EVALUATING WATER WITHDRAWALS AND WATER AVAILABILITY FOR PROJECTED THERMOELECTRIC POWER GROWTH IN THE EASTERN INTERCONNECTION OF THE UNITED STATES

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ABSTRACT

Water is an essential resource to the thermoelectric power sector, which is the largest user of water in the United States. As water-related issues continue to grow due to drought, climate change, and tension between multiple sectors, it is becoming increasingly important that water resources are considered in long-term energy planning.

This study has evaluated projected implications on water resources as energy demand grows and new power plants are built. Capitalizing on recent energy-demand projections from the Eastern Interconnection Planning Collaborative (EIPC) and water availability data from Sandia National Laboratories, we have identified watersheds at highest risk for future water stress due to new-build thermoelectric power plant water withdrawals for three possible future scenarios - 1) a business as usual scenario (designated F1S17 by the EIPC) defined by no new energy or environmental policies or programs at the federal, state or regional level, 2) a scenario (designated F6S10) with national renewable portfolio standards implemented at the regional level, and 3) a federal carbon constraint scenario (designated F8S7).

Total thermoelectric capacity increased 7.5% between the year 2011 and 2040 for the business as usual future scenario. Relatively no change in total thermoelectric capacity was observed for the future scenario with regional implementation of national renewable portfolio standards. Finally, a 36.6% decrease in total thermoelectric capacity was seen for the carbon reduction future scenario. While the capacity varied, all three future scenarios yielded a decrease in the total amount of water withdrawn from 2011 through 2040. Nearly all watersheds containing thermoelectric power plants were shown to have less than 10% of the total available water withdrawn for thermoelectric use. Overall, the distribution of new capacity in this study yielded 2 watersheds at-risk of over 10% withdrawal of total water available in the Eastern

Interconnection for F1S17, and 3 watersheds at risk of over 10% withdrawal of total available water for both F6S10 and F8S7. This work only includes the investigation of effects on watersheds due to thermoelectric capacity growth and does not consider implications on watersheds due to other water-using sectors.

DEDICATION

I would like to dedicate my thesis to my parents, Moe and Vicki Quinter. All that I am or hope to be, I owe to them.

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DATA SOURCES USED

Power Plant Attributes	(U.S. EIA 2005, U.S. EIA 2010; U.S. EPA 2010)
USGS 2010 Thermoelectric Water Use	(USGS 2010)
Eastern States Water Metrics	(Sandia National Laboratories, 2015; Tidwell et al., 2015)
F1S17 Stakeholder Report	(EIPC 2015a)
F6S10 Stakeholder Report	(EIPC 2015b)
F8S7 Stakeholder Report	(EIPC 2015c)
MRN-NEEM BAU Modeling Assumptions	(EIPC 2011b)
EIA 860	(U.S. EIA 2013)

ABBREVIATIONS AND ACRONYMS

AFY	Acre-foot per Year
BAU	Business as Usual
C	Capacity
CC	Combined Cycle
CF	Capacity Factor
CT	Combustion Turbine
d	Days
DG	Distributed Generation
DR	Demand Response
EIA	Energy Information Administration
EE	Energy Efficiency
EI	Eastern Interconnection
EIPC	Eastern Interconnection Planning Collaborative
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
F1S17	Future 1, Sensitivity 17
F6S10	Future 6, Sensitivity 10
F8S7	Future 8, Sensitivity 7
FL	Florida
G	Generation
GA	Georgia
h	Hours
HUC-8	8-Digit Hydrologic Unit Code
IGCC	Integrated Gasification Combined Cycle
KS	Kansas
kWh	Kilowatt-hour
MGD	Million Gallons per Day
MI	Michigan
MISO	Midcontinent Independent System Operator
MISO WUMS	MISO Wisconsin-Upper Michigan (NEEM region listed in Table 1)
MRN-NEEM	Multi-Region National - North American Electricity and Environment Model

MS	Mississippi
MW	Megawatt
MWh	Megawatt-hour
NB	New Build (Capacity)
ORISPL	Office of Regulatory Information Systems Plant Location
Ren	Renewables (biofuel for thermoelectric power)
Ret	Retired (Capacity)
RPS/R	Renewable Portfolio Standards/Regional
RTO	Regional Transmission Operator
SOCO	Southern Company (NEEM region listed in Table 1)
STOG	Gas Steam and Oil Steam
TN	Tennessee
U.S.	United States
VACAR	South Carolina/North Carolina NEEM region (listed in Table 1)
WD	Withdrawn
WF	Withdrawal Factor
WW	Water Withdrawals

1. Introduction

The purpose of this study is to estimate future water withdrawal needs for thermoelectric power generation and use water availability data to identify areas of the eastern U.S. that could experience water shortages due to thermoelectric power growth. Thermoelectric power in this study represents power fueled by coal, oil, natural gas, nuclear, combined cycle, and biomass using a steam turbine. A significant amount of water is required for these power plants to operate making thermoelectric power the largest user of water in the United States (U.S.) (Maupin et al., 2014). A weighted average for all thermoelectric power generation shows that approximately 25 gallons of water is needed to generate each kilowatt-hour (kWh) of thermoelectric power (Feeley et al., 2008). This water is used primarily for cooling purposes, thus the type of cooling a thermoelectric power plant utilizes can have a large impact on the amount of water it withdraws and consumes.

This study focuses on water withdrawals – the amount of water taken from a source – due to thermoelectric capacity and considers the availability of surface water, potable groundwater, brackish[1] groundwater and wastewater available in each HUC-8 watershed in the eastern U.S. Water withdrawals were investigated by utilizing projected thermoelectric capacity for three separate future scenario possibilities provided by the Eastern Interconnection Planning Collaborative (EIPC) and HUC-8 watershed water availability data provided by Sandia National Laboratories. The impacts of thermoelectric generation on water resources is increasingly important as the thermoelectric sector will need to compete with other large water-users such as agriculture and public supply in water-stressed areas of the U.S. (Feeley et al., 2008). Thus,

[1] Brackish groundwater was defined by Tidwell et al. 2015 as consisting of salinities between 1,000 and 10,000 ppm total dissolved solids.

understanding where water-stressed areas may occur and planning new thermoelectric power plants accordingly could help prevent the thermoelectric industry from experiencing water shortages or competition for limited water resources in the future.

2. Background

2.1. The Eastern Interconnection Planning Collaborative

North America is made up of alternating-current power grids, also known as "interconnections" (U.S. DOE n.d.). Three regional interconnections frame the United States; the Western Interconnection, the Eastern Interconnection (EI), and the Texas Interconnection. These are shown in Figure 1.

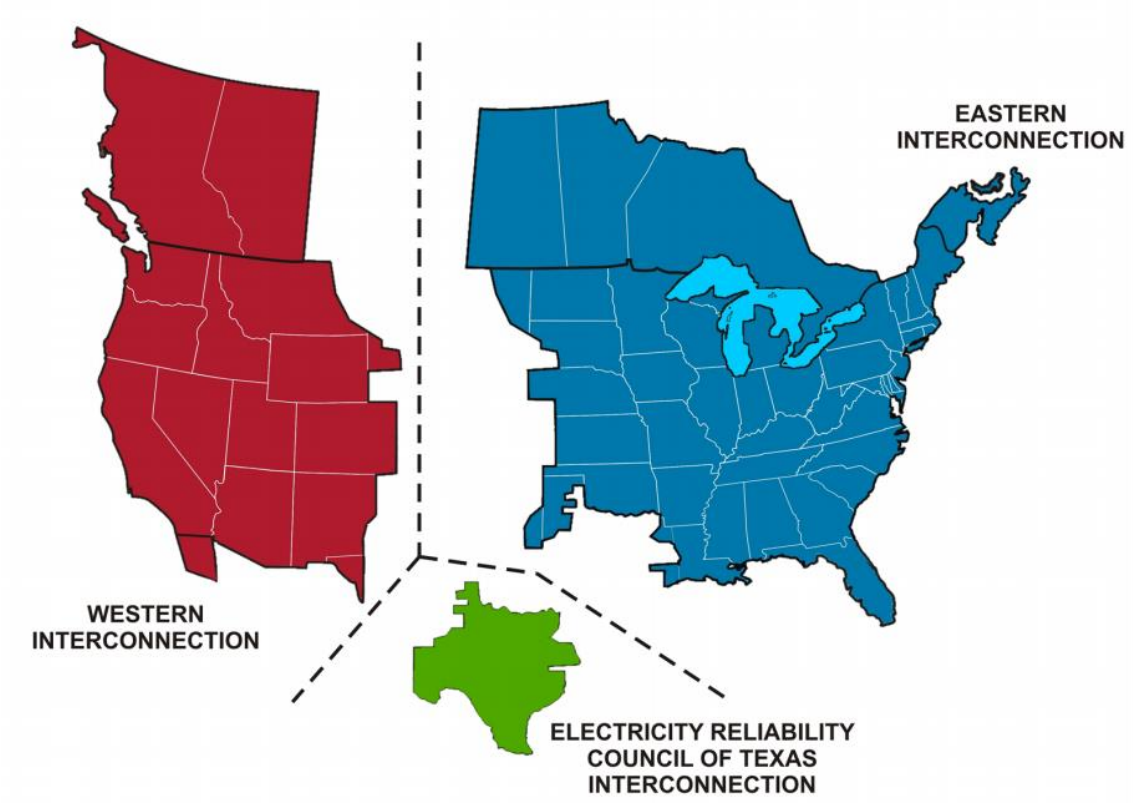

Figure 1. North American Electric Reliability Corporation Interconnections (U.S. DOE n.d.)

An average frequency of 60 Hz is maintained by each of these interconnections and each must operate as close to 60 Hz as possible in order to continue providing stable power (Hanley et al., 2011; U.S. DOE n.d.). Deviating from this stated frequency can cause serious instability in the

network and result in damage to equipment as well as blackouts (Hanley et al., 2011). This instability could be the product of a variety of stresses on the transmission systems including fluctuating demand (U.S. DOE 2002). Growth can put extreme pressure on the network. If the transmission system does not have the capability to handle all power requests, congestion and bottlenecks may occur in the system, leading to power failures (U.S. DOE 2002).

The Eastern Interconnection has shown a tendency for congestion in the transmission system (U.S. DOE 2002). In an attempt to manage these issues and gain insight to a variety of possible future transmission scenarios, the Eastern Interconnection Planning Collaborative (EIPC) was formed to conduct a transmission study consisting of two phases with the assistance of Planning Authorities in the east. The first phase was a step to envision and analyze possible future transmission scenarios through 2040 including information regarding future generation, demand and alternatives while the second phase was an examination of three of the possible future scenarios in more detail (Hadley, Gotham, & Luciani, 2014).

The EI was divided into regions based on Charles River Associates' capacity expansion model[2] known as the Multi-Region National - North American Electricity and Environment Model (MRN-NEEM) used for phase 1 of the EIPC study and so they were termed NEEM regions. The boundaries of these NEEM regions were created based on many similar groupings of the grid including utilities, regional transmission operators, coordinating authorities and independent system operators (Hadley et al., 2014). The NEEM regions included in the EI are listed in Table 1 along with short descriptions and they are shown in Figure 2 as the non-gold areas.

[2] A capacity expansion model constructs and retires capacity over a few decades in order to assess future energy supply and demand (Hadley et al., 2014).

Table 1. NEEM Regions in the Eastern Interconnection
(Hadley et al., 2014)

ENT	Entergy Corp. + other utilities in central MO, AR, LA, MS, east TX
FRCC	Florida minus panhandle
MAPP US	Mid-Continent Area Power Pool (MAPP) U.S. (non-MISO regions in MT, ND, SD, MN, IA)
MISO IN	Midcontinent Independent System Operator (MISO) Indiana
MISO MI	MISO West (parts of MT, ND, SD, MN, IA, MN, WI)
MISO MO-IL	MISO Missouri-Illinois (eastern MO, much of IL)
MISO W	MISO in Michigan
MISO WUMS	MISO Wisconsin-Upper Michigan
NE	Nebraska
NEISO	New England Independent System Operator
Non-RTO Midwest	Non-RTO in Midwest (most KY, some OH)
NYISO A-F	New York Independent System Operator (ISO) in Upstate NY
NYISO G-I	New York ISO in lower Hudson Valley
NYISO J-K	New York ISO in New York City – Long Island
PJM E	PJM Eastern Mid-Atlantic Area Council (MAAC) (NJ, DE, east MD)
PJM ROM	PJM Rest of MAAC (parts of PA, MD, DC)
PJM ROR	PJM Rest of Region (parts of IL, OH, PA, MD, WV, VA, NC)
SOCO	Southern Company + other utilities in GA, AL, east MS, west FL
SPP N	Southwest Power Pool (SPP) North (Kansas, western Missouri)
SPP S	SPP South (Oklahoma, north TX, east NM, west AR, west LA)
TVA	Tennessee Valley Authority (TN, north MS, north AL, south KY)
VACAR	South Carolina, west North Carolina

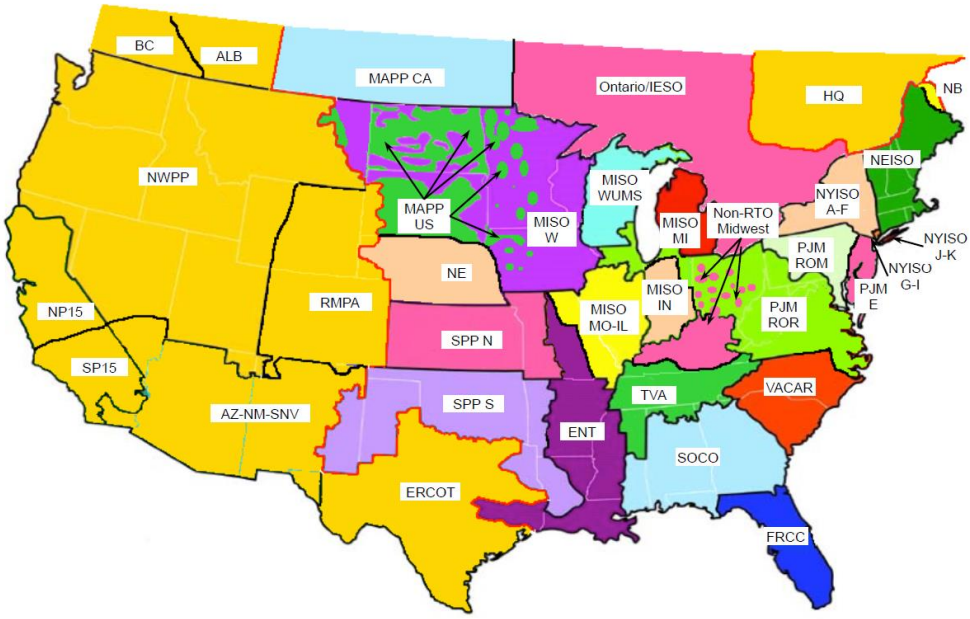

Figure 2. Map of North American Electricity and Environment Model regions
(Hadley et al., 2014)

The term "future" was used in the EIPC study as a way to represent future scenarios based on various assumed inputs such as technologies, policies, and costs. The study defined eight future scenarios in an attempt to cover the broad array of policies possible (Hadley et al., 2014). The future scenarios envisioned by the EIPC in the first phase are shown in Table 2.

Table 2. Futures Scenarios from Phase 1 of the EIPC Study
(Hadley et al., 2014)

Future	Label	Definitions
1	BAU	Business as usual scenario
2	CO_2/N	High CO_2 cost scenario, national implementation
3	CO_2/R	High CO_2 cost scenario, regional implementation
4	EE/DR	Aggressive energy efficiency (EE), demand response (DR) and distributed generation (DG)
5	RPS/N	National renewable portfolio standard (RPS), national implementation
6	RPS/R	National RPS, regional implementation
7	NUC	Nuclear resurgence
8	CO_2+	High CO_2 costs scenario with aggressive EE, DR, DG, and nationally implemented RPS

The EIPC study (EIPC 2011c; Hadley et al., 2014) defined sensitivities in order to create multiple sub-scenarios for each main future scenario. Sensitivities refer to a collection of inputs or conditions used to model a variety of possibilities that could affect the course of a specific future. Table 3 summarizes the main sensitivities studied and the futures to which they were applied. In total, the EIPC study analyzed 72 scenarios covering the eight future scenarios and three of them were chosen for more extensive analysis in phase 2 of the EIPC study. The three scenarios chosen were from future 1, future 6, and future 8. These three future scenarios were chosen because they represent significantly different future scenarios possible in that they comprise of 1) a business as usual scenario, 2) a nationally implemented low-carbon policy scenario, and 3) a regionally-implemented low-carbon policy scenario. A second key motive for choosing these three future scenarios was to ensure that robust transmission build-outs would result from the study. The sensitivity chosen within each future was selected based on efforts to ensure balance in terms of policy goals, transmission build-outs, implementation levels and total costs. Ultimately, significant diversity regarding fuel types, policies implemented, etc. was the goal for the final three future scenarios selected. The three scenarios are discussed briefly below; some details as to motivations for selecting these three scenarios are complex so the reader is referred to the full phase I report (EIPC 2011c) for more information.

Table 3. Main Sensitivities the EIPC Studied in Phase 1
(Hadley et al., 2014)

Sensitivities	Future 1: BAU	Future 2: CO_2/N	Future 3: CO_2/R	Future 4: EE/DR	Future 5: RPS/N	Future 6: RPS/R	Future 7: NUC	Future 8: CO_2+
Expand transmission	X	X	X		X	X	X	X
+/- Load growth	X	X	X		X	X	X	
+/- Gas price	X	X	X		X	X		X
+/- Renewable cost or deployment	X	X	X		X	X		X
Delay regulations	X							
CO_2 cost adjustment		X	X				X	X
PEV variations				X	X	X		
Extra EE savings				X				
Clean Energy Standard					X	X		
Small modular reactors							X	
Higher RPS limits								X

EIPC analyzed 17 different sensitivities for future 1, also known as the business as usual (BAU) future scenario. Future 1 is a continuation of present trends into the future - meaning state policies and regulations existing as of 2010 are established, existing regional programs continue, and there are no new federal or state legislations or programs. This future also assumes that fuel prices will remain stable and there will be no major technological advances. The final sensitivity of future 1, F1S17 (future 1, sensitivity 17), was chosen for further investigation. F1S17 is unique in that it includes revised characterization of Environmental Protection Agency (EPA) regulations (EIPC 2011c).

F6S10 (future 6, sensitivity 10) was the second future scenario chosen for more extensive analysis. Future 6 focused on regional implementation of a national renewable portfolio standard

(RPS/R) requiring that 30% of electricity from each load serving entity be obtained through renewable resources by the year 2030 (EIPC 2011a). Thus, the capacities estimated by the EIPC for future 6 assume that 30% of the electricity consumed in the EI in 2030 comes from renewable energy sources including wind, solar, geothermal, biomass, landfill gas, fuel cells using renewable fuels, marine hydrokinetic and hydropower. (EIPC 2011a). Sensitivity 10 was chosen for this future because it represents a wide variety of generation mix including new build generation for coal, gas, wind, nuclear, hydro, offshore wind and renewable technologies. This generation mix brought a greater diversity of generation as well as a greater variety of policy drivers to the three chosen scenarios (EIPC 2011c).

The final future scenario chosen was F8S7 (future 8, sensitivity 7). Future 8 involves combined federal climate and energy policy in an attempt to reduce global warming emissions through a federal cap on carbon and policies designed to drive the advancement of renewable technologies and efficiency (EIPC 2011a). Future 8 also states that 60% of the emission reductions by 2030 will be the responsibility of the electricity sector due to energy efficiency, renewable energy and more (EIPC 2011a). Sensitivity 7 includes a hardened build-out of transmission inter-regionally resulting in approximately 37,000 MW of transfer capability (EIPC 2011c).

While the EIPC study included other types of capacity in the EI such as non-thermoelectric renewable energy, this study only focuses on thermoelectric power and thus, only thermoelectric data was pulled from the EIPC report. Figure 3 shows how thermoelectric capacity by fuel type differs between F1S17, F6S10 and F8S7 in 2040 when compared to the BAU F1S17 2015 scenario as projected by the EIPC study. Future thermoelectric capacity projections for F1S17 and F6S10 yield similar results and estimate increases in combined cycle (CC) capacity with relatively no change in steam oil or gas (STOG) capacity. However, while coal capacity increases

in F1S17, it decreases in F6S10 and that capacity decrease is made up for by an increase in renewables (Ren), consisting only of biomass renewables. F8S7 is very different in that coal capacity decreases substantially and CC capacity doesn't increase as much as it would in F1S17 and F6S10. Nuclear capacity is expected to grow in F8S7 while it is expected to decrease in both F1S17 and F6S10. All three future scenarios project different means of meeting the future thermoelectric power needs. Integrated gasification combined cycle (IGCC) and geothermal (Geo) capacity projections were also included in the EIPC projections but IGCC showed very minimal changes and there was no reported new build geothermal capacity from 2011-2040. Thermoelectric capacity projection data reported by EIPC for each of the three future scenarios just described were used as the thermoelectric capacity growth basis for this work.

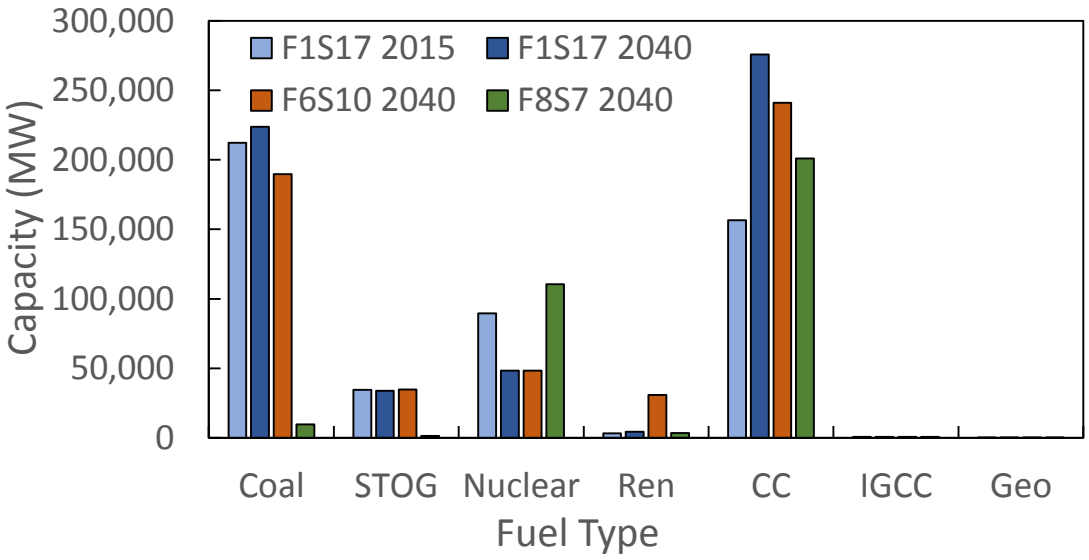

Figure 3. 2015 F1S17 BAU Capacity and 2040 Projected Capacity for F1S17, F6S10, and F8S7 by fuel type as estimated by the EIPC

2.2. Thermoelectric Power Sector and its Water Use

Encompassing coal, nuclear, oil, and natural gas power plants, thermoelectric power generation is the largest producer of electricity in the United States (Feeley et al., 2008).

Thermoelectric power plants generate electricity by boiling water or non-water working fluid to produce the steam used for turning turbines (Fleischli & Hayat, 2014). Large amounts of water are then used to cool the steam back into liquid (Fleischli & Hayat, 2014). Thus, the amount of water a plant uses largely depends on which type of cooling technology it utilizes (Averyt et al., 2011). The two main types of wet cooling systems used are once-through and recirculating (Feeley et al., 2008). Approximately 42.7% of thermoelectric capacity uses once-through cooling systems and about 41.9% use wet cooling towers – the most common type of recirculating system utilized (Feeley et al., 2008).

Power plants equipped with once-through cooling systems withdraw[3] water from a local water source directly, use the water for cooling, and then discharge the water back to the same body of water (Feeley et al., 2008). This type of system accounted for 47% of net power generated but required 94% of total water withdrawals for thermoelectric power in 2010 (Maupin et al., 2014).

Plants with recirculating cooling systems withdraw up to 95% less water than once-through systems (Energy and Environmental Research Center, n.d.). However, they consume[4] a great deal more water than once-through systems due to evaporation and the need for blowdown – discharging water from the system to prevent mineral and sediment build-up in the water from

[3] Withdrawal of water defines the total amount of water taken from a water source (Feeley et al., 2008).
[4] Water consumption refers to the portion of the water withdrawn that does not return to the source (Feeley et al., 2008). Consumption typically occurs due to evaporation and is a large concern because the water consumed is no longer available for others to use (Averyt et al., 2011).

affecting the system's performance (Averyt et al., 2011). For example, the median water withdrawal factor for a generic coal power plant with a recirculating cooling system is reported at 687 gallons per MWh while the median water consumption factor for these same plants is reported at 1005 gallons per MWh (Macknick, Newmark, Heath, & Hallett, 2012). The plants with recirculating cooling systems only comprised about 6% of the total water withdrawals in 2010 and were able to produce 53% of the net power generated by thermoelectric power plants (Maupin et al., 2014). The large difference in water withdrawal between once-through and recirculating systems can be attributed to recirculating systems keeping water in closed-loop piping so the water is available to use repeatedly (U.S. EIA 2014).

The amount of water withdrawn by thermoelectric power plants depends largely on the type of fuel used at the plant and, more importantly, the type of cooling system used by the facility as previously discussed. Water withdrawal factors for thermoelectric power plants with recirculating cooling systems are given in Table 4 (Macknick et al., 2012).

Table 4. Water withdrawal factors for fuel-based electricity generating technologies with recirculating cooling systems (gal/MWh)
Table adapted from Macknick et al., 2012

Fuel Type	Cooling	Technology	Median	Min	Max	Sources
Coal	Tower	Generic	1005	500	1200	(Dziegielewski & Bik, 2006; EPRI 2002; Hoffmann, Forbes, & Feeley, 2004; Meridian, 1989)
Gas Steam	Tower	Steam	1203	950	1460	(CEC 2008; Feeley, Green, Murphy, Hoffmann, & Carney, 2005)
Nuclear	Tower	Generic	1101	800	2600	(Dziegielewski & Bik, 2006; EPRI 2002; NETL 2010b)
Renewables (biofuel)	Tower	Steam	878	500	1460	(CEC 2008)
Gas CC	Tower	Combined Cycle	225	150	283	(EPRI 2002; NETL 2007a, NETL 2007b, NETL 2010a, NETL 2010b, NETL 2010c)

2.3. Recent Water-Energy Nexus Studies

Thermoelectric power generation is the largest user of water in the U.S. in terms of withdrawals (Maupin et al., 2014). The Eastern states are largely responsible for this as 86% of the total water withdrawals by thermoelectric plants in 2010 were in the Eastern U.S (Maupin et al., 2014). This large reliance on water suggests how vulnerable the thermoelectric power sector is to the change in water availability, which is likely to face continued stress as climate change, droughts, population growth, and competition for water from other sectors grows (Fleischli & Hayat, 2014; IEA 2012; Sovacool & Sovacool, 2009).

Due to this vulnerability, the thermoelectric sector has become an important area of study with regards to future water availability and water supply changes (Carter, 2014). Recent studies have shown that the Pacific Northwest and Texas areas are especially vulnerable to changes in water supply (Harto et al., 2011). Texas relies heavily on surface water sources for thermoelectric cooling and the region has appeared to experience, on average, more severe droughts (Harto et al., 2011). For example, in 2011 Texas experienced a record low amount of rainfall over a 12 month period causing some rivers to have such low water flows that the water users were not able to continue using the amount they were legally allotted (King & Carbajales-Dale, 2016). Another study, investigating fresh water availability and water consumption due to future thermoelectric growth the entire U.S., identified the West, Southwest, Great Plains and parts of Florida as regions with limited water availability to support future thermoelectric development (Tidwell, Kobos, Malczynski, Klise, & Castillo, 2012).

While many studies have focused on the western states, it is also important for the eastern states to consider water availability for the planning of future generation to mitigate the water shortage risks that could come from poor planning. Recently Illinois was the focus of a study

investigating how the power sector can prepare for sustainable water use through fuel shifts, changes in cooling systems and proper planning (DeNooyer, Peschel, Zhang, & Stillwell, 2016). Atlanta, Georgia was also of focus in a recent study presenting how the continuation and growth of today's U.S. thermoelectric power path could deplete the water recharging Georgia's Lake Lanier causing water supply issues for other users in the region as well as downstream (Sovacool & Sovacool, 2009). These studies all show how proper planning for future thermoelectric growth is very important across the entire U.S. to reduce the potential of water stress and competition between sectors.

3. Objectives

The first objective of this research was to merge data sets, retire and add capacity to individual power plants based on the EIPC capacity projections through 2040, and validate the capacity estimates achieved in this study with the EIPC projections.

This work's second objective was to evaluate water withdrawals due to changes in thermoelectric capacity from 2011-2040 for three different future scenarios (F1S17, F6S10 and F8S7) and to identify HUC-8 watersheds that could experience water availability stress due to water withdrawals by thermoelectric power plants in the future.

4. Methods

This study made use of existing data sets to assess various predictive scenarios for thermoelectric capacity in the EI through the year 2040. Thermoelectric capacity projections estimated by the EIPC for three future scenarios and water availability data compiled by Sandia National Laboratories were used alongside the primary thermoelectric power plant data set (explained in section 4.1) for this study to analyze the estimated change in thermoelectric water withdrawals from 2015 to 2040. This study examined capacity changes on an individual power plant basis so that water withdrawals versus water availability could be analyzed at the HUC-8 watershed level. The EIPC study projected future capacity by NEEM region and by fuel type only, thus in order to see how the future thermoelectric capacity changes could affect water resources at the HUC-8 watershed level, the projections needed to be allocated on a plant-by-plant basis in this study.

4.1. Gathering Current Power Plant Data

The primary data set comprised of various existing power plant attributes from three sources including two from the EIA and one from the EPA (U.S. EIA 2005, U.S. EIA 2010; U.S. EPA 2010). This data set contained a list of power plants in the U.S. along with information regarding each plant's capacity and capacity factor[5], latitude and longitude, and their HUC-8 watershed assignments. Also included in this data set was the primary fuel type for each power plant which would be the fuel type assumed for the capacity of the entire plant throughout this study. The second key data set was from the United States Geological Survey (USGS) and contained water use information for the thermoelectric power plants in the U.S. (USGS 2010).

[5] The capacity factor of a power plant is the ratio of net electricity generated over a certain period of time to the energy that could have been generated in that same period of time had the plant been operating at full-power continuously (U.S.NRC 2016).

The power plant attributes and thermoelectric water use data sets were combined and only thermoelectric plants located within the EI were kept for further analysis. Power plants were assigned to their respective NEEM region based on location and control entities as specified by the EIPC (EIPC 2011b). The data set for this study's analysis comprised of 920 thermoelectric power plants when completed.

4.2. Objective 1 – Data Validation through matching the EIPC's Capacity Projections

The purpose of Objective 1 was to validate the merged data sets as a quality control step. The total thermoelectric capacity by NEEM region and by fuel type for each NEEM region was calculated by tabulating and summing the data for all the individual power plants. This was compared to the total capacity reported by the EIPC study. The EIPC data set did not give information for individual power plants, but only summary data by fuel type at the NEEM region level. Thus, the tabulation of individual plants' capacity data by fuel type and NEEM region and then comparing this data to the EIPC's projections was a means of verifying that each plant was correctly assigned to its correct NEEM region and fuel type.

For each future scenario, the EIPC gave capacity projections by 5-year periods from 2011 through 2040. These projections were presented by NEEM region and by fuel type for retired capacity, new build capacity, and total capacity in each 5 year period. For example, from 2016-2020 the EIPC data would include total capacity at the end of 2015, retired capacity from 2016-2020, new build capacity from 2016-2020 and total capacity in 2020.

The EIPC's projections of retired and new build capacity were used to retire power plants and add capacity to existing power plant locations in the data set for each 5-year period in order

to get as close as possible to the EIPC's 2040 estimates of total capacity by NEEM region and fuel type.

The purpose of this was to retire and add capacity to existing power plants based on the retirement and new build projections specified by the EIPC study. The final result of this process is a list of specific power plants and their locations that represent the capacity estimated by the EIPC study in 2040. Thus, EIPC's projections are estimated on an individual plant basis so analysis of water use due to thermoelectric capacity at the HUC-8 watershed level can be accomplished.

4.2.1. Retiring Thermoelectric Capacity in the EI

To begin retiring thermoelectric power plant capacity based on the retirement projections given by the EIPC study, the EIA 860 data set was utilized (U.S. EIA 2013). This data included a list of planned retirement capacity for power plants in the U.S by fuel type and year. Thus, the first plants to be retired in each 5-year period were those included in this data set. If the EIPC retirement capacity for each NEEM region was still greater than the amount of capacity retired in this study's data set based on planned retirements, then power plants were retired manually based on those that were oldest and had the lowest capacity factor. This retirement method was done for all three future scenarios.

Retiring plants based on the EIA 860 dataset posed issues as not all the nameplate[6] capacities in the primary dataset were equal to what the EIA 860 dataset reported. Therefore, plants retired by the EIA were sometimes retiring more capacity than they had available

[6] Nameplate capacity is designated by the manufacturer as the maximum output of the specific power producing equipment and is typically expressed in megawatts (MW) on a nameplate attached to the generator (U.S. EIA n.d.). A power plant's nameplate capacity is the summation of all nameplates assigned to each generator at a power plant.

according to the data used in this study. To correct this, capacities resulting in negative values after the EIA retirements were assigned a 0 MW capacity and the total retirement capacity for each NEEM region was calculated by subtracting the total capacities for the 5 year periods.

Figure 4 displays how closely matched the retirement capacity between the EIPC study and this study were by fuel type for all three future scenarios after retiring capacity through 2040. The values for these graphs are reported in Table A-10 in Appendix A. Additional graphs for each scenario presenting the retirement capacity of each fuel type by 5 year period can be found in Appendix A.

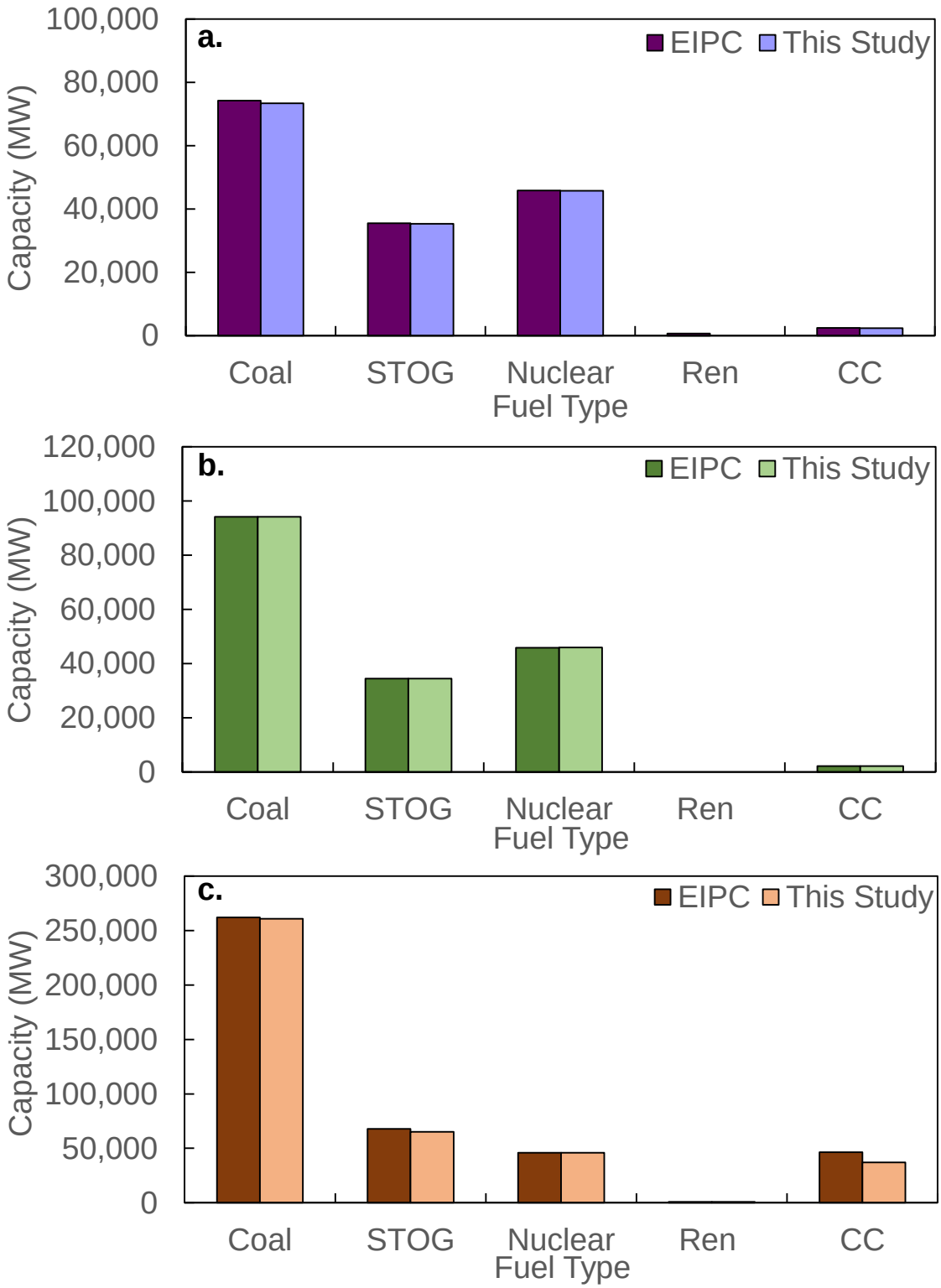

Figure 4. Total retired capacity estimated by the EIPC in this study from 2011-2040 for **a.** F1S17 **b.** F6S10 **c.** F8S7

4.2.2. Adding New Build Thermoelectric Capacity in the EI

The EIPC data set contained a breakdown of the total capacity by fuel type projected to be added to each NEEM region through 2040. However, this data set did not identify the exact location of each plant, so the effort of this task was to create a logical framework for deciding which watersheds were most likely to receive new power plant capacity (also referred to as new build capacity) in future years.

