GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Richard E. Dunn, Director

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March 30, 2018

Colonel James DeLapp
District Commander
Mobile District, U.S. Army Corps of Engineers
Post Office Box 2288
Mobile, Alabama 36628

Re: State of Georgia's Updated Allatoona Lake Water Supply Request

Dear Colonel DeLapp,

On January 10, 2018, the United States District Court for the Northern District of Georgia issued an order (the "Order") requiring the United States Army Corps of Engineers to act by March 1, 2021, on water supply requests submitted by the State of Georgia and the Cobb County-Marietta Water Authority ("Cobb-Marietta"). The State submitted its request on January 24, 2013, in a letter from Governor Nathan Deal to the Honorable Jo-Ellen Darcy (the "2013 Request"). Cobb-Marietta submitted its original request on November 16, 1981 and more recently updated that request on October 22, 2012. *See* Letter from G. Page to Colonel S. J. Roemhildt (Oct. 22, 2012). As part of the Order, the State and Cobb-Marietta agreed that the Corps could fulfill its duty to answer both pending requests by responding to and addressing the issues raised by the State's 2013 Request, as updated. This letter and the two attached memoranda provide that update.

The first memorandum is from the Metropolitan North Georgia Water Planning District (the "Metro District") and outlines the Metro District's anticipated water supply demands from and returns to Allatoona Lake through the year 2050. To provide the updated information required under the Order, the Metro District worked with Cobb-Marietta, the City of Cartersville, and Bartow County (which the City of Cartersville supplies) to update both projected demands from and returns to Allatoona Lake using the best available data and the parties' most reliable current projections.

The second memorandum is from Dr. Wei Zeng, Chief of Georgia Environmental Protection Division's Hydrology Unit, and provides a technical evaluation and analysis of the effects of this updated request. Dr. Zeng's memorandum demonstrates that updated request will not seriously affect project purposes or flows downstream of Allatoona Lake.

Based on those memoranda, the State requests that the Corps take the following actions to reallocate storage in and revise its storage accounting methodology for Allatoona Lake:

Storage Reallocation and Contract

The State requests that the Corps enter into a storage contract providing storage capacity in Allatoona Lake sufficient to enable Georgia users to sustain annual average withdrawals from Allatoona Lake in the amount of 94 million gallons per day ("mgd") through 2050 (instead of 123.9 to 147.9 mgd through 2040 as contained in the 2013 Request). If the Corps determines not to grant the entire storage capacity needed to support the stated demand, the State requests that the Corps specify how much storage it can reallocate and provide a detailed explanation of its reasoning.

Storage Accounting

The State recognizes that the storage capacity needed to support average annual withdrawals of 94 mgd will depend upon the assumptions the Corps makes about the relationship between storage capacity and yield. These include assumptions about the total natural inflow to Allatoona Lake; the extent to which natural inflows are augmented by "made inflows"; the manner in which "made inflows" will be allocated to users; the rule that is used to determine when storage space allocated to water supply users is full; and the rule that will be used to determine each user's share of conservation storage for purposes of allocating natural inflows to the project. As explained in detail below, this request separates those assumptions into two categories: made inflows and other storage accounting issues.

The Corps' current assumptions regarding both categories are reflected in the storage accounting system that the Corps currently employs at Allatoona Lake. The State disagrees with the Corps' assumptions and requests that the Corps resolve all storage accounting issues consistent with the below requests.

Made Inflows

The State's 2013 Request sought changes to the Corps' storage accounting system and included a specific request to credit certain "made inflows," consisting of releases from the Hickory Log Creek Reservoir and return flows to Allatoona Lake.

Since the 2013 Request was submitted, the Georgia Department of Natural Resources promulgated rules clarifying the Georgia Environmental Protection Division's authority and procedures for allocating made inflows to particular users. *See* Ga. Comp. Rules & Regs. 391-3-6-.07(2)(o), (16)(a). And, pursuant to that authority, the State of Georgia has allocated certain made inflows to Cobb-Marietta. This allocation is reflected in Georgia Environmental Protection Division Permit No. 008-1491-05 (Modified Nov. 7, 2014) ("Cobb-Marietta's Permit"). The State, therefore, requests that the Corps honor Cobb-Marietta's Permit (and any subsequent renewal thereof), which grants Cobb-Marietta the exclusive right to impound water released from Hickory Log Creek Reservoir and certain return flows in Cobb-Marietta's existing storage space in Allatoona Lake, subject to available space in Cobb-Marietta's storage. In addition, the State requests that the Corps credit made inflows in accordance with any future allocations by the Georgia Environmental Protection Division ("EPD"). If the Corps does not honor Cobb-Marietta's Permit and EPD's authority to allocate made inflows, please provide a detailed and reasoned explanation because the State does not believe the Corps retains discretion to override EPD's express water allocation decisions.

Other Storage Accounting Issues

In addition to made inflows, there are other outstanding storage accounting issues at Allatoona Lake that are the subject of ongoing litigation between Cobb-Marietta and the Corps. *See Cobb County-Marietta Water Authority v. U.S. Army Corps of Engineers*, Civil Action No. 1:17-cv-400-RWS (N.D. Ga.) (the "Storage Accounting Litigation"). For example, under the Corps' current storage accounting methodology, the Corps at times calculates Cobb-Marietta's storage as empty, even when the reservoir is above the rule curve and conservation storage in the project is completely full as defined by the top of the variable rule curve. The State requests that the Corps determine that water supply storage accounts in Allatoona Lake must be full whenever conservation storage, as defined by the project's rule curve, is full.

Likewise, the Corps' current accounting improperly allocates natural inflows (all inflows that are not made inflows) using a fixed percentage of conservation storage, despite the fact that Cobb-Marietta's *pro rata* share of conservation storage increases in the winter when the volume of conservation storage is reduced. The State requests that the Corps determine that natural inflows should be allocated to users in proportion to the percentage of conservation storage held by a user at the time the inflow occurs, as defined by the top-of-conservation rule curve.

Structure of the Reallocation Study

The Corps will be responding to this request against the backdrop of the pending Storage Accounting Litigation and while promulgating a national rule addressing some, but not all, of the storage accounting issues. *See* 2016 Notice of Proposed Rulemaking, U.S. Army Corps of Engineers, *Use of U.S. Army Corps of Engineers Reservoir Projects for Domestic, Municipal & Industrial Water Supply*, 81 Fed. Reg. 91556 (Dec. 16, 2016) (the "Water Supply Rule"). While the Corps has previously taken the position that any change to the assumptions embedded in its current storage accounting methodology at Allatoona Lake would have to await a "national policy review," the State believes the Order requires the Corps to address the disputed storage accounting questions in response to this request.

In responding to the 2013 Request, it is unclear whether the Corps intends to fully reconsider its storage accounting policies and procedures at Allatoona Lake or whether the Corps will merely apply those existing policies and procedures. Accordingly, the State requests that the reallocation study be structured, not only to study the impact of the requested reallocation, but also to ensure that the reallocation study and supporting NEPA documentation bracket the possible outcomes of the Water Supply Rule and the Storage Accounting Litigation. This will ensure the reallocation study process will move forward without potential delays caused by external developments related to storage accounting.

If you require additional information from Georgia, please let me know.

Respectfully Submitted,

Richard E. Dunn
Director
Georgia Environmental Protection Division
On behalf of the State of Georgia

Metropolitan North Georgia Water Planning District

MEMORANDUM

Date: **March 30, 2018**

To: **Rick Dunn, Director, Georgia Environmental Protection Division**

From: **Katherine Zitsch, Director**

Re: **Projected Future Water Supply Demands and Returns for the Allatoona Lake System**

As requested, this Memorandum provides updated projections for water supply demands and returns for jurisdictions within the Metropolitan North Georgia Water Planning District (the "Metro Water District" or "District") that withdraw water from, and return water to, Allatoona Lake and the Etowah River between Allatoona dam and the Kingston gage downstream of the reservoir. The information provided is based on information developed as part of the District's 2017 update to its Water Resources Management Plan for the 15-county metropolitan Atlanta area, and new information developed since the District Plan was finalized and adopted. I understand this information will be provided to the U.S. Army Corps of Engineers to be used to support a reallocation study for Allatoona Lake to be undertaken in response to a court decision in Georgia v. U.S. Army Corps of Engineers, Civil Action No. 1:14-cv-3593 (N.D. Ga.).

This memorandum proceeds in four parts: (1) it briefly introduces the Metro Water District and the recent update to its water management plan for the Atlanta metropolitan area; (2) it projects future water supply needs for water providers that withdraw water from Allatoona Lake; (3) it describes an expected change in water supply source for one District jurisdiction downstream of Allatoona Lake (Paulding County); and (4) it projects treated wastewater return flows for those water providers that withdraw water from Allatoona Lake.

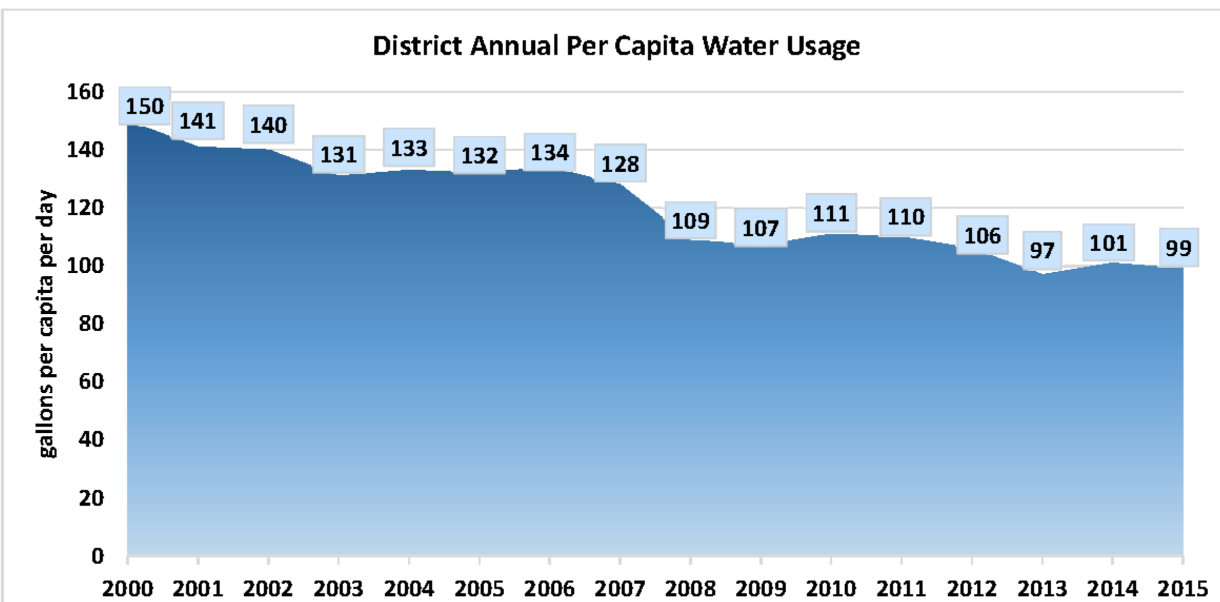
I. Background on the Metro Water District and the 2017 District Plan

The State of Georgia established the Metro Water District in 2001. By statute, the District is charged with developing comprehensive regional and watershed-specific water resource management plans to be implemented by local governments in the 15-county metropolitan Atlanta area.

A. The District's Water Conservation and Efficiency Successes

The District issued its first water resource management plans in 2003. At that time, the District issued three separate plans: Water Supply and Water Conservation, Wastewater Management and Watershed Management. These plans include a range of water conservation and efficiency requirements, which must be implemented by each jurisdiction within the District. The District updated these plans in 2009 to include additional water conservation and efficiency requirements, with additional conservation and efficiency measures added by amendment in 2010.

Collectively, the water conservation and efficiency measures required under the District's plans—combined with investments by District jurisdictions in water conservation and efficiency, leak detection and decreasing water loss, and indirect potable reuse—have dramatically reduced water demands within the District. Per capita water withdrawals in the District declined by more than 30% between 2000 and 2015, falling from 150 gallons per capita day (gpcd) in 2000 to 99 gpcd in 2015. (Figure 1) Total water supply withdrawals have likewise decreased by 10% over the same period, despite the fact that the District's population has grown by more than 1 million people, or 20%. (Figure 2) As a result of these successes, District jurisdictions are now projected to use approximately 25% less water in 2050 than they were when the District's plans were updated in 2009.



Note: The US Census Bureau revised population estimates for 2000 through 2009 after the decennial census was conducted in 2010. Per Capita numbers for 2000 - 2009 have been updated from prior published values to reflect the new population estimates.

