

CITY OF CROSSVILLE
OPERATING ACCOUNT

392 N. MAIN STREET
CROSSVILLE, TN 38555

122584

VEND:0629 TN Dept of Env & Conservation

122584 2/20/2015

DATE	I.D.	EO #	DESCRIPTION	——— G/L DISTRIBUTION ———	AMOUNT
2/20/2015	201502207678		Fees for Inter Basin Permi	413-52130-565	17,500.00

TN DEPT OF ENVIRONMENT
AND CONSERVATION

FEB 23 2015

DIV OF WATER RESOURCES
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CHECK TOTAL 17,500.00

THE FACE OF THIS DOCUMENT HAS A COLORED BACKGROUND ON WHITE PAPER

CITY OF CROSSVILLE
OPERATING ACCOUNT
392 N. MAIN STREET
CROSSVILLE, TN 38555

CUMBERLAND COUNTY BANK
CROSSVILLE, TN 38557

122584

87-834/641

DATE 2/20/2015 122584

AMOUNT 17,500.00

PAY ---- SEVENTEEN THOUSAND FIVE HUNDRED & 00/100 DOLLARS ----

TN Dept of Env & Conservation

TO THE
ORDER
OF



VOID AFTER 90 DAYS
CITY MANAGER
Frank C. Houston 7th
FINANCE DIRECTOR

CITY OF CROSSVILLE

392 NORTH MAIN STREET
CROSSVILLE, TENNESSEE 38555-4275
TEL (931) 484-5113
FAX (931) 484-7713

January 15, 2015

Mr. R. Jim McAdoo
Tennessee Department of Environment & Conservation
William R. Snodgrass TN Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, TN 37243

TN DEPT OF ENVIRN
AND CONSERVATION

FEB 23 2015

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RE: Renewal of Inter-Basin Transfers

Mr. McAdoo:

Enclosed please find a technical memorandum for the renewal of the City of Crossville's Inter-Basin Transfer permits. I could not find a renewal form for the permits but all necessary data is included in the memorandum.

There is basically no change in the transfers and the total fee will be \$17,500 which is included in the form of a check.

Thank you for your assistance with this matter. If you should have any questions or require any additional information, please feel free to contact me in my office at (931) 456-6172, cell phone 931-248-5172 or by email tim.begley@crossvilletn.gov.

Sincerely,



Tim Begley
Director of Engineering



Environmental & Civil Engineering Services

Engineering ♦ Geotechnical ♦ Testing

IN DEPT OF ENVIRONMENTAL
AND CONSERVATION

Technical Memorandum

Project: City of Crossville
Subject: City of Crossville Water System Inter-Basin Transfers
Project Number: 15008
Date: February 19, 2015

FEB 23 2015

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SECTION 1. DEFINITIONS

1.1. Inter-Basin Transfer

Inter-Basin Transfers refer to the withdrawal, diversion, or pumping of surface water from one river basin and the use or discharge of all or any part of the water in a basin different from the basin of origin where the basins are two distinct watersheds as defined in the Tennessee Inter-basin Water Transfer Act, P.Ch. 854 of the Acts of 2000 (TCA 69-8-201, note that the legal reference to TCA 69-8-201 in the short title of the Act is actually in error and the Act is codified as TCA 69-7-201). The Inter-basin Transfer Act defined a “basin” or “river basin” as the entire topographic extent of the following ten watersheds and combinations of watersheds:

- The Mississippi River and all of its tributaries west of the Tennessee River Valley;
- The Duck River, the Elk River, and the western Tennessee River Valley;
- The lower Cumberland River to the downstream point of the mouth of the Caney Fork River, the Harpeth and the Stones Rivers;
- The tributaries of the Barren River;
- The upper Cumberland River, the Caney Fork, the Obed, and the Big South Fork of the Cumberland River; (please note that this is in error, as the Obed River is part of the Upper Tennessee River and the Obey River is part of the upper Cumberland River drainage basin.)
- The lower Tennessee River in East Tennessee up to and including the Hiwassee River;
- The Conasauga River
- The Upper Tennessee River in East Tennessee upstream of the Hiwassee, the Little Tennessee, the Clinch, and the Emory Rivers;
- The French Broad River and the Nolichucky River; and
- The Holston River and the Watauga River.

Inter-basin transfers in Tennessee are regulated under authority of the Inter-basin Water Transfer Act and subsequent regulations of the Tennessee Department of Environment and Conservation. The Department’s regulations and rules are codified as Chapter 1200-4-13 of the Rules of the Water Quality Control Board.

In Tennessee, it is important to know that the rules state that, “The primary purpose of The Inter-basin Water Transfer Act is to allow regulation on the basis of the quantity of water in river basins. Although the common law addresses some of these concerns, it relies on after-the-fact litigation rather than a modern regulatory system. As The Inter-basin Water Transfer Act is remedial and police power legislation, the General Assembly has declared that it shall be liberally construed to effectuate its purpose.”



The rules apply to all persons or entities that have the power to acquire water, water rights and associated property by eminent domain or condemnation; or which acquire or supply water for the use or benefit of a public water supply system.

Entities required to do so by the Act are required to apply for a permit when proposing to increase the amount of water withdrawn, when some or all of the water will be transferred to a different river basin; or located a new intake for withdrawal, when some or all of the water will be transferred to a different river basin.

Systems that were currently transferring water out of a river basin in 2000 have been grandfathered into the permit system based on the average daily amount of transfer calculated for the highest continuous 90-day period between January 1, 1997 and December 31, 1999.

1.2. Water Withdrawal

For the purposes of this technical memorandum, water withdrawal is the volume of water withdrawn from a water source by the City of Crossville Water System for intake into a water treatment plant or harvested to another reservoir for possible intake into a water treatment plant at another date.



SECTION 2. BACKGROUND INFORMATION

2.1. General

The City of Crossville water system operates two water treatment facilities; one on Meadow Park Lake and one on Lake Holiday. Due to its geographic position at the top of the Tennessee Divide, the City of Crossville cannot avoid performing inter-basin transfers. The Crossville water system obtains raw water for the two treatment plants from three sources; Meadow Park Lake, Lake Holiday, and Lake Tansi. The Crossville water system withdraws water in two basins from these three sources. The Meadow Park Lake is located in the Upper Cumberland Basin while Lake Holiday and Lake Tansi are located in the Upper Tennessee – Clinch/Emory River Basin as defined in the Act.

The City's distribution system has customers within each basin as well as a wholesale customer, Grandview Utility District, which has customers within the Lower Tennessee – Hiwassee River Basin.

2.2. Grandfathered Permits

The City's construction of the Meadow Park water treatment plant in 1938 created the first documentable inter-basin transfer. Since 1938, the water from the Meadow Park Lake has been transferred into the corporate boundaries of the City of Crossville, the majority of which is within the Upper Tennessee – Clinch/Emory River Basin.

In addition, the City of Crossville has had a transfer from the Upper Tennessee – Clinch/Emory River Basin to the Upper Cumberland River Basin since the construction of the Lake Holiday Water Treatment Plant in the early 1960s. The City for most of this time sold water to the West Cumberland Utility District and to the Catoosa Utility District; the majority of which was produced at the Lake Holiday Water Treatment Plant. The West Cumberland Utility District is almost entirely within the Upper Cumberland River Basin and numerous customers of the Catoosa Utility District are within the Upper Cumberland River Basin.

In 2000 with the passage of the Tennessee Inter-basin Water Transfer Act, the City of Crossville was grandfathered an inter-basin transfer permit from the Upper Cumberland River Basin into the Upper Tennessee – Clinch/Emory River Basin at a rate of 1.1 MGD. The City of Crossville was also grandfathered an inter-basin transfer permit from the Upper Tennessee – Clinch/Emory River Basin into the Lower Tennessee – Hiwassee River Basin at a rate of 2000 gallons per day. For unknown reasons, the City of Crossville was not officially grandfathered a permit to transfer from the Upper Tennessee – Clinch/Emory River Basin to the Upper Cumberland River Basin even though the City had been executing this transfer for at least 30 years.

The City of Crossville Inter-basin Water Transfer Report of 2009 reported a maximum ninety day period transfer of 2.016 MGD from the Upper Cumberland River Basin to the Upper Tennessee Clinch/Emory River Basin. The City of Crossville Inter-basin Water Transfer Report of 2009 also reported a maximum ninety day period transfer of 7536 gallons per day from the Upper Tennessee Clinch/Emory River Basin to the Lower Tennessee – Hiwassee River Basin.



The historical growth of the distribution system has been such that the majority of the customers of the system are located within the Upper Tennessee – Clinch/Emory River Basin.

2.3. 2010 Permits

In 2007, the City of Crossville proposed a water supply project that involves the harvesting of water from the Lake Tansi reservoir in Cumberland County, Tennessee for transfer to the Meadow Park Lake reservoir in Cumberland County, Tennessee or directly into the City of Crossville's water treatment facility located on the banks of the Meadow Park Lake. This water harvesting project began construction in 2010 and was completed in 2011. The Lake Tansi reservoir is located in the Upper Tennessee – Clinch/Emory River Basin and as previously stated, the Meadow Park Water Treatment Plant and Meadow Park Lake are within the Upper Cumberland Basin.

The proposed project to harvest water from Lake Tansi to the Meadow Park Water Treatment Plant or the Meadow Park Lake requires a new and separate inter-basin transfer permit. The proposed permit transfer rate is based on a pumping rate of 5000 gpm from Lake Tansi. This is equivalent to a transfer of 7.2 MGD. The permit application requests a transfer of 5.0 MGD to be permitted. This transfer is proposed as an intermittent transfer as the City of Crossville's agreement with the Lake Tansi POA does not contain provisions for continual transfer or even daily transfer that would be beneficial to the City. The transfer is limited to transfer during certain months and during emergency or drought conditions or at times that high flows are present over the spillway of Lake Tansi.

The Lake Tansi Water Harvesting Project had several benefits and uses for the City of Crossville. Primary among these were providing a mechanism to counterbalance the existing and projected inter-basin transfers, to augment the City's water supplies to facilitate the necessary repairs to the Meadow Park Dam, and provide additional raw water source for the City of Crossville to meet projected 20-year demands.

Lake Tansi is a 404-acre impoundment at normal pool located in the Upper Tennessee-Clinch/Emory River Basin. Meadow Park Lake is located within two miles of Lake Tansi on the other side of the Tennessee Divide in the Upper Cumberland River Basin. Both impoundments are man-made. The Lake Tansi reservoir has a drainage area of 4.48 square miles.

The City of Crossville has a written agreement with the Lake Tansi POA for the transfer of water from Lake Tansi. The agreement allows for the following transfers:

Transfer at anytime that the spillway is overflowing as long as such transfer does not cause the lake surface elevation to recede below the spillway invert elevation,

Transfer from October 15th of each year to April 15th of the following year as long as the lake surface elevation is not depressed more than 4 inches below the spillway invert elevation,

Transfer of all planned water releases from Lake Tansi by the Lake Tansi POA

Transfer of water due to emergency conditions as long as the lake surface elevation is not depressed more than 24 inches below the spillway invert elevation.



Transfer of water during the construction period during which the Meadow Park Dam is renovated.

The transfer system from Lake Tansi to Meadow Park Water Treatment Plant and Meadow Park Lake is comprised of wedge-wire type stainless steel screens located in Lake Tansi connected to 30" diameter steel pipes supplying a concrete wetwell. Two 5000-gpm rated capacity vertical turbine pumps are located in the wetwell and are driven by 250 horsepower electric motors controlled by variable frequency drives. The pumps transfer the water via a 30" diameter DIP pipeline to the outfall location at Meadow Park Lake and the inlet piping to the Meadow Park Water Treatment Plant. The pumps are capable of operating between 2500 gpm and 5000 gpm when controlled by the variable frequency drives.

