Facilities Plan Update

Henderson Water Utility

North Wastewater Treatment Plant

June 2012

Henderson Water Utility
111 Fifth Street
Henderson, KY 42420
www.hkywater.org

HENDERSON WATER UTILITY

Water • Wastewater • Stormwater

MANAGED BY THE CITY OF HENDERSON WATER & SEWER COMMISSION

BRUCE L. SHIPLEY, PE
GENERAL MANAGER

11 June 2012

Anshu Singh, PhD, Supervisor
Wastewater Planning Section
Water Infrastructure Branch
Kentucky Division of Water
200 Fair Oaks Lane, 4th Floor
Frankfort, Kentucky 40601

RE: Regional Facilities Plan – North WWTP
Henderson Water Utility (HWU)
Henderson, Kentucky

Dear Anshu:

Attached find a Regional Facilities Plan for Henderson's North Wastewater Treatment Plant. This plan was prepared in-house by HWU, with assistance from J.R. Wauford & Co., Consulting Engineers, and is being submitted in accordance with the requirements of 401 KAR 5:006.

Please do not hesitate to contact me at 270.869.6621, if you have questions or need additional information.

Sincerely,

HENDERSON WATER UTILITY

Tom Williams, P.E.
Director of Engineering

Cc: Bruce Shipley, P.E., HWU
Greg Davenport, P.E., J.R. Wauford

STATE OF KENTUCKY
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Table of Contents

Chapter 1: INTRODUCTION

Purpose and Goals of this Plan 1-1
Background 1-2
Planning Area Descriptions 1-2
Recommended Alternatives 1-3
Summary of Estimated Costs 1-3
Schedule of Implementation 1-3

Chapter 2: STATEMENT OF NEED

Introduction 2-1

Chapter 3: PHYSICAL CHARACTERISTICS OF THE PLANNING AREA

Planning Area and Service Area Boundaries 3-1
Topographic and Geographic Features 3-1
Land Use 3-2
Floodplain 3-3
Future Service Area 3-3

Chapter 4: SOCIOECONOMIC CHARACTERISTICS OF THE PLANNING AREA

Introduction 4-1
Population Trends 4-1
Socio-Economic Conditions 4-2
Income and Poverty Status 4-3

Chapter 5: EXISTING ENVIRONMENT

Introduction 5-1
Physical Land Features 5-1

Topography 5-1
Geology 5-1
Soils 5-1
Floodplain 5-3
Wetlands 5-3
Water Sources and Supply 5-3

Surface and Groundwater Hydrology 5-4

Climate and Precipitation 5-4
Air Quality 5-4
Biological Resources 5-6
Archeology & Historic Sites 5-7
Impact of State and Federal Projects 5-7

Chapter 6: EXISTING WASTEWATER SYSTEM FACILITIES

Introduction 6-1
Collection System Description 6-1

General 6-1
Downtown (Ohio River) Drainage Basin 6-1
Canoe Creek Drainage Basin 6-2

North Wastewater Treatment Plant (NWWTP) 6-4

General Description of Unit Processes 6-4
Unit Process Summary 6-5
Effluent Limits 6-8
Influent Flows and Loadings and Effluent Parameters 6-8

Treatment Plant Performance Summary 6-15
Major Industrial Users 6-18
Facilities Operation and Maintenance Staff 6-19
Biosolids Disposal 6-20
Small Disposal Systems 6-20
Unsewered Areas 6-20

Chapter 7: FUTURE CONDITIONS

Introduction 7-1
Wastewater Flow Projections 7-1

Base Wastewater Flow 7-3
Infiltration and Inflow 7-8
Summary of Wastewater Flows 7-9

Waste Load Projections 7-11
Collection System 7-11

General 7-11
Long-Term Control Plan for the CSS 7-11

Separation Projects 7-12
Verification of Effectiveness of CSO Controls 7-13

Pretreatment Program Efficiency 7-14

Chapter 8: EVALUATION OF ALTERNATIVES

No Action Alternative 8-1
Optimization of Existing Facilities 8-1
Regionalization 8-4
Treatment Alternatives 8-4
Detailed Cost Analysis 8-14
Recommended Alternatives 8-14

Chapter 9: CROSS-CUTTER CORRESPONDENCE

Threatened and Endangered Species 9-1
Historical Resources 9-1
Aquatic Resources 9-2
Agricultural Resources 9-2

Chapter 10: RECOMMENDED PLAN

Environmental Impacts 10-1
Institutional Structure 10-1
Funding Plan 10-1
Current and Projected User Charges 10-1
Implementation Schedule 10-2

Chapter 11: PUBLIC PARTICIPATION

Public Meeting and Comments 11-1

Chapter 1. REGIONAL FACILITY PLAN SUMMARY

A. PURPOSE AND GOALS OF THIS PLAN

The goal of this Facilities Plan Update is to develop a cost effective and environmentally sound strategy for improving the wastewater system in the City of Henderson's North Wastewater service area to accommodate existing needs and projected growth to the year 2030. Henderson County faces the potential for significant future growth with the construction of Interstate 69, connecting our region to the upper Midwest and Canada, and to the American Southwest and Mexico. Planning for that growth must start now.

Specific objectives of the Facilities Plan include:

- Review and evaluate existing Henderson Water Utility (HWU) wastewater treatment facilities at the North WWTP to assess their current physical condition, capacities, and improvement needs;
- Perform a review for compliance with existing, proposed and anticipated Clean Water Act regulations and the North plant's KPDES permit;
- Study the treatment train and develop cost-effective treatment strategies and process improvements for the North WWTP;
- Incorporate the results of the Long Term Control Plan and consent judgment in relation to CSO control and abatement;
- Update the existing hydraulic model of the collection system, utilizing software that takes advantage of HWU's investment in GIS;
- Use the model to evaluate the collection system, reviewing capacities, maintenance and improvement needs;
- Plan and schedule future collection system expansions and large maintenance and rehabilitation projects; and
- Update HWU's capital improvement program (CIP) to include projected wastewater system enhancements.

Recommended capital improvements in this plan will serve as a basis for the design, construction, and financing of facilities to meet Henderson's wastewater needs for the next 20 years. The recommended system improvements are those required to provide adequate and dependable wastewater collection and treatment systems to existing and future customers, while reducing combined sewer overflows to acceptable levels, and taking into consideration population trends, changes in water use, regulatory requirements, and the ability of HWU's customers to bear the costs of the proposed improvements.

A further goal of this effort is to make this Facilities Plan an ongoing process, with periodic updates and revisions that allow HWU to maintain an organized, documented approach to planning, allowing decision-making to be well-informed and transparent.

B. BACKGROUND

The Henderson Water Utility (HWU) is the management entity for both water and wastewater services in the City of Henderson and in some areas of Henderson County. The Water and Sewer Commission and the General Manager oversee the operation of HWU and its two wastewater treatment plants, along with two drinking water plants. The North wastewater treatment plant (NWWTP) is located within the Henderson city limits and was originally constructed as a primary treatment facility in 1954 and upgraded to secondary treatment in 1975. In 1991 the NWWTP was expanded to a capacity of 7.5 million gallons per day (mgd), with a subsequent expansion in 1996 to 15.0 mgd. In conjunction with the treatment plant, approximately 130 miles of collection lines have been constructed as a part of the HWU system. The South wastewater treatment plant (SWWTP) was constructed in southern Henderson County near the Webster County line in 1995 and early 1996. The SWWTP has a 4.0 mgd treatment capacity and was constructed to serve residential, commercial, and industrial facilities in portions of Henderson, Webster and McLean Counties. Due to the distance separating the two wastewater service areas, a separate and distinct planning area was designated for the SWWTP, and a separate Facilities Plan will be produced for that plant.

The primary documents used in the planning process as a guide to expanding the Henderson wastewater system include the Henderson, Kentucky 201 Facilities Plan Update – Henderson, Kentucky Planning Areas, June 1996; the revised HWU Combined Sewer Overflow Long-Term Control Plan (LTCP), September 2011; and the Henderson – Henderson County Comprehensive Plan, August 2006.

C. RECOMMENDED ALTERNATIVES

Henderson has chosen to implement Alternative No. 1, Renovation of the Existing Lagoon Extended Aeration Process as an interim step, with Alternative No. 2, Construction of an Oxidation Ditch, as an ultimate goal.

Alternative No. 1 is being studied as an interim measure, for two reasons. First, Henderson has significant investment in the existing plant which is not fully depreciated, nor at the end of its useful life. In order to reap the full benefits of these sunk costs, Henderson desires to extend the life of the current plant assets to the maximum extent possible. However, the existing Extended Aeration Process will likely not be able to remove nutrients without substantial modification and increased operational costs due to chemical addition.

Given these two conditions, Henderson has chosen the Construction of an Oxidation Ditch, as a follow-up project after Alternative No. 1 is constructed and has been in operation for some time. Construction of the Oxidation Ditch alternative will only be pursued if nutrient removal is required in a future KPDES permit.

D. SUMMARY OF ESTIMATED COSTS

Cost estimates for the Alternatives to be constructed are shown in attachments to Chapter 8. The costs are estimated at $ 12,070,000 for Alternative No. 1, and $ 16,360,000 for Alternative No. 2 (as a follow-up project to Alternative No. 1).

E. SCHEDULE OF IMPLEMENTATION

Design of the project outlined in Alternative No. 1 - Renovation of the Existing Lagoon Extended Aeration Process, will begin in late 2012. Construction is scheduled to begin in the second quarter of 2013, with completion in early 2015.

Other projects in the plan related to Henderson's Long-Term Control Plan for the reduction of combined sewer overflows include the Canoe Creek Interceptor (Phase II), currently under construction; two further phases of the Canoe Creek project, scheduled for construction in 2013 and 2015, and the Center & Julia Phase III project, scheduled for construction in 2013.

F. WATER QUALITY OBJECTIVES

The water quality objectives for this Facilities Plan are consistent with mandates established by the Federal Clean Water Act: to prevent degradation and maintain surface water quality. Pursuant to Kentucky Revised Statutes (KRS) 224.034, facilities operated by HWU must comply with their Kentucky Pollutant Discharge Elimination System (KPDES) permits. Table 1-1 shows the KPDES permitted effluent limits for the North WWTP. The KPDES permit for NWWTP is permit number KY0020711, issued in November 2009, effective as of 1 January 2010, and expiring on 31 December 2014. A copy of the permit is provided in Appendix A.

Table 1-1
KPDES Permit Discharge Limits
Henderson North Wastewater Treatment Plant

Parameter	Monthly Average	Weekly Average	Other
Design Capacity	---	---	15.0 MGD [1]
BOD_5 [2]	30 mg/L [3]	45 mg/L	---
TSS [4]	30 mg/L	45 mg/L	---
Escherichia Coli (N/100 ml) [5]	130/100 [7]	240/100 [7]	---
NH_3-N [6]	20 mg/L	30 mg/L	---
Dissolved Oxygen	2 mg/L (Minimum)	2 mg/L (Minimum)	---
Total Residual Chlorine	0.019 mg/L	---	0.019 mg/L (daily minimum)
Bio-Monitoring	---	---	1.0 acute toxicity unit

Notes: 1 – MGD - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – mg/L - Milligrams per liter
4 – TSS - Total suspended solids
5 – N/100 ml – Number per 100 milliliters
6 – Ammonia Nitrogen
7 – 30-day and 7-day Geometric Means

Chapter 2. STATEMENT OF NEED

A. REASONS FOR PERFORMING A PLAN UPDATE

Under the Federal Clean Water Act, Kentucky and the other states are required to establish and maintain a continual planning process to provide for the control of water pollution. KRS 224.10-100 requires the Energy and Environment Cabinet to develop comprehensive plans for the management of water resources, and to provide for the prevention, abatement and control of water pollution. Administrative regulations contained in 401 KAR 5:006 establish Kentucky's regional facility planning process for publicly-owned wastewater treatment works that are point sources of pollution in designated planning areas.

The Cabinet has designated the Henderson Water Utility as the regional planning agency for the areas of Henderson County and surrounding counties served by HWU. Henderson has submitted facility plans in the past, most recently in 1996 for the North system, and in 2000 for the South system.

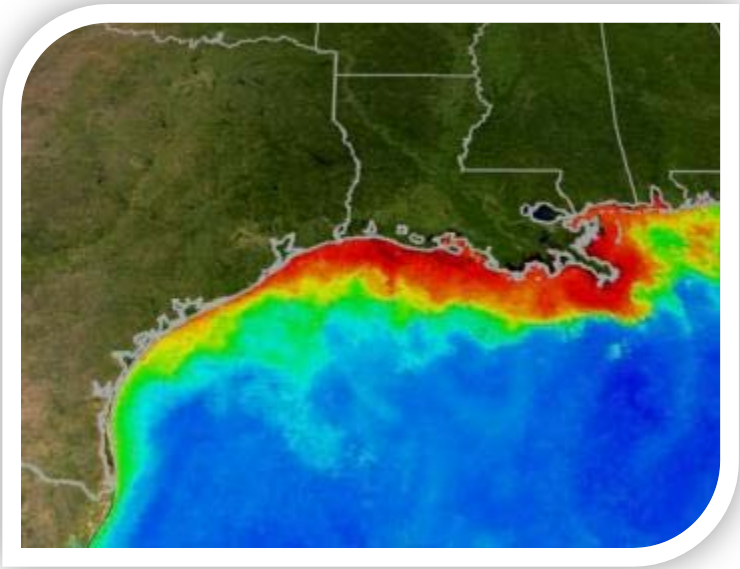
401 KAR 5:006 requires submittal of a new regional facility plan when a new wastewater plant is to be constructed, or when an existing plant's capacity is to be expanded by more than 30 percent. In this case, HWU proposes to expand the capacity of the North Wastewater Treatment Plant (NWWTP) by 70 percent initially (from 15 to 25.5 MGD), with an eventual capacity increase to 36 MGD, an increase of 140 percent over existing capacity.

Henderson's decision to expand the NWWTP is based in part on requirements of a Consent Judgment between the Cabinet and the City of Henderson/Henderson Water Utility entered in August, 2007, and on preliminary engineering studies begun as design of the required projects commenced. This judgment stipulated the completion of a Long-Term Control Plan (LTCP) for management of combined sewer overflows (CSO). Henderson submitted its LTCP in March 2009, and final comments on the plan were received in summer 2011. Henderson's responses to these comments were delivered in September 2011, and final approval was received in April 2012.

The LTCP contains several projects intended to implement HWU's "transport and treat" strategy, which is designed to reduce CSO discharges to acceptable levels by intercepting sanitary sewer flows and transporting them to the NWWTP for treatment.

Henderson's strategy for implementation of these projects consists of a phased approach which will allow the existing treatment facilities to be utilized to the maximum extent possible, in order to spread out the costs of the eventual process train build-out over time. This will allow construction of the needed facilities in an orderly, planned manner, without undue financial burdens on rate-payers.

Regulatory trends also have an impact on HWU's plans. Nutrient limits, related to the hypoxic zone in the Gulf of Mexico, are likely to be imposed on Kentucky wastewater treatment facilities in the not-too-distant future. The existing treatment processes at the NWWTP cannot be easily modified to achieve expected limitations on discharges of phosphorus and nitrogen. HWU's plant expansion strategy takes this into account, and envisions the eventual 36 MGD plant containing an oxidation ditch or other technology that will facilitate nutrient removal.



Summertime satellite observations of ocean color from MODIS/Aqua show highly turbid waters which may include large blooms of phytoplankton extending from the mouth of the Mississippi River all the way to the Texas coast. When these blooms die and sink to the bottom, bacterial decomposition strips oxygen from the surrounding water, creating an environment very difficult for marine life to survive in. Reds and oranges represent high concentrations of phytoplankton and river sediment. Image taken by NASA and provided courtesy of the NASA Mississippi Dead Zone web site.

Chapter 3. PHYSICAL CHARACTERISTICS OF THE PLANNING AREA

A. PURPOSE

This section delineates the planning area boundaries and describes key topographic, geographic and pertinent natural or man-made features of the area.

B. SERVICE AREA BOUNDARIES

The Henderson Water Utility operates two distinct service areas, referred to as the North Service Area and the South Service Area. The limits of the North Service Area are shown on Figure 3-1, and they are generally described as:

- *Henderson Facilities Planning Area – North Service Area*: The planning area includes the City of Henderson and adjacent fringe areas. The major wastewater customers to be served by facilities within the planning area include the City of Henderson, adjacent areas of Henderson County and the City of Corydon, as well as several large industries in areas to the south and west of the City. Service may be provided at some point in the future to areas outside the current sewer system, including the communities of Zion, Baskett and Geneva, as well as areas that may be impacted by the future construction of I-69.
- *Henderson Facilities Planning Area – South Service Area*: The planning area includes a portion of southern Henderson County, a portion of northern Webster County, and a portion of western McLean County. The major wastewater customers to be served by facilities within this planning area include the Tyson Foods Poultry Processing Plant, a nearby industrial area, the Tyson Foods Rendering Plant, the Tyson Foods Hatchery, the Town of Robards and the City of Sebree. The South Service Area is not addressed in this report, as it is separate and not interconnected with the North area.

C. TOPOGRAPHIC AND GEOGRAPHIC FEATURES

Henderson County, located in western Kentucky along the Ohio and Green Rivers, has an area of 440 square miles and is ranked 23rd out of Kentucky's 120 counties in terms of land area. A change in the river's course isolated a small portion of the county on the north shore of the Ohio River. The City of Henderson is the County seat and is located on the Ohio River at the junction of U.S. Highways 60 and 41. Henderson's location on the river has made it an important river port. However, since the City is located on a bluff, it has not suffered flood damage as have many other Ohio River towns. Henderson County has two other incorporated towns: Corydon in the western portion of the County is a fifth class city incorporated in 1868, and Robards, located in the southern portion of the County is a sixth class city incorporated in 1997.

Henderson County is located in the Western Kentucky Coalfield Physiographic Region. This region comprises the southern edge of a larger geologic feature called the Illinois Basin, which includes the coal fields of Indiana and Illinois to the north. Quaternary sediments are also present, and are mostly restricted to the floodplains of rivers and creeks. These sediments consist mostly of silts, sands, gravel and clay eroded from Paleozoic rocks. However, some contain rocks that were transported into areas along the Ohio River by melt waters from glacial ice.

The topography of Henderson County is characterized by flat lowlands and rolling uplands. The flat lowlands are typically associated with river sediment deposits and are mostly used for cropland. Land use in these areas is limited due to seasonal flooding. The rolling uplands in the county are typically associated with eroded loess deposits and are used for cropland, pasture land, and residential and commercial development. The broad floodplain along the Ohio River has elevations of 350 to 370 above mean sea level. The normal pool of the Ohio River at Henderson is 331 feet. The highest elevations in the County are found in the bluffs adjacent to the Ohio and Green Rivers. At Wolf Hills, northeast of Henderson, the highest elevation in the County is 588 feet, which is more than 200 feet above the adjacent flood plain.

D. LAND USE

Henderson and Henderson County have planning and zoning. Through its Comprehensive Plan, Henderson has land use policies that purport to encourage residential growth in areas where transportation, utilities and public services are available. Low intensity residential uses are encouraged only where on-site wastewater disposal can be used. Commercial activities are encouraged where a support population exists, in areas adjacent to existing or planned commercial facilities, or areas accessible to existing transportation facilities. Industrial development is encouraged in dispersed industrial subdivisions where transportation facilities are available. Recent growth in Henderson has followed these guidelines; future growth can be expected to follow them also. A land use map for Henderson is shown in Figure 3-2.

The majority of residential, commercial, and industrial development in the County should be expected to occur in, adjacent to, or near Henderson. The U.S. Department of Agriculture Natural Resources Conservation Services has compiled land uses in Kentucky Counties as part of its National Resource Inventory. The information from the inventory for Henderson County is shown in Table 3-1.

The predominant land uses in Henderson County is cropland, forests, and pastureland. Urban and built-up areas constitute a relatively small fraction of the total land use. Land use is not expected to change significantly throughout the planning period.

Table 3-1
Land Use in Henderson County

Land Use	*Acres*	*Percentage of Total*
Cultivated Cropland	162,000	54.5
Non-Cultivated Cropland	8,400	2.8
Forest	49,500	16.6
Miscellaneous/Minor Land	8,100	2.7
Pastureland	25,800	8.7
Rural Transportation (roads & railroads)	7,200	2.4
Urban, small and large	14,900	5.0
Water-Large Streams (> 660 ft wide, or 40 acre water bodies)	18,100	6.1
Water-Small Streams (all others)	3,500	1.2
Total	297,500	100.0

Source: Natural Resources Conservation Service, National Resources Inventory, downloaded September 2011.

E. FLOODPLAIN

The Canoe Creek, Green River, and Ohio River floodplains cover a significant fraction of the planning area. Approximately 30 percent of the land in Henderson County is subject to flooding. Much of this land lies outside the North service area, adjacent to the Ohio and Green Rivers, both upstream and downstream of Henderson. Henderson's downtown and most residential areas of the City are well above the 100-year flood elevation for river flooding. The most significant watershed in the county is Canoe Creek, which covers approximately 75,000 acres and drains most of the City of Henderson. Portions of the Canoe Creek watershed are affected by backwater flooding from the Ohio River.

During "normal" years, January, February, March, April and December are months when extended periods of wet weather are accompanied by extended periods of high river levels, and generally higher groundwater levels. River flooding is highly variable from year to year. During 2010 the spring flood season was practically non-existent; in May 2011, the spring flood was the 8th highest ever recorded.

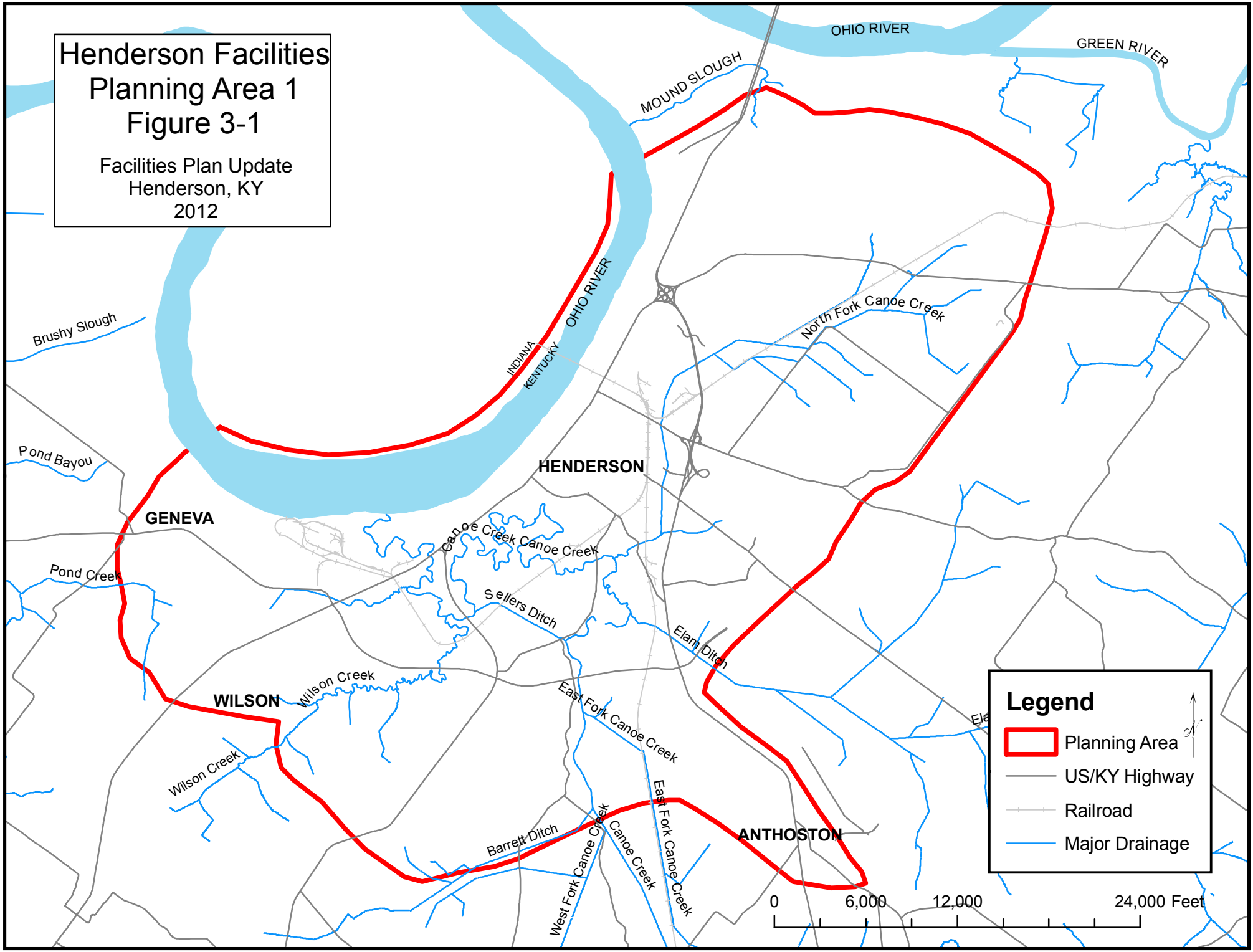
F. FUTURE SERVICE AREA

As development occurs in the Service Area, expansion of the existing collection system to provide service will be necessary. Areas projected to require service within a five year period include those immediately adjacent to the current City Limits, including areas on Highway 60 East and West, near the Henderson Riverport, along US 41A between the City Limits and Canoe Creek (Finley Addition), and along outer Second Street – Zion Road. Development along the KY 425 Bypass is feasible, but has been slow to occur.

Some areas adjacent to the North Service Area are unlikely to develop because of restrictions on development due to floodplains and potential flooding. These include lowland areas subject to Ohio River flooding in the Horseshoe Bend area, and the large parcel of Kentucky land that lies north of the Ohio River, around Ellis Park.

As the development of the new route for Interstate 69 progresses, expansion of sewer service to areas near interchanges on US 60 East and on KY 351 (Zion Road) will be necessary. At present, forecasts are for I-69 to not be developed in the areas east of Henderson until at least 2025. Expansion of sewer service to this corridor will allow service extensions to outlying subdivisions, including Broadview, Country Club, Thornridge, Graham Hill, Happy Acres, and possibly the outlying small communities of Baskett and Zion.

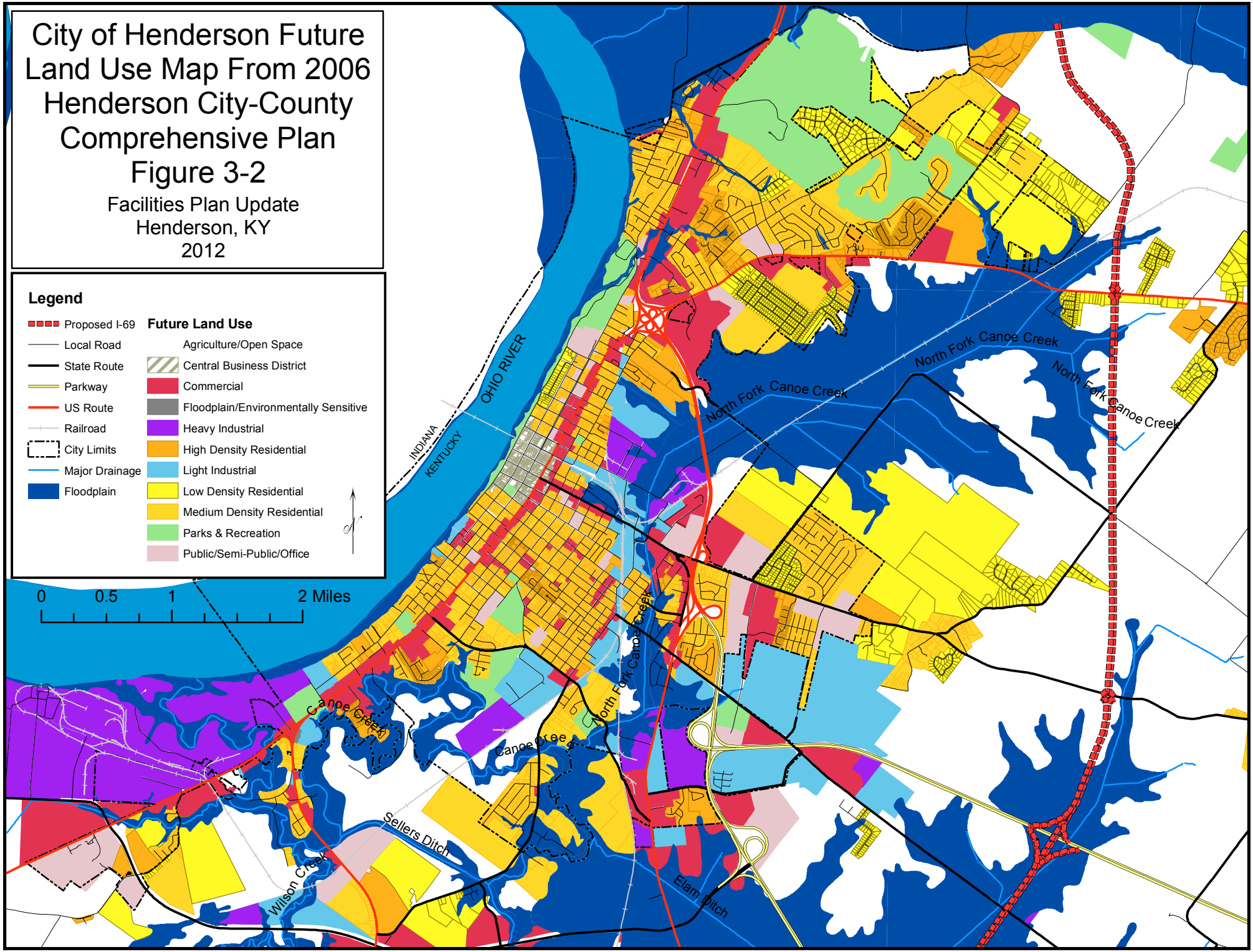
Since growth in the I-69 corridor is uncertain, and the corridor definition is not yet final, HWU does not propose to change the delineation of the North Service Area from that shown in the most recent (1996) Facilities Plan. At the time that the I-69 route is finalized, HWU may make changes to the Service Area boundary in an update to this facilities plan.


Henderson Facilities
Planning Area 1
Figure 3-1
Facilities Plan Update
Henderson, KY
2012
OHIO RIVER
GREEN RIVER
MOUND SLOUGH
OHIO RIVER
INDIANA
KENTUCKY
Brushy Slough
Pond Bayou
Pond Creek
GENEVA
HENDERSON
WILSON
ANTHOSTON
North Fork Canoe Creek
Canoe Creek
Canoe Creek
Sellers Ditch
Elam Ditch
Wilson Creek
Wilson Creek
East Fork Canoe Creek
East Fork Canoe Creek
Barrett Ditch
West Fork Canoe Creek
Canoe Creek
Legend
Planning Area
US/KY Highway
Railroad
Major Drainage
0
6,000
12,000
24,000 Feet

City of Henderson Future Land Use Map From 2006 Henderson City-County Comprehensive Plan

Figure 3-2

Facilities Plan Update
Henderson, KY
2012



Chapter 4. SOCIO-ECONOMIC CHARACTERISTICS OF THE PLANNING AREA

A. PURPOSE

This section reviews the current population trends in HWU's North System service area and summarizes future population projections. This section also presents data on socio-economic conditions, labor force, and income and poverty conditions.

B. HISTORICAL POPULATION TRENDS

Henderson is currently the 10th largest city in Kentucky. Population data for Henderson, Henderson County and the Commonwealth of Kentucky from 1900 through 2010 are shown in Table 4-1. Since 1900 the population within the City of Henderson has almost tripled while the population of Henderson County has increased by almost 40 percent. During this same period, the population of Kentucky doubled. The 2010 population of Henderson County was 46,250, a 3.2 percent increase above the 2000 population.