The EIA 860 data set was also used for adding capacity as it contained some planned new build thermoelectric capacity by individual power plants (U.S. EIA 2013). The new build capacity listed in the EIA 860 data set was added to the same plants in this study's data as what was listed in the EIA 860 data before distribution of the remaining new build capacity needed to match the EIPC's projections was done.

For each future scenario, remaining new build capacity was first distributed evenly across all individual, retired power plant locations of the same fuel type. If there were no retired power plants of the same fuel type, the capacity was instead distributed evenly across all the individual, operating power plants of the same fuel type. In the cases where there were no power plants of the same fuel type as the new build capacity, the capacity was manually assigned to other retired power plants in the same NEEM region and the fuel type was adjusted for that power plant location. When none of the above were available, new build capacity was manually added and was typically placed in a location where other capacity exists. This methodology for new build capacity placement was used under the assumption that areas where thermoelectric power plants have existed are the probable locations for new power plants because they are most likely ideal for water use and already have the infrastructure in place.

Figure 5 displays how closely matched the retirement capacity between the EIPC study and this study were by fuel type for all three future scenarios after adding new build capacity through 2040. The values for these graphs are reported in Table A-11 in Appendix A. Additional graphs for each scenario presenting the added capacity of each fuel type by 5 year period can be found in Appendix A.

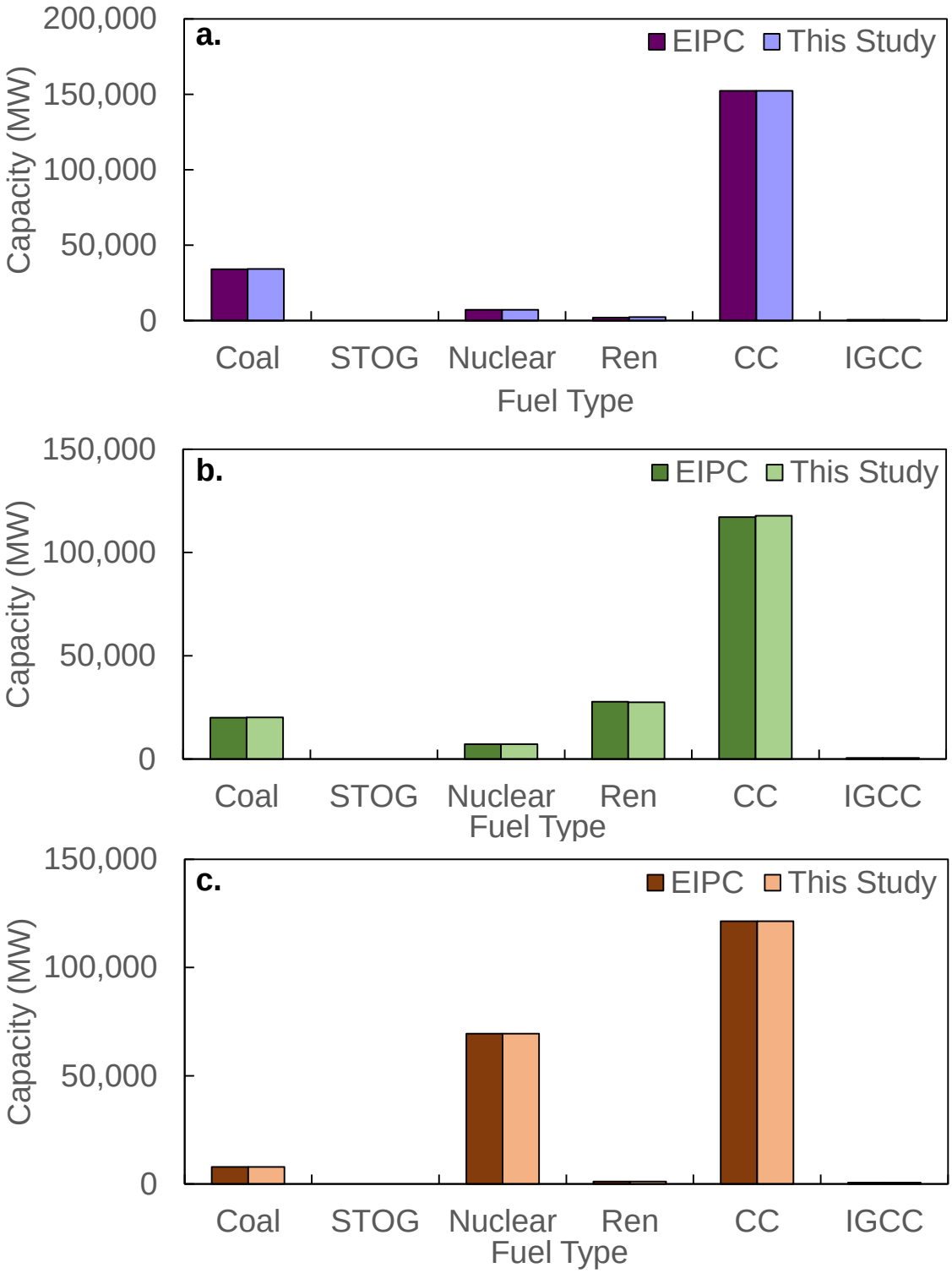

Figure 5. Total new build capacity estimated by the EIPC and total new build capacity in this study from 2011-2040 for **a.** F1S17 **b.** F6S10 **c.** F8S7

4.2.3. Total Capacity

For each future scenario, the percent difference of total capacity including all capacity in all EI NEEM regions for 2015 and 2040 was less than 5% except for F8S7 which had a 10.6% difference when comparing this study's 2040 capacity and the EIPC study's 2040 capacity. The total capacity by NEEM region in this study's data compared with the EIPC's data is shown in Appendix B for each future scenario. Appendix B also includes graphs of total capacity by fuel type for this study compared with the EIPC study. Total capacity by fuel type for all scenarios showed large differences of nearly 100,000 MW between STOG and CC which can be attributed to the EIPC predicting more CC and less STOG capacity than what was reported in the primary data set used for this study for 2010.

4.3 Objective 2 – Evaluating and Mapping Water Use by the Thermoelectric Sector

The USGS 2010 Thermoelectric Water Use data set included annual withdrawal values for existing power plants in million gallons per day (MGD). Thus estimated water withdrawal values only needed to be calculated for all new build capacity. To begin calculating amount of water withdrawn for the new build capacity on an individual power plant basis, the capacity was first converted to generation (G) as MWh by multiplying the power plant's reported capacity (C) in MW, a capacity factor (CF) and the hours (h) in a day (d) for 365 days. Existing plants had capacity factors listed in the primary data set, but new build capacity had to be assigned a capacity factor. This was done based on the fuel type at the plant. Capacity factors used by the EIPC for their study were derived from their data set using reported generation and reported capacity values and are stated in Table 5. Also shown in Table 5 are the average capacity factors which were calculated using the power plants existing within this study's primary data set. The most conservative capacity factor values were used for this study and are listed in Table 5. This

study defines conservative as the larger capacity factor values which would result in higher generation and greater withdrawals of water so as to not under-estimate withdrawals by each individual power plant.

Table 5. Capacity Factors by Fuel Type

Capacity Factors/Fuel Type	Coal	Gas Steam	Oil Steam	Nuclear	Renewables	Gas CC	Oil CC
Existing Plant Averages	0.482	0.230	0.121	0.877	0.552	0.301	0.024
2015 EIPC	0.746	0.034	0.034	0.889	0.336	0.536	0.536
2040 EIPC	0.847	0.043	0.043	0.889	0.74	0.548	0.548
2015 Conservative	0.746	0.232	0.121	0.889	0.552	0.536	0.536
2040 Conservative	0.847	0.232	0.121	0.889	0.74	0.548	0.548

$$G = C * CF * 365\ d * 24\frac{h}{d} \quad (1)$$

Once the generation of all capacity in 2010 and 2040 was calculated for each scenario, water withdrawal factors were used to calculate the amount of water withdrawn by each plant with new-build capacity based on their fuel type and amount of generation they produce. The water withdrawal factors used can be found in Table 4.

This data was used alongside HUC-8 watershed water availability data (Tidwell et al., 2015) in ArcGIS. A shapefile of the U.S. (ESRI n.d.), a shapefile of NEEM regions (Moreland, 2015), and a shapefile of HUC-8 watersheds (USGS 2000) were all used for mapping the data. The levels of accuracy for the data reported in this study will vary due to the use of multiple sources to derive, calculate, and estimate the values used. A sensitivity analysis was performed for one future to check the differences that may have occurred had the maximum or minimum water withdrawal factors been used instead of the median withdrawal factors that were assumed in this study. The sensitivity analysis can be found in section 5.3.

5. Results and Discussion

5.1. Capacity

Compared to the total thermoelectric capacity in 2010, the total thermoelectric capacity calculated for 2040 from this study increases by about 7.5% in F1S17 and shows a negligible 0.07% decrease in F6S10. F8S7 shows a large decline in the percent change in capacity at 36.5%. These values vary slightly from the EIPC estimates as explained previously and are shown in Table 6. The net change in capacity for each future scenario by NEEM regions was also mapped and are shown in Figure 6.

Table 6. This study's estimated capacity and capacity changes for F1S17, F6S10 and F8S7

Future Scenario	2010 Capacity (MW)	2011-2040 New Build Capacity (MW)	2011-2040 Retired Capacity (MW)	2011-2040 Net Change in Capacity (MW)	2040 Capacity (MW)	Percent Change in Capacity from 2011-2040 (%)
F1S17	568,709	199,308	156,734	42,574	611,283	7.49
F6S10	568,709	176,289	176,689	-400	568,309	-0.07
F8S7	568,709	201,751	409,632	-207,881	360,828	-36.55

Fuel distribution in 2040 for the three future scenarios varied as shown in Figure 7. All three futures showed a reduction in the percent of thermoelectric capacity coming from coal-fired power plants. However, while F1S17 and F6S10 had only slight decreases projected for coal, F8S7 showed a dramatic decrease to only about 12.7% capacity from coal compared to the 48% capacity due to coal in 2015 for BAU F1S17. STOG remained fairly consistent for all three scenarios in 2040, only decreasing slightly in F1S17 and F6S10 and increasing slightly in F8S7 from 24.4% to 26.9%. About half of the nuclear capacity was estimated to survive by 2040 in F1S17 and F6S10 while F8S7 estimated that nuclear capacity would be almost doubled by 2040.

CC capacity increased by 2040 for all three future scenarios and thermoelectric renewables did not show much difference by 2040 except for F6S10 which estimated a 5% increase.

Overall, F1S17 and F6S10 had many similarities in fuel distribution projected for 2040. F8S7 was very different, projecting a decrease in coal capacity from 48.3% to 12.7% and an increase in nuclear from 16.8% to 31.5%.

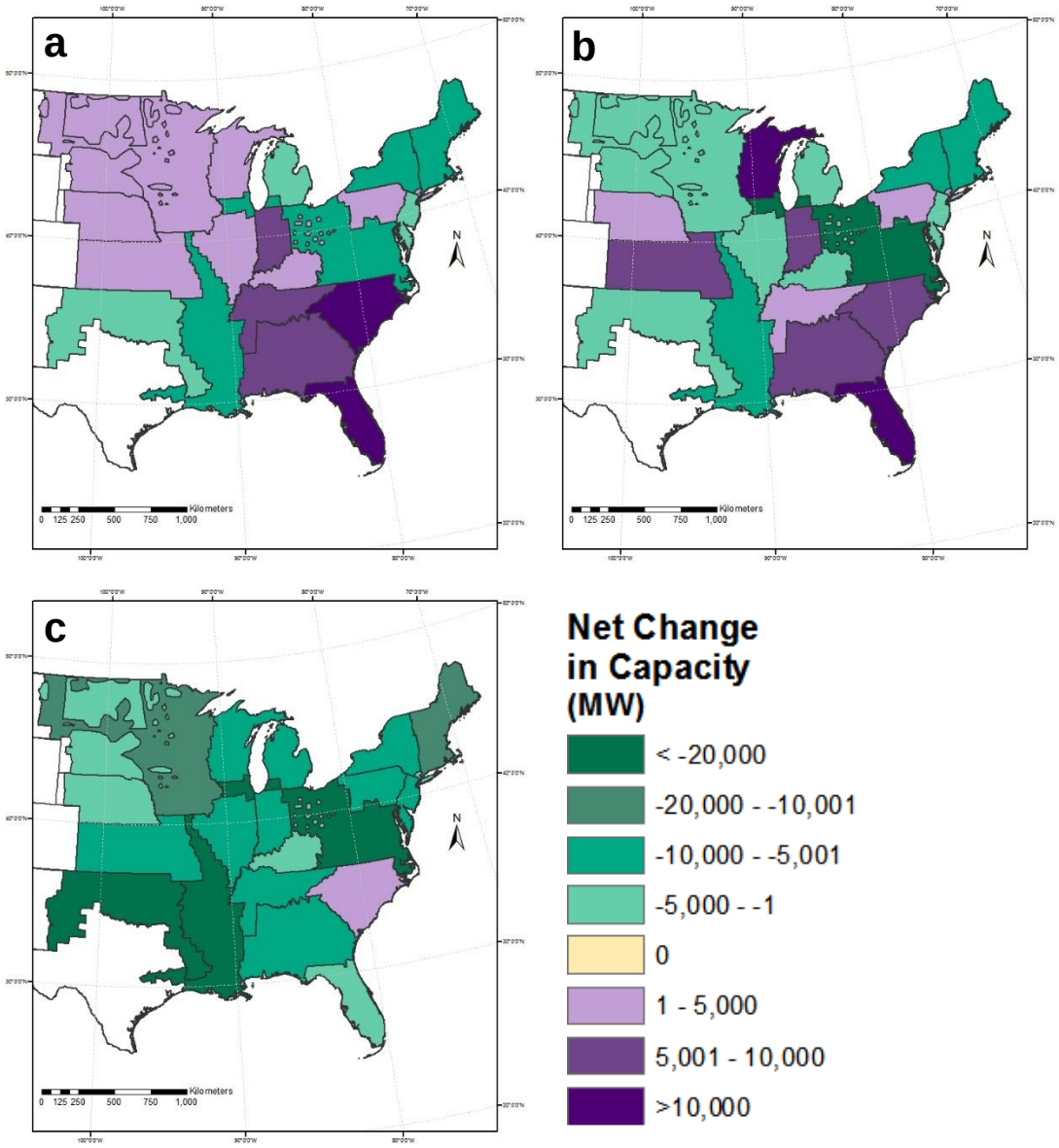

Figure 6. This study's total estimated net change in capacity (MW) by NEEM region after attempting to match the EIPC's capacity projections through 2040 for **a.** F1S17 **b.** F6S10 **c.** F8S7

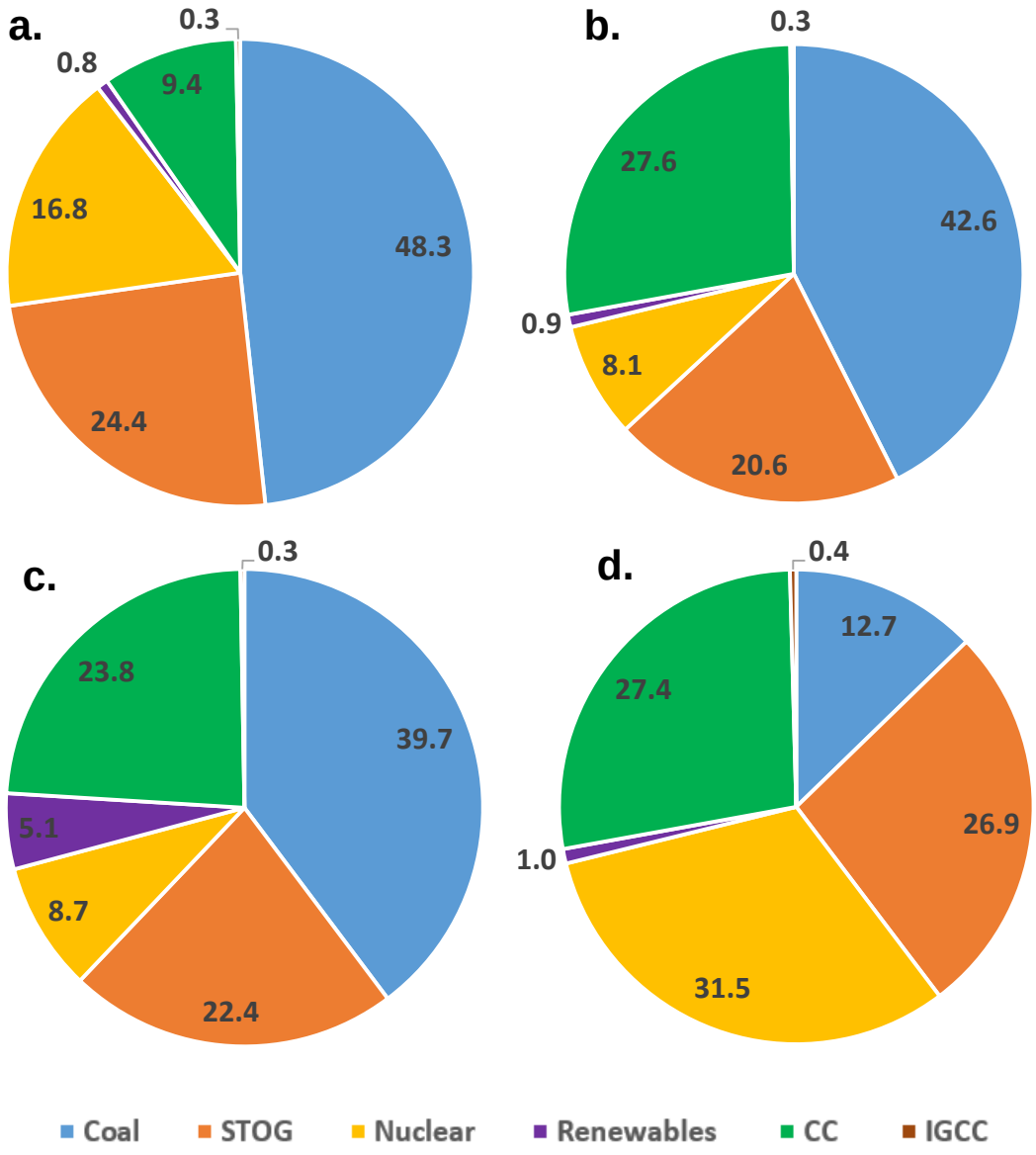

Figure 7. Percent fuel distribution for total thermoelectric capacity in **a.** 2015 F1S17 BAU scenario **b.** 2040 F1S17 **c.** 2040 F6S10 **d.** 2040 F8S7

5.2 Water Withdrawals

Water withdrawals (WW) in gallons per day annually were calculated using equation 2 which included the generation (G) in MWh for each plant and the median water withdrawal factors (WF) in gallons per MWh found in Table 4 for the respective plant fuel type assuming that the new build capacity would use recirculating cooling systems. It is assumed that all new build thermoelectric power plants will use recirculating cooling systems and the water withdrawal factors represent that assumption.

$$G * WF = WW \quad (2)$$

The net change in amount of water withdrawn from 2011-2040 varied between all three future scenarios studied and is shown in Table 7. F1S17 and F6S10 both showed similar decreases reporting net changes in withdrawals of -46,126 MGD and -51,476 MGD from 2011 to 2040 while F8S7 yielded a much larger decrease in the amount of water withdrawn from watersheds in the EI of the U.S. F8S7 reported a net change in water withdrawals of -86,984 MGD from 2011-2040.

Table 7. Water withdrawn due to thermoelectric capacity from 2011-2040 for each future scenario including water withdrawn for all new build capacity, water no longer being withdrawn due to capacity being retired, and the net change between the new build capacity withdrawals and the retired capacity withdrawals.

Future Scenario	New Build Withdrawals (MGD)	Retired Withdrawals (MGD)	Net Change in Withdrawals (MGD)
F1S17	1,434	47,560	-46,126
F6S10	1,643	53,119	-51,476
F8S7	2,000	88,984	-86,984

The net decrease in future water withdrawals could be attributed to a few different factors. The large decrease in total thermoelectric capacity in the U.S. part of the EI for F8S7 helps to explain why the water use for this future scenario had such a dramatic decrease. With a great deal less thermoelectric capacity comes less need to withdraw water for thermoelectric use. While F6S10 showed a very small change in capacity, F1S17 showed an increase in total thermoelectric capacity but still had a reduction in the amount of water withdrawn by 2040. This is due to an increase in the utilization of more efficient cooling systems by the thermoelectric industry in the future. All new build capacity was assumed to have recirculating cooling systems, thus the amount of water withdrawn by these new builds is much less than the amount of water that was being withdrawn by the older plants.

Although the overall water withdrawals for each future scenario saw declines through 2040, some specific HUC-8 watersheds showed increased water withdrawals. Water withdrawals for each future scenario due to new build thermoelectric capacity and water no longer being withdrawn due to retired thermoelectric capacity (retired withdrawals) were mapped and can be seen for each HUC-8 watershed containing thermoelectric capacity in Figure 8 and Figure 9. F8S7 shows a few more watersheds with a greater increase in water withdrawals than F1S17 and F6S10. However, F8S7 also has a great deal more watersheds with water no longer being used due to retired capacity.

The net change in withdrawals (new build withdrawals minus retired withdrawals) for each future scenario by HUC-8 watersheds is shown in Figure 10. The largest increases in withdrawals due to thermoelectric power for this data set are shown as the red-colored watersheds and they occur in F8S7 for HUC-8 watersheds in Georgia (3060108-GA and 3070202-GA) and Tennessee

(6020001-TN). The large increase in net change in water withdrawals for these watersheds can be attributed to the increase in nuclear capacity for F8S7 in the TVA and SOCO NEEM regions. Another watershed with a predicted net change of greater than 100 MGD by 2040 was predicted for F6S10 in Michigan (4020105-MI). This large increase in water use is due to all of the new build CC capacity for MISO WUMS being distributed to a power plant that was retired in this watershed. Thus, this is attributed to the way the new build capacity was distributed in this study's method. It is not likely that all new build CC capacity would be added to a single location such as was done in this study.

Other watersheds showing large net increases in water withdrawals are presented as a dark orange color. For F1S17 and F6S10, these watersheds appear in Mississippi (MS) and Kansas (KS); both states have been shown to have water shortage potential and issues in the past (MSN 2010; USGS 2015). F8S7 also shows watersheds in the VACAR region (North Carolina and South Carolina) as having large net increases in water withdrawals. These, much like the watersheds in Georgia and Tennessee, can be attributed to new build nuclear capacity for the region being assigned to existing nuclear power plants rather than building a new nuclear plant in a separate watershed.

In the following maps, HUC-8 watersheds that are not colored are either watersheds not included in the EI (far West and most Texas watersheds) or are watersheds in the EI that do not have thermoelectric capacity located within them.

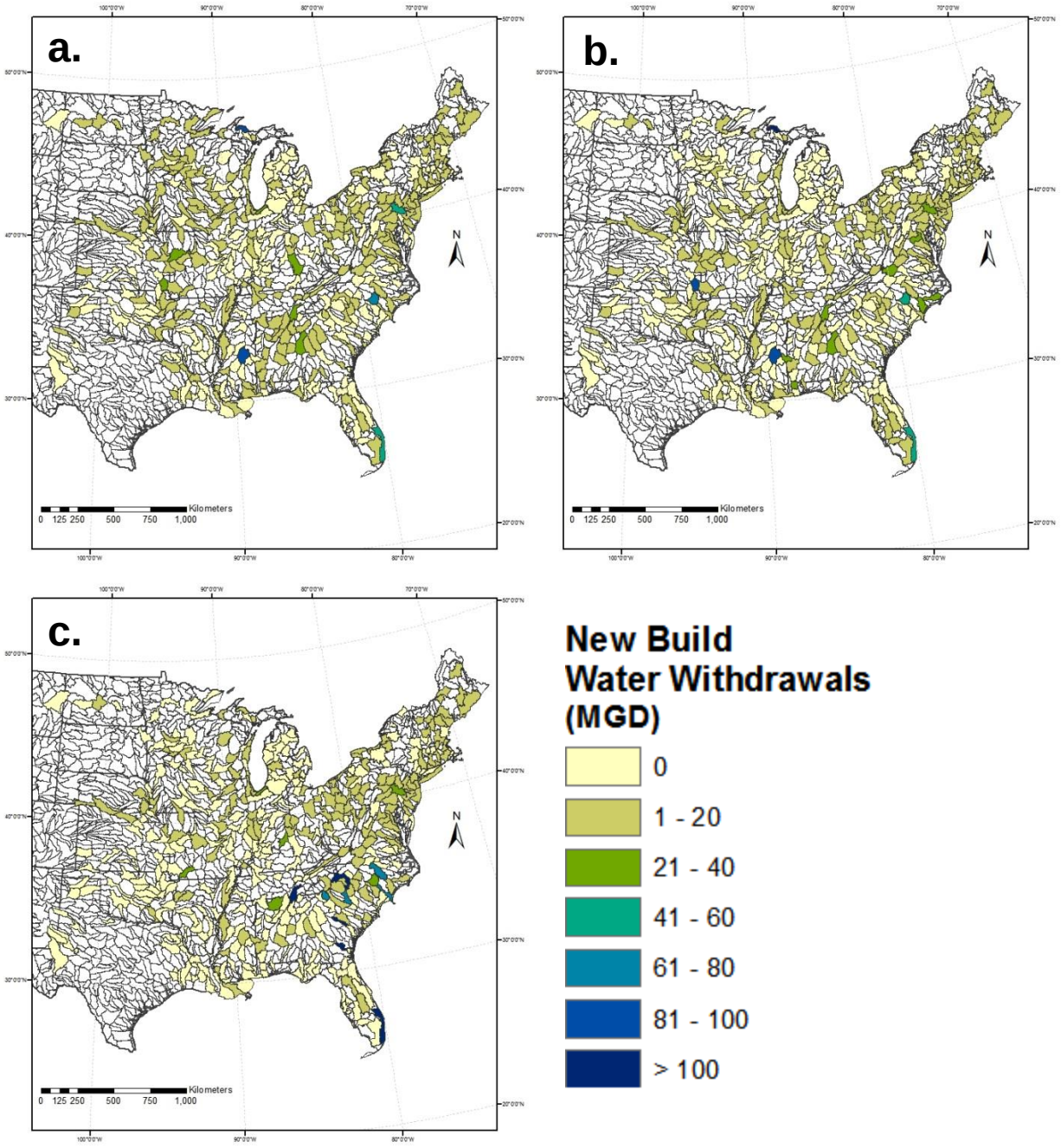

Figure 8. Water withdrawals (MGD) due to new thermoelectric capacity built between 2011-2040 by HUC-8 watersheds for **a.** F1S17 **b.** F6S10 **c.** F8S7

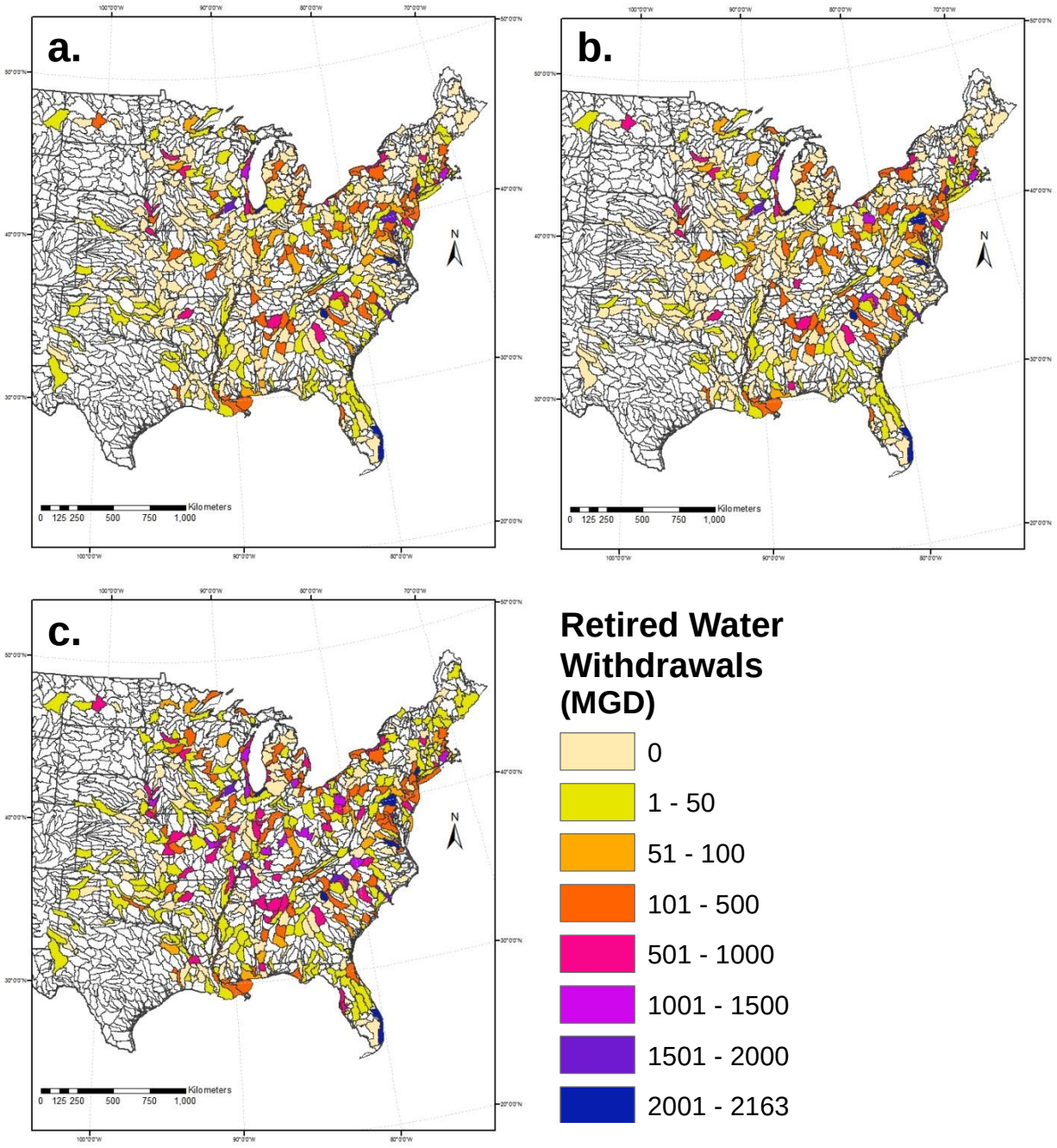

Figure 9. Water no longer being withdrawn (MGD) due to retired thermoelectric capacity between 2011-2040 by HUC-8 watershed for **a.** F1S17 **b.** F6S10 **c.** F8S7

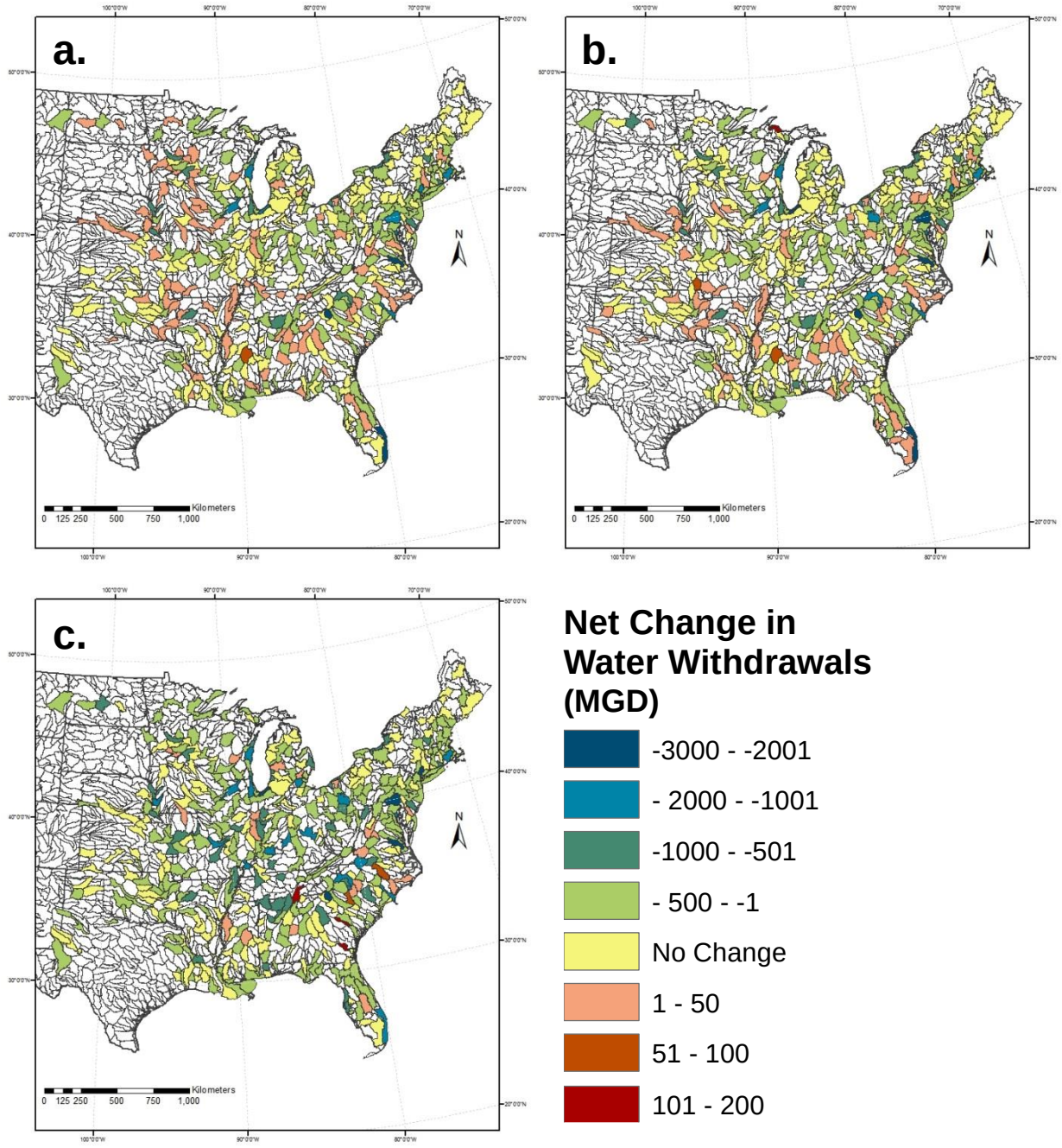

Figure 10. Net change (new build capacity withdrawals – retired capacity withdrawals) in amount of water withdrawn (MGD) between 2011-2040 by HUC-8 watersheds for **a.** F1S17 **b.** F6S10 **c.** F8S7. Colors representing negative values denote watersheds that would experience a decrease in water withdrawn while positive values signify increases in amount of water withdrawn for the placement of power plants in this study.

Water availability was reported by Sandia National Laboratories in terms of acre-foot per year (AFY) by HUC-8 watersheds for unappropriated surface water, potable ground water, wastewater and brackish groundwater (Tidwell et al., 2015). The methodology for determining water availability was similar to what was reported previously for the western U.S. (Tidwell et al., 2014). The availability data for each of these water types in the eastern U.S. was mapped using GIS and can be seen in Figure 11. Fresh water availability (including unappropriated surface water and potable groundwater) and total water availability were also mapped and are shown in Figure 12.

