APPENDIX A: WISSAHICKON CREEK OBSERVED DATA REPORT

1. INTRODUCTION

The Wissahickon Creek watershed has been subject to an abundance of water quality monitoring for each grab and continuous samples. The available stream water quality data were observed by Philadelphia Water Department, Pennsylvania Department of Environmental Protection, and United States Geological Survey. Monitoring has occurred over many years however 2005 was a year of particular focus for sampling. This summary report presents the constituents that were observed which relate to a eutrophication modeling effort. That is, the constituents which are used to each force and inform model development as well as compare to simulation output. The data were developed into a Water Resources Database (WRDB) application (WRDB 2012). The observed data frequency may be sub-daily, daily, or other time basis. Therefore having one application which holds the multitude of data provides an immediate benefit to a project. WRDB was designed with many summary and graphing features which substantially aid the process of getting to know the data for a specific project.

This brief report is intended to organize the voluminous data in a way that will promote later data analysis to assess trends and conditions and to facilitate the management and integration of the observed data with the modeling effort.

2. WATER RESOURCES DATABASE

The water resources database (WRDB) software was used to house the observed water quality data relevant to the modeling effort in the Wissahickon watershed. WRDB is a relational database and can be developed simply or more complex. WRDB is a water resources specific database application which affords many benefits to a project life cycle. Project data typically comes from multiple agencies with a variety of station-parameter observations. One or multiple working tables can be created within one WRDB project. Many stations, parameters, and agencies can be specified. A summary of a few of the key components and characteristics are presented in Table D-1.

Table D-1. Overview of Limited Key WRDB Program Items

WRDB Program Item	Comment
Working Tables	One or more may be created by a user in a single WRDB project. A user may choose to create a working table by agency or perhaps by type of data.
Support Tables	There are numerous support tables, a few are described as follows. • Stations – Station ID, name, geographic coordinates, branch, river mile, and more. • Parameter (PCODE) – Parameter acronym, name, analysis method, units, detection limit, and more. • Composite code (CCODE) – Defined by user to describe the sample as composite, grab, daily, monthly, etc. • Result code (RCODE) – Defined by user to describe result as less than, greater than, and more. • Branch ID – A user specified convention to describe the connection of the various reaches in a study area.
Reports	A variety of summary reports are included in the WRDB program such as summarizing by station and parameter with average, begin date, end date, and more noted.
Graphing	A graphing application is included in WRDB with a variety of options that typically aid water resources work. These include time series, longitudinal, histogram, flow-duration, and more.
Formats	WRDB is developed to promote near seamless ability to receive and produce a variety of typical formats used in water resources projects. It can read data in from the clipboard, Excel, Access, and more. It further has format features to interact with each ASCII and binary files used by a wide variety of water resources modeling applications.

WRDB allows for a wide range of complex queries of the data from one or multiple working tables. A user can set a query based only on station or perhaps on a combination of station, PCODE, and CCODE. The working tables and stations will be discussed later in this report. The CCODES and branches are presented in Table D-2 and

Table D-3. The CCODES are used to help further describe the data, for example, as a continuous or grab sample. The branch IDs can be used in a variety of ways including simple queries to interpretive longitudinal plots of a user specified parameter.

Table D-2. WRDB CCODES Used for Wissahickon Creek Watershed

CCODE	Description	Comment
15M	15 minute reporting increment	Observations reported at 15 minute increment
AAA	Placeholder	Dummy CCODE
CO	Composite	Flow, depth, or time weighted composite sample
CON	Continuous	Continuous sampling, recording increment may vary
GR	Grab	Grab sample

