GEORGIA POWER
A SOUTHERN COMPANY

MORGAN FALLS hydro

FERC Project Number 2237

AN OPERATIONS PRIMER

For the September 1, 2004

Technical Workshop for Stakeholders

A Morgan Falls Operations Primer

Introduction and Purpose of the Primer

Georgia Power has prepared this Operations Primer in response to stakeholder feedback from the Morgan Falls Study Plan Meetings, which took place July 28 – 30, 2004. At the meetings, stakeholders indicated that they would like to have a better understanding of how Georgia Power operates the Morgan Falls Project. Several stakeholders, including representatives of the National Park Service and the Upper Chattahoochee Riverkeeper, asked specific questions about operations at the meeting and subsequently.

The Primer is intended to provide a better basic understanding of the limited operational flexibility of the Morgan Falls Project and answer specific questions raised by stakeholders. The Primer first narrates the method of operations at Morgan Falls, and then uses graphs to illustrate Buford Dam/Lake Lanier releases, Morgan Falls estimated inflows, Morgan Falls reservoir levels, and Morgan Falls releases on an hourly basis for a dry week, a normal flow week, and a high flow week. Much of the information in this Primer has previously appeared in the Pre-Application Document (PAD), was presented at the Scoping Meeting, or was discussed in the Study Plan Meetings. Specific questions Georgia Power received from stakeholders are answered in a separate section at the end of the document.

Morgan Falls Minimum Flow Operation Under the Statement of Policy Agreement with the Atlanta Regional Commission

1. What the Statement of Policy Does

The Morgan Falls license does not specify a minimum flow at the project. Article 27 of the license requires Georgia Power to operate the Morgan Falls Project in accordance with the Statement of Policy issued on March 5, 2001, by Georgia Power and the Atlanta Regional Commission (ARC). Under the Statement of Policy Georgia Power has agreed to operate Morgan Falls to support ARC's Water Management System for the Chattahoochee River.

2. How the Statement of Policy Works

On a weekly basis ARC calculates the minimum release necessary at Morgan Falls dam to meet withdrawal needs of downstream water users and still leave 750 cfs flow in the river immediately above the confluence with Peachtree Creek (after subtracting water withdrawals between Morgan Falls dam and Peachtree Creek). The 750-cfs minimum flow target is set by the Georgia Environmental Protection Division as the basis for determining wastewater discharge limits for meeting water quality standards in the river. Expressly subject to receiving sufficient inflow, Morgan Falls provides a minimum flow release during off-peak power periods of up to 1164 cfs, so that the 750-cfs minimum flow target can be reliably met. Under a separate contract with ARC, the U.S. Army Corps of Engineers (Corps) provides enough inflow into Morgan Falls so that Georgia Power can meet ARC's requested minimum flow,

particularly on weekends. This minimum flow at Morgan Falls is passed through the turbines and used to generate power.

3. The Corps' Role in the Water Management System at Morgan Falls

The agreement between the Corps and ARC is necessary because the Morgan Falls' reservoir (Bull Sluice Lake) has a mere 2250 acre-feet of usable storage, compared with Lake Lanier's 1,089,400 acre-feet of usable storage. Morgan Falls has only enough storage to supplement downstream flows in the Chattahoochee for a matter of hours. Over 76 per cent of the inflows to Morgan Falls comes from Lake Lanier. Without a guarantee of inflow from Lake Lanier, Morgan Falls cannot support ARC's flow needs. Flows in the Chattahoochee River at Morgan Falls are inconsistent because of the way Buford Dam operates. The Corps operates Buford Dam as a peaking plant, generating when demand is greatest. Peak demand periods usually occur in the afternoon, Monday through Friday, but may occur in early morning hours also. These are the times when Buford generates, and consequently, when Buford releases the most water through its turbines.

At present, Buford Dam releases up to 10,000 cfs, maximum turbine flow when peaking. These flows raise the Chattahoochee River level downstream and in the Morgan Falls' reservoir. During Buford Dam's non-peak power periods, Buford Dam discharges only 600 cfs through a small minimum flow turbine. As Morgan Falls continues its releases aimed at meeting a 750-cfs minimum flow target at Peachtree Creek, and Buford releases just its 600-cfs minimum flow during non-peak power periods, the elevation of the Morgan Falls' reservoir falls.

Morgan Falls Modified Run-of-River Operation

4. How the Local Operators at Morgan Falls Manage the Project Flows

The Morgan Falls operators monitor the Norcross, Roswell and Big Creek stream gages upstream of the Morgan Falls' reservoir. Whenever these gages show flows above those necessary to meet ARC's minimum flow request, the operators will increase hydropower generation to utilize that excess inflow up to Morgan Falls' maximum turbine flow of 5,500 cfs. The operators use actual flows observed in the river to make operating decisions. They do not operate Morgan Falls based upon generation scheduled at Buford Dam until the Corps actually releases flows, because that schedule is subject to change at any time. Moreover, it takes 12 hours for Buford releases to arrive at Morgan Falls.

From a power system perspective it would be desirable to store excess inflows for use during peak power demand periods, but Morgan Falls does not have enough storage to re-regulate excess inflows to this extent. The increase in generation occurs when there is excess inflow. Such flows may or may not occur during peak power demand periods, depending upon the time of day and week when excess inflows arrive. The excess inflow is passed by increasing the flow rate through the turbines as necessary, up to the maximum turbine discharge rate of 5,500 cfs. If the reservoir reaches full pond elevation of 866 ft[1], and inflows exceed 5,500 cfs, then the inflow amount above 5,500 cfs is discharged by opening a spillway gate.

[1] Based on plant datum. Plant datum = mean sea level +12.39 feet.

5. Previous Attempts to Optimize Operations at Morgan Falls

Attempts were made in the late 1970s and early 1980s to develop a real-time computer program to optimize the operation at Morgan Falls. The goals of this program were to: 1) meet minimum flows 100 percent of the time, and 2) use excess inflows in the most optimum manner for power generation. Inputs into the program were: 1) Buford actual and scheduled generation, 2) current reservoir elevation, 3) minimum flow requirement, and 4) Big Creek flows (used to estimate local inflow). The effort was abandoned when Georgia Power realized that, due to a number of different factors (gage errors, errors in routing Buford releases to Morgan Falls, errors in estimating total local inflow, changes in the operating schedule at Buford Dam, the 12-hour lag for Buford releases to reach Morgan Falls, etc.) the storage at Morgan Falls was too small to adjust for the errors in all the other inputs. As a result, Morgan Falls presently operates as described above, with the local operators determining the appropriate generation based on constantly changing local conditions.