The water availability data by HUC-8 watersheds was used alongside the calculated water withdrawals for each HUC-8 watershed in order to determine the percent of available water that would be withdrawn for use by thermoelectric capacity in each future scenario. This was done for both fresh water as shown in Figure 13 and total water available as shown in Figure 14.

Nearly all of the watersheds show that less than 10% of the water available is withdrawn for thermoelectric use. Seven watersheds in the EI (most of which were located in Florida) reported no fresh water available, thus power plants requiring water in these areas must use other water types available. The water withdrawals for these watersheds are graphed in Figure 15 and Figure 16. A few watersheds reported larger than 10% withdrawals of total water available and are identified in Table 8. All watersheds and their reported water use percentages can be found in Appendix D for each future scenario. Figure 17 shows graphs of the water availability and water withdrawal needs by future scenario for watersheds reporting greater than 10% water withdrawals of total water available that are not already graphed in Figures 15 and 16. Figures 15, 16, and 17 include some bars representing water that will no longer be withdrawn due to retired power plants. This reported water no longer being withdrawn was not added to the amount of water available in this study.

The watersheds reporting larger than 10% of available water projected to be withdrawn by net new thermoelectric capacity had high water withdrawal percentages due to 1) the method used for distribution of new capacity and/or 2) no fresh water available.

For the watersheds with fresh water available, the high percentage of water withdrawals reported can be attributed to the new capacity distribution method. Both watersheds in Georgia (GA), 3060108 and 4020105 show high water withdrawals due to an increase in nuclear capacity in F8S7. The new nuclear capacity was distributed to already existing plants and thus high water withdrawals are projected for those areas. Similarly, a watershed in Michigan (MI), 4020105, saw an increase in water withdrawals due to all new build CC capacity for its NEEM region being added to a single retired power plant location in that watershed.

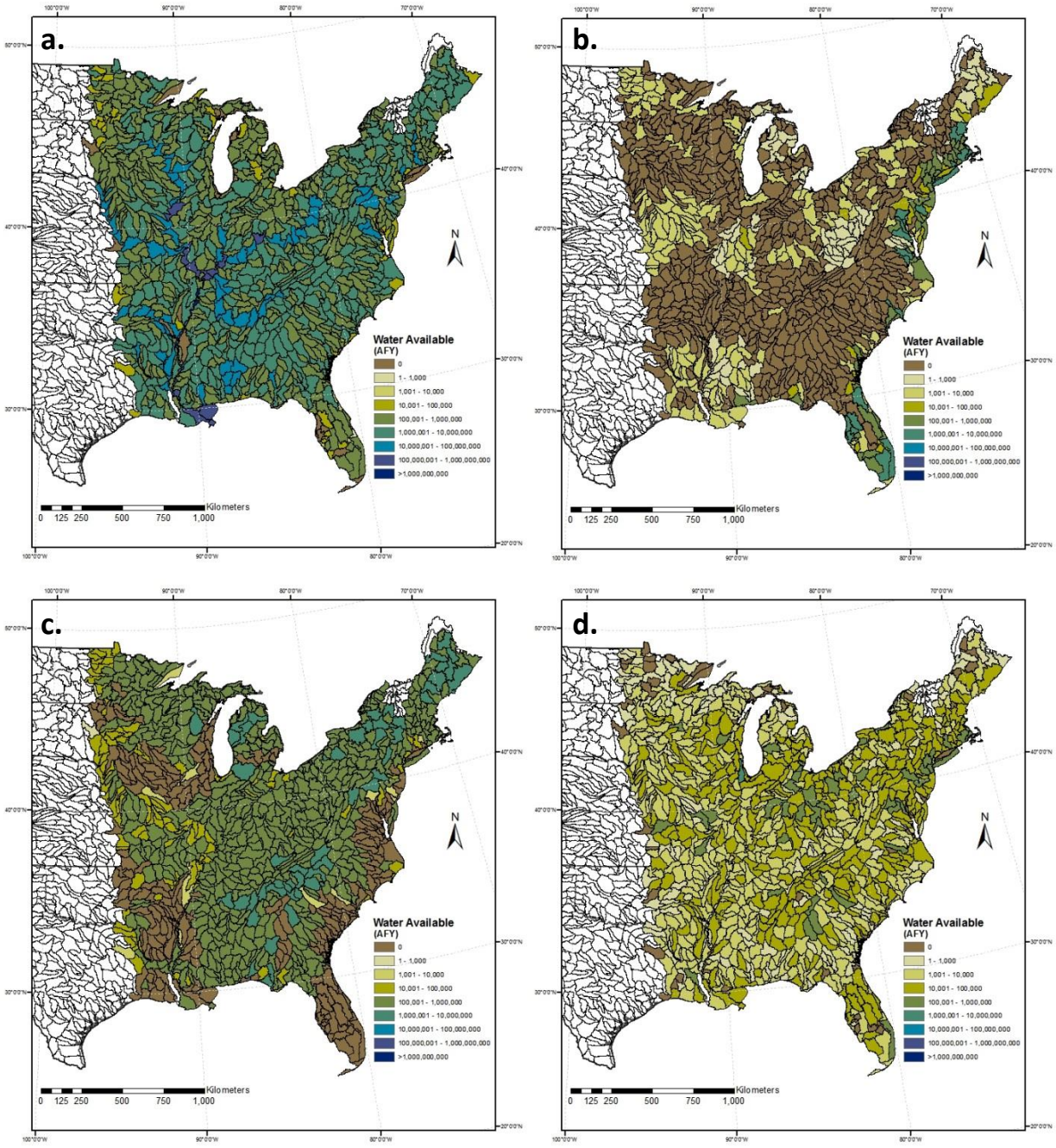

Figure 11. Water available (AFY) for use in HUC-8 watersheds of the Eastern Interconnection of the U.S. for different water types: **a.** Unappropriated surface water available for use **b.** Brackish groundwater available for use **c.** Potable groundwater available for use **d.** Wastewater available for use.

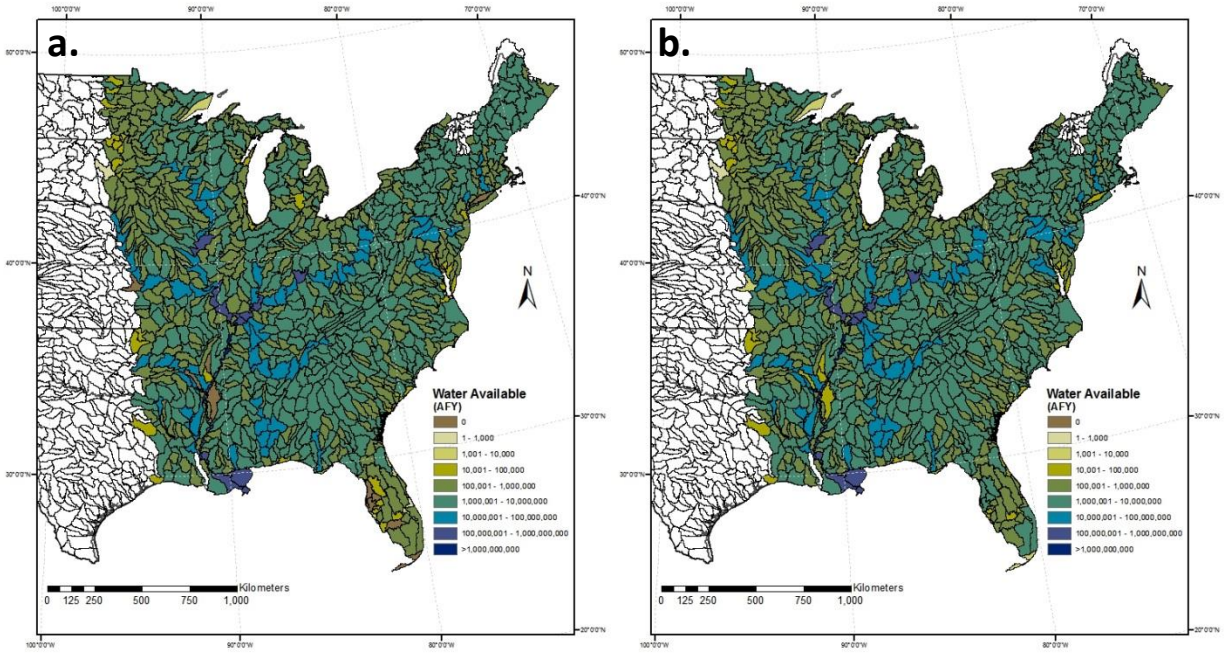

Figure 12. Water available (AFY) for use by HUC-8 watersheds in the Eastern Interconnection of the U.S.: **a.** Available fresh water (unappropriated surface water + potable ground water) **b.** Total water available (unappropriated surface water + potable ground water + brackish ground water + wastewater).

Table 8. Percent of total water available projected to be withdrawn due to net new thermoelectric capacity built between 2011-2040 for HUC-8 watersheds reporting greater than 10% withdrawals from total water available in the watershed.

Future Scenario	HUC-8 Watershed	State	Percent of water projected to be withdrawn
F1S17	10270104	KS	27.58
F1S17	8030207	MS	52.33
F6S10	10270104	KS	27.58
F6S10	4020105	MI	16.49
F6S10	8030207	MS	40.17
F8S7	3060108	GA	26.15
F8S7	3070202	GA	52.80
F8S7	8030207	MS	30.48

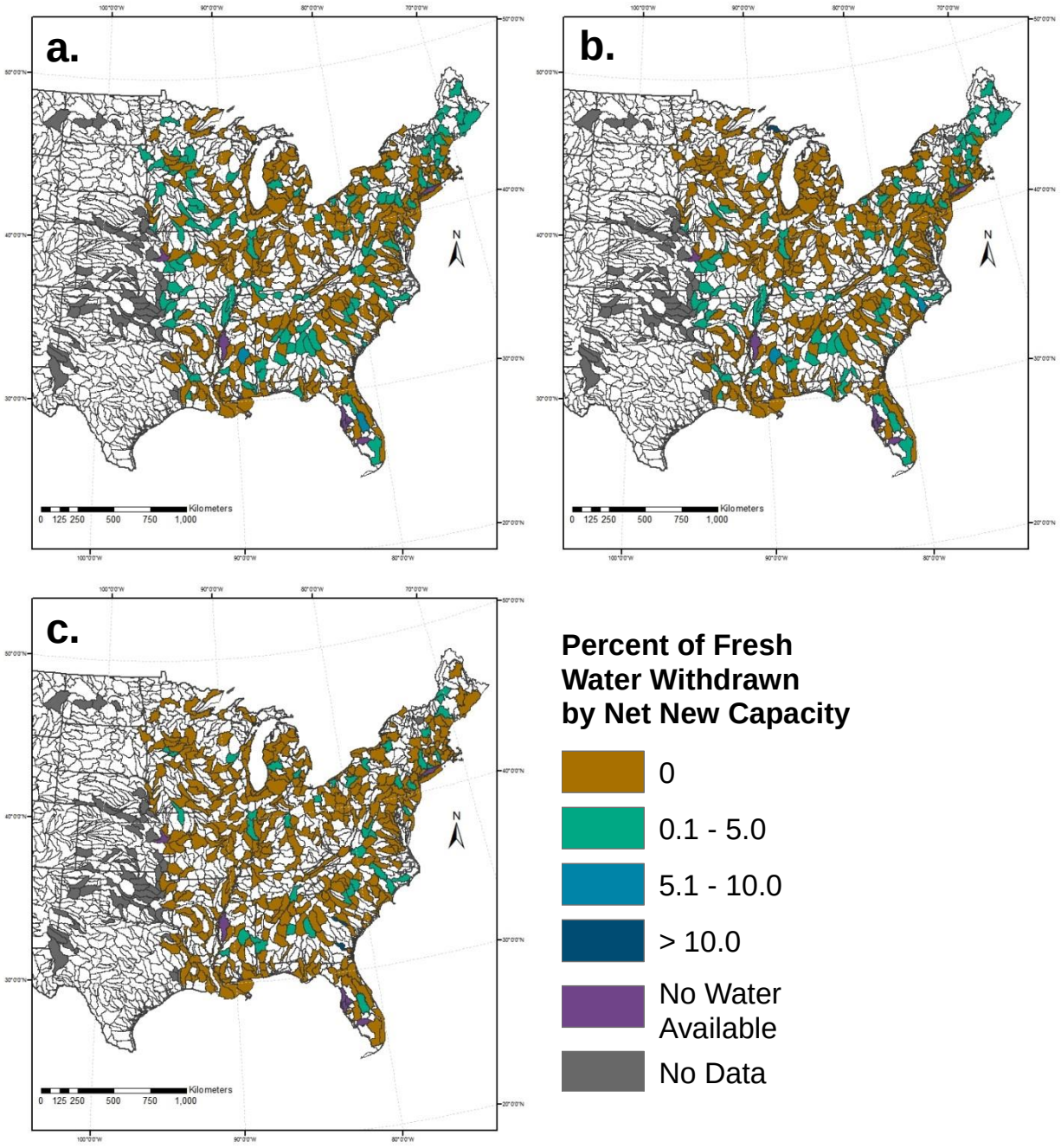

Figure 13. Percent of available fresh water withdrawn due to net new capacity (availability of brackish groundwater and wastewater is not considered here) for **a.** F1S17 **b.** F6S10 **c.** F8S7.

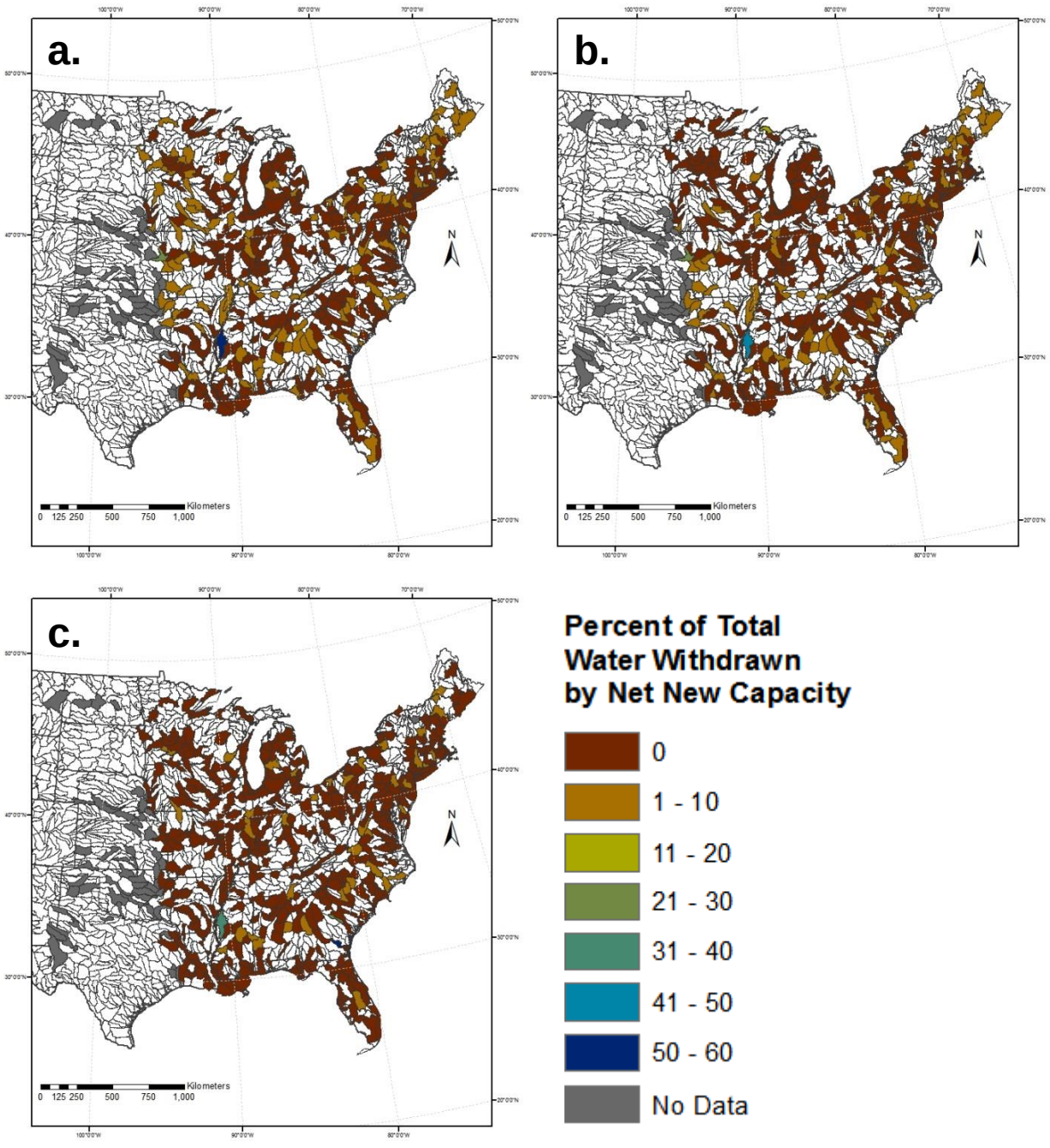

Figure 14. Percent of total water available withdrawn by net new thermoelectric capacity for **a.** F1S17 **b.** F6S10 **c.** F8S7.

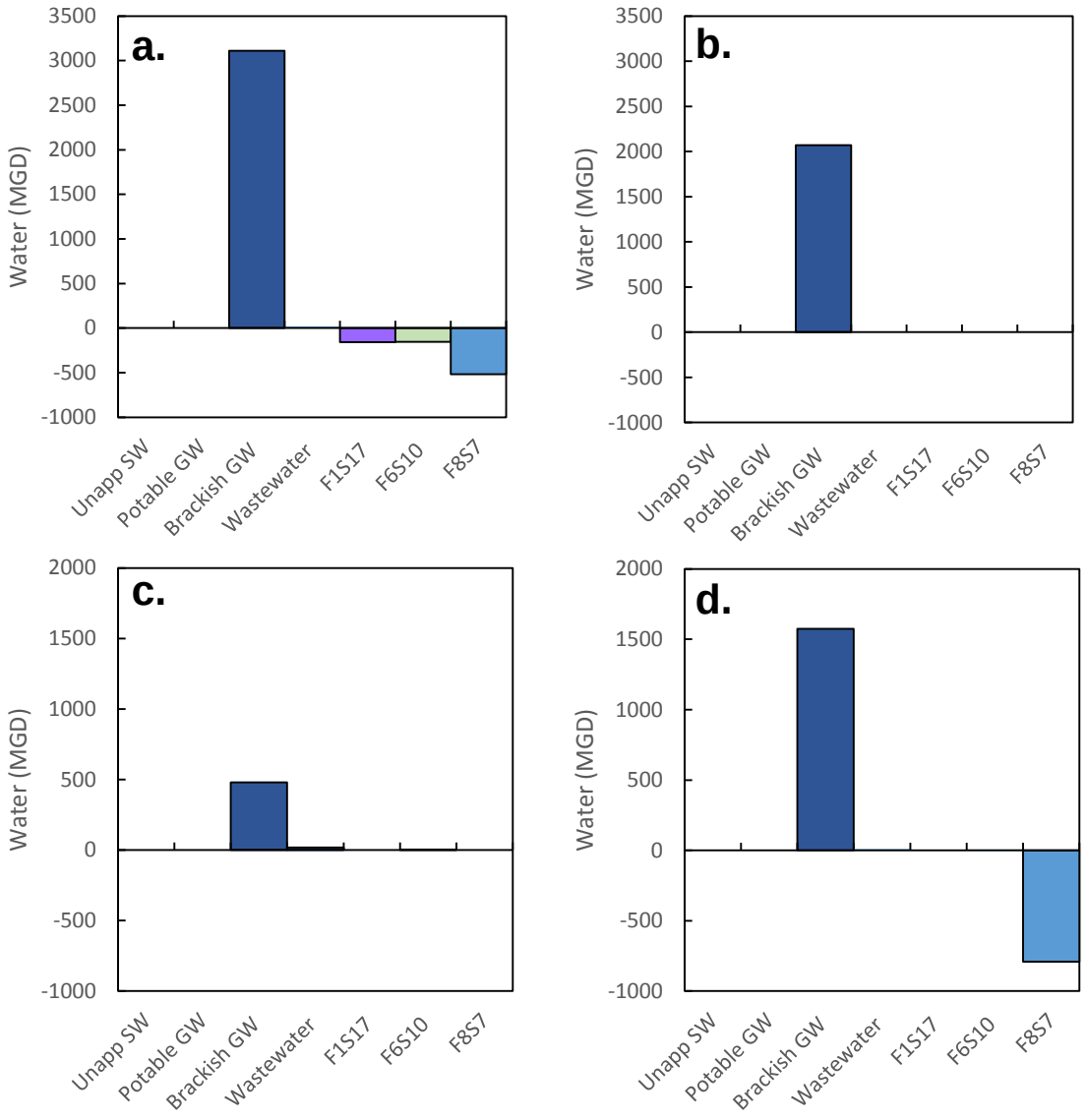

Figure 15. Water availability (unappropriated surface water, potable ground water, brackish ground water, and wastewater) and amount of water projected to be withdrawn (MGD) for F1S17, F6S10 and F8S7 for watersheds in Florida reporting no fresh water availability: **a.** HUC-8 watershed 3100207-FL **b.** HUC-8 watershed 3100205-FL **c.** HUC-8 watershed 3090205-FL **d.** HUC-8 watershed 3100206-FL.

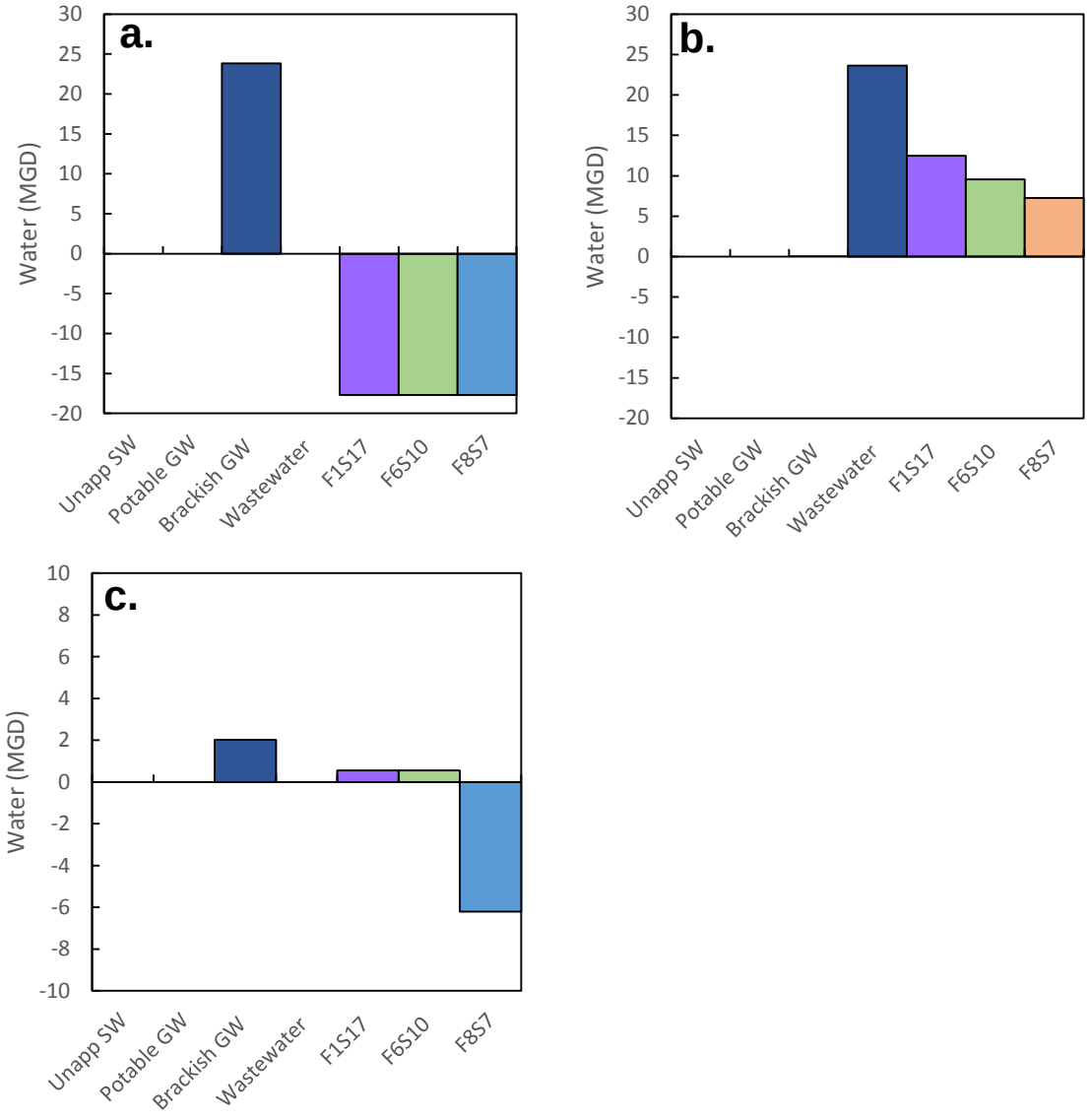

Figure 16. Water availability (unappropriated surface water, potable ground water, brackish ground water, and wastewater) and amount of water projected to be withdrawn (MGD) for F1S17, F6S10 and F8S7 for other watersheds in the EI of the U.S. reporting no fresh water availability: **a.** HUC-8 watershed 2030203-CT **b.** HUC-8 watershed 8030207-MS **c.** HUC-8 watershed 10270104-KS.

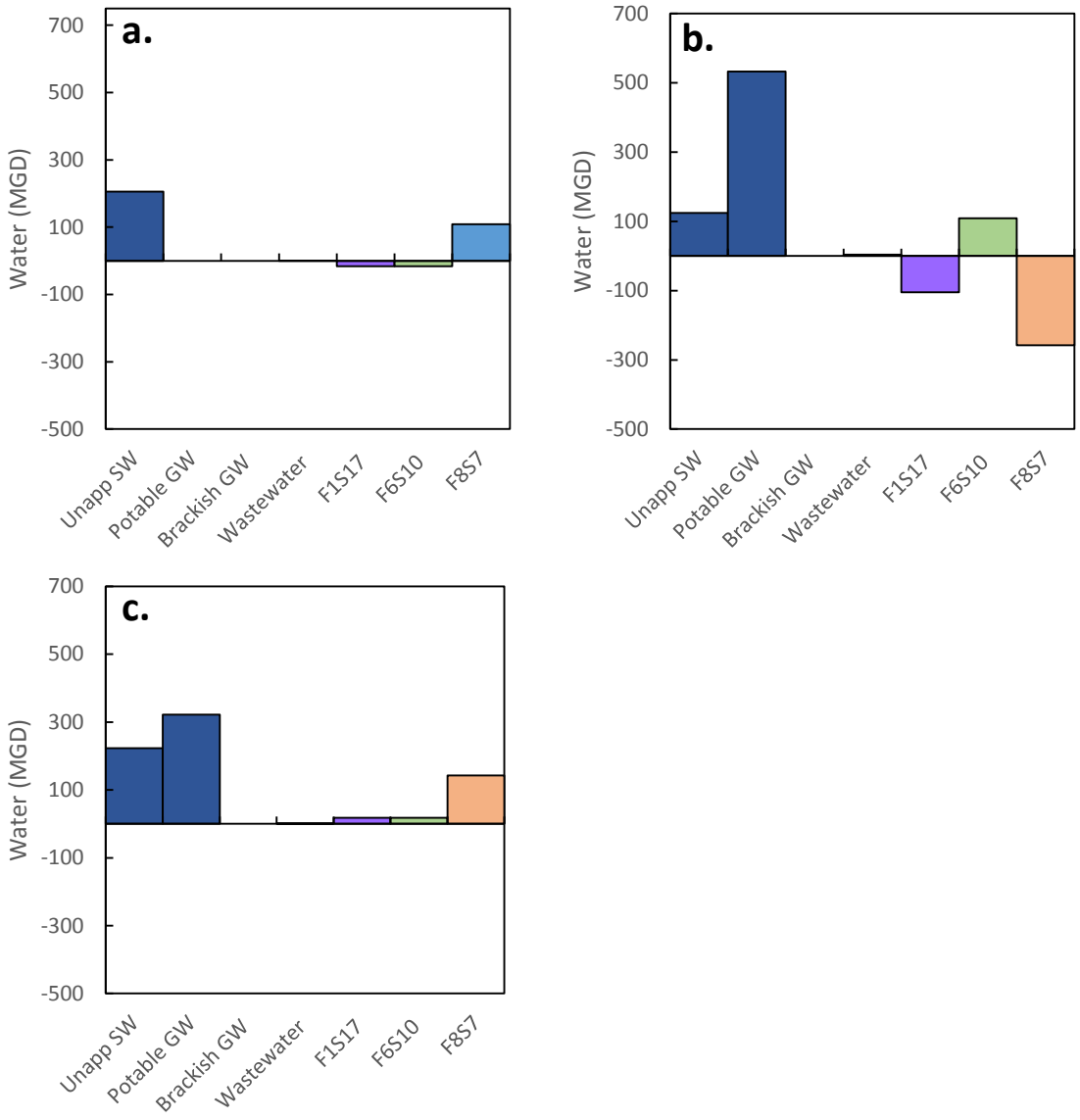

Figure 17. Water availability (unappropriated surface water, potable ground water, brackish ground water, and wastewater) and amount of water projected to be withdrawn (MGD) for F1S17, F6S10 and F8S7 for watersheds with high percentage of withdrawals to water available in the EI of the U.S.: **a.** HUC-8 watershed 3070202-GA **b.** HUC-8 watershed 4020105-MI **c.** HUC-8 watershed 3060108-GA.

5.3 Sensitivity Analysis

A sensitivity analysis was done for F1S17 to evaluate how this study may have varied had the maximum or minimum withdrawal factors from Table 4 been used in place of the median withdrawal factors for this study. Table 9 lists the total new build, retired, and net change in withdrawals for thermoelectric power in the entire EI using the reported minimum, median, and maximum withdrawal factors from Table 4. Retired withdrawals did not change because they were calculated using the individual power plant's water use information; only the water withdrawals for new build thermoelectric generation were calculated using the minimum, median, and maximum withdrawal factors listed in Table 4. In other words, existing plant water withdrawals are known, not estimated; only withdrawals for future new plants needed to be estimated. It is noteworthy that when taking the entire EI into consideration, as done for Table 9, the withdrawal factor assumption does not greatly affect the net change in total water withdrawn; there is only a 2.3% difference between the min and max assumptions. This is because the water no longer being withdrawn due to retired plants is far larger than the new build withdrawals.

Table 9. Total withdrawal values for the entire EI through 2040 using the F1S17 future scenario and comparing the total calculated withdrawals using minimum, median, and maximum withdrawal factors (WF).

WF Assumption	New Build WD (MGD)	Retired WD (MGD)	Net Change in WD (MGD)
Min.	854.89	47,560.07	-46,705.18
Med.	1,434.22	47,560.07	-46,125.84
Max.	1,936.10	47,560.07	-45,623.97

Even though the water withdrawals for the entire EI are not greatly affected by the withdrawal factor assumption, individual watersheds may be affected; these are watersheds where large amounts of new build capacity are projected. The minimum, median, and maximum water withdrawal values in MGD for ten watersheds with the largest water withdrawn due to new builds through 2040 are graphed in Figure 18. The watershed with the greatest variability was 3180001

(in Mississippi) with a 65 MGD difference in withdrawal between min and max factor assumptions. The second most variable watershed was 6020001 (in Tennessee) with a 60 MGD difference. These withdrawal variabilities are 3% and ~0% of the total water available in these two watersheds. This is encouraging because the min and max assumptions are the best estimates of the best and worst-case water withdrawal scenarios, respectively. Even though the numbers look quite different in Figure 18, the actual impact on the future water withdrawals is small. What is less obvious in this analysis is that watershed 8030207 (in Mississippi) is a location where the variability is small (8 MGD) between max and min, but the water available is only 24 MGD; thus the variability is 33% of the availability. This watershed was discussed above as being of interest, but it is worth noting again here. Future work should focus on that watershed (and the other highly impacted watersheds discussed above) to ensure that the withdrawal factors and availability numbers are accurate.

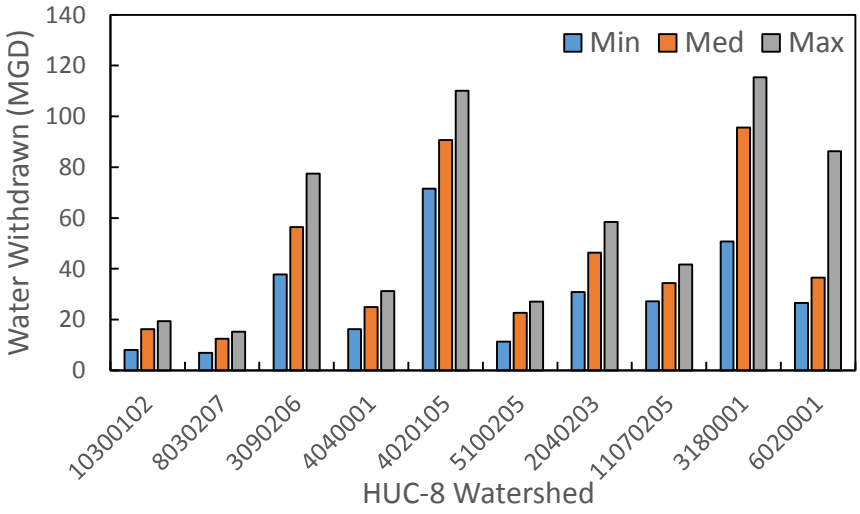

Figure 18. Minimum, median, and maximum water withdrawals (MGD) due to new build capacity for ten different watersheds in the EI through 2040.

With regard to the sensitivity analysis a question arises as to the reasons for the variability between min, median, and max withdrawal factors. On one level, these differences can be attributed to the fuel types being utilized in each specific watershed. Certain fuel types have wider ranges between their water withdrawal factors which then carries over into the calculated amount of water withdrawn. For example, HUC-8 watershed 3180001 is comprised of coal and gas CC power plants. The water withdrawal factors listed in Table 4 show that the minimum and median withdrawal factors for coal with recirculating cooling systems differ by 505 gal/MWh while the difference between the median and maximum withdrawals only have a 195 gal/MWh difference. This helps to explain why the median withdrawal value is closer to the maximum value than the minimum value for HUC-8 watershed 3180001 in Figure 18. Similarly, HUC-8 watershed 6020001 shows median water withdrawal values reporting closer to the minimum rather than the maximum withdrawal values in Figure 18. This watershed is comprised of nuclear power and Table 4 shows that the median withdrawal factor for nuclear power plants with recirculating cooling systems only differs from the minimum withdrawal factor by 301 gal/MWh while it differs from the maximum withdrawal factor by over 1,499 gal/MWh. Thus, these trends are carried through and can be seen in Figure 18 for water withdrawals in MGD.

On a deeper level, there remains a question as to the reason for variability in withdrawal factors within the fuel-type categories. One explanation may be that plants in different regions—even if they have the same fuel type—have cooling waters with different temperatures. When only warm water is available, more withdrawals are required to achieve the same heat removal that would be achieved with cooler waters. There are certainly other causes of variability to consider; some of these are explained in the publication from which the water withdrawal factors were obtained (Macknick et al., 2012).

6. Conclusion

Thermoelectric capacity will grow by 2040 unless more firm policies are put in place such as in F6S10 or F8S7. While total water withdrawals in the EI due to thermoelectric power are not expected to increase (due to more efficient technologies and the greater use of recirculating cooling systems), some watersheds of the EI, such as Kansas and Mississippi, may still experience increasingly high water withdrawals for thermoelectric use. Roughly 7 watersheds in the EI of the U.S. reported having no fresh water available for use from 2011-2040, most of which were located in Florida. These areas should be avoided for new build thermoelectric power plants unless they are willing to use brackish water or wastewater that is available.

Overall, the distribution of new capacity in this study yielded 2 watersheds at-risk of over 10% withdrawal of total water available in the Eastern Interconnection for F1S17, and 3 watersheds at risk of over 10% withdrawal of total available water for both F6S10 and F8S7. Most watersheds containing thermoelectric power plants showed projections of less than 10% of the available water withdrawn for thermoelectric use. While 10% may not seem substantial, it is important to note that the available water in each watershed will have various other sectors using it as well. Thus, the thermoelectric industry must carefully consider other sectors' needs for water when planning future capacity as the availability of water in some areas may not be sustainable for multiple sector use and competition for the water could occur. With careful siting of future thermoelectric capacity, the EI appears to have enough water available to support the future of thermoelectric capacity based on all three future scenarios investigated.

