Green Infrastructure for Stormwater Management at the Marshall County Children's Art Center

1201 Elm Street Benton Kentucky

Final Report

319(h) Nonpoint Source Implementation Grant No: C9994861-09

Application Number: 09-14

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City of Benton
1001 Main Street
Benton, KY 42025

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Contents

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The City of Benton would like to thank our partners on this project, including:

- Marshall County Arts Commission
- Marshall County Fiscal Court
- Marshall County Conservation District
- Four Rivers Basin Team
- Bacon Farmer Workman Engineering & Testing, Inc.
- Kentucky Ready Mixed Concrete Association
- Federal Materials Company
- Benton Main Street Renaissance
- Marshall County School District
- Marshall County Master Gardeners
- Marshall County Cooperative Extension Service
- University of Kentucky Cooperative Extension Service
- Kentucky Chapter US Green Building Council
- England Contracting, LLC
- Paul Howard Landscaping
- Worms Turf & Sod
- Jett Setters

Executive Summary

The City of Benton is located in far western Kentucky in Marshall County. This small city has an increasing trend of urbanization, with most land use devoted to residential and transportation uses. This small city does not fall under the requirements of an MS4, and as such does not have a formal stormwater management strategy, but the city experiences many problems associated with urban runoff and stormwater, including nonpoint source pollution, flooding and stress on the local wastewater treatment plant. In this area, there are also concerns about water quality due to the nonpoint source pollutants associated with urban runoff. A segment of the Clarks River located just outside of Benton, mile 34.8 to 42.6, has been identified as partially supporting warm water aquatic habitat in the *2010 Integrated Report To Congress on the Condition of Water Resources in Kentucky* (KDOW, 2010). Nonpoint source pollutants could be transported from urban and residential areas throughout town to the Clarks River and the Clarks River National Wildlife Refuge. These pollutants could greatly affect the ecosystem health of the Refuge and the overall quality of bottomland hardwood habitat and the associated riverine systems present in the area. Bottomland hardwood habitats are extremely beneficial habitats, and are in need of protection.

The City of Benton was awarded a Community Block Development Grant to establish a community Children's Art Center that will serve children from all over the county. The Center is located near the heart of town, right off of Court Square, within walking distance of the local elementary and middle school, making this an optimal location for demonstration project to showcase green infrastructure practices for stormwater management.

Through this project, a series of several different green infrastructure practices for stormwater management for stormwater management were installed. Partnering with Bacon Farmer Workman Engineering & Testing, Inc., Kentucky Ready Mixed Concrete Association, and the Marshall County Master Gardeners, pervious concrete was installed in the parking stalls, with bioswales bordering the parking stalls, and a rain garden was installed in the center grassy area. An artistic rain barrel designed by students from Benton Middle School was incorporated into the drainage system for rooftop runoff. Permeable paver sidewalks were installed around the perimeter of the property by Paul Howard Landscaping, LLC. A grass pave turfstone parking area was constructed for overflow parking by Paul Howard Landscaping, LLC.

In this region of Kentucky, there has been much apprehension about some green infrastructure practices for stormwater management. As such, a large component of this project was the education and outreach component, to communicate to the local community, including local officials, developers and the general public that these practices not only work in this area, but can also be attractive. A "Watersheds 101" class was developed and is planned to ensure local officials are knowledgeable about nonpoint source pollution and urban runoff. Kentucky Ready Mixed Concrete Association hosted a training session for city and county workers and local contractors to learn how pervious concrete is installed. A community wide event was held upon completion of the project to showcase all of the different technologies installed at the site. Brochures and educational signs were developed to showcase cost and benefits of these different technologies. The long term goal of this project is to change the mindset of the local community by showing them the enormous benefits to be gained by installation of these technologies.

Introduction & Background

The City of Benton is located near the center of Marshall County in western Kentucky. Because of its strategic location in the county and the tourism potential for the area, Benton has served as the central retail and government center for the area. According to the *2008 Comprehensive Plan for the City of Benton, Kentucky* prepared by the Purchase Area Development District, the city will continue to experience positive economic development over the coming years due to its location, tourism potential, and availability of affordable power and a stable workforce. In and around the City of Benton, there is an increasing trend of urbanization, with the bulk of land use in the city, approximately 60%, being devoted to residential uses. Streets, highways, and other transportation corridors represent the second major land use in the city, comprising approximately 16% of total land use in the city (PADD, 2008). The location of the city, projected development forecast and existing problems with urban runoff and stormwater make this area a great place to showcase new technologies, such as green infrastructure techniques for stormwater management.

According to 2009 census data, the population of Benton was 4,350, making this community exempt from stormwater regulations associated with larger communities. As such, Benton has no formal stormwater management program. Flooding is a significant problem for the city. While some of this flooding has to do with the city's proximity to the Clarks River and its tributaries, much of it also has to do with the amount of impervious cover in the area and lack of stormwater management. The north end of both Main Street and Poplar Street often become hazardous during heavy rainfall events because of flooding, likely due to urban runoff from impervious surfaces in higher elevation areas throughout the city. The local wastewater treatment plant is also greatly affected by runoff, with small rainfall events often overloading the system due to inflow and infiltration. The system is currently permitted to discharge one million gallons per day, but during extreme rainfall events, can experience upwards of four million gallons per day. Urban runoff and stormwater represent a major source of the inflow and infiltration affecting the wastewater treatment plant. Much work and money has been invested identifying where the sources of inflow and infiltration are and correcting them, but working towards a better stormwater management strategy could greatly help with this problem.

In addition to the flooding affecting the City of Benton, there are also concerns about water quality due to nonpoint source pollution associated with urban runoff, including sediment, oil and grease, pesticides and nutrients, bacteria, salts, etc. A segment of the Clarks River located just outside of Benton, mile 34.8 to 42.6, has been identified as partially supporting warm water aquatic habitat in the *2012 Integrated Report To Congress on the Condition of Water Resources in Kentucky* (Kentucky Division of Water, 2012). Causes include benthic macroinvertebrate bioassessments, particle distribution (embeddedness), sedimentation/siltation, nitrate/nitrite, and total phosphorus. Suspected sources include non-irrigated crop production, crop production, agriculture, channelization, and streambank modifications/destabilization. While these potential sources are not directly related to urban runoff and stormwater, this project, in combination with a better stormwater management strategy, could reduce runoff during extreme flow events and help to decrease sedimentation and other types of nonpoint source pollution.

Nonpoint source pollution associated with urban runoff and stormwater could be picked up from urban and residential areas and transported to the many small tributaries throughout town, and ultimately the Clarks River and the Clarks River National Wildlife Refuge. This pollution could greatly affect the ecosystem health of the

Refuge and the overall quality of bottomland hardwood habitat and the associated riverine systems. As flood waters recharge wetlands found along the Clarks River, any habitat and wildlife utilizing that habitat may also be affected by this pollution. With the bulk of land in the city being developed, and the high percentage of impervious cover within the city, it is vital to show the local community the water quality and flooding issues associated with stormwater, and different ways to manage stormwater based on the variety of land uses present in the area to prevent nonpoint source pollution from affecting the unique ecosystems found along the Clarks River.

The City of Benton, on behalf of the Marshall County Arts Commission, was awarded a Community Block Development Grant to establish a community Children's Art Center that will serve children from all over the county. The Center is located near the heart of town, right off of Court Square, within walking distance of the local elementary and middle school, making it a prime location to be used as a demonstration area for green infrastructure technologies. The location of the Center, in Benton between Mayfield, Murray and Paducah, three MS4 communities, will make these techniques visible not only to the local communities, including stormwater managers, developers, engineers, architects, contractors, local officials, and citizens, but also to the numerous tourists that the City of Benton attracts because of its proximity to Land Between the Lakes, Kentucky Dam Village State Resort Park and Kenlake State Resort Park., making this area an ideal location to reach large numbers of people with information regarding green infrastructure, nonpoint source pollution and stormwater management.

Through this project, a series of green practices for stormwater management were installed to demonstrate to the local community that green infrastructure techniques can be attractive and successful in this region, including pervious concrete parking areas, permeable paver sidewalks, grass pave turfstone parking areas, a rain garden, a vegetative bioswale bordering the parking area, and an artistic rain barrel designed by students from the local middle school. Education and outreach were a critical part of this project. In the local development community, there is an unwillingness to incorporate these types of technologies into projects because they are largely untested in this region. This project served to educate not only the development community about these techniques, but also local officials and the general public through a series of public events and educational materials that were developed. The ultimate goal of this project is to change the mindset of the local community by showing them the enormous benefits to be gained by installation of these technologies.

According to the *2008 Comprehensive Plan for the City of Benton, Kentucky* prepared by the Purchase Area Development District, goals of the planning commission and city council are to "promote and redevelop the Central Business District as the City core and a viable center for community activity" and "encourage developments to be sensitive to specific environmental constraints and the general surrounding natural environment." This project directly met these goals, and has shown how the recommended redevelopment can occur in an environmentally sustainable manner. The City of Benton is a close-knit community with a deep sense of pride in being and doing the best. Despite its small size, the city has displayed a willingness to learn about practices used in larger areas and to implement them where possible. Local officials are extremely interested in learning more about nonpoint source pollution and stormwater management, and are open to suggestions that will help this community. The location of the city, continued growth over the past few years and existing problems with urban runoff and stormwater make this area a great place to showcase green infrastructure techniques for stormwater management.

The potential for long term implications, outside the time frame of this project, are great. As mentioned earlier, Benton has many problems with flooding, and inflow and infiltration is a large problem for the wastewater treatment plant. Some outreach from this project targeted local officials, with the hopes that they will see the potential these technologies offer in addressing nonpoint source pollution, flooding and stress on the wastewater treatment plant. A future goal would be to develop city ordinances that require new development to manage stormwater runoff and nonpoint source pollution through a variety of practices, such as pervious concrete and rain barrels.

Materials & Methods

Description of the Project Area

The Marshall County Children's Arts Center is located in the Clarks River Watershed, specifically in the Watch Creek – Clarks River subwatershed, hydrologic unit code 060400060402 (Figure 1). The Clarks River watershed is located in four counties of the Jackson Purchase region of western Kentucky, including Calloway, Graves, Marshall and McCracken counties. The Clarks River watershed has several stream reaches identified as impaired in the 2012 *Integrated Report to Congress on the Condition of Water Resources in Kentucky* (Kentucky Division of Water, 2012). This includes segments impaired for the warm water aquatic habitat, primary contact recreation, and fish consumption designated uses. In 2011, US EPA approved a Total Maximum Daily Load (TMDL) developed by Kentucky Division of Water for *E. coli* for 40 stream segments located within the Clarks River watershed (Kentucky Division of Water, 2011). These factors all make this watershed an important area to watershed implementation projects.

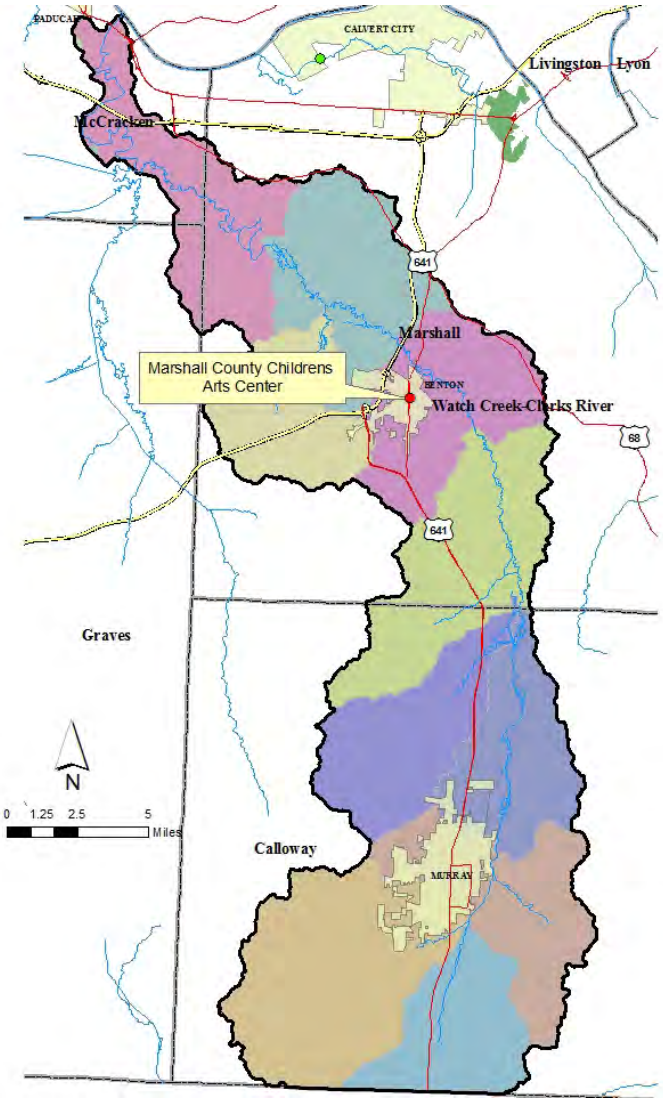

Figure 1. Location of the Marshall County Children's Arts Center in the Clarks River Watershed (outlined in black), and more specifically the Watch Creek - Clarks River subwatershed.

The Marshall County Children's Arts Center is located in the heart of town, one block off of the Court Square, on the corner of Elm Street and 12th Street (Figure 2). The Center is located three blocks away from Benton Elementary, located off Olive Street, and two blocks from the Benton branch of the Marshall County Public Library located near 10th Street. As mentioned in the introduction, the Marshall County Children's Arts Center is centrally located between Paducah, Murray and Mayfield and is in close proximity to several tourist destinations, including Land between the Lakes National Recreation Area, the Clarks River National Wildlife Refuge, Kentucky Dam Village State Resort Park, Kenlake State Resort Park, and Lake Barkley State Resort Park (Figure 3). All of these factors make the Marshall County Children's Arts Center an ideal location to reach large numbers of people with information regarding green infrastructure, nonpoint source pollution and stormwater management.

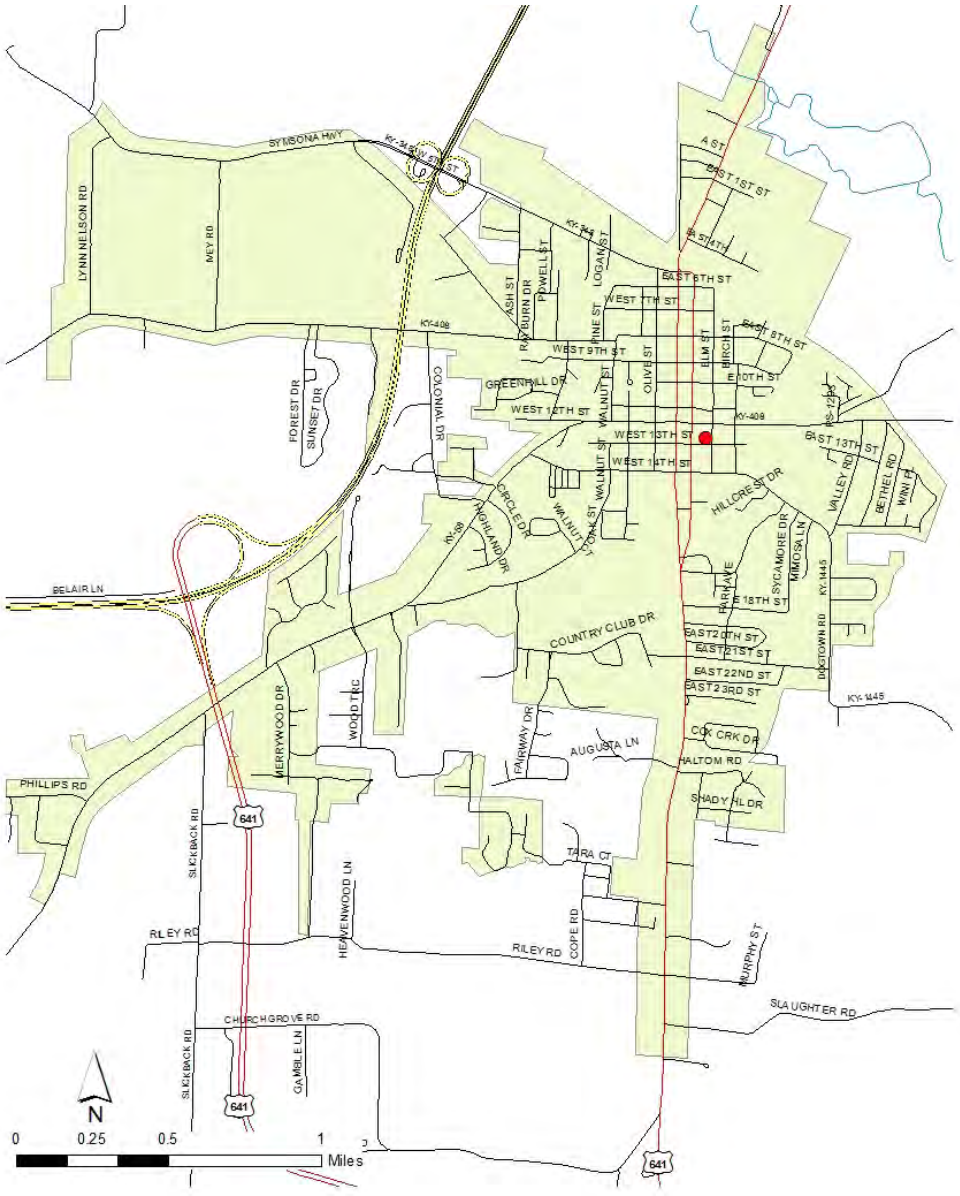

Figure 2. Location of the Marshall County Children's Arts Center in Benton, Kentucky.

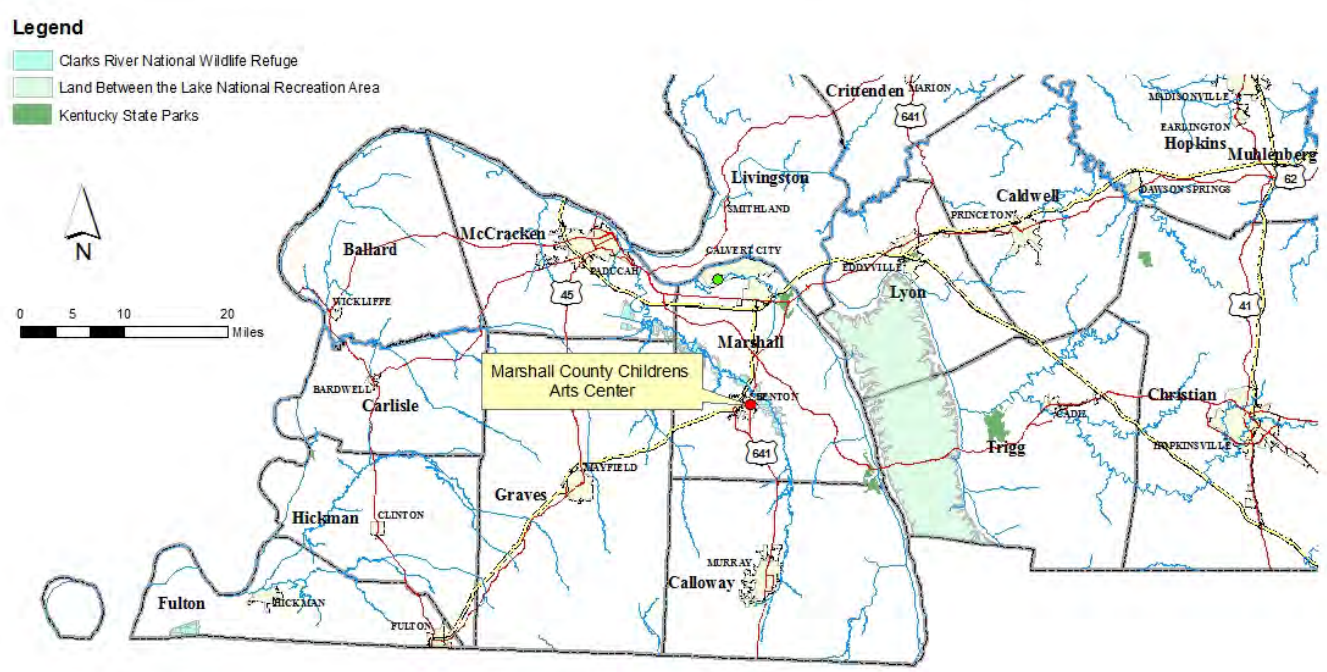

Figure 3. Location of the Marshall County Children's Arts Center in reference to several tourist destinations in the area.

In recent years, the city of Benton has continued to grow, resulting in increased services offered to residents of the city. According to the *2008 Comprehensive Plan for the City of Benton, Kentucky* prepared by the Purchase Area Development District, the city will continue to experience positive economic development over the coming years due to its location, tourism potential, and availability of affordable power and a stable workforce. Because of this, much of the land use in the city has become urbanized, with over 60% of the land area devoted to residential uses, and 16% of the land use being devoted to transportation corridors (PADD, 1998).

Description of Methods Used

Through this project, six different best management practices were installed at the Marshall County Children's Arts Center to show the community the benefits of green infrastructure techniques for stormwater management, including pervious concrete parking stalls, permeable paver sidewalks, an overflow grass pave turfstone parking area, a rain garden, a vegetative bioswale surrounding the pervious concrete parking stalls, and a rain barrel. Engineering and design work for some of the technologies to be installed, including the main parking area for the Center, the rain garden, and the vegetative bioswale, was completed by Bacon Farmer Workman Engineering and Testing, Inc. Plans were presented to the project team and the Kentucky Division of Water along with a BMP Implementation Plan (Appendix B).