Explanation of Illustrative Graphs of Typical Morgan Falls Operations

Several stakeholders requested graphical presentations to clarify the operations at Morgan Falls. The graphs that follow characterize typical operations of the Morgan Falls Project for different hydrologic conditions. The average annual discharge at Morgan Falls is approximately 2,317 cfs. The following graphs give a snapshot of the project's operations during weeks where the average discharge was 956 cfs (a dry week), 2,381 cfs (an average flow week), and 6,411 cfs (a week of high flows.)

The main parameters driving the operation of Morgan Falls are the inflow and the required discharge. Since the required discharge does not vary that much over a year, then the main parameter affecting operations is the inflow. On an unregulated river there are significant differences in average flows from one season to the next (for example the highest flow month of the year may be March, and the lowest may be October). However, the Chattahoochee River is highly regulated by Buford Dam, which on average provides 76 percent of the Morgan Falls inflow. Because of this regulation, the releases from Buford Dam are the dominant parameter in how Morgan Falls operates. The reservoir storage at Buford Dam is so large that it can affect large changes in seasonal flows. These three graphs typify operations for a range of hydrologic conditions from dry to wet, controlled more by Buford Dam releases than the season of the year.

The time period shown in each graph represents one week. The data are plotted on an hourly basis. On all the graphs the first day shown is Monday. All flows are in cfs. The dark blue line indicates Buford Dam releases in cfs, as

measured at the U.S. Geological Survey (USGS) Chattahoochee at Buford gage. The yellow line shows estimated inflow, calculated as follows:

> Estimated Inflow = Flow at USGS Chattahoochee above Roswell gage + (flow at USGS Big Creek gage × ratio of drainage area between Roswell gage and Morgan Falls gage to the drainage area at the Big Creek gage).

The yellow line also represents what flows in this section of the Chattahoochee would be if the Morgan Falls dam were not in place, or if it was operated as a pure run-of-river project where outflow always equal inflow and the reservoir level does not change. The light blue line indicates Morgan Falls discharges as measured at the USGS Chattahoochee below Morgan Falls gage. The green line shows lake level elevations. Elevation 866 is full pond, and elevation 858 represents the crest of the spillway and the bottom of the reservoir's usable storage. The spillway is controlled by eight foot high spillway gates (elevation 858 to 866).

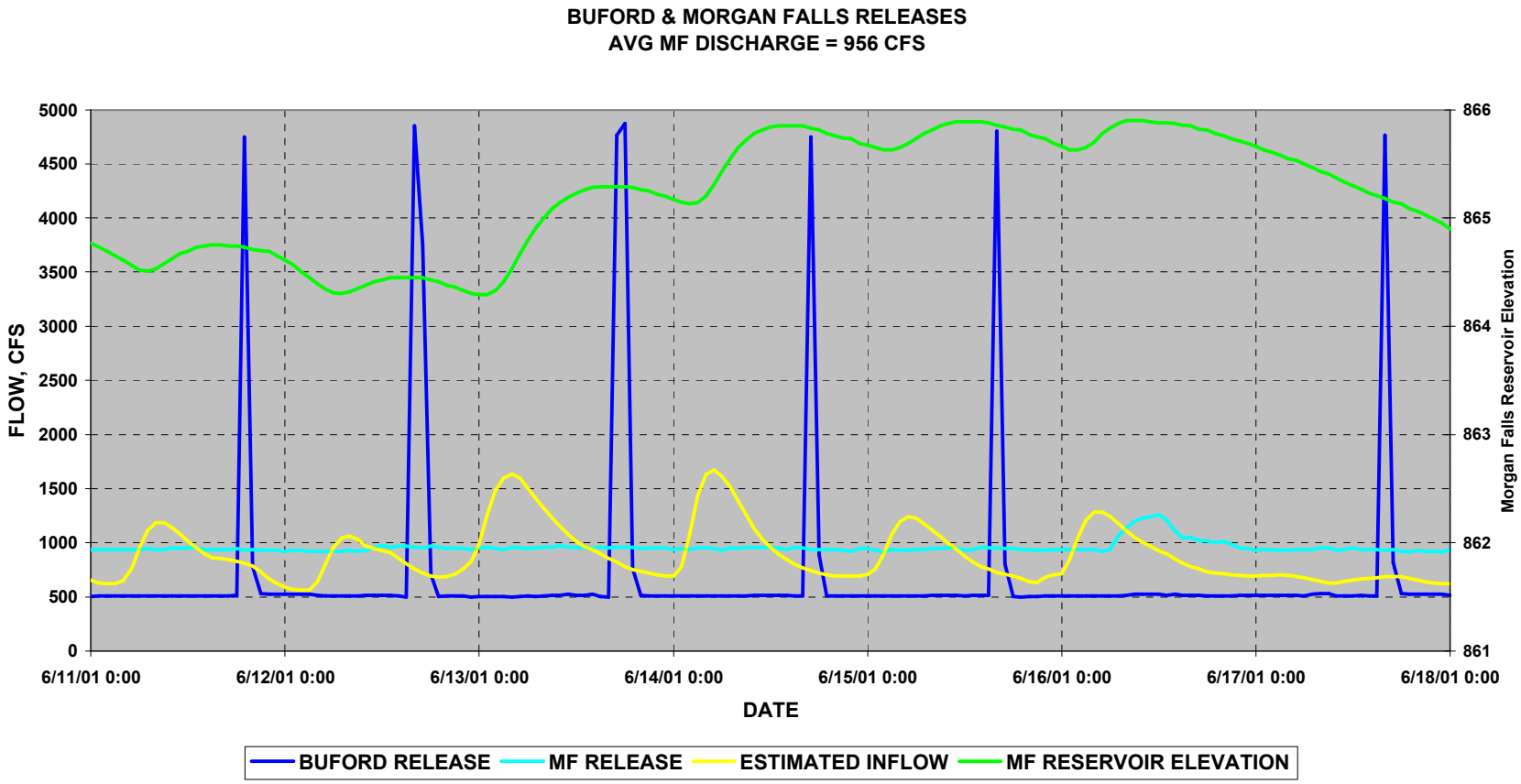
In collecting data for the representative weeks, only the last few years were considered, because the hourly USGS data for the Morgan Falls tailrace has only been recorded for a few years. Drought years occurred in 1998 through 2002 and a "normal" year occurred in 2003. Because of the drought years and turbine upgrades at Buford Dam that are still ongoing, all examples show only one unit (instead of two units) operational at Buford Dam, or peak Buford releases of about 5,000 cfs. Graphs for the same volume release using two units at Buford (10,000 cfs release) would be similar, with the maximum inflow into Morgan Falls reaching a higher flow, and the minimum inflow dropping slightly lower.

