

Prepared for:
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Response to the NYSDEC CWA § 401 Water Quality Certification Notice of Denial Related to Thermal Discharges at Indian Point

ASA Project 09-167

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Executive Summary

On 2 April 2010, the New York State Department of Environmental Conservation (NYSDEC) Staff issued a proposed denial of the Entergy Indian Point Nuclear Generating Units 2 and 3 (collectively, "Indian Point") application for a § 401 Water Quality Certification (WQC). While NYSDEC Staff is equivocal about whether thermal discharge considerations played a role in its notice of denial, it did indicate that it wanted to establish that an appropriately conservative analysis was undertaken.

In general, the work performed to date and documented (the Report [Swanson et al., 2010]) with respect to Indian Point establishes – under extreme, but historically realistic, environmental conditions that represent an appropriately conservative (worst case) analysis – that Indian Point complies with New York thermal criteria governing temperature rise across the River surface as well as across the River vertical cross section. Responses are presented below to the specific series of statements in the notice of denial:

- An analysis was made of the August 2005 period to ascertain that it was equivalent to the “conservative approach” referenced in the NYSDEC letter of 2 April 2010. Specifically the period selected contained actual extreme environmental conditions.
- The 7Q river flow rate was within 3% of the MA7CD10 flow suggested by NYSDEC, but more importantly, the freshwater flow accounts for less than 1% of the total flux in the River, since the River is tidally dominated.
- An analysis was performed on historical USGS temperature information and there was no ambient temperatures reaching 90°F during anytime in the record. Highest temperatures in the mid 80s (°F) actually occurred during August 2005 for the West Point and Poughkeepsie stations.
- Tidal conditions run in the August 2005 included all phases of the tide cycle including “slack ebb begin” and “slack flood begin”.
- The model reproduced the thermal stratification observed in August 2005.
- The 3 July 2009 NYSDEC letter did not reference any specific environmental conditions such as MA7CD10 River flow or 90°F ambient River temperature in contrast to the statement in the 2 April 2010 letter.
- The model was successfully calibrated to an intensive data collection program in the River during September and October 2009. Once calibrated the model can be and was used to predict “worst case” environmental conditions. Without any a priori knowledge that 2010 might be a “worst case” year additional field work is scheduled for the summer period in 2010.
- Plant loading from other plants was not explicitly used in the model because an analysis of the USGS temperature data at West Point indicated that there was no evidence that the thermal plumes from Danskammer or Roseton affected that data. Lovett is now decommissioned and therefore its discharge would not be simulated. Bowline is 5 mi downstream of Indian Point and

not likely to influence temperatures in the vicinity of Indian Point. Finally a very conservative thermal load of 32% greater than published capacity from Indian Point was assumed.

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1. Introduction

On 2 April 2010, the New York State Department of Environmental Conservation (NYSDEC) Staff issued a proposed denial of the Entergy Indian Point Nuclear Generating Units 2 and 3 (collectively, “Indian Point”) application for a § 401 Water Quality Certification (WQC). While NYSDEC Staff is equivocal about whether thermal discharge considerations played a role in its notice of denial, it did indicate that it wanted to establish that an appropriately conservative analysis was undertaken, as follows:

“The scenario simulation presented in the Thermal Report for the “worst-case scenario” used a joint probability analysis of data in the vicinity. The conservative approach used by Department staff to predict “worst-case” is the MA7CD10 (7 day, 10 year low flow) and the lowest flow for the available record period, background temperature in the river of 90 degrees Fahrenheit (at “slack ebb begin” and “slack flood begin” tide conditions), and during thermal stratification periods. This was discussed in the meeting on March 22, 2010. Moreover, and as noted in its July 3, 2009 letter to Entergy, the Department requires the model to be run at these critical conditions, and the results compared to the thermal criteria in 6 NYCRR § 704.2. Furthermore, in-stream data must be gathered during July-September critical periods and used to verify correct calibration of the model. All predictions are to be performed at All Plants at Capacity (APAC) conditions.” (pgs 12-13 of the proposed denial)

Responses are presented below to the specific series of statements above. As importantly, as detailed below, the work performed to date and documented (the Report [Swanson et al., 2010]) with respect to Indian Point establishes – under extreme, but historically realistic, environmental conditions that represent an appropriately conservative (worst case) analysis – that Indian Point complies with New York thermal criteria governing temperature rise across the River surface as well as across the River vertical cross section.

2. Selection of Scenario Simulation (August 2005)

The “worst case” modeling scenario ASA used was based on extreme environmental conditions that have or could actually occur in the Hudson River in the vicinity of Indian Point based on a joint probability analysis of low flow, high water temperature and high air temperature. The purpose and effect of a joint probability analysis is to identify the worst-case coincidence of key factors, during a specific time period. Here, the Department does not disagree with the key factors – again, of low flow, high water temperature and high air temperature (the appropriateness of which is documented in the Report). Likewise, the Department does not disagree with the 10-year timeframe, which represented the available dataset for all factors. Finally, the Department does not object to the 95% percentile occurrence of the three variables as being worst case – a timeframe that represents the likelihood of the joint occurrence during one hour in any given 6250-hr (8.5-month) period. Importantly, this period of occurrence is so rare, and its location and duration so limited, that practical potential environmental consequences are expected to be few, if any.

From an analysis of the distribution of the three variables, the August 2005 period was selected because it contained the continuous occurrence of the joint probability condition of at least the 95th percentile exceedance level that was based on an analysis of a 10-yr record of all datasets available (2000 – 2009). Figure 1 shows the time variation of the individual probabilities and the three-way joint probability. The

three way joint probability (shown in red) actually exceeds the 97th percentile during this period, and frequently ranges to over the 99th percentile. Thus, the worst-case scenario is even more extreme. The air temperature (brown) shows a range of exceedance probabilities from approximately 60th] to above the 99th percentile with lower percentiles occurring naturally at night and higher during the day; the water temperature (blue) shows a range from approximately the 96th to above the 99th percentile; and the river flow (green) shows a range from approximately the 50th to the 99th percentile with lower percentiles lasting for only approximately 1 hr.