At the time of the construction of the Lake Tansi Water Harvesting Project, the City of Crossville had exceeded the grandfathered permit limits of 2000 gpd for the inter-basin transfer of water from the Upper Tennessee – Clinch/Emory River Basin to the Lower Tennessee – Hiwassee River Basin by 5536 gallons per day. The permit was proposed for modification to increase the limit from 2000 gpd to a permit limit of 25,000 gallons per day.

The City of Crossville, at the same time, had also exceeded the grandfathered permit limits of 1.1 MGD for the inter-basin transfer of water from the Upper Cumberland River Basin to the Upper Tennessee – Clinch/Emory River Basin by 0.916 MGD based on the most recent reporting year (2009). The permit was proposed for modification to increase the limit from 1.1 MGD to a permit limit of 3.5 MGD.

On March 8, 2010, the City of Crossville was issued NPDES Permit No. IWT0000009 by the State of Tennessee for the inter basin transfer of up to 25,000 gallons per day from the Upper Tennessee – Clinch/Emory River Basin to the Lower Tennessee – Hiwassee River Basin. The permit became effective on March 15, 2010 and is set to expire on March 2, 2015.

On March 8, 2010, the City of Crossville was issued NPDES Permit No. IWT0000010 by the State of Tennessee for the inter basin transfer of up to 3.5 million gallons per day from the Upper Cumberland River Basin to the Upper Tennessee – Clinch/Emory River Basin. The permit became effective on March 15, 2010 and is set to expire on March 2, 2015.

On March 8, 2010, the City of Crossville was issued NPDES Permit No. IWT0000011 by the State of Tennessee for the inter basin transfer of up to 5.0 million gallons per day from the Upper Tennessee – Clinch/Emory River Basin to the Upper Cumberland River Basin. The permit became effective on March 15, 2010 and is set to expire on March 2, 2015.

2.4. New Permits and/or Permit Renewal

New permits or permit renewals for all three inter basin transfers of the City of Crossville are required due to the expiration on March 2, 2015 of the permits issued on March 8, 2010. The City of Crossville is not seeking modification of the transfer limits for each of the transfers under the 2010 permits.



SECTION 3. ESTIMATES OF FUTURE DEMAND

3.1. Population Forecasts

The Tennessee Advisory Commission on Intergovernmental Relations (TACIR) in conjunction with the University of Tennessee Center for Business and Economic Research produce population projections for the State of Tennessee as well as for each county and city in 5 year increments (Ref. 18 and 19). The following two tables present the TACIR projections for Cumberland County and the cities within Cumberland County.

Tennessee Advisory Commission on Intergovernmental Relations Population Projections for Tennessee, 2005 to 2025					
County or City	2005	2010	2015	2020	2025
Cumberland County	50,082	54,059	58,045	61,922	66,119
Crab Orchard	881	946	1010	1077	1144
Crossville	9881	10,725	11,580	12,422	13,343
Pleasant Hill	586	632	685	731	780
Unincorporated	38,733	41,755	44,770	47,692	50,852

Tennessee Advisory Commission on Intergovernmental Relations Population Projections for Tennessee, 2010 to 2030					
County or City	2010	2015	2020	2025	2030
Cumberland County	54,251	61,112	65,343	68,231	71,249
Crab Orchard	985	1146	1261	1346	1421
Crossville	11,249	12,875	14,049	14,967	15,925
Pleasant Hill	537	518	502	503	522
Unincorporated	41,480	46,573	49,531	51,415	53,381

The U.S. Census of 2010 placed the 2010 population of Cumberland County at 56,053 people. Obviously, the population of Cumberland County has already exceeded the population projections of the Tennessee Advisory Commission on Intergovernmental Relations. The Tennessee Advisory Commission on Intergovernmental Relations population projections suggest that the majority of the growth in Cumberland County will occur in unincorporated areas first and the City of Crossville corporate boundaries second.



In September 2008, the U.S. Army Corps of Engineers along with GKY and Associates produced a Memo on the land-use assumptions for the Cumberland County Regional Water Supply Study. The Memo summarizes that "all of the analysis described above ultimately show that the 'expected' growth scenario predicts that Cumberland County's population will grow at an annual average growth rate of about 1.78% over the next fifty years. The slow growth scenario predicts about 1.0% annual growth over 50 years."

The University of Tennessee Institute for Public Service and Institute of Agriculture produced a report entitled *The Long-Term Impacts of Retiree In-Migration on Rural Areas: A Case Study of Cumberland County, Tennessee* in September 2007. The report provides a detailed examination of the population trends of Cumberland County as compared to two other basis groups defined from Tennessee Counties comparable to Cumberland. The report shows the significant growth of Cumberland County as it has continued to outpace the other groups. The report shows that Cumberland County has had a sustained average growth rate of 2.63% on an annual average basis for the period of 1970 through 2004.

Numerous population forecasts have been performed on the Cumberland County area; although, all are based on numerous assumptions that may or may not prove to be valid assumptions. A sustained average annual growth rate of 2.63% over a 34 year period cannot be easily ignored in any population forecast made. Often times, once a city achieves a certain size, growth tends to occur faster than it did when the City was smaller. Furthermore, a small amount of error in the projected growth rates can result in serious errors in estimates of water demand, particularly for fast growing regions such as Cumberland County.

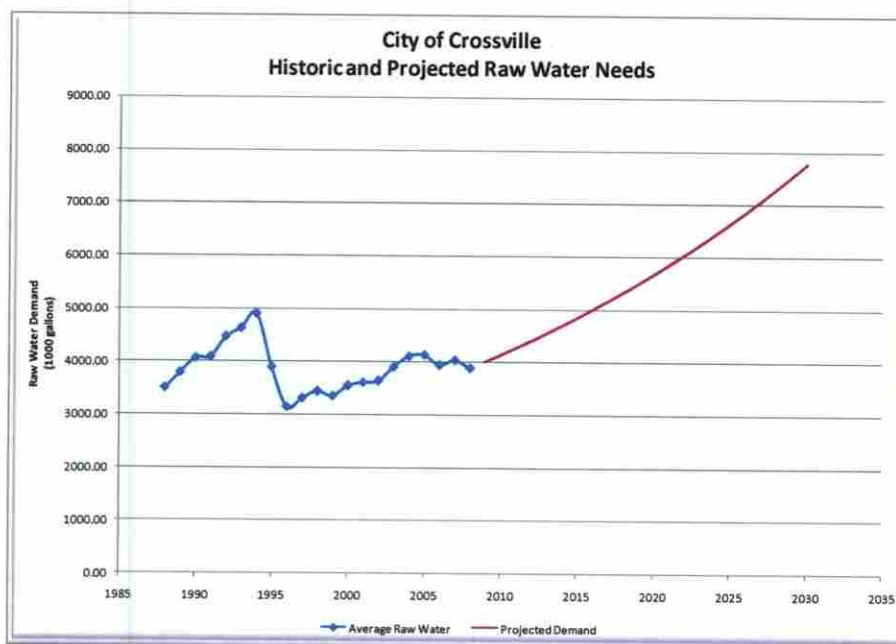
Population forecasts for water use forecasts within this memorandum have been based on a sustained average growth rate of 2.5%. This rate of population growth was used in the application for permits in 2010. This should provide a degree of conservatism in planning for future water needs and demands.

3.2. Raw Water Needs Forecasts

Based on the information available and attempting to be somewhat conservative in forecasting, the growth rate for demand on the City of Crossville water system is forecast as a sustained average annual growth rate of 3.2%.

The following graph depicts the projected raw water requirements through a planning period of 20 years from 2009 to 2029 for the City of Crossville Water System.





Comparisons were performed for the full calendar years of 2013 and 2014; the most recent data available to evaluate the accuracy of the projections. The projected annual average daily withdrawal for the City of Crossville was 4.40 MGD for 2013 and 4.54 MGD for 2014. The actual annual average daily withdrawal for the Crossville Water System was 4.36 MGD for 2013 and 4.05 MGD for 2014. Various factors can affect annual fluctuations in water withdrawals; however, the projections appear to be within a reasonable range of accuracy at the current time. As previously stated, planning for the water system is based on including some conservatism into the estimates to insure adequate facilities are available on a timely basis.

The projected raw water demand for the planning period and beyond is summarized in the following table and demonstrates a projected 2035 demand of 7.54 MGD. The table also includes the projected expected scenario demand from the latest county wide information produced by the U.S. Army Corps of Engineers and GKY and Associates as contained in reference 1. Several of the references to this technical memorandum include projections of raw water demand; however, only the described two are presented in detail here. The USACE projections appear to exceed the projections made by the methods described above until between 2040 and 2050; however, the USACE projections include all of Cumberland County while the projections by ECE Services only include demand for the City of Crossville system. This in effect excludes the Crab Orchard Utility District demand until it grows beyond the capacity of its existing permitted withdrawal. The City of Crossville Water System with 4.0 MGD treatment and withdrawal capacity at Lake Holiday and 3.5 MGD treatment and withdrawal capacity at Meadow Park Lake in conjunction with the transfer of approximately 0.2 MGD from Lake Tansi is capable of meeting the projected twenty year demand as required by funding from the State Revolving Fund. Previous studies show that Lake Holiday has a safe yield in excess of 4.0 MGD

but the City does not have treatment capacity to exceed the 4.0 MGD without additional capital construction.

City of Crossville Water System
Recent Actual and Projected Raw Water Demand

Year	Actual Demand (1000 gallons per day)	Projected Demand (1000 gallons per day)	USACE & GKY Projected Expected Demand (linearly interpolated) (1000 gallons per day)
2013	4357.1	4403.1	5390
2014	4052.8	4544.0	
2015		4689.4	5990
2016		4839.5	
2017		4994.4	
2018		5154.2	
2019		5319.1	
2020		5489.3	6722
2021		5665.0	
2022		5846.3	
2023		6033.4	
2024		6226.4	
2025		6425.7	7487
2030		7521.7	8216
2035		8804.7	8936
2040		10,306.6	9664
2050		14,122.5	10,836

3.3. Basis of Harvesting

There are several events that will or may produce need for the City of Crossville to harvest water from the Lake Tansi reservoir. These include:

- Normal demand beyond the yield of the Meadow Park and Lake Holiday reservoirs,
- To assist the City in maintaining environmental balance between the Upper Cumberland River Basin and the Upper Tennessee – Clinch/Emory River basin,
- To meet system demand requirements during maintenance and/or construction work on the Meadow Park Dam and/or the Lake Holiday Dam,



- To meet system demand requirements during contamination or failure of the water supply at Meadow Park or Lake Holiday,
- Drought conditions that require additional water supply beyond the yield of the Meadow Park and Lake Holiday reservoirs.