Site preparation work, including all excavation and grading, was completed by the Marshall County Road Department with their equipment. During the site preparation phase, a grave site was found, requiring a work stoppage until further investigations and archaeological studies were complete. To continue site preparation work, the Kentucky State Historic Preservation Office required that an approved firm be present on site for the remainder of all excavation work to ensure all artifacts found were properly catalogued and protected. Dr. Ken Carstens with Archaeological & Museum Consulting Services, Inc. from Murray, Kentucky was hired to perform this task. A slight modification had to be made to design plans during the site preparation process due to the

discovery of an old cistern in one of the parking stalls. Under the direction of Archaeological & Museum Consulting Services, Inc., this parking stall was left as it was and not excavated.

Once site preparation work was completed, Kentucky Ready Mixed Concrete Association worked with the project team to host a NRMCA Pervious Concrete Contractor Certification Course, training city and county staff, and other interested construction firms, in how to place and finish pervious concrete. A flyer describing this training has been included in Appendix F. Upon completion of this training, city and county workers, under the direction of the Kentucky Ready Mixed Concrete Association, installed the pervious concrete in the stalls of the main parking area for the Marshall County Children's Arts Center, as designed in the original site plans developed by Bacon Farmer Workman Engineering and Testing, Inc. The pervious concrete blend used in the parking stalls was provided by Federal Materials Company. England Contracting, LLC was hired to install the conventional concrete drive lanes, as designed in the original site plans.

Permeable pavers for the sidewalks were purchased from Midwest Block and Brick in Paducah, Kentucky and installed by Paul Howard Landscaping, LLC. Site preparation and excavation was completed by Paul Howard Landscaping, LLC according to manufacturer recommendations. Pavers were part of the Ledgestone product line from Midwest Block and Brick, and were installed according to manufacturer recommendations.

Grass pave turfstone pavers for the overflow parking area were purchased from Midwest Block and Brick in Paducah, Kentucky and installed by Paul Howard Landscaping, LLC. Site preparation and excavating was completed by Paul Howard Landscaping, LLC according to manufacturer recommendations. Pavers were part of the Turfstone product line, and were installed according to manufacturer recommendations. A fescue – rye grass seed blend was spread between the turfstone pavers by volunteers.

The vegetative bioswale bordering the pervious concrete parking stalls was designed by Bacon Farmer Workman Engineering and Testing, LLC. To make this swale more aesthetically appealing, large rocks and wetland-type plants were added to make it look more like a creek bed. Rocks were purchased from Lee Brick and Block in Hardin, Kentucky. Wetland-type plants, including buttonbush, thalia, swamp milkweed, white milkweed, chairmaker's rush, soft rush, and globe sedge were ordered from Missouri Wildflowers Nursery, LLC. Planting of the vegetative bioswale was completed by volunteers.

The rain garden was designed by Bacon Farmer Workman Engineering and Testing, LLC. Modifications to this design were made by Brad Lee, University of Kentucky College of Agriculture, Food and Environment Extension Associate for Water Quality. Modifications included backfilling the depression area with a soil blend mix of 85% coarse washed masonry sand, 10% fine material that passes a #200 screen, and 2-5% organic matter (pine bark fines or wood material) to ensure proper drainage of the rain garden; adding in an overflow on the east side of the rain garden; and installing a water control structure to properly manage water levels within the rain garden. The soil blend mix was created on site with masonry sand from Federal Materials Company, top soil donated by FLW Fishing, and bark mulch from Holt's Sawmill and mixed in the garden by Benton city workers. The water control structure was purchased from Advanced Drainage Systems and installed by Benton city workers. Plant selection for the rain garden was completed by the Marshall County Master Gardeners, and included eastern bluestar, butterfly weed, blue wild indigo, American beautybush, lanceleaf tickseed, Tennessee coneflower, rattlesnake master, strawberry bush or bursting heart, western sunflower, alum root or coral bells, oakleaf

hydrangea, dwarf crested iris, cardinal flower or Indian pink, great blue lobelia, fragrant sumac, orange coneflower, little bluestem, prairie dropseed, and giant ironweed. Plants were purchased through a grant from U.S. Fish and Wildlife Service Ecological Services Section from Missouri Wildflowers Nursery, LLC, Beans to Blossom Nursery, and Rolling Hills Nursery. Planting of the rain garden was done by the Marshall County Master Gardeners and volunteers following a Rain Garden Training hosted by the University of Kentucky Cooperative Extension Service.

Middle school students from Benton Middle School painted a 55 gallon rain barrel that was installed on site using a rain barrel installation kit purchased from Rain Brothers, Inc. by Marshall County Conservation District. The rain barrel was installed on the northwest corner of the building by volunteers per the recommendations with the installation kit.

Description of Specialized Materials Used in Data Collection

No data was collected during this project as this was an education and outreach project to demonstrate to the community the benefits of green infrastructure techniques for stormwater management.

Description of Education and Outreach Component

Education and outreach has been an integral part of this demonstration project, as the main goal of the project was to show that green infrastructure techniques can be both attractive and successful in this area. As such, several educational materials were developed and several public events and trainings were held. Educational materials that were developed include a brochure that described the problems with runoff pollution and included information about each of the different technologies installed through this project, and a series of educational signs that described each of the different technologies installed at the site, including signs about rain barrels, rain gardens, pervious concrete, bioswales, and permeable pavers/turfstone. Copies of these materials have been included in Appendix F.

In addition to the educational materials that were developed for this project, several public events were held to showcase these technologies, with professionals on hand to answer questions about the different techniques utilized at the site. A pervious concrete training session was hosted by the Kentucky Ready Mixed Concrete Association to allow city and county workers the opportunity to learn about pervious concrete and the benefits that accompany this technology. This event was advertised and open for all to attend. A rain garden training was hosted by the Marshall County Cooperative Extension Service at the Marshall County Children's Arts Center that included information about rain gardens, and how these could be installed in a residential setting. This event was open to the public. A community event/field day was held with various booths set up to educate the community not only about the technologies installed at the Marshall County Children's Arts Center, but also green living in general. A Watersheds 101 was developed for local officials to give them more information about runoff pollution and how green infrastructure could be integrated into city landscapes. Local officials from around the region have been invited to this training, scheduled for _____.

In addition the educational materials that were developed and events that were held, a long term education and outreach plan was developed to ensure that the green infrastructure techniques utilized at the Marshall County Children's Arts Center continue to be used as a demonstration for the greater community long into the future. This plan has been included in Appendix D.

Results & Discussion

Through this project, a series of different best management practices for stormwater management were installed at the Marshall County Children's Arts Center located at 1202 Elm Street in Benton, Kentucky. In May of 2014, upon completion of all site excavation and preparation work, 27 pervious concrete parking stalls that measured, 10 feet by 20 feet were installed by city and county workers under the direction of the Kentucky Ready Mixed Concrete Association according to the site plans included in Appendix C. A total of 6,254 square feet of pervious concrete were installed at the site. Due to apprehension of engineering staff and project advisors, pervious concrete was not installed in the drive lanes. In July of 2014, conventional concrete was installed in the drive lanes by England Contracting, LLC to ensure long term survival of the technology in an area where more vehicular traffic would be turning around and potentially damaging pervious concrete. Approximately 8,718 square feet of conventional concrete was installed at the site. Runoff from approximately half of that conventional concrete, 4,332 square feet, will be directed into the green infrastructure technologies installed at the site, the pervious concrete areas or the bioswale area. Currently these technologies are performing as anticipated.

In August of 2014, a large demonstration rain garden was installed at the site under the direction of University of Kentucky Cooperative Extension specialists Brad Lee and Rick Durham with slight modifications to the original design plans developed by Bacon Farmer Workman Engineering and Testing. The rain garden is approximately 1,866 square feet in size, and was backfilled with a special soil mix of 85% coarse masonry sand, 10% top soil and 5% bark. Prior to backfilling the rain garden, a 4" perforated pipe was installed at the bottom of the rain garden and covered with a weedblock fabric. A Nyloplast® Water Control Structure was connected to this perforated pipe in the bottom of the rain garden to ensure that the special soil mix held enough water for plant survival, but not so much that plants were submerged under water for longer than 72 hours after a rainfall event. The Nyloplast ® Water Control Structure allows for a controlled release of water from the rain garden, and the water level can be manipulated as needed during storm events. Water released from the Nyloplast® Water Control Structure is directed into the bioswale area in an effort to prevent as much runoff from the site as possible. An overflow area for the rain garden was also installed and covered with large rocks to prevent erosion. This overflow area connected with a shallow swale that drained to the larger bioswale area. Plants for the rain garden were selected by the Marshall County Master Gardeners, and included eastern bluestar, butterfly weed, blue wild indigo, American beautybush, lanceleaf tickseed, Tennessee coneflower, rattlesnake master, strawberry bush or bursting heart, western sunflower, alum root or coral bells, oakleaf hydrangea, dwarf crested iris, cardinal flower or Indian pink, great blue lobelia, fragrant sumac, orange coneflower, little bluestem, prairie dropseed, and giant ironweed. The rain garden is performing well at this point; however, some plants will need to be replaced due to their lack of survival. A rain garden maintenance training session has been scheduled for May 12, 2016, and plants will be replaced as needed on that date. To prevent erosion from much of the bare area at the site, including the slope surrounding the rain garden area, a fescue bluegrass blend sod was installed in November of 2014. A total of approximately 15,295 square feet of sod was installed. Currently, sod is surviving well and no problems are anticipated with this.

In November of 2014, a permeable paver sidewalk was installed around the site by Paul Howard Landscaping, LLC according to the manufacturer recommendations. Bacon Farmer Workman Engineering and Testing, Inc. was consulted to ensure that sidewalks were installed appropriately. Approximately 429 linear feet of sidewalk that

is 6 feet wide was installed, for a total of 2,571 square feet of permeable paver sidewalks. To date, the sidewalk is performing as expected.

In November of 2014, an overflow parking area was constructed along 12th Street. This overflow parking area utilized grass pave turfstone pavers from Midwest Brick and Block in Paducah, Kentucky. This parking area was installed by Paul Howard Landscaping, LLC according to manufacturer recommendations. Bacon Farmer Workman Engineering and Testing, Inc. was consulted to ensure that the parking area was installed appropriately. A total of 2,505 square feet of grass pave turfstone pavers were installed at the site. The original intention of the project team was to backfill the turfstone pavers with a topsoil/grass seed blend and grow grass between openings in the paver. However, the contract backfilled the turfstone pavers with a washed gravel. While this does not affect the overall performance of this technology in terms of managing stormwater runoff, it does change the aesthetic appeal that the project team originally hoped for. The project team still intended to back the area with a topsoil mix and select a hardy grass to try to grow between the openings in the turfstone pavers. Overall, this technology is performing as expected, however, the contract has yet to finish some of the edge work needed after multiple phone calls from the City of Benton. The contractor has promised to complete this work in the spring of 2016.

In April of 2015, an artistic rain barrel painted by Benton Middle School students was installed at the Marshall County Children's Arts Center. The barrel was connected to one of the gutters utilizing a kit purchased from Lowes by city workers. Installation followed recommendations in the kit. To date, the barrel is performing as expected, collected runoff from approximately 620 square feet of roof.

In May of 2015, construction of the bioswale was completed. Preparation of the bioswale area followed the site plans developed by Bacon Farmer Workman Engineering and Testing, Inc. Site preparation work was completed by city and county workers. To make the bioswale more aesthetically appealing, large rocks and a series of wetland plants were installed in the bioswale, including buttonbush, thalia, swamp milkweed, white milkweed, chairmaker's rush, soft rush, and globe sedge. Plants were selected by the project team with help from the Marshall County Master Gardeners. A bridge was constructed over this bioswale to allow connection of the parking area with the rain garden area. To date, the bioswale area is performing as anticipated.

To ensure maintenance of these technologies occurs as needed upon completion of this project, a long term maintenance plan was developed for the site. This plan includes information about each of the different technologies installed and the maintenance requirements for each technology. In December of 2016, a training session was held with city workers and volunteers for the Marshall County Children's Arts Center to determine who would be responsible for each maintenance component. A copy of this maintenance plan has been included in Appendix E.

In addition to the different technologies that were installed at the Marshall County Children's Arts Center, a variety of education and outreach activities took place throughout the project. Educational materials that were developed included a brochure about the different technologies and educational signs about the different technologies. Copies of these materials have been included in Appendix F. These educational materials were developed by the project team in cooperation with Jett Setters, a local firm that does graphic design work. The

intended audience of these materials was the general public. These materials have been very well received by the local community.

In addition to the development of educational materials, a series of outreach activities also occurred during the project time frame. A NRMCA Pervious Concrete Contractor Certification Course was hosted in October of 2013 to train city and county workers, and any other guests, about pervious concrete and its installation. A total of 15 attended this training. A rain garden training session was hosted by the Marshall County Cooperative Extension Service with extension specialists from the University of Kentucky College of Agriculture, Food and Environment in August of 2014. In addition to learning about rain gardens, their benefits and how to install them, attendees also had the opportunity to help plant the rain garden at the Marshall County Children's Arts Center. This event was open to the general public. A total of 19 attended this training. In April of 2015, an open house/field day event was held at the Marshall County Children's Arts Center and hosted by the Marshall County Conservation District. A series of different booths with information about the technologies installed at the site were set up and participants could visit them throughout the day. Giveaways were held during this event to attract members of the public to come. While the original application specified a series of different field days targeting different sectors throughout the construction process, due to scheduling constraints, this event served to fulfill all field days and public events. Approximately 50 people attended this event. During this event, 8th not 7th graders from Benton Middle School also came to listen to a series of speakers talk about the different practices installed at the site and their benefits to water quality.

In addition to the outreach events above that were directly tied to the Marshall County Children's Arts Center, members of the project team also partnered with Benton Elementary and Benton Middle Schools to offer students lessons on runoff pollution on several different occasions, including March and April of 2013, March of 2015 and December of 2015. Members of the project team also participated in a county wide field day, teaching 4th grade students from across the county about runoff pollution.

Conclusions

This project was intended to be a demonstration project to showcase a series of different green infrastructure best management practices that can be used to prevent and treat stormwater runoff. The prime location of the Marshall County Children's Arts Center made this location an attractive venue to reach the most people. Since constructing of the Marshall County Children's Arts Center, events have been held at the center every week, allowing not only children participating in the events, but also their parents to see that green infrastructure can be both attractive and successful in this region. We hope that more community members will see that some of these techniques, like rain gardens and rain barrels, would be easy to implement on a residential scale, and implement them at their home. We have already seen an interest from the community in rain barrels, and hope to see more over time. Over the long term, we anticipate the community as a whole will see the benefits from these practices that could be gained in terms of preventing flooding in Benton, which has been plagued by flash flooding events in certain areas of town. We are hopeful that some requirements for green infrastructure could be integrated into ordinances as these techniques are proven beneficial.

This project was not without its difficulties, especially with regards to the discovery of an old grave. This discovery not only delayed construction tremendously, it also required some revisions to the budget to allow for the hiring of an archaeologist for the remainder of the site preparation process. Thankfully, the U.S. Fish and Wildlife Partners for Fish and Wildlife Program stepped up and agreed to help with costs associated with the rain garden, which freed up some of the budget to help pay for the archaeologist. The value of different partners on projects like these cannot be overstated – whether it be the Marshall County Road Department that performed all site excavation and prep work for free, or Bacon Farmer Workman Engineering and Testing, Inc. that performed their engineering services at a reduced rate, or Federal Materials Company that offered concrete at a tremendous costs savings, the U.S. Fish and Wildlife Services that stepped in to help with the rain garden or the City of Benton workers who willingly performed work throughout this grant.

The measures of success that were developed for each objective of this project and status of each measure include:

Objective: Create a green infrastructure program for the Marshall County Children's Art Center that will allow filtration of urban runoff from impervious surfaces at the site.

- Preliminary design plan presented to the project team and local community for approval – plans developed by Bacon Farmer Workman Engineering and Testing, Inc. and submitted to project team 7/30/13 and approved 10/28/13.
- BMP Implementation Plan developed and submitted to Division of Water for approval – developed by Bacon Farmer Workman Engineering and Testing, Inc. submitted to Kentucky Division of Water on 7/1/2013. This plan was approved on 7/17/2013.
- Approval of all necessary permits – no additional permits were necessary.
- Installation training program hosted by KRMCA with 30 attendees successfully completing the program – this training was held on 10/17/2013 with 15 attendees.

- Installation of pervious concrete in the parking lot of the Children's Art Center with successful attendees from the training program – completed on 5/13/14 and 5/15/14. Photographs have been included in Appendix G.
- Installation of a rain garden at the site of the Children's Art Center – completed on 8/15/14. Photographs have been included in Appendix G.
- Installation of a bioswale surrounding the parking lot of the Children's Art Center – completed on 6/6/15. Photographs have been included in Appendix G.
- Installation of artistic rain barrels at the site of the Children's Art Center – completed on 4/20/2015. Photographs have been included in Appendix G.

Objective: Working with Bacon Farmer Workman Engineering and Testing, Inc., Kentucky Ready Mixed Concrete Association, and Marshall County Master Gardeners, develop a written operation and maintenance policy that identifies appropriate management activities for the site.

- Creation of an operation and maintenance plan for the technologies installed at the Children's Art Center available at Benton City Hall and the Benton Maintenance Shop – see Appendix E.
- Maintenance training session during the project time frame to ensure city workers to ensure are aware of appropriate management techniques with attendees verbally communicating their understanding and comfort level with the material presented – completed on 12/6/2015.
- Conduct additional training sessions as needed due to turnover in the city maintenance department upon completion of the project with attendees verbally communicating their understanding and comfort level with the material presented – ongoing as needed outside project time frame.
- Host annual community events upon completion of the project allowing the local community to get involved in rain garden maintenance – maintenance training session has been scheduled for 5/12/2016.

Objective: Educate the development community, local officials, and local governments about the feasibility and cost of these technologies.

- Identification of the target audience for the "Watershed 101" class and field days with assistance from the project team – completed with assistance from Four Rivers Basin Team.
- Provide advance notice of target audience, educational materials and dates for the "Watershed 101" class and field days to the Division of Water – completed.
- Hold the "Watershed 101 class" with field component after installation of parking lot with a total of 25 local officials from city and county governments – scheduled for _____.
- Conduct pre and post questionnaires for attendees at the "Watershed 101" class to better define the success of the class – planned in conjunction with "Watersheds 101" scheduled for _____.
- Hold two field days during the construction process targeting the development community and Marshall County Technical Center students with a total 50 attendees: one after installation of parking lot, and one after installation of remaining technologies – due to scheduled constraints because of construction delays, these field days were combined with the community wide event.
- Hold one community wide event with 200 attendees at the end of the construction process targeting local officials, the community at large, development community and Marshall County Technical Center

students – held on 4/22/2015 targeting all audiences. Unfortunately, not as successful as hoped, approximately 50 attendees.

- Conduct pre and post surveys at each of the educational events to determine the likelihood of future implementation of the technologies showcased – due to the structure of the event (i.e. being come and go as you please), these were not conducted.
- Development of educational materials and handouts approved by the Division of Water – completed with the development of an educational brochure and educational signs about the different technologies installed at the site.

Objective: Educate the general public about green infrastructure technologies that could be utilized in a residential setting to reduce runoff and nonpoint source pollution.

- Hold a community event (same event as mentioned above to educate the development community, local officials and local governments) with approximately 200 attendees that includes tours of the site, educational materials, education stations, etc. – held on 4/22/2015 targeting all audiences. Unfortunately, not as successful as hoped, approximately 50 attendees.
- Conduct pre and post surveys of attendees at the community event, as reasonably achievable, to ascertain knowledge, attitudes, and likelihood to implement practices at their own property – due to the structure of the event (i.e. being come and go as you please), these were not conducted.
- Newspaper article in the local paper about the community event and the goals of the project – an article was put in the local newspaper, the Marshall County Tribune Courier, about the community event.

Objective: Develop an ongoing long term education and outreach plan demonstrating the benefits of stormwater management in this community.

- Long term education and outreach plan approved by Kentucky Division of Water developed and maintained at the Marshall County Conservation District office – completed and approved on 2/10/2016, see Appendix D.
- Educational materials approved by Kentucky Division of Water available at the Marshall County Conservation District and Benton City Hall upon completion of the project for interested individuals - completed.

Objective: Educate city council members about the benefits of this specific technology, and other stormwater management practices that could be used throughout Benton to reduce runoff and NPS, thus decreasing the severity of flooding in the area and stress on the wastewater treatment plant.

- Attendance of city council members at the "Watershed 101" class – scheduled for _____.
- Conduct a pre and post survey questionnaire for city council members to better define their understanding of NPS and the causes of localized flooding in the area and possible solution before and after the "Watersheds 101" class – planned in conjunction with "Watersheds 101" scheduled for _____..

- Presentations by local communities with a stormwater management strategy, providing examples of management plans and/or city ordinances at a city council meeting or planning commission meeting – unfortunately not completed during the project time frame.
- A long term measure of success, outside the timeframe of this project, would include incorporation of stormwater management strategies into city ordinances for new and re-development projects – ongoing evaluation outside the time frame of this project.

Literature Cited

Kentucky Division of Water (2012). *2012 Integrated Report To Congress on the Condition of Water Resources in Kentucky.* Kentucky Environmental and Public Protection Cabinet, Division of Water. Frankfort, KY.

Kentucky Division of Water. 2011. *Total Maximum Daily Load for Escherichia coli 40 Stream Segments within the Clarks River Watershed Calloway, Graves, Marshall, and McCracken Counties, Kentucky.* Kentucky Environmental and Public Protection Cabinet, Division of Water. Frankfort, KY.

