



# Water Demand and Supply in Florida: Past, Current, and Future Trends

Dat Tran, Economist

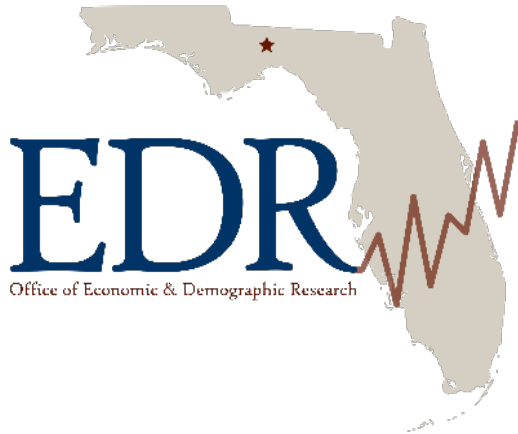
Economic and Demographic Research, Florida Legislature

Former Postdoctoral Scholar, University of California, Riverside

# Economic and Demographic Research (EDR)

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- A research arm of the Florida Legislature



- Principally concerned with forecasting economic and social trends that affect policy making, revenues, and appropriations
- EDR provides objective information to committee staffs and members of the legislature in support of the policy making process
- EDR publishes all the official economic, demographic, revenue, and agency workload forecasts

# Acknowledgment

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- Appreciate the assistance by Dr. Tatiana Borisova, USDA-ERS; Dr. Sorna Khakzad-Knight and Ms. Kate Beggs, economists, Land and Water Team, Economic and Demographic Research, Florida Legislature
- All photo images are from the University of Florida / Institute of Food and Agricultural Sciences (UF/IFAS) Photography Database, <http://photos.ifas.ufl.edu/>
- Any opinion, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of EDR



**Annual Assessment of Florida's Water  
Resources and Conservation Lands**

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*2021 Edition*

2022 Edition will be  
available soon!

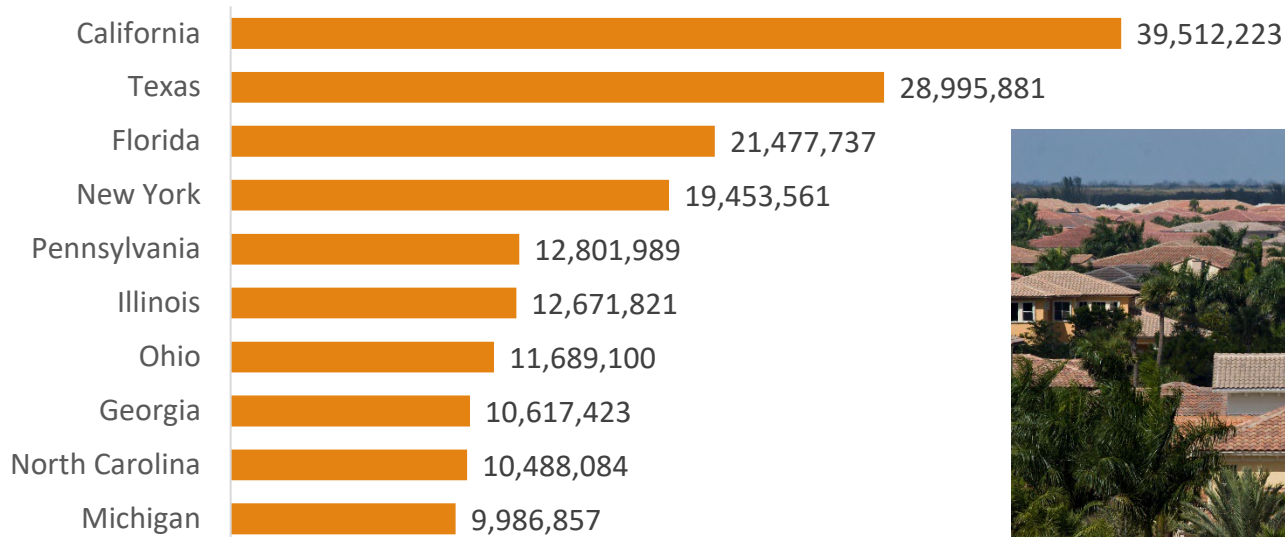
<http://edr.state.fl.us/Content/natural-resources/index.cfm>

# Motivation

- 19.90 million people rely on groundwater for domestic use (USGS 2019, BEBR 2019)
- \$7.36 billion in agricultural products sold - market value (USDA 2017)
- ~50% of agricultural irrigation is from groundwater
- Water scarcity and competition among urban, agriculture, and environmental water uses

# Florida Population

Top 10 Most Populous States: 2019



Source: US Census,  
<https://www.census.gov/newsroom/press-releases/2019/pepest-nation.html>

