Watershed Management Plan for Dry Run Creek Watershed

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1. General Purpose and Vision Statement

The Dry Run Creek watershed is in a state of constant change. Urban development has produced habitat alteration and a drastic increase in the rate and volume of stormwater inputs. It is the goal of this project to work to repair the damage done to in-stream habitat and reduce the rate and volume of stormwater flow using infiltration practices. In addition agricultural lands will also require attention in an effort to reduce the delivery of eroded soils to the creek. Agricultural practices including grassed waterways, buffer strips, conservation tillage and many others will be used to achieve the desired reduction. Goals and objectives for this project will be described in further detail in section 5.1. Working with stakeholders to achieve these goals will allow us to not only address the damage that has been done but also to work to avoid its return.

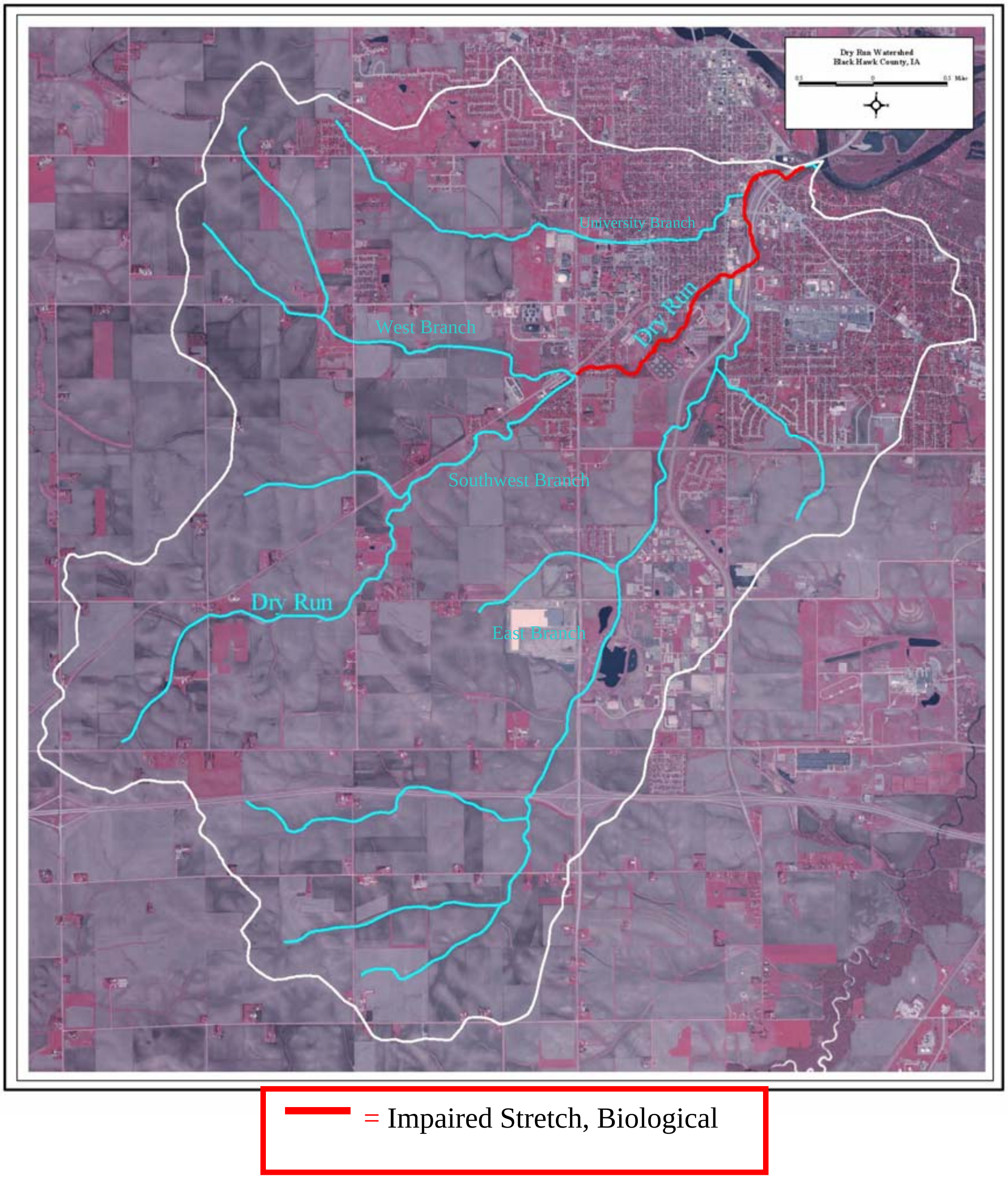
Currently, legislation is moving through the City of Cedar Falls local government that would mandate all new development in such as way that post-development runoff is not allowed to exceed pre-development runoff and the first flush of stormwater must be infiltrated on site. Given the high demand for practices this will likely create, it is important that implementation on behalf of the district and its partners serves not only to improve water quality, but also to educate local stakeholders about the diversity of practices available to meet these new demands. This is an integral part of the Dry Run Creek information and education program and vital to the sustained health of the creek.

Vision Statement:

Connecting urban and rural communities for the improvement and preservation of the Dry Run Creek Watershed.

2. <u>Watershed Introduction</u>

2.1. Watershed Map and Boundaries



2.2. Location Narrative and History

Dry Run Creek is a 15,177 acre watershed (HUC# 070600050204) which flows west to east through rural, residential, industrial and commercial areas including the city of Cedar

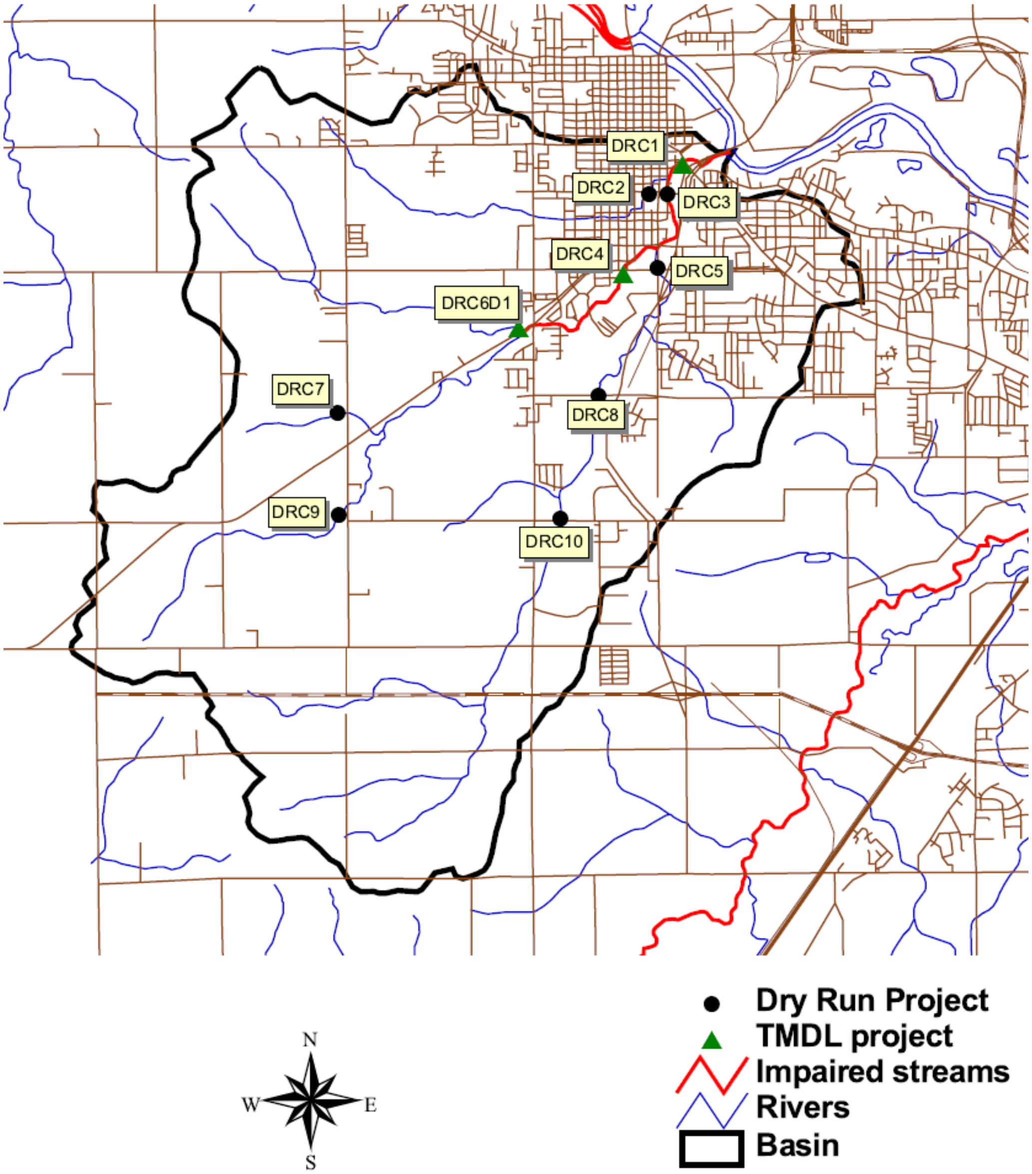
Falls and the University of Northern Iowa before outletting into the Cedar River in Cedar Falls.

Dry Run Creek is currently classified as a class B (LR) warm water stream by the Iowa Department of Natural Resources (IDNR). A segment of the southwest branch of Dry Run Creek, within the city of Cedar Falls, is listed on the State of Iowa's 303(d) list of impaired waters. According to the 305 Assessment, water samples collected by the IDNR Biologist did not yield the macro invertebrates/aquatic life that should be found in a healthy stream, yielding a biological impairment.

As Tom Wilton (IDNR), stated in his assessment of the Dry Run Creek Watershed, "streams are complex and dynamic ecological systems…. rarely is it possible to identify one stressor that alone is responsible for impairment in the aquatic community. Dry Run Creek is probably no exception. A consideration of watershed, riparian corridor and in-stream characteristics suggests two major areas of concern that are likely to contribute to diminished aquatic life in stream segments through the watershed: 1) hydrologic alteration; and 2) sedimentation.

Independent sampling conducted by the Black Hawk Soil and Water Conservation District, Hawkeye Community College, IOWATER volunteers, and IDNR all identified e. coli bacteria in excessive levels throughout much of the watershed. In 2008 the Dry Run Creek Watershed received a second impaired designation when it was placed on the 303(d) list for bacterial impairment on the Southwest, East, and University Branches. The most severe violations existed on the East Branch at DNR monitoring site 5 (see map 2.2.1) which, after 33 samples had a geometric mean of 2,093 org/100 mLs. Sites 8 and 10 also had geometric means at least triple the state criterion of 126 orgs/100mLs. On the Southwest Branch sites 1, 3, 4 and 6 all exceeded the geometric mean on a consistent basis. The most severe violations on this branch were seen at DRC sites 1 and 3, with geometric means of 672 and 560 orgs/100 mLs, respectively. These sites lie directly downstream of the confluence of the University and Southwest Branches and just upstream from the mouth of the creek. Data from site 2 on the University Branch indicated that a bacterial impairment also existed through this area. Of the branches studied, this branch displayed the lowest e. coli concentrations at 221 orgs/100mLs. However, this number is still considerably higher than the state standard and should be addressed through further action. More information regarding potential causes for these high levels will be discussed in section 4.

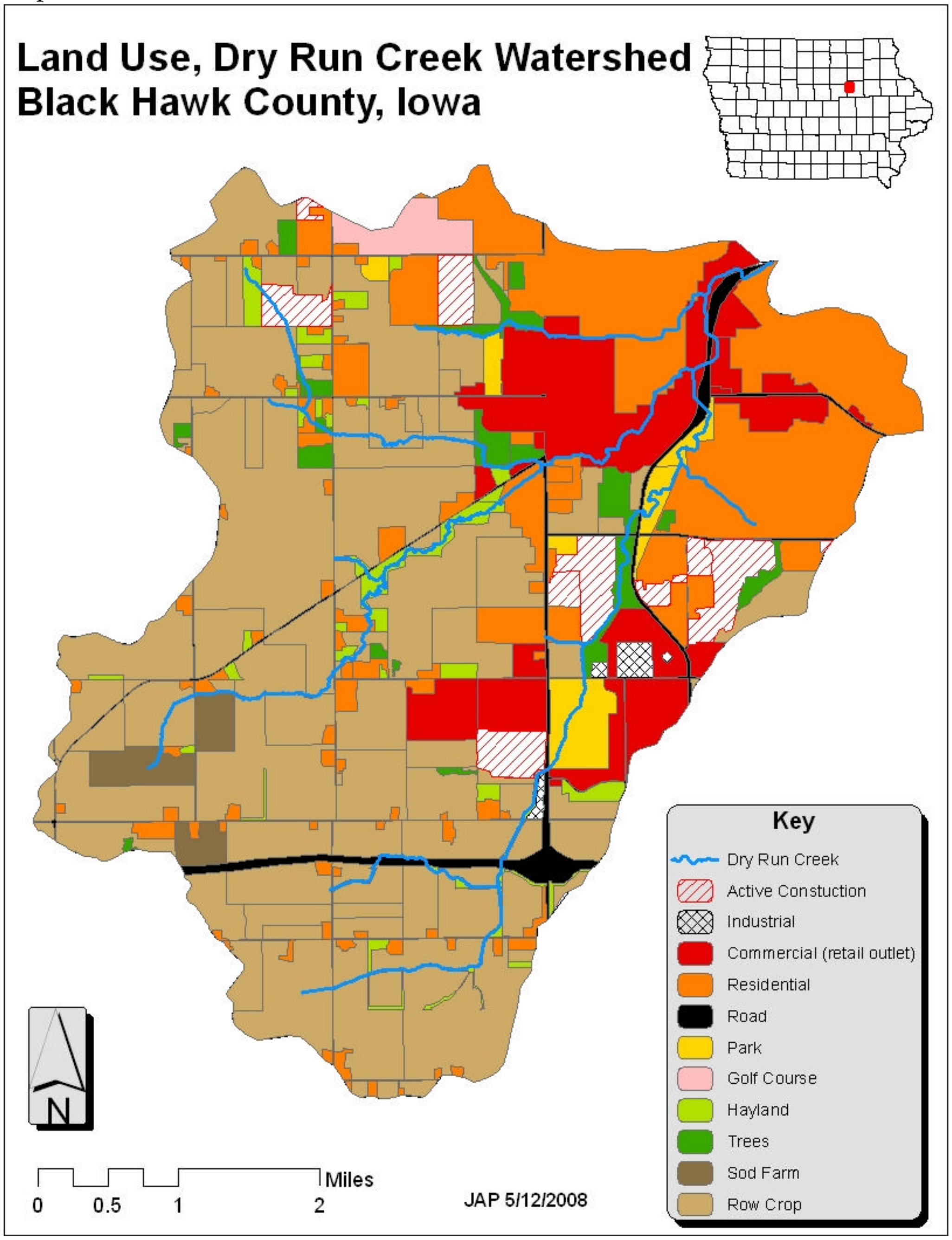
Map 2.2.1



2.3. Watershed Characteristics

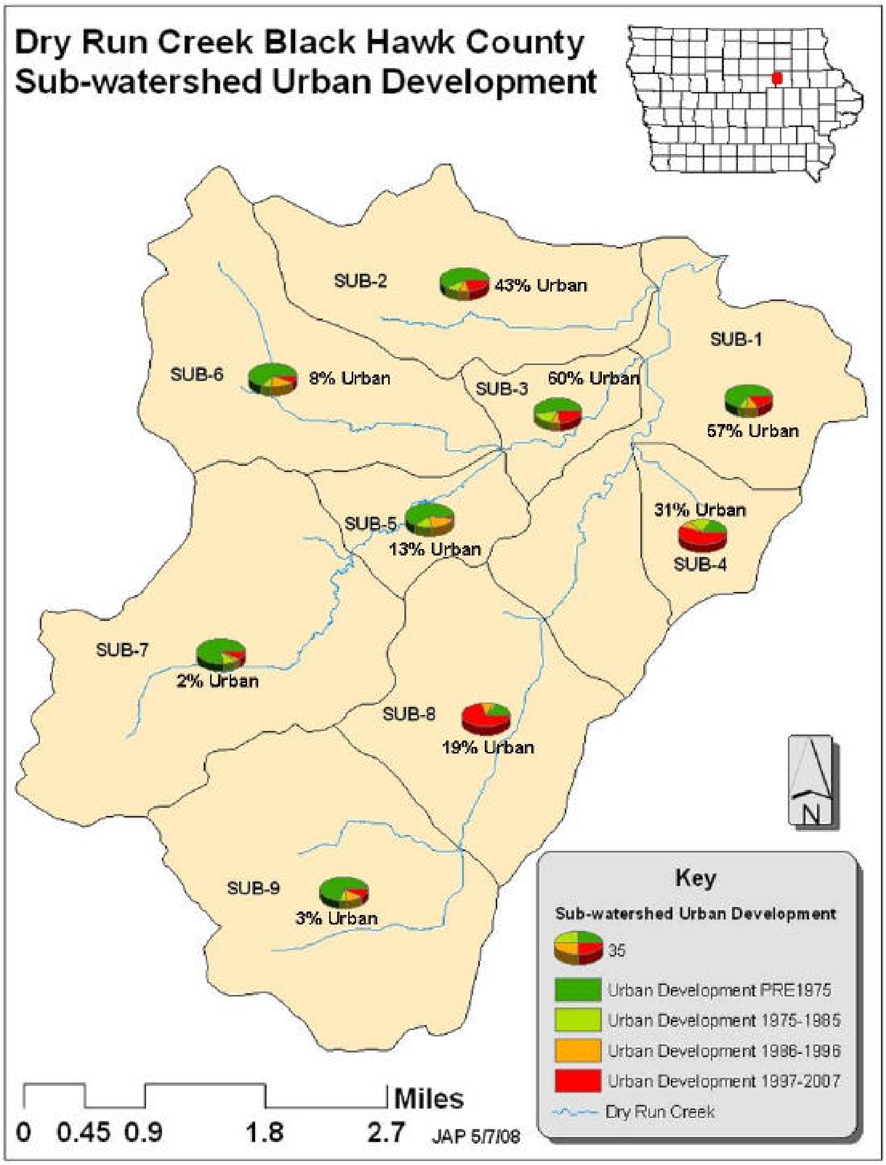
A detailed watershed inventory was completed by the Black Hawk SWCD in 2004 – 2005 and repeated in 2006. Data from this field inventory was used in conjunction with the 2005 RASCAL to assess the current land use, conservation practices, applied tillage systems and livestock operations located in the watershed. Both the RASCAL and the watershed inventory are to be repeated in 2010. The inventory identified three zones of land use in the watershed: rural sector, urban sector and development sector. The location of these zones changes from year to year as further areas are developed. Map 2.3.1 shows the areas of development present in the creek in 2008.

Map 2.3.1.



While the areas of development do change from year to year, the areas seeing the highest amount of development in recent years have been subwatersheds four and eight on the East Branch. A breakdown of subwatershed development can be seen in map 2.3.2.

Map 2.3.2



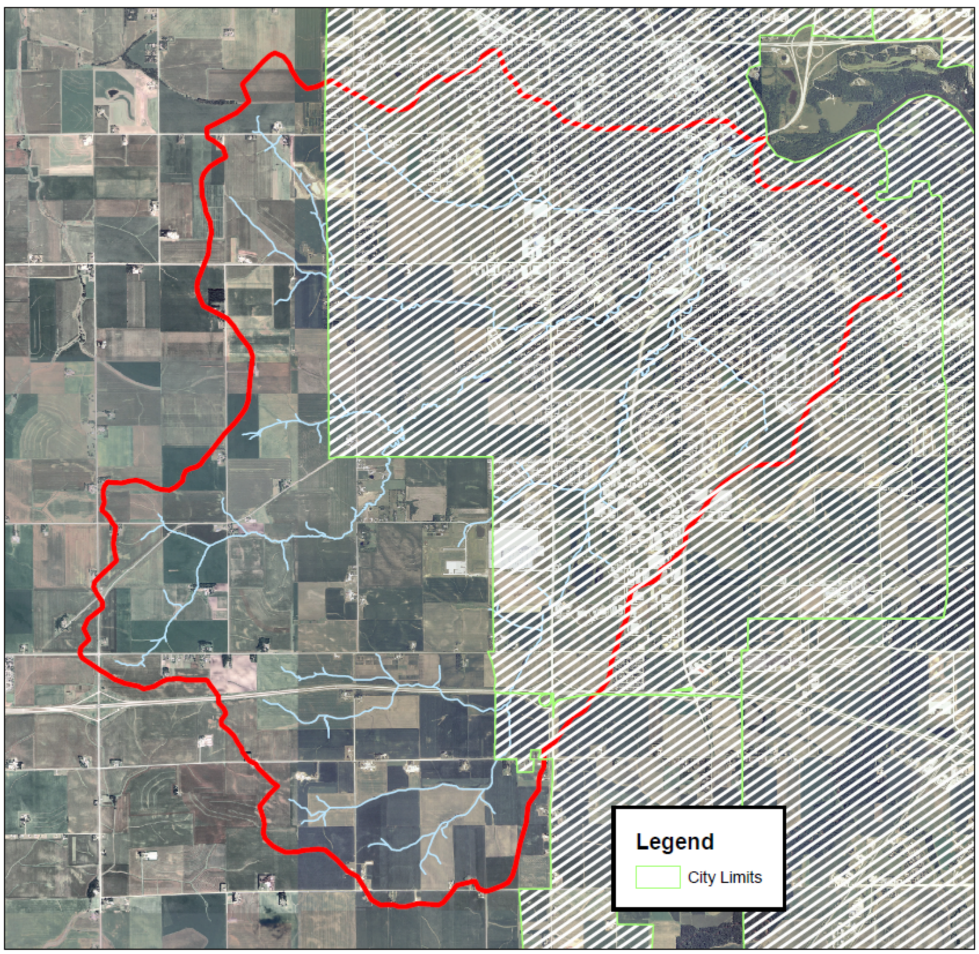
Urban Lands:

Urban expansion is occurring in the lower reaches of the watershed and expanding upstream. With the rapid growth of urbanization, increased quantities of urban runoff and pollutant delivery will occur. While the City of Cedar Falls requires storm water detention the ordinance requires detention of 10-year frequency storms. While high intensity storms are throttled down by current storm water detention requirements, the high-frequency low-intensity storms are passed unaffected.

Dry Run Creek drains 85% of the City of Cedar Falls and a small amount of the City of Hudson (see map 2.3.3.) Overall, 36% of the Dry Run Creek Watershed is urbanized, with over 24% of the total watershed being covered with impervious surface. Studies by Tom Schueler, et. al at the Center for Watershed Protection have shown that urban streams without watershed protection begin to degrade when 10 percent of a watershed becomes developed. Urban streams lose their ability to maintain ecological integrity when 25 percent to 30 percent of a watershed becomes urbanized. Urban growth is projected to increase and cover one percent of the watershed each year, making the developing urban sector a key aspect of watershed protection needs. This impervious surface exacerbates the current challenges facing the creek by drastically increasing the rate at which stormwater reaches the creek. According to the Iowa Department of Agriculture and Land Stewardship (IDALS) the native hydrology of Iowa was groundwater driven, with only 10% of a given rainfall entering the water body by runoff. In contrast, all of the rainfall which falls on the impervious surface of new development is generated as runoff. For a low intensity rain of 1.25" on a typical post development value of 62% imperviousness this is an additional 21,043 gallons of direct runoff per acre developed. This swift runoff results in a flashy hydrology characterized by large stormwater surges which wash out habitat and erode banks and channels.

Map 2.3.3

Dry Run Creek Watershed City Limits



In a comparable situation a recent analysis of the watershed above Ledges State Park, where urban expansion is the primary land use change anticipated for the future, data led researchers to believe that efforts should be made to focus storm water management on high-frequency low-intensity rainfall events. Hydrologic modeling for this watershed projected a 70% increase in runoff from rainfalls of 1.4 inches in 24 hours (which can be expected to occur 4 times a year – ¼ yr. storm). Run off is expected to increase 48% from 1.9 inches of rainfall in 24 hours (which can be expected to occur twice a year – a ½ yr. storm).

Most storm water management requirements focus on controlling run off from 5-yr or 10-yr storm events. Runoff in the Ledges park watershed from 5-yr storms (4 inches in 24 hours.) is expected to increase 26 percent under projected land use changes. Run off from 10-yr storms (4.7 inches in 24 hrs) is expected to increase 21 percent while run off from a 100-yr storm would increase 15 percent. This data demonstrates that the impact of development on stream hydrology is most apparent in frequent, low intensity rains. The effects of urbanization are less distinguishable from pre-development circumstances for more intense rains as soil saturation would have led to large amounts of runoff from these storms even in pre-development conditions. In the effort to return watershed hydrology to less variable flows the most effective use of funds is to design and implement practices which manage the initial first flush of water from low-intensity rains.

Analysis of the data from hydrological modeling in this watershed clearly indicates a need to adopt new storm water management practices that address the high-frequency low-intensity rainfall events to control run off and provide biofiltration for low-intensity rains. This addresses the “first flush” phenomenon, or the early volume of runoff which is responsible for the majority of pollutant delivery in urban runoff. While management of higher volumes such as the channel protection volume is desirable, funding constraints are now and likely will always be present in the watershed. With a limited amount of funding having more practices treating smaller volumes will allow us to treat a greater volume of runoff on an annual basis.

