DEVELOPMENT AND CALIBRATION OF A HYDRODYNAMIC MODEL OF THE TIDAL RANCOCAS CREEK

DELAWARE RIVER BASIN COMMISSION

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Calibration of a Hydrodynamic Model of the Tidal Rancocas Creek

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1 Introduction and Background

In December 2000, the New Jersey Department of Environmental Protection (NJDEP) issued Grant Agreement #GO-042-48508000047 to the Delaware River Basin Commission (DRBC) for the development of a hydrodynamic model of the tidal section of Rancocas Creek. This report documents the completion of this effort, and forwards the resultant model to NJDEP.

As indicated in the Scope of Work for the Grant Agreement, tasks associated with this project included:

- Compilation and analysis of existing data;
- Selection of an appropriate hydrodynamic modeling platform with the following features;
    - Time-varying simulation;
    - Capability to be linked to a water quality model;
    - Capability to be linked to a watershed runoff model; and
    - Tidal forcing function;
- Plan for monitoring and collection of calibration data;
- Development and calibration of the model; and
- Preparation of a report.

1.1 Objective

As indicated in the Objective of the Scope of Work:

> *A monitoring plan and hydrographic model application for the tidal portion becomes important and unavoidable for the future TMDL development in Rancocas Creek. This effort will focus on the development and application of a hydrodynamic model for the tidal portion of Rancocas Creek.*

Therefore, the objective of this project was to develop and apply a hydrodynamic model for the tidal portion of Rancocas Creek. As this report demonstrates, the hydrodynamic model of tidal Rancocas Creek was developed and applied, and this objective was met.

1.2 Tidal Rancocas Creek Description

Rancocas Creek is located in west central New Jersey, in the coastal plain region, as shown in Figure 1. Rancocas Creek confluences with the Delaware River between Delran and Riverside, at Delaware River Mile 111.06. Two major branches, North Branch Rancocas Creek and South Branch Rancocas Creek, confluence at Rancocas Woods, approximately 12,700 meters from the mouth of Rancocas Creek. Tidal influence extends through Rancocas Creek, into the North Branch to the dam at Mt. Holly, and into the South Branch to Vincentown.

Tributaries to the tidal portion of Rancocas Creek include Mill Creek, Parkers Creek, Masons Creek, Bobbys Run, and the Southwest Branch of Rancocas Creek.

Conceptually, flows in the tidal Rancocas Creek model will be driven by flows from the non-tidal upstream portion of the watershed from the North and South Branches, and by the tidal boundary at the confluence with the Delaware River. During the model calibration period, non-tidal flows ranged from very low to very high, providing an extraordinary opportunity to develop the model through a wide range of conditions. Between March 27, 2004 and October 31, 2004 mean daily flows at the North Branch gage at Pemberton ranged from a low of 53 CFS on July 11, 2004 to a high of 1,780 CFS on July 14, 2004. Analyses of the data from the North Branch gage at Pemberton show that the July 14, 2004 discharge exceeds every recorded value for the verified period of record from 1922 through 2002. The lowest North Branch discharge value for the 2004 data collection period exceeds the computed Q7-10 flow of 32.2 CFS. Figure 2 shows the daily flow values at three USGS stream gages in the Rancocas watershed between March and October 2004, including the model calibration and confirmation periods. For reference, Figure 3 shows the flow duration curve for the USGS stream gage on the North Branch Rancocas Creek at Pemberton.

Figure 1. Location of Rancocas Creek Watershed.

Figure 2. Daily Discharge Measurements from Three USGS Gages During Model Calibration and Confirmation Periods.

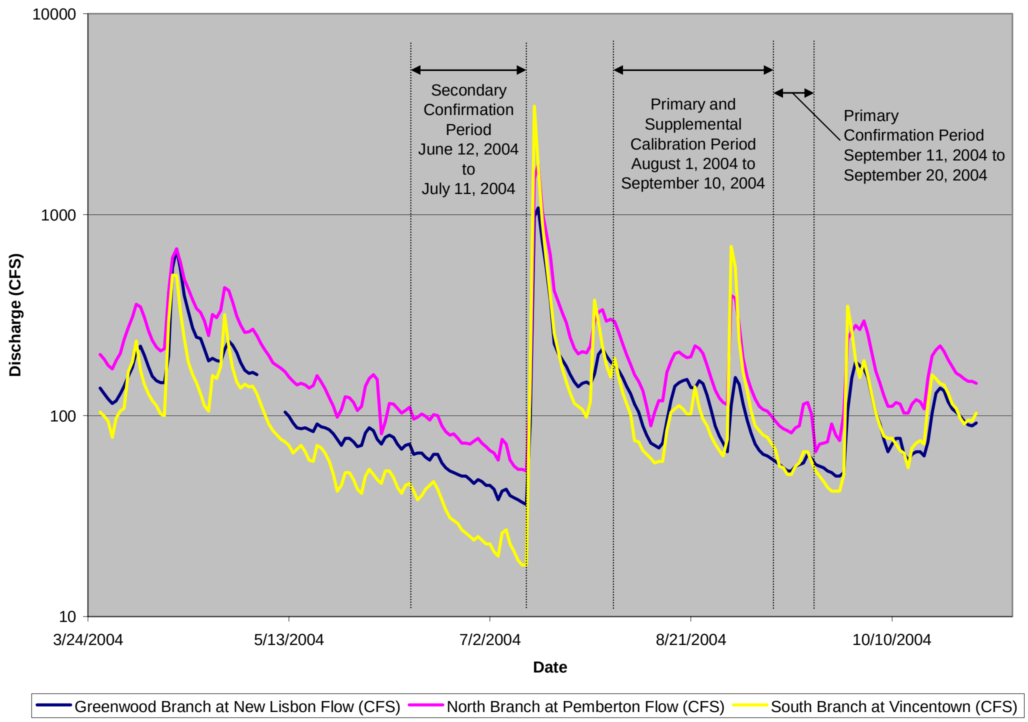
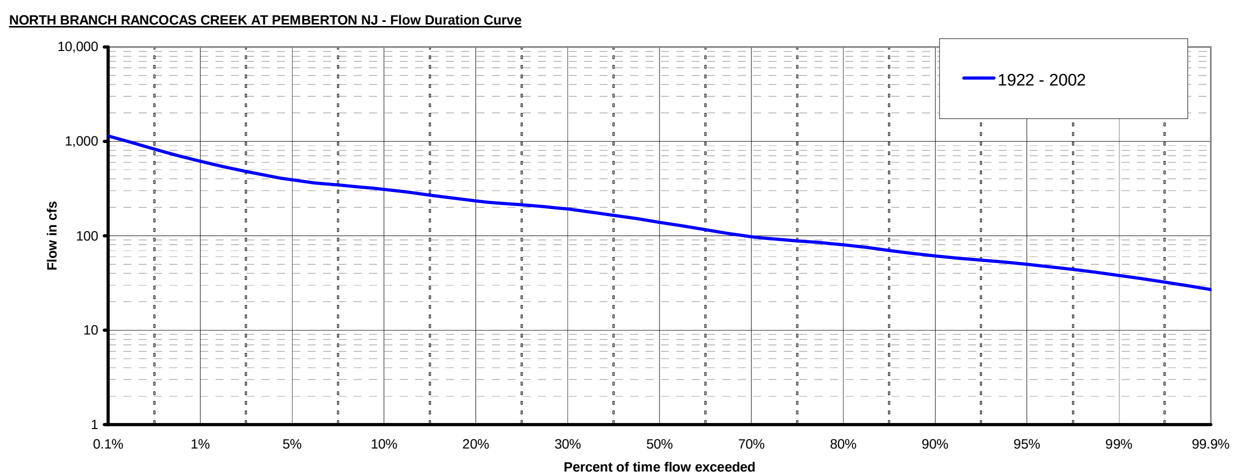


Figure 3. Flow Duration Curve for the North Branch Rancocas Creek at Pemberton for the Period of Record from 1922 to 2002.



1.3 Model Platform Selection

As indicated in the Scope of Work for the Grant Agreement, one of the tasks associated with this project included:

- Selection of an appropriate hydrodynamic modeling platform with the following features;
    - Time-varying simulation;
    - Capability to be linked to a water quality model;
    - Capability to be linked to a watershed runoff model; and
    - Tidal forcing function;

In evaluating the available modeling platforms, we considered the following characteristics in order of importance:

- The model must be capable of simulating flow and transport in a tidal environment;
- The model must be easily linkable to a water quality modeling framework, that is capable of simulating receiving water quality subject to both point and diffuse loads;
- The model should have a good history of use, good documentation, and be well supported by an accessible organization;
- The model should be exclusively run in the Unix operating environment;
- A model in the public domain with no user or licensing fees would be preferable.

We considered two sources of information on available model platforms. First, we reviewed the available model information on EPA's Watershed & Water Quality Modeling Technical Support Center web page (http://www.epa.gov/ATHENS/wwqtsc/). The site includes up to date information on various modeling platforms. The second source of information we used is the USGS Surface Water and Water Quality Modeling Information Clearinghouse (SMIC) at http://smig.usgs.gov/SMIC/SMIC.html. This USGS site is a similar product that offers descriptions and features of environmental surface water and water quality models, and abstracts of projects using those models. From the two sites, we populated a model selection matrix, included here as Table 1.

We developed a matrix of the available model platforms their characteristics. Using the criteria previously described, we eliminated from further consideration any model platforms that did not match our criteria. Since we were looking to screen the available platforms and to find the best match to our anticipated application, we eliminated platforms which could theoretically be successfully used in our application, but which would be a poor match.

Table 1. Model Platform Selection Matrix.

Model Platform	Applications	Flow / WQ?	Dimensions / Type	Operating System Interface(1)	Public Domain?	Support
BRANCH	rivers, estuaries, channel networks	Flow (linkable to WQ)	1-D	no	Yes	USGS
CH3D-WES	rivers, lakes, estuaries, reservoirs, coastal areas	Flow (linkable to WQ)	3-D	yes	No	USACE-WES
DAFLOW	rivers, channel networks	Flow (linkable to WQ)	1-D	U	Yes	USGS
DR3M	watersheds, channel networks	Flow (linkable to WQ)	watershed	no	Yes	NS
DYNHYD5	rivers, estuaries	Flow (linkable to WQ)	1-D	W	Yes	EPA Athens
FEQ	rivers, channel networks	Flow Only	1-D	W	Yes	USGS
FESWMS	rivers, lakes, estuaries, reservoirs, coastal areas	Flow (linkable to WQ)	2-D	U/W	No	HSGS
FourPt	rivers, channel networks	Flow (linkable to WQ)	1-D	no	Yes	HSGS
HEC-HMS	watersheds, channel networks	Flow (linkable to WQ)	watershed	W	Yes	NS
HEC-RAS	rivers, channel networks	Flow Only	1-D	W	Yes	NS
RMA2	rivers, lakes, estuaries, reservoirs, coastal areas	Flow (linkable to WQ)	2-D	U/W	No	USACE-WES
TOPMODEL	watersheds, channel networks	Flow (linkable to WQ)	watershed	U/W	Yes	Lancaster U.
UNET	rivers, channel networks	Flow (linkable to WQ)	1-D	W*	No	NS
BLTM	rivers, estuaries	WQ Only (no flow)	1-D	no	Yes	USGS
CE-QUAL-ICM	rivers, lakes, estuaries, reservoirs, coastal areas	WQ Only (no flow)	1,2,3-D	U/W*	Yes	WES (limited)
CE-QUAL-R1	reservoirs, lakes	WQ	1-D	no	Yes	WES
OTEQ	rivers	WQ (metals only)	1-D	no	Yes	USGS
OTIS	rivers	WQ	1-D	U	Yes	USGS
RMA4	rivers, lakes, estuaries, reservoirs, coastal areas	WQ Only (no flow)	2-D	U/W	No	USACE-WES
SED-2D	rivers, lakes, estuaries, reservoirs, coastal areas	Sediment related Parameters	2-D	U/W	No	USACE-WES
WASP7	rivers, lakes, estuaries, reservoirs, coastal areas	WQ Only (no flow)	1, 2, 3-D	W	Yes	EPA
CE-QUAL-RIV1	rivers, channel networks	Flow and WQ	1-D	no	Yes	WES
CE-QUAL-W2	rivers, reservoirs, estuaries	Flow and WQ	2-D (v)	U/W*	Yes	WES, ATS, JEA
EPD-RIV1	rivers, streams (non-tidal and tidal)	Flow and WQ	1-D	W	Yes	EPA
EFDC/HEM3D	rivers, lakes, estuaries, reservoirs, coastal areas	Flow and WQ	1,2,3-D	W*	Yes	TetraTech / EPA Athens
HSPF	watersheds, channel networks	Flow and WQ	watershed	W	Yes	EPA/AquaTerra
MIKE 11	estuaries, rivers, channel networks	Flow and WQ	1-D	W	No	DHI
MIKE 21	estuaries, coastal areas	Flow and WQ	2-D (h)	W	No	DHI
MIKE 3	rivers, lakes, estuaries, reservoirs, coastal areas	Flow and WQ	3-D	U/W	No	DHI
MIKE SHE	watersheds, channel networks	Flow and WQ	watershed	W	No	DHI
PRMS	watersheds, channel networks	Flow and WQ	watershed	U	Yes	USGS
QUAL2E / QUAL2K	rivers, channel networks	Flow and WQ	1-D	W	Yes	EPA
RMA10	rivers, lakes, estuaries, reservoirs, coastal areas	Flow and WQ	3-D	U/W	No	USACE-WES
SNTEMP	rivers, channel networks	Flow and WQ	1-D	no	Yes	USGS
SSTEMP	rivers, channel networks	Flow and WQ (temp. only)	1-D	W	Yes	USGS
BASINS	watersheds, rivers, channel networks	Integrated Model Systems	System	W	Yes	EPA
GenScn	watersheds, rivers, channel networks	Integrated Model Systems	System	W	Yes	EPA
MMS	watersheds, channel networks	Integrated Model Systems	System	U	No	USGS
SMS	rivers, lakes, estuaries, reservoirs, coastal areas	Integrated Model Systems	System	U/W	No	EMS-I

(1) W=Windows, U=Unix, no=no user interface, yes=separate user interface, *=interface under development

Color Code

(orange)	Not oriented toward tidal environment
(pink)	Wrong flow / WQ focus
(green)	Not receiving water model (watershed only)
(blue)	Unix operating system only
(purple)	Not public domain (license fee required)
(yellow)	Support by accessible organization (EPA, USGS, WES preferred) not indicated
(grey)	Model not recommended for additional consideration based on selection factors

First, we eliminated platforms that were not oriented toward a tidal environment. Next, we eliminated platforms that didn't address flow, were not easily linkable to a water quality model, or that were not oriented toward the appropriate water quality parameters (presumably nutrients). We eliminated platforms that were not capable of simulating receiving water (i.e. watershed models). We eliminated platforms that only run in the UNIX operating environment. We eliminated platforms that were not fully within the public domain or for which license fees were required. Finally, we eliminated platforms without current support from an accessible organization such as EPA, USGS, or WES.

After screening, remaining platforms included:

- BRANCH
- DYNHYD5
- CE-QUAL-W2
- EPD-RIV1
- EFDC-HEM3D

We investigated each of these platforms in more detail. A review of relevant applications of each model platform suggests that all 5 remaining platforms are suitable for application to the tidal Rancocas. DYNHYD5, however, has several advantages that recommend it above the other suitable platforms.

DYNHYD was originally part of the WASP water quality modeling platform, and retains a solid seamless linkage to all versions of WASP, including the most current release. The WASP platform is highly adaptable to wide range of water quality simulations, including simple eutrophication, complex eutrophication, and toxic organic pollutants.

DRBC staff are well experienced with the DYNHYD platform and are very familiar with pre- and post-processing DYNHYD data, including linkage to WASP. In fact, DYNHYD5 provides the hydrodynamic basis for the Delaware Estuary PCB model used in the development of the PCB TMDL.

DYNHYD has a long history of applications, including some development in the Delaware Estuary. The SMIC website lists several reports documenting applications within water quality studies in the US and abroad, although many more applications exist.

Finally, the DYNHYD5 platform is relatively simple compared to the other platforms. Of all the platforms considered, DYNHYD5 is probably most suitable for development of a turnkey model, where future use of the model will not necessarily be performed by the original developers.

In light of this selection process and the features described above, we selected DYNHYD5 and developed the model for the tidal Rancocas Creek based on that platform.

1.4 Description of the DYNHYD5 Modeling Platform

DYNHYD5 solves the one-dimensional shallow-water equations of continuity and momentum for a branching or channel-junction (link-node) computational network. The model is capable of handling variable tidal cycles, wind, and unsteady inflows. The model assumes that Coriolis and other accelerations normal to the direction of flow are negligible, that channels can be adequately represented by rectangular geometry, and that bottom slopes are moderate. Most natural flow conditions in large rivers and estuaries would be acceptable; small streams or rivers with a large bottom slope cannot be simulated.

DYNHYD5 is the dynamic estuary model hydrodynamics program. As described in the DYNHYD5 users manual:

> *The WASP5 hydrodynamics model DYNHYD5 is an update of DYNHYD4 (Ambrose, et al., 1988), which was an enhancement of the Potomac Estuary hydrodynamic model DYNHYD2 (Roesch et al., 1979) derived from the original Dynamic Estuary Model (Feigner and Harris, 1970). DYNHYD5 solves the one-dimensional equations of continuity and momentum for a branching or channel-junction (link-node), computational network. Driven by variable upstream flows and downstream heads, simulations typically proceed at 1- to 5-minute intervals. The resulting unsteady hydrodynamics are averaged over larger time intervals and stored for later use by the water-quality program.*

2 Model Segmentation and Parameters

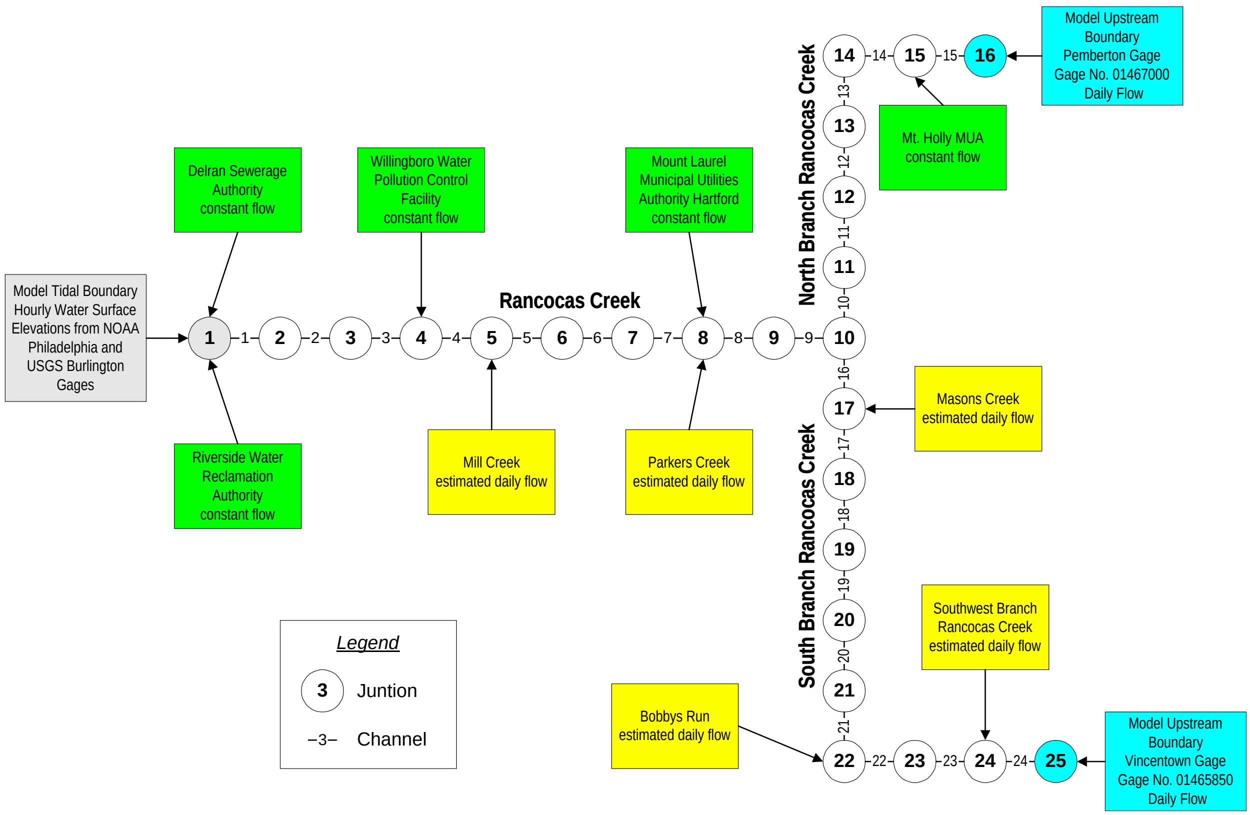
DYNHYD5 models are composed of links representing channels and nodes or junctions. As described in the DYNHYD5 user's manual:

> *A flexible, computationally efficient type of network has been developed for these equations (Feigner and Harris, 1970). The "link-node" network solves the equations of motion and continuity at alternating grid points. At each time step, the equation of motion is solved at the links, giving velocities for mass transport calculations, and the equation of continuity is solved at the nodes, giving heads for pollutant concentration calculations.*

This model of the tidal portion of Rancocas Creek is composed of 24 channels and 25 junctions, with separate branches representing the North and South Branches of Rancocas Creek. Daily flow values from the USGS gages at Pemberton and Vincentown are applied to Junctions 16 and 25 respectively, as upstream boundary inflows. Hourly tidal elevations derived from the NOAA tide gage in Philadelphia and the USGS gage at Burlington are applied at Junction 1, as forcing downstream boundary tides. Figure 4 shows the locations of the model segments, relevant tributaries, data collection sites, and point discharge outfalls plotted on a Rancocas watershed map. Figure 5 shows the relationship between model channels and junctions, boundary inputs, tributary inflows, and point discharges.

Figure 4. Tidal Rancocas Creek Map and Model Segments.

Figure 5. Segmentation of the Tidal Rancocas Model



2.1 Channel and Junction Parameters

The DYNHYD5 input parameters associated with channels are length, width, hydraulic radius or depth, channel orientation, initial velocity, and Manning's roughness coefficient. After the initial time step, DYNHYD recomputes the hydraulic radius and velocity. The initial values for hydraulic radius and velocity therefore impact only the first few time steps. Values specified for this model are included in Table 2 for the model channels and in Table 3 for the model junctions. Datums for vertical elevations were converted to NAVD88 for this modeling work. Initial bottom elevations were specified using profiles from FEMA Flood Insurance Studies from the tidal Rancocas Creek. Initial elevations were adjusted slightly to accommodate the schematized channel sections required by DYNHYD5.

Table 2. Final Calibrated Channel Parameters for Tidal Rancocas Creek Model.

Channel no.	Length of channel (m)	Width of channel (m)	Initial Hydraulic Radius	Channel angle	Manning roughness coefficient	initial mean velocity (m/s)	connecting junction at lower end	connecting junction at upper end
1	1,524.39	271.34	11.2	70.5	0.09	0	1	2
2	1,524.39	182.93	11.0	98.5	0.09	0	2	3
3	1,524.39	246.95	9.7	99.5	0.09	0	3	4
4	1,524.39	213.41	9.0	121.5	0.09	0	4	5
5	1,524.39	271.34	8.4	132.5	0.09	0	5	6
6	1,524.39	216.46	6.5	127.0	0.09	0	6	7
7	1,524.39	225.61	6.2	128.0	0.09	0	7	8
8	1,524.39	182.93	6.3	115.0	0.09	0	8	9
9	515.24	85.37	6.4	77.0	0.09	0	9	10
10	1,524.39	30.49	6.2	76.5	0.09	0	10	11
11	1,524.39	42.68	3.5	98.5	0.1	0	11	12
12	1,524.39	27.44	3.8	109.0	0.1	0	12	13
13	1,524.39	24.39	2.6	77.0	0.1	0	13	14
14	1,524.39	24.39	3.9	105.0	0.1	0	14	15
15	1,524.39	27.44	3.8	99.0	0.1	0	15	16
16	1,524.39	57.93	2.57	118.5	0.1	0	10	17
17	1,524.39	33.54	4.89	152.0	0.08	0	17	18
18	1,524.39	51.83	4.95	105.0	0.08	0	18	19
19	1,524.39	33.54	4.89	144.5	0.08	0	19	20
20	1,524.39	39.63	4.25	137.5	0.08	0	20	21
21	1,524.39	24.39	3.66	117.0	0.08	0	21	22
22	1,524.39	24.39	3.74	163.5	0.08	0	22	23
23	1,524.39	24.39	3.82	154.0	0.08	0	23	24
24	1,524.39	24.39	1.49	192.0	0.08	0	24	25

Table 3. Final Calibrated Junction Values for Tidal Rancocas Creek Model.

Junction No.	Initial Water Surface Elevation (m)	Surface water area at Junction (m^2)	Bottom elevation (m)	Channels entering junction	Channels entering junction	Channels entering junction
1	0.9	317,636	-6.73	1		
2	0.9	498,832	-6.58	1	2	
3	0.9	415,226	-5.69	2	3	
4	0.9	464,954	-5.21	3	4	
5	0.9	506,602	-4.72	4	5	
6	0.9	489,974	-3.38	5	6	
7	0.9	457,184	-3.2	6	7	
8	0.9	448,949	-3.3	7	8	
9	0.9	235,274	-3.39	8	9	
10	0.9	113,131	-3.39	9	10	16
11	0.9	69,360	-1.22	10	11	
12	0.9	62,626	-1.5	11	12	
13	0.9	55,556	-0.51	12	13	
14	0.9	51,346	-1.49	13	14	
15	0.9	72,895	-1.37	14	15	
16	0.9	47,642	-0.56	15		
17	0.9	93,551	-2.3	16	17	
18	0.9	80,497	-2.3	17	18	
19	0.9	68,220	-2.3	18	19	
20	0.9	74,903	-1.8	19	20	
21	0.9	82,984	-1.4	20	21	
22	0.9	58,741	-1.5	21	22	
23	0.9	40,093	-1.6	22	23	
24	0.9	79,720	0.1	23	24	
25	2	59,518	1.4	24		

3 Boundaries and Forcing Functions

3.1 Upstream Boundary North Branch Rancocas Creek

Daily flows were applied to the upstream model boundary on the North Branch at model junction 16 using the daily discharge values from USGS gage 01467000 on the North Branch Rancocas Creek at Pemberton NJ for both the calibration and confirmation periods. Daily flows were obtained from the USGS web site at:

http://waterdata.usgs.gov/nj/nwis/uv?01467000

3.2 Upstream Boundary South Branch Rancocas Creek

Daily flows were applied to the upstream model boundary on the South Branch at model junction 25 using the daily discharge values from USGS gage 01465850 on the South Branch Rancocas Creek at Vincentown NJ for both the calibration and confirmation periods. Daily flows were obtained from the USGS web site at:

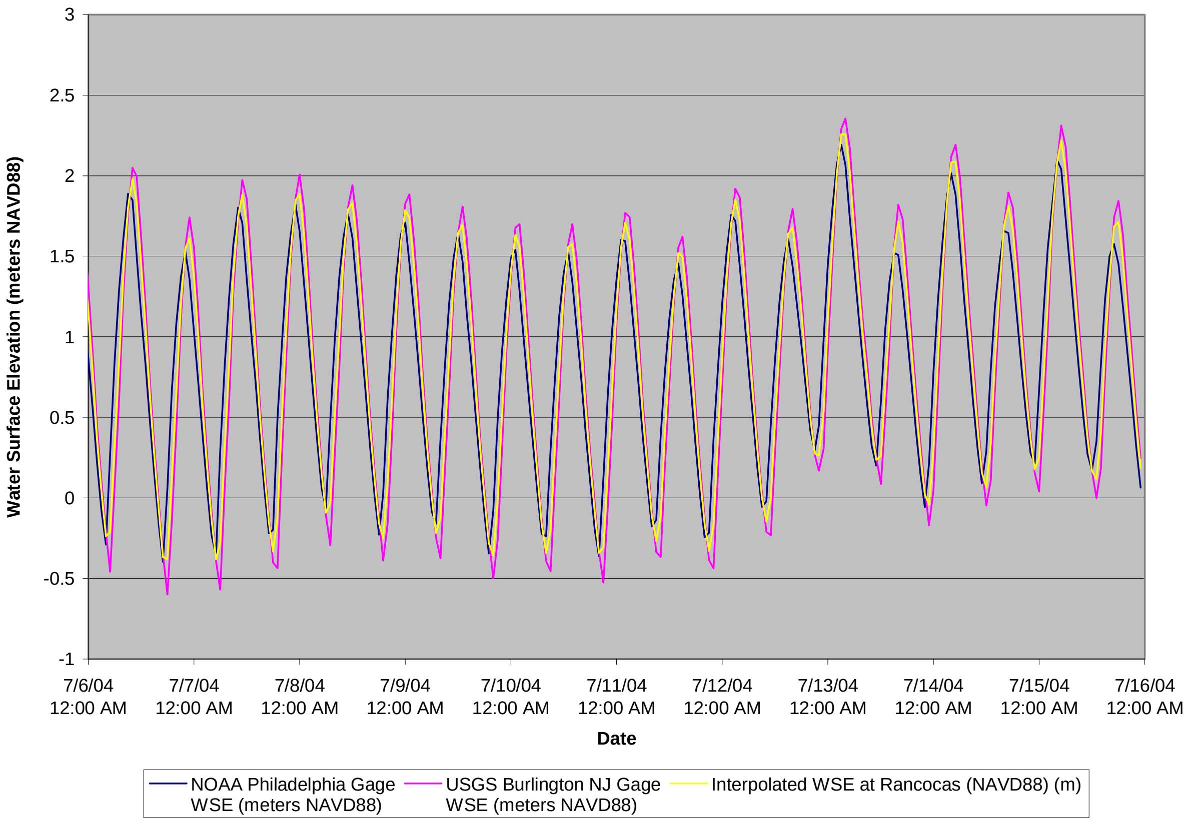
http://waterdata.usgs.gov/nj/nwis/uv?01465850

3.3 Tidal Boundary at Delaware River

There are two tidal gages on the mainstem Delaware River in the vicinity of the mouth of Rancocas Creek. The U.S. Geological Survey maintains gage 01464598 at Burlington, New Jersey, and the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) maintains water level station 8545240 near the Coast Guard Station in Philadelphia, PA. The mouth of the Rancocas is located approximately 6.3 miles downstream from the Burlington gage and approximately 12.4 miles upstream from the Philadelphia gage. A comparison of both gage records suggests that the changes in phase and amplitude between the two gage stations are relatively small.