Purchase Area Development District (2008). *2008 Comprehensive Plan for City of Benton, Kentucky.*

24. Budget Summary (Revised)							
Category	BMP Implementation	Project Management	Education, Training, or Outreach	Monitoring	Technical Assistance	Other	Total Amount
Personnel	$0	$0	$0	$0	$0	$0	$0
Supplies	$15,000	$0	$7,500	$0	$0	$0	$22,500
Equipment	$0	$0	$0	$0	$0	$0	$0
Travel	$0	$0	$0	$0	$0	$0	$0
Contractual	227.976.48	$0	$0	$0	$18,000	$0	$245976.48
Operating Costs	$0	6523.52	$0	$0	$0	$0	6523.52
Other	$0	$0	$0	$0	$0	$0	$0
TOTAL	242976.48	6523.52	$7,500	$0	$18,000	$0	$275,000

25. Detailed Budget (Revised)			
Budget Categories (Itemize all Categories)	§319(h) (60% of funds)	Non-Federal Match (40% of funds)	TOTAL
Personnel	$0	$0	$0
Supplies	$22,500	$0	$22,500
Equipment	$0	$0	$0
Travel	$0	$0	$0
Contractual	$142,500	103476.48	$245976.48
Operating Cost	0	6523.52	6523.52
Other	$0	$0	$0
TOTAL	$165,000	$110,000	$275,000

26. Budget Narrative: Describe in detail the Federal and Non-Federal match for each of the following Budget Categories.

Personnel:

Federal- No federal funds will be utilized for personnel for this project.

Non-Federal match- has been removed to reflect the additional match that will be provided in the contractual category by the Marshall County Road Department for site preparation and excavation at the Marshall County Children's Art Center. No match funds will be used for the personnel category.

Supplies:

Federal- $22,500 of federal funds will be used for supplies, including $15,000 for the rain garden and bioswale, and $7,500 for educational materials, including brochures, handouts and a sign.

Non-Federal match- has been removed to reflect the additional match that will be provided in the contractual category by the Marshall County Road Department for site preparation and excavation at the Marshall County Children's Art Center. No match funds will be used for the supplies category.

Equipment:

Federal- No federal funds will be utilized for equipment.

Non-Federal match- has been removed to reflect the additional match that will be provided in the contractual category by the Marshall County Road Department for site preparation and excavation at the Marshall County Children's Art Center. No match funds will be used for the equipment category.

Travel:

Federal- No federal funds will be utilized for travel.

Non-Federal match- has been removed to reflect the additional match that will be provided in the contractual category by the Marshall County Road Department for site preparation and excavation at the Marshall County Children's Art Center. No match funds will be used for the travel category.

Contractual:

Federal- The bulk of federal funds for this project will be required for design and materials of the pervious concrete parking lot. BFW will require $18,000 for design, staking and inspection of the parking lot. $124,500 has been included in the budget for materials and equipment rental.

Non-Federal match- source has been changed to reflect the additional match that will be provided by the Marshall County Road Department for site preparation and excavation at the Marshall County Children's Art Center, including employee time (salary plus fringes for operators and laborers), equipment (dump trucks, trackhoe, dozer, gradall, roller, etc.) and materials, estimated at a total value of $103476.48. This includes all work necessary to bring the site to subgrade per the design completed by Bacon Farmer Workman Engineering and Testing, Inc.

Operating Costs:

Federal- No federal funds will be used for operating costs.

Non-Federal match- The City of Benton typically requires 15% for administration of grants, but is willing to provide their services as match to the grant for a total of $6523.52. This includes personnel time for grant administration, incidental supplies, office space for the grant administration, etc.

Other:

Federal- No federal funds have been budgeted for other expenses.

Non-Federal match- No match funds will be used for the other category.

City of Benton
And
Marshall County Conservation District
Long Term Education Plan

Marshall County Children's Art Center
1201 Elm Street Benton Kentucky

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the City of Benton Grant #C9994861-09

Contents

Introduction

Water is essential to all forms of life on Earth. There is no new water available on Earth, only the water that is presently in the water cycle in its various states. It may seem as if water is quite plentiful, approximately 71% of the Earth's surface is covered by water. However, only approximately 1% is available for human uses, the water found in lakes, rivers, reservoirs and underground aquifers. Of this very small amount of water that is available for human uses, we have direct effects on the quality and quantity of water available to us now and in the future. This is extremely important, as the quality of water affects the quality of health and life of all other organisms.

Human activities and influences, such as the building and maintenance of homes, businesses, and industries, raising of crops and livestock, treatment of human waste, recreational activities, cutting of timber, mining, construction and maintenance of water lines, sewer lines, roads, pipelines, and other types of infrastructure, support human populations. All of these conditions and activities have an effect on the water that moves over and through the land as it drains into the streams and rivers. Rain and snowmelt, commonly referred to as stormwater, will soak into the ground in a natural watershed that hasn't been altered by humans. Some of the stormwater will be absorbed by the plants, trees and other vegetation. As more stormwater falls and the ground has soaked up all it can hold, the water will slowly begin to run off the surface of the ground and into nearby streams. As the stormwater runoff moves across the ground, it will pick up materials on the land surface, such as dirt, sewage, animal waste, chemicals, oils or fertilizers and carry them into local streams. The water and pollution that run off into streams and lakes are called runoff pollution (Water Health Guide).

Because runoff pollution can come from many sources, it is complicated to manage. Since this type of water pollution is created by stormwater runoff, many of the strategies for dealing with it involve ways to prevent the runoff in the first place. These strategies, or best management practices (BMPs), for stormwater and runoff pollution use four common principles for effectiveness: slow it down, settle it out, spread it out and soak it in (Water Health Guide). The Marshall County Children's Arts Center in Benton, Kentucky, showcases many different examples of these BMPs that could be incorporated into residential or commercial developments to prevent stormwater runoff, including a rain garden, a rain barrel, a bioswale, pervious paver sidewalks, a turfstone overflow parking area, and pervious concrete in the main parking area. This site was selected as a prime location for implementation of these BMPs as it is ideal for educating a variety of general stakeholders that water affects everyone. Visitors to the county might be interested in the signage and infrastructure as it is highly visible. Local educators will find the central location in the county to be beneficial as will local officials who wish to bring water quality issues to light.

This document has been designed to use effective education and outreach tools to spread the message about the importance of clean water, the prevention of runoff pollution, and the effectiveness of different BMPs in terms of maintaining a healthy water supply.

Purpose

The location of the Marshall County Children's Arts Center in the heart of Benton, Kentucky makes it a prime spot for educating a wide variety of audiences, including students from the local elementary and middle school that are within walking distance of the site, city and county officials that are less than a block away from the site, and the community in general that are enjoying the multitude of programs that are hosted by the Marshall County Children's Arts Center and the Marshall County Arts Commission. The purpose of this Long Term Education Plan is to provide formal and non-formal educators with effective strategies to educate their respective audiences about runoff pollution in general, and the different best management practices that have been incorporated at the Marshall County Children's Arts Center to prevent and deal with the runoff from this development. These strategies include providing signage at the site explaining the technologies, brochures at the site and partner sites which also explain the technologies, formal lesson plans developed with the aid of local educators that utilize the different resources available at the site, hosting of community events at the site by project partners with knowledge of the technologies, and a Watersheds 101 class for local officials.

This Long Term Education Plan identifies three target audiences: Educators, Local Officials, and Other Visitors/Community Members. This plan seeks to provide materials and information in the form of formal, grade specific lesson plans for both formal and informal educators, more in depth information through the availability of the Watersheds 101 training for Local Officials, and brochures and educational signage for Other Visitors/Community Members. The community events hosted by project partners will serve as opportunities for informal, one-on-one education for community members who can then perhaps apply some of the technologies at their own homes.

Background

In 2011, the City of Benton received a $500,000 Community Development Block Grant on behalf of the Marshall County Arts Commission for the construction of a Children's Arts Center located at 1201 Elm Street in Benton, Kentucky. Through a 2012 EPA 319(h) grant from the Kentucky Division of Water, the City of Benton received $275,000 to integrate green infrastructure techniques for stormwater management into the newly constructed Children's Art Center, including pervious concrete parking areas, pervious paver sidewalks, a turfstone overflow parking area, a bioswale, a rain garden and rain barrels. At the time of this project in 2012, there were not many examples of green infrastructure in the far western Kentucky region. The location of the Marshall County Children's Arts Center, in Benton between Mayfield, Murray and Paducah, has made these techniques visible not only to the local communities, including stormwater managers, developers, engineers, architects, contractors, local officials, and citizens, but also to the numerous tourists that the area attracts because of its proximity to Land Between the Lakes, Kentucky Dam Village State Resort Park and Kenlake State Resort Park. This, in combination with the Center's close proximity to a local elementary and middle school and the main branch of the public library in the county has made the Marshall County Children's Arts Center an opportune location to reach large numbers of people with information regarding green infrastructure, runoff pollution and stormwater management. The City of Benton and the Marshall County Arts Commission have intended for the Center to serve as a catalyst for economic and cultural development in an environmentally sustainable manner,

and as such, have tried to incorporate the best technologies available to them as a way to educate the local community and surrounding communities about these different technologies.

Through this EPA 319 (h) grant, funds were used for engineering and design fees; construction materials and labor for the pervious concrete parking area, pervious paver sidewalks, turfstone overflow parking area, and rain garden; and educational materials, including permanent signs installed at the site and brochures available at the site and at partner locations. The overall goal of this project was to demonstrate different types of best management practices that could be integrated in commercial and residential developments to prevent and manage runoff pollution, with the hopes that the local community would then take these technologies and implement them on a much broader scale. Additional goals for the project included ensuring that technologies are preserved long term, which was accomplished through the development of a Maintenance Plan for the site (available upon request), and developing a multifaceted education program that targets different sectors throughout the project time frame and ensures continued education and outreach upon completion of the project, which was accomplished with the development of this Long Term Education Plan.

Core Messaging

All products, activities and programs outlined in this Long Term Education Plan will have a clear and consistent message that communicates the current threats to our water resources from runoff pollution, and the value of best management practices that can be undertaken to manage and reduce runoff pollution. A basic understanding of the numerous benefits that humans receive from having available clean water resources not impacted by pollution is a necessary foundation upon which to build community support for the different best management practices that can reduce and manage runoff pollution and to change individual behaviors to support these types of conservation practices.

Target Audiences

Educators

Description of Audience

This audience will include formal and informal educators (K-12).

Goals and Recommended Activities

Goal 1: Educate teachers and students about runoff pollution in general, and the importance of best management practices that reduce runoff pollution.

Activities:

1. Provide long term education about specific best management practices, including their effects on runoff pollution, through permanent signage installed at the site.
2. Provide long term education about runoff pollution in general and the different best management practices installed at the site through educational brochures that are available

at the Marshall County Children's Arts Center and various partner locations throughout Marshall County, including Benton City Hall and the Marshall County Conservation District.

3. Marshall County Conservation District plans to host an annual Earth Day event at the site that showcases the best management practices installed at the Marshall County Children's Arts Center and allows schools to participate in tours of practices installed at the with knowledgeable guides, and offers a field day experience for students to learn about other concepts related to runoff pollution with invited guest speakers and demonstrations.
4. Marshall County Conservation District will provide resources for implementing environmental education lessons to local teachers. These resources will include lesson plans tailored to the specific requests of the teachers involved, some materials, and personnel. The lessons can be used as inspiration for writing; focused on math by figuring area of rain gardens, spacing of plants, etc.; targeting changes in earth over time; effects of pollution; and more.
5. Marshall County Conservation District personnel will be available for visits to the site with classes to assist teachers and/or direct lessons regarding water quality and the technologies installed on site as schedules permit.
6. Marshall County Conservation District will make available educational materials that will help teachers introduce the concepts of runoff pollution to students, including an Enviroscape, River Lab and Groundwater Model.

Local Officials

Description of Audience

This audience will include mayors, judge executives, city managers, city engineers, city council representatives, and planning and zoning officials and board members.

Goals and Recommended Activities

Goal 1: Local officials understand the impact that runoff pollution can have on our water resources and how development in their communities can impact runoff pollution.

Activities:

1. Host a Watersheds 101 training for local officials in conjunction with this project that includes basic information on water quality pollution and the connection between different types of land use and runoff pollution. Local officials from Marshall County and surrounding areas will be invited to this training to be held in March, 2016.
2. Make sure local officials are aware of future Watersheds 101 trainings as they become available.
3. Meet with newly elected officials as turn over occurs to ensure that they understand the impacts of runoff pollution and the connections between land use and runoff pollution.

Goal 2: Local officials understand how best management practices could be integrated into their community to reduce the threats from runoff pollution.

Activities:

1. Host a Watersheds 101 training for local officials in conjunction with this project that includes information on different types of best management practices and how they have been integrated into other communities. Local officials from Marshall County and surrounding areas will be invited to this training to be held in March, 2016.
2. Make sure local officials are aware of future Watersheds 101 trainings as they become available.
3. Arrange for local officials that have successfully implemented best management practices to come and speak with the city councils, planning commissions and fiscal courts as requested by city and county officials.

Other Visitors/Community Members

Description of Audience

This audience will include the residents of Marshall County and surrounding areas and tourists visiting the community. It may include citizens who know and care about environmental and conservation issues, or it may include citizens who have no background with environmental and conservation issues.

Goals and Recommended Activities

Goal 1: Educate the local community and visitors to the community about runoff pollution in general, and the importance of best management practices that reduce runoff pollution.

Activities:

1. Provide long term education of the community about specific best management practices, including their effects on runoff pollution, through permanent signage installed at the site.
2. Provide long term education of the community about runoff pollution in general and the different best management practices installed at the site through educational brochures that are available at the Marshall County Children's Arts Center and various partner locations throughout Marshall County, including Benton City Hall and the Marshall County Conservation District.
3. Marshall County Conservation District plans to host an annual Earth Day event at the site that showcases the best management practices installed at the Marshall County Children's Arts Center and allows the community to tour these practices with knowledgeable guides.

Goal 2: Show the local community that many of the best management practices installed at the site could be implemented in a residential setting at their homes.

Activities:

1. Marshall County Conservation District plans to host an annual Earth Day event at the site that showcases the best management practices installed at the Marshall County Children's Arts Center and allows the community to tour these practices with knowledgeable guides.
2. Host various workshops at the site in the future that allow the community to get specific instructions about implementing best management practices, such as rain garden workshops, rain barrel workshops, etc.

Summary

As previously stated, this document has been designed to use effective education and outreach tools to spread the message about the importance of clean water, the prevention of runoff pollution, and the effectiveness of different BMPs in terms of maintaining a healthy water supply. The three target audiences (Educators, Local Officials, and Other Visitors/Community Members) are key components in helping to educate the community at large by word of mouth and by voluntary modeling of the example BMP's in other locations. The clear and consistent message communicates the current threats to our water resources from runoff pollution, and the value of best management practices that can be undertaken to manage and reduce runoff pollution. By increasing the number of individual stakeholders who possess the basic understanding of the numerous benefits that humans receive from having available clean water resources not impacted by pollution, the community can reduce and manage runoff pollution and change individual behaviors to support these types of conservation practices.

Maintenance Plan
Marshall County Children's Arts Center
1201 Elm Street
Benton, Kentucky

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the City of Benton Grant #C9994861-09

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Section 1 – Pervious Concrete

What is Pervious Concrete?

Pervious concrete is similar to regular concrete, but lacks the fine materials that are incorporated into conventional concrete, such as sand. Because these fine aggregates are not present, the concrete is porous, meaning that it allows water to pass through the concrete to the surface below, preventing runoff and replenishing groundwater supplies.

Why Pervious Concrete?

When land is covered with hard surfaces that don't allow water to penetrate the soil, such as driveways, parking lots and roads, rainfall is unable to soak into the ground as it would under normal conditions, and instead runs off the land into our local streams and rivers, picking up pollution along the way. This results in pollution entering our streams and river, flooding due to the increased runoff, and erosion because of the fast speed at which the water is running off the land. According to the USEPA, runoff can send as much as 90% of parking area pollution (oils, gases, antifreeze and litter) directly into our streams and rivers.

Pervious concrete allows water to pass directly through the pavement into the soil below, instead of collecting on the surface and running off into our streams and rivers. This can prevent flooding and downstream erosion since rainfall is kept on site. This also replenishes our groundwater supplies because the water is absorbed through the concrete, through a gravel storage layer into the soil below, where it slowly seeps into our groundwater supplies. Much of the pollution from the land surface, including the oils, gases, antifreeze, is absorbed through the concrete where microorganisms "treat" the toxins with biological processes.

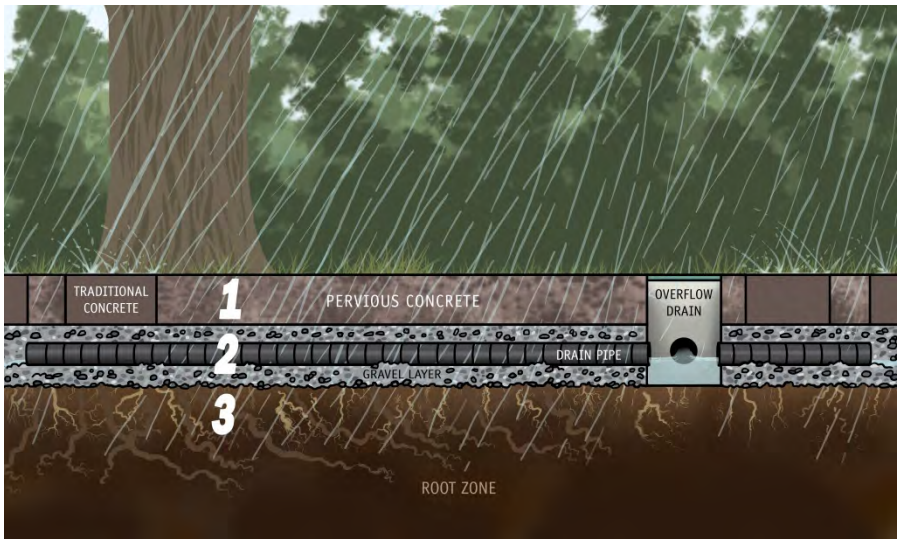


Photo Credit: Kentucky Department of Fish and Wildlife Resources

1. Pervious concrete is porous, allowing water to pass through the concrete and soak into the ground.

2. Water is held in the gravel storage layer, which slowly releases water into the soil below. While in this layer, microorganisms biologically remove many of the pollutants in the water. This layer is equipped with an overflow drain if the gravel storage layer becomes full.

3. Cleaner water from the soil slowly seeps into our groundwater supplies.

Maintenance of Pervious Concrete

The primary maintenance activity for pervious concrete generally centers around removing accumulated sediment and debris from the concrete by vacuuming. Other potential maintenance tasks include the visual inspections of the concrete for deterioration, maintenance of adjacent grassy areas to prevent sediment

accumulation, etc. These tasks have been discussed in more detail below. An example of a routine maintenance schedule has also been included below. This section of the manual has been developed with recommendations from the *Pervious Concrete Pavement Maintenance and Operations Guide* developed by the National Ready Mixed Concrete Association.

Activity	Schedule
• Avoid sealing or repaving with impervious materials. In particular, never use asphalt or other tar-type sealers on pervious concrete.	N/A
• Visually inspect pervious concrete to ensure that it: o Is clean of debris o De-waters between storms o Is clean of sediment	Monthly
• Maintain the upland and adjacent grassy areas. • Seed upland and adjacent bare areas. • Keep the pervious concrete surface free of sediment by blowing, sweeping or vacuuming. • Divert excessive water flow carrying debris toward the pavement.	As needed
• Inspect the pervious concrete surface for deterioration or spalling.	Annually

Routine Maintenance

Routine maintenance activities should include visual inspection of the pervious concrete to ensure it is clean of debris and sediments, and that it drains between storm events. Routine cleaning procedures include blowing debris off of the concrete (with a leaf blower or similar equipment), truck sweeping and/or dry vacuuming. These activities should help to prevent clogging by keeping sediment from becoming ground into the concrete's pores. These activities should be performed as needed, but at a minimum monthly to keep the site clean. To determine if these activities need to be done, you can visually inspect the concrete during or immediately following a rain event – if you see ponding or puddles, it is time to clean the pavement.

Should moss growth become an issue, baking soda can be sprinkled on the surface, followed with vacuuming within a few weeks. Moss growth can be eliminated with lime water applications. Because this concrete is porous and designed to infiltrate water, any surface treatment must be evaluated for the environmental impacts it will have on groundwater.

Periodic Maintenance

Periodic maintenance activities should be done prior to winter to ensure that the pervious concrete voids are clean of free of any material that could prevent draining and therefor cause freeze-thaw damage. Proper cleaning procedures would include pressure washing and/or vacuuming the concrete with a dry vacuum or regenerative vacuum sweeper. Caution should be used with the pressure washer to avoid extremely high pressures, as this could degrade the bonding cement paste and cause raveling.

Deep Cleaning/Unclogging

Over time, deep cleaning or unclogging of the pervious concrete may become necessary. This is best accomplished by simultaneous pressure washing and vacuuming. Several equipment manufacturers have developed pressure washing/vacuum systems that have proven to rehabilitate the pore structure of pervious concrete. For best results, follow the equipment manufacturer's recommendations.

Because this concrete is porous and designed to infiltrate water, the use of chemicals to clean pervious concrete should be done with extreme caution to prevent environmental contamination of groundwater, the biological organisms within the pervious concrete that are breaking down pollution, or the concrete itself.

Winter Maintenance

Freeze-thaw resistance of pervious concrete depends on the saturation level at the time of freezing. When the large pores or voids are saturated, complete freezing can cause serious damage to the pavement. For these reasons, it is extremely important to perform the periodic maintenance activities discussed above.

Deicing chemicals should not be used on any type of concrete in the first year. As with conventional concrete, applying a penetrating sealer can improve its performance in freezing weather. Use a penetrating sealer manufactured specifically for concrete. Concrete penetrating sealer should not be confused with impermeable sealers, such as asphalt seal coats.