Table D-3. WRDB Branches Used for Wissahickon Creek Watershed

Branch ID	Reach Name	Confluences with:
01-00-00	Wissahickon Cr	Schuylkill River
01-01-00	Monoshone Cr	Wissahickon Cr
01-02-00	Kitchen's Lane	Wissahickon Cr
01-03-00	Gorgas Run	Wissahickon Cr
01-04-00	Cresheim Cr	Wissahickon Cr
01-05-00	Valley Green Run	Wissahickon Cr
01-06-00	Hartwell Run	Wissahickon Cr
01-07-00	Wise's Mill Run	Wissahickon Cr
01-08-00	Bell's Mill	Wissahickon Cr
01-09-00	Cathedral Run	Wissahickon Cr
01-10-00	Paper Mill Run	Wissahickon Cr
01-11-00	Lorrain Run	Wissahickon Cr
01-12-00	Sunny Brook	Wissahickon Cr
01-13-00	Sandy Run	Wissahickon Cr
01-13-01	Pine Run	Sandy Run
01-14-00	Prophecy Cr	Wissahickon Cr
01-15-00	Tannery Run	Wissahickon Cr
01-16-00	Rose Valley Cr	Wissahickon Cr
01-17-00	Houston Run	Wissahickon Cr
01-18-00	Willow Run West	Wissahickon Cr
01-19-00	Penllyn Cr	Wissahickon Cr
01-20-00	Willow Run East	Wissahickon Cr
01-21-00	Trewellyn Cr	Wissahickon Cr
01-22-00	Haines-Dittingers Cr	Wissahickon Cr

3. HYDROLOGY DATA

A working table was created and named "USGS" to hold data reported from USGS. There were two USGS stations (Table D-4) reporting flow at 15-minute increments. The data were first reviewed and data that were either absent or determined to be suspect were removed. The remaining data were imported into the WRDB project.

Table D-4. USGS Observations Stations

Station ID	Name	Drainage Area (mi^2)	No. of Obs.	Begin Date	End Date
01473900	Wissahickon Creek at Fort Washington, PA	40.8	386,410	06/01/2000	07/05/2011
01474000	Wissahickon Creek at Mouth, Philadelphia, PA	64.0	688,523	10/15/1993	7/5/2011

4. WATER QUALITY DATA

4.1 United States Geological Survey

The USGS maintained physical-chemical data sondes at each of the flow monitoring locations in the watershed. They continuously recorded water temperature, specific conductivity, turbidity, pH, and dissolved oxygen data at a 30-minute interval. The data were processed to move only those with a data quality flag of "good" to the WRDB project files. If no data quality flag were provided it was assumed that the data were good and they were moved into the WRDB project files. The stations and parameters are noted in Table D-5 and

Table D-6.

Table D-5. USGS Continuous Sample Observations Stations

Station	Station Name	First Date	Last Date	No. Obs
01473900	Wissahickon Cr at Fort Washington	2000-11-03	2011-07-05	187,535
01474000	Wissahickon Cr at Mouth	2007-04-30	2011-07-05	189,446

Table D-6. USGS Continuous Sample Parameter Summary

PCode	Parameter Name	Units	No. Obs	Mean	First Date	Last Date
DO	Dissolved Oxygen	mg/L	73,798	8.9	2000-11-03	2011-07-05
PH	pH	pHU	75,262	7.9	2000-11-03	2011-07-05
SPCOND	Specific Conductivity at 25 deg C	uMHO/cm	76,612	713	2000-11-03	2011-07-05
TURB	Turbidity	NTU	73,380	12	2006-10-18	2011-07-05
WTEM	Water Temperature	deg C	77,929	16.7	2000-11-03	2011-07-05

4.2 Philadelphia Water Department

The PWD data consisted of grab samples and continuous monitoring. The observed data were assessed to remove data tagged with a quality concern flag. The remaining data were placed in the WRDB project files.

4.2.1 Grab Samples

The Philadelphia Water Department has conducted extensive spatial and temporal sampling of the Wissahickon Creek watershed. The grab sample stations are noted in

Table D-7. The first and last dates and number of samples are listed. The parameters related to eutrophication are shown in Table D-8. Samples that were reported at the detection limit were entered into WRDB with a value of half the detection limit and assigned and RCODE of 1.