By performing a linear interpolation between the two data sets using the relative distances as weighting factors, we can develop a third time series corresponding to the mouth of Rancocas Creek, as shown in Figure 6. This method of interpolation allows direct construction of a time series at the mouth of Rancocas Creek without having to develop and calibrate a mainstem Delaware River model between the two gages. For the period between April 1, 2004 and October 20, 2004, the mean elevation difference between daily Higher High Water (HHW) and Lower Low Water (LLW) was approximately 2.15 meters at the mouth of Rancocas Creek.

Figure 6. Interpolation of Tidal Data for Development of Tide Heights at Rancocas Creek



3.4 Tributary Flows

We computed subwatershed areas for sizable tributaries to the tidal portions of Rancocas Creek downstream of the USGS gaging stations using GIS coverages. We then used the ratio of the tributary watershed areas to the area above the gaging station to develop a daily tributary flow, as described below:

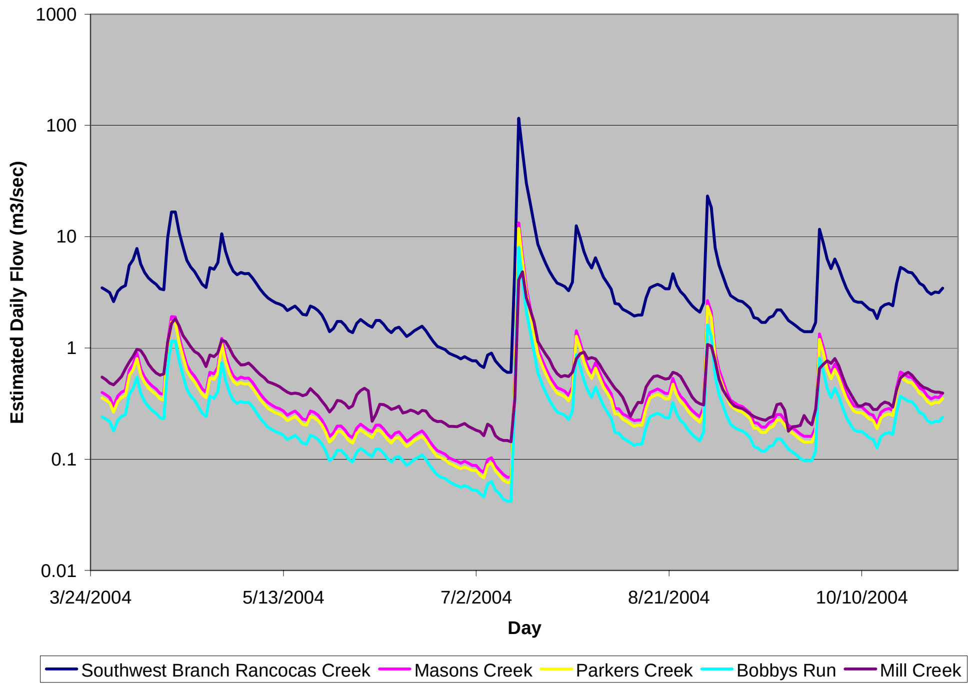
$$Q_{trib} = \frac{A_{trib}}{A_{gage}} Q_{gage}$$

where:

Q_{trib} = Tributary daily flow
A_{trib} = Drainage area of the tributary
A_{gage} = Drainage area above the USGS gage
Q_{gage} = Daily discharge at the USGS gage

Daily flow time series were computed for Mill Creek, Parkers Creek, Masons Creek, Bobbys Run, and the Southwest Branch of Rancocas Creek. The daily flows for Mill Creek were developed using the drainage area ratio to the gage on the North Branch Rancocas Creek at Pemberton. All other daily flows were developed using the drainage area ratio to the gage on the South Branch at Vincentown. Figure 7 below shows the estimated daily tributary flows during the calibration period.

Figure 7. Estimated Daily Flows for Five Tributaries to the Tidal Rancocas Creek During the Model Calibration Period.



3.5 Point Discharge Flows

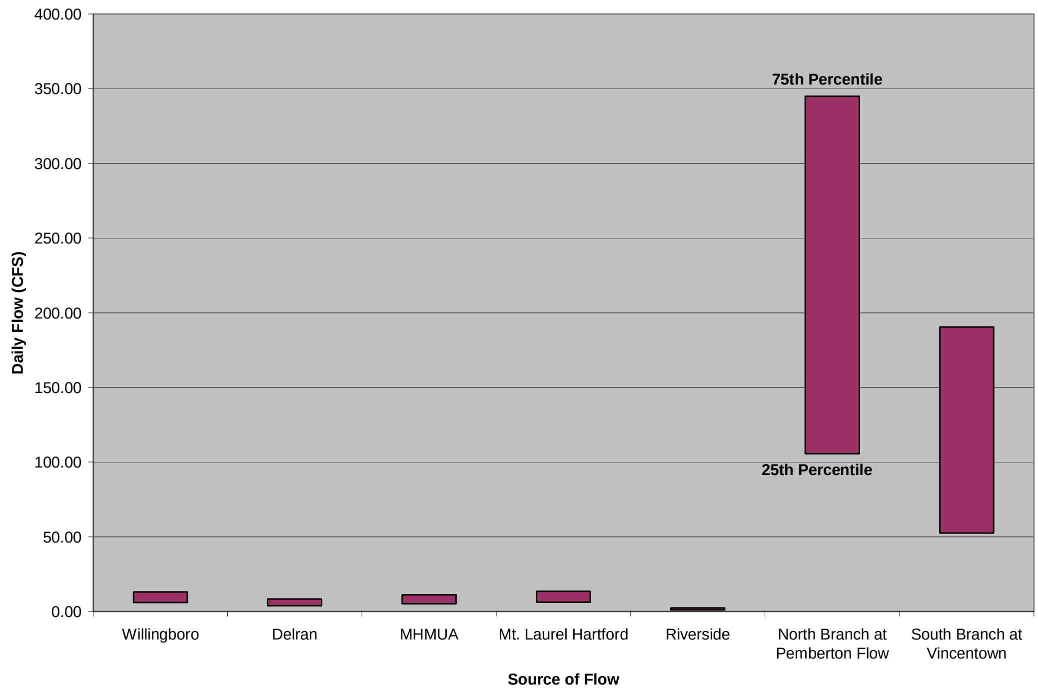
DRBC sent letters to all dischargers within the Rancocas Creek watershed requesting discharge and outfall location information. After plotting outfall locations, we determined that the following facilities discharged within the model domain

- Delran Sewerage Authority
- Riverside Water Reclamation Authority
- Mt. Holly Municipal Utilities Authority
- Willingboro Water Pollution Control Facility
- Mount Laurel Municipal Utilities Authority, Hartford Plant

To assess the variability of the point discharge flows, we plotted the range between the 25^{th} and 75^{th} percentiles for available daily discharge values for all 5 treatment plants and for the North Branch and South Branch USGS gages during the calibration period, as shown in Figure 8. This comparison demonstrates that both the magnitude and variability of the point discharge flows is much less than the magnitude and variability of upstream boundary flows from the North and

South Branches of Rancocas Creek. We determined that application of mean daily flow values for each of the point discharges would adequately represent these flows in the model and would minimize computational and data processing time.

Figure 8. Comparison of Interquartile Ranges of Daily Flow Values from Point Discharges and Upstream Boundaries.



The following mean daily flow values (in m^3/sec) were applied to the model.

Table 4. Specified Point Discharge Mean Daily Flows

Facility	Mean Daily Flow (m^3/sec)
Delran	0.121
Riverside	0.033
Mount Laurel	0.193
Willingboro	0.175
MHMUA	0.158

4 Data Collection

Water surface elevation data was collected at three locations in the tidal Rancocas Creek during the model calibration and confirmation period:

- Rancocas Creek offshore from the Willingboro VFW Post at 28 Creekview Rd.;
- North Branch Rancocas Creek at the Mt. Holly MUA wastewater treatment plant at 300 Rancocas Rd; and
- South Branch Rancocas Creek in Lumberton immediately downstream of the Lumberton railroad bridge.

Water surface elevation data on the Rancocas and South Branch Rancocas Creek were collected using two Design Analysis Associates, Inc. WaterLOG series model DH-21 Submersible Logger Pressure Transducers. The DH-21 uses a submersible pressure transducer containing a data logger attached by vented cable to a secondary assembly that remains on land for atmospheric pressure compensation. Each piece of equipment was calibrated for 0-15psi, allowing for a depth range of 0-34.60 ft. Depth estimates were derived from standard freshwater density values and measured temperature. Each logger was set to measure at 15 minute intervals over the entire period of record. Data was retrieved from each logger using WaterGEN software (DAA, inc.) and imported into Microsoft Excel for storage and analysis.

A DH-21 Pressure Transducer was deployed in South Branch Rancocas Creek in mid June 2004, but it was destroyed during the flooding July 12, 2004 before the data could be retrieved. We ordered and received a replacement unit and deployed it on August 19, 2004. The transducer stopped logging on September 20, 2004, when the cable connecting the submersible and shore apparatus was severed, probably due to flood debris. The unit was shipped back to the manufacturer for retrieval of the logged data. Portions of the memory were damaged, however, and only data collected on August 19 and 20, 2004 and between September 2 and 20, 2004 could be retrieved.

As such, the observation data set for the South Branch Rancocas Creek is shorter than the data sets for both Rancocas Creek and the North Branch Rancocas Creek, and is limited to August 19 and 20, 2004 and the period between September 2 and 20, 2004.

5 Calibration and Confirmation

The model was calibrated in two steps to data collected from August 1, 2004 through September 10, 2004 and confirmed for two separate data sets. The model was calibrated to a Primary Calibration Period from August 1, 2004 through August 30, 2004 and to a shifted Supplemental Calibration Period from August 12, 2004 through September 10, 2004. The Supplemental Calibration was added to ensure adequate calibration of the South Branch using available retrievable pressure transducer data, while still allowing a separate and independent data set for model confirmation. A primary model confirmation period of September 11 to September 20, 2004 was selected, to take advantage of the limited water surface data in the South Branch. A secondary confirmation period in late June was used to assess the model's performance during low flow conditions, which are likely to be the target conditions during any subsequent water quality modeling.

Table 5. Model Calibration and Confirmation Periods

Type of Model Run	Model Start and End Dates	Data Sets used for Comparison
Primary Calibration	8/1/2004 to 8/30/2004	Rancocas Creek (8/1/2004 – 8/30/2004) North Branch (8/1/2004 – 8/30/2004) South Branch (8/19/2004 – 8/20/2004)
Secondary Calibration	8/12/2004 to 9/10/2004	Rancocas Creek (8/12/2004 – 9/10/2004) North Branch (8/12/2004 – 9/10/2004) South Branch (9/2/2004 – 9/10/2004)
Primary Confirmation	9/11/2004 to 9/20/2004	Rancocas Creek (9/11/2004 – 9/20/2004) North Branch (9/11/2004 – 9/20/2004) South Branch (9/11/2004 – 9/20/2004)
Secondary Confirmation	6/12/2004 to 7/11/2004	Rancocas Creek (6/12/2004 – 7/11/2004) North Branch (6/12/2004 – 7/11/2004) South Branch (No Data Available)

To calibrate the model, we iteratively ran the model, compared the model output to the observed water surface elevations, and adjusted model parameters. Adjustments were made primarily to the Manning's Roughness value specified for each channel, the available surface area for each junction, and the specified bottom elevation. The computational time step for DYNHYD5 was set to 1 second, and model computations were output every 1.5 hours.

Initial estimates of junction surface area were made from GIS coverages. However, since DYNHYD model segments are rectangular, the initial junction surface area does not account for the additional storage volume available during higher elevations from fringe marsh and gently sloping banks. The initial junction surface areas are incrementally adjusted upward, until good agreement between modeled and observed surface elevation range is attained.

Similarly, initial bottom elevations were obtained from Flood Insurance Studies prepared in the 1970s. Again, since DYNHYD approximates the actual channel cross section with a rectangle, some increases in specified bottom elevation are usually necessary to achieve a comparable hydraulic cross sectional area and surface elevation.

For Manning's Roughness values, we initially specified a value of 0.08. Comparisons of model phase and amplitude indicated, however, that higher values were required. Final calibration resulted in Manning's Roughness values of 0.08 in the South Branch, 0.1 in the North Branch, and 0.09 in the Rancocas Creek. These values are in agreement with published ranges and are consistent with our field observations that flow in much of the North Branch is probably impeded by obstructions, such as tree branches, and by dense wetland fringe. In addition, DYHNYD model segmentation does not explicitly represent hydraulic structures such as bridge abutments. Higher roughness values allow for the consideration of these structures implicitly.

For each model run, we developed three graphical comparisons to the observed data. Time series plots show the direct computed and observed water surface elevations over a period of time. Bivariate plots compare paired predicted and observed elevations, yielding the coefficient of regression (R^2) also known as the correlation of determination and providing an indication of any biases. Finally, comparative cumulative frequency distributions plots allow a comparison of the range and frequencies in both predicted and observed values. For these comparisons, all elevations were converted to normalized water surface elevations by subtracting the mean of the comparison period from the individual values. Using the normalized water surface elevation minimizes datum conversion differences from location to location.

5.1 Final Calibration Output and Results

Selected model / data comparisons are provided below. The full set of plots is provided in Appendix A. Graphical comparisons were made at 3 locations:

- observations made at Rancocas Creek near the Willingboro VFW post were compared to model Junction 5;
- observations on the North Branch Rancocas Creek near the Mt. Holly MUA were compared to model junction 15; and
- observations on the South Branch Rancocas near the Lumberton, NJ railroad bridge were compared to model junction 22.

Figures 9 and 10 demonstrate close agreement between predicted and observed water surface elevations in the Rancocas Creek. Elevations and flows in this section of the creek are strongly influenced by the tidal boundary.

As indicated in Figure 11, the range and distribution of predicted water surface elevations in Rancocas Creek closely match those observed during the same period.

Figures 12 and 13 demonstrate close agreement between the predicted and observed water surface elevations in the North Branch Rancocas Creek. Figure 14 shows that the model slightly over predicts the highest water surface elevations in the North Branch, but generally produces a range and distribution of results similar to observations.

Figure 15 shows a comparison of time series for the predictions and observations on the North Branch, including high flows that occurred between August 31 and September 2, 2004. Interestingly, the model follows the general changes in water surface elevation well, but fails to capture the interruption of tidal fluctuations that was observed around September 1, 2004. This tidal interruption may be due to obstructions in the North Branch, not explicitly included in the model, or overbank flow.

Figures 16 and 17 show generally good agreement between predicted and observed water surface elevations in the South Branch.

Figure 9. Rancocas Creek Time Series Calibration Plot.

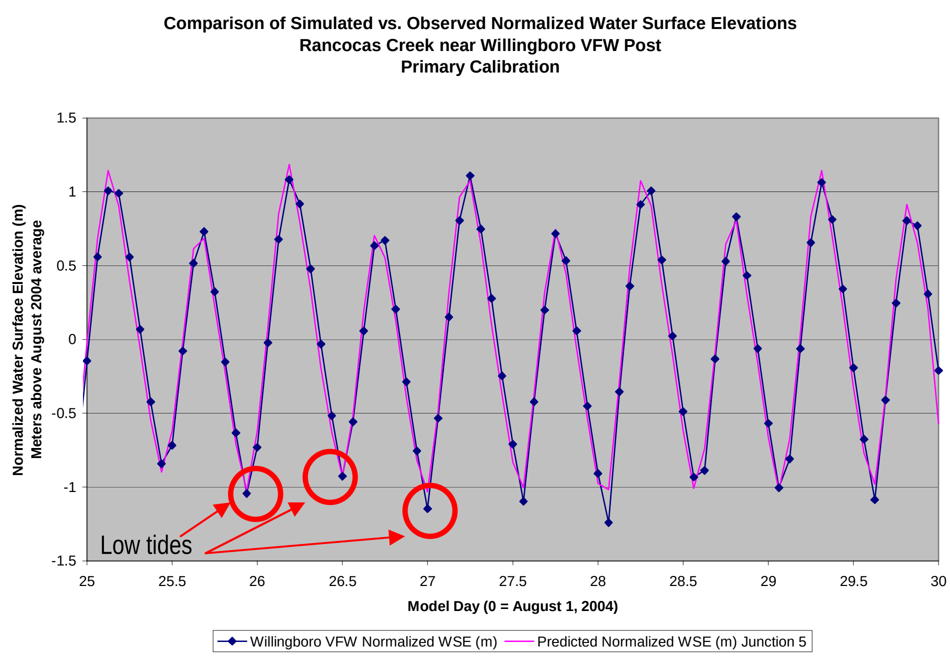


Figure 10. Rancocas Creek Bivariate Calibration Plot.

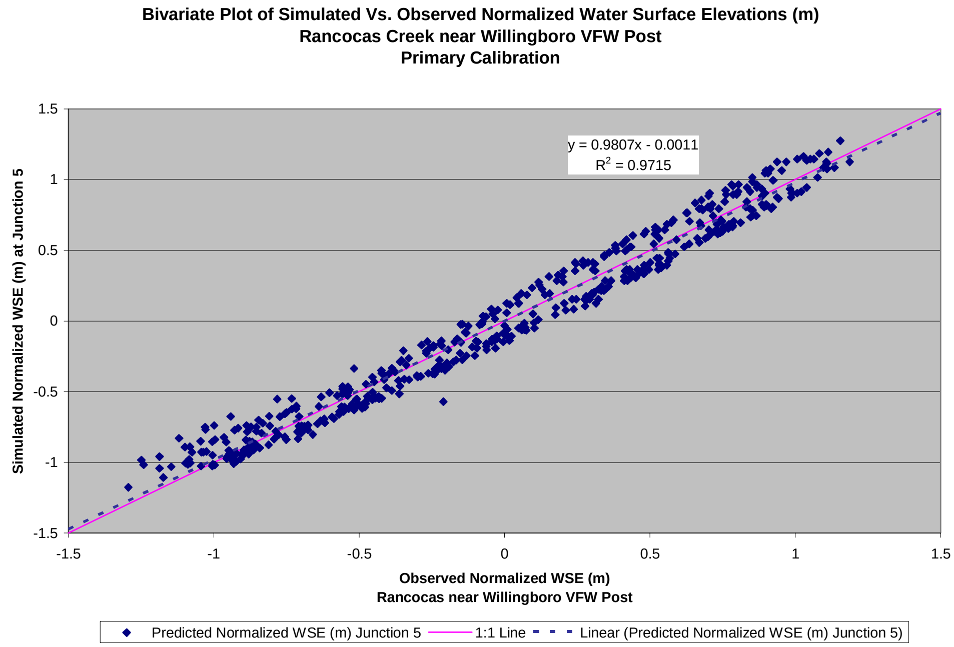


Figure 11. Rancocas Creek CFD Calibration Plot.

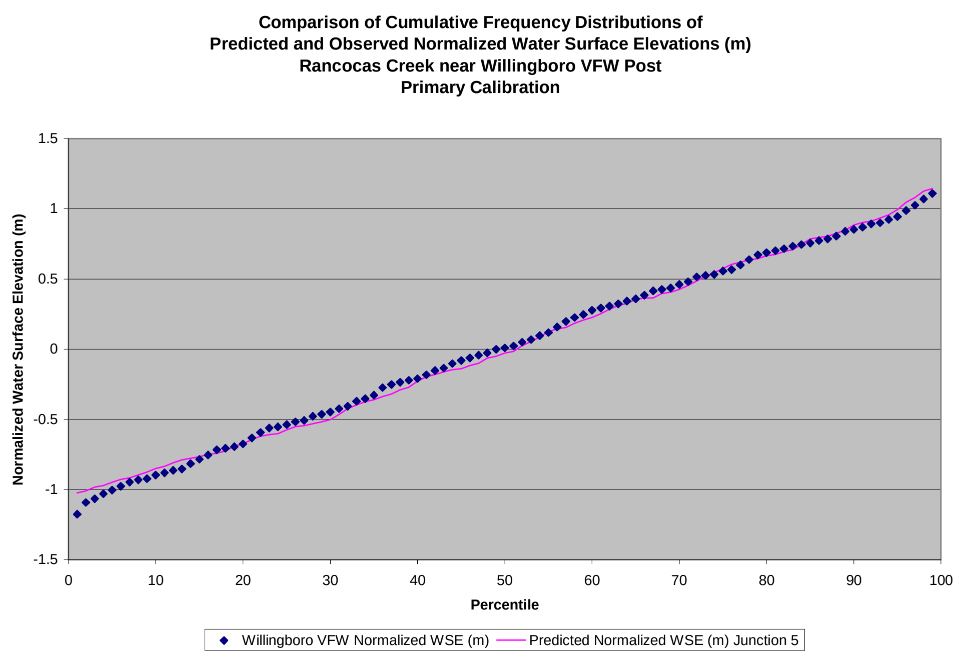


Figure 12. North Branch Rancocas Time Series Calibration Plot.

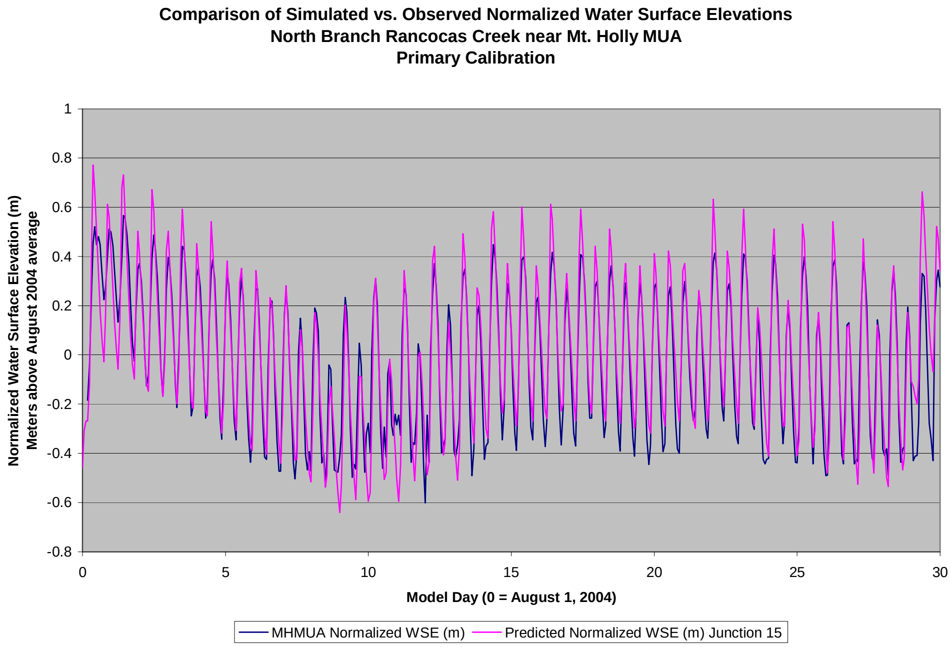


Figure 13. North Branch Rancocas Bivariate Calibration Plot.

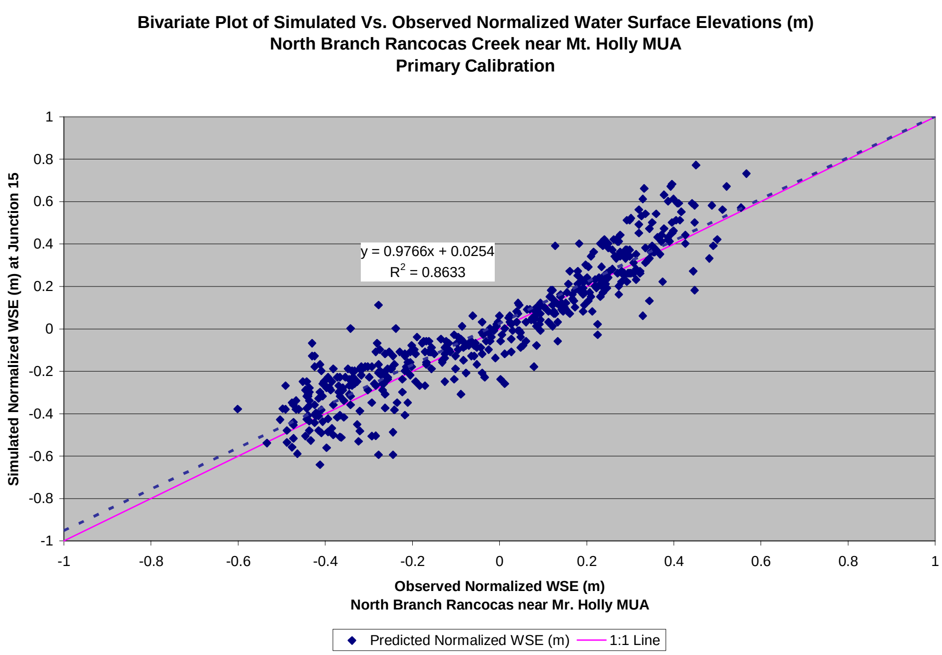


Figure 14. North Branch Rancocas CFD Calibration Plot.

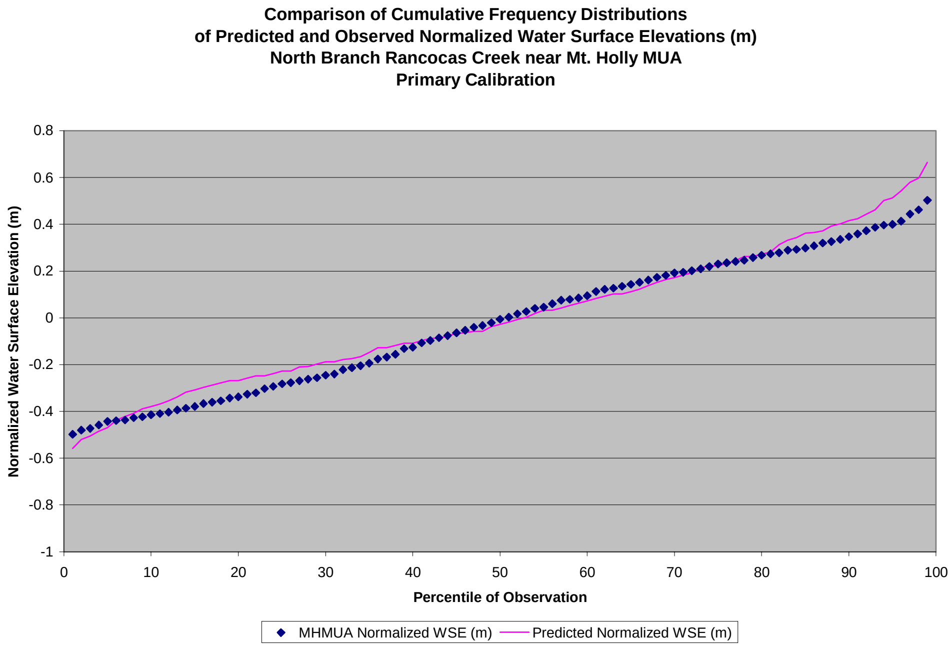


Figure 15. North Branch Rancocas Time Series Calibration Plot featuring High Flow Event.

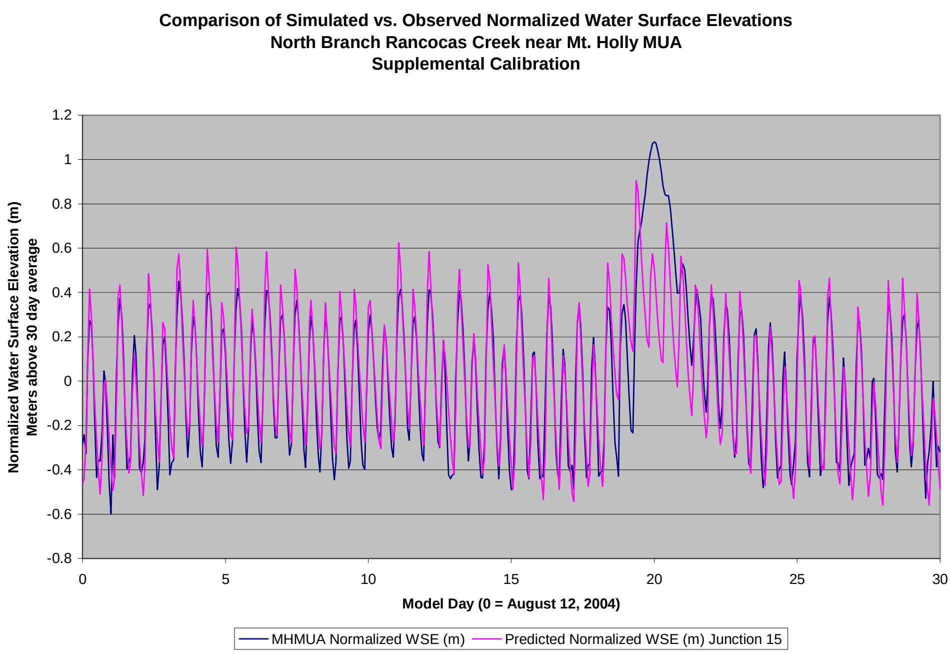


Figure 16. South Branch Rancocas Time Series Calibration Plot.