Graph No. 1: Dry Week (Average weekly discharge = 956 cfs)

This graph shows the situation at Morgan Falls during the week of June 11 – 18, 2001. In this chart, the minimum release ARC requested for the week was 956 cfs. Morgan Falls was releasing only minimum flow all week long, except for a brief period on Saturday. The yellow line, or Estimated Inflow, represents the flow that would have been in the river if Morgan Falls dam were not there, or if it were operated as a pure run-of-river project where outflow always equal inflow and the reservoir level does not change. Note that the minimum required flow needed by ARC would not have been met many times during this particular week if Morgan Falls had not been smoothing Buford Dam's releases. As you can see from the green line, Morgan Falls' reservoir fluctuation was less than 2 feet over the entire week.

[See Graph No. 1 on next page]

Graph No 1. Morgan Falls Operations During a Dry Inflow Week

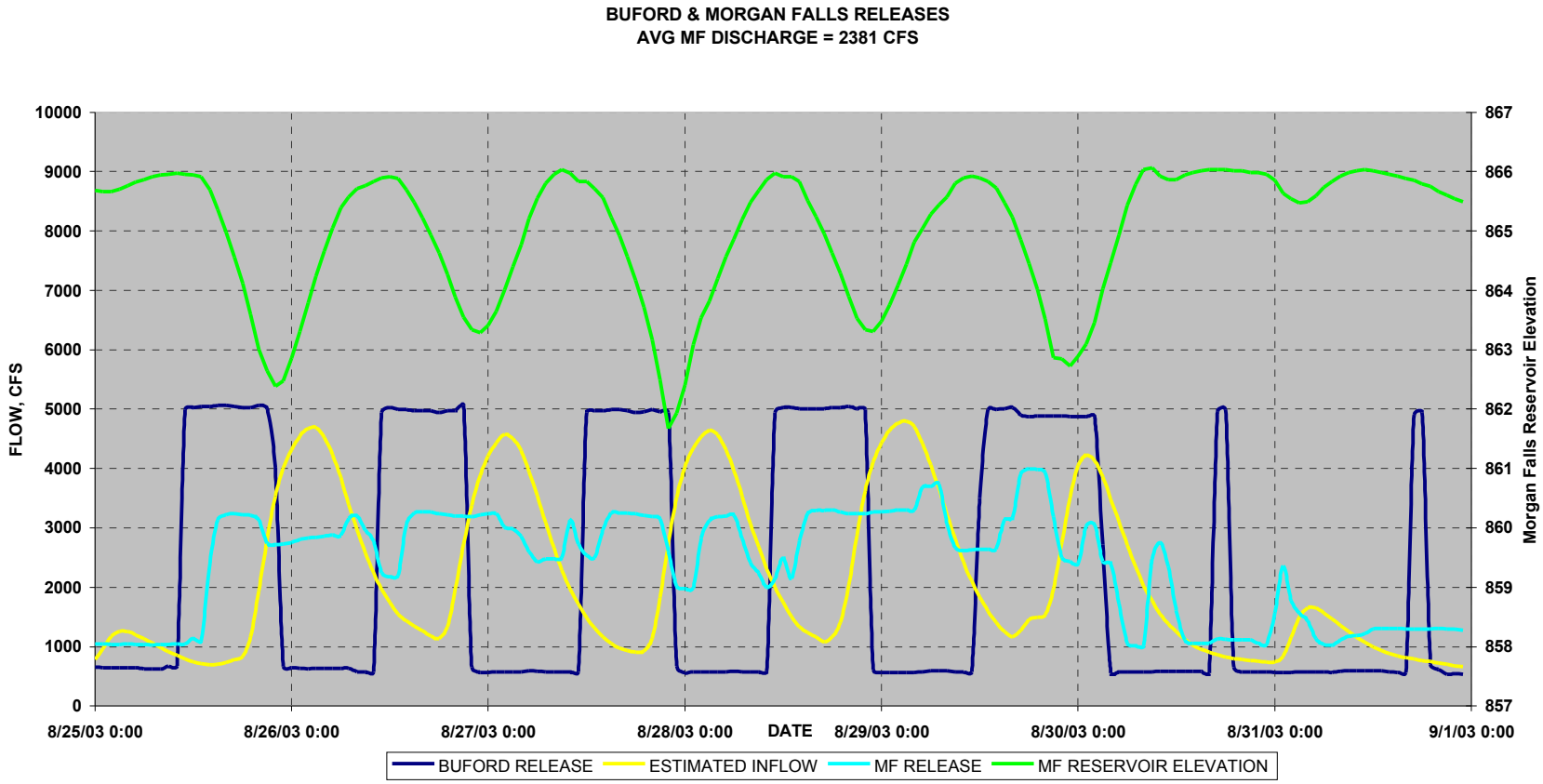


Graph no 2: Average Week (Average Weekly Discharge = 2,381 cfs)

This graph shows the conditions at Morgan Falls during the week of August 25 – September 1, 2003. ARC's minimum requested release for this week was 948 cfs. Note that Morgan Falls was providing only the minimum flow for part of the day on Monday, Saturday, and Sunday. Higher releases were made during the week as the plant operators detected excess flow coming down the river at the Roswell and Norcross gages. The yellow line, or Estimated Inflow, represents the flow that would have existed if Morgan Falls was not there , or if it were operated as a pure run-of-river project where outflow always equal inflow and the reservoir level does not change. Note that the minimum required flow would not have been met for periods on Monday, Wednesday, Saturday, and Sunday if Morgan Falls were not smoothing the releases. Morgan Falls' reservoir fluctuation was about 4 feet over the entire week.