Table D-7. PWD Grab Sample Observations Stations

Station	Station Name	First Date	Last Date	No. Obs
MCRR002	Unknown	2005-05-18	2005-07-11	404
WS005	Wissahickon Creek 125 yds below Ridge Ave Dam	2005-01-04	2011-07-12	1395
WS014	Wissahickon Creek above Ridge Ave Dam	2009-06-30	2011-06-27	88
WS024	Wissahickon Creek at Upper Ridge Ave Dam	2009-04-28	2009-05-07	10
WS076	Wissahickon Creek 150 yds upstream of Gypsy Lane &	2005-01-13	2010-08-12	1751
WS1075	Wissahickon Creek at Skippack Rd	2005-01-13	2011-06-27	727
WS1210	Wissahickon Creek at Morris Rd	2005-01-13	2008-05-21	265
WS122	300 ft d/s of Monoshone Cr confluence	2005-01-13	2005-09-08	236
WS1850	Wissahickon Creek at Swedesford & Township Line	2005-01-13	2010-08-12	733
WS1879	Wissahickon Creek 10 m dwnstr of Upper Gwynedd STP	2006-06-15	2006-08-21	17
WS1882	Wissahickon Creek 40 m upstr Upper Gwynedd STP	2006-06-15	2006-06-19	6
WS1963	North Wales Rd/West Walnut St bridge	2005-11-03	2005-11-03	9
WS2141	800ft u/s of Sumneytown Pike bridge	2005-11-03	2005-11-03	9
WS354	500 feet d/s of Livezy Rd dam	2005-01-13	2005-09-08	237
WS363	Wissahickon Creek at Livezy Dam	2010-08-12	2010-08-12	8
WS492	350 ft d/s of Rex Av bridge	2005-01-13	2005-09-08	238
WS754	Morris Arboretum Northwestern 1300 ft u/s of Northwest Av	2005-01-13	2010-08-12	1571
WS844	Wissahickon Creek at Stenton Ave	2007-03-20	2007-04-24	8
WS976	Wissahickon Creek at Valley Green Road	2007-03-20	2007-04-24	15
WSBM007	Bell's Mill trib adjacent to FPC parking lot	2005-09-14	2007-04-16	312
WSBM090	330 ft d/s of start of tributary	2005-09-14	2005-10-10	446
WSCC016	Cresheim Creek at concrete bridge upstr of Devil's	2006-06-19	2006-10-19	442
WSCR008	400 ft u/s of Wissahickon confl	2005-11-09	2005-11-21	242
WSMC001	Mouth of the Monoshone Cr	2008-02-11	2008-06-23	4
WSMC016	Monoshone Cr d/s of Rittenhousetown stone bridge	2005-05-18	2007-04-27	276
WSMC025	Monoshone Cr 400 ft u/s of Rittenhousetown stone bridge	2005-05-18	2010-09-20	184

Station	Station Name	First Date	Last Date	No. Obs
WSMC076	50 ft d/s of Monoshone outfall W-065-5	2005-05-18	2005-09-29	22
WSPC017	400 ft u/s of Butler Av bridge	2005-01-13	2005-09-08	229
WSSR058	Sandy Run at Bethlehem Pike	2005-01-13	2008-05-21	279
WSWM006	Wise's Mill trib approx 100 m u/s of Forbidden Dr	2005-11-14	2006-11-08	492

Table D-8. PWD Grab Sample Parameter Summary

PCode	Parameter Name	Units	No. Obs	Mean	First Date	Last Date
BOD30	BOD 30d	mg/L	118	6.91	2005-01-13	2005-09-08
BOD5	BOD 5d	mg/L	120	1.40	2005-01-13	2005-09-08
CBOD5	CBOD 5d	mg/L	118	1.06	2005-01-13	2005-09-08
CHLA	Chlorophyll-a	ug/L	97	3.01	2005-01-13	2005-09-08
DO	Dissolved Oxygen	mg/L	271	9.93	2005-01-13	2011-06-27
NO2	Nitrite	mgN/L	661	0.04	2005-01-13	2008-05-21
NO3	Nitrate	mgN/L	760	3.46	2005-01-04	2011-06-27
PH	pH	pHU	352	7.78	2005-01-04	2011-07-12
PO4	Orthophosphate	mgP/L	753	0.41	2005-01-04	2011-06-27
TKN	Total Kjeldahl Nitrogen	mgN/L	514	1.30	2005-01-13	2006-07-23
TNH3	Total Ammonia	mgN/L	641	0.13	2005-01-04	2011-07-12
TP	Total Phosphorus	mgP/L	440	0.70	2005-01-13	2008-05-21
TSS	Total Suspended Solids	mg/L	651	60.67	2005-01-13	2007-04-27
TURB	Turbidity	NTU	964	17.82	2005-01-04	2011-07-12

4.2.2 Data Sonde

The Philadelphia Water Department deployed data sondes for continuous sampling in 2004 - 2005. The data sonde sample stations are noted in
Table D-9. The start and end dates and number of samples are listed in that table. The parameters related to eutrophication are shown in Table D-10.