SECTION 4. INTER-BASIN TRANSFER BASE DATA

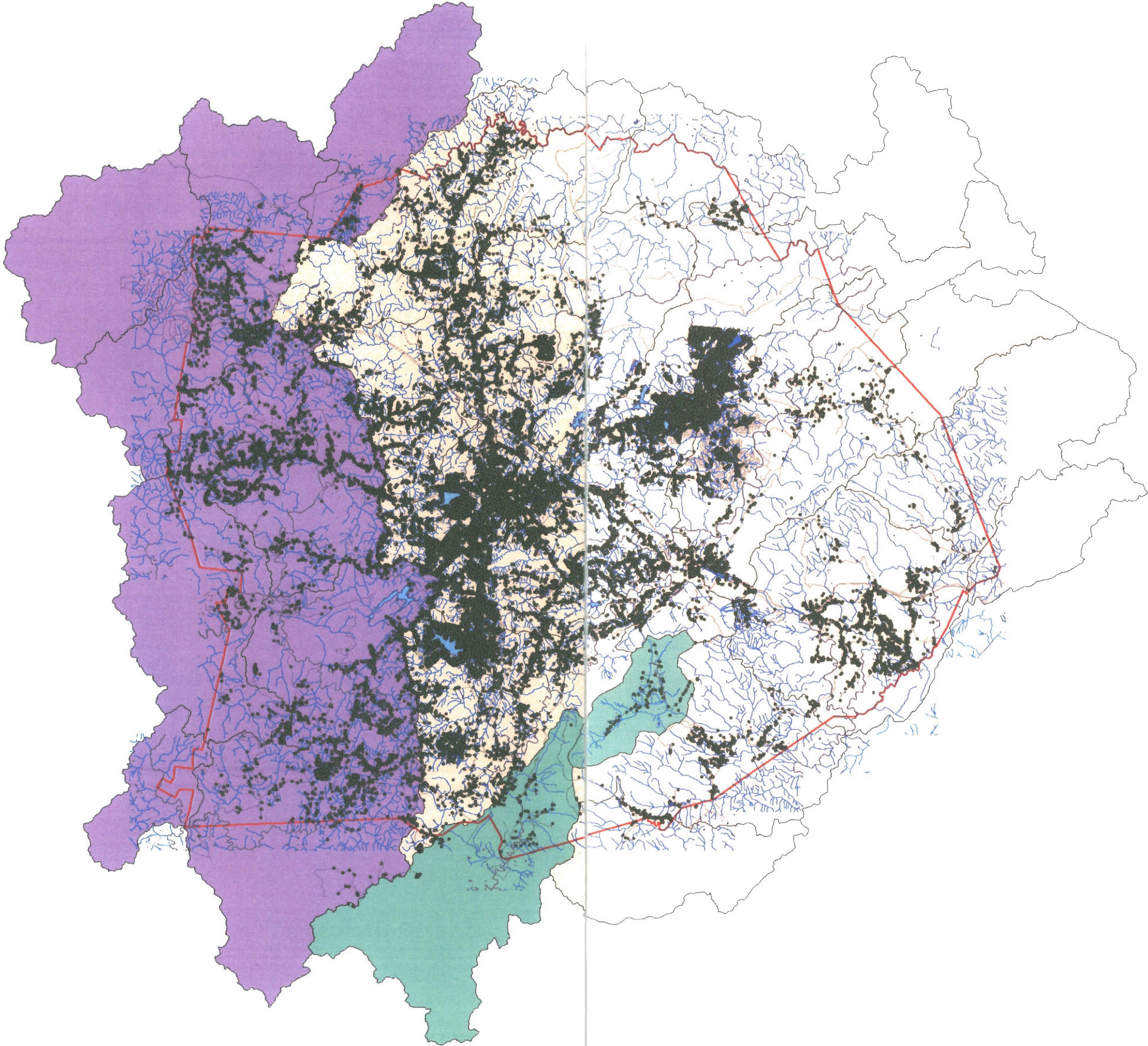
4.1. Base Year

The base year for projections of inter-basin transfers for the City of Crossville was taken as the most recent calendar year with complete data at the time of filing applications for the 2010 permits. Therefore, the base year for calculations is the calendar year 2008. Details of the calculations for the base year are defined below and presented on the spreadsheet included in this section. The spreadsheet details the inter-basin calculations by month.

The following map depicts the presence of every 911 address in Cumberland County, Tennessee as of January 2010 in relationship to the boundaries of the three distinct drainage basins in which customers that consume the water are located. All 911 addresses are not residences or structures that have a water service. However, the map gives a good representation of the overall development within the County and the general areas of heavy demand for water.



Cumberland County Watershed Map



Legend

Watershed_Cumberland

HUC 4

Cumberland River

Hawassee-Middle Tennessee Rivers

Upper Tennessee River

•

911 Addresses

Lakes

Streams, Rivers, Ditches

Local Roads

Cumberland County Boundary

4.2. Base Year Withdrawals

During 2008, the City of Crossville withdrew an average of 1.894 MGD from the Meadow Park Lake and 1.976 MGD from Lake Holiday. These values are taken from Monthly Operating Reports submitted to the Department of Environment and Conservation for the two operating water treatment plants. The withdrawal from Meadow Park included an average 0.153 MGD that was used for process water in the treatment plant and was returned to the drainage basin resulting in a net 1.741 MGD input into the City's distribution system. The withdrawal from Lake Holiday included an average 0.154 MGD that was used for process water in the treatment plant and was returned to the drainage basin resulting in a net 1.822 MGD input into the City's distribution system.

The base year included a net 3.562 MGD average daily pumpage into the distribution system.

4.3. Base Year Sales to South Cumberland Utility District

The City of Crossville sells water to the South Cumberland Utility District which has customers within the Upper Tennessee River – Clinch/Emory River Basin and the Upper Cumberland River Basin. Exact values of the number of customers within each basin have not been defined. Although, review of the 911 addresses within Cumberland County suggest that the value is approximately 80% in the Upper Tennessee– Clinch/Emory River Basin and 20% in the Upper Cumberland River Basin.

Base Year Sales to the South Cumberland Utility District based on the four meter locations were 0.591 MGD average.

4.4. Base Year Sales to the Grandview Utility District

The City of Crossville sells water to the Grandview Utility District which has customers within the Lower Tennessee- Hiwassee River Basin. Due to its physical location, only a small percentage of the customers of the Grandview Utility District are within the Lower Tennessee - Hiwassee River Basin. Assuming that the reported transfer to the Lower Tennessee – Hiwassee River Basin of 7536 gallons per day is an average for the period, 7.77% of the water sales to the Grandview Utility District are transferred into the Lower Tennessee – Hiwassee River Basin.

Base Year Sales to the Grandview Utility District based on one meter location were 0.097 MGD average.

4.5. Base Year Usage by the City of Crossville Water Department and Catoosa Water Department

Base year usage by the City of Crossville Water Department and Catoosa Water Department was calculated by subtracting the sales to the South Cumberland Utility District and to the Grandview Utility District from the average daily pumpage into the distribution system. The net demand in the two departments averaged 2.874 MGD for the year.

4.5.01. Catoosa Water Department Base Year

The Catoosa Water Department usage is no longer metered from the City of Crossville. Therefore, the data contained within Reference 1 was used to estimate the water usage



within the Catoosa Water Department. Reference 1 shows the annual average residential demand to be 119.69 gpd/hhld for the South Cumberland Utility District and 118.90 gpd/hhld for the Crab Orchard Utility District. It is anticipated that the residential water consumption within the Catoosa Water Department is within the values shown to exist for the South Cumberland Utility District and the Crab Orchard Utility District. The Catoosa Water Department has approximately 4170 customers. Therefore, the Catoosa Water Department is assumed to use 114 gpd/hhld for its 4170 customers plus an additional 90,000 gallons per day for commercial uses.

Based on this analysis, the average demand of the Catoosa Water Department is 0.565 MGD. Catoosa demand is then split based upon records kept by the Catoosa Water Department related to inter-basin transfers. Catoosa Utility District has 480 customers (11.51%) in the Upper Cumberland Basin and 3690 customers (88.49%) in the Upper Tennessee Basin. Demand flows are then multiplied by the percentage of customers in each basin to determine the discharge into each basin.

The Catoosa Water Department discharged 0.065 MGD in the Upper Cumberland Basin and 0.500 MGD in the Upper Tennessee Basin for the 2008 base year according to the analysis.

4.5.02. City of Crossville Base Year

The City of Crossville uses all water not used by the South Cumberland Utility District, Grandview Utility District, or the Catoosa Water Department. The analysis reveals that the City of Crossville demand averages 2.308 MGD. A check of the discharge of the City of Crossville wastewater treatment facility was performed to check the assumptions made to this point. The wastewater treatment facility discharges were approximately 1.25 MGD during the summer months. Discharges were higher during the winter months, presumably the result of inflow and infiltration within the wastewater collection system. Therefore, slightly more than half of the demand assigned to the City of Crossville is discharged into the wastewater treatment facility. Based on general information regarding the locations that have public sewer, this is a reasonable estimate of the City of Crossville demand. The average City of Crossville demand is estimated at 296.6 gpd/customer.

To arrive at the number of Crossville Water Department customers within each drainage basin, a database of the addresses of Crossville water customers was matched with a database of all 911 addresses for Cumberland County. All addresses that matched were plotted in a GIS system to determine the number that occurred in each drainage basin. The Crossville water department has 7783 customers. The database join was able to match 6502 of the customers or 83.5%. Of the addresses that were matched, 6376 customers (98.06%) are within the Upper Tennessee River Basin and 126 customers (1.94%) are within the Upper Cumberland River Basin. The remaining customers that did not match in the database join, 1407 customers, were split between the two drainage basins on the same percentages that the matched customers demonstrated. The result being that Crossville water department has a total of 151 customers in the Upper Cumberland Basin and the remaining 7632 customers are within the Upper Tennessee Basin.



Demand in each of the two drainage basins for the Crossville Water Department was then based upon the number of customers within each basin times the average demand for the period per customer for the City of Crossville.

4.6. Summary of Results for Base Year

The base year data is summarized from a water budget model as far as inter-basin transfers are concerned as shown in the following table.

City of Crossville 2008 Water Budget

Water Budget Component	Flow (million gallons)	Percentage	Flow (MGD)
Annual Withdrawal from Upper Cumberland	635.38	48.9%	1.741
Annual Withdrawal from Upper Tennessee	664.93	51.1%	1.822
Total Withdrawals	1300.31		3.562
Crossville Upper Tennessee Usage	826.15		2.263
Catoosa Dept Upper Tennessee Usage	182.61		0.500
SCUD Upper Tennessee Usage	172.70		0.473
Grandview UD Upper Tennessee Usage	32.82		0.090
Total Upper Tennessee Usage	1214.27		3.237
Net Flow Into Upper Tennessee Basin	549.34		1.505
Crossville Upper Cumberland Usage	16.35		0.045
Catoosa Dept Upper Cumberland Usage	23.75		0.065
SCUD Upper Cumberland Usage	43.18		0.118
Total Upper Cumberland Usage	83.27		0.228
Net Flow Into Upper Cumberland Basin	-552.11		-1.513
Grandview UD Lower Tennessee Usage	2.76		0.008
Total Lower Tennessee Usage	2.76		0.008
Net Flow Into Lower Tennessee Basin	2.76		0.008
Total Usage	1300.31		3.562
Unaccounted for Water in Balance	0.0%		

Results of the Water Budget indicate that the average transfer into the Upper Tennessee Basin is 1.51 MGD while the 2009 Inter-basin Water Transfer Report shows an average of 1.36 MGD, while the average transfer into the Lower Tennessee Basin is 0.008 MGD from the water budget and 0.007 MGD from the Report. The results indicate that the model of the water budget overestimated the transfer into the Upper Tennessee Basin by 11.0% and overestimated the transfer into the Lower Tennessee Basin by 14.3%. The model is considered to be a conservative model on which to base estimates of future inter-basin transfers.



SECTION 5. INTER-BASIN TRANSFER PROJECTIONS

5.1. Projections of Total Withdrawals

Future net annual withdrawals for all water sources was estimated from the raw water demand projections contained within the Facilities Plan for the City of Crossville SRF/ARRA Raw Water Harvesting Project. The growth in raw water demand is projected to grow at 2.5% per year. The same percentage of process water (7.94%) that was observed in the base year was subtracted from the projected raw water demands to determine the Total Withdrawals for the system. Because the basis of projections are not a net of a number of customers times a demand per customer but instead are based on estimates of customers and usages in each basin, the model will not match in the total withdrawals versus total usage.

The breakdown of withdrawals from Meadow Park versus Lake Holiday or Lake Tansi is based upon the preference for source and treatment plant based on treatment capacities and costs associated with operation. The City of Crossville can maximize production at the Meadow Park treatment plant when there is adequate water available preventing the labor cost of operating the Lake Holiday plant. Consequently, the projections assume that the Lake Holiday Plant is operated for one shift initially and does not go to a two shift operation until treatment capacity is maximized at Meadow Park.