[See Graph No. 2 on Next Page]

Graph No 2. Morgan Falls Operations During an Average Inflow Week

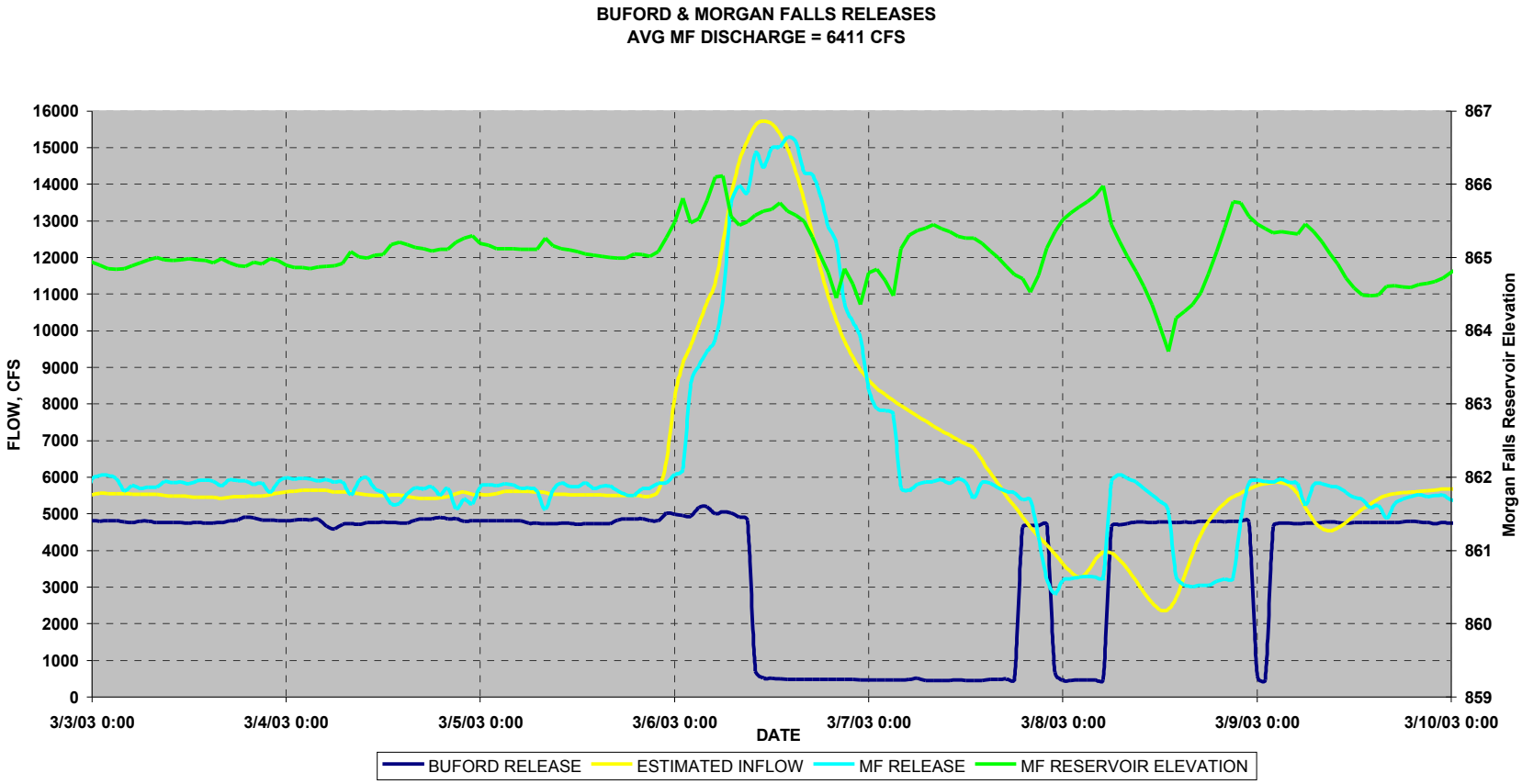


Graph No. 3: Wet Week (Average Weekly Discharge = 6,411 cfs)

This graph represents operations at Morgan Falls during the week of March 3 – 10, 2003. ARC requested a minimum release for this week of 888 cfs. Releases never dropped to minimum flow during the whole week. The yellow line, or Estimated Inflow, represents the flow that would have existed if Morgan Falls was not there , or if it were operated as a pure run-of-river project where outflow always equal inflow and the reservoir level does not change. For Monday through Friday inflow and outflow were always about equal, because Morgan Falls did not have sufficient storage to attenuate the high inflows. Morgan Falls' reservoir fluctuation was less than 2.5 feet over the entire week.

[See Graph No. 3 on Next Page]

Graph No 3. Morgan Falls Operations During a Wet Inflow Week



Questions Asked by Stakeholders

1. Can Morgan Falls provide a higher minimum release than it does now? (National Park Service)

No. The ARC contract with the COE provides only enough inflow for Morgan Falls to make releases to meet the 750 cfs target downstream. Georgia Power is not a part of this contract, and can only assume that the Corps will release enough inflow to meet this requirement. Attached is a table of the ARC weekly requested minimum flow releases for 2003, and the percentage of the Average Annual Discharge (AAD) that this represents.

2. What are the fluctuations in weekly minimum flow, especially as requested by ARC? Does ARC nearly always ask for the same minimum flow or do their requests change frequently? (National Park Service)

The attached table gives you an example of the minimum flow requested by ARC on a weekly basis for 2003. As you can see, there is only a small amount of variation in the requests. This small variation is due to changes in local inflows from the tributaries and runoff from rainfall events and changes due to local municipal demands for water supply. Requested changes in the middle of the week are typically only a few cfs due to changes in estimated parameters.

[See Table on Next Page]

ARC Requested Minimum Release
at Morgan Falls
Year 2003

Start of Week	Requested Minimum Flow CFS	Requested Minimum Flow % of AAD
1/6/03	892	38.5%
1/13/03	883	38.1%
1/20/03	901	38.9%
1/27/03	965	41.6%
2/3/03	937	40.4%
2/10/03	896	38.7%
2/17/03	889	38.4%
2/24/03	886	38.2%
3/3/03	888	38.3%
3/10/03	879	37.9%
3/17/03	875	37.8%
3/24/03	887	38.3%
3/31/03	887	38.3%
4/7/03	890	38.4%
4/14/03	886	38.2%
4/21/03	895	38.6%
4/28/03	895	38.6%
5/5/03	897	38.7%
5/12/03	849	36.6%
5/19/03	901	38.9%
5/26/03	897	38.7%
6/2/03	904	39.0%
6/9/03	930	40.1%
6/16/03	902	38.9%
6/23/03	872	37.6%
6/30/03	921	39.7%
7/7/03	898	38.8%
7/14/03	903	39.0%
7/21/03	911	39.3%
7/28/03	923	39.8%
8/4/03	939	40.5%
8/11/03	926	40.0%
8/18/03	927	40.0%
8/25/03	948	40.9%
9/1/03	963	41.6%
9/8/03	950	41.0%
9/15/03	957	41.3%
9/22/03	964	41.6%
9/29/03	972	42.0%
10/6/03	982	42.4%
10/13/03	964	41.6%
10/20/03	951	41.0%
10/27/03	949	41.0%
11/3/03	924	39.9%
11/10/03	926	40.0%
11/17/03	910	39.3%
11/24/03	904	39.0%
12/1/03	907	39.1%
12/8/03	912	39.4%
12/15/03	910	39.3%
12/22/03	898	38.8%
12/29/03	903	39.0%

