

# *Preliminary Engineering Report*

## *City of Danville Water System Improvements*

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### *Executive Summary*

#### *Introduction*

In April 2011, HDR Engineers was retained by the City of Danville to review the alternatives for upgrading the city's water treatment plant (WTP) in order to:

- Assure source and production capacity were sufficient to meet a growing demand
- Identify any treatment improvements needed to insure compliance with upcoming regulations
- Replace any treatment assets that are obsolete or in an advanced condition of deterioration

This report is the summary of the investigation that has been undertaken to accomplish those objectives. This report is broken down into several sections to deal with specific topics or to remain compliant with standard formats for Preliminary Engineering Reports (PER) that are required by various funding agencies. The PER summary report consists of the following sections:

- Section 1 – Background/Purpose of Report
- Section 2 – Review of Existing Water Treatment Facilities
- Section 3 – Additional Investigations and Site Visits
- Section 4 – Need for Project
- Section 5 – Advanced Treatment Technologies Considered
- Section 6 – Project Alternatives
- Section 7 – Recommendations

The executive summary will include pieces of each section that were considered important in the development of cost estimates or the recommendation of the process. Some general information will also be included as context requires. The Executive Summary will only provide a small portion of the information on this subject and a review of the entire document is encouraged for a more complete understanding of the report.

#### *Section 1 – Background/Purpose of Report*

This section included the identification of background information including the following items:

- Project Planning Area/Area of Service
- Environmental Impact/Resources Present in Project Area

- Historical Impacts of the Project

The Area of Service included Table ES-1 which was provided to illustrate Danville’s water supply footprint.

**Table ES-1**  
***Danville Community/Wholesale Customers***  
***City of Danville Water System Improvements***

<i>Community/Utility</i>	<i>Customers Served</i>	<i>Affected Population</i>
Danville	10,300	25,750
Perryville (community)	NA	NA
Junction City (community)	NA	NA
Hedgeville (community)	NA	NA
Garrard County Water Association (wholesale)	5,352	13,000
Lake Village Water Association (wholesale)	2,219	5,500
Hustonville Water District (wholesale)	1,875	4,600
Parksville (wholesale)	1,594	3,900
North Mercer Water District (wholesale)	4,308	10,000
Stanford (emergency connection)	2,926	7,300

***Section 2 – Review of Existing Water Treatment Facilities***

This section includes a description and of all water treatment plant facilities as well as a discussion of their current level of performance both as an individual system and as a collect treatment process. The following facilities have been reviewed through either by a condition assessment or by operating performance.

- Lake Herrington Source Water
  - Typical quality and yield
  - Bin number ID for cryptosporidium
  - Water quality at various lake depths
  - Historical removal capabilities of TOC through treatment
- Danville Raw Water Intake
  - Intake configuration/pump floor layout
  - Influent tunnels condition/intake video inspection
  - Multi-discipline inspection of pumping station
  - KMNO4 system inspection
  - Transmission main condition/emergency supply options
- Danville WTP
  - Multi-discipline review of existing treatment systems
  - Review of chemical capabilities
  - Identification of facilities for decommissioning
  - Existing Site Survey
- Existing System Performance
  - Reviewed for turbidity removal – excellent

- Reviewed for TOC reduction – compliant
- Reviewed for THM/HAA – Both compliant with current regulations, recent excursions provide concern about process capabilities. See Table ES-2 below for current status