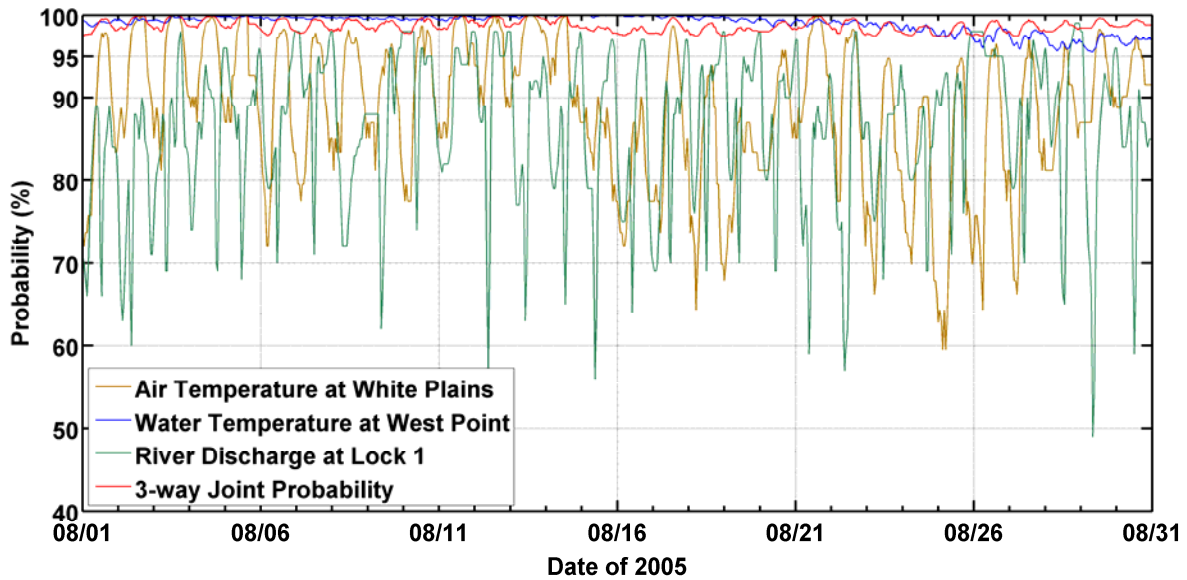


Figure 1 Time series of individual and joint probabilities during August 2005.

An analysis was performed to identify specific hours during the August period when all three variables individually show percentiles above the 95th. The hourly value actually represents the average of the values from one half hour before to one half hour after the denoted hour. Table 1 lists the dates and hours when this occurs, and reflects predominantly multi-hour blocks of time on several different dates.

Table 1 Dates during August 2005 and hours when individual variables each exceed the 95th percentile.

Date in 2005	Hour
8/3	17:00
8/3	18:00
8/3	19:00
8/7	15:00
8/9	15:00
8/9	16:00
8/10	12:00
8/10	13:00
8/10	16:00
8/10	17:00
8/10	18:00
8/11	11:00

Date in 2005	Hour
8/11	12:00
8/11	13:00
8/11	14:00
8/11	21:00
8/11	22:00
8/11	23:00
8/12	12:00
8/12	13:00
8/12	14:00
8/12	15:00
8/12	16:00
8/12	17:00
8/12	18:00
8/12	19:00
8/13	22:00
8/22	14:00
8/22	15:00
8/22	16:00
8/22	17:00
8/26	12:00
8/26	13:00
8/26	15:00
8/26	16:00
8/27	15:00

The longest duration, lasting eight hours, occurs on 12 August from 11:30 to 19:30 (shown in the Table as hours 12:00 through 19:00). Two shorter events, one lasting four hours from 10:30 to 14:30 and the other lasting three hours from 20:30 to 23:30, occur on 11 August. Therefore, as further detailed below, the joint probability analysis captures the extreme environmental conditions that can actually occur in the vicinity of Indian Point, as opposed to a hypothetical and unrealistic set of extreme conditions that potentially never occur.

3. River Flow Specification

The NYSDEC Staff's statement above indicates that a "worst case" flow is equivalent to MA7CD10 (7Q10) flow, a statement echoed by NYSDEC's position during the March 22nd meeting between Entergy and NYSDEC Staff. The United States Environmental Protection Agency (EPA) computer program, DFLOW, was used to determine the 7Q10 flow for Green Island (USGS Station 01358000), with results shown in Table 2. The use of this station for establishing freshwater flow is conservative, in that additional flow enters the River from the watershed downstream between Albany and Indian Point, a span of 102 miles with numerous tributaries.

Table 2 DFLOW results for 7Q10 at Green Island (USGS station 01358000 for different periods in time.

Record Duration	Days in Record	7Q10 (cfs)	Percentile Flow Above
1947-2008	23,010	2,840	98.43

The full dataset of sixty two years resulted in a 7Q10 value of 2,840 cfs. The most recent (1999 – 2008) 7Q10 flow rate for Green Island is 2,160 cfs. The August 2005 period had a lowest 7-day average (7Q) of 2,917 cfs, within 3% of the 62-yr 7Q10 and therefore adequately conservative. As such, the analysis documented in the Report reflects extremely low river flow conditions (2,917 cfs).

As long as the freshwater flow in the River is relatively low the actual value is not particularly significant since flow in the Hudson River is controlled primarily by the tides. A comparison between freshwater flow and tidal flow can be made to show the relative importance of each. The tidal flow is calculated from the tidal prism, which is the volume of water that flows upstream on a flood tide and flows downstream on an ebb tide. Assuming a mean tide range of 4 ft and a River surface area of 1.827 billion ft² gives a volume of 7.306 billion ft³. Multiplying the volume by one half the typical tidal cycle period (12.42 hrs) results in an average tidal flow rate of 327,345 cfs. This is 112 times larger than the 7Q for the August 2005 period of 2,917 cfs. Thus, the net freshwater flow in the River accounts for less than 1% of the total flux in the River, clearly indicating that the choice of low flowrate conditions is not a significant factor in assessing Indian Point's thermal discharge relative to the New York thermal criteria.

4. Background River Temperature

NYSDEC Staff suggest that 90°F may be the temperature to be used as background water temperature. We believe this suggestion may be a typographic error or based on a misunderstanding of the extensive River temperature information, which does not support this suggestion.

Specifically, the United States Geological Survey (USGS) temperature data is available both online and by request for four stations along the River from Hastings to Albany. Data is collected and processed on a daily-averaged basis. A summary of the stations from the USGS website is provided below.

