You Have Better Water Than You Think

The water quality in your reservoir is as variable as the weather, but your current raw water intake options may not have the ability to keep up. With grab sample monitoring and limited fixed level intakes, you often find yourself uninformed and ill equipped for stratification, rain events and turnover changes to the reservoir's composition. Nutrient rich reservoirs offer significant reservoir water quality management and raw water treatment challenges. The physical makeup of the reservoir provides crucial information to better understand the impact to water quality and treatment performance. Practically speaking no one reservoir management technique will remedy all water quality and treatment challenges. Implementation of one method to address issues can result in exasperation of a different one. But once the water has reached the drinking water treatment plant or the raw water user, the problem must be addressed as a treatment challenge exposing the weaknesses in the process and resulting in increased costs of operation and maintenance and leading to increased risk of poor treatment outcomes and potential public relations complications.

The Water Selector Model

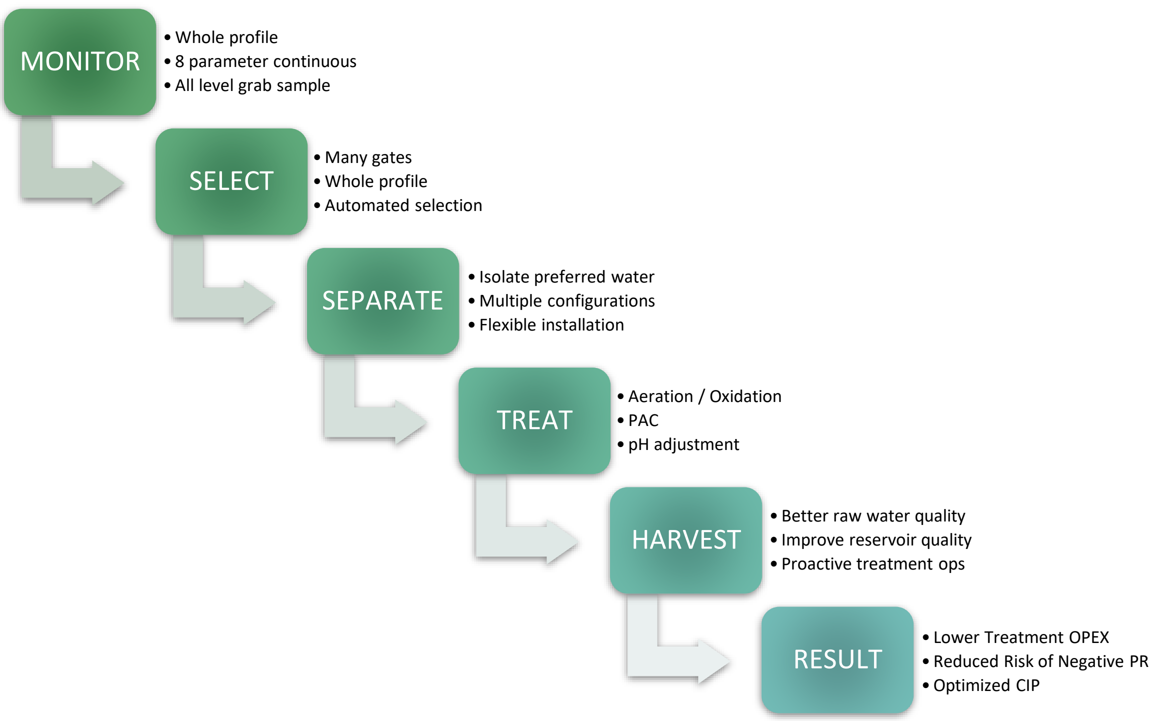
Ixom's Water Selector™ (patent pending) focuses on preventing source water issues from ever leaving the source and is a key part of effective raw water treatment and an integral component of a comprehensive reservoir management program. By continuously monitoring reservoir water quality, in real time, over the entire depth profile and allowing operators to choose the raw water they want to treat with active withdrawal control, Water Selector reduces chemical costs, reduces risk of negative treatment outcomes, and optimizes treatment plant and reservoir management Capital Improvement Planning.

The Intake Water Selector (IWS) offers the ability to allow a thin layer of preferred water to enter the Selector's water quality barrier isolating it from undesirable water found in the reservoir. Within this isolated zone only preferred water exists and therefore only preferred water is permitted to enter the fixed gates of the plant intake.