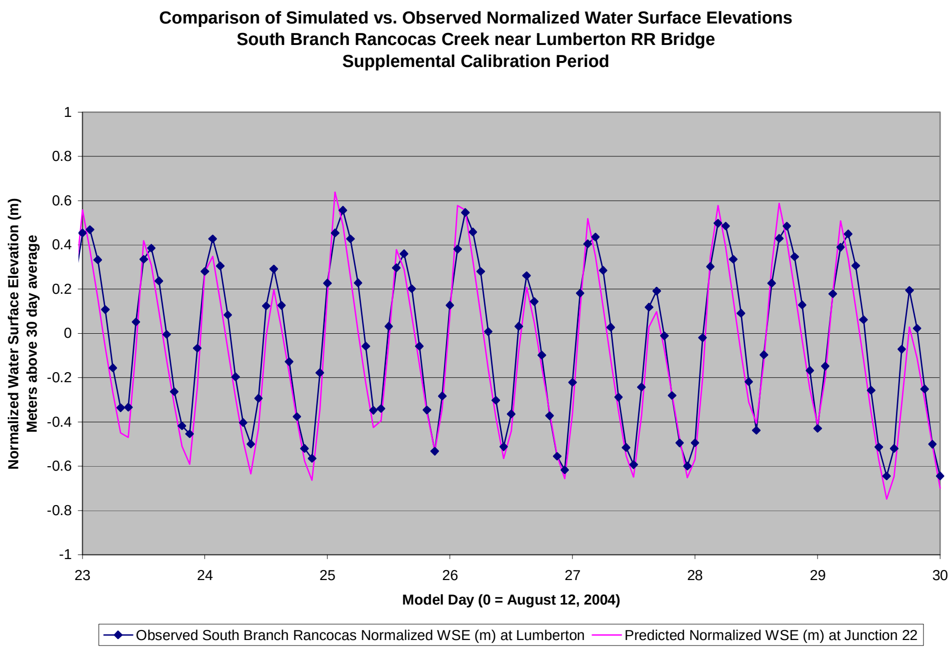
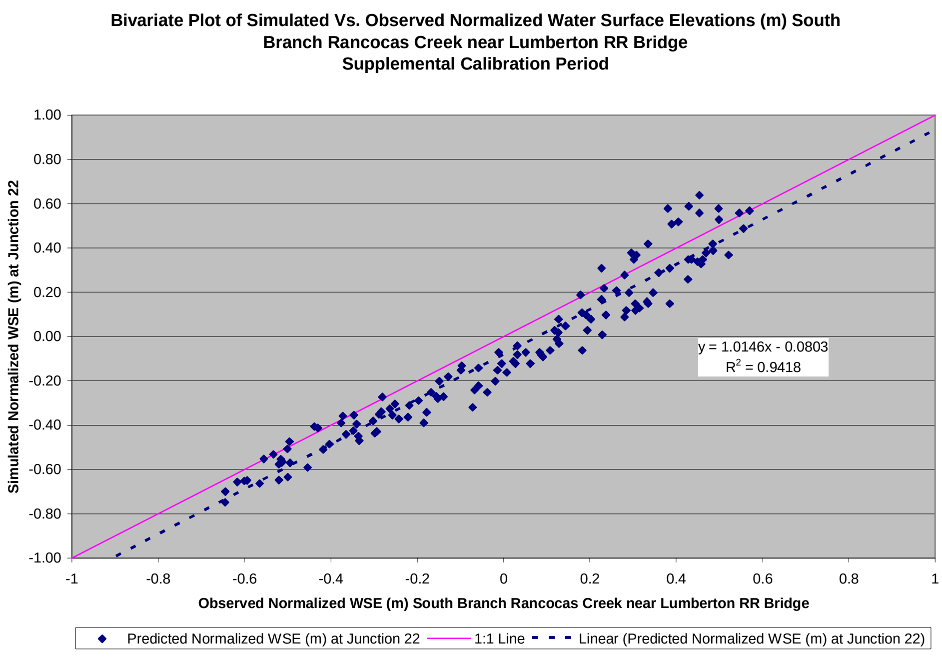


Figure 17. South Branch Rancocas Bivariate Calibration Plot.



5.2 Confirmation Output and Results

Figures 18, 19, and 20 continue to demonstrate good agreement between predicted and observed water surface elevations in Rancocas Creek near the Willingboro VFW post, similar to that demonstrated in the calibration plots.

Figure 21, again demonstrates some loss of tidal fluctuation at high flows not captured by the model. Figure 21 also suggests some variability in water surface elevation at low tide that is not captured by the model.

Figures 24, 25, and 26 continue to demonstrate relatively good agreement between predicted and observed water surface elevations in the South Branch.

As indicated previously, and as shown in Figure 27, variations in water surface elevation were observed at low tide, but not captured in the model. There are several possible explanations.

First, the model segmentation does not explicitly include bypass channels located on the North Branch upstream from the Mt. Holly MUA discharge. Based on our work on the mainstem Delaware, DYNHYD's ability to simulate branching channels is poor. For this application, we chose not to include any branching channels. The hydraulics of the bypass and natural channel combination could result in a secondary water surface elevation rise during ebbing tide.

Second, the data collection site for the North Branch is located at the Mt. Holly MUA, immediately adjacent to the discharge outfall. In the model, we specified a constant flow for the outfall. If the flow is more variable, the disturbance at low tide could be the result of variable flow from the outfall.

Other possible explanations include bank inflows during low tide forcing a more constant elevation, and potential impact by wind setup. However, the model reliably reproduced water surface elevations at 3 locations of the Rancocas Creek.

Figure 18. Rancocas Creek Time Series Confirmation Plot.

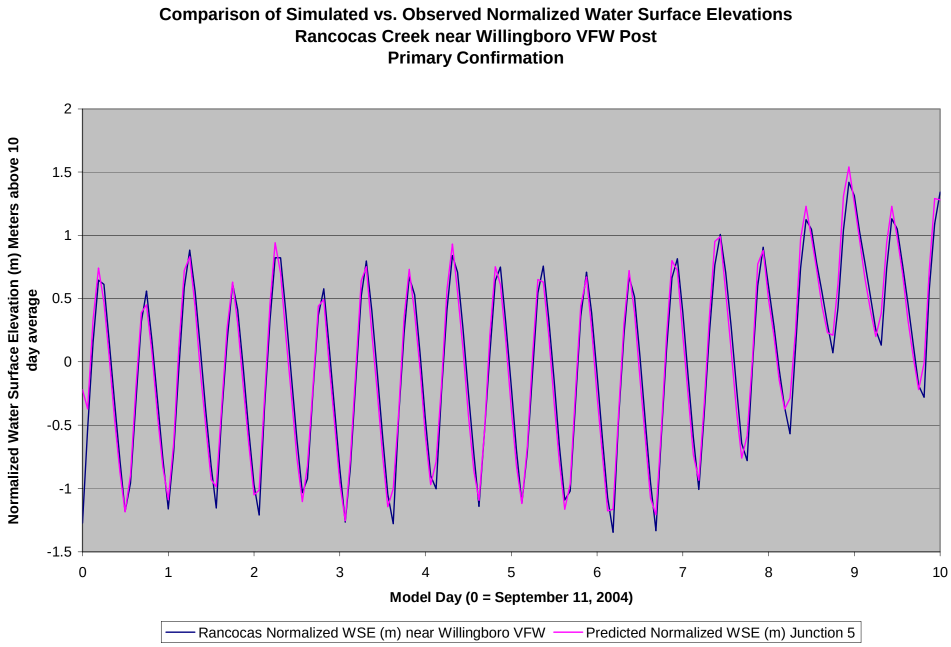


Figure 19. Rancocas Creek Bivariate Confirmation Plot.

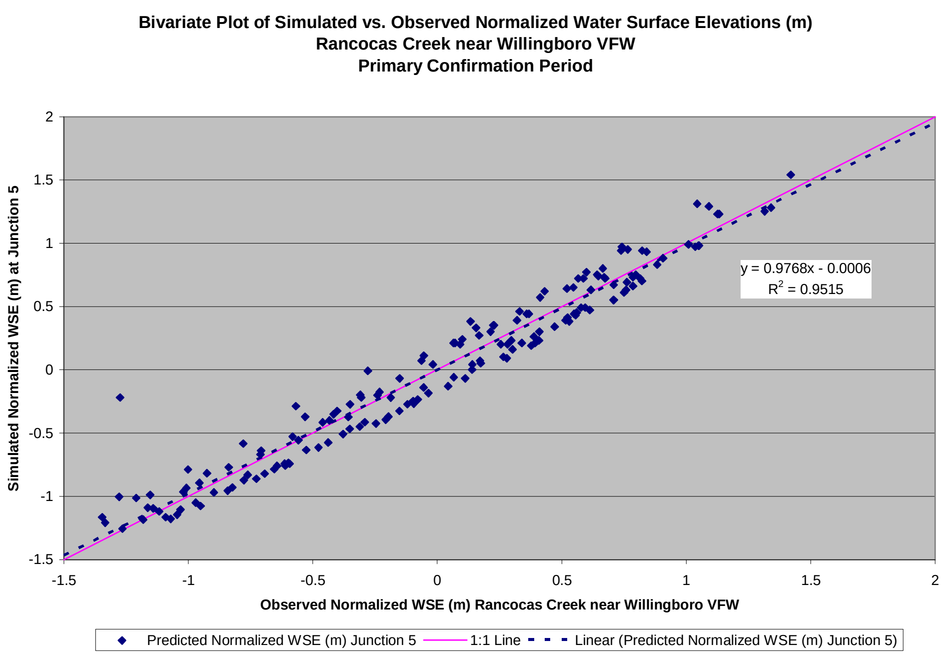


Figure 20. Rancocas Creek CFD Confirmation Plot.

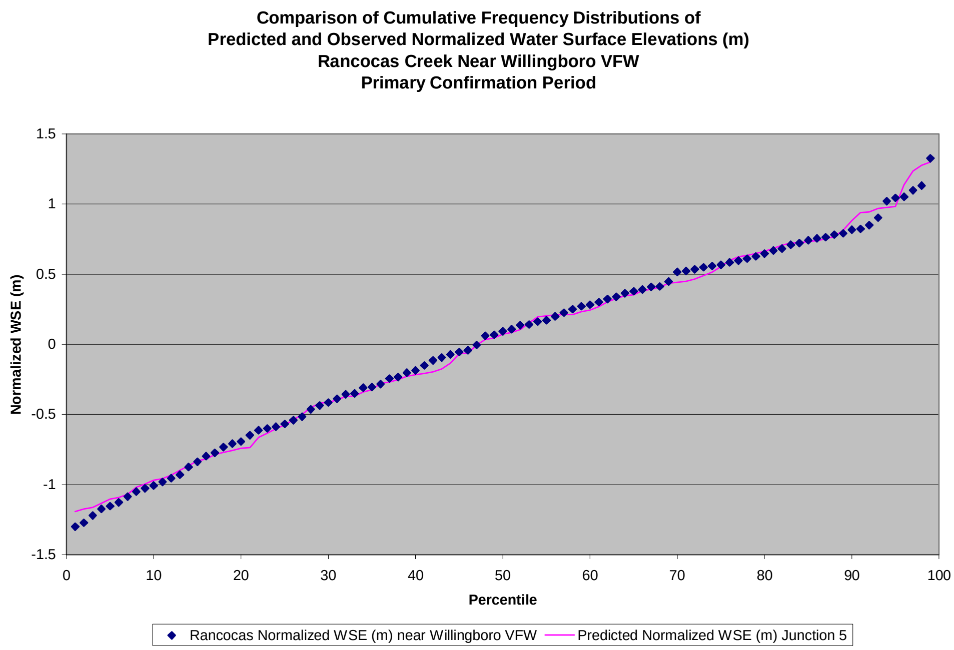


Figure 21. North Branch Rancocas Time Series Confirmation Plot.

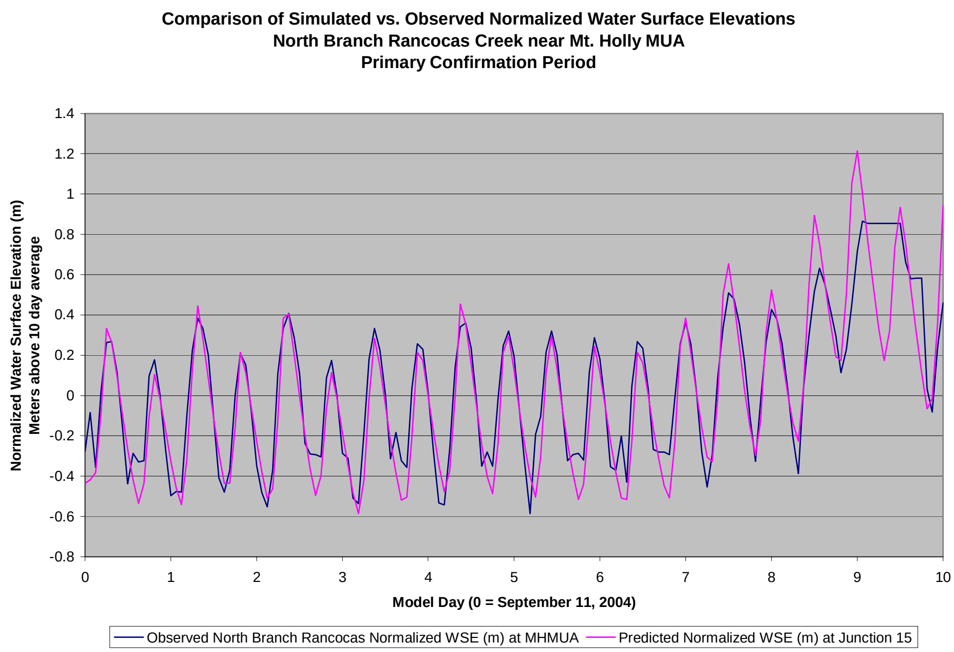


Figure 22. North Branch Rancocas Bivariate Confirmation Plot.

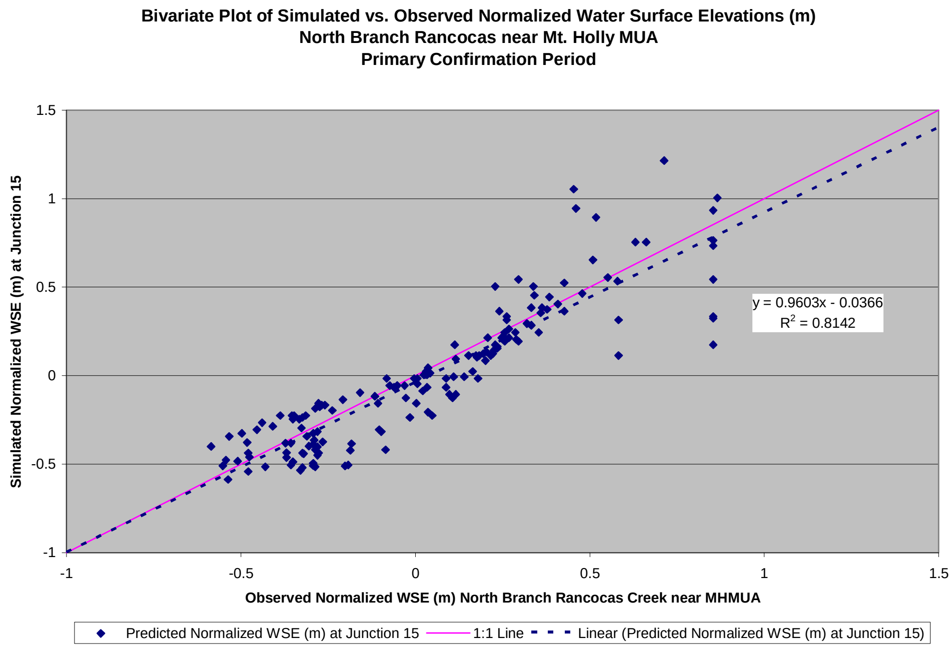


Figure 23. North Branch Rancocas CFD Confirmation Plot.

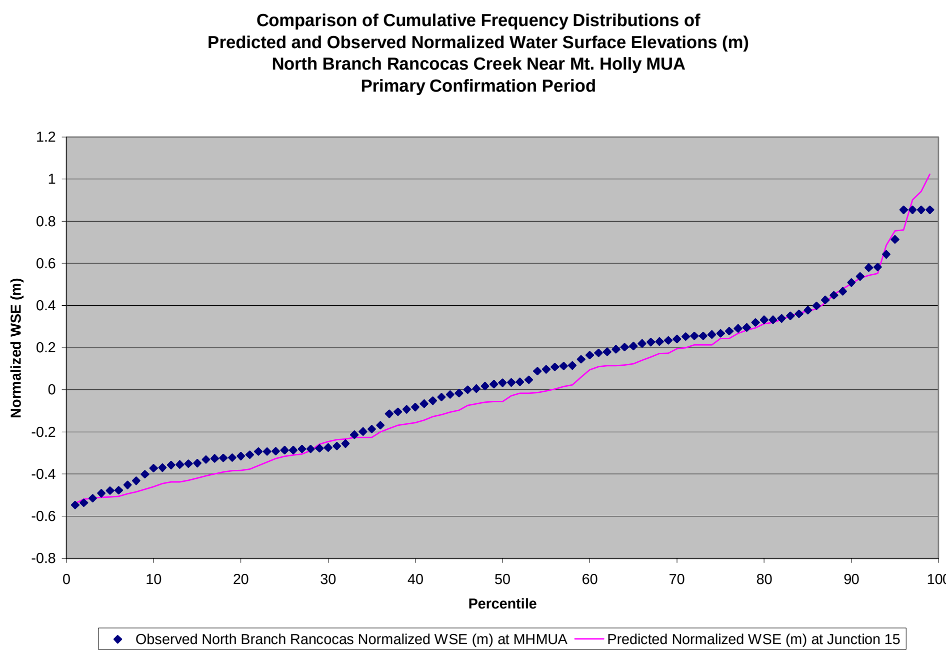


Figure 24. South Branch Rancocas Time Series Confirmation Plot.

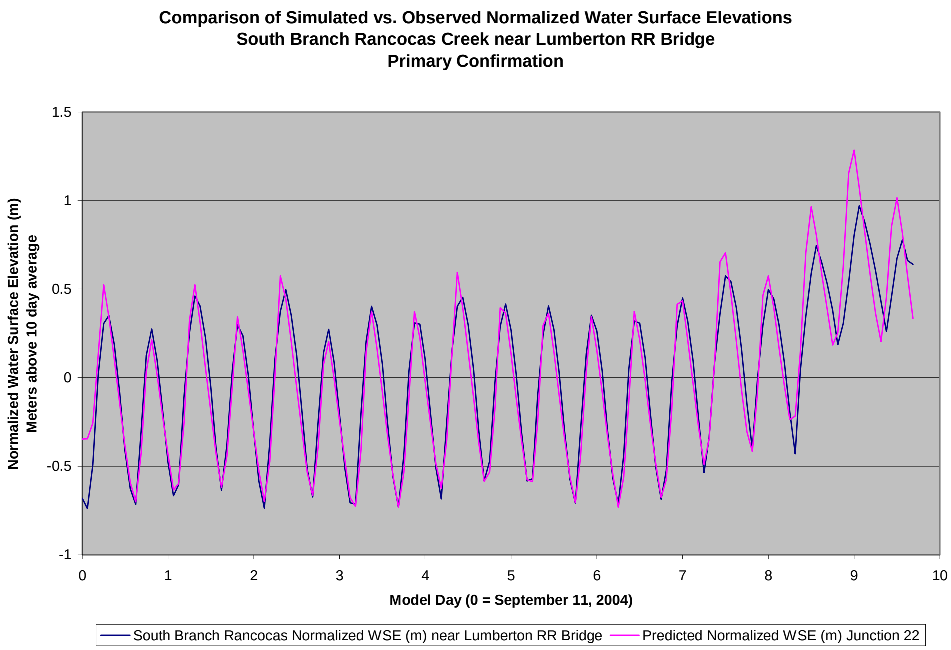


Figure 25. South Branch Rancocas Bivariate Confirmation Plot.

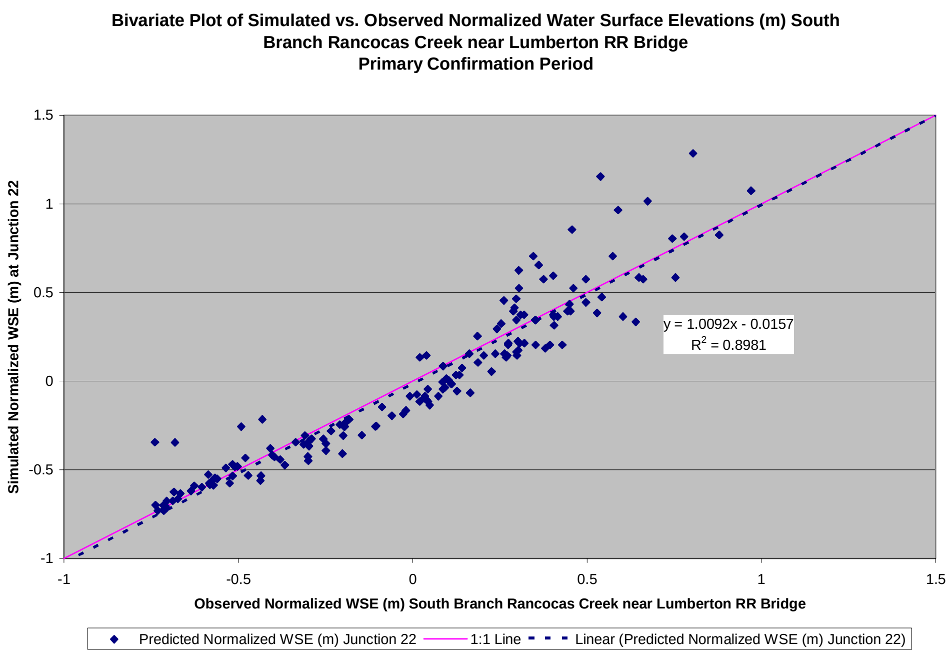


Figure 26. South Branch Rancocas CFD Confirmation Plot.

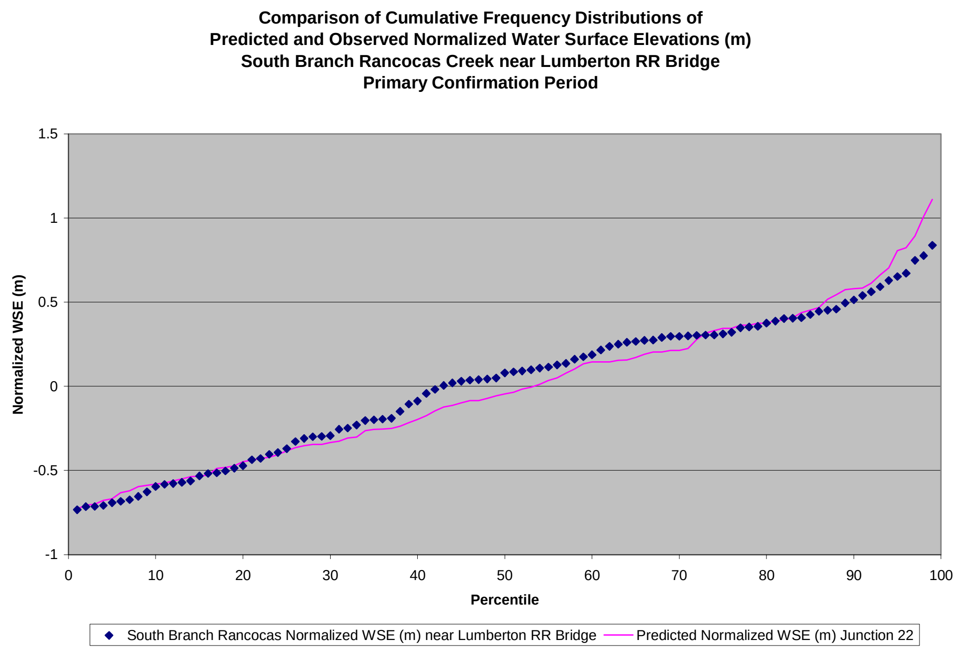
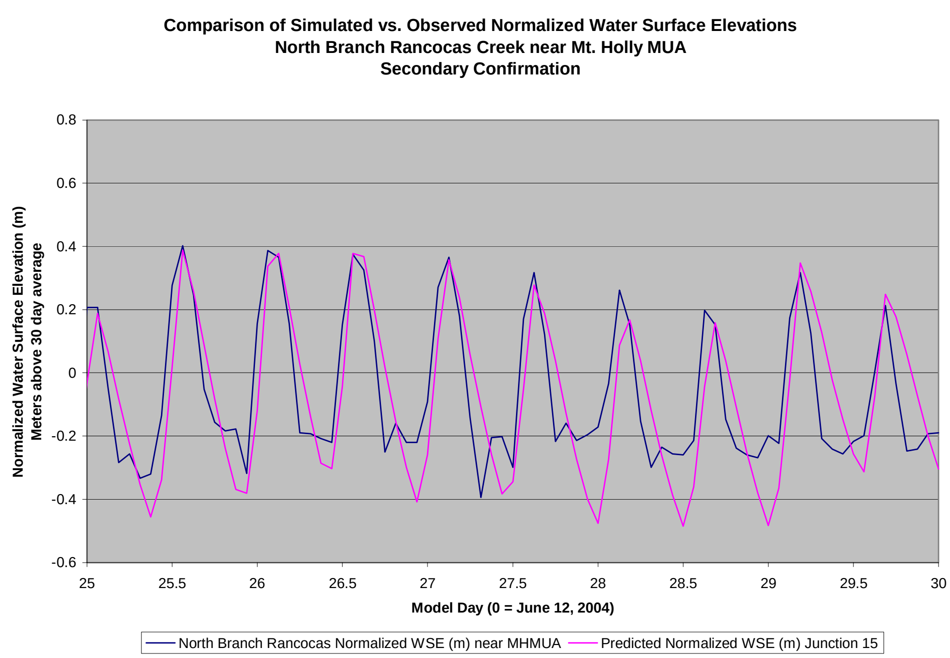


Figure 27. North Branch Rancocas Time Series Low Flow Confirmation Plot.



6 Discussion

The calibrated model reliably reproduced observed water surface elevations at three stations through the tidal Rancocas Creek. The model correctly captured tidal phases, ranges, and impacts of upstream flow. Observations on the Rancocas, North Branch Rancocas, and South Branch Rancocas were all reliably reproduced. Using the final calibration parameters, regression coefficients (r) ranged from 0.9754 to 0.9936 on Rancocas Creek, from 0.8495 to 0.9291 on North Branch Rancocas Creek, and from 0.9477 to 0.9888 on the South Branch Rancocas Creek.

Model performance matched observations most closely on the Rancocas Creek between the confluence of the North and South Branches and the Delaware River. Rancocas Creek is also the receiving water for 4 of the 5 major point discharges to the tidal Rancocas.

We believe that this hydrodynamic model is suitable for coupling with an appropriate water quality model for management of water quality in Rancocas Creek.

6.1 Next Steps Toward Development of a TMDL

Conceptually, the next steps toward development of a TMDL for the tidal Rancocas Creek would involve the following:

- Identify impairment(s) for which a TMDL will be developed;
- Select an appropriate water quality model framework for the TMDL. Given the adaptability and seamless linkage between DYNHYD5 and WASP, we presume that WASP would be a strong candidate for most water quality modeling needs;
- Develop a water quality model calibration strategy including selection of a model calibration flow regime and suitable calibration period;
- Identify the variables to be quantified in developing the water quality model;
- Assemble existing data to quantify the variables within the;
    - Non-tidal boundaries (headwaters);
    - Tidal boundaries (main stem Delaware River);
    - Tidal Rancocas Creek (for model calibration, verification);
    - Point Discharges;
    - Non-point source runoff;
    - Other sources as needed
- Develop and execute a field sampling plan to appropriately fill data gaps in the variables to be quantified;
- Calibrate and verify the water quality model;
- Develop the wasteload allocations and load allocations and compute the TMDL;
- Coordinate as needed and establish the TMDL.

There are of course many tasks involved in each of these bullets. Different tasks could be very involved and time consuming. Furthermore, depending the regulatory drivers and sources of funding for development of the TMDL, the water quality model could require a separate quality assurance plan and consultation with a modeling expert panel. Stakeholder coordination as well could be a larger element depending on the nature of the impairments and the disparity between the current loads and the TMDL wasteload allocation.

7 Recommendations and Conclusion

We recommend that this model be accepted for use in future development of a water quality model for the tidal Rancocas Creek. Model refinements could be realized through the collection of current refined bathymetry data, or through the utilization of a three dimensional model, but we do not feel that these refinements are necessary for managing water quality. The model presented here is sufficient in detail, precision, and accuracy to proceed with the development of an appropriate water quality model.

