustainable manner. Objective 4a, Increase density in activity centers and transit corridor.

RECOMMENDATION:

Staff recommends approval of this request with the following conditions:

1. The regulations and standards listed on Attachment 3 shall govern and control the use and development of the land in Use Permit Number 423 in a manner consistent with the attached site plan (Attachment 5).

2. The proposed automobile service garage shall be located and constructed in substantial conformance to the attached site plan.

SURROUNDING LAND USES:

AREA	ZONING	LAND USE
North	HM	Manufacturing and industrial uses
East	PD 136	Automotive parts store uses
South	PD 136	Office uses
West	PD 136	Convenience store and fueling station

ZONING ORDINANCE REQUIREMENTS:

1. The conditional use permit procedure is designed to provide the Planning and Zoning Commission and the City Council with an opportunity for discretionary review of requests to establish or construct uses or structures which may be necessary or desirable in a zoning district, but which may also have the potential for a deleterious impact upon the health, safety and welfare of the public. In granting a conditional use, the Planning and Zoning Commission may recommend, and the City Council may impose such conditions, safeguards and restrictions upon the premises benefited by the conditional use as may be necessary to comply with the standards set out in the Zoning Ordinance to avoid, or minimize, or mitigate any potentially adverse or injurious effect of such conditional uses upon other property in the neighborhood. The general standards for conditional use permits are listed in Attachment 3.
2. No conditional use permit shall be valid for a period longer than 18 months from the date City Council grants the conditional use permit, unless within this 18 months:
    a. A building permit is obtained and the erection or alteration of a structure is started; or
    b. An occupancy permit is obtained and the conditional use is begun.

COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* of the *Comprehensive Plan* designates this area along the Sunshine Street corridor as appropriate for medium-intensity retail, office and residential uses. General Retail is one of the zoning districts recommended in these areas. The General Retail District is intended for uses that provide community-wide personal and business services, shopping centers and specialty shops. The need for community-wide

accessibility dictates that this district be located along or at the intersection of two or more arterial or higher classification streets.

STAFF COMMENTS:

1. This is a request for a Conditional Use Permit to allow an automobile service garage within a GR, General Retail District generally located at 2420 E. Sunshine Street. This use is not currently permitted by the existing PD 136 Amended. A request to rezone this property to GR, General Retail (Z-9-2016) is being concurrently processed with this conditional use permit request.

2. The *Growth Management and Land Use Plan* of the *Comprehensive Plan* identifies this property as an appropriate area for medium intensity retail, office or housing. The site is an appropriate location for an automobile service garage. Approval of this request will provide for the productive use of the subject property where investments have been made in public infrastructure and services. Staff has reviewed the applicant's request for a Conditional Use Permit and has determined that it satisfies the standards for Conditional Use Permits outlined in Section 36-363 (10) of the Zoning Ordinance.

3. Development of this site will comply with all of the requirements of the GR, General Retail District. All requirements for parking, open space, bufferyards and height will be met with the development of this property.

4. Staff has reviewed the applicant's request for a Conditional Use Permit and has determined that it satisfies the standards for Conditional Use Permits outlined in Section 36-363 (10) of the Zoning Ordinance. Any development of this property must also follow the GR, General Retail District requirements.

5. The proposed Conditional Use Permit was reviewed by City departments and comments are contained in Attachment 1.

NEIGHBORHOOD MEETING:

The applicant held a neighborhood meeting with property owners, residents and any registered neighborhood association within 500 feet of the subject properties on May 12, 2016. A summary of the meeting is attached (Attachment 2).

PUBLIC COMMENTS:

The property was posted by the applicant or their representative on June 10, 2016 at least 10 days prior to the public hearing. The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet. Nine (9) property owners within one hundred eighty-five (185) feet of the subject property were notified by mail of this request.

CITY COUNCIL PUBLIC HEARING:

July 25, 2016

STAFF CONTACT PERSON:

Daniel Neal
Senior Planner
864-1036

ATTACHMENT 1
DEPARTMENT COMMENTS
CONDITIONAL USE PERMIT 423

BUILDING DEVELOPMENT SERVICES COMMENTS:

No issues with the Conditional Use Permit.