- **Hastings** (USGS station 01376304) located 21 mi above Battery at Lat 40°59'16", Long 73°53'15" referenced to North American Datum of 1927, Westchester County, NY, Hydrologic Unit 02030101, 180 feet from left bank on abandoned Mobil Oil Corporation platform, 0.5 mi southwest of railroad station, at Hastings-on-Hudson.
- **West Point** (USGS station 01374019) located 51 mi above Battery at Lat 41°23'10", Long 73°57'20" referenced to North American Datum of 1927, Orange County, NY, Hydrologic Unit 02020008, on right bank at South Dock at West Point.
- **Poughkeepsie** (USGS station 01372058) located 77 mi above Battery at Lat 41°39'03", Long 73°56'42" referenced to North American Datum of 1927, Dutchess County, NY, Hydrologic Unit 02020008, on left bank at IBM pumping station, 2.3 mi south of Poughkeepsie, and 3.5 mi south of the Mid-Hudson bridge.
- **Albany** (USGS station 01359139) located 144 mi above Battery at Lat 42°38'46", Long 73°44'53" referenced to North American Datum of 1927, Albany County, NY, Hydrologic Unit 02020006, on

right bank 0.1 mi upstream from bridge on U.S. Highways 9 and 20 in Albany, and 0.7 mi downstream from railroad bridge.

Water temperature and specific conductance are measured at a depth of 10 feet below the National Geodetic Vertical Datum of 1929 (approximately mean sea level) at each of these stations. The USGS data sets may be slightly biased low as a measure of surface temperature due to the depth of the measurements. The datasets also may be significantly biased high due to the station locations (on the River banks) where water depths are shallower with warmer temperatures.

The highest temperatures found in the USGS periods of record are summarized in Table 3. The maximum measured temperature was 85.1°F occurring in August 2006 at Hastings, a location 21 mi downstream from Indian Point. The highest temperatures fall slightly going upstream with 84.0°F at West Point, 9 mi upstream of Indian Point; 83.8°F at Poughkeepsie, 35 mi upstream of Indian Point; and 83.5°F at Albany, 102 mi upstream of Indian Point. The West Point and Poughkeepsie stations have the highest temperatures occurring during August 2005, the scenario period selected via the joint probability analysis. Thus, the Report (Swanson et al., 2010) reflects the highest temperature period identified in the River.

Table 3 Maximum hourly-averaged temperatures measured by USGS at Hudson River stations for periods of record.

USGS Station	Start Date of Record	Maximum Temperature (F)	Date of Maximum Temperature
Hastings	2 May 1992	85.1	3 August 2006 12:00
West Point	1 October 1990	84.0	14 August 2005 19:00
Poughkeepsie	1 October 1993	83.8	14 August 2005 21:00
Albany	26 February 2002	83.5	4 August 2007 17:00

All of available hourly-average USGS data for periods of record (10 to 22 yrs) for the Hudson River stations that are located within the ASA hydrothermal model domain (River Mile 21 to 144) show that the temperature never reaches 90°F (see Table 3).

Further, the specification by NYSDEC of a maximum ambient water temperature of 90°F is identical to their thermal criteria in 6 NYCRR § 704.2 that states that a discharge cannot cause the water temperature to exceed 90°F. As such, NYSDEC's selection of this temperature seems particularly inappropriate – i.e., selected to result in potential violations of thermal criteria.

It should be noted that a recent study was conducted for the Charles Poletti Power Project to demonstrate that the plant operated in compliance with NYSDEC thermal criteria (Lowe et al., 2009). The plant is located in Queens, New York City, and discharges to the East River, a tidal estuary. The selection of ambient water temperature was determined by calculating the 95th percentile of daily water temperatures between June and September based on five years (2001-2005) of data. This statistically derived ambient water temperature is in contrast to the unsupported 90°F ambient water temperature specified by NYSDEC Staff for compliance determination of Indian Point.

5. Tidal Conditions

NYSDEC Staff requests results reflecting “slack ebb begin” and “slack flood begin”. Due to the dynamic nature of the River a tidally varying downstream boundary was used in the model that captured all phases of the tide (i.e., slack before ebb, maximum ebb velocity, slack before flood, maximum flood velocity and all other times). It is then possible to see which tidal conditions have the largest effect on the temperature distribution in the River and more, precisely, whether Indian Point is in compliance with NYSDEC thermal criteria. Model results for the August 2005 scenario are presented below to show the extent of the Indian Point thermal plume.

Figure 2 shows the time history of the surface area of the River exceeding 90°F and the tidal velocity during a representative 1-week period. The area peaks to approximately 33 acres depending on two stages of the tide: slack before ebb and just before maximum ebb. Slack before ebb (equivalent to “slack ebb begin”) is the short period of slack velocity between the time when the tide stops flooding upstream and then turns to an ebb condition. This slack period allows a pool of water greater than 90°F to accumulate before being swept downstream and dispersed. However, only alternating slack before flood conditions exhibit this behavior. The other condition exhibits a peak area that is delayed by approximately 2 hours after slack before ebb, which is just before maximum ebb. These alternating occurrences are due to a established tidal phenomena known as the diurnal inequality, where, in this case, subsequent ebb tides are less energetic (lower maximum ebb velocities).]