Figure 1. Metro Water District per capita water use trend (2000-2015)
Reproduced from District Plan Figure 3-2

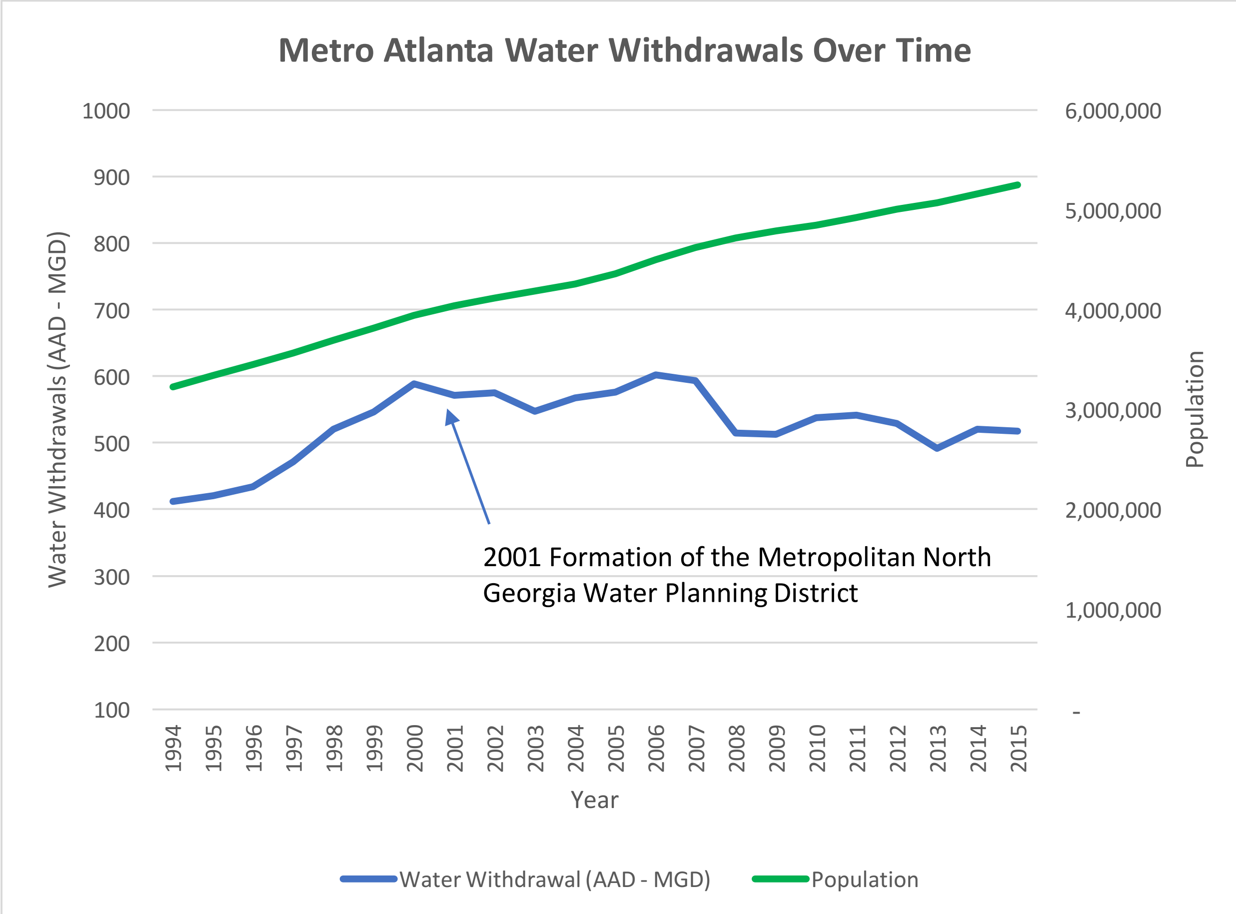


Figure 2. Total Water Withdrawals in the Metro Water District Compared to Population

These successes are a testament to the District's member jurisdictions and reflect their commitment to water conservation and efficiency.

B. The District's 2017 Plan and Its Updated Demand Projections

The District's most recent plan was adopted in 2017 (the "District Plan").[1] The District Plan combines the three separate plan documents into one comprehensive plan to highlight the interrelationships between approaches to water, wastewater and watershed/stormwater management.

In connection with this work, the Metro Water District prepared water demand projections and wastewater return projections for the current planning period extending through the year 2050. These projections address water needs for residential, commercial, industrial and institutional uses supplied by municipal systems across the Metro Water District. The Metro Water District projections do not include thermoelectric uses or industrial uses not supplied by municipal systems. Neither of these exist as withdrawals from Allatoona Lake.

[1] Metropolitan North Georgia Water Planning District, Water Resource Management Plan (June 2017), available at http://northgeorgiawater.org/plans-manuals.

II. Water Supply Demand Projections for Allatoona Lake

As requested, we have isolated and projected year 2050 water demands to be met from Allatoona Lake. These incorporate the water demand projections developed by the District for the 2017 District Plan. As described below, they also reflect new information developed since the projections used in the District Plan were derived. As such, they represent the best and most reliable projection of the range of future water supply demands from Allatoona Lake and wastewater returns for these jurisdictions.

A. County-Level Projections from the District Plan

The 2017 District Plan includes water demand projections out to the year 2050 for each of the 15 counties in the District. The methods used to develop these projections are described in Chapter 4 of the District Plan. In general, base water demands were calculated for each county to create a representative base year, which reflect the effects of the Metro Water District's award-winning conservation programs and existing state codes and standards.

The base water demands for each county were then paired with corresponding county-level population and employment forecasts developed by the Atlanta Regional Commission ("ARC") and the University of Georgia's Vinson Institute for the State of Georgia's Office of Planning and Budget ("OPB"). The ARC and OPB population and employment forecasts for each county used in the District Plan are included as Table 1 and Table 2, respectively.

Because the ARC and OPB projections were derived using different methodologies, the ARC and OPB forecasts are separate and independent projections of future population and employment for each county in the District. These independent projections were used to develop two different projection scenarios for water demand and wastewater flows to improve forecast reliability.

The ARC and OPB population and employment scenarios were then analyzed using the Demand Side Management Least Cost Planning Decision Support System (DSS) Model developed by Maddaus Water Management. The DSS Model thus provided two independent water demand forecasts for each of the 15 District counties from 2015 through 2050.

To address potential uncertainties in the demand forecasts, the District evaluated historic variability in four key water demand drivers: population growth rate; employment/population ratio; per capita residential water use; and per employee commercial water use. Probability distributions based on historical data were created for each demand driver and truncated to remove unrealistic extremes. Then, a Monte Carlo analysis was conducted to determine future water demand probabilities based on the observed historical variability in demand drivers.

Based on industry practice and methods used in planning efforts for other major metropolitan areas, the 65th percentile of the water demand forecast was used to calculate the uncertainty factor applied to each individual county. For each county, this resulted in an increase in water demands of approximately three percent at the start of the projections that grew to approximately 13 percent for the 2050 projections. The final county-level projections for each scenario are included below in Table 3.

Table 1. ARC and OPB Population Projections
Reproduced from District Plan Table 4-1

County	ARC Population Projections (Scenario 1)				OPB Population Projections (Scenario 2)			
	2020	2030	2040	2050	2020	2030	2040	2050
Bartow	130,924	160,133	178,780	189,569	108,763	118,274	125,461	131,085
Cherokee	270,994	336,152	394,907	437,370	265,020	331,015	406,740	494,713
Clayton	283,792	304,371	327,266	350,555	282,488	302,823	315,351	321,509
Cobb	726,369	799,383	893,279	969,932	781,311	863,236	930,414	984,089
Coweta	165,321	204,744	235,587	256,038	152,575	182,430	213,856	247,779
DeKalb	725,746	789,454	870,176	945,468	756,138	800,302	824,638	835,063
Douglas	148,812	175,224	201,144	220,545	155,959	185,446	215,834	247,930
Fayette	109,427	124,558	140,809	148,739	114,379	122,584	127,011	129,033
Forsyth	255,412	356,079	431,478	468,230	245,429	334,694	450,066	597,255
Fulton	1,050,286	1,143,594	1,235,645	1,310,110	1,104,788	1,278,928	1,453,507	1,631,265
Gwinnett	927,056	1,073,102	1,239,115	1,392,162	985,396	1,176,845	1,375,267	1,581,299
Hall	234,487	287,486	330,425	362,697	210,468	244,958	280,791	318,828
Henry	256,188	311,014	353,232	379,989	241,568	289,270	339,799	395,121
Paulding	169,951	213,806	259,524	297,884	170,901	209,745	253,980	304,621
Rockdale	96,909	113,320	129,993	145,344	95,285	106,944	116,872	126,086
Total	**5,551,674**	**6,392,420**	**7,221,360**	**7,874,632**	**5,670,468**	**6,547,495**	**7,429,586**	**8,345,677**

Table 2. ARC and OPB Employment Projections
Reproduced from District Plan, Table 4-2.

County	ARC Employment Projections (Scenario 1)				OPB-based Employment Projections (Scenario 2)			
	2020	2030	2040	2050	2020	2030	2040	2050
Bartow	62,524	69,819	76,352	82,193	56,867	60,238	64,315	67,420
Cherokee	95,421	108,787	123,123	128,021	93,318	107,124	126,812	144,806
Clayton	187,706	201,227	216,228	231,625	186,843	200,204	208,356	212,433
Cobb	526,073	581,725	641,877	699,093	565,865	628,192	668,561	709,297
Coweta	64,037	71,972	79,668	86,453	59,100	64,128	72,319	83,664
DeKalb	524,712	573,647	625,031	679,851	546,685	581,529	592,322	600,463
Douglas	71,786	81,812	91,924	100,510	75,234	86,585	98,637	112,990
Fayette	84,908	93,954	102,838	111,192	88,750	92,465	92,761	96,461
Forsyth	85,801	100,872	115,834	134,805	82,447	94,814	120,824	171,952
Fulton	1,098,358	1,182,107	1,268,878	1,360,794	1,155,354	1,321,998	1,492,600	1,694,373
Gwinnett	488,390	549,702	611,597	671,565	519,125	602,845	678,798	762,803
Hall	118,756	133,564	147,120	160,535	106,591	113,806	125,021	141,118
Henry	96,029	107,685	118,775	127,670	90,549	100,156	114,258	132,754
Paulding	54,898	63,544	72,732	80,089	55,205	62,337	71,178	81,900
Rockdale	54,289	61,027	67,890	74,363	53,379	57,593	61,037	64,510
Total	**3,613,688**	**3,981,444**	**4,359,867**	**4,728,759**	**3,735,312**	**4,174,014**	**4,587,799**	**5,076,944**

Table 3. Projected County-Level Water Demands
Reproduced from District Plan, Table 4-7.

County	Baseline Water Demand (AAD-MGD)	2025 Water Demand (AAD-MGD)		2050 Water Demand (AAD-MGD)	
		Scenario 1	Scenario 2	Scenario 1	Scenario 2
Bartow	27.5	36.4	31.4	52.0	40.4
Cherokee	19.9	25.0	24.4	35.2	39.5
Clayton	25.0	28.9	29.1	37.6	33.6
Cobb	71.3	77.1	80.6	98.1	96.0
Coweta	13.7	17.4	16.0	23.7	23.5
DeKalb	73.0	77.5	78.7	95.4	83.2
Douglas	12.8	14.9	15.2	20.0	21.7
Fayette	11.8	12.9	12.8	16.7	14.0
Forsyth	22.7	31.5	29.5	47.9	59.6
Fulton	142.7	155.3	166.4	186.4	227.4
Gwinnett	84.4	96.2	101.2	132.1	145.2
Hall	20.2	25.0	22.7	33.9	31.0
Henry	23.7	29.6	28.1	39.4	41.5
Paulding	12.8	15.6	15.5	23.0	24.0
Rockdale	13.2	15.4	14.8	21.1	18.3
District Total	**574.5**	**658.6**	**666.5**	**862.5**	**899.0**

B. Allatoona Lake Demands

Two entities withdraw water from Allatoona Lake: the Cobb County-Marietta Water Authority ("Cobb-Marietta") and the City of Cartersville, Georgia. As shown below in Table 4, total projected year 2050 water demands for these entities to be met from Allatoona Lake is 94 million gallons per day (mgd). This includes 57 mgd for Cobb-Marietta and 37 mgd for the City of Cartersville, which in turn serves Bartow County and the City of Emerson. Additional information regarding the projected demands for each user is provided below.

Table 4. Total Projected Water Demands to be Supplied from Allatoona Lake

Water Provider	Average Annual Day – Million Gallons per Day (AAD-MGD)
Cobb County-Marietta Water Authority	57
City of Cartersville / Bartow County	37
Total Demand	**94**

1. Cobb-Marietta

Cobb-Marietta is an authority created by the State of Georgia in 1951. It currently provides finished water to 11 wholesale customers in the metropolitan Atlanta area, including the Cobb County Water

System, Cherokee County Water and Sewage Authority, Douglasville/Douglas County Water and Sewer Authority, City of Marietta, City of Austell, City of Powder Springs, City of Smyrna, Paulding County, City of Mountain Park, City of Woodstock, and Lockheed Martin Corporation.

Cobb-Marietta withdraws water from two sources, both of which involve the U.S. Army Corps of Engineers. First, it withdraws water from Allatoona Lake under a Water Supply Act storage contract executed in 1963. This contract grants Cobb-Marietta the right to use 13,140 acre-feet of storage in the reservoir to store and withdraw water allocated to it by the State of Georgia. Second, Cobb-Marietta operates a water supply intake on the Chattahoochee River below Buford Dam and Lake Lanier, which the Corps operates to ensure that sufficient water is available in the Chattahoochee River for Cobb-Marietta and other metro Atlanta utilities to withdraw.

In the State of Georgia's water supply request for Lake Lanier and the Chattahoochee River System, the District projected year 2050 water demands from the Chattahoochee River for Cobb-Marietta ranging from 37 mgd to 61 mgd.[2] This was based on a total projected demand 103 mgd, with varying assumptions regarding the amount of water that would be withdrawn from Allatoona Lake (42 mgd to 66 mgd). This was intended to reflect ongoing uncertainty and litigation regarding the supply available to Cobb-Marietta from its existing storage space in Allatoona Lake.

In March 2017, the Corps' adopted a new Master Water Control Manual for the Apalachicola-Chattahoochee-Flint ("ACF") reservoir system. The ACF Manual states that the Corps will operate Lake Lanier to provide up to 379 mgd for Cobb-Marietta and other users withdrawing water from the Chattahoochee River below the reservoir. This includes the higher projected demand of 61 mgd for Cobb-Marietta, corresponding to approximately 42 mgd for supplies from Allatoona Lake.[3]

Based on current information and recent experience in the drought of 2016, the District projects that Cobb-Marietta needs 57 mgd AAD from Allatoona Lake in the year 2050 (Table 4), reflecting Cobb-Marietta's existing treatment plant capacity in the ACT basin. Supplying up to 57 mgd AAD of Cobb-Marietta's demand from Allatoona Lake will allow Cobb-Marietta to utilize existing constructed water treatment plant capacity in the ACT (57 mgd (AAD) and 72 mgd (peak day)). It will also provide Cobb-Marietta with needed operational flexibility. Among other things, this would allow Cobb-Marietta to respond to operational needs and system maintenance requirements and to manage overall demands between sources. This would enhance Cobb-Marietta's and the Corps' ability to adjust system operations to account for differing hydrologic conditions and differences in available supply in the ACF and ACT basins.

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[2] Memorandum from Katherine Zitsch, Director, Metropolitan North Georgia Water Planning District, to Jud Turner, Director, Georgia Environmental Protection Division, Projected Future Water Supply Demands for the Chattahoochee River and Lake Lanier System (Dec. 2, 2015).

[3] The ACF Manual is the subject of ongoing litigation, where the State of Alabama and others have challenged the Corps' ability to accommodate water supply withdrawals downstream of Lake Lanier at the level described above. The supply available to Cobb-Marietta from the Chattahoochee River thus remains uncertain.

The needed amount of 57 mgd is predicated on levels of supply provided in the ACF Manual. Additional supply from Allatoona Lake would be required if the supply available to Cobb-Marietta from the Chattahoochee River were constrained as a result of ongoing legal or other challenges.