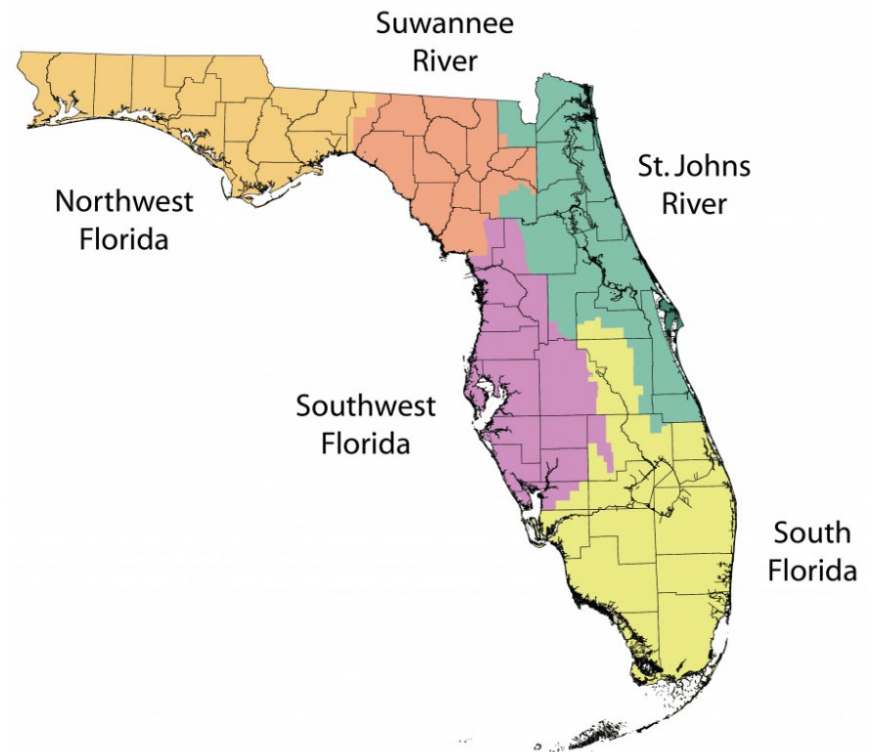
- Florida's population growth: approximately 1,000 people per day (between April 2019 and 2020, 1.83%) (Source: EDR, Florida: An Economic Overview, December 30, 2020)
- These increases are analogous to adding a city about the size of Orlando every year

# Relevant Laws and Regulations

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## Water Supply Planning (Section 373.036, Florida Statutes)

- Districts' water supply assessment:
  - Determine whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for all existing legal uses and reasonably anticipated future needs and to sustain water resources and related natural systems over the next 20 years.
  
- Regional Water Supply Plans (RWSP):
  - Developed in the areas where it is determined that existing water sources are inadequate to meet the needs over the next 20 years



## Research Question

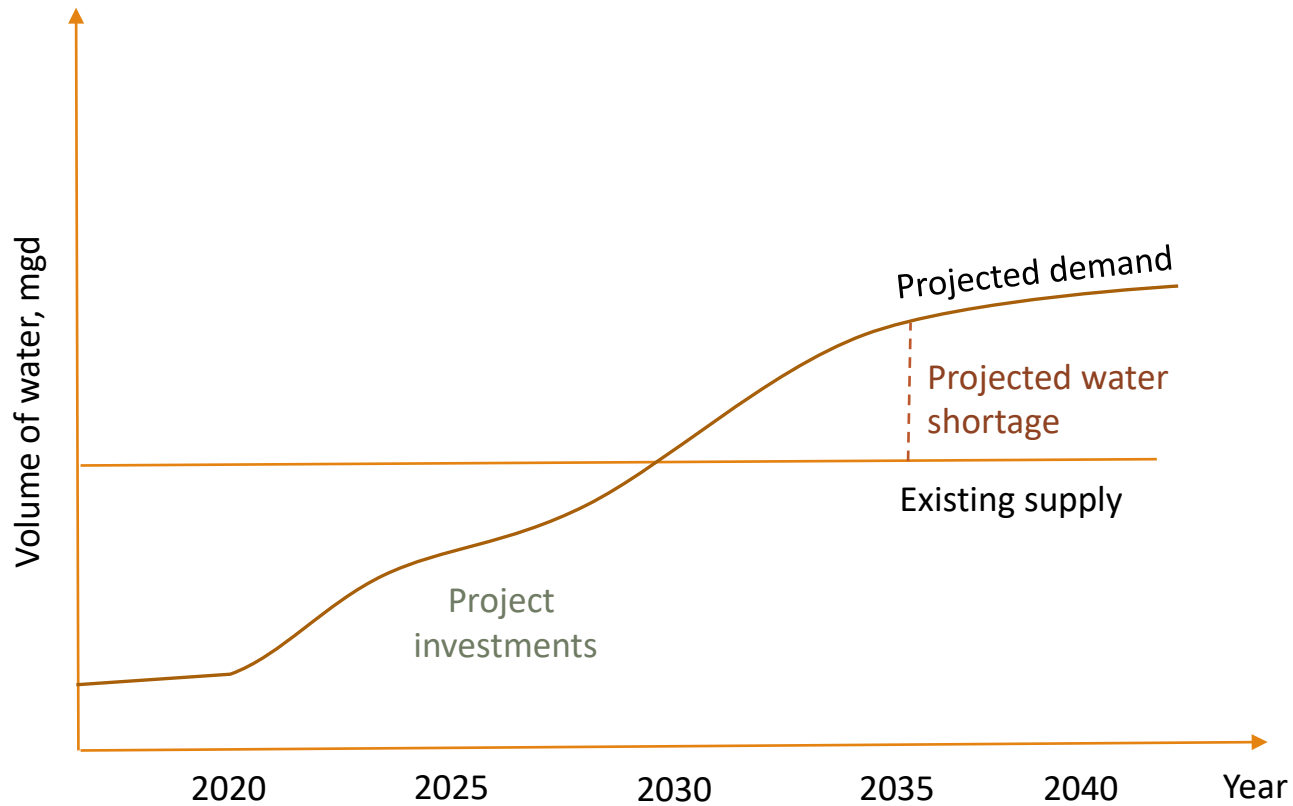
### **Expenditures necessary to meet the growing water demand in Florida over the next 20 years**