For those cases of epilimnion (upper stratified layer within the reservoir) high levels of taste and odor (T&O) and perhaps turbidity associated with algae, one or more of the Water Selector gates would be opened that is below the well mixed upper layer but above the oxygen poor lower depths. Therefore, with the lower fixed intake gate(s) open, only preferred water with lower T&O and yet also minimized iron, manganese, hydrogen sulfide and organics is permitted into the water quality barrier making treatment easier, less costly and with reduced risk of unacceptable treated water to the customer.

The monitoring and selection of preferred water works similarly for poor hypolimnion (bottom stratified layer) water quality withdrawals and turnover events where real time profile monitoring allows operators to proactively determine where the best raw water exists and then choose to allow only that water to enter the intake structure.

Once isolated within the water quality barrier, the IWS provides an additional benefit for the treatment plant; pre-treatment. Residence time, contact chambers and dosing capabilities can be incorporated into the design of the isolation zone. By way of example, to augment iron and manganese oxidation prior to reaching the rapid mix in a conventional plant, permanganate can be dosed in the isolation zone where contact is controlled and critical residence time is achieved. Alternately, aeration can be incorporated providing similar benefit in addition to H2S stripping. The pre-treatment options are many including pH adjustment; other forms of oxidation such as chlorine dioxide, hypochlorite, peroxide, ozone; PAC addition; and others.



The Power of Selection

The first Water Selector installation, located near the Walter William Filtration Plant (plant) outside of LaGrange, Georgia (West Point Lake). The City of LaGrange is the regional water provider for the city, some of the unincorporated portions of Troup County, and areas in Meriwether County including the City of Greenville. LaGrange is a midsize, mixed economic development area with some industry. It is located in west, central Georgia with a population of approximately 30,000. Like many communities in Georgia, water is the key to the growth and economic future of LaGrange.

The City's drinking water is provided via the Walter William Filtration Plant (WWFP) which draws raw water from West Point Lake. The water treatment plant (WTP) capacity is 22 million gallons per day (MGD) with current average demand of about 7-8 MGD (up to about 12 MGD). West Point Lake is a relatively large man-made reservoir primarily sourced from Chattahoochee River downstream of Atlanta. The lake is influenced by nutrient loading from the Chattahoochee as well as significant recreational use and runoff. The lake level can vary widely and can change quickly due to flood control measures and also downstream flow requirements as managed by the Army Corps of Engineers. These influences are particularly notable during drought conditions. Low flow conditions have a significant impact to lake water quality which directly affects the water treatment plant raw water condition and system performance. Historically late summer algae blooms have contributed to occasional taste and odor problems and aesthetics issues at the tap which necessitate dosing powdered activated carbon at great expense. In addition, rain events can lead to large spikes in turbidity resulting in treatment difficulties and requirements for significant increase in chemical consumption.

The water treatment plant currently experiences problematic turbidity spikes, taste and order and manganese in raw water from the Lake. As described above, these factors increase the difficulty of treatment and can contribute to color, taste and odor issues within the treatment process. In addition, especially during period of low rainfall or drought conditions, the nature of the organics present particular coagulation and flocculation challenges. The plants currently doses liquid alum for turbidity removal and organics reduction and chlorine dioxide and permanganate to oxidize manganese for improved conventional treatment floc/sed/filtration. Powdered Activated Carbon (PAC) and chlorine dioxide are also dosed to reduce taste and odor (T&O).

The Water Selector was installed and commissioned in October 2017. Soon thereafter the weather turned colder and lake turnover began. However, limited warm water data was obtained which provided excellent indications of the value selection will offer the City. The following data plots (Figures 1 and 2) show profile data taken late in October. The preceding days were generally sunny and mild (low 70s / low 40s). Each Figure plots data from an OTT Hydromet multi-parameter sonde; pH, Temperature, Turbidity and Chlorophyll a. Also shown are the elevations of the water level, the four fixed Intake Structure gates and the Water Selector gate that was opened at the time (el. 612ft).