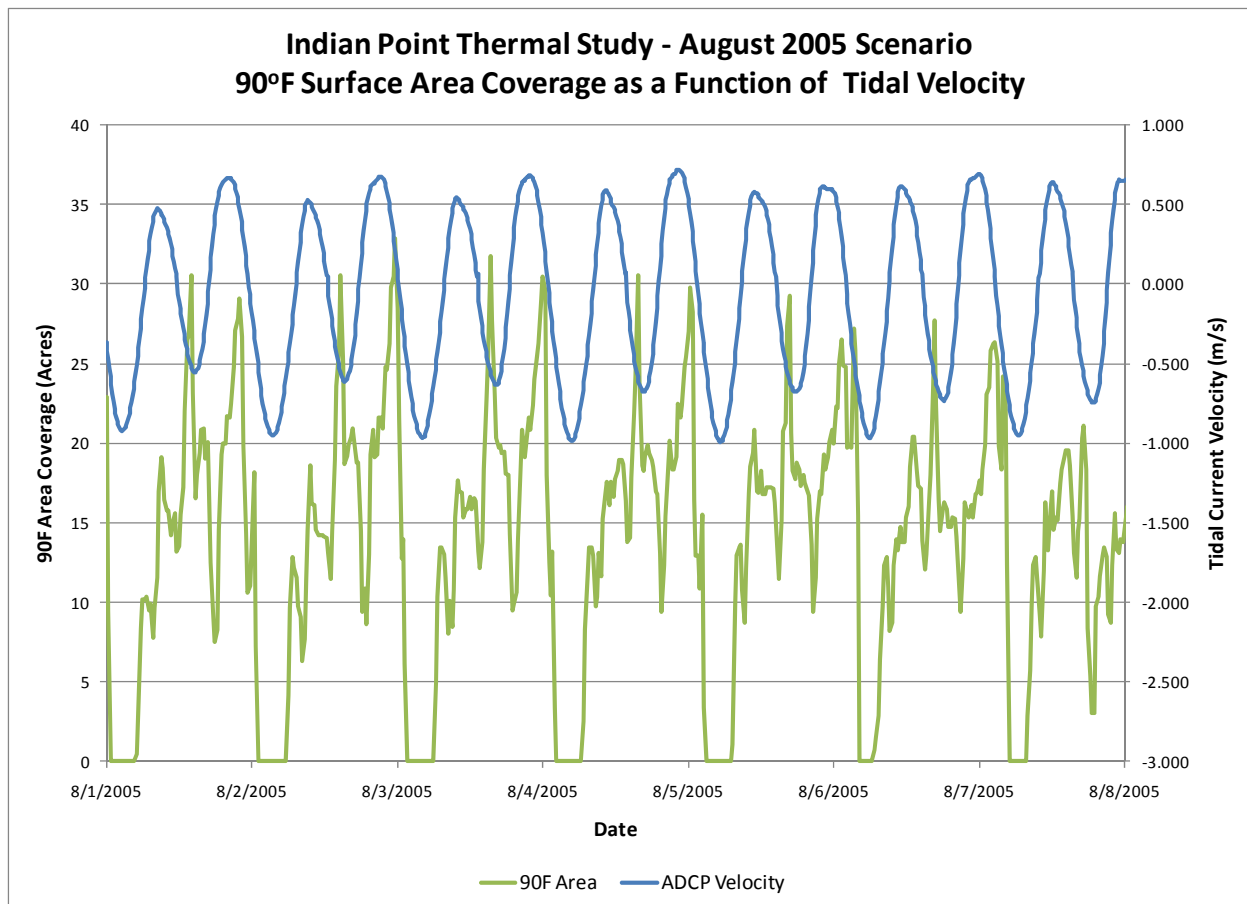


Figure 2 Time history of the surface area of the River exceeding 90°F and the tidal velocity during a representative 1-week period during August 2005.

Figure 3 shows the time history of the cross-River extent of the surface thermal plume as defined by a 4°F temperature rise and the tidal velocity during the same representative 1-week period. A series of River cross sections were examined and the section at Stony Point, where the River is narrower than the other sections near Indian Point, was found to have the highest cross river extent. For this measure of compliance with the NYSDEC thermal criteria, the maximum cross-River extent always occurs at or just prior to maximum ebb. This timing is reasonable since the plume must travel downstream some distance after its initial local buildup during the previous slack before ebb condition. The diurnal inequality is represented here as larger distances when the maximum ebb is larger, which occurs on alternating ebb tides.

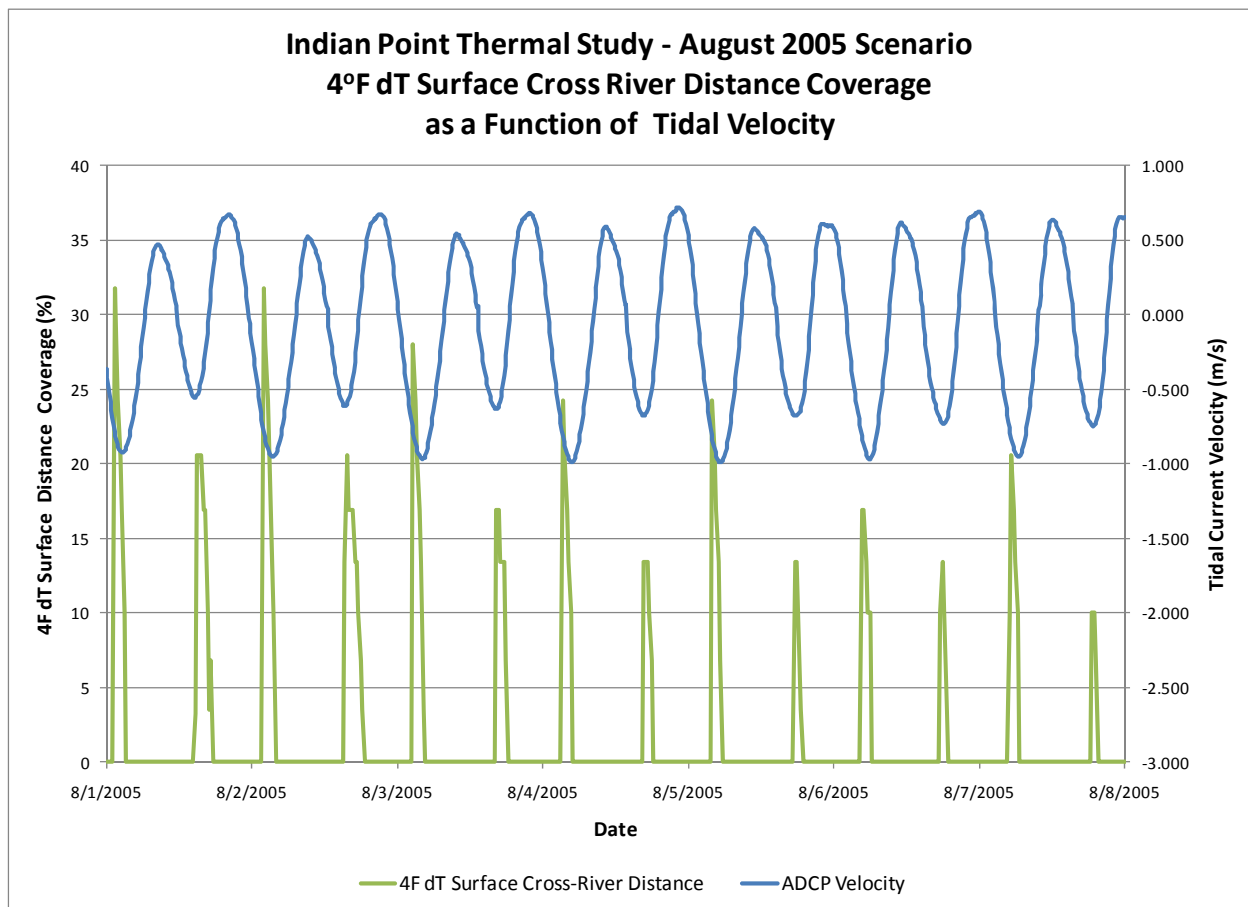


Figure 3 Time history of the cross river extent of the surface thermal plume as defined by a 4°F temperature rise and the tidal velocity during a representative 1-week period during August 2005.