3. Does Morgan Falls have the ability to increase or decrease the minimum flow requests from ARC? If so, by how much and how often does this happen? (National Park Service)

Decreasing the minimum release below that requested by the ARC is physically possible but would result in not meeting the state mandated flow of 750 cfs. In addition, the agreement between the ARC and Georgia Power that dictates the minimum discharge at Morgan Falls is incorporated into Article 27 of the FERC license, and to deliberately reduce minimum flows could be a violation of that agreement. Increases are not possible for the reason described in the first question.

4. What are the fluctuations of the Morgan Falls reservoir? (National Park Service)

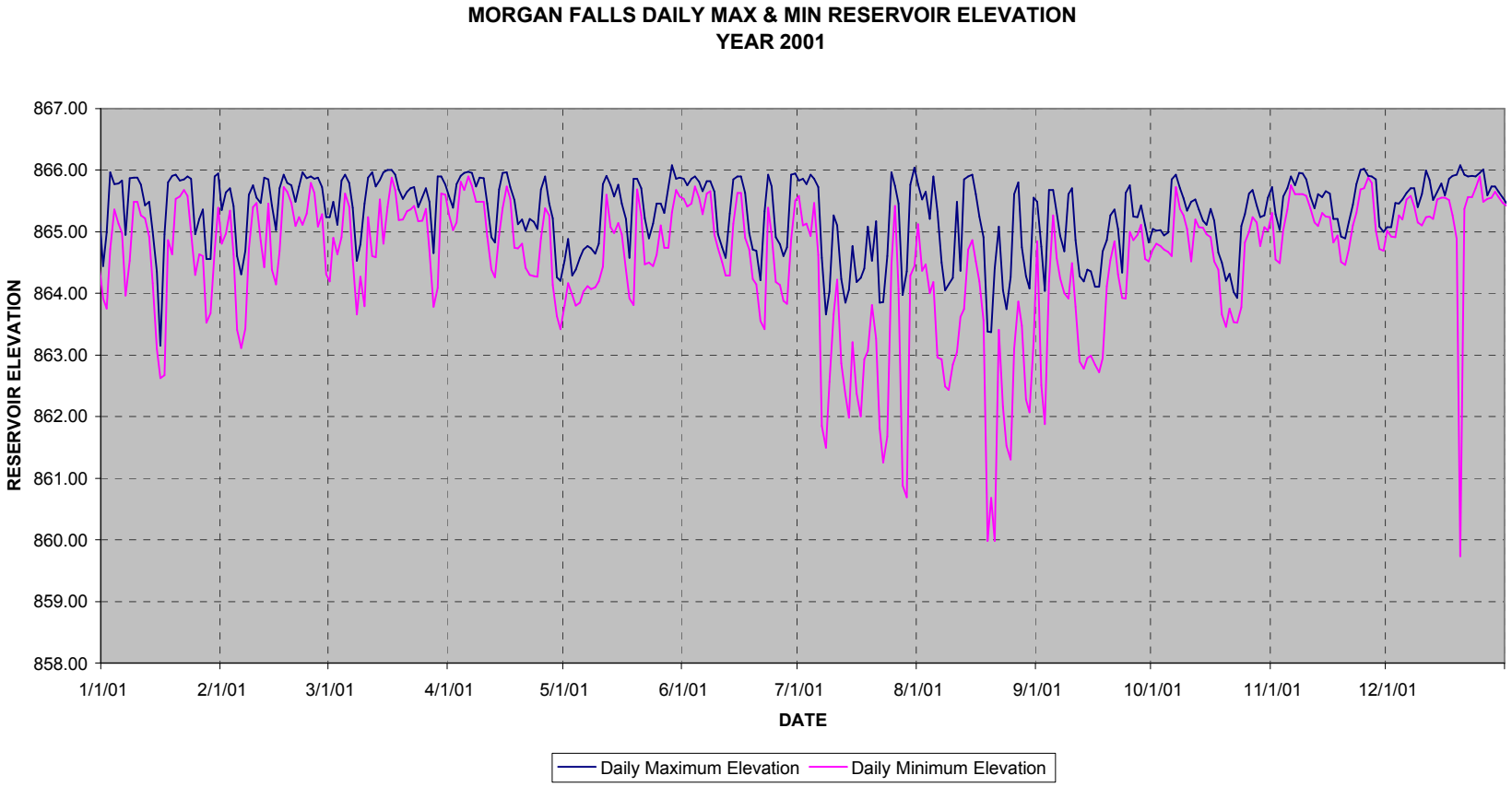
Attached are graphs for the years 2001, a dry year (Graph No. 4) and 2003, a normal year (Graph No. 5) that show daily maximum and minimum reservoir elevations. Full pond is elevation 866. Top of the spillway crest is elevation 858. It is unusual to pull the reservoir as low as elevation 858. Spillway operations are controlled by eight foot high spillway gates (elevation 858 to 866).

Very little storage exists below elevation 858 (about 200 acre-feet). Because there is no low level discharge the only way to pass flow below 858 is through the turbines. If transmission lines to the powerhouse are interrupted when the reservoir level is below 858 there is no way to discharge water until the reservoir rises above the spillway crest and a gate can be opened. For this reason the reservoir is rarely pulled below 858.