**Table ES-2**  
***Danville THM and HAA Testing Summary***  
***City of Danville Water System Improvements***

<i>TTHM</i>	<i>2010</i>				<i>2011</i>		<i>LRAA</i>
	<i>1Q</i>	<i>2Q</i>	<i>3Q</i>	<i>4Q</i>	<i>1Q</i>	<i>2Q</i>	
<b>Trihalomethane (THM) Levels at Specific Sample Sites (mg/l)</b>							
<b>110</b>	0.031	0.049	0.061	0.041	0.034	0.031	0.042
<b>111</b>	0.037	0.049	0.066	0.053	0.039	0.040	0.050
<b>112</b>	0.025	0.036	0.047	0.033	0.022	0.022	0.031
<b>113</b>	0.039	0.062	0.077	0.054	0.031	0.041	0.051
<b>TPA</b>	0.012	0.024	0.026	0.025	0.014	0.020	0.021
<b>THM QA</b>	0.033	0.049	0.063	0.045	0.028	0.031	
<b>THM RAA</b>	0.049	0.050	0.051	0.047	0.046	0.041	
<b>HAA</b>							
<b>110</b>	0.058	0.059	0.079	0.044	0.033	0.032	0.047
<b>111</b>	0.053	0.055	0.075	0.047	0.044	0.047	0.053
<b>112</b>	0.055	0.042	0.047	0.028	0.025	0.025	0.031
<b>113</b>	0.071	0.071	0.083	0.047	0.032	0.050	0.053
<b>TPA</b>	0.48	0.026	0.028	0.025	0.013	0.016	0.021
<b>QA</b>	0.059	0.057	0.071	0.042	0.034	0.039	
<b>RAA</b>	0.063	0.072	0.071	0.057	0.051	0.047	

### ***Section 3 – Additional Investigations and Site Visits***

As part of the PER activities, previous investigations in Danville have been examined and additional investigations have been undertaken in order to gain a further understanding of some of the proposed treatment technologies. In addition, the project team and Danville staff have taken several site visits to get feedback from other product installations in order to get a handle on costs, operations and effectiveness of various processes. These additional investigations and site visits are identified below in Table ES-3 and detailed in Section 3.

#### ***Additional Investigations***

- GAC Test Column at Danville WTP – On-site GAC testing to determine performance. Table 3-1 reveals results
- GAC Confirmation Testing at Colorado University – Initial results from two RSSCT investigations that will help estimate GAC media life
- Geotechnical Investigation of WTP Site

**Table ES-3**  
***WTP GAC Pilot Column Testing***  
***City of Danville Water System Improvements***

<b><i>Sample Location/Parameter</i></b>	<b><i>Sample Date</i></b>				<b><i>Average Values</i></b>
	<b><i>5/6/11</i></b>	<b><i>5/9/11</i></b>	<b><i>5/26/11</i></b>	<b><i>5/30/11</i></b>	
Intake TOC	4.67	NS	4.97	4.13	4.59
Contactor 1 Influent TOC (mg/l)	2.88	NS	2.74	2.79	2.80
Contactor 1 Effluent TOC (mg/l)	2.04	NS	2.02	1.88	1.98
Contactor 1 TOC Reduction (%)	29.1%	NS	26.3%	32.6%	29.3%
Contactor 1 Influent HAAFP(mg/l)	0.08 <sup>3</sup>	0.133	0.145	0.115	0.131
Contactor 1 Effluent HAAFP (mg/l)	0.01 <sup>3</sup>	0.075	0.87	0.05	0.071
Contactor 1 HAAFP Reduction (%)	87.5% <sup>3</sup>	43.6%	40.0%	56.5%	46.7%
Contactor 2 Influent TOC (mg/l)	3.32	NS	2.76	2.37	2.82
Contactor 2 Effluent TOC (mg/l)	1.94	NS	2.31	1.87	2.04
Contactor 2 TOC Reduction (%)	41.5%	NS	16.3%	21.0%	26.2%
Contactor 2 Influent HAAFP(mg/l)	0.09 <sup>3</sup>	0.174	0.172	0.112	0.152
Contactor 2 Effluent HAAFP (mg/l)	0.01 <sup>3</sup>	0.064	0.074	0.054	0.064
Contactor 2 HAAFP Reduction (%)	88.9% <sup>3</sup>	63.2%	56.3%	51.7%	57.0%

Notes: <sup>1</sup>Average of multiple samples  
<sup>2</sup>NS – Not sampled  
<sup>3</sup>Results Discarded