Table 4-1
Population Trends
Henderson, Henderson County and Kentucky

Year	*Henderson*		*Henderson County*		*Kentucky*	
	Population	*Percent Change*	*Population*	*Percent Change*	*Population*	*Percent Change*
1900	10,272	--	32,907	--	2,147,174	--
1910	11,452	11.5	29,352	-10.8	2,289,905	6.6
1920	12,169	6.3	27,609	-5.9	2,416,630	5.5
1930	11,668	-0.1	26,295	-4.7	2,614,589	8.2
1940	13,160	12.8	27,020	2.7	2,845,627	8.8
1950	16,837	27.9	30,175	13.6	2,944,806	3.5
1960	16,892	<0.1	33,519	9.1	3,038,156	3.2
1970	22,976	36.0	36,031	7.5	3,220,711	6.0
1980	24,834	8.5	40,849	13.4	3,660,777	13.7
1990	25,945	4.5	43,044	5.4	3,685,296	0.7
2000	27,474	5.9	44,829	4.1	4,041,769	9.7
2010	28,757	4.7	46,250	3.2	4,339,367	7.4

Source: Kentucky State Data Center, University of Louisville (Downloaded Sept. 15, 2011)

Based on this data, there is no discernible correlation in population growth trends between Henderson, Henderson County, and the state as a whole.

C. SOCIO-ECONOMIC CONDITIONS

1. Labor Force/Employment

In March 2012, the civilian labor force in Henderson County was estimated at 22,449 persons. Of the total labor force, in Henderson County 20,745 were employed with 1,704 unemployed for an unemployment rate of 7.6 percent. The historical unemployment rate through most of the last decade has been about 5 percent, but the rate in Henderson County peaked at 12.6 percent in January 2010 (Source, Kentucky State Data Center).

Table 4-2 reflects the number of employees for each of ten employment classifications in December 2010, as well as the percentage of total employment for each sector. Agricultural employment in Henderson County represents a small percentage of the total labor force.

Table 4-2
Employment in Henderson County, September 2011

	Employment By Economic Sector	*Percent of Total Employment*	*Average Weekly Wages*
Services	11,092	41.0%	$ 596
Manufacturing	4,404	16.3%	838
Utilities & Transportation	3,539	13.1%	729
Education & Health Services	2,403	8.9%	710
Professional & Business Services	2,012	7.4%	510
Leisure & Hospitality	1,712	6.3%	238
Construction	856	3.2%	794
Finance, Insurance, Real Estate	487	1.8%	747
Natural Resources & Mining	374	1.4%	1,449
Information	185	0.7%	753
Other	1	0.0%	528

Source: U.S. Department of Labor, Bureau of Labor Statistics – Quarterly Census of Employment and Wages (downloaded 5.8.2012). Average Weekly Wage is Q3 2011 Data.

2. Total Annual Payroll and Average Pay per Employee

Kentucky Cabinet for Economic Development data indicates a more diverse non-agricultural economy in Henderson County than in some surrounding counties. Average weekly wages for the various employment segments are shown in Table 4-2. In 2011, services were the largest contributor to the total annual payroll in Henderson County, with manufacturing and utilities & transportation following closely behind.

In Henderson County, mining had the highest weekly salaries, and leisure and hospitality (restaurant and hotel workers) had the lowest. A list of the major employers in Henderson County is shown in Table 4-3.

Table 4-3 Major Employers in Henderson County		
Industry Name	*Description*	*Employment (2012)*
Tyson Foods Inc	Chicken slaughtering, processing & packaging	1,350
Gibbs Die Casting Corp	Aluminum & magnesium die castings, headquarters	650
Rio Tinto Alcan	Aluminum extrusion billets & ingots	488
Dana Corporation	Truck axles & brake components	370
Brenntag Mid-South Inc	Chemical blending, industrial chemical distribution	240
Audubon Metals LLC	Heavy-media separator and secondary specification aluminum alloy producer	195
Accuride Corp	Truck wheels & rims	182
Columbia Sportswear Company	Storage and distribution of footwear and apparel products	130
Sitex Corporation	Headquarters and uniform supply service	124
Sonoco	Aluminum & steel can ends	112
Hugh E Sandefur Training Center Inc	Vocational rehabilitation, manufacturing plant producing corrugated products; boxes, partitions, die cuts.	100
Service Tool & Plastics	Injection molded plastics	99
International Paper	Recycled linerboard	82
Royster's Machine Shop LLC	Machine shop, custom grinding, steel fabricating, arc & gas welding, lathe & mill work	71
Hercules Manufacturing Co	Insulated & dry freight truck bodies & trailers	70
Shamrock Technologies Inc	Teflon recycling, micronized polytetrafluoroethylene, dry lubricant powders.	67
Azteca Milling LP	Milled Mexican corn flour	65
Cresline Plastic Pipe Co Inc	Plastic pipe & fittings	60
SGS North American Inc	Analytical coal testing	60
Matrix Composites Inc	Weave and knit fiberglass rolled good products	56

Source: Kentucky Cabinet for Economic Development (Downloaded – 7 May 2012)

3. Income and Poverty Status

The 2000 per capita, household and family incomes and poverty status for Henderson and Henderson County are shown in Table 4-4. Henderson County's poverty level is lower than both the State and National averages.

Table 4-4 Poverty Status and Income in Henderson County		
Category	*Henderson*	*Henderson County*
Number of Persons Below Poverty Level	4,376	6,627
Percentage of Persons Below Poverty Level	16.5 %	14.8 %
Number of Families Below Poverty Status	969	1,218
Percentage of Families Below Poverty Level	13.2 %	9.7 %
Per Capita Personal Income	$ 17,925	$ 18,470
Median Family Income	$ 39,887	$ 44,703

Source: Kentucky State Data Center, University of Louisville (2000 Census Data)

D. NORTH WWTP PLANNING AREA – POPULATION PROJECTIONS

Development of a wastewater system master plan starts with evaluation of an area's historic population trends and projected growth patterns. To accurately predict future wastewater demands, it is necessary to determine the trends of future population growth. Population data, obtained from the U.S. Census Bureau and the Kentucky State Data Center (KSDC), are presented in Table 4-5.

Table 4-5
Henderson County Historical and Projected Population
Source: Kentucky State Data Center

1990 Census	*2000 Census*	2010 Census	*2030 Estimated*
43,044	44,829	46,250	45,355

In the 1996 Sewer Master Plan, the population from the 2000 Census was estimated at 44,400, an underestimate of less than one percent, which is reasonably accurate. From 1990 to 2000, Henderson County's population grew by 4.1 percent, or approximately a 0.4% annual rate. According to the 2006 Henderson County Comprehensive Plan, the City of Corydon lost population from 1990 to 2000 (-4.0%), while the City of Henderson grew by 4.7%. The 2010 census population of Henderson County was 46,250, which indicates an annual rate of increase of approximately 0.3% from 2000 to 2010. This means that, while Henderson's population has grown steadily in recent years, the rate of increase has declined dramatically. Henderson County is experiencing the same population trends as the United States as a whole, namely, the birth rate is substantially lower than in the past, and migration is now the key component of growth. This reduction in growth has been especially prevalent in rural areas, and in the industrial upper Midwest.

The average household size for Henderson County was 2.47 persons per household in the 2010 census, based on 18,705 total households. This compares to a size of 2.56 in the 1990 census, and a size of 2.43 in 2000. Average household size is expected to continue a slow decline, reaching a rate of 2.35 in 2020 and leveling off (Source, Kentucky State Data Center). For purposes of this study, the average household size in 2011 is assumed to be 2.45 persons per household.

Historical and projected population for census tracts in Henderson County are shown in Table 4-6, based on data from the U.S. Census and the KSDC. This table shows that from 1990 to 2010, the US 60 East corridor in the northeast portions of the County (census tracts 207.01 & 207.02) had a combined increase in population of 23.3%. Tracts 206.01 and 206.01, the fringe areas of the City had about a 19% net increase. Tracts in the core of the City of Henderson (201 through 205) had a net combined decrease of 9.5%. The areas within the City limits that showed the largest net decrease were the northern two tracts (201 and 202), which had an average drop of 14%. Western and southeast areas of the County showed little change.

Population densities varied from 38 persons per square mile in western Henderson County, to nearly 2,500 per square mile in the Downtown core.

Table 4-6
Historical and Projected Population in Henderson County

Census Tract Identification	*Area (sq. miles)*	*1990 Census*	*2000 Census*	2010 Census	*GRADD 2030 Estimated*
201	1.0	2,095	1,755	1,775	1,906
202	0.71	1,967	1,723	1,719	1,852
203	0.33	2,018	2,019	1,936	2,168
204	1.00	2,621	2,632	2,566	2,801
205	1.08	2,712	2,464	2,337	2,647
206.01	5.66	5,771	6,357	6,454	6,868
206.02	5.80	3,980	4,428	5,129	4,867
207.01	79.21	4,238	5,407	5,908	5,777
207.02	39.39	5,936	6,446	6,633	6,902
208	110.40	4,274	4,359	4,479	4,574
209	192.69	7,432	7,239	7,314	7,664
City of Henderson	*15.13*	*25,945*	*27,474*	*28,757*	*29,036*
Henderson County	*482.41*	*43,044*	*44,829*	*46,250*	*48,149*

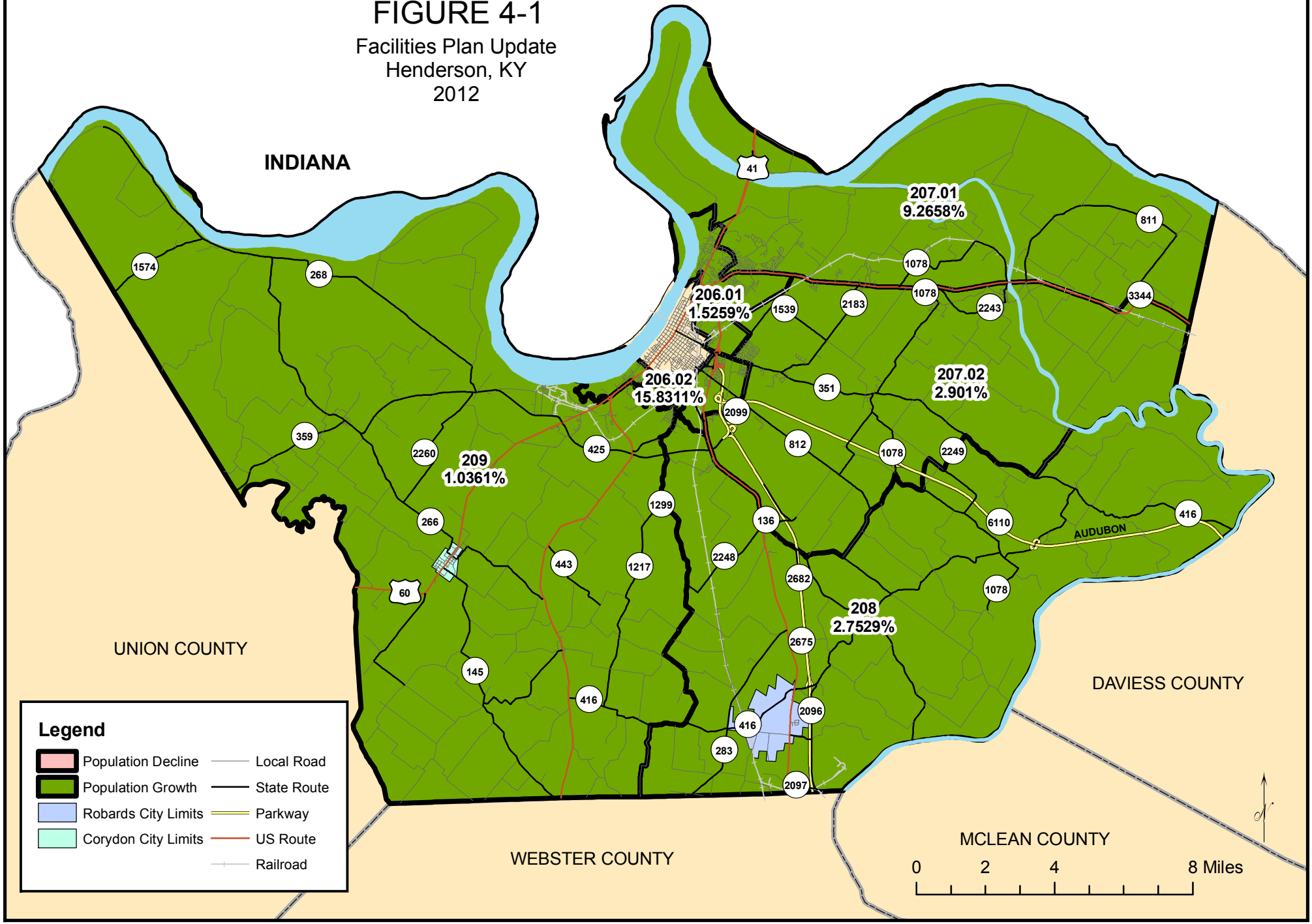
Note: Census Tract Maps are shown at the end of this Chapter as Exhibits 4-1 and 4-2.

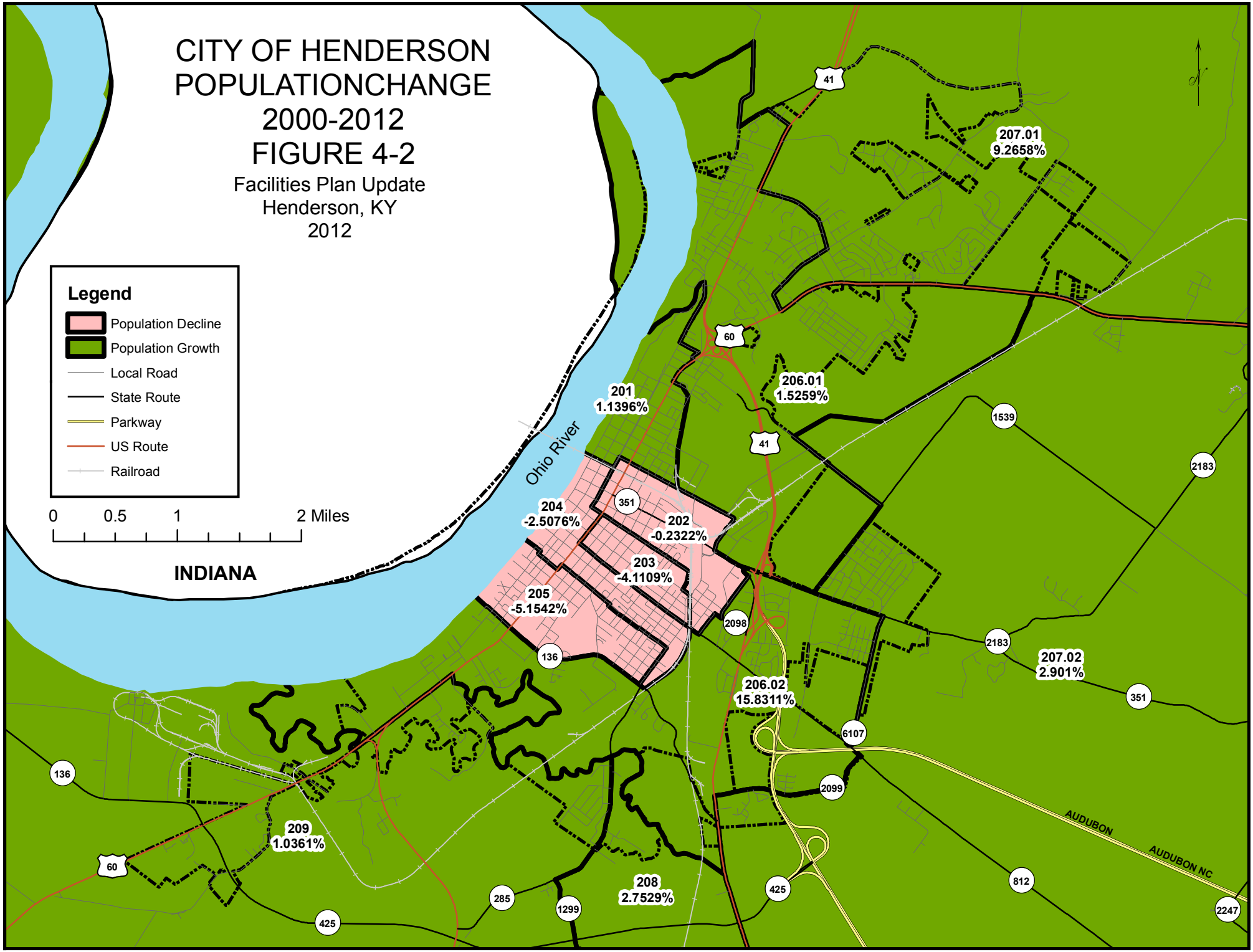
Population projections for Henderson County have also been developed by the Green River Area Development District (GRADD) and are shown in the far right column of Table 4-6, and shows growth of 4 percent in the County's overall population. GRADD's projections show population growth of 7 to 13 percent in the older, established portions of Henderson, including the Downtown, and the inner city and Audubon areas. This differs from the projections of the KSDC, which show little growth or a slight decline. Since treatment capacity is based on per-population estimates of water use, the more conservative approach of assuming 4 percent growth is being used.

From a delineation of the planning area and possible future growth in and adjacent to that area, HWU determined that 70 percent of Henderson County's total population could be served by the North WWTP. From the GRADD 2030 population estimate for Henderson County, this equates to a service area population of 33,700, the maximum number of people that potentially could be served by the Henderson North wastewater system. The current number of people served by the Henderson North WWTP is approximately 30,394. This includes the population of the City of Henderson (pop. 28,757), plus the City of Corydon (pop. 779), and an estimated number of about 350 households that are served by sewer but are outside the City Limits. If the entire available population for the North system were served by 2030, that would represent a 10.9 % increase from the current population served, assuming the GRADD population growth projections are correct.

HENDERSON COUNTY POPULATION CHANGE 2000-2010
FIGURE 4-1

Facilities Plan Update
Henderson, KY
2012




CITY OF HENDERSON
POPULATIONCHANGE
2000-2012
FIGURE 4-2
Facilities Plan Update
Henderson, KY
2012
Legend
Population Decline
Population Growth
Local Road
State Route
Parkway
US Route
Railroad
0
0.5
1
2 Miles
INDIANA
Ohio River
207.01
9.2658%
206.01
1.5259%
201
1.1396%
204
-2.5076%
202
-0.2322%
203
-4.1109%
205
-5.1542%
206.02
15.8311%
207.02
2.901%
209
1.0361%
208
2.7529%
AUDUBON
AUDUBON NC
41
60
351
136
2098
1539
2183
6107
2099
425
285
1299
812
2247

Chapter 5. EXISTING ENVIRONMENT

A. PURPOSE

This section describes existing physical, biological, cultural and other resource features within the planning area, and also reviews data on land features, floodplains, general climate and precipitation information, air quality, wetlands, and archeological and historic resources.

B. PHYSICAL LAND FEATURES

1. Topography

Henderson is located on the northern edge of the Western Coal Field physiographic region of Kentucky. Topography is generally rolling and somewhat hilly, with large relatively flat and poorly drained areas. Some very sharp hills rise near the edge of the Ohio River floodplain in the northernmost area of Henderson County, near Audubon Park.

The topography within the City of Henderson is flatter than the surrounding area due to the city's proximity to the Ohio River. Although the City abuts the Ohio River, much of the drainage in Henderson flows away from the river, to Canoe Creek. Downtown Henderson is about 70 feet above the low water level of the Ohio River and has not been flooded by the Ohio River in historical memory. The Ohio and Green River bottomlands account for 36 percent of the land in Henderson County, and are subject to spring flooding. Elevations in Henderson County range from greater than 500 feet above mean sea level (MSL) near Tunnel Hill to 360 feet MSL near the Ohio River. Figure 5-1 depicts major topographic and surface water features.

2. Geology

Geology is defined as a study of the composition, structure, and history of the earth. Henderson County is generally covered by alluvial and loess deposits which may reach as deep as 190 feet. The rocks underlying these alluvial/loess deposits are generally are a part of the Lisman formation of Upper Pennsylvanian age. The Madisonville Limestone is a predominant member of this formation. The rocks in the Lisman formation are predominantly shale, limestone, sandstone and coal. The principal minerals found in this formation are oil and coal.

3. Soils

Soils within any area are classified into distinct soil associations by the U.S. Soil Conservation Service. Each association consists of a combination of similar soils in specified fractions, fairly constant throughout a defined geographic area. Characteristics defining soil associations are

drainage, permeability, slope, depth, and type. The composition of each association will have an effect on groundwater recharge, drainage, construction methods and development costs. Figure 5-2 shows the locations of the soil associations for the area near the City of Henderson. General descriptions of the associations in the North WWTP planning area follow.

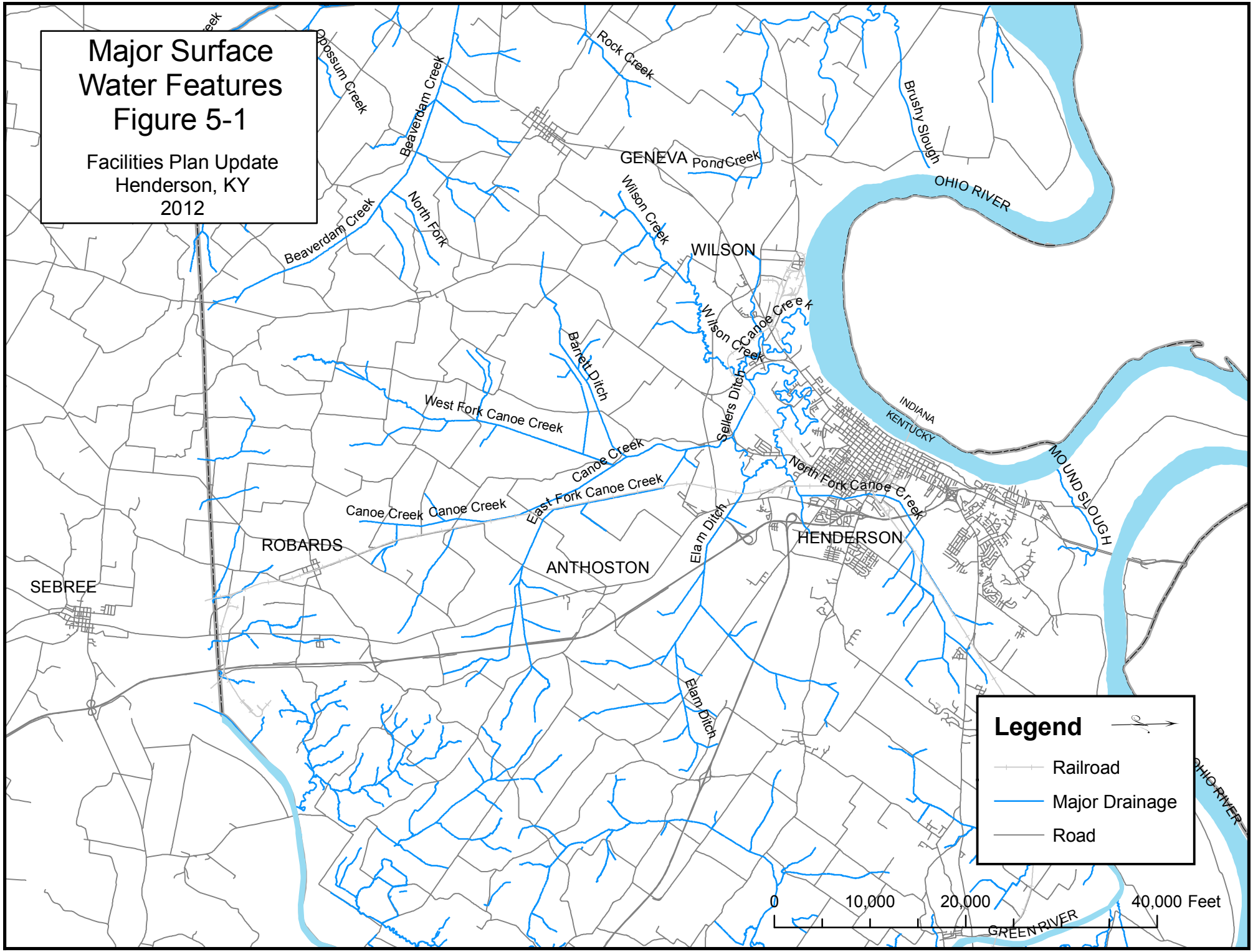
The Huntington-Egam-Newark association is found across the northern portion of the planning area and forms a belt of one to three miles wide, including most Ohio River bottom lands. These soils are brown, nearly level, well drained, and silty. Some swampy areas are included, and the association is usually flooded yearly by the Ohio River. Most of the land is farmed in corn and soybeans, with very few habitable structures.

The Ginat-Melvin association covers a small, generally linear area of northern Henderson County, parallel to the Ohio River and upland of the floodplain. These soils are brown or grey, nearly level or gently sloping, mainly poorly drained, and silty. The area covered by this association consists of wet flats separated by gently sloping ridges. A large portion of the land is cultivated with corn and soy beans, while some acreage is used for hay, tobacco, pasture and grain. About 40 percent of the area is flood prone; however, flooding normally occurs during the winter or spring and does not affect crops. This area has some habitable structures and small communities, including Reed and Beals, in eastern Henderson County.

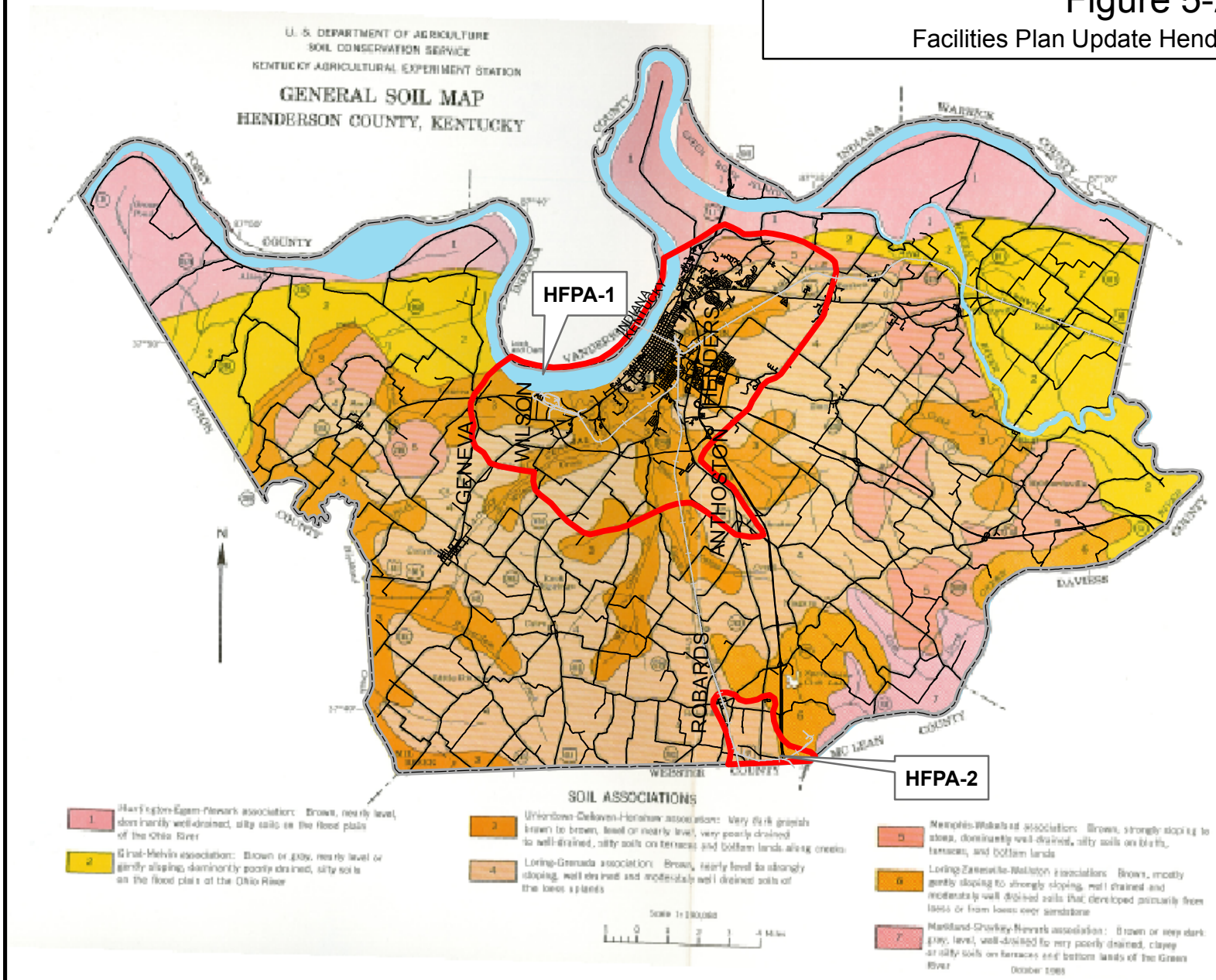
The Uniontown-Dekoven-Henshaw association is primarily found in the bottomlands along Canoe Creek and its tributaries. The soils are very dark grayish-brown to brown, level or nearly level, very poorly drained to well drained, and silty. This association has been mostly cleared of trees and is used for corn and soy beans. A total of about 40 percent of this association is subject to flooding during the winter or spring when crops are generally not on the land. This association includes large areas of the City of Henderson, along the North Fork of Canoe Creek.

The Loring-Grenada association is found in areas characterized by gently sloping ridge tops. This is the most extensive association in Henderson County, and includes the higher areas of downtown Henderson, areas north and east along Highway 60 East, and the Zion, Anthoston and Corydon areas. Soils are brown, nearly level to gently sloping, and well drained to moderately well drained. Most of the area is cultivated and is suited to general farming. The main crops are corn, soy bean, and small grain, with scattered areas of tobacco. Large and medium-sized family farms are prevalent in this area, with much scattered housing and some subdivisions in outlying areas.

The Memphis-Wakeland association is found randomly on bluffs, terraces, and bottom lands along the Green and Ohio Rivers, including the Wolf Hills area along Stratman Road in the northern fringe of the planning area, and the immediate Spottsville vicinity. These soils are brown, strongly sloping to steep, predominately well drained, and silty. Most of the bluff areas are wooded and not suitable for agriculture. However, bottomlands in this association are used to grow corn and soy beans.


Major Surface Water Features
Figure 5-1
Facilities Plan Update
Henderson, KY
2012
Opossum Creek
Beaverdam Creek
Beaverdam Creek
North Fork
Rock Creek
GENEVA
Pond Creek
Wilson Creek
WILSON
Brushy Slough
OHIO RIVER
Wilson Creek
Canoe Creek
Barrett Ditch
Sellers Ditch
West Fork Canoe Creek
Canoe Creek
East Fork Canoe Creek
Canoe Creek
Canoe Creek
INDIANA
KENTUCKY
North Fork Canoe Creek
MOUND SLOUGH
HENDERSON
Elam Ditch
ROBARDS
ANTHOSTON
SEBREE
Elam Ditch
OHIO RIVER
GREEN RIVER
Legend
Railroad
Major Drainage
Road
0
10,000
20,000
40,000 Feet

Henderson County Soils in the Planning Areas
Figure 5-2
Facilities Plan Update Henderson, KY 2012



Legend

- Railroad
- Road

0 25,000 50,000 100,000 Feet

4. Floodplain

The Canoe Creek, Green River, and Ohio River floodplains cover a significant fraction of the planning area. Approximately 30 percent of the land in Henderson County is subject to river flooding.

