EFDC Falls Lake Model Simulation Videos

The Upper Neuse River Basin Association (UNRBA) has developed three lake water quality models to simulate water quality in Falls Lake and evaluate nutrient management strategies. One of these models, the Environmental Fluid Dynamics Code (EFDC), has been used to develop simulation videos of lake water quality. These videos show the period May 2016 to October 2016. This summer period was selected for two reasons. First, warm summer months tend to have higher algal growths rates. Management of algae is the focus of the UNRBA. Second, the model was calibrated for years 2015 and 2016, and this period provides a good representation of lake water quality based on measurements. Calibration means reasonable adjustment of the model to fit water quality measurements.

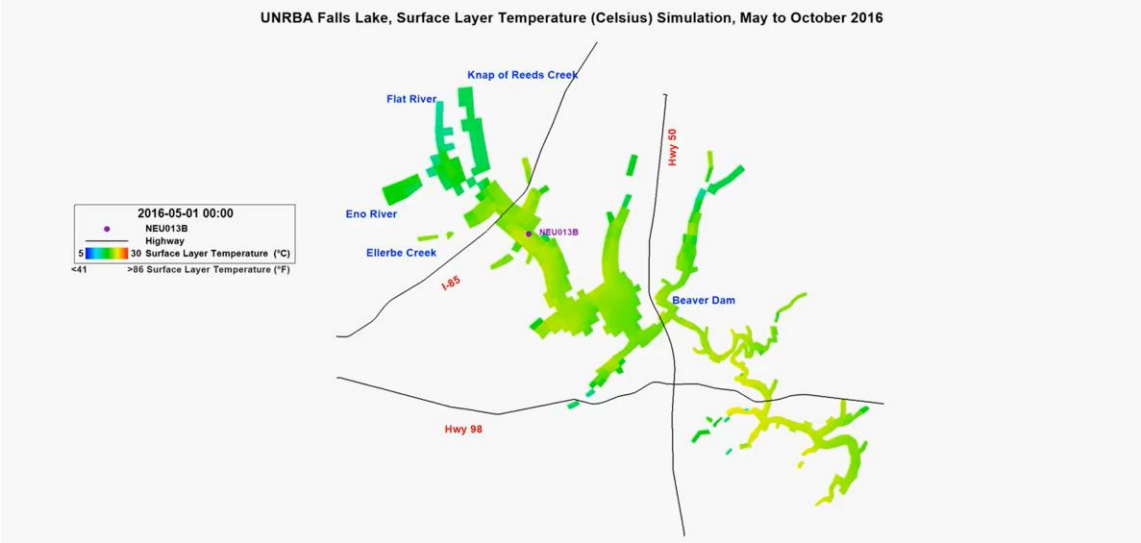
The EFDC model simulates many parameters. Simulation videos have been developed to illustrate key parameters of concern. Table 1 lists the parameters with videos and their importance to the management of Falls Lake. For more information, see the UNRBA Lake Model Report available at https://unrba.org/resource-library.

Table 1. Water Quality Parameters with EFDC Simulation Videos

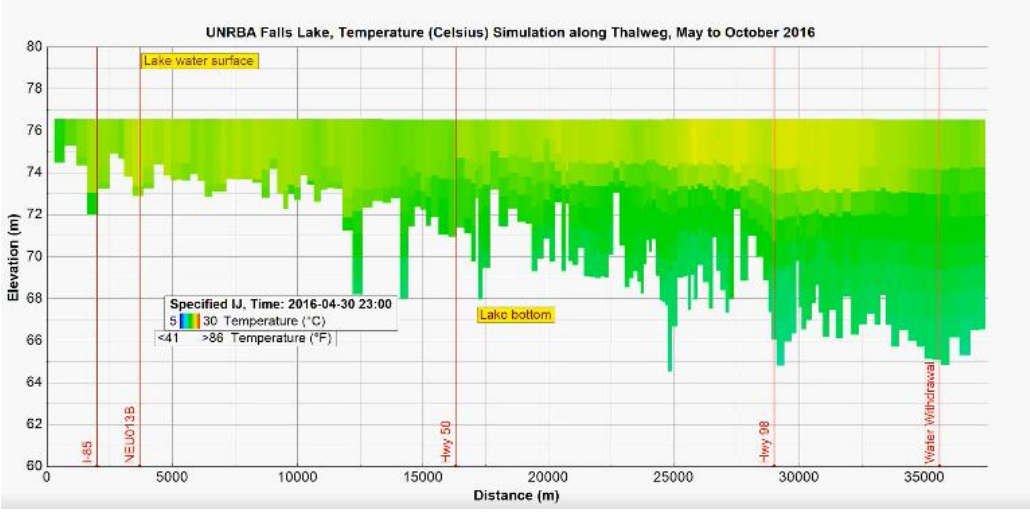
Parameter	Description
Chlorophyll-a	Chlorophyll-a is the regulatory driver for the Falls Lake Nutrient Management Strategy as it remains a key indicator of algal biomass in water bodies. High concentrations of chlorophyll-a can indicate potential negative impacts on aquatic ecosystems.
Temperature	Temperature affects reaction rates. Within Falls Lake, changes in temperature can impact algae species composition and growth, dissolved oxygen concentrations, and the rates of chemical reactions in water.
Dissolved oxygen (DO)	Dissolved oxygen is also an important parameter for reaction rates. Within Falls Lake, dissolved oxygen supports aquatic organisms like fish. Low levels indicate potentially stressful conditions for aquatic life.
Total organic carbon (TOC)	Total organic carbon is an important consideration for drinking water supplies like Falls Lake. Understanding the amount originating from the watershed is important for management decisions. Total organic carbon is not currently addressed through water quality standards or established as a control parameter for water supplies. However, drinking water providers monitor and consider total organic carbon in operational decisions.
Total nitrogen (TN)	Total nitrogen is comprised of ammonia, nitrate plus nitrite, and organic nitrogen. Factors such as heavy precipitation can lead to runoff from land into streams, elevating nitrogen levels delivered to Falls Lake. High concentrations of total nitrogen can lead to excessive algae growth and potentially oxygen depletion.
Total phosphorus (TP)	Characterization of total phosphorus loading to Falls Lake is crucial for effective lake management. Factors such as streambank erosion contribute to elevated phosphorus levels, with erosion rates increasing with development intensity. High concentrations of total phosphorus can lead to excessive algae growth and potentially oxygen depletion.