Urban runoff adds to water quality problems in other ways as well. Fertilizers and pesticides used in lawn care practices move with runoff into stream systems. Organic matter contributions (i.e. lawn clippings) also create high oxygen demands in urban streams, reducing the ability of a stream to maintain ecological functions. Car related pollutants move with urban run off to degrade water quality. Super heated runoff from roofs, roads and parking surfaces in summer also generate thermal pollution that alters the ecology of receiving urban streams.

Development Sector

Development is occurring in the watershed at a rate of roughly one percent per year (IDNR, 2008). In addition to increasing the impervious surface and the volume of water reaching the creek through storm sewers these areas of active construction contribute a considerable amount of sediment to the creek. According to 2008 estimates the 500 acres of active construction that were present in the watershed contributed 1,300 tons of sediment delivery. While the total area in active construction accounted for less that 3.5% of the watershed it contributed roughly 47% of the total estimated sediment delivery from upland sources (IDNR, 2008).

The Dry Run Creek Watershed Improvement Project is limited in its ability to address this issue due to the lack of legal authority held by the grantee. The Black Hawk Soil and Watershed Conservation District is not a regulatory body. However, measures to control construction site erosion are mandated by ordinances passed by the watershed’s two NPDES permit holding entities: the University of Northern Iowa and the City of Cedar Falls. The Dry Run Creek Watershed Improvement Project dedicates a considerable amount of effort through its information and education program to ensure that developers and contractors working in the watershed have the resources and technical assistance available to them to implement practices that will reduce their sediment contributions.

Agricultural Lands

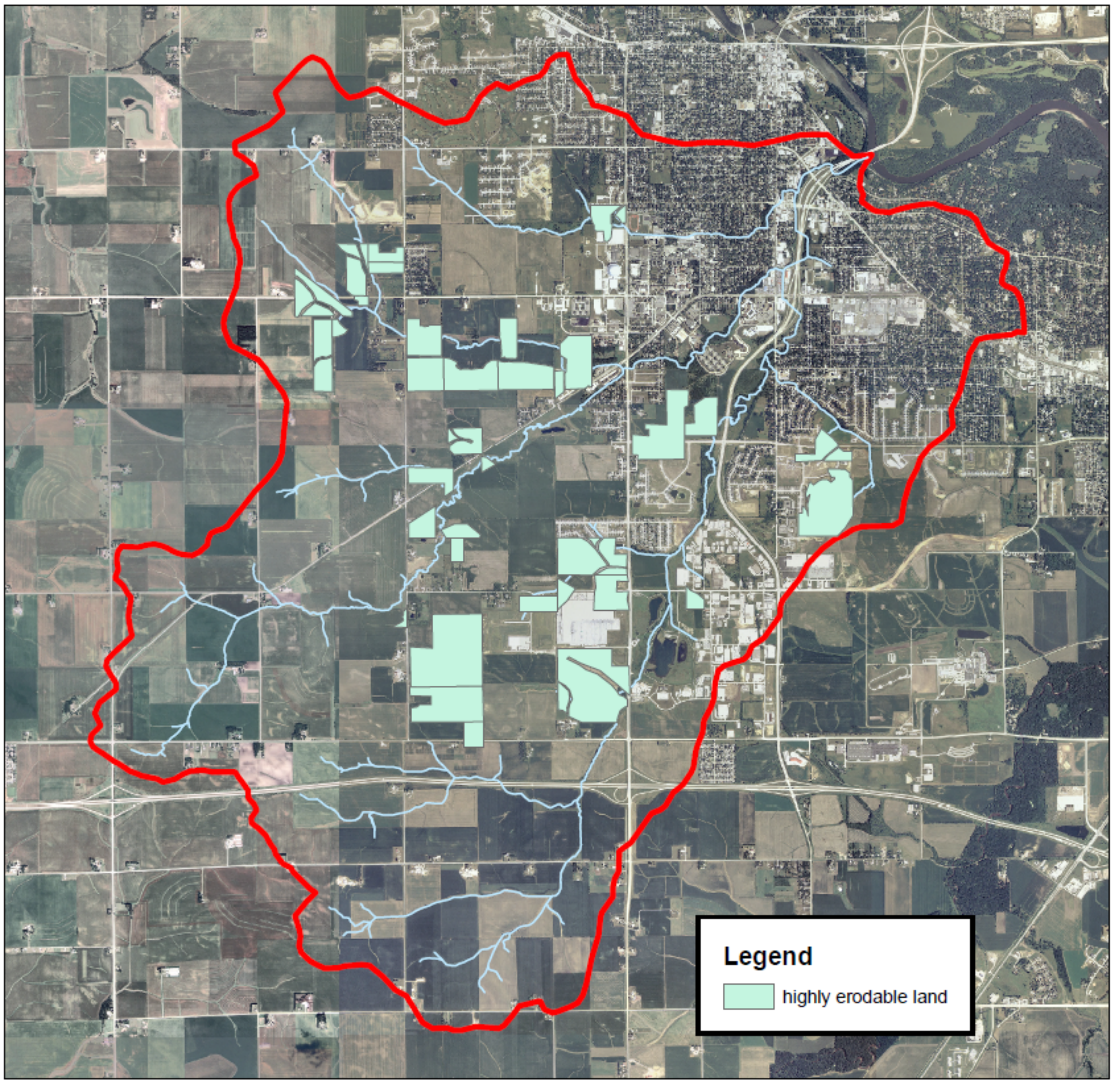
Dry Run Creek Watershed is a predominantly agricultural watershed, with expanding urban development occurring in the lower portion of the watershed. Dry Run Creek lies upon a geographic land form known as the Iowan Surface. Two soil associations predominate in this watershed. The uplands are Kenyon-Clyde-Floyd association with the valley floors being dominated by the Sparta-Flagler association.

The Kenyon-Clyde-Floyd soil association is moderately well drained (ridge tops) to poorly drained (drainage ways) soils formed in loamy material over glacial till. The majority of these soils are tiled to maximize row crop production. The Sparta-Flagler soil association is excessively drained to poorly drained loamy soils formed in loamy alluvial sediments with underlying coarse sandy alluvium.

The landscape for Dry Run Creek is nearly level to gently sloping. According to the United States Department of Agriculture-Natural Resources Conservation Service, there are 1,169 acres classified as highly erodible land (HEL) (see map 2.3.4). NRCS personnel reported that 100 percent of the operators and owners are in compliance with USDA Farm Bill related programs. The Dry Run Creek Watershed is over 95 percent privately owned. The public lands (trails, parks and schools) are owned by the city of Cedar Falls and the University of Northern Iowa.

Map 2.3.4.

Dry Run Creek Highly Erodible Land



A breakdown of the acres and percent of land use in the watershed is:

Land use	Acres	% of Total
Cropland	8318	55
Pastureland/Hay land	413	3
Timberland	399	3
Urban (includes residential, commercial, roads)	5460	36
CRP Filter strips	36	-
Parks/Golf	506	3
Idle water	45	-

According to the completed resource inventory, 95 percent of the cropland acres are in a corn – soybean rotation. As you traverse from the streams, the farmland becomes highly productive. According to a representative of Iowa State University, most farm operators

in Dry Run Creek have consistently over applied plant nutrients, set unrealistic yield goals, and have not taken credit for carry over nitrogen or for manure applied.
This is one potential source of unionized ammonia, which was identified as a secondary stressor by the IDNR stressor identification study conducted in 2008. The pursuit of profits in the face of increasing market pressures has led many farmers to seek out cheaper, often less sustainable chemical input regiments which may have a negative impact on the water quality of Dry Run Creek.

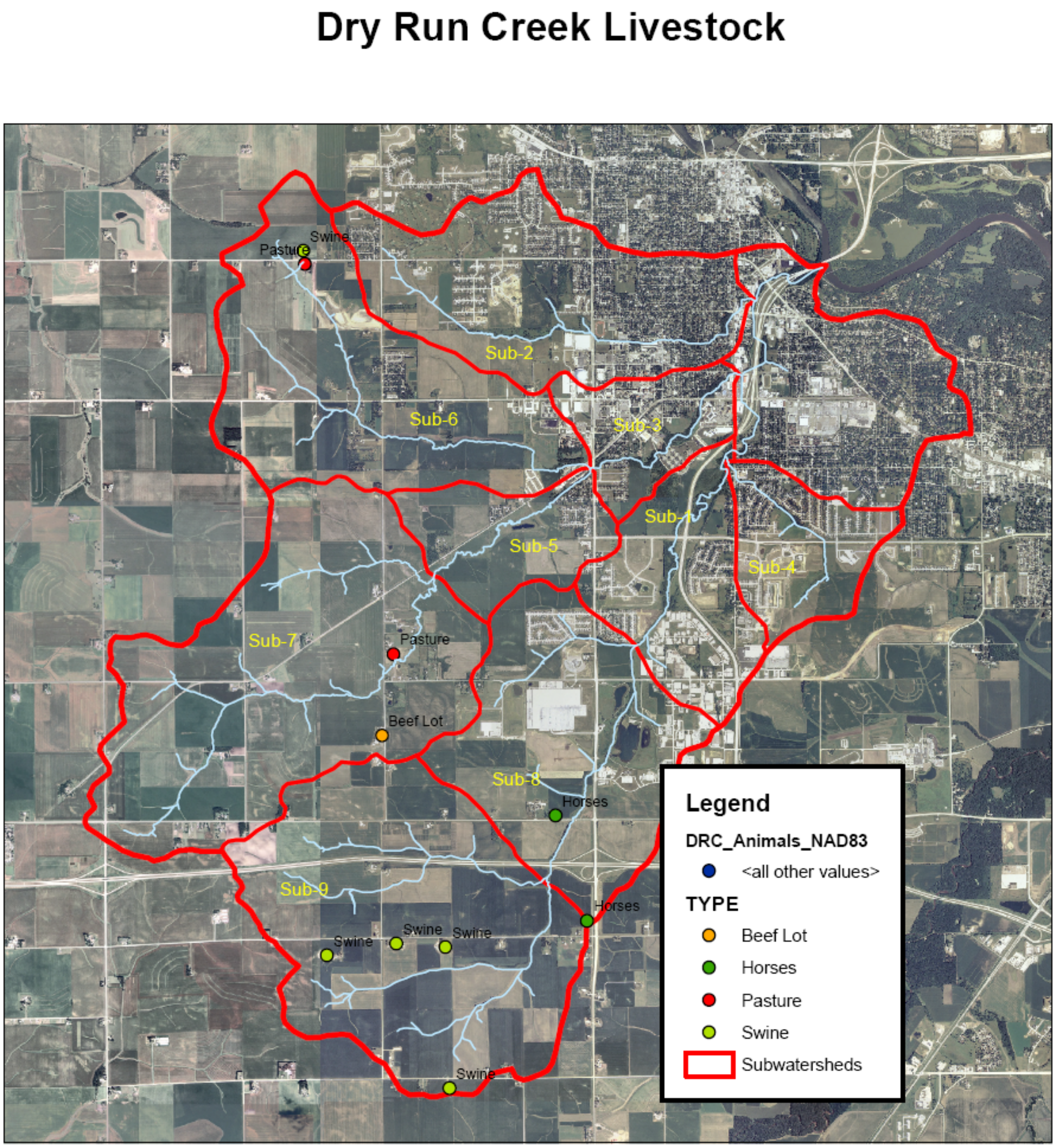
While pesticides were not specifically defined as being a primary stressor in the Dry Run Creek Watershed the stressor identification did state that one of the major stressors on the creek was the multitude of tract pollutants entering the creek through runoff, pesticides included. The 2008 stressor identification did show hazardous amounts of pentachlorophenol, a pesticide and wood preservative. Environmental Protection Agency studies into the effects of pentachlorophenol indicated that it was a probable human carcinogen and an acute and chronic toxin to both humans and wildlife. Use of this chemical as a pesticide was banned in 1972, but the chemical remains a common wood preservative. The actual source of this pollutant in the watershed has not been identified.

The farmers operating within the watershed have largely adopted tillage systems that leave less than 20 percent residue cover after planting. Some no-till soybeans are planted in the Dry Run Creek. Soil losses on the average for the entire watershed are at “T” or less.

Very few other water quality conservation practices have been applied in the watershed. There are a few filter strips, funded through the Conservation Reserve Program (CRP), along some segments of the streams. Over 50 of those CRP contracts are in the second half of their contract life. The majority of the soil erosion occurs during rainfall events of one inch or more in the spring of the year when the soil is the most susceptible to move.

Livestock issues in this watershed are somewhat minimal. There are three hog confinements, two open beef lots, and four horse farms (ranging from 5 – 20 horses) (see map 2.3.5). The contribution of animal manure to water quality degradation, though not documented, is believed to be small.

Map 2.3.5.



2.4. Public Opinion Survey

An extensive public survey was conducted by Kathy Scholl, Assistant Professor of Health, Physical Education and Human Services at the University of Northern Iowa.

Results of the public survey indicated a general lack of public awareness towards water quality concerns in the Dry Run Creek watershed. An example of the survey can be seen in figure 2.4.1. in Appendix B) According to the study:

> "The survey established the local population's perception of the Dry Run Creek watershed. One survey question concerned the public's "awareness" of the present water quality regarding Dry Run Creek. 53 percent responded that they were "Unaware", 22 percent were "not sure", while 25 percent of those who responded were "aware"" (*Kathleen Scholl, PhD., University of Northern Iowa, 2005*).

Respondents were also asked to choose from a list of 17 available conservation practices which they would be most likely to implement on their own land. According to survey results the most popular practices were native landscaping (wildflower or raingardens), backyard conservation (wildlife habitat improvement), and urban construction control. (*University of Northern Iowa, 2005).*

In addition to the surveys 5 local city officials were interviewed to assess their understanding and opinions of water quality issues. A general consensus was attained that problems facing the creek stem from rural, industrial and urban sources. When asked what could be done to resolve the water quality issues the most popular practices were detention and catchment basins for urban lands, and grassed waterways and terraces for rural areas. An elected official also suggested that all local city administrators should be further educated on water quality issues and effective ways to implement conservation practices (*Scholl, 2005).*

3. **Pollutant(s) and Cause(s)**

3.1. Impaired Designation

The impaired designation of Dry Run Creek is the product of several studies conducted by the Iowa Department of Natural Resources. An initial biological assessment conducted in 1992 indicated that the stream may be biologically impaired. The observations leading to this conclusion included a limited fish population. The suspected cause of this impairment was the lack of substrate diversity seen along the impaired stretch.

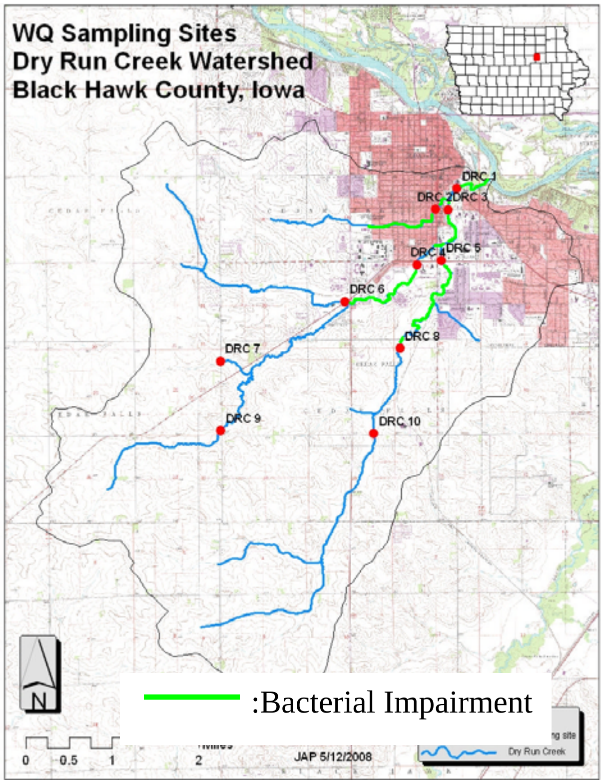
In 1996 a fish kill was reported along the impaired stretch and further investigation conducted in 1999 revealed a reduced biotic condition index level in areas of the creek designated for biological use. Available information was assembled and the likely contributors to the impairment were identified. The 2.8 mile stretch of Dry Run Creek was placed on the state's 303(d) list of impaired waters in 2002. The stream was designated as partially supporting of aquatic life due to unknown causes. Biological assessments conducted between 2005 and 2008 upheld the previous assessment and the watershed remains on the state's 303(d) list. Benthic macroinvertebrate index of biotic integrity and fish index of biotic integrity scores for Dry Run Creek consistently ranked below those of regional reference streams. In 2008 the DNR completed the stressor identification study (SI) for Dry Run Creek to attain more conclusive results. The major sources of impairment identified in the stressor identification were increased storm water inputs, increased suspended and bedded sediment, and a decrease in habitat complexity and in-stream cover *(Iowa Department of Natural Resources, 2008).*

Other secondary causes were also identified in the stressor identification. Acute dissolved oxygen deficiencies were observed on several occasions at one site and the East and Southwest branches were both observed to have occasional dissolved oxygen deficiencies. This deficiency may at times result in acute mortality to organisms in the stream and can also cause chronic stresses on aquatic life (*Iowa Department of Natural Resources, 2008).*

Another potential secondary cause is the abundance of chlorine in some stretches of Dry Run. In 2007 a study was conducted by University of Northern Iowa's Associate Professor of Biology Dr. Kurt Pontasch, PhD to investigate this toxin. Chlorine toxicity can result in acute mortality of stream biota. Lesser, chronic toxicity can also place significant stress on the ecosystem by negatively impacting periphyton and algal populations (*Iowa Department of Natural Resources, 2008).* The study revealed an absence of pollutant intolerant mayfly taxa and low chlorophyll a levels which seemed to indicate toxicity of effluent sources (Pontasch, 2007). Several possible point sources were identified within the watershed. Numerous private water features in the watershed which drain into the creek were being treated with chlorine to reduce occasional algae blooms and a local business was found to be draining chlorinated drinking water into the creek. These point sources have been addressed through NPDES permits and through actions taken by the landowners. While there was evidence of chlorine inputs in certain areas of Dry Run Creek other areas without known chlorine inputs showed similar condition. Henceforth, while chlorine toxicity may be a source of stress in certain areas of the watershed it is not considered a significant source of impairment.

In addition to the ongoing biological impairment the Dry Run Creek Watershed received a second impaired designation when it was placed on the 303(d) list for bacterial impairment on the Southwest, East, and University Branches in 2008 (see map 3.1.1). The most severe violations existed on the East Branch at DNR monitoring site 5 which, after 33 samples had a geometric mean of 2,093 org/100 mLs. Sites 8 and 10 also had geometric means at least triple the state A1 stream criterion of 126 orgs/100mls. On the Southwest Branch sites 1, 3, 4 and 6 all exceeded the geometric mean on a consistent basis. The most severe violations on this branch were seen at DRC sites 1 and 3 (see map 2.2.1), with geometric means of 672 and 560 orgs/100 mLs, respectively. These sites lie directly downstream of the confluence of the University and Southwest Branches and just upstream from the mouth of the creek. Data from site 2 on the University Branch indicated that a bacterial impairment also existed through this area. Of the branches studied, this branch displayed the lowest e. coli concentrations at 221 orgs/100mls. However, this number is still considerably higher than the state standard and should be addressed through further action. More information regarding potential causes for these high levels will be discussed in section 4.

Map 3.1.1.



3.2. Water Quality Data

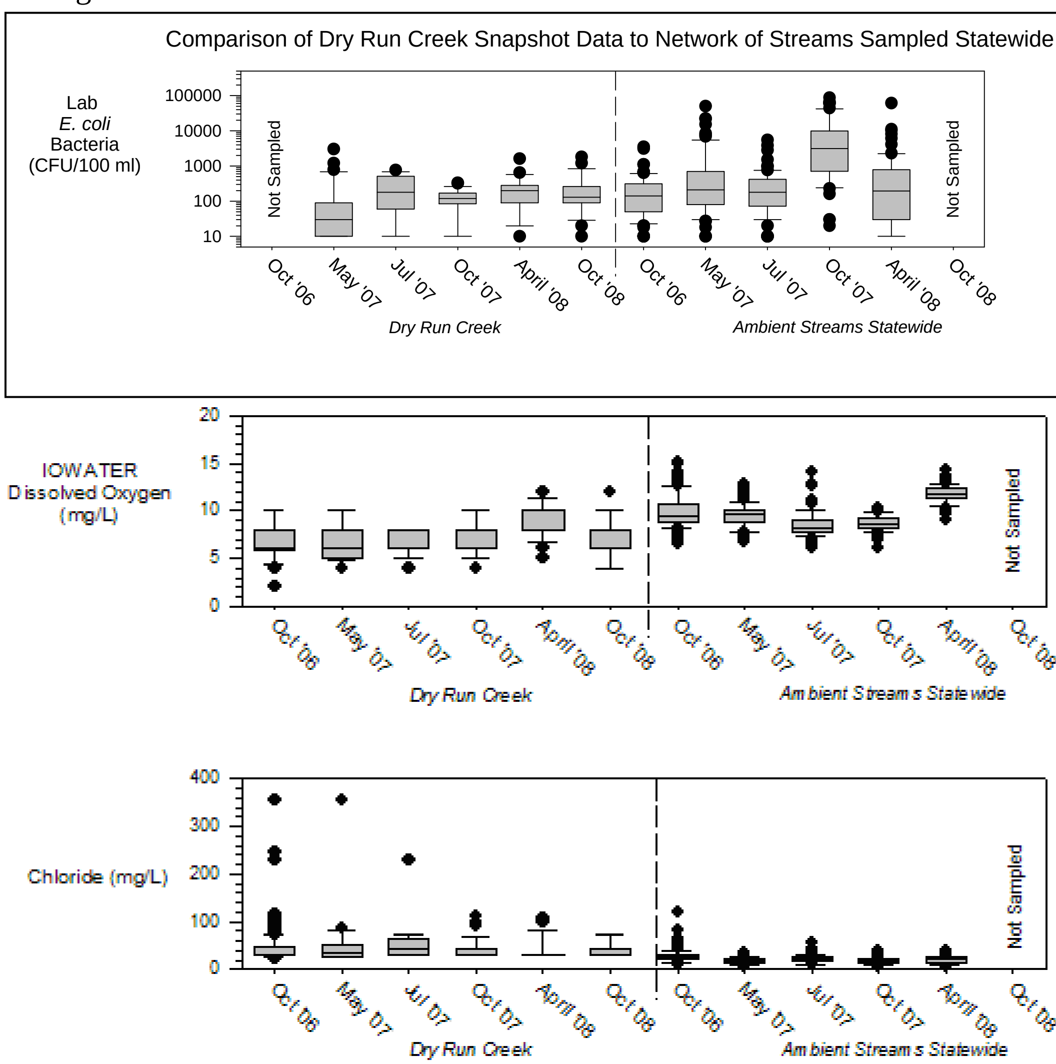
Several monitoring programs have been used to collect water quality data for this project. IOWATER snapshots have been conducted bi-annually since 2006 in conjunction with the IOWATER statewide snapshot days. This data allows the project to establish baseline data to determine trends and also creates a comparative dataset statewide. Data from these snapshots was compiled and the watershed-wide means from each sampling event were summarized using box plots. These box plots were also combined with statewide average from each event. The resulting analysis is provided in figure 3.2.1 (*diagrams and analysis used with permission, provided by: Iowa Department of Natural Resources, 2008).* When compared to statewide levels, Dry Run Creek's watershed average for e. coli levels was typically at or below the statewide average, as was the creeks dissolved oxygen content. While the e. coli levels have typically lain below the statewide average identified by these snapshots, it is nevertheless in consistent violation of state environmental standards.

It must be made clear, however, that the results throughout the watershed vary greatly by location and sampling event. Investigations done by the Iowa Department of Natural Resources from 2005 through 2007 went into further detail regarding the chemical pollutants present at their sampling sites. The annual site means were calculated per site and compiled into table 3.2.1 (Appendix B) (*Iowa Department of Natural Resources, 2007).* Sites along the East Branch of Dry Run Creek (see map 2.2.1,) (*Iowa Department of Natural Resources, 2008)* typically had the highest levels of e. coli bacteria.

According the DNR standards the acceptable sample average for an A1 designated stream is 126 orgs/100mL, the one-time maximum standard is 235 orgs/100 mL. Sampling sites 1, 3, and 5 exceeded this standard during more than 70% of the sampling events. The highest values recorded during the study period were found at Site 5 in 2005. The annual mean for Site 5 was 31,772 orgs/100mL with a peak value of 260,000.

Of the three primary stressors identified by the DNR the only identified pollutant was excessive sediment (*Iowa Department of Natural Resources, 2008)*. Total suspended solids, or TSS, is one indicator of the level of sedimentation present in a creek. IDNR data (table 3.2.1, Appendix B) shows that the areas with the highest TSS values were sites 2, 3, 4, 5, and 6. These sites correspond roughly with the areas of prevalent commercial land use (see map 2.3.1.). Site 10 also saw high TSS values during 2007, though much of this was likely caused by a major construction project that was occurring just upstream.