Figure 4 shows the time history of the vertical cross sectional area of the thermal plume as defined by a 4°F temperature rise and the tidal velocity during the same representative 1-week period. A series of River cross sections were examined and the section at Indian Point, defined as the section from the cooling water discharge location at Indian Point across to the western shore, was found to have the highest vertical cross section area extent. For this measure of compliance with the NYSDEC thermal criteria, the maximum cross section area occurs at either slack before ebb or slack before flood. These slack periods allow a pool of water to accumulate and spread across a portion of the River before being swept up- or down-stream and dispersed.

Since all phases of the tide were simulated in the model, it therefore can be concluded that the model was run during “slack begin flood” and “slack begin ebb”.]

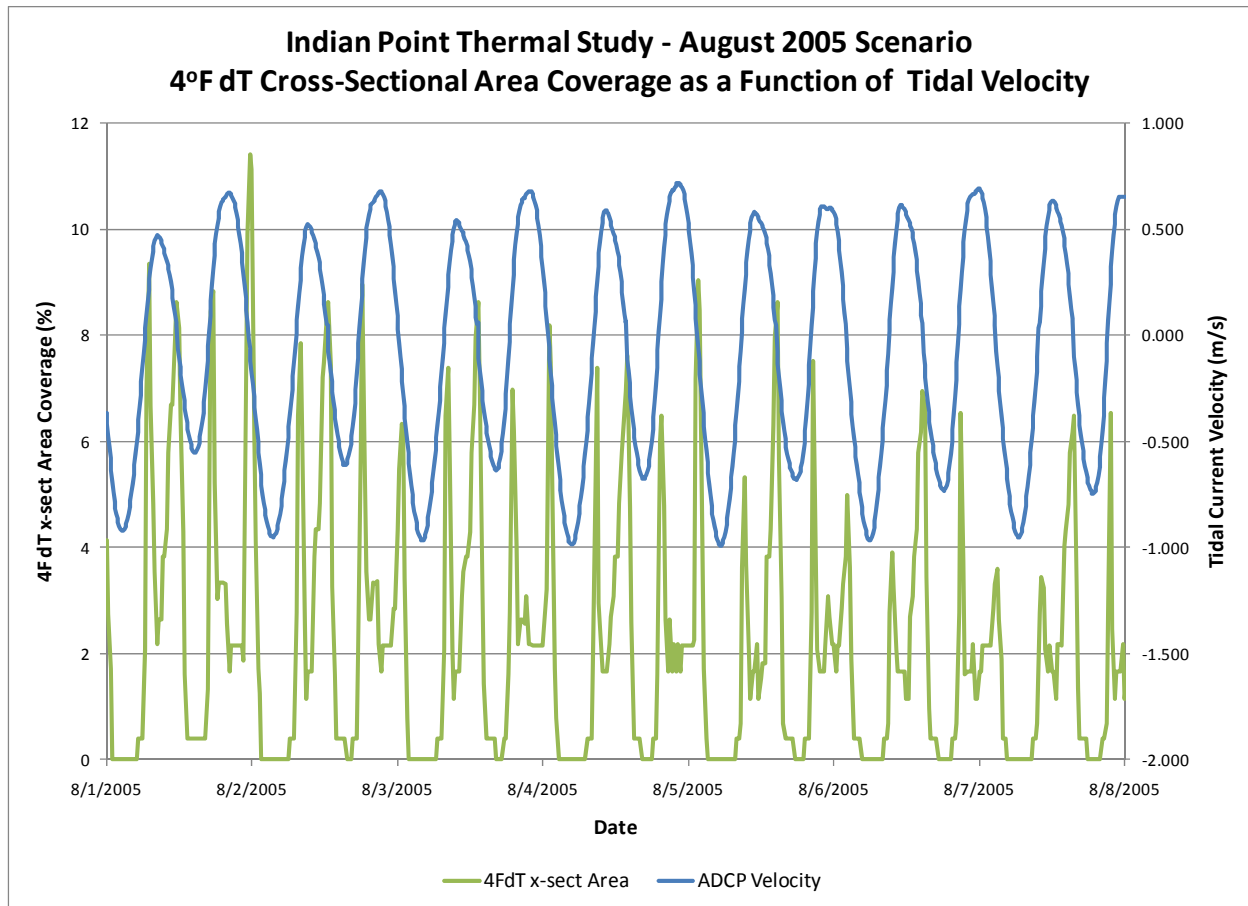


Figure 4 Time history of the vertical cross sectional area of the thermal plume as defined by a 4°F temperature rise and the tidal velocity during a representative 1-week period during August 2005.

To get a better perspective on the physical location of the plume both horizontally and vertically, representative plan and section views of the temperature structure are shown in Figure 5. The color contours show temperature rise above ambient either below or above 4°F. The environmental window shows that this image was created at maximum ebb (low tide) on 2 August 2005 with the plume moving south along the eastern side of the River and the widest surface extent occurring at Stony Point. The vertical section shows that the cross section greater than 4°F is a relatively small fraction of the total River cross section, and satisfies New York thermal criteria.