CLEAN WATER SERVICES COMMENTS:

No impact on public sewer.

CITY UTILITIES:

No objections to use permit.

FIRE DEPARTMENT:

No comments.

MODOT COMMENTS:

Any work, material, equipment on state r/w requires a MoDOT permit.

PUBLIC WORKS TRAFFIC DIVISION COMMENTS:

The City's Transportation Plan classifies Sunshine Street as a Primary Arterial and Madrid Street as a local commercial roadway. Sunshine is a State maintained street. The standard right of way for Madrid Street is 30 feet from the centerline. The most recent traffic count on Sunshine Street is 33,021 vehicles per day. There is no recent traffic count on Madrid Street. There is one existing driveway access points along the property frontage on Sunshine Street and one on Madrid Street. There is a sidewalk along Sunshine Street but no sidewalk along Madrid Street. The existing infrastructure meets current city standards. On-street parking is not allowed along the adjacent streets. There is not a greenway trail in the area. There is one bus stop along Sunshine Street and no bus stops along Madrid Street. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area. There are not any proposed improvements along Sunshine Street or Madrid Street. Staff recommends approval of this rezoning request.

Public Works Traffic Division	Response
Street classification	Sunshine - Primary Arterial; Madrid - Local Commercial
On-street parking along streets	No
Trip generation - existing use	720 trips per day
Trip generation - proposed use	20 trips per day per service bay

Existing street right of way widths	50 feet from centerline for Sunshine (city standards - this is a MoDOT route) 30 feet from centerline for Madrid
Standard right of way widths	50 feet from centerline for Sunshine (city standards - this is a MoDOT route) 30 feet from centerline for Madrid
Traffic study submitted	Not required
Proposed street improvements	None

PUBLIC WORKS STORMWATER COMMENTS:

The property is located in the Galloway Creek drainage basin. The property is not located in a FEMA designated floodplain. Staff is aware of flooding problems in the area. If the project increases the amount of impervious surfacing; detention and water quality is required according to Chapter 96. Buyout in lieu of on-site stormwater detention is not an option. Since the project will be disturbing less than one (1) acre there will not be a land disturbance permit required. There is an existing detention basin and underground storm sewer serving this development. There are no sinkholes on the proposed property.

Public Works Stormwater Division	Response
Drainage Basin	Galloway Creek
Is property located in Floodplain?	No
Is property located on a sinkhole?	No
Is stormwater buyout an option?	No

ATTACHMENT 2
REQUIREMENTS FOR CONDITIONAL USE PERMIT 423

1. An automobile service garage is permitted in substantial conformance with Attachment 5.

2. All other standards of the Zoning Ordinance and other applicable ordinances shall be adhered to.

Attachment 3

LEE ENGINEERING AND ASSOCIATES, L.L.C.

CIVIL ENGINEERING & DESIGN

2101 W. CHESTERFIELD BLVD., SUITE C202, SPRINGFIELD, MO 65807
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

April 28, 2016

Re: Conditional Use Permit – Tire Service Center
2420 E Sunshine St.

The existing site is a closed Sonic facility. The owner would like to construct a Plaza Tire Service facility. Plaza Tire Service is an automotive tire and vehicle repair facility.

With respect to all proposed conditional uses, to the extent applicable:

1. The proposed conditional use will be consistent with the adopted policies in the Springfield Comprehensive Plan;

The proposed tire service center is consistent with the Comprehensive Plan. The lot has been zoned Planning Development (PD) which allows GR uses. We are proposing GR zoning with this conditional overlay to allow automotive tire and vehicle repair. This conditional use permit will allow for the tire service center to be developed on the lot.

2. The proposed conditional use will not adversely affect the safety of the motoring public and of pedestrians using the facility and the area immediately surrounding the site;

The site is located at 2420 E. Sunshine. Sunshine St. has a five lane section with a center turn lane. The traffic volume for an automobile repair shop will be less than for a fast food restaurant. There are existing sidewalks on the South side of Sunshine St. which will assist in pedestrian safety.