Some general winter maintenance recommendations include:

- Never use anti-icing pre-treatments on pervious concrete. If these products are used on adjacent pavements, care should be taken to prevent the runoff from infiltrating the pervious concrete.
- Never use deicers containing magnesium chloride, calcium magnesium acetate or potassium acetate on pervious concrete.
- Never use deicing agents that contain fertilizer ingredients, such as ammonium sulfate or ammonium nitrate, as they may cause chemical deterioration of the pervious concrete.
- After the first year, calcium chloride impregnated sand may be used as a deicing agent.
- Coarse sand (minimum 1/8”), or small crushed aggregate (1/4 – 10 or similar gradation) may be used as an anti-skid material as long as vacuuming cleaning will be performed after the winter season.
- Never use fine sands such as masonry sand or play sand as a deicing agent on pervious concrete.
- Snow plowing can be performed with trucks mouthed with plows, but the plow should be fitted with a polyurethane cutting edge. The use of a snow blower would be preferable to plowing.
- Never use front end loaders or skid loaders to perform snow removal by either scooping or back dragging.
- Never use pervious concrete as a storage area to pile snow from other areas.

Section 2 – Rain Gardens

What is a Rain Garden?

A rain garden is a shallow depression filled with native plants that capture runoff so the runoff can be absorbed into the ground and cleansed of pollution. Essentially, rain gardens serve as sponges for the land, absorbing and holding runoff, allowing it to soak into the ground or runoff slowly.

Why Rain Gardens?

As water runs across the land surface, it picks up different types of pollution, including fertilizers that are used to encourage plant growth, pesticides, sewage from humans and animals, litter, oils and other chemicals from cars and trucks, and dirt. This pollution is carried across the land surface to our local streams, where it can negatively affect water quality and stream health. Rain gardens are an attractive, simple system that collect the runoff and filter out the pollution before the runoff reaches our local streams. In addition, rain gardens provide food and habitat for butterflies, birds and other wildlife. Rain gardens also provide storage for floodwater during heavy rainfall events, minimizing the impacts from flooding events. Rain gardens serve to beautify communities and neighborhoods and require minimal maintenance once established.

Photo Credit: Jett Setters

1. Runoff – runoff from roofs, driveways and roads collects in the rain garden.
2. Native plants – native plants trap sediment and metals while their long roots absorb water and fertilizers. Because these plants are adapted to local conditions, they are easy to maintain once established and require little to no watering. They are also important for wildlife, attracting beneficial pollinators, birds and butterflies.

3. Soils – water filters through the soil, where chemicals and pollution are broken down further, replenishing groundwater stores that are often used for drinking water.
4. Mulch – a shredded hardwood mulch is used minimize weeds and maintain moisture in the garden.
5. Roots – deep rooted plants are essential, as they prevent erosion and absorb more water. The root systems of some native plants can penetrate the soil up to 16 feet!
6. Berm – an earthen berm at the bottom of the slope helps to hold water in the rain garden.
7. Overflow - Overflow from the rain garden leaves cleaner with much of the pollution removed and flows into our local streams, improving water quality and stream health.

Maintenance of Rain Gardens

The primary maintenance activity for rain gardens generally centers around removing accumulated sediment and debris from the garden. Other potential maintenance tasks include the replacement of plants, soil pH regulation, repair of eroded areas, replacement of mulch, repairing the overflow area, etc. These tasks have been discussed in more detail below. An example of a routine maintenance schedule has also been included below.

Activity	Schedule
• Water to promote plant growth and survival. • Inspect following rainfall events and add/replace plants as needed in areas with erosion.	As needed
• Prune and weed garden. • Remove any accumulated trash or debris. • Replace mulch as needed.	Monthly
• Inspect inflow area for sediment accumulation and remove any sediment or debris. • Inspect garden for erosion and add/replace mulch or plants in eroded areas. • Inspect garden for dead or dying plants and replace plants as necessary. • Test soil pH. If pH is below 5.2, limestone application may be necessary.	Annually
• Remove and replace mulch.	Every 2 to 3 years

Plant Care

Plants native to this region of Kentucky have been included in this garden. As discussed earlier, native species offer multiple benefits to the garden and wildlife. Please see Appendix A for a list of the plants included in this garden.

1. Pruning

Pruning directs the growth of plants, improves health and increases the production of flowers and fruits. In a rain garden, dense shrub growth is encouraged to provide increased filtering capacity of runoff. Dead, diseased or hazardous branches should be removed as they appear. Trees and shrubs may also be pruned for shape. Trees, shrubs and flowers may need to be pinched, pruned, thinned or dead-headed during the growing season to encourage more flowering. Pruning of trees should occur during the winter, before budding occurs. Pruning of flowering shrubs should occur right after the plants have finished blooming. For additional information or specific questions, contact the Marshall County Master Gardeners at (270)527-3285.

2. Weeding

Until the plants become fully established, more frequent weeding will be required. Weeding should be limited to invasive and exotic species, which can overwhelm the native species originally planted in this garden. Weeding should occur once per week during the summer and once per month during the remainder of the growing season. The use of chemical herbicides should be avoided.

3. Watering

Regular watering is critical during hot, dry spells in the first two years after planting. During the first two years, plants should be watered whenever the top four inches of soil is dry. After the first two years, the plants should be more established, and watering should only be necessary during drought conditions. When watering plants, water deeply to ensure that water reaches below the mulch layer into the soil a minimum of every 3 to 6 days. If plants wilt during the day but recover in the evening, watering is not necessary. If plants do not recover in the evening, watering is probably necessary. Signs of overwatering include wilting of leaves or petals, yellowing of leaves, ringed spots on leaves, and soft or rotting plant base. Watering should be performed in the early morning, between 6:00 am and 8:00am.

4. Fertilizing

Rain gardens are designed to absorb excess nutrients from the runoff that flows into them. For this reason, it is not likely that fertilizing will be necessary. Should you suspect fertilization might be needed, a soil test should be conducted first. Contact the Marshall County Extension Office to schedule a soil test at (270) 527-3285. If fertilization is necessary, only organic fertilizers should be used.

5. Plant Replacement

When replacing a plant, place the new plant in the same location as the old plant, or as near as possible, unless the reason for plant death is improper placement (i.e., in an area that is too wet or too dry) or if diseased plant material was used and could have infected the soil. The best time to plant is in early to mid-fall or early to mid-spring. Trees can be planted as long as the soil temperature is above 32°F at a depth of six inches. Plants should be put in the ground as soon as possible after purchase to ensure the best chance of survival.

6. Soil pH

Soil tests should be conducted annually. The pH should be slightly acidic. If the pH is less than 5.2, limestone should be applied. If the pH is greater than 8.0, aluminum sulfate or sulfur should be applied. Soil amendments should only be applied when no storms are expected. For more specific information on this, contact the Marshall County Extension Office at (270) 527-3285.

Mowing

When mowing near the rain garden, use a mulching blade or point the mower away from the rain garden. Fresh grass clippings are high in nitrogen and should be kept out of the rain garden.

Sediment and Debris Removal

Since the primary purpose of a rain garden is to serve as a catchment basin for runoff, sediment and debris will tend to accumulate within the garden. Remove any large debris or trash by hand. With a flat shovel, remove any soil that has accumulated within the garden, being careful to avoid the plants. After heavy storm events, be sure to monitor the garden for sediment accumulation.

Mulching

Mulch has many benefits in the rain garden – it reduces competition between grass roots and tree and plant roots; it controls weeds; it prevents and reduces soil compaction; it preserves soil moisture; it discourages mowing and weed eating near the base of plant material; etc. Rain gardens should receive a protective layer of mulch over root areas, similar to the protection provided by leaf litter in a natural forest. The mulch layer should not exceed 3 inches around plant material. Shredded hardwood mulch should be used instead of chipped mulch to prevent the floating of mulch. The mulch will decompose and blend with the soil over time, and will have to be replaced. Fresh grass clippings, animal waste and compost should not be used as mulch in the garden.

Erosion Control

The garden should be periodically inspected for areas of erosion. Should bare areas be observed, they should be stabilized immediately and excessive flow should be redirected to prevent erosion from occurring in the future.

Section 3 – Rain Barrels

What is a Rain Barrel?

A rain barrel is a container or system that collects and stores rainwater from your rooftop for later use. This rainwater would otherwise be lost to runoff and diverted to storm drains and local streams.

Why Rain Barrels?

As water runs across the land surface, it can pick up different types of pollution on the land surface, including fertilizers that are used to encourage plant growth, pesticides, sewage from humans and animals, litter, oils and other chemicals from cars and trucks, and dirt. Runoff containing this pollution flows untreated directly into our local streams or down storm drains and then into our local streams.

As we increase the amount of hard surfaces that don't allow water to soak into the ground, such as rooftops, driveways, sidewalks and streets, more water runs off. Because less water is soaking into the ground, underground water supplies are not replenished. This increased runoff also leads to more frequent flood events, as there is less area for rainfall or snowmelt to soak into the ground. Not only do these flood events occur more frequently, they are often more catastrophic.

Increased runoff also leads increased erosion of stream banks because the velocity of water flowing through streams is greater. This causes more dirt to enter our streams, clogging habitat for aquatic life and making it difficult for aquatic life to survive.

Rain barrels serve to prevent some of this increased runoff by storing water from rooftops in collection systems so that the water can be used in a beneficial way at a later date. There are numerous benefits that come from the incorporation of rain barrels:

- **Helps Reduce Runoff Pollution -** Rainwater stored in rain barrels helps reduce the amount of runoff and the amount of pollution that is picked up off the land surface and carried to storm drains, streams and rivers.
- **Conserves Water -** Lawn and garden watering makes up nearly 40% of total household water use during the summer. Rainwater used from rain barrels helps reduce the amount of water used from local sources.
- **Better for Plants and Gardens -** Rainwater stored in rain barrels is naturally soft water and doesn't contain minerals, chlorine, fluoride and other chemicals. Plants respond well to this. After all, it's what plants in the wild thrive on!
- **Saves You Money -** A rain barrel will save most homeowners about 1,300 gallons of water during the peak summer months. Saving water not only helps protect the environment, it saves you money and energy.

Maintenance of Rain Barrels

Rain barrels require minimal maintenance. However, proper upkeep will help to ensure that the rain barrel continues to work well long term. Maintenance activities include:

- Periodically clean your filter screen and downspout outlet. Remove any accumulated debris such as leaves and twigs. If needed, guards can be installed on gutters to minimize the amount of rooftop debris entering the barrel.
- Make sure the lid is properly sealed and the screen is free of cuts and tears. Securing the lid will make the barrel safer for children and pets and will prevent insects such as mosquitoes from entering the barrel. However, if mosquitoes still become an issue, products such as biological larvicides are available at pond supply stores to control mosquito breeding.
- To discourage algae growth, empty your rain barrel every 5 to 7 days and, if possible, keep your barrel out of direct sunlight. Plus, for your rain barrel to be most effective at capturing runoff, it should be empty before each rain event.
- Occasionally inspect and check your over-flow hose and connections to make sure your water flow is flowing properly - down the gutter's downspout, into the rain barrel and excess water exiting from the overflow drain.
- During the winter months, store your rain barrel indoors or open all spigots and leave it outdoors. It is recommended that you drain your barrel completely, including any connecting piping or hoses. If you disconnect your rain barrel from your downspout, you will need to extend your downspout and direct the flow away from your foundation.

Section 4 – Permeable Pavers and Turfstone

What are Permeable Pavers and Turfstone?

Permeable pavers are connected blocks with materials such as stone or gravel between the blocks that allow water to pass through, filling the gaps between the paving blocks. These pavers provide a strong, solid surface that can be installed on driveways, walkways and patios while also serving as an attractive landscape feature.

Turfstone pavers feature a lattice style concrete grid with open holes that are planted with grass, allowing rainwater and runoff to be filtered back into the soil naturally, resulting in the control and stabilization of soil erosion. With 40% open area, these pavers allow ground cover, such as grass, to grow, but still provide the necessary structural strength for traffic.

Why Permeable Pavers and Turfstone?

Patios, sidewalks and driveways are hard surfaces that prevent water from soaking into the ground, also referred to as impervious surfaces. As we increase the amount of these hard impervious surfaces in the landscape, more water runs off the land. This results in increased pollution from the land surface (fertilizers, pesticides, sewage, litter, oils, dirt, etc.) running into our local streams.

Because these hard impervious surfaces cause less water to soak into the ground, our underground water supplies are not replenished, which is the source of drinking water for many of us in this region. The increased runoff from these hard surfaces also leads to more frequent flood events, as there is less area for rainfall or snowmelt to soak into the ground. Not only do these flood events occur more frequently, they are also more catastrophic.

Increased runoff from these hard impervious surfaces also leads to increased erosion of stream banks because the velocity of water flowing through the streams is greater. This causes more dirt to enter our streams, clogging habitat for aquatic life and making it difficult for aquatic life to survive. Permeable pavers and turfstone allow infiltration of runoff between the blocks, thus preventing runoff and all of the problems that come from increased runoff. There are numerous benefits that come from the incorporation of permeable pavers and turfstone into projects:

- **Helps Reduce Runoff Pollution –** Because these pavers allow water to soak into the ground between blocks, the amount of runoff and thus, the amount of pollution that is picked up off the land surface and carried to storm drains, streams and rivers is reduced.
- **Helps Reduce Overall Irrigation Needs –** Because these pavers allow water to seep into the ground, the direct and surrounding areas will need less irrigation, saving you money and reducing your irrigation needs.
- **Reduced Heat Island Effects –** Because these pavers allow water to seep into the ground, the surface and surrounding area temperatures will be cooler than a hard surface that prevents water from soaking into the ground.
- **Attractive –** These pavers can be extremely attractive, resulting in increased property values.

Maintenance of Permeable Pavers and Turfstone

Permeable pavers and turfstone require minimal maintenance. However, proper upkeep will help to ensure that the these systems continue to work well long term. Maintenance activities include:

- Regular cleaning and sweeping
- Removal of dirt, debris and fall leaves
- Frequent inspections to identify clogged areas

Permeable Paver Maintenance

Permeable pavers sidewalks have been installed at the Marshall County Children's Arts Center. Maintenance of these pavers is fairly minimal, and should focus on cleaning the surface drainage voids. Fine debris and dirt that accumulate in the drainage openings reduce the pavers' flow capacity. The surface of the pavers should be kept clean of organic material (i.e. leaves or plant material), and periodic vacuuming and low-pressure washing should be used to keep voids between the pavers clear and draining. Approximately four times per year, sidewalks should be cleaned with conventional street sweeps with vacuums, brushes and water. A sample maintenance schedule has been included below.

Activity	Schedule
• Inspection of the site for drainage problems	Monthly at first, then annually after rain events
• Removal of fine debris and dirt with street sweeper	Quarterly
• Replacement of damaged pavers	As needed

With regards to snow removal, sand or ash shouldn't be used, as it may cause clogging of the pavers. Plowing is allowable, but the blade should be lifted to clear gravel surfaces between pavers. Salt should be used sparingly, as it can create a pollution problem, since salt is not a pollutant removed by the permeable paver system. De-icing products should be carefully selected to ensure that they won't harm the surface of the pavers.

Turfstone Maintenance

Turfstone has been installed in the overflow parking area along 12th Street at the Marshall County Children's Arts Center. Maintenance activities for this turfstone are similar to that of any other grassy area, and include mowing and irrigating as needed to maintain a healthy stand of grass. As traffic increases on the grassy area, micronutrients or environmentally friendly fertilizers may be needed. A sample schedule has been included below.

Activity	Schedule
• Inspection of the site for drainage problems	Monthly at first, then after rain events
• Removal of accumulated fine debris and dirt	As needed
• Replacement of damaged pavers	As needed
• Irrigation – set up schedule and follow	According to established schedule

More information about specific maintenance activities have been included below:

1. *Bare spots due to erosion*

Intercept the source of water and redirect to reduce impact on turfstone and grass. Reseed bare spots.

2. *Bare spots due to high traffic*

Increase water and fertilization with environmentally friendly fertilizers, and reduce traffic on bare areas temporarily until grassy areas are repaired. Reseed bare spots.

3. *Irrigation*

Regular irrigation is necessary to maintain stands of grass. Set up an irrigation schedule and maintain, especially during dry summer months.

4. *Oil/Antifreeze spills*

For small spills, naturally occurring microorganisms in the soil can break down oil and antifreeze products, cleaning these spills before water has the ability to reach the water table below. Large spills may kill all grass and prevent the growth of grass for several years to come. in this case, affected soil should be removed (can be done with street sweeper) and replaced and the affected area should be reseeded.

5. *Snow Removal*

Turfstone areas can be plowed of snow using snow plow blades with small skids on the corner to keep the bottom of the blade off of the grass surface by approximately 1 inch. This will minimize surface skinning.

Section 5 – Bioswales

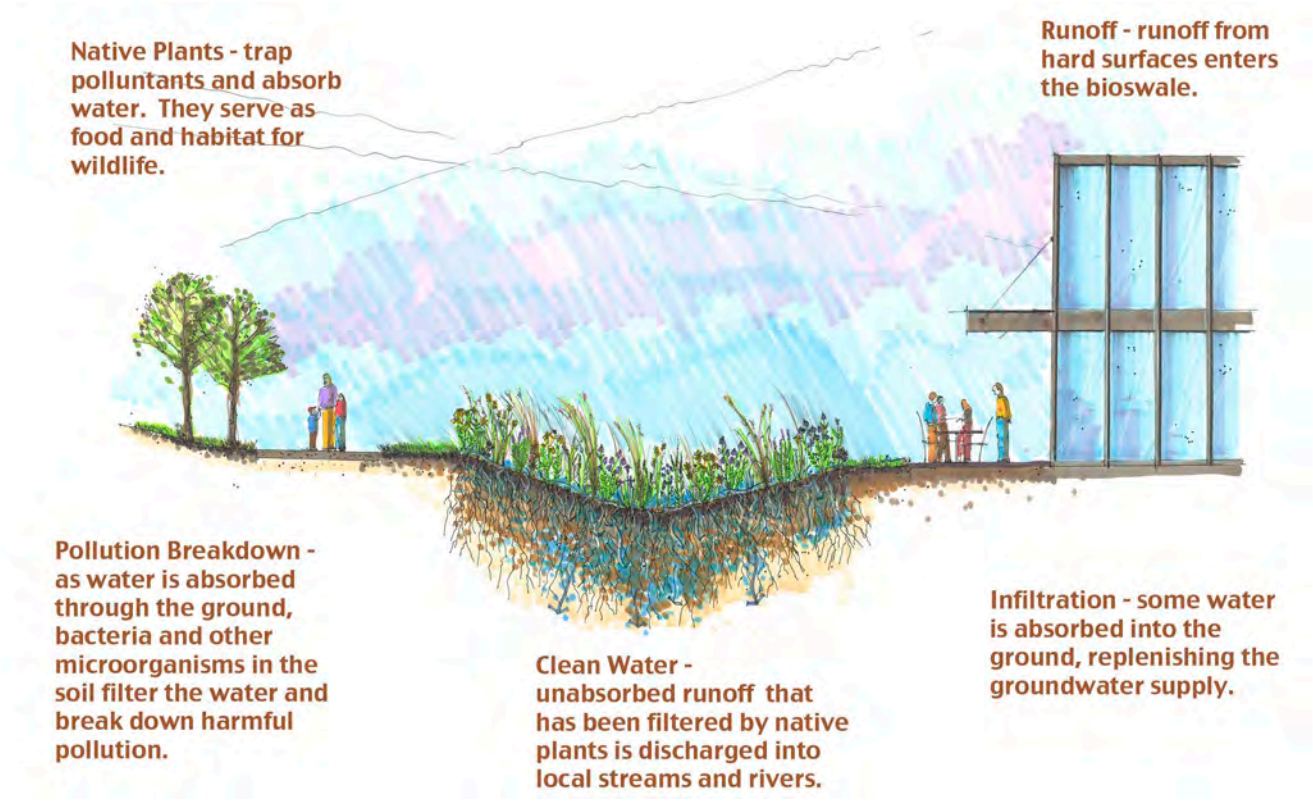
What are Bioswales?

Bioswales are ditches or shallow swales that are designed to slow, filter and absorb runoff from hard surfaces that don't allow water to soak into the ground, such as sidewalks, driveways, parking lots and roads. Bioswales allow that runoff to slowly soak back into the ground, removing dirt and pollution from the runoff. During large storm events, excess runoff is directed through the storm sewer to local streams.

Why Bioswales?

Every time it rains, excess rainwater runs off hard surfaces that don't allow water infiltration, such as roads, driveways and parking lots. This runoff picks up many types of pollution, such as oil, fertilizer and other chemicals, while traveling across these surfaces. Typically, this pollution flows through storm drains, untreated, into our local streams and rivers. Bioswales serve as a natural way to capture and treat runoff to remove pollution and also increase groundwater recharge by holding water and allowing percolation through the soil.

Runoff from hard surfaces is directed into the bioswale where water is slowly absorbed back into the ground. Plant roots increase absorption of runoff into the soil and reduce the amount of runoff, helping to reduce flooding. This absorption replenishes our groundwater supplies, and allows dirt and other pollution to be filtered out of the water and broken down by bacteria and other organisms in the soil. Unabsorbed runoff that is cleaner is discharged through the storm sewer system into our local streams and rivers. Plants within the bioswale also serve as food and habitat for wildlife.



Maintenance of Bioswales

Bioswales require minimal maintenance, but proper upkeep and inspections will ensure this system functions long-term. An unmaintained bioswale may cause rainwater to pool on the surface and become a breeding place for insects, such as mosquitos; can stop filtering runoff and allow pollution to enter our local streams and rivers; and can block the flow of water and cause localized flooding. Maintenance activities for bioswales include inspecting the swale after storm events to ensure runoff has drained and there is no erosion, removing sediment, debris and trash from around the swale, removing weeds or invasive plants, and removing leaves in the fall. Fertilizers or pesticides should not be used in the bioswale. An example maintenance schedule has been included below.