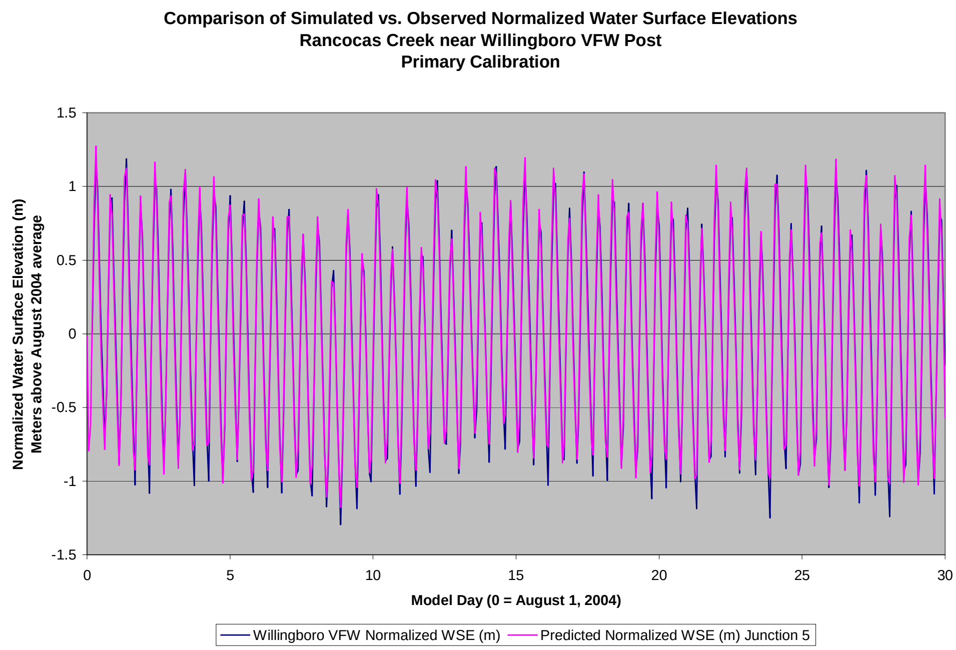
As indicated in the Objective of the Scope of Work:

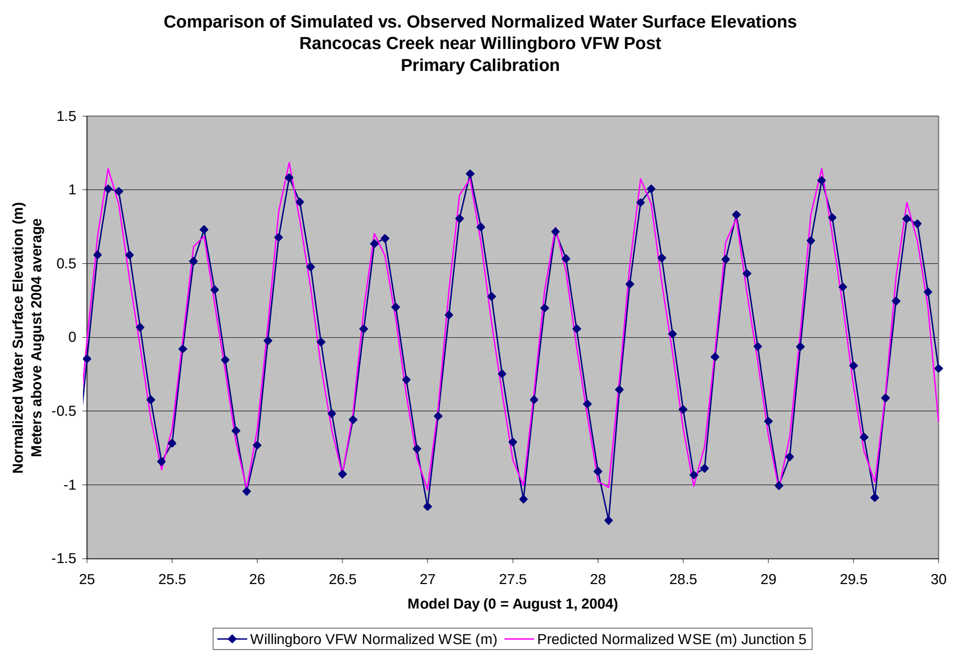
> *A monitoring plan and hydrographic model application for the tidal portion becomes important and unavoidable for the future TMDL development in Rancocas Creek. This effort will focus on the development and application of a hydrodynamic model for the tidal portion of Rancocas Creek.*

Therefore, the objective of this project was to develop and apply a hydrodynamic model for the tidal portion of Rancocas Creek. As this report demonstrates, the hydrodynamic model of tidal Rancocas Creek was developed and applied, and this objective was met.

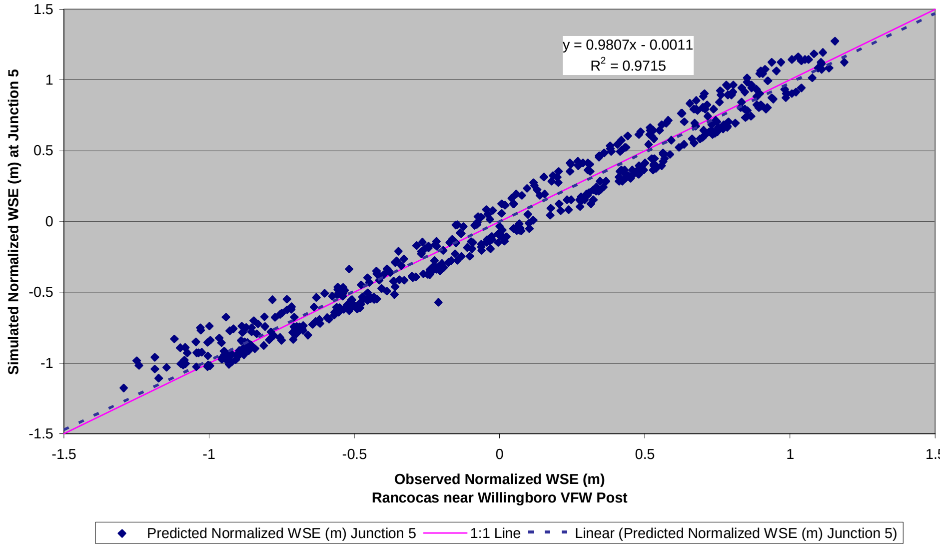
Appendix A

Full Set of Model / Data Comparisons

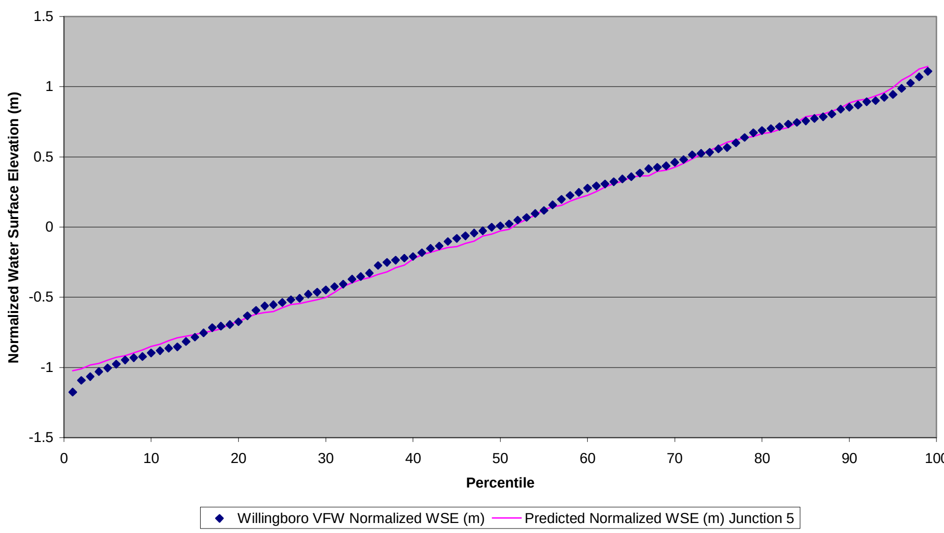

Comparison of Simulated vs. Observed Normalized Water Surface Elevations
Rancocas Creek near Willingboro VFW Post
Primary Calibration
Normalized Water Surface Elevation (m)
Meters above August 2004 average
1.5
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25
30
Model Day (0 = August 1, 2004)
Willingboro VFW Normalized WSE (m)
Predicted Normalized WSE (m) Junction 5


Comparison of Simulated vs. Observed Normalized Water Surface Elevations
Rancocas Creek near Willingboro VFW Post
Primary Calibration
Normalized Water Surface Elevation (m)
Meters above August 2004 average
1.5
1
0.5
0
-0.5
-1
-1.5
25
25.5
26
26.5
27
27.5
28
28.5
29
29.5
30
Model Day (0 = August 1, 2004)
Willingboro VFW Normalized WSE (m)
Predicted Normalized WSE (m) Junction 5

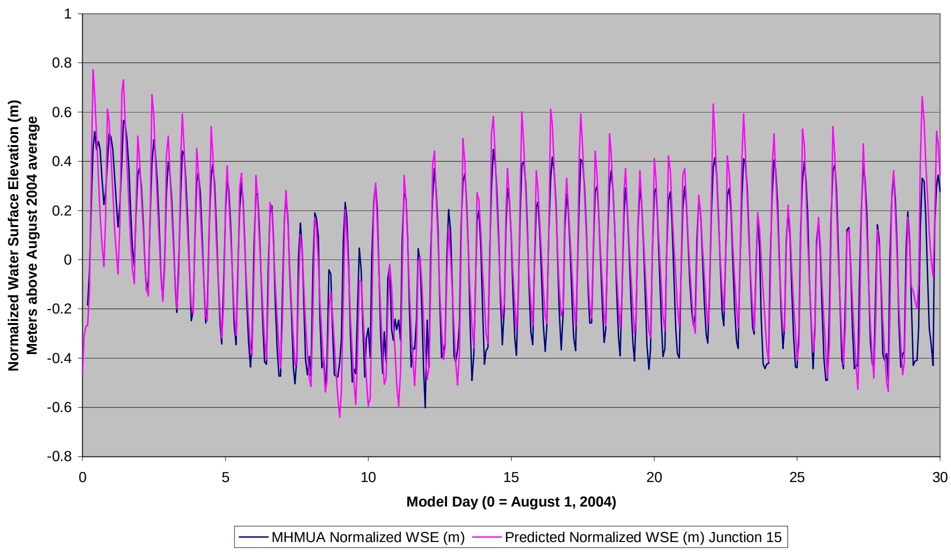
Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m)
Rancocas Creek near Willingboro VFW Post
Primary Calibration



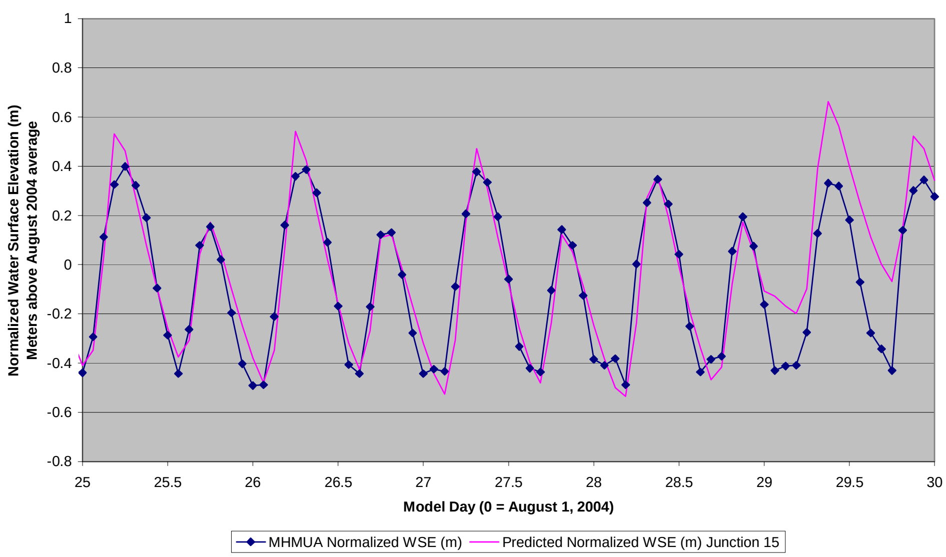
Comparison of Cumulative Frequency Distributions of
Predicted and Observed Normalized Water Surface Elevations (m)
Rancocas Creek near Willingboro VFW Post
Primary Calibration



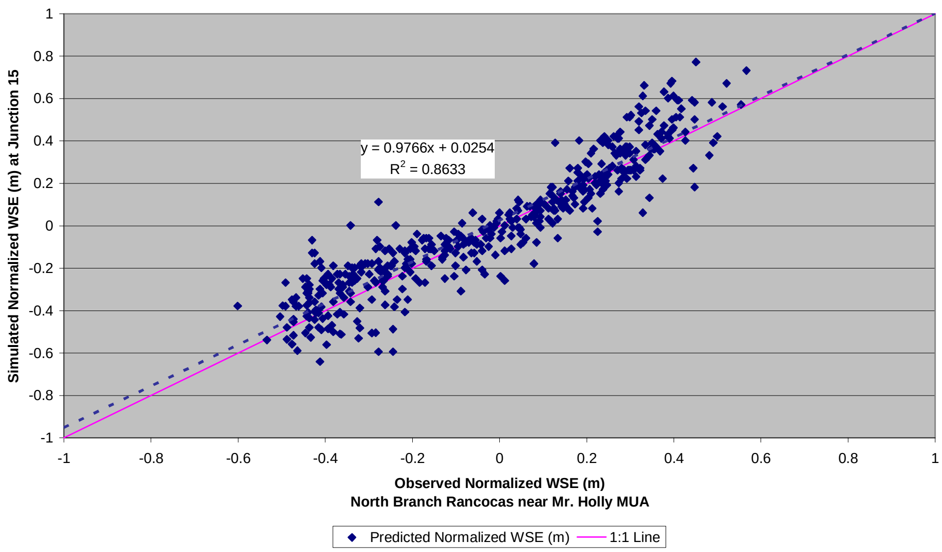
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Primary Calibration



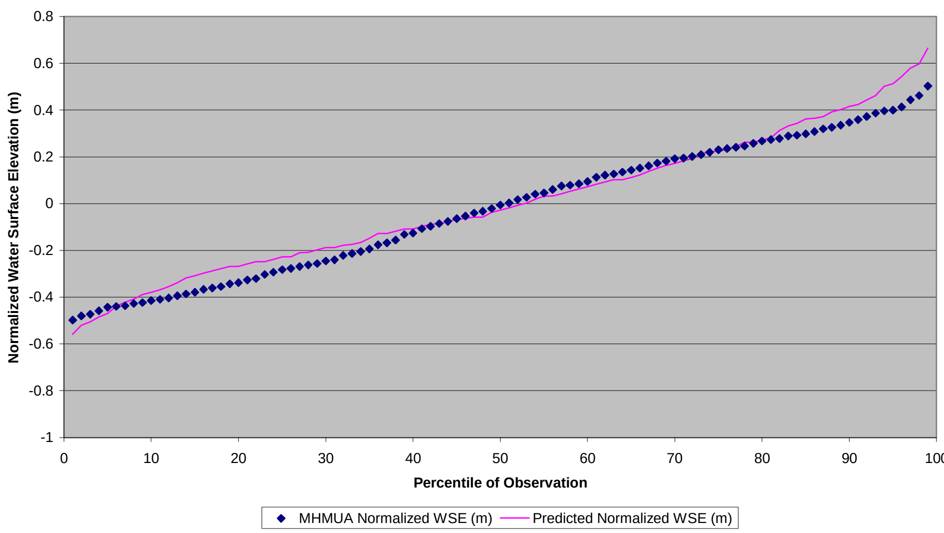
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Primary Calibration



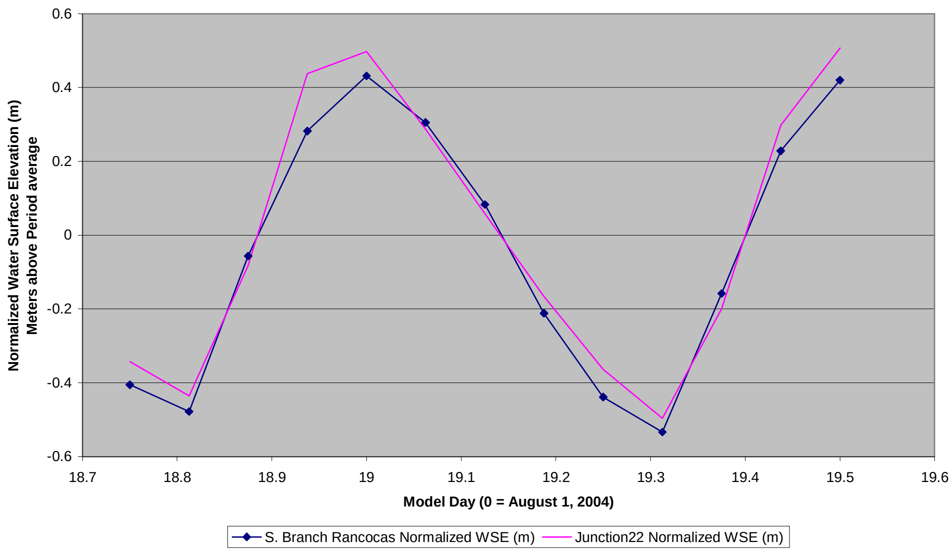
Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m)
North Branch Rancocas Creek near Mt. Holly MUA
Primary Calibration



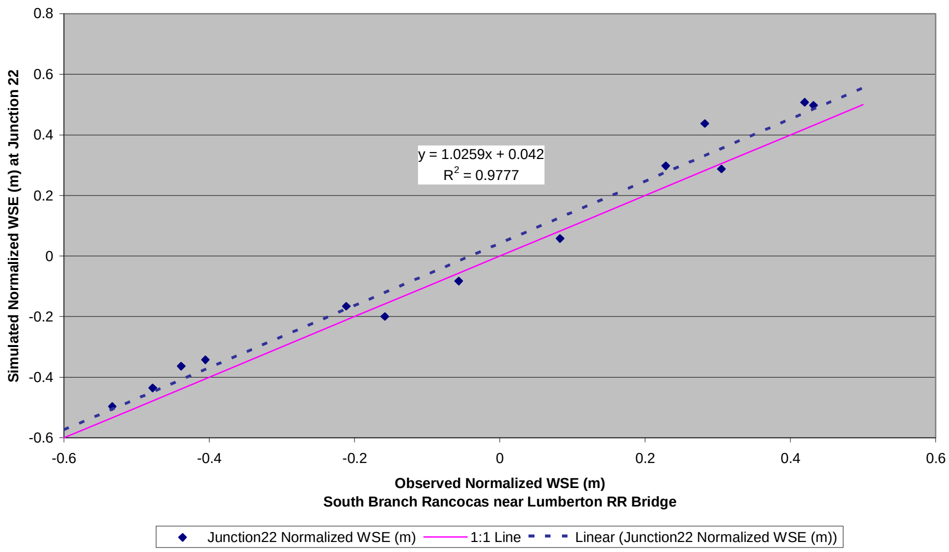
Comparison of Cumulative Frequency Distributions
of Predicted and Observed Normalized Water Surface Elevations (m)
North Branch Rancocas Creek near Mt. Holly MUA
Primary Calibration



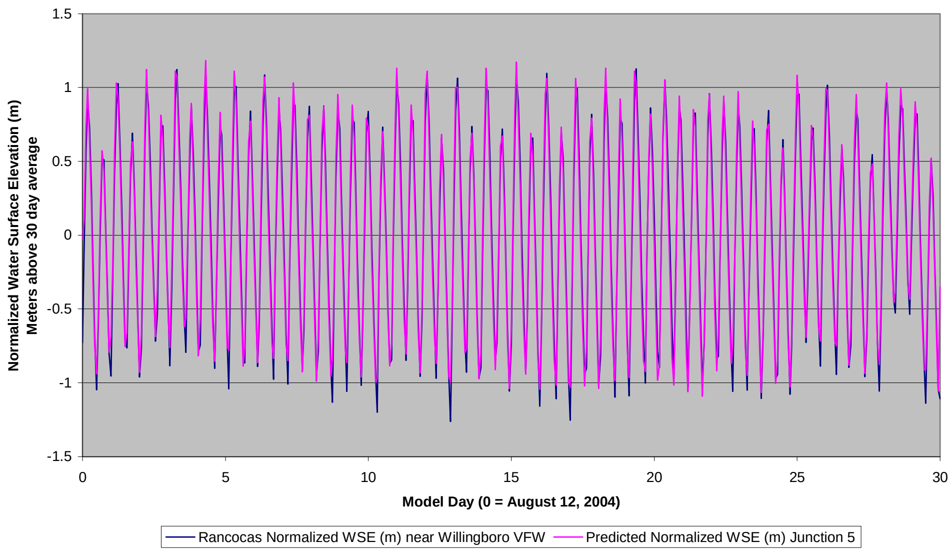
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
South Branch Rancocas Creek near Lumberton RR Bridge
Primary Calibration



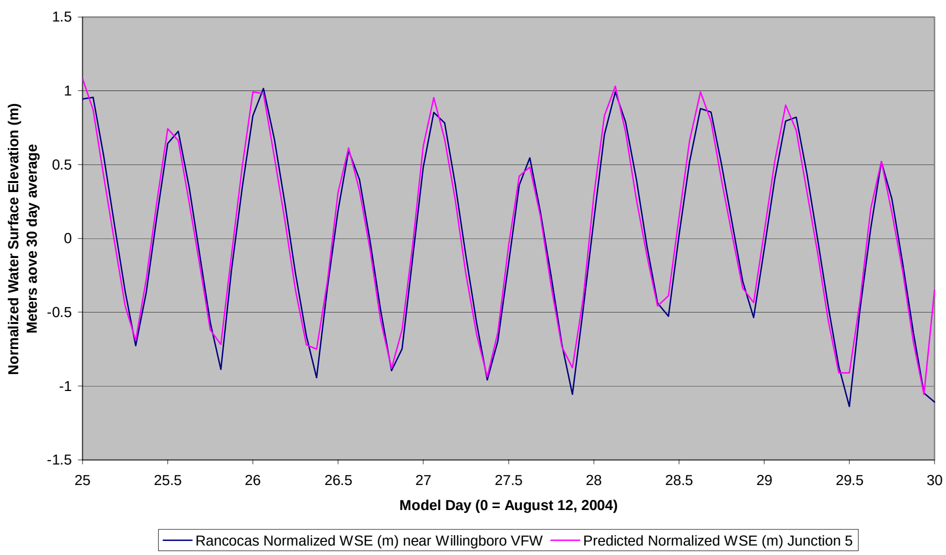
Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m) South Branch Rancocas Creek near Lumberton RR Bridge
Primary Calibration



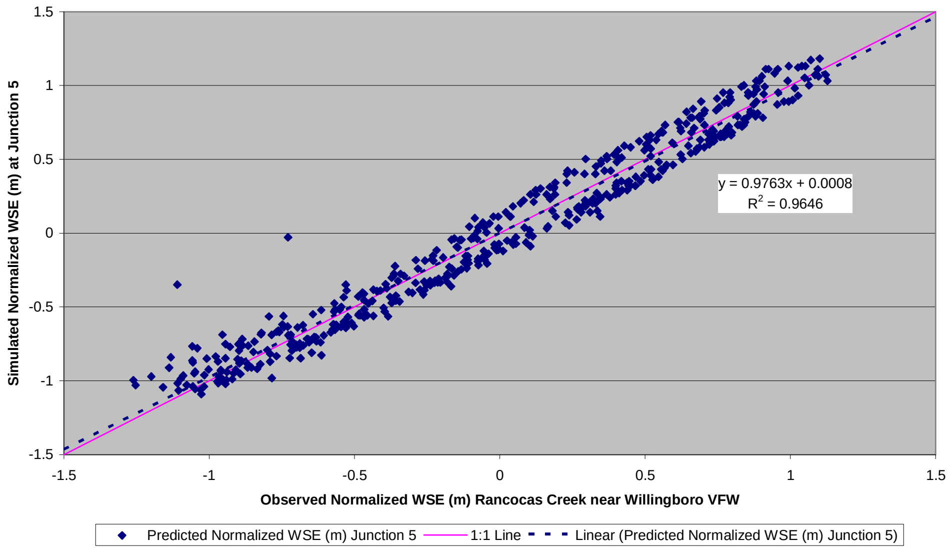
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
Rancocas Creek near Willingboro VFW Post
Supplemental Calibration Period



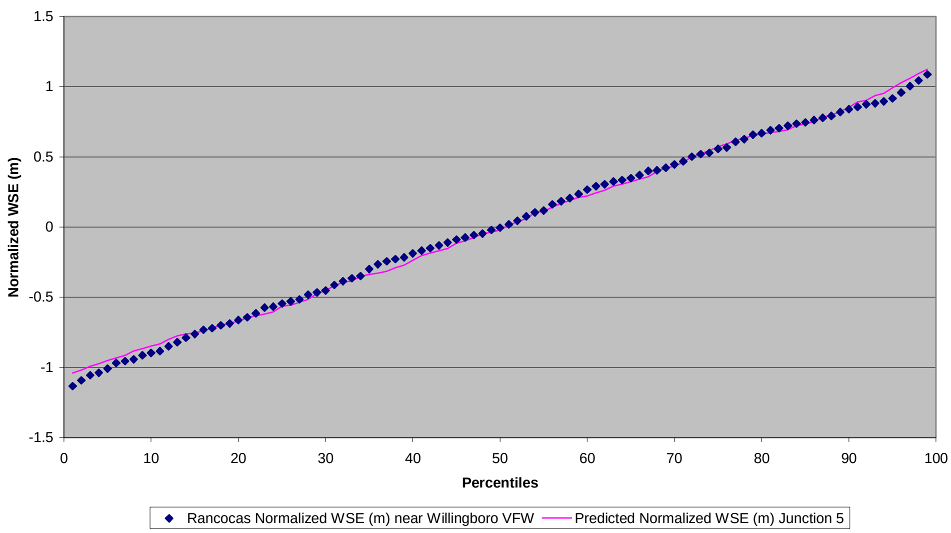
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
Rancocas Creek near Willingboro VFW Post
Supplemental Calibration Period

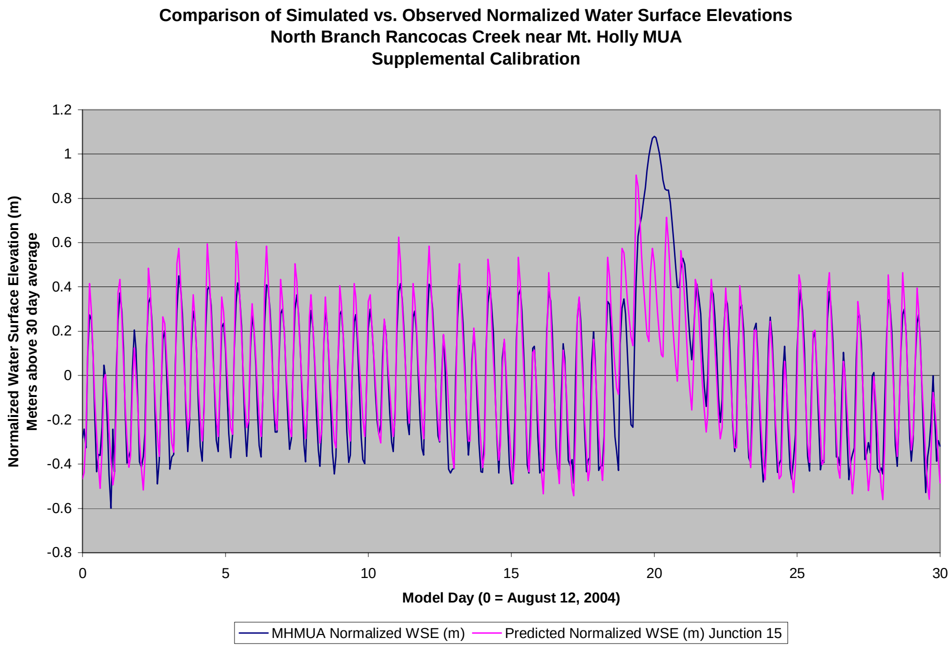


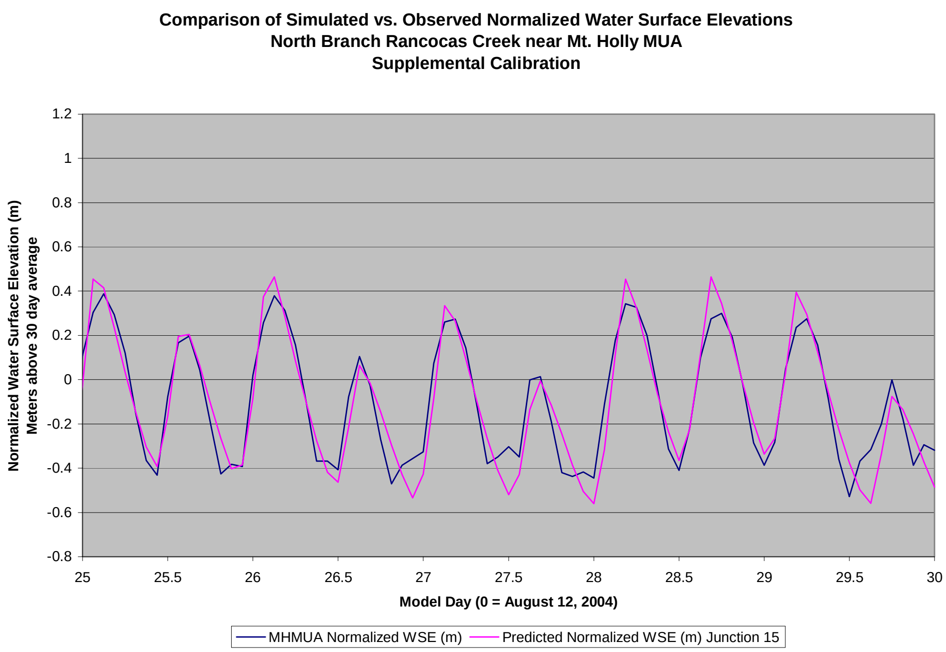
Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m) Rancocas Creek near Willingboro VFW
Supplemental Calibration



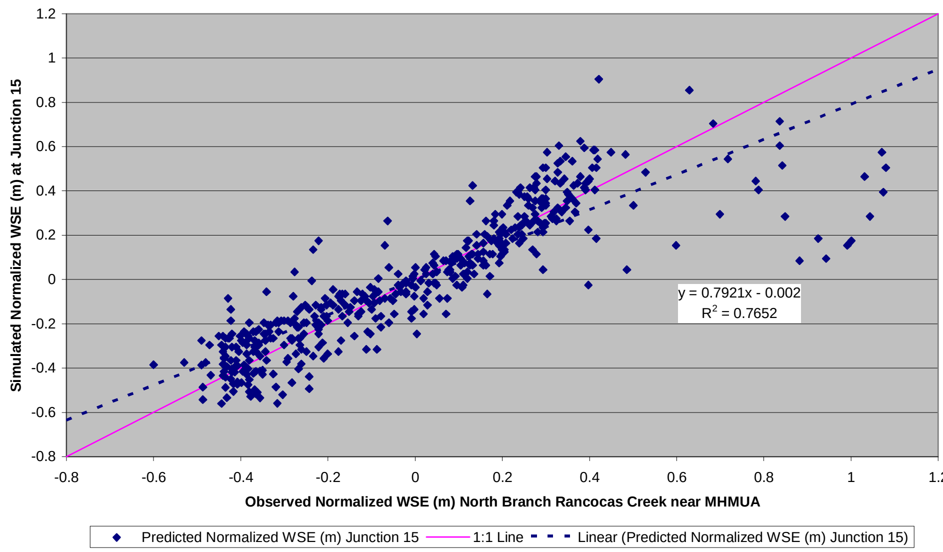
Comparison of Cumulative Frequency Distributions of Predicted and Observed Normalized Water Surface Elevations (m)
Rancocas Creek near Willingboro VFW
Supplemental Calibration