3. The proposed conditional use will adequately provide for safety from fire hazards, and have effective measures of fire control;

The tire service center will be built per the latest fire code required by the City of Springfield to adequately provide for safety.

4. The proposed conditional use will not increase the hazard to adjacent property from flood or water damage;

The existing site is fully developed with similar flows to the proposed site. The proposed tire service center will be designed to the latest standards to prevent flood damage to the adjacent property owners.

5. The proposed conditional use will not have noise characteristics that exceed the sound levels that are typical of uses permitted as a matter of right in the district;

The site is in the middle of other retail developments. The noise from an automotive repair shop should not be significantly higher than the existing fast food restaurant.

6. The glare of vehicular and stationary lights will not affect the established character of the neighborhood, and to the extent such lights will be visible from any residential district, measures to shield or direct such lights so as to eliminate or mitigate such glare are proposed;

The tire service center lights will be typical for a commercial development and similar to the existing lighting. The site lighting will follow City of Springfield lighting standards. The site is not adjacent to any residential districts.

7. The location, lighting, and type of signs and the relationship of signs to traffic control is appropriate for the site;

The proposed tire service center signage will be in accordance with the zoning ordinance.

8. Such signs will not have an adverse effect on any adjacent properties;

The signage will be along the Sunshine St. right of way. The adjoining property is zoned Planning Development (PD) with GR uses and should not be affected by signage.

9. The street right-of-way and pavement width in the vicinity is or will be adequate for traffic reasonably expected to be generated by the proposed use;

The surrounding pavement widths are typical of a primary arterial and adequate for GR uses.

10. The proposed conditional use will not have any substantial or undue adverse effect upon, or will lack amenity or will be incompatible with, the use or enjoyment of adjacent and surrounding property, the character of the neighborhood, traffic conditions, parking utility facilities, and other matters affecting the public health, safety and general welfare;

The proposed tire service center will not have adverse effect on the businesses surrounding its location.

11. The proposed conditional use will be constructed, arranged and operated so as not to dominate the immediate vicinity or to interfere with the development and use of neighboring property in accordance with the applicable district regulations. In determining whether the proposed conditional use will so dominate the immediate neighborhood, consideration shall be given to:

a. The location, nature and height of buildings, structures, walls and fences on the site; and

The proposed facilities will be similar in location, nature, and height of building to the adjoining Kum & Go and Autozone. We are not proposing fences or walls.

b. The nature and extent of landscaping and screening on the site;

The proposed facilities will have similar landscaping and screening to the adjoining properties. The nature and extent of landscaping and screening will be consistent with the requirements of the zoning ordinance.

LEE ENGINEERING AND ASSOCIATES, L.L.C.
2101 W. CHESTERFIELD BLVD. • SUITE C202 • SPRINGFIELD, MO 65807
FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz • TELEPHONE: (417) 886-9100

12. The proposed conditional use, as shown by the application, will not destroy, damage, detrimentally modify or interfere with the enjoyment and function of any significant natural topographic or physical features of the site;

The existing site is a Sonic fast food facility. The proposed tire service center will not adversely affect natural topographic or physical features of the site.

13. The proposed conditional use will not result in the destruction, loss or damage of any natural, scenic or historic feature of significant importance;

The existing site is a vacant fast food facility that is not of any significant natural, scenic, or historical importance.

14. The proposed conditional use otherwise complies with all applicable regulations of the Article, including lot size requirements, bulk regulations, use limitations and performance standards;

The proposed tire service center complies with all the other standards.

15. The proposed conditional use at the specified location will contribute to or promote the welfare or convenience of the public;

The proposed tire service center will allow a facility to be constructed on site that benefit motorists using Sunshine St and is easily accessible off of Highway 65. The adjoining Kum & Go and the adjoining Autozone will benefit from the service center customers. If the Conditional Use Permit is not granted, the development would not occur.