Table D-9. PWD Data Sonde Observations Stations

Station	Station Name	First Date	Last Date	No. Obs
WS076	Wissahickon Creek 150 yds upstream of Gypsy Lane &	2005-03-10	2005-11-17	89620
WS1075	Wissahickon Creek at Skippack Rd	2005-03-10	2005-11-21	103341
WS1210	Wissahickon Creek at Morris Rd	2005-03-10	2005-11-02	87982
WS1850	Wissahickon Creek at Swedesford & Township Line	2004-08-10	2005-11-02	110580
WS354	500 feet d/s of Livezy Rd dam	2005-03-10	2005-10-13	81314
WS754	Morris Arboretum Northwestern 1300 ft u/s of Northwest Av	2004-08-10	2005-10-22	114361
WSCR008	400 ft u/s of Wissahickon confl	2005-11-09	2005-11-21	5713
WSLR005	Valley Green Rd bridge	2004-08-10	2004-09-14	15520
WSSR058	Sandy Run at Bethlehem Pike	2004-08-10	2004-09-14	18643
WSWM006	Wise's Mill trib approx 100 m u/s of Forbidden Dr	2005-11-09	2005-11-21	5728

Table D-10. PWD Data Sonde Sample Parameter Summary

PCode	Parameter Name	Units	No. Obs	Mean	First Date	Last Date
CORRDEP	Corrected Depth	in	114085	17.13	2004-08-10	2005-11-21
DO	Dissolved Oxygen	mg/L	115510	8.56	2004-08-10	2005-11-21
PH	pH	pHU	115510	7.78	2004-08-10	2005-11-21
SPCOND	Specific Conductivity at 25 deg C	uMHO/cm	115510	812	2004-08-10	2005-11-21
TURB	Turbidity	NTU	55173	70	2004-08-10	2005-11-17
WTEM	Water Temperature	deg C	115510	17.54	2004-08-10	2005-11-21

4.3 Pennsylvania Department of Environmental Protection

The PADEP observation station locations are co-located with the USGS stations (Table D-11). The grab sample parameters are summarized in Table D-12. There were no water quality data flagging to process therefore all data are initially adopted as good. The samples reported as less than detection limit were assigned a value of half the detection limit and tagged with an RCODE value of 1.

Table D-11. PADEP Observations Stations

Station	Station Name	First Date	Last Date	No. Obs
WQN0115	Wissahickon Cr at Mouth	2002-02-11	2011-03-30	824
WQN0193	Wissahickon Cr at Fort Washington	2002-02-07	2011-03-14	750

Table D-12. PADEP Grab Sample Parameter Summary

PCode	Parameter Name	Units	No. Obs	Mean	First Date	Last Date
DO	Dissolved Oxygen	mg/L	101	11.81	2002-02-07	2011-03-30
DOC	Dissolved Organic Carbon	mg/L	7	3.53	2009-10-08	2011-03-14
FLOWCFS	Flow	cfs	84	91.11	2002-02-07	2010-06-28
NO2	Nitrite	mgN/L	102	0.04	2002-02-07	2011-03-30
NO3	Nitrate	mgN/L	102	5.46	2002-02-07	2011-03-30
PH	pH	pHU	204	7.99	2002-02-07	2011-03-30
PO4	Orthophosphate	mgP/L	100	0.71	2002-04-08	2011-03-30
SPCOND	Specific Conductivity at 25 deg C	uMHO/cm	204	739	2002-02-07	2011-03-30
TN	Total Nitrogen	mgN/L	103	6.06	2002-02-07	2011-03-30
TNH3	Total Ammonia	mgN/L	102	0.05	2002-02-07	2011-03-30
TOC	Total Organic Carbon	mg/L	37	4.76	2002-02-07	2005-03-07
TP	Total Phosphorus	mgP/L	102	0.81	2002-02-07	2011-03-30
TSS	Total Suspended Solids	mg/L	102	10.94	2002-02-07	2011-03-30
WTEM	Water Temperature	deg C	102	12.95	2002-02-07	2011-03-30