5.2. Projections of Crossville Water Department Upper Tennessee River Discharge

The Crossville Water Department's Upper Tennessee – Clinch/Emory River Basin Discharge is the fastest growing portion of the area included in the base year information primarily due to the commercial and industrial influences on this portion of the planning area. The base year discharge is projected to grow at 3.2% per year within the Crossville Water Department's Upper Tennessee – Clinch/Emory River Basin.

5.3. Projections of Catoosa Water Department Upper Tennessee River Discharge

The demand on the Catoosa Water Department within the Upper Tennessee – Clinch/Emory River Basin is projected to grow at 2.7% per year.

5.4. Projections of South Cumberland Utility District (SCUD) Upper Tennessee River Discharge

The demand on the South Cumberland Utility District within the Upper Tennessee – Clinch/Emory River Basin is projected to grow at 2.7% per year.

5.5. Projections of Crab Orchard Utility District Upper Tennessee River Discharge

The Crab Orchard Utility District currently furnishes their own water from an impoundment on Otter Creek in the northern part of Cumberland County. The impoundment is within the Upper Tennessee – Clinch/Emory River Basin and all of Crab Orchard Utility District's water demand is within the same river basin. Crab Orchard Utility District's current demand averages approximately 1.55 MGD. The District's water supply is limited at 2.0 MGD withdrawal. The City of Crossville and the Crab Orchard Utility District have agreed to enter into a mutual aid agreement for water supply. It is therefore assumed that when Crab Orchard Utility District



reaches a consumer demand of 1.75 MGD, the remaining demand will be furnished by the City of Crossville. The Crab Orchard Utility District's average demand is projected to grow at 2.6% per year.

5.6. Projections of Crossville Water Department Upper Cumberland River Discharge

The Crossville Water Department's Upper Cumberland River Basin Discharge is projected to grow at 2.3% per year above the base year demand.

5.7. Projections of Catoosa Water Department Upper Cumberland River Discharge

The Catoosa Water Department's Upper Cumberland River Basin Discharge is projected to grow at 2.3% per year above the base year. This growth projection does not include the growth within the Cumberland Cove area. The Catoosa Water Department is currently constructing a major project to provide potable water to the Cumberland Cove Development at the request of the residents of the development. A significant portion of the cost to construct the additions to the Catoosa Water Department system is being paid by the residents of the development.

5.8. Projections of South Cumberland Utility District (SCUD) Upper Cumberland River Discharge

The South Cumberland Utility District's Upper Cumberland River Basin Discharge is projected to grow at an annual rate of 2.3% above the base year.

5.9. Projections of Cumberland Cove Upper Cumberland River Discharge

There was no base year demand for the Cumberland Cove Development area since the development was not served by the Catoosa Water Department in 2008. The current project to extend public water system to the Cumberland Cove Development will ultimately increase the Catoosa Water Department's Upper Cumberland River Discharge. To account for this in the projections of the Inter-basin Transfers, the Cumberland Cove Development demand has been projected to begin in 2010. The based demand for 2010 is formulated from Table 14 of Reference 1 which shows the self-supply water use in 2006 in Cumberland Cove as 0.026 MGD. The Cumberland Cove Development is estimated to have a base demand of 0.030 MGD beginning in 2010. Table 3 of Reference 1 presents a housing projection for the Cumberland Cove area. The projected number of houses in the Expected Growth Scenario is 1924 in 2056 and 477 in 2006. This growth is approximately equal to a 2.9% annual increase in the number of houses. The Cumberland Cove Upper Cumberland River Basin Discharge is projected to grow at an annual rate of 3.1%.

5.10. Projections of Grandview Utility District Lower Tennessee – Hiwassee River Basin Discharge

The Grandview Utility District serves a relatively remote portion of Cumberland and Rhea Counties. The Grandview Utility District's Lower Tennessee – Hiwassee River Basin Discharge is projected to grow at 1.5% per year above the base year.

5.11. Projections of Grandview Utility District Upper Tennessee – Clinch/Emory River Basin Discharge



The Grandview Utility District serves a relatively remote portion of Cumberland and Rhea Counties. The Grandview Utility District's Upper Tennessee – Clinch/Emory River Basin Discharge is projected to grow at 1.5% per year above the base year.



SECTION 6. PERMIT VOLUMES OF PROPOSED WITHDRAWAL AND TRANSFER

6.1. General

The projections of withdrawal volumes and estimates of transfer between basins were performed with water harvesting from Lake Tansi and without water harvesting from Lake Tansi. These projections are used to demonstrate the effects on inter-basin transfer volumes for the City of Crossville Water System with and without the proposed project in demonstration of the environmental benefit derived from including Lake Tansi as a water source to help reduce the net transfer into the Upper Tennessee – Clinch/Emory River Basin. The National Park Service has expressed concern over the increase of flow observed in the Obed River over the past few years. This is partially a result of the continued increase in the inter-basin transfer into the Upper Tennessee – Clinch/Emory River Basin by the City of Crossville. Although, the proposed project cannot eliminate the flow increase, it can partially mitigate the future increases.

The net transfer cannot be used as a basis for permits based upon documentation received from the State of Tennessee, Department of Environment and Conservation. The permit volume is considered the volume removed from a source and delivered to another source. Because of the layout of the City of Crossville Water System and the topography of the area, it is impossible to define every time water crosses between basins and the volumes of the transfer at each crossing. The proposed system would include a transfer from Lake Tansi to the Meadow Park Lake and Treatment Plant permitted at the total volume removed from Lake Tansi. This transferred volume would then be partially transferred back into the Upper Tennessee – Clinch/Emory River Basin from which it originated. Therefore, permit volumes for transfer are additive in some instances.

6.2. Meadow Park Intake

The permit volume for the Meadow Park intake is based upon the average daily flow for a 90-day period transferred from the Upper Cumberland Basin into the Upper Tennessee – Clinch/Emory River Basin customers of the system. This volume potentially will include water already transferred under separate permit from the Lake Tansi Intake. The projected permit volume is calculated as the Withdrawal from Upper Cumberland at Meadow Park less the sum of 60% of the Crossville Upper Cumberland Usage and the SCUD Upper Cumberland Usage. Therefore, the projected volume of this transfer for the 2010 to 2015 period was a maximum of 2.33 MGD. The projected volume of this transfer for the 2015 to 2020 period is a maximum of 2.47 MGD based on an average daily volume. Peak daily volumes may be higher than average daily volumes. A permit volume of 3.5 MGD is recommended to account for operation practices and seasonal variations; as well as to allow operation of the Meadow Park Treatment Plant at capacity.

6.3. Lake Holiday Intake

A portion of the water treated at the Lake Holiday Water Treatment Plant is delivered to the Lower Tennessee – Hiwassee River Basin through customers of the Grandview Utility District. The projected permit volume for the transfer from the Upper Tennessee – Clinch/Emory River



Basin to the Lower Tennessee – Hiwassee River Basin is represented by the maximum average daily flow for a 90-day period as shown on the projections as the Total Lower Tennessee Usage from 2010 to 2015. The projections show a maximum transfer of 0.008 MGD on an annual basis for the period of 2010 to 2015. The projections show a maximum transfer of 0.009 MGD on an annual basis for the period of 2015 to 2020. To provide some reserve permit capacity to account for seasonal fluctuation in demand over such a small number of customers, it is prudent to apply for a permit for 25,000 gpd maximum transfer.

A portion of the water treated at the Lake Holiday Water Treatment Plant is delivered to customers in the Upper Cumberland River Basin due to piping arrangements in the water system. The volume of this water is approximately equal to the Catoosa Dept Upper Cumberland Usage plus approximately 40% of the Crossville Upper Cumberland Usage plus the Additional Cumberland Cove Upper Cumberland Usage. The projections indicate that this volume is approximately 0.15 MGD over the period of 2010 to 2015. This volume should be included in the permit volumes for the Upper Tennessee – Clinch/Emory River Basin to Upper Cumberland River Basin.

6.4. Lake Tansi Intake

The permit volume for the Lake Tansi intake is based upon the average daily flow for a 90-day period transferred to the Meadow Park Lake and/or Meadow Park Water Treatment Plant. Since the permit is only good for a five-year period, the permit volume should not exceed the maximum projected transfer volume from 2010 to 2015 divided by 90 days or 7.2 MGD; whichever is less. It is assumed due to electrical demand costs that the most economical operation of the system involves operating over the shortest time period with the least start and stops to minimize the electrical cost to operate the system. Therefore, if transfer is necessary, the most economical use will be during a wet season period during which the system can be operated non-stop. The maximum projected transfer volume between 2010 and 2015 of 413.3 million gallons over a 90 day period results in an average transfer of 4.59 MGD which is less than the pumping capacity of 7.2 MGD. Therefore, the Upper Tennessee – Clinch/Emory River to Upper Cumberland River Transfer should be permitted at a volume in excess of 4.59 MGD plus 0.15 MGD or approximately 5.0 MGD.



SECTION 7. CONSUMPTIVE USE ANALYSIS

7.1. Definition

Consumptive use is defined as the withdrawals from the water system less returns to the original water system. Consumptive use includes all water that is evaporated, transpired, incorporated into products or crops, consumed by humans, consumed by animals, or otherwise not returned to the drainage basin.

7.2. Evaluation

7.2.01. Water Treatment Plant Water Use

Monthly operating reports for each of the water treatment plants reflect the water withdrawal for the treatment plants as well as the amount of finished water produced. The data reviewed for the period of 1989 to the present indicate that the average production water is 13.7% of all water withdrawal. This is the water rejected by the water treatment plants and is returned to settling basins to remove floc particles and chemicals prior to being returned to the water source. A portion of this water will be lost to evaporation while remaining in the settling basins. No records are available to estimate the amount lost to evaporation.

The settling basins at the treatment plants will also pickup additional water during all precipitation events that will be released with the rejection water. It is assumed that the loss to evaporation does not exceed the additional water added by precipitation events and that there is no net consumptive use of the rejection water.

7.2.02. Water Loss Records

The City of Crossville has maintained detailed monthly water loss records since from 1997 until the current time. These records are based upon the monthly consumption, water loss due to flushing, water loss due to leaks, and water loss due to fire fighting.

For 2012, the total consumptive use was 1,063,046,100 gallons with 4,534,535 gallons used in flushing; 8,300,843 gallons lost in leaks; and 245,780 gallons used in fire fighting. A total of 13,081,158 gallons were used by the City internally. This left an unaccounted for water of 262,629,742 gallons or 20%.

For 2013, the total consumptive use was 1,031,007,600 gallons with 2,947,964 gallons used in flushing; 27,781,636 gallons lost in leaks; and 8,852 gallons used in fire fighting. A total of 30,738,452 gallons were used by the City internally. This left an unaccounted for water of 374,248,949 gallons or 26%.

For 2014, the total consumptive use was 1,070,959,700 gallons with 3,422,657 gallons used in flushing; 25,412,764 gallons lost in leaks; and 15,000 gallons used in fire fighting. A total of 28,850,421 gallons were used by the City internally. This left an unaccounted for water of 297,782,779 gallons or 21%.



These records indicate that the water loss for the City of Crossville averages approximately 23%. This water loss can be the result of stolen water, unknown water leaks, and normal loss from joints in the distribution system. With the exception of water stolen from the system, the water loss should be introduced into the ground subsurface. Since there is no way to account for the stolen water, all water loss volumes are assumed to not contain any consumptive use.

The wholesale customers of the City of Crossville have water distribution systems that are on average much younger than the City of Crossville's system. Consequently, water loss in these utility district's should be less than within the City of Crossville unless management techniques are resulting in excessive losses.