2. Cartersville

The City of Cartersville withdraws water from Allatoona Lake pursuant to Water Supply Act storage contracts, which give Cartersville the right to use 6,371 acre-feet of storage in the reservoir to store and withdraw water allocated to it by the State of Georgia. Major finished water customers for the City of Cartersville include Bartow County (and its customers) and Anheuser Busch. Allatoona Lake is currently the sole source of supply for the City of Cartersville and, through Cartersville, it is the primary source of supply for Bartow County.[4]

The 2017 District Plan projects year 2050 water demands for Bartow County, including the City of Cartersville, ranging from 40.4 mgd to 52.0 mgd from all water supply sources. Based on discussions with these jurisdictions, the requested water supply for the year 2050 from Allatoona Lake is 37 mgd.

C. Change in Water Source for Paulding County

Paulding County is currently supplied by Cobb-Marietta. In the baseline year of 2006, Cobb-Marietta supplied 10.57 mgd of water to Paulding County. Paulding County is in the process of constructing its own water supply reservoir, Richland Creek Reservoir, a pump-storage reservoir located on a tributary of the Etowah River. Paulding County is also currently constructing the reservoir's associated pump station on the Etowah River downstream of Allatoona Lake. Once completed, the Richland Creek Reservoir is expected to replace Cobb-Marietta as the County's primary water supply source.

III. Projected Returns of Treated Wastewater

A. Cobb-Marietta

Cobb-Marietta's largest wholesale customer, the Cobb County Water System, returns highly treated wastewater to Allatoona Lake from two water reclamation facilities: the Noonday Creek Water Reclamation Facility ("WRF") and Northwest Cobb WRF (the "Allatoona Lake WRFs"). These return flows have been allocated to Cobb-Marietta by the State of Georgia, which has granted Cobb-Marietta the exclusive right to impound and withdraw these return flows to Allatoona Lake.[5]

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[4] The City of Cartersville currently has two intakes – one for withdrawal directly from Allatoona Lake and one for withdrawal from the Etowah River immediately downstream of the reservoir. The City is not currently operating their river withdrawal intake, but instead is withdrawing all water from Allatoona Lake. For the purposes of the water supply request, it is assumed that the City will continue to withdraw only from Allatoona Lake throughout the 2050 planning horizon.

[5] Georgia Environmental Protection Division, Permit to Withdraw, Divert or Impound Surface Water issued to Cobb-Marietta by Georgia EPD, Permit No. 008-1491-05 (Nov. 7, 2014).

Existing permitted capacities for the Noonday Creek WRF and Northwest WRF are 16 mgd (AAD) and 9.6 mgd (AAD), respectively. As in the memorandum accompanying the ACF water supply request, the District projects that these facilities will be operated at their capacities and that year 2050 returns from the Allatoona Lake WRFs will be 25.6 mgd.[6] (Table 5)

Table 5. Projected Return Flows to Allatoona Lake
Reproduced from Zitsch ACF Memorandum Table A-9

	AAD-MGD
Projected Sewered Flow	92.4
Allatoona Lake discharges	
Noonday WRF	16
Northwest Cobb WRF	9.6
Total Allatoona Lake discharges	**25.6**
Total Chattahoochee River discharges downstream of Peachtree Creek	**66.8**

Note: Allatoona Lake discharges assumed at currently permitted discharge amounts (25.6 AADF = 32 max month / 1.25)

Operation of the Allatoona Lake WRFs to maximize return flows to Allatoona Lake, as described above, would likely impose additional treatment and operational costs, owing to the need to redistribute sewered flows across treatment plants and sub-basin divides. Willingness to operate in this manner thus may depend on the adoption of appropriate policies that credit returns from the Allatoona Lake WRFs in accordance with the State of Georgia's permit issued to Cobb-Marietta.

B. Bartow County / City of Cartersville

No jurisdiction in Bartow County presently returns reclaimed water to Allatoona Lake. Instead, these return flows to the ACT Basin enter the system below Allatoona Lake, either to the Etowah River (Cartersville WPCP and Bartow Southeast WPCP) or to tributaries of the Etowah River (Emerson Henry Jordan WWTP, Bartow Two Run WPCP, Adairsville South WPCP, and Adairsville North WPCP). The District projects that total return flows from these facilities in the year 2050 will be 23.7 mgd. Of these returns, approximately 20.3 mgd originate from water to be withdrawn from Allatoona Lake for the City of Cartersville. These returns may be created by the City of Cartersville or by an entity purchasing water from the City of Cartersville. In either case, they are projected to occur into the Kingston reach.[7]

[6] Memorandum from Katherine Zitsch, Director, Metropolitan North Georgia Water Planning District, to Jud Turner, Director, Georgia Environmental Protection Division, dated Jan. 25, 2016, Table A-9.

[7] The District understands that some or all of the water returned by the City of Cartersville to the Etowah River may instead be returned to Allatoona Lake if the Corps makes appropriate policy changes and the State of Georgia allocates those flows to the City. If that were to occur, the City would be returning the flows in order to enhance the yield of the City's water supply storage in the reservoir.

Memorandum

To: Richard Dunn, Director, Georgia EPD

From: Wei Zeng, Hydrology Unit, Georgia EPD

Date: March 30, 2018

Subject: Technical Analysis of Georgia's updated Water Supply Request in Allatoona Lake in the Coosa River Basin

Introduction

In January 2013, the State of Georgia submitted to the Army Corps of Engineers (Corps) a Water Supply Request asking the Corps to allocate storage, for water supply purpose, from Allatoona Lake in the Alabama-Coosa-Tallapoosa (ACT) River Basin. The 2013 Request included a technical memorandum analyzing the effects of the Request.

As a result of a court order issued by the U.S. District Court of the Northern District of Georgia, the Corps is now taking action to respond to the 2013 Request and requests made by the Cobb County-Marietta Water Authority (CCMWA) as updated pursuant to the court's order (Updated Request). In a memorandum to EPD dated March 30, 2018, the Metropolitan North Georgia Water Planning District (Metro Water District) provided updated information on projected future water supply demands and returns for the Allatoona Lake system. This updated information predicts that less water will be needed to meet 2050 water supply needs than anticipated in the 2013 Request. It is therefore necessary for the technical analysis to be updated to reflect these changes. The purpose of this memorandum is to summarize this updated analysis.

ACT Water Control Manual

In October 2014, the Corps released its ACT Basin Water Control Manual Final Environmental Impact Statement (FEIS) detailing its intended operations of the ACT Basin and the impacts of such operations. On May 4, 2015, the Corps issued a Record of Decision adopting the ACT Water Control Manual.

The new ACT Basin Water Control Manual contains a Master Manual governing the overall water control operations in the ACT Basin, and individual project manuals for each Corps water control facility in the ACT Basin, including the two federal reservoirs in the Georgia portion of the Basin. These two reservoirs are Allatoona and Carters.

The new Allatoona Manual contains a revised rule curve (or top of conservation pool) with a phased drawdown in the fall, a set of new action zones, a revised peaking power generation guidance, a minimum release reflecting the service unit's release and leakage, and a description of Allatoona's role in the newly developed basin-wide drought contingency operation plan.

This analysis incorporates the Corps' operations as described in the 2015 ACT Water Control Manual.

ACT HEC-ResSim Model

ResSim stands for Reservoir System Simulation software developed by the Corps' Institute of Water Resources, Hydrologic Engineering Center (HEC). ResSim is used to model reservoir operations at one or multiple reservoirs with multiple operational goals and constraints. The model is the Corps' state-of-the-art tool for analyzing complicated reservoir or reservoir system operations. As HEC states, "HEC-ResSim is a decision support tool that meets the needs of modelers performing reservoir project studies as well as meeting the needs of reservoir regulators during real-time events." HEC also states, "HEC-ResSim is now the standard for USACE reservoir operation modeling."

The ACT ResSim model was initially developed by the Corps' Mobile District and HEC and applies the ResSim model to the specifics of the ACT Basin. This model contains physical characteristics of federal and private (Alabama Power) reservoirs in the ACT Basin, including Allatoona and Carters. The model also contains operations and constraints as described in the 2015 ACT Water Control Manual.

The model makes use of 73 years (1939-2011) of hydrology, in the form of daily unimpaired incremental inflows to the model's numerous nodes representing the ACT Basin's various reaches. The model simulates the Corps' operations as described by the 2015 ACT Water Control Manual. Water demands, in the form of water withdrawals from the reaches and discharges of treated wastewater to the reaches, whether recorded or projected, can be incorporated in the model to assess their impacts.

We used the ACT HEC-ResSim model to assess the impact of Georgia's Updated Request to the Corps. We analyzed four water demand scenarios, as described below, and analyzed the impact of Georgia's Updated Request on the Corps' authorized purposes at the federal reservoirs inside Georgia, as well as resulting flows at the Georgia/Alabama state line.

Water Demand Scenarios

As described in more detail below, to analyze the impact of water demands as specified in the Updated Request, we considered two baseline scenarios reflecting recorded water use data in

2006 and 2011 and two impact scenarios reflecting changes in water demand under the Updated Request. The impact scenarios are designated as Scenario E-2006 and Scenario E-2011. Scenarios A-D were presented in my technical memorandum supporting the 2013 Request.

Georgia EPD, through its permitting process, regulates all municipal and industrial water withdrawal activities from surface water sources with a flow rate greater than 0.1 million gallons per day (mgd). This regulation applies across the state, including the Georgia portion of the ACT Basin. EPD also regulates, through delegated authority under the Clean Water Act, discharges of treated wastewater, including flow rates at which such treated wastewater is returned to receiving water bodies. Such delegated regulation is administered through National Pollutant Discharge Elimination System (NPDES) permitting. Finally, under the Georgia Water Quality Control Act and its implementing regulations, EPD regulates and authorizes the impoundment and withdrawal of certain "made inflows" in the State of Georgia. All withdrawing and discharging facilities permitted by EPD, and any entity to which EPD has allocated made inflows, have the responsibility of reporting their water use activities to the State on a regular basis. Such reporting is usually done on a monthly basis.

EPD's Hydrology Unit, through coordination with other programs and district offices, maintains a consumptive water use database (CUD) that captures monthly water use activity across the State, including the Georgia portion of the ACT Basin. This database contains monthly withdrawal and discharge rates of municipal and industrial facilities going back approximately twenty years. The CUD also contains consumptive water use by thermoelectric power generating facilities with cooling tower operations. This portion of the data dates back to the early 2000s.

EPD estimates agricultural water use by applying irrigated acreage and estimated application rates. State-wide irrigated acreage has been mapped by EPD and its contractors by analyzing satellite imagery. Irrigation application rates have been estimated by prior studies by the "National Environmentally Sound Production Agriculture Laboratory" (NESPAL) authored by Dr. James Hook and others. The volume of water applied for agricultural irrigation is estimated by multiplying irrigated acreage with monthly application rates.

It is worth noting that among all of the following water use scenarios, operation of the entire ACT Basin remains identical and consistent with the 2015 ACT Water Control Manual.

1. Baseline-2006

We chose 2006 as one of the two Baseline scenarios because the Corps used 2006 as its baseline year in the FEIS and because 2006 is a recent drought year in Georgia. The Corps stated in its FEIS that it chose 2006 because this was a year with the highest consumptive water use from the ACT Basin and the year with "the greatest stress on the system from water withdrawals." In this water use scenario, recorded 2006 surface water withdrawals by all permitted municipal and industrial facilities have been compiled at monthly time steps. These withdrawals have been grouped into different river reaches, representing different portions of the river basin, and aggregated to represent reach totals. Consumptive water uses by thermoelectric facilities have been incorporated into such reach-aggregated withdrawals. For planning purposes, agricultural water use is considered to be 100% consumptive, with no return flows. Therefore, estimated agricultural withdrawals have been incorporated into the reach withdrawal aggregation.

Similarly, recorded 2006 discharges of treated wastewater by permitted municipal and industrial facilities have been compiled at monthly time steps. These include all of the facilities whose discharge data are reported and compiled into a federal database, or its mirror image database maintained by Georgia EPD – GAPDES. These data are also grouped by their locations into river reaches and aggregated to represent total reach return flows.

In general, these reach aggregated withdrawals and returns result in reach-wise consumptive water use rates, i.e. their differences. The consumptive water use rates are inputs to the ACT HEC-ResSim model. In two reaches (Allatoona and Kingston), the Corps singled out certain individual facilities' withdrawals or returns in the model. For example, CCMWA and the City of Cartersville's withdrawals in the Allatoona Reach, Cobb County's Noonday Creek and Northwest Cobb discharging facilities in the Allatoona Reach, and the City of Cartersville's discharging facility in the Kingston Reach have been separated from reach consumptive use aggregations. For consistency, we followed the Corps' approach and included these facilities' individual withdrawals or discharges.

2. Baseline-2011

We chose 2011 as the second Baseline scenario because it represents a recent drought year in Georgia and was used in our original technical analysis of the 2013 Water Supply Request. The Baseline-2011 scenario is very similar to Baseline-2006 scenario, with recorded withdrawals and discharges in 2011 forming the basis of reach-wise consumptive water use calculations. For consistency with the Baseline-2006 scenario and the Corps' modeling approach, we maintained the same reach configuration in Allatoona and Kingston reaches as in Baseline-2006, i.e. separation of individual facilities (or groups of facilities) from reach aggregations.

3. Scenario E-2006

Scenario E-2006 isolates the impact of just the requested changes sought by this Updated Request while holding all other water use activities in the Basin unchanged from Baseline-2006 conditions.

This scenario is based on Baseline-2006, with changes to certain withdrawals and discharges directly associated with this Updated Request. CCMWA's recorded 2006 water withdrawal (47.2 mgd) has been replaced with its projected 2050 withdrawal (57 mgd). The City of Cartersville's recorded 2006 water withdrawal (13.9 mgd) has been replaced with its projected 2050 withdrawal (37 mgd).

Cobb County's recorded 2006 discharge (17.2 mgd – with discharges from Noonday Creek WRF and Northwest Cobb WRF combined) has been replaced with its projected 2050 discharge (25.6 mgd). The City of Cartersville's recorded 2006 discharge (8.9 mgd) has been replaced with its projected 2050 discharge (20.3 mgd).

There is one additional change made to Scenario E-2006. Under Baseline-2006, approximately 10.6 mgd was supplied to Paulding County by CCMWA. As the memo from the Metro Water District explains, Paulding County is currently constructing the Richland Creek Reservoir (a pump-storage project with an intake on the Etowah River below Allatoona Lake). This reservoir is projected to replace CCMWA as Paulding County's water supply source. As a result, the projected 2050 CCMWA withdrawal from Allatoona Lake does not contain any amount for Paulding County and the Paulding County's existing need (10.6 mgd) is placed in the Kingston Reach, which is immediately downstream of Allatoona Lake. This approach is consistent with the stated objective of keeping all other water use conditions the same as in Baseline-2006.