5. EXAMPLE WRDB FUNCTIONALITY

The development of a WRDB project typically involves the primary level of effort on the front end of the project life cycle. However, during a project lifecycle there are times when data are revised, added, or calculated within the WRDB project files, making it a "living" part of the project. A wide variety of investigation and assessment can be performed on a complex data set including data summaries, numerous graphing techniques, aggregation, calculation of load, and much more. The following sections provide a limited example specific to the Wissahickon watershed dataset regarding the usefulness of the WRDB project files.

5.1 Station Key

There were two primary locations in the Wissahickon watershed where the three agencies performed water quality observations and thy will be referenced in this section. The locations were at Fort Washington and at the mouth, the stations are summarized in Table D-13.

Table D-13. Two Primary Sampling Location Station IDs by Agency

Name	River Mile	USGS Station ID	PWD Station ID	PADEP Station ID
Wissahickon Cr at Fort Washington, PA	10.75	01473900	WS1075	WQN0193
Wissahickon Cr at Mouth, Philadelphia, PA	0.05	01474000	WS0005	WQN0115

5.2 Example Figures

A longitudinal plotting feature is among the graph options available in WRDB. It selects data by a user specified time window, for example a given day, week, or all data. The user selects the branch, for this example it is the mainstem of Wissahickon Creek. The box and whisker plots represent the maximum, 75th percentile, median, 25th percentile, and minimum values. The line connects the median values. Figure D-1 through Figure D-3 present all the PWD grab sample data for dissolved oxygen, nitrate, and orthophosphate. These figures are particularly useful to quickly see trends in the data, make initial assessments on where areas of interest may be, and start to visualize what the desired behavior of the model simulation should be.