Activity	Schedule
• Inspect the bioswale after storm events.	Monthly
• Remove sediment, debris or trash from bioswale.	Monthly
• Manually remove weeds or invasive plants.	As needed
• Remove leaves in fall.	Fall

Appendix A – Rain Garden Plant List

***Amsonia tabernaemontana* - Eastern Bluestar**

Erect 1 to 3 foot perennial that grows in large, multi-stemmed clumps. Smooth stems are crowded with narrow, oval leaves that turn golden yellow in the fall. Blue, tubular flowers that appear in loosely congested clusters at the tip of the stem. Nectar attracts butterflies and other pollinators, including hummingbirds, carpenter bees and hummingbird moths.


***Asclepias tuberosa* -Butterfly Weed**

Bushy 1 ½ to 2 foot tall perennial that has large flat-topped clusters of bright orange flowers. Stems are hairy, erect and grow in numerous clumps. Leaves are alternate, simple, and lance-shaped. There is a watery sap within the stem and leaves, the "milk". Provides nectar for butterflies and serves as the host plant for Monarch caterpillars.

***Baptisia australis* - Blue Wild Indigo**

Perennial that grows well in many areas and does well without watering. Flowers are blueish purple and pea-like. Leaves are divided into three leaflets. In the late fall, the plant turns silvery-gray. Requires no fertilizer or pesticide treatment and needs no pruning. Attracts butterflies.


***Calliacarpa Americana* - American Beautybush**

Perennial shrub 5 to 8 feet tall and wide with drooping branches. Elliptical to ovate shaped leaves with opposite arrangement and saw toothed margins. Inconspicuous flowers of blue, violet, pink or white that appear in the late spring to early summer and clusters of small purple to blue berries that appear in August to September. Fruit is an important food source for many birds, including bobwhite quail, mockingbirds, robins, towhees and brown thrashers.


***Coreopsis lanceolata* - Lanceleaf Tickseed**

Perennial herb that grows 1 to 2 ½ feet tall. Lance- shaped, pointed leaves are 3 to 4 inches long. Herb has yellow flowers with a yellow center from April to June. Attracts butterflies, hummingbirds and songbirds.

***Echinacea tennesseensis* - Tennessee Coneflower**

Herbaceous coneflower that grows 12 to 18 inches tall. Has flat, pastel pink flowers with green and burgundy centers. Attracts birds and butterflies.

***Eryngium yuccifolium* - Rattlesnake Master**

Warm-season perennial that grows 2 to 6 feet tall from a short, thick rootstock. Blueish green basal leaves up to 3 feet long and 1 ½ inches wide. Leaves along the stem are much shorter, but may be as wide as the basal

leaves. Flower heads are on stout peduncles at the tip of the stem. Flower heads have a honey-like odor and are in bloom June to September.


***Euonymus americanus* - Strawberry Bush or Bursting Heart**

Deciduous shrub that grows 2 to 6 feet tall. Shrub has yellowish-green or greenish purple flowers that appear from March to June. The bright green oval leaves become dark red in the fall when bright red fruits open to reveal orange seeds. Attracts birds, including eastern bluebirds, mockingbirds, wood thrushes, fox sparrows and yellow-rumped warblers.

***Helianthus occidentalis* - Western Sunflower**

Perennial sunflower 2 to 4 feet tall with a few small leaves at the base of the plant. Yellow flowers that appear mid-summer to early fall and last about 1 month. Attracts birds and butterflies.


***Heuchera richardsonii* - Alum Root or Coral Bells**

Perennial with basal leaves that resemble those of a hard maple with rounded lobes that are supported on long petioles. Petioles have straight, white hairs that are quite long and conspicuous. Tall flowering stalk is hairy and

generally leafless and rises 1 to 2 feet. Small, cream to green drooping flowers on short, individual stalks. Pollinated by small bees.



***Hydrangea quercifolia* - Oakleaf hydrangea**

Fast growing deciduous mound shaped shrub 3 to 12 feet tall. Showy fragrant greenish flowers turn creamy white them purplish when dried and persist on the shrub until mid-winter. Opposite, simple, bold leathery leaves that are deeply lobed and shaped like that of a red oak. Leaves become colorful in the fall. Seeds are eaten by birds.

***Iris cristata* - Dwarf Crested Iris**

Small iris with clusters of narrow, pointed leaves ranging in height from 4 to 16 inches. Has blue-violet flowers that are marked with a central yellow or white, purple striped band. Crested ridges called beards appear along the band.

***Lobelia cardinalis* - Cardinal flower or Indian Pink**

Herbaceous perennial that grows 1 to 6 feet tall with showy, red flowers in terminal spikes. Each flower has three spreading lower petals and two upper petals that are all united into a tube at the base. The lower portion

of the erect stem is lined with lance-shaped leaves. Plant relies on hummingbirds, which feed on the nectar, for pollination.

***Lobelia siphilitica* - Great Blue Lobelia**

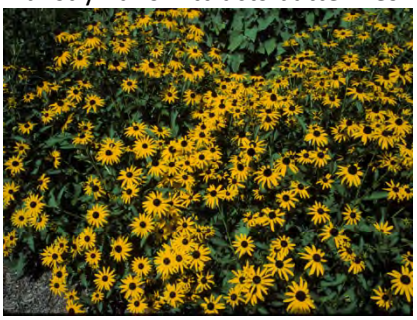
Herbaceous perennial 2 to 3 feet tall with frequently branched, erect stems. Lavender-blue, tubular flowers that are crowded together on the upper portion of the stem. Each flower has three spreading lower petals and two upper petals that are all united into a tube at the base. Nectar attracts pollinators, including butterflies, bees and hummingbirds.


***Rhus aromatic* - Fragrant Sumac**

Deciduous shrub that is 6 to 12 feet tall, with velvety twigs and lower branches turned at the tips. Shrub has glossy, somewhat blue-green, coarsely toothed, trifoliate leaves that turn orange, red, purple and yellow in the winter. Yellow catkin-like flowers precede dark red berries that persist into March. Fruit is important food source for birds and small mammals.

***Rudbeckia fulgida* - Orange Coneflower**

Perennial coneflower that grows 1 to 3 feet tall. Has yellow-orange flowers that have slightly curved petals. Plant has scattered, oval leaves with bristly hairs. Attracts butterflies.




***Schizachyrium scoparium* - Little Bluestem**

Deep rooted native grass. Has coarse stems and basal leaves and flat bluish basal shoots. Leaves are smooth, but frequently covered with hair at the base next to the sheath. Blue green stems become radiant mahogany-red with white, shining seed tufts in the fall with color remaining through the winter. Height varies from 18 inches on droughty sites to 3 feet on deep, fertile sites.

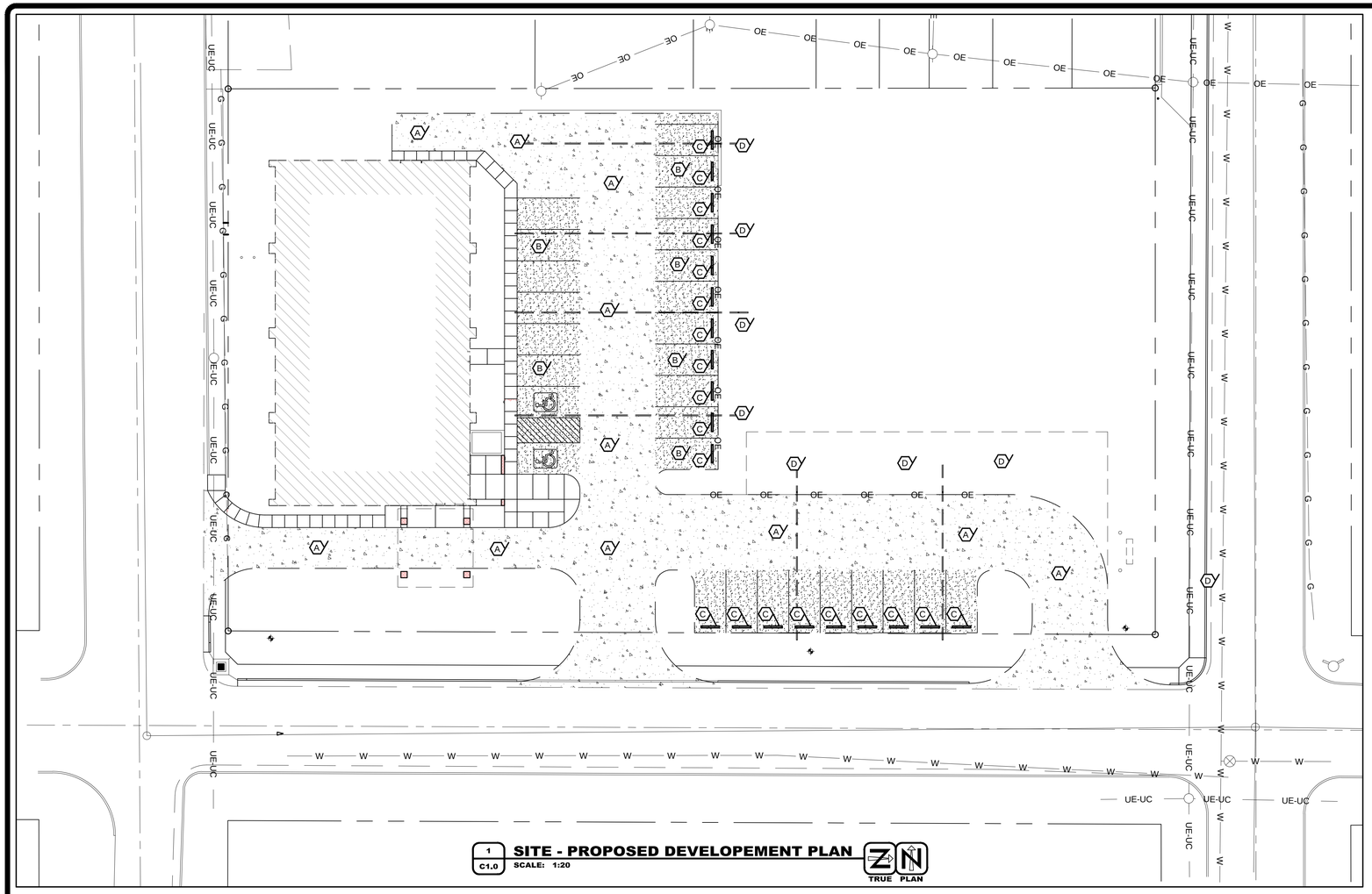

***Sporobolus heterolepis* - Prairie Dropseed**

Warm season, drought tolerant bunchgrass with leaves that curve gracefully outward forming large, round tufts. Delicate seed heads appear above the tuft in midsummer, rising 2 feet high. Fall color is a tan-bronze.


***Vernonia altissima* - Giant ironweed**

Upright perennial with a highly visible dark red stem that grows over 7 feet tall and is widely branched at the top. Purple disk flowers arranged in loose clusters at the ends of branches. Flowers are produced from July to

October. Has lance-shaped, pointed leaves that have short downy hairs on the lower surface. Low maintenance plant that attracts butterflies.



CLIENT	OWNER
CITY OF BENTON 1009 MAIN STREET BENTON, KY 42025	CITY OF BENTON 1009 MAIN STREET BENTON, KY 42025

PROPERTY OWNER _____ DATE _____

PROPERTY ADDRESS: BENTON CHILDRENS PERFORMING ARTS CENTER
EAST 12TH STREET
BENTON, KY 42025

PROPERTY AREA = 51,194.4103 SQ. FT. 1.18 ACRES

UTILITY LOCATIONS SHOWN WERE TAKEN FROM TOPOGRAPHIC SURVEY. LOCATIONS OF UNDERGROUND UTILITIES ARE APPROXIMATE, AND UNMARKED UNDERGROUND UTILITIES MAY BE PRESENT. CONTACT UTILITY OWNERS PRIOR TO CONSTRUCTION.

PARKING DATA:
10' X 20 SPACE: 26 STANDARD SPACES
2 ACCESSIBLE SPACES
TOTAL PARKING PROVIDED 28 SPACES

FLOOD ZONE INFORMATION:

THIS PROPERTY IS LOCATED IN FLOOD ZONE X, "OTHER AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN", AS SHOWN ON THE NATIONAL FLOOD INSURANCE RATE MAP, COMMUNITY PANEL NO. 21157C0151E, EFFECTIVE JUNE 2, 2011.

SITE DEVELOPMENT NOTES:

1. ALL ASPHALT SURFACE OF EXISTING ROADWAYS DAMAGED DURING CONSTRUCTION SHALL BE SAWCUT, REMOVED AND REPLACED. THE NUMBER OF SAWCUTS SHALL BE MINIMIZED IN ORDER TO MAKE ONE CONTINUOUS PATCH AS DIRECTED BY THE PROJECT MANAGER AND OR LOCAL & STATE OFFICIALS.
2. THE CONTRACTOR SHALL REMOVE ALL EXISTING TREES, SHRUBS, ASPHALT, CONCRETE AND ETC. FROM THE SITE AND OR CONSTRUCTION AREA. ALL MATERIAL, ASPHALT, VEGETATION, DIRT, GRAVEL, ROCK, TREE LIMBS AND ETC. REMOVED BY THE CONTRACTOR SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM THE PROPERTY IN AN APPROVED MANNER AT NO ADDITIONAL COST TO THE OWNER.
3. ALL AREAS DESIGNATED AS LANDSCAPE SHALL RECEIVE A MINIMUM OF 6" TOPSOIL.
4. ALL HANDICAP RAMPS SHALL BE IN CONFORMANCE WITH ADA STANDARDS.
5. COMPACTION REQUIREMENTS:
   BUILDING - 98%
   PAVEMENT & SIDEWALK AREAS - 95%
   ALL OTHER AREAS - 90%
   COMPACTION SHALL BE PER ASTM D-698, STANDARD PROCTOR (%, MAXIMUM DRY DENSITY).
6. ALL SITE CONCRETE SHALL BE AIR ENTRAINED 4000 psi @ 28 DAYS, 1 1/2" MAX. AGGREGATE SIZE WITH "WELDED WIRE FABRIC" REINFORCING.
7. ALL LOCAL BUILDING PERMITS, FEES AND ETC. ARE THE RESPONSIBILITY OF THE CONTRACTOR. ALL WORK SHALL BE IN CONFORMANCE WITH THE CITY OF BENTON STANDARDS AND PROCEDURES.
8. EXACT LOCATION, SIZE, TYPE OF PYLON SIGN SHALL BE IN ACCORDANCE WITH ALL LOCAL ORDINANCES AND CODES. SIGN APPROVAL PER BY SEPARATE PERMIT.
9. ALL WORK WITHIN ROADWAY EASEMENTS & R/W SHALL CONFORM TO LOCAL STANDARDS. IF DISTURBED, ALL ASPHALT PAVEMENT, SIDEWALK & CURB & GUTTER AND ETC. TO BE REINSTALLED SHALL MATCH EXISTING WIDTHS, THICKNESS' & ETC.
10. CONTRACTOR SHALL IMPLEMENT TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH APPLICABLE STATE & LOCAL STANDARDS, PROCEDURES AND REGULATIONS WHILE WORKING WITHIN ROADWAY EASEMENTS & R/W OR WHEN WORK AFFECTS TRAFFIC FLOW OR SAFETY.
11. ALL STREETS AND ROADWAYS ADJACENT TO PROJECT SHALL BE CLEANED OF DIRT AND DEBRIS AT THE END OF EACH DAY.
12. ALL ASPHALT PAVEMENT, SIDEWALK & CURB & GUTTER AND ETC. TO BE REINSTALLED SHALL MATCH EXISTING WIDTHS, THICKNESS' & ETC.
13. PRIOR TO BEGINNING CONSTRUCTION, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING AND FIELD LOCATING ALL UTILITIES WITHIN THE PROJECT LIMITS SO THAT CONSTRUCTION WILL NOT DAMAGE OR INTERFERE WITH EXISTING UTILITY LINES. IF ANY UTILITY LINES ARE DAMAGED, IT IS THE CONTRACTOR'S RESPONSIBILITY TO REPAIR AND/OR REPLACE THE UTILITY LINES AT THE CONTRACTOR'S EXPENSE. FINISHED REPLACEMENT OR REPAIR SHALL MEET THE APPROVAL OF THE SPECIFIC UTILITY OWNER.
14. IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, THE CONTRACTOR WILL BE SOLELY AND COMPLETELY RESPONSIBLE FOR CONDITIONS OF THE JOB SITE, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THIS REQUIREMENT WILL APPLY CONTINUOUSLY AND WILL NOT BE LIMITED TO NORMAL WORKING HOURS.
15. BEFORE CONSTRUCTION, THE CONTRACTOR SHOULD CONTACT KENTUCKY 811 OR 800-752-6007 .
16. THE CONTRACTOR SHALL NOT SCALE FROM THESE PLANS FOR FIELD SURVEY LOCATIONS.

CERTIFICATE OF OWNERSHIP

"I (WE) HEREBY CERTIFY THAT I AM (WE ARE) THE OWNER(S) OF THE PROPERTY SHOWN AND DESCRIBED HERON AND THAT I (WE) HEREBY ADOPT THIS PLAN WITH MY (OUR) FREE CONSENT."

OWNER'S SIGNATURE _____ DATE _____

SITE PLAN KEY NOTES:

* ALL KEY NOTES ARE FOR PROPOSED ITEMS. SEE SITE DETAIL SHEETS FOR SPECIFIC DETAILS OF CONSTRUCTION

A. STANDARD DUTY CONCRETE PAVEMENT . SEE DETAIL 1, SHEET C5.0.
B. PERVIOUS CONCRETE PAVEMENT . SEE DETAIL 2, SHEET C5.0.
C. CURB STOP. SEE DETAIL 3, SHEET C5.0.
D. RAIN GARDEN. SEE DETAIL 4, SHEET C5.0.

LEGEND

- PROPERTY LINE
- ADJOINING PROPERTY LINE
- EASEMENTS
- EXISTING CURB AND GUTTER
- EXISTING BUILDING
- EXISTING PAVEMENT
- EXISTING SIDEWALK
- EXISTING PARKING STRIPE
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PROPOSED BUILDING
- PROPOSED STANDARD CURB AND GUTTER
- PROPOSED PARKING STRIPE
- PROPOSED REVERSE CURB AND GUTTER
- EXISTING BUILDING
- EXISTING ASPHALT PAVEMENT
- EXISTING CONCRETE PAVEMENT
- PROPOSED BUILDING
- PROPOSED HEAVY DUTY ASPHALT PAVEMEN
- PROPOSED STANDARD DUTY ASPHALT PAVE
- PROPOSED CONCRETE PAVEMENT
- CATCH BASIN
- UTILITY POLE

BURIED UTILITIES NOTE

BURIED UTILITIES ARE SHOWN AT THEIR APPROXIMATE LOCATION BASED UPON INFORMATION OBTAINED FROM UTILITY COMPANIES AND FIELD EVIDENCE. OTHER BURIED UTILITIES MIGHT EXIST ON THE SUBJECT SITE WHICH ARE NOT SHOWN ON THIS DRAWING. USE EXTREME CAUTION DURING EXCAVATION PROCEDURES AND CONTACT KENTUCKY 811 @ 811 OR 1-800-752-6007 FOR EXACT LOCATION OF BURIED FACILITIES PRIOR TO EXCAVATION OPERATIONS.