Figure 1 reveals elevated concentrations of chlorophyll (presence of algae) in the upper ~15ft and a mild thermocline between elevations 615ft and 610ft. The data was collected in the afternoon when you might expect slightly cooler diurnal surface water temperature and somewhat increased phytoplankton activity. The turbidity is fairly low, 6 to 8 NTU, in the upper ~10ft of lake level, then increases quickly in the thermocline and even more rapidly through the hypolimnion.

The plant intake gates that are normally used are those at elevation 618ft and 623ft (typically two gates are open to meet hydraulic requirements). Prior to the Water Selector installation, the WTP would experience raw water quality impacts associated with algae, i.e. taste & odor and TOC, as in this case, the chlorophyll levels would be about 10µg/L transferred to the plant where pre-chlorination takes place. To respond to these conditions the plant typically dosed 18 ppm carbon prior to the rapid mix.

With the Water Selector providing preferred water from elevation 612ft the plant realized an improvement in raw water quality and subsequently was able to reduce the carbon dose to 12 ppm, a 33% decrease. While the preferred raw water had a slightly higher turbidity, the level did not require an increase in coagulant (alum) dosing.

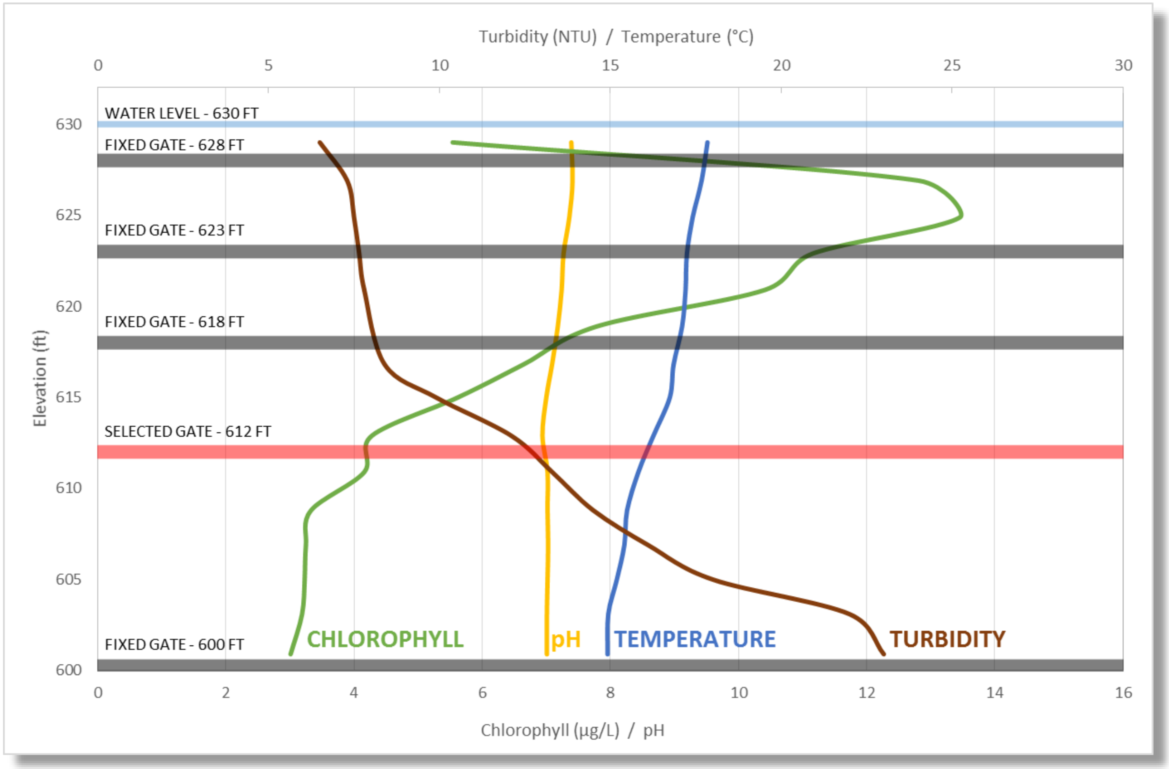


Figure 1

Figure 2 represents raw water quality data sampled from within the Water Selector's water quality barrier. Generally, the water within the barrier consists of only water from the slice withdrawn from elevation 612ft. While the plant intake open gates remained 618ft and 623ft, it was water from 612ft that was transferred to the plant. Figure 2 shows how, within the barrier, the water throughout the profile varies little.