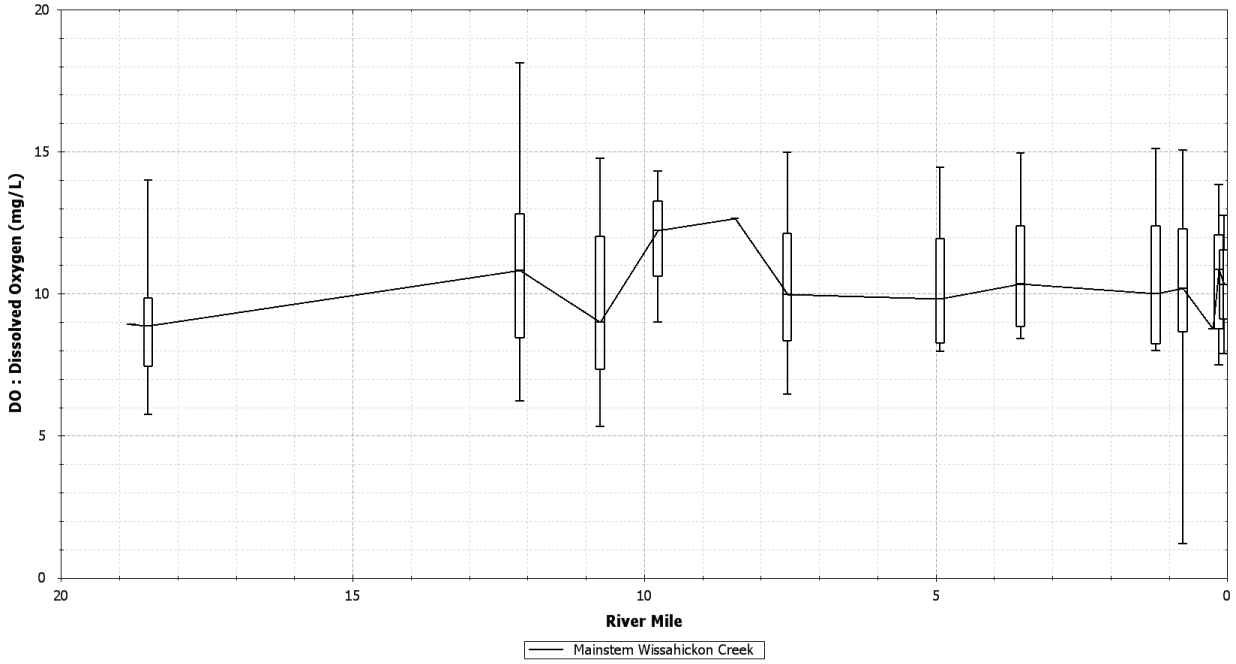

Figure D-1. Longitudinal Profile of Dissolved Oxygen, PWD Grab Samples

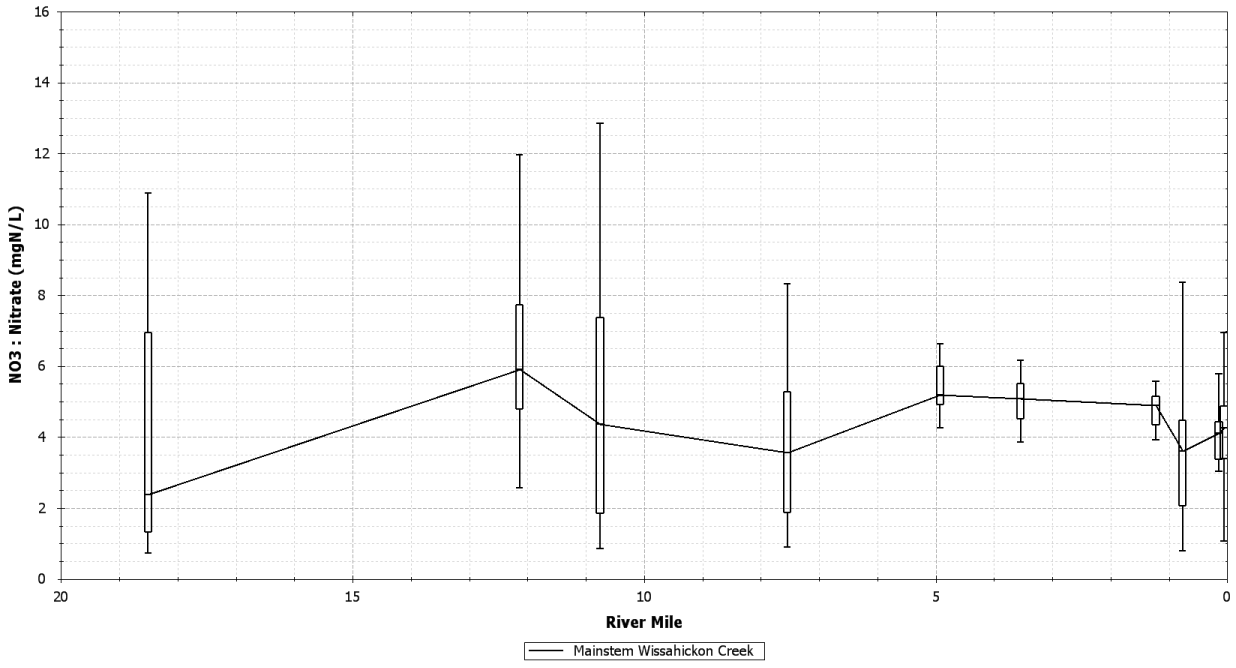

Figure D-2. Longitudinal Profile of Nitrate, PWD Grab Samples

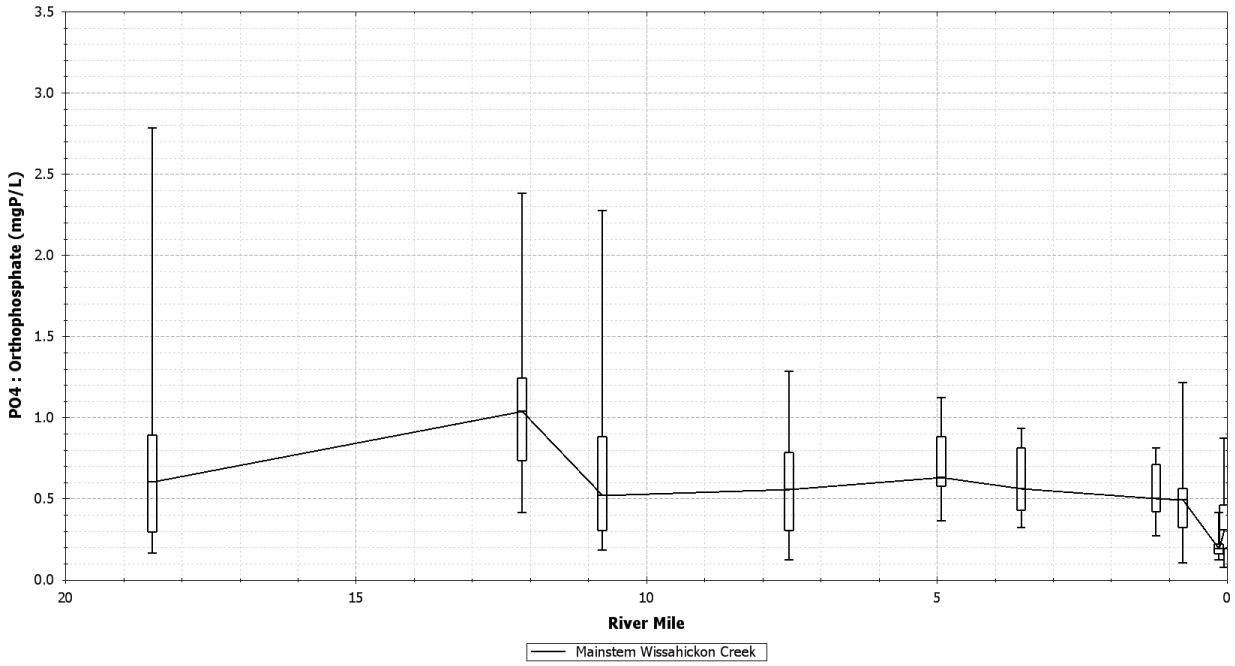

Figure D-3. Longitudinal Profile of Orthophosphate, PWD Grab Samples

Figure D-4 and Figure D-5 are time series plots of the continuous sampling conducted by PWD and USGS, respectively. Time series plots are quickly generated in WRDB and easy to maneuver in, that is to select differing time periods to focus upon. The data were collected at the same location and represent the growing season period of different years. There is a trend of greater range of DO values in April compared to the rest of the growing season. Using WRDB to view the data as such also affords the ability to quickly see where data gaps may be. Figure D-5 shows us that June 2009 has some notable data gaps.