7.2.03. City of Crossville Direct Customers

The City of Crossville uses all water not used by the South Cumberland Utility District, Grandview Utility District, or the Catoosa Water Department. The analysis reveals that the City of Crossville demand averages 2.308 MGD. A check of the discharge of the City of Crossville wastewater treatment facility was performed to check the assumptions made to this point. The wastewater treatment facility discharges were approximately 1.25 MGD during the summer months. Discharges were higher during the winter months, presumably the result of inflow and infiltration within the wastewater collection system. Therefore, slightly more than half of the demand assigned to the City of Crossville is discharged into the wastewater treatment facility.

Not all City of Crossville water customers are provided with sewer service. Therefore, the average 1.058 MGD (45.8%) not returned to the wastewater treatment plant contains the water loss from the volume as well as the portion delivered to customers without sewer service and the consumptive use within the City of Crossville. The water loss on 2.308 MGD at 23% indicates that 0.53 MGD of this volume is due to water loss. Therefore, there is an estimated 0.72 MGD (31.2%) of consumptive use and water delivered to customers without sewer service.

Based on this analysis, consumptive use can be estimated within the City limits of Crossville to be approximately 18 to 22% of water.

7.2.04. Effect of Tile Plants

The City of Crossville is home to several large industrial facilities that make ceramic tile. Water from the City of Crossville is used in the tile production process and is ultimately evaporated in the curing process for the tile. This constitutes a significant portion of the total consumptive use of water from the water withdrawals by the City. In effect, skewing the percentage of consumptive use based upon the City of Crossville direct customers.

Consumptive use outside of the city limits would not be expected to be large in comparison to the consumptive use within the City.

7.3. Estimated Water Use Percentages



The following water use percentages are presented as a percentage of the raw water withdrawals.

Rejected Water	13.7%
Water Loss	19.8%
Consumptive Use	15.0%



SECTION 8. SUMMARY OF RESULTS

8.1. Inter-basin Transfer Results without Lake Tansi Water Harvesting

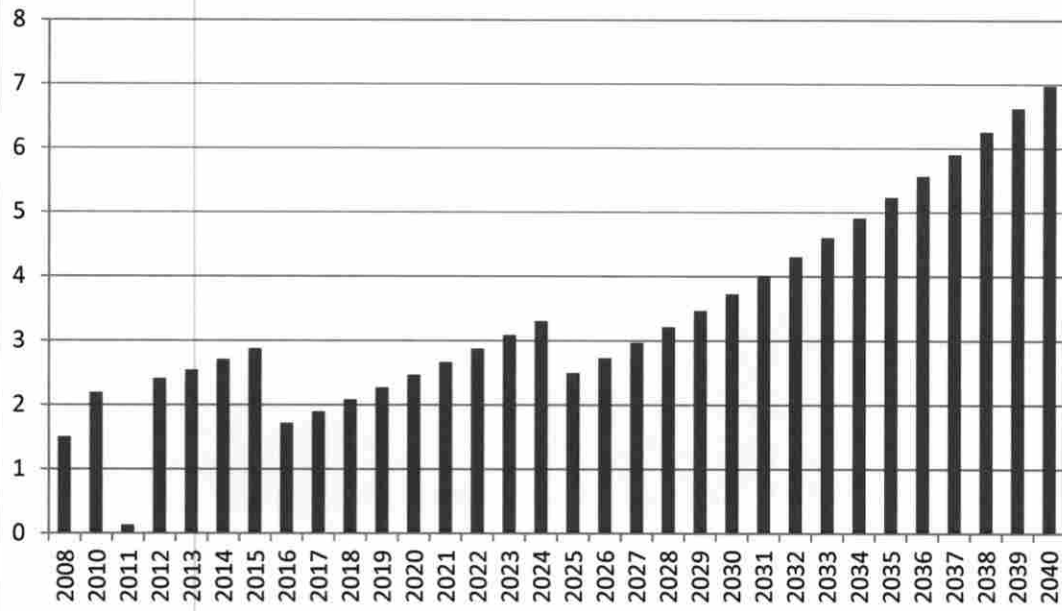
Calculations based upon the base year discharges and the projections detailed in Section 4 were prepared to determine the projected inter-basin transfers for the City of Crossville Water System on the basis that all water supply would continue to come from Lake Holiday and Meadow Park Lake for the period of 2010 through 2040. The projection of inter-basin transfer for this scenario is based upon assuming that no new treatment works would be built at Lake Holiday. Therefore, the Lake Holiday supply into the distribution system is limited to approximately 3.7 MGD to account for the process water used in treatment and the fact that the treatment plant cannot be operated at peak capacity continuously.

Obviously, the City of Crossville Water System cannot meet the projected demands without water harvesting from Lake Tansi until the year 2040. By year 2030, the withdrawal from Meadow Park begins to exceed the safe yield of the reservoir while the Lake Holiday Treatment Plant is operated at capacity. Water harvesting from Lake Tansi, pushes the date through which the City could meet demand to well past the year 2040; the last year for which projections are included.

The following graph displays the projection of the net transfer into the Upper Tennessee – Clinch/Emory River Basin under this scenario. The following four pages are the spreadsheet calculations of the projections.



**City of Crossville Water System
Projected Net Transfer Into Upper Tennessee
- Clinch/Emory River Basin without Lake
Tansi Water Harvesting**



	<u>2008</u>		<u>2010</u>		<u>2011</u>		<u>2012</u>		<u>2013</u>		<u>2014</u>		<u>2015</u>		<u>2016</u>		<u>2017</u>	
	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>
Annual Withdrawal from Upper Cumberland - Meadow Park	635.38	1.741	905.76	2.482	159.49	0.437	996.30	2.730	1043.76	2.860	1092.73	2.994	1143.27	3.132	708.76	1.942	762.59	2.089
Annual Withdrawal from Upper Tennessee - Lake Holiday	664.93	1.822	486.67	1.333	1277.50	3.500	486.67	1.333	486.67	1.333	486.67	1.333	486.67	1.333	973.33	2.667	973.33	2.667
Annual Withdrawal from Upper Tennessee - Lake Tansi			0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total Withdrawals (w/out Process Water)	1300.31	3.562	1392.43	3.815	1436.99	3.937	1482.97	4.063	1530.43	4.193	1579.40	4.327	1629.94	4.466	1682.10	4.608	1735.93	4.756
Days of Water Harvesting at Lake Tansi					0.00		0.00		0.000		0.000		0.000		0.000		0.000	
Crossville Upper Tennessee Usage	826.15	2.263	879.87	2.411	908.02	2.488	937.08	2.567	967.06	2.649	998.01	2.734	1029.95	2.822	1062.91	2.912	1096.92	3.005
Catoosa Dept Upper Tennessee Usage	182.61	0.500	192.61	0.528	197.81	0.542	203.15	0.557	208.63	0.572	214.26	0.587	220.05	0.603	225.99	0.619	232.09	0.636
SCUD Upper Tennessee Usage	172.70	0.473	181.44	0.497	186.34	0.511	191.37	0.524	196.54	0.538	201.85	0.553	207.30	0.568	212.89	0.583	218.64	0.599
Crab Orchard Utility District Upper Tennessee Usage	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	7.61	0.021	25.07	0.069	42.99	0.118	61.40	0.168	80.30	0.220
	32.82	0.090	33.81	0.093	34.31	0.094	34.83	0.095	35.35	0.097	35.88	0.098	36.42	0.100	36.97	0.101	37.52	0.103
Total Upper Tennessee Usage	1214.27	3.327	1287.72	3.528	1326.48	3.634	1366.43	3.744	1415.20	3.877	1475.07	4.041	1536.70	4.210	1600.15	4.384	1665.47	4.563
Net Flow Into Upper Tennessee Basin	549.34	1.505	801.05	2.195	48.98	0.134	879.76	2.410	928.53	2.544	988.40	2.708	1050.04	2.877	626.82	1.717	692.14	1.896
Crossville Upper Cumberland Usage	16.35	0.045	17.11	0.047	17.50	0.048	17.90	0.049	18.31	0.050	18.73	0.051	19.17	0.053	19.61	0.054	20.06	0.055
Catoosa Dept Upper Cumberland Usage	23.75	0.065	24.86	0.068	25.43	0.070	26.01	0.071	26.61	0.073	27.22	0.075	27.85	0.076	28.49	0.078	29.15	0.080
SCUD Upper Cumberland Usage	43.18	0.118	45.18	0.124	46.22	0.127	47.29	0.130	48.37	0.133	49.49	0.136	50.62	0.139	51.79	0.142	52.98	0.145
Add'l Cumberland Cove Upper Cumberland Usage			10.95	0.03	11.28945	0.031	11.639423	0.032	12.00	0.033	12.37	0.034	12.76	0.035	13.15	0.036	13.56	0.037
Total Upper Cumberland Usage	83.27	0.228	98.10	0.269	100.44	0.275	102.84	0.282	105.30	0.288	107.82	0.295	110.40	0.302	113.04	0.310	115.74	0.317
Net Flow Into Upper Cumberland Basin	-552.11	-1.513	-807.67	-2.213	-59.05	-0.162	-893.46	-2.448	-938.46	-2.571	-984.91	-2.698	-1032.88	-2.830	-595.73	-1.632	-646.85	-1.772
Grandview UD Lower Tennessee Usage	2.76	0.008	2.85	0.008	2.89	0.008	2.93	0.008	2.98	0.008	3.02	0.008	3.07	0.008	3.11	0.009	3.16	0.009
Total Lower Tennessee Usage	2.76	0.008	2.85	0.008	2.89	0.008	2.93	0.008	2.98	0.008	3.02	0.008	3.07	0.008	3.11	0.009	3.16	0.009
Net Flow Into Lower Tennessee Basin	2.76	0.008	2.85	0.008	2.89	0.008	2.93	0.008	2.98	0.008	3.02	0.008	3.07	0.008	3.11	0.009	3.16	0.009
Total Usage	1300.31	3.562	1388.67	3.805	1429.82	3.917	1472.20	4.033	1523.48	4.174	1585.91	4.345	1650.17	4.521	1716.30	4.702	1784.38	4.889
Unaccounted for Water in Balance	0.0%		0.3%		0.5%		0.7%		0.5%		-0.4%		-1.2%		-2.0%		-2.8%	