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PROJECT NO.: 12331 DATE: APRIL 2013
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REV	DESCRIPTION	BY	DATE

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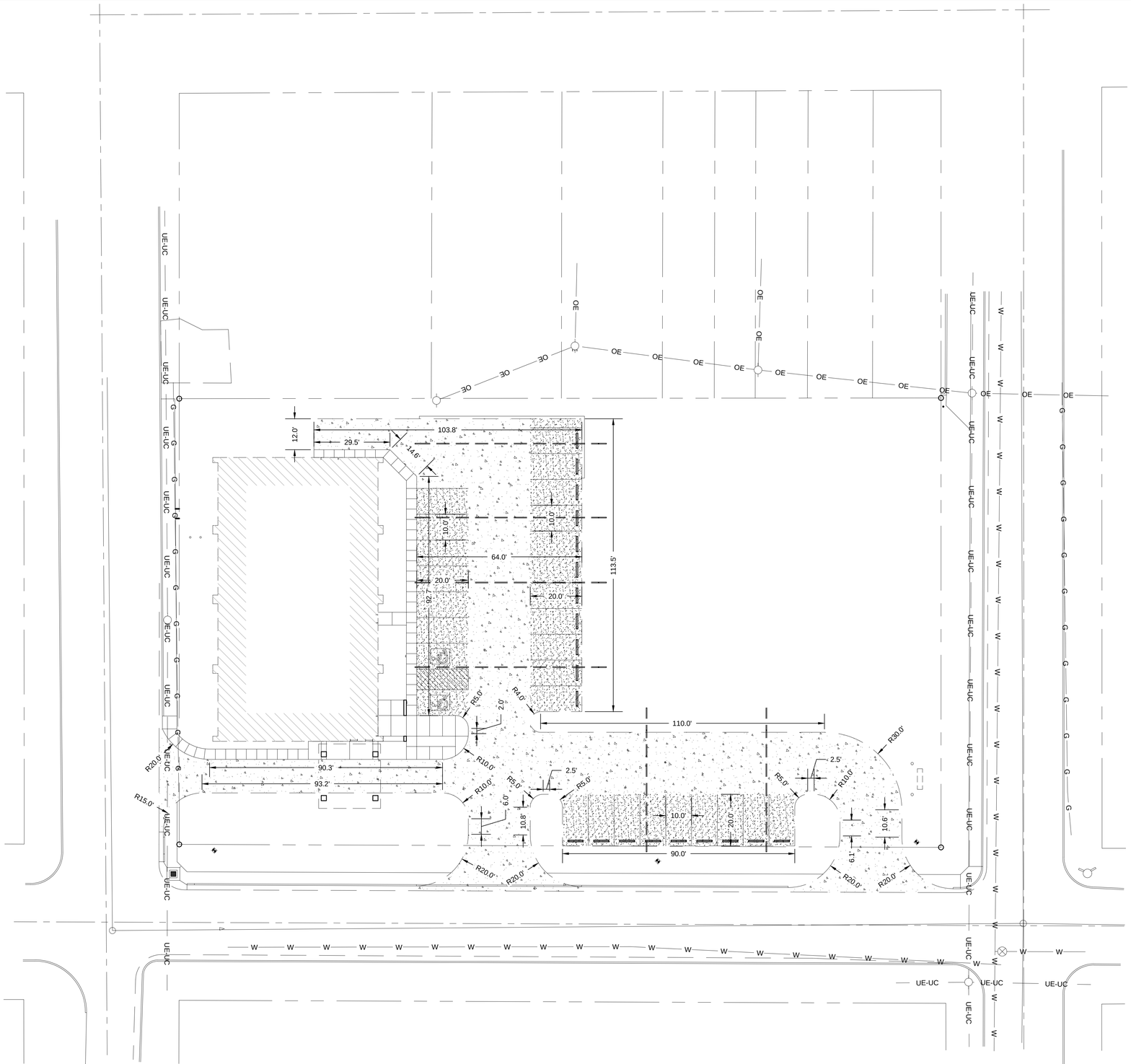
ENGINEERING & TESTING, INC.
900 SOUTH 12th STREET PADUCAH, KY 42003 PHONE - 270.443.1995
403 NORTH COURT STREET MARION, IL 62959 PHONE - 618.997.5190
1215 DIEGUID DRIVE MURRAY, KY 42071 PHONE - 270.753.3307
www.bfwengineers.com

SITE - PROPOSED DEVELOPEMENT PLAN

BENTON CHILDRENS PERFORMING ARTS CENTER
EAST 12TH STREET
BENTON, KY 42025

BENTON CHILDREN PERFORMING ARTS CENTER

SHEET
C1.0



LEGEND

- PROPERTY LINE
- ADJOINING PROPERTY LINE
- EASEMENTS
- EXISTING CURB AND GUTTER
- EXISTING BUILDING
- EXISTING PAVEMENT
- EXISTING SIDEWALK
- EXISTING PARKING STRIPE
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PROPOSED BUILDING
- PROPOSED STANDARD CURB AND GUTTER
- PROPOSED PARKING STRIPE
- PROPOSED REVERSE CURB AND GUTTER
- EXISTING BUILDING
- EXISTING ASPHALT PAVEMENT
- EXISTING CONCRETE PAVEMENT
- EXISTING GRAVEL SURFACE
- PROPOSED BUILDING
- PROPOSED HEAVY DUTY ASPHALT PAVEMEN
- PROPOSED STANDARD DUTY ASPHALT PAVE
- PROPOSED CONCRETE PAVEMENT
- 1/2" DIAMETER REBAR & CAP STAMPED "BFW KJW #3445" (SET)
- BOUNDARY LINE ANGLE POINT
- CATCH BASIN

1 C2.0 **SITE - PROPOSED DIMENSIONAL PLAN**
SCALE: 1:20

TRUE PLAN

PROJECT NO.: 12331 DATE: APRIL 2013
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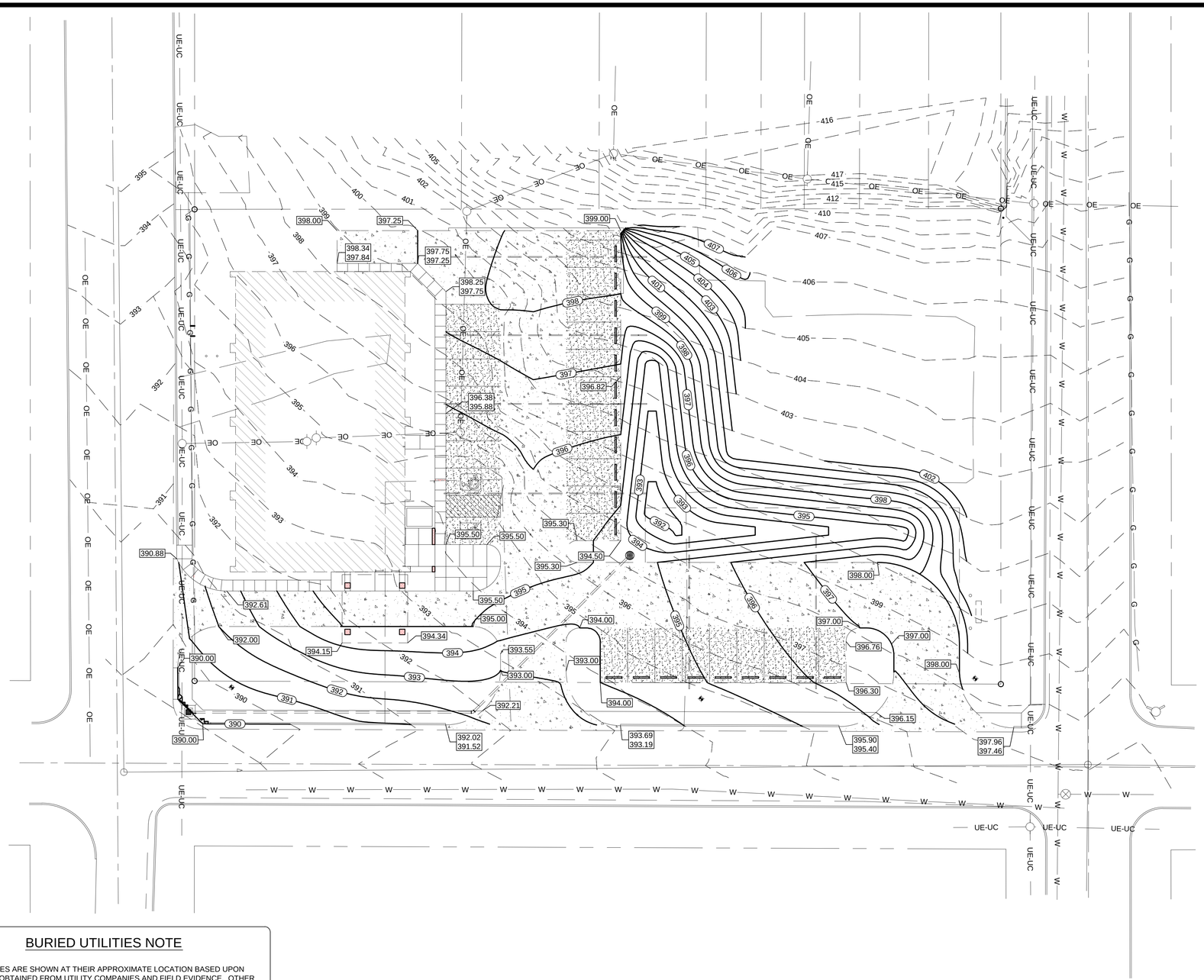
PHONE - 270.443.1995 PHONE - 618.997.5190 PHONE - 270.753.2307
www.bfwengineers.com

SITE - PROPOSED DIMENSIONAL PLAN

BENTON CHILDRENS PERFORMING ARTS CENTER
EAST 12TH STREET
BENTON, KY 42025

BENTON CHILDREN PERFORMING ARTS CENTER

SHEET
C2.0



BURIED UTILITIES NOTE

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1 / C3.0 **SITE - PROPOSED EARTHWORK GRADING PLAN**
SCALE: 1:20

TRUE PLAN

SITE GRADING NOTES:

1. ALL CONTOURS AND SPOT ELEVATIONS INDICATE FINISH GRADE, ON EARTH, ASPHALT OR CONC. SINGLE SPOT ELEVATIONS INDICATE PAVEMENT SURFACE ELEVATION OR GUTTER FLOW LINE ELEVATION.
2. PRIOR TO COMPLETING A BID AND BEGINNING CONSTRUCTION, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING AND FIELD LOCATING ALL UTILITIES WITHIN THE PROJECT LIMITS SO THAT CONSTRUCTION WILL NOT DAMAGE OR INTERFERE WITH EXISTING UTILITY LINES. IF ANY UTILITY LINES ARE DAMAGED, IT IS THE CONTRACTOR'S RESPONSIBILITY TO REPAIR AND/OR REPLACE THE UTILITY LINES AT THE CONTRACTOR'S EXPENSE. FINISHED REPLACEMENT OR REPAIR SHALL MEET THE APPROVAL OF THE SPECIFIC UTILITY OWNER.
3. ALL FILL AREAS SHALL BE COMPACTED TO A MINIMUM OF 95% (BUILDING PADS 98%) OF THE MAXIMUM DRY DENSITY PER STANDARD PROCTOR ANALYSIS ASTM D 698 OR TO THE PROJECT SPECIFICATIONS.
4. IMPROPER GRADING/FINISHING OF ALL EXCAVATION AND FILL PLACEMENT WITHIN THE PROJECT LIMITS OR ADJACENT RIGHT-OF-WAYS THAT RESULTS IN DRAINAGE PROBLEMS SHALL BE REMOVED AND REINSTALLED TO IMPLEMENT POSITIVE DRAINAGE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
5. THE CONTRACTOR IS RESPONSIBLE FOR SEDIMENTATION CONTROL OF ONSITE RUNOFF IN ACCORDANCE WITH THE ACCEPTED EROSION AND SEDIMENTATION CONTROL PRACTICES FOR CONSTRUCTION ACTIVITIES IN THE STATE OF KY AND/OR CITY OF BENTON.
6. THE IMPROVEMENT OF THIS SITE SHALL NOT OBSTRUCT THE NECESSARY DRAINAGE REQUIRED.
7. THE DRAINAGE PATTERN CREATED BY THE DEVELOPMENT OF THIS SITE SHALL BE CONSISTENT WITH THE PREVIOUS STORMWATER DRAINAGE PATTERNS. THE ADJACENT PROPERTY OWNERS SHALL NOT REALIZE ANY CHANGE IN RUNOFF TO THEIR PROPERTY.
8. ALL POTENTIAL EROSION SHALL BE CONTROLLED IN SUCH A MANNER SO AS TO PREVENT ANY DISPLACEMENT OF SILT TO THE ADJACENT PROPERTY OWNERS OR RIGHT-OF-WAY.
9. IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, THE CONTRACTOR WILL BE SOLELY AND COMPLETELY RESPONSIBLE FOR CONDITIONS OF THE JOB SITE, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THIS REQUIREMENT WILL APPLY CONTINUOUSLY AND WILL NOT BE LIMITED TO NORMAL WORKING HOURS.
10. BEFORE CONSTRUCTION, THE CONTRACTOR SHOULD CONTACT KENTUCKY 811 OR 800-752-6007.
11. ALL DISTURBED AREAS NOT TO RECEIVE PAVEMENT SHALL BE BACKFILLED WITH MINIMUM 6" TOPSOIL, FINE GRADED TO DRAIN, SEEDED, SODDED OR LANDSCAPED, FERTILIZED, AND PROTECTED.
12. THE CONTRACTOR SHALL NOT SCALE FROM THESE PLANS FOR FIELD SURVEY LOCATIONS.
13. ALL SOFT AND UNSUITABLE MATERIAL IN AREAS TO RECEIVE FILL MUST BE OVER-EXCAVATED TO A STABLE SUB-BASE, AND BACKFILLED WITH AN APPROVED ENGINEERED BACKFILL. ALL BACKFILL MUST MEET THE COMPACTION REQUIREMENTS OF THE SPECIFICATIONS OR AS SHOWN ON THIS DRAWING, WHICHEVER IS THE MORE STRINGENT REQUIREMENT.
14. AT PROPOSED ENTRANCES CONTRACTOR IS TO CUT AND REMOVE EXISTING CURB. CONTRACTOR IS TO MATCH PROPOSED CURB WITH EXISTING CURB USING RECOMMENDED RADIUS. CONTRACTOR IS TO MATCH PROPOSED PAVEMENT WITH EXISTING PAVEMENT TO MEET CITY STANDARDS.

LEGEND

- PROPERTY LINE
- ADJOINING PROPERTY LINE
- EASEMENTS
- EXISTING CURB AND GUTTER
- EXISTING PAVEMENT
- 500 — EXISTING MAJOR CONTOUR
- 501 — EXISTING MINOR CONTOUR
- UE — EXISTING UNDERGROUND ELECTRIC
- OE — OVERHEAD ELECTRIC TO BE DEMOLISHED
- UC — EXISTING UNDERGROUND COMMUNICATIONS
- W — EXISTING WATER LINE
- G — EXISTING GAS LINE
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PROPOSED STANDARD CURB AND GUTTER
- PROPOSED PARKING STRIPE
- PROPOSED REVERSE CURB AND GUTTER
- 500 — PROPOSED CONTOURS
- EXISTING BUILDING
- PROPOSED CONCRETE PAVEMENT

NEEDS PERVIOUS CONCRETE BLOCK

- CATCH BASIN
- EXISTING BOUNDARY MARKER AS NOTED
- FIRE HYDRANT
- LIGHT POLE
- WATER VALVE
- UTILITY POLE

PROJECT NO.: 12331 DATE: APRIL 2013
DRAWN BY: SLH CHECKED BY: KDM

REV	DESCRIPTION	BY	DATE

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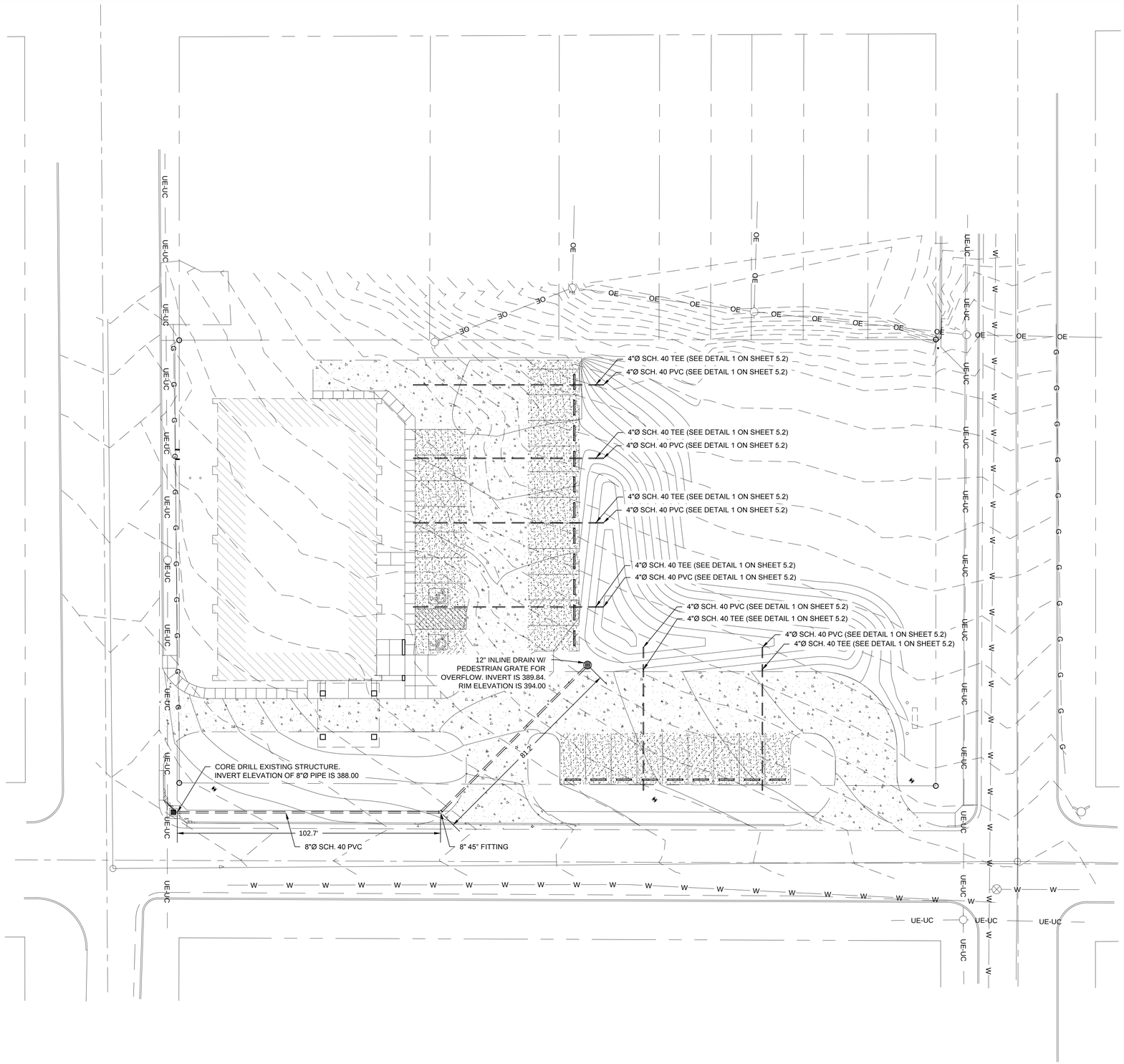
401 NORTH COURT STREET MARION, IL 62959 PHONE - 618.997.5100
1215 DIXIELAND DRIVE MURRAY, KY 42071 PHONE - 270.753.7307
www.bfwengineers.com

SITE - PROPOSED EARTHWORK GRADING PLAN

BENTON CHILDRENS PERFORMING ARTS CENTER
EAST 12TH STREET
BENTON, KY 42025

BENTON CHILDREN PERFORMING ARTS CENTER

SHEET
C3.0



1 / C4.0 **SITE - PROPOSED STORMWATER PLAN**
SCALE: 1:20

TRUE PLAN

STORMWATER NOTES:

1. ALL STORM WATER PIPE WITHIN THE CITY RIGHT-OF-WAY SHALL BE REINFORCED CONCRETE PIPE (RCP). STORM PIPE USED FOR YARD DRAINS SHALL BE ADS PIPE WITH CAST IRON GRATES OR APPROVED EQUAL.
2. ALL BACKFILL MATERIALS SHALL BE AS SPECIFIED ON THE DETAILS. SEE SITE DETAIL SHEETS FOR SPECIFIC INFORMATION.
3. ALL STORM WATER PIPE SHALL HAVE A MINIMUM COVER OF 12" OVER THE TOP OF PIPE (NOT INCLUDING PAVEMENT SECTIONS). CONTRACTOR SHALL PROVIDE MINIMUM COVER IN ALL CASES. IF DISCREPANCIES EXIST IN THE GRADING PLAN OR IF UNSEEN SITE CONDITIONS EXIST THAT WILL NOT ALLOW THIS COVER AS DESIGNED, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY.
4. ALL STORM WATER PIPE BENEATH PAVEMENT SHALL BE BACKFILLED FULL DEPTH WITH DENSE GRADED AGGREGATE (DGA).
5. STORM WATER STRUCTURES SHALL BE PRE-CAST CONCRETE, UNLESS SPECIFIED OTHERWISE, AND SHALL MEET ALL THE SPECIFICATIONS FOR DRAINAGE STRUCTURES AS OUTLINED IN THE LOCAL STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, CURRENT EDITION.
6. PIPE FITTINGS ARE NOT DESIGNATED ON THESE DRAWINGS. CONTRACTOR IS RESPONSIBLE FOR OBTAINING AND INSTALLING ALL FITTINGS TO COMPLETE THE STORM WATER PIPING INSTALLATION AS PART OF THEIR CONTRACT WITH NO ADDITIONAL COST TO THE OWNER. ALL CONNECTIONS REQUIRE FITTINGS. PARTICULARLY, ALL DOWNSPOUTS SHALL BE CONNECTED TO THE MANIFOLD LINES WITH APPROPRIATE FITTINGS. FITTINGS INCLUDE, BUT NOT LIMITED TO, TEE'S, WYE'S, ELBOWS, CROSSES, CONNECTING BANDS, GASKETS, ETC.
7. CONTRACTOR IS RESPONSIBLE FOR SUBMITTING PIPE AND DRAINAGE STRUCTURE MATERIAL CERTIFICATIONS, SIZES AND QUANTITIES TO THE ENGINEER FOR WRITTEN APPROVAL PRIOR TO CONSTRUCTION.
8. STORM WATER PIPE AND DRAINAGE STRUCTURES SHALL BE INSTALLED IN PROPER CONSTRUCTION SEQUENCE SUCH THAT SITE DRAINAGE IS ALLOWED TO DRAIN FROM THE SITE. IT IS CRITICAL THAT THE STORM WATER RUNOFF BYPASS AND/OR EXIT THE AREAS OF CONSTRUCTION TO PREVENT DEGRADATION OF THE SITE CAUSED BY PRECIPITATION AND/OR PONDING WATER.
9. ALL STORM WATER PIPE AND DRAINAGE STRUCTURES SHALL BE PROTECTED DURING THE COURSE OF CONSTRUCTION. SPECIAL PROVISIONS MAY BE NECESSARY TO ACCOMMODATE CONSTRUCTION TRAFFIC AND ASSOCIATED LOADING. CONTRACTOR SHALL REPAIR OR REPLACE ANY PIPE OR DRAINAGE STRUCTURES DAMAGED DURING CONSTRUCTION, AT NO ADDITIONAL COST TO THE OWNER.