Figure 3.2.1



3.3. Studies

3.3.1. Department of Natural Resources Monitoring

Initial monitoring of Dry Run Creek began in 1994. The initial findings indicated a lack of substrate diversity and only fair development of pool and riffle sequences. Other observations noted that while there was a fair diversity of fish species there was also low abundance. Along much of the stream channel clearing of riparian vegetation and channelization were seen. Early indications were "urban land use (is) probably a major contributor to (the) degradation of (the) stream" (*Iowa Department of Natural Resources, 1994).*

Further monitoring conducted in 1996 made no new observations regarding the condition of the creek, but did delve into further detail regarding the sources of the impairment. These findings indicated that industrial point sources and urban runoff from storm sewers were the largest likely contributors to the impairment. The study also indicated that other sources were helping cause the impairment, these were identified only as "cause unknown" (*Iowa Department of Natural Resources, 1996)*

Also occurring in 1996 a fish kill was reported in the impaired region of the creek. The kill extended for 0.3 miles of stream channel and consisted of over 60 animals. The cause of this event remains unknown and further monitoring of the creek did not occur until 1998. In the 1998 monitoring and fish surveys the findings showed low diversity within the fish community, presence of less than a majority of expected fish taxa, and impacts of development to the physical character of the stream, including channel alterations and bank erosion. No changes were made to the defined impairment causes or sources. (*Iowa Department of Natural Resources, 1998)*

Biological Monitoring conducted between 1998 and 2000 was to test the use support of the creek for aquatic life. Fish Index of Biotic Integrity (FIBI) and Benthic Macroinvertebrate Index of Biotic Integrity (BM-IBI) studies were undertaken and the results were compared to ecoregion standards. The creek was then given a rating (0-100) for both the FIBI and the BM-IBI tests. Dry Run Creek scored 50 (fair) in the FIBI test and 48 (fair) on the BM-IBI test. The creek's scores were then cross-referenced against the 2002 Section 305(b) report and the creek was given an aquatic life use support rating of "partially supporting"(*Iowa Department of Natural Resources, 2002)*. These methods continued to be applied on the creek through 2004, when the results were updated. However, neither the scores, nor the identified pollutant causes or sources were altered (*Iowa Department of Natural Resources, 2004)*.

In 2008 the results of sampling conducted from 2005 to 2006 were analyzed and released. Before the 2008 305(b) cycle the Dry Run Creek watershed had been listed for both primary contact and aquatic life uses. However, do to high levels of indicator bacteria (e. coli) the stream is now listed as "not supporting" for "overall use support" and "primary contact recreation". Its listing as "partially supporting" of aquatic life use remains unchanged (*Iowa Department of Natural Resources, 2008*). Also, a new impairment cause was identified, namely "pathogens". Other tests conducted during this monitoring cycle indicated no additional impairments, though there were noted deficiencies in dissolved oxygen content, "one additional violation of the Class B(WW2) criterion for dissolved oxygen at Site 6D1 would have indicated impairment of these uses" (*Iowa Department of Natural Resources, 2008).*

3.4. TMDL

Link to Status of Total Maximum Daily Load (TMDL) Development:
A TMDL for Dry Run Creek has not yet been completed by IDNR. District and partners agree to work with DNR when a TMDL is completed. Necessary revisions will be made to the watershed management plan, desired BMPs and budget upon TMDL completion.

4. <u>Identify Pollutant Sources</u>

4.1. Stressor Identification

A stressor identification study was completed for Dry Run Creek in 2008. The goal of this study was to name the major factors contributing to the impairment of Dry Run Creek. The study identified possible causes (see Figure 4.1.3.1, Appendix B) and then used a ranking system to determine which were the greatest causes of impairment.

The three stressors identified as having the strongest impact were sedimentation of rocky substrates, decreased habitat diversity and availability, and increased storm water inputs and hydrologic alteration (*Iowa Department of Natural Resources, 2008*).

4.2. RASCAL (SVAP)

Conducted in 2005 by the Environmental Geology class at the University of Northern Iowa this study was supervised by Lynn Brant, PhD. The project objective was "to classify the geologic and geomorphic features of the stream corridor and observe specific areas of concern" (*Brandt, et. al, University of Northern Iowa, 2005*). A GIS component was also included in the study and used to map results recorded in the field (an example of a field data form can be seen at figure 3.3.2 in Appendix B).

The findings of the visual assessment inventoried predominant land use; livestock access; canopy cover; bank height, material, stability; hydrologic variability; frequency of pools; substrate; and in-stream habitat. Land use within the first 75 feet of the streambanks included 50.7% grassland or tree plantings, though it was observed that in the rural areas cropland was prevalent. Only 2.5% of the watershed had livestock access to the stream. Bank stability was found to decrease in areas of increased urbanization. Over 95% of the stream's banks were found to be composed of sand and silt, while a small amount of rocky banks were found in urban areas. More than 88% of the stream had 30% habitat opportunity or less. In addition only 20% of the stream has pool and riffle structures while only 1.39% of the stream had pools of greater than 3 foot depth. 14.76% of the stream has 75% or higher canopy cover. 71.9% of the stream substrate consisted of sand or silt, slightly higher than 10% of the channel had cobble bottoms (*University of Northern Iowa, 2005)*.

A repeat of this study is slated for fall of 2009. A partnership with the University of Northern Iowa is being pursued to conduct a study looking into the physical, chemical and biological condition of Dry Run Creek. Concerns not addressed in the initial study including the excessive e. coli throughout urban stretches of the creek will be addressed in the new assessment.

4.2. Pollutant Data Analysis

One of the primary stressors identified in the watershed was sedimentation. Sediment also reduces the availability of habitat and the diversity of substrate. According to the Department of Natural Resources "As sediment loading increases, the large and small spaces between rocks become filled with fine sediment particles, making this important habitat niche less suitable for invertebrates and fish that utilize it for feeding, shelter, spawning, and egg incubation." (*Department of Natural Resources, 2008*).

Potential sources of sediment in the watershed include: storm water runoff from construction sites and urban areas, sheet and rill erosion from agricultural fields, gully erosion, and stream bed/bank erosion.

The estimated potential sheet and rill erosion based on 2007 land cover and soil survey data is 23,114 tons/year. Using a sediment delivery ratio of 12 percent (value for the Iowan Surface land form region) yields total overland soil delivery to the stream of 2,752 tons/year. The lower reach of DRC contains the oldest sections of Cedar Falls; soil mapping data was unavailable in these 2,530 acres of the watershed. It is likely that with the exception of construction sites, very little sediment is moving in this area of the watershed. The average sediment delivery rate in the DRC watershed is 1.8 tons/acre/year. The areas of highest sediment delivery potential are construction sites located in the mid sections of the watershed, in the rapidly developing areas of Cedar Falls.

These areas of construction have the potential to contribute significantly to the sediment load of DRC, especially on a reach scale. There was approximately 500 acres of active construction in the DRC watershed during 2007. Given the rate of growth in recent years, this number is unlikely to decrease in the near future. The estimate for total sediment delivered from the 500 acres of active construction is 2.64 tons/acre/year. This accounts for over 1,300 tons of the sediment delivered to DRC on an annual basis. This means that over 47 percent of the estimated sediment contribution from upland sources is delivered from only four percent of the total area. Given the close proximity of many construction sites to DRC it is likely that these activities significantly impact the stream at a local scale.

Evidence of streambed and bank erosion in the DRC watershed is mixed. Stream bank stability and vegetative conditions in some stream reaches were rated as relatively good and in other areas they were rated as poor. Excessive bank erosion/sloughing was reported at only two of 13 (15%) rapid bioassessment sites and appeared to only be a problem at one of the two full biocriteria sampling sites. At DRC site 4, the percentage area of vertical stream bank (55-110 degree slope), which might be considered the most vulnerable to erosion and sloughing, averaged 30 percent (range: 10-50), slightly higher than the 75th percentile (27.5%) for regional reference sites. Additionally, DRC 4 had elevated levels of undercut streambank (115-180 degree slope), with an average of 10 percent, this site fell above the 47c ecoregion 75th percentile value of 2.5 percent. Streambanks along this site may be considered unprotected by vegetation as average bare bank exposure was 81%, above the 75th percentile value for the 47c ecoregion (75%). This site has heavy tree cover; average channel shading was 98 percent. It is possible that streambanks which appear bare due to lack of herbaceous vegetation may in fact be stabilized by tree roots. This would explain the higher than expected occurrence of undercutting on relatively bare streambanks. Information gathered at DRC 4 indicates that streambank erosion is a potentially significant local source of sediment. Conversely, data collected from DRC 1 showed minimal problems associated with streambank erosion. At DRC 1 the values for vertical bank, undercut bank and percent bare bank (10%, 0%, & 61% respectively) fell within or below the interquartile range for 47c ecoregion reference sites. These observations indicate that actual onsite streambank conditions are highly variable within this stream system. Information collected during the 2007 SVAP was used to assess the condition of streambanks within the DRC channel system.

An analysis of the data collected during the assessment shows the percentage of total stream length, by stream order, classified as having moderately unstable to unstable streambanks is highest in the second order sections of the stream network (66%) followed by first order tributaries (39%) and then by the main stem or third order (35%). The unstable streambanks in the second order areas have an average height of around five feet and account for roughly 30,000 ft worth of stream channel or about 19 percent of the total stream length (155,000 ft). The estimated surface area of the potentially severely eroding streambank in these areas is 300,000 ft^2. The stream length in first order tributaries classified as having unstable streambanks averaged five feet high and had a total length of roughly 35,000 ft (23% of total channel length). Using the same calculation as the second order sections yielded a total surface area of potentially severely eroding streambanks of roughly 350,000 ft^2. Unstable streambanks averaged nine feet in height along the main stem of DRC. The total surface area of these streambanks was roughly 58,000 ft^2. From a potential sediment source ranking the streambanks along the third order sections of this watershed are a relatively minor contributor.

Taken as a whole, streambank derived sediment appears to be most problematic in the first and second order tributaries of DRC. A comparison of the data from the first and second order tributaries unveils a potentially important trend. As expected, the total stream length represented by first order stream is nearly double (47%) that of second order (94,000 ft to 44,000 ft). However, the length of channel classified as having unstable streambanks only differed by five percent between the two. This indicates that the streambank derived sediment in second order sections of the stream network has a higher potential to cause localized sedimentation problems. These data displayed visually clearly show a hot spot for potentially severe streambank erosion along the east branch, specifically within sub-watersheds 1 and 4. The RBP site, DRC15, located directly downstream of this area, was observed to have the highest RBP rankings for percent embeddedness (>75%) and percent channel impacted by sediment deposition (>50%). Site DRC 15 ranked among the lowest average metric fish and average total metric scores. (IDNR, 2008)

Sediment also contributes to the bacterial impairments in the creek. According to a study conducted by the city of Melbourne, Australia increases in suspended solids can contribute to higher levels of e. coli and other bacteria by providing an increase in available substrate on which populations can grow and multiply.

Urban development data indicates that areas in and upstream of subwatersheds 4 and 8 have experienced a rapid expansion of urban land use in the last 10 years. The increased frequency of unstable streambank conditions in this area are likely a direct response to increased storm water runoff and increases in flow velocities & volumes. It is likely that expansion of the City of Cedar Falls will continue in this area of the watershed. Without widespread adoption of urban storm water Best Management Practices (BMP's) in this rapidly urbanizing area, geomorphic condition in the south east branch will likely continue to degrade, further stressing in-stream biota.

Increases in urban storm water inputs has the effect of creating a flashy hydrology which peaks and falls quickly during rainfall events (*Iowa Department of Natural Resources, 2008*) as shown in Figure 4.2.1 (*Iowa Department of Natural Resources, 2008*).

Figure 4.2.1

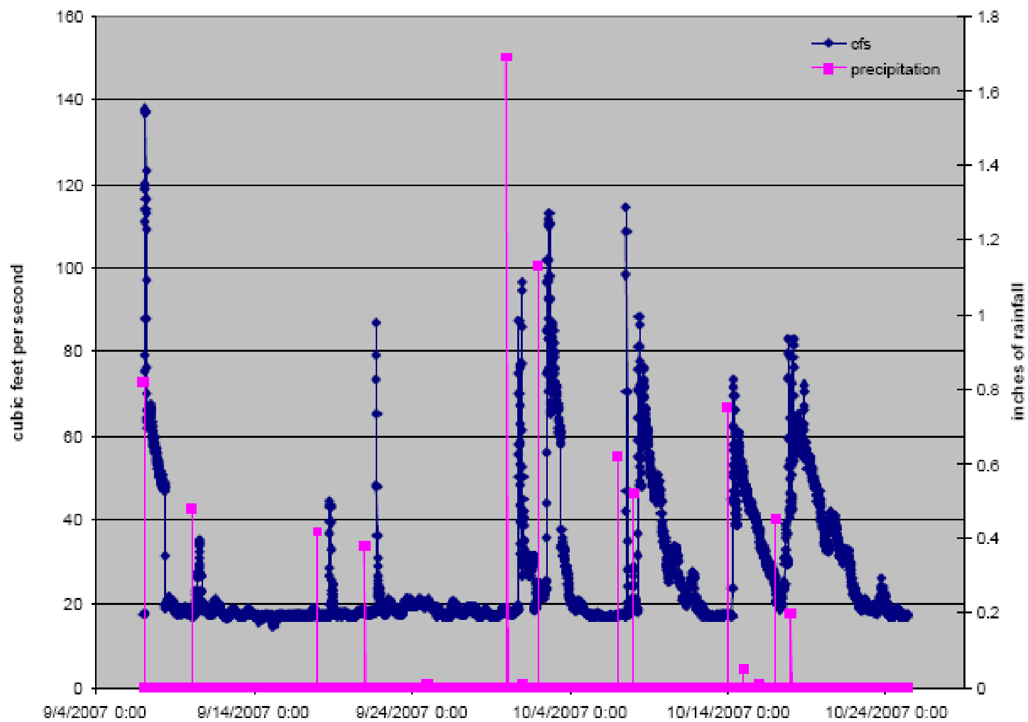


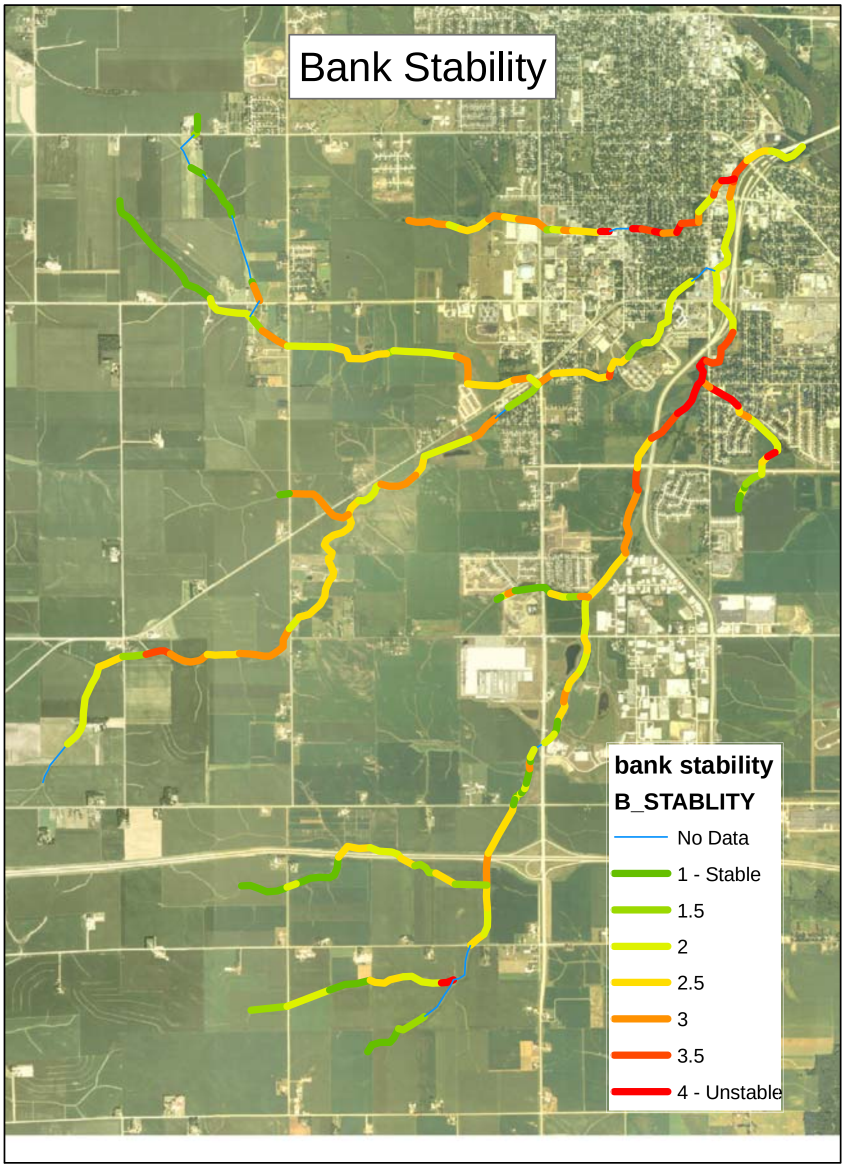
Figure 7 Response of stream stage to rain events

Preliminary modeling performed by the Iowa Department of Natural Resources using the Soil Water Assessment Tool (SWAT) indicated base flows were lower than would be expected in the Dry Run Creek Watershed, illustrating the fact that, with progressing urban development, an increasing amount of stormwater is being input from fast moving drainage systems and direct runoff while less is reaching the creek through slow-moving groundwater sources.

The impact of these increased flows is the creation of excessive scour and changes in the physical character of the stream. According to the DNR "Increases in peak velocity will result in changes in channel geomorphology. Typical reactions include channel incision (bed degradation) followed by channel widening (streambank sloughing/erosion)" (*Iowa Department of Natural Resources, 2008*).

This relationship seems to be collaborated by the mapping results of the stream channel analysis conducted by the University of Northern Iowa. While we do not have sufficient data to directly analyze the relationship between areas of high storm sewer inputs and bank instability we can see that bank instability tends to be most prevalent in urban areas (See Map 4.2.1.) (*University of Northern Iowa, 2005*).

Map 4.2.1 Watershed Bank Stability



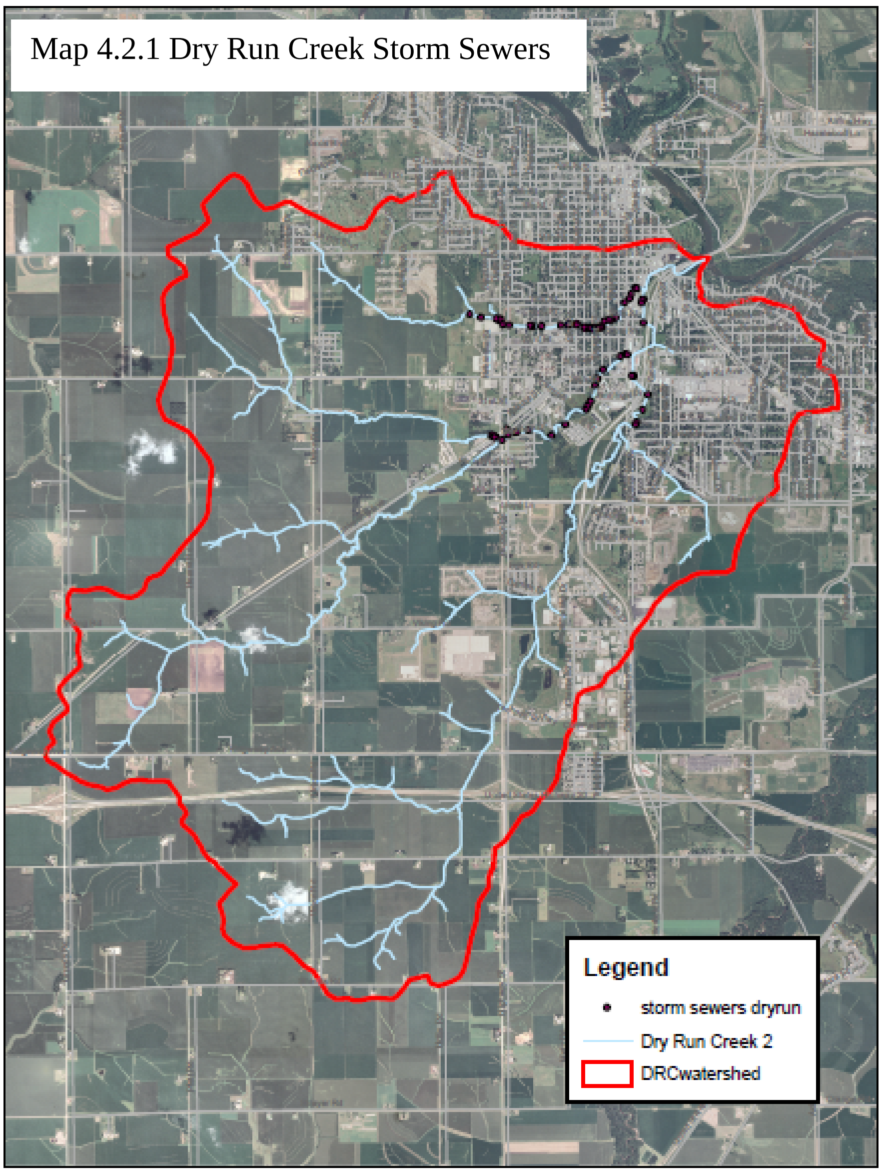
The impacts of urban storm water inputs are not limited to hydrologic alteration and sediment loading, however, they also affect the biota directly.

> "Increases in stream flow velocities directly impact biota through increased hydraulic scour of benthic surfaces. Organisms exposed to these shear forces may be dislodged and transported downstream, experience stresses that

reduce reproduction and feeding efficiency, or may suffer from direct mortality" (*Iowa Department of Natural Resources, 2008*).

Sources for increases in stormwater inputs expand each year as new areas are developed and added to the storm sewer systems existing in the watershed. A great many stormsewer outlets and outfalls are identified in map 4.2.1. Though the stormsewer flow is not explicitly defined for each branch one can observe that stormsewer outlets predominate in the University and Southwest Branches of Dry Run Creek. This is illustrative of the impact these systems can have on the stream's flow patterns.

Dry Run Creek Watershed Storm Sewers



Map 4.2.1 Dry Run Creek Storm Sewers

The last identified pollutant, e.coli will require further study in order to identify its exact sources. Genetic or fluorescence testing will be required to determine if the bacteria is stemming from human or animal sources. One likely source of bacteria is fecal matter from urban wildlife. Canada Geese, raccoons, rats, and birds nesting under overpasses are possible contributors. This could account for the widespread distribution of e. coli contaminations, which affect all four branches of Dry Run Creek in the urban portion of the watershed.

Another potential source is agricultural waste. While livestock operations are not a prominent land use in the watershed several sites were noted that did have pastureland within 75 ft. of the creek banks and in some areas livestock did have direct access to the creek. Nutrient inputs from row crop fields may also serve to bolster bacterial populations, though this is largely unsubstantiated due to the relatively low levels of sheet and rill erosion in the watershed's cropland.

One possible point source of bacteria is the unsewered community located on Main Street near the East Branch of Dry Run Creek. Unmaintained or leaking septic systems could explain the extreme readings seen on this branch.

Previously discussed issues with high sediment are also likely contributors to high e. coli levels. Excessive amounts of suspended sediment can result in higher e. coli populations by providing additional substrate on which colonies can grow and multiply.

Due to the limited amount of information regarding the bacterial impairment in the Dry Run Creek watershed the management of bacteria will not be discussed in further detail. Once the TMDL has been completed for bacteria, the watershed management plan will be updated to include additional goal and objectives in relation to the bacteria impairment.

5. <u>Goals and Objectives</u>

5.1. Statement of Goals

Project Goals and Objectives:
In order to reduce the identified water quality issues on Dry Run Creek, the Black Hawk SWCD proposes the following objectives:

1. Treat the runoff from the initial 1.25" of rainfall events in urban areas of the watershed. Initially these target areas will focus around the impaired stretch of the Southwest Branch. The targeted areas will be expanded and refined based on the completion of TMDL studies for both the bacterial and biological impairments. Treatment will be achieved using infiltration based BMPs.

2. Reduce sediment by 30 percent delivered to the streams. This project proposes to use a variety of BMPs to reduce the sediment delivery. Most of the sediment reaching the stream is from stream bank and sheet and rill erosion during rainstorms of one inch or greater during critical times of the year.

   Urban efforts to reduce sedimentation will include streambank stabilization projects completed in critical areas of bank instability which were identified as a major contributor to stream sedimentation, as well as traditional rural erosion control structures such as terraces, conservation tillage and grassed waterways.

   Construction site erosion is also having a significant effect on stream sedimentation. The project will address this concern through its information and education program. Special attention has been and will be paid to discuss topics ranging from stormwater pollution prevention plan (SWPPP) development and implementation to construction site best management practice design to local NPDES regulations and stormwater ordinances.

3. Improve/protect instream habitat along 25 percent of the stream corridor.
   In rural and low-flow areas these practices will consist mainly of buffer strips installed along the creek with stabilization practices where warranted. Urban areas may be treated with streambank stabilizations, riparian tree and shrub plantings, and pool and riffle structures being installed in areas where channels are unstable or habitat is lacking.