	<u>2018</u>		<u>2019</u>		<u>2020</u>		<u>2021</u>		<u>2022</u>		<u>2023</u>		<u>2024</u>		<u>2025</u>		<u>2026</u>	
	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>
Annual Withdrawal from Upper Cumberland - Meadow Park	818.14	2.241	875.47	2.399	934.63	2.561	995.69	2.728	1058.69	2.901	1123.72	3.079	1190.82	3.263	882.91	2.419	954.38	2.615
Annual Withdrawal from Upper Tennessee - Lake Holiday	973.33	2.667	973.33	2.667	973.33	2.667	973.33	2.667	973.33	2.667	973.33	2.667	973.33	2.667	1350.50	3.700	1350.50	3.700
Annual Withdrawal from Upper Tennessee - Lake Tansi	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total Withdrawals (w/out Process Water)	1791.47	4.908	1848.80	5.065	1907.96	5.227	1969.02	5.395	2032.03	5.567	2097.05	5.745	2164.16	5.929	2233.41	6.119	2304.88	6.315
Days of Water Harvesting at Lake Tansi	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Crossville Upper Tennessee Usage	1132.02	3.101	1168.24	3.201	1205.63	3.303	1244.21	3.409	1284.02	3.518	1325.11	3.630	1367.52	3.747	1411.28	3.867	1456.44	3.990
Catoosa Dept Upper Tennessee Usage	238.36	0.653	244.79	0.671	251.40	0.689	258.19	0.707	265.16	0.726	271.79	0.745	278.59	0.763	286.11	0.784	293.83	0.805
SCUD Upper Tennessee Usage	224.55	0.615	230.61	0.632	236.83	0.649	243.23	0.666	249.80	0.684	256.54	0.703	263.47	0.722	270.58	0.741	277.89	0.761
Crab Orchard Utility District Upper Tennessee Usage	99.71	0.273	119.65	0.328	140.13	0.384	161.16	0.442	182.76	0.501	204.94	0.561	227.72	0.624	251.11	0.688	275.14	0.754
	38.08	0.104	38.65	0.106	39.23	0.107	39.82	0.109	40.42	0.111	41.03	0.112	41.64	0.114	42.27	0.116	42.90	0.118
Total Upper Tennessee Usage	1732.72	4.747	1801.95	4.937	1873.23	5.132	1946.61	5.333	2022.16	5.540	2099.41	5.752	2178.93	5.970	2261.34	6.195	2346.20	6.428
Net Flow Into Upper Tennessee Basin	759.39	2.081	828.62	2.270	899.90	2.465	973.28	2.667	1048.83	2.873	1126.08	3.085	1205.60	3.303	910.84	2.495	995.70	2.728
Crossville Upper Cumberland Usage	20.52	0.056	20.99	0.058	21.47	0.059	21.97	0.060	22.47	0.062	22.99	0.063	23.52	0.064	24.06	0.066	24.61	0.067
Catoosa Dept Upper Cumberland Usage	29.82	0.082	30.50	0.084	31.20	0.085	31.92	0.087	32.66	0.089	33.41	0.092	34.18	0.094	34.96	0.096	35.77	0.098
SCUD Upper Cumberland Usage	54.20	0.148	55.45	0.152	56.72	0.155	58.03	0.159	59.36	0.163	60.72	0.166	62.12	0.170	63.55	0.174	65.01	0.178
Add'l Cumberland Cove Upper Cumberland Usage	13.98	0.038	14.41	0.039	14.86	0.041	15.32	0.042	15.79	0.043	16.28	0.045	16.79	0.046	17.31	0.047	17.85	0.049
Total Upper Cumberland Usage	118.51	0.325	121.35	0.332	124.26	0.340	127.23	0.349	130.28	0.357	133.41	0.365	136.61	0.374	139.88	0.383	143.24	0.392
Net Flow Into Upper Cumberland Basin	-699.63	-1.917	-754.12	-2.066	-810.37	-2.220	-868.45	-2.379	-928.41	-2.544	-990.31	-2.713	-1054.22	-2.888	-743.03	-2.036	-811.14	-2.222
Grandview UD Lower Tennessee Usage	3.21	0.009	3.26	0.009	3.31	0.009	3.35	0.009	3.41	0.009	3.46	0.009	3.51	0.010	3.56	0.010	3.61	0.010
Total Lower Tennessee Usage	3.21	0.009	3.26	0.009	3.31	0.009	3.35	0.009	3.41	0.009	3.46	0.009	3.51	0.010	3.56	0.010	3.61	0.010
Net Flow Into Lower Tennessee Basin	3.21	0.009	3.26	0.009	3.31	0.009	3.35	0.009	3.41	0.009	3.46	0.009	3.51	0.010	3.56	0.010	3.61	0.010
Total Usage	1854.44	5.081	1926.56	5.278	2000.79	5.482	2077.20	5.691	2155.85	5.906	2236.27	6.127	2319.04	6.354	2404.79	6.588	2493.05	6.830
Unaccounted for Water in Balance	-3.5%		-4.2%		-4.9%		-5.5%		-6.1%		-6.6%		-7.2%		-7.7%		-8.2%	

	2027		2028		2029		2030		2031		2032		2033		2034		2035	
	MG	MGD	MG	MGD	MG	MGD	MG	MGD	MG	MGD	MG	MGD	MG	MGD	MG	MGD	MG	MGD
Annual Withdrawal from Upper Cumberland - Meadow Park	1028.14	2.817	1104.25	3.025	1182.80	3.241	1263.87	3.463	1347.53	3.692	1433.87	3.928	1522.97	4.173	1614.92	4.424	1709.81	4.684
Annual Withdrawal from Upper Tennessee - Lake Holiday	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700
Annual Withdrawal from Upper Tennessee - Lake Tansi	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total Withdrawals (w/out Process Water)	2378.64	6.517	2454.75	6.725	2533.30	6.941	2614.37	7.163	2698.03	7.392	2784.37	7.628	2873.47	7.873	2965.42	8.124	3060.31	8.384
Days of Water Harvesting at Lake Tansi	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Crossville Upper Tennessee Usage	1503.04	4.118	1551.14	4.250	1600.78	4.386	1652.00	4.526	1709.82	4.684	1769.67	4.848	1831.60	5.018	1895.71	5.194	1962.06	5.376
Catoosa Dept Upper Tennessee Usage	301.77	0.827	309.92	0.849	318.28	0.872	326.88	0.896	335.70	0.920	344.77	0.945	354.08	0.970	363.64	0.996	373.45	1.023
SCUD Upper Tennessee Usage	285.39	0.782	293.10	0.803	301.01	0.825	309.14	0.847	317.48	0.870	326.05	0.893	334.86	0.917	343.90	0.942	353.18	0.968
Crab Orchard Utility District Upper Tennessee Usage	299.81	0.821	325.15	0.891	351.18	0.962	377.91	1.035	405.36	1.111	433.55	1.188	462.50	1.267	492.23	1.349	522.77	1.432
	43.54	0.119	44.20	0.121	44.86	0.123	45.53	0.125	46.22	0.127	46.91	0.129	47.61	0.130	48.33	0.132	49.05	0.134
Total Upper Tennessee Usage	2433.56	6.667	2523.50	6.914	2616.11	7.167	2711.45	7.429	2814.58	7.711	2920.94	8.003	3030.65	8.303	3143.80	8.613	3260.52	8.933
Net Flow Into Upper Tennessee Basin	1083.06	2.967	1173.00	3.214	1265.61	3.467	1360.95	3.729	1464.08	4.011	1570.44	4.303	1680.15	4.603	1793.30	4.913	1910.02	5.233
Crossville Upper Cumberland Usage	25.18	0.069	25.76	0.071	26.35	0.072	26.96	0.074	27.58	0.076	28.21	0.077	28.86	0.079	29.52	0.081	30.20	0.083
Catoosa Dept Upper Cumberland Usage	36.59	0.100	37.43	0.103	38.29	0.105	39.17	0.107	40.07	0.110	40.99	0.112	41.94	0.115	42.90	0.118	43.89	0.120
SCUD Upper Cumberland Usage	66.51	0.182	68.04	0.186	69.60	0.191	71.20	0.195	72.84	0.200	74.52	0.204	76.23	0.209	77.98	0.214	79.78	0.219
Add'l Cumberland Cove Upper Cumberland Usage	18.40	0.050	18.97	0.052	19.56	0.054	20.16	0.055	20.79	0.057	21.56	0.059	22.36	0.061	23.18	0.064	24.04	0.066
Total Upper Cumberland Usage	146.67	0.402	150.20	0.411	153.80	0.421	157.50	0.431	161.28	0.442	165.28	0.453	169.38	0.464	173.59	0.476	177.91	0.487
Net Flow Into Upper Cumberland Basin	-881.46	-2.415	-954.06	-2.614	-1029.00	-2.819	-1106.37	-3.031	-1186.25	-3.250	-1268.59	-3.476	-1353.58	-3.708	-1441.33	-3.949	-1531.90	-4.197
Grandview UD Lower Tennessee Usage	3.67	0.010	3.72	0.010	3.78	0.010	3.84	0.011	3.89	0.011	3.95	0.011	4.01	0.011	4.07	0.011	4.13	0.011
Total Lower Tennessee Usage	3.67	0.010	3.72	0.010	3.78	0.010	3.84	0.011	3.89	0.011	3.95	0.011	4.01	0.011	4.07	0.011	4.13	0.011
Net Flow Into Lower Tennessee Basin	3.67	0.010	3.72	0.010	3.78	0.010	3.84	0.011	3.89	0.011	3.95	0.011	4.01	0.011	4.07	0.011	4.13	0.011
Total Usage	2583.90	7.079	2677.42	7.335	2773.69	7.599	2872.79	7.871	2979.75	8.164	3090.17	8.466	3204.04	8.778	3321.47	9.100	3442.56	9.432
Unaccounted for Water in Balance	-8.6%		-9.1%		-9.5%		-9.9%		-10.4%		-11.0%		-11.5%		-12.0%		-12.5%	

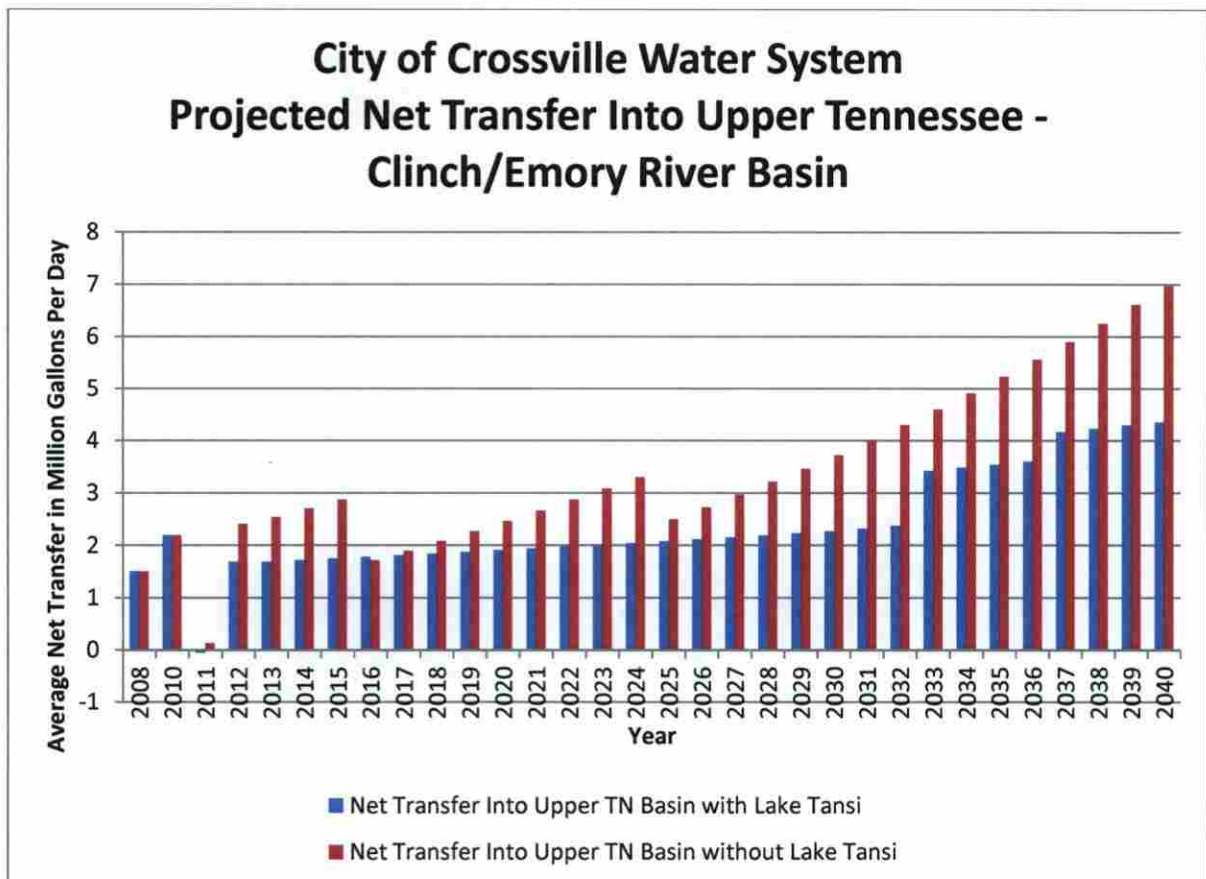
	2036		2037		2038		2039		2040	
	MG	MGD	MG	MGD	MG	MGD	MG	MGD	MG	MGD
Annual Withdrawal from Upper Cumberland - Meadow Park	1807.74	4.953	1908.80	5.230	2013.10	5.515	2120.74	5.810	2231.82	6.115
Annual Withdrawal from Upper Tennessee - Lake Holiday	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700
Annual Withdrawal from Upper Tennessee - Lake Tansi	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total Withdrawals (w/out Process Water)	3158.24	8.653	3259.30	8.930	3363.60	9.215	3471.24	9.510	3582.32	9.815
Days of Water Harvesting at Lake Tansi	0.000		0.000		0.000		0.000		0.000	
Crossville Upper Tennessee Usage	2030.73	5.564	2101.81	5.758	2175.37	5.960	2251.51	6.169	2323.56	6.366
Catoosa Dept Upper Tennessee Usage	383.54	1.051	393.89	1.079	404.53	1.108	415.45	1.138	426.67	1.169
SCUD Upper Tennessee Usage	362.72	0.994	372.51	1.021	382.57	1.048	392.90	1.076	403.51	1.106
Crab Orchard Utility District Upper Tennessee Usage	554.13	1.518	586.34	1.606	619.42	1.697	653.39	1.790	688.27	1.886
	49.79	0.136	50.54	0.138	51.29	0.141	52.06	0.143	52.84	0.145
Total Upper Tennessee Usage	3380.91	9.263	3505.09	9.603	3633.18	9.954	3765.31	10.316	3894.85	10.671
Net Flow Into Upper Tennessee Basin	2030.41	5.563	2154.59	5.903	2282.68	6.254	2414.81	6.616	2544.35	6.971
Crossville Upper Cumberland Usage	30.90	0.085	31.61	0.087	32.33	0.089	33.08	0.091	33.84	0.093
Catoosa Dept Upper Cumberland Usage	44.90	0.123	45.93	0.126	46.99	0.129	48.07	0.132	49.17	0.135
SCUD Upper Cumberland Usage	81.61	0.224	83.49	0.229	85.41	0.234	87.37	0.239	89.38	0.245
Add'l Cumberland Cove Upper Cumberland Usage	24.93	0.068	25.85	0.071	26.81	0.073	27.80	0.076	28.66	0.079
Total Upper Cumberland Usage	182.34	0.500	186.88	0.512	191.54	0.525	196.32	0.538	201.06	0.551
Net Flow Into Upper Cumberland Basin	-1625.40	-4.453	-1721.92	-4.718	-1821.56	-4.991	-1924.42	-5.272	-2030.76	-5.564
Grandview UD Lower Tennessee Usage	4.19	0.011	4.26	0.012	4.32	0.012	4.39	0.012	4.45	0.012
Total Lower Tennessee Usage	4.19	0.011	4.26	0.012	4.32	0.012	4.39	0.012	4.45	0.012
Net Flow Into Lower Tennessee Basin	4.19	0.011	4.26	0.012	4.32	0.012	4.39	0.012	4.45	0.012
Total Usage	3567.44	9.774	3696.22	10.127	3829.04	10.491	3966.01	10.866	4100.36	11.234
Unaccounted for Water in Balance	-13.0%		-13.4%		-13.8%		-14.3%		-14.5%	