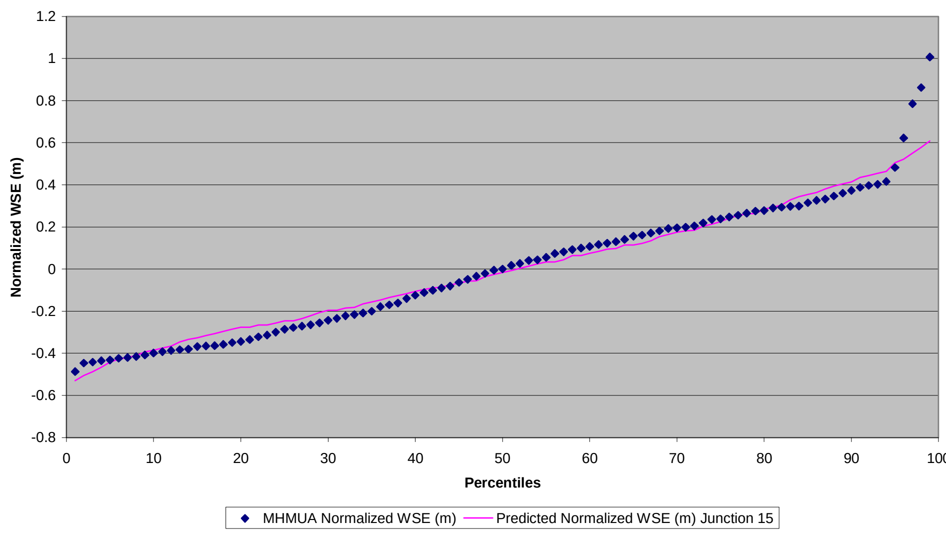

Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Supplemental Calibration
Normalized Water Surface Elevation (m)
Meters above 30 day average
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
5
10
15
20
25
30
Model Day (0 = August 12, 2004)
MHMUA Normalized WSE (m)
Predicted Normalized WSE (m) Junction 15

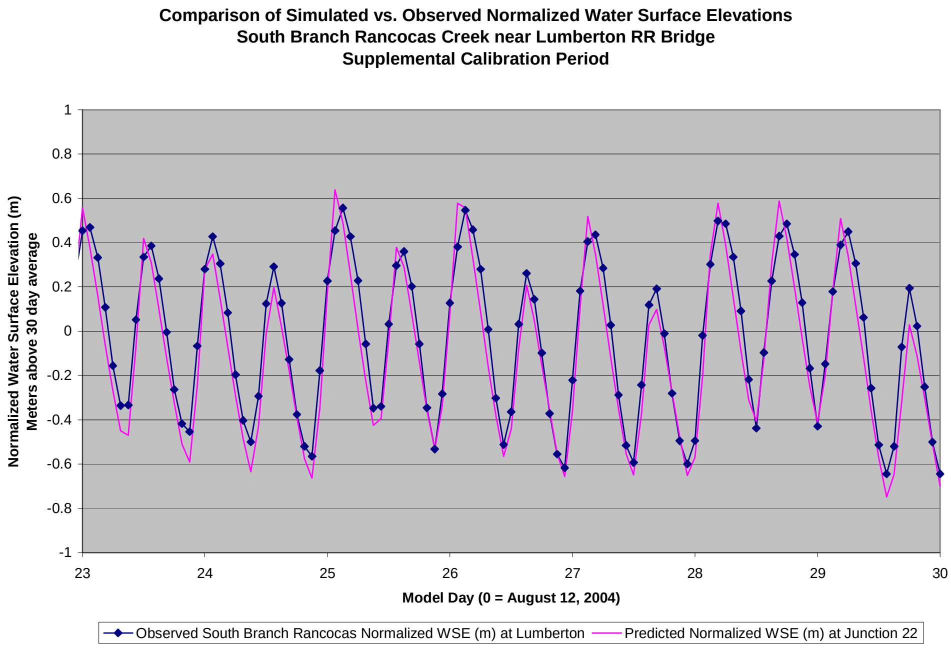

Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Supplemental Calibration
Normalized Water Surface Elevation (m)
Meters above 30 day average
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
25
25.5
26
26.5
27
27.5
28
28.5
29
29.5
30
Model Day (0 = August 12, 2004)
MHMUA Normalized WSE (m)
Predicted Normalized WSE (m) Junction 15

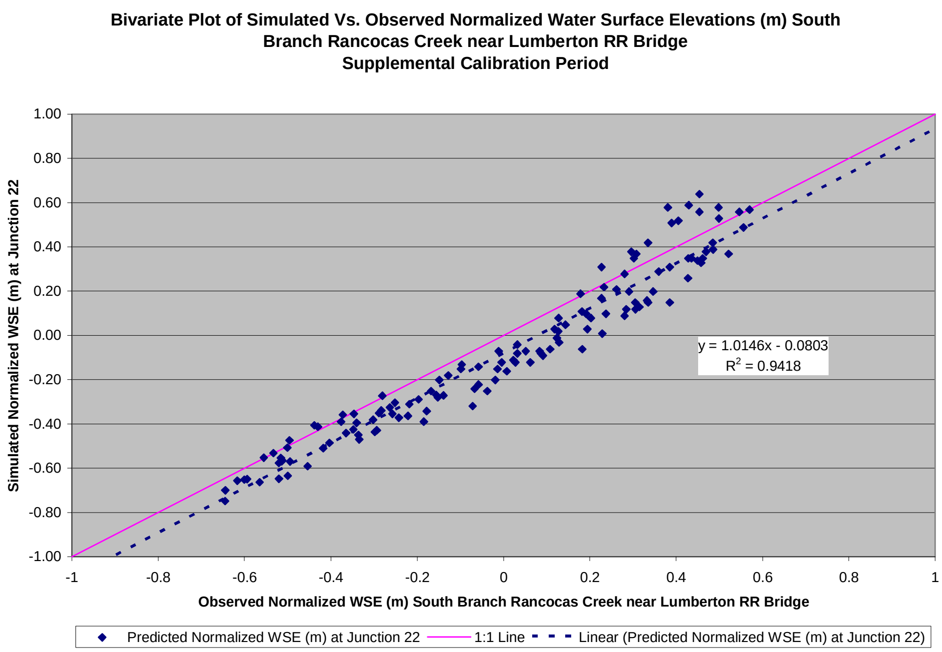
Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m) North Branch Rancocas Creek near Mt. Holly MUA Supplemental Calibration

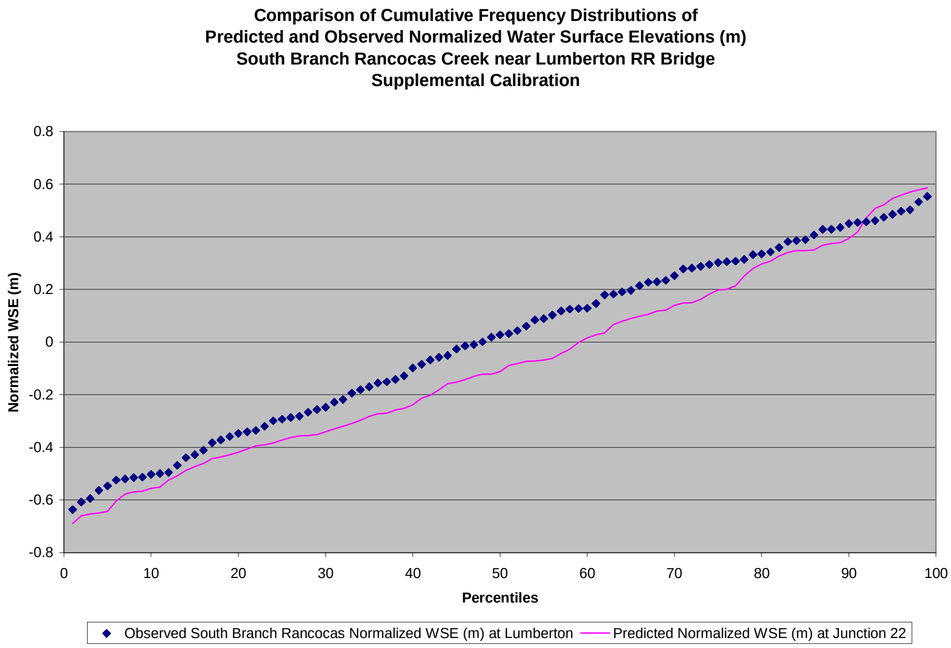


Comparison of Cumulative Frequency Distributions of Predicted and Observed Normalized Water Surface Elevations (m) North Branch Rancocas Creek near Mt. Holly MUA Supplemental Calibration

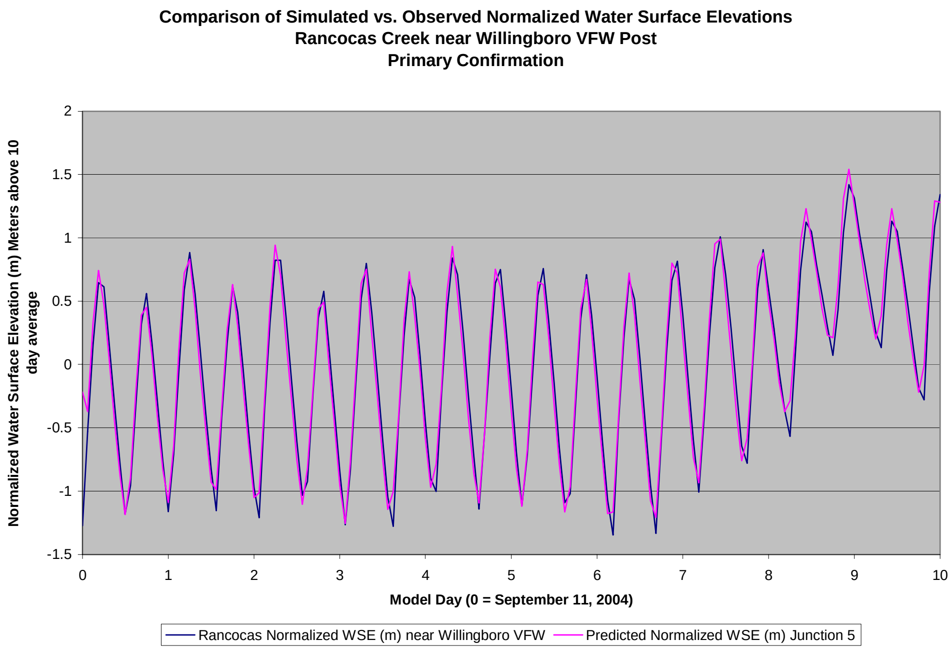


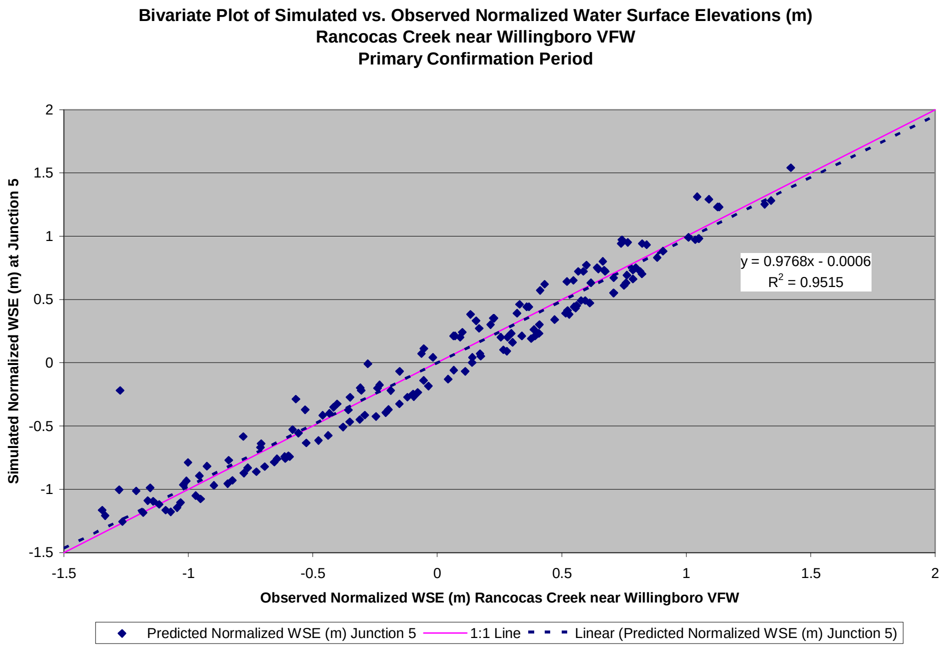

Comparison of Simulated vs. Observed Normalized Water Surface Elevations
South Branch Rancocas Creek near Lumberton RR Bridge
Supplemental Calibration Period
Normalized Water Surface Elevation (m)
Meters above 30 day average
Model Day (0 = August 12, 2004)
Observed South Branch Rancocas Normalized WSE (m) at Lumberton
Predicted Normalized WSE (m) at Junction 22

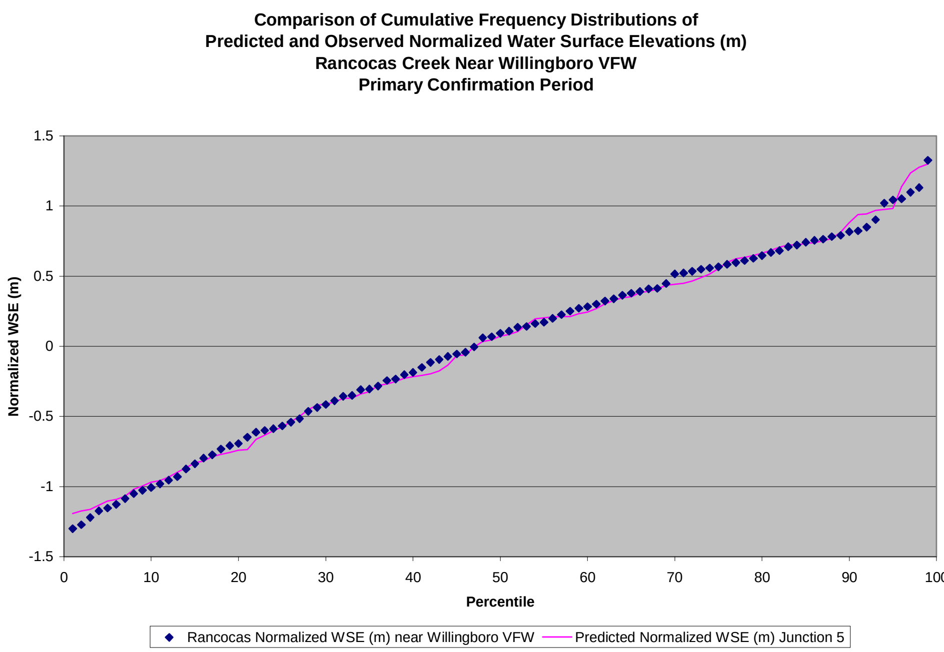

Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m) South Branch Rancocas Creek near Lumberton RR Bridge
Supplemental Calibration Period
Simulated Normalized WSE (m) at Junction 22
y = 1.0146x - 0.0803
R2 = 0.9418
Observed Normalized WSE (m) South Branch Rancocas Creek near Lumberton RR Bridge
Predicted Normalized WSE (m) at Junction 22
1:1 Line
Linear (Predicted Normalized WSE (m) at Junction 22)

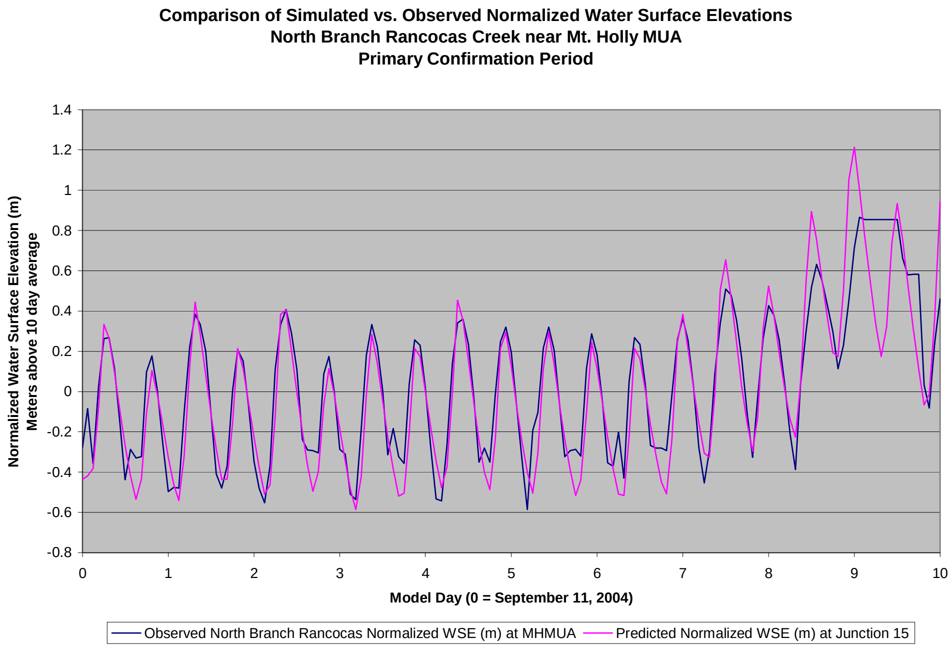


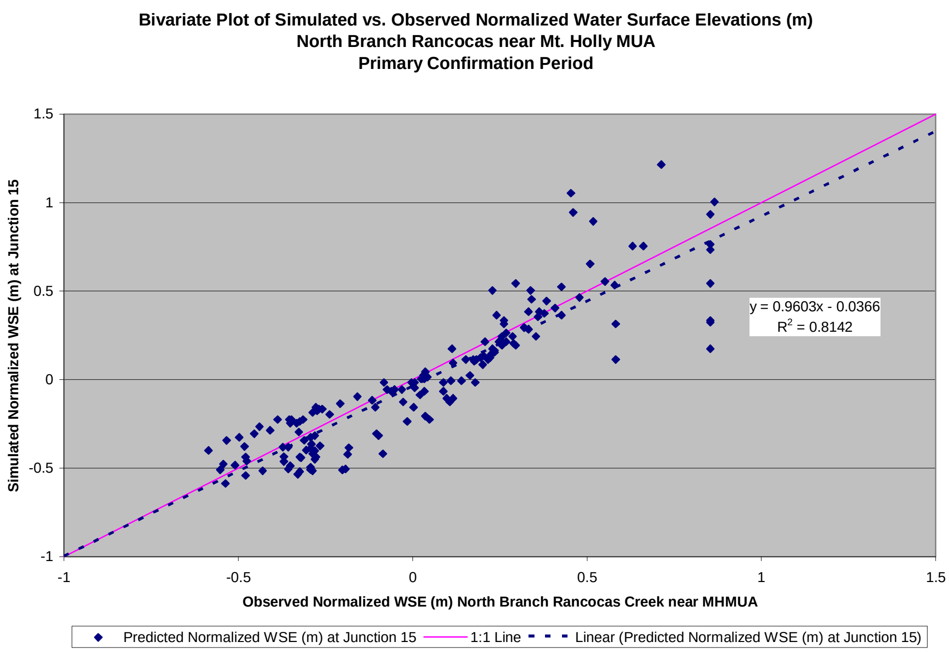
Confirmation Output and Results



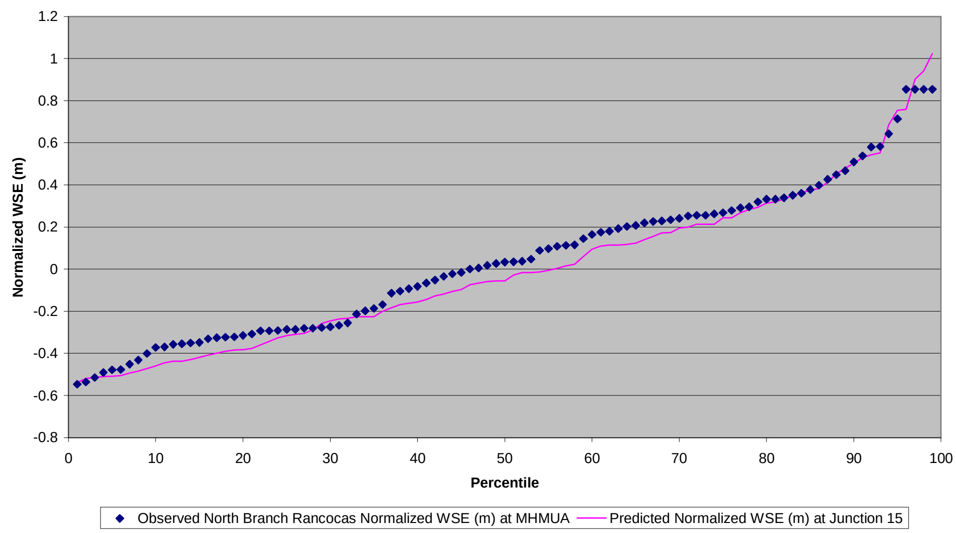

Bivariate Plot of Simulated vs. Observed Normalized Water Surface Elevations (m)
Rancocas Creek near Willingboro VFW
Primary Confirmation Period
Simulated Normalized WSE (m) at Junction 5
Observed Normalized WSE (m) Rancocas Creek near Willingboro VFW
y = 0.9768x - 0.0006
R2 = 0.9515
Predicted Normalized WSE (m) Junction 5
1:1 Line
Linear (Predicted Normalized WSE (m) Junction 5)


Comparison of Cumulative Frequency Distributions of
Predicted and Observed Normalized Water Surface Elevations (m)
Rancocas Creek Near Willingboro VFW
Primary Confirmation Period
Normalized WSE (m)
Percentile
Rancocas Normalized WSE (m) near Willingboro VFW
Predicted Normalized WSE (m) Junction 5

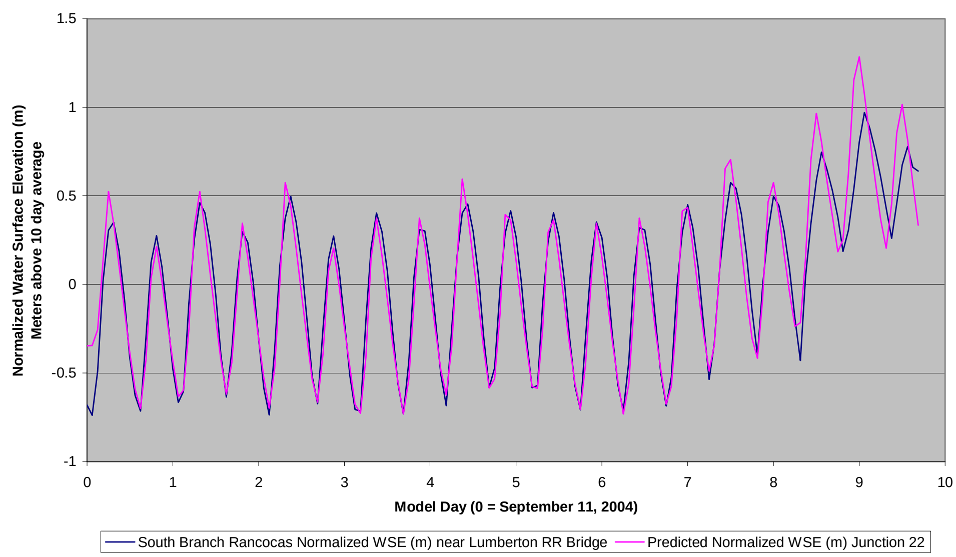

Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Primary Confirmation Period
Normalized Water Surface Elevation (m)
Meters above 10 day average
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
1
2
3
4
5
6
7
8
9
10
Model Day (0 = September 11, 2004)
Observed North Branch Rancocas Normalized WSE (m) at MHMUA
Predicted Normalized WSE (m) at Junction 15


Bivariate Plot of Simulated vs. Observed Normalized Water Surface Elevations (m)
North Branch Rancocas near Mt. Holly MUA
Primary Confirmation Period
Simulated Normalized WSE (m) at Junction 15
1.5
1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1
1.5
y = 0.9603x - 0.0366
R2 = 0.8142
Observed Normalized WSE (m) North Branch Rancocas Creek near MHMUA
Predicted Normalized WSE (m) at Junction 15
1:1 Line
Linear (Predicted Normalized WSE (m) at Junction 15)

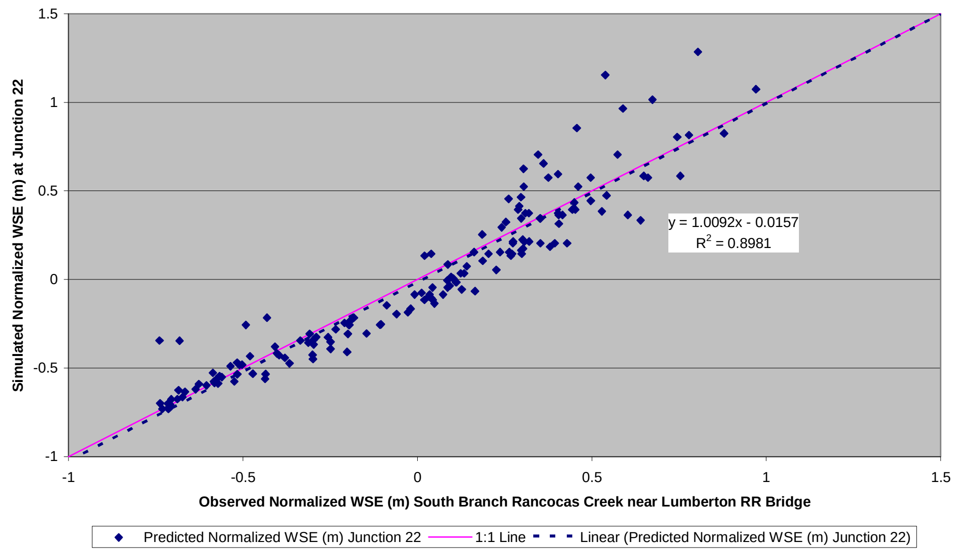
Comparison of Cumulative Frequency Distributions of Predicted and Observed Normalized Water Surface Elevations (m) North Branch Rancocas Creek Near Mt. Holly MUA Primary Confirmation Period



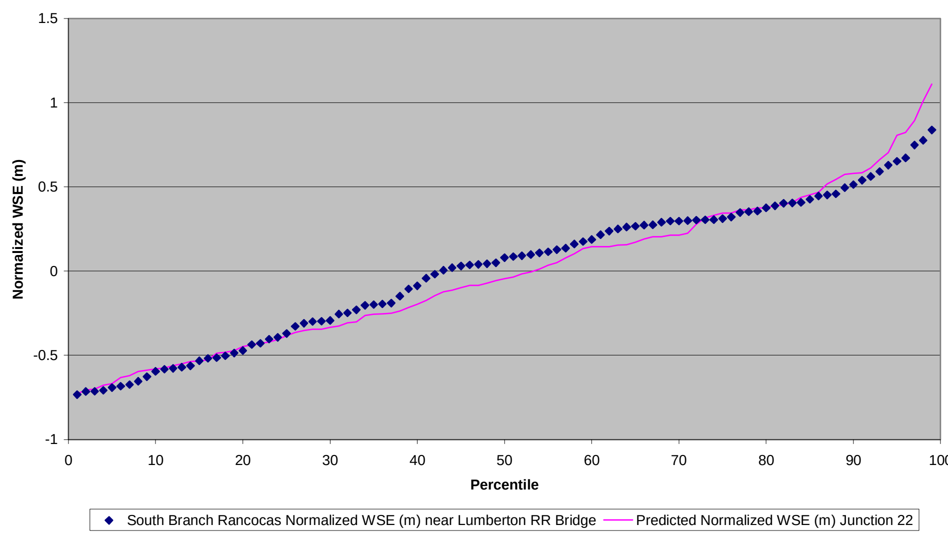
Comparison of Simulated vs. Observed Normalized Water Surface Elevations South Branch Rancocas Creek near Lumberton RR Bridge Primary Confirmation



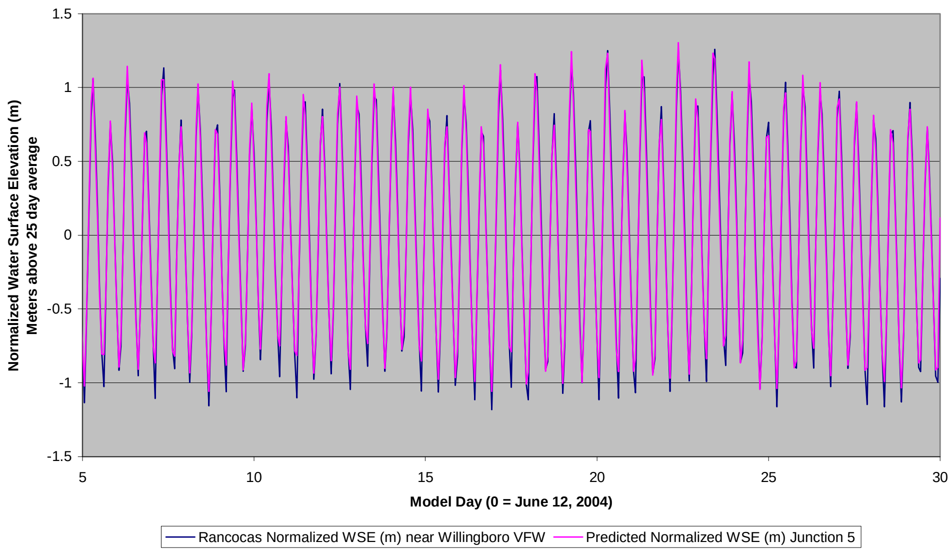
Bivariate Plot of Simulated vs. Observed Normalized Water Surface Elevations (m) South Branch Rancocas Creek near Lumberton RR Bridge
Primary Confirmation Period