5. Wetlands

The National Wetlands Inventory Maps were reviewed for the presence of wetlands. The North WWTP study area contains numerous small patches of wetlands. A few large tracts of wetlands exist along streams. No wetlands exist at the site of the North WWTP. In general, when proper construction and remediation techniques are used, the building of sewers, pump stations, and force mains creates very little permanent damage to wetlands. Therefore, wetlands should not be an important deterrent to the implementation of this plan. Few large lakes (over 200 acres) exist in the service area. Many smaller lakes, ponds and other impoundments in the area are associated with residential, agricultural and recreational uses of the surrounding land.

6. Water Sources and Supply

The Henderson Water Utility owns and operates the North Water Treatment Plant (NWTP) which treats water from the Ohio River and provides water service to the entire North Sewer Service Area. The NWTP was originally constructed in 1961, placed in service in 1963, and was upgraded in 1990 to increase the rated capacity of the plant to 12.0 MGD. Facilities at the plant include a raw water intake, rapid mix, clarification, filtration, high service pumping, a clearwell, and various chemical storage and feed, electrical and control systems.

The Raw Water Intake (RWI) facility was formerly operated by Henderson Municipal Power and Light (HMPL) as the cooling water intake for the Station 1 power plant. When Station 1 was taken out of service in November 2008, HWU assumed responsibility for maintenance and repair of the intake. HWU has undertaken a current project to upgrade and rehabilitate the RWI, replacing screens, raw water pumps, controls and electrical components. This project should be completed in the fourth quarter of 2012.

Storage facilities in the North water system include six tanks with a total capacity of 7.58 million gallons. The North water system is operated in three pressure zones, North, Central and South, aided by two water booster pumping stations.

Areas outside the water service area of HWU are served with potable water by the Henderson County Water District (HCWD), which purchases water under a contract with HWU. In addition, HWU operates a South Water Treatment Plant which draws raw water from the Green River and serves industrial customers, the HCWD south service area, and the Cities of Sebree and Beech Grove.

7. Surface and Groundwater Quality

The primary source of drinking water in Henderson County is the Ohio River. The Ohio is the source of drinking water for more than 5 million people in the Midwest and Southern United States. Nearly 25 million people live in the portions of fifteen states that make up the Ohio River Basin and twenty-nine drinking water utilities and 49 electric power generating facilities draw water from the Ohio (source, *ORSANCO*). The Ohio River Valley Water Sanitation Commission (*ORSANCO*) monitors and controls water quality in the Ohio River, and publishes an annual report. According to the 2010 Annual Report, the entire Ohio River fully supports public water supply use, as less than 10 percent of samples taken exceeded pollutant criteria. Two-thirds of the River is considered impaired for contact recreation, due to the presence of bacteria.

Groundwater resources in Henderson County are abundant, due to the deep, well-drained soils, and the presence of two large rivers. Extensive wetland areas, especially in the bottomland of the Ohio and Green Rivers, point to the availability of groundwater at relatively shallow depth. Approximately 4,400 residents of Henderson County rely on private domestic water supplies, mostly private wells.

C. CLIMATE AND PRECIPITATION

The Henderson area has a temperate climate that is favorable for supporting a variety of plant and animal life. Summers are generally warm and humid, and winters are moderately cold. Between winter and summer, the area experiences wide temperature fluctuations. Data reported here are based on the NOAA weather station in Evansville, Indiana. The annual mean temperature is 57.2 degrees Fahrenheit (F). In winter, an average temperature of 39.6 degrees F can be expected; in the summer 76.8 degrees F is the average. The average annual rainfall for the area is approximately 42 inches, and is usually fairly well-distributed throughout the year. In most years, October has the least precipitation and March has the most. However, year to year fluctuations in rainfall can be large; calendar year 2011 saw more than 70 inches of total rainfall, a record year. To illustrate year to year variations, the average precipitation for the month of June is 3.9 inches. During periods of drought, occurring about one year in ten, less than 1 inch of rainfall is received in June. During periods of excessive rainfalls, about one year in ten, June rainfall can be more than 7 inches.

D. AIR QUALITY

In 1970, the Clean Air Act required that each state have an air quality control program. This program included regulations for implementation of plans, standards, and a timetable. Enforcement of the program was delegated to the Division of Air Pollution, Kentucky Cabinet for Natural Resources and Environmental Protection.

Air pollution is the presence of contaminants in the air: 1) in sufficient quantities; 2) of such characteristics; and 3) for sufficient duration to be dangerous to human health, safety, and welfare or harmful to animal life or property. The two major sources of pollution generally are industry and motor vehicles. Pollutants, with their side effects from these and other sources, include particulates, sulfur oxide, carbon monoxide, photochemical oxidants (ozone), nitrogen dioxide, and lead.

The planning area lies in the Henderson-Evansville Air Quality Control Region. Primary and secondary air quality standards have been established for six air pollutants and are shown in Table 5-1 along with the values measured in the Henderson-Evansville Air Quality Control Region. Primary ambient air quality standards are those levels of air quality which are judged to be necessary, with an adequate margin of safety, to protect the public health. Secondary ambient air quality standards are those levels of air quality that are judged to be necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

The air quality of the Henderson-Evansville Air Quality Control Region is currently monitored at sites in Henderson, Hancock, Daviess, and McLean Counties. None of these sites currently experiences consistently high levels of pollution. Air quality in the planning area is good.

Table 5-1
Air Quality Data and
National Ambient Air Quality Standards

Criteria Pollutants	*Maximum Concentration*		*Regional Air Quality*	
	Primary Standard	*Secondary Standard*	*Annual Average (2009) Henderson/Evansville Region*	*Number of Times Exceeded 2009*
Carbon Monoxide 8-hour average 1-hour average	 9 ppm 35 ppm	 9 ppm 35 ppm	4 ppm	0
Sulfur Oxides 24-hour average Annual average 3-hour average	 0.14 ppm 0.03 ppm	 --- --- 0.50 ppm	0.06	0
Nitrogen Dioxide Annual average	 0.05 ppm	 0.05 ppm	0.015	0
Lead Calendar Quarter Average	 .15 mg/m^3	 .15 mg/m^3		---
Ozone 1-hour average	 0.12 ppm	 0.12 ppm	0.077 ppm	0
Particulate Matter (measured as PM_{10}) Annual average 24-hour average	 50 mg/m^3 150 mg/m^3	 50 mg/m^3 150 mg/m^3	27.5 mg/m^3	0

Source: Kentucky Administration Regulations, 401 KAR 53.010
Kentucky Ambient Air Quality 2009 Annual Report, (downloaded 8.5.2010)

E. BIOLOGICAL RESOURCES

The Henderson area is fortunate to have a wide variety of plant and animal species, and is located along a national wildlife corridor. The Sloughs Wildlife Management Area in western Henderson County contains Kentucky's largest great blue heron rookery, and up to 20,000 Canada geese and 10,000 ducks winter there annually.

The Henderson County area supports common species native to the geographical region of western Kentucky. The Kentucky Nature Preserves Commission and the Kentucky Department of Fish and Wildlife Resources have identified several species that are of special concern, threatened or endangered, shown in Table 5-2, based on federal or state criteria. Listed species residing totally outside Henderson County have been removed from this list.

Table 5-2
Threatened/Endangered Plant and Animal Species

NAME	***SCIENTIFIC NAME***	***STATUS***
PLANTS		
Eggert's sunflower	Helianthus eggertii	Threatened
Virginia spiraea	Spiraea virginiana	Threatened
Braun's rock cress	Arabis perstellata var. perstellata	Endangered
Cumberland sandwort	Minuartia cumberlandensis	Endangered
Short's goldenrod	Solidago shortii	Endangered
Running buffalo clover	Trifolium stoloniferum	Endangered
MUSSELS		
Fanshell	Cyprogenia stegaria	Endangered
Pink mucket	Lampsilis abrupta	Endangered
Ring pink	Obovaria retusa	Endangered
Purple catspaw pearlymussel	Epioblasma o. obliquata	Endangered
Orange-foot pimpleback	Plethobasus cooperianus	Endangered
Sheepnose	Plethobasus cyphyus	Candidate
Clubshell	Pleurobema clava	Endangered
Rough pigtoe	Pleurobema plenum	Endangered
Fat pocketbook	Potamilus capax	Endangered
Cumberland bean	Villosa trabalis	Endangered
Spectaclecase	Cumberlandia monodonta	Endangered
INSECTS		
American burrowing beetle	Nicrophorus americanus	Endangered
BIRDS		
Bald eagle	Haliaeetus leucocephalus	Threatened
MAMMALS		
Gray bat	Myotis grisescens	Endangered
Indiana bat	Myotis sodalis	Endangered

Source: Kentucky Dept of Fish and Wildlife Resources (downloaded 8.25.2010)
U.S. Fish and Wildlife Service (letter dated 16 April 2012)

F. ARCHEOLOGY & HISTORIC SITES

No known significant archeological or cultural features in the planning area are anticipated to be impacted by the wastewater improvements envisioned under this plan. Land acquired for expanding a WWTP or to install collection system improvements will be subject to an archeological and cultural overview to determine the presence of any significant site. If any artifacts are discovered during construction, the site will be investigated to determine their significance and the feasibility of recovering artifacts before construction continues.

There are currently 26 Henderson County sites listed on the National Register of Historic Places. None of these sites are anticipated to be impacted by improvements envisioned under this plan.

G. IMPACT OF OTHER STATE AND FEDERAL PROJECTS

Projects which are planned or under construction, which may have some impact on the wastewater needs in Henderson are considered in the planning process. One such recently completed project was the widening of US 60 West to four lanes. HWU anticipated the impact of the road improvements and has upgraded the water and sewer utilities to serve this area.

Another much-anticipated project is the future construction of I-69 through Henderson County, including upgrading the existing Breathitt Parkway to Interstate standards, construction of 5 miles of new alignment bypassing Henderson, and erection of a new Ohio River bridge. While the initial design phases of portions of this project are funded in current Kentucky Transportation Cabinet Six-Year plans, the ultimate time-line for completion of the entire project is uncertain.

Chapter 6. EXISTING WASTEWATER SYSTEM

A. INTRODUCTION

This chapter will provide a general description of the existing treatment systems at the North WWTP, and will describe current operation and maintenance programs for the treatment systems. It also will describe the sewer collection system that contributes flow to the North WWTP, with reference to the Long-Term Control Plan (LTCP) prepared and submitted by HWU in September 2011.

For detailed discussion of the Nine Minimum Controls, Combined Sewer Overflow (CSO) volumes, and the recommended CSO control plan, please reference the LTCP.

B. COLLECTION SYSTEM DESCRIPTION

1. General

HWU owns and operates a Combined Sewer System (CSS) that serves the downtown portions of the City of Henderson, Kentucky and certain outlying areas, covering approximately 10,800 acres. The majority of sewered area is located in the Henderson city limits. The sewered area is divided into the separate sanitary system (SSS) area and the CSS system. The CSS makes up about 13 percent of the sewered area (approximately 1,440 acres). The separate system is located outside the CSS and makes up about 87 percent or the sewered area (approximately 9,360 acres). Figure 6-1 shows the current service area of the Henderson collection system.

The CSS is divided into 15 sewersheds. These sewersheds were developed for the 1996 Combined Sewer Operation Plan (CSOP) to subdivide the CSS area based on the primary CSO serving each area. Wastewater is conveyed by sewers towards the Ohio River or Canoe Creek, where all flow is intercepted and pumped to the North WWTP. The Downtown (Ohio River) Drainage Basin is 470 acres, or approximately 33 percent of the CSS, and the Canoe Creek Drainage Basin is approximately 970 acres, or approximately 67 percent of the CSS. Since 1996, HWU has been proactive at separating the CSS area. Figure 6-1 shows a dividing line between the CSS area that drains to the Ohio River Drainage Basin and the Canoe Creek Drainage Basin, and the combined sewer area in the CSS, as well as a general delineation of CSS areas previously separated. Figure 6-2 shows more detail of CSS areas previously separated.

2. Downtown (Ohio River) Drainage Basin

Wastewater in the Downtown Drainage Basin flows toward the Ohio River in a combined sewer system (CSS). The layout of the combined sewers within the downtown drainage basin consists of large combined sewer pipes, typically with a smaller drop pipe located in the bottom of a manhole prior to the large pipe's discharge point at the river. The drop pipe diverts dry weather separate sanitary sewer flows to a 36-inch interceptor (Downtown Interceptor) which

runs parallel to the Ohio River. During dry weather, sanitary waste in the Downtown Interceptor flows to the Janalee Drive Pumping Station and then to the North WWTP. The Janalee Drive Pumping Station is the largest pumping station in the CSS with a capacity of approximately 11.5 million gallons per day (mgd).

During wet weather, the diversion structures within each sewershed and at the Janalee Drive Pumping Station act as regulators or control devices. The control devices are passive systems, that is, they have no moving parts and operate by allowing wastewater to flow over a weir, thus permitting combined sewage flow volumes exceeding the capacity of the downstream transport system to be discharged to the Ohio River. Figures 6-3 and 6-4 show a typical layout for diversion structures in the downtown drainage basin.

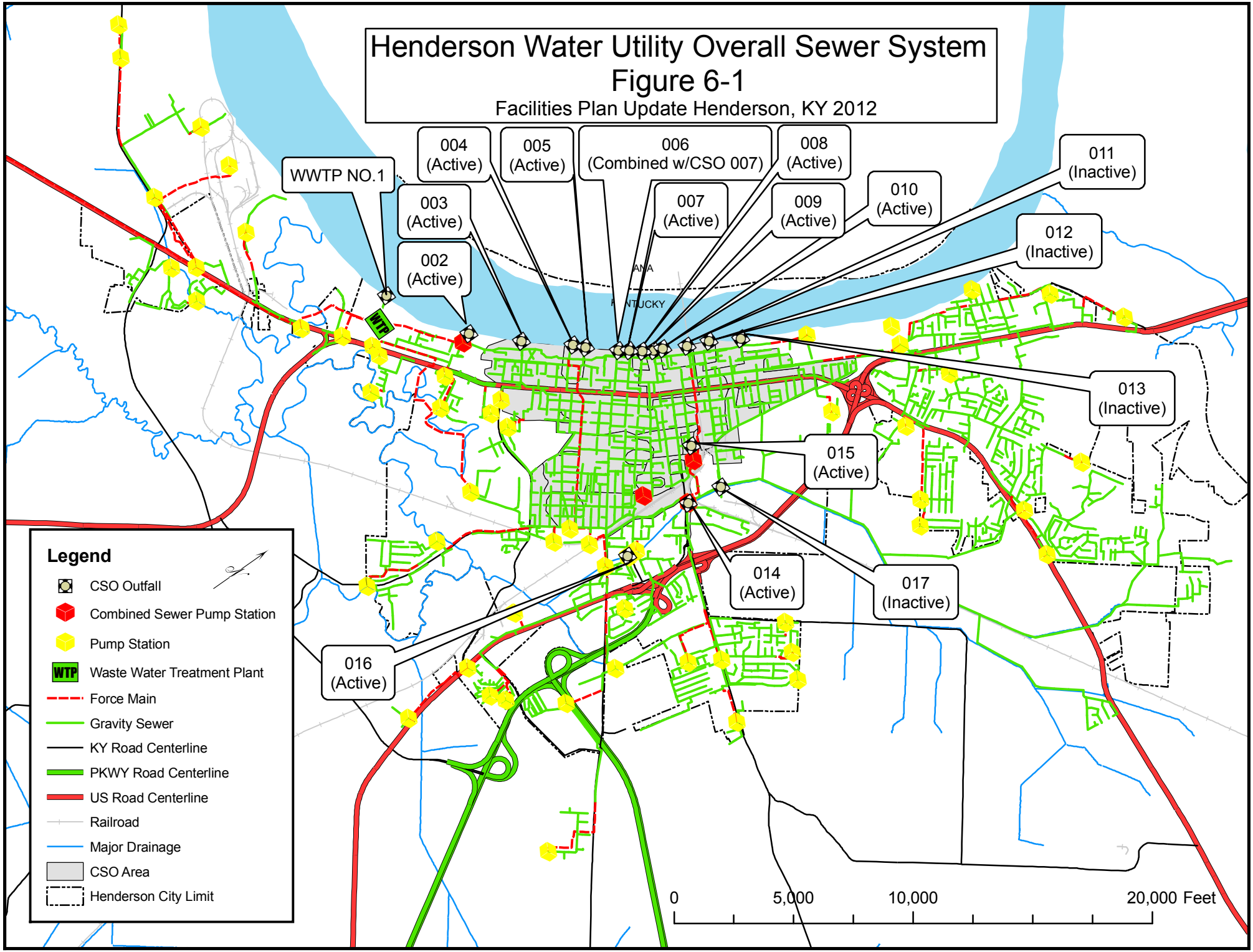
Originally, the Henderson CSS had 12 permitted CSO points along the Ohio River. Since 1995, three CSO locations have been rendered inoperative and disconnected from the CSS. Nine CSO locations still have the potential to discharge to the Ohio River. Most CSO structures in the downtown basin have a separate outfall pipe to the Ohio River, although two points share an overflow outfall pipe.

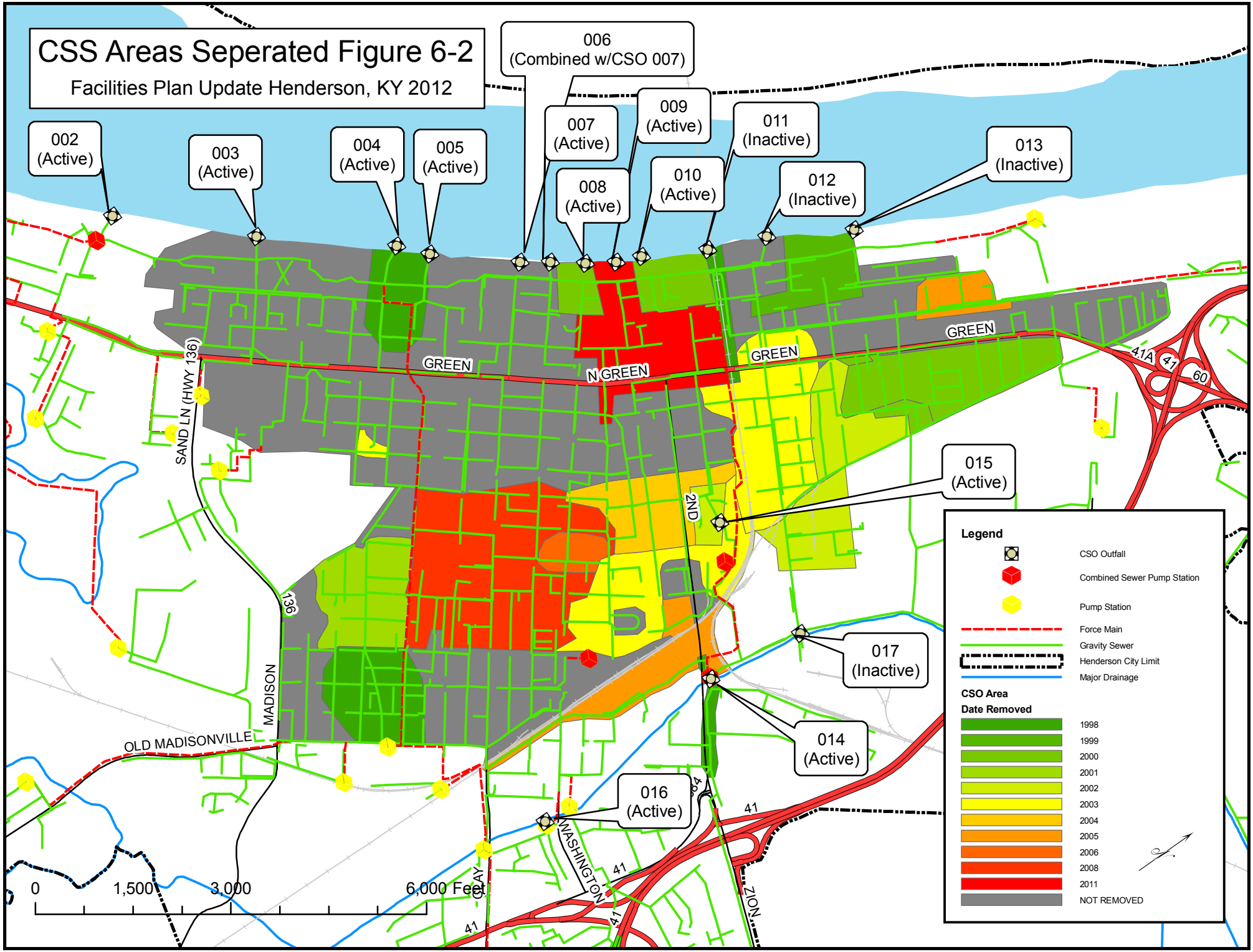
CSO #002 is located at the Janalee Drive Pumping Station, which is the most downstream CSO in the Ohio River portion of the CSS. The overflow point consists of a 10-foot weir adjacent to the pumping station wet well. CSO #002 provides flow relief at the Janalee Drive Pumping Station to prevent flooding and failure of the pumping station as well as limiting the surcharge on the 36-inch Downtown Interceptor. A flap gate is installed downstream of the weir on the CSO #002 outfall pipe to prevent high water on the Ohio River from back flooding the outfall pipe.

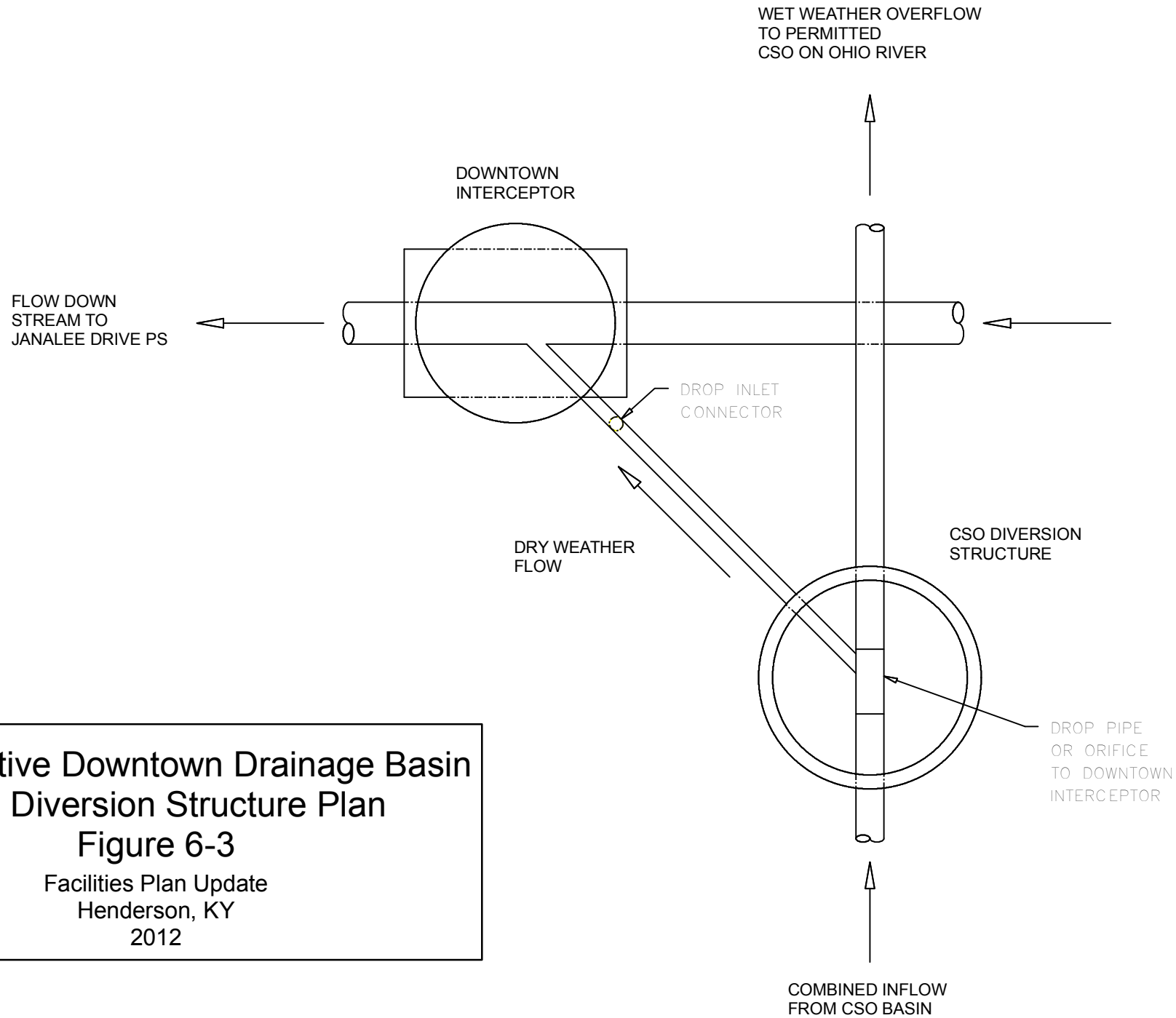
3. Canoe Creek Drainage Basin

Wastewater in the Canoe Creek Basin flows away from the Ohio River, toward Canoe Creek. During dry weather, wastewater is currently conveyed to two main pumping stations, the Second Street Pumping Station (capacity is approximately 5.4 mgd) and the Atkinson Street Pumping Station (capacity is approximately 2.9 mgd). These pumping stations pump wastewater from the Canoe Creek Drainage Basin to the 36-inch Downtown Interceptor in the Downtown Drainage Basin. During wet weather, the Canoe Creek collection system begins to surcharge at the Second Street Pumping Station. Eventually, if the storm is large enough, CSO #014 at the Second Street Pumping Station and CSO #015 at the Third Street Basin begin to discharge.

Originally, the Henderson CSS had a total of four CSOs discharging to Canoe Creek, CSO 014 through CSO #017. Three of these CSOs (014, 015 and 016) are still active; CSO 017 was disconnected as part of Phase I of the Canoe Creek Interceptor project.

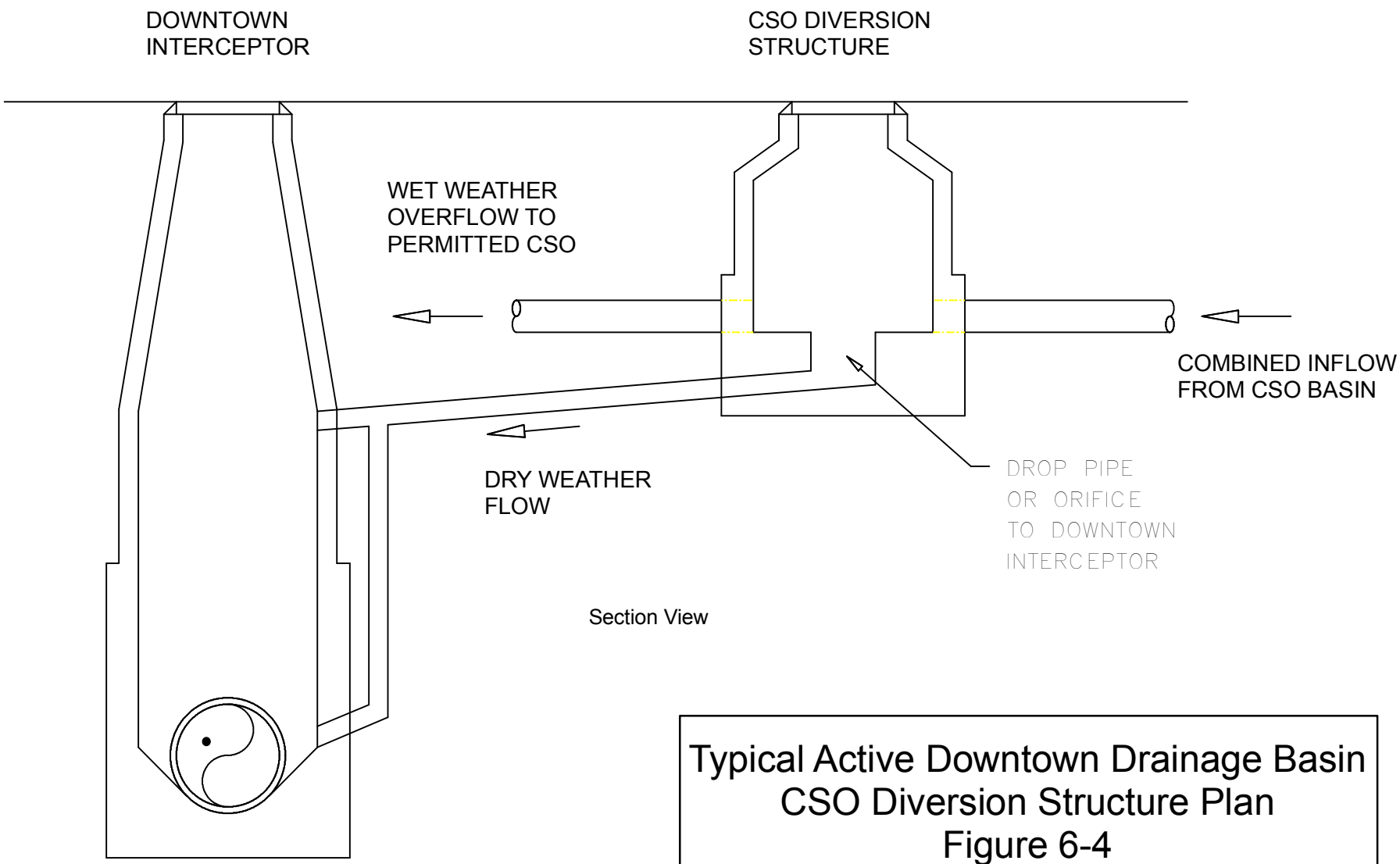

Henderson Water Utility Overall Sewer System
Figure 6-1
Facilities Plan Update Henderson, KY 2012
WWTP NO.1
002 (Active)
003 (Active)
004 (Active)
005 (Active)
006 (Combined w/CSO 007)
007 (Active)
008 (Active)
009 (Active)
010 (Active)
011 (Inactive)
012 (Inactive)
013 (Inactive)
014 (Active)
015 (Active)
016 (Active)
017 (Inactive)
WTP
Legend
CSO Outfall
Combined Sewer Pump Station
Pump Station
Waste Water Treatment Plant
Force Main
Gravity Sewer
KY Road Centerline
PKWY Road Centerline
US Road Centerline
Railroad
Major Drainage
CSO Area
Henderson City Limit
0
5,000
10,000
20,000 Feet


CSS Areas Seperated Figure 6-2
Facilities Plan Update Henderson, KY 2012
002 (Active)
003 (Active)
004 (Active)
005 (Active)
006 (Combined w/CSO 007)
007 (Active)
008 (Active)
009 (Active)
010 (Active)
011 (Inactive)
012 (Inactive)
013 (Inactive)
014 (Active)
015 (Active)
016 (Active)
017 (Inactive)
GREEN
N GREEN
SAND LN (HWY 136)
136
MADISON
OLD MADISONVILLE
2ND
CLAY
WASHINGTON
ZION
41A
41
60
0
1,500
3,000
6,000 Feet
Legend
CSO Outfall
Combined Sewer Pump Station
Pump Station
Force Main
Gravity Sewer
Henderson City Limit
Major Drainage
CSO Area
Date Removed
1998
1999
2000
2001
2002
2003
2004
2005
2006
2008
2011
NOT REMOVED



Typical Active Downtown Drainage Basin
CSO Diversion Structure Plan
Figure 6-3

Facilities Plan Update
Henderson, KY
2012



Typical Active Downtown Drainage Basin CSO Diversion Structure Plan

Figure 6-4

Facilities Plan Update
Henderson, KY
2012

Third Street CSO Basin Dry Weather Flow Conditions
Combined Sewer Overflow Long Term Control Plan
Figure 6-5
Facilities Plan Update Henderson, KY 2012
CSO 015 Control Structure
Entry Structure
CSO Pump Station #1
2nd Street PS/3rd Street Basin Force Main
CSO Overflow Culvert
Emergency Dishcharge Culvert to Canoe Creek
Flow From
Center and Julia Area
CSO Basin
CSO Pump Station #2
Discharge to Canoe Creek
(3) 21" HDPE
CSO Pump Station #2
2nd Street Pump Station
Legend
Storm Pump Station
Sewer Flow Direction
CSO Outfall
Pump Station
Open Channel
Storm Main
ssForce Main
ssGravity Sewer
Major Drainage
0
250
500
1,000 Feet

CSO 014 is located at the Second Street Pumping Station. In the 1996 CSOP, CSO 014 consisted of an overflow pipe in the Second Street Pumping Station wet well wall connected to Canoe Creek. After the 1996 CSOP, the Second Street Pumping Station was rebuilt and the CSO 014 outfall was modified by enclosing it with a metal coffer dam and two 24-inch flap gates. The metal coffer dam increased the combined sewage storage in the CSS, and the flap gates prevented Canoe Creek from flooding the Second Street Pumping Station in normal high water situations. In FY 2006-2007, HWU recorded over 150 million gallons of overflow at this location. In 2008, HWU modified this overflow again by welding the flap gates shut. In FY 2008-2009 there were no CSO discharges. In January 2010, HWU discovered a previously unknown 24-inch diameter CSO point on Canoe Creek, downstream from CSO 016; this overflow was plugged, and KDOW notified. Early in 2011 it became apparent that plugging this overflow point was creating a problem with backups near the Second Street pumping station. HWU lowered the weir height at the Second Street overflow by 21.75 inches, thus allowing maximization of storage without adversely impacting local schools and businesses.