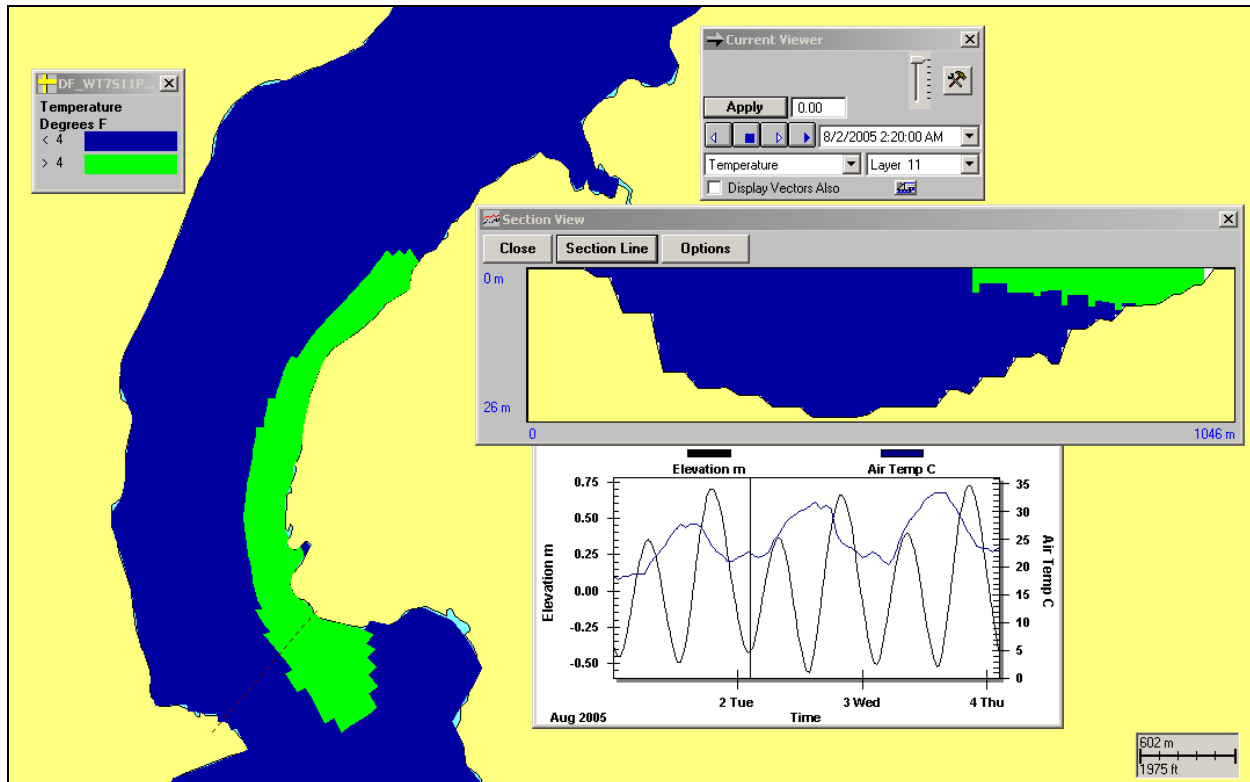


Figure 5 Plan and section views of the thermal plume defined by the 4°F temperature rise above ambient at maximum ebb on 2 August.

6. Thermal Stratification

NYSDEC also specifies the hydrothermal model be run during periods of thermal stratification. In general the River is minimally thermally stratified due to the energetic mixing occurring from the strong tidal currents. The August 2005 scenario period run in the model used actual River temperatures and atmospheric conditions. From the Ichthyoplankton Survey conducted by Normandeau for Indian Point the surface to bottom temperature difference during August 2005 varied from 0 to 3.2°F during the 10 August 2005 survey and from 0 to 1.4°F during the 24 August 2005 survey. The model predictions during that same period showed a surface to bottom temperature difference from 0 to 1.7°F, consistent with the observations.

Therefore the model was run during thermal stratification conditions.

7. Criteria Specified in 3 July 2009 Letter

The NYSDEC letter to Dara Gray of 3 July 2009 included comments on the proposed Tri-Axial Thermal Study Protocol (Swanson, 2009). In that Protocol, the suggested field program included deployments of instruments during the summer period of peak air and water temperatures. That NYSDEC letter was reviewed again, and no actual critical conditions were enumerated in contrast to the assertion in the NYSDEC 2 April 2010 letter. In the Response to the NYSDEC's July 3, 2009 letter (Swanson and Mendelsohn, 2009), a plan was presented to investigate the last ten years of environmental data to determine "worst case" conditions, as was documented in the Report and is summarized above.

8. Additional Field Work

NYSDEC Staff suggest that additional field work must be conducted in the July-September period to “verify” correct calibration of the model. The whole purpose of the modeling effort is to calibrate the model to available data, in this case, the September – October 2009 period, and then use the model to predict other actual time periods when critical conditions occur. These critical condition time periods cannot be known *a priori* which is why the modeling is performed. NYSDEC Staff do not raise objections to the model, which has been widely accepted by environmental regulators, and therefore this concern should be addressed through NYSDEC Staff’s review of the model calibration.

Nonetheless, additional field work is scheduled for the summer period in 2010.

9. Plant Loading

NYSDEC Staff suggests that all predictions are to be performed at All Plants at Capacity (APAC) conditions. Indian Point was run at at-capacity (or slightly over capacity) condition. We also have determined whether the influence of other relevant Hudson River plants, and their operating conditions, were observed in the measured temperature data. As detailed below, we have determined that stations in proximity to Indian Point, that is Danskammer, Roseton, Lovett, and Bowline, were operating during the August 2005. Some general information was used to assess operations. This included operational characteristics for these plants (Barnthouse et al., 1988) and summarized in Table 4.

Table 4 Characteristics of power plants on the Hudson River in proximity to Indian Point.

Plant	Location (River Mile)	Maximum Cooling Water Flow (kgpm)	Maximum Temperature Rise (°F)	Heat Rejection (MW thermal)
Danskammer Point (1-4)	66	295	18	778
Roseton (1-2)	66	641	17.8	1,673
Indian Point (2-3)	43	1,740	15.3	3,902
Lovett (3-5)	42	267	19.1	745
Bowline Point (1-2)	37	768	14.9	1,681
Total				8780

Information (daily or monthly averages) for plant operating during August 2005 (some of which have since ceased operating) were provided (Normandeau) to compare with maximum capacity summarized in Table 4. Monthly averaged flow values were used for Danskammer and Roseton with maximum temperature rises assumed, and suggest substantial daily operations (and are expected to reflect capacity or close to capacity operations during the month of August). Daily averaged flow values and temperature rises were combined into monthly averaged values for Bowline and Lovett, the latter of which no longer operates, but which in combination likewise reflect substantial daily operations. A conservative estimate of flow and temperature rise was used for Indian Point. It should be noted that this conservative heat rejection rate for Indian Point is 32% higher than the maximum level reported in Table 4.

Table 5 Summary of plant operations in August 2005.