“An analysis and estimates of future expenditures (...) necessary to achieve the Legislature’s intent that sufficient water be available for all existing and future reasonable-beneficial uses and the natural systems”

(§ 403.928, 2020 Florida Statutes)

# How to Estimate Water Supply Shortages

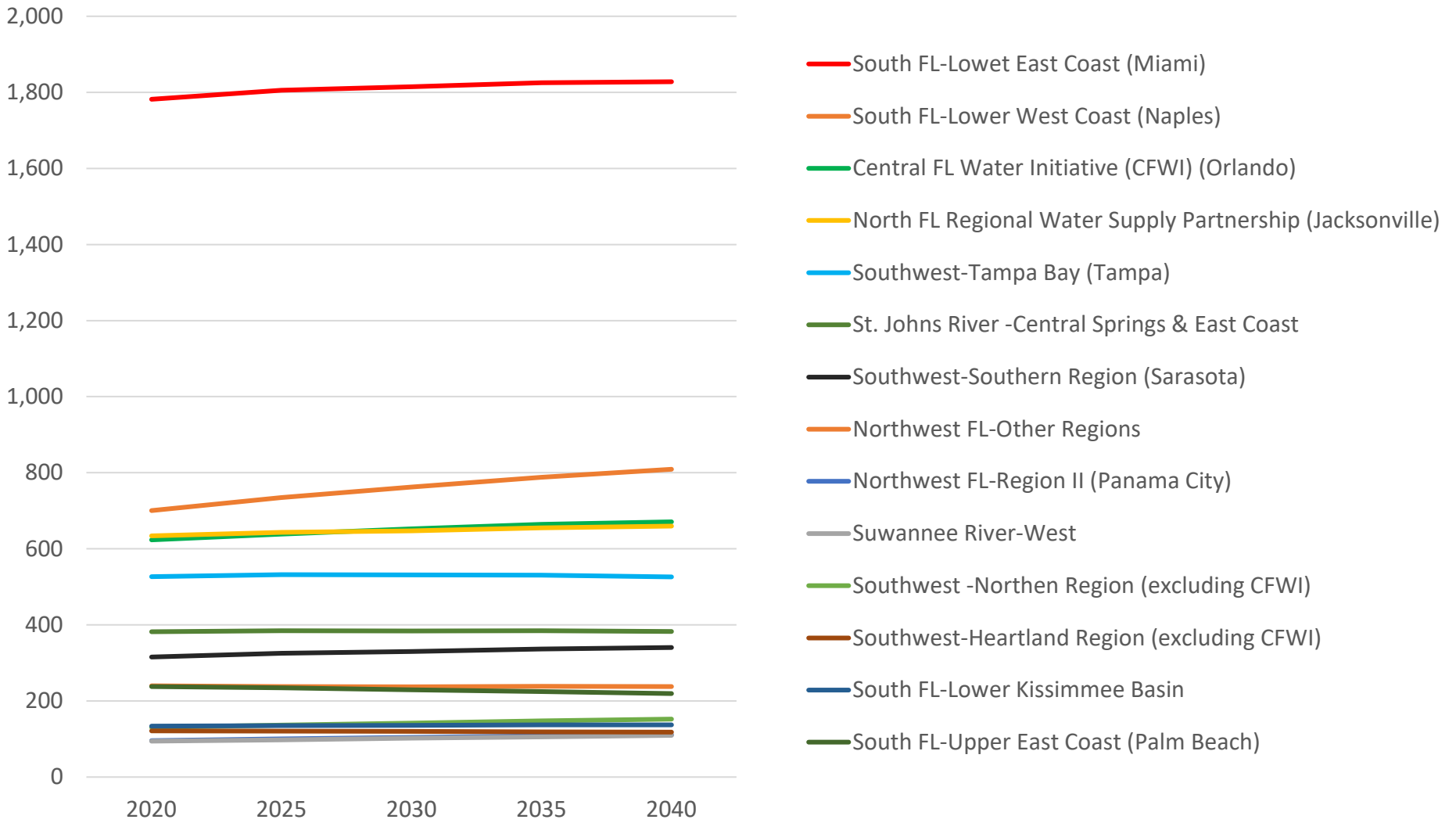
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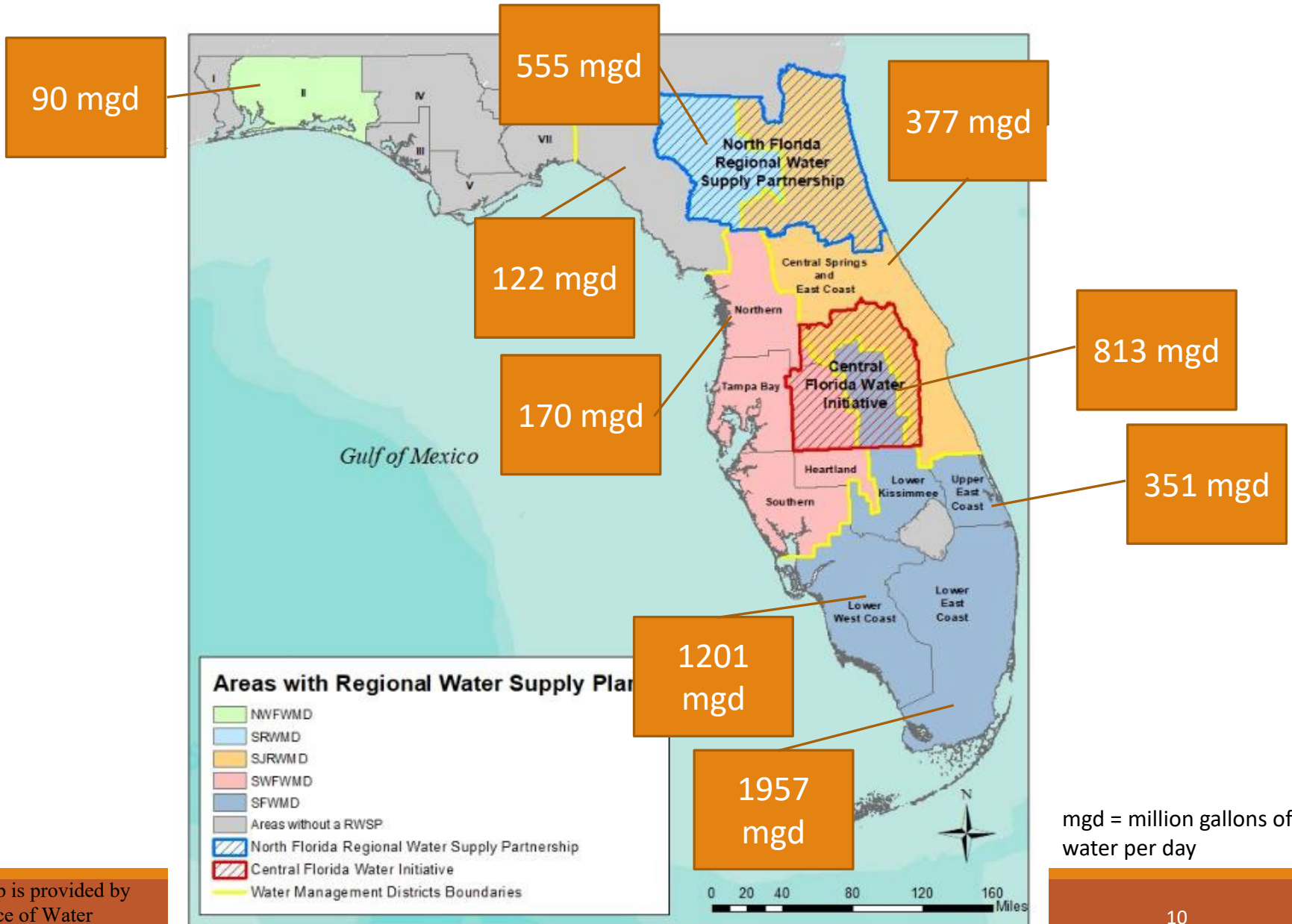
Mgd = million gallons of water per day



# Water Use Projections from WMDs (mgd)



# Inferred Water Supply for Regions with Water Shortages



# Database of water supply development and demand management projects

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Assembled by Florida Department of Environmental Protection

Project status:

- Completed
- In design, construction, or on hold
- Future project opportunities

Capital costs (indexed to \$2021)