In 1999, HWU constructed the Third Street CSO/Stormwater Detention Basin. Approximately 420 acres of commercial and residential CSS area are served by the basin. This basin was designed to provide 15 million gallons of detention capacity for combined sewage discharging from the CSO #015 outfall. A 66-inch x 44-inch elliptical brick sewer carries combined sanitary sewage and stormwater to the CSO #015 control structure. The control structure utilizes a 36-inch drop pipe to convey flow around the basin to the Second Street Pumping Station. During wet weather conditions, when the 36-inch pipe (which transitions to a 24-inch downstream) is at capacity and begins to surcharge, the flow is diverted over a weir in the CSO #015 control structure into an 8-foot x 5-foot box culvert leading to the Third Street Basin. Up to 15 million gallons of combined flow can be captured by the Third Street Basin.

The Third Street Basin currently contains two pumping stations. CSO Pumping Station No. 1 has two submersible pumps with a total capacity of 1,200 gpm and pumps to the Second Street Pumping Station force main. CSO Pumping Station No.2 has three submersible pumps with a total capacity of 15,000 gpm and pumps to a drainage ditch tributary to Canoe Creek. CSO Pumping Station No. 2 is currently out of service. The Third Street Basin provides screening and some removal of solids from the flow. Until the Canoe Creek Interceptor Phase 2 is installed, Pumping Station No.1 operation is tied to the activity of the Second Street Pumping Station. Pumping Station No. 1 pumps from the basin if there is any liquid detected in the basin and continues to pump until the basin is empty. This station will only pump if the Second Street Pumping Station is not overflowing. Figure 6-5 shows a plan view of the Third Street Basin.

CSO 016 at the Cooper Park Pumping Station is located outside the main CSS. Stormwater in a small, isolated, residential subdivision is collected and conveyed to the Cooper Park Pumping Station. When the Cooper Park Pumping Station capacity is exceeded, then the wet well level rises to an 8-inch CSO overflow pipe on the wet well wall. The Cooper Park pump station is to be eliminated as part of the implementation of the Long Term Control Plan.

C. NORTH WASTEWATER TREATMENT PLANT (NWWTP)

1. General Description of Unit Processes

The North WWTP is located on Drury Lane near the Ohio River southwest of the Henderson downtown area. The plant was originally constructed as a primary treatment facility in 1954. It was upgraded to secondary treatment in 1975 and renovated and expanded in 1991, 1996 and 2001. The 1991 expansion increased the design capacity to 7.5 mgd, while addition of the second aerated lagoon in 1996 increased the capacity to 15.0 mgd. The organic capacity of the current facility is 48,000 pounds per day (lbs/day) of five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS), or 400 milligrams per liter (mg/L) BOD_5 and TSS at 15 MGD. A third lagoon was added in 2001 to accommodate increased organic loadings from the International Paper (formerly McMillan-Bloedel) plant, but did not increase the hydraulic capacity of the plant. The wastewater treatment train includes preliminary treatment (flow measurement, coarse and fine screening, and grit collection), biological secondary treatment in extended aeration basins, final clarifiers, chlorine contact basins that also serve as tertiary clarifiers, dechlorination, and discharge to the Ohio River. The facilities associated with a former activated bio-filter process constructed in 1975 have been demolished.

The headworks system currently includes influent flow measurement, coarse screening, grit removal, and fine screening. All flow to the plant is pumped to the headworks, which is the likely source of hydrogen sulfide and severe corrosion of metals in that part of the plant. The influent flume appears to be a limitation and may be inaccurate at peak flows because of approach channel constraints. The coarse screens, which are intended to remove large debris including leaves from the CSS, are not capable of handling the loads they receive, and adversely affect the performance of the fine screens downstream. The existing grit system (Pista grit) is equipped with an air lift grit removal pump, which does not function well. The existing rotary fine screens have one-half inch openings, and perform reasonably well.

The headworks wastewater is routed around the primary sedimentation basins to the extended aeration basins at the recirculation pumping station (sometimes referred to as the mixed liquor wetwell), and the primary basins are not currently useable. There are four pumps installed at this location, two with a capacity of 10 mgd each and two with a capacity of 7.5 mgd each. A limitation in the electrical system allows only three of the four pumps to operate. The fourth pump can be run in the event one of the other pumps is not operating. At this location, screened wastewater is pumped to the aerated basin flow splitter box. Return activated sludge (RAS) is also pumped, through a separate force main, to the basin flow splitter box. The RAS pump station occupies a tank that was formerly the secondary for the bio-filter process. Due to the way the primary and RAS flows are piped into the flow splitter box, there may be inadequate mixing of the two flow streams.

From the basin flow splitter box, influent wastewater and RAS are sent to each of the three extended aeration basins, which utilize a Biolac®-type aeration system of suspended coarse

bubble diffusers. Following aeration, the mixed liquor flows to two 136-foot inside diameter final clarifiers (measured inside the weirs). The third basin, constructed in 1999, was piped into the effluent flow lines for the original two basins, in order to help equalize the flow from three basins to two clarifiers. There is no splitter box between the basins and the secondary clarifiers, and flow splitting is controlled by valves, which can cause problems with flow equalization and short circuiting. RAS from the clarifiers is pumped back to the aeration basin flow splitter box. RAS pumping capacity appears to be adequate. It is possible the clarifiers could handle peak flows up to 18.75 mgd, based on surface overflow rates, at a surface overflow rate of 600 gallons per day per square foot. This relatively low rate is due to the unique sloped bottom/sides of these clarifiers, and is a conservative estimate. Secondary effluent from the clarifiers flows to the tertiary clarifiers, which have been converted to chlorine contact tanks, where chlorine gas is used for disinfection. These tanks have a volume of approximately 680,000 gallons that would allow for flows up to 31 mgd with a 31 minute hydraulic detention time. These tanks have no baffling, which is not recommended practice.

After the chlorine contact tanks, a final small circular tank is used for dechlorination. Final effluent flows over a curved weir at the downstream end of the dechlorination tank into the plant outfall pipe, which discharges by gravity to the Ohio River. An in-line flow meter was installed in the effluent pipe in August 2011, due to problems encountered in calibrating and measuring flow over the curved outfall weir.

Waste solids are decanted and aerobically digested, and are then dewatered on belt filter presses before being hauled by a composter for disposal. Expanded treatment of peak flows at the WWTP would not be expected to have a substantial impact on solids production at the treatment plant, since the additional flow is largely rainwater.

2. Unit Process Summary

Figure 6-6 shows the overall layout and schematic flow diagram of the NWWTP. The following unit process summary describes the wastewater and sludge treatment facilities.

1. Influent Characteristics (Design)	
- Design Flow	15.0 MGD
- Peak Hydraulic Flow Rate	18.75 MGD
-BOD5	385 mg/L
	48,000 lbs/day
-TSS	415 mg/L
	52,000 lbs/day
2. Parshall Flume	
- Throat Width	18 inches
- Maximum Flow Capacity	15.9 MGD

3. Mechanical Coarse Bar Screen

- Number of Units	2
- Type Screen	Mechanical Rake
- Channel Width	3 feet
- Opening Width	1 inch

4. Mechanical Fine Bar Screen

- Number of Units	2
- Type Screen	Rotary
- Channel Width	3 feet
- Opening Width	½ inch

5. Grit Collectors

- Number of Units	1
- Type	Vortex
- Diameter	16 feet

6. Advanced Pretreatment Basins (former Primary Basins - no longer in service)

- Number of Basins	3
- Type	Rectangular
- Length	122.5 feet
- Width	33 feet
- Side Water Depth	9.5 feet
- Total volume (2 basins)	574,520 gallons

7. Extended Aeration Basin

- Number of Units	3
- Length at Water Surface	331 feet
- Width at Water Surface	221 feet
- Nominal Water Depth	16 feet
- Volume	7.01 MG each
- Detention Time at Design Flow	32.4 hours

8. Blower Buildings - Two Buildings

- Number of Blowers	9
	Basin 1 – 3 @ 200-Hp
	Basin 2 – 3 @ 200-Hp
	Basin 3 – 3 @ 200 Hp
- Type	Centrifugal
- Air Flow Capacity per Unit	3 @ 3,900 scfm
- Pressure Rating	8.0 psig

9. Final Clarifiers

- Number of Units	2
- Diameter	136 feet
- Total Surface Area	29,038 sq. ft.
- Surface Overflow Rate at Design Flow	517 GPD/sq. ft.
- Surface Overflow Rate at Peak Hydraulic Flow	646 GPD/sq. ft.

10. Chlorine Contact Basins (Tertiary Clarifiers)

- Number of Basins	2
- Diameter	80 feet
- Side Water Depth	8 feet
- Total Volume	680,000 gallons
- Detention Time at Design Flow (15 MGD)	65 minutes
- Detention Time at Peak Hydraulic Flow Rate	52 minutes

11. Dechlorination Basin

- Number of units	1
- Volume	117,496 gallons
- Detention Time at Design Flow	23 minutes
- Detention Time at Peak Hydraulic Flow Rate	9 minutes

12. Sludge Holding Tanks

- Number of Units	2
- Diameter	50 feet
- Maximum Depth	22 feet
- Total Volume	687,052 gallons
- Type/Number of Aerators	Submerged turbine /2
- Horsepower per Aerator	50HP
- Number of Units	2
- Length	90 feet
- Width	45 feet
- Maximum Depth	15 feet
- Total Volume	732,250 gallons
- Type/Number of Blowers	Rotary Lobe / 3
- Horsepower per Blower	75 HP

13. Belt Filter Presses

- Number of Units	2
- Belt Width, Per Unit	2.5 meters
- Capacity	70-110 Gallons per hour
- Feed Solids Concentration	3 percent
- Cake Solids	17-22 percent
- Solids Capture	95+ percent

3. Effluent Limits

Facilities operated by HWU must comply with Kentucky Pollutant Discharge Elimination System (KPDES) permits. Table 6-1 shows the KPDES permitted effluent limits for the North WWTP. The KPDES permit for NWWTP is permit number KY0020711, issued in November 2009, effective as of 1 January 2010, and expiring on 31 December 2014.

Table 6-1
KPDES Permit Discharge Limits
Henderson North Wastewater Treatment Plant

Parameter	Monthly Average	Weekly Average	Other
Design Capacity	---	---	15.0 MGD [1]
BOD_5[2]	30 mg/L [3]	45 mg/L	---
TSS[4]	30 mg/L	45 mg/L	---
Escherichia Coli (N/100 ml) [5]	130/100 [7]	240/100 [7]	---
NH_3-N [6]	20 mg/L	30 mg/L	---
Dissolved Oxygen	2 mg/L (Minimum)	2 mg/L (Minimum)	---
Total Residual Chlorine	0.019 mg/L	---	0.019 mg/L (daily maximum)
Bio-Monitoring	---	---	1.0 acute toxicity unit

Notes: 1 – MGD - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – mg/L - Milligrams per liter
4 – TSS - Total suspended solids
5 – N/100 ml – Number per 100 milliliters
6 – Ammonia Nitrogen
7 – 30-day and 7-day Geometric Means

4. Influent Flows and Loadings

Tables 6-2, 6-3, 6-4, 6-5, 6-6 and 6-7 present a summary of monthly operating data for calendar years 2007, 2008, 2009, 2010, 2011 and 2012-to-date, respectively.

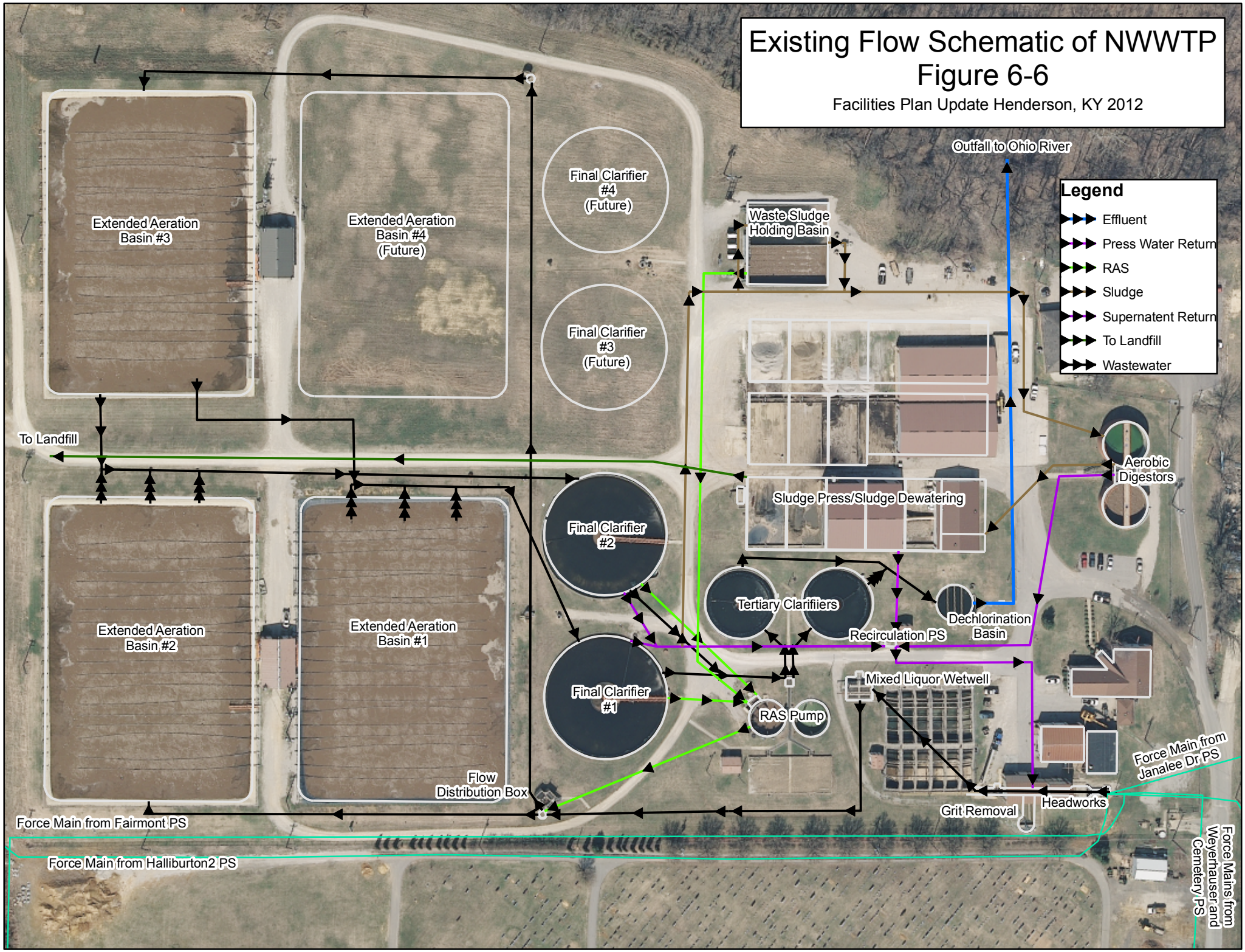

Existing Flow Schematic of NWWTP
Figure 6-6
Facilities Plan Update Henderson, KY 2012
Legend
Effluent
Press Water Return
RAS
Sludge
Supernatent Return
To Landfill
Wastewater
Extended Aeration Basin #3
Extended Aeration Basin #4 (Future)
Final Clarifier #4 (Future)
Final Clarifier #3 (Future)
Waste Sludge Holding Basin
Outfall to Ohio River
To Landfill
Aerobic Digestors
Sludge Press/Sludge Dewatering
Final Clarifier #2
Tertiary Clarifiers
Dechlorination Basin
Recirculation PS
Extended Aeration Basin #2
Extended Aeration Basin #1
Final Clarifier #1
Mixed Liquor Wetwell
RAS Pump
Force Main from Janalee Dr PS
Flow Distribution Box
Headworks
Grit Removal
Force Main from Fairmont PS
Force Main from Halliburton2 PS
Force Mains from Weyerhauser and Cemetery PS

Table 6-2
Monthly Operating Data – 2007 Calendar Year
Summary of Flows and Loads
Henderson North Wastewater Treatment Plant

Month	Average Daily Flow (mgd) [1]	Maximum Daily Flow (mgd)	BOD_5 [2]			TSS [3]			Geometric Mean Effluent Fecal Coliform (N/100 ml) [6]	Maximum Effluent Cl_2 [7] Residual (mg/L)	Average Effluent (NH_3-N) [8] (mg/L)
			Average Influent Concentration (mg/L) [4]	Average Influent Load (lb/day) [5]	Average Effluent Concentration (lb/day)	Average Influent Concentration (mg/L)	Average Influent Load (lb/day)	Average Effluent Concentration (mg/L)			
1/2007	9.793	14.259	194	15,397	3.77	254	20,032	11	29	0.001	0.12
2/2007	8.345	13.869	254	16,530	4.33	276	18,982	14	6	0.001	0.27
3/2007	7.436	10.023	257	16,626	4.07	411	26,246	11	15	0.001	0.16
4/2007	8.821	13.966	224	16,695	4.33	340	23,606	9	44	0.001	0.22
5/2007	6.200	11.242	358	18,400	3.14	504	26,584	5	125	0.001	0.38
6/2007	5.409	7.923	391	17,504	3.77	491	21,202	6	55	0.001	0.14
7/2007	4.999	7.236	427	18,725	4.50	372	16,405	9	33	0.001	0.26
8/2007	4.653	7.038	327	13,476	5.07	798	32,859	12	92	0.001	0.11
9/2007	4.638	8.209	436	17,983	4.11	291	11,815	5	20	0.001	0.50
10/2007	5.186	11.592	387	17,076	2.95	300	13,563	7	19	0.001	0.11
11/2007	5.423	9.550	531	23,421	3.36	267	12,226	8	12	0.001	0.24
12/2007	8.679	13.294	408	28,475	2.92	333	23,649	6	10	0.75	0.39
Average	***6.632***	***10.683***	***349***	***18,359***	***4***	***386***	***20,597***	***9***	***38***	***0.063***	***0.24***

Notes: 1 – mgd - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 - mg/L - Milligrams per liter
5 – lb/day – pounds per day
6 – N/100 ml – Number per 100 milliliters – reported as a geometric mean, per KPDES Permit
7 – Cl_2 – Chlorine
8 - NH_3-N - Ammonia Nitrogen

Table 6-3
Monthly Operating Data – 2008 Calendar Year
Summary of Flows and Loads
Henderson North Wastewater Treatment Plant

Month	Average Daily Flow (mgd) [1]	Maximum Daily Flow (mgd)	BOD_5 [2]			TSS [3]			Geometric Mean Effluent Fecal Coliform (N/100 ml) [6]	Maximum Effluent Cl_2 [7] Residual (mg/L)	Average Effluent (NH_3-N) [8] (mg/L)
			Average Influent Concentration (mg/L) [4]	Average Influent Load (lb/day) [5]	Average Effluent Concentration (lb/day)	Average Influent Concentration (mg/L)	Average Influent Load (lb/day)	Average Effluent Concentration (mg/L)			
1/2008	7.255	11.090	412	25,381	4.21	611	37,389	11	9	0.001	0.11
2/2008	10.395	14.309	265	22,618	4.08	398	34,714	14	28	0.001	0.26
3/2008	10.709	14.894	246	22,176	4.33	287	26,844	12	18	0.001	0.50
4/2008	9.383	13.835	332	24,144	3.08	237	17,766	6	24	0.001	0.26
5/2008	7.519	10.435	438	28,729	2.79	432	27,497	7	101	0.001	0.50
6/2008	5.366	9.951	624	30,571	2.54	657	31,192	5	55	0.001	0.26
7/2008	5.385	10.103	523	26,259	3.23	371	17,745	6	45	0.001	0.10
8/2008	6.166	7.567	598	31,267	2.46	1623	83,900	7	33	0.001	0.20
9/2008	5.710	7.626	600	29,929	2.08	734	35,945	6	20	0.001	0.41
10/2008	5.643	8.742	561	27,389	2.60	330	16,131	6	55	0.001	0.17
11/2008	6.129	9.396	364	20,448	2.25	235	12,630	10	53	0.06	0.33
12/2008	7.773	11.685	335	21,723	2.87	242	16,476	11	68	0.001	0.55
Average	***7.286***	***10.803***	***442***	***25,886***	***3***	***513***	***29,852***	***8***	***42***	***0.006***	***0.30***

Notes: 1 – mgd - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 - mg/L - Milligrams per liter
5 – lb/day – pounds per day
6 – N/100 ml – Number per 100 milliliters – reported as a geometric mean, per KPDES Permit
7 – Cl_2 – Chlorine
8 - NH_3-N - Ammonia Nitrogen

Table 6-4
Monthly Operating Data – 2009 Calendar Year
Summary of Flows and Loads
Henderson North Wastewater Treatment Plant

Month	Average Daily Flow (mgd) [1]	Maximum Daily Flow (mgd)	BOD_5 [2]			TSS [3]			Geometric Mean Effluent Fecal Coliform (N/100 ml) [6]	Maximum Effluent Cl_2 [7] Residual (mg/L)	Average Effluent (NH_3-N) [8] (mg/L)
			Average Influent Concentration (mg/L) [4]	Average Influent Load (lb/day) [5]	Average Effluent Concentration (lb/day)	Average Influent Concentration (mg/L)	Average Influent Load (lb/day)	Average Effluent Concentration (mg/L)			
1/2009	7.127	9.291	378	22,471	2.97	320	19,661	11	28	0.001	0.72
2/2009	9.285	12.736	287	22,025	3.00	297	23,005	9	56	0.001	1.19
3/2009	8.988	12.626	307	23,055	3.58	227	17,021	12	49	0.001	1.03
4/2009	9.311	13.414	247	19,026	3.79	269	19,614	11	9	0.001	0.23
5/2009	8.927	13.653	354	24,391	3.46	415	31,671	12	40	0.001	0.63
6/2009	6.132	9.678	537	28,577	3.00	337	17,433	8	26	0.001	0.11
7/2009	6.303	11.275	429	25,700	2.53	269	14,884	8	66	0.001	0.29
8/2009	6.305	11.761	483	23,738	2.08	303	15,210	6	83	0.001	0.23
9/2009	6.633	10.363	514	28,223	2.31	326	17,514	6	34	0.001	0.21
10/2009	8.844	14.896	493	40,262	5.57	324	24,300	17	37	0.001	2.43
11/2009	7.785	10.991	678	44,838	6.75	633	41,753	13	28	0.001	1.74
12/2009	8.397	11.511	760	53,319	4.40	841	57,511	16	25	0.001	0.71
Average	***7.836***	***11.850***	***456***	***29,635***	***4***	***380***	***24,965***	***11***	***40***	***0.001***	***0.79***

Notes: 1 – mgd - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 - mg/L - Milligrams per liter
5 – lb/day – pounds per day
6 – N/100 ml – Number per 100 milliliters – reported as a geometric mean, per KPDES Permit
7 – Cl_2 – Chlorine
8 - NH_3-N - Ammonia Nitrogen

Table 6-5
Monthly Operating Data – 2010 Calendar Year
Summary of Flows and Loads
Henderson North Wastewater Treatment Plant

Month	Average Daily Flow (mgd) [1]	Maximum Daily Flow (mgd)	BOD_5 [2]			TSS [3]			Geometric Mean Effluent E. coli (N/100 ml) [6]	Maximum Effluent Cl_2 [7] Residual (mg/L)	Average Effluent (NH_3-N) [8] (mg/L)
			Average Influent Concentration (mg/L) [4]	Average Influent Load (lb/day) [5]	Average Effluent Concentration (lb/day)	Average Influent Concentration (mg/L)	Average Influent Load (lb/day)	Average Effluent Concentration (mg/L)			
1/2010	7.874	11.798	432	30,968	6.64	451	30,380	19	24	0.001	0.54
2/2010	7.458	10.161	389	24,115	6.17	479	30,339	17	111	0.001	0.44
3/2010	7.974	10.879	303	19,832	5.54	390	25,761	15	28	0.001	0.38
4/2010	7.799	9.401	237	15,684	4.21	353	23,176	11	24	0.001	0.39
5/2010	7.598	10.570	281	16,368	3.25	507	31,700	9	82	0.001	0.48
6/2010	6.664	7.486	306	17,204	2.77	382	21,562	7	27	0.001	0.56
7/2010	6.566	9.143	356	19,480	2.79	402	22,428	9	11	0.001	0.34
8/2010	6.307	7.577	362	19,404	2.17	334	17,957	5	8	0.001	0.34
9/2010	5.625	6.368	470	22,818	2.71	721	34,816	8	9	0.001	0.42
10/2010	5.496	7.700	501	22,785	2.46	407	19,062	7	13	0.001	0.17
11/2010	5.974	9.584	465	22,177	2.83	313	16,118	8	52	0.001	0.28
12/2010	5.796	7.340	411	19,876	2.67	464	22,116	6	16	0.001	0.46
Average	***6.761***	***9.001***	***376***	***20,893***	***4***	***433***	***24,618***	***10***	***34***	***0.001***	***0.40***

Notes: 1 – mgd - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 - mg/L - Milligrams per liter
5 – lb/day – pounds per day
6 – N/100 ml – Number per 100 milliliters – reported as a geometric mean, per KPDES Permit – Switched to E. Coli January 2010
7 – Cl_2 – Chlorine
8 - NH_3-N - Ammonia Nitrogen

Table 6-6
Monthly Operating Data – 2011 Calendar Year
Summary of Flows and Loads
Henderson North Wastewater Treatment Plant

Month	Average Daily Flow (mgd) [1]	Maximum Daily Flow (mgd)	BOD_5 [2]			TSS [3]			Geometric Mean Effluent E. coli (N/100 ml) [6]	Maximum Effluent Cl_2 [7] Residual (mg/L)	Average Effluent (NH_3-N) [8] (mg/L)
			Average Influent Concentration (mg/L) [4]	Average Influent Load (lb/day) [5]	Average Effluent Concentration (lb/day)	Average Influent Concentration (mg/L)	Average Influent Load (lb/day)	Average Effluent Concentration (mg/L)			
1/2011	6.451	8.339	455	24,505	3.67	314	16,704	8	9	0.001	0.68
2/2011	6.897	10.106	392	22,054	3.83	635	37,354	8	8	0.001	1.27
3/2011	8.413	10.564	341	22,677	2.71	916	63,667	9	7	0.001	0.26
4/2011	7.999	10.292	290	19,062	4.08	978	64,100	25	14	0.001	0.33
5/2011	8.027	11.995	257	16,019	2.67	938	58,732	8	40	0.001	0.41
6/2011	7.450	9.898	443	25,718	2.85	981	58,293	8	159	0.001	0.40
7/2011	7.551	10.188	393	23,978	2.15	353	23,010	5	18	0.001	0.23
8/2011	5.825	7.717	658	31,446	2.85	486	23,603	6	11	0.001	0.21
9/2011	6.116	7.927	521	24,271	2.15	286	14,196	4	5	0.001	0.34
10/2011	5.910	7.774	507	27,110	3.00	633	32,344	4	4	0.001	0.18
11/2011	7.115	8.695	434	25,830	2.38	870	52,920	5	9	0.001	0.32
12/2011	7.220	8.505	351	21,546	2.86	632	39,127	6	12	0.001	0.46
Average	***7.081***	***9.333***	***420***	***23,685***	***3***	***668***	***40,338***	***8***	***25***	***0.001***	***0.42***

Notes: 1 – mgd - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 - mg/L - Milligrams per liter
5 – lb/day – pounds per day
6 – N/100 ml – Number per 100 milliliters – reported as a geometric mean, per KPDES Permit
7 – Cl_2 – Chlorine
8 - NH_3-N - Ammonia Nitrogen

Table 6-7
Monthly Operating Data – 2012 Calendar Year
Summary of Flows and Loads
Henderson North Wastewater Treatment Plant

Month	Average Daily Flow (mgd) [1]	Maximum Daily Flow (mgd)	BOD_5 [2]			TSS [3]			Geometric Mean Effluent E. coli (N/100 ml) [6]	Maximum Effluent Cl_2 [7] Residual (mg/L)	Average Effluent (NH_3-N) [8] (mg/L)
			Average Influent Concentration (mg/L) [4]	Average Influent Load (lb/day) [5]	Average Effluent Concentration (lb/day)	Average Influent Concentration (mg/L)	Average Influent Load (lb/day)	Average Effluent Concentration (mg/L)			
1/2012	6.676	7.623	512	29,085	3.83	852	48,471	8	20	0.001	0.20
2/2012	6.631	7.382	490	27,848	4.54	742	41,918	10	70	0.001	0.24
3/2012	6.828	8.433	522	30,358	4.15	801	47,071	10	40	0.001	1.38
4/2012	5.629	7.314	550	26,001	3.08	826	38,640	8	58	0.001	0.31
5/2012	5.707	6.645	550	26,799	2.71	723	34,642	5	71	0.001	0.37
6/2012											
7/2012											
8/2012											
9/2012											
10/2012											
11/2012											
12/2012											
Average	***6.294***	***7.479***	***525***	***28,018***	***4***	***789***	***42,148***	***8***	***52***	***0.001***	***0.50***

Notes: 1 – mgd - Million gallons per day
2 – BOD_5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 - mg/L - Milligrams per liter
5 – lb/day – pounds per day
6 – N/100 ml – Number per 100 milliliters – reported as a geometric mean, per KPDES Permit
7 – Cl_2 – Chlorine
8 - NH_3-N - Ammonia Nitrogen

D. TREATMENT PLANT PERFORMANCE SUMMARY

During the study period January 2007 to January 2012, the monthly average daily flow varied from 4.638 to 10.709 mgd. The peak Maximum Daily Flow over this period was measured at 14.896 mgd. The monthly average influent BOD_5 concentration varied from 194 to 760 mg/L and the monthly average TSS concentration varied from 227 to 1623. The averages of the monthly averages over all the years in the preceding tables is average BOD_5 of 410 and average TSS of 482.

Analysis of selected flow and loading parameters over the four year study period in Tables 6-8 through 6-11 show some interesting trends.