4. Conduct an extensive information and education program to increase stakeholder awareness on the impacts of their land use decisions on local natural areas and to inform them of programs and practices available to them. Further information regarding the proposed information and education programs can be found in section 7.

5.2. Best Management Practices

5.2.1. Practices needed to protect water quality:

Since the DNR’s stressor identification study indicated that the problems facing Dry Run Creek were largely hydrological the first priority of the project will be to reduce the rate and volume of stormwater entering the creek. This will be done largely through infiltration practices. The infiltration practices used will depend on predominate land use in the area of treatment.

In residential communities where green space is relatively abundant green infiltration practices such as raingardens, biocells and bioswales will be used. The total area of residential land use in the Dry Run Creek watershed is approximately 3,557.75 acres. With an estimated rate of imperviousness of 62%, this yields a total impervious area of 2,205.8 acres. Given that the treatment area for infiltration practices aimed at treating the first flush of stormwater is 10% of the impervious drainage area the total area of green infiltration practices required to treat this land use is 220.58 acres.

In industrial, commercial and institutional lands greenspace is more restrictive. Thus, the practices used for infiltration in these areas will be ones which require minimal greenspace and can be implemented in hardscape areas. Practices such as permeable paving and biocell islands will be main method of treatment for these land uses. While biocell islands are preferred due to their aesthetic value and ability to draw attention to the project and practices, they are impractical in some industrial areas where large equipment will need to be maneuvered in the hardscape areas. In addition, there is a minimum parking area standard assigned for all commercial properties based on the square footage of the business complex. In some areas, biocell islands could not be implemented without removing some of the parking area needed to meet this minimum. For this reason, it is estimated that pervious parking will make up a slight majority of approximately 70% of the required treatment area and a total of 97.12 acres of treatment. Approximately 39.61 acres of biocell islands are also planned throughout the watershed.

While urban areas and their impervious surfaces are the most significant acre-by-acre contributor to the hydrological problems facing Dry Run Creek, an estimated 65% of the watershed remains in rural land uses. These areas have low levels of imperviousness, however the extensive tile drainage systems in place in today's farmsteads ensure that rainwater falling on these lands reaches the creek far more quickly than it would have in predevelopment times. Given the extent of land in agricultural use these areas cannot be ignored entirely in our efforts to reduce the volume of peak flows in the impaired areas of Dry Run Creek. Most rural branches of Dry Run Creek are treated by detention basins prior to their entry into urban areas. This practice helps to create a buffer to prevent the large areas of rural drainage from contributing greatly to urban peak flows during major rain events (typically these practices are designed to detain water from 10 year rain event or larger). Currently the West Branch, which drains all of subwatershed 6, has no such practice implemented. A detention basin to detain waters from this subwatershed is therefore recommended as a BMP to be implemented in partnership with the City of Cedar Falls.

Another potential contributor to the biological impairment in Dry Run Creek is the excessive sedimentation of the stream's waters. A great deal of this sediment is assumed to be runoff from construction sites in areas of development. The district has no regulatory authority with which to enforce city NPDES regulations for construction sites, nor will it contribute funds towards the implementation of the construction site BMPs which are currently required by city mandate. However, as discussed previously this source is and will be addressed through the project's information and education program which has a strong focus on construction site erosion and sediment control.

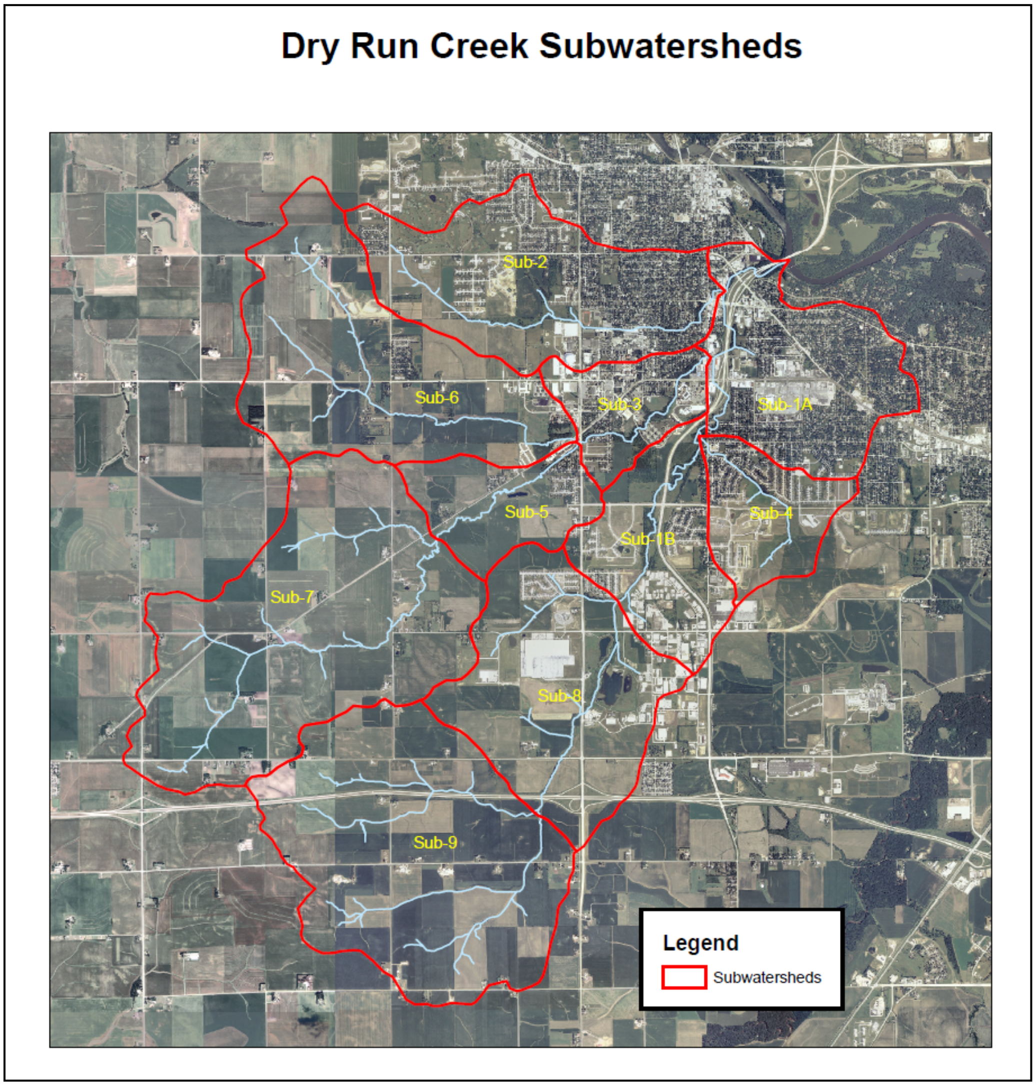
Erosion from streambanks is another significant source of sediment within the creek. Areas of bank instability were identified and mapped as part of the 2005 SVAP study. These areas are generally found in the urban reaches of the watershed and are most common on the East Branch. The total lineal footage of streambank stabilization required to treat these areas is 12,282.5 ft.

Rural areas of Dry Run Creek will also require treatment over the life of the project. In an effort to reduce sediment delivery and runoff from these sites practices such as conservation tillage and grassed waterways will be used, along with filter strips in key areas where sediment is determined to be reaching the creek. It is estimated that 25% of the rural land area will require treatment through these methods, for a total of 52.5 acres of filter strips, 346.47 acres of conservation tillage and grassed waterways for HEL (highly erodible land) areas, and 2,040.96 acres of conservation tillage and grassed waterways for NHEL (non-highly erodible land) areas.

For the sake of implementation scheduling and consideration of resource needs the aforementioned BMPs have been divided by subwatersheds (see map 5.2.2.1) based on the land uses in those areas and are described in detail below.

The areas which are considered below are based on the lands in their current use. Future development is not taken into consideration in this document due to the expected passage of the City of Cedar Falls' Post Construction Ordinance. Should this ordinance pass, in all areas of new development post-construction runoff will not be allowed to exceed pre-construction runoff and the first flush of 1.25" of rainfall from a given rain event must be infiltrated on site. This allows us to focus our urban efforts solely on areas which are Currently developed and in need of retrofitting.

Map 5.2.2.1

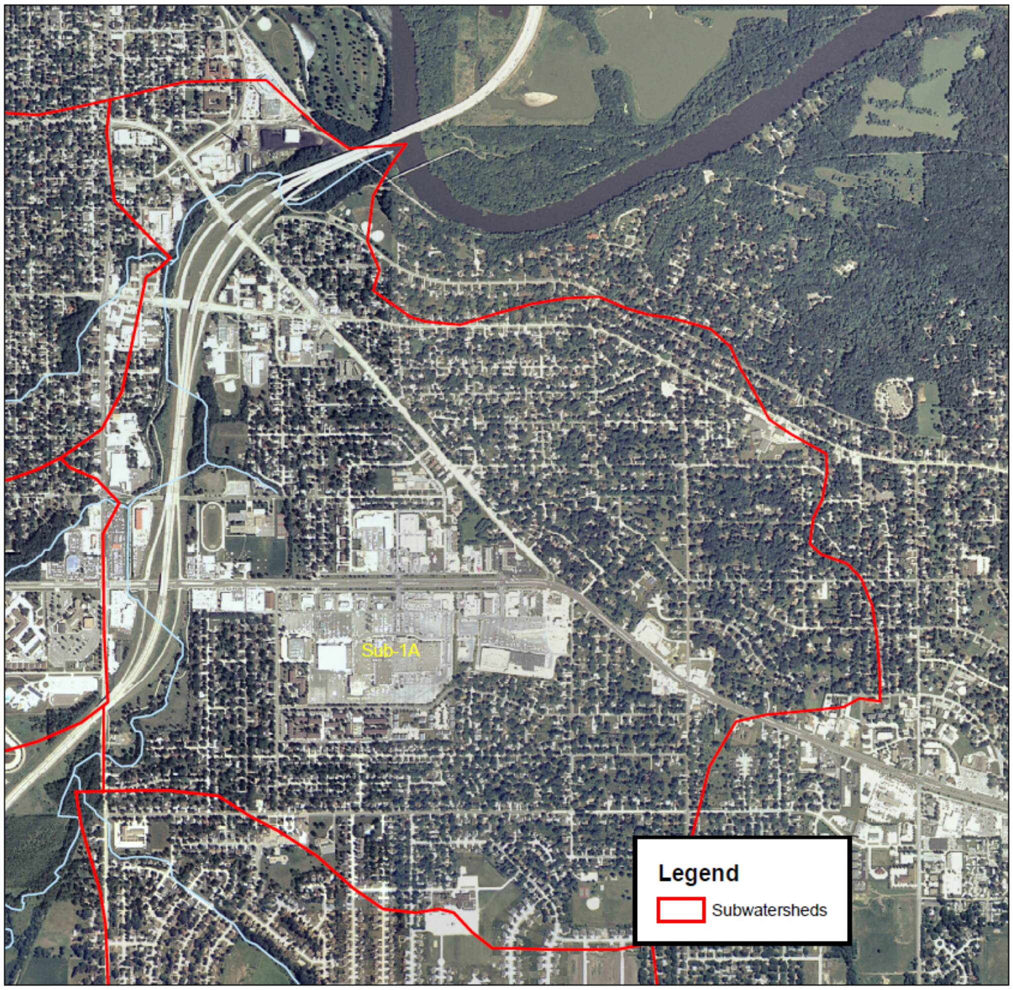


Subwatershed 1A:

Subwatershed 1 was broken into two separate subwatersheds for the sake of prioritizing the areas of drainage and scheduling the implementation of BMPs. Subwatershed 1A (Map 5.2.2.2) drains a total of 1,316 acres and contains 479 acres of commercial or industrial property and 836.95 acres of residential property. The treatment needs for infiltration practices in this subwatershed total 32.83 acres of permeable pavement, 14.1 acres of biocell islands, and 51.89 acres of green infiltration practices.

In addition to the necessary infiltration practices, a total of 2,357 ft. of streambanks in this subwatershed were designated as being unstable and will need to be stabilized through regrading, seeding, and, where necessary, armoring.

Map 5.2.2.2 **Dry Run Creek Subwatershed 1A**

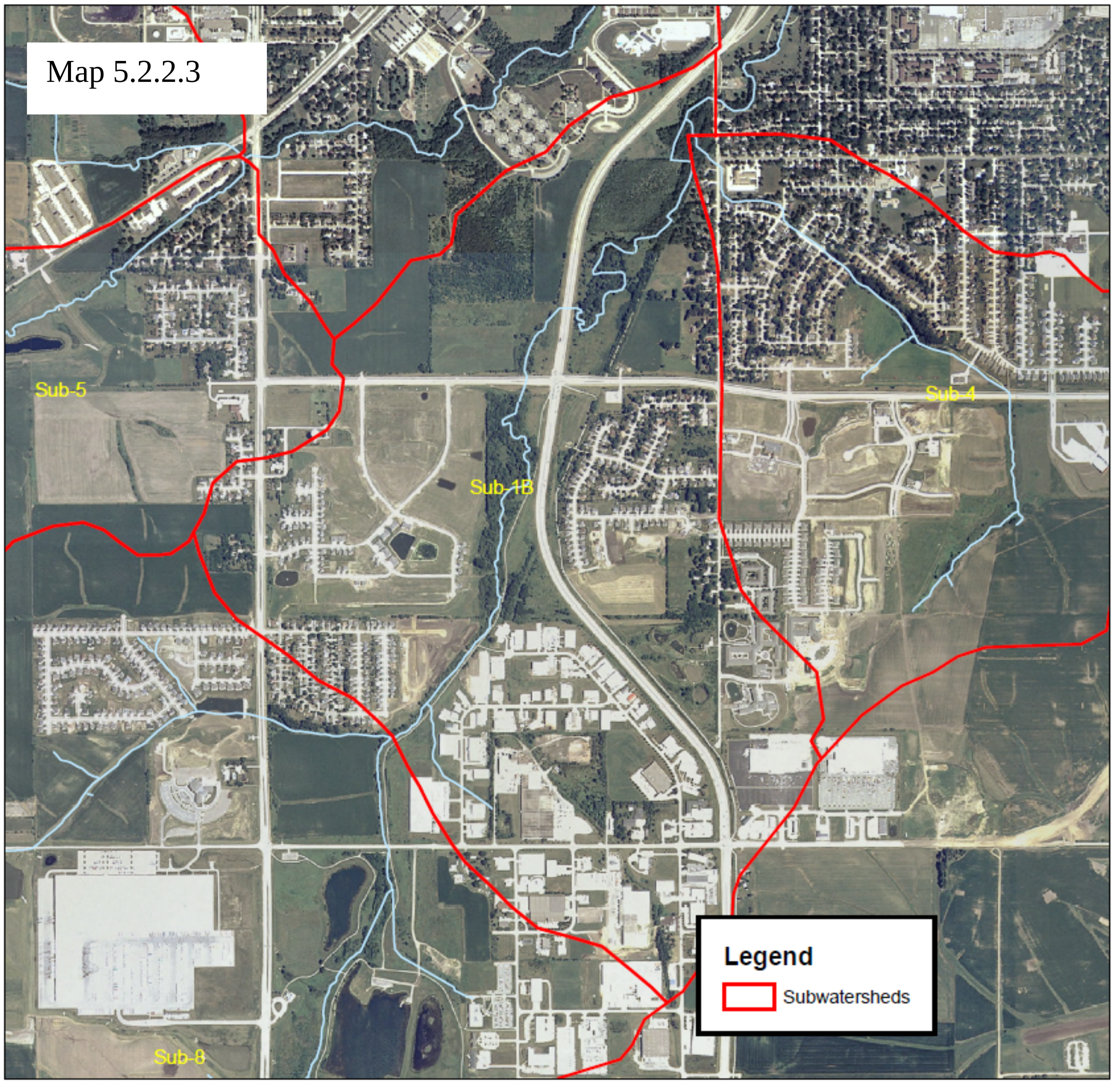


Subwatershed 1B:

Subwatershed 1B (see Map 5.2.2.3) is the area of subwatershed 1 that lies west of subwaershed 4. This subwatershed contains 162 acres of residential land, requiring 10 acres of green infiltration practices. Additionally, this is an area of heavy industrial activity, with 304 acres of industrial lands, which will require 17.6 acres of permeable pavement and 7.5 acres of biocell islands to treat.

This subwatershed also has the greatest lineal footage of unstable banks of any subwatershed, with 4,229.5 ft of unstable banks which will require treatment to minimize sedimentation.

Dry Run Creek Subwatershed 1B



Subwatershed 2:

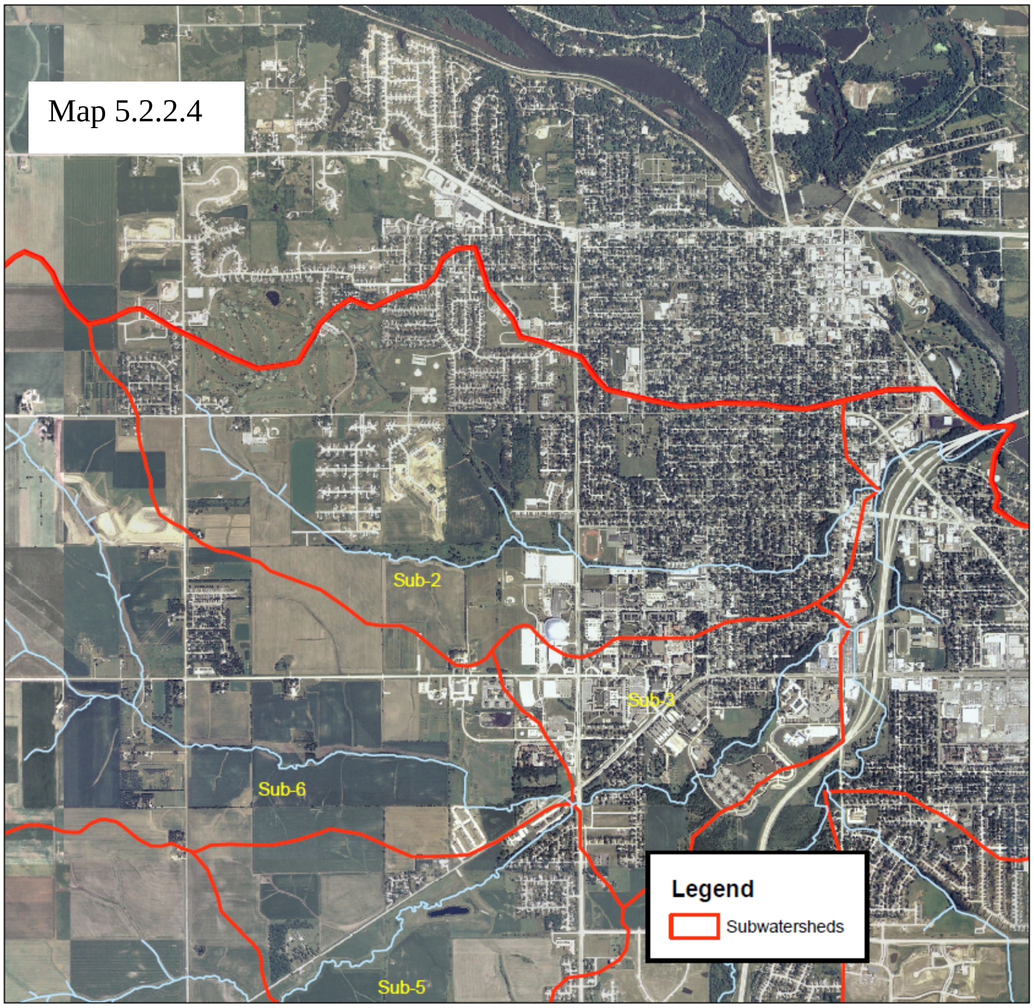
Subwatershed 2 (see Map 5.2.2.4) is the northernmost subwatershed in Dry Run Creek and has a total area of 1,762 acres with 13.3 acres of commercial/industrial, 876 acres of residential, 728 acres of rural or undeveloped and 145 acres of institutional lands, which are owned primarily by the University of Northern Iowa.

Infiltration treatment of this subwatershed will require 54 acres of green infiltration practices for the residential areas, 4 acres of biocell islands, and 9 acres of permeable paving.

A total of 1,987 feet of unstable banks are present and will require stabilization.

Lastly, with 728 acres of rural lands, agricultural or rural practices will be needed to treat this subwatershed. Very little HEL is present in subwatershed 2, with only 5.63 acres of HEL conservation tillage and grassed waterways being needed, however there is a great deal of untreated NHEL land requiring 176.37 acres of conservation tillage and grassed waterway implementation. An additional 3.93 acres of filter strips will be required to prevent agricultural erosion from reaching the stream.

Dry Run Creek Subwatershed 2



Subwatershed 3:

Subwatershed 3 (see Map 5.2.2.5) sits east of the confluence of the Southwest and West Branches of Dry Run Creek. It is among the most developed subwatersheds in Dry Run Creek, with 258 acres of institutional lands belonging mostly to the University of Northern Iowa and Nazareth Lutheran Church. The subwatershed also contains 258 acres of residential lands and 82 acres of undeveloped land.

The infiltration treatment of these lands will necessitate the implementation of 13.33 acres of green infiltration practices, 6 acres of biocell islands and 14 acres of permeable pavement.

Additionally, 719 lineal feet of unstable banks are present in this subwatershed which will require stabilization.

The undeveloped lands in this subwatershed do not currently require treatment aside from necessary stabilization work as there is no land use in them which is damaging the creek.

Dry Run Creek Subwatershed 3

Map 5.2.2.5

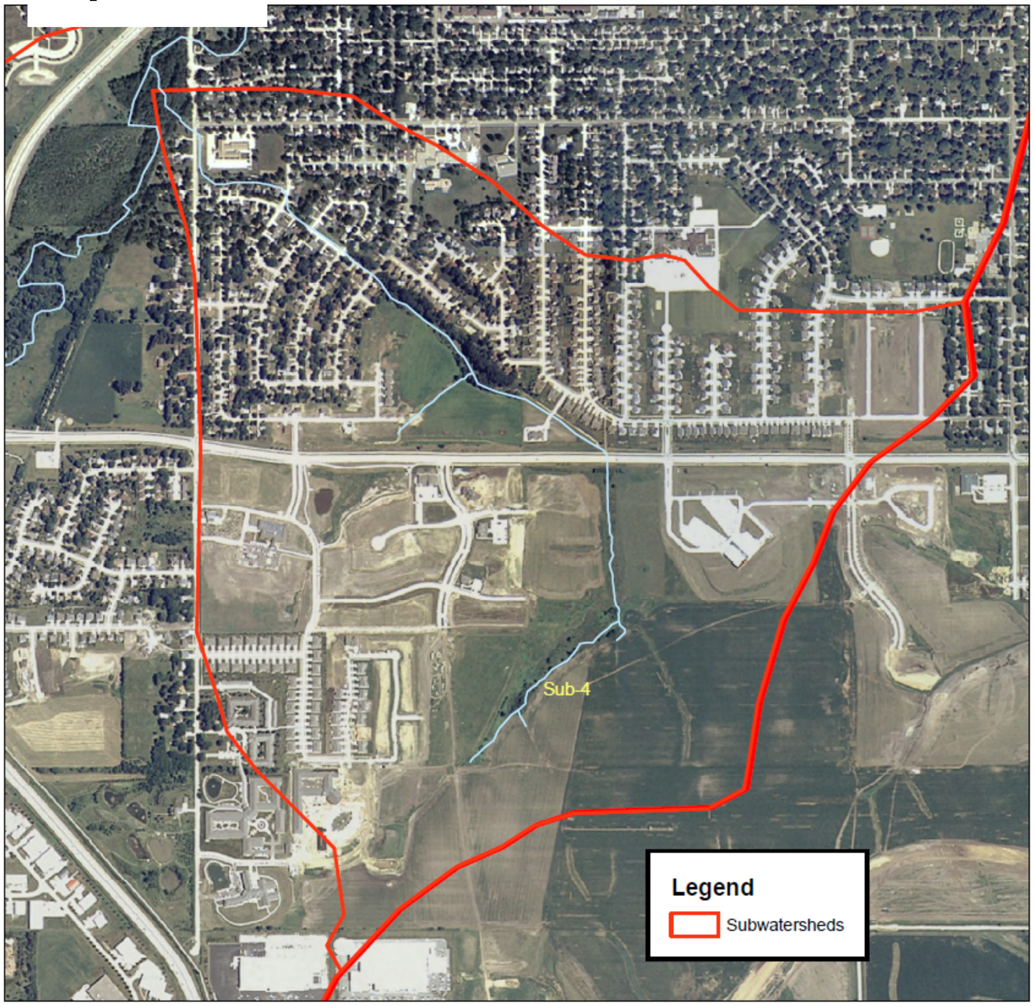
Subwatershed 4:

Subwatershed 4 (see Map 5.2.2.6) has seen a very high rate of development over the last decade. The majority of this development has been residential in nature. The subwatershed currently contains 74 acres of institutional lands, consisting primarily of a student housing development owned and operated by the University of Northern Iowa. In addition to these institutional lands, there exists within the watershed 386 acres of residential lands. The total impervious land area within this subwatershed is approximately 299 acres. Treatment of this surface through infiltration practices will require 24 acres of green infiltration practices, 1.8 acres of biocell islands and 4.2 acres of permeable pavement.

