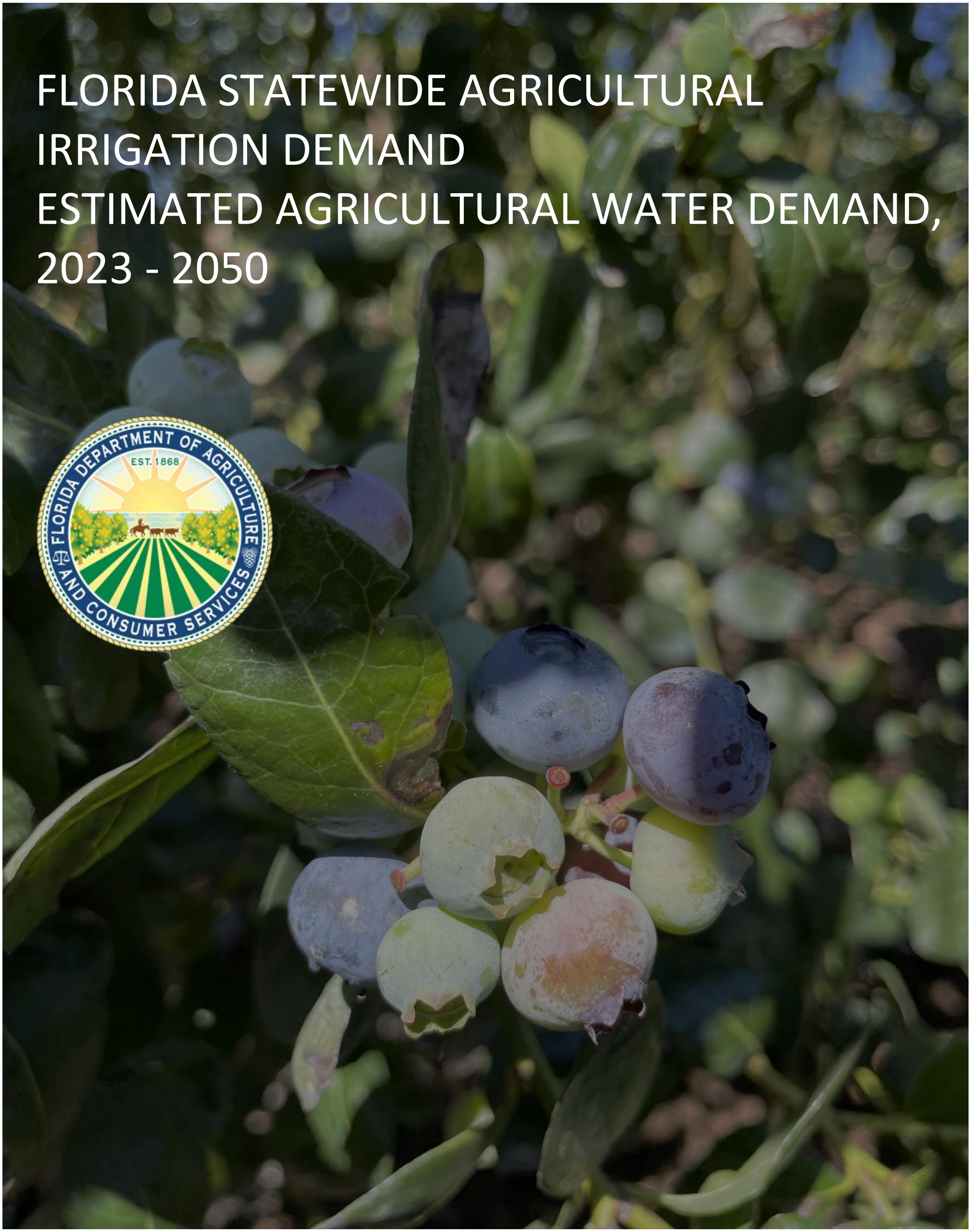
JUNE 30, 2025

FLORIDA STATEWIDE AGRICULTURAL IRRIGATION DEMAND
ESTIMATED AGRICULTURAL WATER DEMAND, 2023 - 2050



THE BALMORAL GROUP
165 Lincoln Ave Winter Park, FL 32789

Table of Contents

Separate Appendices

Appendix A – Acreage Projections
Appendix B – GIS Maps
Appendix C – Cropland Water Use Projections
Appendix D – Other Agricultural Water Use Projections
Appendix E – Technical Information
- FSAID Methodology
- Sensitivity Analysis
- Model Performance
- Climate Risks to Florida Agriculture
- Emerging Crops
- Citrus Evaluation
- FSAID Methodology for Dry-Year Water Demand Estimation
- Irrigation efficiency improvements