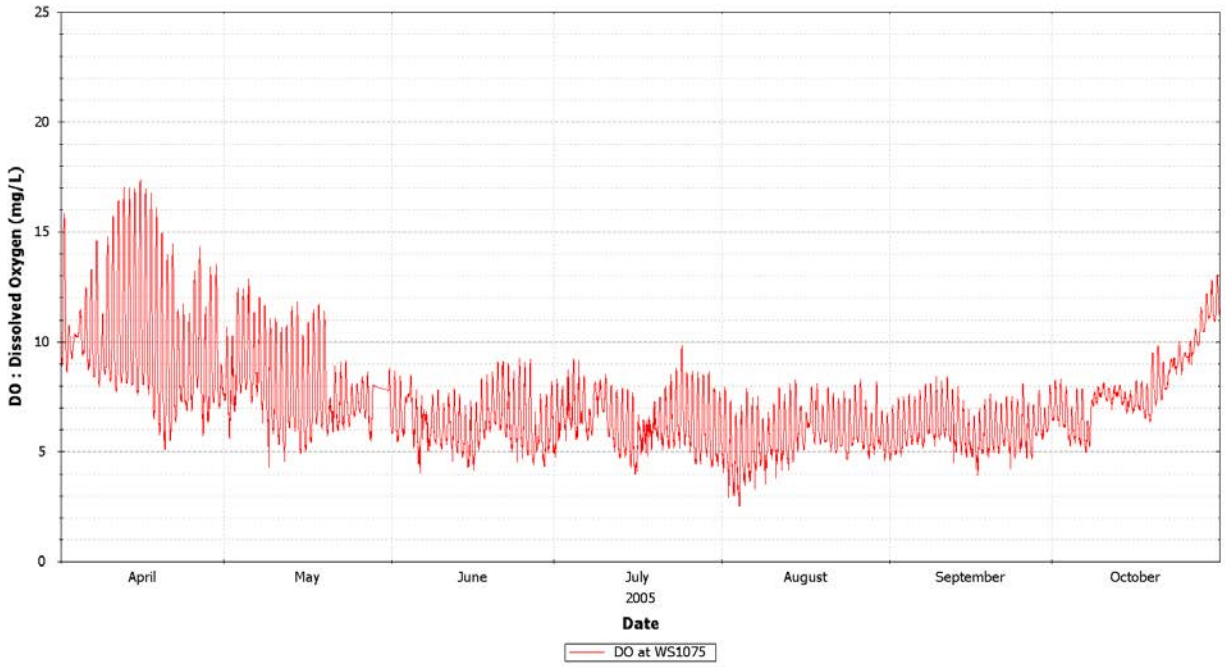

Figure D-4. Time Series of Dissolved Oxygen, PWD Continuous Sampling

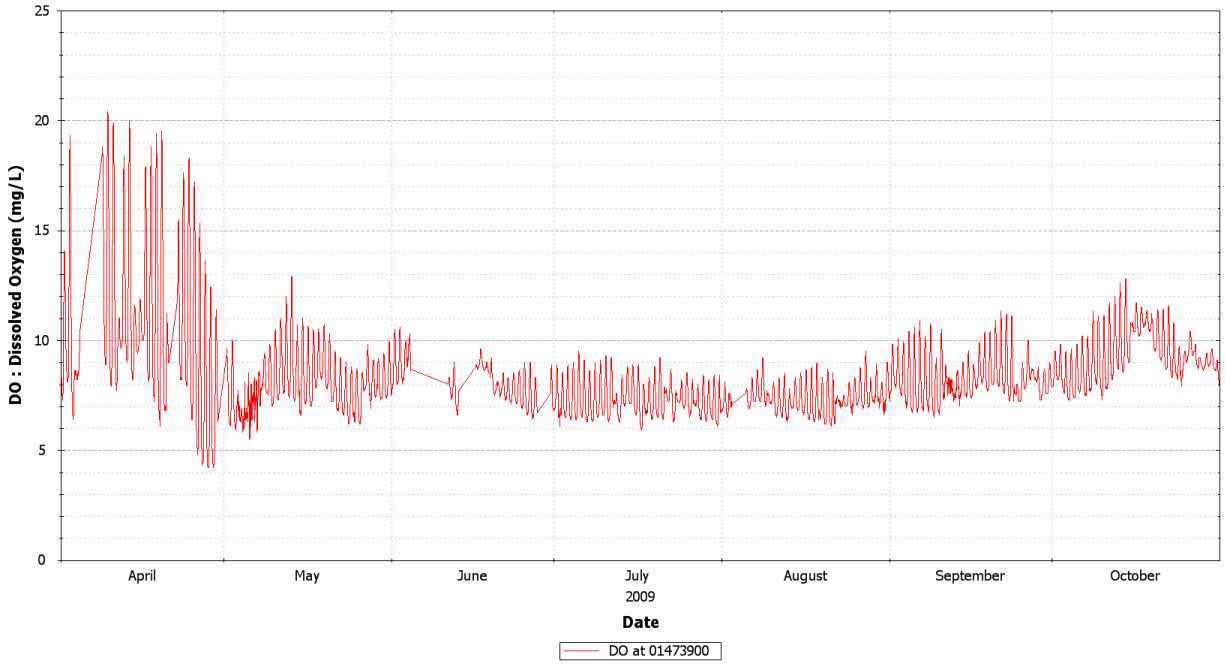

Figure D-5. Time Series of Dissolved Oxygen, USGS Continuous Sampling

6. REFERENCES

www.usgs.gov
www.wrdb.com
http://www.phillywatersheds.org/