Table 6-8
Analysis of Monthly Average Flow Data – Year over Year
Henderson North Wastewater Treatment Plant

Average Flow:	*2007*	*2008*	*2009*	*2010*	*2011*	*Change, 07 to 08*	*Change, 08 to 09*	*Change, 07 to 10*	*Change, 07 to 11*
January	9.793	7.255	7.127	7.874	6.451	-26%	-2%	-20%	-34%
February	8.345	10.395	9.285	7.458	6.897	25%	-11%	-11%	-17%
March	7.436	10.709	8.988	7.974	8.413	44%	-16%	7%	13%
April	8.821	9.383	9.311	7.799	7.999	6%	-1%	-12%	-9%
May	6.200	7.519	8.927	7.598	8.027	21%	19%	23%	29%
June	5.409	5.366	6.132	6.664	7.450	-1%	14%	23%	38%
July	4.999	5.385	6.303	6.566	7.551	8%	17%	31%	51%
August	4.653	6.166	6.305	6.307	5.825	33%	2%	36%	25%
September	4.638	5.710	6.633	5.625	6.116	23%	16%	21%	32%
October	5.186	5.643	8.844	5.496	5.910	9%	57%	6%	14%
November	5.423	6.129	7.785	5.974	7.115	13%	27%	10%	31%
December	8.679	7.773	8.397	5.796	7.220	-10%	8%	-33%	-17%
					Average	*12%*	*11%*	*7%*	*13%*

Monthly average daily flow increased from 2007 to 2008, and from 2008 to 2009 at double digit rates, and this growth has been maintained through 2011 (year to date). Even with 2010 being a year of extended drought, there was an average increase of 7 percent, from 2007 through 2010. Also during "normal" years, January, February, March, April and December are months when extended periods of wet weather are accompanied by extended periods of high river levels, and generally higher groundwater levels. River flooding is highly variable from year to year. During 2010 the spring flood season was practically non-existent; in May 2011, the spring flood was the 8th highest ever recorded.

Table 6-9
Analysis of Monthly Maximum Daily Flow Data – Year over Year
Henderson North Wastewater Treatment Plant

Maximum Daily Flow:	*2007*	*2008*	*2009*	*2010*	*2011*	*Change, 07 to 08*	*Change, 08 to 09*	*Change, 07 to 10*	*Change, 07 to 11*
January	14.259	11.090	9.291	11.798	8.339	-22%	-16%	-17%	-42%
February	13.869	14.309	12.736	10.161	10.106	3%	-11%	-27%	-27%
March	10.023	14.894	12.626	10.879	10.564	49%	-15%	9%	5%
April	13.966	13.835	13.414	9.401	10.292	-1%	-3%	-33%	-26%
May	11.242	10.435	13.653	10.570	11.995	-7%	31%	-6%	7%
June	7.923	9.951	9.678	7.486	9.898	26%	-3%	-6%	25%
July	7.236	10.103	11.275	9.143	10.188	40%	12%	26%	41%
August	7.038	7.567	11.761	7.577	7.717	8%	55%	8%	10%
September	8.209	7.626	10.363	6.368	7.927	-7%	36%	-22%	-3%
October	11.592	8.742	14.896	7.700	7.774	-25%	70%	-34%	-33%
November	9.550	9.396	10.991	9.584	8.695	-2%	17%	0%	-9%
December	13.294	11.685	11.511	7.340	8.505	-12%	-1%	-45%	-36%
					Average	*4%*	*14%*	*-12%*	*-7%*

This data shows that the maximum daily flow at the North WWTP has not exceeded the plant current design capacity of 15.0 mgd during the study period. Peak flows are closely associated with rainfall events. There was a general trend of double-digit increases in maximum flows during the summer months (May to September) from 2007 to 2009, which appears to have been reversed in 2010. Again, this may be attributed to the drought in 2010, where precipitation was below average by almost 30 percent.

Table 6-10
Analysis of Monthly Average Influent BOD Concentration – Year over Year
Henderson North Wastewater Treatment Plant

Average Influent BOD Concentration:	*2007*	*2008*	*2009*	*2010*	*2011*	*Change, 07 to 08*	*Change, 08 to 09*	*Change, 07 to 10*	*Change, 07 to 11*
January	194	412	378	432	455	112%	-8%	122%	134%
February	254	265	287	389	392	5%	8%	53%	55%
March	257	246	307	303	341	-4%	25%	18%	32%
April	224	332	247	237	290	49%	-26%	6%	29%
May	358	438	354	281	257	22%	-19%	-22%	-28%
June	391	624	537	306	443	60%	-14%	-22%	13%
July	427	523	429	356	393	23%	-18%	-17%	-8%
August	327	598	483	362	658	83%	-19%	11%	101%
September	436	600	514	470	521	38%	-14%	8%	20%
October	387	561	493	501	507	45%	-12%	29%	31%
November	531	364	678	465	434	-31%	86%	-12%	-18%
December	408	335	760	411	351	-18%	127%	1%	-14%
					Average	*32%*	*10%*	*15%*	*29%*

Table 6-11
Analysis of Monthly Average Influent TSS Concentration – Year over Year
Henderson North Wastewater Treatment Plant

Average Influent TSS Concentration:	*2007*	*2008*	*2009*	*2010*	*2011*	*Change, 07 to 08*	*Change, 08 to 09*	*Change, 07 to 10*	*Change, 07 to 11*
January	254	611	320	451	314	141%	-48%	77%	24%
February	276	398	297	479	635	45%	-25%	74%	130%
March	411	287	227	390	916	-30%	-21%	-5%	123%
April	340	237	269	353	978	-30%	13%	4%	187%
May	504	432	415	507	938	-14%	-4%	1%	86%
June	491	657	337	382	981	34%	-49%	-22%	100%
July	372	371	269	402	353	0%	-28%	8%	-5%
August	798	1623	303	334	486	103%	-81%	-58%	-39%
September	291	734	326	721	286	152%	-56%	148%	-2%
October	300	330	324	407	633	10%	-2%	36%	111%
November	267	235	633	313	870	-12%	170%	17%	226%
December	333	242	841	464	632	-27%	248%	39%	90%
					Average	*31%*	*10%*	*26%*	*86%*

Analysis of the data in Tables 6-10 and 6-11 shows that monthly average BOD and TSS influent concentrations increased by 15% and 26% overall, respectively, from 2007 through 2010, and by 29% and 86%, respectively from 2007 through 2011. The changes in BOD and TSS loadings from 2007 to 2011 are an anomaly caused by loadings from a sludge pond cleaning operation at one large industrial customer. Over the period from 2007 to 2011, the monthly average daily flow increased by 13%. Year-over-year average change in organic loading has consistently been in a double-digit range, but these numbers appear to be skewed by occasional large monthly changes. The data show that the plant is handling these increased concentrations well; note from Tables 6-2 to 6-7 that average effluent BOD concentrations are consistently 3's and 4's, and that TSS in the effluent rarely reaches double digits, often falling in the 6 to 9 range.

Lower average flows, and increased TSS loadings in early 2010 seem to be associated with slightly higher effluent TSS numbers, and a slightly elevated fecal coliform count. This may be a blip caused by a high fecal count in February 2010, but bears further study and monitoring.

From Table 6-6, the 2011 average influent loading of 23,685 lbs/day BOD_5 was lower than the plant's nominal organic capacity of 48,000 lbs/day. The average influent solids loading of 40,338 lbs/day TSS was lower than the rated capacity of 52,000 lbs/day. These BOD_5 and TSS loadings did not appear to affect the degree of treatment. For calendar year 2011, treatment efficiency (average influent concentration, minus average effluent concentration, divided by average influent concentration) was 99.30 % for BOD, 98.80% for TSS.

E. MAJOR INDUSTRIAL USERS

HWU has issued industrial wastewater contribution permits to 14 major industries in Henderson which discharge to the NWWTP. A list of these industries and pertinent identification information is presented in Table 6-12. A summary of the hydraulic and organic contributions of these industries to the NWWTP is shown in Table 6-13. The total average daily flow for these industries for calendar year 2009 was 1,546,729 gpd, or 1.55 mgd. For this same period, the base influent wastewater flow to the NWWTP, excluding infiltration/inflow and industrial flow, was 3.37 MGD. Therefore, industry contributed 46 percent of the base wastewater flow in the system on an annual average basis. Organically, the industries discharged 34,276 lbs/day BOD_5 and 12,945 lbs/day TSS.

Table 6-12
Major Industrial Users
Henderson North Wastewater Treatment Plant

*IU Type **	*Name and Address*	*SIC Code No.*
Categorical	Accuride Corporation P.O. Box 40 2315 Adams Lane	3499
Significant	Azteca Milling 5301 Industrial Park Drive	2041
Categorical	Brenntag Mid-South (formerly PB&S) 1405 Hwy. 136 West P.O. Box 46	5169
Categorical	Custom Resins 1421 Hwy. 136 West P.O. Box 46	2821
Categorical	Hydro Aluminum 5801 Riverport Road	3341
Categorical	International Paper 1500 Commonwealth Drive	2631
Significant	Sitex Corporation 1300 Commonwealth Drive	7389
Categorical	Sunspring America, Inc. 1105 Fifth Street P.O. Box 318	3364-3471-3544
Categorical	Teknor Apex 3070 Ohio Drive	3087
Categorical	Teknor Color 3050 Ohio Drive	3087

* *Categorical - Categorical as classified by 40 CFR*
Significant - Significant Industrial User as defined by 40 CFR

Table 6-13
Summary of Industrial Monitoring Reports for CY 2010
Henderson North Wastewater Treatment Plant

Industry	*Average Daily Flow (gpd)* [1]	*BOD_5* [2]			*TSS* [3]		
		Limit [4] *(mg/L)* [5]	*Average Concentration (mg/L)*	*Average Load (lb/day)* [6]	*Limit (mg/L)*	*Average Concentration (mg/L)*	*Average Load (lb/day)*
Accuride Corporation (C)	96,260	400	117	94	400	54	43
Azteca Milling	45,898	400	138	53	400	247	95
Brenntag Mid-South (C)	77,191	400	158	102	400	132	85
Custom Resins (C)	78,464	400	1,853	1,213	400	76	50
Gibbs (Community)	37,602		No Process Flow			No Process Flow	
Hydro Aluminum (C)	41,272	400	26	9	400	12	4
International Paper	1,079,000	400	3,577	32,189	400	1,381	12,427
Polymer Partners LLC (C)	20,695	400	39	7	400	124	21
Sitex Corporation	61,226	400	1,150	587	400	404	206
Sunspring America, Inc. (C)	35,169	400	63	18	400	25	7
Teknor Apex (C)	4,860	400	21	0.85	400	61	2.47
Teknor Color (C)	6,694	400	74	4	400	56	3

Notes: 1 – gpd - gallons per day
2 – BOD5 – Five-day biochemical oxygen demand
3 – TSS – Total Suspended Solids
4 – Average Monthly/Maximum Daily
5 – mg/L – Milligrams per liter
6 – lb/day – pounds per day

F. FACILITIES OPERATION AND MAINTENANCE STAFF

The classification of wastewater systems in Kentucky is based on population served, character and volume of wastes to be treated, and the use and characteristics of the receiving waters. In accordance with 401 Kentucky Administrative Regulation 5:010, HWU's wastewater system is classified as a Class IV system which indicates a design capacity over 7.5 MGD. The Henderson WWTP operation and maintenance staff consists of 9 full-time employees as follows:

- One Treatment Plant Operator Chief
- One Water Quality Specialist (Laboratory Technician)
- Two Wastewater Treatment Plant Operator Sr.
- Three Wastewater Treatment Plant Operators
- One Maintenance Technician
- One Pretreatment Coordinator (Water Quality Specialist) – Shared resource with South System

G. SMALL DISPOSAL SYSTEMS

In addition to the NWWTP operated by Henderson, the north planning area contains six small WWTP's. These existing disposal systems receive wastewater flow from residential developments, schools, commercial establishments, and industrial facilities. The long-term goal of HWU is to replace the small WWTP's with interceptors or pump stations and force mains connecting to the collection systems of either the North or South WWTP's. The existing average daily flow of these facilities for the NWWTP service area is a very small percentage of the total flow to the North WWTP. Therefore, the capacity of the NWWTP would allow service to the areas served by these small WWTP's with minimal impact. Table 6-14 provides general information regarding the facility name, location, receiving water and approximate average daily flow for each of the WWTP's.

Table 6-14
Small Treatment Plants
Henderson North Wastewater Treatment Plant Area

DOW Permit ID	*Facility Name*	*Location*	*Receiving Water*	*Approximate Average Daily Flow (gpd)* [1]
KY0076074	Ashford Mobile Home Park (Barb's MHP)	Fair Street, Henderson	Canoe Creek	Currently Off-Line
KY0076058	Cairo Elementary School	US Highway 41A, South	Barrett Ditch	
KY0084336	Henderson Country Club	Country Club Drive	Race Creek	
KY0076295	Niagara Elementary School	KY Highway 136, East	East Fork, Canoe Creek	
KY0083615	Spottsville Elementary School	KY Highway 1078, Spottsville	Race Creek	
KY0023141	Rising Sun Resources, LLC	KY 812, Henderson	Elam Ditch	Currently Off-Line

Source: KDOW website
Note 1: gpd = gallons per day

H. BIOSOLIDS DISPOSAL

Biosolids from the NWWTP are currently disposed of by a composter. Henderson does not operate the composting facility, which is under a separate State permit.

I. UN-SEWERED AREAS

Those areas within the planning area not served by a sanitary sewer system primarily rely on septic tanks and leach field systems for waste disposal. All new construction of septic tanks and leach field systems require the local health department's approval for this type of on-site disposal. All areas not served by the NWWTP and the small WWTP's listed above are generally

served by individual wastewater disposal systems. The Henderson/Henderson County Planning Commission requires the installation of a wastewater collection system in all developments within the city limits or the fringe areas of Henderson. If a development is in the fringe area and sewer service can not be immediately provided, the installation of septic systems along with the collection system for future use is required.

Chapter 7. FUTURE CONDITIONS

A. INTRODUCTION

This chapter will review 20-year population projections for the North WWTP planning area, project future influent wastewater flows, and forecast associated organic loadings for the NWWTP.

This chapter will also address proposed improvements to the Collection System, both as relates to the Long-Term Control Plan (LTCP) implementation, and related to future projects that could increase capacity for future growth, increase reliability, enhance sustainability, implement inflow & infiltration reduction projects, and increase the life of the existing collection system assets through operations and maintenance activities.

B. WASTEWATER FLOW PROJECTIONS

1. Base Wastewater Flow

Future wastewater flows were projected for the North WWTP by multiplying the projected population by the wastewater contribution per capita. The total wastewater flow received at a typical treatment facility represents a combination of several sources including:

- Wastewater purposely discharged to the collection system by residential, commercial, and industrial sources
- Groundwater infiltration.
- Surface water inflow due to precipitation.

The per capita wastewater contribution was determined by quantifying the flow without the influence of extraneous water and separately monitored flow from industry. Influent flow records for the North WWTP were reviewed on days with negligible effects from infiltration/inflow (I & I), that is, days when there was no precipitation.

Calendar years 2008 through 2011 were used as the basis for this evaluation. Daily precipitation records, obtained from a rain gauge maintained by HWU at the Third Street CSO Basin, were used to select days with no rainfall. HWU has direct access to data from five rain gauges, at the 3rd Street Basin, on US 60, at the NWWTP, at the State Police Post on US 41 South, and since September 2008 a USGS gauge has been available at the Raw Water Intake. The Third Street Basin gauge was used due to its central location in the North WWTP service area, and the relative completeness of the data set. Total rainfall recorded at this gauge was 45.8 inches in 2008, 43.5 inches in 2009, 26.8 inches in 2010, and 61.1 inches in 2011. Average precipitation over the 30 year period prior to 2008 was 44.3 inches.

Tables 7-3, 7-4, 7-5 and 7-6 list the daily wastewater flows on non-rainfall days for the four year study period. Average daily flow on non-rainfall days varies throughout the year, with higher flows generally occurring during the winter months, likely associated with higher river levels and higher ground water levels. Flows average in the 5 to 6 mgd range in June through September, and typically are higher in the period from March to May, reaching 8 to 9 mgd on average.

Table 7-3
North WWTP Flows During Non-Rainfall Days
2008

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	6.012		7.660		6.446	5.999	4.733	6.571	5.843	5.740	5.336	6.379
2	5.957	5.396	7.345	11.483		6.594	4.394	5.852	6.435	5.169	5.191	6.097
3	6.878	5.846			7.109	6.301		5.394	5.607	5.559	5.208	
4	6.120				5.978	5.641		6.150		4.754	5.509	6.963
5			12.738	12.755	6.718	6.300	4.322	7.567	6.188	4.582	6.804	6.445
6	5.526	13.935	12.011	11.729	6.400	5.016	4.000		4.996	4.996		5.866
7	5.940	12.054	10.719	10.486		4.708		6.199	4.583		5.536	5.764
8		11.020	10.361	9.702		4.525		6.038	5.628		5.127	6.186
9	10.624	9.719	10.550	9.029	8.064	4.716		5.827	6.057	6.105	5.057	
10		8.314	10.960		7.956		5.752	5.200	5.632	5.790	5.452	
11	9.050	8.525	10.207			4.992	5.147	5.906	5.848	5.575		6.948
12	8.645	10.315	9.240	12.528	8.936	5.064		6.263		5.283		6.908
13		10.947	8.096	10.176	8.278			6.723	5.868	5.563	6.128	6.175
14	7.398	11.827		9.260		5.904	4.867	5.635	4.551	4.983		6.601
15	7.463			8.847		5.369	5.138	4.968	5.842			
16	7.358		10.094	7.733	7.863	5.328	5.052	4.902	5.907	5.506	5.651	7.435
17			9.190	7.855	6.566	4.402	5.103	5.248	5.756	5.646	5.971	7.068
18	7.359	11.704			6.150	5.136	5.289	5.913	5.356	5.592	5.891	7.230
19	7.089	10.309			6.780	4.522	4.378	5.726	5.090	4.711	5.722	
20	6.506	9.777	13.429	7.517	5.706		4.100	6.235	4.869	5.058	5.609	7.078
21	6.743		12.630	7.279	5.640	3.827	4.865		4.913	6.031	5.458	6.334
22	6.982		11.408	7.532	7.530		5.038	5.640	6.043	5.752	5.496	6.223
23	6.813	10.891	9.997	6.906	6.184	4.799	5.026	6.180	5.910		6.412	
24	6.683	11.002	9.376	6.522	5.003	4.719	5.051	6.972	5.685			
25	6.272		9.308	8.027	4.997	4.238	5.588	7.202	5.882	5.393	7.082	8.535
26	5.769	11.126					4.202	7.264	5.486		6.350	8.171
27	5.560	9.951		6.621			3.957	6.998	5.578	5.384	4.698	
28	6.408	9.140		6.344	7.691	4.634	4.318	6.877	5.292	5.080	4.464	10.229
29			8.345	6.767	6.498	4.649	5.296	6.695	5.800	6.116	5.510	8.510
30	5.861			6.646	6.380	4.805	7.449	6.164		5.170		8.815
31								5.808		5.723		8.261
Total	165.016	191.798	203.664	191.744	148.873	122.188	113.065	178.117	150.645	135.261	129.662	164.221
# of Non-Rain Days	24	19	20	22	22	24	23	29	27	25	23	23
Average	6.876	10.095	10.183	8.716	6.767	5.091	4.916	6.142	5.579	5.410	5.637	7.140

Note: All flows in million gallons per day (mgd)

Table 7-4
North WWTP Flows During Non-Rainfall Days
2009

Date	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1	7.176		8.183	11.258		5.015	5.277		4.672	8.147	9.828	6.235
2	7.433	10.430	7.786			5.971	5.017	11.761	6.025		9.357	
3		10.130	8.166			5.893	4.126	10.314		5.227	9.383	8.737
4	6.358	8.757	7.789	10.457		5.947			4.905	6.257	8.165	8.255
5	7.414	8.257	7.424		10.848	5.981		7.809		6.471	8.076	6.963
6		9.505	7.687	11.221		4.267	5.464	7.186			7.798	7.174
7	8.501	10.325	6.902	9.791	11.188	5.779	6.038	6.154	7.104	6.714	6.967	7.722
8	7.414	9.158		8.956		5.656	5.154	5.869	6.070		6.651	
9	6.629	8.703	8.712		12.506	4.856	4.713	5.582	6.816		6.352	10.728
10					11.164	6.937	5.110		6.988	11.153	6.229	8.883
11	6.454			9.119	9.304		4.403	6.036	6.312	8.906	7.706	8.368
12	6.599	12.231	10.368	8.613	8.278	6.867		5.796	4.533	8.647	8.088	7.568
13	7.246	10.484	9.087		7.431	5.996	4.801	5.860	5.162	9.166	7.467	
14	7.663	9.016	8.670				5.560	6.062	6.023		7.244	7.881
15	6.793	8.058	7.700	7.232				4.747	5.123		7.281	6.850
16	6.852	8.654	7.906	7.278			7.235	5.393	4.965	10.294	8.481	7.054
17	6.705	8.806	7.690	6.475	7.893	6.703		5.665	5.212	9.241		7.142
18	6.185	8.777	8.415	5.528	7.110	6.845	5.777	5.731	5.473	8.220	9.125	
19	6.844	7.870			7.384	6.633	4.795	5.847	4.815	8.011	8.326	
20	5.899	7.201	7.283		6.354		5.616			7.757	8.263	6.307
21	6.523		7.785	10.686	6.963	5.476		5.601	6.104	7.017	7.941	7.639
22	6.625	6.953	6.859	8.869	6.242	5.594		5.875			8.454	6.765
23	6.082	8.351	7.825	7.963	5.753	6.320	6.748	4.838			7.748	
24	6.128	7.471		7.622		5.898	5.959	5.164		6.906	8.161	
25	5.668	7.782		7.014		5.050		5.571		7.179	6.966	
26	5.465	8.875	10.057	6.176	5.103	4.893	5.262	4.613		3.981	5.777	9.769
27	9.291		9.842	6.351	6.752	4.790	5.579	5.442	6.701		6.457	9.767
28	7.091	8.324				4.884		4.744	7.106	10.094	6.685	8.926
29	9.117		10.742	7.925	6.556	4.952	5.791	5.693	8.710	9.050	6.457	9.148
30	8.373		10.267		5.803	5.226		4.360	7.505		7.132	
31	8.579				5.418		11.275	4.048		11.516		8.957
Total	197.107	204.118	193.145	158.534	148.050	142.429	119.700	161.761	126.324	169.954	222.565	176.838
# of Non-Rain Days	28	23	23	19	19	25	21	27	21	21	29	22
Average	7.040	8.875	8.398	8.344	7.792	5.697	5.700	5.991	6.015	8.093	7.675	8.038

Note: All flows in million gallons per day (mgd)

Table 7-5
North WWTP Flows During Non-Rainfall Days
2010

Date	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1	8.489	7.412	6.620	8.188		7.486	6.498	6.035	5.686	5.674	5.324	6.671
2	8.157	8.512	7.090	7.711		6.586	5.983	6.692	6.014	5.145	5.493	6.030
3	7.718	7.024	6.498		10.395		5.880	7.128	5.654	4.734	5.411	6.661
4	6.783	7.927	6.996	7.902		6.390	5.897	7.577	5.179	5.183	5.395	5.671
5	5.087		6.315	7.803	9.612	6.445	5.670	7.157	4.991	5.612	5.231	5.390
6	6.169	8.928	6.448	7.592	9.113	6.228	6.035	6.295	5.953	5.559	4.999	5.490
7	6.883	7.535	6.430		8.532	6.651	5.937	6.098	5.555	5.070	4.765	5.882
8	6.107	6.581	6.322		7.967			6.210	5.480	5.503	5.339	5.289
9	5.696	7.519	6.674	7.751	8.144			6.410	5.526	5.537	5.837	5.697
10	5.521	7.616	6.856	7.283	8.137		5.832	6.134		5.504	5.531	5.546
11	6.682	7.459		7.335	7.996		5.798	6.399		5.794	5.372	7.340
12	6.350	7.607		7.099	8.127	6.615	6.966	6.557	5.564		5.272	5.600
13	7.009	7.306	7.303	8.046	7.842	6.286	6.340	6.331	5.632	5.771		5.296
14	6.149	7.007		8.519	7.847	6.475	5.914	6.127	5.884	5.584	5.027	5.875
15	6.228	6.844	7.225	8.168			6.554		5.799	5.452	4.882	6.300
16	6.544	7.078	7.177			6.971	6.221	6.131		5.287		
17		7.333	6.975	7.626	7.337	7.205	6.196	6.176	5.422	5.328	5.373	5.627
18	6.878	7.279	7.038	7.232	6.694	6.538		6.196	5.419	5.411	5.508	5.530
19	7.430	7.571	7.043	7.470	6.373			6.205	5.387	5.438	5.090	5.047
20		7.522	7.040	6.699		6.725		5.996	5.495	5.344	5.000	5.752
21				6.341	7.292	6.779			5.091	5.232	5.199	5.710
22	11.561			7.307	6.568	6.783	7.309	5.817	5.879	5.533	6.397	5.663
23	10.969	7.391	10.064		6.345	6.538	6.779	6.228	6.262	5.144		5.717
24		6.984	8.779		6.590	6.079	6.527	6.320	5.558	5.456		5.461
25	11.417	7.218			6.734	6.172	6.284	6.189	5.060			5.530
26	9.788	6.725	10.865	7.758	5.511	5.845	6.389	6.593	5.171		6.739	5.706
27	9.452	6.865	10.172				6.491	6.131	5.729	5.549	5.383	5.321
28	8.780	6.550		7.760	5.560		5.899	5.639	5.585	5.506	5.866	4.889
29	8.428		9.725	6.939	6.041	6.531	6.176	5.776	5.417	5.155		
30	7.171		8.552	8.082	6.293	6.465	6.642	5.895	6.020	5.224	8.887	5.774
31	7.168		8.335					6.048		4.939		
Total	204.614	183.793	182.542	166.611	171.050	137.793	150.217	182.490	150.412	150.668	133.320	160.465
# of Non-Rain Days	27	25	24	22	23	21	24	29	27	28	24	28
Average	7.578	7.352	7.606	7.573	7.437	6.562	6.259	6.293	5.571	5.381	5.555	5.731

Note: All flows in million gallons per day (mgd)

Table 7-6
North WWTP Flows During Non-Rainfall Days
2011

Date	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1			9.721	7.468		6.656	7.276	5.983	5.562	6.337	6.268	7.497
2	5.879	6.730	8.217	6.762		7.323	6.052	6.174		5.530		7.597
3	6.682	6.923	8.071	6.864		7.205		6.512	5.154	5.695	7.384	7.261
4	5.947	6.910			10.534	6.428		5.710	6.728	5.681	6.074	
5	6.106	6.908		8.506	10.469		7.320	5.980	6.019	5.731	5.842	
6	6.089		8.350	6.784	10.199	7.276	7.189			6.318		7.492
7	6.187	7.504	8.272	6.766		6.599	8.190	6.833	4.898	5.798	6.177	7.052
8	6.544	6.496		6.786	10.120	6.635		6.574		5.666		7.178
9	5.726	6.059			10.355	7.099	9.533	6.610		5.339		7.177
10	6.066	5.816		6.412	9.173	5.936	9.252		6.102	5.616	6.211	6.482
11	6.087	6.124	9.347		7.719	5.296	9.003	6.001	5.011	5.902	6.069	6.852
12	6.422	5.645	8.725	8.084	7.184	5.652		5.635	5.081		5.827	6.768
13	6.160	6.419	8.715	7.873		5.800		5.707	5.533		5.730	
14	6.375	6.264		7.657	6.178			5.401		5.904		7.010
15	6.431	5.788	10.304		6.599	5.897	9.275	5.401		5.277		
16	6.269	5.792	10.298		7.681	6.552	8.111	5.469	4.907	5.059	8.056	6.787
17		6.199	10.334	7.628	7.162		7.267	5.688	5.116	5.290	7.628	6.920
18		5.669	9.800	7.841	6.950		7.795	5.521	6.883		7.486	6.504
19	6.929	5.711	8.141		6.593		7.506	5.660	7.362		7.366	7.257
20	6.856	5.963	7.488		7.178	9.306	7.394	5.129	6.646	7.261	7.805	
21	6.421		7.934	8.487	6.031	8.489	7.114	5.488	7.209	5.256	8.167	
22	6.289	5.620	7.694		6.576	7.759	6.613	5.261		5.094		
23	6.303	6.363	7.420			7.286	6.768	5.381		5.270		7.434
24	6.557		6.622		6.217	7.045		5.485	7.927	5.736	7.479	6.676
25	6.541		6.383				5.937	5.333	7.358	5.347	7.358	6.729
26	6.793	7.726					6.075	6.186	6.703		7.688	
27	6.804	8.933	6.699		6.797			5.698				
28	6.563		6.509	9.470	6.495	9.101	6.214	5.015	6.592	7.774	7.924	7.097
29	5.771		6.079	9.619	6.484	8.006	6.026	5.676	5.949	6.091	7.932	7.278
30	5.785		6.592	10.292	6.399	7.373	5.807	5.703		5.759		7.155
31	5.617		6.797		6.835		5.717	5.328		5.542		7.150
Total	176.199	141.562	194.512	133.299	169.093	154.719	167.434	166.542	122.740	144.273	140.471	155.353
# of Non-Rain Days	28	22	24	17	22	22	23	29	20	25	20	22
Average	6.293	6.435	8.105	7.841	7.686	7.033	7.280	5.743	6.137	5.771	7.024	7.062

Note: All flows in million gallons per day (mgd)

During a continuous 14-day period from August 7th to August 20th, 2008, rainfall amounts in the Henderson area were not measurable, and this period was chosen for analysis. Three days following the last preceding day of measurable precipitation were excluded from the base flow computation to reduce the potential influence from groundwater infiltration. A similar 12-day period from August 21st to September 1st, 2009, is also included on the table below, along with a 21-day period from August 11th to August 31st , 2011 . North WWTP monthly reports were then used to determine the average daily flow during the time period. Table 7-7 provides the dates and corresponding wastewater flows used to determine the base flow.

Table 7-7
North WWTP
Sample Dry Weather Wastewater Flows

Date (2008)	*Daily Flows (MGD)*	*Date (2009)*	*Daily Flows (MGD)*	*Date (2011)*	*Daily Flows (MGD)*
August 10	5.200	August 24	5.164	August 14	5.401
August 11	5.906	August 25	5.571	August 15	5.401
August 12	6.263	August 26	4.613	August 16	5.469
August 13	6.723	August 27	5.442	August 17	5.688
August 14	5.635	August 28	4.744	August 18	5.521
August 15	4.968	August 29	5.693	August 19	5.660
August 16	4.902	August 30	4.360	August 20	5.129
August 17	5.248	August 31	4.048	August 21	5.488
August 18	5.913	September 1	4.672	August 22	5.261
August 19	5.726			August 23	5.381
August 20	6.235			August 24	5.485
				August 25	5.333
				August 26	6.186
				August 27	5.698
				August 28	5.015
				August 29	5.676
				August 30	5.703
				August 31	5.328
Total Flow	*62.719*	*Total Flow*	*44.307*	*Total Flow*	*98.823*

From Table 7-7, the total wastewater flow for the 11-day period in 2008 was 62.719 MG, for the nine day period in 2009 it was 44.307 MG, and for the 18 day period it was 98.823 MG. The average daily flow from industry in Henderson in 2009 was 1.55 MGD (see Chapter 6). Therefore, the base flow for each period can be computed by dividing the total flow by the number of day, minus the industrial flow of 1.55 MGD.