Aside from the needed infiltration practices there exists 1,782 ft. of unstable banks in subwatershed 4 which will require stabilization to control bank erosion and reduce sedimentation.

Dry Run Creek Subwatershed 4

Map 5.2.2.6



Subwatershed 5:

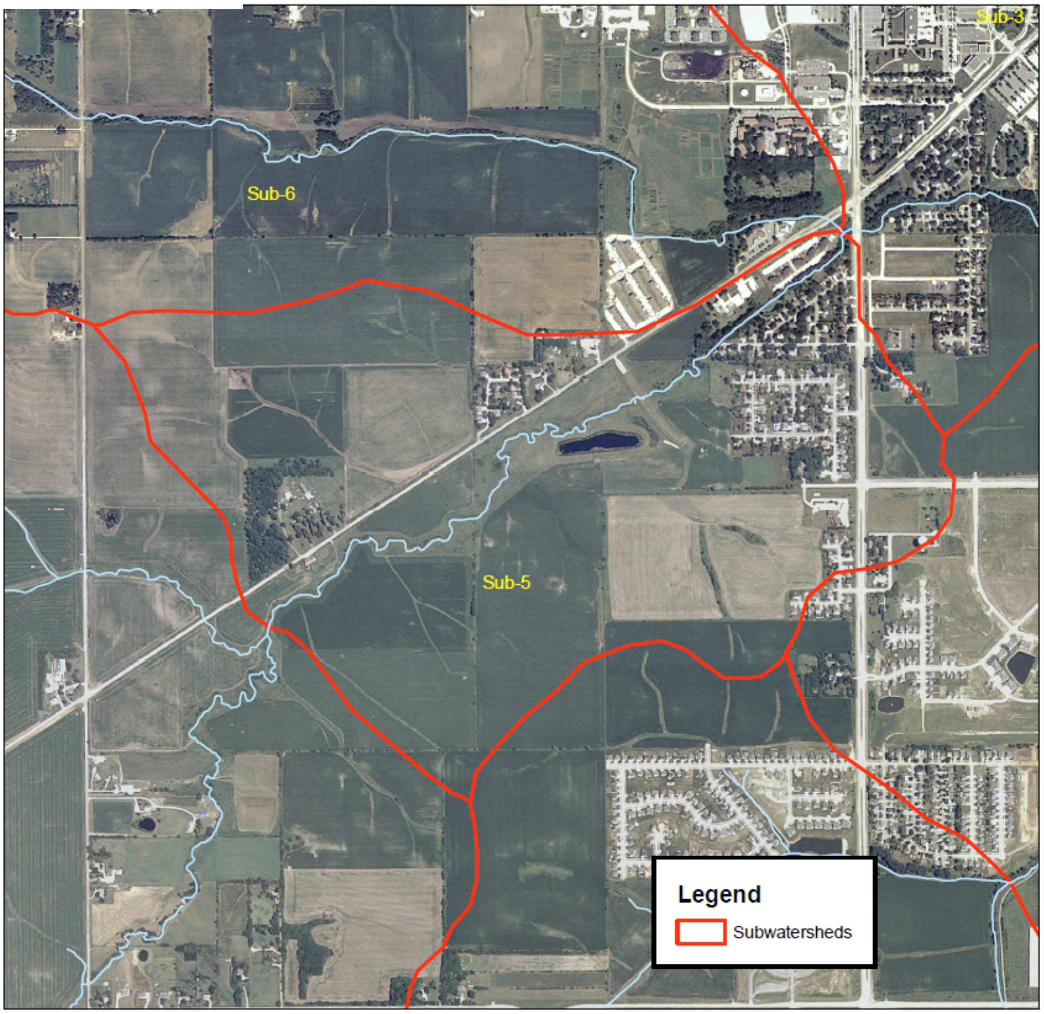
Subwatershed 5 (see Map 5.2.2.7) contains a large stretch of the Southwest Branch west of the confluence of the West and Southwest Branches of Dry Run Creek. This area is likely to see development in the near future. Currently, the primary land use in this subwatershed is agricultural, containing 565.8 acres of cropland. There is also 91.7 acres of residential lands consisting of housing developments and apartments. The residential lands within the subwatershed will require 5.68 acres of green infiltration practices.

The agricultural lands will constitute the bulk of the work required here, with 2.24 acres of filter strips required to reduce rural sediment delivery in addition to 92.68 acres and

48.77 acres of conservation tillage and grassed waterways for NHEL and HEL lands, respectively.

Dry Run Creek Subwatershed 5

Map 5.2.2.7



Subwatershed 6:

Subwatershed 6 (see Map 5.2.2.8) is among the largest of the creek's subwatersheds, draining a total of 2,082.5 acres of land and containing the entire West Branch. The land use is mostly agricultural, with 1,957.5 acres of cropland drainage being handled. There are also limited amounts of developed land use, including 74.7 acres of residential development and 5 acres of institutional and industrial lands, containing the westernmost area of the University of Northern Iowa campus and the university's powerplant.

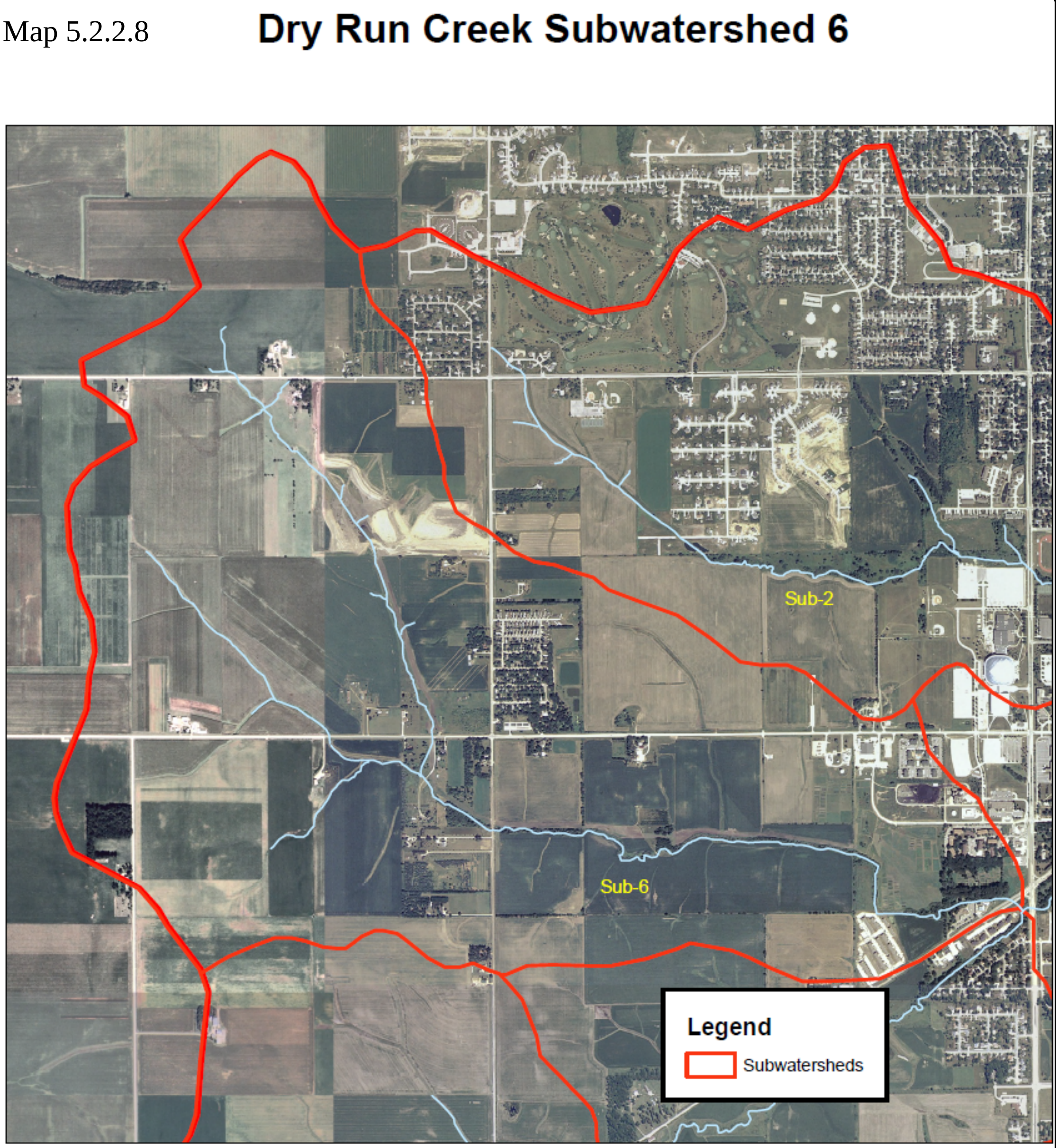
The residential area of 74.7 acres contains 46.3 acres of impervious surface (62% imperviousness) and will require 4.6 acres of green infiltration practices. The remaining 5 acres of industrial treatment will likely be rendered entirely with permeable pavement, since the heavy machinery used in these areas may have difficulty maneuvering around biocell islands.

Subwatershed 6 also contains 34% of the total HEL acreage contained within the Dry Run Creek watershed. With 354 acres of HEL land, there will be a required 88.48 acres of HEL grassed waterways and conservation tillage practices and an additional 400.89 acres of NHEL grassed waterways and conservation tillage.

With over 24,530 lineal ft. of rural stream channel an estimated 9.29 acres of filter strips will require implementation. Subwatershed 6 requires no stream reaches which have been identified as having unstable banks, therefore streambank stabilization projects are not anticipated for this area.

Lastly, Dry Run Creek's West Branch, which exists wholly in subwatershed 6, is the only rural branch of Dry Run Creek not currently treated with a detention basin before it reaches the urban lands. This allows large volumes of water to enter into the impaired reach of the Southwest Branch during rain events. It is desirable to see a detention basin built in this location which could help to reduce the damage done by these major storm events.

Map 5.2.2.8

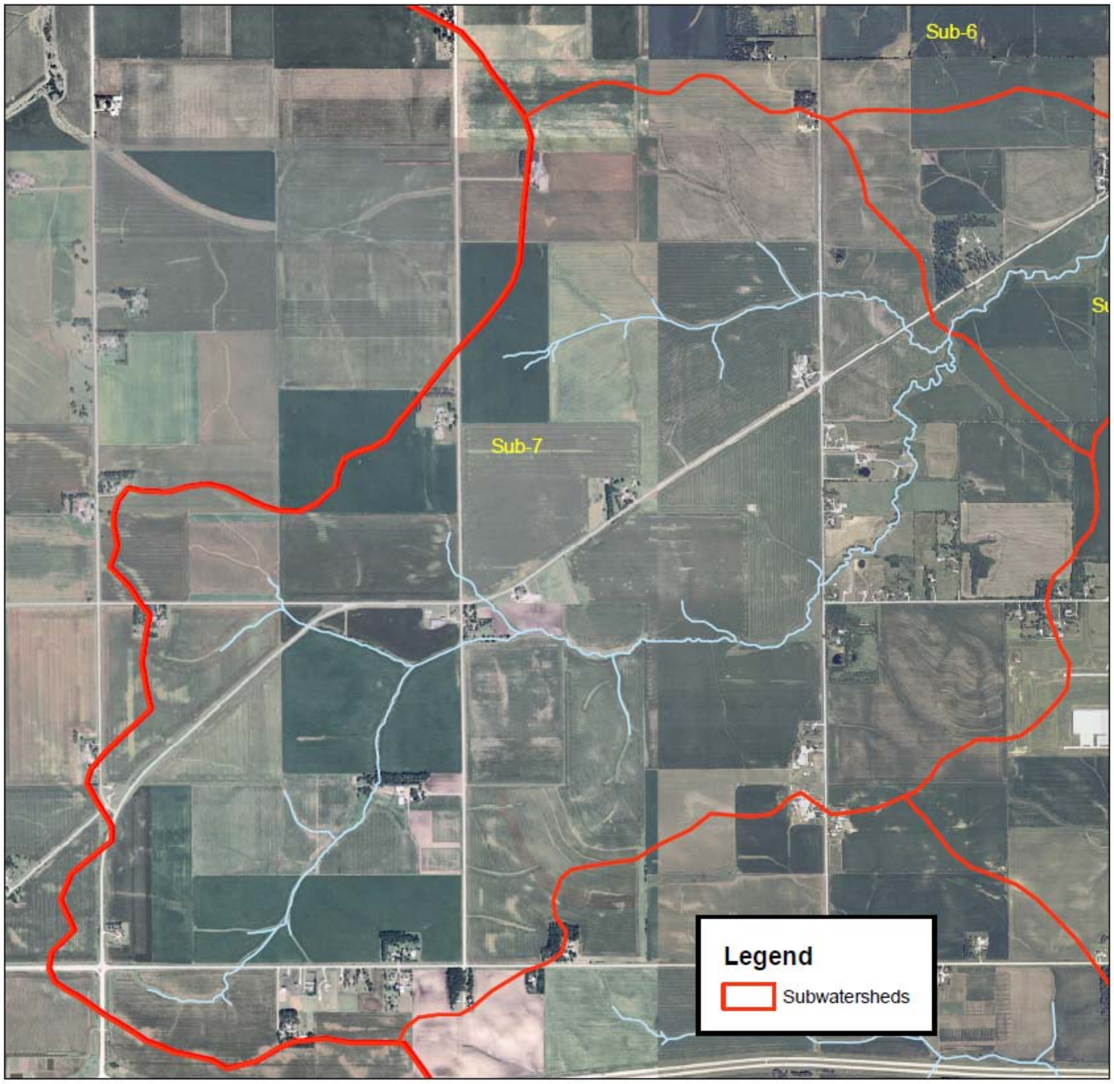


Subwatershed 7:

Subwatershed 7 (see Map 5.2.2.9) consists entirely of rural land, much of which is in agricultural production. Most of this land is considered NHEL. This watershed does also contain a great deal of rural stream channel with nearly 38,000 lineal ft. Considering the 25% treatment estimate 14.38 acres of filter strips will be necessary in order to help reduce the amount of rural sediment delivery. The subwatershed will require 44.8 acres of HEL waterways and conservation tillage and an additional 647.74 acres of NHEL conservation tillage and grassed waterways.

Dry Run Creek Subwatershed 7

Map 5.2.2.9



Subwatershed 8:

Along with subwatershed 4, subwatershed 8 (see Map 5.2.2.10) is among the fastest developing areas in the watershed. It contains the majority of the Cedar Falls Industrial Park and will likely see further development in the near future. The total area of this subwatershed is 1,747.5 acres. This includes 210.7 acres of industrial, 96.13 acres of residential lands and 1,440.7 acres of rural or undeveloped land.

The total impervious surface from industrial areas of this subwatershed equals 206.49 acres. This necessitates 20.7 acres of infiltration based BMPs to be broken into 14.49 acres of permeable pavement and 6.21 acres of biocell islands.

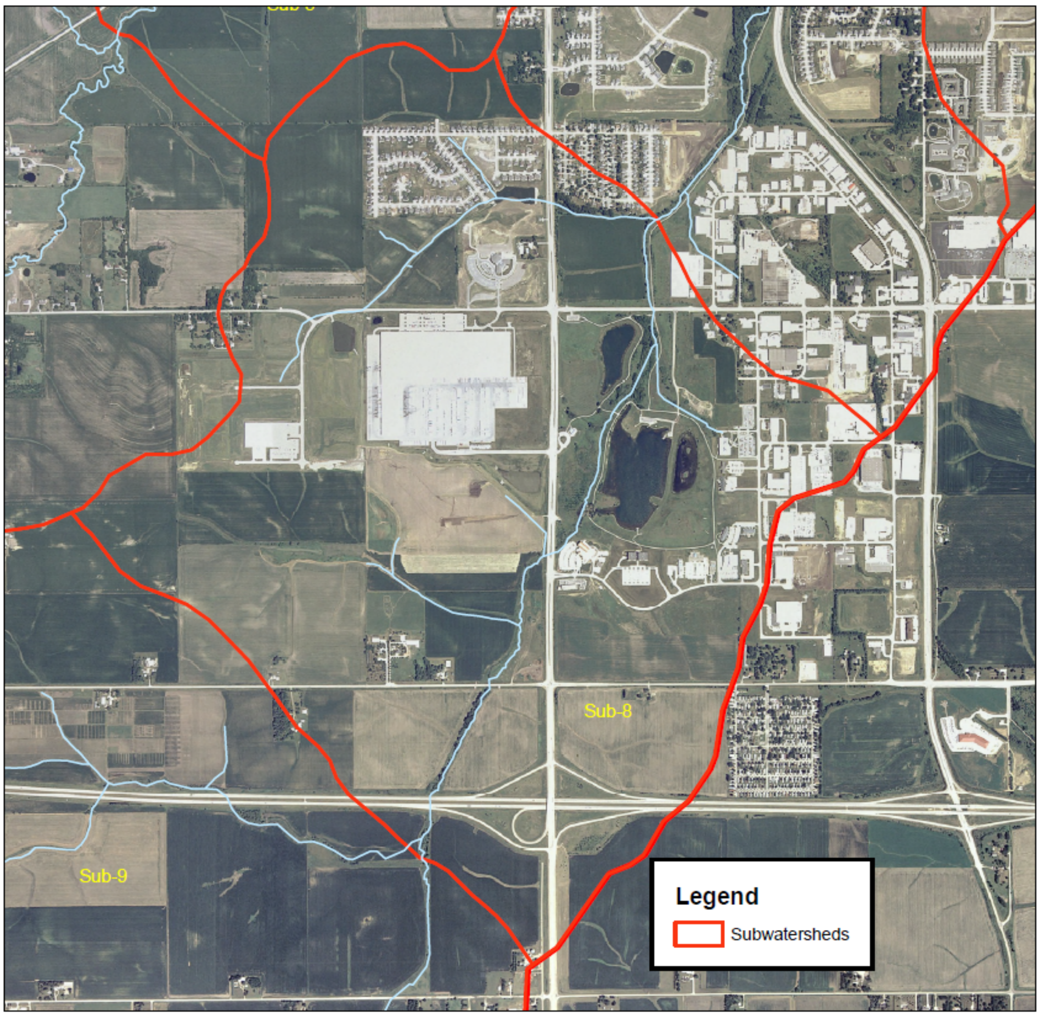
The residential lands in this subwatershed contribute an additional 59.6 acres of imperviousness and will require roughly 5.96 acres of green infiltration practices in order to treat.

In addition to the infiltration practices, this subwatershed contains 14,571 ft. of rural stream channel which will require approximately 5.52 acres of filter strips.

Lastly, the subwatershed contains both HEL and NHEL cropland. This will require 143.92 acres of NHEL grassed waterways and conservation tillage and an additional 73.25 acres of HEL ground will require the same practices. This will be used to treat the approximately 868.68 acres of land in crop. The remainder of the rural or undeveloped land is set aside either for future development or for the detention basin in this subwatershed used to treat the East Branch's upstream rural areas.

Dry Run Creek Subwatershed 8

Map 5.2.2.10



Subwatershed 9

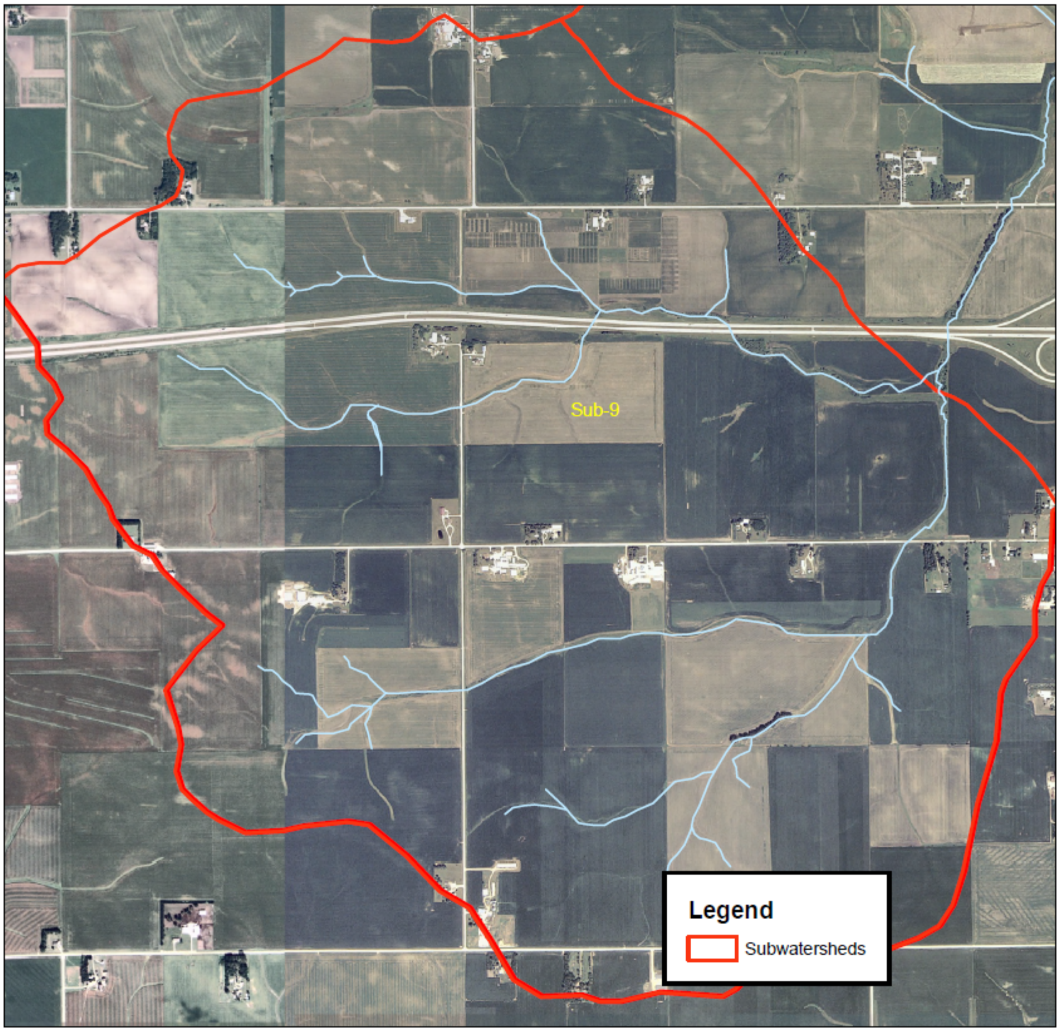
Subwatershed 9 (see Map 5.2.2.11) is the southernmost subwatershed of Dry Run Creek. It is comprised solely of agricultural land uses and contains 45,238 lineal ft. of rural stream channel. Treatment of 25% of this channel length will require 17.14 acres of filter strips.

The subwatershed will also require 85.54 acres of conservation tillage and grassed waterway treatment for the HEL lands and 579.36 acres of conservation tillage and grassed waterways for NHEL land.

Lastly, 386 lineal ft. of stream in this channel has designated unstable banks. These areas will require streambank stabilization to reduce the amount of sediment delivered to the stream.

Dry Run Creek Subwatershed 9

Map 5.2.2.11



5.3. Implementation Schedule of total watershed needs

For the purposes of this document, the schedule will be created by weighing known data regarding the contributions of each subwatershed to each of the two identified impairments within the watershed. For instance, subwatershed 1A contributes a great deal of impervious area to the reach of stream which is biologically impaired. Since hydrologic change was identified as a primary stressor for this impairment, and since subwatershed 1 also contains some of the highest values for e. coli levels, this subwatershed would be considered a high priority and implementation for this subwatershed would be sought with the first round of projects. The subwatersheds were grouped according to their relative impact on the impaired stream reaches and were then organized into three phases which, considering funding, workload, willingness of stakeholders and the strength of local regulations were estimated to last 30 years each, or 20 years in the case of Phase 3, since much of the implementation proposed for Phase 3 will be conducted through state and federal cost share programs and it will therefore be progressing simultaneously during the implementation of Phases 1 and 2. The phases were then further divided into 10 year increments according to feasible implementation rates.

While the schedule will be based on these rankings and will call for focus on these areas during the designated time frames, opportunities outside of these identified subwatersheds will be considered on a case-by-case basis as they present themselves. If, for example the schedule suggests that efforts be focused on subwatershed 3 during a designated period of time and an opportunity to retrofit a large commercial parking lot in subwatershed 1A, or a large institutional parking lot in subwatershed 2 these opportunities should not be swept aside since they may not present themselves for another 30 years (life of the parking lot).

The designated timeframes for working within the given areas are based on estimates of what can realistically be accomplished in a given year. This is difficult to estimate due to the pending legislation within the City of Cedar Falls. Should this legislation pass it would require local businesses and institutions to modify their plans when they are replacing a given impervious surface (i.e. a parking lot) to infiltrate the first flush of stormwater. The reactions from local institutions could be varied and range from some looking to replace these structures quickly in the hopes of securing grant assistance to others putting off necessary repairs as long as possible to delay the added expense. While it is impossible to know which of these attitudes will be more prevalent the process of developing this schedule and estimating the funding required to complete the suggested practices within this plan has brought to light several realities which must be acknowledged.