Plant	Monthly Avg Cooling Water Flow (kgpm)	Monthly Avg Temperature Rise (°F)	Heat Rejection (MW thermal)	Percent of Capacity
Danskammer Point (1-4)	274	18	724	93
Roseton (1-2)	559	17.8	1,460	87
Indian Point (2-3)	1762	20.0	5,163	132
Lovett (3-5)	224	14.8	487	65
Bowline Point (1-2)	267	4.0	283	17
Total			8,117	92

It will be shown below that the thermal impact of these stations is not a material factor in establishing the potential thermal impacts of Indian Point. As such, the APAC condition is not material in assessing Indian Point's thermal discharge.

An analysis is shown below for Danskammer and Roseton, the two plants north of Indian Point by determining whether their thermal signature is found at West Point. Lovett is not considered since it has been decommissioned. Bowline was implicitly modeled since the lower model boundary condition used temperature from the USGS station at Hastings approximately 16 mi downstream of Bowline. The water elevation, salinity and temperature measured at USGS West Point and Hastings stations were investigated for both the extreme scenario (August 2005) and calibration (September 2009) periods in order to evaluate whether there is any thermal impact from the power plants located upstream of Indian Point (e.g., Danskammer and Roseton).

Figure 6 shows temporal variation of water elevation, salinity and temperature at USGS West Point station during a portion of August 2005 (i.e., extreme condition period). Water elevation, which can be used for proxy of tidal current pattern, shows the semi-diurnal (12.42 hr) tidal cycle with a clear signal of diurnal inequality (i.e., one high tide is higher than the next high tide). Salinity shows a tidal fluctuation of approximately 1 psu as saltier water was transported upstream with the flood tide. The diurnal inequality was more prominent in the salinity variation where higher salinity occurred during higher high tide conditions (i.e., stronger flood tide). Most importantly, the temperature shows a diurnal variability of heating during the late afternoon and early evening periods before cooling after sundown. Since there is no clear tidal (semidiurnal) signal of transport of heated water from upstream during ebb, there is no evidence that the West point station is influenced by thermal discharge from the two generating plants, Danskammer and Roseton, located upstream. If there were thermal influences from these plants it is expected that the time series would show a temperature rise on each ebbing tide as the thermal plumes move downriver to West Point.

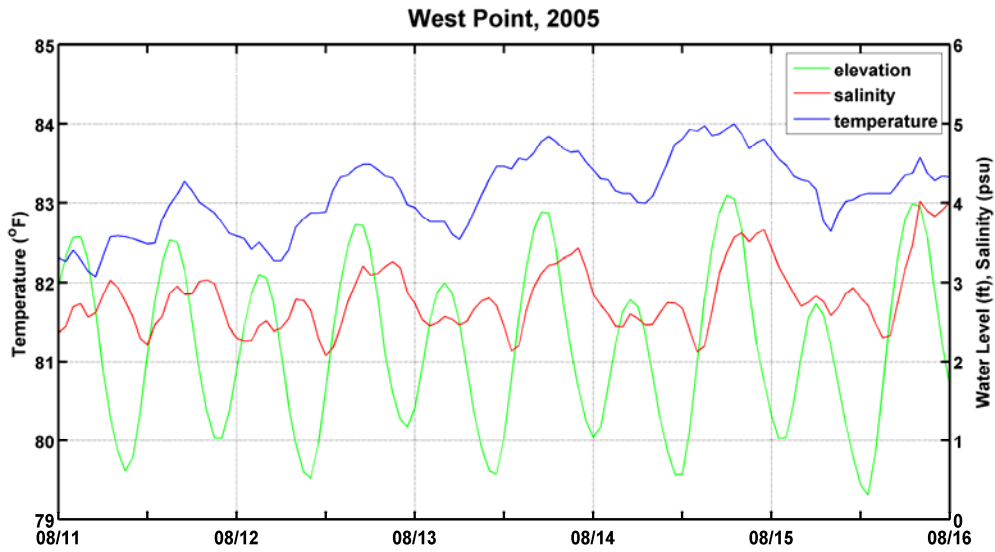


Figure 6 Elevation, salinity and temperature at USGS West Point station during August 2005.

Figure 7 shows temporal variation of water elevation, salinity and temperature at USGS Hastings station during August 2005. The semi-diurnal tidal signal in water elevation leads the transport of salt water from downstream, so that higher salinity occurred just after high tide. However, higher temperature occurs just after low tide, coincidentally with lower salinity, which implies that the warmer (less saltier) water is transported from upstream, i.e., Haverstraw Bay. Haverstraw Bay consists mostly of broad, shallow regions which can easily be heated by solar radiation.

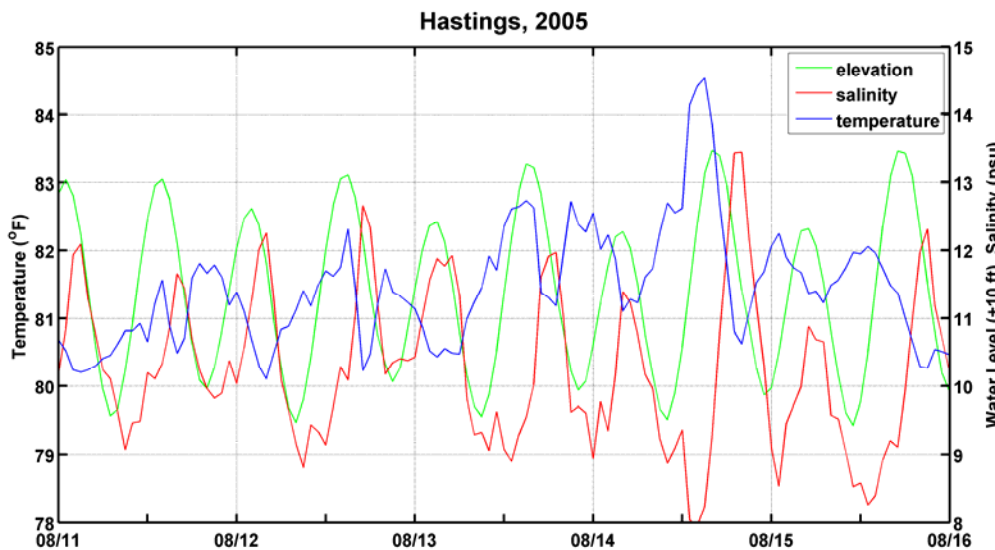


Figure 7 Elevation, salinity and temperature at USGS Hastings station during August 2005.