16. Off-street parking and loading areas will be provided in accordance with the standards set out in 5-1500, 5-1600 and 6-1300 of this article, and such areas will be screened from any adjoining residential uses and located so as to protect such residential uses from any injurious effect;

The proposed tire service center will follow the standards set out in 5-1500, 5-1600 and 6-1300. There are no adjoining residential uses.

17. Adequate access roads or entrance or exit drives will be provided and will be designed so as to prevent traffic hazards and to minimize traffic congestion in public streets and alleys;

The site will be designed to meet the City of Springfield's site design guidelines. The existing roads are adequate to minimize traffic congestion.

18. The vehicular circulation elements of the proposed application will not create hazards to the safety of vehicular or pedestrian traffic on or off the site, disjointed vehicular or pedestrian circulation paths on or off the site, or undue interference and inconvenience to vehicular and pedestrian travel;

The proposed tire service center will not affect vehicular circulation elements.

19. The proposed use, as shown by the application, will not interfere with any easements, roadways, rail lines, utilities and public or private rights-of-way;

The proposed tire service center will not interfere with any easements, roadways, rail lines, utilities and public or private rights-of-way.

20. In the case of existing structures proposed to be converted to uses requiring a conditional use permit, the structures meet all fire, health, building, plumbing and electrical requirements of the City of Springfield.

The existing structures will be removed and the new structure will meet the fire, health, building, plumbing and electrical requirements of the City of Springfield.

21. The proposed conditional use will be served adequately by essential public facilities and services such as highways, streets, parking spaces, police and fire protection, drainage structures, refuse disposal, water and sewers, and schools; or that the persons or agencies responsible for the establishment of the proposed use will provide adequately for such services.

The proposed tire service center will be adequately served by essential public facilities and services such as highways, streets, parking spaces, police and fire protection, drainage structures, refuse disposal, water and sewers, and schools.

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2101 W. CHESTERFIELD BLVD. • SUITE C202 • SPRINGFIELD, MO 65807
FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz • TELEPHONE: (417) 886-9100

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: PD 136 *(existing zoning)* to GR *(proposed zoning)*
2. Meeting Date & Time: May 12, 2016 4 to 6:30pm
3. Meeting Location: Panera Bread, 2924 East Sunshine
4. Number of invitations that were sent: 47
5. How was the mailing list generated: City of Springfield
6. Number of neighbors in attendance (attach a sign-in sheet): 3
7. List the verbal comments and how you plan to address any issues:
(City Council does not expect all of the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

Dan Malachowski telephoned our office with concerns about noise issues. Attached is a letter from Plaza Tire that was given to Mr. Malachowski at the neighborhood meeting in regards to that concern.

8. List or attach the written comments and how you plan to address any issues:

No written comments.

I, Leslie Chrystal *(print name)*, attest that the neighborhood meeting was held on 5/12/16 *(month/date/year)*, and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Leslie Chrystal

Signature of person completing affidavit

Leslie Chrystal

Printed name of person completing affidavit

LEE ENGINEERING AND ASSOCIATES, L.L.C.
CIVIL ENGINEERING & LAND SURVEYING

1200 E. WOODHURST DR., SUITE D200, SPRINGFIELD, MO 65804
TELEPHONE: (417) 886-9100 • FACSIMILE: (417) 886-9336 • dlee@leeengineering.biz

SIGN IN SHEET

Neighborhood Meeting

Thursday, May 12, 2016

Re: Proposed Rezone
With A Conditional Use Permit
2420 East Sunshine
Springfield, Missouri

NAME	ADDRESS	PHONE
Ken Blankenship	2315 E Washita	886-7463
Toni Lightner	2402 E Madrid	883-3235
DAN MALACHOWSKI	2432 E. MADRID	886-1111

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www.plazatireservice.com

May 12, 2016

Mr. Derek Lee
Lee Engineering
1200 E Woodhurst Dr Bldg D 200
Springfield MO 65804

RE: New Plaza Tire Service, 2420 East Sunshine, Springfield, Missouri

Dear Derek,

Please allow this letter to address concerns about possible noise issues coming from our store operations.