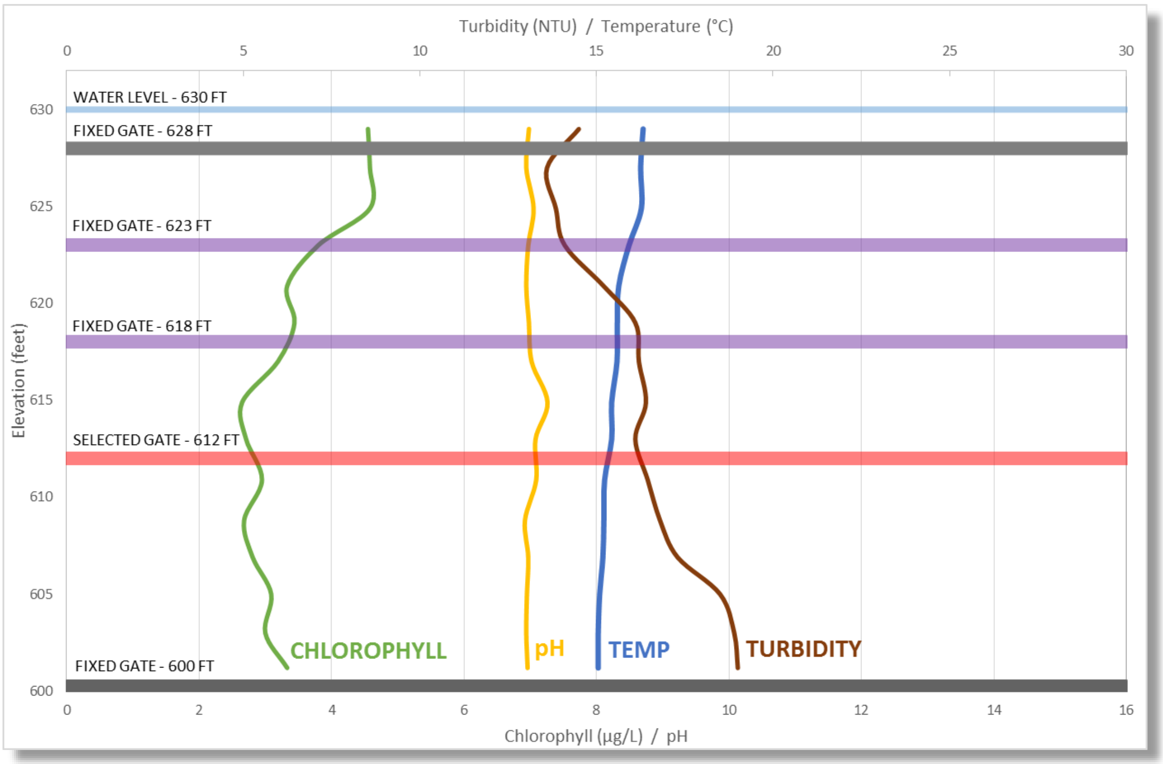


Figure 2

As fall became winter in southwest Georgia, West Point Lake experiences seasonal turnover with cyclical colder and warmer days leading to relatively little to no stratification. However, this is also typically a wet time of year and rain events have historically proven especially impactful. West Point Lake (the location of the WTP intake in particular) is about 50 miles from the Atlanta metropolitan area and is influenced by discharges and runoff. The Lake typically turns brown and the turbidity influent to the plant can spike dramatically during rain events upstream along the Chattahoochee River towards Atlanta. In late December 2015 a rainfall event measuring less than 1 inch in Atlanta led to a turbidity spike at the plant to over 70 NTU and a corresponding increase in alum dose to 34 mg/L (over 50% increase).

This past December a similar rain event occurred in the Atlanta area and of course a turbidity increase in the Lake occurred. Figures 3 and 4 are plots of data representative of the raw water profile, for turbidity and chlorophyll, respectively, prior to and following the rain that occurred in December.