First, the willingness of stakeholders within the watershed to invest in the additional expense of hydrologically sustainable practices, and through this willingness the demand for grant dollars, varies greatly depending on external economic conditions and public opinion. Due to this variability, it will at times be impossible to secure sufficient grant funding to meet the demand within a given period of time. For this reason, some of the work within the watershed has been and will be completed without contributions on behalf of the district.

Second, these same fluctuations which may lead to excess demand in some timeframes may also lead to a lack of demand in others. This, coupled with the flexibility needed to address opportunities as they present themselves, emphasizes the fact that this management plan must be considered a living document which will be amended as new information and opportunities are revealed.

The total project has been broken down into phases based on prioritization of subwatersheds. This information is presented below:

Table 5.3.1 Implementation Schedule and milelstones:

		Total		PHASE 1			PHASE 2		PHASE 3	
objective 1	**Infiltrate a 1.25" rainfall in urban areas**		2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2060-2070	2070-2080	2080-2090
	Green infiltration (acres treated)	220.58	23	30	16.82	29.3	29.3	29.3	33.5	33.5
	Biocell Islands (acres treated)	39.61	6.7	6.7	6.7	4.4	4.4	4.5	3.21	3
	Pervious Paving (acres treated)	97.04	17.25	17.25	17.25	10.3	10.3	10.3	9.71	9.71
	Detention Basin (number installed)	1	0	1	0	0	0	0	0	0

objective 2	**Reduce sediment delivery by 30%**									
	Conservation Tillage/Grassed Waterways NHEL (acres)	1806.16	55.4	55.4	55.4	58	58	59	814.5	814.5
	Conservation Tillage/Grassed Waterways HEL (acres)	831.63	118	118	118	5.63	0	0	412.5	412.5
	Filter Strips (acres)	26.25	0	0	0	0	0	0	12.25	12
objective 3	**Improve streambank habitat along 25% of the stream**									
	Streambank Stabization (ft)	12282.5	1025	1025	1026	2666	2666	2666	603	604
	Filter Strips (acres)	26.25	0	0	0	0	0	0	12	12.25
objective 4	**Conduct an extensive I&E program**									
	See Section #7									

Table 5.3.2. Sediment Loading Reductions by Milestone (All Figures Listed in Tons)

	Phase 1			Phase 2			Phase 3		**Total**
	2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2060-2070	2070-2080	2080-2090	**2010-2090**
NHEL	7	7	7	7	7	7	97	97	236
HEL	42	42	42	2	0	0	148	148	424
Streambank Stabilization	144	144	144	373	373	373	84	85	1720
Filter Strips	0	0	0	15	0	0	90	91	196
Total	193	193	193	397	380	380	419	421	**2576**

Table 5.3.3. Runoff Reduction by Milestone (All Figures Listed in Millions of gallons)

	Phase 1			Phase 2			Phase 3		**Total**
	2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2060-2070	2070-2080	2080-2090	**2010-2090**
Green Infiltration	186.8	243.7	136.6	238	238	238	272.7	272.1	1825.9
Biocell Islands	54.4	54.4	54.4	35.7	35.7	36.6	26.1	24.4	321.7
Pervious Paving	140.1	140.1	140.1	83.7	83.7	83.7	78.9	78.9	829.2
Total	381.3	438.2	331.1	357.4	357.4	358.3	377.7	375.4	**2976.8**

Phase 1: Subwatershed 1A and 3, Subwatershed 6 detention basin

Subwatershed 1A is identified as a top priority for the watershed because it contains one of the largest reaches of the biologically impaired stream channel and is the single largest contributor of impervious surface in the watershed. In addition, subwatershed 1A is home to the highest e. coli levels in the Dry Run Creek watershed.

Subwatershed 3 contains the rest of the biologically impaired stream channel along with a relatively high level of imperviousness.

Altogether, the total needs for these subwatersheds will require 65.22 acres of green infiltration practices, 20.1 acres of biocell islands and 46.83 acres of permeable pavement. In addition, 3,076 lineal ft. of streambank will require stabilization.

A detention basin to be placed in subwatershed 6 is also of a high priority to the project. It is a rare opportunity to make a significant impact on the impaired reach of stream with a single practice.

Phase 2: Subwatersheds 2, 1B and 4

Subwatershed 1B does not contain any of the biologically impaired segment of the stream, it does, however drain a significantly developed industrial area which empties into the impaired branch shortly downstream in subwatershed 1A. Subwatershed 1B also contains a great deal of the bacteriologically impaired stream channel. The East Branch of Dry Run Creek, which runs in part through subwatershed 1B has consistently seen the highest e. coli levels of the creek's four branches.

Like subwatershed 1B subwatershed 4 drains a well-developed urban area which empties into the biologically impaired section of the creek shortly downstream. This subwatershed also contains areas of high e. coli levels which serve to exasperate existing problems on the main stretch of the East Branch.

Subwatershed 2 contains some of the least impacted urban areas in the watershed. These areas are nonetheless storm-sewered grounds which present the same hydrological challenges as any others. Infiltration practices to reduce the flashiness of the urban stream's flow will serve to lessen the damage of the existing development and protect what habitat still exists. While this, the University Branch, does not contain any of the biologically impaired stream reaches, it does drain directly into the biologically impaired reach immediately after exiting Subwatershed 2 and entering Subwatershed 1B. Subwatershed 2 also contains a relatively large amount of agricultural land use which will require treatment to minimize sediment runoff.

Combined, treatment of these subwatersheds will require 88 acres of green infiltration practices, 13.3 acres of biocell islands, and 30.8 acres of permeable pavement to meet infiltration goals. In addition to these infiltration practices 7,998.5 ft. of streambank will require stabilization to reduce sediment loading.

Rural practices required to treat these subwatersheds will be comprised of 3.93 acres of filter strips, 176.37 acres of NHEL and 5.63 acres of HEL grassed waterways and conservation tillage.

Phase 3: Subwatersheds 5, 6, 7, 8, 9

For these rural subwatersheds, first priority will be given to the subwatershed nearest the impaired regions of the creek. This would include subwatersheds 6, 8, and 5.

Subwatershed 8 contains the largest amount of impervious surface of all of the Phase 3 subwatersheds. Subwatershed 8 also has the highest e.coli levels of the Phase 3 subwatersheds.

Subwatershed 6 contains large amounts of HEL ground and drains directly into the biologically impaired stretch of the Southwest Branch.

Subwatershed 5 is a relatively small subwatershed which, like subwatershed 6, contains a great deal of HEL ground. This subwatershed is also likely to see a great deal of development in the future and special attention should be paid to construction occurring in these HEL grounds. This will be done through the projects information and education component, though, and will not require assistance for structural practices.

Subwatersheds 7 and 9 are entirely agricultural in their land use and contain very little impervious surface. Subwatershed 9 contains a large amount of HEL ground while subwatershed 7 contains significantly less. Both of these subwatersheds also contain streambank which requires stabilization.

Treatment of this phase of the project will need to include 67.36 acres of green infiltration practices, 6.21 acres of biocell islands, and 19.49 acres of permeable pavement to meet the stated infiltration goals. In addition, rural grounds will require 48.57 acres of filter strips, 1,864.59 acres of grassed waterways and conservation tillage for NHEL grounds and 340.84 acres of the same practices for HEL lands. Lastly, 1,208 ft. of streambank will require stabilization.

6. Water Quality Monitoring Plan

Overview

The following monitoring and sampling activities are recommended to ensure a robust data set for ongoing watershed planning and management initiatives within the Dry Run Creek watershed.

The recommendations within this plan are based on previous monitoring efforts within the watershed. This includes bi-weekly sampling done as part of the Stressor Identification project; along with storm event-related sampling and ongoing flow and temperature monitoring from 2005-2007. Also, snapshot monitoring and event sampling of impervious surfaces was conducted during this time period. Each instance has been considered as this plan was developed. The overall objective of this plan is to determine program effectiveness and watershed improvement.

Sampling Recommendations for Dry Run Creek

In order to make efficient use of existing funds, monitoring activities within the Dry Run Creek watershed will concentrate on those parameters identified during the Stressor ID process that are likely contributors to impairment. These parameters include hydrologic alteration, sedimentation and storm-related alterations to water quality.

Recommended Monitoring Methods

Monthly Sampling

IOWATER field parameters will be combined with samples taken for E. coli bacteria and total suspended solids (TSS) from April to October. Sites will be consistent with sampling locations from the 2005-2007 monitoring data.

Storm-Event Sampling

Automatic sampling devices have been purchased by the UNI GeoTREE Center and will be deployed by WAMS staff. The primary objective of deploying these instruments is to verify the effectiveness of the model the GeoTREE Center is developing for the City of Cedar Falls and the University of Northern Iowa regarding urban watershed assessment. This data may also be integrated with monitoring efforts throughout the watershed, as sites selected for installation will include previous data collection sites during the 2005-2007 monitoring seasons.

Ongoing Flow & Temperature Measurement

Flow measurements are recommended for monitoring alterations in hydrology. Four pressure transducers were purchased with funds from a grant awarded by the Iowa Watershed Improvement Review Board (WIRB.) These transducers will be installed in April 2009 and will remain fixed at specific locations through October 2009.

Temperature sensors will also be installed to collect ongoing, “real time” temperature data. These sensors were also purchased with WIRB funds and may be used for ongoing data collection in the watershed. 2009 locations will include areas not impacted by impervious surfaces, and areas where runoff is generated from impervious surfaces. The objective is to determine the relative impact from such runoff on habitat.

Possible Student Projects

Should University of Northern Iowa students be available and interested in assisting with the Dry Run Creek project, below are two recommended studies to assist with data collection. One is a research project on metals regarding parking lot runoff and bioretention cells. The other is a study on hydrologic activity within the Southwest Branch of Dry Run Creek. While these projects are ineligible for funding through the existing project grant, they may be considered for other funding sources or in-kind support.

Monitoring Cost Estimates

Yearly Monitoring Cost: $7,642

Breakdown of Expenses by Category:
Monthly Sampling: $4,160
Storm-Event Sampling: $3,512
Temperature & Flow: In-kind

April-Oct. Monthly Sampling Costs (included with IOWATER field parameters)

Analyte	Cost/Test	12 Sites, 10x/yr (120 samples)
Bacteria	$15	$1800
TSS	$18	$2160

Estimated 10-month Lab Analysis Costs: $3,960
Courier Fees: $200
Total Monthly Sampling Costs: **~$4,160**

Storm Event Sampling

6 Events .5" to 1.25"	Cost/Test	4 Sites, 6/yr (24 samples)
Bacteria	$15	$360
TSS	$18	$432
Total P	$18	$432
Nitrate	$18	$432

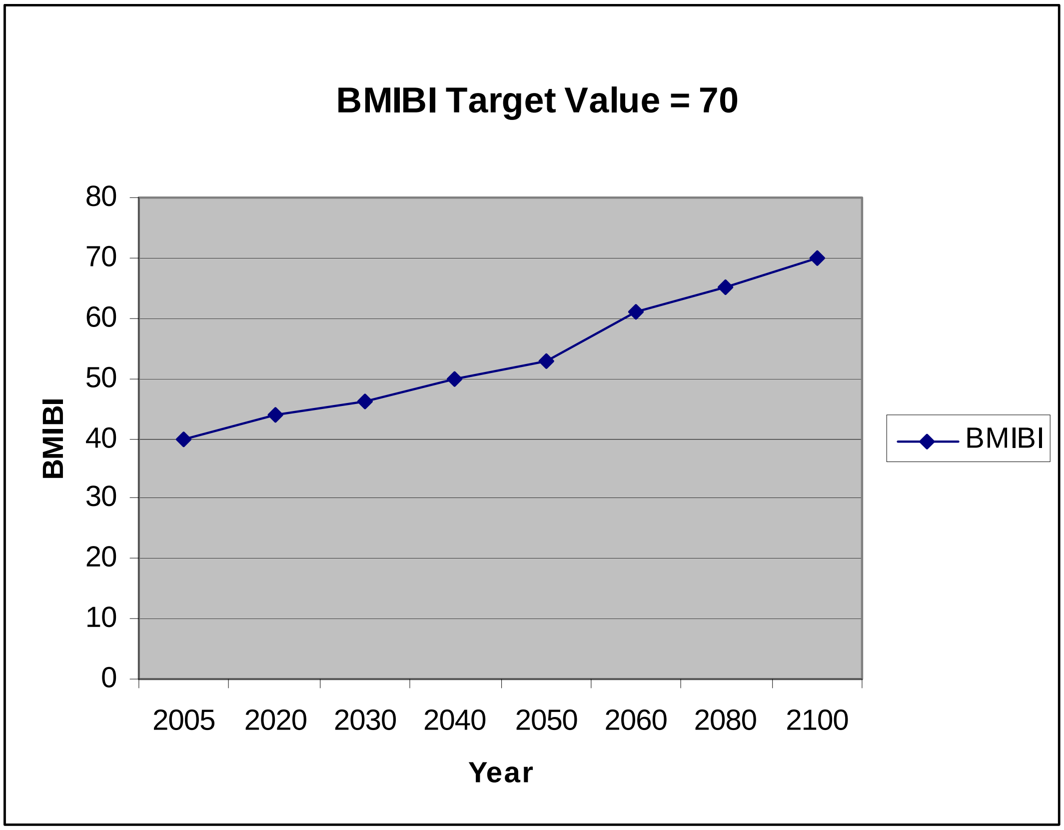
6 Events >1.25"	Cost/Test	4 Sites, 6/yr (24 samples)
Bacteria	$15	$360
TSS	$18	$432
Total P	$18	$432
Nitrate	$18	$432

Estimated Storm Event Lab Analysis Costs: $3,312
Courier Fees: $200
Total Storm Event Costs: **~$3,512**

Interim Water Quality Milestones

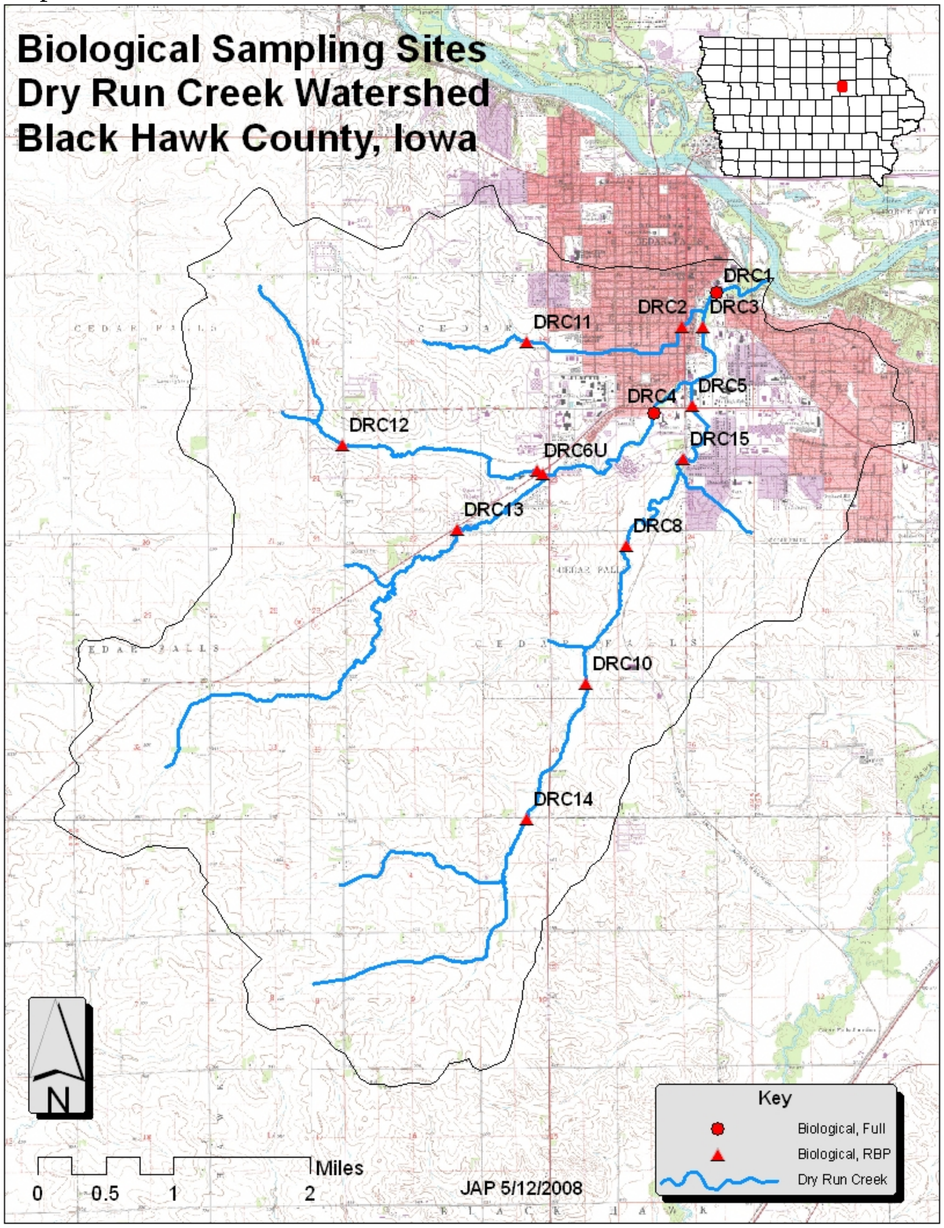
To measure improvement in water quality in the Dry Run Creek watershed biological monitoring will be completed at DRC1, and DRC4 (Map 6.1) every five years. The average Benthic Macroinvertebrate Index of Biological Integrity (BMIBI) of the two sites will be used to measure water quality improvement. In 2005 the average BMIBI at DRC1 and DRC4 was 40. By the end of phase 3 the project anticipates the BMIBI will reach 70 (Table 6.1).

Table 6.1 – DRC Interim Water Quality Milestones



Cost of Biological Monitoring every 5 years = $7000/season
Cost of Biological Monitoring for life of Watershed Management Plan = $126,000

Map 6.2



7. <u>Information and Education</u>

An information and education program will be designed to teach stakeholders about the problems facing Dry Run Creek, what the impact of their land use decisions might be, and how they can effectively mitigate those impacts. A series of workshops, field days, newsletters and demonstrations will be used to accomplish this task. Further details regarding specific aspects of the proposed information and education system are presented in greater detail in the proceeding sections.

Dry Run Creek
Public Outreach Plan
July 2009

1. SET YOUR PLAN GOALS

1. Treat the runoff from the initial 1.25” of rainfall events in urban areas of the watershed.
2. Reduce sediment delivered to the streams by 30 percent.
3. Improve/protect in-stream habitat along 25 percent of the stream corridor.
4. Increase the awareness of Dry Run Creek and understanding of water quality issues among the Cedar Falls community, and increase the community’s support of improving and protecting the creek.

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2. DETERMINE YOUR TARGET AUDIENCES

Who do you depend on to make changes to the land and in the water?

- Agricultural landowners
- Rural non-farming landowners
- Urban residents (both renters and homeowners)
- Urban business owners or facility managers
- Other owners of non-residential urban land
- Contractors and developers
- University of Northern Iowa Facilities Services
- City of Cedar Falls

Who do you depend on to keep your project afloat?

- Dry Run Creek Advisory Board
- City of Cedar Falls
- Black Hawk County
- University of Northern Iowa
- Cedar Falls Mayor Jon Crews
- Black Hawk County Supervisors
- State Senator Jeff Danielson
- State Representative Doris Kelley
- U.S. Senators Chuck Grassley and Tom Harkin
- U.S. Representative Bruce Braley
- DNR, IDALS-DSC, NRCS

Who do you depend on to spread your message to these people?

- Respected individuals in the Cedar Valley that can serve as project leaders and spokespeople
- Large campaign: UNI coaches, mayor, KWWL anchors, radio personalities, well-known residents like Gary Kelley, etc. Also, on a smaller neighborhood

-respected in their areas; farmers who are well-respected, ag business leaders, etc.)

- Project partners and stakeholders including the University of Northern Iowa, the City of Cedar Falls, Lockard Development
- Business and trade associations, especially those dealing with construction and urban development
    - Possible sources of support from this group could include members of the Cedar Valley Homebuilders Association as well as local developers that the project has worked with in the past, including Weichert Realtors and Lockard Company
- Local businesses
    - Home and garden stores
        - Platt's
        - Jordan's Nursery
        - Teidt Nursery
        - Earl May Nursery
        - Meyer's Nursery
        - Bear Creek Landscapes
    - Businesses serving farming community
        - East Central Iowa Cooperative
        - Tractor Supply Company
        - Blain's Farm and Fleet
        - John Deere Waterloo Implement
        - Pioneer Seeds
        - Black Hawk County Farm Bureau
    - Businesses serving construction industry
        - Menards
        - Home Depot
        - Lowe's
        - Pro Build
        - Barnes Building Materials
    - Greater Cedar Valley Chamber of Commerce
- Local clubs and organizations
    - Homeowner and neighborhood associations
    - Agriculture
        - 4H
        - FFA
        - Iowa Pork Producers
        - Iowa Corn Growers Association
        - Agribusiness Association of Iowa
        - Black Hawk County Farm Bureau
    - Environment
        - Black Hawk County Conservation Board
        - Pheasants Forever
        - Cedar Valley Wetlands Association
        - Ducks Unlimited

        - Whitetails Unlimited
        - The National Turkey Federation (Iowa Chapter)
    - Gardening
        - Master Gardener's Club (Black Hawk County Extension)
    - Service
        - Rotary Club
        - Northeast Iowa Community Foundation
    - Churches
        - Nazareth Lutheran Church
        - Lutheran Student Center
        - Wesley Foundation
        - Heartland Vineyard Church
        - First Presbyterian Church
        - United Church of Christ
        - Our Redeemer Lutheran Church
        - St. John Lutheran Church
        - St. Luke's Episcopal Church
        - First United Methodist Church
        - Church of Jesus Christ of Latter Day Saints
        - Bethlehem Lutheran Church
        - First Christian Church
        - Cedar Heights Presbyterian Church
        - United Church of Christ
        - Cedar Falls Mennonite Church
        - St. Patrick Church
        - St. Timothy's Methodist Church
        - Prairie Lakes Church
        - Cedar Heights Baptist Church
        - Trinity Wesleyan Church
        - Cedar Falls Church of Christ
        - Washington Chapel United Methodist Church
        - St. Paul Lutheran Church
        - First Evangelical Free Church
        - Fredsville Evangelical Lutheran Church
        - Faith Wesleyan Church
        - First Church of Christ's Scientist
        - Valley View Baptist Church
        - Cedar Falls Gospel Hall
        - Catholic Student Center
        - Community of Christ
        - Brammer Memorial Center
        - Greenhill Baptist Church
        - Unitarian Universalist Society of Black Hawk County
        - Bethany Bible Chapel
        - Glad Tidings Assembly of God
        - Living Water Church of the Nazarene
        - New Light Media

- Cornerstone Fellowship Church
- Baha’I Center
- Orchard Hill Church

- Newspapers:
  - Waterloo-Cedar Falls Courier
  - Cedar Falls Times
- Television:
  - KWWL, Waterloo
  - KCRG, Cedar Rapids
  - KGAN, Cedar Rapids

- Radio:

  Include in press release distribution:
  - KUNI (90.9, news/NPR)
  - KWLO-AM (1330, news/classic hits)
  - KXEL-AM (1540, news/talk)
  - KOEL-AM (950, News/talk/ag/country)

  Other stations that are less news-oriented, but may be potential partners in promotional events:
  - KFMW (107.9, rock)
  - KOKZ (105.7, oldies)
  - KOEL-FM (98.5, country)
  - KCRR (97.7, Classic rock)
  - KKHQ (Q 92.3, Top 40)

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3. RESEARCH YOUR TARGET AUDIENCES

Research strategies:

1. Public opinion survey conducted by University of Northern Iowa, 2005 and 2008 (landowners in watershed)

Barriers to participating in project:

- More than 50 percent of landowners in the Dry Run Creek watershed are not sure about the quality of water in the creek (if it's declining or not)
- 34 percent of landowners not willing to donate time to project
- Majority only willing to minimum participation (learning more)
- Landowners believe that taxpayers, not individual landowners, should bear the cost of Dry Run Creek watershed improvements
- 25 percent of landowners believe that regulations protecting the watershed limit their choices and personal freedom
- Overall landowner interest in specific conservation practices decreased from 2005 (although no information on specific barriers)

Motivators, incentives or benefits for participating in project:

- Those with stronger environmental beliefs are more likely to participate in project
- 29 percent believe poor water quality in the creek affects local economic development

Preferred ways to receive watershed project information:

- City of Cedar Falls Currents newsletter
- Waterloo-Cedar Falls Courier
- SWCD newsletters
- KWWL News Channel 7

(Note: no information on one-on-one meetings with coordinator or direct mail)

How landowner makes decisions regarding his or her land:

- 25 percent of landowners believe that regulations protecting the watershed limit their choices and personal freedom

Perception of current water quality in Dry Run Creek:

- 53 percent of landowners aware of water quality issues regarding Dry Run Creek (28 percent not sure, 20 percent unaware)
- 37 percent agree water quality in creek is declining; 52 percent not sure; 10 percent disagree
- Majority of landowners agree that runoff from paved surfaces, new development, lawn fertilizers and septic systems negatively affect the creek
- Most landowners are not sure of the impact of agricultural fertilizers and livestock production on Dry Run Creek