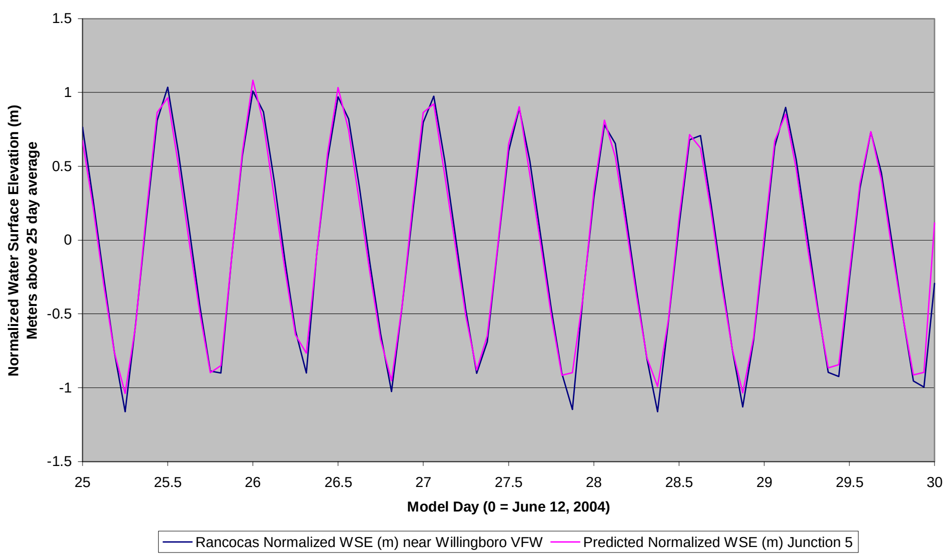
Comparison of Cumulative Frequency Distributions of
Predicted and Observed Normalized Water Surface Elevations (m)
South Branch Rancocas Creek near Lumberton RR Bridge
Primary Confirmation Period

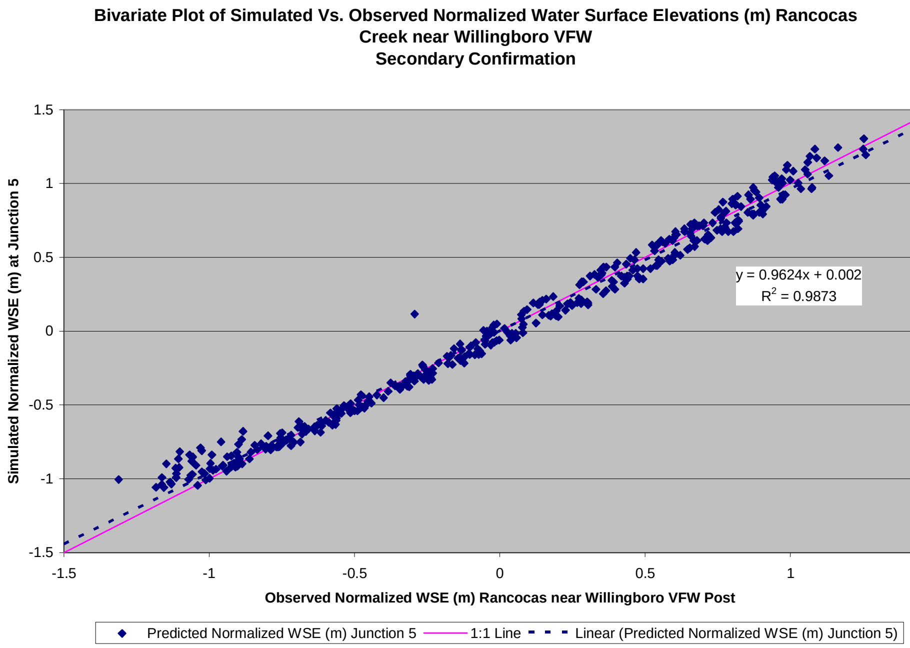


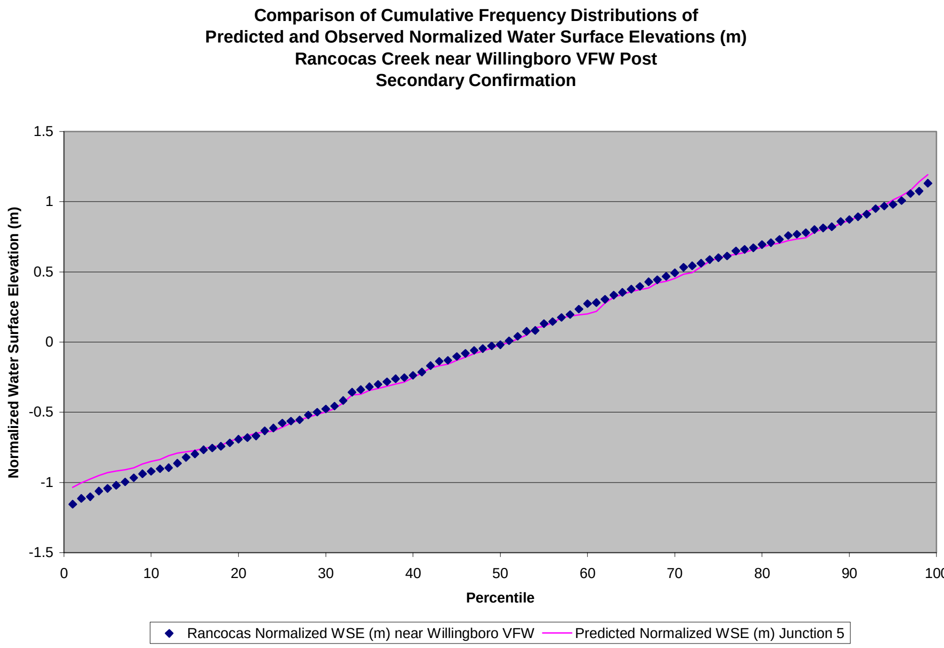
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
Rancocas Creek near Willingboro VFW Post
Secondary Confirmation



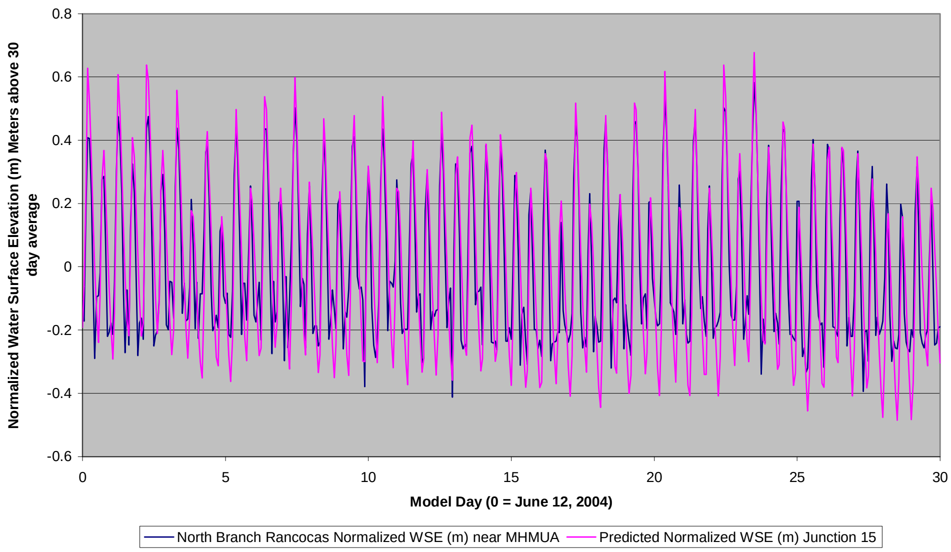
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
Rancocas Creek near Willingboro VFW Post
Secondary Confirmation



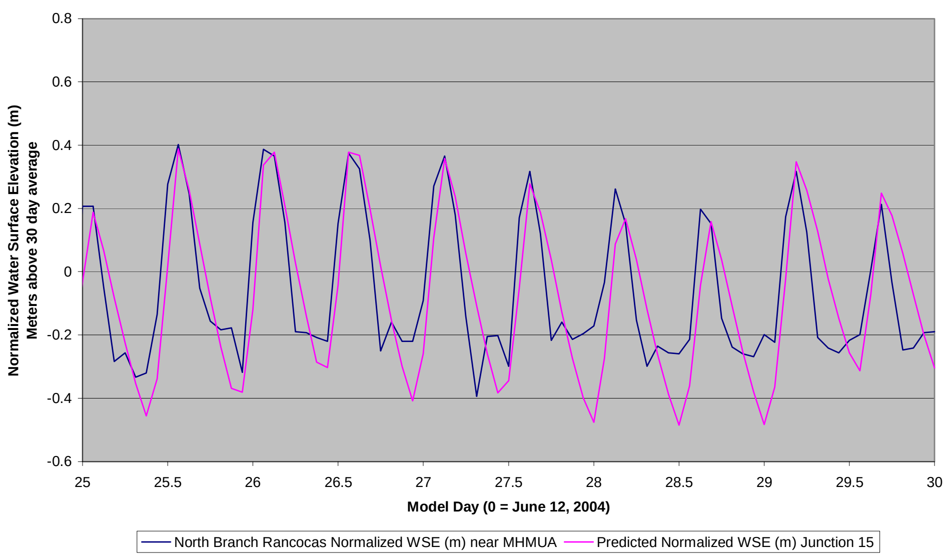

Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m) Rancocas Creek near Willingboro VFW
Secondary Confirmation
Simulated Normalized WSE (m) at Junction 5
Observed Normalized WSE (m) Rancocas near Willingboro VFW Post
y = 0.9624x + 0.002
R2 = 0.9873
1.5
1
0.5
0
-0.5
-1
-1.5
Predicted Normalized WSE (m) Junction 5
1:1 Line
Linear (Predicted Normalized WSE (m) Junction 5)


Comparison of Cumulative Frequency Distributions of Predicted and Observed Normalized Water Surface Elevations (m)
Rancocas Creek near Willingboro VFW Post
Secondary Confirmation
Normalized Water Surface Elevation (m)
Percentile
0
10
20
30
40
50
60
70
80
90
100
Rancocas Normalized WSE (m) near Willingboro VFW
Predicted Normalized WSE (m) Junction 5

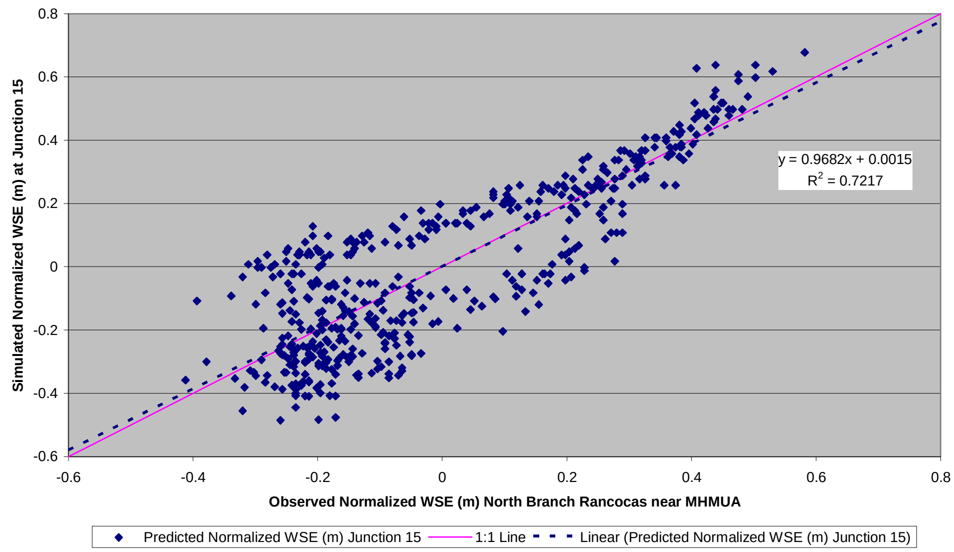
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Secondary Confirmation



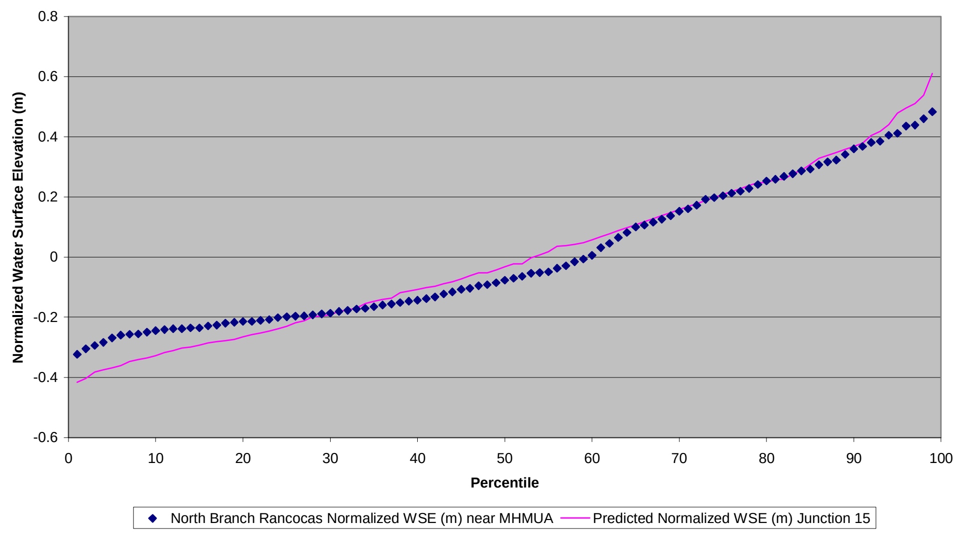
Comparison of Simulated vs. Observed Normalized Water Surface Elevations
North Branch Rancocas Creek near Mt. Holly MUA
Secondary Confirmation



Bivariate Plot of Simulated Vs. Observed Normalized Water Surface Elevations (m) North Branch Rancocas Creek near Mt. Holly MUA
Secondary Confirmation



Comparison of Cumulative Frequency Distributions of Predicted and Observed Normalized Water Surface Elevations (m) North Branch Rancocas Creek near Mt. Holly MUA
Secondary Confirmation



Appendix B

VBA Excel Code for Pre- and Post-Processors

VBA Excel Code for Pre-Processor

```
'*******************************************************************************
'*                                                                             *
'*              DYNHYD PRE-PROCESSOR                                           *
'*              a VBA Program to create Dynhyd Input Files from Excel Worksheets  *
'*                                                                             *
'*              Programmed by:                                                 *
'*                  John Yagecic                                               *
'*                  Delaware River Basin Commission                            *
'*                  609-883-9500 x271                                          *
'*                  jyagecic@drbc.state.nj.us                                  *
'*                  www.state.nj.us/drbc/                                      *
'*                                                                             *
'*                  August 2003                                                *
'*                                                                             *
'*******************************************************************************

Option Explicit

Dim junctioncount As Integer
Dim channelcount As Integer
Dim nt As Integer, i As Integer, j As Integer, z As Integer


Dim tidedata(4, 1000) As Double
Dim quadrow(1000) As String
Dim k As Integer, filerows As Integer
Dim tideinstring(1000) As String
Dim rowrecnum1 As Integer, rowrecnum2 As Integer, rowrecnum3 As Integer
Dim rowrecnum4 As Integer

Dim imed1(1000) As String
Dim imed2(1000) As String
Dim imed3(1000) As String
Dim imed4(1000) As String
Dim ts(4, 1000) As String
Dim cl(4, 1000) As Integer
Dim rn1 As Integer, rn2 As Integer, rn3 As Integer, rn4 As Integer

Dim b As Integer

' General string variables

Dim starsline As String, Header1 As String, Header2 As String, Header3 As String
Dim Header4 As String, Header5 As String, Header6 As String, Header7 As String
Dim Header8 As String, Header9 As String, Header10 As String, Header11 As String
Dim Header12 As String, Header13 As String
Dim nodata As String
Dim logfile As String
Dim logpath As String



' Simulation control variables

Dim today As String
Dim simtype As String
Dim simtypeval As Integer
Dim name1 As String
Dim simdate As String
Dim seqrun As String
Dim seqtemp As String
Dim seq4space As String
Dim seqval As Integer
Dim modeler As String
Dim description As String
Dim line1 As String
Dim line2 As String
```

```
Dim stars As String


' Program control variables

Dim juncnum As String
Dim channum As String
Dim timesteps As String
Dim timeinterval As String
Dim initcon As String
Dim firstday As String
Dim hourbegin As String
Dim minbegin As String
Dim lastday As String
Dim hourend As String
Dim minend As String
Dim pcd(11) As Integer


' Printout Control Variables

Dim printstart As String
Dim printinterval As String
Dim printjuncnos As String
Dim pn(3) As Integer
Dim jl(100) As Integer
Dim icheck As Integer
Dim rcheck As Double
Dim printjuncs As Integer
Dim junctions(100) As String


' Summary Control Variables

Dim sumfileopt As String
Dim sumdaystart As String
Dim sumhourstart As String
Dim summinstart As String
Dim intermedinterval As String
Dim hydperwq As String
Dim hydtoscratch As String
Dim sml(7) As Integer


' Junction Variables

Dim modjuncs(100) As String
Dim jhead(100) As String
Dim jarea(100) As String
Dim bottomelev(100) As String
Dim chanent(100, 6) As String
Dim mj(100) As Integer
Dim jh(100) As Integer
Dim ja(100) As Integer
Dim be(100) As Integer
Dim che(100, 6) As Integer


' Channel Data Variables

Dim modchans(100) As String
Dim chanlen(100) As String
Dim chanwidth(100) As String
Dim Hydrad(100) As String
Dim chanang(100) As String
Dim mannings(100) As String
Dim velinit(100) As String
Dim usjunc(100) As String
Dim dsjunc(100) As String
Dim mc(100) As Integer
Dim ce(100) As Integer
```

```
Dim cw(100) As Integer
Dim hr(100) As Integer
Dim ang(100) As Integer
Dim mr(100) As Integer
Dim vi(100) As Integer
Dim uj(100) As Integer
Dim dj(100) As Integer


' Constant Flow Variables

Dim conflownum As Integer
Dim conflowstr As String
Dim conflowjunc(100) As String
Dim conflowrate(100) As String
Dim cfn As Integer
Dim cfj(100) As Integer
Dim cfr(100) As Integer


' Unsteady Flow Variables

Dim varflowcount As Integer
Dim varflowstr As String
Dim varflowjunc(100) As String
Dim varflowbreaksstr(100) As String
Dim varflowbreak(100) As Integer
Dim varflowday(100, 1000) As String
Dim varflowhour(100, 1000) As String
Dim varflowmin(100, 1000) As String
Dim varflowrate(100, 1000) As String
Dim vst As Integer
Dim vfj(100) As Integer
Dim vfb(100) As Integer
Dim vfd(100, 1000) As Integer
Dim vfh(100, 1000) As Integer
Dim vfm(100, 1000) As Integer
Dim vfr(100, 1000) As Integer
Dim vfjlimit As Integer

Dim seaopt As String
Dim seaboundnum As String
Dim seaboundjunc As String
Dim seaboundbreak As Double
Dim seaboundbreakstr As String
Dim so As Integer
Dim sbn As Integer
Dim sbj As Integer
Dim sbb As Integer



Sub MakeInFile()

' general string variables
stars = "*************************"
Header1 = "PROGRAM CONTROL DATA**********"
Header2 = "PRINTOUT CONTROL DATA*********"
Header3 = "SUMMARY CONTROL DATA**********"
Header4 = "JUNCTION DATA*****************"
Header5 = "CHANNEL DATA******************"
Header6 = "CONSTANT FLOW DATA************"
Header7 = "VARIABLE FLOW DATA************"
Header8 = "SEAWARD BOUNDARY DATA*********"
Header9 = "WIND DATA*********************"
Header10 = "EVAP / PRECIP*****************"
Header11 = "DATA JUNCTION GEOMETRY DATA***"
Header12 = "CHANNEL GEOMETRY DATA*********"
Header13 = "MAP TO WASP*******************"
nodata = "    0"
```

```
' get Simulation control data

today = Now
Sheets("Simulation Control").Select
Range("B1").Select
name1 = ActiveCell.Value
Range("B2").Select
simdate = ActiveCell.Value
Range("B3").Select
seqrun = ActiveCell.Value
seqval = ActiveCell.Value
seqtemp = "0000000000" & seqrun
seq4space = Right(seqtemp, 4)
Range("B4").Select
modeler = ActiveCell.Value
Range("b5").Select
description = ActiveCell.Value
Range("j9").Select
simtypeval = ActiveCell.Value
If simtypeval = 1 Then simtype = "Test"
If simtypeval = 2 Then simtype = "Calibration"
If simtypeval = 3 Then simtype = "Confirmation"
If simtypeval = 4 Then simtype = "Simulation"

line1 = name1 & " : " & today & " : Run No. " & simtype & "-" & seq4space & " : " & modeler
line2 = description
logfile = "InputLog" & simtype & seq4space

Range("B9").Select
ActiveCell.Value = line1
Range("B10").Select
ActiveCell.Value = line2

seqval = seqval + 1
Range("b3").Select
ActiveCell.Value = seqval


' get Program Control Data

Sheets("Program Control Data").Select
Range("b1").Select
juncnum = ActiveCell.Value
junctioncount = ActiveCell.Value
Range("b2").Select
channum = ActiveCell.Value
channelcount = ActiveCell.Value
Range("b3").Select
timesteps = ActiveCell.Value
Range("b4").Select
timeinterval = ActiveCell.Value
Range("b5").Select
initcon = ActiveCell.Value
Range("b7").Select
firstday = ActiveCell.Value
Range("b8").Select
hourbegin = ActiveCell.Value
Range("b9").Select
minbegin = ActiveCell.Value
Range("b11").Select
lastday = ActiveCell.Value
Range("b12").Select
hourend = ActiveCell.Value
Range("b13").Select
minend = ActiveCell.Value

pcd(1) = Len(juncnum)
pcd(2) = Len(channum)
pcd(3) = Len(timesteps)
```

```
pcd(4) = Len(timeinterval)
pcd(5) = Len(initcon)
pcd(6) = Len(firstday)
pcd(7) = Len(hourbegin)
pcd(8) = Len(minbegin)
pcd(9) = Len(lastday)
pcd(10) = Len(hourend)
pcd(11) = Len(minend)


' get Printout Control Data

Sheets("Printout Control Data").Select
Range("b1").Select
printstart = ActiveCell.Value
Range("b2").Select
printinterval = ActiveCell.Value
Range("b3").Select
printjuncnos = ActiveCell.Value

pn(1) = Len(printstart)
pn(2) = Len(printinterval)
pn(3) = Len(printjuncnos)

Range("A6").Select
nt = ActiveCell.Row
Selection.End(xlDown).Select
nt = ActiveCell.Row - nt + 1

printjuncs = 0

icheck = Int(nt / 16)
rcheck = nt / 16
If icheck = rcheck Then
    printjuncs = Int(nt / 16)
Else
    printjuncs = Int((nt / 16) + 1)
End If

Range("e1").Select
ActiveCell.Value = nt

Range("A6").Select
For i = 1 To nt
    junctions(i) = ActiveCell.Value
    jl(i) = Len(junctions(i))
    ActiveCell.Offset(1, 0).Select
Next i


' get Summary Control Data

Sheets("Summary Control Data").Select
Range("b1").Select
sumfileopt = ActiveCell.Value
Range("b2").Select
sumdaystart = ActiveCell.Value
Range("b3").Select
sumhourstart = ActiveCell.Value
Range("b4").Select
summinstart = ActiveCell.Value
Range("b5").Select
intermedinterval = ActiveCell.Value
Range("b6").Select
hydperwq = ActiveCell.Value
Range("b7").Select
hydtoscratch = ActiveCell.Value

sml(1) = Len(sumfileopt)
sml(2) = Len(sumdaystart)
sml(3) = Len(sumhourstart)
```

```
sml(4) = Len(summinstart)
sml(5) = Len(intermedinterval)
sml(6) = Len(hydperwq)
sml(7) = Len(hydtoscratch)


' get Junction Data

Sheets("Junction Data").Select

Range("a2").Select

i = 0
For i = 1 To junctioncount
    modjuncs(i) = ActiveCell.Value
    mj(i) = Len(modjuncs(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("b2").Select

i = 0
For i = 1 To junctioncount
    jhead(i) = ActiveCell.Value
    jh(i) = Len(jhead(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("c2").Select

i = 0
For i = 1 To junctioncount
    jarea(i) = ActiveCell.Value
    ja(i) = Len(jarea(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("d2").Select

i = 0
For i = 1 To junctioncount
    bottomelev(i) = ActiveCell.Value
    be(i) = Len(bottomelev(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("e2").Select

i = 0
For i = 1 To junctioncount
    chanent(i, 1) = ActiveCell.Value
    che(i, 1) = Len(chanent(i, 1))
    ActiveCell.Offset(0, 1).Select
    chanent(i, 2) = ActiveCell.Value
    che(i, 2) = Len(chanent(i, 2))
    ActiveCell.Offset(0, 1).Select
    chanent(i, 3) = ActiveCell.Value
    che(i, 3) = Len(chanent(i, 3))
    ActiveCell.Offset(0, 1).Select
    chanent(i, 4) = ActiveCell.Value
    che(i, 4) = Len(chanent(i, 4))
    ActiveCell.Offset(0, 1).Select
    chanent(i, 5) = ActiveCell.Value
    che(i, 5) = Len(chanent(i, 5))
    ActiveCell.Offset(0, 1).Select
    chanent(i, 6) = ActiveCell.Value
    che(i, 6) = Len(chanent(i, 6))
    ActiveCell.Offset(1, -5).Select
Next i
```

```
' get Channel Data

Sheets("Channel Data").Select

Range("a2").Select
i = 0
For i = 1 To channelcount
    modchans(i) = ActiveCell.Value
    mc(i) = Len(modchans(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("b2").Select
i = 0
For i = 1 To channelcount
    chanlen(i) = ActiveCell.Value
    ce(i) = Len(chanlen(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("c2").Select
i = 0
For i = 1 To channelcount
    chanwidth(i) = ActiveCell.Value
    cw(i) = Len(chanwidth(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("d2").Select
i = 0
For i = 1 To channelcount
    Hydrad(i) = ActiveCell.Value
    hr(i) = Len(Hydrad(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("e2").Select
i = 0
For i = 1 To channelcount
    chanang(i) = ActiveCell.Value
    ang(i) = Len(chanang(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("f2").Select
i = 0
For i = 1 To channelcount
    mannings(i) = ActiveCell.Value
    mr(i) = Len(mannings(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("g2").Select
i = 0
For i = 1 To channelcount
    velinit(i) = ActiveCell.Value
    vi(i) = Len(velinit(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("h2").Select
i = 0
For i = 1 To channelcount
    usjunc(i) = ActiveCell.Value
    uj(i) = Len(usjunc(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("i2").Select
i = 0
For i = 1 To channelcount
```

```
    dsjunc(i) = ActiveCell.Value
    dj(i) = Len(dsjunc(i))
    ActiveCell.Offset(1, 0).Select
Next i


' get Constant Flow data

Sheets("Constant Flow Data").Select

Range("b1").Select
conflowstr = ActiveCell.Value
conflownum = ActiveCell.Value
cfn = Len(conflowstr)

Range("b4").Select
i = 0
For i = 1 To conflownum
    conflowjunc(i) = ActiveCell.Value
    cfj(i) = Len(conflowjunc(i))
    ActiveCell.Offset(1, 0).Select
Next i

Range("c4").Select
i = 0
For i = 1 To conflownum
    conflowrate(i) = ActiveCell.Value
    cfr(i) = Len(conflowrate(i))
    ActiveCell.Offset(1, 0).Select
Next i


' get Variable Flow Data

Sheets("Variable Flow Data").Select
Range("b1").Select

varflowcount = ActiveCell.Value
varflowstr = ActiveCell.Value
vst = Len(varflowstr)

Range("b4").Select

For i = 1 To varflowcount
    varflowjunc(i) = ActiveCell.Value
    vfj(i) = Len(varflowjunc(i))
    ActiveCell.Offset(1, 0).Select
    varflowbreaksstr(i) = ActiveCell.Value
    varflowbreak(i) = ActiveCell.Value
    vfb(i) = Len(varflowbreaksstr(i))
    vfjlimit = varflowbreak(i)
    ActiveCell.Offset(3, 0).Select

    For j = 1 To vfjlimit
        varflowday(i, j) = ActiveCell.Value
        vfd(i, j) = Len(varflowday(i, j))
        ActiveCell.Offset(0, 1).Select
        varflowhour(i, j) = ActiveCell.Value
        vfh(i, j) = Len(varflowhour(i, j))
        ActiveCell.Offset(0, 1).Select
        varflowmin(i, j) = ActiveCell.Value
        vfm(i, j) = Len(varflowmin(i, j))
        ActiveCell.Offset(0, 1).Select
        varflowrate(i, j) = ActiveCell.Value
        vfr(i, j) = Len(varflowrate(i, j))
        ActiveCell.Offset(1, -3).Select
    Next j

    Range("b4").Select
    ActiveCell.Offset(0, (5 * i)).Select
```

```
Next i


' get Seaward Boundary Data

filerows = 0
i = 0
j = 0
k = 0
b = 0
rowrecnum1 = 0
rowrecnum2 = 0
rowrecnum3 = 0
rowrecnum4 = 0

Sheets("Seaward Boundary").Select

Range("b2").Select
seaboundnum = ActiveCell.Value
sbn = Len(seaboundnum)
Range("b3").Select
seaopt = ActiveCell.Value
so = Len(seaopt)
Range("b4").Select
seaboundjunc = ActiveCell.Value
sbj = Len(seaboundjunc)
Range("b5").Select
seaboundbreak = ActiveCell.Value
seaboundbreakstr = ActiveCell.Value
sbb = Len(seaboundbreakstr)

Range("b9").Select
nt = ActiveCell.Row
Selection.End(xlDown).Select
nt = ActiveCell.Row - nt + 1

Range("b9").Select

For i = 1 To nt
    For j = 1 To 4
        tidedata(j, i) = ActiveCell.Value
        ts(j, i) = Str(tidedata(j, i))
        cl(j, i) = Len(ts(j, i))
        ActiveCell.Offset(0, 1).Select
    Next j
    ActiveCell.Offset(1, -4).Select
Next i

icheck = Int(nt / 4)
rcheck = nt / 4
If icheck = rcheck Then
    filerows = Int(nt / 4)
Else
    filerows = Int((nt / 4) + 1)
End If

' open output file

Open "c:\Rancocas\Dynhyd5\examples\temp.inp" For Output As #3


' write to output file

 Print #3, line1
 Print #3, line2
 Print #3, stars & Header1 & stars
 Print #3, Tab(6 - pcd(1)); juncnum; Tab(11 - pcd(2)); channum; Tab(16 - pcd(3)); timesteps;
Tab(21 - pcd(4)); timeinterval _
 ; Tab(26 - pcd(5)); initcon; Tab(31 - pcd(6)); firstday; Tab(34 - pcd(7)); hourbegin; Tab(36 -
pcd(8)); minbegin _
 ; Tab(41 - pcd(9)); lastday; Tab(44 - pcd(10)); hourend; Tab(46 - pcd(11)); minend
```

```
 Print #3, stars & Header2 & stars
 Print #3, Tab(11 - pn(1)); printstart; Tab(21 - pn(2)); printinterval; Tab(26 - pn(3));
printjuncnos
 For i = 1 To printjuncs
    z = ((i - 1) * 16) + 1
    Print #3, Tab(6 - jl(z)); junctions(z); Tab(11 - jl(z + 1)); junctions(z + 1); Tab(16 - jl(z
+ 2)); junctions(z + 2); Tab(21 - jl(z + 3)); junctions(z + 3); _
    Tab(26 - jl(z + 4)); junctions(z + 4); Tab(31 - jl(z + 5)); junctions(z + 5); Tab(36 - jl(z +
6)); junctions(z + 6); Tab(41 - jl(z + 7)); junctions(z + 7); _
    Tab(46 - jl(z + 8)); junctions(z + 8); Tab(51 - jl(z + 9)); junctions(z + 9); Tab(56 - jl(z +
10)); junctions(z + 10); Tab(61 - jl(z + 11)); junctions(z + 11); _
    Tab(66 - jl(z + 12)); junctions(z + 12); Tab(71 - jl(z + 13)); junctions(z + 13); Tab(76 -
jl(z + 14)); junctions(z + 14); Tab(81 - jl(z + 15)); junctions(z + 15)
 Next i
 Print #3, stars & Header3 & stars
 Print #3, Tab(6 - sml(1)); sumfileopt; Tab(11 - sml(2)); sumdaystart; Tab(14 - sml(3));
sumhourstart; Tab(16 - sml(4)); summinstart; Tab(21 - sml(5)); intermedinterval; _
 Tab(26 - sml(6)); hydperwq; Tab(31 - sml(7)); hydtoscratch
 Print #3, stars & Header4 & stars
 For i = 1 To junctioncount
    Print #3, Tab(6 - mj(i)); modjuncs(i); Tab(16 - jh(i)); jhead(i); Tab(26 - ja(i)); jarea(i);
Tab(36 - be(i)); bottomelev(i); _
    Tab(41 - che(i, 1)); chanent(i, 1); Tab(46 - che(i, 2)); chanent(i, 2); Tab(51 - che(i, 3));
chanent(i, 3); Tab(56 - che(i, 4)); chanent(i, 4); _
    Tab(61 - che(i, 5)); chanent(i, 5); Tab(66 - che(i, 6)); chanent(i, 6)
 Next i
 Print #3, stars & Header5 & stars
 For i = 1 To channelcount
    Print #3, Tab(6 - mc(i)); modchans(i); Tab(16 - ce(i)); chanlen(i); Tab(26 - cw(i));
chanwidth(i); Tab(36 - hr(i)); Hydrad(i); Tab(45 - ang(i)); chanang(i); _
    Tab(56 - mr(i)); mannings(i); Tab(66 - vi(i)); velinit(i); Tab(71 - uj(i)); usjunc(i); Tab(76
- dj(i)); dsjunc(i)
 Next i
 ' Constant Flow Data
 Print #3, stars & Header6 & stars
 Print #3, Tab(6 - cfn); conflowstr
 For i = 1 To conflownum
    Print #3, Tab(11 - cfj(i)); conflowjunc(i); Tab(21 - cfr(i)); conflowrate(i)
 Next i
 Print #3, stars & Header7 & stars
 Print #3, Tab(6 - vst); varflowstr
 For i = 1 To varflowcount
    Print #3, Tab(11 - vfj(i)); varflowjunc(i); Tab(21 - vfb(i)); varflowbreaksstr(i)
    icheck = Int(varflowbreak(i) / 4)
    rcheck = varflowbreak(i) / 4
    If icheck = rcheck Then
        vfjlimit = Int(varflowbreak(i) / 4)
    Else
        vfjlimit = Int((varflowbreak(i) / 4) + 1)
    End If
        For j = 1 To vfjlimit
        rn1 = ((j - 1) * 4) + 1
        rn2 = rn1 + 1
        rn3 = rn1 + 2
        rn4 = rn1 + 3
            Print #3, Tab(6 - vfd(i, rn1)); varflowday(i, rn1); Tab(9 - vfh(i, rn1));
varflowhour(i, rn1); Tab(11 - vfm(i, rn1)); varflowmin(i, rn1); Tab(21 - vfr(i, rn1));
varflowrate(i, rn1); _
            Tab(26 - vfd(i, rn2)); varflowday(i, rn2); Tab(29 - vfh(i, rn2)); varflowhour(i,
rn2); Tab(31 - vfm(i, rn2)); varflowmin(i, rn2); Tab(41 - vfr(i, rn2)); varflowrate(i, rn2); _
            Tab(46 - vfd(i, rn3)); varflowday(i, rn3); Tab(49 - vfh(i, rn3)); varflowhour(i,
rn3); Tab(51 - vfm(i, rn3)); varflowmin(i, rn3); Tab(61 - vfr(i, rn3)); varflowrate(i, rn3); _
            Tab(66 - vfd(i, rn4)); varflowday(i, rn4); Tab(69 - vfh(i, rn4)); varflowhour(i,
rn4); Tab(71 - vfm(i, rn4)); varflowmin(i, rn4); Tab(81 - vfr(i, rn4)); varflowrate(i, rn4)
        Next j
    Next i
 Print #3, stars & Header8 & stars
 Print #3, Tab(6 - sbn); seaboundnum
 Print #3, Tab(6 - so); seaopt; Tab(11 - sbj); seaboundjunc; Tab(16 - sbb); seaboundbreakstr; "
0  0.0  0.0  0.0  1.0"
 i = 0
```

```
    For i = 1 To filerows
        z = i
        rn1 = ((z - 1) * 4) + 1
        rn2 = rn1 + 1
        rn3 = rn1 + 2
        rn4 = rn1 + 3
        Print #3, Tab(6 - cl(1, rn1)); ts(1, rn1); Tab(9 - cl(2, rn1)); ts(2, rn1); Tab(11 -
cl(3, rn1)); ts(3, rn1); Tab(21 - cl(4, rn1)); ts(4, rn1); _
        Tab(26 - cl(1, rn2)); ts(1, rn2); Tab(29 - cl(2, rn2)); ts(2, rn2); Tab(31 - cl(3, rn2));
ts(3, rn2); Tab(41 - cl(4, rn2)); ts(4, rn2); _
        Tab(46 - cl(1, rn3)); ts(1, rn3); Tab(49 - cl(2, rn3)); ts(2, rn3); Tab(51 - cl(3, rn3));
ts(3, rn3); Tab(61 - cl(4, rn3)); ts(4, rn3); _
        Tab(66 - cl(1, rn4)); ts(1, rn4); Tab(69 - cl(2, rn4)); ts(2, rn4); Tab(71 - cl(3, rn4));
ts(3, rn4); Tab(81 - cl(4, rn4)); ts(4, rn4)
    Next i
 Print #3, stars & Header9 & stars
    Print #3, nodata
 Print #3, stars & Header10 & stars
    Print #3, nodata
 Print #3, stars & Header11 & stars
    Print #3, nodata
 Print #3, stars & Header12 & stars
    Print #3, nodata
 Print #3, stars & Header13 & stars
    Print #3, nodata; nodata


Close #3


' open Log File
logpath = "c:\Rancocas\Dynhyd5\examples\InputLogFiles\" & logfile & ".txt"
Open logpath For Output As #4


' write to output file

 Print #4, line1
 Print #4, line2
 Print #4, stars & Header1 & stars
 Print #4, Tab(5 - pcd(1)); juncnum; Tab(10 - pcd(2)); channum; Tab(15 - pcd(3)); timesteps;
Tab(20 - pcd(4)); timeinterval _
 ; Tab(25 - pcd(5)); initcon; Tab(30 - pcd(6)); firstday; Tab(33 - pcd(7)); hourbegin; Tab(35 -
pcd(8)); minbegin _
 ; Tab(40 - pcd(9)); lastday; Tab(43 - pcd(10)); hourend; Tab(45 - pcd(11)); minend
 Print #4, stars & Header2 & stars
 Print #4, Tab(10 - pn(1)); printstart; Tab(20 - pn(2)); printinterval; Tab(25 - pn(3));
printjuncnos
 For i = 1 To printjuncs
    z = ((i - 1) * 16) + 1
    Print #4, Tab(5 - jl(z)); junctions(z); Tab(10 - jl(z + 1)); junctions(z + 1); Tab(15 - jl(z
+ 2)); junctions(z + 2); Tab(20 - jl(z + 3)); junctions(z + 3); _
    Tab(25 - jl(z + 4)); junctions(z + 4); Tab(30 - jl(z + 5)); junctions(z + 5); Tab(35 - jl(z +
6)); junctions(z + 6); Tab(40 - jl(z + 7)); junctions(z + 7); _
    Tab(45 - jl(z + 8)); junctions(z + 8); Tab(50 - jl(z + 9)); junctions(z + 9); Tab(55 - jl(z +
10)); junctions(z + 10); Tab(60 - jl(z + 11)); junctions(z + 11); _
    Tab(65 - jl(z + 12)); junctions(z + 12); Tab(70 - jl(z + 13)); junctions(z + 13); Tab(75 -
jl(z + 14)); junctions(z + 14); Tab(80 - jl(z + 15)); junctions(z + 15)
 Next i
 Print #4, stars & Header3 & stars
 Print #4, Tab(5 - sml(1)); sumfileopt; Tab(10 - sml(2)); sumdaystart; Tab(13 - sml(3));
sumhourstart; Tab(15 - sml(4)); summinstart; Tab(20 - sml(5)); intermedinterval; _
 Tab(25 - sml(6)); hydperwq; Tab(30 - sml(7)); hydtoscratch
 Print #4, stars & Header4 & stars
 For i = 1 To junctioncount
    Print #4, Tab(5 - mj(i)); modjuncs(i); Tab(15 - jh(i)); jhead(i); Tab(25 - ja(i)); jarea(i);
Tab(35 - be(i)); bottomelev(i); _
    Tab(40 - che(i, 1)); chanent(i, 1); Tab(45 - che(i, 2)); chanent(i, 2); Tab(50 - che(i, 3));
chanent(i, 3); Tab(55 - che(i, 4)); chanent(i, 4); _
    Tab(60 - che(i, 5)); chanent(i, 5); Tab(65 - che(i, 6)); chanent(i, 6)
 Next i
```

```
 Print #4, stars & Header5 & stars
 For i = 1 To channelcount
    Print #4, Tab(5 - mc(i)); modchans(i); Tab(15 - ce(i)); chanlen(i); Tab(25 - cw(i));
chanwidth(i); Tab(35 - hr(i)); Hydrad(i); Tab(45 - ang(i)); chanang(i); _
    Tab(55 - mr(i)); mannings(i); Tab(65 - vi(i)); velinit(i); Tab(70 - uj(i)); usjunc(i); Tab(75
- dj(i)); dsjunc(i)
 Next i
 Print #4, stars & Header6 & stars
 Print #4, Tab(5 - cfn); conflownum
 For i = 1 To conflownum
    Print #4, Tab(10 - cfj(i)); conflowjunc(i); Tab(20 - cfr(i)); conflowrate(i)
 Next i
 Print #4, stars & Header7 & stars
 Print #4, Tab(5 - vst); varflowstr
 For i = 1 To varflowcount
    Print #4, Tab(10 - vfj(i)); varflowjunc(i); Tab(20 - vfb(i)); varflowbreaksstr(i)
    icheck = Int(varflowbreak(i) / 4)
    rcheck = varflowbreak(i) / 4
    If icheck = rcheck Then
        vfjlimit = Int(varflowbreak(i) / 4)
    Else
        vfjlimit = Int((varflowbreak(i) / 4) + 1)
    End If
        For j = 1 To vfjlimit
        rn1 = ((j - 1) * 4) + 1
        rn2 = rn1 + 1
        rn3 = rn1 + 2
        rn4 = rn1 + 3
            Print #4, Tab(5 - vfd(i, rn1)); varflowday(i, rn1); Tab(8 - vfh(i, rn1));
varflowhour(i, rn1); Tab(10 - vfm(i, rn1)); varflowmin(i, rn1); Tab(20 - vfr(i, rn1));
varflowrate(i, rn1); _
            Tab(25 - vfd(i, rn2)); varflowday(i, rn2); Tab(28 - vfh(i, rn2)); varflowhour(i,
rn2); Tab(30 - vfm(i, rn2)); varflowmin(i, rn2); Tab(40 - vfr(i, rn2)); varflowrate(i, rn2); _
            Tab(45 - vfd(i, rn3)); varflowday(i, rn3); Tab(48 - vfh(i, rn3)); varflowhour(i,
rn3); Tab(50 - vfm(i, rn3)); varflowmin(i, rn3); Tab(60 - vfr(i, rn3)); varflowrate(i, rn3); _
            Tab(65 - vfd(i, rn4)); varflowday(i, rn4); Tab(68 - vfh(i, rn4)); varflowhour(i,
rn4); Tab(70 - vfm(i, rn4)); varflowmin(i, rn4); Tab(80 - vfr(i, rn4)); varflowrate(i, rn4)
        Next j
    Next i
 Print #4, stars & Header8 & stars
 Print #4, Tab(5 - sbn); seaboundnum
 Print #4, Tab(5 - so); seaopt; Tab(10 - sbj); seaboundjunc; Tab(15 - sbb); seaboundbreakstr; "
0  0.0  0.0  0.0  1.0"
 i = 0
    For i = 1 To filerows
        z = i
        rn1 = ((z - 1) * 4) + 1
        rn2 = rn1 + 1
        rn3 = rn1 + 2
        rn4 = rn1 + 3
        Print #4, Tab(5 - cl(1, rn1)); ts(1, rn1); Tab(8 - cl(2, rn1)); ts(2, rn1); Tab(10 -
cl(3, rn1)); ts(3, rn1); Tab(20 - cl(4, rn1)); ts(4, rn1); _
        Tab(25 - cl(1, rn2)); ts(1, rn2); Tab(28 - cl(2, rn2)); ts(2, rn2); Tab(30 - cl(3, rn2));
ts(3, rn2); Tab(40 - cl(4, rn2)); ts(4, rn2); _
        Tab(45 - cl(1, rn3)); ts(1, rn3); Tab(48 - cl(2, rn3)); ts(2, rn3); Tab(50 - cl(3, rn3));
ts(3, rn3); Tab(60 - cl(4, rn3)); ts(4, rn3); _
        Tab(65 - cl(1, rn4)); ts(1, rn4); Tab(68 - cl(2, rn4)); ts(2, rn4); Tab(70 - cl(3, rn4));
ts(3, rn4); Tab(80 - cl(4, rn4)); ts(4, rn4)
    Next i
 Print #4, stars & Header9 & stars
    Print #4, nodata
 Print #4, stars & Header10 & stars
    Print #4, nodata
 Print #4, stars & Header11 & stars
    Print #4, nodata
 Print #4, stars & Header12 & stars
    Print #4, nodata
 Print #4, stars & Header13 & stars
    Print #4, nodata; nodata
```

```
Close #4

Sheets("Simulation Control").Select
Range("a1").Select

End Sub
```