1) All work will be inside the building
2) The bays will be facing west toward Kum & Go.
3) We will use rotary driven compressor not a piston type compressor. This compressor makes noise similar to a residential refrigerator.

The noise from our operations is typical of retail developments such as Kum & Go or Sonic. We have never had a compliant or violation regarding noise from any of our other 58 stores. Some stores operate within 100' from residential areas. This is our first store in Springfield and we want to be a part of the Springfield community. We will fully comply with the City's noise ordinance (Division 2 Sec. 78-111-114). It is our goal to be a good neighbor and corporate citizen to the City of Springfield.

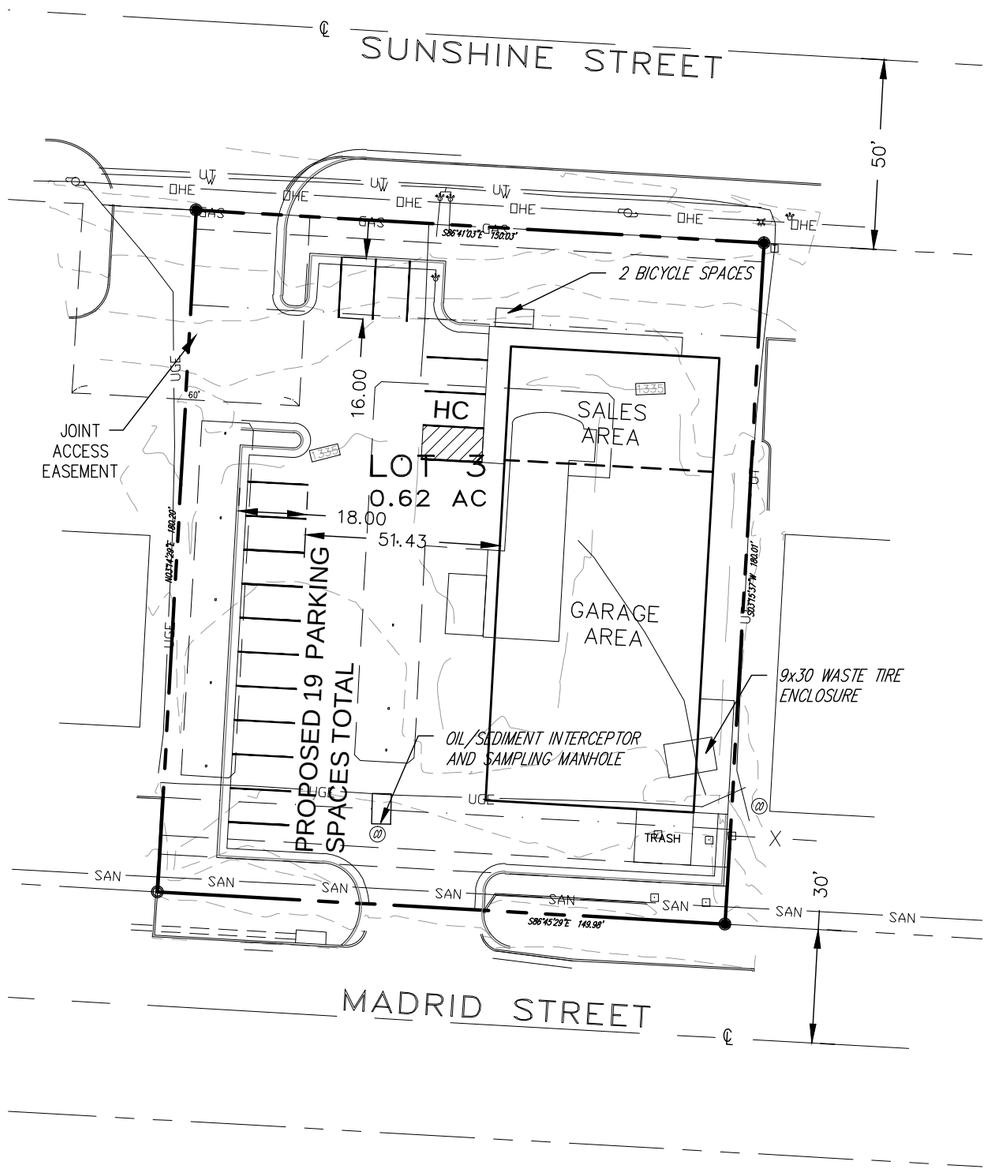
Sincerely,

Plaza Tire Service, Inc.