For 2008 Period:	(62.719/11) = 5.702	5.702 – 1.55 = 4.152 MGD
For 2009 Period:	(44.307/9) = 4.923	4.923 – 1.55 = 3.373 MGD
For 2011 Period:	(98.823/18) = 5.490	5.490 – 1.55 = 3.940 MGD

The average of these three periods is 3.82 MGD, which is the assumed Base Flow. The estimated population served in the North WWTP service area in 2009 was 30,394 (from Chapter 4, Section D). Therefore, the average per capita wastewater flow, including residential and commercial flow, but excluding Infiltration and Inflow (I & I) and industrial flow, is 3.82 MGD divided by a population of 30,394, or 126 gallons per capita per day (gpcd).

2. Infiltration/Inflow

Infiltration and Inflow (I & I) are separate sources of extraneous water and must, therefore, be quantified separately. Infiltration refers to groundwater that enters pipes through joints, leaking bells, crevices, or other imperfections in pipes and structures. Inflow refers to rainfall that enters the system directly through catch basins in the combined sewer system, through leaking manhole lids, pick holes, or other means.

The average infiltration was calculated by subtracting the base wastewater flow from the average non-rainfall wastewater flow for the study years 2008, 2009, 2010 and 2011. Based on HWU precipitation records, there were 1,136 days during the four year study period in which Henderson did not experience a rainfall event (rainfall event being defined as precipitation at the rain gauge located at the Third Street Basin of more than 0.05 inches in 24 hours). Little inflow occurs during these periods. Tables 7-3, 7-4, 7-5 and 7-6 show the daily wastewater flows for those non-rainfall days. A total of 7,762 MG was recorded at the WWTP during the 1,136 non-rainfall days, resulting in an average daily flow of 6.83 MGD. Therefore, the average non-rainfall flow yields an average infiltration rate of 6.83 MGD minus the sum of the base flow and industrial flow (3.82 + 1.55 = 5.37 MGD), or 1.46 MGD.

Maximum infiltration occurs during periods when groundwater level is high, which correlates roughly to elevated levels on the Ohio River. Analysis of precipitation records and seasonal river fluctuations indicate that a high infiltration rate occurred during an 8 day period from February 2 to February 9, 2009. The total flow recorded at the NWWTP was 75.26 MG for this period. Therefore, the maximum infiltration rate was 75.26 MG / 8 days = 9.41 MGD minus the sum of the base flow and industrial flow of 5.39 MGD, or 4.02 MGD, more than twice the average.

Inflow enters the collection system only during or immediately following a rainfall event. The amount of inflow is determined by subtracting the base flow, industrial flow, and average infiltration from the total wastewater volume. The average daily flow at the North WWTP for the four year study period (every day of 2008, 2009, 2010 and 2011) was 7.24 MGD. The average inflow computes to be 7. 24 MGD minus (3.82 + 1.55 + 1.46 MGD), or 0.41 MGD.

Maximum inflow occurs during periods of high intensity precipitation which may be accompanied by isolated flooding. The presence of combined sewers in Henderson may result in the bypassing of some inflow which enters the wastewater collection system. Consequently, flow measurements recorded at the North WWTP may not accurately reflect the maximum

inflow volumes. The LTCP projected a yearly overflow volume of 28.7 MG. The increase in influent flow resulting directly from inflow can be estimated. During a two-day period in late July 2009, precipitation in Henderson was 2.77 inches and the average daily flow at the WWTP was 10.53 MGD. It is assumed that infiltration was the median of the average and maximum values previously calculated. Therefore, the maximum inflow is the maximum daily flow minus the sum of the base flow, industrial flow, and median infiltration, or 10.53 MGD minus (3.82 + 1.55 + ((1.47 + 4.02 MGD)/2) = 2.42 MGD.

3. Summary of Wastewater Flows

Table 7-8 presents a summary of wastewater flows for 2012, and projected flows for the 20-year planning period for the North WWTP. Wastewater flow projections for the year 2032 include the following considerations:

- All new residential and commercial units within the City Limits will require sewer service.
- Some areas adjacent to the City Limits will be provided sewer service, but these additions will be limited.
- Per customer residential and commercial wastewater contributions will not change significantly.
- Average and maximum infiltration and inflow will remain constant during the planning period.
- Peak daily flows, excluding inflow and infiltration, are 150 percent of average daily flows.
- The population served by the North WWTP in year 2032 will be 33,700.
- Per capita wastewater flow, including residential, commercial, and institutional, equals 126 gcd and will remain constant throughout the planning period.
- The average daily industrial flow of 1.55 MGD for the North WWTP is based on the Annual Pretreatment Report for 2009. This number includes un-reduced flow from International Paper. The industrial flow forecast includes a 50% growth factor.

Table 7-8 North WWTP Wastewater Flow Projections			
Year	*User/Type*	*Average Daily Flow [1]*	*Peak Daily Flow [1]*
2012	Res./Com./Institutional	3.82	5.76
	Industrial	1.55	1.55
	Infiltration	1.46	4.02
	Inflow	0.41	2.42
	Total	7.27	13.73
2032	Res./Com./Institutional	4.25	6.50
	Industrial [3]	2.32	2.32
	Infiltration	1.46	4.02
	Inflow	0.41	2.42
	Total	8.44	15.24
2032	Total Flow with Addition of North Fork Pumping Station Flow	20.5	25.5

Notes: 1 – in MGD - Million gallons per day
2 – Peak Daily Flows, excluding I&I, are assumed to be 150 percent of average daily flows
3 – Assumes 50% additional industrial growth
4 – Assume average and maximum infiltration will increase 10 percent

During the design of the new North Fork sewer pumping station, HWU and our consultant installed flow monitors in the influent sewers to the new station. This flow monitoring revealed that the new pumping station would need a 12 MGD capacity initially, and a 24 MGD capacity ultimately, in order to minimize combined sewer overflows to North Fork Canoe Creek. This new pumping station will discharge directly to the North WWTP, and is essentially a "new" source of flow to the plant, due to the fact that the Second Street pumping station currently discharges to the Downtown Interceptor, and then to Jannalee Drive pumping station. Consequently, the peak daily flow to the North WWTP will be increased by this 12 MGD flow, minus some redirected flow from the Jannalee Drive pumping station. Since all flows to the North WWTP are pumped, we can directly calculate the flow that will be seen at the plant during peak (rainfall) flows by adding the pumping capacities of the various pump stations:

Jannalee Drive:	11.5 MGD
North Fork:	12.0 MGD
International Paper:	1.0 MGD
Other:	1.0 MGD

The peak flow expected at the North WWTP is thus 25.5 MGD. Average daily flow is not impacted by construction of the new pumping station.

C. WASTE LOAD PROJECTIONS

Waste load projections for the year 2030 were computed by using the estimated average daily flow of 8.44 MGD and the approximate average daily concentrations of 460 mg/L BOD_5 and 380 mg/L TSS, based on the averages from the 2009 monthly operating reports. Table 7-9 presents the year 2032 design waste load projections in the raw wastewater flow stream.

Table 7-9
North WWTP
Waste Load Projections – Year 2030

Flow Stream	*Design Flow (mgd)* [1]	*Constituent*	*Concentration (mg/L)* [2]	*Load (lbs/day)* [3]
Raw Wastewater	8.44	BOD_5	460	32,685
		TSS	380	27,001

Notes: 1 – MGD - Million gallons per day
2 – mg/L - Milligrams per liter
3 – pounds per day
4 – BOD_5 – Five-day biochemical oxygen demand
5 – TSS - Total suspended solids

D. COLLECTION SYSTEM

1. General

The collection system in the North WWTP planning area can be divided into three parts for the discussion of ways to improve the efficiency of the system. They are the combined sewer system (CSS) of the City of Henderson, the separate sewer system (SSS) of the City of Henderson, and the separate sewer system of the City of Corydon.

The separate sewer system of Corydon is not operated and maintained by HWU, and its optimization is not addressed in this plan.

The separate sanitary sewer system of Henderson has not had as much formal study as the combined sewer system. However, HWU continues to make studies and improvements to the separate system to increase its efficiency. These improvements are also described in this section.

2. Long-Term Control Plan (LTCP) for the Combined Sewer System

Since the development of the first Combined Sewer Operating Plan (CSOP) in 1996, HWU has adopted a proactive approach to CSO issues within the community. HWU has been actively implementing a CSO control strategy consistent with the intent of the 1994 CSO Control Policy. HWU has been designing and constructing sewer separation projects and other improvements to reduce CSO volumes and occurrences. Even as a small community with limited resources, HWU has already committed $17.3 million to reduce CSO within the CSS.

HWU has been working towards mitigating the effects of CSOs since the mid-1990s and over time developed an approach to CSO control that relies on two time-tested approaches: separation and conveyance for treatment. HWU's pro-active and aggressive approach to CSO control is evident in the many accomplishments it has made prior to preparing this LTCP:

- Investing over $17 million in CSO control and mitigation efforts,
- Eliminating 4 CSOs, including all CSOs upstream of Henderson's public drinking water intake,
- Separating 48% of the CSS,
- Constructing a 15 million gallon detention basin with primary treatment,
- Hosting numerous public events to inform and involve the community in the CSO control process,
- Meeting all of the Nine Minimum Controls requirements, and
- Completing ahead of schedule the Center and Julia Phase II Separation Project which was a commitment made in the Early Action Plan as set forth in the Consent Judgment.

The LTCP builds on HWU's long-standing commitment to conforming to the CSO control policy by presenting a plan that exceeds the requirements set out in Policy guidance:

- Eliminating or capturing for treatment 92% of the volume of the combined sewage collected in the system during rain-events on an average annual basis,
- Separating a total of 56% of the CSS,
- Disconnecting 77% of the contributing flow through the CSS through separation and rerouting of flows,
- Making an additional seven CSOs inactive,
- Expanding treatment capacity at the WWTP, and
- Constructing a multi-phase, interceptor, pump station and force main to transport wet weather flows away from the CSS and to the WWTP.

This section summarizes the projects and outcomes anticipated by the implementation of the LTCP. It concludes that HWU will meet or exceed the minimum requirements of the Presumptive approach as defined in CSO Control Policy Guidance.

3. Separation Projects

Separating combined sewers has been a foundation of HWU's approach to CSO control. Since 1996, when the CSO Control Policy was developed and implemented, HWU has been implementing the projects defined in the CSOP as a long-term program to separate 56 percent of the CSS area, as shown in Table 7-10.

Table 7-10
Combined Sewer Separation Projects

Year	Acres Separated	Cumulative Acres Separated	Cumulative Percentage of CSS Separated	Status
Before 1998	64	64	4%	Complete
1998	31	95	6%	Complete
1999	32	127	9%	Complete
2000	101	228	16%	Complete
2001	50	278	19%	Complete
2002	75	353	24%	Complete
2003	150	503	34%	Complete
2004	41	544	37%	Complete
2005	58	602	41%	Complete
2006-2008	114	716	48%	Complete
2009	112	828	56%	Under Design

Additional separation projects include:

A. Center & Julia Stormwater Phase III: This project is designed to complete the Center & Julia Phase II Stormwater Separation Project. It will reroute the separated stormwater flow from the Third Street CSO Storage Basin and take it directly to Canoe Creek. This will reduce the volume of separated stormwater entering the basin and reserve more capacity for the combined flow. This project is now in construction and will be completed in the first quarter of 2013.
B. Downtown Sewer Separation Project: This project will separate sanitary sewer and stormwater from 16 blocks of the main downtown area. This project will also eliminate all combined flow to CSOs 008, 009, and 010. This project started in July 2010 and was completed in January 2012.
C. Ershig Stormwater Line (Ragan and Green Streets): This project consisted of installing a box culvert and ditch work to reroute stormwater away from the CSS at Green Street. This water formerly flowed into intakes on a 42" combined sewer line that goes to the Ragan Street CSO outfall. This project is complete.

Figure 6-2 shows the areas within the CSS that have been separated or are slated to be separated.

4. Verification of the Effectiveness of CSO Control

The capture for treatment of no less than 85 percent (by volume) of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis is the threshold necessary in the Presumptive Approach, according to CSO LTCP guidance. The HWU control plan exceeds these criteria. The estimated annual average percentage of captured flow

under the LTCP is 92 percent. This estimate is based on spreadsheet calculations utilizing the rational method to determine surface runoff into the CSS. The spreadsheets were purposely set up to be inherently conservative in their prediction of capture by not including time of concentration factors or significant amounts of in line storage.

The approach also provides for a more comprehensive examination of the effectiveness of CSO control by going beyond a typical year analysis that can ignore the potential for large (20-year, 50-year, etc.) rain events by simulating the improvements using 60 years of historical hour-by-hour rainfall data annualized to provide a true historical average annual wet weather flow capture rate. By using actual hourly rainfall data collected over the past six decades, HWU is able to test the effectiveness of the control plan under a larger variety of rain events.

To verify that HWU's plan meets the standards of the National CSO Control Policy, HWU is committed to continue its flow monitoring program as part of LTCP implementation. This program will monitor the flow of every overflow as well as key points within the system and at the WWTP to track the total flow entering and leaving its system during rain events. With this information, HWU can evaluate the effectiveness of the CSO controls.

Through yearly reports to KDOW, HWU will communicate progress toward CSO mitigation. HWU has set a goal for compliance before the year 2018, so it is crucial that HWU adjust their CSO control program based on its review of the success of their strategy, if appropriate, after full implementation. Due to variations in annual rainfall patterns, HWU prefers to evaluate results for several consecutive years.

E. PRETREATMENT PROGRAM EFFICIENCY

HWU performs industrial wastewater discharge monitoring as part of its routine operations. As previously discussed in Chapter 6, 14 major industrial dischargers are currently registered with HWU. Each of these discharges is monitored quarterly. 24-hour composite samples are collected on a scheduled and unscheduled basis. Surveillance testing is also performed as needed, such as an increase in typical flows from a particular industry, or other cause for concern.

HWU has dedicated a pretreatment program inspector for this effort. A full range of organic and chemical testing is conducted by an independent laboratory on each sample collected. Table 6-13 presented the summary of industrial discharge test results for 2010. All of the monitored industries were in compliance with the pretreatment program. The Henderson North WWTP consistently meets and exceeds its KPDES discharge permit, and there is no indication that industrial wastewater interferes with the plant's performance.

The Pretreatment section of the Sewer Use Ordinance has been updated to comply with the Streamlining Rule promulgated by USEPA, specifically in dealing with the potential for slug discharges that could inhibit WWTP performance.

Chapter 8. EVALUATION OF ALTERNATIVES

A. NO ACTION ALTERNATIVE

If no action is taken, the current North WWTP facilities and the North Area collection system would continue to meet existing demands, if no growth occurs. The current NWWTP has several deficiencies which would continue unabated, such as inadequate screening and grit removal, inadequate clarification to treat projected flows and loadings, and an inability of the process treatment train to meet future regulatory requirements, such as nutrient removal.

The North Collection System is also subject to the requirements of a Consent Judgment dealing with combined sewer overflows. If the North WWTP is not expanded, combined sewer overflows will exceed the requirements of the CSO Policy and the Consent Judgment. Considering these challenges, the No Action Alternative has been rejected.

B. OPTIMIZATION OF EXISTING FACILITIES

1. Collection System – General Considerations

The existing sanitary collection system in this planning area includes gravity sewers, pump stations and force mains which transport wastewater to the North WWTP. This includes all of the combined sewer system operated by Henderson.

As residential, commercial and industrial development in the planning area occurs, expanding the existing collection system to provide service may be necessary. The location and sizing of new collection system facilities is dependent upon development patterns, which are dictated by private developers. Locating and sizing lines and stations prior to the submittal of specific development plans is very difficult and sizing and installing new facilities to handle rapidly approaching development is an ongoing challenge. Therefore, no locations or sizes of future collection system improvements are included in this Facilities Plan Update. HWU attempts to anticipate future growth when installing new collection facilities and sizes them to handle future growth, where practicable.

HWU's systems include a large number of pump stations relative to system size. Over a number of years, we have attempted to replace pump stations whenever new development makes that possible or practical. An example of this effort was the Augusta-Hubbard pump station, which was eliminated in early 2012 through a project that installed 500 feet of 8" PVC sewer and two new manholes, allowing the flow at this location to drain by gravity through a recently developed subdivision and eliminating the pump station. At least three other such projects are being planned for future implementation as funds become available. The implementation of the LTCP project on Canoe Creek Phase II will result in the elimination of four pump stations and a permitted CSO outfall. Pump station elimination helps to optimize

the collections system efficiency by eliminating the concentration of flows and lessening the incidence of overflows by eliminating opportunities for mechanical failure.

2. Collection System – Long Term Control Plan / Combined Sewer Area Projects

The CSO control policy provides for several presumptive design guides for CSO controls to meet water quality-based goals of the Clean Water Act. HWU has proposed to meet the CSO Control Policy by eliminating or capturing for treatment a minimum of 85 percent by volume of flow collected in the CSS during precipitation events on a system wide annual average basis. The LTCP, therefore, focuses on the potential cost impact of constructing system improvements based on modeling results that would reduce flows and/or provide adequate conveyance and treatment capacity to achieve that goal.

Since the development of the Combined Sewer Operating Plan (CSOP) in 1996, HWU has adopted a proactive approach to CSO issues within the community. HWU has been actively implementing a CSO control strategy consistent with the intent of the 1994 CSO Control Policy. HWU has been designing and constructing sewer separation projects and other improvements to reduce CSO volumes and occurrences. Even as a small community with limited resources, HWU committed $17.3 million to reduce CSO within their CSS, prior to the 2009 submittal of the LTCP.

Henderson's CSOP includes measures to optimize flow in the combined sewer system and avoidance of combined sewer overflows to the maximum degree practicable. For details of these efforts, see the CSOP and refer to the LTCP, approved in April, 2012.

Future improvement and separation projects, such as the Canoe Creek Interceptor, are currently being designed and constructed. Modeling results for the current plan of action shows 85 percent capture of wet weather flows. It was not appropriate to evaluate other alternatives that would have deviated from the diversion and separation approach to CSO control implemented by HWU over 10 years ago.

HWU's LTCP continues our ongoing strategy which includes:

1. Installing separate sanitary sewers in the older downtown area and converting old combined sewer lines to storm-only lines to reduce the amount of stormwater entering the CSS. This project is now complete.

2. Rerouting sanitary flows that currently flow through the Downtown Interceptor away from the downtown area to increase available capacity within the CSS. One large project implementing this strategy (Canoe Creek Phase II) is currently under construction.

3. Make improvements to the WWTP to accommodate the higher flow rates being captured and transported to the WWTP. This phase of the LTCP is currently in design and is the primary focus of this facilities plan update.

The currently proposed plan indicates a substantial amount of reduction in CSO volume and a large increase in percent of capture. Upon completion of this plan, approximately 56 percent of the CSS will be completely separated which includes all of the downtown area with the highest percentage of impervious surfaces. While further separation projects are not part of the LTCP, HWU intends to continue funding separation projects in the short and long term future, to further reduce CSO volume, and to reduce to the maximum extent possible the amount of stormwater that must be treated at the wastewater plant.

Modeling results verify that separation efforts and planned projects by HWU will result in capturing at least 85 percent of the combined sewer flow as required by the Presumptive Approach. Although all models have some degree of inaccuracy, every component of our model has been assembled to generate a conservative simulation of the results that will be achieved by implementing HWU's LTCP. HWU is committed to achieving compliance with the CSO Control Policy by meeting or exceeding the 85 percent capture threshold.

Finally, post-construction monitoring is required by the CSO Policy, as a way of verifying that treatment goals are being achieved.

3. North WWTP

The North WWTP is located on Drury Lane near the Ohio River, southwest of the Henderson downtown area. The plant was originally constructed as a primary treatment facility in 1954. It was upgraded to secondary treatment in 1975 and renovated and expanded in 1991, 1996 and 2001. The 1991 expansion increased the design capacity to 7.5 mgd, while addition of the second aerated lagoon in 1996 increased the capacity to 15.0 mgd.

To optimize current treatment capacity at the NWWTP, HWU has a current project to renovate Extended Aeration Basin # 1. The liner on this basin failed in late 2009, and the renovation includes elements designed to make the liner more robust, to increase the aeration efficiency and increasing the design capacity of this unit.

Addition of the third lagoon in 2001 was designed to allow the plant to accept increased BOD and TSS loadings from a large industrial customer, while maintaining the remainder of the plant and optimizing flow through the other process train elements.

C. REGIONALIZATION

1. Collection System – Satellite Operations – Plants and Collection Systems

HWU serves satellite operations in Henderson, Webster and McLean Counties. Sewer flow is accepted from an independent collection system operated by the City of Corydon under an agreement signed in June 1993. The Corydon flow enters the North system near the Henderson Community College campus, and flows from there to the NWWTP. Maintenance of this system is the responsibility of Corydon, including the pumping station located at the west edge of town and the force main from Corydon to Henderson. Henderson maintains a flow meter at Corydon's pump station for billing purposes.

HWU also operates the South System, which was constructed to serve a large industrial customer near the southern border of Henderson County. As part of that development, the water and sewer elements of the South System were aligned to allow provision of water service and acceptance of sanitary flows from the City of Sebree, to accept sewage from a chicken hatchery in McLean County, and to provide water service to the City of Beech Grove. Sebree is responsible for its sewer collection system, and for all pumping stations except the main stations required to transfer flows to the Henderson South treatment system. Henderson is responsible for these main stations and for the force main lines from Sebree to the South WWTP.

As the largest City in the three county area served, Henderson is the logical and likely entity to serve as the lead, regional agency. Other public agencies in Henderson County, including Henderson Fiscal Court and the Henderson County Water District, have expressed informally that they have no desire to enter the business of provision of sewer service.

2. Finley Addition Sewer Project

As an example of Regionalization initiatives involving our system, Henderson County Fiscal Court is sponsoring a project which uses State grant funds to provide sewer service to an area just outside the Henderson city limits on U.S. Highway 41A, locally referred to as the "Finley Addition". This project will eliminate a number of failed septic systems and straight pipes, and the sewers will be accepted into the HWU system once constructed. This is an example of a project where regional agencies work together to utilize available resources to do the most good.

D. TREATMENT ALTERNATIVES

1. General

The existing North Wastewater Treatment Plant (NWWTP) can currently reliably treat a design flow of 15 MGD. With the construction of the new North Fork Sewage Pumping Station, which is scheduled to be complete in the summer of 2013, the peak flow to the NWWTP will be

increased to approximately 25 million gallons per day (MGD), which includes flows required by the Henderson Long-Term Control Plan. As a result, the peak flow treatment capacity of the NWWTP must be increased, which will include the design and construction of a new headworks and one new final clarifier. The raw, mixed liquor, return and waste activated sludge, and effluent piping systems must be rerouted and expanded to provide capacity to handle this increased flow. Another item that is in need of renovation or replacement is the disinfection process.

The following three alternative treatment strategies are described here: (1) Renovation of the existing extended aeration process, (2) Construction of a new Oxidation Ditch type process, and (3) Construction of a new Sequencing Batch Reactor (SBR) type process. Following a brief description of each possible alternative, individual process train elements are analyzed in light of each treatment strategy, and specific aspects of changes required to these elements are described.

2. Overview of Alternative Treatment Strategies

A. Alternative No. 1 – Renovation of the Existing Lagoon Extended Aeration Process

Alternative No. 1 consists of the renovation of the existing Extended Aeration Process utilizing the existing basins and existing technology. Alternative No. 1 is being studied as an interim measure, for two reasons. First, Henderson has significant investments in the existing plant and equipment, which are not fully depreciated nor at the end of their useful life. In order to reap the full benefits of these sunk costs, Henderson desires to extend the life of the current plant assets to the maximum extent possible. However, the existing Extended Aeration Process will likely not be able to remove nutrients without substantial new construction and modification, with increased operational costs due to chemical addition. Given these conditions, Henderson is investigating two additional alternatives, one of which would be a follow-up project after Alternative No. 1 is constructed and has been in operation for some time.

Alternative No. 1 includes a new headworks structure, new process division structure, new return and waste activated sludge pumping station, new 165 foot diameter clarifier, new ultraviolet disinfection structure, and associated site piping. These improvements are estimated to cost $ 12,070,000 as shown on Cost Estimate No. 1. The improvements are shown on Exhibit 8-1.

B. Alternative No. 2 – Oxidation Ditch Technology

Alternative No. 2 consists of the construction of a new Oxidation Ditch-type plant and abandonment of the existing Extended Aeration process. An oxidation ditch is a modified activated sludge biological treatment process that utilizes long solids retention times (SRTs) to remove biodegradable organics. Typical oxidation ditch treatment systems consist of single or

multi-channel configurations in an oval or serpentine-shaped basin (often referred to as "racetrack" reactors). Horizontally or vertically mounted aerators provide circulation, oxygen transfer, and aeration of the ditch. Oxidation ditches are fully-demonstrated and commonly used technology, and are especially applicable in plants that require nitrification and nutrient removal.

The scope of this alternative includes a new headworks structure, a new process division structure, two new parallel oxidation ditches, new return and waste activated sludge pumping station, a new 165 foot diameter clarifier, renovation of two existing 136 foot diameter final clarifiers, new ultraviolet disinfection, and associated site piping. These improvements are estimated to cost $ 24,080,000 as shown on Cost Estimate No. 2A. The additional cost in present day dollars of this alteration, if constructed as a follow-on project to Alternative No. 1 is $ 16,360,000, as shown on Cost Estimate 2B. The improvements are shown on Exhibit 8-2.

C. Alternative No. 3 – Sequencing Batch Reactor (SBR) Technology

Alternative No. 3 consists of the construction of a new Sequencing Batch Reactor (SBR) plant and abandonment of the existing Extended Aeration Process. While there are several configurations of SBRs the basic process is simple. SBRs consist of at least two identically equipped tanks with a common inlet, which can be switched between them. The tanks function as a batch system, with raw wastewater (influent) coming in at one end and treated water (effluent) flowing out the other. While one tank is in fill/aeration mode, others are in settle/decant mode. Since one tank is always in fill mode, continuous flow into the plant can be achieved, but as the effluent is discharged in a batch fashion, flow equalization is usually required at the end of the SBRs.

The scope of this alternative includes a new headworks structure, new parallel SBRs, conversion of Aeration Basin No. 1 to a flow equalization basin, a new effluent pumping station, conversion of two existing 136 foot diameter final clarifiers to chemical phosphorous precipitation clarifiers, new ultraviolet disinfection structure, and associated site piping. These improvements are estimated to cost $27,230,000 as shown on Cost Estimate No. 3, and the improvements are shown on Exhibit 8-3.

The construction of this alternative as a follow up project to Alternative No. 1 is not suggested due to the required demolition of new Final Clarifier No. 3, which is not required as part of the SBR process.

3. Process Element Descriptions for Each Alternative Treatment Strategy

The following discussion highlights changes to each major treatment process element in the NWWTP as they relate to the different alternative treatment strategies being explored. Some elements of the plan, like the Headworks, are identical for each alternative strategy.

A. Headworks (Common to all Alternatives)

Construction of the Headworks structure is being proposed due to the age and deteriorated condition of the existing headworks. As shown in Chapter 6, the unit process capacities of the screening, grit removal and flow measurement units are inadequate for the proposed interim and ultimate flow capacities of the plant. In addition, the headworks channel and covering structure are deteriorated and in need of replacement. The headworks location, near the adjacent Fairmont Cemetery is also a concern due to odor. For this reason, the Headworks construction is included in each of the Alternative Treatment Strategies, and does not change depending on the strategy chosen.

The proposed headworks structure consists of two new fine screens, a manual bypass screen, grit classifier and removal system, and electromagnetic flow meter. All flow entering the new headworks is proposed to be pumped up to approximate elevation 412 which will allow for full gravity flow through the entire NWWTP. This concept will result in the top of the headworks being at approximate elevation 415 which is approximately 16 feet above the existing ground elevation. All flow entering the new headworks is proposed to pass through a 36-inch magnetic flow meter for flow measurement. A spare section of flanged ductile iron pipe of equal length to the flow meter will be provided to allow continued plant operation should the meter need to be removed for maintenance. The Headworks is also being moved to a more central location in the plant, to help with odor issues.

After passing through the magnetic flow meter, flow enters a distribution channel and is routed to two automatic fine screens and one manual bar screen. The two automatic fine screens are proposed to treat the peak flow while removing particles larger than 0.125 inch (1/8”). If one of the screens needs to be taken out of service for repair, a manual bypass screen is located between the two automatic screens and can handle the flow of one of the automatic screens. The manual screen is only proposed to be used for temporary operation and will require regular attention from the plant operators. Both of the automatic fine screens will be installed with screenings washing presses to wash organic matter from the screenings into the channel for treatment and also to compact the screenings, which reduces the water content and screenings disposal costs, and alleviates odor issues. The screenings will discharge off the side of the headworks by gravity to dumpsters for disposal at a local landfill. Six aluminum slide gates will be furnished to isolate the screens from the wastewater flow during times of maintenance or when the manual screen is not required.

After screening, the sewage passes into a grit classification and removal system consisting of two parallel units, each capable of treating half the NWWTP design flow. The grit removal unit consists of a grit concentrator followed by a slurry cup classification unit. The concentrator is a completely hydraulic unit which uses a vortex flow and stacked tray design to efficiently capture and settle fine grit via large surface area and short settling distance. The slurry cup is a completely hydraulic, free-vortex unit that captures, classifies, and removes grit, fine sand, and high density fixed solids (like small rocks) from the grit slurry. A center trough between the grit removal units allows flow to be routed around the grit removal units if necessary for

maintenance. The mechanical equipment furnished as part of the grit removal unit will be housed in an enclosed building constructed as part of the new headworks.

B. Process Division Box Structure (Alternatives No. 1 & 2 only)

Due to the proposed location of the new Headworks and the need for process flow splitting, the Process Division Box Structure is common to Alternatives 1 and 2, but is not required for the SBR, Alternative 3. In the SBR, process flow splitting is accomplished with automatic valves.

After treatment at the new headworks, the screened and degritted sewage is proposed to enter a new process division box, the purpose of which is to appropriately split flows to various treatment units. This unit will centralize flow management of constituent flows between the three separate process flows (raw sewage (RAW), mixed liquor suspended solids (MLSS), and return activated sludge (RAS)), which must be routed between the process train elements within the plant. Flow division is accomplished by using a central distribution box for each flow, around which are arrayed a series of weirs for each process stream which will allow appropriate amounts of each process stream to flow to the individual treatment units. The division boxes for each process stream will be constructed as one structure for cost savings accomplished by using common walls. Additionally, the RAS portion of the structure will include pumps and telescopic valves, and a method for wasting sludge. The current Waste Activated Sludge pumping station is inadequately sized and needs to be replaced due to its condition.

For the raw wastewater flow from the Headworks, it is proposed to use four eight foot weirs, three of which will initially be used to split the flow to the existing three extended aeration basins. The fourth weir will be used in the future if a fourth basin is constructed. The MLSS effluent from the extended aeration basins is proposed to be split with two seven foot weirs (one for each of two existing 136 foot diameter clarifiers) and one 10 foot weir for the new 165 foot diameter clarifier discussed hereinafter. A fourth 10 foot weir is proposed for a future 165 foot diameter clarifier. The RAS flow is proposed to be split with four – 4 foot weirs, three of which will be used for the existing extended aeration basins and one for future expansion if a new extended aeration basin is constructed.

C. Secondary Treatment

Note that in this discussion, the following processes are referenced frequently. Their definitions are:

Anaerobic – processes that break down material in the absence of Oxygen
Anoxic – processes which operate in low-oxygen environments. Similar to "hypoxic".
Aerobic – processes which function in an oxygenated environment.

1. Existing System: Secondary treatment of the wastewater flow is currently achieved in the Extended Aeration Basins. With modifications to influent and effluent piping, and slight elevation of the ground elevation at the top of slope, the existing basins can adequately handle the flow of 25 MGD.