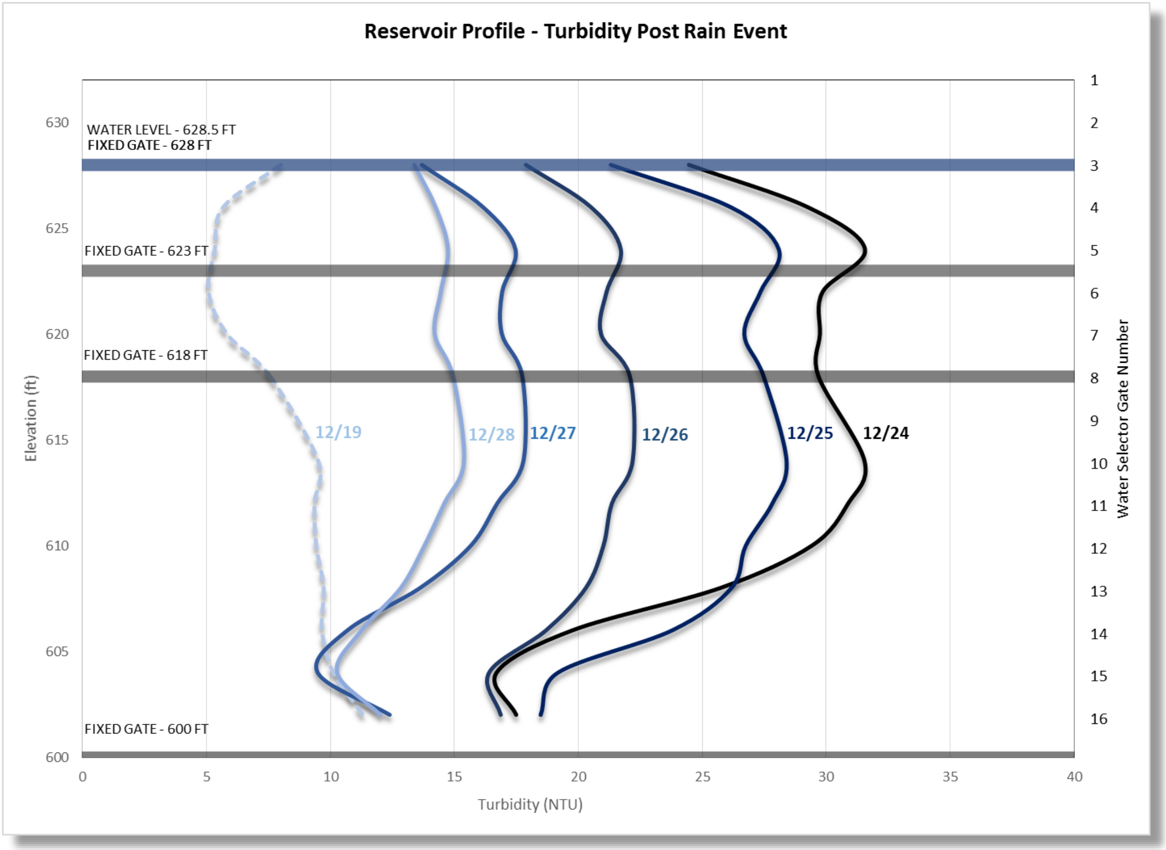


Figure 3

The turbidity on December 19 peaked at about 10 NTU (not accounting for the water at the lake bottom where you would expect to see higher turbidity but would not typically choose to withdraw from that point). Most of the rain fell on December 20 measuring over 1 inch in the Atlanta area. The water plant operators report they usually experience the impact of upstream rains, at the intake, within a few days. At the time of the transient, Water Selector gate 6 was selected and influent turbidities were running about 5 NTU.

As can be seen, the turbidity spiked to over 30 NTU from about 3 ft below the surface to about 20 ft down on December 24. By selecting one of the lower gates, i.e. gate 13, 14 or 15, a much smaller turbidity increase would be experienced providing for less required adjustment for coagulation and a lower risk of a poor treatment outcome. By December 28, the turbidity had approached a new destratified profile.