***Site Visits to Relevant Facilities***

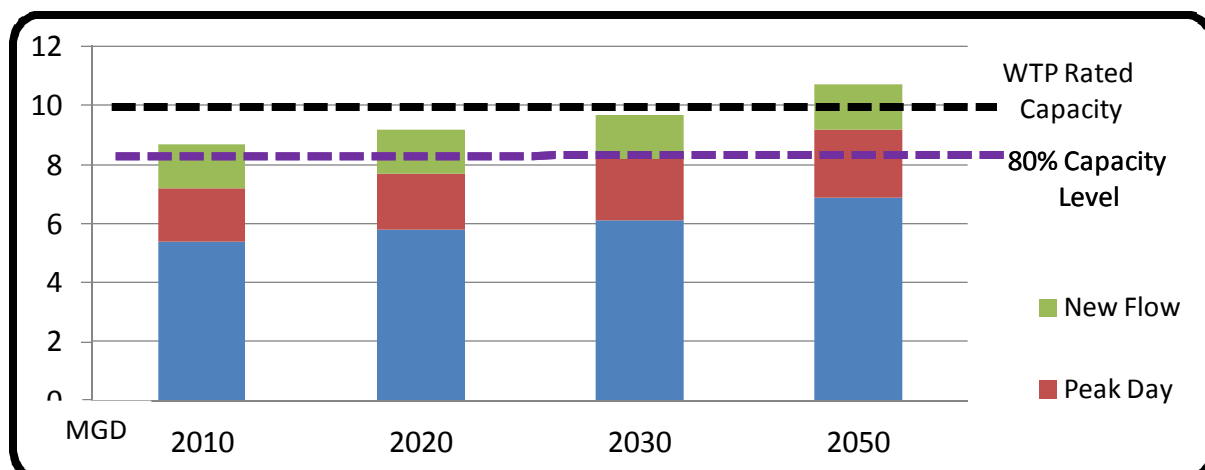
- Greater Cincinnati Water Works (Richard Miller Plant) – Largest GAC contactor plant in the region with operations data back to 1984
- Indianapolis Water (T.W. Moses Plant) – First Actiflo Carb plant in North America which has been in operation for approximately 1 year
- Toyota/Georgetown Wastewater Plant – GAC pressure contactor installation with similar size to proposed Danville system

***Section 4 – Need for Project***

This section recaptures the need for the project which has been discussed in detail. The main project drivers were highlighted as part of the development of the one page project brochure and are re-stated in this section. These drivers are identified below in Figure ES-1 and detailed in Section 4.

- Confirmation of sufficiency of raw water source – Previous studies have identified that Herrington can meet Danville’s long term needs, especially with new KU agreement in place
- Determination of treatment capacity adequacy to meet the needs of customers

**Figure ES-1**  
***Water Demand and New Flow Projections***  
***City of Danville Water System Improvements***



- Implementation of treatment methods to meet regulations – Based on recent WTP performance, the addition of enhanced treatment is being recommended.
- Replacement of deteriorating infrastructure – Portions of Danville’s WTP are over 75 years old and in deteriorating condition. Some facilities can be renovated and re-purposed while others would be decommissioned

***Section 5 – Advanced Treatment Technologies Considered***

This section outlines the advanced treatment technologies considered for implementation at the water treatment plant in order to remove total organic carbon (TOC) and disinfection by-products (DBPs) as discussed in the previous sections. Technologies considered and evaluated include the following that are summarized below but described in detail in Section 5.

- Granular Activated Carbon Contactors – Gravity Flow
- Granular Activated Carbon Contactors – Pressure Flow
- Magnetic Ion Exchange (MIEX) Process
- Actiflo Carb Process
- Membrane Filtration

***Section 6 – Project Alternatives***

This section outlines and compares (when directly comparable options are available) various alternatives for improving the water supply and treatment process in order to provide a sufficient quantity of finished water that meets or exceeds all regulatory standards to Danville’s customers. Several processes or improvement alternatives are being considered. For the

purpose of comparison, each alternative option under consideration is provided below in Table ES-4, along with its capital cost and estimated annual O&M (if applicable for comparison). Some of the alternatives are not full solutions and not fully comparable. Detailed descriptions of each process alternative is provided in Section 6.