LEGEND

- PROPERTY LINE
- ADJOINING PROPERTY LINE
- EASEMENTS
- EXISTING CURB AND GUTTER
- EXISTING BUILDING
- EXISTING PAVEMENT
- EXISTING SIDEWALK
- EXISTING PARKING STRIPE
- EXISTING STORM SEWER
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK
- PROPOSED BUILDING
- PROPOSED STANDARD CURB AND GUTTER
- PROPOSED PARKING STRIPE
- PROPOSED REVERSE CURB AND GUTTER
- PROPOSED STORM SEWER
- EXISTING BUILDING
- EXISTING ASPHALT PAVEMENT
- EXISTING CONCRETE PAVEMENT
- EXISTING GRAVEL SURFACE
- PROPOSED BUILDING
- PROPOSED HEAVY DUTY ASPHALT PAVEMEN
- PROPOSED STANDARD DUTY ASPHALT PAVE
- PROPOSED CONCRETE PAVEMENT
- 1/2" DIAMETER REBAR & CAP STAMPED "BFW KJW #3445" (SET)
- BOUNDARY LINE ANGLE POINT
- CATCH BASIN

PROJECT NO.: 12331 DATE: APRIL 2013
DRAWN BY: SLH CHECKED BY: KDM

REV	DESCRIPTION	BY	DATE

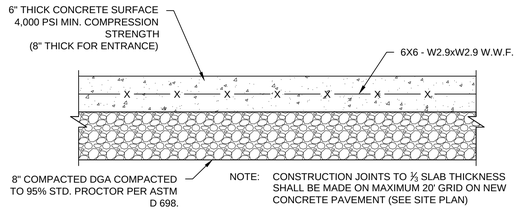
BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.
500 SOUTH 17th STREET 403 NORTH COURT STREET 1215 DRUGHI DRIVE
PADUCAH, KY 42003 MARION, IL 62959 MURRAY, KY 42071
PHONE - 270.443.1995 PHONE - 618.997.9190 PHONE - 270.753.3307
www.bfwengineers.com

SITE - PROPOSED STORMWATER PLAN

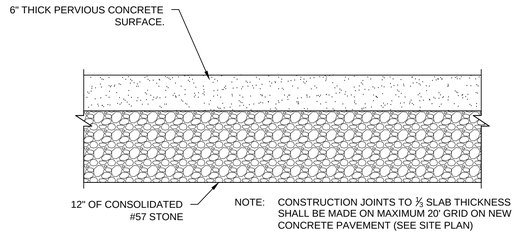
BENTON CHILDRENS PERFORMING ARTS CENTER
EAST 12TH STREET
BENTON, KY 42025

BENTON CHILDREN PERFORMING ARTS CENTER

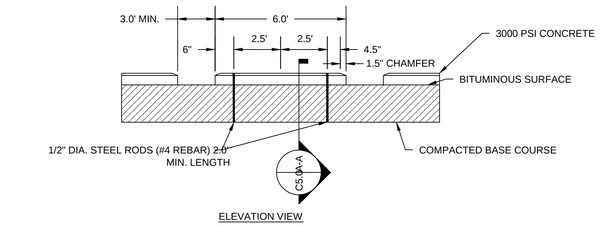
SHEET
C4.0



1 / C5.0 STANDARD DUTY CONCRETE PAVING
SCALE: N.T.S.

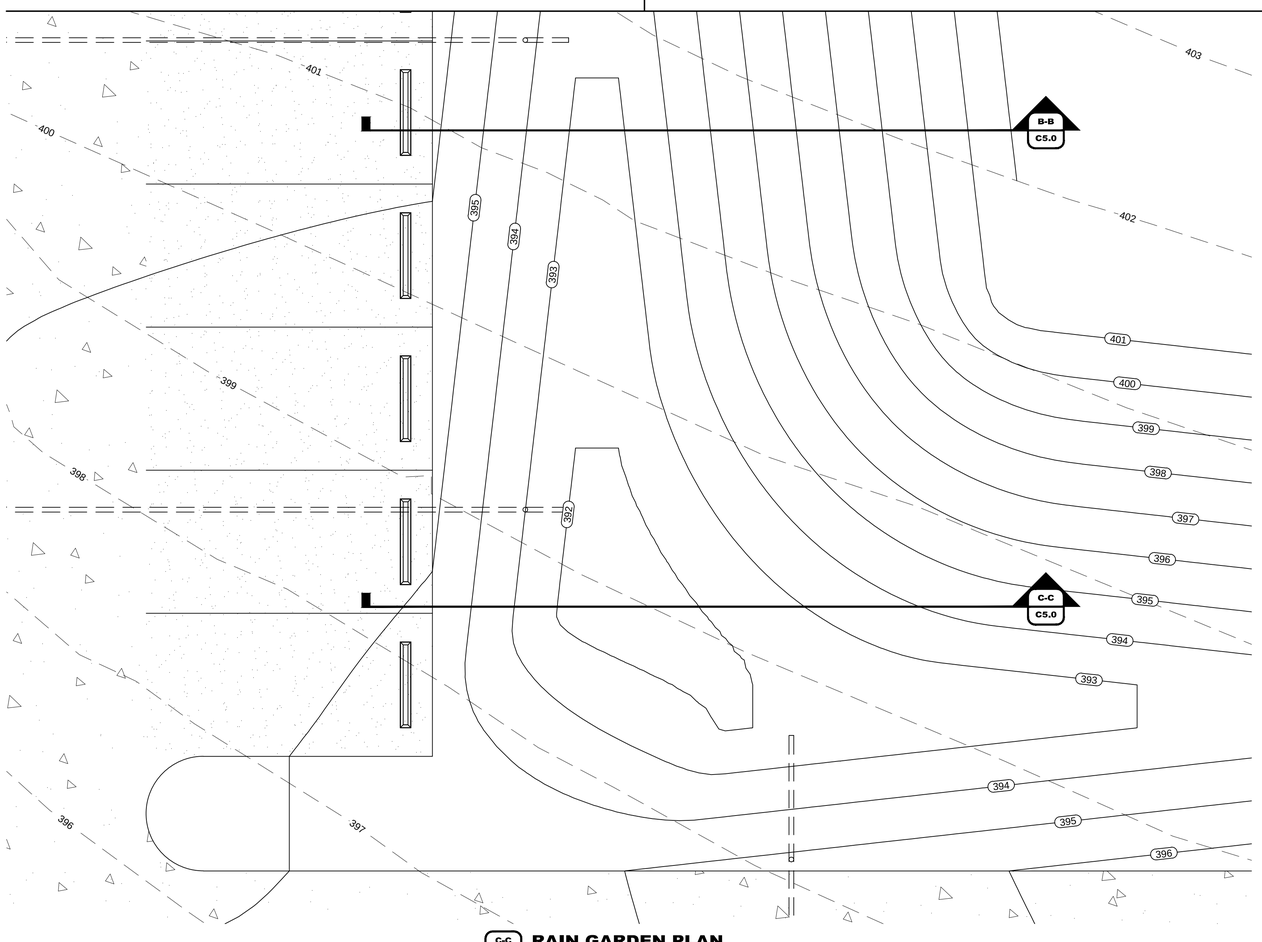


2 / C5.0 PERVIOUS CONCRETE PAVING
SCALE: N.T.S.

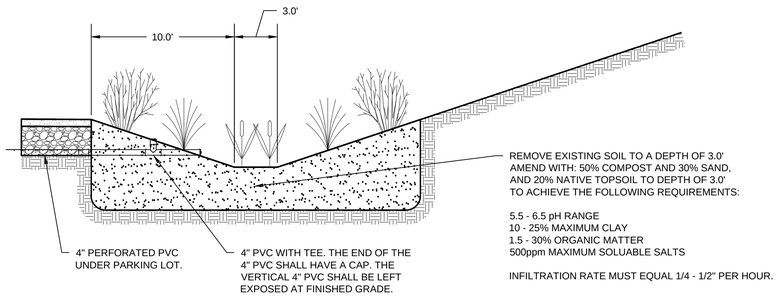


NOTE:
1. ANCHOR RODS TO BE SLEEVED OR GREASED THRU CONCRETE CURBS TO PERMIT RELOCATION OF CURBS.
2. SEE SITE PLAN FOR CURB STOP LOCATIONS.

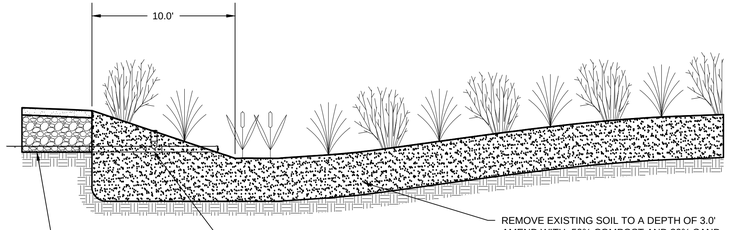
3 / C5.0 CURB STOP
SCALE: N.T.S.



C-C / C5.0 RAIN GARDEN PLAN
SCALE: 1" = 5'



B-B / C5.0 RAIN GARDEN SECTION
SCALE: 1" = 5'



C-C / C5.0 RAIN GARDEN SECTION
SCALE: 1" = 5'

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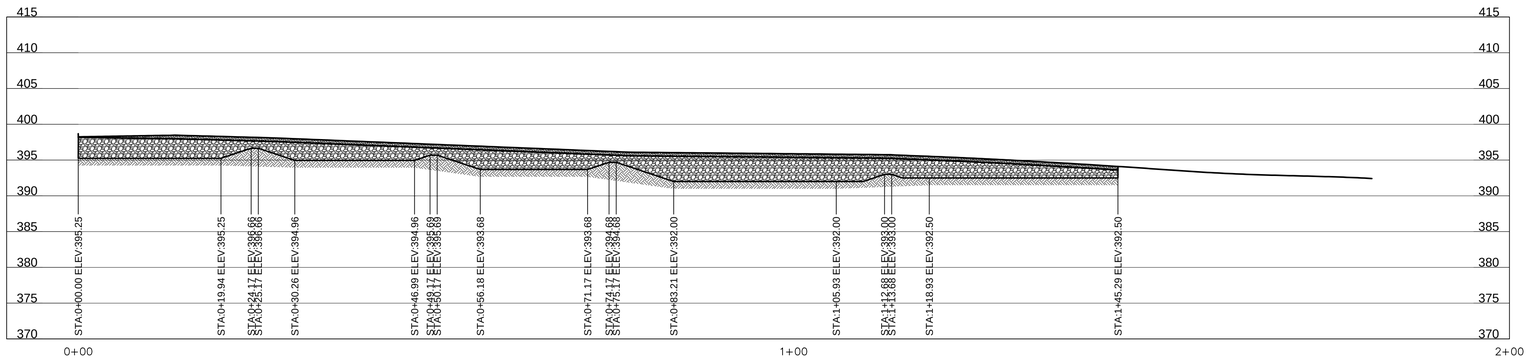
PHONE - 270.443.1995 PHONE - 618.997.5190 PHONE - 270.753.2307
www.bfwengineers.com

SITE - DETAILS

BENTON CHILDRENS PERFORMING ARTS CENTER
EAST 12TH STREET
BENTON, KY 42025

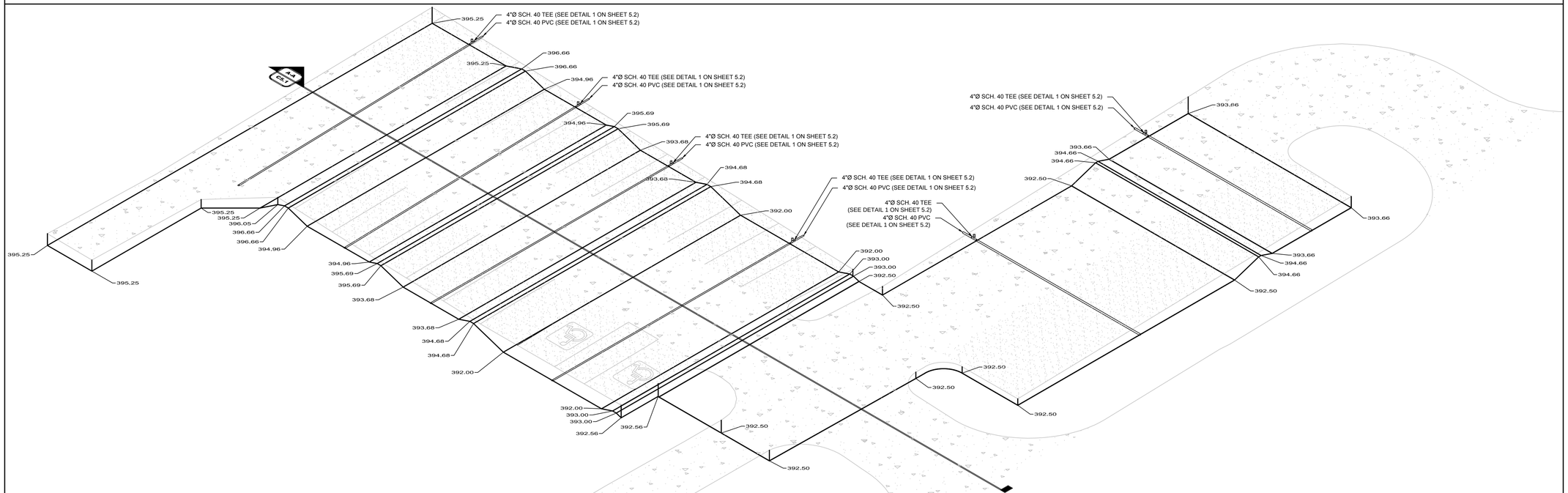
BENTON CHILDREN PERFORMING ARTS CENTER

SHEET
C5.0



A-A / C5.1 PARKING LOT PROFILE

SCALE: 1" = 10'



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PADUCAH, KY 42003 MARION, IL 62959 MURRAY, KY 42071
PHONE - 270-443-3995 PHONE - 618-997-5190 PHONE - 270-753-7307
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REV.	DESCRIPTION	BY	DATE

SITE - DETAILS

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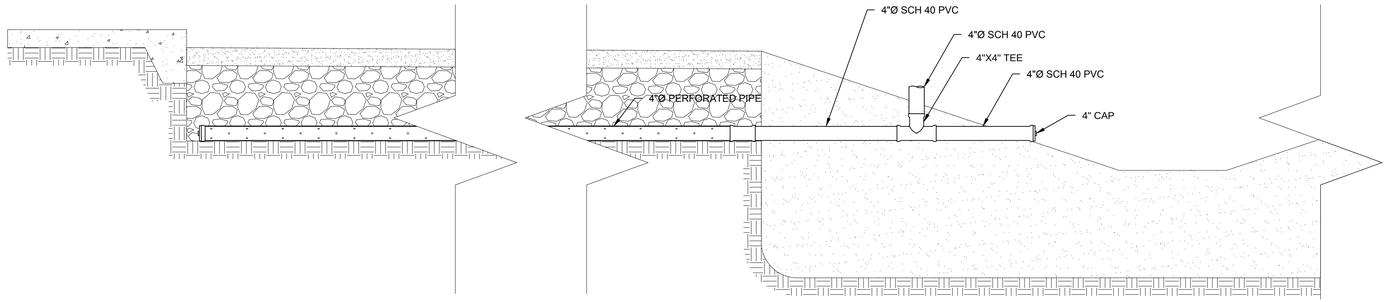
EAST 12TH STREET
BENTON, KY 42025

BENTON CHILDREN PERFORMING ARTS CENTER

SHEET
C5.1

NOTE:
PIPE INVERT SHALL BE PLACED
AT SUBGRADE ELEVATION.



1
C5.2
PARKING LOT DRAINAGE DETAIL
SCALE: 1" = 2'

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SITE - DETAILS

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BENTON CHILDREN PERFORMING ARTS CENTER

SHEET
C5.2

STORM WATER
BEST MANAGEMENT
PRACTICES IMPLEMENTATION PLAN (BMP IP)

FOR

BENTON CHILDREN'S PERFORMING ARTS CENTER

12TH STREET

BENTON, MARSHALL County, Kentucky

Prepared By:

BFW Engineering & Testing, Inc.

Project No. 12331

500 S. 17th Street ● P.O. Box 120 ● Paducah. KY 42002-0120 ● Ph.: (270) 443-1995 ● Fax (270) 443-1904

TABLE OF CONTENTS

1.0 OBJECTIVE

The purpose of this report is to present the Best Management Practice (BMP) implementation plan for demonstration BMPs in fulfillment of the Benton Children's Performing Arts Center outlined for the City of Benton. This BMP Implementation Plan identifies the BMP selection criteria and presents the selected site BMP options.

2.0 Technologies to be Installed

2.1 Rain Garden

A rain garden is a planted depression or swale that allows rainwater to be routed to the garden and filtered naturally by the plants and soils in the garden.

2.2 Vegetative Swale

A vegetated swale is a planted depression vegetated with erosion resistant and vegetation.

2.3 Pervious Pavement

Pervious pavement is a special pavement with a high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from the site and allowing groundwater recharge.

2.4 Structure for Water Control

A structure in a stormwater management system that maintains a desired water surface elevation and measures water.

2.5 Subsurface Drain

A subsurface drain is a perforated conduit, such as tile, pipe or tubing, installed below the ground surface to intercept, collect, and/or convey drainage water. Subsurface drains are designed to remove excess water from soil

3.0 Selection Process

3.1 Constructed Vs. Natural

BMPs should be selected that have a more natural appearance as opposed to a hard structural appearance.

3.2 Total Cost

Rain garden costs will vary depending on the site preparation and the number of plants used and whether you are putting it in yourself or paying for the labor. The cost can range from $3-$4 a square foot if you are providing the labor and $10 - $12 a square foot depending on soil conditions and the density and type of plants used. Labor will be provided by the owner which will reduce the unit cost. Costs of vegetated swales vary widely depending on the size, number of plants used and labor, much like the rain garden. They can create a cost savings because they decrease the need to put in curb and gutter.

Pervious pavements are more expensive than traditional forms of paving. Traditional concrete typically costs $4.00 - $6.00 per square foot where pervious pavement may cost $7.00 - $8.00 per square foot. On the other hand they can create savings in decreasing the need for storm drains and in land consumption. The labor will be provided by the owner.

3.3 Aesthetics of BMPs

Identification of BPs that will enhance the surroundings and work well with the facility so they will be well received by the general public

3.4 BMP as "Usable" land

The pervious concrete will also serve as parking for the performing arts center.

3.5 Demonstrating Effectiveness of Selected BMPs

This is the ability of the BMP to be effective and scalable for implementation. Another component of this project is education. The City of Benton personnel and project partners will develop presentations and articles to demonstrate the tools and methods used to integrate water quality BMPs in urban rehabilitation projects. Also associated with the educational aspect of this project we will plan field days during the construction and after which will provide invaluable information, insight, and education to Design Professionals, Developers, and Decision Makers (DDD) and the general public.

3.6 Maintenance

Rain Garden maintenance is similar to that of a regular flower bed. The first few years require the most maintenance. The rain garden will need to be weeded and mulched. This becomes less necessary as the garden matures. The maintenance requirements for a vegetated swale are inspection for erosion an formation of gullies, removal of sediment buildup and debris, and mowing. Porous Pavement requires more maintenance than other forms of pavement. The porous pavement needs to be kept clear of debris and needs to be vacuum swept quarterly, which is similar to the city's regular schedule, to keep the surface free of sediment. The city of Benton will be responsible for the long-term maintenance of the BMPs since the site will be owned by the city.

3.7 Life Expectancy

How long will the BMP last? Rain Gardens and vegetated swales are permanent fixtures once they are built. They will continue to perform, as long as they are maintained, until they are removed. Porous pavement has a life expectancy similar to that of traditional pavement types.

3.8 Permits

All applicable permits will be obtained prior to implementation.

4.0 Financial Plan of Acton

Money for the project comes from grant and in-kind contributions. The total estimated cost of the project is $275,000. Of the construction costs 60% ($165,000) come from the 319 grant. Non-federal match in-kind contributions of materials, labor, and user of equipment for construction comprise 40% ($110,000) of total estimated costs.

5.0 Maintenance Agreement

The City of Benton will be responsible for the operation and maintenance of the BMPs through their life expectancy.

6.0 The Notification Process to DOW

The NPS Section Technical Advisor (TA) and Grant Administrator will be notified of the selected BMP before implementation begins. The notification will include a description of the chosen BMP, the location where the BMP will be installed and the expected date of implementation.

7.0 Project Revisions

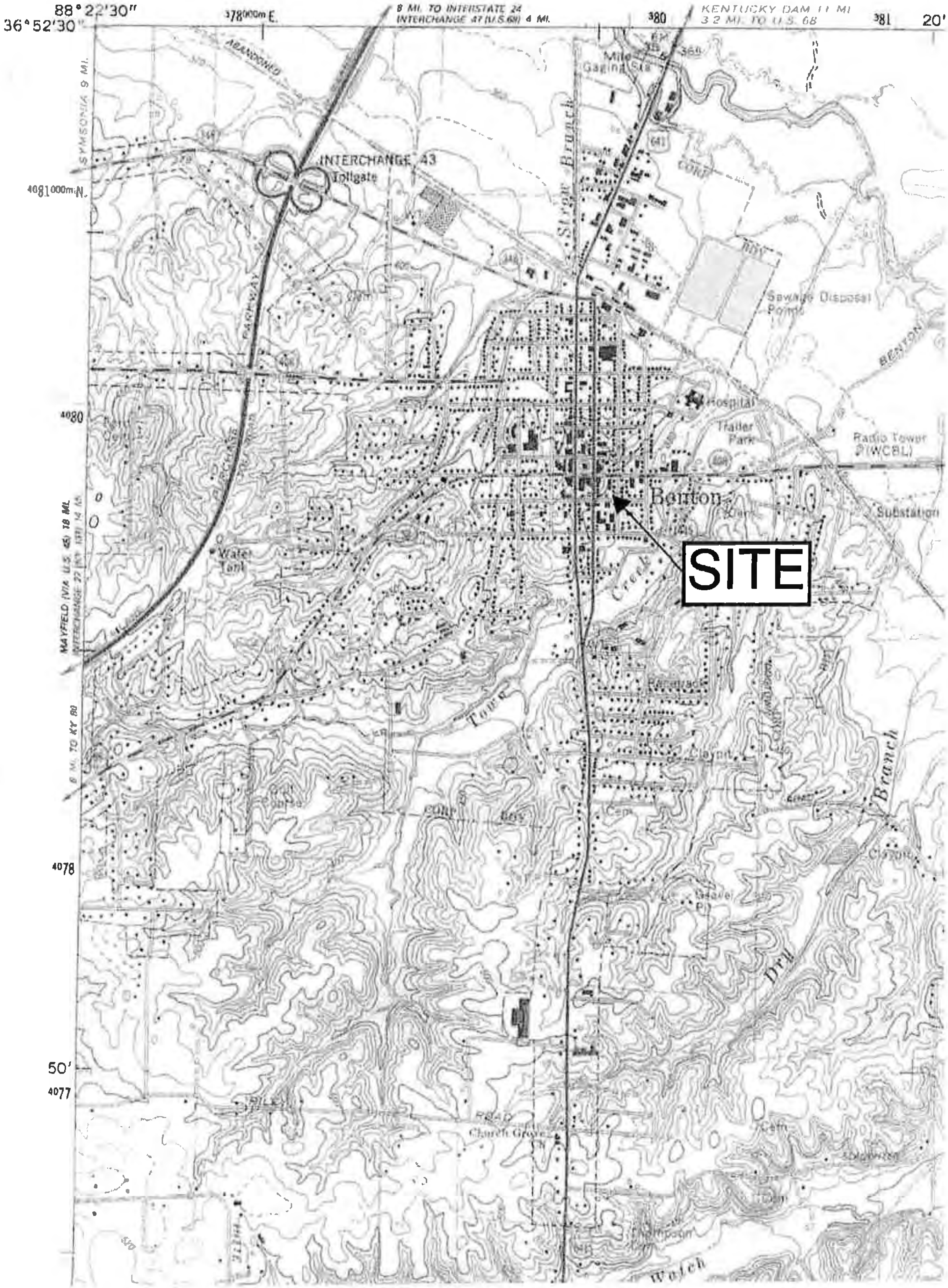
If any modifications are made to the selected BMP's during the course of construction that vary from the construction documents as approved by KDOW, the contractor shall submit a revised BMP Implementation Plan reflecting those changes along with updated design drawings and materials.