Landowners' perceived value of Dry Run Creek:

- Unknown

Conservation practices of highest interest to landowners:

- Assistance in disposal of household hazardous waste
- Permeable paving
- Inlet protection for storm sewers (note: usually only city can install this)
- Native landscaping, wildflower and rain gardens

2. Survey developers and construction companies that work in Cedar Falls

Research knowledge of stormwater requirements and regulations, barriers to using stormwater practices, what would motivate them to use and promote practices

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4. USE RESEARCH TO DEVELOP YOUR OUTREACH STRATEGY

GOAL 1:

Treat the runoff from the initial 1.25" of rainfall events in urban areas of the watershed (reduce rate and volume of stormwater entering creek by using infiltration practices)

Audience 1: Urban residents in a targeted area
Known barriers:

- Belief that taxpayer money, not individual landowners, should pay for/make improvements
- 25 percent of landowners believe that regulations protecting the watershed limit their choices and personal freedom
- Majority (63 percent) interested in only minimal project participation
- More than 50 percent of landowners in the Dry Run Creek watershed are not sure about the quality of water in the creek (if it's declining or not)

Assumed barriers (research needed to verify):

- Limited or no knowledge of creek location or water quality problems
- Limited or no knowledge of how yards affect the creek
- Limited or no knowledge of what conservation practices are and what they do
- Weak ties or lack of a sense of ownership in creek
- Limited or no knowledge of things urban residents can do to help
- Limited or no knowledge of how to install practices or who to contact for help
- Cost
- Competition for time

Possible solutions and opportunities:

- Cost-share and grant funding
- Emphasize financial and technical assistance available
- Results of water quality improvement plan (TMDL) will help pinpoint priority neighborhoods where conservation practices needed most
- Show homeowner what public entities are doing (city, etc.) and explain why additional work on private land is needed
- Help landowners develop a feeling of ownership in the creek (why should they care? Show benefits – less flooding, safer for kids playing in creek, etc.)
- Make a connection as to how conservation practices can help reduce flooding and flooding impacts; show other benefits of rain gardens, biocells, bioswales
- Show how homeowners can make changes with small efforts (if possible)
- Make conservation practices visible and attractive, yet unobtrusive, to others in the neighborhood as a project "advertisement;" consider temporary signage as allowed
- Encourage "block leaders" participating in the project to discuss the creek and practices with neighbors (show people that people they know and trust are getting involved)
- Bring neighbors together to create a sense of joint ownership in creek
- Knowledge of problems: 76 percent agreed that runoff from paved surfaces affects Dry Run Creek

Messages:

- Making simple changes to your yard can help improve water quality in Dry Run Creek

- Soaking up rainwater as it falls means a better yard for you and a cleaner Dry Run Creek
- Help reduce flooding, clean our creek and beautify your yard with simple changes
- Help save Dry Run Creek – in your own backyard (slogan)
- Green your lawn, help our creek (slogan)

Message delivery:

- Annual workshop focused solely on urban practices and issues (create promotion plan)
- Guided tour of homes in the area successfully using conservation practices (create promotion plan)
    - Partner with real estate agents, nurseries, Master Gardeners Club
- Work with homeowner and neighborhood associations
- Neighborhood-level meetings in targeted areas
- Find local "block leaders" – respected and trusted neighbors who can serve as an example and spokesperson for project in the neighborhood
- Phone calls followed by one-on-one meetings with landowners in a targeted area
- City of Cedar Falls newsletter
- Direct mail pieces
- Incentive program (earn a Dry Run Creek participator yard sign and potentially prizes, discounts or coupons donated by local businesses) (create promotion plan)
- Partner with gardening clubs and/or home and garden stores on native landscaping, rain garden demonstrations and promotion (on-site demos, signs in stores, presentations at club meetings, tours of homes and gardens, place informational packet on practices at stores, work with store employees on messaging)
- Run simple "thank you" ads highlighting outstanding landowners or participating neighborhoods in Courier (metro section or Celebrations tabloid)

Audience 2: City of Cedar Falls
(creating detention basin in subwatershed 6, wetlands along Greenhill Road expansion)

Known barriers:

- None known

Assumed barriers (research needed to verify):

- Cost

Possible solutions:

- Cost-share
- Loans and grants

Messages:

- The Dry Run Creek watershed project can help you complete these important projects.

Message delivery:
- Meetings with Cedar Falls city officials, stakeholders, funding agencies

Audience 3: Industrial/commercial landowners, land-owning small businesses and churches in a targeted area

Known barriers:
- Only 9 percent of survey respondents were business owners – difficult to determine needs specific to this audience

Assumed barriers (research needed to verify):
- Cost
- Time
- Interruption of business activities during construction
- Possibly not required to implement these practices by law or ordinance?
- Perceived extra or difficult maintenance

Possible solutions:
- Show owners benefits to their business of using permeable paving and biocell islands
- Promote financial and technical assistance available
- Churches: church members may be able to provide volunteer labor or make financial donations to make practices possible

Message:
- Permeable paving and biocell islands can beautify your business while helping protect your community's water quality
- Financial and technical assistance is available from the Dry Run Creek watershed project to improve your business site for better water quality

Message delivery:
- Phone calls with follow-up one-on-one meetings with owners of businesses in targeted subwatersheds
- Direct mail pieces to business owners in the watershed touting benefits and financial, technical assistance available
- Annual workshop focused solely on practices and issues for industrial and commercial landowners (create promotion plan)
    - Partner with business associations, chamber of commerce
- Presentations at trade shows, conferences, annual meetings, chamber of commerce meetings (potentially offer tour of practices in conjunction with presentation)

GOAL 2:
Reduce sediment delivered to the streams by 30 percent.

Audience 1: Urban residents (streambank erosion)
Note: *Even with 75 percent cost-share, streambank stabilization is an expensive practice, making this a limited practice. The audience will be very targeted to reflect this.*

Known barriers:

- Belief that taxpayer money, not individual landowners, should pay for/make improvements
- 25 percent of landowners believe that regulations protecting the watershed limit their choices and personal freedom
- Majority (63 percent) interested in only minimal project participation
- More than 50 percent of landowners in the Dry Run Creek watershed are not sure about the quality of water in the creek (if it's declining or not)

Assumed barriers (research needed to verify):

- Cost
- May be unsure who owns or is responsible for maintaining streambank
- Concerns of drawing wildlife undesirable to homeowner
- Limited or no knowledge of water quality problems
- Limited or no knowledge of how yards affect the creek
- Limited or no knowledge of what conservation practices are and what they do
- Weak ties or lack of a sense of ownership in creek
- Limited or no knowledge of things urban residents can do to help
- Limited or no knowledge of how to install practices or who to contact for help

Possible solutions:

- Identify landowners located along critical areas of streambank and target outreach efforts there
- Emphasize financial and technical assistance available
- Cost-share and grant funding
- Show benefits of streambank stabilization practices to creek and homeowner's yard
- Show homeowner what public entities are doing (city, etc.) and explain why additional work on private land is needed
- Help landowners develop a feeling of ownership in the creek (why should they care? Show benefits – less flooding, safer for kids playing in creek, etc.)

Message:

- Financial and technical assistance is available to help you shore up your streambank.
- We have a responsibility to take care of the stream in our backyards for the good of our community.
- The health of Dry Run Creek depends on individuals.
- Protect Dry Run Creek for our kids that splash and play there

Message delivery:

- Annual workshop focused solely on urban practices and issues (create promotion plan)
- Neighborhood-level meetings in targeted areas
- Find local "block leaders" – respected and trusted neighbors who can serve as an example and spokesperson for project in the neighborhood.
- Direct mail pieces
- Incentive program (earn a Dry Run Creek participator yard sign and potentially prizes, discounts or coupons donated by local businesses) (create promotion plan)
- Run simple "thank you" ads highlighting outstanding landowners or participating neighborhoods in Courier (metro section or Celebrations tabloid)

Audience 2: Rural residents (streambank, sheet and rill erosion)
Known barriers:

- Only 16 percent of survey respondents were rural landowners – difficult to determine needs specific to ag audience

Assumed barriers (research needed to verify):

- Cost
- Conservation tillage seen as "sloppy farming"
- Perceived concern over attracting wildlife undesirable to farmer
- Loss of farmable ground

Possible solutions:

- Show benefits of conservation tillage, grassed waterways and filter strips to farming operations
- Emphasize financial and technical assistance available
- Promote wildlife benefits to interested landowners

Messages:

- Conservation tillage can save you soil, time and money
- Keep soil on the land and out of the water with grassed waterways and filter strips
- The Dry Run Creek watershed project can help get practices on the ground with financial and technical assistance

Message delivery:

- Letters to targeted rural landowners explaining practices available, benefits to their farming operation, and how the project can help (financial, technical)
- Follow-up phone calls and one-on-one meetings to landowners in targeted areas
- Annual workshop focused solely on agricultural and rural practices and issues (create promotion plan)
    - Partner with local agriculture organizations and businesses
- Field days highlighting conservation tillage, grassed waterways and filter strips
- Find local "field leaders" – respected and trusted individuals in the farming community who can serve as an example and spokesperson for project in his/her area.
- Have information on practices and financial and technical assistance available, and benefits of practices to farmers, available at East Central Co-Op and seed dealers
- Submit articles to local agriculture groups (4-H, Farm Bureau, etc.)

Audience 3: Urban contractors and developers (construction site erosion)
Known barriers:

- Less than 3 percent of survey respondents were developers – difficult to determine needs specific to this audience

Assumed barriers (research needed to verify):

- Cost
- Limited, incorrect or no knowledge of city, county, state and national storm water regulations, requirements, ordinances, etc.

Possible solutions:

- Research developers and contractors as a separate audience with a separate approach (survey, etc.) to determine barriers, opportunities and best message delivery methods.
- Provide educational opportunities and assistance in understanding permit requirements and ordinances, regulations, etc.
- Promote technical assistance available

Message:

- Know your stormwater pollution prevention plan
- The Dry Run Creek watershed project offers assistance in understanding stormwater requirements

Message delivery:

- Annual workshop focused solely on practices and issues for industrial and commercial landowners, and urban contractors and developers (create promotion plan)

    - Partner with city, county, DNR, businesses serving industry, Cedar Valley Homebuilders Association, Lockard Companies, Weichert Realtors
- Presentations at trade shows, conferences, annual meetings, chamber of commerce meetings
- Direct mail
- Submit articles to local trade and industry organizations' newsletters, publications
- One-on-one meetings with contractors and developers working in targeted areas
- In-store messaging at construction supply stores; work with store employees on using messaging

Audience 4: City of Cedar Falls and University of Northern Iowa (publicly-owned lands)
Known barriers:

Assumed barriers (research needed to verify):
- Cost

Possible solutions:
- Cost-share
- Loans and grants

Message delivery:
- Meetings with UNI and Cedar Falls city officials, stakeholders, funding agencies

GOAL 3:
Improve/protect in-stream habitat along 25 percent of the stream corridor.

Audience 1: Urban residents in targeted areas
Note: *Most urban habitat work will be done in conjunction with stream stabilization (goal #2); most riparian work will be done in rural areas.*

Known barriers:
- Belief that taxpayer money, not individual landowners, should pay for/make improvements
- 25 percent of landowners believe that regulations protecting the watershed limit their choices and personal freedom
- Majority (63 percent) interested in only minimal project participation
- More than 50 percent of landowners in the Dry Run Creek watershed are not sure about the quality of water in the creek (if it's declining or not)

Assumed barriers (research needed to verify):
- Homeowners may see wildlife (in stream and the wildlife that plantings attract) as a nuisance rather than a benefit
- Homeowner may see grasses, etc. in buffer strips as "weeds"

- Cost
- Concerns over amount or type of maintenance required
- Limited or no knowledge of water quality problems
- Limited or no knowledge of how yards affect the creek
- Limited or no knowledge of what conservation practices are and what they do
- Weak ties or lack of a sense of ownership in creek
- Limited or no knowledge of things urban residents can do to help
- Limited or no knowledge of how to install practices or who to contact for help
- Competition for time

Possible solutions:
- Present benefits of streambank stabilization, and riparian tree and shrub plantings to homeowners
- Cost-share and grant funding
- Emphasize financial and technical assistance available
- Show homeowner what public entities are doing (city, etc.) and explain why additional work on private land is needed
- Help landowners develop a feeling of ownership in the creek (why should they care? Show benefits – less flooding, safer for kids playing in creek, etc.)
- Make a connection as to how conservation practices can help reduce flooding and flooding impacts; show other benefits

Messages:
- Work with the Dry Run Creek watershed project to plant trees and shrubs to protect the creek

Message delivery:
- Annual workshop focused solely on urban practices and issues, include information on habitat, streambank stabilization, riparian tree and shrub plantings, and pool and riffle structures (create promotion plan)
    - Partner with real estate agents, nurseries, Master Gardeners Club
- Neighborhood-level meetings in targeted areas
- Find local “block leaders” – respected and trusted neighbors who can serve as an example and spokesperson for project in the neighborhood.
- Submit article to City of Cedar Falls newsletter editor
- Direct mail pieces
- Incentive program (earn a Dry Run Creek participator yard sign and potentially prizes, discounts or coupons donated by local businesses) (create promotion plan)
- Run simple “thank you” ads highlighting outstanding landowners or participating neighborhoods in Courier (metro section or Celebrations tabloid)

Audience 2: Rural residents
Known barriers:

- Only 16 percent of survey respondents were rural landowners – difficult to determine needs specific to this audience.

Assumed barriers (research needed to verify):

- Cost
- Loss of farmable ground
- Perceived concern over attracting wildlife undesirable to farmer

Possible solutions:

- Promote benefits of buffer strips and streambank stabilization to farming operation
- Emphasize financial and technical assistance available

Messages:

- Protect your land and the creek with streambank stabilization
- Buffer strips help water quality and can attract pheasant, turkey

Message delivery:

- Annual workshop focused solely on agricultural and rural practices and issues (create promotion plan)
- Find local "field leaders" – respected and trusted individuals in the farming community who can serve as an example and spokesperson for project in his/her area.
- Phone calls and one-on-one meetings to landowners in targeted areas
- Work with Pheasants Forever, Ducks Unlimited, Iowa Turkey Federation, Cedar Valley Wetlands Association, about potential for wildlife habitat projects, working with landowners (as appropriate)

GOAL 4:

Increase the awareness of Dry Run Creek and understanding of water quality issues among the Cedar Falls community, and increase the community's support of improving and protecting the creek.

Known barriers:

- More than 50 percent of landowners in the Dry Run Creek watershed are not sure about the quality of water in the creek (if it's declining or not)

Assumed barriers (research needed to verify):

- Limited or no knowledge of creek location or water quality problems
- Limited or no knowledge of how yards, businesses affect the creek
- Limited or no knowledge of what conservation practices are and what they do
- Weak ties or lack of a sense of ownership in creek
- Limited or no knowledge of things urban residents can do to help
- Limited or no knowledge of how to install practices or who to contact for help

- Perception that other people will take care of creek and that there is no need for concern and involvement

Possible solutions:

- Make creek and associated conservation practices more visible and recognizable to community
- Increase sense of ownership in and responsibility in protecting creek
    - Work with schools, churches, service clubs
- Provide ways for residents to get involved in project from small efforts (washing the car on the lawn, cleanup days) to large (installing bigger practices)
- Large, community-wide social marketing campaign to draw awareness to water quality problems and move people to make behavior changes

Messages:

- A cleaner Dry Run Creek for a healthier Cedar Falls
- Protect Dry Run Creek: the Heart of Cedar Falls
- Let's work together for a cleaner Dry Run Creek

Message delivery:

- Create a project logo for brand identity
- Public support campaign that identifies Dry Run Creek to community, why it has problems, why the creek matters to the community, what we (as residents) can do; possibly launch a incentive program (do five of 10 practices at home and earn a sign and prizes – these would be general, like using no-P fertilizer and picking up pet waste – goal here is to raise awareness and ownership in creek. Additional targeted efforts (see goals 1-3) are needed to accomplish specific project goals.
- Annual workshop focused solely on urban practices and issues (for residents) (create promotion plan)
    - Include special session for real estate agents
- Guided tour of homes in the area successfully using conservation practices (create promotion plan)
- Interpretive signs placed strategically along high-traffic (pedestrian and auto) areas near the creek and its tributaries (UNI campus, Hudson Road, multi-use recreation trails)
- Road signs identifying creek at bridge crossings
- Send letters to churches (or meet with area religious council, if available) encouraging them and their members to get involved in the project as stewards of their land and of the community; provide ways they can get involved; offer to give presentations or help organize events; use secular language
- Host creek "clean up" days to draw awareness to creek, preferably in highly visible areas like the UNI campus, churches, schools
- Regular, newsworthy updates on project, creek sent to media, City of Cedar Falls newsletter editor

- Send annual project update letter to partners, local officials and legislators updating them on the project and thanking them for their support and/or partnership
- Send thank you notes to individuals or groups participating in the project
- Project newsletter
- Direct mail
- News releases to media, stakeholders, partners as needed to promote project successes, events, funding opportunities, volunteer opportunities
- Appearances at local events (create promotion plan)
    - Day at the Quarry, Raymond
    - Cedar Valley Home and Landscape Show
    - Other suggestions:
        - Sturgis Falls, College Hill Arts Festival, UNI-Dome tailgating, annual tour of homes (if a home has a rain garden, for example), Black Hawk County Fair
- Work with science teachers to use the stream as an outdoor classroom
    - Schools close to creek or tributary:
        - Peet Junior High
        - NU High School/Price Lab elementary
        - University of Northern Iowa
    - Other schools in watershed:
        - Orchard Hill, Southdale, Cedar Heights, Hansen elementaries
        - Holmes Junior High (on watershed border)
        - Cedar Falls High School (on watershed border)
    - Schools outside watershed:
        - North Cedar, Lincoln elementaries
        - Hawkeye Community College
- Work with schools to conduct sampling
    - Train 25 teachers for IOWATER (Lions Club grant)
    - Train 25 Hawkeye Community College natural resources students for IOWATER (seeking IOWATER grant)
- Create scholarship program for local high school juniors and seniors focusing on conservation essays (create promotion plan)

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5. CARRY OUT THE PLAN

Note: As the Dry Run Creek project is a 90-year project, this plan will reflect five years of outreach at a time. While the outreach plan will be continually evaluated and updated, every four years the project should begin developing an outreach plan for the next five year period.

YEAR 1:
First quarter (July-Sept.):

- Meet with city of Cedar Falls on detention basin, wetlands
- Create and install bridge crossing signs
- Continue work with schools
- Begin working with urban homeowners in targeted areas
    - Direct mail, phone calls, meetings, identifying block leaders as appropriate
- Begin working with urban businesses
    - Direct mail, phone calls, meetings
- Project news releases, newsletter submissions as appropriate

Second quarter (Oct.-Dec.):
- Work with home and garden stores, nurseries to place informational rain garden packets in stores and work with store employees on using messaging
- Work with co-op, seed dealers to place informational conservation practice packets in their businesses and work with employees on using messaging
- Begin promoting scholarship program
- Project news releases, newsletter submissions as appropriate

Third quarter (Jan.-Mar.):
- Plan residential and small business workshop
- Plan construction and industrial business workshop
- Begin working with construction companies and developers
    - Consider developing and conducting survey
- Contact Cedar Valley Homebuilders Association about speaking to group
- Send reminders on scholarship program deadline
- Project news releases, newsletter submissions as appropriate

Fourth quarter (Apr.-June):
- Work with home and garden stores, nurseries to place informational rain garden packets in stores and work with store employees on using messaging
- Work with co-op, seed dealers to place informational conservation practice packets in their businesses and work with employees on using messaging
- Consider native landscaping, rain garden demonstrations
- Think about attending summer and fall community events, conferences, etc.
- Project news releases, newsletter submissions as appropriate
- Announce scholarship winner
    - Work with Waterloo-CF Courier to publish winning essay

YEAR 2:
First quarter:
- Plan annual agriculture workshop
- Project news releases, newsletter submissions as appropriate

Second quarter:
- Consider running thank-you ads or PSAs

- Consider developing incentive program for homeowners, community-wide public relations campaign
- Begin promoting scholarship program
- Project news releases, newsletter submissions as appropriate

Third quarter:
- Plan residential and small business workshop
- Plan construction and industrial business workshop
- Send reminders on scholarship program deadline
- Project news releases, newsletter submissions as appropriate

Fourth quarter:
- Announce scholarship winner
    - Work with Waterloo-CF Courier to publish winning essay
- Project news releases, newsletter submissions as appropriate

YEAR 3:
First quarter:
- Consider tour of homes/gardens featuring urban conservation practices
- Plan annual agriculture workshop
- Consider running thank-you ads or PSAs
- Project news releases, newsletter submissions as appropriate

Second quarter:
- Begin promoting scholarship program
- Project news releases, newsletter submissions as appropriate

Third quarter:
- Plan residential and small business workshop
- Plan construction and industrial business workshop
- Send reminders on scholarship program deadline
- Consider running thank-you ads or PSAs
- Project news releases, newsletter submissions as appropriate

Fourth quarter:
- Announce scholarship winner
    - Work with Waterloo-CF Courier to publish winning essay
- Project news releases, newsletter submissions as appropriate

YEAR 4:
First quarter:
- Plan annual agriculture workshop
- Consider running thank-you ads or PSAs
- Project news releases, newsletter submissions as appropriate

Second quarter:
- Begin promoting scholarship program
- Project news releases, newsletter submissions as appropriate

Third quarter:

- Plan residential and small business workshop
- Plan construction and industrial business workshop
- Send reminders on scholarship program deadline
- Consider running thank-you ads or PSAs
- Project news releases, newsletter submissions as appropriate

Fourth quarter:

- Announce scholarship winner
  - Work with Waterloo-CF Courier to publish winning essay
- Project news releases, newsletter submissions as appropriate

YEAR 5:

First quarter:

- Plan annual agriculture workshop
- Consider running thank-you ads or PSAs
- Project news releases, newsletter submissions as appropriate

Second quarter:

- Begin promoting scholarship program
- Project news releases, newsletter submissions as appropriate

Third quarter:

- Plan residential and small business workshop
- Plan construction and industrial business workshop
- Send reminders on scholarship program deadline
- Consider running thank-you ads or PSAs
- Project news releases, newsletter submissions as appropriate

Fourth quarter:

- Announce scholarship winner
  - Work with Waterloo-CF Courier to publish winning essay
- Project news releases, newsletter submissions as appropriate

6. MEASURE AND EVALUATE EFFECTIVENESS; PROMOTE SUCCESSES

- Ability of sites to infiltrate first 1.25” of rainfall
- Reduction in sediment delivery
- Number of practices installed
- Number of acres protected

- Number of people involved in project (installing practices, volunteering)
- Attendance at workshops
- Number of stories run in local media
- Improvements in awareness, concern over Dry Run Creek (as measured by follow-up public opinion and contractor/developer surveys)

8. Resource Needs

Due to the changing nature of the Dry Run Creek Watershed and the likely continuation of urban expansion into rural areas the future financial resources needed to continue the improvement and protection of the watershed are difficult to project. Human resource needs will include a watershed conservationist to work with private landowners in the area and promote the implementation of low impact development practices in areas of future development. The establishment of such a position is being pursued in the form of a joint funding venture between local and countywide MS4 communities. Such a position would allow the district to dedicate a larger portion of future grant funded projects to storm water management and promotional activities and would also provide the community members with a resource that could help educate them on available practices and programs in their community.

The watershed conservationist would need access to office facilities and equipment, vehicles and necessary information technology resources. These tools are essential to the ability of any individual with administrative responsibilities to be able to communicate with partners and coworkers, develop publications and reports, attend meetings and conferences, and reach potential practices sites and landowners. Other necessities also include access to larger buildings for the purpose of conferences or workshops.

Additionally, access to technical services and professional consultation will be needed at times to assist in the development of technical plans and services, events coordination, and the design or coordination of public relations materials. Much of this professional assistance is available through the established network of DNR, Natural Resource Conservation Service, and Iowa Department of Agriculture and Land Stewardship employees. Outside assistance is also available from continuing partnerships with the University of Northern Iowa and the Dry Run Creek Advisory Board. The level of expertise and the diversity of interests available through these two parties is a great asset to the project.

Relationships with partners who have large publication and distribution networks, particularly in the rural community will also need to be strengthened in the future. One of the greatest challenges facing a project coordinator is reaching the many landowners in their watershed. By taking advantage of pre-established audiences present in these large publication and distribution networks it becomes possible to keep the stakeholders informed of the activities and goals of the Dry Run Creek Project.

Lastly, a much stronger relationship with local city and county officials and technical staff is required in order to share information and concerns regarding water quality in the community. The City of Cedar Falls recently began instituting a storm water fee program administered through its utilities operations in order to raise funds for storm water management practices, they have aggressively pursued their NPDES Phase II regulations and have partnered with the district on several projects around the Dry Run Creek watershed. Cedar Falls also has access to a large pool of engineers who can assist with project designs and advice as to site locations and future city projects. Relationships with local officials must also be developed in an effort to create policies that encourage sustainable land use and responsible storm water management practices in future developments.