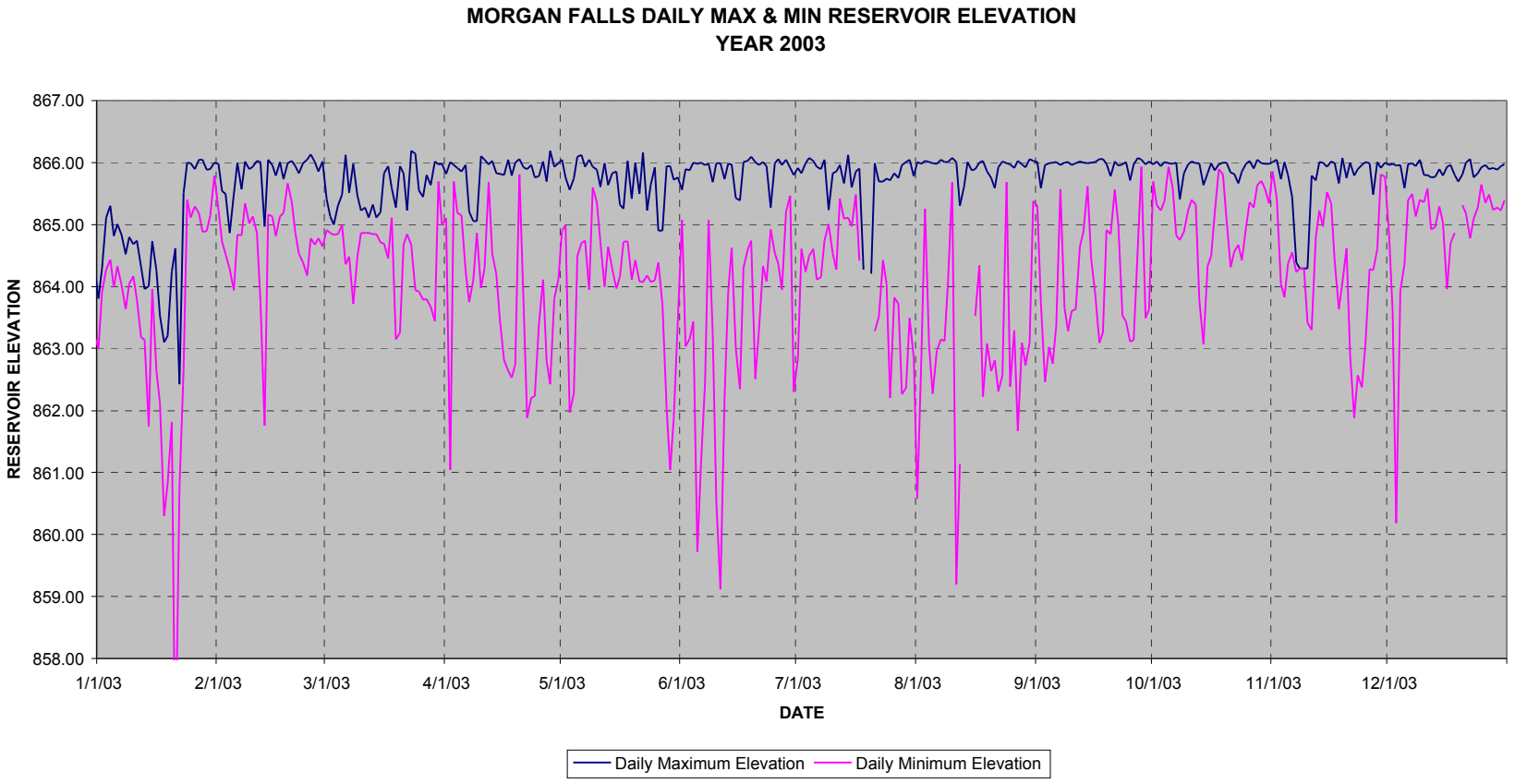
Note the very low minimum levels in January 2003. A trash rack for the number 3 unit collapsed, and it was necessary to draw the reservoir down a number of times for repairs. For this unusual operational condition (with the Morgan Falls storage largely depleted) the Corps worked closely with Georgia Power to ensure adequate Buford releases so that minimum flow could be maintained downstream of Morgan Falls.

[See Graphs Nos. 4 and 5 on Next Pages]

Graph No 4. Morgan Falls Reservoir Fluctuations During A Drought Year (2001)



Graph No 5. Morgan Falls Reservoir Fluctuations During A Normal Year (2003)



5. How does Morgan Falls utilize its ability to peak for hydropower? How does hydropower peaking occur and on what time schedule? What are the associated flows and water levels downstream when peaking occurs? Are there alternatives to passing these flows rather than peaking with them? (National Park Service)

Refer to the section on "Morgan Falls Modified Run of River Operations" for a detailed description of when and why Morgan Falls increases generation above minimum flow.

Briefly summarized, because the limited storage at Morgan Falls does not allow excess inflows to be stored until it would be most desirable to use the excess to generate during peak power demand periods, the water is used as it arrives. The limited storage does not allow for alternatives to pass the excess inflow.