4. Scenario E-2011

Scenario E-2011 also isolates the impact of the requested changes contained in the Updated Request, except that this scenario reflects conditions from Baseline-2011 instead of Baseline-2006.

In this scenario, CCMWA's recorded 2011 water withdrawal (38.2 mgd) has been replaced with its projected 2050 withdrawal (57 mgd). The City of Cartersville's recorded 2011 water withdrawal (11.3 mgd) has been replaced with its projected 2050 withdrawal (37 mgd).

Cobb County's recorded 2011 discharge (14.5 mgd – with discharges from Noonday Creek WRF and Northwest Cobb WRF combined) has been replaced with its projected 2050 discharge (25.6 mgd). The City of Cartersville's recorded 2011 discharge (6.8 mgd) has been replaced with its projected 2050 discharge (20.3 mgd).

Just like in Scenario E-2006, for Scenario E-2011, the existing 10.6 mgd of Paulding County's water supply is placed in the Kingston Reach.

Results and Analysis

The modeling results are presented as follows: Scenario E-2006 is compared to Baseline-2006 in the first set of comparisons; Scenario E-2011 is compared to Baseline-2011 in the second set of comparisons. The potential impact of the Updated Request is described with regard to:

(1) Reservoir Elevations
    a. Average elevations in Allatoona Lake;
    b. Ninety percent exceedance elevations in Allatoona Lake;
    c. Minimum elevations in Allatoona Lake;
    d. Elevation duration curves in Allatoona Lake;
(2) Daily average power generation in the federal reservoirs of Allatoona and Carters;
(3) Percentage of time when there is some level of recreational impact; and
(4) State line flow duration curve.

Appendix A is a set of slides summarizing model results and comparisons among the various scenarios. The discussion below references those specific slides.

Reservoir Elevations

Modeling results on Allatoona elevation are evaluated and presented in four ways. The first is a look at simulated daily average elevation from January 1 to December 31. The period of simulation has 73 years of daily elevation output. The 73 January 1 values are averaged to represent the first day of the year. The same averaging process is repeated for the other three hundred and sixty-four days.

Simulation results show very little difference among the scenarios. When looking at the average daily elevation at Allatoona of Baseline-2006 and Scenario E-2006 (Slide 8), very little difference can be detected in the months of January through July and December. For example, when comparing to the 2006 baseline, on May 1, average Allatoona elevation under Scenario E-2006 would be 0.07 feet lower than under Baseline-2006. Modeling results for the Baseline-2011 and Scenario E-2011 comparisons are similar (Slide 17). For example, when compared to the 2011 baseline, on May 1, average Allatoona elevation would be 0.10 feet lower in Scenario E-2011 than under Baseline-2011. All scenarios point to effective refill of Allatoona.

Some small differences can be seen among the scenarios in the months August through November. For example, on October 1, average Allatoona elevation under Scenario E-2006 would be 0.30 feet lower than under Baseline-2006. In the second set of comparisons, Allatoona elevation on October 1 under Scenario E-2011 would be 0.41 feet lower than under Baseline-2011.

Second, Slides 9 and 18 show the daily elevations for Allatoona Lake for each scenario that would be exceeded 90 percent of the time over the modeled period of record, which is representative of extremely low basin inflow (or drought) conditions in the basin. As can be seen, projected elevations mostly differ only by inches between the Baseline scenarios and their corresponding isolated impact scenarios. For example, the average difference between Baseline 2006 and Scenario E-2006 is 0.32 feet. While the differences between the two scenarios in October and November are somewhat more pronounced than the rest of the year, the average difference between the two scenarios in these two months is only 0.86 feet. Similarly, the average difference between Baseline 2011 and Scenario E-2011 is 0.42 feet, with an average difference for October and November of 1.10 feet. Overall, the lowest projected 90-percent exceedance elevation for either impact scenario is 822.4, while the minimum simulated elevation under any scenario is 818.5. This approximates the lowest actual elevation recorded by the Corps, which was 818.9 feet in December 2007.

The third way of evaluating and presenting simulated elevations compares the minimum daily values. Similar to the process used in obtaining the daily average, the minimum values of each of the three hundred and sixty-five days in a year from the 73-syear record have been obtained and plotted in Slide 10 (Baseline-2006 and Scenario E-2006) and Slide 19 (Baseline-2011 and Scenario E-2011).

The largest difference between a Baseline and its corresponding Water Supply scenarios takes place in the month of December. For example, the minimum Allatoona elevation on December 15 under Scenario E-2006 is 1.64 feet lower than under Baseline-2006 (Slide 10). The differences in the second set of comparisons are slightly larger, mostly because water demand conditions in 2011 were less than in 2006. For example, Allatoona elevation on December 15 under Scenario E-2011 would be 3.02 feet lower than under Baseline-2011 (Slide 19). Note again that the lowest actual elevation recorded by the Corps was 818.9 feet in December 2007.

The fourth way of evaluating simulated elevations is to look at the elevation exceedance curves. An exceedance curve (also referred to as a duration curve) represents a statistical summary of a time-varying quantity (e.g. daily reservoir elevation or daily stream flow over a long period of time). A point on an exceedance curve indicates the percentage of time (x-coordinate) when a quantity (y-coordinate) has been exceeded over the entire period of record. For example, in Slide 11, we can roughly see (from any one of the scenarios) that simulated Allatoona elevation would be higher than 834 feet for about 50 percent of the time. We can also see that an elevation of 830 feet is exceeded more than 70 percent of the time. The exceedance curves in this analysis are in one percentage point increments.

Slide 11 presents a comparison of exceedance curves for Baseline-2006 and Scenario E-2006. For the most part, both scenarios are very similar, with the exception of the lowest point (or

100 percent exceeded) where there is a 1.71 feet difference between Baseline-2006 and Scenario E-2006. For all of the other percentage points, the differences between the Scenario E-2006 and Baseline-2006 are only inches. For example, the largest difference (aside from the lowest point) between Baseline-2006 and Scenario E-2006 is 0.27 feet (or 3.2 inches) around 59 and 60 percent exceedance level.

Slide 20 compares exceedance curves for Baseline-2011 and Scenario E-2011. For the most part, both scenarios are again very similar, with the exception of the lowest point (or 100 percent exceeded) where there is a 2.90 feet difference between Baseline-2011 and Scenario E-2011. For all of the other percentage points, the differences between Scenario E-2011 and Baseline-2011 are only inches. For example, the largest difference (aside from the lowest point) between Baseline-2011 and Scenario E-2011 is 0.39 feet (or 4.7 inches) at 64 percent exceedance level.

Hydropower Generation

Results of power generation are summarized in Slide 12 (for Baseline-2006 and Scenario E-2006) and Slide 21 (for Baseline-2011 and Scenario E-2011). The amount of power generation can be expressed as daily average or annual average values.

In comparison to Baseline-2006, where a daily average amount of power generation at Allatoona Lake is 312 MWH, average daily simulated hydropower generation under Scenario E-2006 is projected to decrease by less than 9 MWH, or less than 2.8%, to approximately 303 MWH. System generation at both federal reservoirs in Georgia is projected to decrease by only 0.4% from Baseline-2006. (See Slide 12 for comparisons.)

In comparison to Baseline-2011, where a daily average amount of power generation at Allatoona Lake is 315 MWH, average daily simulated hydropower generation under Scenario E-2011 is projected to decrease by 11.8 MWH, or 3.7%, to approximately 304 MWH. System generation at both federal reservoirs in Georgia is projected to decrease by less than 0.6% from Baseline-2011. (See Slide 21 for comparisons.)

Recreational Impact

The 2015 Water Control Manual defines the primary recreational season as May through September and Allatoona's peak recreational season as Memorial Day to Labor Day. For purposes of this analysis, we used the period between May 20 and September 10 as the window for recreational impact assessment.

The Corps has defined three levels of recreational impact. They are Initial Impact Level (837 feet), Recreation Impact Level (835 feet), and Water Access Impact Level (828 feet), as discussed in the FEIS.

Our analysis tallies the average number of days when simulated Allatoona elevation falls below any one of the three recreation impact levels and presents a comparison of the percentage of time when the level is breached. Slide 13 shows a comparison between Baseline-2006 and Scenario E-2006. Under Baseline-2006, the Lake elevation would be below the Initial Impact Level 33.0% of the time, below the Recreation Impact Level, 17.1% of the time, and below the Water Access Impact Level 0.6% of the time. In comparison, Scenario E-2006 would increase Initial Impact Level by 2.3%, Recreation Impact Level by 2.0%, and Water Access Impact Level by 0.3%.

Slide 22 shows a comparison between Baseline-2011 and Scenario E-2011. Under Baseline-2011, the Lake elevation would be below the Initial Impact Level 31.8% of the time, below the Recreation Impact Level 16.0% of the time, and below the Water Access Impact Level 0.3%. In comparison, Scenario E-2011 would increase Initial impact Level by 3.2%, Recreation Impact Level by 2.9%, and Water Access Impact Level by 0.5%.

State Line Flow

The effect of the Updated Request on stream flow, isolated for water supply differences in Allatoona, can be assessed at the Coosa River near the Georgia/Alabama state line. Similar to how exceedance curves have been used to portray lake elevations, exceedance curves (duration curves) are also used to show statistical features of stream flow.

Slide 14 contains state line flow duration curves for Baseline-2006 (blue) and Scenario E-2006 (green). The two curves are very hard to distinguish simply because they are nearly identical. Slide 15 is a zoomed-in view of Slide 14, where only the lowest 50% of the entire flow spectrum is shown. Between Scenario E-2006 and Baseline-2006, where the only difference is the Updated Request, there is mostly a difference of approximately 20 to 40 cfs.

Slide 23 contains state line flow duration curves for Baseline-2011 (blue) and Scenario E-2011 (green). The two curves are very hard to distinguish simply because they are nearly identical. Slide 24 is a zoomed-in view of Slide 23, where only the lowest 50% of the entire flow spectrum is shown. Between Scenario E-2011 and Baseline-2011, where the only difference is the Updated Request, there is mostly a difference of approximately 30 to 50 cfs.

For a perspective of the magnitude of such changes, the long-term average flow at the state line as observed by USGS is 6,441 cfs.

Appendix A
Evaluations of Updated ACT Water Supply Requests

Georgia EPD

Hydrology Unit

March 30, 2018

Updated ACT Water Supply Request Model Scenarios

- Baseline-2006: Existing Conditions
  - 2006 recorded M&I water use through out the Georgia portion of the basin, including on Allatoona
  - Total withdrawal on Allatoona 61.1 mgd
  - Cobb County return to Allatoona 17.2 mgd
  - Estimated 2006 agricultural water use through the Georgia portion of the basin
  - Otherwise HEC-ResSim model representing May 2015 ACT Water Control Manual

Updated ACT Water Supply Request Model Scenarios

- Baseline-2011: Existing Conditions
  - 2011 recorded M&I water use through out the Georgia portion of the basin, including on Allatoona
  - Total withdrawal on Allatoona 49.6 mgd
  - Cobb County return to Allatoona 14.5 mgd
  - Estimated 2011 agricultural water use through the Georgia portion of the basin
  - Otherwise HEC-ResSim model representing May 2015 ACT Water Control Manual

Updated ACT Water Supply Request Model Scenarios

- Scenario E-2006: Isolating Water Supply Impacts
  - Total withdrawal on Allatoona 94 mgd (57 mgd from CCMWA and 37 mgd from City of Cartersville)
  - Total Cobb County return 25.6 mgd
  - City of Cartersville return 20.3 mgd downstream of Allatoona Dam
  - Paulding County existing 10.6 mgd demand placed downstream of Allatoona Dam
  - Model otherwise same as Baseline-2006 with May 2015 Water Control Manual operation

Updated ACT Water Supply Request Model Scenarios

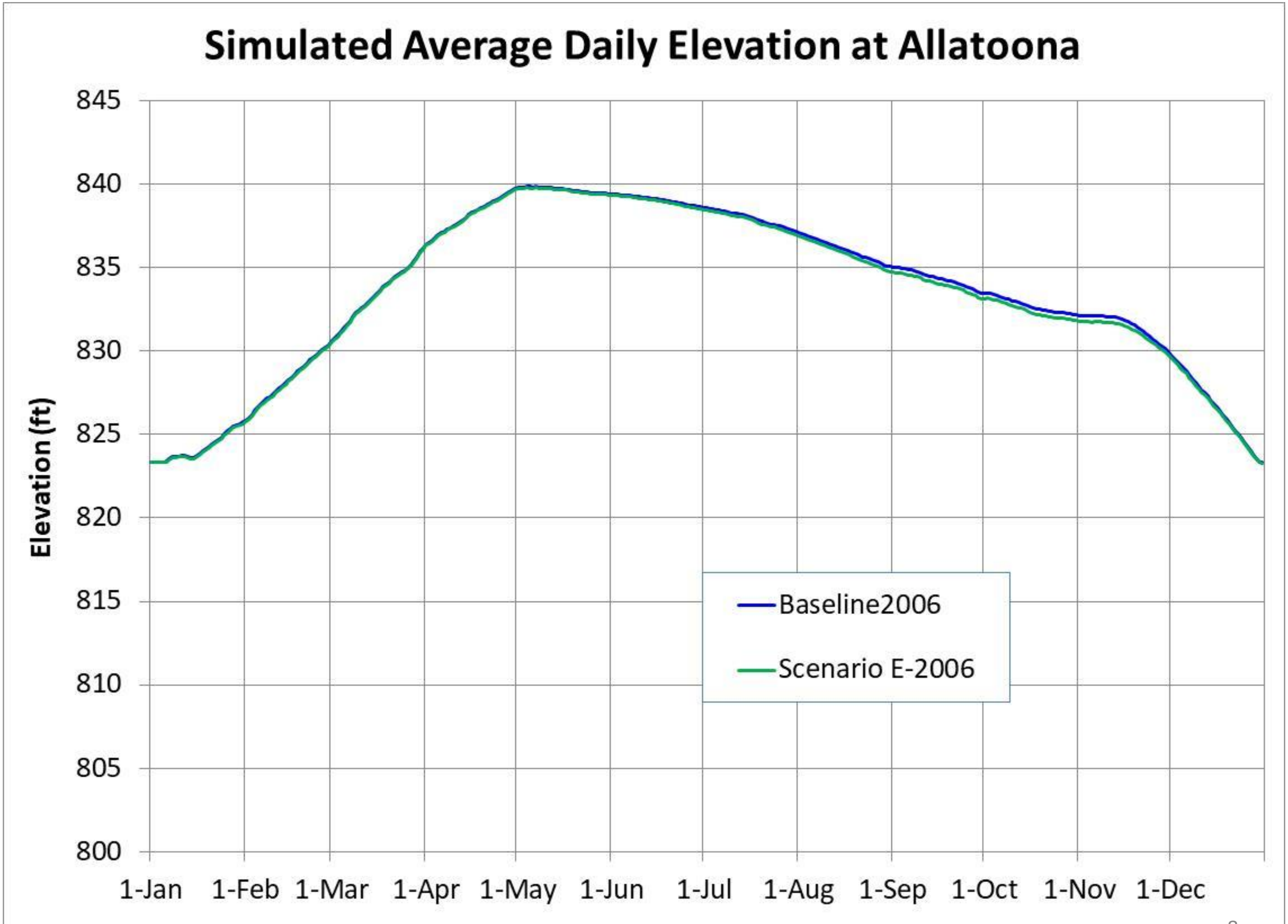
- Scenario E-2011: Isolating Water Supply Impacts
  - Total withdrawal on Allatoona 94 mgd (57 mgd from CCMWA and 37 mgd from City of Cartersville)
  - Total Cobb County return 25.6 mgd
  - City of Cartersville return 20.3 mgd downstream of Allatoona Dam
  - Paulding County existing 10.6 mgd demand placed downstream of Allatoona Dam
  - Model otherwise same as Baseline-2011 with May 2015 Water Control Manual operation