Project capacity



# Project Database from DEP

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## WATER DEMAND MANAGEMENT

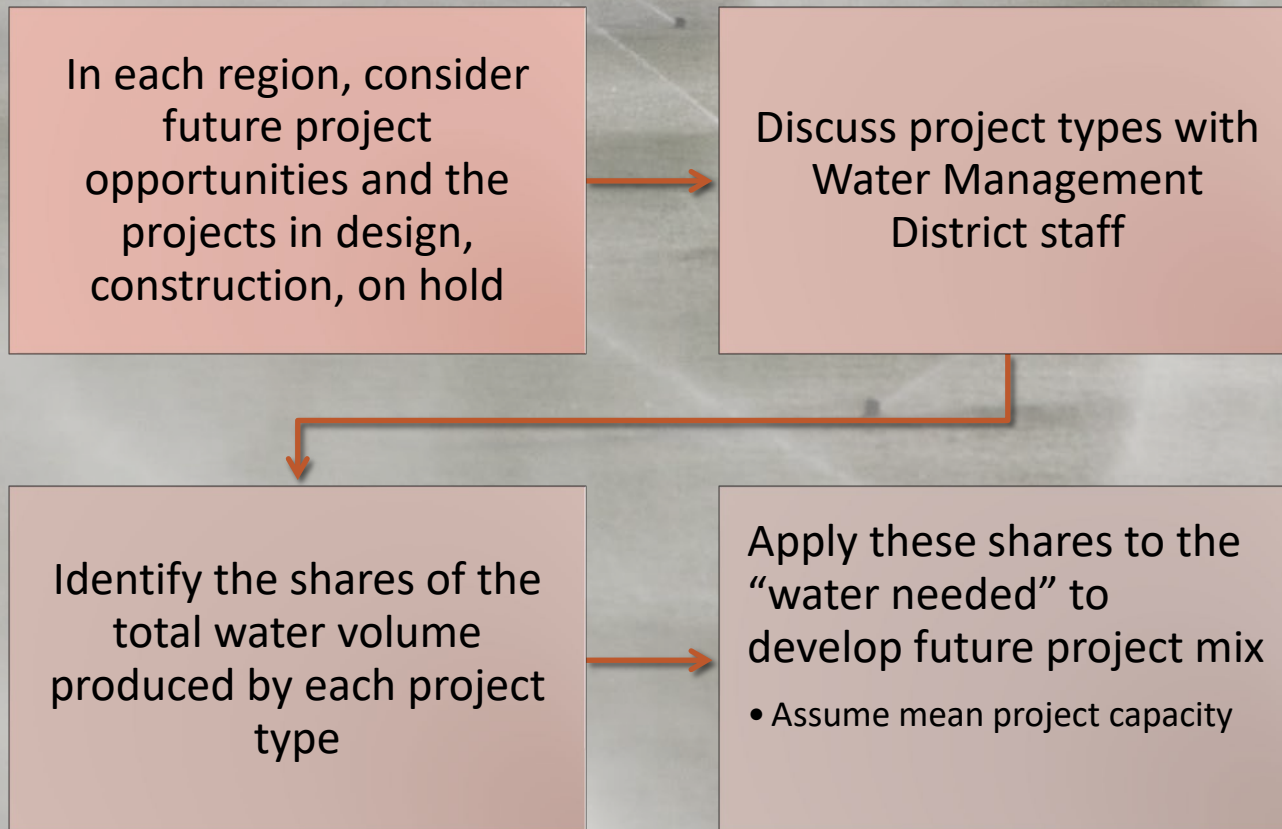
- Agricultural water conservation
- Public supply and commercial/industrial/institutional water conservation