Scott M. Rhodes
Vice President
Co-Owner

ESTABLISHED 1966

SCALE 1" = 40'



ZONING INFORMATION:
CURRENT ZONING - PD 136 AMENDMENT 1
PROPOSED ZONING - GR
PROPOSED CUP - AUTOMOBILE SERVICE GARAGE
MINIMUM OPEN SPACE REQUIRED: 20%
OPEN SPACE PROVIDED: 20%

PARKING SCHEDULE:
PARKING REQUIRED - 2 FOR EACH SERVICE GARAGE PLUS EMPLOYEES: THE PROPOSED GARAGE HAS UP TO 7 BAYS AND 5 EMPLOYEES.

7 BAYS * 2 SPACES = 14 SPACES
5 EMPLOYEES * 1 SPACE = 5 SPACES
TOTAL REQUIRED = 19 SPACES

PARKING PROVIDED: 19 SPACES

BICYCLE PARKING SCHEDULE:
BICYCLE SPACES REQUIRED = 2 SPACES

TOTAL BICYCLE SPACES PROVIDED = 2 SPACES

VICINITY MAP
NOT TO SCALE

FLOOD NOTE:
This property lies in Flood Zone "X" (areas determined to be outside of the 0.2% annual chance floodplain) according to FIRM Community Panel 29077C 0361 E, effective December 17, 2010.

DESCRIPTION –
LOT 3, LONE PINE PLACE, A SUBDIVISION IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI.

LEE Engineering & Associates, L.L.C.
1200 E. Woodhurst,
Suite D200
Springfield, MO 65804
417-886-9100 (phone)
417-886-9336 (fax)
dlee@leeengineering.biz
"Engineering with integrity"
Missouri State Certificate of Authority
Engineering #2005015504
Land Surveying #2009028050

CONDITIONAL USE PERMIT SKETCH PLAN
FOR PLAZA TIRE, INC.

2420 E Sunshine
Springfield, Greene County, Missouri

SURVEY BY	DESIGN	SCALES	SHEET 1
FIELD BK	DRAWN DRB	HOR. 1"=40'	OF 1 SHEETS
LEVEL BK	CHECKED LEE	VERT. n/a	FILE NO.
DWG: CUP Sketch.dwg	PROJECT NO.: 1619		
DATE: 06/02/2016			

PLANNING AND DEVELOPMENT DEPARTMENT
DEVELOPMENT REVIEW
MEMORANDUM

DATE: June 28, 2016

TO: Planning and Zoning Commission

FROM: Daniel Neal
Senior Planner

SUBJECT: Initiate amendments to Section 36-483. – Off-street parking and loading area design standards for single-family detached, single-family semi-detached, duplex, townhouse and mobile homes.

Staff is requesting amendments to the design standards of surfacing material for off-street parking areas for single-family detached, single-family semi-detached, duplex, townhouse and mobile homes. The current requirements do not allow these residential uses to utilize pervious pavers, permeable pavement or other alternative methods to reduce impervious surfaces. The current requirements, however, do allow multi-family, commercial and industrial uses to utilize pervious or porous pavers.

Staff is proposing to modify the Off-street parking and loading area design standards section (36-483.) of the Zoning Ordinance to allow all uses to utilize this alternative to constructing off-street parking surfaces. This will provide an alternative to reducing impervious surface areas and stormwater runoff.

Staff requests that Commission initiate amendments to the Zoning Ordinance to consider modifications as specified. If approved Staff will prepare and draft changes to the Zoning Ordinance and schedule a public hearing at the next available date for both the Commission and the City Council.