VBA Excel Code for Post Processor

```
'*******************************************************************************
'*                                                                             *
'*            DYNHYD Post-PROCESSOR                                            *
'*            a VBA Program to extract data from DYNHYD5 DFF files             *
'*                                                                             *
'*            Programmed by:                                                   *
'*                John Yagecic                                                 *
'*                Delaware River Basin Commission                              *
'*                609-883-9500 x271                                            *
'*                jyagecic@drbc.state.nj.us                                    *
'*                www.state.nj.us/drbc/                                        *
'*                                                                             *
'*                August 2003                                                  *
'*                                                                             *
'*******************************************************************************

Option Explicit
Dim temp As String
Dim i As Integer, j As Integer, k As Integer, z As Integer
Dim chancount As Integer
Dim timestepnum(10000) As Double
Dim channum(10000) As Double
Dim flow(1000, 100) As Double
Dim vel(1000, 100) As Double
Dim mannings(1000, 100) As Double
Dim dshead(1000, 100) As Double
Dim ushead(1000, 100) As Double
Dim usdepth(1000, 100) As Double
Dim dsdepth(1000, 100) As Double
Dim header As String


Dim alllines(10000) As String
Dim linecount As Integer, recnum As Integer
Dim timestepcount As Integer
Dim nt As Double
Dim tableheader As String


Sub ddfreader()

' initialize values

i = 0
j = 0
k = 0
z = 0

chancount = 0
header = "0"
temp = "0"
linecount = 0
recnum = 0
timestepcount = 0
nt = 0
tableheader = "0"

For i = 1 To 1000
    For j = 1 To 100
        flow(i, j) = 0
        vel(i, j) = 0
        mannings(i, j) = 0
        dshead(i, j) = 0
        ushead(i, j) = 0
        usdepth(i, j) = 0
        dsdepth(i, j) = 0
    Next j
Next i
```

```
For i = 1 To 10000
    timestepnum(i) = 0
    channum(i) = 0
    alllines(i) = 0
Next i

' determine number of channels
Sheets("sheet1").Select
Range("A4").Select
chancount = ActiveCell.Value

' Determine the number of tide data

Sheets("sheet2").Select

Range("B1").Select
nt = ActiveCell.Row
Selection.End(xlDown).Select
nt = ActiveCell.Row - nt + 1

' number of timesteps
timestepcount = (nt / (chancount * 4))

' reset active cell
Range("B1").Select

For i = 1 To timestepcount
    z = i
    timestepnum(z) = ActiveCell.Value
    ActiveCell.Offset((chancount * 4), 0).Select
Next i

i = 0
j = 0

' read flow values to array
Range("A2").Select


For i = 1 To timestepcount
    For j = 1 To chancount
        flow(i, j) = ActiveCell.Value
        ActiveCell.Offset(4, 0).Select
    Next j
Next i

i = 0
j = 0

' read velocity values to array

Range("b2").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        vel(i, j) = ActiveCell.Value
        ActiveCell.Offset(4, 0).Select
    Next j
Next i

i = 0
j = 0

' read upstream head values to array

Range("c2").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        ushead(i, j) = ActiveCell.Value
```

```
        ActiveCell.Offset(4, 0).Select
    Next j
Next i

i = 0
j = 0

' read downstream head values to array

Range("d2").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        dshead(i, j) = ActiveCell.Value
        ActiveCell.Offset(4, 0).Select
    Next j
Next i

i = 0
j = 0

Range("a1").Select

' flow page

Sheets("Flow").Select
ActiveSheet.Name = "Flow"

Range("A1:Z60000").ClearContents
Range("A1").Select
tableheader = "Flow (cms)"
ActiveCell.Value = tableheader


Range("B2").Select
z = 0

For i = 1 To chancount
    z = i
    header = "Junction " & Str(z)
    ActiveCell.Value = header
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(0, 1).Select
Next i

Range("A3").Select

For j = 1 To timestepcount
    ActiveCell.Value = timestepnum(j)
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(1, 0).Select
Next j

i = 0
j = 0
z = 0


Range("b3").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        ActiveCell.Value = flow(i, j)
        ActiveCell.Offset(0, 1).Select
    Next j
    z = -1 * chancount
    ActiveCell.Offset(1, z).Select
Next i

' Velocity Table
```

```
Sheets("Velocity").Select
ActiveSheet.Name = "Velocity"
Range("A1:Z60000").ClearContents

Range("A1").Select
tableheader = "Velocity (m/s)"
ActiveCell.Value = tableheader


Range("B2").Select
z = 0

For i = 1 To chancount
    z = i
    header = "Junction " & Str(z)
    ActiveCell.Value = header
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(0, 1).Select
Next i

Range("A3").Select

For j = 1 To timestepcount
    ActiveCell.Value = timestepnum(j)
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(1, 0).Select
Next j

i = 0
j = 0
z = 0


Range("b3").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        ActiveCell.Value = vel(i, j)
        ActiveCell.Offset(0, 1).Select
    Next j
    z = -1 * chancount
    ActiveCell.Offset(1, z).Select
Next i


' Upstream Head Table

Sheets("Upstream Elevation").Select
Range("A1:Z60000").ClearContents

Range("A1").Select
tableheader = "Upstream Elevation (m)"
ActiveCell.Value = tableheader


Range("B2").Select
z = 0

For i = 1 To chancount
    z = i
    header = "Junction " & Str(z)
    ActiveCell.Value = header
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(0, 1).Select
Next i

Range("A3").Select

For j = 1 To timestepcount
    ActiveCell.Value = timestepnum(j)
    Selection.Interior.ColorIndex = 36
```

```
    ActiveCell.Offset(1, 0).Select
Next j

i = 0
j = 0
z = 0


Range("b3").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        ActiveCell.Value = ushead(i, j)
        ActiveCell.Offset(0, 1).Select
    Next j
    z = -1 * chancount
    ActiveCell.Offset(1, z).Select
Next i

' Downstream Head Table

Sheets("Downstream Elevation").Select
Range("A1:Z60000").ClearContents

Range("A1").Select
tableheader = "Downstream Elevation (m)"
ActiveCell.Value = tableheader


Range("B2").Select
z = 0

For i = 1 To chancount
    z = i
    header = "Junction " & Str(z)
    ActiveCell.Value = header
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(0, 1).Select
Next i

Range("A3").Select

For j = 1 To timestepcount
    ActiveCell.Value = timestepnum(j)
    Selection.Interior.ColorIndex = 36
    ActiveCell.Offset(1, 0).Select
Next j

i = 0
j = 0
z = 0


Range("b3").Select

For i = 1 To timestepcount
    For j = 1 To chancount
        ActiveCell.Value = dshead(i, j)
        ActiveCell.Offset(0, 1).Select
    Next j
    z = -1 * chancount
    ActiveCell.Offset(1, z).Select
Next i

End Sub
```

Appendix C

Flow Data from USGS gages and from Point Dischargers

USGS Gage Flow Data

Date	Greenwood Branch at New Lisbon Flow (CFS)	North Branch at Pemberton Flow (CFS)	South Branch at Vincentown Flow (CFS)
3/27/2004	137	201	104
3/28/2004	128	191	99
3/29/2004	121	178	94
3/30/2004	115	171	78
3/31/2004	118	187.5	97
4/1/2004	128	204	105
4/2/2004	140	239	109
4/3/2004	157	274	165
4/4/2004	174	310	186
4/5/2004	209	358	235
4/6/2004	221	347	169
4/7/2004	200	309	143
4/8/2004	175	265	128
4/9/2004	157	237	119
4/10/2004	149	219	112
4/11/2004	146	210	102
4/12/2004	146	215	100
4/13/2004	198	411.5	293
4/14/2004	542	608	499
4/15/2004	676	677	498
4/16/2004	534	580	329
4/17/2004	395	477	242
4/18/2004	328	426	184
4/19/2004	273	377	160
4/20/2004	245	341	146
4/21/2004	242	326	128
4/22/2004	214	296	112
4/23/2004	187	250	105
4/24/2004	193	318	158
4/25/2004	188	307	153
4/26/2004	186	334	176
4/27/2004	213	433	318
4/28/2004	235	419	221
4/29/2004	224	367	173
4/30/2004	206	313	147
5/1/2004	184	282	137
5/2/2004	168	259	143
5/3/2004	162	261	139
5/4/2004	164	269	140
5/5/2004	160	250	128
5/6/2004		229	114
5/7/2004		212	101
5/8/2004		199	91
5/9/2004		183	84
5/10/2004		177	80
5/11/2004		172	76
5/12/2004	104	165	74
5/13/2004	99	156	71
5/14/2004	92	148	65
5/15/2004	87	142	68
5/16/2004	86	145	71
5/17/2004	87	142	66
5/18/2004	85	137	60
5/19/2004	83	141	59
5/20/2004	91	158	71
5/21/2004	88	147	69
5/22/2004	87	136	65
5/23/2004	85	123	59
5/24/2004	81	111	51
5/25/2004	76	98	42
5/26/2004	71	107	45
5/27/2004	77	124	52
5/28/2004	77	123	52
5/29/2004	74	116	48
5/30/2004	70	106	43
5/31/2004	71	111	41
6/1/2004	82	140	50
6/2/2004	87	153	54

Date	Greenwood Branch at New Lisbon Flow (CFS)	North Branch at Pemberton Flow (CFS)	South Branch at Vincentown Flow (CFS)
6/3/2004	84	160	51
6/4/2004	76	151	48
6/5/2004	72	81	46
6/6/2004	78	93	53
6/7/2004	80	115	53
6/8/2004	78	114	49
6/9/2004	72	109	44
6/10/2004	68	103	41
6/11/2004	71	106	45
6/12/2004	72	110	46
6/13/2004	64	96	42
6/14/2004	65	98	38
6/15/2004	65	102	40
6/16/2004	62	99	43
6/17/2004	60	95	45
6/18/2004	64	101	47
6/19/2004	64	100	43
6/20/2004	58	89	38
6/21/2004	55	83	34
6/22/2004	53	80	31
6/23/2004	52	81	30
6/24/2004	51	77	29
6/25/2004	50	73	27
6/26/2004	50	73	26
6/27/2004	48	72	25
6/28/2004	46	74.5	24
6/29/2004	48	77	25
6/30/2004	47	73	24
7/1/2004	45	70	23
7/2/2004	45	67	23
7/3/2004	43	65	21
7/4/2004	38	60	20
7/5/2004	42	76	26
7/6/2004	43	72	27
7/7/2004	40	60	23
7/8/2004	39	56	21
7/9/2004	38	54	19
7/10/2004	37	54	18
7/11/2004	36	53	18
7/12/2004	91	128	159
7/13/2004	980	1510	3470
7/14/2004	1080	1780	1750
7/15/2004	732	1040	909
7/16/2004	544	815	600
7/17/2004	376	627	392
7/18/2004	228	418	257
7/19/2004	204	367	208
7/20/2004	190	325	173
7/21/2004	176	289	147
7/22/2004	160	244	129
7/23/2004	147	216	115
7/24/2004	139	203	111
7/25/2004	145	208	107
7/26/2004	147	205	98
7/27/2004	143	222	117
7/28/2004	161	295	375
7/29/2004	201	327	294
7/30/2004	214	337	220
7/31/2004	198	295	179
8/1/2004	185	301	156
8/2/2004	177	294	193
8/3/2004	168	261	157
8/4/2004	155	227	130
8/5/2004	140	201	115
8/6/2004	128	179	101
8/7/2004	114	160	75
8/8/2004	104	148	74
8/9/2004	89	133	67

Date	Greenwood Branch at New Lisbon Flow (CFS)	North Branch at Pemberton Flow (CFS)	South Branch at Vincentown Flow (CFS)
8/10/2004	80	111	64
8/11/2004	73	89	61
8/12/2004	71	104	58
8/13/2004	69	119	59
8/14/2004	73	118	59
8/15/2004	94	164	84
8/16/2004	119	186	104
8/17/2004	140	204	108
8/18/2004	146	207	112
8/19/2004	149	200	108
8/20/2004	151	194	102
8/21/2004	138	196	102
8/22/2004	137	222	139
8/23/2004	149	216	110
8/24/2004	144	204	96
8/25/2004	126	177	89
8/26/2004	107	154	79
8/27/2004	89	134	72
8/28/2004	79	122	67
8/29/2004	73	116	63
8/30/2004	66	113	76
8/31/2004	112	395	694
9/1/2004	155	383	547
9/2/2004	143	282	238
9/3/2004	115	194	166
9/4/2004	95	156	133
9/5/2004	82	136	106
9/6/2004	72	121	89
9/7/2004	67	111	84
9/8/2004	64	107	80
9/9/2004	63	105	78
9/10/2004	61	100	73
9/11/2004	59	94	68
9/12/2004	57	89	56
9/13/2004	55	86	55
9/14/2004	53	84	51
9/15/2004	53	82	51
9/16/2004	56	87	56
9/17/2004	57	89	58
9/18/2004	58	114	66
9/19/2004	64	116	66
9/20/2004	61	102	59
9/21/2004	57	66	53
9/22/2004	56	72	50
9/23/2004	55	73	47
9/24/2004	53	74	44
9/25/2004	52	91	42
9/26/2004	50	80	42
9/27/2004	50	75	42
9/28/2004	52	103	51
9/29/2004	105	240	350
9/30/2004	154	262	264
10/1/2004	185	281	188
10/2/2004	177	268	155
10/3/2004	171	296	188
10/4/2004	155	256	158
10/5/2004	125	204	126
10/6/2004	103	166	103
10/7/2004	91	145	89
10/8/2004	76	126	79
10/9/2004	66	111	77
10/10/2004	72	111	77
10/11/2004	77	116	72
10/12/2004	77	114	67
10/13/2004	64	103	65
10/14/2004	60	103	55
10/15/2004	64	114	69
10/16/2004	66	120	73

Date	Greenwood Branch at New Lisbon Flow (CFS)	North Branch at Pemberton Flow (CFS)	South Branch at Vincentown Flow (CFS)
10/17/2004	66	117	75
10/18/2004	63	108	72
10/19/2004	74	154	114
10/20/2004	103	198	159
10/21/2004	129	212	152
10/22/2004	137	222	144
10/23/2004	133	209	142
10/24/2004	117	190	129
10/25/2004	108	175	114
10/26/2004	104	163	109
10/27/2004	99	158	97
10/28/2004	94	152	91
10/29/2004	90	148	95
10/30/2004	89	148	94
10/31/2004	92	145	103