## WATER SUPPLY DEVELOPMENT

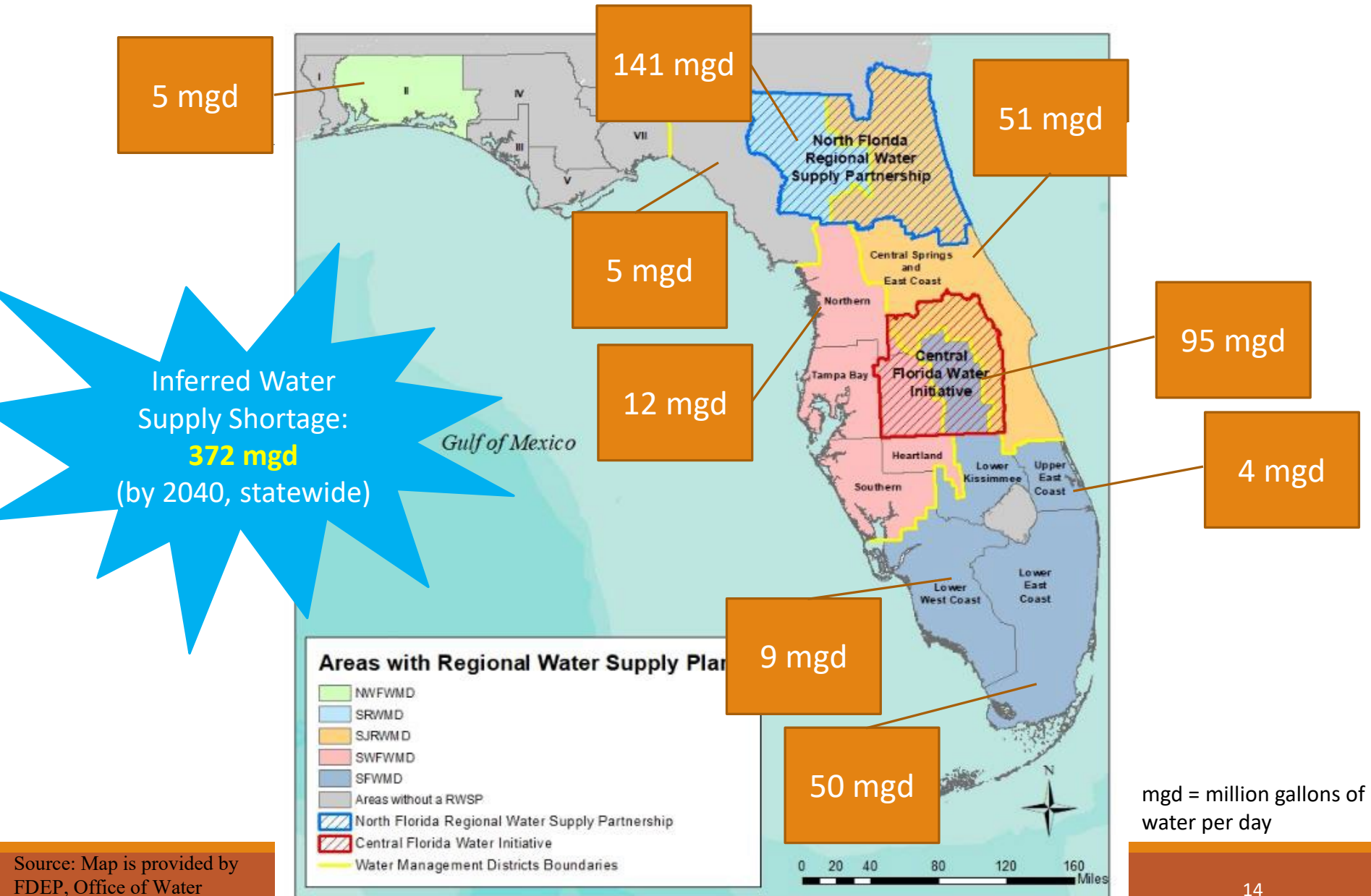
- Aquifer Storage and Recovery
- Brackish Groundwater
- Groundwater Recharge Other Non-Traditional Source and Projects
- Reclaimed Water (for potable offset)
- Stormwater
- Surface Water and Storage

# Project Scenario for Expenditures Forecast

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# Inferred Water Supply Shortages



Source: Map is provided by FDEP, Office of Water Policy.

# Estimated Project Expenditures per Unit of Capacity (million \$2021 per mgd)

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	Brackish Groundwater	Groundwater Recharge	Reclaimed water
SR–West			\$12.27
SJR–CSEC	\$5.60		\$9.28
SW – N***			\$14.69
NFRWSP		\$0.77	\$5.48
CFWI	\$1.23		\$4.84

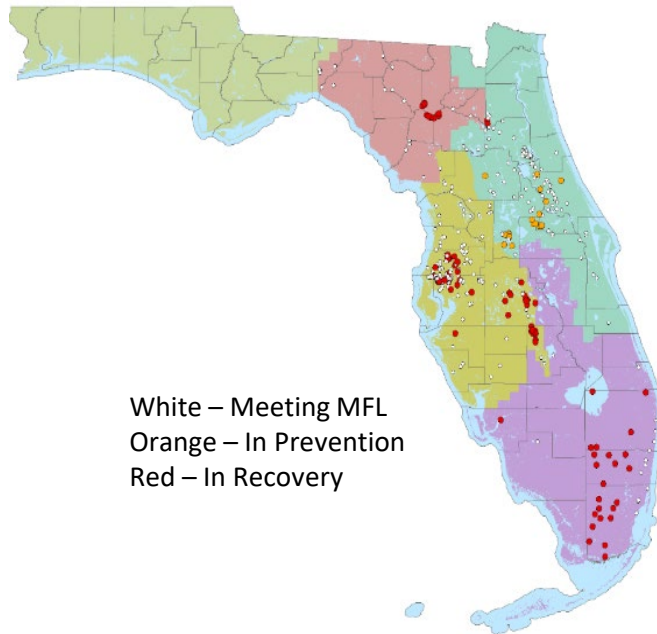
# Estimated Project Expenditures per Unit of Capacity (million \$2021 per mgd)