7. Future Work

This study was the beginning of a larger effort and as such, there are many areas of this work that could be further developed and investigated through future research. The first and probably most obvious enhancement to this research would be the inclusion of water consumption estimates due to thermoelectric power alongside the water withdrawals estimated in this study. While water withdrawals were estimated to decrease in this study, water consumption will most likely increase due to the use of recirculating cooling systems. Therefore, the changes in future water consumption due to thermoelectric use should be explored.

Median withdrawal factors were assumed for this study. To identify watersheds that may experience high water withdrawals in the worst-case scenario, an analysis using the maximum water withdrawals should be completed. Minimum water withdrawal factors could also be used to analyze the best-case scenario for water withdrawals in the EI.

The new build capacity in this study was placed where there is or was existing capacity and capacity was retired based on the oldest plants with the lowest capacity factors. Thus, the locations of the new capacity in this study are only an initial estimate of where the capacity may be placed based on historical positions of capacity within each NEEM region. To enhance this study, more accurate siting of new thermoelectric capacity should be completed. With proper siting of new thermoelectric capacity based on river and lake locations, other industries, etc., this research could be a supportive aid for both transmission planners as well as local and state governments to ensure that new capacity is built in areas that can support it, and to keep water stressed areas free of increasing use.

This work only investigates watersheds at risk due to thermoelectric capacity growth and does not consider whether there is enough water available for multiple uses such as agriculture

and drinking water. The results from this study should be incorporated in a broader investigation of multiple users of water in the eastern U.S. to identify areas where competition over water may become an issue.

Finally, this work could be improved upon by accounting for predicted changes in precipitation patterns as well as changes in groundwater availability through the next few decades due to continued use of the resource.

APPENDICES

Appendix A

Additional Retired and New Build Capacity Data

Table A-10. This Study's Retired Capacity (MW) versus the EIPC study's retired capacity (MW) by fuel type for each future scenario from 2011-2040.

Fuel Type	F1S17 This Study's Retired Capacity	F1S17 The EIPC Study's Retired Capacity	F1S17 % Error	F6S10 This Study's Retired Capacity	F6S10 The EIPC Study's Retired Capacity	F6S10 % Error	F8S7 This Study's Retired Capacity	F8S7 The EIPC Study's Retired Capacity	F8S7 % Error
Coal	73377	74189	1.09	94169	94188	0.02	260832	262078	0.48
STOG	35272	35484	0.60	34469	34396	0.21	65213	67809	3.83
Nuclear	45711	45814	0.23	45946	45814	0.29	45946	45814	0.29
Ren	0	668	100	0	0	0	694	695	0.15
CC	2373	2376	0.15	2104	2104	0.01	36945	46486	20.52
IGCC	0	0	0	0	0	0	0	0	0
Sum	156733	158532	1.13	176687	176502	0.10	409630	422881	3.13

Table A-11. This Study's New Build Capacity (MW) versus the EIPC study's new build capacity (MW) by fuel type for each future scenario from 2011-2040.

Fuel Type	F1S17 This Study's New Build Capacity	F1S17 The EIPC Study's New Build Capacity	F1S17 % Error	F6S10 This Study's New Build Capacity	F6S10 The EIPC Study's New Build Capacity	F6S10 % Error	F8S7 This Study's New Build Capacity	F8S7 The EIPC Study's New Build Capacity	F8S7 % Error
Coal	34264	34157	0.31	20241	20135	0.53	7859	7859	0
STOG	0	0	0	0	0	0	0	0	0
Nuclear	7271	7271	0	7271	7271	0	69376	69376	0
Ren	2354	2111	11.53	27502	27763	0.94	1184	1183	0.08
CC	152294	152294	0	117839	117189	0.55	121413	121413	0
IGCC	618	618	0	618	618	0	618	618	0
Sum									

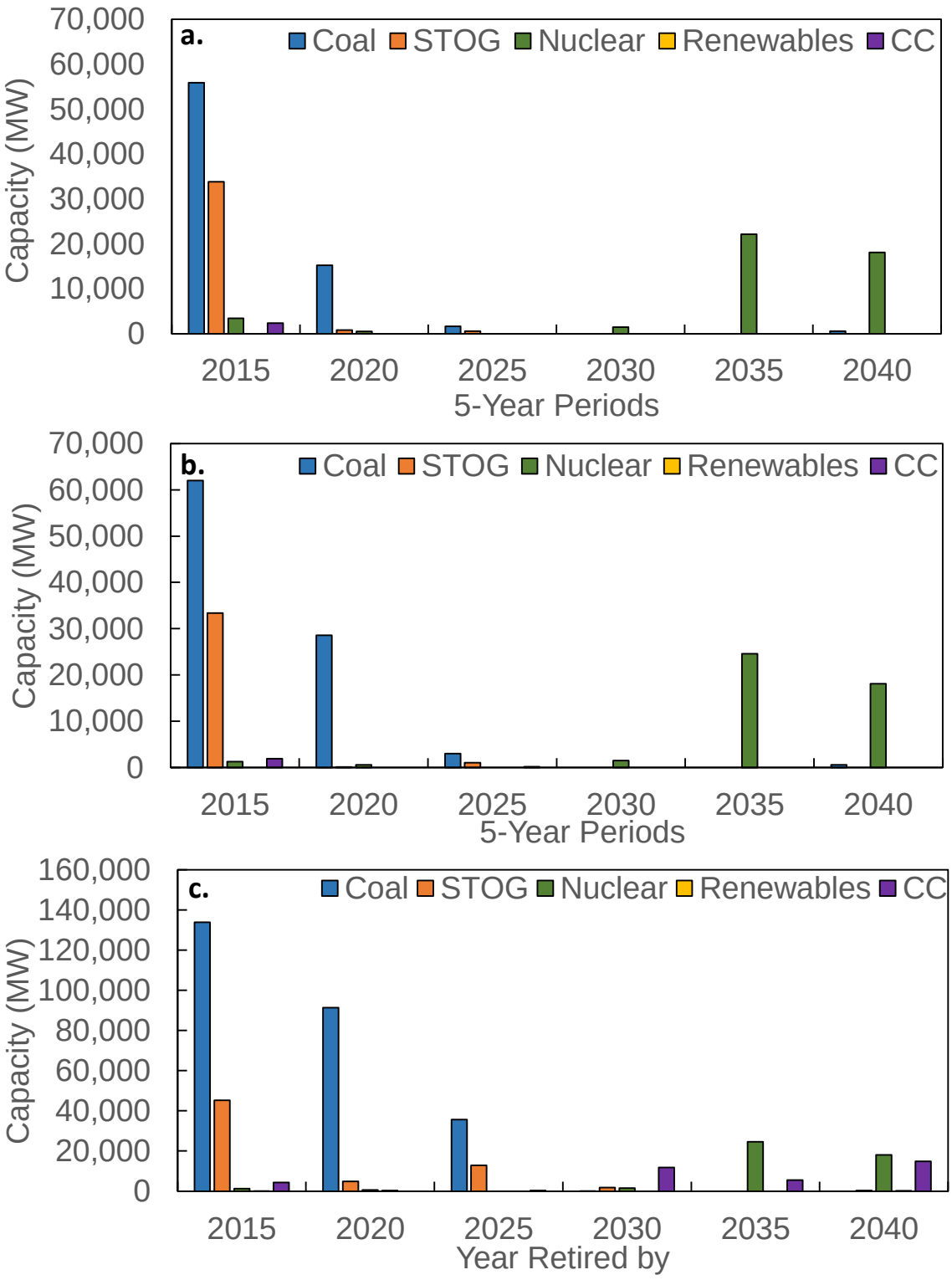

Figure A-19. Retirements of thermoelectric capacity by fuel type and year (in 5-year periods) for all U.S., EI NEEM regions for **a.** F1S17 **b.** F6S10 **c.** F8S7

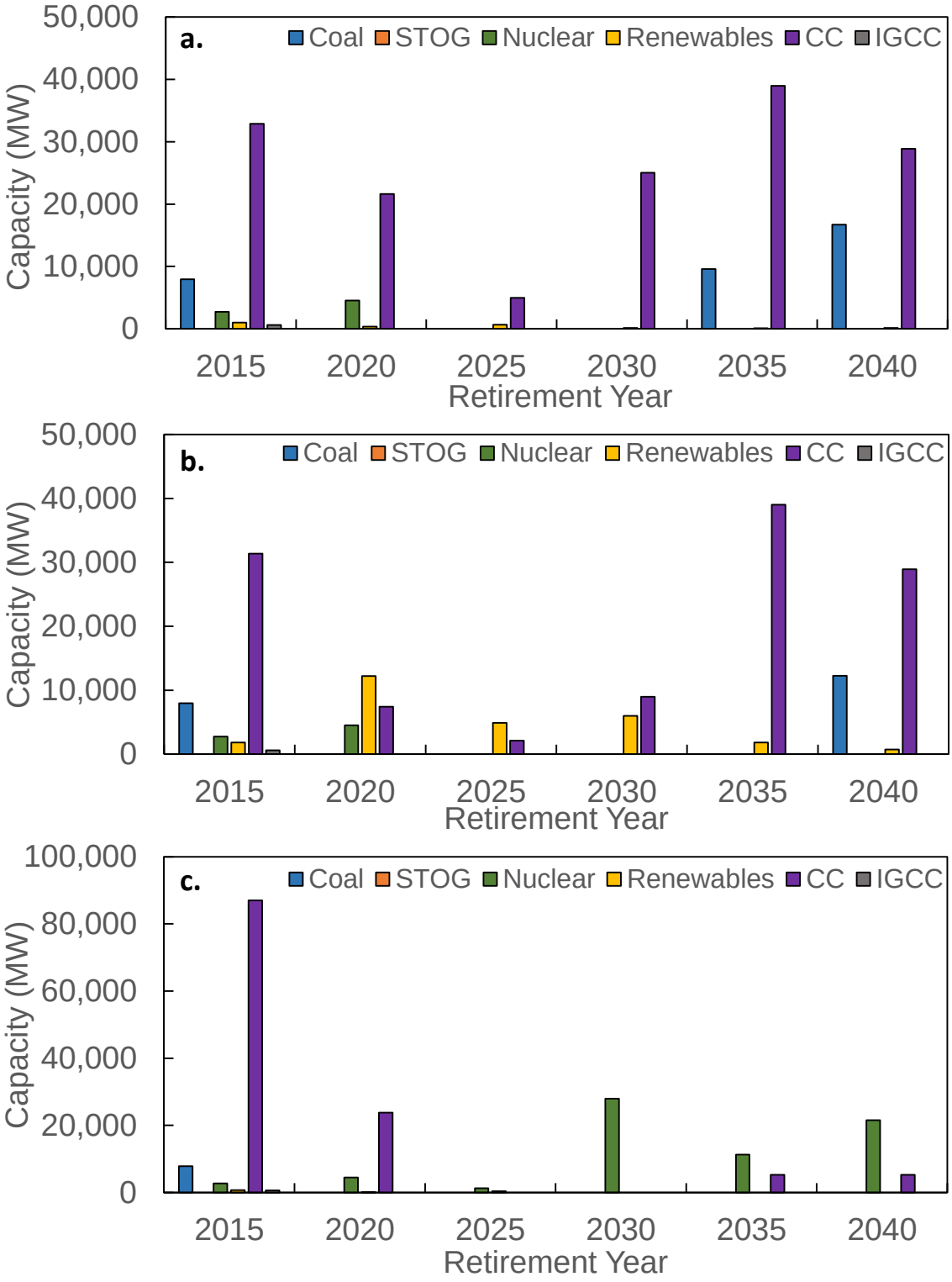

Figure A-20. Thermoelectric capacity added (new build) by fuel type and year (in 5-year periods) for all U.S., EI NEEM regions for **a.** F1S17 **b.** F6S10 **c.** F8S7

Appendix B

This Study's Capacity Data Validated with the EIPC Study Capacity Data

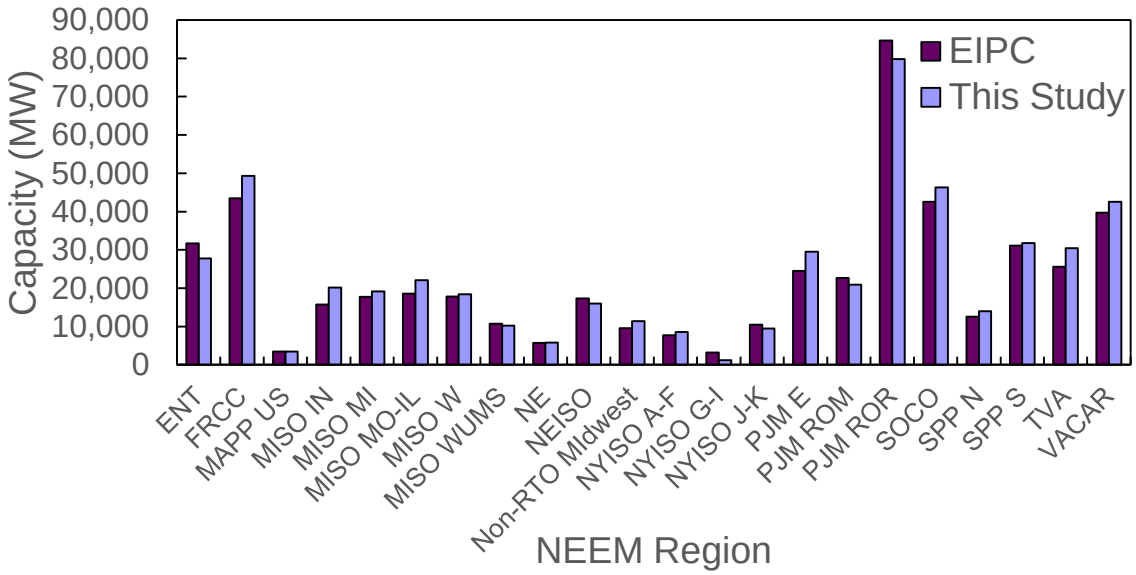

Figure B-21. Comparison of this study's estimated 2015 Capacity and the EIPC's estimated 2015 capacity for F1S17 by NEEM region.

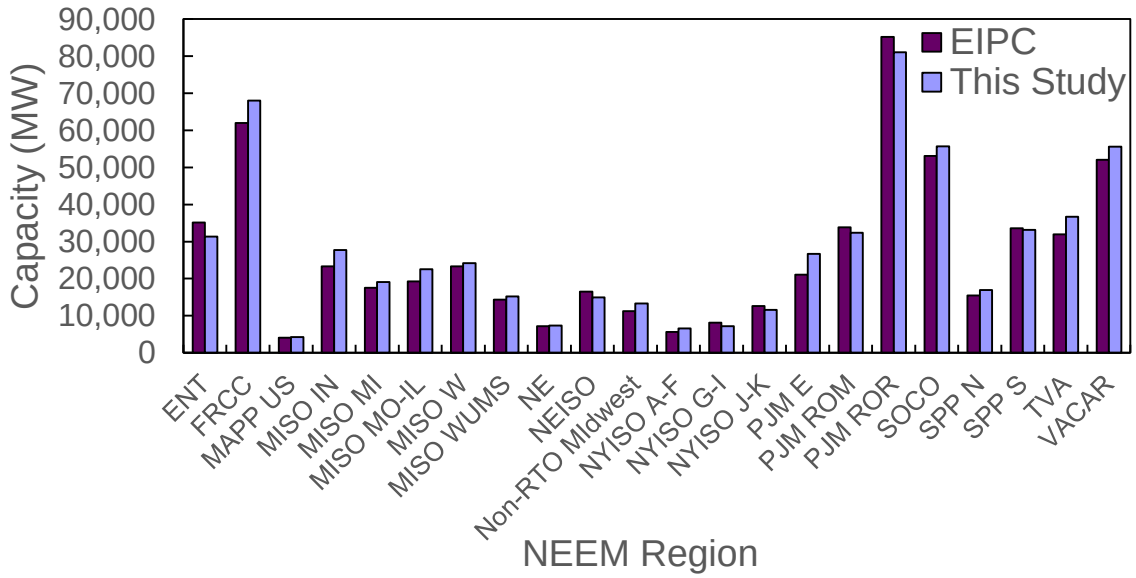

Figure B-22. Comparison of this study's estimated 2040 Capacity and the EIPC's estimated 2040 capacity for F1S17 by NEEM region.

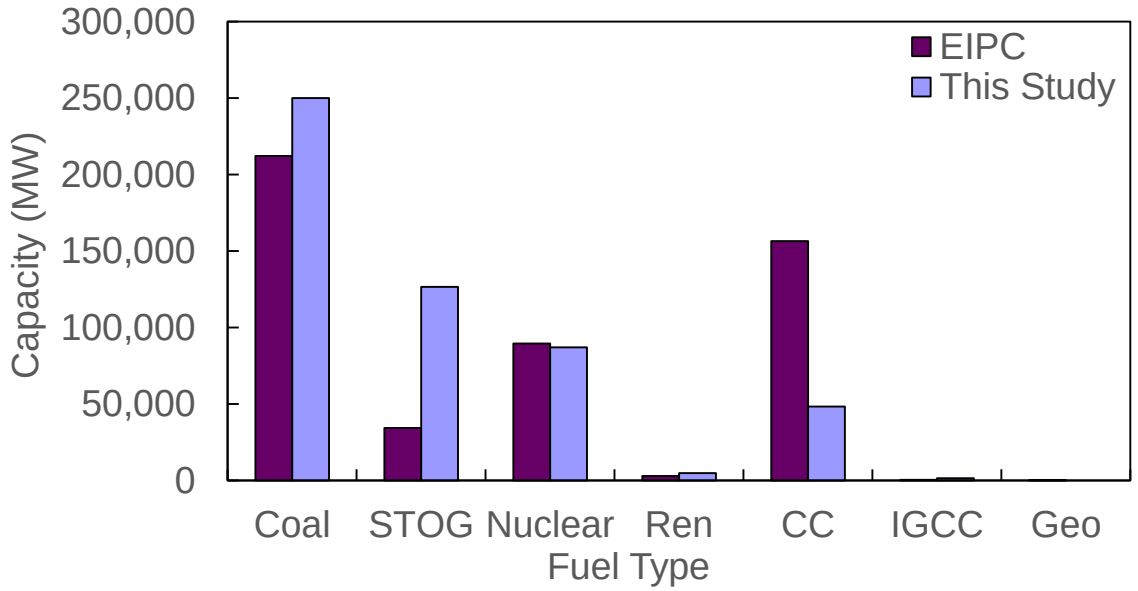

Figure B-23. Comparison of this study's estimated 2015 capacity and the EIPC's estimated 2015 capacity for F1S17 by fuel type.

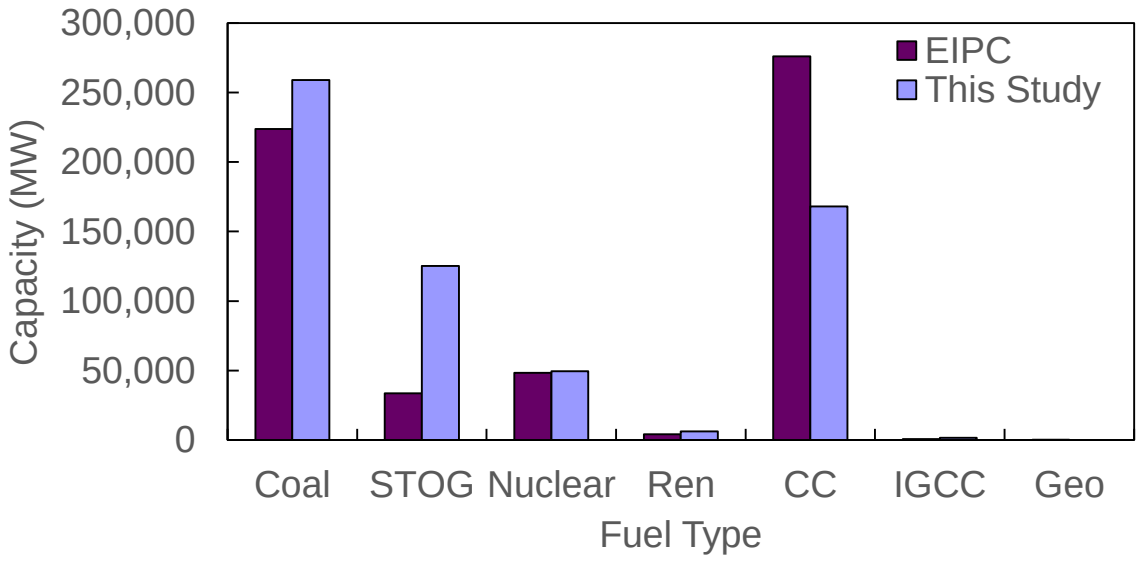

Figure B-24. Comparison of this study's estimated 2040 capacity and the EIPC's estimated 2040 capacity for F1S17 by fuel type.

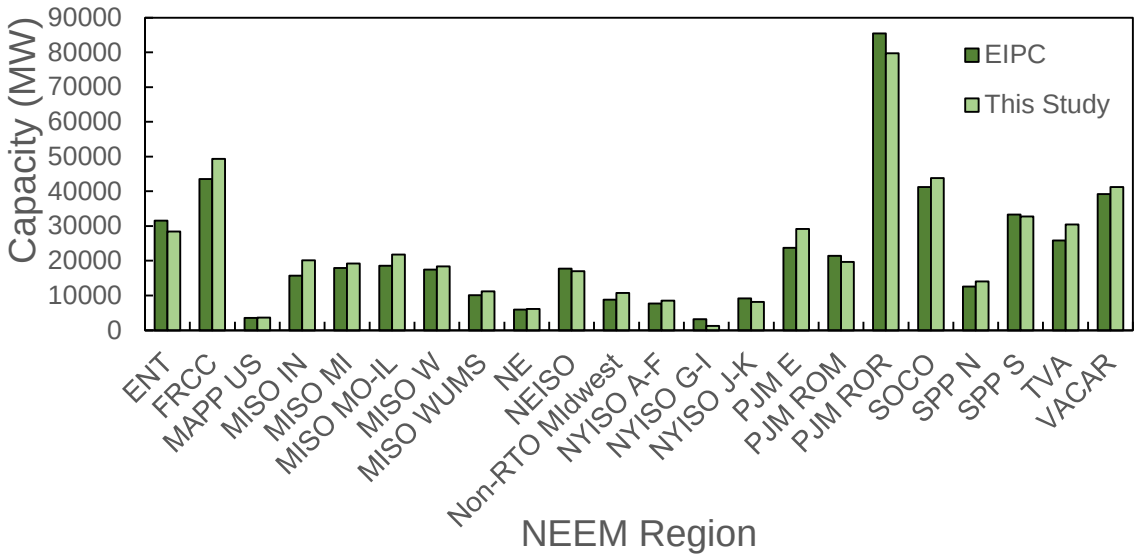

Figure B-25. Comparison of this study's estimated 2015 capacity and the EIPC's estimated 2015 capacity for F6S10 by NEEM region.

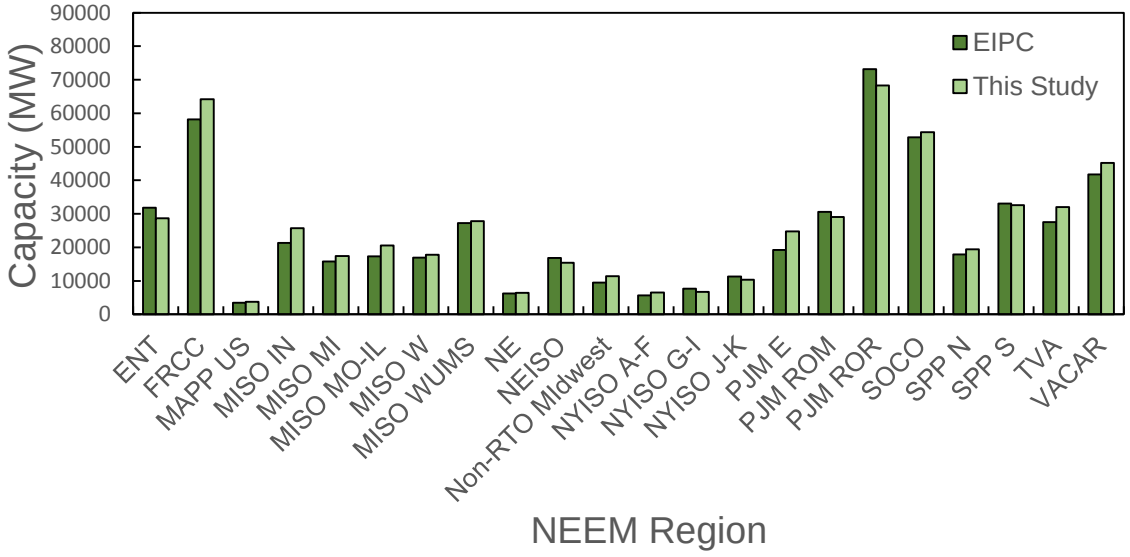

Figure B-26. Comparison of this study's estimated 2040 capacity and the EIPC's estimated 2040 capacity for F6S10 by NEEM region.

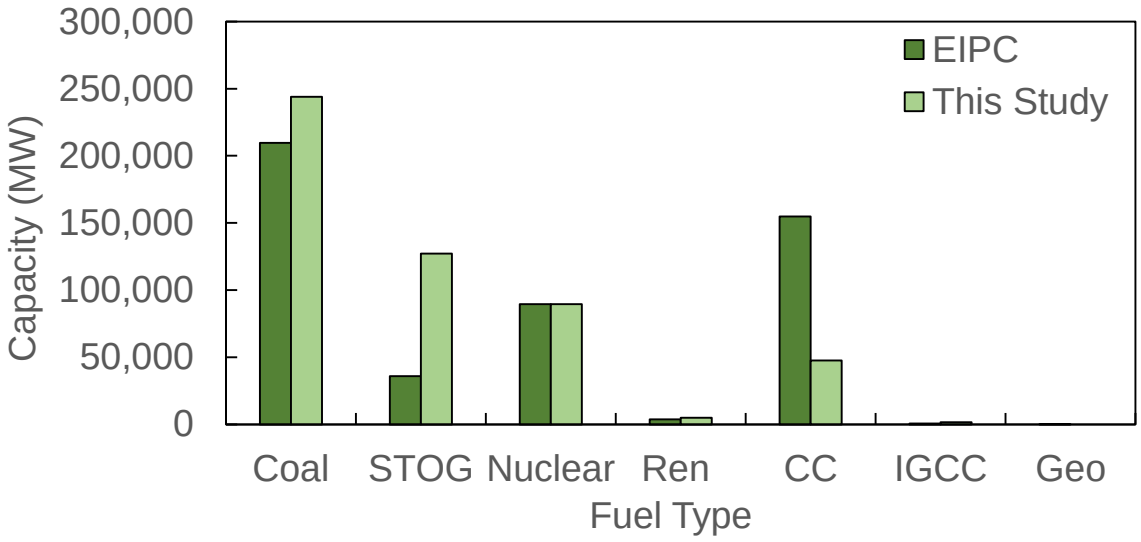

Figure B-27. Comparison of this study's estimated 2015 capacity and the EIPC's estimated 2015 Capacity for F6S10 by Fuel Type

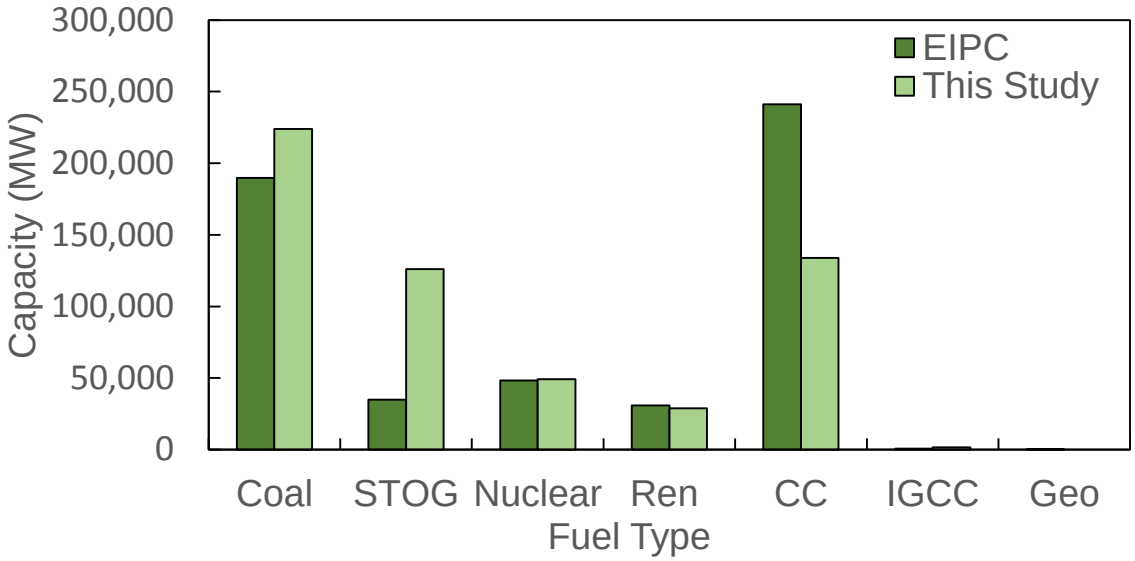

Figure B-28. Comparison of this study's estimated 2040 capacity and the EIPC's estimated 2040 Capacity for F6S10 by Fuel Type

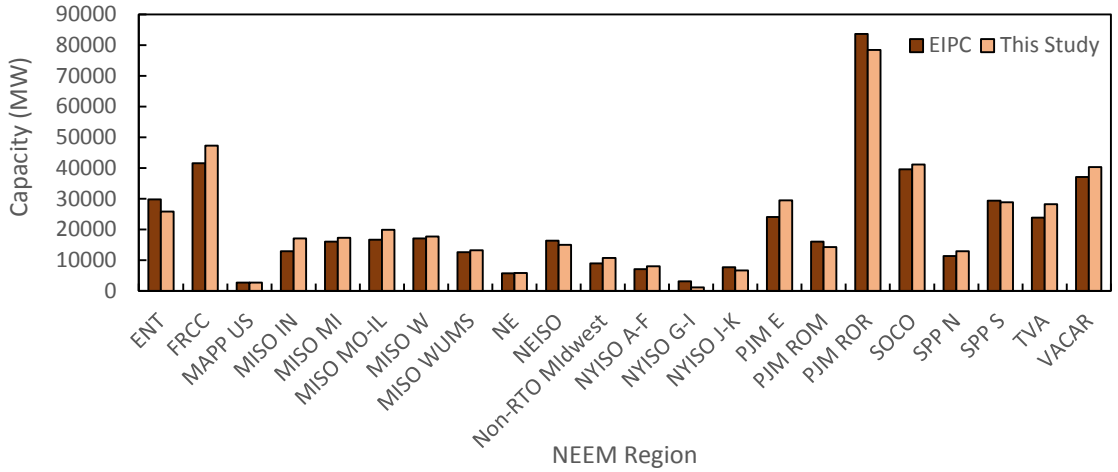

Figure B-29. Comparison of this study's estimated 2015 capacity and the EIPC's estimated 2015 capacity for F8S7 by NEEM region.

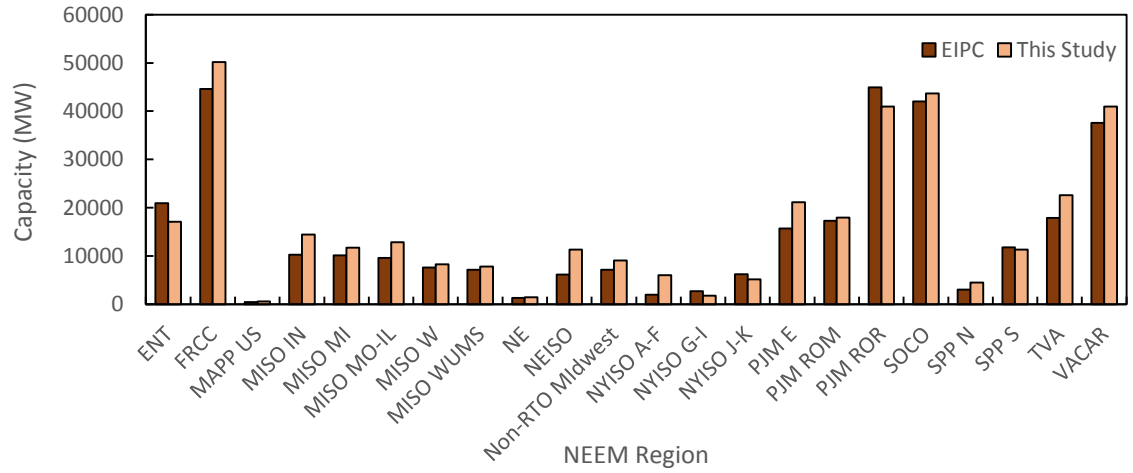

Figure B-30. Comparison of this study's estimated 2015 capacity and the EIPC's estimated 2015 capacity for F8S7 by NEEM region.

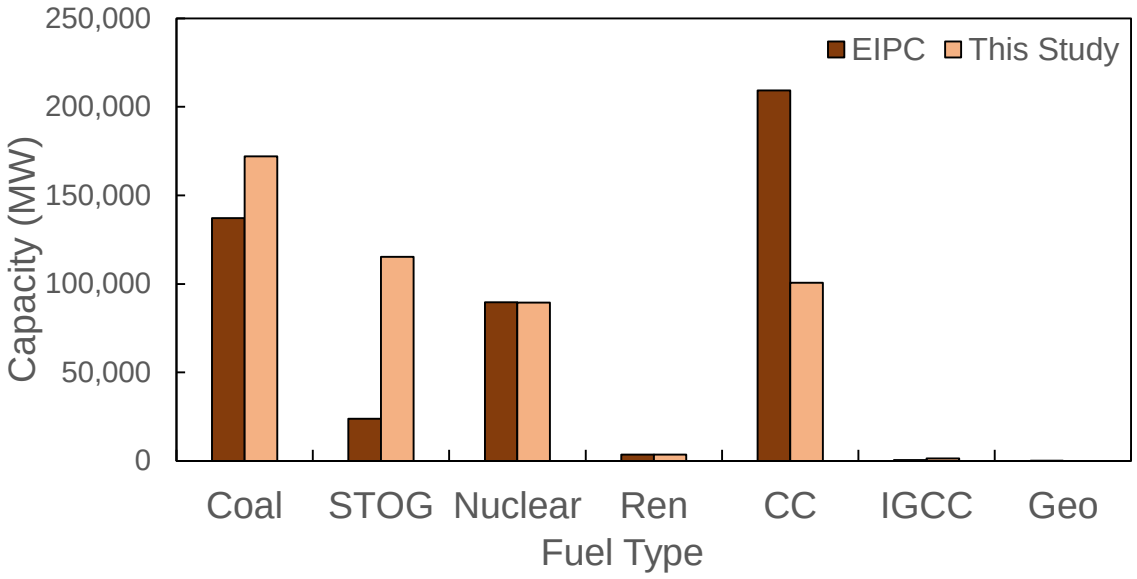

Figure B-31. Comparison of this study's estimated 2015 capacity and the EIPC's estimated 2015 Capacity for F8S7 by Fuel Type

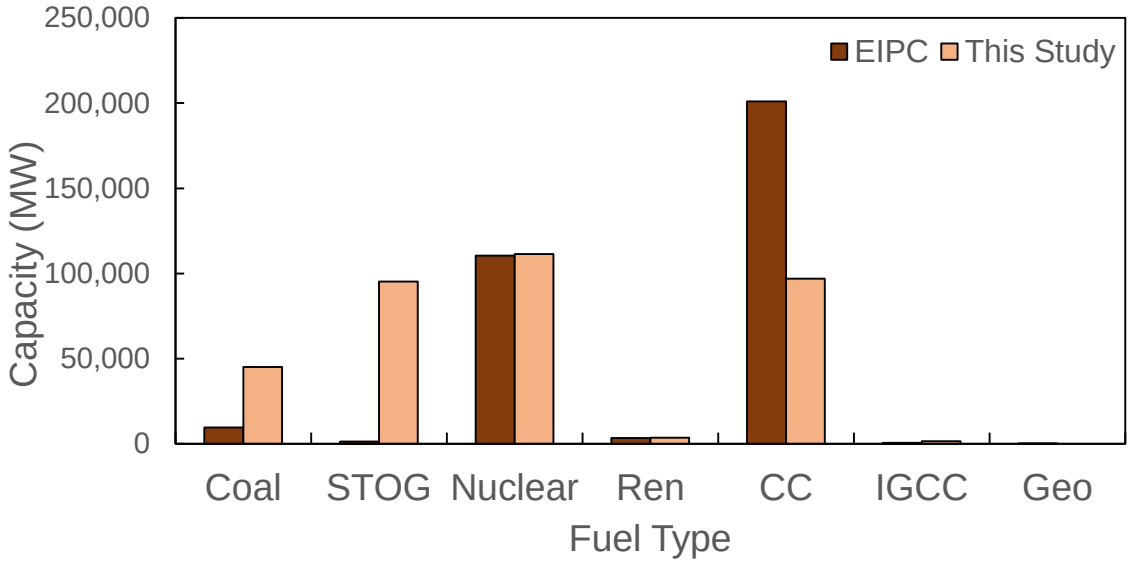

Figure B-32. Comparison of this study's estimated 2040 capacity and the EIPC's estimated 2040 Capacity for F8S7 by Fuel Type

Appendix C

Additional Capacity Data by NEEM Region

Table C-12. This study's capacity data by NEEM Region for F1S17 including new build and retirement capacity from 2011-2040, net change in capacity from 2011-2040 and the final capacity in 2040.