The existing aeration lagoons use large amounts of air for mixing, more than is required for biological respiration. This air is supplied by large blowers which consume electricity, so the lagoon aeration process is inefficient in its use of power, leading to higher operational costs than some other treatment processes. In addition, the current "drop" aeration mechanisms require maintenance personnel to perform frequent repairs while in a boat on the lagoon, a serious safety and time concern.

The NWWTP currently fully nitrifies ammonia entering the plant producing an effluent that complies with the KPDES permit. There is a reasonable chance that the NWWTP will receive an effluent nitrate and/or phosphorous limitation during the period covered by this study. Retrofitting the existing extended aeration process to remove nutrients will be difficult. First, two phosphorous release tanks will be required upstream of the mixed liquor splitter box to combine the return activated sludge and raw sewage in an anaerobic environment. Next, two new denitrification tanks will be required to receive recirculated mixed liquor, which is nitrate rich, and the effluent from the phosphorous release tank. A new recirculation pumping station will be required to pump the aeration basin effluent at up to four times the influent flow rate to the denitrification basin. This style plant will be costly and difficult to operate and will not be sufficiently reliable to consistently meet future nutrient effluent limitations. The following two alternatives are being studied to address the nutrient removal issue.

2. Oxidation Ditch Alternative: One alternative for addressing future nutrient limitations at the NWWTP is to replace the existing extended aeration basins with a new oxidation ditch process. This Alternative would consist of two parallel oxidation ditch units equipped with biological phosphorous removal and denitrification facilities. This concept will reuse some of the unit process improvements in the Interim Alternative No. 1, including the headworks, process division box, final clarifiers, RAS/WAS pumping station, and ultraviolet disinfection facilities.

   Screened and degritted raw sewage travels from the headworks through a 48-inch raw sewage line to the oxidation ditches. Flow is split to two 36 –inch pipes with half the flow entering each oxidation ditch. The anaerobic reactor at the inlet to the oxidation ditch will receive the raw sewage and return activated sludge into a mixed unaerated tank. In this process, the bacteria in the return sludge will switch from aerobic to anaerobic respiration which causes them to release the phosphorous contained in their cells. After these bacteria return to an aerobic respiration state, they are revived, and consume all of the released phosphorous and the phosphorous contained in the raw sewage (up to three times the originally released amount). Phosphorous is removed from the process when these bacteria are wasted from the process by the waste sludge pumps. It is important to note that virtually no phosphorous is destroyed during sewage treatment so the only way to remove it from the process is to waste the bacteria that consume it. It is important that the wasted bacteria not be allowed to enter an anaerobic environment further along in the process, or they will release the

phosphorous out of their cell wall which will cause it to be recycled to the plant via supernatant flow, as from a digester.

The effluent weirs from the anaerobic phosphorous release zones are the same length and ensure that 50 percent of the flow is routed to each oxidation ditch. Effluent from the anaerobic zone enters a mixed anoxic zone which receives a portion of the recycled nitrified mixed liquor from the oxidation ditch through a vertical opening in the wall between the anoxic zone and the downstream aerobic zone. The reaction desired in the anoxic zone is the conversion of biochemical oxygen demand using nitrate as a respiration source. This reaction converts the nitrate entering from the aerobic zone to nitrogen gas which is known as the denitrification process. The effluent from the anoxic zone enters the aerobic zone of the oxidation ditch which consists of the large, concrete serpentine tanks typically associated with this process. The effluent from the oxidation ditch flows to the division box constructed as part of Alternative No. 1 and then discharges to the final clarifiers.

Chemical Phosphorus Clarification: Although the biological nutrient removal process described above is efficient and typically meets the total nitrate limitations proposed by most state regulatory agencies, this process cannot reliably meet total phosphorous limitations below 1.0 mg/l. If effluent phosphorous limitations below this level are established for the NWWTP, it is likely that chemical precipitation will be required to achieve compliance. One solution to this problem is to construct the new final clarifier at a lower elevation so that effluent flow from the existing final clarifiers can be routed through the new final clarifiers in series. During normal flows less than 15 MGD, all effluent from the oxidation ditches is routed to existing final clarifiers 1 and 2. During rainfall events when the influent flow increases above 15 MGD, the control system will automatically lower the weir gates in the mixed liquor diversion structure allowing the mixed liquor to flow in parallel to all three final clarifiers. After the flow decreases below 15 MGD, the weir gates will be raised, placing the plant back into series clarification mode. Chemical phosphorous precipitation can occur during the series operation by feeding an iron salt or other precipitant to the effluent from the first set of clarifiers allowing the phosphorous to precipitate and settle out in the second set of clarifier(s)

3. SBR Alternative: The second alternative for addressing future nutrient limitations at the NWWTP is to replace the existing extended aeration basins with a new Sequencing Batch Reactor process. In this Alternative the screened and degritted raw sewage flows to the SBR units through a 48-inch raw sewage pipeline. The discharge of raw sewage to each of six SBR basins (the number appropriate for this size plant) is controlled by automatically operated influent valves which allow one of the six basins to accept raw sewage while the other basins are at differing stages of treatment. SBR technology achieves treatment through batch type treatment consisting of the following cycles: (1)

raw sewage fill, (2) aeration, (3) settling, and (4) decant. Continuous influent flow can be maintained because one of the six basins will always be in the "fill" cycle.

During the fill cycle, an electronically operated influent valve opens allowing sewage to enter the basin until the level in the basin reaches a preset level and then the valve closes. The control system will initiate influent valve opening at the next basin scheduled for operation so that it can begin its fill cycle. After the influent valve closes, the control system starts the blowers for the aeration cycle. If nutrient removal is desired, the aeration system will remain off, and instead, a series of mixers will begin operation to allow the basin to become anaerobic or anoxic for the desired phosphorous or nitrate removal stage. The SBR process offers flexibility regarding nutrient removal due to its ability to combine multiple mix and aeration cycles, which can be modified to address the specific flows and nutrient waste loads.

After preset time intervals, the mixers will stop and then aeration will begin for BOD removal. After a secondary preset time has elapsed, the aeration cycle will stop, and the settling cycle will begin. After sufficient time, the settling cycle will end and the basin will begin the decant cycle, where clear effluent is pulled from the upper volume of the lagoon and discharged to downstream facilities. Decanting is accomplished with a floating mechanism having multiple takeoff orifices allowing for a homogenous removal of the top layer of supernatant, while preventing the discharge of the settled sludge to the downstream facilities. Waste sludge is removed from the basins on a volumetric basis. No return sludge pumping facilities are required with SBRs, since the bacteria remain in the treatment vessel after settling.

Clear effluent from the SBR process discharges in batches, rather than the continuous discharge associated with most wastewater treatment processes. The batch type discharge can present challenges with the capacity of downstream treatment structures if flow equalization is not utilized. Batch operation interferes with UV disinfection processes especially, since UV works best with flows that don't change rapidly or frequently. Flow equalization allows the downstream treatment facilities to be designed at a peak flow equal to the peak capacity of the plant in lieu of the decant flow rate which can be much higher.

To accomplish equalization in a cost efficient manner, the effluent from the SBR will discharge to existing Aeration Basin No. 1 which is currently being renovated. The existing basin can store approximately 7 million gallons. A new SBR effluent pumping station will be necessary if the SBR option is implemented to transfer effluent to the converted phosphorous precipitating clarifiers, and modification of influent and effluent piping will be required. The new pumping station should have a capacity of at least 15 MGD with two of three pumps operating at full speed. This concept will allow one pump to transfer low flows operating at minimum speed with the use of variable frequency drives. In the event that the flow entering the plant exceeds 15 MGD and the

flow equalization basin is full, the decant from the SBR process is proposed to be routed around the phosphorous precipitating clarifiers directly to disinfection. This concept is discussed above in the section entitled "Chemical Phosphorous Clarification". Construction of this equalization/effluent pumping station adds costs for both initial construction and subsequent operation of the SBR process.

D. Final Clarification (New Clarifier for Alternatives No. 1 and 2 only)

Mixed liquor from the secondary treatment process flows to a new MLSS division structure which uses sets of weirs to route the appropriate amount of MLSS to the final clarification stage. The MLSS division structure is part of the Division Box Structure outlined in section B, above. The proposed improvements to the final clarification process include rehabilitation of the mechanical equipment in the two existing 136 foot diameter clarifiers allowing their continued use, and the construction of a new 165 foot diameter clarifier which will increase the final clarification treatment capacity to 25.5 million gallons per day (MGD). This option only applies to Alternatives No. 1 & 2. The existing final clarifiers have a diameter of 136 feet which yields a surface area of 14,520 square feet (SF). The original design plans for these clarifiers indicate a design capacity of 7.5 MGD using a surface overflow rate of 516 GPD/SF. These clarifiers incorporate a unique design concept which utilizes an intermediate sloped bottom which apparently causes the sludge to be routed to the center hopper at a faster rate. The capacity of these units should be monitored closely since the sloped bottom can create a condition at high flows that causes the re-suspension of settled sludge and subsequent carryover to the effluent weirs. Modification of the existing final clarifiers is common to all of the Alternative Treatment Strategies, and does not change depending on the strategy chosen, with the exception that Alternative No. 3 does not require additional clarification capacity.

For Alternatives No. 1 and 2, a new 165 foot diameter clarifier is proposed with a capacity of 10.5 MGD at a surface overflow rate of 500 GPD/SF which is conservative. Other factors affect clarifier performance including solids loading rate and weir loading rate. The dimensions of the new final clarifier will be selected during the detailed design phase.

If Alternative No. 2, the Oxidation Ditch, is expanded in the future to an ultimate capacity of 36 MGD, an additional 165 foot diameter clarifier is proposed with a capacity of 10.5 MGD at a surface overflow rate of 500 GPD/SF which is conservative. This would only be constructed should future growth or an increase in pumping capacity at the North Fork Sewage Pumping Station require this capacity increase.

For the SBR Alternative, the two existing 136 foot clarifiers will suffice. They will become phosphorus precipitation clarifiers, functioning along the lines of the description above under "Chemical Phosphorus Clarification". An iron salt of other chemical will be added to the clarifier influent flow.

E. Return and Waste Activated Sludge Pumping Station (Alternatives No. 1 and 2 only)

The sludge that settles in the final clarifiers in Alternatives No. 1 & 2 is returned to the inlet of the secondary treatment process to ensure proper treatment. This flow must be pumped since the water surface of the final clarifiers is below the elevation of all the secondary treatment processes studied. Since the surface area of the new 165 foot diameter final clarifier is approximately 50 percent larger than the two existing 136 foot diameter clarifiers, the amount of sludge that must be returned from these units differs. As a result, the sludge from each clarifier should discharge to a central wetwell where the rate of discharge from each clarifier can be controlled by adjustable telescopic valves. This concept gives the operators the ability to increase or decrease the sludge underflow rate from each clarifier independently which typically leads to better performance. This central wet well will be part of the Division Box Structure detailed in Section B, above, and only applies to Alternatives No. 1 & 2.

The new RAS/WAS pumping station should contain an inlet pipe and telescopic valve for each existing and future final clarifier. The telescopic valves discharge to a wetwell that contains two submersible RAS pumps equipped with variable frequency drives and two constant speed WAS pumps. The RAS and WAS discharge lines will contain electromagnetic flow meter, allowing the operators to increase or decrease the speed of the RAS pumps as the process dictates and also allowing metering of sludge wasting rates (WAS) and pump operation intervals. Frequent sludge wasting is better for the process than intermittent (once daily) wasting, and metering of the volume of waste sludge allows the operators to accurately track the mixed liquor suspended solids inventory, an important operational benchmark.

F. Disinfection and Post Aeration (Common to all Alternatives)

The current disinfection system utilizes chlorine gas, which is hazardous and presents safety and security concerns. The system has also reached the end of its useful life. HWU has determined that a UV disinfection system as detailed below is safer, easier to operate, and may have a short payback period, depending on future power and chemical pricing.

The disinfection process proposed for the plant expansion consists of open channel ultraviolet (UV) disinfection. UV disinfection applies 254 nanometer (nm) UV light to the effluent flow, dosing bacteria and altering their DNA, subsequently preventing them from reproducing. The intensity of light necessary to provide compliance with KPDES permit limits depends upon the transmissivity of the effluent waste stream, which is affected by color, mineral content, and solids concentration. UV technology has been successfully used for the disinfection of wastewater effluent for many years. Due to restricted pipe sizes in the existing disinfection system, and a lack of space in the current disinfection location for expansion, a new system must be constructed. These changes to the Disinfection stage are common to all of the Alternative Treatment Strategies, and do not change depending on the strategy chosen.

The disinfection system for the NWWTP consists of two open-channel UV units located in series, each capable of treating 18 MGD, half the peak design flow. During peak flows both units will be in operation and during lower average daily flows, one unit can be turned off to

manage power usage. The units consist of vertical racks of horizontal UV bulbs which are aligned with the direction of effluent flow. An electromagnetic flow meter is proposed to be mounted upstream of the units to meet the requirements of the KPDES discharge permit and also to provide an analog signal to the UV controller. The controller utilizes the flow signal input and also the output from a transmissivity sensor that is supplied with the UV equipment. These two signals are used by the controller's programmable logic controller (PLC) to calculate the appropriate UV dose for adequate disinfection.

UV units require that the water level over the bulbs be maintained within a certain tolerance to keep the bulbs cool and also to apply an adequate disinfection dose. This can be accomplished by using the manufacturer's patented level control device which uses a swivel mounted plate with a counterweight to introduce the appropriate amount of head loss, a serpentine weir or a series of weir troughs can be used to accomplish the desired level range.

Although the KPDES permit for the NWWTP only requires dissolved oxygen be above 2.0 mg/l, a small post aeration device can be designed to ensure this is accomplished. This will consist of a series of steps over which the flow will cascade, entraining air in a non-mechanical method. Typical dissolved oxygen concentrations from final clarifier effluent from the extended aeration process are 3 to 4 mg/l.

E. COST ANALYSIS

Cost estimates for the Alternatives to be constructed are shown in attachments to this Chapter. The costs are estimated at $ 12,070,000 for Alternative No. 1, $ 24,080,000 for Alternative No. 2, and $27,230,000 for Alternative No. 3.

If Alternative No. 2B is constructed as a follow-up project to Alternative No. 2, the additional cost for Alternative No. 2 completion is $ 16,360,000.

Henderson has borrowed $ 20 million to complete the first phases of the LTCP projects. Some of the first projects (Downtown Area Separation, Center & Julia) were partially funded through prior rate increases and from reserves. Funding of future projects will be from further bonding, and the debt service will be covered by future rate increases as detailed in Section D. of Chapter 10.

When comparing the costs of the various alternatives studied to each other, the only major cost center that is different between the three studied is the Secondary Treatment process. The three alternatives analyzed along with operating horsepower are as follows:

Alternative No. 1 – Extended Aeration with Lagoons:	Six – 200 HP Blowers One - 50 HP RAS pump One - 10 HP Final Clarifier No. 3 drive *Total = 1260 HP* ***Total Present Worth Cost $5,747,004***
Alternative No. 2 – Oxidation Ditch:	Two - 300 HP main aerators Four – 10 HP Anaerobic Mixers Six – 5 HP Anoxic Mixers One – 50 HP RAS Pump One – 10 HP Final Clarifier drive unit *Total = 730 HP* ***Total Present Worth Cost $3,329,613***
Alternative No. 3 – SBR:	Four – 200 HP Blowers One – 75 HP Effluent Pump *Total = 875 HP* ***Total Present Worth Cost $3,990,975***

Alternative No. 2, the Oxidation Ditch, has the lowest future operating costs. These connected loads only apply to the biological processes to estimate the electrical operating cost for comparison sake. The operating costs of the existing final clarifiers are not included, since they are utilized in all three alternatives. The analysis uses a beginning power cost of $0.035, a 4% yearly power cost increase, and a 3% yearly monetary inflation.

F. RECOMMENDED ALTERNATIVE

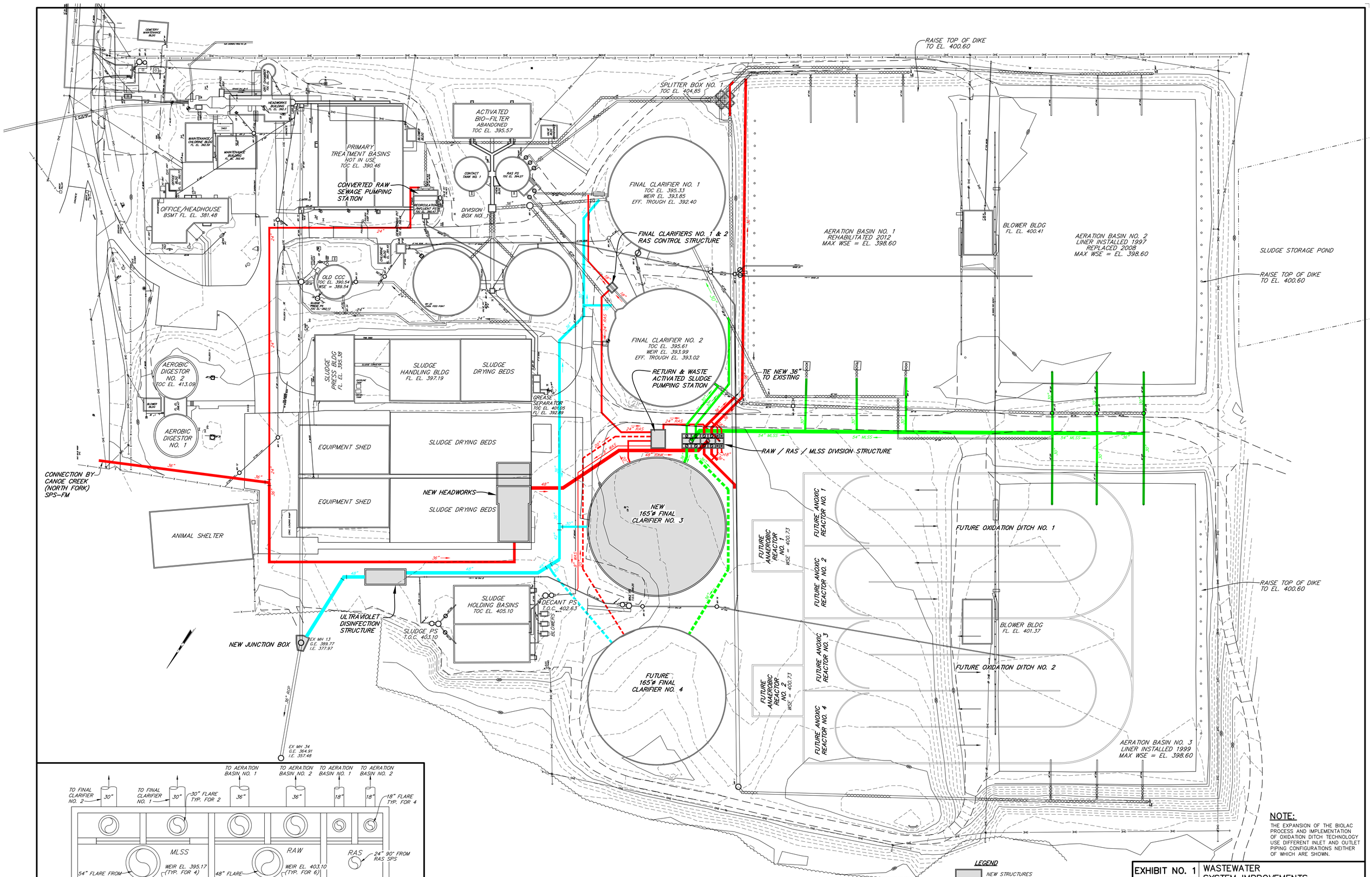
Henderson has chosen to implement Alternative No. 1, Renovation of the Existing Lagoon Extended Aeration Process as an interim step, and Alternative No. 2, Construction of an Oxidation Ditch, as an ultimate goal.

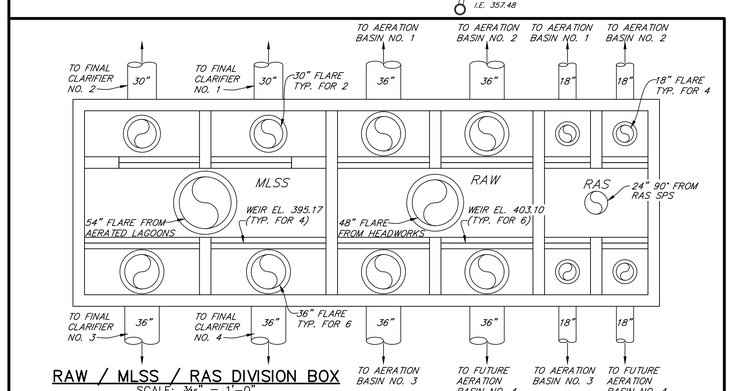
Alternative No. 1 is being constructed as an interim measure, for two reasons. First, Henderson has significant investment in the existing plant which is not fully depreciated, nor at the end of its useful life. In order to reap the full benefits of these sunk costs, Henderson desires to extend the life of the current plant assets to the maximum extent practicable. However, the existing Extended Aeration Process will likely not be able to remove nutrients without substantial modification and increased operational costs due to chemical addition, and multiple pumping of flows.

Given these constraints, Henderson has chosen the Construction of an Oxidation Ditch as a follow-on project after Alternative No. 1 is constructed and has been in operation for some time. Construction of the Oxidation Ditch alternative will only be pursued if nutrient removal is

required in a future KPDES permit, or if flow increases require an increase in capacity that would lead to substantial additional expenditures to meet capacity requirements.

Construction of the Oxidation Ditch alternative will also allow future increases in capacity of the plant up to 36 MGD, which is possible if future growth occurs, or if the LTCP's post-construction monitoring requirement shows a need for increased pumping capacity at the North Fork Pump station to further reduce combined sewer overflow volumes on Canoe Creek.





RAW / MLSS / RAS DIVISION BOX
SCALE: 3/16" = 1'-0"

NOTE:
THE EXPANSION OF THE BIOLAC PROCESS AND IMPLEMENTATION OF OXIDATION DITCH TECHNOLOGY USE DIFFERENT INLET AND OUTLET PIPING CONFIGURATIONS NEITHER OF WHICH ARE SHOWN.

EXHIBIT NO. 1	WASTEWATER SYSTEM IMPROVEMENTS	
REVISIONS	ALTERNATIVE NO. 1 – CONTINUED USE OF EXTENDED AERATION	
	FOR HENDERSON WATER UTILITY HENDERSON, KENTUCKY	
APPROVED	SCALE 1" = 40'	DESIGNED JGD
	J. R. WAUFORD & CO. CONSULTING ENGINEERS, INC. NASHVILLE, TENNESSEE	DRAWN AWR
	DATE MAY 2012	CHECKED JGD
	JOB NO. 1949	

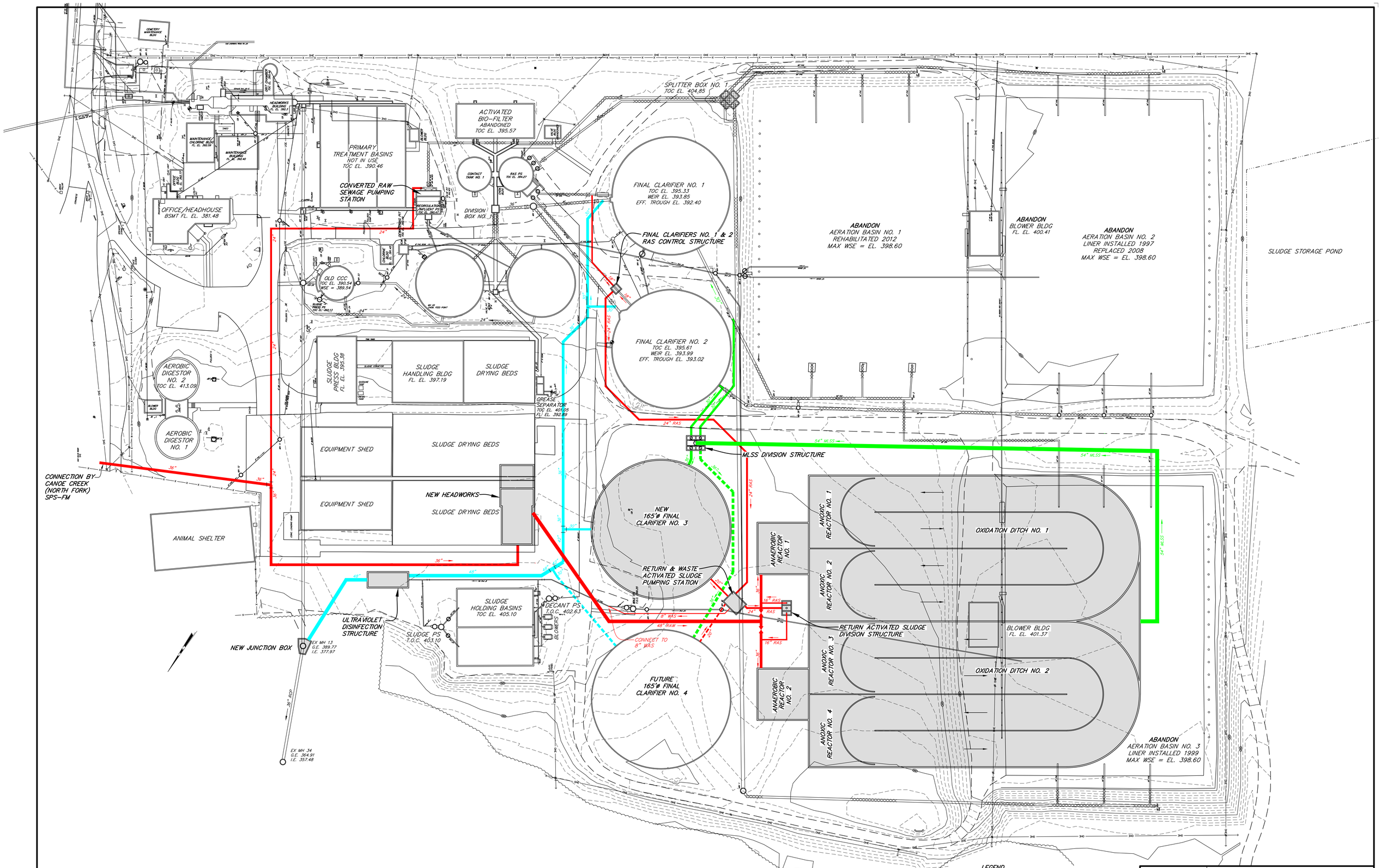


EXHIBIT NO. 2	WASTEWATER SYSTEM IMPROVEMENTS	
REVISIONS	ALTERNATIVE NO. 2 – OXIDATION DITCH TECHNOLOGY	
	FOR HENDERSON WATER UTILITY HENDERSON, KENTUCKY	
APPROVED	SCALE 1" = 40'	DESIGNED JGD
	DATE MAY 2012	DRAWN AWR
	J. R. WAUFORD & CO. CONSULTING ENGINEERS, INC. NASHVILLE, TENNESSEE JOB NO. 1949	CHECKED JGD

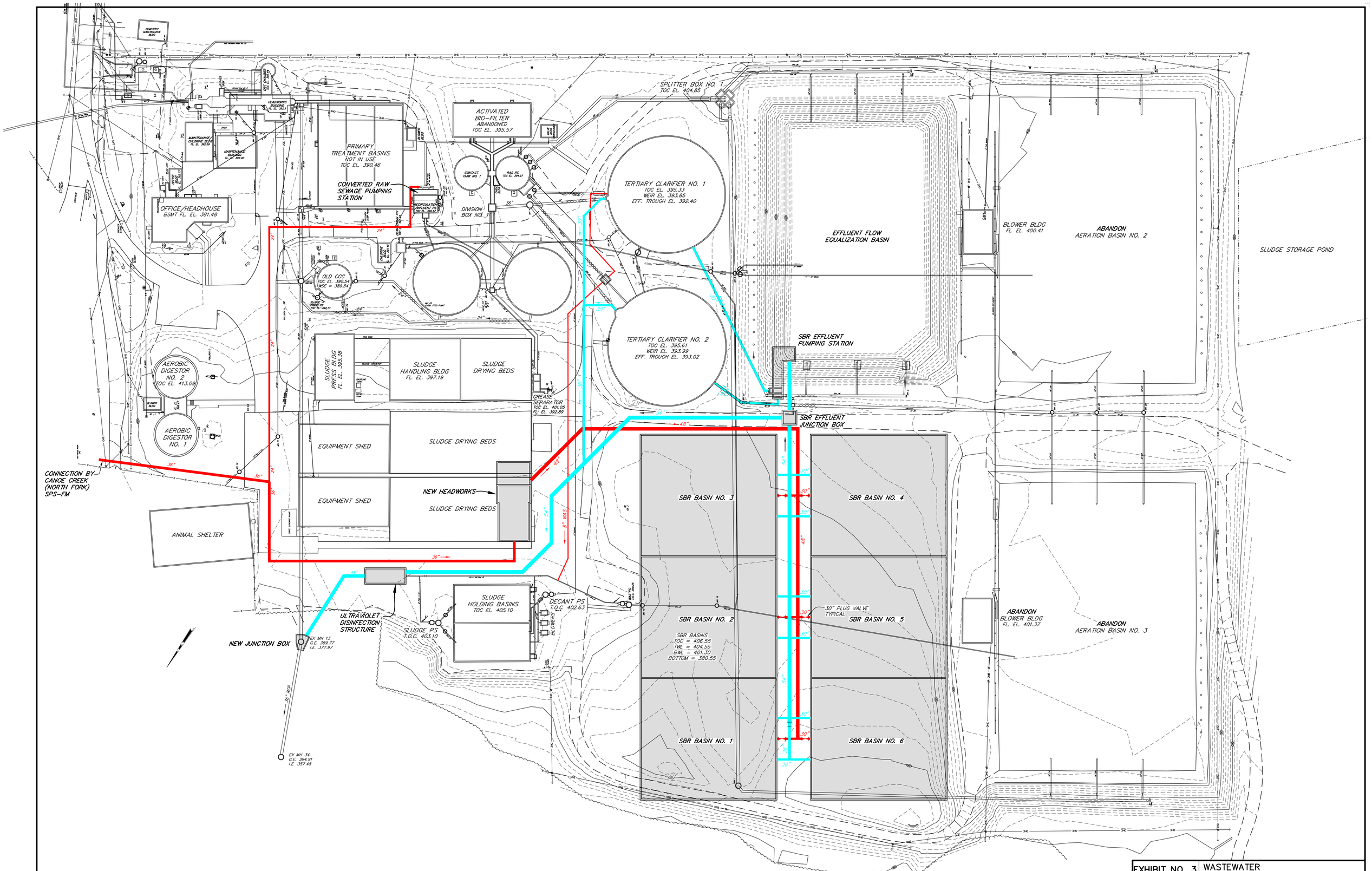


EXHIBIT NO. 3	WASTEWATER SYSTEM IMPROVEMENTS	
REVISIONS	ALTERNATIVE NO. 3 – SEQUENCING BATCH REACTOR TECHNOLOGY	
	FOR HENDERSON WATER UTILITY HENDERSON, KENTUCKY	
APPROVED	SCALE 1" = 40'	J. R. WAUFORD & CO. CONSULTING ENGINEERS, INC. NASHVILLE, TENNESSEE
	DATE MAY 2012	JOB NO. 1949
	DESIGNED JGD	DRAWN AWR	CHECKED JGD

COST ESTIMATE NO. 1 - NORTH WASTEWATER TREATMENT PLANT RENOVATION ALTERNATIVE NO. 1 - CONTINUATION OF EXTENDED AERATION PROCESS, NEW HEADWORKS, 165 FOOT DIAMETER FINAL CLARIFIER, AND ULTRAVIOLET DISINFECTION HENDERSON WATER UTILITY JRWCO JOB NO. 1949