The total monetary resources required are summarized in table 8.1. At an expected cost of $15 per square foot, (based on estimates from Iowa Department of Agriculture and Land Stewardship staff), the total cost of urban infiltration practices required to meet the goal of infiltrating the first flush of stormwater would be approximately $233,466,354. The expected expense of $1,056,353 for the subwatershed 6 detention basin was estimated using the cost of the recently completed detention basin in subwatershed 2. Given the total cost of the detention basin in subwatershed 2 and its area of drainage, a cost per acre of drainage was calculated and applied to the proposed subwatershed 6 detention basin. The expected expense of $614,125 for streambank stabilization work was figured using an estimated $50 per square foot based on the cost of previous projects and information given by IDALS employees. Filter strip costs were calculated on an acre-by-acre basis consistent with current costshare rates. Lastly, the expense per acre of agricultural land was estimated at $15 per acre for NHEL ground and $25 for HEL ground. HEL ground costs were estimated based on the anticipated need for five 800 ft. long waterways and $8.75 per acre for conservation tillage practices. NHEL ground treatment costs were estimated based on the need for one 1,000 ft. long waterway and $8.75 per acre for conservation tillage. For further detail regarding financial needs please see table 8.1.

Table 8.1 Total Resource Needs

Subwatershed	Green Infiltration (residential) (acres)	Biocell Islands(industrial/commercial/institutional) (acres)	Pervious Paving (industrial/commercial/institutional) (acres)	Filter Strips (acres)	Conservation Tillage and Grassed waterways (NHEL acres)	Conservation Tillage and Grassed waterways (HEL acres)	Streambank Stabilization (ft.)	Detention Basin (count)	Cost
1A	51.89	14.1	32.83	0	0		2357	0	$ 64,686,838
1B	10	7.5	17.6	0	0		4229.5	0	$ 23,145,815
2	54	4	9	3.93	182	5.63	1987	0	$ 43,880,290
3	13.33	6	14	0	0	0	719	0	$ 21,813,772
4	24	1.8	4.2	0	0	0	1782	0	$ 19,691,100
5	56.8	0	0	2.24	92.68	48.77	0	0	$ 37,115,931
6	4.6	0	4.92	9.29	166.09	353.91	0	1	$ 7,288,896
7	0	0	0	14.38	647.74	44.8	822	0	$ 53,230
8	5.96	6.21	14.49	5.52	143.92	292.98	0	0	$ 17,429,624
9	0	0	0	17.14	579.36	85.54	386	0	$ 31,672
Total:	220.58	39.61	97.04	52.5	1806.16	831.63	12282.5	1	$ 235,137,168
Total Cost:	$ 144,126,972	$25,881,174	$63,405,936	$4,725	$27,092	$ 20,791	$ 614,125	$ 1,056,353	$ 235,137,168

Appendix A. Works Cited

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Appendix B. Tables and Forms

Figure 3.2.1 Monitoring Data Table – Annual Means

		Ammonia	*E.coli*		Nitrate + Nitrite N	Ortho-phosphate	Total Kjeldahl N	Total Phosphate	TSS
		(mg/L)	(colonies/100mL)	%>235	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
DRC1	2007*	<0.05 (<0.05-<0.05)	927 (<10-3700)	68	5.8 (2.4-12)	0.04 (<0.02-0.2)	0.4 (0.1-2.2)	0.1 (<0.02-0.65)	26 (<1-270)
	2006	<0.05 (<0.05-0.09)	925 (73-6900)	68	5.1 (1.8-13)	0.03 (<0.02-0.11)	0.3 (<0.1-0.8)	0.05 (<0.02-0.16)	9 (<1-58)
	2005	<0.05 (<0.05-<0.05)	3088 (110-34000)	75	2.6 (1-9.7)		0.2 (<0.1-0.9)	0.06 (<0.02-0.28)	
DRC2	2007*	<0.05 (<0.05-<0.05)	264 (<10-570)	44	2 (1.1-5.2)	0.02 (<0.02-0.08)	0.3 (0.1-1.1)	0.06 (<0.02-0.26)	14 (<1-130)
	2006	<0.05 (<0.05-0.15)	433 (10-4000)	56	2.3 (1-7)	0.03 (<0.02-0.14)	0.3 (<0.1-1)	0.05 (<0.02-0.18)	6 (1-39)
	2005	<0.05 (<0.05-<0.05)	459 (82-3000)	33	1 (0.087-2.3)		0.1 (<0.1-0.34)	0.05 (<0.02-0.12)	
DRC3	2007*	<0.05 (<0.05-<0.05)	911 (10-5300)	67	6.6 (3.2-12)	0.04 (<0.02-0.22)	0.4 (0.1-2.1)	0.1 (0.02-0.65)	28 (1-280)
	2006	<0.05 (<0.05-0.25)	1853 (50-25000)	78	5.7 (0.08-14)	0.02 (<0.02-0.11)	0.3 (<0.1-1)	0.06 (<0.02-0.16)	10 (<1-63)
	2005	<0.05 (<0.05-0.029)	3352 (100-42000)	71	3.2 (1.2-11)		0.3 (<0.1-0.98)	0.07 (0.02-0.32)	
DRC4	2007*	<0.05 (<0.05-<0.05)	705 (20-5800)	58	6 (3-11)	0.03 (<0.02-0.13)	0.4 (0.1-2)	0.09 (0.02-0.56)	32 (<1-320)
	2006	0.05 (<0.05-0.33)	461 (20-4200)	37	5.2 (2.3-13)	0.04 (<0.02-0.23)	0.3 (<0.1-1.4)	0.06 (0.02-0.3)	10 (1-76)
	2005	<0.05 (<0.05-<0.05)	534 (<10-3400)	52	3.3 (2.1-10)		0.2 (<0.1-0.34)	0.05 (<0.02-0.12)	
DRC5	2007*	<0.05 (<0.05-0.06)	1116 (10-7700)	68	8.8 (3.4-14)	0.05 (<0.02-0.26)	0.5 (0.2-2.2)	0.11 (0.02-0.72)	32 (<1-400)
	2006	<0.05 (<0.05-0.24)	3311 (55-25000)	67	9.9 (3.2-18)	0.03 (<0.02-0.14)	0.5 (0.3-1.5)	0.07 (0.02-0.27)	13 (<1-110)
	2005	0.05 (<0.05-0.051)	31772 (400-260000)	100	3.3 (<0.05-13)		0.8 (0.2-4.6)	0.11 (0.02-0.44)	
DRC6	2007*	0.05 (<0.05-0.4)	1347 (<10-11000)	63	9.2 (3.6-14)	0.05 (<0.02-0.17)	0.6 (0.2-1.7)	0.15 (0.04-0.61)	60 (1-480)
	2006	0.159 (<0.05-1.7)	701 (30-4900)	47	9.3 (0.23-18)	0.08 (<0.02-0.89)	0.8 (0.2-4.2)	0.14 (0.04-1.2)	13 (3-44)
	2005	0.153 (<0.05-0.153)	1194 (60-5900)	83	4.6 (<0.05-16)		4.6 (0.3-46)	0.84 (0.05-5.9)	
DRC7	2007*	<0.05 (<0.05-<0.05)	150 (<10-1000)	16	13.5 (6.3-19)	0.03 (<0.02-0.17)	0.2 (0-1)	0.06 (<0.02-0.35)	2 (<1-13)
	2006	<0.05 (<0.05-<0.05)	116 (<10-740)	22	17.4 (13-23)	0.03 (<0.02-0.21)	0.2 (<0.1-0.6)	0.04 (<0.02-0.21)	4 (<1-14)
	2005	<0.05 (<0.05-0.03)	307 (<10-2200)	25	12.1 (5.2-14)		0.4 (<0.1-1.1)	0.07 (<0.02-0.2)	
DRC8	2007*	<0.05 (<0.05-0.06)	675 (<10-4600)	56	9.8 (4.3-16)	0.05 (<0.02-0.25)	0.5 (0.2-1.8)	0.11 (0.03-0.54)	22 (2-200)
	2006	<0.05 (<0.05-<0.05)	882 (<10-11000)	44	10.9 (3.4-19)	0.03 (<0.02-0.12)	0.4 (0.2-0.8)	0.06 (0.02-0.17)	7 (1-36)
	2005	<0.05 (<0.05-0.03)	1970 (<10-12000)	76	3.9 (0.47-14)		0.5 (0.3-0.9)	0.09 (0.03-0.26)	
DRC9	2007*	<0.05 (<0.05-<0.05)	492 (<10-2500)	58	10.1 (6.2-15)	0.04 (<0.02-0.25)	0.4 (0.1-1.6)	0.08 (<0.02-0.53)	18 (1-150)
	2006	<0.05 (<0.05-<0.05)	569 (20-2900)	61	12.6 (6-33)	0.03 (<0.02-0.09)	0.3 (<0.1-0.7)	0.06 (0.02-0.13)	12 (3-38)
	2005	<0.05 (<0.05-0.09)	763 (130-2700)	71	6.5 (1-15)		0.3 (0.09-1.2)	0.09 (<0.02-0.5)	
DRC10	2007*	<0.05 (<0.05-0.15)	1290 (10-12000)	68	11.5 (4.8-17)	0.07 (<0.02-0.38)	0.6 (0.2-2.7)	0.14 (<0.02-0.92)	31 (2-270)
	2006	<0.05 (<0.05-<0.05)	427 (27-3000)	44	14.3 (4.6-22)	0.03 (<0.02-0.14)	0.4 (0.2-0.8)	0.06 (0.02-0.17)	6 (2-17)
	2005	<0.05 (<0.05-0.06)	2228 (<10-29000)	76	4.5 (0.05-16)		0.4 (0.1-0.79)	0.08 (0.04-0.17)	
* Data from 1/2007-10/2007									
avg (range)									

Figure2.4.1 Survey Form

“Dry Run Creek” Watershed Survey

The following questions were designed to help the Soil and Water Conservation District (SWCD) of Black Hawk County identify the concerns and attitudes that individuals like yourself hold regarding the water quality of Dry Run Creek, which runs through the City of Cedar Falls, Iowa. In addition, the SWCD would like to determine which conservation practices you think are important to support. Your response to this survey will assist the SWCD in their efforts to obtain federal dollars to help implement conservation practices for protecting and enhancing the Dry Run Creek watershed.

For each question, please give the answer you think is correct most of the time from your point of view. We would like to know what your answer is to **each question.** Your answers are confidential, or "private."

Section A

1. Different people will have different levels of knowledge about the Dry Run Creek Watershed. Please indicate (✔) your level of awareness with the following statement.

	Aware	Not Sure	Unaware
Are you aware of the water quality issues regarding the Dry Run Creek watershed today?	❑	❑	❑

2. Different people will have different concerns and attitudes about various non-point source pollutants (NPS). NPS means that there is no single location that a pollutant comes from. Please indicate (✔) your level of agreement or disagreement with the following statements.

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Do you believe that the water quality of Dry Run Creek is declining?	❑	❑	❑	❑	❑
Water contamination is an important environmental issue in Dry Run Creek	❑	❑	❑	❑	❑
Agriculture fertilizers have significantly impacted the water quality in Dry Run Creek	❑	❑	❑	❑	❑
Lawn fertilizers have significantly impacted the water in Dry Run Creek	❑	❑	❑	❑	❑
Poor water quality in Dry Run Creek effects economic development in this area of Iowa	❑	❑	❑	❑	❑
New construction and development have increased the amount of soil loss in this area	❑	❑	❑	❑	❑
Septic Systems can effect the water quality of Dry Run Creek	❑	❑	❑	❑	❑
Livestock production contributes to the reduction of	❑	❑	❑	❑	❑

water quality of Dry Run Creek					
Run off from paved surfaces including parking lots effect the water quality of Dry Run Creek	❑	❑	❑	❑	❑

Please indicate (✔) if you are interested in implementing or learning more about the following practices for the Dry Run Creek watershed:

	Interested but need more information	No interest Not Applicable	Already Adopted Practice
Wetland Restoration	❑	❑	❑
Private Septic System Upgrades	❑	❑	❑
Conservation cover	❑	❑	❑
Native Landscaping/Wildflower gardens/Rain gardens	❑	❑	❑
*Permeable Paving: A*lternatives to traditional paved surfaces which provide the support but allow water to infiltrate.	❑	❑	❑
Backyard Conservation/Wildlife habitat improvement	❑	❑	❑
Filter strips along the stream	❑	❑	❑
Waterways	❑	❑	❑
Inlet protection for storm sewers	❑	❑	❑
Urban Construction Control	❑	❑	❑
Terraces	❑	❑	❑
Minimal use of lawn and garden fertilizers and pesticides.	❑	❑	❑
Rock Check Dams	❑	❑	❑
Assistance in disposal of household hazardous waste	❑	❑	❑
Contour strips	❑	❑	❑
Community Sewage Treatment	❑	❑	❑
Windbreaks around dwellings	❑	❑	❑

3. Please indicate (✔) the top four most effective resources that would assist you in making a decision about participation in a Dry Run Creek watershed project? (Please check as many resources that might assist you)

Informal meetings	❑
Field days/tours	❑
Internet information sites, web pages	❑
Demonstration projects	❑

Face-to-face contact	❑
Newspapers	❑
Newsletters	❑
Workshops	❑

4. If funding for a special watershed project were to be approved, would you be willing to participate in one or more conservation practices to help improve to the stream water quality and lessen the impact of land disturbing activities that effect Dry Run Creek?
   - ❑ No
   - ❑ Yes

Section B

SWCD is collecting the following information in order to better understand the characteristics of our survey participants. All of the information will be kept completely confidential and will only be reported at the group level.

5. Which category best represents you ?
   - ❑ Urban resident of Cedar Falls
   - ❑ Rural Resident in and around Cedar Falls
   - ❑ Industrial Park Business
   - ❑ Cedar Falls Business outside of Industrial Park
   - ❑ Rural farmer in and around Cedar Falls
   - ❑ Absentee land owner
   - ❑ University of Northern Iowa facility management personnel
   - ❑ Developer who is/has worked on projects within/around Cedar Falls

6. How long have you owned, operated, or resided at your present location? ___ 0-5 years ___6-15 years___>15 years

7. Have you noticed changes to Dry Run Creek over the time you have owned, operated, or resided at this location?
   - ❑ No
   - ❑ Yes. If yes, please describe change.

   ____

   ____

   ____

   ____

   ____

8. In the past, there has been **flooding** that has occurred along Dry Run Creek. The City of Cedar Falls has constructed retention basins in various locations to reduce the amount of flooding that periodically occurs.

   Do you see flooding as a reoccurring problem along Dry Run Creek?
   - ❑ Yes
   - ❑ No (if no, please, skip to question 10)

Where along Dry Run Creek do you find flooding to be a problem?

Location: ____

What time of year did the flooding listed above occur: (Check all that apply)

- ☐ Spring (March-May)
- ☐ Fall (September – November)
- ☐ Summer (June – August)
- ☐ Winter (December- February)

How frequently is the above location effected by flooding of Dry Run Creek?

- ☐ Every 2 years
- ☐ My location is never effected by flooding
- ☐ Once a year
- ☐ Other: ______________________________
- ☐ Twice a year

9. Do you have any other comments about Dry Run Creek related to potential conservation practices that will enhance water quality?

____

____

____

____

____

Thank you for completing this questionnaire. Your participation is greatly appreciated! The success of this project depended on the amount of support from the watershed community and land users. **Your response by January 25, 2005 is greatly appreciated.** Please use the enclosed envelope.

Surveys should be returned to:

Kathleen G. Scholl, Ph.D.
203 WRC
University of Northern Iowa
Cedar Falls, Iowa 50614-0241

Figure 3.3.2. Stream Channel Analysis Worksheet

Stream Corridor Assessment Worksheet

Site No. ____________________ Date: ____ / ____ / 04

Predominant Land Use (75 feet on either side of stream while looking downstream)

Left Bank: row crop trees grassland pasture urban/residential other ____________

Right Bank: row crop trees grassland pasture urban/residential other ____________

If livestock access is an issue, on which side(s) of the stream?	Left Right Both
If riparian dominated by grass, are they warm or cool season species?	Warm Mixed Cool
If point-source runoff flows untreated to the waterbody, from which source?	Urban Farmstead ______

	0-10%	10-25%	25-50%	50-75%	>75%
Degree of woody and/or herbaceous canopy cover over stream	1	2	3	4	5

If riparian trees are present, pick the three most predominant species:

Hybrid Poplar	Silver Maple	White Ash	Hackberry
Hybrid Cottonwood	Basswood	Green Ash	Ohio Buckeye
Cottonwood	Black Walnut	Black Ash	Sycamore
Boxelder	Red Elm	White Elm	Honey Locust
Black Locust	Mulberry	Sugar Maple	Bitternut Hickory
Hybrid Willow	Red Oak	River Birch	Swamp White Oak
Black Willow	Burr Oak	Shellbark Hickory	Eastern Red Cedar

Other: ____________________

Avg. Bank Height (ft.) =

	Rock		Gravel		Sand		Silt
Bank Material	1	2	3	4	5	6	7

	Stable		Moderately Stable		Moderately Unstable		Unstable		Artificially Stable
Bank Stability Class	1	1.5	2	2.5	3	3.5	4		or

	Uniform Depth Uniform Width	Somewhat Variable	Natural Pool & Riffle
Degree of hydrologic variability in the stream channel	1	2	3

	None	< 1 pool / 250 ft	> 1 pool / 250 ft	Frequently > 3 ft.
Frequency of pools deeper than 3 feet	1	2	3	4

	Cobble		Gravel		Sand		Silt
Dominant Substrate:	1	2	3	4	5	6	7

	Completely Exposed	Partially Exposed	Mostly Embedded
If substrate is rock/gravel, how embedded are they in silt or clay?	1	2	3

	None	<30% of Segment	30%-60% of Segment	>60% of Segment
Degree of in-stream habitat (i.e. large boulders, logs, root wads)	1	2	3	4

Figure 4.1.3.1 Candidate Causes of Impairment

Table 4 Dry Run Creek Watershed aquatic life use impairment candidate causes and probability rankings: (1) high; (2) medium; (3) low.

- Toxins (sediment and water)
  - Metals
    - Arsenic (2.5)
    - Cadmium (2.5)
    - Chromium (2.5)
    - Copper (2.5)
    - Lead (2.5)
    - Mercury (2.5)
    - Selenium (2.5)
    - Zinc (2.5)
    - Other
  - Non-Metals
    - Chlorine (1)
    - Cyanide (3)
    - Oil / grease (2)
    - PAHs (2)
    - Pharmaceuticals (3)
    - SOCs (3)
    - Unionized ammonia (2)
    - Other
  - Pesticides
    - Fungicides (3)
    - Herbicides (2)
    - Insecticides (1.5)
    - Other
- Water quality characteristics
  - Chlorophyll a (2)
  - Dissolved oxygen (1)
  - Nutrients
    - Nitrogen (2)
    - Phosphorus (2)
  - pH (3)
  - Salinity / TDS (2)
  - Turbidity / TSS (1.5)
  - Water temperature (2)
- Habitat Alterations
  - Bank erosion (1.5)
  - Channel incision / loss of floodplain connectivity (2)
  - Channel Straightening (1)
  - Dewatering (3)
  - Excessive algae/macrophyte growth (2.5)
  - Flow impoundment (3)
  - Lack of woody debris / channel roughness and structure (2)
  - Physical barriers (1.5)
  - Riparian vegetation loss (1)
  - Sedimentation (2)
- Hydrologic Alterations
  - Flow diversion (3)
  - Flow regulation (dams) (2)
  - Pumping (withdrawals) (3)
  - Subsurface tile drainage (2)
  - Urban stormwater outfalls (1)
  - Wetland loss (3)
- Exotic/Introduced Species and Other Biotic Factors
  - Competition (3)
  - Disease (3)
  - Endrocrine disruption (3)
  - Harvest (3)
  - Refugia depletion/isolation (2)
  - Predation (3)

Figure 6.1 Equipment List

Item	Location	Purpose	Maintenance Needs
First Flush Unit	Towers Parking Lot	Runoff Sampling	Collect after rainfall events
First Flush Unit	Price Lab Parking Lot	Runoff Sampling	Collect after rainfall events
First Flush Unit	Kwik Star Parking Lot	Runoff Sampling	Collect after rainfall events
First Flush Unit	BCS Cells	Runoff Sampling	Collect after rainfall events
First Flush Unit	McLeod Parking Lot	Runoff Sampling	Collect after rainfall events
Lysimeter	Towers Biocell	Vadose Sampling	Collect after rainfall events & Dry periods
Lysimeter	BCS Cells	Vadose Sampling	Collect after rainfall events & Dry periods
Lysimeter	McLeod Parking Lot	Vadose Sampling	Collect after rainfall events & Dry periods
Lysimeter	College Hill Streetscape	Vadose Sampling	Collect after rainfall events & Dry periods
Pressure Transducers (4)	University Branch - DRC	Flow/CFS	Remove sediment from sensors periodically
pH reader	portable unit	Field monitoring	Regular calibration
DO & Temp Sensor	portable unit	Field monitoring	Monthly calibration
Turbidimeter	portable unit	Field monitoring	Regular calibration
Temperature Sensor	McLeod Parking Lot	Subdrain chamber monitoring	Winter maintenance
Temperature Sensor	WRC Parking Lot	Subdrain chamber monitoring	Winter maintenance
Rain Gauge	McLeod Center Rooftop	Weather Monitoring/Rainfall Data	TBD

Purchased, Need Placement	Price	Justification
Temperature Gauge	$ 650.00	In-stream ongoing temp measurement in University Branch
Chlorine Meter	$ 345.00	Monitoring effluent discharge from UNI, other sites in town
First Flush Units (6)	$ 1,200.00	Additional sampling sites - including un-treated areas

Figure 6.2 Monitoring Agreement

Term Agreement

Urban Monitoring Program

To: Robert N. Hansen, Chair

From: Iowa DNR – Watershed Assessment & Monitoring Section

CC: Paul Meyermann, UNI Facilities & Physical Plant

Date: November 10, 2008

Re: Monitoring Equipment for the Dry Run Creek Project

Purpose

This agreement is to define objectives, roles, and responsibilities as they related to partners associated with urban water quality monitoring efforts within the Dry Run Creek watershed.

Scope

This agreement applies only to equipment that was purchased with dollars from the Watershed Improvement Review Board (WIRB) grant to address water quality concerns within the Dry Run Creek watershed.

Roles

Black Hawk SWCD – As the fund manager for the WIRB grant, Black Hawk SWCD administers and allocates funds through December 31, 2008 for equipment, lab analysis and materials related to monitoring conducted within the watershed.

Iowa DNR – WAMS – DNR provides staff time and resources to operate and maintain equipment. This includes portable equipment used in the field as well as fixed instruments which are or will be installed tot gather data from within the watershed.

UNI – Equipment that is to be installed or requires temporary storage will be held at UNI within a storage facility managed by UNI Physical Plant. UNI permits access to campus to install, maintain or remove equipment to Iowa DNR and Black Hawk SWCD as is necessary for proper function and data collection.

Responsibilities

Black Hawk SWCD – Should additional funds be sought for expanded monitoring and data collection efforts within the watershed, Black Hawk SWCD would serve as a local resource to manage funds and assist DNR with data collection periodically.

Iowa DNR –Iowa DNR is expanding monitoring efforts within urban areas, using protocols and methods that were developed as part of the Dry Run Creek watershed project. Because DNR staff remain dedicated to monitoring efforts within the Dry Run Creek watershed project, this location will serve as an initial test site for future developments in urban watershed monitoring and assessment.

UNI – Several practices being monitored for water quality and performance are located on the UNI campus. As a result, UNI serves as a primary resource for physical data collection, as well as student involvement with monitoring efforts.

Communications

Black Hawk SWCD – Should future funds be sought by Black Hawk SWCD for improvements in the Dry Run Creek watershed, Black Hawk SWCD will be requested to inform other partners listed in this agreement of status, details and requests for future support related to water quality monitoring.

Iowa DNR – As data is collected throughout all DNR urban watershed monitoring efforts, information will be available to partners. Quarterly monitoring reports will be made available to all parties.

UNI – Should monitoring and data collection efforts be featured at University-sponsored events or other means of promotion, partners shall be informed and potentially requested to present or develop information to assist with technology transfer.

Maintenance & Operations

Black Hawk SWCD – The District is responsible for operations only of equipment under warranty that is purchased with WIRB funds. Should an item be purchased with WIRB funds and function improperly while under warranty, Black Hawk SWCD, at its option, may obtain refunded dollars or replacement equipment.

Iowa DNR – Because monitoring efforts are anticipated to extend beyond the term of the WIRB grant, Iowa DNR assumes responsibility for obtaining, maintaining and operating additional equipment needed for purchase beyond December 31, 2008.

UNI – As the primary location for urban monitoring efforts in Black Hawk County, equipment will be stored for use on the UNI Campus under a previous agreement with Paul Meyermann and UNI Facilities & Physical Plant.

Cancellation of Agreement

Any of the three parties may cancel this agreement at any time by giving a 90 day written notice each to the other party.

Agreement of Terms

By signing this agreement, I agree to abide by these terms and consider other signatures partners in this urban water quality monitoring effort, as of the date first written above.

Robert N Hansen 11/11/08

Robert N. Hansen, Black Hawk SWCD Date

Mary Skopec 12/12/08

Mary Skopec, PhD, Iowa DNR Date

Paul Meyermann 11/10/08

Paul Meyermann, UNI Facilities & Physical Plant Date