NEEM Region	New Build Capacity (MW)	Retired Capacity (MW)	Net Change in Capacity (MW)	2040 Capacity (MW)
ENT	7679	14917	-7238	31352
FRCC	27557	10425	17132	68056
MAPP US	1166	890	276	4239
MISO IN	8376	1312	7064	27687
MISO MI	1945	4290	-2345	19115
MISO MO-IL	3466	2056	1409	22503
MISO W	9095	5302	3793	24148
MISO WUMS	6582	4351	2231	15170
NE	3044	1550	1493	7361
NEISO	4453	13380	-8927	14974
Non-RTO Midwest	1878	1101	778	13278
NYISO A-F	902	5957	-5054	6553
NYISO G-I	7003	4737	2266	7191
NYISO J-K	3269	1129	2141	11559
PJM E	5964	7951	-1987	26687
PJM ROM	15847	11234	4613	32362
PJM ROR	23206	29615	-6409	81077
SOCO	18502	11918	6584	55649
SPP N	3713	452	3261	16905
SPP S	3843	4980	-1137	33125
TVA	14061	8315	5746	36670
VACAR	27756	10874	16882	55621

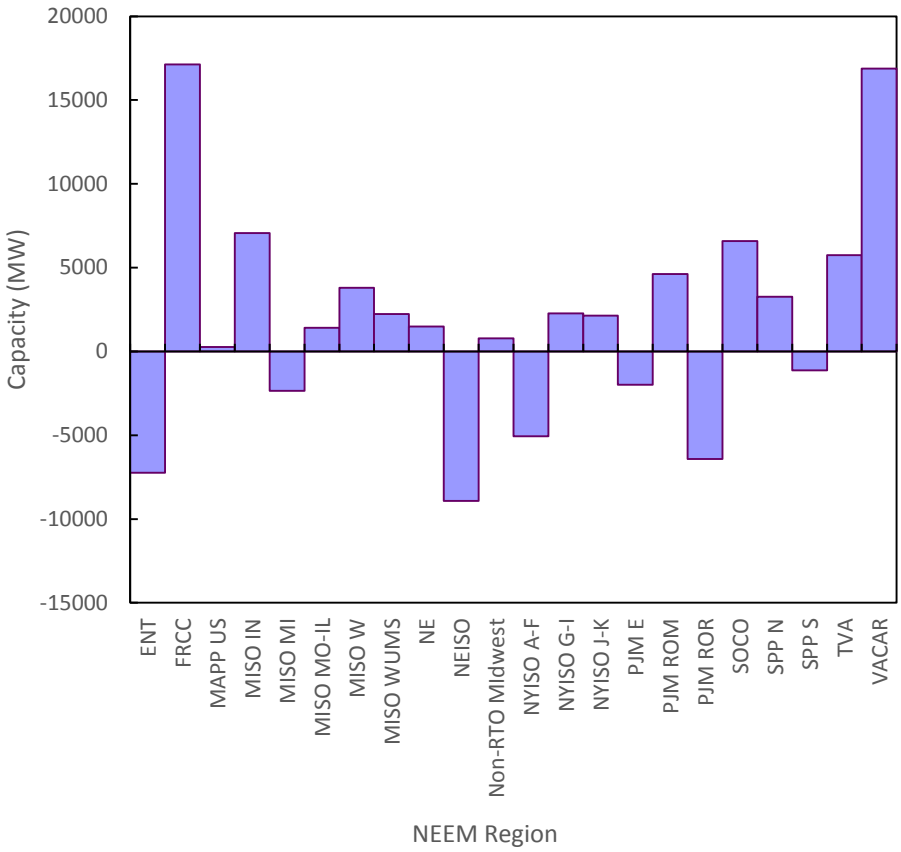

Figure C-33. Net change in capacity for F1S17 from 2011-2040

Table C-13. This study's capacity data by NEEM Region for F6S10 including new build and retirement capacity from 2011-2040, net change in capacity from 2011-2040 and the final capacity in 2040

NEEM Region	New Build Capacity (MW)	Retired Capacity (MW)	Net Change in Capacity (MW)	2040 Capacity (MW)
ENT	4791	14711	-9920	28670
FRCC	23414	10161	13252	64176
MAPP US	954	1187	-232	3731
MISO IN	6365	1312	5053	25676
MISO MI	240	4290	-4049	17411
MISO MO-IL	1790	2362	-572	20522
MISO W	2721	5302	-2581	17774
MISO WUMS	20068	5221	14847	27786
NE	1841	1280	561	6429
NEISO	4421	12925	-8504	15397
Non-RTO Midwest	717	1790	-1073	11428
NYISO A-F	902	5957	-5054	6553
NYISO G-I	6571	4737	1834	6759
NYISO J-K	3309	2426	884	10302
PJM E	4898	8821	-3923	24751
PJM ROM	15029	13709	1320	29069
PJM ROR	16011	35173	-19162	68324
SOCO	20470	15156	5314	54379
SPP N	6514	769	5745	19388
SPP S	1701	3396	-1695	32567
TVA	10941	9871	1071	31994
VACAR	22619	16133	6485	45224

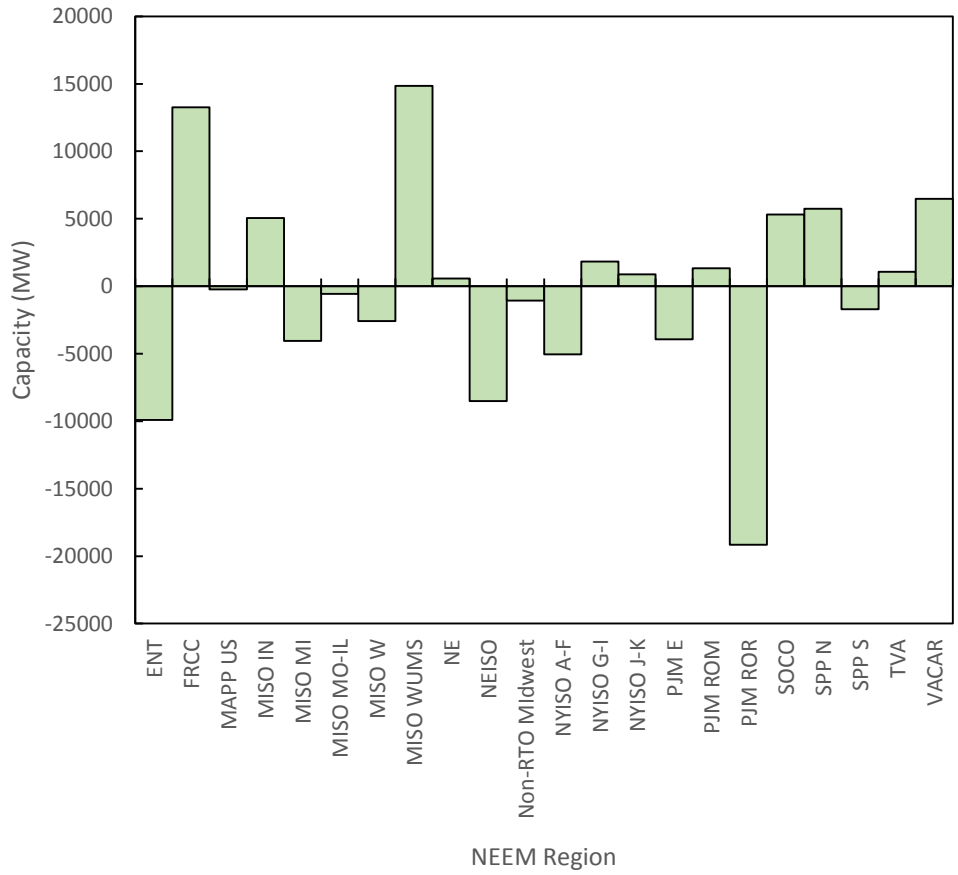

Figure C-34. Net change in capacity for F6S10 from 2011-2040

Table C-14. This study's capacity data by NEEM Region for F8S7 including new build and retirement capacity from 2011-2040, net change in capacity from 2011-2040 and the final capacity in 2040

NEEM Region	New Build Capacity (MW)	Retired Capacity (MW)	Net Change in Capacity (MW)	2040 Capacity (MW)
ENT	3755	25265	-21510	17080
FRCC	37915	38633	-718	50206
MAPP US	380	3743	-3363	600
MISO IN	8837	15026	-6190	14433
MISO MI	5332	15068	-9736	11724
MISO MO-IL	6321	14561	-8240	12854
MISO W	3677	15780	-12102	8253
MISO WUMS	4577	9744	-5167	7772
NE	304	4746	-4442	1426
NEISO	2748	15320	-12572	11329
Non-RTO Midwest	7017	10437	-3420	9081
NYISO A-F	813	6431	-5617	5990
NYISO G-I	1609	4737	-3128	1797
NYISO J-K	1175	5432	-4257	5162
PJM E	4765	12303	-7538	21136
PJM ROM	10866	20673	-9807	17942
PJM ROR	24494	71002	-46508	40978
SOCO	30683	36064	-5381	43684
SPP N	465	9632	-9167	4476
SPP S	1701	24642	-22941	11321
TVA	14158	22462	-8304	22620
VACAR	30158	27932	2226	40965

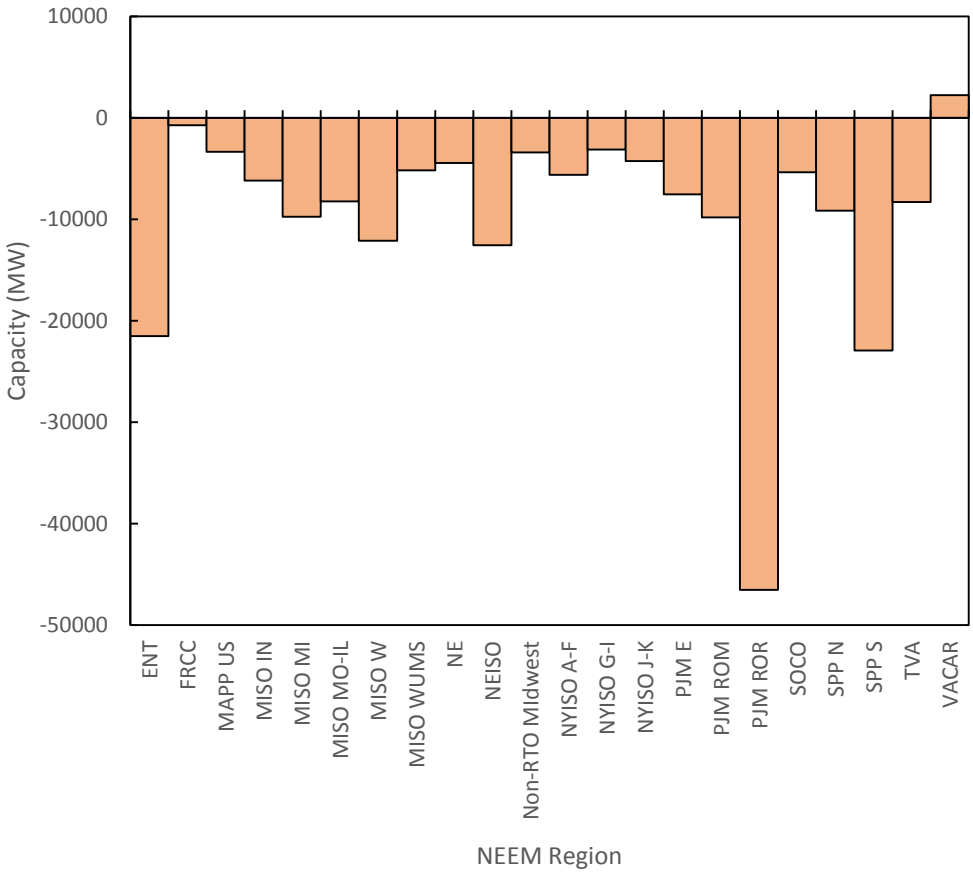

Figure C-35. Net change in capacity for F8S7 from 2011-2040

Appendix D

Supplemental Data by HUC-8 Watersheds

Note: watersheds where water availability information was not available have been assigned NA in Tables D-15, D-16, and D-17

Table D-15. F1S17 Capacity and Water Withdrawal Data by HUC-8 Watersheds

HUC-8	Net Change in Capacity from 2011-2040 (MW)	NB WD from 2011-2040 (MGD)	Ret WD from 2011-2040 (MGD)	Net Change in WD from 2011-2040 (MGD)	Total Water Available (MGD)	Total Fresh Water Available (MGD)	Percent of Total Water Available WD by Net Positive NB Capacity between 2011-2040	Percent of Fresh Water Available WD by Net Positive NB Capacity between 2011-2040
1010004	9.70	0.15	0.00	0.15	2617.26	2615.61	0.01	0.01
1020005	222.04	0.78	0.00	0.78	6517.79	6507.38	0.01	0.01
1030001	9.70	0.15	0.00	0.15	1760.08	1759.95	0.01	0.01
1030002	9.70	0.15	0.00	0.15	982.85	982.85	0.02	0.02
1040002	-12.20	0.15	0.00	0.15	4573.68	4567.82	0.00	0.00
1050002	9.70	0.15	0.00	0.15	2954.03	2911.99	0.01	0.01
1060001	-815.47	0.15	24.20	-24.05	1212.71	1149.63	0.00	0.00
1060002	19.40	0.30	0.00	0.30	2995.23	2976.22	0.01	0.01
1060003	-491.81	0.00	124.20	-124.20	2669.45	1627.08	0.00	0.00
1070001	9.70	0.15	0.00	0.15	1325.45	1322.00	0.01	0.01
1070004	9.70	0.15	0.00	0.15	869.53	760.17	0.02	0.02
1070006	1009.95	3.32	0.00	3.32	5093.69	4008.61	0.07	0.08
1080103	29.10	0.45	0.00	0.45	4087.73	4086.93	0.01	0.01
1080106	29.10	0.45	0.00	0.45	7174.38	7156.88	0.01	0.01
1080107	-616.13	0.00	501.00	-501.00	8022.78	8014.72	0.00	0.00
1080201	-164.68	0.00	33.68	-33.68	14034.66	14003.18	0.00	0.00
1080204	-750.14	0.00	28.99	-28.99	698.37	693.07	0.00	0.00
1080205	-323.42	2.54	35.55	-33.01	13529.08	12672.50	0.00	0.00
1080206	0.00	0.00	0.00	0.00	632.63	629.99	0.00	0.00
1090001	-1309.70	3.02	375.95	-372.93	1397.10	744.67	0.00	0.00
1090002	-1210.21	0.00	13.06	-13.06	1697.13	536.03	0.00	0.00
1090003	-457.56	0.00	1.44	-1.44	990.75	759.29	0.00	0.00
1090004	-2349.56	0.63	1100.94	-1100.32	3271.25	1422.64	0.00	0.00
1100001	9.70	0.15	0.00	0.15	1529.12	811.26	0.01	0.02
1100003	-1521.93	0.30	719.36	-719.06	3380.15	932.62	0.00	0.00
1100004	19.40	0.30	0.00	0.30	228.56	181.69	0.13	0.17
1100005	651.21	2.39	0.21	2.18	2215.24	1941.93	0.10	0.11
1100006	-510.53	0.00	43.48	-43.48	910.20	92.27	0.00	0.00
2010003	9.70	0.15	0.00	0.15	NA	NA	NA	NA

2020003	0.00	0.00	0.00	0.00	6454.36	6432.98	0.00	0.00
2020006	0.00	0.00	0.00	0.00	6748.10	6682.74	0.00	0.00
2020008	5357.00	0.33	166.57	-166.24	7900.94	7648.27	0.00	0.00
2030101	-3069.82	0.00	1804.10	-1804.10	16572.72	15418.46	0.00	0.00
2030102	0.00	0.00	0.00	0.00	1121.15	221.57	0.00	0.00
2030103	1443.32	5.62	103.52	-97.90	1485.98	523.33	0.00	0.00
2030104	-156.30	2.29	95.11	-92.82	970.47	19.80	0.00	0.00
2030105	4.29	0.07	0.00	0.07	766.82	524.76	0.01	0.01
2030201	-228.00	0.00	9.10	-9.10	639.58	111.04	0.00	0.00
2030202	3169.35	9.67	18.14	-8.46	3282.64	563.63	0.00	0.00
2030203	-451.27	0.00	17.70	-17.70	23.83	0.00	0.00	0.00
2040105	-576.89	0.11	147.00	-146.89	8255.62	8200.11	0.00	0.00
2040106	-80.68	0.05	0.00	0.05	1755.84	1745.28	0.00	0.00
2040201	-644.03	0.13	157.06	-156.93	8791.52	8662.63	0.00	0.00
2040202	-518.92	1.49	118.90	-117.42	12297.25	11712.60	0.00	0.00
2040203	14639.80	46.32	68.42	-22.10	2116.35	1828.61	0.00	0.00
2040205	0.00	0.00	0.00	0.00	1168.93	718.91	0.00	0.00
2040206	-8.50	5.16	910.10	-904.95	12072.36	6425.50	0.00	0.00
2040207	754.67	2.22	0.11	2.11	236.19	125.15	0.89	1.68
2040301	-238.08	1.33	494.94	-493.61	1374.56	458.24	0.00	0.00
2040303	-340.00	0.00	35.23	-35.23	342.99	227.02	0.00	0.00
2050103	-81.55	0.00	0.00	0.00	5537.26	5535.36	0.00	0.00
2050107	2.25	0.04	0.00	0.04	6346.13	6331.19	0.00	0.00
2050201	-611.18	0.05	240.00	-239.95	1688.21	1672.20	0.00	0.00
2050206	4.50	0.07	0.00	0.07	4556.80	4543.24	0.00	0.00
2050301	-408.48	0.05	188.00	-187.95	10417.44	10379.83	0.00	0.00
2050305	-783.75	0.04	14.30	-14.26	12970.81	12930.69	0.00	0.00
2050306	-2245.50	0.25	1826.15	-1825.90	27825.44	27755.29	0.00	0.00
2060003	-869.93	0.08	203.98	-203.90	1286.47	284.96	0.00	0.00
2060004	-1849.50	0.00	1530.00	-1530.00	1961.75	31.08	0.00	0.00
2060006	-2448.50	0.05	325.31	-325.26	6334.16	319.20	0.00	0.00
2070002	0.00	0.00	0.00	0.00	1843.94	1836.38	0.00	0.00
2070004	-109.50	0.00	26.55	-26.55	6296.56	6280.20	0.00	0.00
2070005	3253.95	9.63	0.00	9.63	865.02	852.60	1.11	1.13
2070006	0.00	0.00	0.00	0.00	360.97	337.03	0.00	0.00
2070008	1074.20	5.84	251.67	-245.83	8792.54	8669.53	0.00	0.00
2070010	-837.18	3.05	99.81	-96.76	9991.26	9081.52	0.00	0.00
2070011	2670.95	7.90	0.00	7.90	13215.03	10889.84	0.06	0.07
2080104	0.00	0.00	0.00	0.00	1024.26	993.97	0.00	0.00
2080106	-75.48	0.08	63.38	-63.29	522.76	475.53	0.00	0.00
2080107	-375.00	0.00	56.71	-56.71	1852.93	916.81	0.00	0.00
2080109	-172.00	0.00	0.03	-0.03	608.68	451.30	0.00	0.00

2080203	-127.45	2.11	97.50	-95.39	2804.46	2798.55	0.00	0.00
2080204	1924.95	5.70	0.00	5.70	537.66	537.56	1.06	1.06
2080206	754.89	11.47	2093.66	-2082.19	5484.27	3594.61	0.00	0.00
2080208	0.00	0.00	0.00	0.00	447.86	84.51	0.00	0.00
3010101	192.50	3.00	0.00	3.00	1365.24	1360.61	0.22	0.22
3010102	0.00	0.00	0.00	0.00	2775.95	2762.56	0.00	0.00
3010103	-290.00	0.00	49.73	-49.73	2230.37	2216.86	0.00	0.00
3010104	0.00	0.00	0.00	0.00	2464.56	2464.14	0.00	0.00
3010107	0.00	0.00	0.00	0.00	3127.76	3103.64	0.00	0.00
3010201	0.00	0.00	0.00	0.00	1120.64	1116.69	0.00	0.00
3010202	0.00	0.00	0.00	0.00	2584.80	491.90	0.00	0.00
3020101	0.00	0.00	0.00	0.00	656.63	629.65	0.00	0.00
3020201	-14.07	9.12	3.50	5.63	1336.20	1286.97	0.42	0.44
3020204	494.69	7.71	0.00	7.71	1757.08	1754.23	0.44	0.44
3030004	22963.53	73.92	173.00	-99.08	2147.98	2119.04	0.00	0.00
3030005	-1882.67	14.74	1636.54	-1621.80	4121.75	2911.45	0.00	0.00
3030007	456.59	7.12	0.00	7.12	578.79	575.09	1.23	1.24
3040102	0.00	0.00	0.00	0.00	649.75	642.83	0.00	0.00
3040103	-367.00	0.00	112.17	-112.17	1999.34	1969.54	0.00	0.00
3040105	230.20	3.59	0.00	3.59	755.88	752.07	0.47	0.48
3040201	-592.60	0.00	310.25	-310.25	5999.07	5977.50	0.00	0.00
3040203	-165.50	0.00	0.76	-0.76	1132.68	1123.29	0.00	0.00
3040206	-163.20	0.00	1.45	-1.45	6509.58	5739.22	0.00	0.00
3040207	0.00	0.00	0.00	0.00	5573.08	5555.81	0.00	0.00
3040208	0.00	0.00	0.00	0.00	963.86	188.76	0.00	0.00
3050101	-355.83	18.24	672.15	-653.91	3906.00	3835.46	0.00	0.00
3050102	-696.00	0.00	292.30	-292.30	551.10	525.86	0.00	0.00
3050103	230.30	3.59	0.00	3.59	1994.79	1980.99	0.18	0.18
3050104	0.00	0.00	0.00	0.00	2228.28	2225.83	0.00	0.00
3050105	-210.00	0.00	2.77	-2.77	3251.98	3199.38	0.00	0.00
3050106	388.33	9.12	0.00	9.12	2265.05	2250.96	0.40	0.41
3050109	-430.00	0.00	147.50	-147.50	985.78	892.87	0.00	0.00
3050110	0.00	0.00	0.00	0.00	3145.39	3145.04	0.00	0.00
3050201	-345.60	0.00	41.25	-41.25	1785.76	1761.89	0.00	0.00
3050204	0.00	0.00	0.00	0.00	295.71	247.15	0.00	0.00
3050206	-121.00	5.62	2.63	2.99	876.84	875.29	0.34	0.34
3060101	-2176.67	9.12	2140.00	-2130.88	1616.27	1578.54	0.00	0.00
3060102	0.00	0.00	0.00	0.00	2885.96	2881.27	0.00	0.00
3060103	0.00	0.00	0.00	0.00	4394.77	4377.77	0.00	0.00
3060106	-71.14	0.00	16.82	-16.82	7201.08	7193.75	0.00	0.00
3060108	756.67	17.77	0.00	17.77	546.23	545.46	3.25	3.26
3060109	516.79	17.39	97.00	-79.61	8458.09	8184.15	0.00	0.00

3070101	-991.09	12.58	509.00	-496.42	2095.71	2088.20	0.00	0.00
3070103	235.53	4.81	0.00	4.81	1020.56	922.24	0.47	0.52
3070104	-117.00	0.00	0.03	-0.03	2455.94	2445.48	0.00	0.00
3070202	-1025.05	17.77	33.83	-16.06	206.51	205.83	0.00	0.00
3070203	-239.15	0.00	0.31	-0.31	1048.87	1035.55	0.00	0.00
3070204	0.00	0.00	0.00	0.00	875.77	795.87	0.00	0.00
3080101	-308.70	0.00	1.21	-1.21	798.97	528.50	0.00	0.00
3080102	5162.15	15.23	0.31	14.92	417.93	403.98	3.57	3.69
3080103	-532.00	0.00	1.59	-1.59	2032.19	1057.83	0.00	0.00
3080202	-792.76	0.00	32.27	-32.27	217.53	89.85	0.00	0.00
3090101	5145.85	15.23	0.00	15.23	309.94	283.49	4.91	5.37
3090202	9.30	0.15	0.00	0.15	1591.03	216.62	0.01	0.07
3090205	0.00	0.00	0.00	0.00	498.30	0.00	0.00	0.00
3090206	10549.14	56.40	2162.87	-2106.47	2691.47	212.71	0.00	0.00
3100101	-134.50	0.00	12.50	-12.50	264.13	255.71	0.00	0.00
3100202	0.00	0.00	0.00	0.00	54.00	50.92	0.00	0.00
3100205	0.00	0.00	0.00	0.00	2072.61	0.00	0.00	0.00
3100206	0.00	0.00	0.00	0.00	1584.63	0.00	0.00	0.00
3100207	-1335.00	0.00	157.57	-157.57	3125.75	0.00	0.00	0.00
3110204	235.53	4.81	0.00	4.81	406.49	405.80	1.18	1.19
3110205	-308.50	0.00	49.00	-49.00	3729.25	3722.24	0.00	0.00
3110206	0.00	0.00	0.00	0.00	535.82	531.33	0.00	0.00
3120001	-50.00	0.00	4.57	-4.57	705.40	690.77	0.00	0.00
3120003	-273.11	0.00	0.79	-0.79	1378.94	1376.94	0.00	0.00
3130002	-167.53	22.21	9.74	12.47	4727.28	4682.23	0.26	0.27
3130005	38.50	0.60	0.00	0.60	1189.73	1068.43	0.05	0.06
3130008	-25.52	4.81	11.30	-6.49	2899.86	2871.01	0.00	0.00
3130011	15.40	0.00	11.60	-11.60	9310.47	9305.97	0.00	0.00
3130012	0.00	0.00	0.00	0.00	1741.32	1730.72	0.00	0.00
3140101	235.53	4.81	0.00	4.81	1967.89	1498.90	0.24	0.32
3140301	0.00	0.00	0.00	0.00	1034.08	1031.99	0.00	0.00
3140305	-314.09	12.58	46.70	-34.12	3039.55	3039.33	0.00	0.00
3150101	0.00	0.00	0.00	0.00	1045.80	1045.80	0.00	0.00
3150104	235.53	4.81	0.00	4.81	986.84	971.08	0.49	0.50
3150105	-217.09	12.58	281.00	-268.42	6203.32	6171.76	0.00	0.00
3150106	485.91	12.58	0.00	12.58	5530.86	5497.50	0.23	0.23
3150107	-825.47	4.81	201.48	-196.67	6219.46	6214.25	0.00	0.00
3150109	3981.93	11.78	0.00	11.78	2178.48	2170.35	0.54	0.54
3150201	3981.93	11.78	0.00	11.78	8847.47	8803.64	0.13	0.13
3160105	0.00	0.00	0.00	0.00	1133.31	1132.27	0.00	0.00
3160109	-14.47	4.81	123.05	-118.23	1749.06	1739.81	0.00	0.00
3160111	235.53	4.81	0.00	4.81	1121.54	1078.37	0.43	0.45

3160113	-81.58	4.81	56.20	-51.39	3797.05	3776.62	0.00	0.00
3160201	42.50	0.66	0.00	0.66	10747.80	10745.20	0.01	0.01
3160202	0.00	0.00	0.00	0.00	980.74	980.12	0.00	0.00
3160203	235.53	4.81	0.00	4.81	11272.22	11271.10	0.04	0.04
3160204	-70.67	4.81	80.32	-75.51	22204.76	22186.18	0.00	0.00
3160205	0.00	0.00	0.00	0.00	442.35	440.31	0.00	0.00
3170001	-128.30	0.00	0.01	-0.01	687.14	681.85	0.00	0.00
3170004	-335.25	0.00	0.48	-0.48	1440.65	1431.79	0.00	0.00
3170006	235.53	4.81	0.00	4.81	5440.36	5436.01	0.09	0.09
3170007	161.93	4.81	0.89	3.92	1256.05	1254.59	0.31	0.31
3170009	-386.19	12.58	74.70	-62.12	1588.68	1452.14	0.00	0.00
3180001	9650.85	95.65	0.00	95.65	1875.18	1864.26	5.10	5.13
3180002	-729.50	0.00	2.40	-2.40	2221.92	2219.99	0.00	0.00
3180005	-1.48	0.00	0.00	0.00	1523.20	1514.85	0.00	0.00
4010101	30.02	2.33	44.82	-42.49	1044.95	1044.95	0.00	0.00
4010201	570.46	13.59	58.50	-44.91	2593.26	2565.57	0.00	0.00
4010301	46.82	2.33	36.09	-33.76	1137.02	1119.58	0.00	0.00
4020101	87.00	2.51	4.68	-2.17	846.83	846.05	0.00	0.00
4020105	5262.79	90.68	194.97	-104.29	661.69	657.52	0.00	0.00
4030101	-1318.40	5.27	1027.61	-1022.33	270.16	258.15	0.00	0.00
4030102	-438.50	2.76	527.00	-524.24	62.26	57.21	0.00	0.00
4030110	0.00	0.00	0.00	0.00	549.02	545.99	0.00	0.00
4030111	71.23	2.51	12.80	-10.29	293.39	288.91	0.00	0.00
4030201	96.10	2.51	0.00	2.51	2066.75	1823.20	0.12	0.14
4030204	-119.00	0.00	47.09	-47.09	1700.01	1694.51	0.00	0.00
4040001	5122.61	24.91	2023.82	-1998.92	122.91	111.54	0.00	0.00
4040002	-1032.50	2.51	405.00	-402.49	47.07	44.11	0.00	0.00
4040003	0.00	0.00	0.00	0.00	198.25	185.49	0.00	0.00
4050001	-55.70	0.00	0.71	-0.71	4359.87	4317.83	0.00	0.00
4050002	-27.00	0.00	13.59	-13.59	284.29	282.32	0.00	0.00
4050003	0.00	0.00	0.00	0.00	316.44	298.44	0.00	0.00
4050004	0.00	0.00	0.00	0.00	116.99	85.82	0.00	0.00
4050006	892.30	2.64	0.00	2.64	2179.74	2085.68	0.12	0.13
4060101	0.00	0.00	0.00	0.00	1401.26	1399.14	0.00	0.00
4060102	-507.00	0.00	175.00	-175.00	1574.09	1568.18	0.00	0.00
4060103	-60.00	0.00	0.00	0.00	1525.86	1524.34	0.00	0.00
4070006	0.00	0.00	0.00	0.00	755.53	754.89	0.00	0.00
4070007	0.00	0.00	0.00	0.00	1559.17	1558.60	0.00	0.00
4080103	-932.00	0.00	228.03	-228.03	320.00	314.93	0.00	0.00
4080201	0.00	0.00	0.00	0.00	1279.65	1272.63	0.00	0.00
4080204	0.00	0.00	0.00	0.00	713.66	687.12	0.00	0.00
4090001	0.00	0.00	0.00	0.00	467.73	404.80	0.00	0.00

4090002	0.00	0.00	0.00	0.00	2371.66	2370.70	0.00	0.00
4090004	-1426.65	0.00	301.20	-301.20	2573.97	2560.58	0.00	0.00
4090005	892.30	2.64	0.00	2.64	253.19	195.76	1.04	1.35
4100001	-1121.00	0.00	206.10	-206.10	857.71	191.59	0.00	0.00
4100002	0.00	0.00	0.00	0.00	627.32	602.61	0.00	0.00
4100009	0.00	0.00	0.00	0.00	2099.71	2002.85	0.00	0.00
4100010	-1385.30	0.08	256.78	-256.70	314.46	287.02	0.00	0.00
4110001	0.00	0.00	0.00	0.00	261.02	213.93	0.00	0.00
4110003	-1302.40	4.21	627.50	-623.29	330.38	303.98	0.00	0.00
4110004	1928.40	5.78	0.00	5.78	391.43	373.57	1.48	1.55
4120101	-596.96	2.11	322.90	-320.79	685.37	658.79	0.00	0.00
4120104	-218.55	0.47	186.00	-185.53	775.90	724.79	0.00	0.00
4130001	-522.95	0.47	368.00	-367.53	461.35	442.52	0.00	0.00
4130002	159.75	0.47	0.00	0.47	581.06	575.03	0.08	0.08
4140101	-2180.50	1.32	578.39	-577.07	468.98	376.11	0.00	0.00
4140102	-1298.55	2.63	838.17	-835.54	1165.72	1161.71	0.00	0.00
4140201	-494.85	0.00	172.08	-172.08	2771.03	2713.56	0.00	0.00
4140202	159.75	0.47	0.00	0.47	2008.06	1921.90	0.02	0.02
4150101	-55.90	0.00	0.00	0.00	2995.25	2984.17	0.00	0.00
4150304	0.00	0.00	0.00	0.00	797.47	796.35	0.00	0.00
4150308	0.00	0.00	0.00	0.00	369.87	369.68	0.00	0.00
5010001	0.00	0.00	0.00	0.00	4138.47	4112.10	0.00	0.00
5010002	-86.00	0.00	0.63	-0.63	1508.71	1502.54	0.00	0.00
5010003	-82.68	0.05	0.00	0.05	4835.49	4825.49	0.00	0.00
5010005	0.00	0.00	0.00	0.00	1342.14	1338.67	0.00	0.00
5010006	-347.18	0.05	147.00	-146.95	6109.54	6019.66	0.00	0.00
5010007	-604.36	0.09	0.00	0.09	1333.78	1308.29	0.01	0.01
5010009	1924.95	5.70	0.00	5.70	6841.95	6816.10	0.08	0.08
5020002	0.00	0.00	0.00	0.00	657.69	647.55	0.00	0.00
5020003	-36.45	2.11	1.67	0.44	3638.01	3622.82	0.01	0.01
5020004	-184.45	2.11	51.80	-49.69	2852.86	2851.69	0.00	0.00
5020005	-412.45	2.11	77.89	-75.78	4852.06	4656.91	0.00	0.00
5030101	-1907.25	0.08	33.97	-33.89	39513.22	39455.08	0.00	0.00
5030103	-140.45	2.11	46.40	-44.29	1108.84	996.64	0.00	0.00
5030104	0.00	0.00	0.00	0.00	1346.39	1342.35	0.00	0.00
5030106	-924.95	2.11	262.00	-259.89	27682.87	27630.39	0.00	0.00
5030201	-134.95	2.11	0.42	1.69	28893.52	28884.65	0.01	0.01
5030202	-1028.90	4.21	222.00	-217.79	37139.86	37126.86	0.00	0.00
5040001	0.00	0.00	0.00	0.00	1656.96	1539.24	0.00	0.00
5040002	69.05	2.11	0.23	1.88	586.86	576.95	0.32	0.33
5040004	-1458.45	2.11	313.70	-311.59	3388.26	3374.36	0.00	0.00
5050002	-226.95	2.11	20.10	-17.99	4317.85	4310.31	0.00	0.00