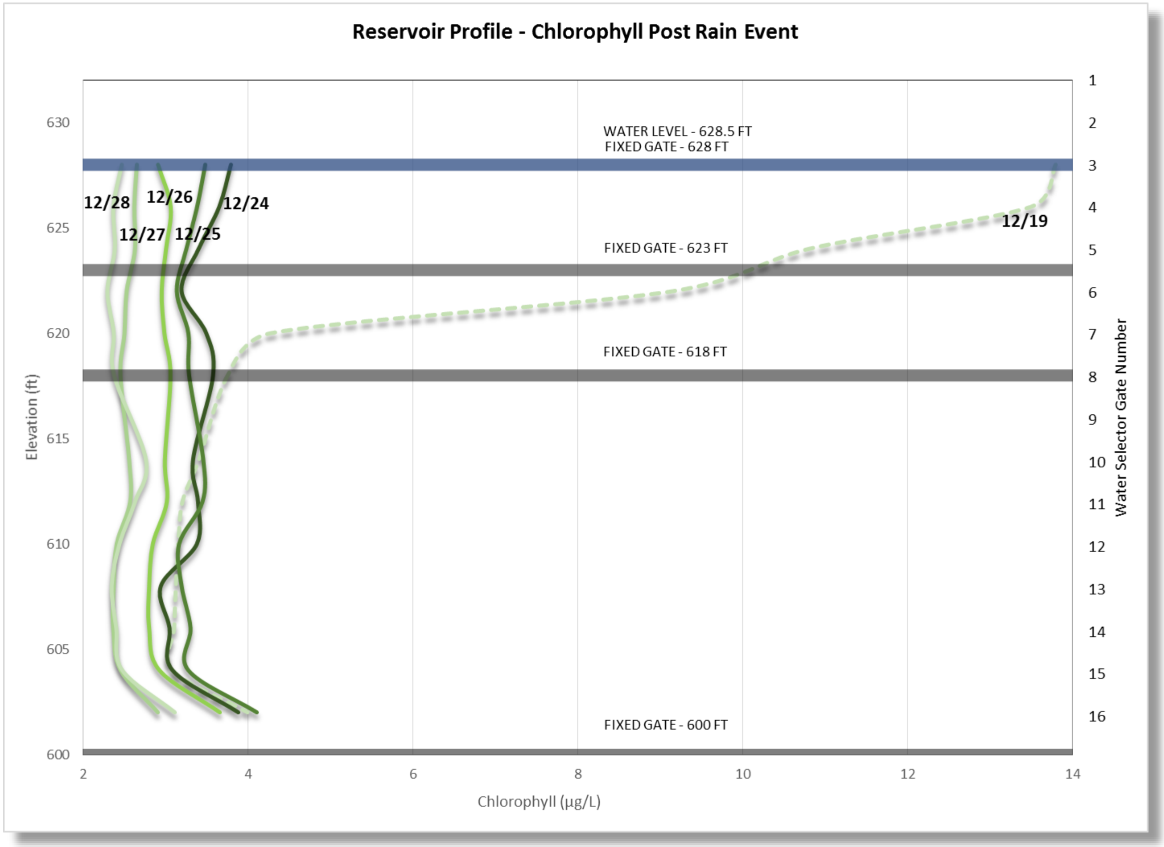


Figure 4

Even during winter months with colder air and water temperatures, cyclical temperature transients and the resulting lake turnover and destratified profile, the Water Selector will smooth out water quality transitions caused by temperature swings and rain events. Figure 4 illustrates shallow Chlorophyll a elevated concentrations following a series of warm days (Dec 19). The rain event and cooling temperatures followed which resulted in a significant reduction in algae. While during this period, the preferred WS gate would likely have been 13, 14 or 15 (reference Figure 3 discussion), the use of the Chlorophyll a data confirms the importance of multiparameter monitoring to ensure ideal gate selection.

Impounded surface waters and lakes provide distinct challenges for the drinking water treatment facilities. Taste and Odor and Iron and Manganese can lead to significant negative public relations outcomes. Turbidity spikes and swings can result in requirements for large and potentially inefficient chemical usage. Effectively dealing with these types of surface water challenges places increased stress on operating staff and results in high operating costs but also often leads to capital improvement planning decisions to upgrade water treatment infrastructure in response. And at the core of the drivers to spend more on chemicals and more capital on treatment is the desire to manage the incalculable public relations risks associated with poor treatment outcomes at the tap. There is clear benefit to taking advantage of knowledge of the reservoir and integrating it with the intelligent multi-option intake selection and the water treatment plant operations.