Figure 8 shows the temporal variation of water elevation, salinity and temperature at USGS West Point station during early October 2009 (i.e., calibration period). Water elevation shows a semi-diurnal tidal cycle (12.42 hr). Salinity shows tidal fluctuations as the saltier water is transported upstream during flood tide. Higher temperature occurs simultaneously with the higher salinity period. Again, it is not

likely that the West Point station is influenced by the thermal discharge from the two other plants located upstream as there is no clear signal for transport of heated water from upstream during ebb. Again, transport of saltier and warmer water to this location occurs only during flood tide.

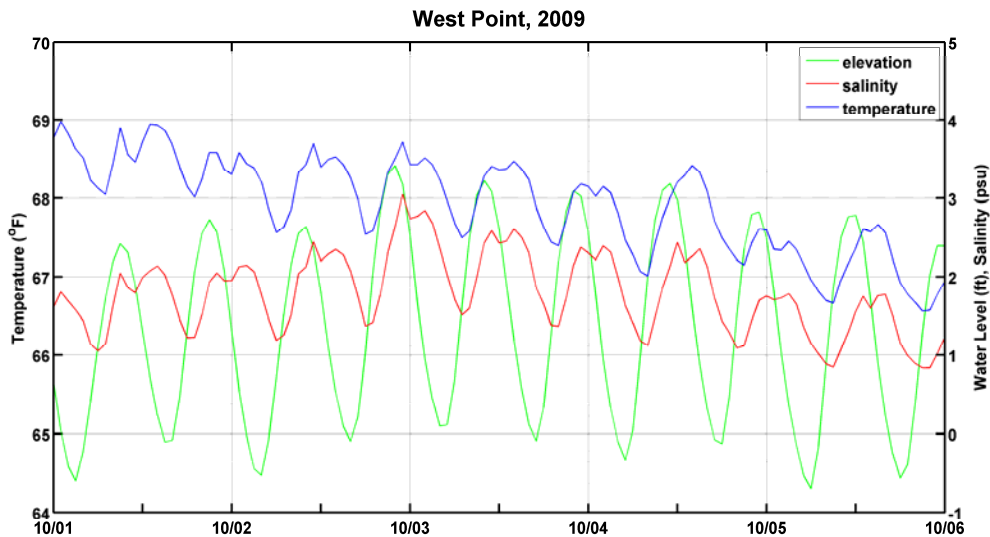


Figure 8 Elevation, salinity and temperature at USGS West Point station during October 2009.

Figure 9 shows temporal variation of water elevation, salinity and temperature at the USGS Hastings station during early October 2009. Both water elevation and salinity show a semi-diurnal tidal cycle (12.42 hr). During the early part of the record (e.g., 02 October), higher temperature was observed during the period of higher salinity, whereas higher temperature occurred during lower salinity period on 4 and 5 October.

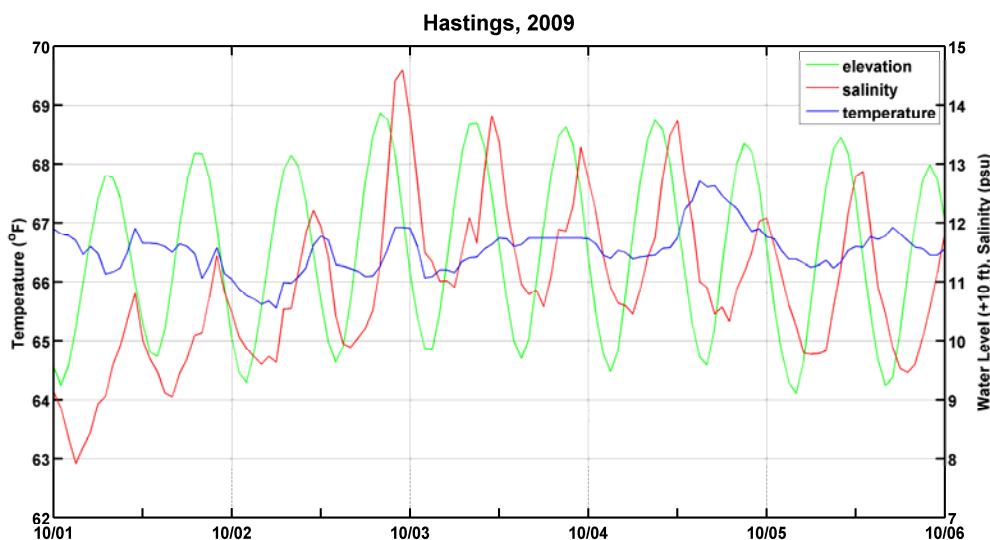


Figure 9 Elevation, salinity and temperature at USGS Hastings station during October 2009.

From the above analysis it is unlikely that the two plants, Danskammer and Roseton, do not contribute heat via a temperature rise to the River, at least south of West Point. In any event, contact is being made with other plant operators (Dynegy and Mirant) to determine their activities during critical times.

10. Summary

An analysis was made of the August 2005 period to ascertain that it was equivalent to the “conservative approach” referenced in the NYSDEC letter of 2 April 2010. Specifically the period selected contained actual extreme environmental conditions.

The 7Q river flow rate was within 3% of the MA7CD10 flow suggested by NYSDEC, but more importantly, the freshwater flow accounts for less than 1% of the total flux in the River, since the River is tidally dominated.

An analysis was performed on historical USGS temperature information and there was no ambient temperatures reaching 90°F during anytime in the record. Highest temperatures in the mid 80s (°F) actually occurred during August 2005 for the West Point and Poughkeepsie stations.

Tidal conditions run in the August 2005 included all phases of the tide cycle including “slack ebb begin” and “slack flood begin”.

The model reproduced the thermal stratification observed in August 2005.

The 3 July 2009 NYSDEC letter did not reference any specific environmental conditions such as MA7CD10 River flow or 90°F ambient River temperature in contrast to the statement in the 2 April 2010 letter.

The model was successfully calibrated to an intensive data collection program in the River during September and October 2009. Once calibrated the model can be and was used to predict “worst case” environmental conditions. Without any a priori knowledge that 2010 might be a “worst case” year additional field work is scheduled for the summer period in 2010.

Plant loading from other plants was not explicitly used in the model because an analysis of the USGS temperature data at West Point indicated that there was no evidence that the thermal plumes from Danskammer or Roseton affected that data. Lovett is now decommissioned and therefore its discharge would not be simulated. Bowline is 5 mi downstream of Indian Point and not likely to influence temperatures in the vicinity of Indian Point. Finally a very conservative thermal load of 32% greater than published capacity from Indian Point was assumed.

11. References

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