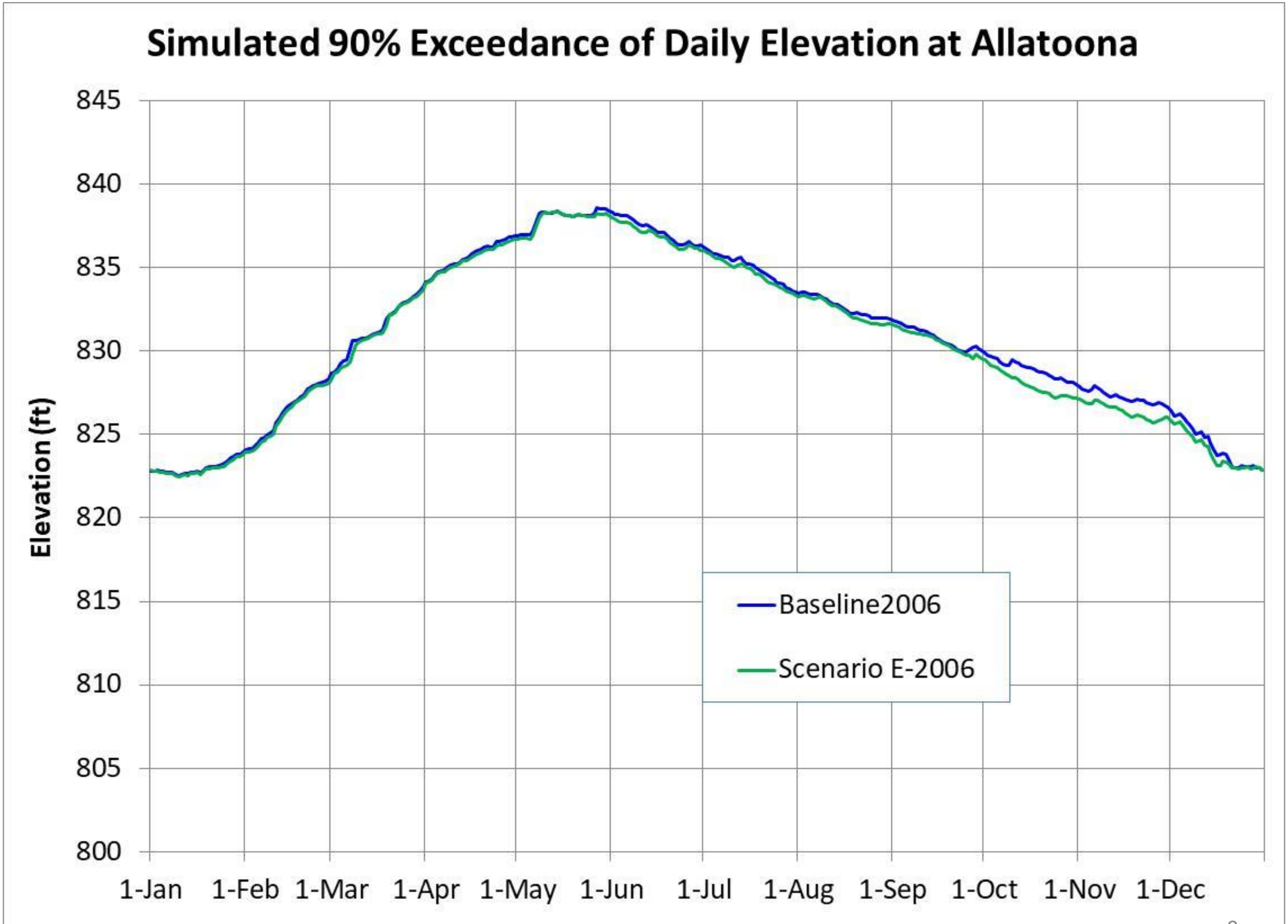
Evaluating Modeling Results

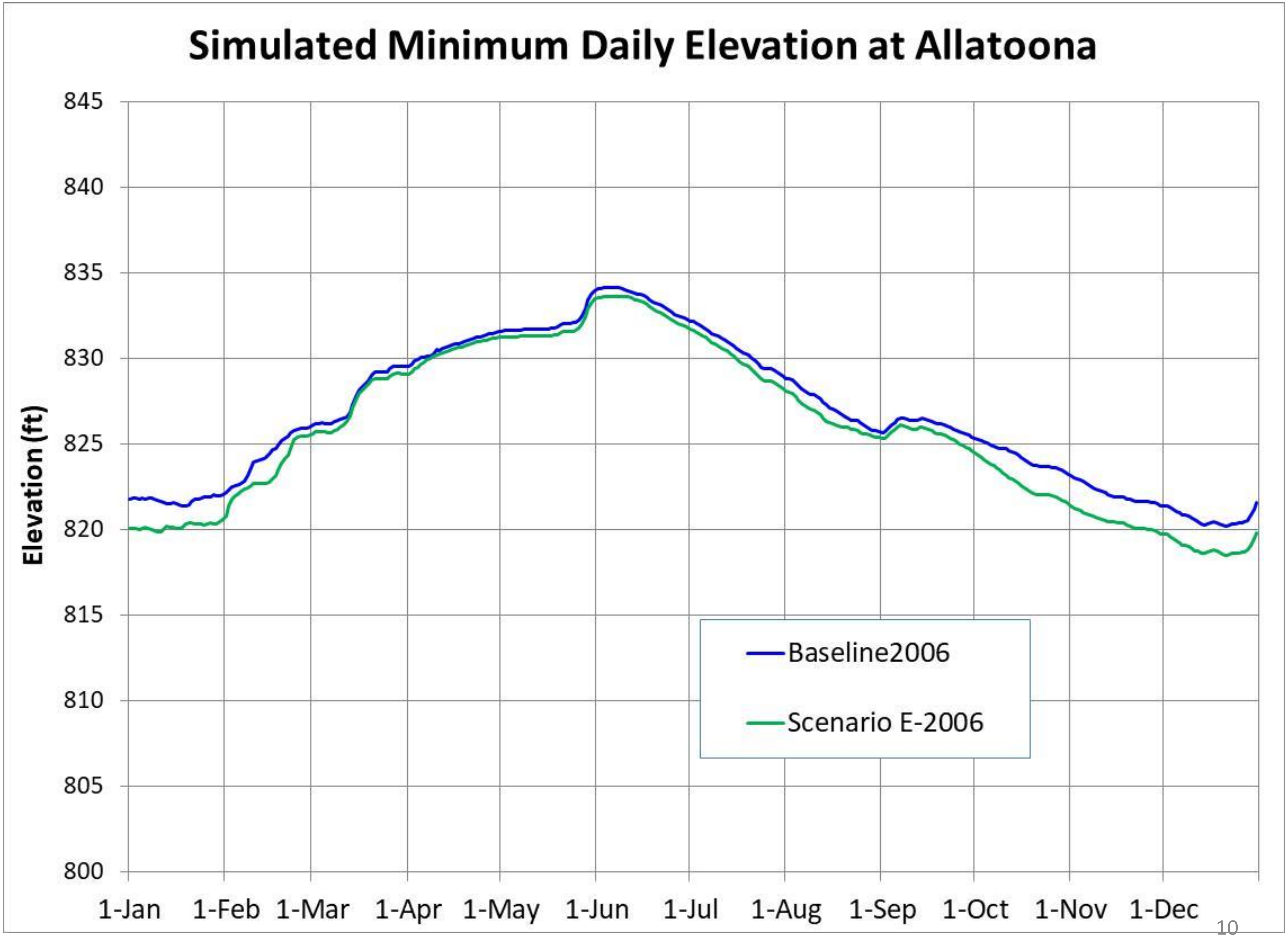
- Allatoona average daily elevation
- Allatoona minimum daily elevation
- Allatoona elevation exceedance curve
- Power generation in Corps projects in GA
- Recreational impacts
- State line flow exceedance curve