5050006	-296.95	2.11	100.00	-97.89	4514.82	4508.88	0.00	0.00
5050008	0.00	0.00	0.00	0.00	6084.27	6054.54	0.00	0.00
5060001	5.55	2.11	7.57	-5.46	1379.48	1226.34	0.00	0.00
5070204	-1060.00	0.00	10.20	-10.20	3407.48	3388.25	0.00	0.00
5080002	-253.95	2.11	23.70	-21.59	1868.17	1840.01	0.00	0.00
5080003	0.00	0.00	0.00	0.00	1505.57	1341.95	0.00	0.00
5090103	0.00	0.00	0.00	0.00	50828.76	50695.29	0.00	0.00
5090201	-1221.30	0.00	315.12	-315.12	61980.03	61941.42	0.00	0.00
5090203	-2199.85	2.11	449.00	-446.89	96792.72	96754.22	0.00	0.00
5100205	1194.37	22.71	87.87	-65.16	3665.17	3640.65	0.00	0.00
5110003	136.17	4.02	90.60	-86.58	3419.15	3413.57	0.00	0.00
5110005	0.00	0.00	0.00	0.00	4582.40	4577.82	0.00	0.00
5120101	0.00	0.00	0.00	0.00	1280.60	1258.52	0.00	0.00
5120104	0.00	0.00	0.00	0.00	447.73	432.99	0.00	0.00
5120108	0.00	0.00	0.00	0.00	3850.07	3830.96	0.00	0.00
5120109	422.17	12.19	1.47	10.72	1016.74	1013.02	1.05	1.06
5120110	0.00	0.00	0.00	0.00	404.83	402.35	0.00	0.00
5120111	-621.20	0.00	225.27	-225.27	9553.43	9519.87	0.00	0.00
5120112	586.91	12.19	0.00	12.19	1003.92	984.06	1.21	1.24
5120113	0.00	0.00	0.00	0.00	22733.19	22718.67	0.00	0.00
5120114	0.00	0.00	0.00	0.00	1204.15	1150.43	0.00	0.00
5120201	254.02	0.00	88.03	-88.03	1487.23	1235.78	0.00	0.00
5120202	-144.20	0.00	16.04	-16.04	4662.24	4649.44	0.00	0.00
5120209	0.00	0.00	0.00	0.00	536.41	535.02	0.00	0.00
5130103	0.00	0.00	0.00	0.00	7472.58	7470.09	0.00	0.00
5130201	196.77	4.02	0.00	4.02	6628.84	6622.86	0.06	0.06
5130205	196.77	4.02	0.00	4.02	24012.74	23966.74	0.02	0.02
5140101	-514.35	0.00	336.91	-336.91	68708.29	68684.45	0.00	0.00
5140201	0.00	0.00	0.00	0.00	83731.55	83686.91	0.00	0.00
5140202	0.00	0.00	0.00	0.00	151320.33	151271.25	0.00	0.00
5140204	0.00	0.00	0.00	0.00	502.88	493.97	0.00	0.00
5140206	196.77	4.02	0.00	4.02	198159.89	198144.34	0.00	0.00
6010104	-163.23	4.02	176.95	-172.93	1981.14	1969.77	0.00	0.00
6010105	0.00	0.00	0.00	0.00	3371.01	3363.16	0.00	0.00
6010205	-237.50	0.00	0.99	-0.99	2658.94	2620.56	0.00	0.00
6010207	196.77	4.02	0.00	4.02	2585.87	2497.43	0.16	0.16
6010208	196.77	4.02	0.00	4.02	952.76	945.81	0.42	0.43
6020001	-1008.34	36.53	44.54	-8.01	13866.66	13852.65	0.00	0.00
6030001	-1196.83	4.02	495.77	-491.75	28024.15	28006.83	0.00	0.00
6030002	-1084.78	3.35	800.78	-797.43	18623.69	18560.09	0.00	0.00
6030005	-480.23	4.02	228.58	-224.56	57086.96	57062.58	0.00	0.00
6040005	-1288.43	4.02	397.07	-393.05	45350.41	45343.31	0.00	0.00

7010101	114.02	2.33	0.00	2.33	725.53	723.82	0.32	0.32
7010203	114.02	2.33	0.00	2.33	2393.12	2385.01	0.10	0.10
7010204	-614.00	0.74	518.25	-517.51	376.26	363.34	0.00	0.00
7010205	0.00	0.00	0.00	0.00	241.39	212.34	0.00	0.00
7010206	228.05	4.66	0.00	4.66	5814.97	5775.26	0.08	0.08
7020001	114.02	2.33	0.00	2.33	256.83	256.26	0.91	0.91
7020004	114.02	2.33	0.00	2.33	594.71	587.99	0.39	0.40
7020007	1160.89	3.44	0.00	3.44	1204.13	1198.38	0.29	0.29
7020009	0.00	0.00	0.00	0.00	789.60	781.06	0.00	0.00
7020012	-162.78	2.33	59.49	-57.16	2011.65	2007.97	0.00	0.00
7030005	114.02	2.33	0.00	2.33	3861.20	3856.09	0.06	0.06
7040001	0.00	0.00	0.00	0.00	12392.67	12158.43	0.00	0.00
7040002	-1085.00	0.74	902.42	-901.68	418.96	409.06	0.00	0.00
7040003	47.05	4.66	28.76	-24.10	10121.07	10102.16	0.00	0.00
7040004	15.02	2.33	0.28	2.05	477.24	471.54	0.43	0.44
7040006	0.00	0.00	0.00	0.00	12981.16	12980.05	0.00	0.00
7060001	190.55	4.66	14.55	-9.89	26583.34	26570.88	0.00	0.00
7060003	-85.98	2.33	103.69	-101.36	28498.07	28490.86	0.00	0.00
7060005	43.82	2.33	19.68	-17.35	34445.57	34422.18	0.00	0.00
7070002	-60.00	0.00	4.70	-4.70	1876.85	1817.29	0.00	0.00
7070005	0.00	0.00	0.00	0.00	14385.66	14374.28	0.00	0.00
7080101	521.43	18.25	216.66	-198.41	31419.79	31401.88	0.00	0.00
7080104	114.02	2.33	0.00	2.33	121131.97	121120.42	0.00	0.00
7080105	515.86	11.26	0.00	11.26	434.89	428.51	2.59	2.63
7080201	114.02	2.33	0.00	2.33	566.58	556.32	0.41	0.42
7080203	0.00	0.00	0.00	0.00	172.78	172.57	0.00	0.00
7080205	228.05	4.66	0.00	4.66	1033.20	1019.66	0.45	0.46
7080206	-590.55	0.74	10.13	-9.39	1562.52	1553.97	0.00	0.00
7080208	302.14	8.93	0.00	8.93	757.61	754.90	1.18	1.18
7090002	-118.19	0.00	2.05	-2.05	1732.35	1725.75	0.00	0.00
7090005	746.70	7.72	1713.26	-1705.55	2690.51	2642.92	0.00	0.00
7100008	0.00	0.00	0.00	0.00	2337.57	2307.43	0.00	0.00
7100009	114.02	2.33	0.00	2.33	5744.43	5737.49	0.04	0.04
7110004	-22.00	0.00	3.90	-3.90	70849.91	70607.29	0.00	0.00
7110009	0.00	0.00	0.00	0.00	81843.77	81834.91	0.00	0.00
7120001	0.00	0.00	0.00	0.00	2673.47	2594.80	0.00	0.00
7120003	-236.84	2.11	284.11	-282.01	65.51	15.01	0.00	0.00
7120004	-583.53	0.08	935.45	-935.37	1280.66	285.01	0.00	0.00
7120005	-1734.00	0.08	27.76	-27.67	1627.02	1623.81	0.00	0.00
7130001	3.45	0.08	0.00	0.08	4810.02	4774.33	0.00	0.00
7130003	-561.00	0.00	85.84	-85.84	6605.06	6597.82	0.00	0.00
7130007	0.00	0.00	0.00	0.00	369.36	366.09	0.00	0.00

7130009	0.00	0.00	0.00	0.00	729.86	707.72	0.00	0.00
7130011	231.67	12.19	75.40	-63.21	8931.86	8629.80	0.00	0.00
7140101	0.00	0.00	0.00	0.00	135097.54	135047.92	0.00	0.00
7140102	-924.00	0.00	412.97	-412.97	1653.59	1413.84	0.00	0.00
7140105	0.00	0.00	0.00	0.00	153254.12	153247.99	0.00	0.00
7140201	0.00	0.00	0.00	0.00	579.31	568.85	0.00	0.00
7140203	0.00	0.00	0.00	0.00	272.48	265.92	0.00	0.00
7140204	0.00	0.00	0.00	0.00	1569.59	1499.32	0.00	0.00
8010208	0.00	0.00	0.00	0.00	1877.51	1874.51	0.00	0.00
8010211	196.77	4.02	0.00	4.02	103.44	94.94	3.89	4.23
8020203	1140.94	7.58	0.64	6.94	2428.34	2394.24	0.29	0.29
8020204	158.77	3.24	0.00	3.24	1129.44	1111.92	0.29	0.29
8020303	0.00	0.00	0.00	0.00	14187.29	14184.27	0.00	0.00
8030100	-726.50	0.00	174.00	-174.00	704058.81	704058.15	0.00	0.00
8030201	0.00	0.00	0.00	0.00	1378.65	1375.11	0.00	0.00
8030206	73.10	0.00	0.01	-0.01	6643.06	6635.13	0.00	0.00
8030207	1606.00	12.48	0.01	12.47	23.83	0.00	52.33	0.00
8040101	-721.00	0.00	18.40	-18.40	860.61	860.05	0.00	0.00
8040102	-134.00	0.00	0.00	0.00	2667.72	2663.17	0.00	0.00
8040201	0.00	0.00	0.00	0.00	3552.02	3539.61	0.00	0.00
8040202	-405.00	0.00	0.02	-0.02	11902.79	11896.26	0.00	0.00
8040205	0.00	0.00	0.00	0.00	919.19	897.15	0.00	0.00
8040207	0.00	0.00	0.00	0.00	9629.39	9624.33	0.00	0.00
8060100	-1188.50	0.00	194.00	-194.00	379024.93	379024.69	0.00	0.00
8060201	0.00	0.00	0.00	0.00	1061.69	1051.85	0.00	0.00
8060203	42.50	1.00	0.00	1.00	534.78	534.10	0.19	0.19
8070100	-1917.00	0.00	65.30	-65.30	379486.60	379486.60	0.00	0.00
8070201	-335.10	1.00	8.08	-7.08	190055.06	190052.07	0.00	0.00
8070202	0.00	0.00	0.00	0.00	1497.53	1459.56	0.00	0.00
8070204	-1185.50	0.00	216.00	-216.00	1911.07	1902.05	0.00	0.00
8070300	-692.53	3.24	124.25	-121.00	347.63	337.83	0.00	0.00
8080102	-125.00	0.00	0.00	0.00	1141.54	1015.14	0.00	0.00
8080103	-89.20	0.00	1.20	-1.20	152.28	115.18	0.00	0.00
8080201	0.00	0.00	0.00	0.00	577.04	568.30	0.00	0.00
8080203	0.00	0.00	0.00	0.00	1185.89	1185.21	0.00	0.00
8080205	92.47	3.24	0.68	2.57	462.13	462.13	0.56	0.56
8090203	-778.00	0.00	179.00	-179.00	190068.50	190052.03	0.00	0.00
8090301	1304.67	7.25	127.00	-119.75	190080.79	190054.98	0.00	0.00
8090302	-84.10	0.00	0.05	-0.05	1927.07	1917.68	0.00	0.00
9020103	-15.68	2.33	7.55	-5.22	276.21	273.63	0.00	0.00
10100004	21.47	0.00	32.60	-32.60	NA	NA	NA	NA
10130101	404.46	16.87	409.82	-392.95	NA	NA	NA	NA

10130201	99.61	2.04	0.00	2.04	NA	NA	NA	NA
10160002	220.22	4.50	0.00	4.50	NA	NA	NA	NA
10190018	424.59	8.67	0.00	8.67	NA	NA	NA	NA
10200101	354.44	8.67	1.46	7.21	NA	NA	NA	NA
10200102	-180.70	0.00	0.00	0.00	NA	NA	NA	NA
10200203	424.59	8.67	0.00	8.67	NA	NA	NA	NA
10220003	424.59	8.67	0.00	8.67	NA	NA	NA	NA
10230001	-393.54	11.26	576.00	-564.74	13607.78	13587.34	0.00	0.00
10230003	114.02	2.33	0.00	2.33	629.15	580.95	0.37	0.40
10230006	-87.49	11.00	473.21	-462.21	15523.52	15519.07	0.00	0.00
10240001	424.59	8.67	0.00	8.67	36033.56	36033.45	0.02	0.02
10240006	-784.90	0.00	722.00	-722.00	NA	NA	NA	NA
10240011	19.42	2.24	16.07	-13.84	18176.63	18129.00	0.00	0.00
10250017	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10270102	54.71	1.12	0.00	1.12	NA	NA	NA	NA
10270104	27.36	0.56	0.00	0.56	2.03	0.00	27.58	0.00
10270202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10270206	424.59	8.67	0.00	8.67	NA	NA	NA	NA
10270207	52.52	0.00	0.00	0.00	NA	NA	NA	NA
10280102	1160.89	3.44	0.00	3.44	889.92	883.23	0.39	0.39
10280203	158.77	3.24	0.00	3.24	261.80	258.81	1.24	1.25
10290102	27.36	0.56	0.00	0.56	962.94	960.52	0.06	0.06
10290108	27.36	0.56	0.00	0.56	880.12	866.54	0.06	0.06
10300101	906.40	24.20	118.68	-94.48	24911.92	24788.97	0.00	0.00
10300102	613.49	16.29	44.30	-28.01	30066.01	30047.63	0.00	0.00
10300104	27.36	0.56	0.00	0.56	543.57	499.82	0.10	0.11
10300200	0.00	0.00	0.00	0.00	31664.35	31598.84	0.00	0.00
11010002	131.73	2.69	0.00	2.69	465.70	459.52	0.58	0.59
11010004	158.77	3.24	0.00	3.24	5691.56	5687.47	0.06	0.06
11010013	-122.00	0.00	0.00	0.00	7339.68	7338.34	0.00	0.00
11030001	15.86	0.56	0.01	0.55	NA	NA	NA	NA
11030004	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030012	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030013	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030015	-5.00	0.00	0.00	0.00	NA	NA	NA	NA
11040006	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11050003	-29.68	0.00	0.01	-0.01	NA	NA	NA	NA
11060004	-34.00	0.00	0.00	0.00	NA	NA	NA	NA
11060006	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11070103	-58.85	0.00	0.00	0.00	NA	NA	NA	NA
11070105	-407.13	1.35	3.92	-2.58	NA	NA	NA	NA
11070204	0.00	0.00	0.00	0.00	NA	NA	NA	NA

11070205	2105.80	34.38	0.00	34.38	NA	NA	NA	NA
11070207	54.71	1.12	0.00	1.12	618.65	606.83	0.18	0.18
11070209	65.87	1.35	0.00	1.35	44.44	44.33	3.03	3.04
11090105	-161.33	1.35	0.96	0.39	NA	NA	NA	NA
11090106	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11090202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11100104	-48.00	0.00	0.24	-0.24	NA	NA	NA	NA
11100301	-538.00	0.00	1.51	-1.51	NA	NA	NA	NA
11100302	-163.00	0.00	0.61	-0.61	NA	NA	NA	NA
11100303	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11110101	-95.00	0.00	0.21	-0.21	NA	NA	NA	NA
11110102	-995.08	1.35	9.92	-8.58	NA	NA	NA	NA
11110103	65.87	1.35	0.00	1.35	292.17	276.98	0.46	0.49
11110105	65.87	1.35	0.00	1.35	222.07	221.21	0.61	0.61
11110201	1427.66	4.22	0.00	4.22	8610.05	8608.58	0.05	0.05
11110202	-1839.00	1.00	734.59	-733.59	13604.25	13603.53	0.00	0.00
11110207	43.77	3.24	0.00	3.24	16211.20	16179.55	0.02	0.02
11130202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11130207	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11130302	-485.00	0.00	1.54	-1.54	NA	NA	NA	NA
11140103	1427.66	4.22	0.00	4.22	NA	NA	NA	NA
11140105	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11140205	-125.00	0.00	0.18	-0.18	526.69	525.58	0.00	0.00
11140206	65.87	1.35	0.00	1.35	552.99	551.85	0.24	0.24
11140207	65.87	1.35	0.00	1.35	8583.47	8581.15	0.02	0.02
11140304	0.00	0.00	0.00	0.00	1122.63	1114.83	0.00	0.00
11140305	-50.00	0.00	2.56	-2.56	NA	NA	NA	NA
11140306	-25.00	0.00	1.36	-1.36	793.51	792.11	0.00	0.00
12010002	-423.13	1.35	48.70	-47.35	33.24	33.24	0.00	0.00
12010005	0.00	0.00	0.00	0.00	2830.80	2827.77	0.00	0.00
12020003	-1824.00	0.00	359.00	-359.00	NA	NA	NA	NA
12020006	49.90	0.78	0.00	0.78	NA	NA	NA	NA
12050002	-178.13	1.35	1.27	0.08	NA	NA	NA	NA
12050003	-138.00	0.00	0.38	-0.38	NA	NA	NA	NA
12080003	0.00	0.00	0.00	0.00	NA	NA	NA	NA
12080004	0.00	0.00	0.00	0.00	NA	NA	NA	NA
13070007	-481.60	0.00	1.62	-1.62	NA	NA	NA	NA

Table D-16. F6S10 Capacity and Water Withdrawal Data by HUC-8 Watersheds

HUC-8	Net Change in Capacity from 2011-2040 (MW)	NB WD from 2011-2040 (MGD)	Ret WD from 2011-2040 (MGD)	Net Change in WD from 2011-2040 (MGD)	Total Water Available (MGD)	Total Fresh Water Available (MGD)	Percent of Total Water Available WD by Net Positive NB Capacity between 2011-2040	Percent of Fresh Water Available WD by Net Positive NB Capacity between 2011-2040
1010004	9.70	0.15	0.00	0.15	2617.26	2615.61	0.01	0.01
1020005	210.13	0.74	0.00	0.74	6517.79	6507.38	0.01	0.01
1030001	9.70	0.15	0.00	0.15	1760.08	1759.95	0.01	0.01
1030002	9.70	0.15	0.00	0.15	982.85	982.85	0.02	0.02
1040002	-12.20	0.15	0.00	0.15	4573.68	4567.82	0.00	0.00
1050002	9.70	0.15	0.00	0.15	2954.03	2911.99	0.01	0.01
1060001	-815.47	0.15	24.20	-24.05	1212.71	1149.63	0.00	0.00
1060002	19.40	0.30	0.00	0.30	2995.23	2976.22	0.01	0.01
1060003	-460.34	0.00	124.20	-124.20	2669.45	1627.08	0.00	0.00
1070001	9.70	0.15	0.00	0.15	1325.45	1322.00	0.01	0.01
1070004	9.70	0.15	0.00	0.15	869.53	760.17	0.02	0.02
1070006	986.14	3.25	0.00	3.25	5093.69	4008.61	0.06	0.08
1080103	29.10	0.45	0.00	0.45	4087.73	4086.93	0.01	0.01
1080106	29.10	0.45	0.00	0.45	7174.38	7156.88	0.01	0.01
1080107	-616.13	0.00	501.00	-501.00	8022.78	8014.72	0.00	0.00
1080201	-164.68	0.00	33.68	-33.68	14034.66	14003.18	0.00	0.00
1080204	-750.14	0.00	28.99	-28.99	698.37	693.07	0.00	0.00
1080205	-335.33	2.51	35.55	-33.04	13529.08	12672.50	0.00	0.00
1080206	0.00	0.00	0.00	0.00	632.63	629.99	0.00	0.00
1090001	-847.03	2.95	299.46	-296.51	1397.10	744.67	0.00	0.00
1090002	-1210.21	0.00	13.06	-13.06	1697.13	536.03	0.00	0.00
1090003	-457.56	0.00	1.44	-1.44	990.75	759.29	0.00	0.00
1090004	-2361.46	0.59	1100.94	-1100.35	3271.25	1422.64	0.00	0.00
1100001	9.70	0.15	0.00	0.15	1529.12	811.26	0.01	0.02
1100003	-1521.93	0.30	719.36	-719.06	3380.15	932.62	0.00	0.00
1100004	19.40	0.30	0.00	0.30	228.56	181.69	0.13	0.17
1100005	639.31	2.36	0.21	2.15	2215.24	1941.93	0.10	0.11
1100006	-510.53	0.00	43.48	-43.48	910.20	92.27	0.00	0.00
2010003	9.70	0.15	0.00	0.15	NA	NA	NA	NA
2020003	0.00	0.00	0.00	0.00	6454.36	6432.98	0.00	0.00
2020006	0.00	0.00	0.00	0.00	6748.10	6682.74	0.00	0.00
2020008	4925.12	0.33	166.57	-166.24	7900.94	7648.27	0.00	0.00
2030101	-3883.82	0.00	1899.74	-1899.74	16572.72	15418.46	0.00	0.00
2030102	0.00	0.00	0.00	0.00	1121.15	221.57	0.00	0.00
2030103	1123.45	4.67	103.52	-98.85	1485.98	523.33	0.00	0.00
2030104	-369.55	1.66	95.11	-93.45	970.47	19.80	0.00	0.00

2030105	4.29	0.07	0.00	0.07	766.82	524.76	0.01	0.01
2030201	-711.10	0.00	51.20	-51.20	639.58	111.04	0.00	0.00
2030202	3209.32	9.79	18.14	-8.35	3282.64	563.63	0.00	0.00
2030203	-451.27	0.00	17.70	-17.70	23.83	0.00	0.00	0.00
2040105	-878.89	0.11	147.37	-147.26	8255.62	8200.11	0.00	0.00
2040106	-80.68	0.05	0.00	0.05	1755.84	1745.28	0.00	0.00
2040201	-644.03	0.13	157.06	-156.93	8791.52	8662.63	0.00	0.00
2040202	-733.54	1.17	137.06	-135.89	12297.25	11712.60	0.00	0.00
2040203	11874.51	38.13	68.42	-30.29	2116.35	1828.61	0.00	0.00
2040205	0.00	0.00	0.00	0.00	1168.93	718.91	0.00	0.00
2040206	-221.75	4.53	910.10	-905.58	12072.36	6425.50	0.00	0.00
2040207	648.05	1.90	0.11	1.79	236.19	125.15	0.76	1.43
2040301	-344.70	1.01	494.94	-493.93	1374.56	458.24	0.00	0.00
2040303	-800.00	0.00	82.90	-82.90	342.99	227.02	0.00	0.00
2050103	-81.55	0.00	0.00	0.00	5537.26	5535.36	0.00	0.00
2050107	245.62	3.83	0.00	3.83	6346.13	6331.19	0.06	0.06
2050201	-611.18	0.05	240.00	-239.95	1688.21	1672.20	0.00	0.00
2050206	491.25	7.66	0.00	7.66	4556.80	4543.24	0.17	0.17
2050301	-408.48	0.05	188.00	-187.95	10417.44	10379.83	0.00	0.00
2050305	-540.38	3.83	14.30	-10.47	12970.81	12930.69	0.00	0.00
2050306	-3004.76	7.84	2521.62	-2513.79	27825.44	27755.29	0.00	0.00
2060003	-626.56	3.88	203.98	-200.11	1286.47	284.96	0.00	0.00
2060004	-1849.50	0.00	1530.00	-1530.00	1961.75	31.08	0.00	0.00
2060006	-2448.50	0.05	325.31	-325.26	6334.16	319.20	0.00	0.00
2070002	0.00	0.00	0.00	0.00	1843.94	1836.38	0.00	0.00
2070004	-109.50	0.00	26.55	-26.55	6296.56	6280.20	0.00	0.00
2070005	2185.04	6.47	0.00	6.47	865.02	852.60	0.75	0.76
2070006	0.00	0.00	0.00	0.00	360.97	337.03	0.00	0.00
2070008	248.66	6.47	251.67	-245.20	8792.54	8669.53	0.00	0.00
2070010	375.36	21.96	99.81	-77.85	9991.26	9081.52	0.00	0.00
2070011	-189.96	4.74	38.00	-33.26	13215.03	10889.84	0.00	0.00
2080104	0.00	0.00	0.00	0.00	1024.26	993.97	0.00	0.00
2080106	-75.48	0.08	63.38	-63.29	522.76	475.53	0.00	0.00
2080107	-375.00	0.00	56.71	-56.71	1852.93	916.81	0.00	0.00
2080109	-172.00	0.00	0.03	-0.03	608.68	451.30	0.00	0.00
2080203	-127.45	2.11	97.50	-95.39	2804.46	2798.55	0.00	0.00
2080204	856.04	2.53	0.00	2.53	537.66	537.56	0.47	0.47
2080206	-1382.92	5.15	2093.66	-2088.51	5484.27	3594.61	0.00	0.00
2080208	0.00	0.00	0.00	0.00	447.86	84.51	0.00	0.00
3010101	1405.04	21.91	0.00	21.91	1365.24	1360.61	1.60	1.61
3010102	0.00	0.00	0.00	0.00	2775.95	2762.56	0.00	0.00
3010103	-364.50	0.00	62.50	-62.50	2230.37	2216.86	0.00	0.00

3010104	-500.00	0.00	191.92	-191.92	2464.56	2464.14	0.00	0.00
3010107	0.00	0.00	0.00	0.00	3127.76	3103.64	0.00	0.00
3010201	0.00	0.00	0.00	0.00	1120.64	1116.69	0.00	0.00
3010202	0.00	0.00	0.00	0.00	2584.80	491.90	0.00	0.00
3020101	0.00	0.00	0.00	0.00	656.63	629.65	0.00	0.00
3020201	-104.17	9.12	4.28	4.84	1336.20	1286.97	0.36	0.38
3020204	2366.57	36.90	0.00	36.90	1757.08	1754.23	2.10	2.10
3030004	11935.19	42.10	293.75	-251.65	2147.98	2119.04	0.00	0.00
3030005	-2157.67	14.74	1639.22	-1624.48	4121.75	2911.45	0.00	0.00
3030007	2328.47	36.31	0.00	36.31	578.79	575.09	6.27	6.31
3040102	0.00	0.00	0.00	0.00	649.75	642.83	0.00	0.00
3040103	-373.00	0.00	114.00	-114.00	1999.34	1969.54	0.00	0.00
3040105	1166.13	18.18	0.00	18.18	755.88	752.07	2.41	2.42
3040201	-592.60	0.00	310.25	-310.25	5999.07	5977.50	0.00	0.00
3040203	-322.50	0.00	1.49	-1.49	1132.68	1123.29	0.00	0.00
3040206	-163.20	0.00	1.45	-1.45	6509.58	5739.22	0.00	0.00
3040207	0.00	0.00	0.00	0.00	5573.08	5555.81	0.00	0.00
3040208	0.00	0.00	0.00	0.00	963.86	188.76	0.00	0.00
3050101	-1655.83	18.24	1268.55	-1250.30	3906.00	3835.46	0.00	0.00
3050102	-696.00	0.00	292.30	-292.30	551.10	525.86	0.00	0.00
3050103	1166.23	18.19	0.00	18.19	1994.79	1980.99	0.91	0.92
3050104	0.00	0.00	0.00	0.00	2228.28	2225.83	0.00	0.00
3050105	-765.00	0.00	10.10	-10.10	3251.98	3199.38	0.00	0.00
3050106	388.33	9.12	0.00	9.12	2265.05	2250.96	0.40	0.41
3050109	-696.10	0.00	198.50	-198.50	985.78	892.87	0.00	0.00
3050110	0.00	0.00	0.00	0.00	3145.39	3145.04	0.00	0.00
3050201	-526.20	0.00	62.80	-62.80	1785.76	1761.89	0.00	0.00
3050204	0.00	0.00	0.00	0.00	295.71	247.15	0.00	0.00
3050206	-396.00	5.62	4.46	1.16	876.84	875.29	0.13	0.13
3060101	-2176.67	9.12	2140.00	-2130.88	1616.27	1578.54	0.00	0.00
3060102	0.00	0.00	0.00	0.00	2885.96	2881.27	0.00	0.00
3060103	0.00	0.00	0.00	0.00	4394.77	4377.77	0.00	0.00
3060106	-649.64	0.00	112.31	-112.31	7201.08	7193.75	0.00	0.00
3060108	756.67	17.77	0.00	17.77	546.23	545.46	3.25	3.26
3060109	254.93	12.04	97.00	-84.96	8458.09	8184.15	0.00	0.00
3070101	-1017.42	12.04	509.00	-496.96	2095.71	2088.20	0.00	0.00
3070103	0.00	0.00	0.00	0.00	1020.56	922.24	0.00	0.00
3070104	-117.00	0.00	0.03	-0.03	2455.94	2445.48	0.00	0.00
3070202	-1025.05	17.77	33.83	-16.06	206.51	205.83	0.00	0.00
3070203	-239.15	0.00	0.31	-0.31	1048.87	1035.55	0.00	0.00
3070204	0.00	0.00	0.00	0.00	875.77	795.87	0.00	0.00
3080101	-308.70	0.00	1.21	-1.21	798.97	528.50	0.00	0.00

3080102	4076.10	13.82	0.31	13.51	417.93	403.98	3.23	3.34
3080103	-532.00	0.00	1.59	-1.59	2032.19	1057.83	0.00	0.00
3080202	-792.76	0.00	32.27	-32.27	217.53	89.85	0.00	0.00
3090101	3916.81	11.59	0.00	11.59	309.94	283.49	3.74	4.09
3090202	295.29	4.60	0.00	4.60	1591.03	216.62	0.29	2.13
3090205	142.99	2.23	0.00	2.23	498.30	0.00	0.45	0.00
3090206	7526.49	54.41	2162.82	-2108.41	2691.47	212.71	0.00	0.00
3100101	8.49	2.23	12.50	-10.27	264.13	255.71	0.00	0.00
3100202	0.00	0.00	0.00	0.00	54.00	50.92	0.00	0.00
3100205	0.00	0.00	0.00	0.00	2072.61	0.00	0.00	0.00
3100206	428.98	6.69	0.00	6.69	1584.63	0.00	0.42	0.00
3100207	-1192.01	2.23	157.57	-155.34	3125.75	0.00	0.00	0.00
3110204	575.58	12.04	0.20	11.84	406.49	405.80	2.91	2.92
3110205	-308.50	0.00	49.00	-49.00	3729.25	3722.24	0.00	0.00
3110206	0.00	0.00	0.00	0.00	535.82	531.33	0.00	0.00
3120001	-50.00	0.00	4.57	-4.57	705.40	690.77	0.00	0.00
3120003	40.99	2.23	0.30	1.93	1378.94	1376.94	0.14	0.14
3130002	-681.44	24.09	14.92	9.17	4727.28	4682.23	0.19	0.20
3130005	1133.20	17.67	0.00	17.67	1189.73	1068.43	1.49	1.65
3130008	328.53	12.04	11.30	0.74	2899.86	2871.01	0.03	0.03
3130011	15.40	0.00	11.60	-11.60	9310.47	9305.97	0.00	0.00
3130012	0.00	0.00	0.00	0.00	1741.32	1730.72	0.00	0.00
3140101	1094.70	17.07	0.00	17.07	1967.89	1498.90	0.87	1.14
3140301	0.00	0.00	0.00	0.00	1034.08	1031.99	0.00	0.00
3140305	-340.42	12.04	46.70	-34.66	3039.55	3039.33	0.00	0.00
3150101	0.00	0.00	0.00	0.00	1045.80	1045.80	0.00	0.00
3150104	0.00	0.00	0.00	0.00	986.84	971.08	0.00	0.00
3150105	-243.42	12.04	281.00	-268.96	6203.32	6171.76	0.00	0.00
3150106	459.58	12.04	0.00	12.04	5530.86	5497.50	0.22	0.22
3150107	-1161.00	0.00	220.47	-220.47	6219.46	6214.25	0.00	0.00
3150109	2420.95	7.71	0.40	7.32	2178.48	2170.35	0.34	0.34
3150201	2606.95	7.71	0.00	7.71	8847.47	8803.64	0.09	0.09
3160105	0.00	0.00	0.00	0.00	1133.31	1132.27	0.00	0.00
3160109	-250.00	0.00	123.05	-123.05	1749.06	1739.81	0.00	0.00
3160111	0.00	0.00	0.00	0.00	1121.54	1078.37	0.00	0.00
3160113	-317.11	0.00	56.20	-56.20	3797.05	3776.62	0.00	0.00
3160201	1137.20	17.73	0.00	17.73	10747.80	10745.20	0.16	0.17
3160202	1933.70	30.15	0.00	30.15	980.74	980.12	3.07	3.08
3160203	0.00	0.00	0.00	0.00	11272.22	11271.10	0.00	0.00
3160204	-953.72	29.11	692.00	-662.89	22204.76	22186.18	0.00	0.00
3160205	0.00	0.00	0.00	0.00	442.35	440.31	0.00	0.00
3170001	-128.30	0.00	0.01	-0.01	687.14	681.85	0.00	0.00

3170004	-335.25	0.00	0.48	-0.48	1440.65	1431.79	0.00	0.00
3170006	0.00	0.00	0.00	0.00	5440.36	5436.01	0.00	0.00
3170007	-73.60	0.00	0.89	-0.89	1256.05	1254.59	0.00	0.00
3170009	-412.52	12.04	74.70	-62.66	1588.68	1452.14	0.00	0.00
3180001	6859.49	99.70	0.00	99.70	1875.18	1864.26	5.32	5.35
3180002	-729.50	0.00	2.40	-2.40	2221.92	2219.99	0.00	0.00
3180005	-1.48	0.00	0.00	0.00	1523.20	1514.85	0.00	0.00
4010101	-84.00	0.00	44.82	-44.82	1044.95	1044.95	0.00	0.00
4010201	313.15	8.34	58.50	-50.16	2593.26	2565.57	0.00	0.00
4010301	-67.20	0.00	36.09	-36.09	1137.02	1119.58	0.00	0.00
4020101	66.50	2.09	4.68	-2.59	846.83	846.05	0.00	0.00
4020105	18748.86	304.06	194.97	109.09	661.69	657.52	16.49	16.59
4030101	-1456.40	4.85	1119.81	-1114.96	270.16	258.15	0.00	0.00
4030102	-556.00	2.76	638.37	-635.61	62.26	57.21	0.00	0.00
4030110	0.00	0.00	0.00	0.00	549.02	545.99	0.00	0.00
4030111	50.73	2.09	12.80	-10.71	293.39	288.91	0.00	0.00
4030201	75.60	2.09	0.00	2.09	2066.75	1823.20	0.10	0.11
4030204	-119.00	0.00	47.09	-47.09	1700.01	1694.51	0.00	0.00
4040001	3111.89	18.96	2023.82	-2004.87	122.91	111.54	0.00	0.00
4040002	-1053.00	2.09	405.00	-402.91	47.07	44.11	0.00	0.00
4040003	0.00	0.00	0.00	0.00	198.25	185.49	0.00	0.00
4050001	-55.70	0.00	0.71	-0.71	4359.87	4317.83	0.00	0.00
4050002	-27.00	0.00	13.59	-13.59	284.29	282.32	0.00	0.00
4050003	0.00	0.00	0.00	0.00	316.44	298.44	0.00	0.00
4050004	0.00	0.00	0.00	0.00	116.99	85.82	0.00	0.00
4050006	0.00	0.00	0.00	0.00	2179.74	2085.68	0.00	0.00
4060101	0.00	0.00	0.00	0.00	1401.26	1399.14	0.00	0.00
4060102	-507.00	0.00	175.00	-175.00	1574.09	1568.18	0.00	0.00
4060103	-60.00	0.00	0.00	0.00	1525.86	1524.34	0.00	0.00
4070006	0.00	0.00	0.00	0.00	755.53	754.89	0.00	0.00
4070007	0.00	0.00	0.00	0.00	1559.17	1558.60	0.00	0.00
4080103	-932.00	0.00	228.03	-228.03	320.00	314.93	0.00	0.00
4080201	0.00	0.00	0.00	0.00	1279.65	1272.63	0.00	0.00
4080204	0.00	0.00	0.00	0.00	713.66	687.12	0.00	0.00
4090001	0.00	0.00	0.00	0.00	467.73	404.80	0.00	0.00
4090002	0.00	0.00	0.00	0.00	2371.66	2370.70	0.00	0.00
4090004	-1346.53	0.00	301.20	-301.20	2573.97	2560.58	0.00	0.00
4090005	0.00	0.00	0.00	0.00	253.19	195.76	0.00	0.00
4100001	-1121.00	0.00	206.10	-206.10	857.71	191.59	0.00	0.00
4100002	0.00	0.00	0.00	0.00	627.32	602.61	0.00	0.00
4100009	0.00	0.00	0.00	0.00	2099.71	2002.85	0.00	0.00
4100010	-1385.30	0.08	256.78	-256.70	314.46	287.02	0.00	0.00