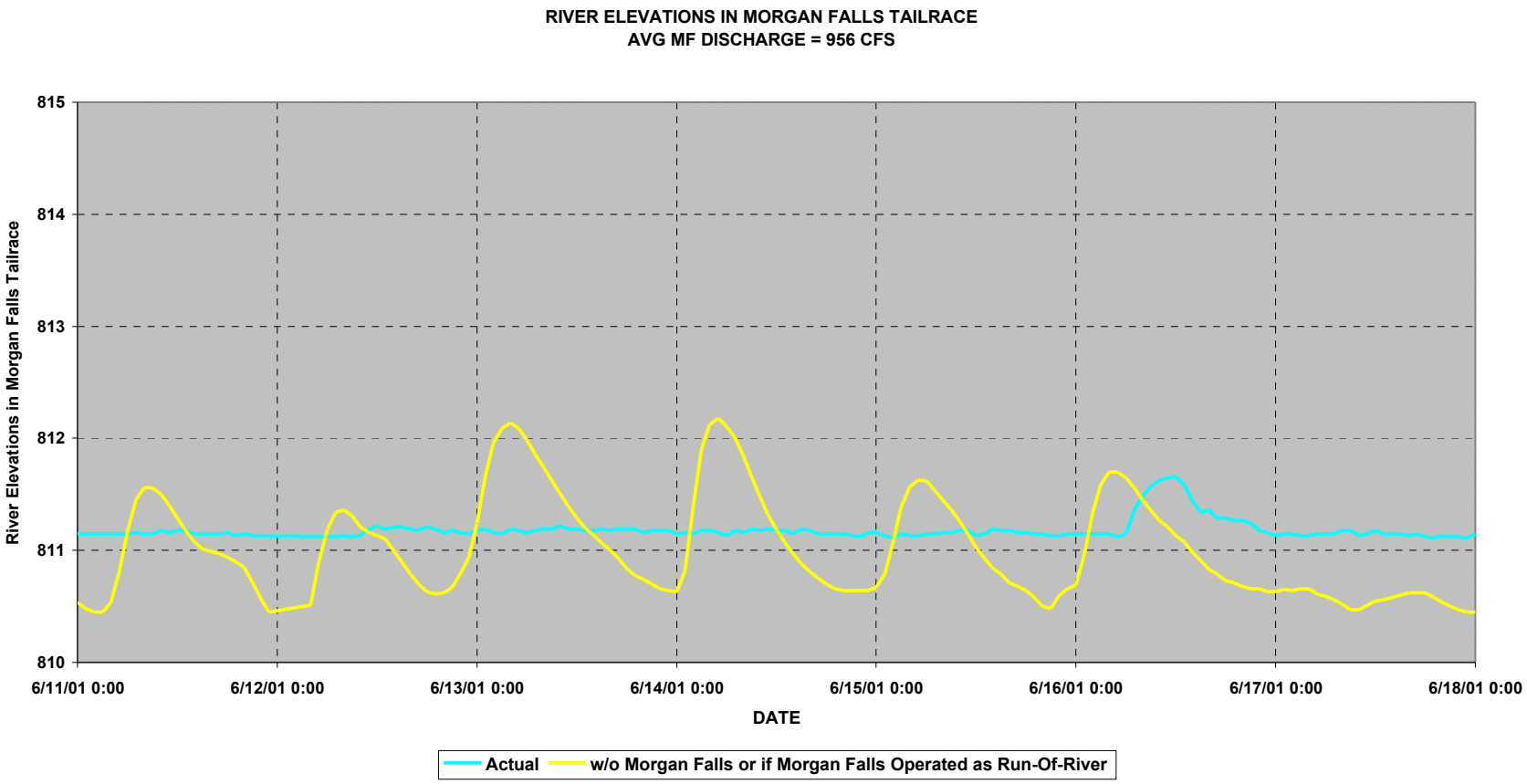
For example, if you refer to Graph No. 2 of operations for an average inflow period, you will see that the very large storage of Buford has been used to save excess inflow and peak during peak power demand periods (this is a typical summer period where the peak power demand periods are in the afternoon). Because of its limited ability to store water, Morgan Falls can only use excess inflows to generate when the flow from Buford Dam becomes available, rather than when it is needed the most to meet peak power demands.

Excess inflows are discharged first through the turbines, at a rate anywhere between the minimum flow rate and the maximum discharge capacity of 5,500 cfs, depending upon the amount of the excess inflow. If necessary, when the reservoir is full, and inflows exceed 5,500 cfs, the spillway gate(s) are opened to pass the excess above 5,500 cfs.

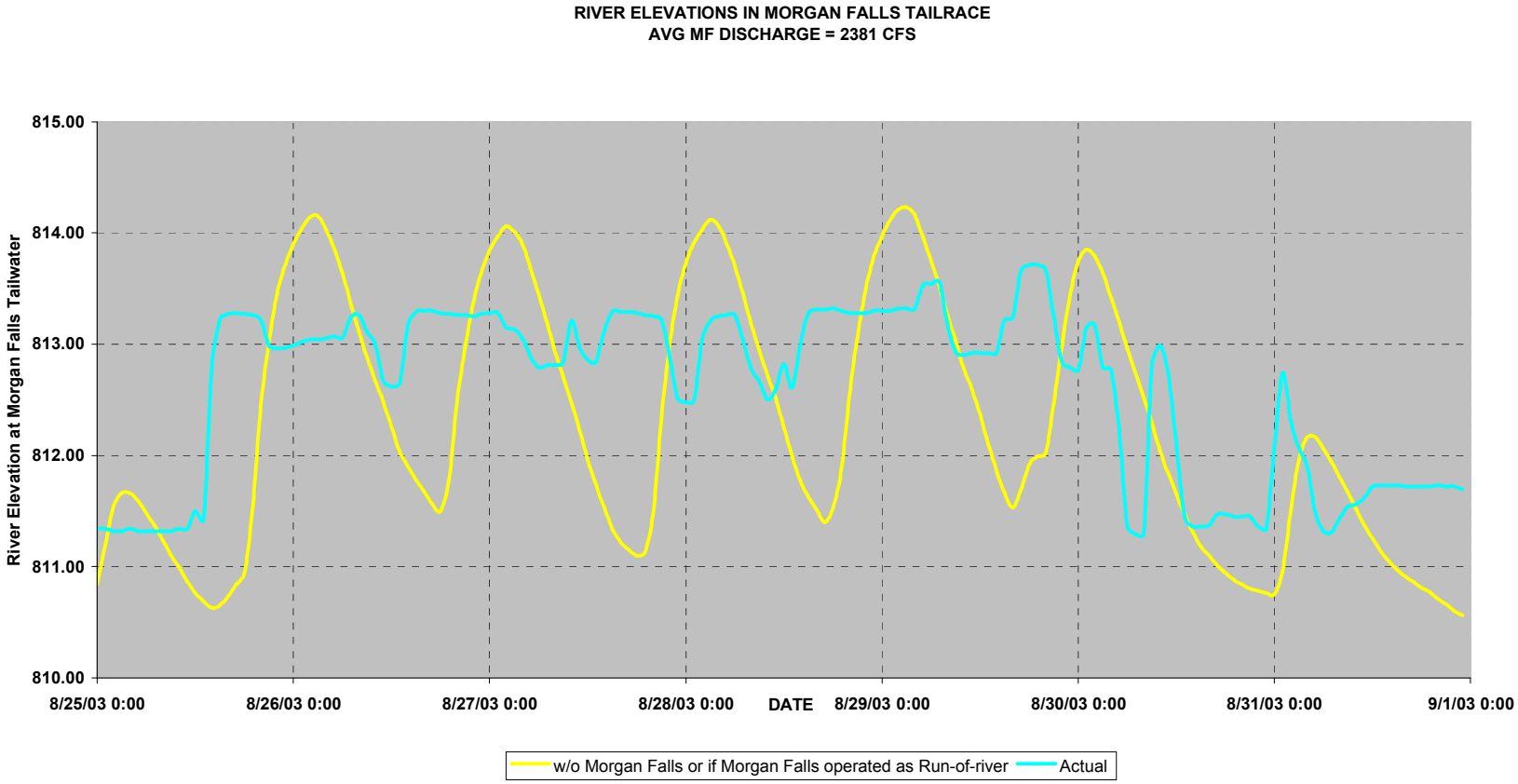
Graph numbers 1, 2 and 3 (characterizing dry, average, and wet week operations) show the variation in the Morgan Falls releases (light blue line). These graphs also show the flow that would have occurred if Morgan Falls either did not exist, or were operated as pure run of river (i.e. outflow always equal inflow). In the dry and average weeks the daily fluctuations in flow are reduced by Morgan Falls. In the wet week the daily flow fluctuations are about the same with or without Morgan Falls.