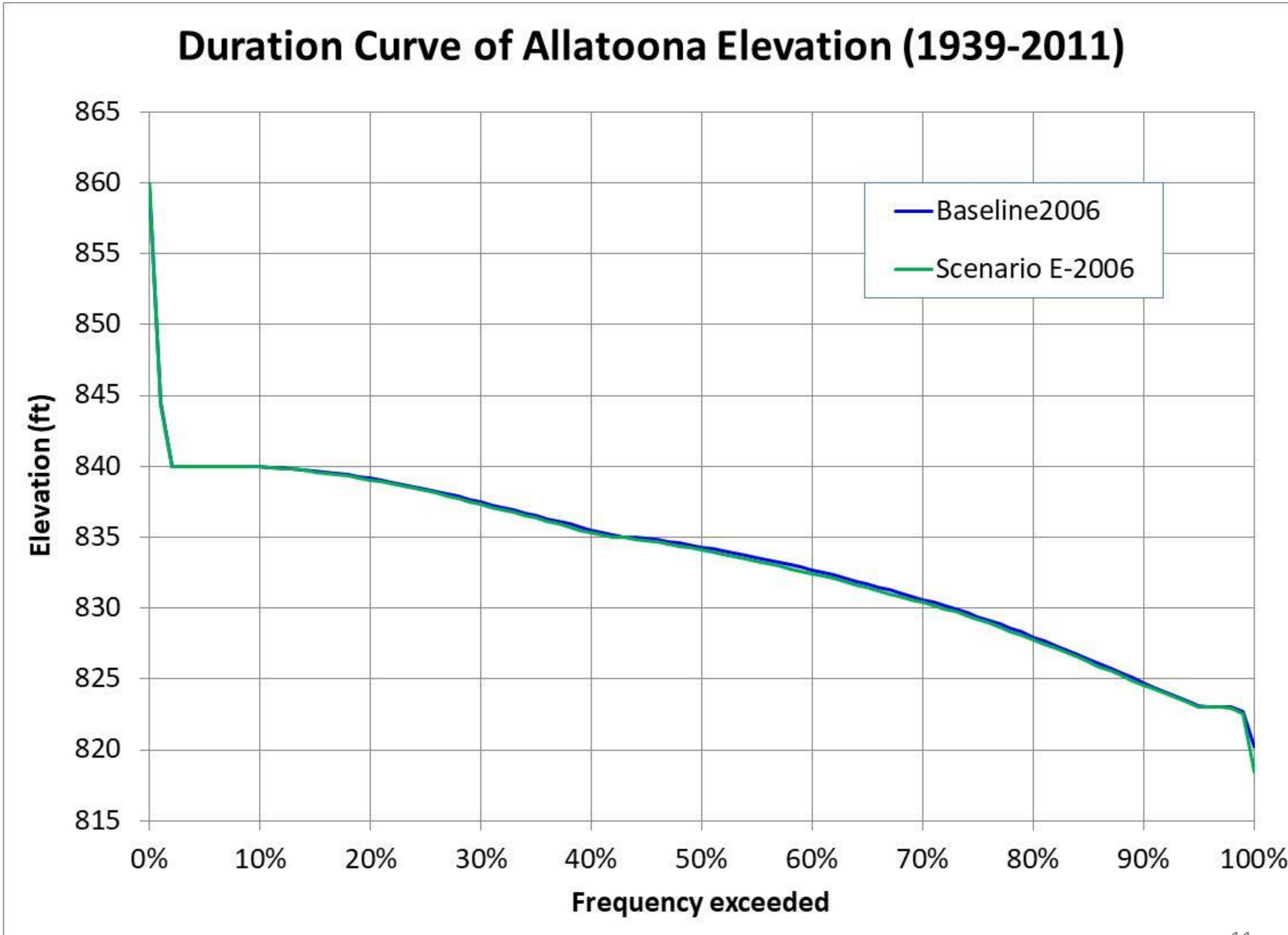
Modeling Results

- Baseline-2006 vs. Scenario E-2006

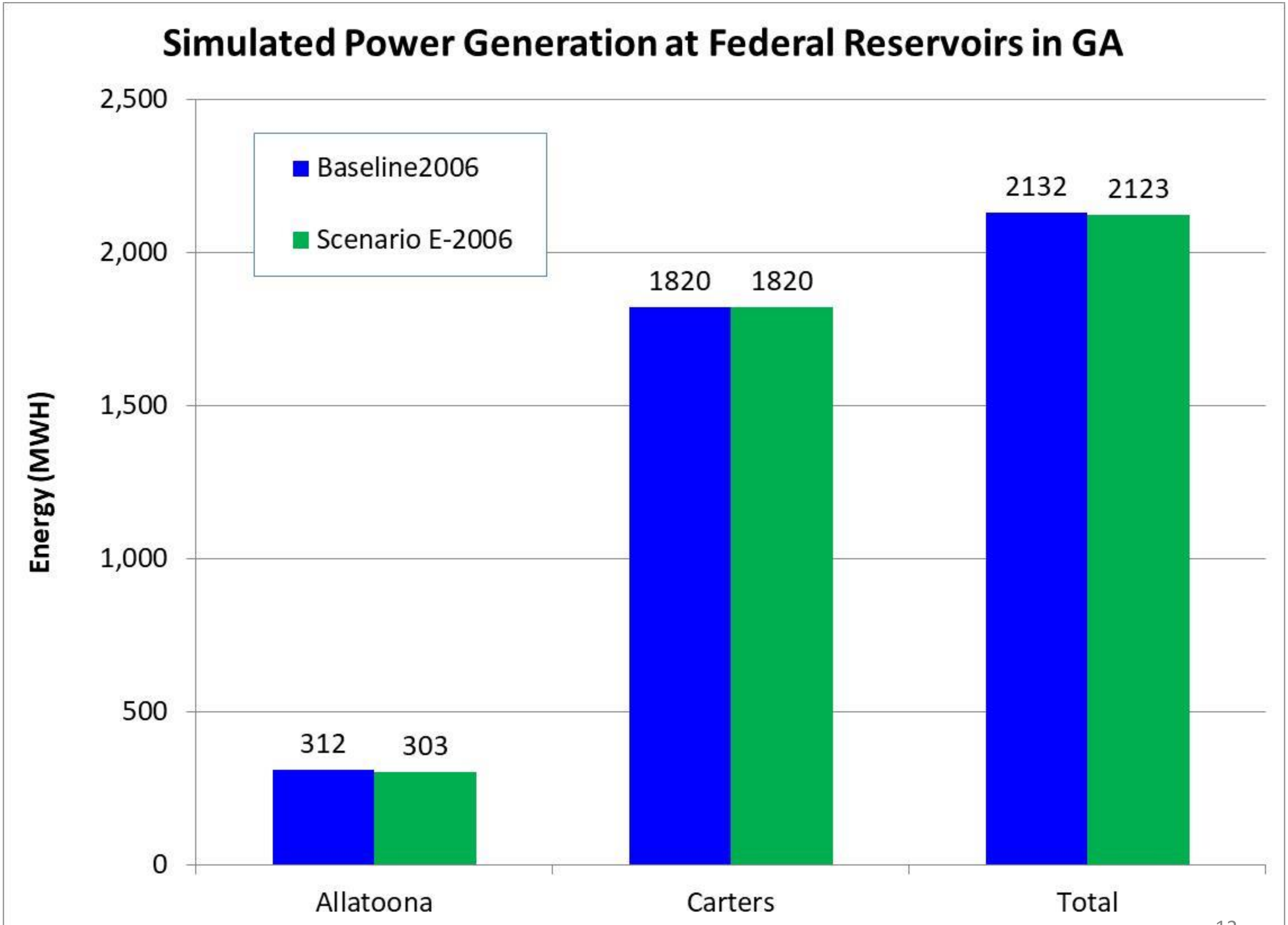

Simulated Average Daily Elevation at Allatoona
845
840
835
830
825
820
815
810
805
800
Elevation (ft)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Baseline2006
Scenario E-2006


Simulated 90% Exceedance of Daily Elevation at Allatoona
845
840
835
830
825
820
815
810
805
800
Elevation (ft)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Baseline2006
Scenario E-2006

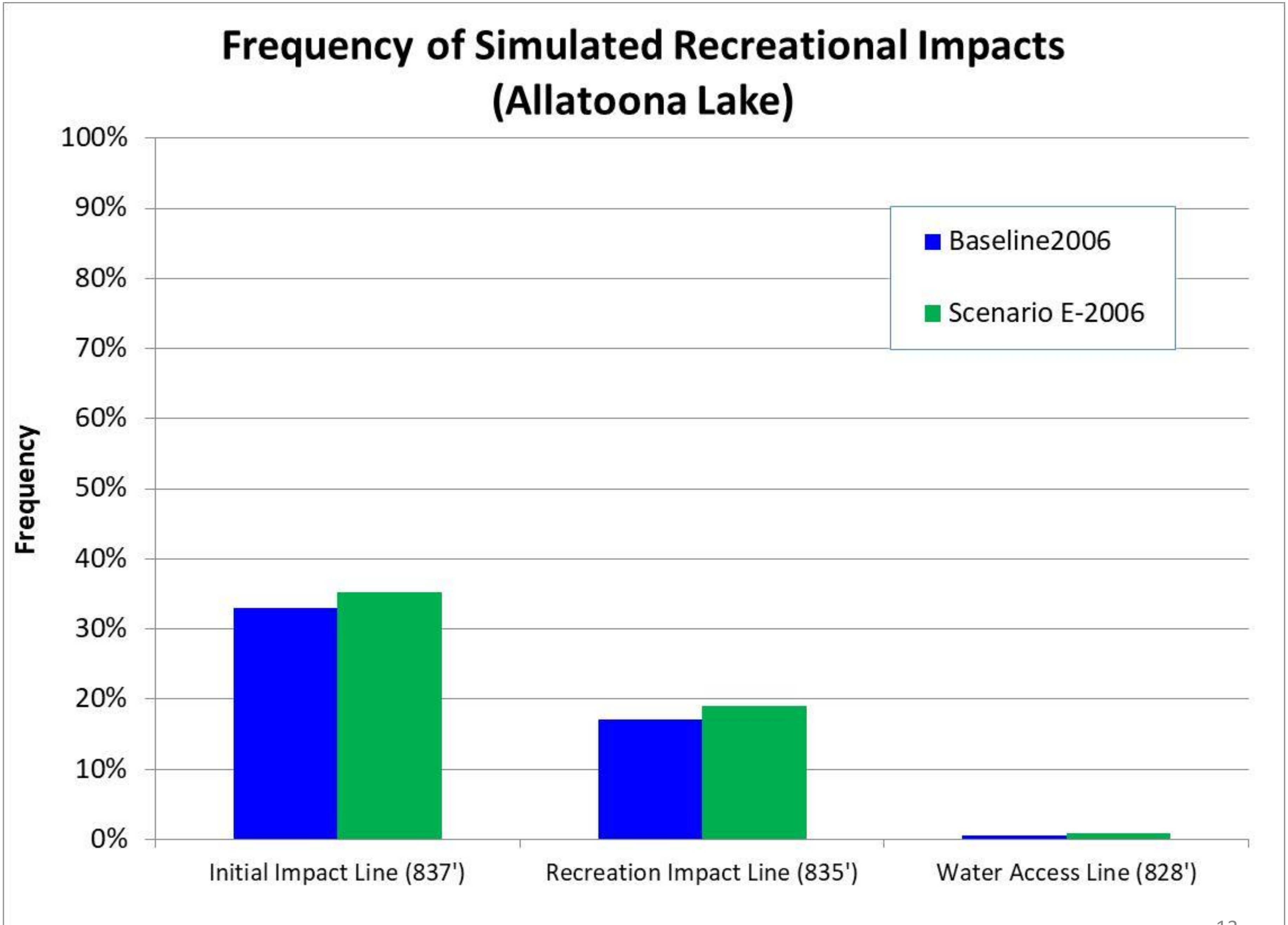

Simulated Minimum Daily Elevation at Allatoona
845
840
835
830
825
820
815
810
805
800
Elevation (ft)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Baseline2006
Scenario E-2006



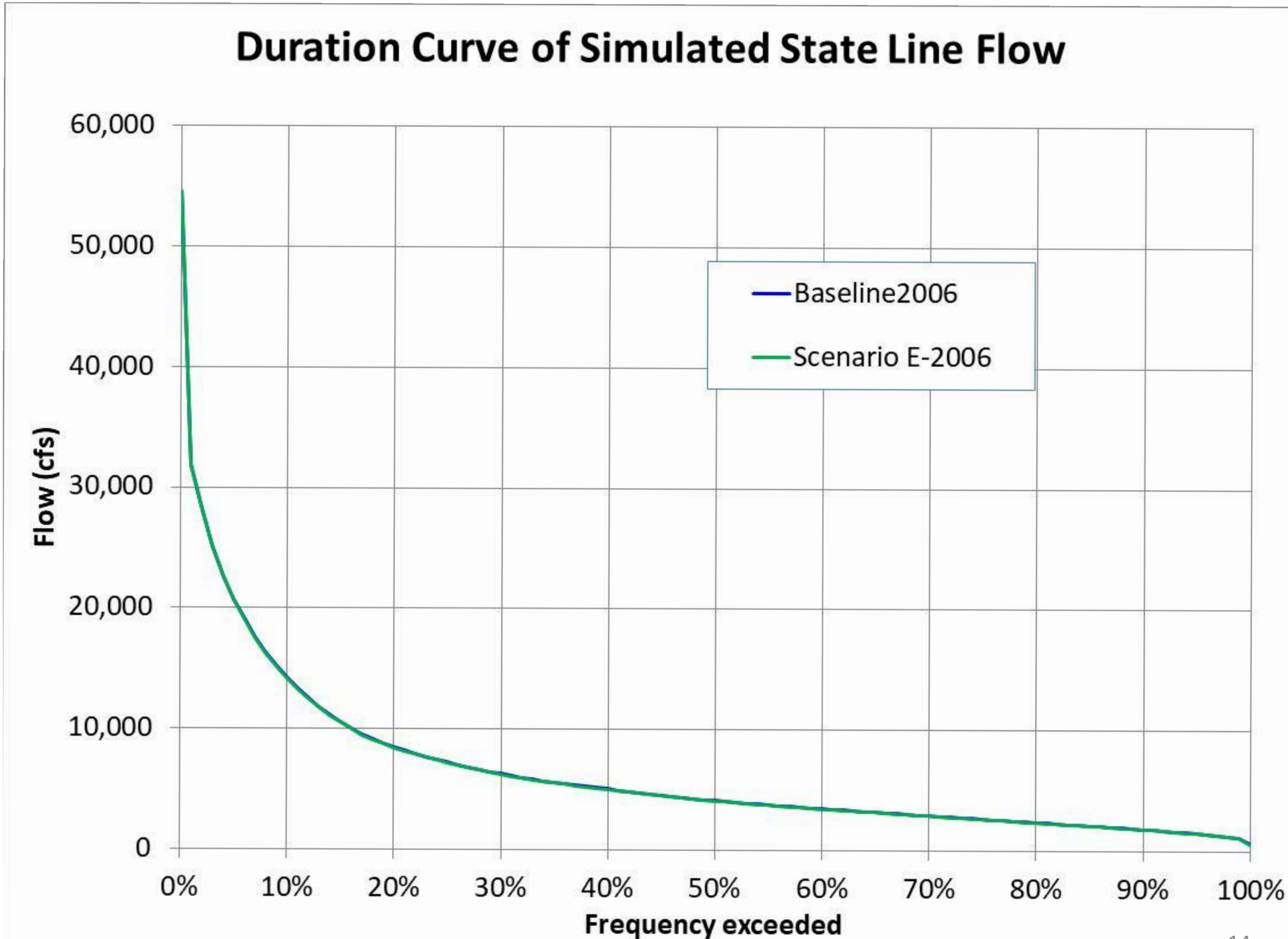
Duration Curve of Allatoona Elevation (1939-2011)
865
860
855
850
845
840
835
830
825
820
815
Elevation (ft)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency exceeded
Baseline2006
Scenario E-2006

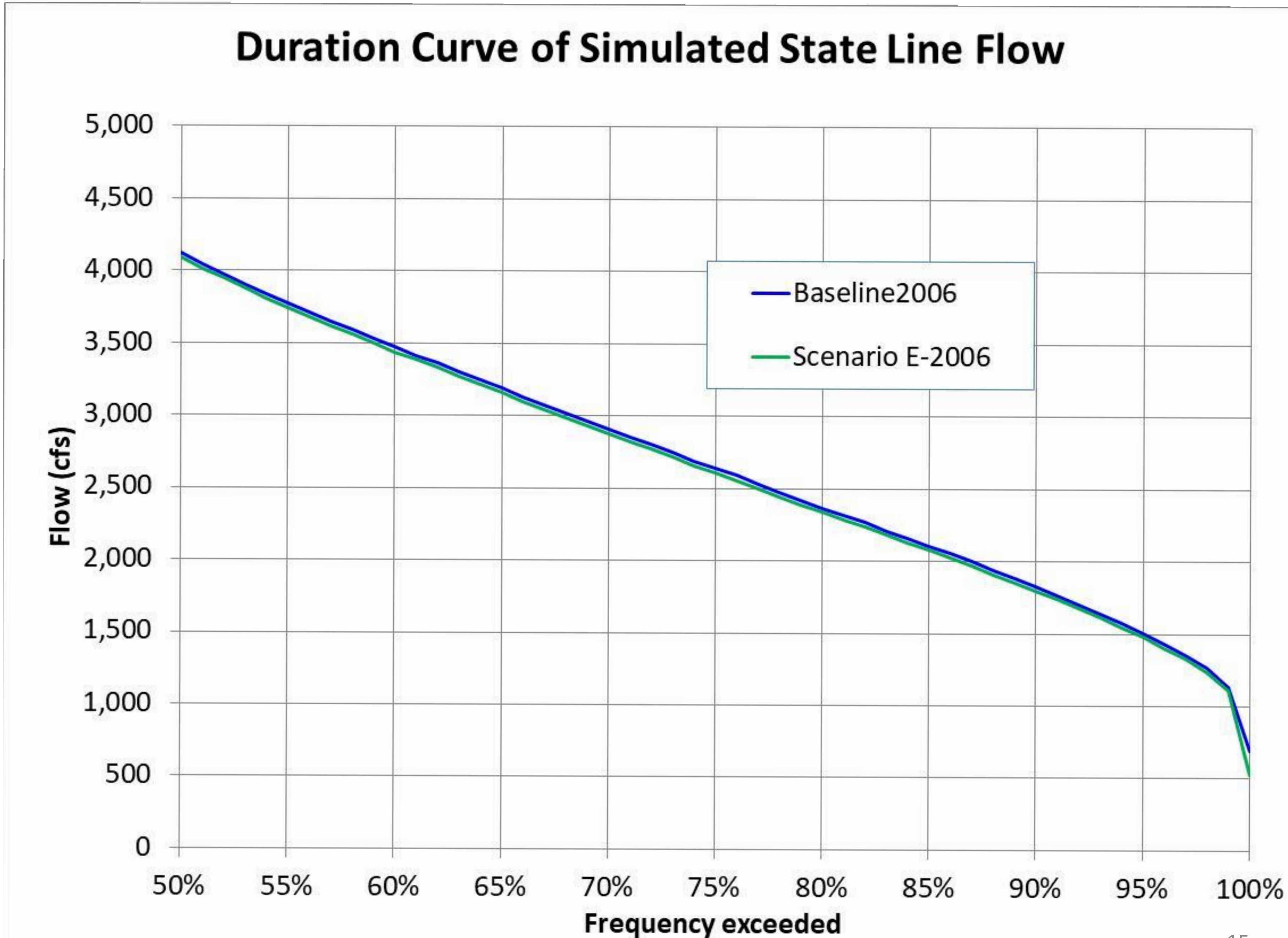


Simulated Power Generation at Federal Reservoirs in GA
Baseline2006
Scenario E-2006
Energy (MWH)
2,500
2,000
1,500
1,000
500
0
312
303
1820
1820
2132
2123
Allatoona
Carters
Total