4110001	0.00	0.00	0.00	0.00	261.02	213.93	0.00	0.00
4110003	-1302.40	4.21	627.50	-623.29	330.38	303.98	0.00	0.00
4110004	859.50	2.61	0.00	2.61	391.43	373.57	0.67	0.70
4120101	-596.97	2.11	322.90	-320.79	685.37	658.79	0.00	0.00
4120104	-218.55	0.47	186.00	-185.53	775.90	724.79	0.00	0.00
4130001	-522.95	0.47	368.00	-367.53	461.35	442.52	0.00	0.00
4130002	159.75	0.47	0.00	0.47	581.06	575.03	0.08	0.08
4140101	-2180.50	1.32	578.39	-577.07	468.98	376.11	0.00	0.00
4140102	-1298.55	2.63	838.17	-835.54	1165.72	1161.71	0.00	0.00
4140201	-494.85	0.00	172.08	-172.08	2771.03	2713.56	0.00	0.00
4140202	159.75	0.47	0.00	0.47	2008.06	1921.90	0.02	0.02
4150101	-55.90	0.00	0.00	0.00	2995.25	2984.17	0.00	0.00
4150304	0.00	0.00	0.00	0.00	797.47	796.35	0.00	0.00
4150308	0.00	0.00	0.00	0.00	369.87	369.68	0.00	0.00
5010001	0.00	0.00	0.00	0.00	4138.47	4112.10	0.00	0.00
5010002	-86.00	0.00	0.63	-0.63	1508.71	1502.54	0.00	0.00
5010003	-82.68	0.05	0.00	0.05	4835.49	4825.49	0.00	0.00
5010005	0.00	0.00	0.00	0.00	1342.14	1338.67	0.00	0.00
5010006	-347.18	0.05	147.00	-146.95	6109.54	6019.66	0.00	0.00
5010007	-1833.36	0.09	11.78	-11.68	1333.78	1308.29	0.00	0.00
5010009	856.04	2.53	0.00	2.53	6841.95	6816.10	0.04	0.04
5020002	0.00	0.00	0.00	0.00	657.69	647.55	0.00	0.00
5020003	-36.45	2.11	1.67	0.44	3638.01	3622.82	0.01	0.01
5020004	-184.45	2.11	51.80	-49.69	2852.86	2851.69	0.00	0.00
5020005	-412.45	2.11	77.89	-75.78	4852.06	4656.91	0.00	0.00
5030101	-4140.25	0.08	1263.97	-1263.89	39513.22	39455.08	0.00	0.00
5030103	-140.45	2.11	46.40	-44.29	1108.84	996.64	0.00	0.00
5030104	0.00	0.00	0.00	0.00	1346.39	1342.35	0.00	0.00
5030106	-924.95	2.11	262.00	-259.89	27682.87	27630.39	0.00	0.00
5030201	-134.95	2.11	0.42	1.69	28893.52	28884.65	0.01	0.01
5030202	-1028.90	4.21	222.00	-217.79	37139.86	37126.86	0.00	0.00
5040001	0.00	0.00	0.00	0.00	1656.96	1539.24	0.00	0.00
5040002	69.05	2.11	0.23	1.88	586.86	576.95	0.32	0.33
5040004	-2991.95	2.11	377.30	-375.19	3388.26	3374.36	0.00	0.00
5050002	-226.95	2.11	20.10	-17.99	4317.85	4310.31	0.00	0.00
5050006	-296.95	2.11	100.00	-97.89	4514.82	4508.88	0.00	0.00
5050008	0.00	0.00	0.00	0.00	6084.27	6054.54	0.00	0.00
5060001	5.55	2.11	7.57	-5.46	1379.48	1226.34	0.00	0.00
5070204	-1060.00	0.00	10.20	-10.20	3407.48	3388.25	0.00	0.00
5080002	-253.95	2.11	23.70	-21.59	1868.17	1840.01	0.00	0.00
5080003	0.00	0.00	0.00	0.00	1505.57	1341.95	0.00	0.00
5090103	0.00	0.00	0.00	0.00	50828.76	50695.29	0.00	0.00

5090201	-1221.30	0.00	315.12	-315.12	61980.03	61941.42	0.00	0.00
5090203	-2199.85	2.11	449.00	-446.89	96792.72	96754.22	0.00	0.00
5100205	-573.19	8.45	90.31	-81.86	3665.17	3640.65	0.00	0.00
5110003	653.34	0.44	549.63	-549.19	3419.15	3413.57	0.00	0.00
5110005	0.00	0.00	0.00	0.00	4582.40	4577.82	0.00	0.00
5120101	0.00	0.00	0.00	0.00	1280.60	1258.52	0.00	0.00
5120104	0.00	0.00	0.00	0.00	447.73	432.99	0.00	0.00
5120108	0.00	0.00	0.00	0.00	3850.07	3830.96	0.00	0.00
5120109	273.00	9.14	1.47	7.67	1016.74	1013.02	0.75	0.76
5120110	0.00	0.00	0.00	0.00	404.83	402.35	0.00	0.00
5120111	-329.20	9.14	279.67	-270.53	9553.43	9519.87	0.00	0.00
5120112	437.74	9.14	0.00	9.14	1003.92	984.06	0.91	0.93
5120113	0.00	0.00	0.00	0.00	22733.19	22718.67	0.00	0.00
5120114	0.00	0.00	0.00	0.00	1204.15	1150.43	0.00	0.00
5120201	254.02	0.00	88.03	-88.03	1487.23	1235.78	0.00	0.00
5120202	-144.20	0.00	16.04	-16.04	4662.24	4649.44	0.00	0.00
5120209	0.00	0.00	0.00	0.00	536.41	535.02	0.00	0.00
5130103	0.00	0.00	0.00	0.00	7472.58	7470.09	0.00	0.00
5130201	21.46	0.44	0.00	0.44	6628.84	6622.86	0.01	0.01
5130205	21.46	0.44	0.00	0.44	24012.74	23966.74	0.00	0.00
5140101	-597.23	0.00	336.91	-336.91	68708.29	68684.45	0.00	0.00
5140201	0.00	0.00	0.00	0.00	83731.55	83686.91	0.00	0.00
5140202	0.00	0.00	0.00	0.00	151320.33	151271.25	0.00	0.00
5140204	0.00	0.00	0.00	0.00	502.88	493.97	0.00	0.00
5140206	-503.54	0.44	293.72	-293.28	198159.89	198144.34	0.00	0.00
6010104	-338.54	0.44	176.95	-176.51	1981.14	1969.77	0.00	0.00
6010105	-726.50	0.00	230.00	-230.00	3371.01	3363.16	0.00	0.00
6010205	-237.50	0.00	0.99	-0.99	2658.94	2620.56	0.00	0.00
6010207	21.46	0.44	0.00	0.44	2585.87	2497.43	0.02	0.02
6010208	21.46	0.44	0.00	0.44	952.76	945.81	0.05	0.05
6020001	-1008.34	36.53	44.54	-8.01	13866.66	13852.65	0.00	0.00
6030001	-1372.14	0.44	495.77	-495.33	28024.15	28006.83	0.00	0.00
6030002	-1084.78	3.35	800.78	-797.43	18623.69	18560.09	0.00	0.00
6030005	-778.54	0.44	270.11	-269.67	57086.96	57062.58	0.00	0.00
6040005	-1463.74	0.44	397.07	-396.64	45350.41	45343.31	0.00	0.00
7010101	0.00	0.00	0.00	0.00	725.53	723.82	0.00	0.00
7010203	0.00	0.00	0.00	0.00	2393.12	2385.01	0.00	0.00
7010204	-614.00	0.74	518.25	-517.51	376.26	363.34	0.00	0.00
7010205	0.00	0.00	0.00	0.00	241.39	212.34	0.00	0.00
7010206	0.00	0.00	0.00	0.00	5814.97	5775.26	0.00	0.00
7020001	0.00	0.00	0.00	0.00	256.83	256.26	0.00	0.00
7020004	0.00	0.00	0.00	0.00	594.71	587.99	0.00	0.00

7020007	0.00	0.00	0.00	0.00	1204.13	1198.38	0.00	0.00
7020009	0.00	0.00	0.00	0.00	789.60	781.06	0.00	0.00
7020012	-276.80	0.00	59.49	-59.49	2011.65	2007.97	0.00	0.00
7030005	0.00	0.00	0.00	0.00	3861.20	3856.09	0.00	0.00
7040001	0.00	0.00	0.00	0.00	12392.67	12158.43	0.00	0.00
7040002	-1085.00	0.74	902.42	-901.68	418.96	409.06	0.00	0.00
7040003	-181.00	0.00	28.76	-28.76	10121.07	10102.16	0.00	0.00
7040004	-99.00	0.00	0.28	-0.28	477.24	471.54	0.00	0.00
7040006	0.00	0.00	0.00	0.00	12981.16	12980.05	0.00	0.00
7060001	-37.50	0.00	14.55	-14.55	26583.34	26570.88	0.00	0.00
7060003	-125.10	2.09	118.00	-115.91	28498.07	28490.86	0.00	0.00
7060005	-70.20	0.00	19.68	-19.68	34445.57	34422.18	0.00	0.00
7070002	-667.00	0.00	52.27	-52.27	1876.85	1817.29	0.00	0.00
7070005	0.00	0.00	0.00	0.00	14385.66	14374.28	0.00	0.00
7080101	36.08	8.34	216.66	-208.32	31419.79	31401.88	0.00	0.00
7080104	0.00	0.00	0.00	0.00	121131.97	121120.42	0.00	0.00
7080105	372.58	8.34	0.00	8.34	434.89	428.51	1.92	1.95
7080201	0.00	0.00	0.00	0.00	566.58	556.32	0.00	0.00
7080203	0.00	0.00	0.00	0.00	172.78	172.57	0.00	0.00
7080205	0.00	0.00	0.00	0.00	1033.20	1019.66	0.00	0.00
7080206	-590.55	0.74	10.13	-9.39	1562.52	1553.97	0.00	0.00
7080208	272.88	8.34	0.00	8.34	757.61	754.90	1.10	1.10
7090002	-118.19	0.00	2.05	-2.05	1732.35	1725.75	0.00	0.00
7090005	-322.20	4.55	1713.26	-1708.71	2690.51	2642.92	0.00	0.00
7100008	0.00	0.00	0.00	0.00	2337.57	2307.43	0.00	0.00
7100009	0.00	0.00	0.00	0.00	5744.43	5737.49	0.00	0.00
7110004	-22.00	0.00	3.90	-3.90	70849.91	70607.29	0.00	0.00
7110009	-150.00	0.00	85.87	-85.87	81843.77	81834.91	0.00	0.00
7120001	0.00	0.00	0.00	0.00	2673.47	2594.80	0.00	0.00
7120003	-236.84	2.11	284.11	-282.01	65.51	15.01	0.00	0.00
7120004	-2259.15	0.08	935.45	-935.37	1280.66	285.01	0.00	0.00
7120005	-1734.00	0.08	27.76	-27.67	1627.02	1623.81	0.00	0.00
7130001	3.45	0.08	0.00	0.08	4810.02	4774.33	0.00	0.00
7130003	-561.00	0.00	85.84	-85.84	6605.06	6597.82	0.00	0.00
7130007	0.00	0.00	0.00	0.00	369.36	366.09	0.00	0.00
7130009	0.00	0.00	0.00	0.00	729.86	707.72	0.00	0.00
7130011	82.50	9.14	75.40	-66.26	8931.86	8629.80	0.00	0.00
7140101	0.00	0.00	0.00	0.00	135097.54	135047.92	0.00	0.00
7140102	-924.00	0.00	412.97	-412.97	1653.59	1413.84	0.00	0.00
7140105	0.00	0.00	0.00	0.00	153254.12	153247.99	0.00	0.00
7140201	0.00	0.00	0.00	0.00	579.31	568.85	0.00	0.00
7140203	0.00	0.00	0.00	0.00	272.48	265.92	0.00	0.00

7140204	0.00	0.00	0.00	0.00	1569.59	1499.32	0.00	0.00
8010208	0.00	0.00	0.00	0.00	1877.51	1874.51	0.00	0.00
8010211	21.46	0.44	0.00	0.44	103.44	94.94	0.42	0.46
8020203	130.43	4.68	0.64	4.04	2428.34	2394.24	0.17	0.17
8020204	164.07	3.35	0.00	3.35	1129.44	1111.92	0.30	0.30
8020303	0.00	0.00	0.00	0.00	14187.29	14184.27	0.00	0.00
8030100	-726.50	0.00	174.00	-174.00	704058.81	704058.15	0.00	0.00
8030201	0.00	0.00	0.00	0.00	1378.65	1375.11	0.00	0.00
8030206	180.50	0.00	0.01	-0.01	6643.06	6635.13	0.00	0.00
8030207	595.49	9.58	0.01	9.57	23.83	0.00	40.17	0.00
8040101	-721.00	0.00	18.40	-18.40	860.61	860.05	0.00	0.00
8040102	-134.00	0.00	0.00	0.00	2667.72	2663.17	0.00	0.00
8040201	0.00	0.00	0.00	0.00	3552.02	3539.61	0.00	0.00
8040202	-405.00	0.00	0.02	-0.02	11902.79	11896.26	0.00	0.00
8040205	0.00	0.00	0.00	0.00	919.19	897.15	0.00	0.00
8040207	0.00	0.00	0.00	0.00	9629.39	9624.33	0.00	0.00
8060100	-1188.50	0.00	194.00	-194.00	379024.93	379024.69	0.00	0.00
8060201	0.00	0.00	0.00	0.00	1061.69	1051.85	0.00	0.00
8060203	42.50	1.00	0.00	1.00	534.78	534.10	0.19	0.19
8070100	-1917.00	0.00	65.30	-65.30	379486.60	379486.60	0.00	0.00
8070201	-335.10	1.00	8.08	-7.08	190055.06	190052.07	0.00	0.00
8070202	0.00	0.00	0.00	0.00	1497.53	1459.56	0.00	0.00
8070204	-1185.50	0.00	216.00	-216.00	1911.07	1902.05	0.00	0.00
8070300	-687.23	3.35	124.25	-120.90	347.63	337.83	0.00	0.00
8080102	-125.00	0.00	0.00	0.00	1141.54	1015.14	0.00	0.00
8080103	-54.40	0.00	1.11	-1.11	152.28	115.18	0.00	0.00
8080201	0.00	0.00	0.00	0.00	577.04	568.30	0.00	0.00
8080205	97.77	3.35	0.68	2.68	462.13	462.13	0.58	0.58
8090203	-572.80	0.00	131.79	-131.79	190068.50	190052.03	0.00	0.00
8090301	288.87	4.25	127.00	-122.75	190080.79	190054.98	0.00	0.00
8090302	-84.10	0.00	0.05	-0.05	1927.07	1917.68	0.00	0.00
9020103	-129.70	0.00	7.55	-7.55	276.21	273.63	0.00	0.00
10100004	93.14	0.00	32.60	-32.60	NA	NA	NA	NA
10130101	-105.22	10.74	568.45	-557.72	NA	NA	NA	NA
10130201	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10160002	106.20	2.17	0.00	2.17	NA	NA	NA	NA
10190018	242.53	4.95	0.00	4.95	NA	NA	NA	NA
10200101	242.53	4.95	0.00	4.95	NA	NA	NA	NA
10200102	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10200203	242.53	4.95	0.00	4.95	NA	NA	NA	NA
10220003	242.53	4.95	0.00	4.95	NA	NA	NA	NA
10230001	-536.82	8.34	576.00	-567.66	13607.78	13587.34	0.00	0.00

10230003	0.00	0.00	0.00	0.00	629.15	580.95	0.00	0.00
10230006	-383.57	4.95	473.21	-468.26	15523.52	15519.07	0.00	0.00
10240001	242.53	4.95	0.00	4.95	36033.56	36033.45	0.01	0.01
10240006	-784.90	0.00	722.00	-722.00	NA	NA	NA	NA
10240011	19.42	2.24	16.07	-13.84	18176.63	18129.00	0.00	0.00
10250017	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10270102	54.71	1.12	0.00	1.12	NA	NA	NA	NA
10270104	27.36	0.56	0.00	0.56	2.03	0.00	27.58	0.00
10270202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10270206	242.53	4.95	0.00	4.95	NA	NA	NA	NA
10270207	143.34	0.00	0.00	0.00	NA	NA	NA	NA
10280102	0.00	0.00	0.00	0.00	889.92	883.23	0.00	0.00
10280203	164.07	3.35	0.00	3.35	261.80	258.81	1.28	1.30
10290102	27.36	0.56	0.00	0.56	962.94	960.52	0.06	0.06
10290108	27.36	0.56	0.00	0.56	880.12	866.54	0.06	0.06
10300101	-513.93	2.24	234.08	-231.85	24911.92	24788.97	0.00	0.00
10300102	624.08	16.51	44.30	-27.79	30066.01	30047.63	0.00	0.00
10300104	27.36	0.56	0.00	0.56	543.57	499.82	0.10	0.11
10300200	0.00	0.00	0.00	0.00	31664.35	31598.84	0.00	0.00
11010002	131.73	2.69	0.00	2.69	465.70	459.52	0.58	0.59
11010004	164.07	3.35	0.00	3.35	5691.56	5687.47	0.06	0.06
11010013	-122.00	0.00	0.00	0.00	7339.68	7338.34	0.00	0.00
11030001	27.36	0.56	0.00	0.56	NA	NA	NA	NA
11030004	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030012	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030013	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030015	-5.00	0.00	0.00	0.00	NA	NA	NA	NA
11040006	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11050003	-29.68	0.00	0.01	-0.01	NA	NA	NA	NA
11060004	-34.00	0.00	0.00	0.00	NA	NA	NA	NA
11060006	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11070103	-58.85	0.00	0.00	0.00	NA	NA	NA	NA
11070105	-459.13	1.35	4.36	-3.01	NA	NA	NA	NA
11070204	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11070205	5998.31	95.71	0.00	95.71	NA	NA	NA	NA
11070207	54.71	1.12	0.00	1.12	618.65	606.83	0.18	0.18
11070209	65.87	1.35	0.00	1.35	44.44	44.33	3.03	3.04
11090105	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11090106	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11090202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11100104	-48.00	0.00	0.24	-0.24	NA	NA	NA	NA
11100301	-538.00	0.00	1.51	-1.51	NA	NA	NA	NA

11100302	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11100303	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11110101	-95.00	0.00	0.21	-0.21	NA	NA	NA	NA
11110102	-995.08	1.35	9.92	-8.58	NA	NA	NA	NA
11110103	65.87	1.35	0.00	1.35	292.17	276.98	0.46	0.49
11110105	65.87	1.35	0.00	1.35	222.07	221.21	0.61	0.61
11110201	356.50	1.05	0.00	1.05	8610.05	8608.58	0.01	0.01
11110202	-1839.00	1.00	734.59	-733.59	13604.25	13603.53	0.00	0.00
11110207	49.07	3.35	0.00	3.35	16211.20	16179.55	0.02	0.02
11130202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11130207	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11130302	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11140103	356.50	1.05	0.00	1.05	NA	NA	NA	NA
11140105	65.87	1.35	0.00	1.35	NA	NA	NA	NA
11140205	-125.00	0.00	0.18	-0.18	526.69	525.58	0.00	0.00
11140206	65.87	1.35	0.00	1.35	552.99	551.85	0.24	0.24
11140207	65.87	1.35	0.00	1.35	8583.47	8581.15	0.02	0.02
11140304	0.00	0.00	0.00	0.00	1122.63	1114.83	0.00	0.00
11140305	-50.00	0.00	2.56	-2.56	NA	NA	NA	NA
11140306	-25.00	0.00	1.36	-1.36	793.51	792.11	0.00	0.00
12010002	-423.13	1.35	48.70	-47.35	33.24	33.24	0.00	0.00
12010005	0.00	0.00	0.00	0.00	2830.80	2827.77	0.00	0.00
12020003	-1824.00	0.00	359.00	-359.00	NA	NA	NA	NA
12020006	49.90	0.78	0.00	0.78	NA	NA	NA	NA
12050002	65.87	1.35	0.00	1.35	NA	NA	NA	NA
12050003	-138.00	0.00	0.38	-0.38	NA	NA	NA	NA
12080003	0.00	0.00	0.00	0.00	NA	NA	NA	NA
12080004	0.00	0.00	0.00	0.00	NA	NA	NA	NA
13070007	0.00	0.00	0.00	0.00	NA	NA	NA	NA

Table D-17. F8S7 Capacity and Water Withdrawal Data by HUC-8 Watersheds

HUC-8	Net Change in Capacity from 2011-2040 (MW)	NB WD from 2011-2040 (MGD)	Ret WD from 2011-2040 (MGD)	Net Change in WD from 2011-2040 (MGD)	Total Water Available (MGD)	Total Fresh Water Available (MGD)	Percent of Total Water Available WD by Net Positive NB Capacity between 2011-2040	Percent of Fresh Water Available WD by Net Positive NB Capacity between 2011-2040
1010004	-37.50	0.15	0.83	-0.68	2617.26	2615.61	0.00	0.00
1020005	-200.15	1.16	2.43	-1.28	6517.79	6507.38	0.00	0.00
1030001	9.70	0.15	0.00	0.15	1760.08	1759.95	0.01	0.01
1030002	9.70	0.15	0.00	0.15	982.85	982.85	0.02	0.02
1040002	-12.20	0.15	0.00	0.15	4573.68	4567.82	0.00	0.00
1050002	-26.45	0.15	0.46	-0.31	2954.03	2911.99	0.00	0.00
1060001	-815.47	0.15	24.20	-24.05	1212.71	1149.63	0.00	0.00
1060002	-15.30	0.30	37.27	-36.96	2995.23	2976.22	0.00	0.00
1060003	-495.21	0.00	124.20	-124.20	2669.45	1627.08	0.00	0.00
1070001	-20.00	0.15	25.84	-25.69	1325.45	1322.00	0.00	0.00
1070004	-40.00	0.15	1.23	-1.08	869.53	760.17	0.00	0.00
1070006	128.63	1.31	59.27	-57.96	5093.69	4008.61	0.00	0.00
1080103	3.71	0.45	0.65	-0.19	4087.73	4086.93	0.00	0.00
1080106	15.18	0.45	0.00	0.45	7174.38	7156.88	0.01	0.01
1080107	-616.13	0.00	501.00	-501.00	8022.78	8014.72	0.00	0.00
1080201	-164.68	0.00	33.68	-33.68	14034.66	14003.18	0.00	0.00
1080204	-750.14	0.00	28.99	-28.99	698.37	693.07	0.00	0.00
1080205	-791.13	1.16	35.55	-34.39	13529.08	12672.50	0.00	0.00
1080206	0.00	0.00	0.00	0.00	632.63	629.99	0.00	0.00
1090001	-2274.20	2.02	480.44	-478.42	1397.10	744.67	0.00	0.00
1090002	-1210.21	0.00	13.06	-13.06	1697.13	536.03	0.00	0.00
1090003	-457.56	0.00	1.44	-1.44	990.75	759.29	0.00	0.00
1090004	-2488.70	1.01	1101.10	-1100.10	3271.25	1422.64	0.00	0.00
1100001	9.70	0.15	0.00	0.15	1529.12	811.26	0.01	0.02
1100003	-1521.93	0.30	719.36	-719.06	3380.15	932.62	0.00	0.00
1100004	19.40	0.30	0.00	0.30	228.56	181.69	0.13	0.17
1100005	183.50	1.01	0.21	0.80	2215.24	1941.93	0.04	0.04
1100006	-510.53	0.00	43.48	-43.48	910.20	92.27	0.00	0.00
2010003	-53.00	0.15	0.86	-0.71	NA	NA	NA	NA
2020003	-11.50	0.00	19.50	-19.50	6454.36	6432.98	0.00	0.00
2020006	0.00	0.00	0.00	0.00	6748.10	6682.74	0.00	0.00
2020008	-58.23	0.00	166.57	-166.57	7900.94	7648.27	0.00	0.00
2030101	-4997.82	0.00	2030.63	-2030.63	16572.72	15418.46	0.00	0.00
2030102	-646.00	0.00	98.97	-98.97	1121.15	221.57	0.00	0.00
2030103	773.95	4.67	103.73	-99.06	1485.98	523.33	0.00	0.00
2030104	-1524.15	1.66	115.15	-113.49	970.47	19.80	0.00	0.00
2030105	4.29	0.07	0.00	0.07	766.82	524.76	0.01	0.01

2030201	-923.90	0.00	59.70	-59.70	639.58	111.04	0.00	0.00
2030202	100.60	3.48	119.59	-116.11	3282.64	563.63	0.00	0.00
2030203	-451.27	0.00	17.70	-17.70	23.83	0.00	0.00	0.00
2040105	-2331.50	0.10	149.15	-149.05	8255.62	8200.11	0.00	0.00
2040106	-81.29	0.03	0.00	0.03	1755.84	1745.28	0.00	0.00
2040201	-644.03	0.13	157.06	-156.93	8791.52	8662.63	0.00	0.00
2040202	-1032.09	1.17	193.53	-192.36	12297.25	11712.60	0.00	0.00
2040203	9291.82	32.37	70.50	-38.13	2116.35	1828.61	0.00	0.00
2040205	0.00	0.00	0.00	0.00	1168.93	718.91	0.00	0.00
2040206	-491.05	4.53	910.50	-905.97	12072.36	6425.50	0.00	0.00
2040207	515.15	1.90	0.11	1.79	236.19	125.15	0.76	1.43
2040301	-344.70	1.01	494.94	-493.93	1374.56	458.24	0.00	0.00
2040303	-800.00	0.00	82.90	-82.90	342.99	227.02	0.00	0.00
2050103	-81.55	0.00	0.00	0.00	5537.26	5535.36	0.00	0.00
2050107	-42.75	0.04	11.50	-11.46	6346.13	6331.19	0.00	0.00
2050201	-611.79	0.03	240.00	-239.97	1688.21	1672.20	0.00	0.00
2050206	-1535.50	0.07	14.80	-14.73	4556.80	4543.24	0.00	0.00
2050301	-409.09	0.03	188.00	-187.97	10417.44	10379.83	0.00	0.00
2050305	-783.75	0.04	14.30	-14.26	12970.81	12930.69	0.00	0.00
2050306	-3759.64	0.28	2645.23	-2644.94	27825.44	27755.29	0.00	0.00
2060003	-1654.93	0.10	254.04	-253.94	1286.47	284.96	0.00	0.00
2060004	-1849.50	0.00	1530.00	-1530.00	1961.75	31.08	0.00	0.00
2060006	-2448.50	0.03	325.23	-325.19	6334.16	319.20	0.00	0.00
2070002	-1728.32	1.00	890.47	-889.47	1843.94	1836.38	0.00	0.00
2070004	-109.50	0.00	26.55	-26.55	6296.56	6280.20	0.00	0.00
2070005	3460.53	10.24	0.00	10.24	865.02	852.60	1.18	1.20
2070006	-2.70	0.00	0.00	0.00	360.97	337.03	0.00	0.00
2070008	1280.78	6.44	251.49	-245.05	8792.54	8669.53	0.00	0.00
2070010	-1029.79	3.04	103.65	-100.61	9991.26	9081.52	0.00	0.00
2070011	692.71	9.52	119.88	-110.36	13215.03	10889.84	0.00	0.00
2080104	-240.00	0.00	1.53	-1.53	1024.26	993.97	0.00	0.00
2080106	-75.48	0.08	63.38	-63.29	522.76	475.53	0.00	0.00
2080107	-1094.82	1.00	173.00	-172.00	1852.93	916.81	0.00	0.00
2080109	-172.00	0.00	0.03	-0.03	608.68	451.30	0.00	0.00
2080203	-181.32	1.00	97.50	-96.50	2804.46	2798.55	0.00	0.00
2080204	2131.53	6.31	0.00	6.31	537.66	537.56	1.17	1.17
2080206	570.96	13.70	2194.40	-2180.70	5484.27	3594.61	0.00	0.00
2080208	-856.50	0.00	300.00	-300.00	447.86	84.51	0.00	0.00
3010101	129.50	3.00	0.00	3.00	1365.24	1360.61	0.22	0.22
3010102	-1005.00	0.00	10.50	-10.50	2775.95	2762.56	0.00	0.00
3010103	-2607.94	1.05	1192.50	-1191.45	2230.37	2216.86	0.00	0.00
3010104	-3239.50	0.00	936.00	-936.00	2464.56	2464.14	0.00	0.00

3010107	-386.15	0.00	0.17	-0.17	3127.76	3103.64	0.00	0.00
3010201	-63.00	0.00	0.00	0.00	1120.64	1116.69	0.00	0.00
3010202	0.00	0.00	0.00	0.00	2584.80	491.90	0.00	0.00
3020101	-120.00	0.00	0.00	0.00	656.63	629.65	0.00	0.00
3020201	2355.46	66.74	4.28	62.46	1336.20	1286.97	4.67	4.85
3020204	148.95	2.32	0.00	2.32	1757.08	1754.23	0.13	0.13
3030004	9063.99	36.57	174.70	-138.12	2147.98	2119.04	0.00	0.00
3030005	194.96	66.74	1636.54	-1569.80	4121.75	2911.45	0.00	0.00
3030007	144.29	2.25	0.00	2.25	578.79	575.09	0.39	0.39
3040102	0.00	0.00	0.00	0.00	649.75	642.83	0.00	0.00
3040103	-321.44	1.05	114.00	-112.95	1999.34	1969.54	0.00	0.00
3040105	74.05	1.15	0.00	1.15	755.88	752.07	0.15	0.15
3040201	-913.00	1.05	505.00	-503.94	5999.07	5977.50	0.00	0.00
3040203	-270.94	1.05	1.49	-0.44	1132.68	1123.29	0.00	0.00
3040206	-163.20	0.00	1.45	-1.45	6509.58	5739.22	0.00	0.00
3040207	-1155.00	0.00	244.00	-244.00	5573.08	5555.81	0.00	0.00
3040208	0.00	0.00	0.00	0.00	963.86	188.76	0.00	0.00
3050101	2326.29	131.38	1624.11	-1492.73	3906.00	3835.46	0.00	0.00
3050102	-1162.00	1.05	509.65	-508.60	551.10	525.86	0.00	0.00
3050103	76.80	1.20	0.00	1.20	1994.79	1980.99	0.06	0.06
3050104	-705.00	0.00	7.33	-7.33	2228.28	2225.83	0.00	0.00
3050105	-806.44	1.05	10.60	-9.55	3251.98	3199.38	0.00	0.00
3050106	2796.39	65.69	0.00	65.69	2265.05	2250.96	2.90	2.92
3050109	-644.54	2.11	221.81	-219.70	985.78	892.87	0.00	0.00
3050110	0.00	0.00	0.00	0.00	3145.39	3145.04	0.00	0.00
3050201	-1317.64	1.05	335.87	-334.81	1785.76	1761.89	0.00	0.00
3050204	0.00	0.00	0.00	0.00	295.71	247.15	0.00	0.00
3050206	-344.44	1.05	2.63	-1.58	876.84	875.29	0.00	0.00
3060101	231.39	65.69	2140.00	-2074.31	1616.27	1578.54	0.00	0.00
3060102	0.00	0.00	0.00	0.00	2885.96	2881.27	0.00	0.00
3060103	0.00	0.00	0.00	0.00	4394.77	4377.77	0.00	0.00
3060106	-649.64	1.05	121.03	-119.97	7201.08	7193.75	0.00	0.00
3060108	6081.45	142.86	0.00	142.86	546.23	545.46	26.15	26.19
3060109	-334.65	0.00	97.00	-97.00	8458.09	8184.15	0.00	0.00
3070101	-1607.00	0.00	509.00	-509.00	2095.71	2088.20	0.00	0.00
3070103	0.00	0.00	0.00	0.00	1020.56	922.24	0.00	0.00
3070104	-117.00	0.00	0.03	-0.03	2455.94	2445.48	0.00	0.00
3070202	4299.73	142.86	33.83	109.03	206.51	205.83	52.80	52.97
3070203	-239.15	0.00	0.31	-0.31	1048.87	1035.55	0.00	0.00
3070204	0.00	0.00	0.00	0.00	875.77	795.87	0.00	0.00
3080101	-2313.00	0.00	9.25	-9.25	798.97	528.50	0.00	0.00
3080102	-104.70	7.00	9.76	-2.76	417.93	403.98	0.00	0.00

3080103	-4135.00	0.00	261.01	-261.01	2032.19	1057.83	0.00	0.00
3080202	-792.76	0.00	32.27	-32.27	217.53	89.85	0.00	0.00
3090101	-48.00	7.00	2.01	4.99	309.94	283.49	1.61	1.76
3090202	0.00	0.00	0.00	0.00	1591.03	216.62	0.00	0.00
3090205	0.00	0.00	0.00	0.00	498.30	0.00	0.00	0.00
3090206	14664.40	602.75	2242.14	-1639.40	2691.47	212.71	0.00	0.00
3100101	-1016.00	0.00	16.49	-16.49	264.13	255.71	0.00	0.00
3100202	-195.00	0.00	1.40	-1.40	54.00	50.92	0.00	0.00
3100205	0.00	0.00	0.00	0.00	2072.61	0.00	0.00	0.00
3100206	-1634.00	0.00	792.00	-792.00	1584.63	0.00	0.00	0.00
3100207	-3568.20	0.00	517.30	-517.30	3125.75	0.00	0.00	0.00
3110204	-14.00	0.00	0.20	-0.20	406.49	405.80	0.00	0.00
3110205	-308.50	0.00	49.00	-49.00	3729.25	3722.24	0.00	0.00
3110206	-427.40	0.00	3.00	-3.00	535.82	531.33	0.00	0.00
3120001	-316.50	0.00	28.90	-28.90	705.40	690.77	0.00	0.00
3120003	-523.50	0.00	1.52	-1.52	1378.94	1376.94	0.00	0.00
3130002	-3667.10	0.00	30.72	-30.72	4727.28	4682.23	0.00	0.00
3130005	18.33	0.29	0.00	0.29	1189.73	1068.43	0.02	0.03
3130008	-261.05	0.00	11.30	-11.30	2899.86	2871.01	0.00	0.00
3130011	15.40	0.00	11.60	-11.60	9310.47	9305.97	0.00	0.00
3130012	0.00	0.00	0.00	0.00	1741.32	1730.72	0.00	0.00
3140101	-899.00	0.00	176.00	-176.00	1967.89	1498.90	0.00	0.00
3140301	0.00	0.00	0.00	0.00	1034.08	1031.99	0.00	0.00
3140305	-930.00	0.00	46.70	-46.70	3039.55	3039.33	0.00	0.00
3150101	0.00	0.00	0.00	0.00	1045.80	1045.80	0.00	0.00
3150104	-3257.00	0.00	40.20	-40.20	986.84	971.08	0.00	0.00
3150105	-833.00	0.00	281.00	-281.00	6203.32	6171.76	0.00	0.00
3150106	-130.00	0.00	0.00	0.00	5530.86	5497.50	0.00	0.00
3150107	-1880.00	0.00	357.00	-357.00	6219.46	6214.25	0.00	0.00
3150109	5188.11	18.16	2.04	16.12	2178.48	2170.35	0.74	0.74
3150201	-99.50	18.16	77.73	-59.57	8847.47	8803.64	0.00	0.00
3160105	0.00	0.00	0.00	0.00	1133.31	1132.27	0.00	0.00
3160109	-1138.00	0.00	560.10	-560.10	1749.06	1739.81	0.00	0.00
3160111	-2751.80	0.00	32.50	-32.50	1121.54	1078.37	0.00	0.00
3160113	-1309.00	0.00	232.00	-232.00	3797.05	3776.62	0.00	0.00
3160201	18.33	0.29	0.00	0.29	10747.80	10745.20	0.00	0.00
3160202	18.33	0.29	0.00	0.29	980.74	980.12	0.03	0.03
3160203	-550.00	0.00	65.60	-65.60	11272.22	11271.10	0.00	0.00
3160204	-2638.00	0.00	692.00	-692.00	22204.76	22186.18	0.00	0.00
3160205	0.00	0.00	0.00	0.00	442.35	440.31	0.00	0.00
3170001	-128.30	0.00	0.01	-0.01	687.14	681.85	0.00	0.00
3170004	-335.25	0.00	0.48	-0.48	1440.65	1431.79	0.00	0.00