Two simulation views are available for each parameter listed in Table 1:

- **Plan view** shows the surface of the lake looking down from above. The top-left of the figure below is where most of the stream flow enters the lake. This part is relatively shallow and receives most of the total nitrogen and total phosphorus loading from the watershed. Shallow water and high nutrient loads stimulate algae growth. The lake becomes narrower and deeper toward the dam (bottom-right). Plan view shows landmarks including major roads and the most upstream water quality monitoring station (NEU013B) where the highest concentrations of chlorophyll-a are observed.



- **Profile view** shows a "slice" of the lake along the deepest channel, called the thalweg. The left side of this view is the shallow, upstream end of the lake. Moving towards the dam (right side), the water becomes deeper. Red lines indicate major road crossings, the most upstream monitoring station (NEU013B), and the water supply intake. The surface of the lake is at the top of the video. The surface moves up and down depending on how full the lake is. The lakebed is shown along the bottom.



Some of the videos include an inset figure showing the relative inflow to the lake from the five largest tributaries: Ellerbe Creek, Eno River, Flat River, Little River, and Knap of Reeds Creek. The relative inflows are shown to demonstrate how lake levels and water quality change when stream flows change.

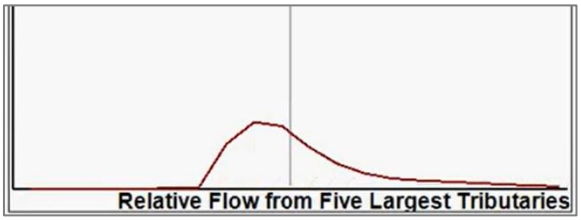


Table 2 provides links to each video listed by parameter, view, and whether the relative inflow is provided.

Table 2. Links to EFDC Simulation Videos

Parameter	View	Relative Inflow Provided?	Link
Chlorophyll-a	Plan	Yes	https://youtu.be/zLz9XGYlEO8?si=ne2rwuZdYqdtd5hn
Chlorophyll-a	Profile	Yes	https://youtu.be/S1j02fnVkH4?si=9WfOsHv7rcHj4Iym
Chlorophyll-a	Plan	No	https://youtu.be/MtWlmrpMYhI?si=E_GLmK6KJ6zPa9gO
Chlorophyll-a	Profile	No	https://youtu.be/WPRuh9Zfw_c?si=Pu94DYeztdar1i2l
Temperature	Plan	Yes	https://youtu.be/qsivnMEP9F0?si=BDhvi55bM_N0e1DN
Temperature	Profile	Yes	https://youtu.be/dtJhx2rbQJg?si=L21MkvixUVYIIVg2
Temperature	Plan	No	https://youtu.be/CeqQYtywa2o?si=noN3B51yPMdVz7u2
Temperature	Profile	No	https://youtu.be/8rNMwC5ZJHs?si=zoKwm29QwPMZzZHc
DO	Plan	Yes	https://youtu.be/HA49B1ABgcY?si=plcfYamDYgHxPxYP
DO	Profile	Yes	https://youtu.be/qSB5-KwNlqg?si=tbMCy0o1ayNq8fd6
DO	Plan	No	https://youtu.be/n1Y7dOW_i6I?si=gpkBSEugdHRql5Ge
DO	Profile	No	https://youtu.be/Gisfv4l7-MA?si=wpkMWUE8nNAWzCet
TOC	Plan	Yes	https://youtu.be/t5qB2JOwi8E?si=7LCm28zWPx2J3-TE
TOC	Profile	Yes	https://youtu.be/8di_nkeB1rc?si=h70ccnDo-cV0mlt_
TOC	Plan	No	https://youtu.be/y1m9YZzFm9A?si=q-fxkau7gm2wVqLo
TOC	Profile	No	https://youtu.be/7_-LcUpoVk?si=a2u_NtN2QWko14LK
TN	Plan	Yes	https://youtu.be/zsb65mlW5Ow?si=4wCw9r00QEUS1zNn
TN	Profile	Yes	https://youtu.be/TuCXQSZZBsA?si=e5rBrFhqlfsD4tvu

TN	Plan	No	https://youtu.be/n8Sl5LnUG4I?si=rNToivaKUFREIcg4
TN	Profile	No	https://youtu.be/s4fiCXjW6VE?si=WWYssMq3ixfX6BKJ
TP	Plan	Yes	https://youtu.be/cvGkkZgYXsg?si=yOQfief13Ne-Wu46
TP	Profile	Yes	https://youtu.be/o3j0lyXy1Ls?si=0emH5ba8Dt_ZOhed
TP	Plan	No	https://youtu.be/gFTp-5CKk1w?si=EfRq9W5gJMfsBVbB
TP	Profile	No	https://youtu.be/0FNm0sNQX0Y?si=O5UdtDXdI4GGCogy