TOPOGRAPHIC MAP

3357 IV NW
(ELVA 6-NW)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Hardin Quadrangle
Kentucky
7.5 Minute Series (Topographic) 6-SE



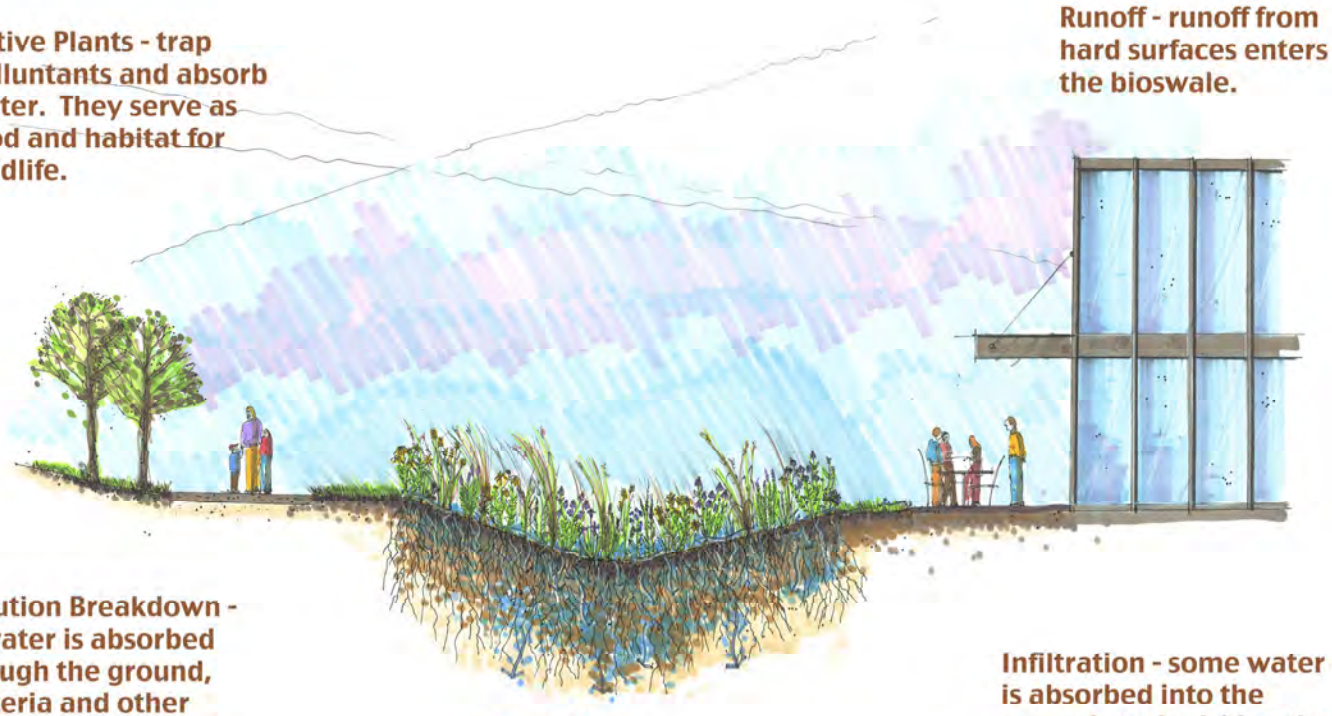
Erosion Control Plans

-See attached plans

What are Biowsales?

Bioswales are ditches or shallow swales that are designed to slow, filter and absorb runoff from hard surfaces that don't allow water to soak into the ground, such as sidewalks, driveways, parking lots and roads. Bioswales allow that runoff to slowly soak back into the ground, removing dirt and pollution from the runoff. During large storm events, excess runoff is directed through the storm sewer to local streams.

Bioswales 101 - The Living Drain



Where Can I Learn More?

The EPA Green Infrastructure website has more information on several stormwater management best practices, inlcuding bioswales.

http://water.epa.gov/infrastructure/greeninfrastructure

Partners

Division of Water · Kentucky Lake · Marshall County Fiscal Court · UK University of Kentucky College of Agriculture, Food and Environment · Kentucky State University · Jackson Purchase Resource Conservation & Development Foundation, Inc. www.jpf.org · Marshall County Arts Commission · Benton Kentucky · National Association of Conservation Districts conserving natural resources for our future

This work was funded in part by a grant from the U.S. Environmental Protection Agency under 319(h) of the Clean Water Act through the Kentucky Division of Water to the City of Benton (Grant #C9994861-09)

PHOTO CREDIT: http://www.lakecountyil.gov

Why Bioswales?

Every time it rains, excess rainwater runs off hard surfaces that don't allow water infiltration, such as roads, driveways and parking lots.

This runoff picks up many types of pollution, such as oil, fertilizer and other chemicals, while traveling across these surfaces.

Typically, this pollution flows through storm drains, untreated, into our local streams and rivers. Bioswales serve as a natural way to capture and treat runoff to remove pollution and also increase groundwater recharge by holding water and allowing percolation through the soil.

Runoff from hard surfaces is directed into the bioswale where water is slowly absorbed back into the ground. Plant roots increase absorption of runoff into the soil and reduce the amount of runoff helping to reduce flooding.

This absorption replenishes our groundwater supplies, and allows dirt and other pollution to be filtered out of the water and broken down by bacteria and other organisms in the soil.

Unabsorbed runoff that is cleaner is discharged through the storm sewer system into our local streams and rivers Plants within the bioswale also serve as food and habitat for wildlife.

WHAT IS THE PROBLEM WITH RUNOFF?

When it rains, excess rainwater runs off hard surfaces that don't allow water to soak into the ground, such as roads, driveways, parking lots and rooftops. As this water runs across these hard surfaces, it can pick up different types of pollution that are on the land surface, including fertilizers that are used to encourage plant growth, pesticides, sewage from humans and animals, litter, oils and other chemicals from cars and trucks, and dirt.

Runoff containing this pollution flows untreated directly into our streams or down storm drains. Runoff that enters storm drains then flows untreated into local streams we use for swimming, fishing, boating or drinking water.

As we increase the amount of these hard surfaces that don't allow water to soak into the ground, more water runs off. Because less water is soaking into the ground, underground water supplies are not replenished. This increased runoff also leads to more frequent flood events, as there is less area for rainfall or snowmelt to soak into the ground. Not only do these events occur more frequently, they are often more cauastrophic.

Increased runoff also leads to increased erosion of stream banks because the velocity of water flowing through streams is greater. This causes more dirt to enter our streams, clogging habitat for aquatic life and making it difficult for aquatic life to survive.

Clean Water. It's your choice.

Kentucky has been blessed with abundant water resources, including nearly 92,000 miles of streams! These water resources provide drinking water for our residents, habitat for fish and wildlife, extraordinary recreational opportunities, and support billion-dollar industries. Unfortunately, polluted runoff remains a significant threat to our treasured water bodies.

WHAT CAN WE DO ABOUT IT?

, there is a solution to address the problem - green infrastructure. Green infrastructure is a network of
agement practices, such as rain gardens, green roofs, trees, rain gardens and permeable pavement,
e and infiltrate rain where it falls.

ts of green infrastructure are numerous, including, but not limited to:

g polluted runoff and improving the health of surrounding waterways
g flooding
energy
g the amount of water entering sewer systems, which reduces stress
tructure and treatment costs
ng green spaces and habitat
ng property values

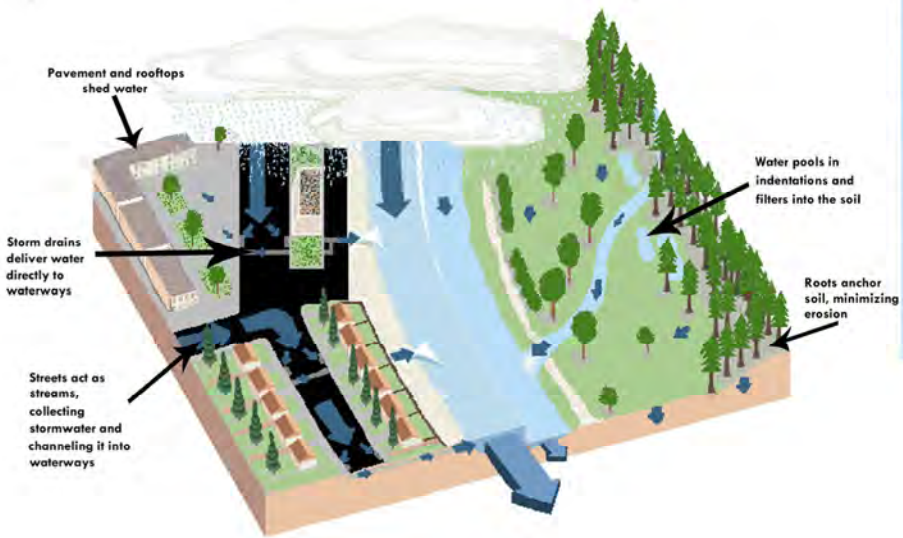
Community Unity
It's our solution to pollution

DEVELOPED LANDSCAPE

Rain pours more quickly off developed lands, and pollutants are washed into streams, rivers and lakes.

NATURAL LANDSCAPE

Trees, brush and soil soak up the rain, slow runoff and help reduce erosion.



RUNOFF

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California
Partnersh

Rain Barrel
A rain barrel is a container used to catch rainwater usually from rooftops in order to reduce runoff. Typically the water collected is then used to care for potted plants or to perform outdoor cleaning tasks.

Pervious Pavement
Pervious concrete is a special pavement with a high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from the site and allowing groundwater recharge.

Subsurface D
A subsurface dr
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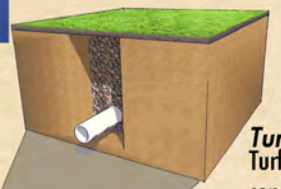
convey drainag
Subsurface drai
designed to ren
water from soil.



Turfstone Paver Parki
Turfstone pavers feature a
concrete grid with open ho
planted with grass, allowin
and runoff to be filtered b
soil naturally, resulting in
and stabilization of soil er
40% open area, these pave
ground cover, such as gras
but still provide the necess
structural strength for traff

aver Sidewalk
rs are connected blocks
uch as stone or gravel between
llow water to pass through,
between the paving blocks.
ovide a strong, solid surface that
on driveways, walkways and patios
ng as an attractive landscape feature.

avement Parking Spaces
otal of 25 parking spaces
ite. Each parking space is
ement, while drive lanes are
ervious) concrete.

Vegetative Swale
A vegetated swale is a planted depression vegetated with erosion resistant vegetation.

Rain Garden
A rain garden is a planted depression or swale that allows rainwater to be routed to the garden and filtered naturally by the plants and soils in the garden.

nded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the City of Benton Grant #C9994861-09

What are Permeable Pavers and Turfstone?

ermeable pavers are connected blocks with materials such as stone or gravel between the blocks that allow water to pass nrough, filling the gaps between the paving blocks. These pavers provide a strong, solid surface that can be installed on riveways, walkways and patios while also serving as an attractive landscape feature. Turfstone pavers feature a lattice tyle concrete grid with open holes that are planted with grass, allowing rainwater and runoff to be filtered back into the oil naturally, resulting in the control and stabilization of soil erosion. With 40% open area, these pavers allow ground over, such as grass, to grow, but still provide the necessary structural strength for traffic.

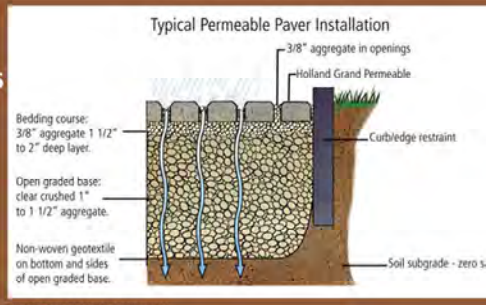
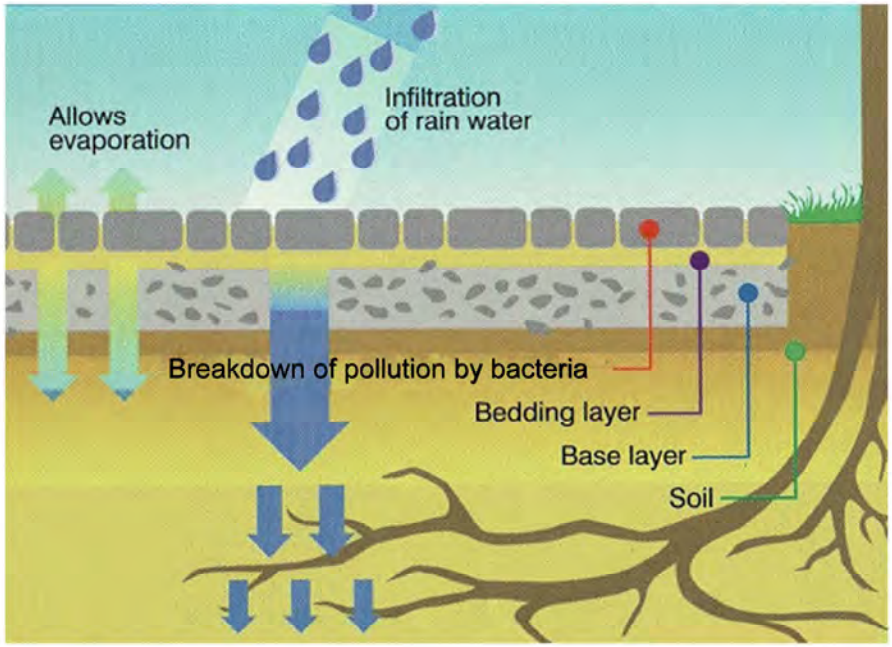


PHOTO CREDIT: MY PAVER DRIVEWAY

Permeable Pavers and Turfstone 101

THE ECO-FRIENDLY CHOICE



Helps Reduce Runoff Pollution:
Because these pavers allow water to soak into the ground between blocks, the amount of runoff and thus, the amount of pollution that is picked up off the land surface and carried to storm drains, streams and rivers is reduced.

Helps Reduce Overall Irrigation Needs:
Because these pavers allow water to seep into the ground, the direct and surrounding areas will need less irrigation, saving you money and reducing your irrigation needs.

Reduced Heat Island Effects:
Because these pavers allow water to seep into the ground, the surface and surrounding area temperatures will be cooler than a hard surface that prevents water from soaking into the ground.

Attractive:
These pavers can be extremely attractive, resulting in increased property values.

Did you know...

The hard surfaces of a city block can generate five times more runoff than a wooded area of the same size!

Why Permeable Pavers or Turfstone?

Patios, sidewalks and driveways are hard surfaces that prevent water from soaking into the ground. As we increase the amount of these hard surfaces in the landscape, more water runs off the land.

This results in increased pollution from the land surface (fertilizers, pesticides, sewage, litter, oils, dirt, etc.) running into our local streams. Because these hard surfaces cause less water to soak into the ground, our underground water supplies are not replenished. This is the source of drinking water for many of us in this region.

The increased runoff from these hard surfaces also leads to more frequent flood events, as there is less area for rainfall or snowmelt to soak into the ground. Not only do these flood events occur more frequently, they are also more catastrophic.

The increased runoff from these hard surfaces also leads to increased erosion of stream banks because the velocity of water flowing through the streams is greater. This causes more dirt to enter our streams, clogging habitat for aquatic life and making it difficult for aquatic life to survive.

Permeable pavers and turfstone allow infiltration of runoff between the blocks, thus preventing runoff and all of the problems that come from increased runoff.

Where Can I Learn More?

he Low Impact Development Urban Design Tools website as information about how to integrate permeable pavers nd turfstone into your property.
ttp://www.lid-stormwater.net/index.html

he Greening EPA website has information on several tormwater management best practices, inluding permeable avers.
ttp://www.epa.gov/greeningepa/stormwater/best_practices.htm

Partners

Division of Water

Paul Howard's CUSTOM LANDSCAPING

conserving natural resources for our future

Jackson Purchase Resource Conservation & Development Foundation, Inc. JPF www.jpf.org

Marshall County Arts Commission

BENTON KENTUCKY

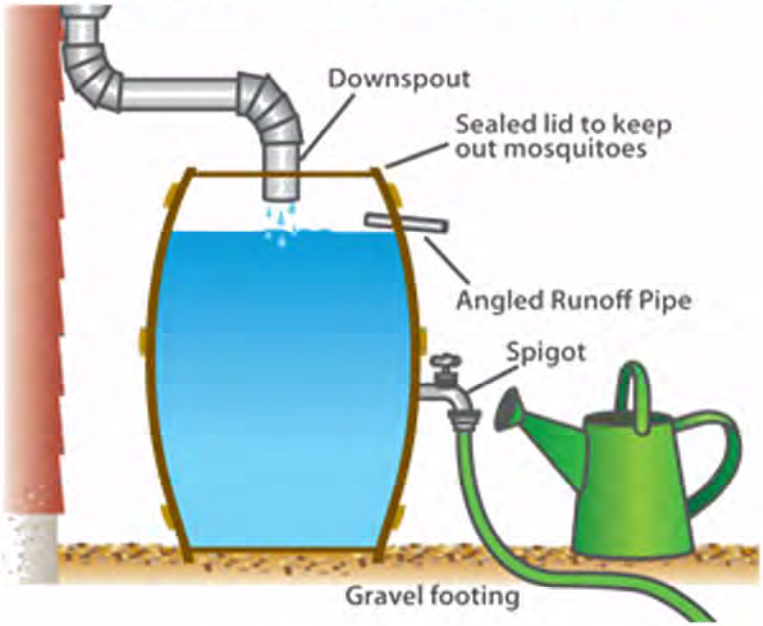
This work was funded in part by a grant from the U.S. Environmental Protection Agency under 319(h) of the Clean Water Act through the Kentucky Division of Water to the City of Benton (Grant #C9994861-09).

What is a Rain Barrel?

A rain barrel is a container or system that collects and stores rainwater from your rooftop for later use. This rainwater would otherwise be lost to runoff and diverted to storm drains and local streams.

Rain Barrels 101

THE SUSTAINABLE SOLUTION FOR LANDSCAPING



Helps Reduce Runoff Pollution:
Rainwater stored in rain barrels helps reduce the amount of runoff and the amount of pollution that is picked up off the land surface and carried to storm drains, streams and rivers.

Conserves Water:
Lawn and garden watering makes up nearly 40% of total household water used during the summer. Rainwater used from rain barrels helps reduce the amount of water used from local sources.

Better for Plants and Gardens:
Rainwater stored in rain barrels is naturally soft water and doesn't contain minerals, chlorine, fluoride and other chemicals. Plants respond well to this. After all, it's what plants in the wild thrive on!

Saves You Money:
A rain barrel will save most homeowners about 1,300 gallons of water during the peak summer months. Saving water not only helps protect the environment, it saves you money and energy.

Did you know...
That 1 inch of rain falling on 1,000 square feet of roof can yield 600 gallons of water? Don't let this free water run away!

Where Can I Learn More?

The University of Kentucky Cooperative Extension Service has excellent resources available, including a manual with instructions for building and installing your own rain barrel.
http://www2.ca.uky.edu/gogreen/

Your local basin coordinator through the Kentucky Division of Water (http://water.ky.gov/watershed/Pages/Basins.aspx) or your local extension agent through the University of Kentucky (http://extension.ca.uky.edu/) will have resources for you.

Partners

Jackson Purchase Resource Conservation & Development Foundation, Inc. JPF www.jpf.org

Division of Water

Marshall County Schools Learning Today Leading Tomorrow

Marshall County Arts Commission

National Association of Conservation Districts conserving natural resources for our future

Kentucky

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PHOTO CREDIT: GREEN LIFE SOCIAL

Why Rain Barrels?

As water runs across the land surface, it can pick up different types of pollution on the land surface, including fertilizers that are used to encourage plant growth, pesticides, sewage from humans and animals, litter, oils and other chemicals from cars and trucks, and dirt.

Runoff containing this pollution flows untreated directly into our local streams or down storm drains and then into our local streams.

Rain barrels serve to prevent some of this runoff by storing water from rooftops in collection systems so that the water can be used in a beneficial way at a later date.