Planning Regions	“Project Total” for the Projects in Design, Construction, and On Hold (million, \$2021)	“Project Total” to Meet Remaining Inferred Shortage (million, \$2021)		Total Forecasted Expenditure to meet 2040 Inferred Supply Shortage (million \$2021)		
		Less expensive	More expensive	Less expensive	More expensive	Average
(1)	(2)	(3)	(4)	(5)	(6)	((5) + (6)) / 2
NWF – II	\$21.16	-	-	\$21.16	\$21.16	\$21.16
SR – West	\$5.01	\$39.26	\$39.26	\$44.27	\$44.27	\$44.27
SJR – CSEC	\$156.07	\$141.51	\$234.51	\$297.58	\$390.58	\$344.08
SW – N**	\$30.46	\$163.06	\$163.06	\$193.52	\$193.52	\$193.52
SF – UEC	\$11.64	-	-	\$11.64	\$11.64	\$11.64
SF – LEC	\$32.62	-	-	\$32.62	\$32.62	\$32.62
SF – LWC	\$22.13	-	-	\$22.13	\$22.13	\$22.13
NFRWSP	\$28.48	\$100.90	\$718.10	\$129.38	\$746.58	\$437.98
CFWI	\$339.61	\$17.65	\$69.45	\$357.26	\$409.06	\$383.16
<b>Statewide (sum of regions)</b>	<b>\$647.18</b>	<b>\$462.39</b>	<b>\$1,224.38</b>	<b>\$1,109.57</b>	<b>\$1,871.56</b>	<b>\$1,490.56</b>



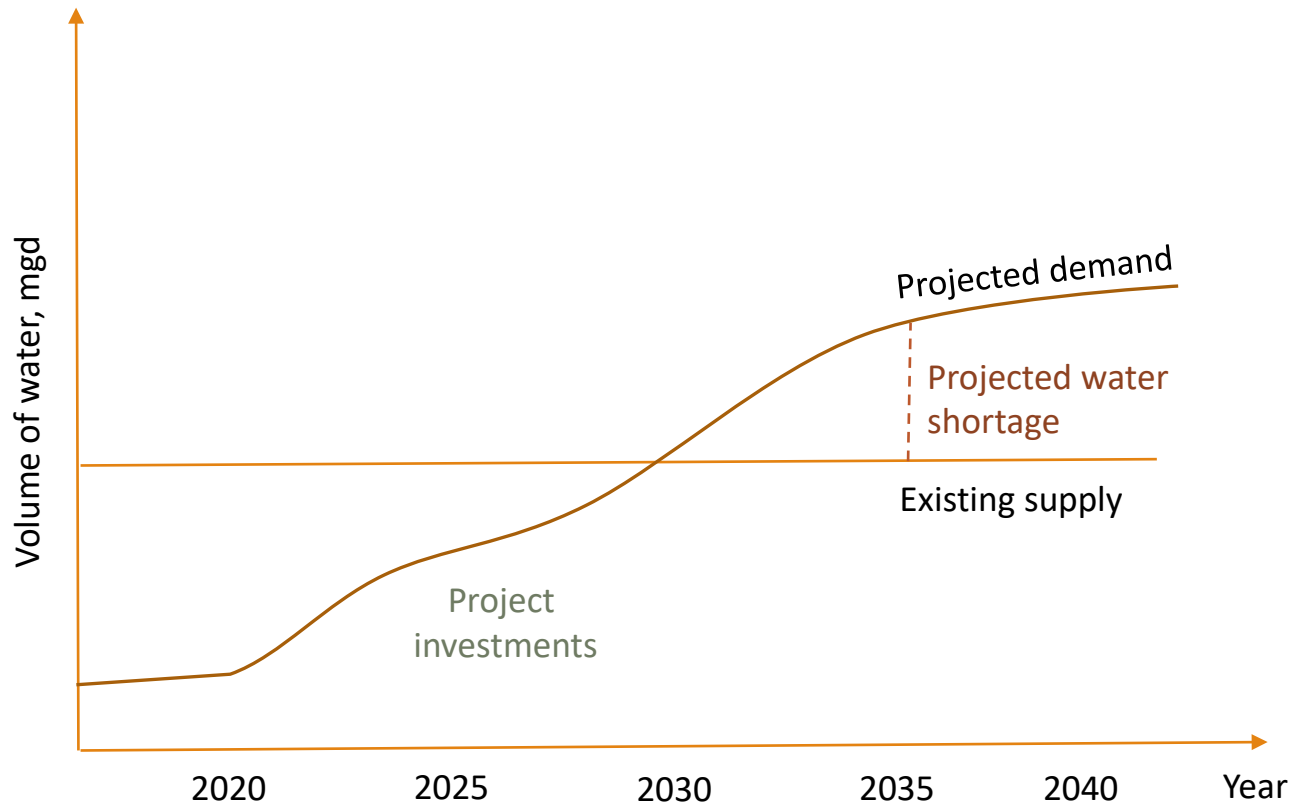
# Ensuring Sufficient Water For Natural Systems

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- Minimum flow or minimum water levels (MFLs)
  - The limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area (§ 373.042, Fla. Stat.)
- The cost to complete known projects that implement a recovery or prevention strategy (RPS) for waterbodies with an established MFL
  - **Approximately 0.84 billion \$2021, excluding Everglades expenditures**
    - This estimate is based on the project database from DEP
    - EDR will update this estimate every year

# How to Estimate Water Supply Shortages



Mgd = million gallons of water per day

# Water Use Categories

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Agriculture (AG)

Public Supply (PS)