Item	Description		Cost
1.	Site Development and Grading		$350,000
2.	Buried Piping (5,200 L.F. of 8-inch to 54-inch)		$1,655,000
3.	Above Ground Piping		$150,000
4.	Existing Piping Connections (23 @ $10,000 each)		$230,000
5.	Structural Concrete (1,700 C.Y. slab and 700 C.Y. walls)		$1,680,000
6.	Miscellaneous Metals		$371,500
7.	Metal Building Construction		$150,000
8.	Equipment Installation		$539,000
9.	Electrical		$1,173,000
10.	Process Painting and Coating		$175,000
11.	Miscellaneous Concrete, Paving, and Fencing		$260,000
12.	Process Equipment		$3,370,000
	Raw Wastewater Screens (2)	$625,000	
	Grit Removal Equipment	$850,000	
	Final Clarifier Equipment	$650,000	
	RAS Pumps and VFD's (2)	$150,000	
	WAS Pumps (2)	$20,000	
	UV Equipment (2)	$675,000	
	Instrumentation and Controls	$400,000	
	ESTIMATED CONSTRUCTION COST		$10,103,500
	CONSTRUCTION CONTINGENCIES (10%)		$1,011,500
	1. Budgeted for Construction		$11,115,000
	2. Engineering: Design		$535,000
	Award		$6,000
	During Construction (18 months)		$396,000
	O & M and Start-Up		$18,000
	TOTAL ESTIMATED PROJECT COST		$12,070,000

ENR CONSTRUCTION COST INDEX – 9267 (03/2012)

1949
May 2012

COST ESTIMATE NO. 2A - NORTH WASTEWATER TREATMENT PLANT RENOVATION
ALTERNATIVE NO. 2A – NEW OXIDATION DITCHES, NEW HEADWORKS, 165 FOOT DIAMETER FINAL CLARIFIER, AND ULTRAVIOLET DISINFECTION
HENDERSON WATER UTILITY
JRWCO JOB NO. 1949

Item	Description		Cost
1.	Site Development and Grading		$850,000
2.	Buried Piping (3,270 L.F. of 8-inch to 54-inch)		$1,134,000
3.	Above Ground Piping		$250,000
4.	Existing Piping Connections (8 @ $10,000 each)		$80,000
5.	Structural Concrete (11,300 C.Y. slab and 5,700 C.Y. walls)		$6,810,000
6.	Miscellaneous Metals		$795,000
7.	Metal Building Construction		$150,000
8.	Equipment Installation		$860,000
9.	Electrical		$1,869,000
10.	Process Painting and Coating		$250,000
11.	Miscellaneous Concrete, Paving, and Fencing		$460,000
12.	Process Equipment		$6,845,000
	Raw Wastewater Screens (2)	$625,000	
	Grit Removal Equipment	$850,000	
	Oxidation Ditch Equipment	$3,375,000	
	Final Clarifier Equipment	$650,000	
	RAS Pumps and VFD's (2)	$150,000	
	WAS Pumps (2)	$20,000	
	UV Equipment (2)	$675,000	
	Instrumentation and Controls	$500,000	
	ESTIMATED CONSTRUCTION COST		$20,353,000
	CONSTRUCTION CONTINGENCIES (10%)		$2,047,000
	1. Budgeted for Construction		$22,400,000
	2. Engineering: Design		$980,000
	Award		$15,000
	During Construction (30 months)		$660,000
	O & M and Start-Up		$25,000
	TOTAL ESTIMATED PROJECT COST		$24,080,000

ENR CONSTRUCTION COST INDEX – 9267 (03/2012)

1949
May 2012

COST ESTIMATE NO. 2B - NORTH WASTEWATER TREATMENT PLANT RENOVATION
ALTERNATIVE NO. 2B – OXIDATION DITCH TECHNOLOGY FOLLOWING CONSTRUCTION OF ALTERNATIVE NO. 1
HENDERSON WATER UTILITY
JRWCO JOB NO. 1949

Item	Description		Cost
1.	Site Development and Grading		$850,000
2.	Buried Piping (700 L.F. of 42-inch to 54-inch)		$257,000
3.	Above Ground Piping		$125,000
4.	Existing Piping Connections (5 @ $15,000 each)		$75,000
5.	Structural Concrete (9,600 C.Y. slab and 5,000 C.Y. walls)		$5,880,000
6.	Miscellaneous Metals		$621,000
7.	Equipment Installation		$580,000
8.	Electrical		$1,260,000
9.	Process Painting and Coating		$125,000
10.	Miscellaneous Concrete, Paving, and Fencing		$330,000
11.	Process Equipment		$3,625,000
	Oxidation Ditch Equipment	$3,375,000	
	Instrumentation and Controls	$250,000	
	ESTIMATED CONSTRUCTION COST		$13,728,000
	CONSTRUCTION CONTINGENCIES (10%)		$1,372,000
	1. Budgeted for Construction		$15,100,000
	2. Engineering: Design		$750,000
	Award		$15,000
	During Construction (21 months)		$468,000
	O & M and Start-Up		$27,000
	TOTAL ESTIMATED PROJECT COST		$16,360,000

ENR CONSTRUCTION COST INDEX – 9267 (03/2012)

COST ESTIMATE NO. 3 - NORTH WASTEWATER TREATMENT PLANT RENOVATION ALTERNATIVE NO. 3 – NEW SEQUENCING BATCH REACTORS, NEW HEADWORKS, AND ULTRAVIOLET DISINFECTION HENDERSON WATER UTILITY JRWCO JOB NO. 1949

Item	Description		Cost
1.	Site Development and Grading		$925,000
2.	Buried Piping (4,400 L.F. of 8-inch to 54-inch)		$1,400,000
3.	Above Ground Piping		$225,000
4.	Existing Piping Connections (6 @ $10,000 each)		$60,000
5.	Structural Concrete (8,900 C.Y. slab and 4,100 C.Y. walls)		$5,130,000
6.	Miscellaneous Metals		$660,000
7.	Building Construction		$600,000
8.	Equipment Installation		$1,400,000
9.	Electrical		$3,230,000
10.	Process Painting and Coating		$250,000
11.	Miscellaneous Concrete, Paving, and Fencing		$480,000
12.	Process Equipment		$8,760,000
	Raw Wastewater Screens (2)	$625,000	
	Grit Removal Equipment	$850,000	
	SBR Equipment	$6,000,000	
	Effluent Pumping Station Equipment	$160,000	
	UV Equipment (2)	$675,000	
	Instrumentation and Controls	$450,000	
	ESTIMATED CONSTRUCTION COST		$23,120,000
	CONSTRUCTION CONTINGENCIES (10%)		$2,310,000
	1. Budgeted for Construction		$25,430,000
	2. Engineering: Design		$1,100,000
	Award		$15,000
	During Construction (30 months)		$660,000
	O & M and Start-Up		$25,000
	TOTAL ESTIMATED PROJECT COST		$27,230,000

ENR CONSTRUCTION COST INDEX – 9267 (03/2012)

Chapter 9. CROSS-CUTTER CORRESPONDENCE AND MITIGATION

A. General

Each Facility Plan is required to include correspondence (termed "Cross-Cutter") with agencies having responsibility for environmental concerns in four areas:

Threatened and Endangered Species	The U.S. Fish and Wildlife Service- Kentucky Ecological Services Field Station Kentucky Department of Fish & Wildlife Resources
Historical Resources	The Kentucky Heritage Council (State Historic Preservation Office)
Aquatic Resources	The US. Army Corps of Engineers (Louisville District)
Agricultural Resources	Natural Resources Conservation Service (NRCS)

A sample of our initial form letter to the agencies is attached as Exhibit 9A. Responses are attached as Exhibit 9B. A discussion of agency findings, and our responses, follows.

B. Threatened and Endangered Species

U.S. Fish and Wildlife Service responded in a letter dated 16 April 2012. The Service response included a list of federally listed species and species of special concern that are known to have occurred or have the potential to occur within the area of interest. Those species are shown in Chapter 5.

As projects become better developed and plans are readied for bid, HWU will engage USFWS in more detailed study of the impacts on these listed species. Projects involving tree removal, stream bank and stream channel disturbance, ground disturbance, and discharges will be assessed for their potential to alter habitat.

The Kentucky Department of Fish and Wildlife Resources responded in a letter dated 9 April 2012 that they do not expect impacts to listed species or critical habitat due the location and nature of the projects.

C. Historical Resources

The Kentucky Heritage Council responded in a letter dated 24 April 2012. The Council response found no impact for the Center & Julia, or North WWTP projects. For the Canoe Creek Phase II project, the Council requested that an archaeological review be performed, and a report

submitted to the State Historic Preservation Office for review. HWU has contracted with an outside archaeologist to perform this review and submit a report.

In addition, the Council requested additional information on the impact that the Canoe Creek force main project may have on the Audubon School property, a National Register listed property near Clay and Shelby Streets. HWU has compiled and submitted information on the lack of impact on that property.

Additional information on houses around the North Fork Pump Station site (Roosevelt and Burdette Streets) has also been compiled and submitted for review. This is due to the requirement that any home more than 50 years old, and within sight of an above-ground structure, be assessed for historic significance.

D. Aquatic Resources

U.S. Army Corps of Engineers responded in a letter dated 8 May 2012. The Corps response indicated that Department of the Army permits will not be required for the Canoe Creek Phases III & IV projects, Center & Julia Phase III, or the North WWTP upgrades. Permits for the Canoe Creek Phase II project have been applied for, and the Corps is reviewing that data at the time of publishing this report.

E. Agricultural Resources

The USDA Natural Resources Conservation Service responded in a letter dated 24 April 2012. The Service response indicated that the projects do not negatively affect Wetland Reserve Program or Grassland Reserve Program easements. There is also no impact on prime farmlands, or conversion of prime land from agricultural to non-agricultural uses.

Exhibit 9A

HENDERSON WATER UTILITY

Water • Wastewater • Stormwater

MANAGED BY THE CITY OF HENDERSON WATER & SEWER COMMISSION

BRUCE L. SHIPLEY, PE
GENERAL MANAGER

30 March 2012

Kentucky Heritage Council / State Historic Preservation Office
300 Washington Street
Frankfort, KY 40601

Attn: Lindy Casebier, Acting Director/State Historic Preservation Officer and
Deputy Secretary, Tourism, Arts and Heritage Cabinet

Dear Ms. Casebier:

The Henderson Water Utility is responsible for water and sewer service in Henderson and in portions of Henderson, McLean and Webster Counties. Under 401 KAR 5:006, we are required to periodically update our Regional Facilities Plans for our sewer plants, and we are now doing that for our North Wastewater System, which serves area predominantly in the City of Henderson.

Attached you will find Project Summaries for five projects that are included in our Facilities Plan. These projects are the result of a Consent Judgment between Henderson and the Environmental and Public Protection Cabinet, in which Henderson agreed to complete and implement a Long-Term Control Plan for reduction of Combined Sewer Overflows. Most of the projects implement our LTCP strategy to transport and treat combined flows, and to separate sanitary and storm flows to the maximum extent we can afford.

Descriptions of the projects, estimated costs, and project schedules are included on these forms, along with a location map. We can provide more details, or meet with you or your staff to explain the projects in more detail, if you wish. Our plan is to complete this Facilities Plan Update within the next 90 days. We are required by the Kentucky Division of Water to obtain documentation from you that these projects have “no impact” on resources under your purview, or stating measures we must undertake to mitigate, minimize or compensate for any adverse impact.

If you have any questions about this matter, please feel free to call me at 270.869.6621.

Sincerely,

Tom Williams, P.E.
Director of Engineering

Exhibit 9B

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

April 16, 2012

Mr. Tom Williams, P.E.
Director of Engineering
Henderson Water Utility
111 Fifth Street
Henderson, Kentucky 42420

Re: FWS 2012-B-0458; Henderson Water Utility Regional Facilities Plan, located within Henderson County, Kentucky

Dear Mr. Williams:

Thank you for your correspondence of March 30, 2012 requesting a list of federally listed species and species of special concern which are known to occur or may occur within the proposed project area of the Henderson Water Utility Regional Facilities Plan. The U.S. Fish and Wildlife Service (Service) offers the following comments in accordance with the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

Because there is no site-specific project information at this time, the Service cannot make site-specific recommendations. However, the Service has searched our database and compiled a list of federally listed species, and species of special concern that are known to occur or have the potential to occur within the area of interest. Those species are:

Common Name	Scientific Name	Federal Status
Indiana bat	*Myotis sodalis*	endangered
gray bat	*Myotis grisescens*	endangered
clubshell	*Pleurobema clava*	endangered
fanshell	*Cyprogenia stegaria*	endangered
fat pocketbook	*Potamilus capax*	endangered
orangefoot pimpleback	*Plethobasus cooperianus*	endangered
pink mucket	*Lampsilis abrupta*	endangered
ring pink	*Obovaria retusa*	endangered
rough pigtoe	*Pleurobema plenum*	endangered
sheepnose	*Plethobasus cyphyus*	candidate
spectaclecase	*Cumberlandia monodonta*	candidate

We must advise you that collection records available to the Service may not be all-inclusive. Our database is a compilation of collection records made available by various individuals and resource agencies. This information is seldom based on comprehensive surveys of all potential habitats and thus does not necessarily provide conclusive evidence that protected species are present or absent at a specific locality.

In general, projects involving tree removal, ground disturbing activities, stream bank disturbances, stream channel disturbances, alteration of stream flow, or discharges have the potential to alter habitat that coincides with the habitat that is required for the above-listed species. Therefore, we recommend submitting projects that would be carried out under the proposed Regional Facilities Plan, which would involve any of these activities, to our office for project-specific consultations. This would ensure that the projects would be in full compliance with the ESA.

Thank you again for your request. Your concern for the protection of endangered and threatened species is greatly appreciated. If you have any questions regarding the information that we have provided, please contact James Gruhala at (502) 695-0468 extension 116.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

KENTUCKY DEPARTMENT OF FISH & WILDLIFE RESOURCES
TOURISM, ARTS, AND HERITAGE CABINET

Steven L. Beshear
Governor

#1 Sportsman's Lane
Frankfort, Kentucky 40601
Phone (502) 564-3400
1-800-858-1549
Fax (502) 564-0506
fw.ky.gov

Marcheta Sparrow
Secretary

Dr. Jonathan W. Gassett
Commissioner

April 9, 2012

Henderson Water Utility
ATTN: Tom Williams
111 Fifth Street
Henderson, KY 42420

RE: Environmental Review for Henderson Water and Sewer Improvement Projects, Henderson County, Kentucky

Dear Mr. Williams:

The Kentucky Department of Fish and Wildlife Resources (KDFWR) has received your request for the above-referenced information. The Kentucky Fish and Wildlife Information System (KFWIS) indicates that state/federal threatened and endangered species are known to occur within a 10 mile radius of the proposed project area. However, KDFWR does not expect impacts to listed species or their critical habitat due to the location and nature of the project. Please be aware that our database system is a dynamic one that only represents our current knowledge of the various species distributions.

KDFWR recommends that erosion control measures be developed and utilized during any construction to minimize siltation into nearby waterways. Such erosion control measures may include, but are not limited to silt fences, staked straw bales, brush barriers, sediment basins, and diversion ditches. Erosion control measures will need to be installed prior to construction and should be inspected and repaired regularly as needed.

I hope this information proves helpful to you. If you have any questions or require additional information, please call me at (502) 564-7109 Extension 4473.

Sincerely,

Joseph Zimmerman
Environmental Biologist Consultant

Cc: Environmental Section File

STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

MARCHETA SPARROW
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

LINDY CASEBIER
ACTING EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

April 24, 2012

Mr. Tom Williams, P.E.
Director of Engineering
Henderson Water Utility
111 Fifth Street
Henderson, KY 42420

Re: Henderson Water Utility Project Summaries for Five Projects

Dear Mr. Williams:

The State Historic Preservation Office has completed review of information in relation to the above referenced project summaries that were submitted to our office in a letter dated March 30, 2012. Our comments for each project are outlined below:

Center and Julia Separation Phase III
No cultural historic or archaeological survey is recommended. We concur with the assessment that this project has no impact on cultural resources.

Canoe Creek PS and Interceptor Phase 2, 3, and 4
A review of our files, and the plans emailed to our office on April 24, 2012, indicates that the proposed project area has not been surveyed in its entirety for archaeological resources. Therefore, I recommend that the proposed project area be surveyed by a professional archaeologist and that the resulting report of these investigations be submitted to our office for review and comment. Where a given project area or portions thereof have been disturbed by prior construction, the applicant may file documentation of that disturbance with the State Historic Preservation Officer and may request an opinion concerning the need of an archaeological survey. The State Historic Preservation Officer must review and approve the survey report. To expedite the review regarding the archaeological concerns associated with this project, an archaeological consultant can indicate which areas of the project area were disturbed and/or previously surveyed which would preclude the need for archaeological survey.

The Phase 2 plans submitted to our office indicate the projects area of potential effect encompasses the southern boundary of a National Register of Historic Places listed property. While the plans indicate that the Audubon School itself will not be impacted, the concern remains for impacts to other historic materials, such as historic curbs, associated with this property. To properly assess the project impact to this property, please submit photos and detailed plans, depicting the project alignment, for the area surrounding the intersection of Shelby and Clay Streets.

In order to make a preliminary determination if other above-ground properties eligible for listing in the National Register of Historic Places will be affected by this project, the applicant must submit photographs of all structures 50 years or older that are within and visible from areas impacted by any above ground structures, such as (but not limited to) pump stations,

associated with this project. Each photograph should be labeled by street address or map coordinates with a brief description of potential impacts or proposed treatment, and should be accompanied by a project map showing their location. Upon completion of our review, this office will advise the applicant if further consultation is required.

WWTP Improvements (Headworks)

As currently described, it is our understanding that this project will involve the replacement or existing infrastructure. As such, no cultural historic or archaeological investigations will be required. However, should the project boundaries or plans change, consultation must be initiated with the Kentucky Heritage Council regarding the potential need for any further documentation of cultural resources.

Should you have any questions, feel free to contact Nick Laracuente of my staff at 502.564.7005, extension 151.

Sincerely,

Lindy Casebier,
Acting Executive Director and
State Historic Preservation Officer

LC:nrl

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
REGULATORY BRANCH, WEST SECTION
P.O. Box 489
NEWBURGH, INDIANA 47629-0489
FAX: (812) 858-2678
http://www.lrl.usace.army.mil

May 8, 2012

Operations Division
Regulatory Branch (West)
ID No. LRL-2012-384-mad

Tom Williams, P.E.
Director of Engineering
Henderson Water Utility
111 Fifth Street
Henderson, KY 42420

Dear Mr. Williams:

This is in regard to your letter of March 30, 2012 on behalf of Henderson Water Utility, concerning a proposal to complete projects associated with a Long-Term Control Plan for reduction of Combined Sewer Overflows in the North Wastewater System located predominantly in the City of Henderson in Henderson County, Kentucky.

This determination is approved based on the information provided by you. Five Project Summaries were submitted for the Corps review as part of the Facilities Plan. According to a phone conversation between the Corps and Mr. Williams on March 7, 2012, a permit application has been submitted for the proposed project titled "Canoe Creek PS and Interceptor Phase 2". Based on the information provided in the project plans, and during the March 7, 2012 phone conversation, it does not appear that a Department of the Army permit will be needed for the projects titled "Center and Julia Separation Phase III", "Canoe Creek PS and Interceptor Phase 3", "Canoe Creek PS Interceptor Phase 4", and "WWTP Improvements (Headworks)", since the projects do not propose the discharge of dredged or fill material into "water of the U.S." "Waters of the U.S." include all waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce.

If the project would necessitate the discharge of dredged or fill material into "waters of the U.S.," including wetlands, a permit application should be submitted for our review.

Our comments on this project are limited to only those effects which may fall within our area of jurisdiction and thus does not obviate the need to obtain other permits from state or local agencies. Lack of comments on other environmental aspects should not be construed as either concurrence or nonconcurrence with stated environmental effects.

If we can be of any further assistance, please contact us by writing to the above address, ATTN: CELRL-OP-FW, or call me at 812-842-0647. Any correspondence on this matter should refer to our ID Number LRL-2012-384.

Sincerely,

Matt Dennis

Matt Dennis
Regulatory Specialist
Regulatory Branch

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
771 Corporate Drive, Suite 210
Lexington, KY 40503

April 24, 2012

Henderson Water Utility
ATTN: Tom Williams, Director of Engineering
111 Fifth Street
Henderson, KY 42420

RE: North Wastewater System

Dear Mr. Williams:

In regards to North Wastewater System regional facilities plan serving the City of Henderson, the USDA-Natural Resources Conservation Service (NRCS) is concerned with potential impacts that projects might have upon prime farmland soils, farmlands of statewide importance, PL-566 watershed structures, wetlands, Wetland Reserve Program (WRP) easements, and Grassland Reserve Program (GRP) easements. Based upon the information provided, Kentucky NRCS does not anticipate the proposed actions will negatively WRP easements, GRP easements or PL-566 watershed structures. If federal dollars are to be used to convert wetlands or convert important prime farmlands from agricultural uses to non-agricultural uses a Form AD-1006 (or Form NRCS-CPA-106 if the project is a corridor type project) must be submitted to the local NRCS office. These forms may be obtained from the local NRCS office and are also available as electronic forms on the web at http://forms.sc.egov.usda.gov/eForms/welcomeAction.do?Home.

The NRCS contact person for Henderson County is:
Kelly Bennett, District Conservationist
706-B North Green Street
Henderson, KY 42420-2951
Phone: 270-827-5157 Email: Kelly.bennett@ky.usda.gov

Sincerely,

JACOB KUHN
Assistant State Conservationist

Chapter 10. EVALUATION OF RECOMMENDED REGIONAL FACILITY PLAN

A. ENVIRONMENTAL IMPACTS

Chapter 9 refers to Cross-Cutter Correspondence with various agencies, showing that the planned North System Service Area projects do not have large construction impacts on agricultural, historic or fish & wildlife resources in the project areas.

In addition, the purpose of these projects is to meet the requirements of the Consent Judgment and subsequent Long-Term Control Plan for reduction of Combined Sewer Overflows. This Plan seeks to implement the requirements of the U.S. EPA's requirements under the Clean Water Act to reduce the volumes and frequency of sewer overflows. The implementation of these projects under the Plan will have a positive impact on water quality in Canoe Creek.

B. INSTITUTIONAL STRUCTURE

There are no changes to the institutional structure of the Henderson Water Utility planned as a result of this study. The service area impacted by these projects is under the control of the Henderson Water and Sewer Commission, as empowered by the Henderson City Commission.

C. FUNDING PLAN

HWU has borrowed $ 20 million to complete the first phases of the LTCP projects. Some of the first projects (Downtown Sewer Separation, Center & Julia) were funded through prior rate increases and from reserves. Funding of future projects will be from further bonding, and the debt service will be covered by future rate increases as detailed in Section D., below.

D. CURRENT/PROJECTED RESIDENTIAL USER CHARGES

Henderson's sewer rate for City residents and Outside-City-Limits customers are shown in Table 10-1. Under a rate ordinance passed on 1 March 2011, these rates are set to increase by 5.85 percent on July 1st of each year through 2018.

Water and Sewer Rates inside the City Limits		
Metered Water	Water/CCF	Sewer/CCF
First 5,000 CF	$ 1.86	$ 3.71
Over 5,000 CF	$ 1.42	$ 2.70
Water and Sewer Rates outside the City Limits		
Metered Water	Water/CCF	Sewer/CCF
First 300 CF	$ 5.18	$ 6.44
Next 700 CF	$ 5.18	$ 10.36
Next 4,000 CF	$ 5.18	$ 4.14
Over 5,000 CF	$ 1.59	$ 3.01

For a “normal” user of 4,000 gallons per month (approximately 534 cubic feet), these rates equate to a sewer charge of $ 20.93 per month in-City, $ 66.21 Out-of-City for sewer use. The Out-of-City rates are based on a rate table that includes varying fixed charges based on meter size. The City rates are a flat volumetric rate. These rates will go up to $ 21.05 and $ 68.62, respectively, on 1 July 2012, and will further increase in the years from now until 2018. This graduated rate increase was adopted to allow financing of the LTCP projects.

While the Henderson community is committed and capable of implementing the plan for the projects outlined herein, economic factors outside of our control may warrant ongoing evaluation of the financial capacity and potential adjustment of the schedule contained in the LTCP.

E. IMPLEMENTATION SCHEDULE

The implementation of the projects outlined in this Facilities Plan is governed by the Consent Judgment and Long-Term Control Plan timetable. The latest version of that schedule is shown on Exhibit 10-1.

Exhibit 10-1

2012 Facilities Plan Update – Henderson, KY

CSO CONTROL PROJECTS IMPLEMENTATION SCHEDULE*

	2008				2009				2010				2011				2012				2013				2014				2015				2016				2017			
Project	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Canoe Creek Pumping Station and Interceptor (Phase 2)																																								
Canoe Creek Pumping Station and Interceptor (Phase 3)																																								
Canoe Creek Pumping Station and Interceptor (Phase 4)																																								
Center and Julia Separation Project – Phase II (Early Action Plan)																																								
Center and Julia Separation Project – Phase III																																								
Downtown Area Separation Project																																								
WWTP Improvements (Headworks)																																								
Ershig Stormwater Line (Ragan and Green Streets)																																								
System Evaluation																																								

*Schedule includes planning, design, permitting, bidding, and construction. Planning is complete on all projects and design has been initiated on most projects.

Legend for Exhibit 10-1	
	Planning and Design
	Permitting and Bidding
	Construction
	Evaluation

Chapter 11. PUBLIC PARTICIPATION

A. PUBLIC MEETING

This section will be added after the public comment period.

Section 12: Regional Facility Plan Completeness Checklist and Forms

Requirements: Two (2) hard copies, one certified by a professional engineer licensed in Kentucky and one (1) non-certified digital copy of the regional facility plan and the planning area shapefile on a Compact Disc (CD) shall be submitted to the Cabinet. This completeness checklist should be completed and submitted with each regional facility plan.

Regional Planning Agency Name: **Henderson Water Utility**

Date:

		PAGE #
SECTION 1		
REGIONAL FACILITY PLAN SUMMARY- This section shall provide a brief summary of the information provided in the facility plan, including the following:		
1.	Purpose of the plan and major problems evaluated in the plan.	1-1
2.	Recommended alternative chosen to remediate or correct the problems and/or serve the area of need identified in the plan. Also, include any institutional arrangements necessary to implement the recommended alternative(s).	1-2
3.	Estimated cost of implementing the proposed plan (including user fees) and the proposed funding method to be used.	1-3
4.	Planning agency commitments necessary to implement the plan.	1-3
5.	Schedule of implementation for projects.	1-3
SECTION 2		
STATEMENT OF PURPOSE AND NEED- This section shall contain a brief description of the purpose and need for a submitting the facility plan.		2-1
SECTION 3		
PHYSICAL CHARACTERISTICS OF THE PLANNING AREA- This section shall delineate the planning area boundaries and describe key topographic, geographic and pertinent natural or man-made features of the area. Digital or electronic submission of the planning area boundary shapefile in a standard GIS format shall also be included. This section shall also include the following maps:		2-1
1.	One (1) up-to-date map, suitable for photocopying, indicate the planning area boundary, service area boundary, watershed boundaries, county lines, populated places, cities and/or towns and project areas or proposed planning period phases.	
2.	One (1) up-to-date map, suitable for photocopying, include locations of wastewater treatment facilities (including package treatment plants), discharge location(s), collection lines (gravity, force main, interceptors), pump stations, public drinking water intake points and groundwater supply areas [Source Water Area Protection Plans (SWAPP) and/or Wellhead Protection Areas (WHPA)].	
3.	One (1) seven and one-half (7 ½) minute USGS topographic map including the location of wetlands, delineation of the 100-year floodplain, surface water(s), and topography.	

4.	If available, a local planning and zoning land use map.	
SECTION 4		
SOCIOECONOMIC CHARACTERISTICS OF THE PLANNING AREA- The following characteristics of the planning area shall be discussed:		
1.	Historical, current, and projected population in the planning area including wastewater contributions from industrial and commercial sources.	4-1
2.	Current and projected population in the existing service area and unsewered parts of the planning area	4-4
3.	Economic or social benefit to the affected community	4-4
SECTION 5		
EXISTING ENVIRONMENT IN THE PLANNING AREA- Describe existing physical, biological, cultural, and other resource features within the planning area with an emphasis on those that may be impacted by the proposed plan or projects, including the following:		
1.	Physical features such as surface and groundwater quality, water sources and supply, wetlands, lakes, streams, air pollution, floodplains, soils, geology, and topography	5-1
2.	Biological: Identify plant and animal communities in the planning area with an emphasis upon endangered and threatened species likely to be impacted	5-6
3.	Cultural: Describe archaeological and historical resources that may be affected by the proposed project	5-7
4.	Other Resource Features such as national and state parks, recreational areas, USDA Designated Important Farmland, and any other applicable environmentally sensitive areas	5-7
SECTION 6		
EXISTING WASTEWATER SYSTEM- This section shall be prepared by a Professional Engineer licensed in Kentucky. A description of the existing facilities within the planning area shall include the following:		
1.	On-site systems in the planning area	6-20
2.	Physical condition of the existing wastewater treatment plant(s) including the type, age, design capacity, process units, peak and average wastewater flows, current discharge permit limits, schematic layout of treatment plant. Include a narrative description of the capacity of the treatment plant to meet reliability and redundancy requirements as outlined in regulation 401 KAR 5:005, Section 13.	6-4
3.	Existing collection and conveyance system and its condition	6-1
4.	Existing biosolids disposal method	6-20
5.	Existing operation, maintenance and compliance issues	6-4
SECTION 7		
FORECASTS OF FLOWS AND WASTE LOADS IN THE PLANNING AREA- This section shall be prepared by a professional engineer licensed in Kentucky and shall include:		
1.	Current and projected commercial, industrial and residential growth for the proposed planning period	7-1
2.	A copy of the waste load allocation (WLA) issued by the DOW for new or expanded treatment plant projects	

SECTION 8		
EVALUATION OF ALTERNATIVES- This section shall be prepared by a professional engineer licensed in Kentucky and include an assessment of alternatives to determine the appropriate facilities that will meet the wastewater needs of the planning area and provide benefits that are cost-effective and environmentally sound. The section shall include:		
1.	No-action alternative	8-1
2.	Optimization of existing facilities	8-1
3.	Regionalization	8-4
4.	Other alternatives	8-4
5.	Detailed cost analysis along with 20 year present worth analysis for each alternative	8-14
6.	Recommended alternative	8-15
SECTION 9		
CROSS-CUTTER CORRESPONDENCE AND MITIGATION- Each facility plan shall include cross-cutter correspondences to and from each agency related to the following four environmental and cultural concerns:		
1.	Threatened and Endangered Species: The U.S. Fish and Wildlife Service-Kentucky Ecological Services Field Station and the Kentucky Department of Fish and Wildlife Resources	9-1
2.	Historical Resources: The Kentucky Heritage Council State Historic Preservation Office	9-1
3.	Aquatic Resources: The US. Army Corps of Engineers (Louisville, Nashville, or Huntington Districts).	9-2
4.	Agricultural Resources: The local office of the Natural Resources Conservation Service (NRCS) or USDA Service Center	9-2
SECTION 10		
EVALUATION OF RECOMMENDED REGIONAL FACILITY PLAN- This section of the facility plan shall summarize the critical components of the recommended plan.		
1.	Environmental impacts	10-1
2.	Institutional structure	10-1
3.	Funding plan	10-1
4.	Current and projected residential user charge rate based on 4,000 gallon usage per month	10-1
5.	Implementation schedule	10-2
SECTION 11		
DOCUMENTATION OF PUBLIC PARTICIPATION- The section shall include a copy of the newspaper advertisement/proof of publication, attendance sheet, and public comments.		