3170006	-2043.00	0.00	478.00	-478.00	5440.36	5436.01	0.00	0.00
3170007	-73.60	0.00	0.89	-0.89	1256.05	1254.59	0.00	0.00
3170009	-1002.10	0.00	74.70	-74.70	1588.68	1452.14	0.00	0.00
3180001	2542.44	19.22	9.96	9.26	1875.18	1864.26	0.49	0.50
3180002	-784.50	0.00	2.54	-2.54	2221.92	2219.99	0.00	0.00
3180005	-1.48	0.00	0.00	0.00	1523.20	1514.85	0.00	0.00
4010101	-230.50	0.00	123.00	-123.00	1044.95	1044.95	0.00	0.00
4010201	-192.98	0.00	59.57	-59.57	2593.26	2565.57	0.00	0.00
4010301	-73.00	0.00	39.20	-39.20	1137.02	1119.58	0.00	0.00
4020101	32.33	1.40	4.68	-3.28	846.83	846.05	0.00	0.00
4020105	3100.39	11.03	268.90	-257.87	661.69	657.52	0.00	0.00
4030101	-1906.32	5.55	1330.09	-1324.54	270.16	258.15	0.00	0.00
4030102	-556.00	2.76	638.37	-635.61	62.26	57.21	0.00	0.00
4030110	0.00	0.00	0.00	0.00	549.02	545.99	0.00	0.00
4030111	16.56	1.40	12.80	-11.40	293.39	288.91	0.00	0.00
4030201	41.43	1.40	0.00	1.40	2066.75	1823.20	0.07	0.08
4030204	-424.55	0.00	168.00	-168.00	1700.01	1694.51	0.00	0.00
4040001	4629.25	25.41	2231.75	-2206.35	122.91	111.54	0.00	0.00
4040002	-2023.92	1.40	749.49	-748.10	47.07	44.11	0.00	0.00
4040003	-260.50	0.00	134.39	-134.39	198.25	185.49	0.00	0.00
4050001	0.00	0.00	0.00	0.00	4359.87	4317.83	0.00	0.00
4050002	-1542.50	0.00	797.06	-797.06	284.29	282.32	0.00	0.00
4050003	0.00	0.00	0.00	0.00	316.44	298.44	0.00	0.00
4050004	-329.80	0.00	150.00	-150.00	116.99	85.82	0.00	0.00
4050006	2586.12	7.65	0.00	7.65	2179.74	2085.68	0.35	0.37
4060101	0.00	0.00	0.00	0.00	1401.26	1399.14	0.00	0.00
4060102	-507.00	0.00	175.00	-175.00	1574.09	1568.18	0.00	0.00
4060103	-60.00	0.00	0.00	0.00	1525.86	1524.34	0.00	0.00
4070006	0.00	0.00	0.00	0.00	755.53	754.89	0.00	0.00
4070007	0.00	0.00	0.00	0.00	1559.17	1558.60	0.00	0.00
4080103	-2221.00	0.00	402.80	-402.80	320.00	314.93	0.00	0.00
4080201	-1553.60	0.00	2.70	-2.70	1279.65	1272.63	0.00	0.00
4080204	0.00	0.00	0.00	0.00	713.66	687.12	0.00	0.00
4090001	-2456.00	0.00	654.79	-654.79	467.73	404.80	0.00	0.00
4090002	-181.50	0.00	14.10	-14.10	2371.66	2370.70	0.00	0.00
4090004	-1426.65	0.00	301.20	-301.20	2573.97	2560.58	0.00	0.00
4090005	1940.12	7.65	0.00	7.65	253.19	195.76	3.02	3.91
4100001	-1121.00	0.00	206.10	-206.10	857.71	191.59	0.00	0.00
4100002	-2863.00	0.00	1432.07	-1432.07	627.32	602.61	0.00	0.00
4100009	0.00	0.00	0.00	0.00	2099.71	2002.85	0.00	0.00
4100010	-1484.82	1.09	330.04	-328.96	314.46	287.02	0.00	0.00
4110001	-747.50	0.00	224.00	-224.00	261.02	213.93	0.00	0.00

4110003	-1410.14	2.01	627.50	-625.49	330.38	303.98	0.00	0.00
4110004	2136.67	7.39	0.24	7.15	391.43	373.57	1.83	1.91
4120101	-718.77	1.00	322.90	-321.90	685.37	658.79	0.00	0.00
4120104	-310.85	0.47	186.02	-185.55	775.90	724.79	0.00	0.00
4130001	-736.05	0.47	368.03	-367.56	461.35	442.52	0.00	0.00
4130002	99.20	0.47	0.19	0.28	581.06	575.03	0.05	0.05
4140101	-2180.50	1.32	578.39	-577.07	468.98	376.11	0.00	0.00
4140102	-1298.55	2.63	838.17	-835.54	1165.72	1161.71	0.00	0.00
4140201	-494.85	0.00	172.08	-172.08	2771.03	2713.56	0.00	0.00
4140202	101.40	0.47	0.01	0.46	2008.06	1921.90	0.02	0.02
4150101	-75.60	0.00	0.24	-0.24	2995.25	2984.17	0.00	0.00
4150304	0.00	0.00	0.00	0.00	797.47	796.35	0.00	0.00
4150308	-18.45	0.00	0.38	-0.38	369.87	369.68	0.00	0.00
5010001	0.00	0.00	0.00	0.00	4138.47	4112.10	0.00	0.00
5010002	-86.00	0.00	0.63	-0.63	1508.71	1502.54	0.00	0.00
5010003	-83.29	0.03	0.00	0.03	4835.49	4825.49	0.00	0.00
5010005	0.00	0.00	0.00	0.00	1342.14	1338.67	0.00	0.00
5010006	-2058.08	0.07	168.20	-168.13	6109.54	6019.66	0.00	0.00
5010007	-3749.87	0.10	32.19	-32.08	1333.78	1308.29	0.00	0.00
5010009	1547.53	6.31	161.00	-154.69	6841.95	6816.10	0.00	0.00
5020002	-1969.00	0.00	21.10	-21.10	657.69	647.55	0.00	0.00
5020003	-1346.22	1.00	12.87	-11.87	3638.01	3622.82	0.00	0.00
5020004	-238.32	1.00	51.80	-50.80	2852.86	2851.69	0.00	0.00
5020005	-2478.64	2.01	177.30	-175.29	4852.06	4656.91	0.00	0.00
5030101	-6927.57	1.09	1292.84	-1291.75	39513.22	39455.08	0.00	0.00
5030103	-194.32	1.00	46.40	-45.40	1108.84	996.64	0.00	0.00
5030104	-288.82	1.00	69.80	-68.80	1346.39	1342.35	0.00	0.00
5030106	-4289.64	3.01	772.20	-769.18	27682.87	27630.39	0.00	0.00
5030201	-1477.82	1.00	14.42	-13.42	28893.52	28884.65	0.00	0.00
5030202	-6098.39	2.01	860.20	-858.19	37139.86	37126.86	0.00	0.00
5040001	-57.72	1.00	14.65	-13.65	1656.96	1539.24	0.00	0.00
5040002	15.18	1.00	0.23	0.77	586.86	576.95	0.13	0.13
5040004	-2996.64	2.01	377.30	-375.29	3388.26	3374.36	0.00	0.00
5050002	-280.82	1.00	20.10	-19.10	4317.85	4310.31	0.00	0.00
5050006	-350.82	1.00	100.00	-99.00	4514.82	4508.88	0.00	0.00
5050008	-2900.00	0.00	24.70	-24.70	6084.27	6054.54	0.00	0.00
5060001	-48.32	1.00	7.57	-6.57	1379.48	1226.34	0.00	0.00
5070204	-1060.00	1.00	10.67	-9.67	3407.48	3388.25	0.00	0.00
5080002	-392.14	2.01	49.50	-47.49	1868.17	1840.01	0.00	0.00
5080003	-50.52	1.00	0.50	0.50	1505.57	1341.95	0.03	0.04
5090103	0.00	0.00	0.00	0.00	50828.76	50695.29	0.00	0.00
5090201	-6937.92	1.00	1235.61	-1234.60	61980.03	61941.42	0.00	0.00

5090203	-4761.22	2.01	484.21	-482.20	96792.72	96754.22	0.00	0.00
5100205	-1840.00	0.00	92.54	-92.54	3665.17	3640.65	0.00	0.00
5110003	-1941.60	0.00	876.34	-876.34	3419.15	3413.57	0.00	0.00
5110005	-949.00	0.00	10.39	-10.39	4582.40	4577.82	0.00	0.00
5120101	-33.80	0.00	0.15	-0.15	1280.60	1258.52	0.00	0.00
5120104	-54.50	0.00	18.10	-18.10	447.73	432.99	0.00	0.00
5120108	-1120.00	0.00	521.00	-521.00	3850.07	3830.96	0.00	0.00
5120109	24.39	4.06	1.47	2.59	1016.74	1013.02	0.26	0.26
5120110	-24.10	0.00	0.00	0.00	404.83	402.35	0.00	0.00
5120111	-1887.51	4.06	878.00	-873.93	9553.43	9519.87	0.00	0.00
5120112	189.13	4.06	0.00	4.06	1003.92	984.06	0.40	0.41
5120113	-3144.00	0.00	27.40	-27.40	22733.19	22718.67	0.00	0.00
5120114	0.00	0.00	0.00	0.00	1204.15	1150.43	0.00	0.00
5120201	-887.50	0.00	178.10	-178.10	1487.23	1235.78	0.00	0.00
5120202	-407.50	0.00	127.80	-127.80	4662.24	4649.44	0.00	0.00
5120209	-13.60	0.00	0.00	0.00	536.41	535.02	0.00	0.00
5130103	-341.00	0.00	154.00	-154.00	7472.58	7470.09	0.00	0.00
5130201	-1646.40	0.00	594.00	-594.00	6628.84	6622.86	0.00	0.00
5130205	0.00	0.00	0.00	0.00	24012.74	23966.74	0.00	0.00
5140101	2895.35	30.61	1410.73	-1380.12	68708.29	68684.45	0.00	0.00
5140201	-1923.20	0.00	1253.00	-1253.00	83731.55	83686.91	0.00	0.00
5140202	-657.00	0.00	4.30	-4.30	151320.33	151271.25	0.00	0.00
5140204	-263.00	0.00	122.53	-122.53	502.88	493.97	0.00	0.00
5140206	-2152.61	4.06	1448.00	-1443.94	198159.89	198144.34	0.00	0.00
6010104	-708.00	0.00	348.00	-348.00	1981.14	1969.77	0.00	0.00
6010105	-674.94	1.05	230.00	-228.95	3371.01	3363.16	0.00	0.00
6010205	-648.32	1.00	2.90	-1.90	2658.94	2620.56	0.00	0.00
6010207	-871.00	0.00	292.00	-292.00	2585.87	2497.43	0.00	0.00
6010208	-1436.00	0.00	262.00	-262.00	952.76	945.81	0.00	0.00
6020001	3764.46	148.65	44.54	104.11	13866.66	13852.65	0.75	0.75
6030001	-1613.50	0.00	574.00	-574.00	28024.15	28006.83	0.00	0.00
6030002	0.64	28.85	800.78	-771.94	18623.69	18560.09	0.00	0.00
6030005	-1634.90	0.00	552.00	-552.00	57086.96	57062.58	0.00	0.00
6040005	-2483.60	0.00	664.00	-664.00	45350.41	45343.31	0.00	0.00
7010101	-1024.49	0.00	92.00	-92.00	725.53	723.82	0.00	0.00
7010203	-2243.40	0.00	22.10	-22.10	2393.12	2385.01	0.00	0.00
7010204	-614.00	0.74	518.25	-517.51	376.26	363.34	0.00	0.00
7010205	-74.15	0.00	0.01	-0.01	241.39	212.34	0.00	0.00
7010206	-24.00	0.00	0.02	-0.02	5814.97	5775.26	0.00	0.00
7020001	-475.64	0.00	3.77	-3.77	256.83	256.26	0.00	0.00
7020004	-19.95	0.00	0.15	-0.15	594.71	587.99	0.00	0.00
7020007	1681.79	5.20	0.03	5.17	1204.13	1198.38	0.43	0.43

7020009	0.00	0.00	0.00	0.00	789.60	781.06	0.00	0.00
7020012	-586.30	0.00	126.00	-126.00	2011.65	2007.97	0.00	0.00
7030005	-527.76	0.00	197.00	-197.00	3861.20	3856.09	0.00	0.00
7040001	0.00	0.00	0.00	0.00	12392.67	12158.43	0.00	0.00
7040002	-1085.00	0.74	902.42	-901.68	418.96	409.06	0.00	0.00
7040003	-594.00	0.00	212.80	-212.80	10121.07	10102.16	0.00	0.00
7040004	-104.00	0.00	0.29	-0.29	477.24	471.54	0.00	0.00
7040006	0.00	0.00	0.00	0.00	12981.16	12980.05	0.00	0.00
7060001	-673.50	0.00	265.00	-265.00	26583.34	26570.88	0.00	0.00
7060003	-209.27	1.40	125.11	-123.71	28498.07	28490.86	0.00	0.00
7060005	-76.70	0.00	21.50	-21.50	34445.57	34422.18	0.00	0.00
7070002	-1021.37	1.40	85.40	-84.00	1876.85	1817.29	0.00	0.00
7070005	-1128.50	0.00	9.39	-9.39	14385.66	14374.28	0.00	0.00
7080101	-1433.20	0.00	369.35	-369.35	31419.79	31401.88	0.00	0.00
7080104	-268.15	0.00	67.50	-67.50	121131.97	121120.42	0.00	0.00
7080105	-35.50	0.00	0.00	0.00	434.89	428.51	0.00	0.00
7080201	-29.30	0.00	0.01	-0.01	566.58	556.32	0.00	0.00
7080203	0.00	0.00	0.00	0.00	172.78	172.57	0.00	0.00
7080205	-51.69	0.00	0.03	-0.03	1033.20	1019.66	0.00	0.00
7080206	-590.55	0.74	10.13	-9.39	1562.52	1553.97	0.00	0.00
7080208	-135.20	0.00	0.00	0.00	757.61	754.90	0.00	0.00
7090002	-467.57	1.40	5.40	-4.00	1732.35	1725.75	0.00	0.00
7090005	953.29	8.33	1713.26	-1704.93	2690.51	2642.92	0.00	0.00
7100008	0.00	0.00	0.00	0.00	2337.57	2307.43	0.00	0.00
7100009	-710.40	0.00	6.66	-6.66	5744.43	5737.49	0.00	0.00
7110004	-44.70	0.00	7.93	-7.93	70849.91	70607.29	0.00	0.00
7110009	-1359.62	4.06	804.00	-799.94	81843.77	81834.91	0.00	0.00
7120001	-1780.00	0.00	18.50	-18.50	2673.47	2594.80	0.00	0.00
7120003	-995.09	2.01	331.00	-328.99	65.51	15.01	0.00	0.00
7120004	-60.37	16.50	1097.33	-1080.83	1280.66	285.01	0.00	0.00
7120005	-1911.50	0.08	27.76	-27.67	1627.02	1623.81	0.00	0.00
7130001	-85.16	4.14	202.00	-197.86	4810.02	4774.33	0.00	0.00
7130003	-1897.61	4.06	99.06	-95.00	6605.06	6597.82	0.00	0.00
7130007	-1730.00	0.00	701.00	-701.00	369.36	366.09	0.00	0.00
7130009	0.00	0.00	0.00	0.00	729.86	707.72	0.00	0.00
7130011	-166.11	4.06	75.40	-71.34	8931.86	8629.80	0.00	0.00
7140101	0.00	0.00	0.00	0.00	135097.54	135047.92	0.00	0.00
7140102	-980.00	4.06	526.89	-522.83	1653.59	1413.84	0.00	0.00
7140105	-530.50	0.00	9.65	-9.65	153254.12	153247.99	0.00	0.00
7140201	0.00	0.00	0.00	0.00	579.31	568.85	0.00	0.00
7140203	-900.00	0.00	412.00	-412.00	272.48	265.92	0.00	0.00

7140204	-1782.00	0.00	16.90	-16.90	1569.59	1499.32	0.00	0.00
8010208	0.00	0.00	0.00	0.00	1877.51	1874.51	0.00	0.00
8010211	-1263.90	0.00	435.00	-435.00	103.44	94.94	0.00	0.00
8020203	43.36	2.37	6.26	-3.89	2428.34	2394.24	0.00	0.00
8020204	-1160.00	0.00	573.00	-573.00	1129.44	1111.92	0.00	0.00
8020303	0.00	0.00	0.00	0.00	14187.29	14184.27	0.00	0.00
8030100	-726.50	0.00	174.00	-174.00	704058.81	704058.15	0.00	0.00
8030201	0.00	0.00	0.00	0.00	1378.65	1375.11	0.00	0.00
8030206	73.10	0.00	0.01	-0.01	6643.06	6635.13	0.00	0.00
8030207	574.42	7.27	0.01	7.26	23.83	0.00	30.48	0.00
8040101	-721.00	0.00	18.40	-18.40	860.61	860.05	0.00	0.00
8040102	-134.00	0.00	0.00	0.00	2667.72	2663.17	0.00	0.00
8040201	0.00	0.00	0.00	0.00	3552.02	3539.61	0.00	0.00
8040202	-405.00	0.00	0.02	-0.02	11902.79	11896.26	0.00	0.00
8040205	-148.00	0.00	0.00	0.00	919.19	897.15	0.00	0.00
8040207	-1548.50	0.00	2.57	-2.57	9629.39	9624.33	0.00	0.00
8060100	-1188.50	0.00	194.00	-194.00	379024.93	379024.69	0.00	0.00
8060201	-473.50	0.00	1.48	-1.48	1061.69	1051.85	0.00	0.00
8060203	42.50	1.00	0.00	1.00	534.78	534.10	0.19	0.19
8070100	-1917.00	0.00	65.30	-65.30	379486.60	379486.60	0.00	0.00
8070201	-335.10	1.00	8.08	-7.08	190055.06	190052.07	0.00	0.00
8070202	0.00	0.00	0.00	0.00	1497.53	1459.56	0.00	0.00
8070204	-1185.50	0.00	216.00	-216.00	1911.07	1902.05	0.00	0.00
8070300	-2004.30	0.00	367.02	-367.02	347.63	337.83	0.00	0.00
8080102	-125.00	0.00	0.00	0.00	1141.54	1015.14	0.00	0.00
8080103	-693.00	0.00	8.64	-8.64	152.28	115.18	0.00	0.00
8080201	0.00	0.00	0.00	0.00	577.04	568.30	0.00	0.00
8080205	-440.30	0.00	4.49	-4.49	462.13	462.13	0.00	0.00
8090203	-778.00	0.00	179.00	-179.00	190068.50	190052.03	0.00	0.00
8090301	322.91	4.35	127.00	-122.65	190080.79	190054.98	0.00	0.00
8090302	-137.68	0.00	0.15	-0.15	1927.07	1917.68	0.00	0.00
9020103	-145.60	0.00	8.47	-8.47	276.21	273.63	0.00	0.00
10100004	21.47	0.00	32.60	-32.60	NA	NA	NA	NA
10130101	-2662.45	0.91	849.48	-848.57	NA	NA	NA	NA
10130201	-910.00	0.00	10.76	-10.76	NA	NA	NA	NA
10160002	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10190018	-907.84	0.68	14.68	-14.01	NA	NA	NA	NA
10200101	-36.99	0.68	1.46	-0.78	NA	NA	NA	NA
10200102	-180.70	0.00	0.00	0.00	NA	NA	NA	NA
10200203	-225.00	0.68	2.58	-1.90	NA	NA	NA	NA
10220003	33.16	0.68	0.00	0.68	NA	NA	NA	NA

10230001	-1588.90	0.00	989.00	-989.00	13607.78	13587.34	0.00	0.00
10230003	0.00	0.00	0.00	0.00	629.15	580.95	0.00	0.00
10230006	-2726.10	0.68	1289.78	-1289.11	15523.52	15519.07	0.00	0.00
10240001	-1331.50	0.68	317.72	-317.04	36033.56	36033.45	0.00	0.00
10240006	-784.90	0.00	722.00	-722.00	NA	NA	NA	NA
10240011	-638.80	4.75	238.76	-234.01	18176.63	18129.00	0.00	0.00
10250017	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10270102	-2412.00	0.00	27.99	-27.99	NA	NA	NA	NA
10270104	-532.00	0.00	6.21	-6.21	2.03	0.00	0.00	0.00
10270202	0.00	0.00	0.00	0.00	NA	NA	NA	NA
10270206	33.16	0.68	0.00	0.68	NA	NA	NA	NA
10270207	52.52	0.00	0.00	0.00	NA	NA	NA	NA
10280102	1693.74	5.20	0.07	5.13	889.92	883.23	0.58	0.58
10280203	-1120.00	0.00	653.00	-653.00	261.80	258.81	0.00	0.00
10290102	-1418.00	0.00	761.00	-761.00	962.94	960.52	0.00	0.00
10290108	-510.00	0.00	305.00	-305.00	880.12	866.54	0.00	0.00
10300101	-1696.80	4.75	642.06	-637.31	24911.92	24788.97	0.00	0.00
10300102	295.95	9.81	44.30	-34.50	30066.01	30047.63	0.00	0.00
10300104	0.00	0.00	0.00	0.00	543.57	499.82	0.00	0.00
10300200	-2449.70	0.00	1490.00	-1490.00	31664.35	31598.84	0.00	0.00
11010002	-677.00	20.18	517.32	-497.14	465.70	459.52	0.00	0.00
11010004	-1678.00	0.00	20.00	-20.00	5691.56	5687.47	0.00	0.00
11010013	-122.00	0.00	0.00	0.00	7339.68	7338.34	0.00	0.00
11030001	-231.70	0.00	0.13	-0.13	NA	NA	NA	NA
11030004	-213.70	0.00	0.83	-0.83	NA	NA	NA	NA
11030012	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11030013	-1140.70	0.00	1.72	-1.72	NA	NA	NA	NA
11030015	-20.80	0.00	0.01	-0.01	NA	NA	NA	NA
11040006	-75.30	0.00	0.17	-0.17	NA	NA	NA	NA
11050003	-29.68	0.00	0.01	-0.01	NA	NA	NA	NA
11060004	-34.00	0.00	0.00	0.00	NA	NA	NA	NA
11060006	-1046.00	0.00	25.70	-25.70	NA	NA	NA	NA
11070103	-58.85	0.00	0.00	0.00	NA	NA	NA	NA
11070105	-1844.00	0.00	15.30	-15.30	NA	NA	NA	NA
11070204	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11070205	-67.00	0.00	0.00	0.00	NA	NA	NA	NA
11070207	-210.00	0.00	1.72	-1.72	618.65	606.83	0.00	0.00
11070209	-1507.50	0.00	13.50	-13.50	44.44	44.33	0.00	0.00
11090105	-1498.00	0.00	13.33	-13.33	NA	NA	NA	NA
11090106	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11090202	-1519.00	0.00	290.00	-290.00	NA	NA	NA	NA
11100104	-48.00	0.00	0.24	-0.24	NA	NA	NA	NA

11100301	-860.00	0.00	2.53	-2.53	NA	NA	NA	NA
11100302	-163.00	0.00	0.61	-0.61	NA	NA	NA	NA
11100303	0.00	0.00	0.00	0.00	NA	NA	NA	NA
11110101	-927.30	0.00	2.82	-2.82	NA	NA	NA	NA
11110102	-1700.30	0.00	15.90	-15.90	NA	NA	NA	NA
11110103	-528.00	0.00	296.00	-296.00	292.17	276.98	0.00	0.00
11110105	0.00	0.00	0.00	0.00	222.07	221.21	0.00	0.00
11110201	-56.51	1.05	11.47	-10.42	8610.05	8608.58	0.00	0.00
11110202	-1815.24	1.56	734.59	-733.04	13604.25	13603.53	0.00	0.00
11110207	-1772.00	0.00	19.20	-19.20	16211.20	16179.55	0.00	0.00
11130202	-269.00	0.00	1.54	-1.54	NA	NA	NA	NA
11130207	-122.00	0.00	1.24	-1.24	NA	NA	NA	NA
11130302	-1099.00	0.00	3.63	-3.63	NA	NA	NA	NA
11140103	-170.51	1.05	1.14	-0.08	NA	NA	NA	NA
11140105	-177.00	0.00	2.10	-2.10	NA	NA	NA	NA
11140205	-125.00	0.00	0.18	-0.18	526.69	525.58	0.00	0.00
11140206	-672.00	0.00	9.39	-9.39	552.99	551.85	0.00	0.00
11140207	-1580.00	0.00	560.00	-560.00	8583.47	8581.15	0.00	0.00
11140304	-655.00	0.00	0.26	-0.26	1122.63	1114.83	0.00	0.00
11140305	-944.00	0.00	6.63	-6.63	NA	NA	NA	NA
11140306	-268.00	0.00	14.60	-14.60	793.51	792.11	0.00	0.00
12010002	-1164.00	0.00	57.93	-57.93	33.24	33.24	0.00	0.00
12010005	0.00	0.00	0.00	0.00	2830.80	2827.77	0.00	0.00
12020003	-1824.00	0.00	359.00	-359.00	NA	NA	NA	NA
12020006	0.00	0.00	0.00	0.00	NA	NA	NA	NA
12050002	-1522.00	0.00	15.10	-15.10	NA	NA	NA	NA
12050003	-624.00	0.00	3.56	-3.56	NA	NA	NA	NA
12080003	-196.00	0.00	0.74	-0.74	NA	NA	NA	NA
12080004	0.00	0.00	0.00	0.00	NA	NA	NA	NA
13070007	-481.60	0.00	1.62	-1.62	NA	NA	NA	NA

Appendix E

Supplemental Thermoelectric Capacity Maps by HUC-8 Watersheds

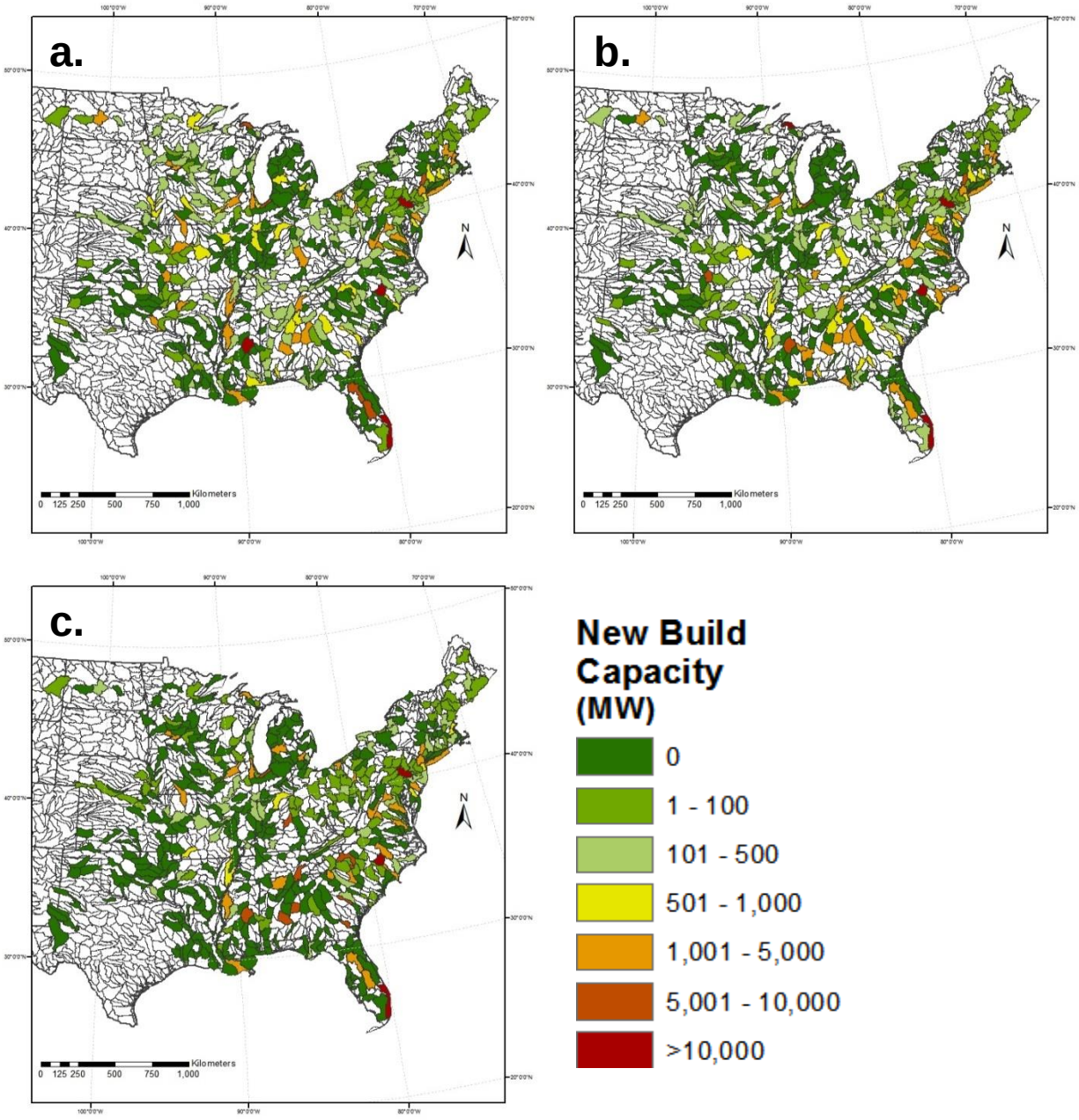

Figure E-36. This study' estimates of new build thermoelectric capacity (MW) added between 2011 and 2040 for HUC-8 watersheds in the EI of the U.S. for three future scenarios: **a.** F1S17 **b.** F6S10 **c.** F8S7

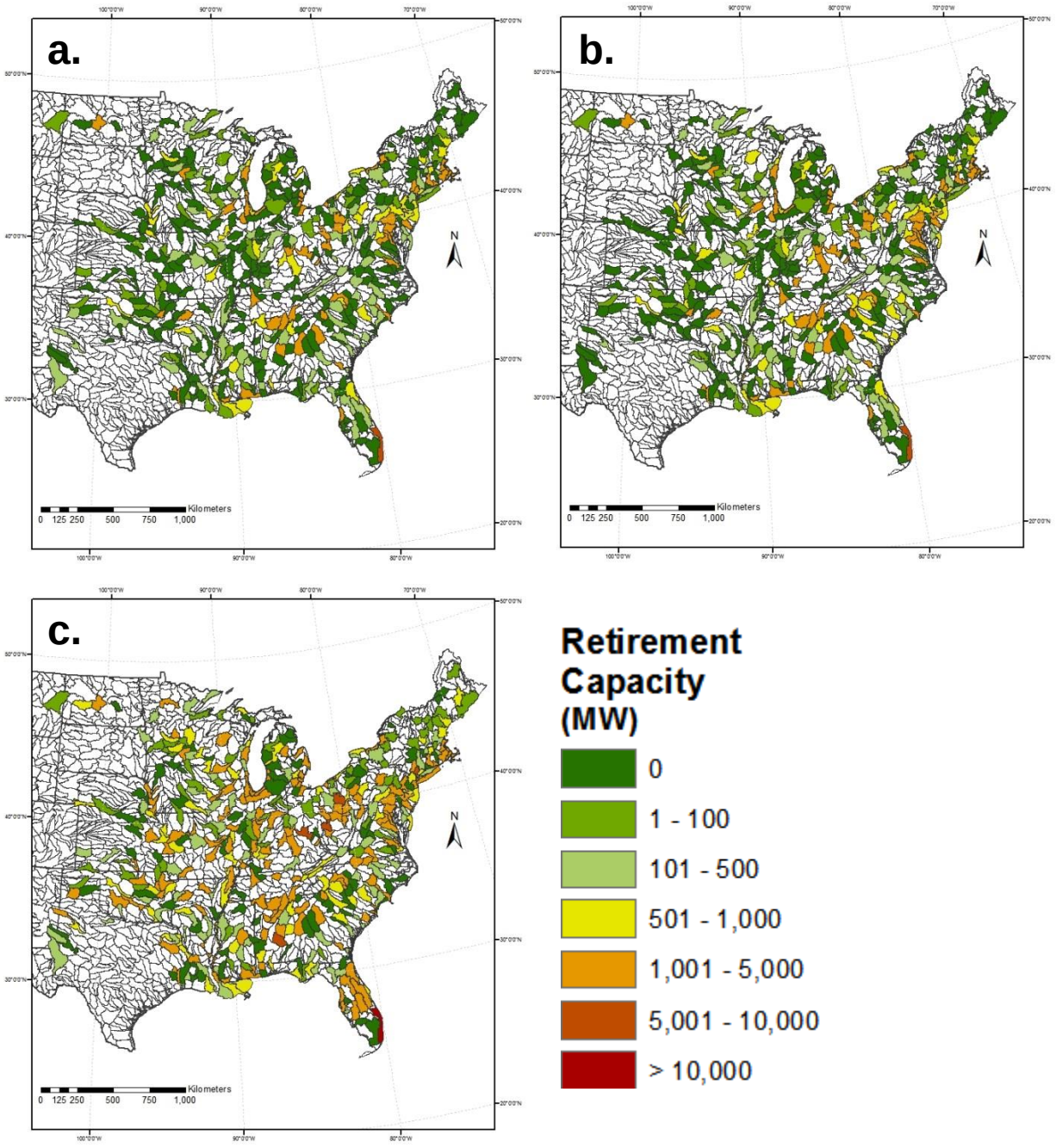

Figure E-37. This study's estimates of thermoelectric capacity (MW) retired between 2011 and 2040 for HUC-8 watersheds in the EI of the U.S. for three future scenarios: **a.** F1S17 **b.** F6S10 **c.** F8S7

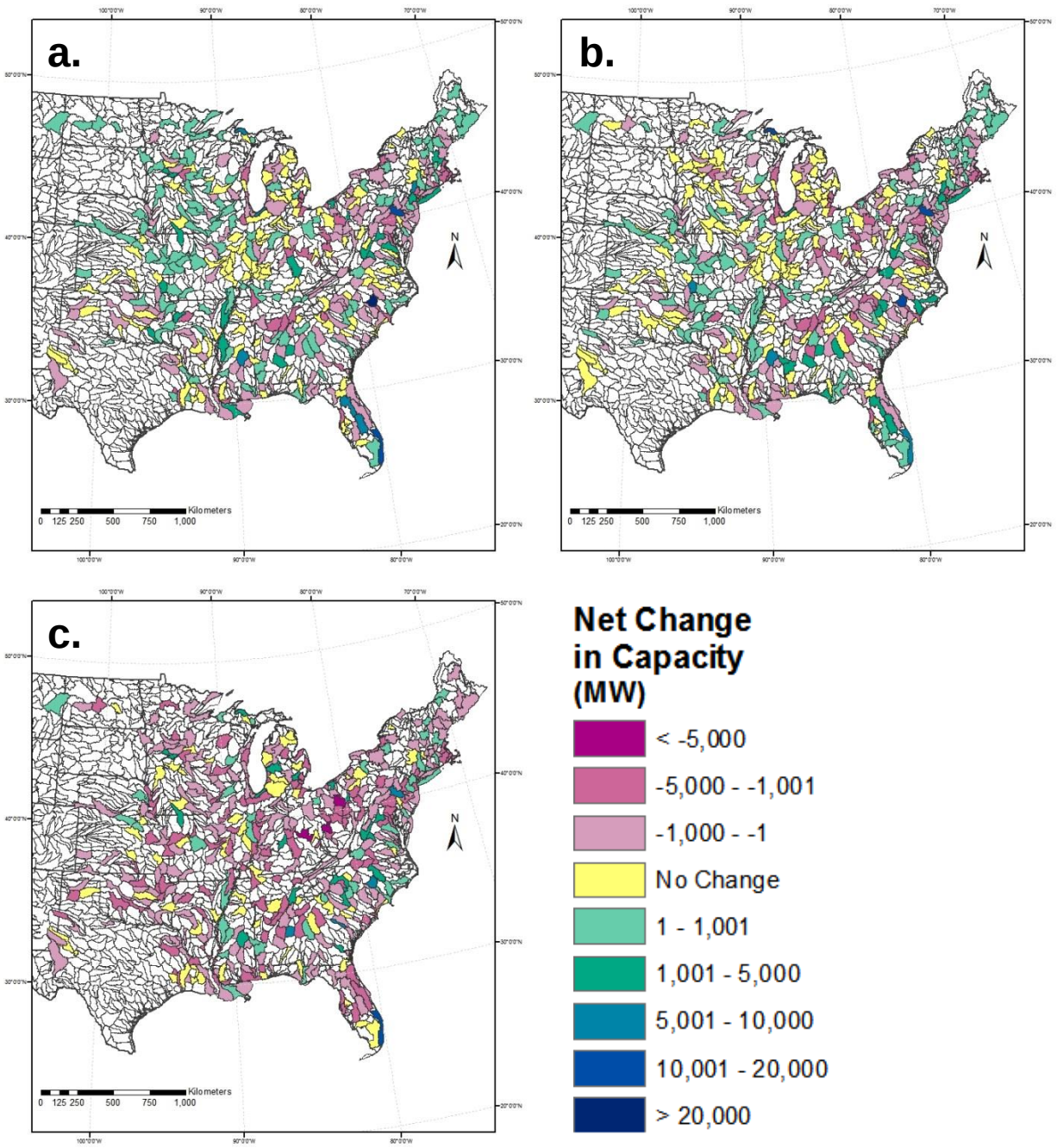

Figure E-38. The net change in capacity (new build capacity in MW minus retired capacity in MW) between 2011 and 2040 for HUC-8 watersheds in the EI of the U.S. for three future scenarios investigated in this study: **a.** F1S17 **b.** F6S10 **c.** F8S7

Appendix F

Supplementary Watershed Data for Figure 18

Table F-18. Water withdrawal projections (MGD) from 2011-2040 estimated for new build thermoelectric capacity. Comparing withdrawal projections using minimum, median, and maximum withdrawal factors.

HUC-8	NB Min WD (MGD)	NB Med WD (MGD)	NB Max WD (MGD)	Difference between Min and Max WD (MGD)
10300102	8.11	16.29	19.45	11.34
8030207	6.94	12.48	15.18	8.24
3090206	37.78	56.4	77.49	39.71
4040001	16.25	24.91	31.28	15.03
4020105	71.61	90.68	110.06	38.45
5100205	11.3	22.71	27.12	15.82
2040203	30.85	46.32	58.44	27.59
11070205	27.15	34.38	41.72	14.57
3180001	50.75	95.65	115.4	64.65
6020001	26.55	36.53	86.27	59.72

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