All Units CFS except as noted

Date	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
9/1/2003	3.01	6.37	1.66		3.07	1.66					
9/2/2003	3.01	6.17	1.41		3.10	1.72					
9/3/2003	2.98	6.27	1.43		3.25	1.63					
9/4/2003	3.10	6.42	1.42		3.27	1.76					
9/5/2003	2.90	5.62	1.35		3.16	1.74					
9/6/2003	2.97	5.60	1.37		3.03	1.66					
9/7/2003	3.03	6.30	1.52		3.07	1.68					
9/8/2003	2.92	6.02	1.51		3.14	1.74					
9/9/2003	2.84	5.53	1.26		2.88	1.67					
9/10/2003	2.82	5.48	1.27		2.98	1.60					
9/11/2003	2.82	5.64	1.24		2.92	1.67					
9/12/2003	2.82	5.49	1.15		3.03	1.72					
9/13/2003	3.13	8.46	1.26		3.33	1.79					
9/14/2003	3.18	5.12	1.30		3.20	1.76					
9/15/2003	3.33	7.29	1.20		3.41	1.74					
9/16/2003	3.09	6.18	1.16		3.13	1.90					
9/17/2003	2.94	5.89	1.16		3.05	1.78					
9/18/2003	2.87	5.87	1.14		3.08	1.80					
9/19/2003	3.09	6.20	1.20		3.17	1.91					
9/20/2003	2.95	6.30	1.21		3.20	1.72					
9/21/2003	3.07	6.06	1.21		3.30	1.64					
9/22/2003	2.91	6.98	1.12		3.45	2.01					
9/23/2003	3.43	7.09	1.31		3.62	1.91					
9/24/2003	3.08	5.95	1.18		3.21	1.90					
9/25/2003	2.67	6.00	1.13		3.22	1.86					
9/26/2003	2.56	5.99	1.10		3.12	1.85					
9/27/2003	2.72	6.06	1.26		3.27	1.74					
9/28/2003	2.83	6.78	1.21		3.37	1.85					
9/29/2003	2.74	5.67	1.61		3.17	1.82					
9/30/2003	2.87	5.34	1.58		3.51	1.88					
10/1/2003	2.81	5.45	1.10		3.62	1.59					
10/2/2003	2.93	4.88	1.12		3.10	1.78					
10/3/2003	2.83	4.89	1.13		3.00	1.81					
10/4/2003	2.99	5.04	1.14		3.18	1.72					
10/5/2003	3.01	5.21	1.19		3.23	1.60					
10/6/2003	2.89	5.09	1.81		3.13	1.76					
10/7/2003	2.90	5.14	1.09		3.38	1.75					
10/8/2003	2.91	5.42	1.14		3.49	1.90					
10/9/2003	2.83	5.50	1.16		3.15	1.51					
10/10/2003	2.80	5.30	1.09		2.94	1.64					
10/11/2003	2.93	5.34	1.14		3.16	1.66					
10/12/2003	2.92	5.81	1.16		3.13	1.71					
10/13/2003	2.96	5.52	1.12		3.14	1.75					
10/14/2003	2.83	5.83	1.20		3.31	1.74					
10/15/2003	3.06	5.02	1.10		3.08	1.70					
10/16/2003	2.78	5.04	1.09		3.07	1.82					
10/17/2003	2.83	4.67	1.06		3.15	1.54					
10/18/2003	2.92	4.69	1.14		3.18	1.87					
10/19/2003	3.04	4.99	1.16		3.28	1.74					
10/20/2003	2.83	5.00	1.08		3.14	1.56					
10/21/2003	2.67	5.68	1.06		3.03	1.72					
10/22/2003	2.72	4.43	1.10		3.15	1.53					
10/23/2003	2.77	4.03	1.06		3.11	1.67					
10/24/2003	2.69	3.94	1.07		2.97	1.43					
10/25/2003	2.75	4.96	1.12		3.24	2.07					
10/26/2003	2.90	5.85	1.16		3.03	1.80					
10/27/2003	3.09	5.78	1.24		3.94	1.87					
10/28/2003	2.93	5.91	1.28		3.35	1.73					
10/29/2003	3.54	5.62	1.29		3.75	2.13					
10/30/2003	3.00	5.02	1.14		3.25	1.70					
10/31/2003	2.96	5.11	1.19		3.04	1.97					
11/1/2003	2.98	5.92	1.18		3.37	1.89					
11/2/2003	3.06	6.20	1.22		3.26	1.89					
11/3/2003	2.86	6.27	1.13		3.03	1.93					
11/4/2003	2.90	5.82	1.11		3.11	1.65					
11/5/2003	2.90	6.28	1.15		3.04	0.98					
11/6/2003	3.09	5.83	1.20		3.26	1.56					
11/7/2003	2.94	5.27	1.08		3.25	2.09					
11/8/2003	2.93	5.15	1.10		3.25	1.75					
11/9/2003	2.93	3.60	1.18		3.18	1.83					
11/10/2003	2.73	4.31	1.18		3.29	1.38					
11/11/2003	2.91	5.37	1.10		3.29	2.13					
11/12/2003	3.08	5.84	1.43		3.42	1.94					
11/13/2003	2.83	4.57	1.09		3.24	1.86					
11/14/2003	2.72	4.40	1.03		3.10	1.71					

All Units CFS except as noted

Date	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
11/15/2003	2.89	4.62	1.10		3.40	1.82					
11/16/2003	2.94	5.02	1.17		3.44	1.87					
11/17/2003	2.92	5.18	1.11		3.51	1.82					
11/18/2003	2.88	5.62	1.05		1.83	1.71					
11/19/2003	3.20	7.19	1.32		3.99	1.95					
11/20/2003	3.66	5.35	1.20		3.49	2.19					
11/21/2003	3.10	5.08	1.16		3.41	1.95					
11/22/2003	3.10	5.31	1.17		3.39	2.08					
11/23/2003	3.12	5.44	1.26		3.45	1.86					
11/24/2003	3.03	5.81	1.16		3.58	1.00					
11/25/2003	3.01	5.24	1.22		3.46	1.77					
11/26/2003	3.03	3.68	1.11		3.66	2.10					
11/27/2003	3.11	4.93	1.24		3.46	1.89					
11/28/2003	2.94	5.52	1.22		3.85	1.92					
11/29/2003	3.17	4.35	1.12		3.71	2.19					
11/30/2003	3.15	4.88	1.14		3.56	1.75					
12/1/2003	2.94	4.29	1.10		3.50	2.35					
12/2/2003	2.95	3.60	1.07		3.24	1.80					
12/3/2003	2.87	3.22	1.08		3.19	1.86					
12/4/2003	2.78	5.97	1.04		2.81	1.75					
12/5/2003	2.86	7.16	1.04		3.39	1.78					
12/6/2003	3.08	7.18	1.09		3.69	1.99					
12/7/2003	3.17	7.53	1.18		4.01	1.80					
12/8/2003	3.02	6.89	1.02		3.36	2.03					
12/9/2003	2.96	7.45	1.00		3.25	1.82					
12/10/2003	3.18	9.12	1.28		3.83	2.07					
12/11/2003	4.41	9.78	1.37		4.55	2.63					
12/12/2003	3.34	7.32	1.17		3.44	2.39					
12/13/2003	3.25	6.95	1.15		3.42	2.14					
12/14/2003	3.56	9.55	1.35		4.46	2.59					
12/15/2003	3.47	8.19	1.47		3.56	2.31					
12/16/2003	3.27	7.83	1.18		3.46	2.14					
12/17/2003	3.53	8.39	1.24		4.01	1.58					
12/18/2003	3.38	7.30	1.19		3.65	1.09					
12/19/2003	3.29	7.22	1.17		3.60	2.08					
12/20/2003	3.20	7.16	1.15		3.74	2.50					
12/21/2003	3.22	7.84	1.17		3.65	2.25					
12/22/2003	3.09	8.22	1.10		3.46	1.87					
12/23/2003	3.11	9.18	1.21		3.71	2.34					
12/24/2003	3.83	10.11	1.38		4.32	2.69					
12/25/2003	3.40	8.05	1.19		3.49	2.34					
12/26/2003	3.18	8.77	1.17		3.80	2.34					
12/27/2003	3.25	8.25	1.16		3.60	2.11					
12/28/2003	3.23	8.03	1.17		3.59	2.10					
12/29/2003	2.97	8.18	1.12		3.40	2.14					
12/30/2003	3.34	8.08	1.09		3.46	2.08					
12/31/2003	3.82	8.50	1.14		3.55	2.25					
1/1/2004		7.26	1.12	4.35	3.29	1.91	7.00				5.45
1/2/2004		8.10	1.08	4.79	3.42	1.78	7.00				5.31
1/3/2004		7.24	1.06	4.18	3.43	1.99	7.00				5.53
1/4/2004		7.82	1.13	4.60	3.58	2.20	7.00				5.65
1/5/2004		8.48	1.08	4.90	3.47	2.11	7.00				5.76
1/6/2004		7.38	1.01	4.61	3.36	2.00	7.00				5.69
1/7/2004		7.65	1.04	4.47	3.37	1.75	7.00				5.35
1/8/2004		6.92	1.05	4.43	3.31	2.05	7.00				5.28
1/9/2004		6.77	1.00	4.25	3.33	1.92	7.00				5.42
1/10/2004		7.03	1.05	4.53	3.32	1.83	7.00				4.96
1/11/2004		7.68	1.10	4.07	3.46	1.98	7.00				4.93
1/12/2004		7.26	1.01	3.91	3.29	2.05	6.00				5.45
1/13/2004		6.60	1.02	4.91	3.31	1.88	6.00				5.78
1/14/2004		6.87	0.98	2.97	3.12	1.97	6.00				5.41
1/15/2004		6.03	1.03	3.06	3.36	1.81	6.00				4.96
1/16/2004		6.51	0.96	4.09	3.16	1.93	6.00				5.13
1/17/2004		7.24	1.02	4.06	3.51	1.83	6.00				5.19
1/18/2004		7.02	1.22	4.44	3.69	1.95	7.00				5.75
1/19/2004		8.19	1.06	4.40	3.46	2.06	7.00				5.81
1/20/2004		6.85	0.97	4.35	3.28	1.89	6.00				5.89
1/21/2004		6.93	0.97	4.30	3.24	1.97	6.00				5.40
1/22/2004		6.93	0.97	4.22	3.29	1.79	6.00				5.15
1/23/2004		6.52	0.96	4.01	3.20	1.79	6.00				5.48
1/24/2004		6.57	1.09	3.97	3.33	1.69	6.00				4.91
1/25/2004		6.93	1.21	3.84	3.53	1.97	6.00				5.23
1/26/2004		6.72	0.92	4.30	3.36	1.85	6.00				5.60
1/27/2004		6.70	1.05	4.20	3.19	1.79	6.00				5.50
1/28/2004		6.50	0.99	4.17	3.00	1.78	6.00				5.05
1/29/2004		6.41	1.20	4.14	3.15	1.78	6.00				5.19

All Units CFS except as noted

Date	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
1/30/2004		6.24	0.94	4.11	2.98	1.85	5.00				5.39
1/31/2004		6.59	1.02	3.87	3.31	1.60	6.00				4.79
2/1/2004		6.78				2.08	6.00				5.35
2/2/2004		6.90				1.88	6.00				5.57
2/3/2004		8.42				2.23	6.00				6.16
2/4/2004		7.32				2.01	7.00				6.09
2/5/2004		6.92				1.73	6.00				6.53
2/6/2004		11.13				2.33	10.00				7.97
2/7/2004		7.84				2.61	10.00				8.63
2/8/2004		7.67				2.20	8.00				6.34
2/9/2004		7.51				2.06	8.00				6.30
2/10/2004		7.20				2.23	7.00				6.16
2/11/2004		6.90				2.02	7.00				5.76
2/12/2004		7.25				2.01	7.00				5.71
2/13/2004		6.87				1.87	6.00				5.69
2/14/2004		7.08				2.07	7.00				5.73
2/15/2004		6.95				2.02	7.00				5.05
2/16/2004		7.31				1.99	7.00				5.55
2/17/2004		6.94				2.06	6.00				5.54
2/18/2004		7.00				1.88	6.00				5.39
2/19/2004		6.88				1.89	6.00				5.54
2/20/2004		6.66				1.95	6.00				5.51
2/21/2004		7.05				1.79	6.00				5.48
2/22/2004		7.15				2.24	6.00				5.51
2/23/2004		6.84				1.80	6.00				5.79
2/24/2004		6.99				1.86	6.00				5.27
2/25/2004		6.90				1.79	6.00				5.36
2/26/2004		6.74				2.00	6.00				5.38
2/27/2004		7.18				1.82	6.00				5.26
2/28/2004		6.78				1.91	6.00				5.41
2/29/2004		6.78				1.97	6.00				5.58
3/1/2004		6.68	0.98			1.85	6.00			0.08	5.91
3/2/2004		7.00	0.96			1.85	6.00			0.06	5.33
3/3/2004		6.66	0.97			1.79	6.00			0.07	5.13
3/4/2004		7.24	1.00			1.52	6.00			0.07	5.40
3/5/2004		8.39	0.97			2.09	6.00			0.08	5.16
3/6/2004		6.89	1.07			2.08	7.00			0.07	5.14
3/7/2004		7.35	1.08			2.07	7.00			0.10	5.92
3/8/2004		8.10	1.00			2.23	7.00			0.09	6.54
3/9/2004		7.71	0.96			2.06	7.00			0.10	6.08
3/10/2004		7.54	0.99			1.84	7.00			0.09	6.34
3/11/2004		7.43	1.00			2.21	7.00			0.08	5.26
3/12/2004		6.96	0.93			1.83	7.00			0.08	5.86
3/13/2004		7.33	0.99			2.15	7.00			0.07	5.98
3/14/2004		7.50	1.04			1.95	7.00			0.07	5.88
3/15/2004		7.17	0.97			2.03	6.00			0.07	5.84
3/16/2004		8.81	1.05			2.14	6.00			0.07	5.17
3/17/2004		7.88	0.98			1.72	7.00			0.08	6.62
3/18/2004		7.81	1.06			2.45	7.00			0.08	6.25
3/19/2004		8.33	1.10			2.33	9.00			0.08	6.21
3/20/2004		8.37	1.12			2.34	9.00			0.11	6.33
3/21/2004		7.61	1.14			2.24	8.00			0.10	6.53
3/22/2004		7.48	1.02			2.19	7.00			0.10	6.13
3/23/2004		7.39	1.01			2.02	7.00			0.07	5.53
3/24/2004		7.00	0.99			2.01	7.00			0.07	5.79
3/25/2004		7.15	1.03			1.95	7.00			0.07	5.99
3/26/2004		6.68	1.01			2.00	7.00			0.07	6.53
3/27/2004		7.19	1.02			1.99	7.00			0.07	5.21
3/28/2004		6.88	1.10			1.99	7.00			0.08	5.94
3/29/2004		7.03	0.97			1.96	6.00			0.09	5.52
3/30/2004		7.20	1.03			1.86	7.00			0.07	5.57
3/31/2004		7.00	1.04			1.93	6.00			0.07	5.64
4/1/2004		6.83				1.90					5.18
4/2/2004		7.95				1.95					5.88
4/3/2004		7.23				2.00					6.64
4/4/2004		8.45				2.25					5.98
4/5/2004		7.74				2.30					7.03
4/6/2004		7.60				1.69					6.17
4/7/2004		7.27				1.92					5.92
4/8/2004		6.81				2.15					5.46
4/9/2004		7.06				1.88					6.25
4/10/2004		6.53				1.73					5.95
4/11/2004		6.59				1.71					5.65
4/12/2004		8.02				1.80					5.35
4/13/2004		7.95				2.54					5.97
4/14/2004		9.19				2.58					8.67

All Units CFS except as noted

Date	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
4/15/2004		8.03				2.60					7.81
4/16/2004		7.28				1.55					6.64
4/17/2004		7.24				1.13					6.77
4/18/2004		7.42				1.49					6.57
4/19/2004		7.59				2.06					6.06
4/20/2004		7.72				2.18					6.69
4/21/2004		7.33				2.20					6.49
4/22/2004		7.25				2.40					5.91
4/23/2004		7.51				1.98					5.52
4/24/2004		7.38				2.53					5.83
4/25/2004		7.86				2.16					6.25
4/26/2004		8.72				2.31					0.63
4/27/2004		8.33				2.50					6.69
4/28/2004		7.23				2.64					7.11
4/29/2004		7.22				2.26					6.39
4/30/2004		7.28				2.14					5.28
5/1/2004		7.07				2.16					6.07
5/2/2004		7.94				2.21					5.52
5/3/2004		7.59				2.25					6.11
5/4/2004		6.88				2.19					5.90
5/5/2004		7.08				2.15					6.04
5/6/2004		6.93				1.98					5.85
5/7/2004		7.27				2.12					6.17
5/8/2004		6.95				1.96					5.70
5/9/2004		7.24				2.06					5.37
5/10/2004		7.13				2.07					5.74
5/11/2004		8.11				2.04					5.66
5/12/2004		7.75				2.00					5.89
5/13/2004		6.82				1.85					5.60
5/14/2004		6.86				1.77					5.58
5/15/2004		6.93				2.20					5.63
5/16/2004		7.13				2.00					5.46
5/17/2004		7.63				2.03					5.56
5/18/2004		7.37				2.00					5.18
5/19/2004		7.60				1.89					5.84
5/20/2004		7.31				1.90					5.61
5/21/2004		8.12				1.87					5.49
5/22/2004		5.86				1.76					5.22
5/23/2004		6.64				1.79					5.62
5/24/2004		6.66				1.87					5.85
5/25/2004		7.53				1.95					4.80
5/26/2004		7.30				1.65					5.20
5/27/2004		7.06				1.89					5.47
5/28/2004		6.94				1.88					5.36
5/29/2004		6.32				1.68					5.28
5/30/2004		6.39				1.84					5.14
5/31/2004		7.57				1.53					5.82
6/1/2004		7.39				1.78			0.52		5.30
6/2/2004		7.08				1.41			0.51		5.30
6/3/2004		7.37				1.38			0.53		5.28
6/4/2004		6.70				1.69			0.53		5.26
6/5/2004		7.43				1.74			0.59		5.41
6/6/2004		7.37				1.78			0.44		5.50
6/7/2004		6.82				1.92			0.51		5.43
6/8/2004		6.77				1.86			0.48		5.27
6/9/2004		6.64				1.76			0.50		5.29
6/10/2004		6.80				1.83			0.53		5.42
6/11/2004		7.37				1.77			0.64		5.24
6/12/2004		6.96				1.78			0.50		5.02
6/13/2004		6.96				1.82			0.43		4.86
6/14/2004		7.54				1.72			0.50		5.38
6/15/2004	2.93	7.73	1.13		3.32	1.76	5.00	5.23	0.50	0.06	5.40
6/16/2004	2.96	7.38	1.20		3.41	1.83	5.00	5.35	0.51	0.07	5.42
6/17/2004	3.02	7.09	1.15		4.01	1.66	6.00	5.96	0.54	0.06	5.52
6/18/2004	2.91	6.97	1.13		2.69	1.88	5.00	5.37	0.50	0.07	5.23
6/19/2004	3.02	6.67	1.11		3.16	1.82	6.00	5.97	0.53	0.07	5.30
6/20/2004	2.90	7.23	1.14		3.07	1.57	6.00	5.91	0.52	0.07	4.93
6/21/2004	2.84	7.18	1.11		3.31	1.70	5.00	6.05	0.52	0.06	5.13
6/22/2004	2.77	7.18	1.11		2.82	1.70	5.00	6.11	0.49	0.07	5.13
6/23/2004	2.66	7.16	1.13		3.19	1.60	5.00	3.88	0.50	0.06	5.29
6/24/2004	2.71	6.96	1.13		2.97	1.54	5.00	3.79	0.52	0.06	5.10
6/25/2004	2.89	6.93	1.09		3.24	1.74	5.00	3.29	0.56	0.06	4.88
6/26/2004	2.92	7.03	1.15		3.08	1.60	6.00	3.93	0.53	0.06	4.69
6/27/2004	2.87	7.15	1.20		3.01	1.55	5.00	3.47	0.41	0.06	5.28
6/28/2004	2.73	7.46	1.14		3.14	1.50	5.00	3.52	0.50	0.06	4.82
6/29/2004	2.90	7.05	1.13		3.07	1.89	5.00	3.82	0.50	0.07	5.21

All Units CFS except as noted

Date	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
6/30/2004	2.81	6.74	1.15		3.20	1.71	5.00	3.68	0.50	0.06	5.17
7/1/2004	2.80	6.45	1.14		2.88	1.60	5.00	4.43	0.00	0.07	4.90
7/2/2004	2.78	6.27	1.07		3.24	1.69	5.00	3.59	0.50	0.06	5.32
7/3/2004	2.87	5.85	1.10		3.12	1.58	5.00	3.80	0.52	0.06	5.32
7/4/2004	2.83	6.05	1.07		2.81	1.44	5.00	3.91	0.59	0.06	4.82
7/5/2004	3.12	6.69	1.20		3.45	1.65	5.00	2.69	0.43	0.06	4.86
7/6/2004	2.92	6.80	1.15		3.35	1.59	5.00	4.05	0.47	0.07	5.34
7/7/2004	2.80	6.57	1.20		3.19	1.70	5.00	4.15	0.50	0.07	5.16
7/8/2004	2.68	6.30	1.15		3.28	1.64	5.00	3.91	0.50	0.07	4.77
7/9/2004	2.69	6.92	1.08		3.03	1.52	5.00	4.30	0.52	0.06	5.02
7/10/2004	2.74	6.44	1.17		3.10	1.58	5.00	4.21	0.55	0.06	4.95
7/11/2004	2.80	6.56	1.18		3.16	1.43	5.00	4.28	0.57	0.06	4.82
7/12/2004	4.26	13.02	1.81		4.89	3.09	7.00	4.78	0.42	0.06	6.89
7/13/2004	4.32	9.08	1.22		3.34	6.19	7.00	4.24	0.89	0.22	7.26
7/14/2004	6.83	7.44	1.26		4.02	3.09	6.00	4.25	0.74	0.13	7.63
7/15/2004	4.87	7.34	1.23		3.03	2.61	6.00	4.10	0.82	0.11	6.28
7/16/2004		7.39	1.18		2.83	2.28	6.00	4.07	0.72	0.09	5.99
7/17/2004		6.74	1.25		2.71	2.01	6.00	4.02	0.90	0.08	5.91
7/18/2004		9.21	1.49		3.32	1.89	7.00	4.49	0.52	0.08	5.73
7/19/2004		8.15	1.28		2.98	2.43	8.00	3.78	0.53	0.09	5.99
7/20/2004		7.38	1.27		2.84	2.38	7.00	4.09	0.60	0.09	6.65
7/21/2004		6.99	1.29		3.02	1.93	6.00	4.13	0.58	0.08	5.00
7/22/2004		6.95	1.29		2.53	1.86	6.00	4.24	0.57	0.08	5.19
7/23/2004		7.64	1.39		2.91	2.25	6.00	4.00	0.54	0.07	5.54
7/24/2004		7.64	1.31		2.54	2.14	7.00	4.26	0.58	0.07	5.76
7/25/2004		7.56	1.37		2.80	2.08	6.00	3.88	0.57	0.08	5.20
7/26/2004		7.16	1.28		2.79	2.02	6.00	4.04	0.43	0.08	5.26
7/27/2004		8.83	1.45		3.25	2.13	7.00	4.04	0.53	0.08	5.95
7/28/2004		7.92	1.45		3.13	2.52	8.00	3.85	0.61	0.13	5.73
7/29/2004		7.23	1.50		2.87	2.47	7.00	4.01	0.61	0.11	5.18
7/30/2004		6.92	1.45		2.93	2.19	7.00	4.44	0.63	0.09	5.38
7/31/2004		6.69	1.40		2.77	2.20	7.00	4.49	0.60	0.08	5.13
8/1/2004			1.69		3.35	2.10	8.00	3.80	0.50	0.08	5.54
8/2/2004			1.47		3.28	2.17	7.00	4.43	0.62	0.08	5.93
8/3/2004			1.43		2.68	2.09	7.00	3.98	0.55	0.12	5.76
8/4/2004			1.35		2.63	2.03	6.00	4.03	0.51	0.09	5.56
8/5/2004			1.33		2.63	1.99	7.00	4.24	0.56	0.08	5.93
8/6/2004			1.23		2.90	2.01	6.00	4.99	0.53	0.08	5.25
8/7/2004			1.23		2.89	1.88	6.00	4.36	0.57	0.07	5.53
8/8/2004			1.33		3.23	1.89	6.00	3.50	0.50	0.07	4.85
8/9/2004			1.24		3.26	1.78	6.00	4.61	0.45	0.08	5.25
8/10/2004			1.24		2.48	1.77	6.00	4.29	0.56	0.08	4.88
8/11/2004			1.38		2.95	1.90	6.00	4.49	0.45	0.07	5.18
8/12/2004			1.49		3.20	1.76	6.00	4.50	0.46	0.07	5.13
8/13/2004			1.37		3.02	1.86	6.00	5.03	0.53	0.07	5.21
8/14/2004			1.30		3.17	1.77	6.00	3.73	0.54	0.06	5.11
8/15/2004	0.01		1.19		3.10	1.85	6.00	3.99	0.58	0.07	5.21
8/16/2004	3.20		1.37		3.18	2.02	6.00	4.39	0.41	0.08	5.36
8/17/2004	3.07		1.27		3.11	1.65	6.00	4.25	0.52	0.08	4.81
8/18/2004	3.05		1.23		3.05	1.81	6.00	4.25	0.53	0.08	5.48
8/19/2004	2.93		1.36		3.11	1.71	6.00	4.24	0.46	0.08	5.20
8/20/2004	3.10		1.23		3.09	1.89	6.00	3.78	0.56	0.07	5.13
8/21/2004	3.58		1.22		3.42	1.95	6.00	4.80	0.58	0.08	5.19
8/22/2004	3.26		1.24		3.16	1.92	6.00	3.91	0.52	0.07	5.03
8/23/2004	2.90		1.44		3.10	1.84	5.00	4.61	0.47	0.09	4.97
8/24/2004	2.85		1.21		3.44	1.66	5.00	4.69	0.53	0.08	5.01
8/25/2004	2.75		1.12		2.67	1.34	5.00	4.60	0.50	0.08	4.98
8/26/2004	2.73		1.12		3.11	2.14	5.00	4.36	0.48	0.07	4.79
8/27/2004	2.73		1.15		3.09	2.07	6.00	4.54	0.54	0.07	4.97
8/28/2004	2.86		1.15		3.01	1.70	6.00	4.05	0.57	0.07	5.05
8/29/2004	2.87		1.28		3.12	1.77	6.00	4.36	0.47	0.07	5.06
8/30/2004	2.88		1.31		3.62	1.76	5.00	3.88	0.44	0.08	5.41
8/31/2004	4.78		1.17		3.46	2.41	6.00	4.30	0.57	0.09	6.14
9/1/2004	3.43		1.19		2.99		5.00	4.46	0.67	0.18	6.04
9/2/2004	3.24		1.18		2.95		5.00	4.39		0.14	5.21
9/3/2004	3.18		1.13		3.08		5.00	4.64		0.10	4.74
9/4/2004	3.19		1.20		3.06		5.00	4.05		0.09	5.38
9/5/2004	3.11		1.13		2.90		5.00	4.66		0.08	4.83
9/6/2004	3.23		1.22		3.41		5.00	3.96		0.08	4.76
9/7/2004	3.03		1.20		3.03		6.00	4.29		0.09	5.42
9/8/2004	3.05		1.24		3.24		5.00	3.91		0.06	5.28
9/9/2004	3.06		1.20		3.27		5.00	4.43		0.07	5.28
9/10/2004	3.00		1.16		3.14		5.00	4.66		0.08	5.17
9/11/2004	3.12		1.21		3.03		5.00	3.88		0.08	5.19
9/12/2004	3.22		1.31		3.39		5.00	3.87		0.08	4.97
9/13/2004	2.95		1.24		2.96		5.00	4.33		0.08	5.26

All Units CFS except as noted

Date	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
9/14/2004	2.98		1.10		2.20		5.00	3.79		0.09	4.95
9/15/2004	3.06		1.12		3.01		5.00	3.85		0.07	5.16
9/16/2004											4.74
9/17/2004											5.33
9/18/2004											5.26
9/19/2004											5.10
9/20/2004											5.26
9/21/2004											5.08
9/22/2004											4.78
9/23/2004											5.25
9/24/2004											5.14
9/25/2004											5.06
9/26/2004											4.95
9/27/2004											5.28
9/28/2004											5.80
9/29/2004											8.58
9/30/2004											5.64
Average (CFS)	3.04	6.82	1.18	4.21	3.25	1.93	6.18	4.28	0.53	0.08	5.56
Average(m3/s)	0.086	0.193	0.033	0.119	0.092	0.055	0.175	0.121	0.015	0.002	0.158
						Delran + Riverside	0.154				
25th Percentile (CFS)	2.86	6.19	1.09	4.07	3.07	1.75	6.00	3.91	0.50	0.07	5.19
75th Percentile (CFS)	3.11	7.39	1.24	4.43	3.41	2.07	7.00	4.49	0.57	0.08	5.85

	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
Average(m3/s)	0.086	0.193	0.033	0.119	0.092	0.055	0.175	0.121	0.015	0.002	0.158

	Pemberton Township	Mount Laurel	Riverside	Moorestown	Evesham/ Elmwood	Medford Township	Willingboro	Delran	Pinelands	Mobile Estates	MHMUA
No. of Days Reported	185	335	277	31	246	366	184	93	93	124	274

Mean Discharge (CMS)	
Delran	0.121
Riverside	0.033
Mount Laurel	0.193
Willingboro	0.175
MHMUA	0.158

No. of Days Reported	
Pemberton Township	185
Moorestown	31
Evesham/Elmwood	246
Medford Township	366
Pinelands	93
Mobile Estates	124
Delran	93
Riverside	277
Mount Laurel	335
Willingboro	184
MHMUA	274