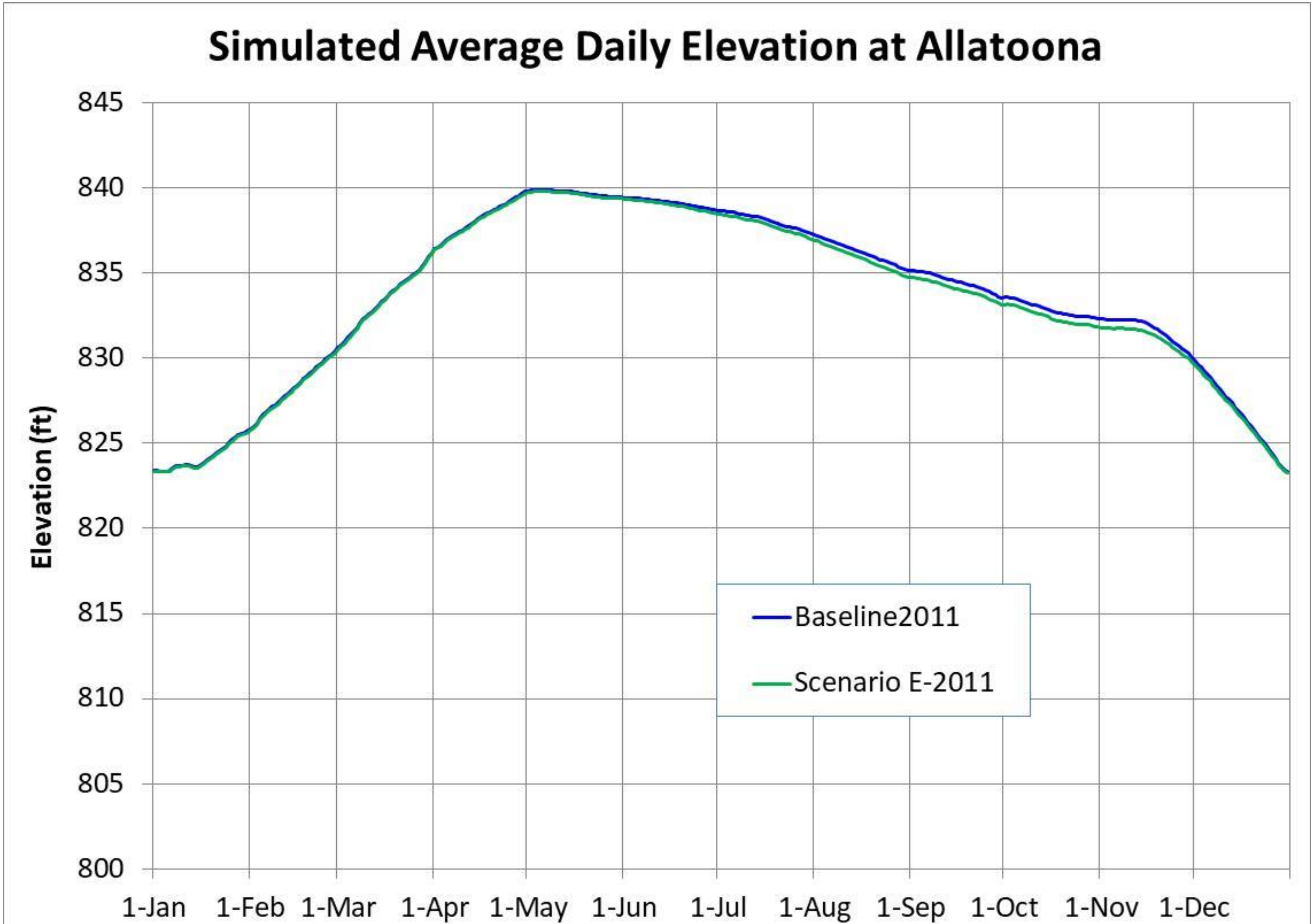
Frequency of Simulated Recreational Impacts
(Allatoona Lake)
Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Baseline2006
Scenario E-2006
Initial Impact Line (837')
Recreation Impact Line (835')
Water Access Line (828')


Duration Curve of Simulated State Line Flow
60,000
50,000
40,000
30,000
20,000
10,000
0
Flow (cfs)
Baseline2006
Scenario E-2006
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency exceeded


Duration Curve of Simulated State Line Flow
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Flow (cfs)
Baseline2006
Scenario E-2006
50%
55%
60%
65%
70%
75%
80%
85%
90%
95%
100%
Frequency exceeded

Modeling Results

- Baseline-2011 vs. Scenario E-2011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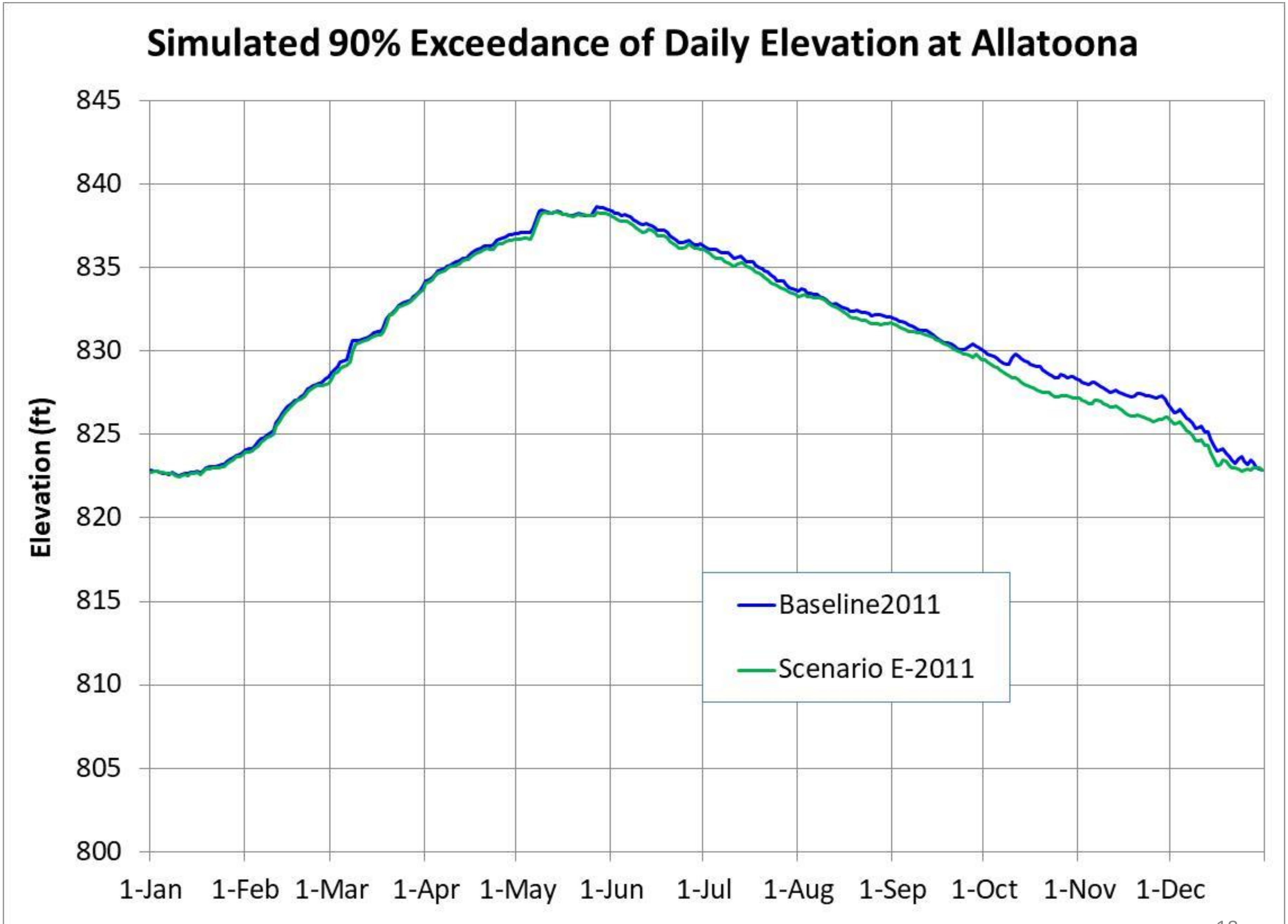
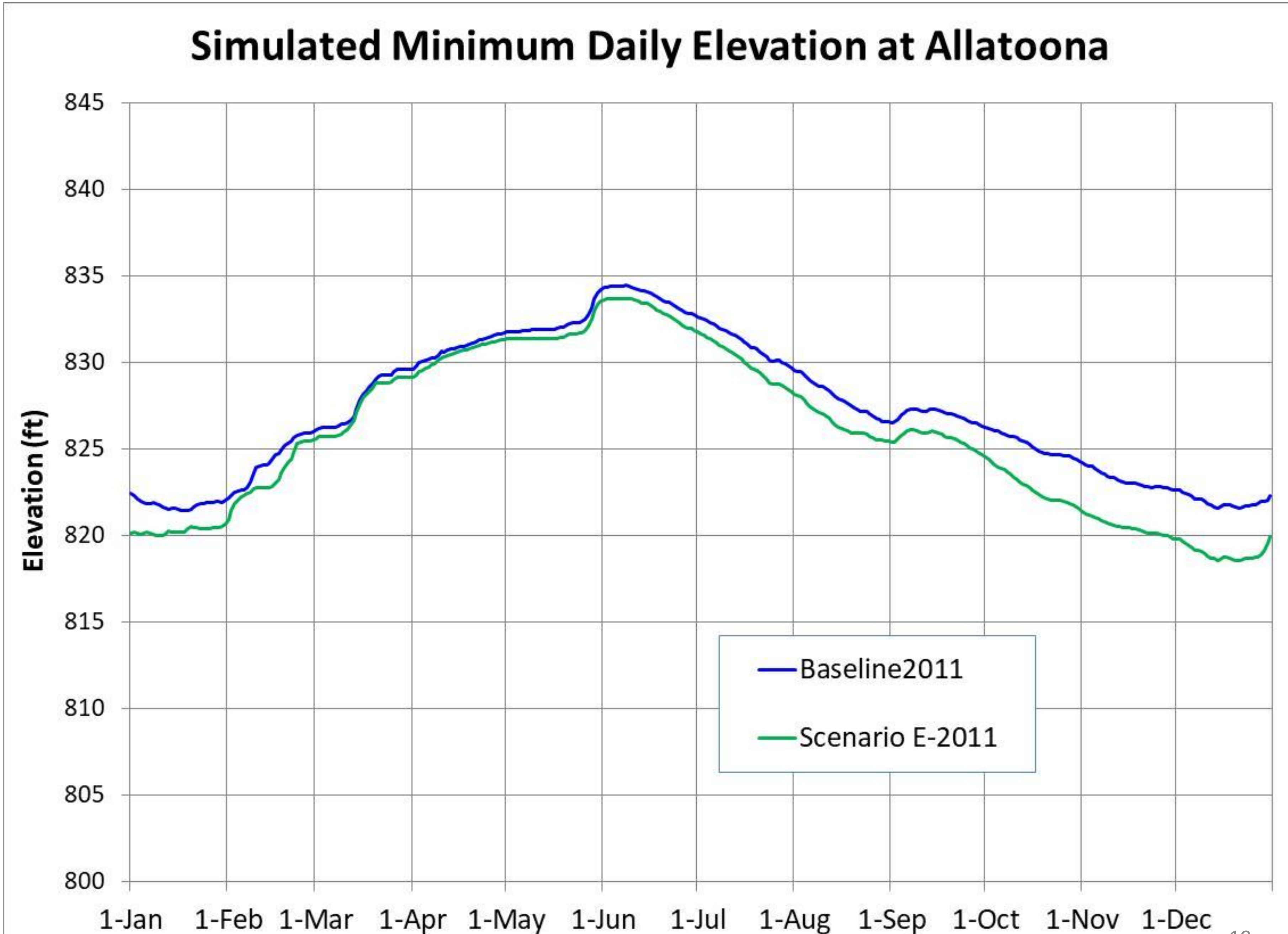
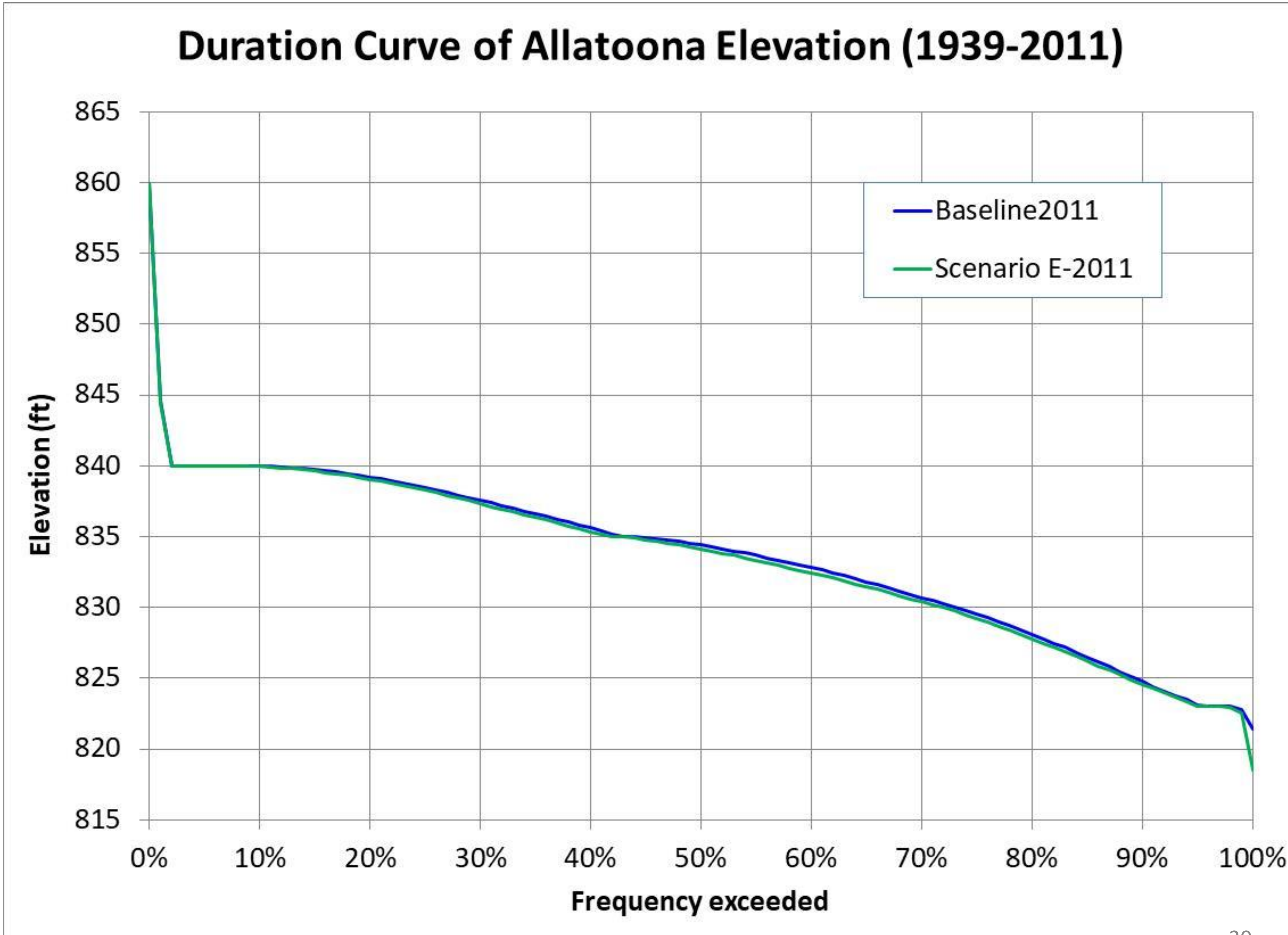
845
840
835
830
825
820
815
810
805
800
Elevation (ft)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Baseline2011
Scenario E-2011