**Table ES-4**  
***Process Alternatives***  
***City of Danville Water System Improvements***

<b><i>Process Alternative No.</i></b>	<b><i>Description</i></b>	<b><i>Estimated Capital Costs</i></b>	<b><i>Estimated Annual O&amp;M Cost</i></b>
1A	Improvements to Ex. Raw Water Intake	\$1,646,453	-
1B	New Floating Intake	\$469,277	-
1C	Embankment Piping for Emergency	\$125,400	-
2	Chemical Feed and Storage Facility	\$4,037,104	-
3A	Conventional Clarification w/ Tube Settlers	\$3,512,482	\$ 705,180
3B	Conventional Clarification w/ Plate Settlers	\$3,197,886	\$ 705,180
4A	Conventional Mixed Media Granular Filtration	\$4,423,467	\$ 100,000
4B	Membrane Filtration	\$9,774,824	\$ 396,500
5	Clearwell	\$1,352,008	-
6	Pumping Facilities	\$1,541,150	-
7	Renovation of Existing Filter Building	\$2,648,100	-
8A	GAC Gravity Contactors	\$4,644,563	\$ 511,250
8B	GAC Pressure Vessels	\$5,107,728	\$ 511,250
8C	MIEX Contactor	\$5,582,697	\$ 445,712
8D	Actiflo Carb	\$5,730,662	\$ 596,120

### ***Section 7 - Recommendations***

This section provides a summary of the process recommendations based on the data that has been developed in the previous sections for the improvements to the Danville WTP. Recommended process options are provided below.

- Raw Water Intake and Pumping Station - Alternative 1A – Improvements to Existing Intake and Pumping Facilities
- Chemical Systems -Alternative 2 – Chemical Storage and Feed Facility
- Clarification Systems- Alternative 3B - Conventional Clarification with Lamella Plate Settlers
- Filtration Systems Alternative 4A - Conventional Mixed Media Granular Filtration
- Finished Water Storage - Alternative 5 – Clearwell
- Pumping Facilities- Alternative 6 – Pumping Facilities in New Building
- Renovation of Existing Filter Building - Alternative 7 – Renovation of Existing Filter Building
- Enhanced/Advanced Treatment Processes - Alternative 8A – GAC Gravity Contactors

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## ***Estimated Project Cost***

The total preliminary estimate of project costs for the recommended improvements to the Danville WTP is provided below in Table ES-5. A detailed estimate of these costs is provided in Appendix H.

**Table ES-5**  
***Preliminary Estimate of Project Costs - Recommended Alternatives***  
***City of Danville Water System Improvements***

<b><i>Item</i></b>	<b><i>Cost</i></b>
<b>Construction</b>	
- Raw Water Intake and Pumping Station	\$1,646,453
- Chemical Feed and Storage Building	\$4,037,104
- Clarification System w/ Lamella Plate Settlers	\$3,197,886
- Gravity Granular Media Filtration	\$4,423,467
- Clearwell	\$1,352,008
- Pumping Facilities	\$1,541,150
- Demolition of Existing Basins	\$285,995
- Renovation of Existing Filter Building	\$2,648,100
- Advanced/Enhanced Treatment Process	\$4,644,563
- Sitework	\$451,710
<b>Construction Total</b>	<b>\$24,228,435</b>
<b>Project</b>	
- Engineering	\$1,421,892
- Resident Representation during Construction	\$485,000
- BGADD Funding Assistance	\$50,000
- Proposed Project Contingency	\$1,307,950
<b>Proposed Preliminary Project Budget</b>	<b>\$27,466,942</b>

## ***Project Financing***

The proposed funding for the project is identified below by source.

### ***Funding Breakdown***

<b><u>Program</u></b>	<b><u>Amount</u></b>
EPA Special Appropriations Grant	\$1,000,000
KY General Assembly Grant	\$1,000,000
KY CDBG Grant	\$1,000,000
DWSRF Loan	\$8,000,000
USDA – RD Grant/Loan	\$12,600,000
Private Market Bonds	<u>\$3,866,942</u>
<b>Total</b>	<b>\$27,466,942</b>