8.2. Inter-basin Transfer Results with Lake Tansi Water Harvesting

The Lake Tansi Water Harvesting system is a wedge wire intake screen within Lake Tansi that supplies water to vertical turbine pumps with variable speed drives. The pumps have a rated capacity of 5000 gpm and can pump to the Meadow Park Lake or into the Meadow Park Water Treatment Facility via a 30 Inch diameter pipeline.

A scenario was evaluated for the period of 2010 through 2040 utilizing this system to transfer water to the Meadow Park facilities from Lake Tansi. This scenario; similar to the scenario without Lake Tansi, is based upon not constructing any new treatment works on Lake Holiday. In addition, it is a balanced scenario in that, the transfers from Lake Tansi are not projected at the maximum withdrawals that could occur. The scenario is limited to approximately 3 months of pumping time at the design 5000 gpm rate.

The following chart compares the net transfer into the Upper Tennessee – Clinch/Emory River Basin for the City of Crossville system for this scenario compared to the scenario without Lake Tansi. Detailed calculations of the scenario are presented in the following four pages.



	<u>2008</u>		<u>2010</u>		<u>2011</u>		<u>2012</u>		<u>2013</u>		<u>2014</u>		<u>2015</u>		<u>2016</u>		<u>2017</u>	
	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>
Annual Withdrawal from Upper Cumberland - Meadow Park	635.38	1.741	905.76	2.482	90.00	0.247	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000
Annual Withdrawal from Upper Tennessee - Lake Holiday	664.93	1.822	486.67	1.333	1277.50	3.500	486.67	1.333	486.67	1.333	486.67	1.333	486.67	1.333	486.67	1.333	486.67	1.333
Annual Withdrawal from Upper Tennessee - Lake Tansi			0.00	0.000	69.49	0.190	266.30	0.730	313.76	0.860	362.73	0.994	413.27	1.132	465.43	1.275	519.26	1.423
Total Withdrawals (w/out Process Water)	1300.31	3.562	1392.43	3.815	1436.99	3.937	1482.97	4.063	1530.43	4.193	1579.40	4.327	1629.94	4.466	1682.10	4.608	1735.93	4.756
Days of Water Harvesting at Lake Tansi					9.65		36.99		43.578		50.380		57.399		64.643		72.119	
Crossville Upper Tennessee Usage	826.15	2.263	879.87	2.411	908.02	2.488	937.08	2.567	967.06	2.649	998.01	2.734	1029.95	2.822	1062.91	2.912	1096.92	3.005
Catoosa Dept Upper Tennessee Usage	182.61	0.500	192.61	0.528	197.81	0.542	203.15	0.557	208.63	0.572	214.26	0.587	220.05	0.603	225.99	0.619	232.09	0.636
SCUD Upper Tennessee Usage	172.70	0.473	181.44	0.497	186.34	0.511	191.37	0.524	196.54	0.538	201.85	0.553	207.30	0.568	212.89	0.583	218.64	0.599
Crab Orchard Utility District Upper Tennessee Usage	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	7.61	0.021	25.07	0.069	42.99	0.118	61.40	0.168	80.30	0.220
Grandview UD Discharge - Upper Tennessee Usage	32.82	0.090	33.81	0.093	34.31	0.094	34.83	0.095	35.35	0.097	35.88	0.098	36.42	0.100	36.97	0.101	37.52	0.103
Total Upper Tennessee Usage	1214.27	3.327	1287.72	3.528	1326.48	3.634	1366.43	3.744	1415.20	3.877	1475.07	4.041	1536.70	4.210	1600.15	4.384	1665.47	4.563
Net Flow Into Upper Tennessee Basin	549.34	1.505	801.05	2.195	-20.50	-0.056	613.46	1.681	614.78	1.684	625.67	1.714	636.76	1.745	648.05	1.775	659.55	1.807
Crossville Upper Cumberland Usage	16.35	0.045	17.11	0.047	17.50	0.048	17.90	0.049	18.31	0.050	18.73	0.051	19.17	0.053	19.61	0.054	20.06	0.055
Catoosa Dept Upper Cumberland Usage	23.75	0.065	24.86	0.068	25.43	0.070	26.01	0.071	26.61	0.073	27.22	0.075	27.85	0.076	28.49	0.078	29.15	0.080
SCUD Upper Cumberland Usage	43.18	0.118	45.18	0.124	46.22	0.127	47.29	0.130	48.37	0.133	49.49	0.136	50.62	0.139	51.79	0.142	52.98	0.145
Add'l Cumberland Cove Upper Cumberland Usage			10.95	0.03	11.28945	0.031	11.639423	0.032	12.00	0.033	12.37	0.034	12.76	0.035	13.15	0.036	13.56	0.037
Total Upper Cumberland Usage	83.27	0.228	98.10	0.269	100.44	0.275	102.84	0.282	105.30	0.288	107.82	0.295	110.40	0.302	113.04	0.310	115.74	0.317
Net Flow Into Upper Cumberland Basin	-552.11	-1.513	-807.67	-2.213	10.44	0.029	-627.16	-1.718	-624.70	-1.712	-622.18	-1.705	-619.60	-1.698	-616.96	-1.690	-614.26	-1.683
Grandview UD Lower Tennessee Usage	2.76	0.008	2.85	0.008	2.89	0.008	2.93	0.008	2.98	0.008	3.02	0.008	3.07	0.008	3.11	0.009	3.16	0.009
Total Lower Tennessee Usage	2.76	0.008	2.85	0.008	2.89	0.008	2.93	0.008	2.98	0.008	3.02	0.008	3.07	0.008	3.11	0.009	3.16	0.009
Net Flow Into Lower Tennessee Basin	2.76	0.008	2.85	0.008	2.89	0.008	2.93	0.008	2.98	0.008	3.02	0.008	3.07	0.008	3.11	0.009	3.16	0.009
Total Usage	1300.31	3.562	1388.67	3.805	1429.82	3.917	1472.20	4.033	1523.48	4.174	1585.91	4.345	1650.17	4.521	1716.30	4.702	1784.38	4.889
Unaccounted for Water in Balance	0.0%		0.3%		0.5%		0.7%		0.5%		-0.4%		-1.2%		-2.0%		-2.8%	