Domestic Self-Supply (DSS)

Landscape / Recreation (L/R)

Commercial-Industrial-Institutional Self-Supply (CII)

Power Generation (PG)

# Current EDR's Water Demand Model

- **Model specification**
  - Linear Regression
    - Time and county fixed effects
- **Data**
  - **Agriculture:**
    - Florida Statewide Agricultural Irrigation Demand (FSAID-8) Geodatabase
  - **Water use:**
    - Water withdrawals
      - USGS and Florida's water management districts
    - Reclaimed water flow
      - Florida Department of Environmental Protection
  - **Water use determinants:**
    - Demographic and economic characteristics
      - Economic and Demographic Research, Florida Legislature
      - Woods and Poole Economics (2021)
    - Weather - monthly rainfall and average temperature
      - NOAA

# Current EDR's Water Demand Model

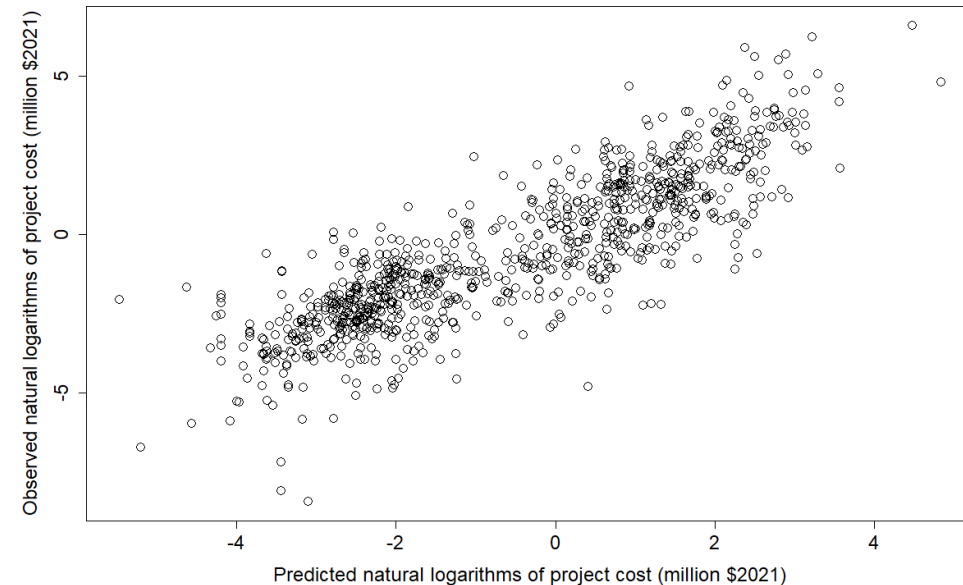


Robust regression  
(R, Version 1.4.1717)  
R-squared > 0.90

Graphs by county\_nmPS

# Current EDR's Expenditure Model

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Robust regression (R, Version 1.4.1717)  
R-squared = 0.71

## ■ Model specification

### • Linear Regression

- Variables: capacity, type, status of project, and region supported
- Project type and status, and region supported fixed effects

## ■ Data

- Project database from DEP (2021)

# Statewide Expenditures Forecast, Total for 2020-2040, EDR's Model (million \$2021)

Planning Regions	Projects in Design, Construction, and On Hold (million, \$2021)	Project Meet Remaining Inferred Shortage (million, \$2021)		All Projects (million \$2021)		
		Less expensive	More expensive	Less expensive	More expensive	Average
(1)	(2)	(3)	(4)	(5)	(6)	((5) + (6)) / 2
SW – TB	\$63.31	\$4.54	\$139.82	\$67.85	\$203.13	\$135.49
NFRWSP	\$28.48	\$33.27	\$236.79	\$61.75	\$265.27	\$163.51
SW – H*	\$1.73	\$393.06	\$393.06	\$394.79	\$394.79	\$394.79
SW – S	\$123.65	\$203.93	\$551.88	\$327.58	\$675.53	\$501.56
<b>Statewide (sum of regions)</b>	<b>\$217.17</b>	<b>\$634.80</b>	<b>\$1,321.54</b>	<b>\$851.97</b>	<b>\$1,538.71</b>	<b>\$1,195.34</b>
<b>Natural Systems</b>				<b>\$842.66</b>	<b>\$842.66</b>	<b>\$842.66</b>
<b>Total Expenditure</b>				<b>\$1,694.63</b>	<b>\$2,381.37</b>	<b>\$2,038.00</b>

# Summary

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- Develop an approach to project expenditures necessary to meet the growing water demand in Florida over the next 20 years
  - Based on WMDs' water projections : \$2.33 billion
  - Based on EDR's water projections : \$2.04 billion



# Economic Questions

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- What are the mechanisms for generating revenues to finance water supply development, rehabilitation of aging infrastructure, and natural system protection and restoration?
- Who will bear the costs?
- Are there effective water demand management strategies?
- Should the state start exploring alternative mechanisms for reallocation of water resources?

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Please make my day with (easy)  
questions?