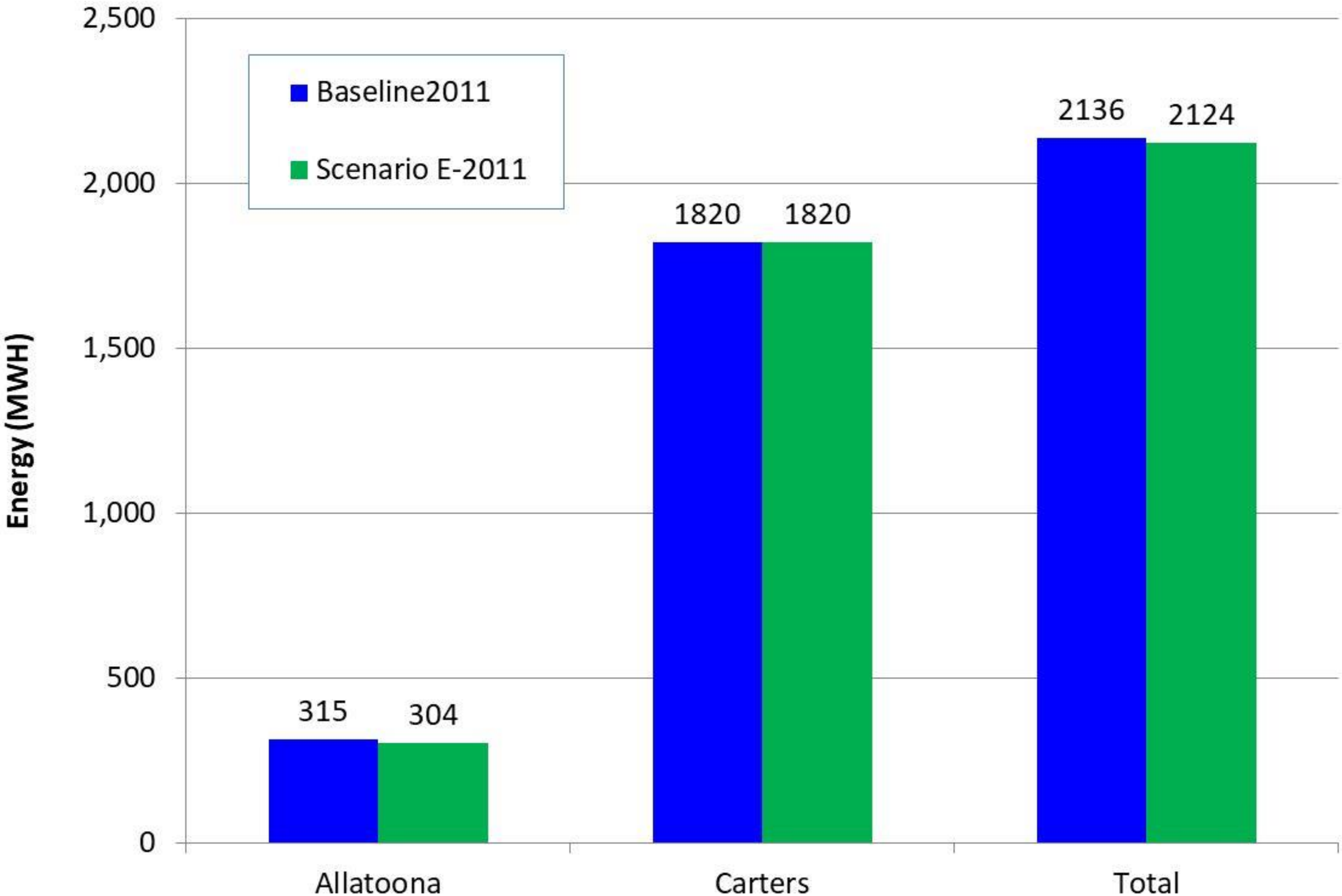

Simulated 90% Exceedance of Daily Elevation at Allatoona
Elevation (ft)
845
840
835
830
825
820
815
810
805
800
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Baseline2011
Scenario E-2011

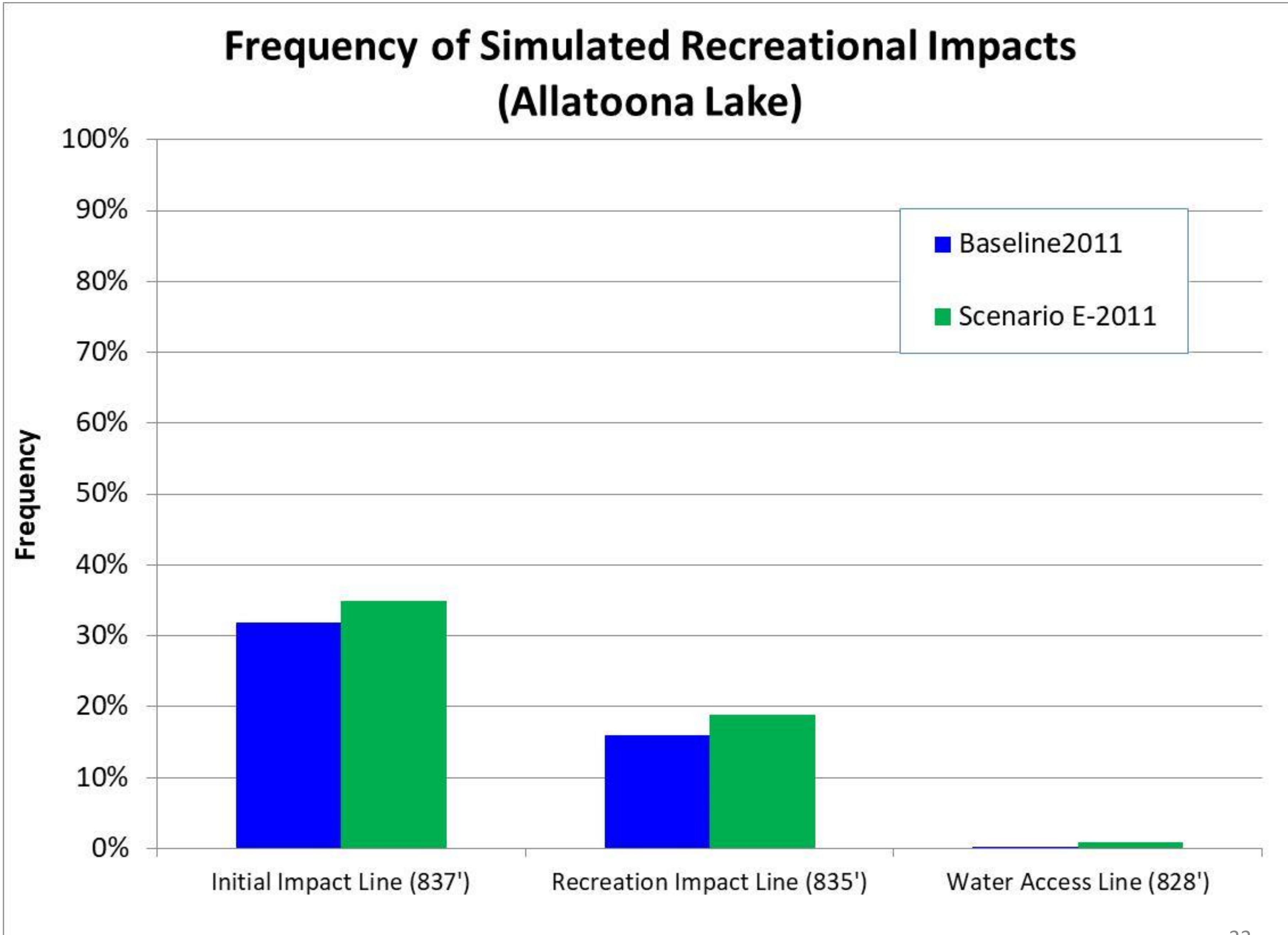

Simulated Minimum Daily Elevation at Allatoona
Elevation (ft)
845
840
835
830
825
820
815
810
805
800
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Baseline2011
Scenario E-2011



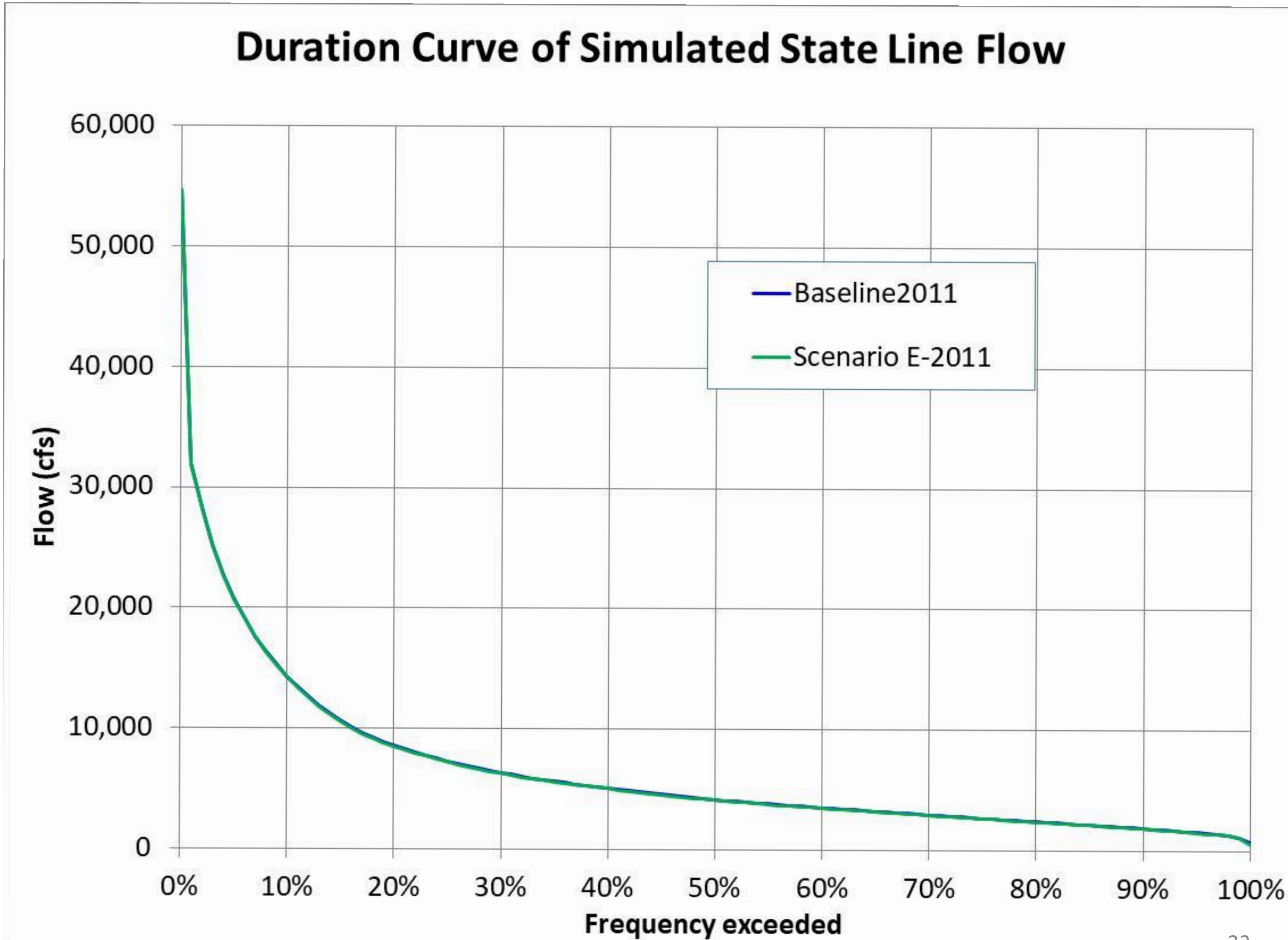
Duration Curve of Allatoona Elevation (1939-2011)
865
860
855
850
845
840
835
830
825
820
815
Elevation (ft)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency exceeded
Baseline2011
Scenario E-2011

Simulated Power Generation at Federal Reservoirs in GA





Frequency of Simulated Recreational Impacts
(Allatoona Lake)
Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Baseline2011
Scenario E-2011
Initial Impact Line (837')
Recreation Impact Line (835')
Water Access Line (828')


Duration Curve of Simulated State Line Flow
Flow (cfs)
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency exceeded
Baseline2011
Scenario E-2011

Duration Curve of Simulated State Line Flow