	<u>2018</u>		<u>2019</u>		<u>2020</u>		<u>2021</u>		<u>2022</u>		<u>2023</u>		<u>2024</u>		<u>2025</u>		<u>2026</u>	
	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>
Annual Withdrawal from Upper Cumberland - Meadow Park	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000
Annual Withdrawal from Upper Tennessee - Lake Holiday	486.67	1.333	486.67	1.333	973.33	2.667	973.33	2.667	973.33	2.667	973.33	2.667	1350.50	3.700	1350.50	3.700	1350.50	3.700
Annual Withdrawal from Upper Tennessee - Lake Tansi	574.81	1.575	632.14	1.732	204.63	0.561	265.69	0.728	328.69	0.901	393.72	1.079	83.66	0.229	152.91	0.419	224.38	0.615
Total Withdrawals (w/out Process Water)	1791.47	4.908	1848.80	5.065	1907.96	5.227	1969.02	5.395	2032.03	5.567	2097.05	5.745	2164.16	5.929	2233.41	6.119	2304.88	6.315
Days of Water Harvesting at Lake Tansi	79.834		87.797		28.421		36.901		45.652		54.683		11.619		21.238		31.164	
Crossville Upper Tennessee Usage	1132.02	3.101	1168.24	3.201	1205.63	3.303	1244.21	3.409	1284.02	3.518	1325.11	3.630	1367.52	3.747	1411.28	3.867	1456.44	3.990
Catoosa Dept Upper Tennessee Usage	238.36	0.653	244.79	0.671	251.40	0.689	258.19	0.707	265.16	0.726	271.79	0.745	278.59	0.763	286.11	0.784	293.83	0.805
SCUD Upper Tennessee Usage	224.55	0.615	230.61	0.632	236.83	0.649	243.23	0.666	249.80	0.684	256.54	0.703	263.47	0.722	270.58	0.741	277.89	0.761
Crab Orchard Utility District Upper Tennessee Usage	99.71	0.273	119.65	0.328	140.13	0.384	161.16	0.442	182.76	0.501	204.94	0.561	227.72	0.624	251.11	0.688	275.14	0.754
Grandview UD Discharge - Upper Tennessee Usage	38.08	0.104	38.65	0.106	39.23	0.107	39.82	0.109	40.42	0.111	41.03	0.112	41.64	0.114	42.27	0.116	42.90	0.118
Total Upper Tennessee Usage	1732.72	4.747	1801.95	4.937	1873.23	5.132	1946.61	5.333	2022.16	5.540	2099.41	5.752	2178.93	5.970	2261.34	6.195	2346.20	6.428
Net Flow Into Upper Tennessee Basin	671.25	1.839	683.15	1.872	695.27	1.905	707.59	1.939	720.13	1.973	732.36	2.006	744.77	2.040	757.93	2.077	771.32	2.113
Crossville Upper Cumberland Usage	20.52	0.056	20.99	0.058	21.47	0.059	21.97	0.060	22.47	0.062	22.99	0.063	23.52	0.064	24.06	0.066	24.61	0.067
Catoosa Dept Upper Cumberland Usage	29.82	0.082	30.50	0.084	31.20	0.085	31.92	0.087	32.66	0.089	33.41	0.092	34.18	0.094	34.96	0.096	35.77	0.098
SCUD Upper Cumberland Usage	54.20	0.148	55.45	0.152	56.72	0.155	58.03	0.159	59.36	0.163	60.72	0.166	62.12	0.170	63.55	0.174	65.01	0.178
Add'l Cumberland Cove Upper Cumberland Usage	13.98	0.038	14.41	0.039	14.86	0.041	15.32	0.042	15.79	0.043	16.28	0.045	16.79	0.046	17.31	0.047	17.85	0.049
Total Upper Cumberland Usage	118.51	0.325	121.35	0.332	124.26	0.340	127.23	0.349	130.28	0.357	133.41	0.365	136.61	0.374	139.88	0.383	143.24	0.392
Net Flow Into Upper Cumberland Basin	-611.49	-1.675	-608.65	-1.668	-605.74	-1.660	-602.77	-1.651	-599.72	-1.643	-596.59	-1.635	-593.39	-1.626	-590.12	-1.617	-586.76	-1.608
Grandview UD Lower Tennessee Usage	3.21	0.009	3.26	0.009	3.31	0.009	3.35	0.009	3.41	0.009	3.46	0.009	3.51	0.010	3.56	0.010	3.61	0.010
Total Lower Tennessee Usage	3.21	0.009	3.26	0.009	3.31	0.009	3.35	0.009	3.41	0.009	3.46	0.009	3.51	0.010	3.56	0.010	3.61	0.010
Net Flow Into Lower Tennessee Basin	3.21	0.009	3.26	0.009	3.31	0.009	3.35	0.009	3.41	0.009	3.46	0.009	3.51	0.010	3.56	0.010	3.61	0.010
Total Usage	1854.44	5.081	1926.56	5.278	2000.79	5.482	2077.20	5.691	2155.85	5.906	2236.27	6.127	2319.04	6.354	2404.79	6.588	2493.05	6.830
Unaccounted for Water in Balance	-3.5%		-4.2%		-4.9%		-5.5%		-6.1%		-6.6%		-7.2%		-7.7%		-8.2%	

	<u>2027</u>		<u>2028</u>		<u>2029</u>		<u>2030</u>		<u>2031</u>		<u>2032</u>		<u>2033</u>		<u>2034</u>		<u>2035</u>	
	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>
Annual Withdrawal from Upper Cumberland - Meadow Park	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	730.00	2.000	1095.00	3.000	1095.00	3.000	1095.00	3.000
Annual Withdrawal from Upper Tennessee - Lake Holiday	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700
Annual Withdrawal from Upper Tennessee - Lake Tansi	298.14	0.817	374.25	1.025	452.80	1.241	533.87	1.463	617.53	1.692	703.87	1.928	427.97	1.173	519.92	1.424	614.81	1.684
Total Withdrawals (w/out Process Water)	2378.64	6.517	2454.75	6.725	2533.30	6.941	2614.37	7.163	2698.03	7.392	2784.37	7.628	2873.47	7.873	2965.42	8.124	3060.31	8.384
Days of Water Harvesting at Lake Tansi	41.408		51.979		62.889		74.149		85.768		97.759		59.440		72.211		85.390	
Crossville Upper Tennessee Usage	1503.04	4.118	1551.14	4.250	1600.78	4.386	1652.00	4.526	1709.82	4.684	1769.67	4.848	1831.60	5.018	1895.71	5.194	1962.06	5.376
Catoosa Dept Upper Tennessee Usage	301.77	0.827	309.92	0.849	318.28	0.872	326.88	0.896	335.70	0.920	344.77	0.945	354.08	0.970	363.64	0.996	373.45	1.023
SCUD Upper Tennessee Usage	285.39	0.782	293.10	0.803	301.01	0.825	309.14	0.847	317.48	0.870	326.05	0.893	334.86	0.917	343.90	0.942	353.18	0.968
Crab Orchard Utility District Upper Tennessee Usage	299.81	0.821	325.15	0.891	351.18	0.962	377.91	1.035	405.36	1.111	433.55	1.188	462.50	1.267	492.23	1.349	522.77	1.432
Grandview UD Discharge - Upper Tennessee Usage	43.54	0.119	44.20	0.121	44.86	0.123	45.53	0.125	46.22	0.127	46.91	0.129	47.61	0.130	48.33	0.132	49.05	0.134
Total Upper Tennessee Usage	2433.56	6.667	2523.50	6.914	2616.11	7.167	2711.45	7.429	2814.58	7.711	2920.94	8.003	3030.65	8.303	3143.80	8.613	3260.52	8.933
Net Flow Into Upper Tennessee Basin	784.92	2.150	798.75	2.188	812.80	2.227	827.08	2.266	846.55	2.319	866.58	2.374	1252.18	3.431	1273.39	3.489	1295.21	3.549
Crossville Upper Cumberland Usage	25.18	0.069	25.76	0.071	26.35	0.072	26.96	0.074	27.58	0.076	28.21	0.077	28.86	0.079	29.52	0.081	30.20	0.083
Catoosa Dept Upper Cumberland Usage	36.59	0.100	37.43	0.103	38.29	0.105	39.17	0.107	40.07	0.110	40.99	0.112	41.94	0.115	42.90	0.118	43.89	0.120
SCUD Upper Cumberland Usage	66.51	0.182	68.04	0.186	69.60	0.191	71.20	0.195	72.84	0.200	74.52	0.204	76.23	0.209	77.98	0.214	79.78	0.219
Add'l Cumberland Cove Upper Cumberland Usage	18.40	0.050	18.97	0.052	19.56	0.054	20.16	0.055	20.79	0.057	21.56	0.059	22.36	0.061	23.18	0.064	24.04	0.066
Total Upper Cumberland Usage	146.67	0.402	150.20	0.411	153.80	0.421	157.50	0.431	161.28	0.442	165.28	0.453	169.38	0.464	173.59	0.476	177.91	0.487
Net Flow Into Upper Cumberland Basin	-583.33	-1.598	-579.80	-1.589	-576.20	-1.579	-572.50	-1.569	-568.72	-1.558	-564.72	-1.547	-925.62	-2.536	-921.41	-2.524	-917.09	-2.513
Grandview UD Lower Tennessee Usage	3.67	0.010	3.72	0.010	3.78	0.010	3.84	0.011	3.89	0.011	3.95	0.011	4.01	0.011	4.07	0.011	4.13	0.011
Total Lower Tennessee Usage	3.67	0.010	3.72	0.010	3.78	0.010	3.84	0.011	3.89	0.011	3.95	0.011	4.01	0.011	4.07	0.011	4.13	0.011
Net Flow Into Lower Tennessee Basin	3.67	0.010	3.72	0.010	3.78	0.010	3.84	0.011	3.89	0.011	3.95	0.011	4.01	0.011	4.07	0.011	4.13	0.011
Total Usage	2583.90	7.079	2677.42	7.335	2773.69	7.599	2872.79	7.871	2979.75	8.164	3090.17	8.466	3204.04	8.778	3321.47	9.100	3442.56	9.432
Unaccounted for Water in Balance	-8.6%		-9.1%		-9.5%		-9.9%		-10.4%		-11.0%		-11.5%		-12.0%		-12.5%	

	<u>2036</u>		<u>2037</u>		<u>2038</u>		<u>2039</u>		<u>2040</u>	
	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>	<u>MG</u>	<u>MGD</u>
Annual Withdrawal from Upper Cumberland - Meadow Park	1095.00	3.000	1277.50	3.500	1277.50	3.500	1277.50	3.500	1277.50	3.500
Annual Withdrawal from Upper Tennessee - Lake Holiday	1350.50	3.700	1350.50	3.700	1350.50	3.700	1350.50	3.700	1400.00	3.700
Annual Withdrawal from Upper Tennessee - Lake Tansi	712.74	1.953	631.30	1.730	735.60	2.015	843.24	2.310	904.82	2.479
Total Withdrawals (w/out Process Water)	3158.24	8.653	3259.30	8.930	3363.60	9.215	3471.24	9.510	3582.32	9.815
Days of Water Harvesting at Lake Tansi	98.992		87.681		102.167		117.116		125.669	
Crossville Upper Tennessee Usage	2030.73	5.564	2101.81	5.758	2175.37	5.960	2251.51	6.169	2323.56	6.366
Catoosa Dept Upper Tennessee Usage	383.54	1.051	393.89	1.079	404.53	1.108	415.45	1.138	426.67	1.169
SCUD Upper Tennessee Usage	362.72	0.994	372.51	1.021	382.57	1.048	392.90	1.076	403.51	1.106
Crab Orchard Utility District Upper Tennessee Usage	554.13	1.518	586.34	1.606	619.42	1.697	653.39	1.790	688.27	1.886
Grandview UD Discharge - Upper Tennessee Usage	49.79	0.136	50.54	0.138	51.29	0.141	52.06	0.143	52.84	0.145
Total Upper Tennessee Usage	3380.91	9.263	3505.09	9.603	3633.18	9.954	3765.31	10.316	3894.85	10.671
Net Flow Into Upper Tennessee Basin	1317.67	3.610	1523.28	4.173	1547.08	4.239	1571.57	4.306	1590.03	4.356
Crossville Upper Cumberland Usage	30.90	0.085	31.61	0.087	32.33	0.089	33.08	0.091	33.84	0.093
Catoosa Dept Upper Cumberland Usage	44.90	0.123	45.93	0.126	46.99	0.129	48.07	0.132	49.17	0.135
SCUD Upper Cumberland Usage	81.61	0.224	83.49	0.229	85.41	0.234	87.37	0.239	89.38	0.245
Add'l Cumberland Cove Upper Cumberland Usage	24.93	0.068	25.85	0.071	26.81	0.073	27.80	0.076	28.66	0.079
Total Upper Cumberland Usage	182.34	0.500	186.88	0.512	191.54	0.525	196.32	0.538	201.06	0.551
Net Flow Into Upper Cumberland Basin	-912.66	-2.500	-1090.62	-2.988	-1085.96	-2.975	-1081.18	-2.962	-1076.44	-2.949
Grandview UD Lower Tennessee Usage	4.19	0.011	4.26	0.012	4.32	0.012	4.39	0.012	4.45	0.012
Total Lower Tennessee Usage	4.19	0.011	4.26	0.012	4.32	0.012	4.39	0.012	4.45	0.012
Net Flow Into Lower Tennessee Basin	4.19	0.011	4.26	0.012	4.32	0.012	4.39	0.012	4.45	0.012
Total Usage	3567.44	9.774	3696.22	10.127	3829.04	10.491	3966.01	10.866	4100.36	11.234
Unaccounted for Water in Balance	-13.0%		-13.4%		-13.8%		-14.3%		-14.5%	

SECTION 9. REFERENCES

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17. Environmental & Civil Engineering Services. May 28, 2009. *City of Crossville Drinking Water Facilities Plan, ARRA Raw Water Harvesting Project.*
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19. Tennessee Advisory Commission on Intergovernmental Relations and University of Tennessee Center for Business and Economic Research. June 2009. *Population Projections for the State of Tennessee, 2010-2030.*