Because Morgan Falls operations reduce flow fluctuations caused by Buford Dam's operation, the river elevation fluctuations are also reduced. Three additional graphs (Numbers 6, 7 and 8) on the following pages show what the river elevation would have been on an hourly basis in the Morgan Falls tailrace if the dam did not exist, or if it were operated as pure run-of-river, compared to actual river elevations for the same dry, average, and wet weeks used to show flows.

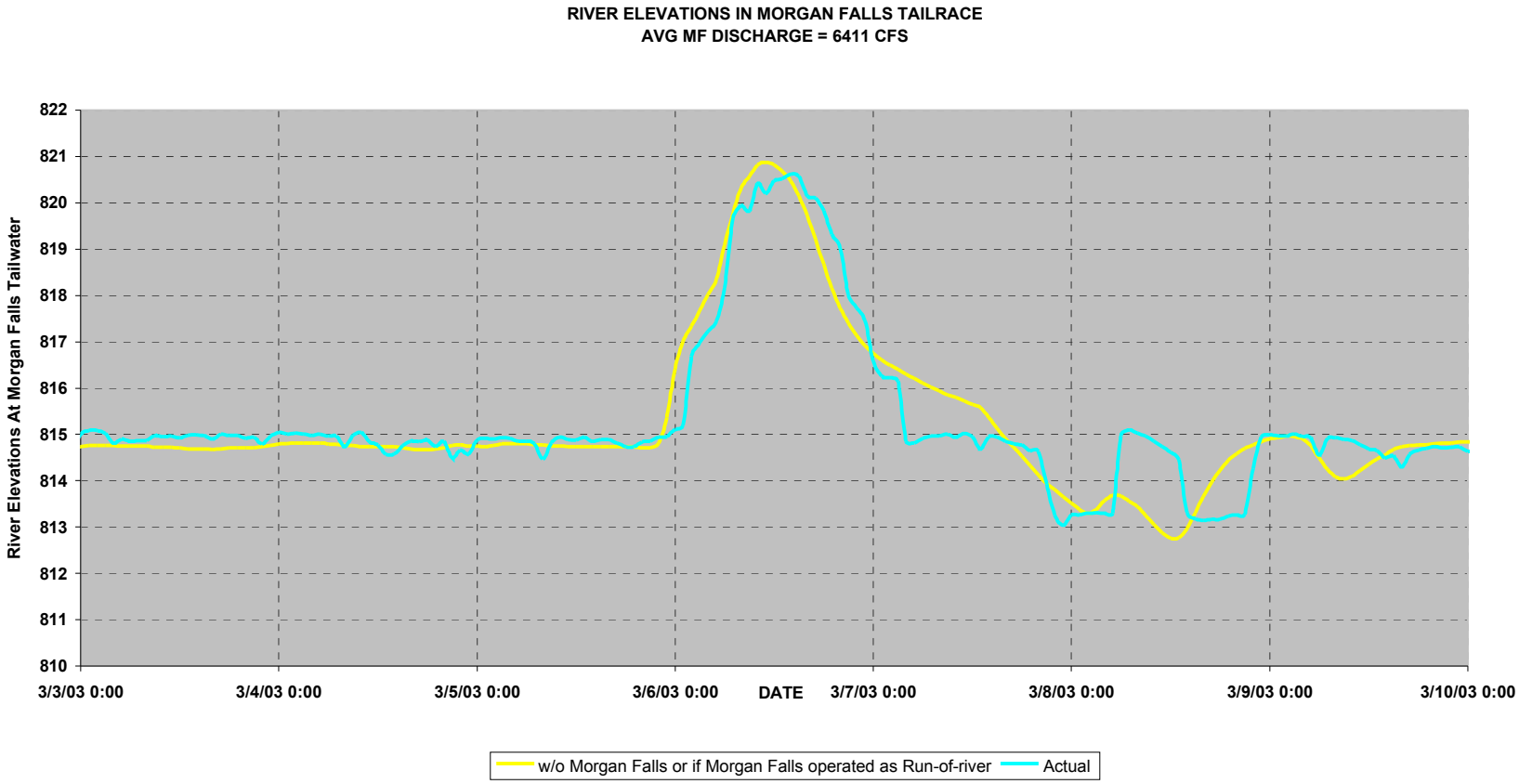
Graph 6: River Level Fluctuations in Morgan Falls Tailrace During a Dry Inflow Week



Graph 7: River Level Fluctuations in Morgan Falls Tailrace During an Average Inflow Week



Graph 8: River Level Fluctuations in Morgan Falls Tailrace During a Wet Inflow Week



6. Provide data on inflows into Morgan Falls (Roswell gage/ Lake Levels/ Morgan Falls Output) (Upper Chattahoochee Riverkeeper)

-correlated on an instantaneous & daily
-analysis showing how these are connected
-how this varies seasonally

This is a complex question that is not easily summarized in a narrative. We have tried to answer this question in the Primer by a narrative and with graphs and their explanations.

7. What USGS gages exist on the Chattahoochee River between Buford Dam and Morgan Falls Dam ? (Upper Chattahoochee Riverkeeper)

Attached is a table showing these gages by their USGS identifying number, name, and their location by river mile. The table also shows the drainage area in square miles represented at each gage, the time for flows from each gage to reach the upper end of the Morgan Falls reservoir and the basis for each gage's measurement.

[See Table on Next Page]

USGS River Gages from Buford Dam to Morgan Falls Dam:

Gage Number	Gage Name	River Mile	Drainage Area (mi^2)	Approx Travel Time to Upper End MF Reservoir	Measures
02334430	Chattahoochee @ Buford	348.1	1040	12 hrs	River Flow
02335000	Chattahoochee near Norcross	330.8	1170	5 hrs	River Flow
02335450	Chattahoochee above Roswell	320.6 (1.3 miles above Morgan Falls Reservoir)	1220	0.5 hrs	River Flow
02335700	Big Ck. Near Alpharetta		72	0 hrs	Creek Flow
02335810	Chattahoochee @ Morgan Falls	312.6	1370	NA	Lake Elevation
02335815	Chattahoochee below Morgan Falls	312.6	1370	NA	Tailrace Discharge