List of Figures

List of Tables

List of Acronyms

AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation
ALG	Agricultural Lands Geodatabase
AWS	Actual Water Savings
CDL	USDA Cropland Data Layer
CFWI	Central Florida Water Initiative
CUP	Consumptive Use Permit
DPI	Division of Plant Industry
ET	Evapotranspiration
EWUR	Estimated Water Use Report
FAPRI	Food and Agricultural Policy Research Institute
FDACS	Florida Department of Agriculture and Consumer Services
FDOR	Florida Department of Revenue
FLUCCS	Florida Land Use/Land Cover and Forms Classification System
FRIS	Farm and Ranch Irrigation Survey
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellites
GPD	Gallons per Day
ILG	Irrigated Lands Geodatabase
INYR	Inches/Year
IWM	Irrigation and Water Management
LKB	Lower Kissimmee Basin
LWC	Lower West Coast
MGD	Millions of Gallons per Day
MIL	Mobile Irrigation Labs
NAIP	National Agricultural Imagery Program
NASS	National Agricultural Statistics Service
NRSP	North Ranch Sector Plan
NWFWMD	Northwest Florida Water Management District
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SRWMD	Suwannee River Water Management District
SWFWMD	Southwest Florida Water Management District
UEC	Upper East Coast
UKB	Upper Kissimmee Basin
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WMD	Water Management District
WUP	Water Use Permit

Executive Summary

The Florida Department of Agriculture and Consumer Services (FDACS) is charged with developing estimates of statewide agricultural water demand[1]. This process is described as the Florida Statewide Agricultural Irrigation Demand project, or FSAID. The current FSAID report covers the projection period through 2050 to align with regional water supply plan projection periods.

A crucial part of estimating statewide agricultural water needs is identifying the agricultural lands that are currently irrigated. **Table ES-1** summarizes irrigated lands as of crop year 2023 to correspond to the most recent year of available water use data from the Water Management Districts (WMDs). This data reflects updated agricultural and irrigated agricultural areas. **Figures 3 and 5** in the report provide graphics of County-level projected changes in acreage and water use.

Table ES- 1. Florida Agricultural Acreage in Production, by WMD

WMD	Agricultural Lands 2023	Irrigated Crop Land 2023
	Acres	Acres
NWFWMD	713,703	55,746
SFWMD	2,909,260	1,014,825
SJRWMD	1,165,581	116,357
SRWMD	805,527	155,459
SWFWMD	1,784,862	313,247
Total	**7,378,931**	**1,655,634**

Through 2050, statewide total irrigated crop acreage is projected to decrease by about 52,000 acres (about a 3% drop in irrigated area). The projected decline in overall irrigated acreage is based on historical county-specific trends in irrigated area from 2015 to 2023, the most recent years of FSAID annual irrigated area refinements. The associated average-year water use is projected to decrease overall by about 2% or 43 Million of Gallons per Day (MGD) by 2050, with varying impacts on individual WMDs. South Florida Water Management District (SFWMD), St. Johns River Water Management District (SJRWMD) and Southwest Florida Water Management District (SWFWMD) are forecast to see declines in irrigated areas, while the northernmost districts, Northwest Florida Water Management District (NWFWMD) and Suwannee River Water Management District (SRWMD), are expected to see increases in the share of agricultural land that is irrigated.

The current total agricultural irrigation water use statewide is estimated at 1,767 MGD for an average year and 2,377 MGD for a 1-in-10 dry year. **Table ES-2** provides a breakdown by WMD of total crop irrigation use. **Table ES-3** provides estimated water use for livestock and aquaculture.

[1] Florida Statute 570.93. Department of Agriculture and Consumer Services; agricultural water conservation and agricultural water supply planning.

Table ES- 2. Estimated Irrigated Cropland Water Use

WMD	2023 Acres	2023 Avg MGD	2023 Inches/Year	1-in-10 Dry MGD
NWFWMD	55,746	45	10.9	63
SFWMD	1,014,825	1,129	15.0	1,505
SJRWMD	116,357	132	15.2	184
SRWMD	155,459	157	13.6	201
SWFWMD	313,247	304	13.0	425
Total	**1,655,634**	**1,767**	**14.3**	**2,377**

Table ES- 3. Estimated Livestock/Aquaculture Water Use

WMD	Livestock water use (MGD)	Aquaculture water use (MGD)
NWFWMD	1.6	4.8
SFWMD	11.4	7.2
SJRWMD	3.9	1.7
SRWMD	9.1	0.4
SWFWMD	6.1	6.3
Total	**32.1**	**20.4**

Table ES-4 shows projected water use estimates by crop. These projections are based on historical water use and projected irrigated acreage, not necessarily specific to a particular crop type. Primary crop categories are based on crop type and similarities to water use **Table ES-5** summarizes WMD level irrigated acreage projections from 2023 to 2050. By 2050, total average-year agricultural irrigation water demand is estimated at 1,724 MGD, down from 1,767 MGD in base year 2023.

Table ES- 4. Irrigation Demand, MGD by Crop, 2023-2045

Statewide	2023	2025	2030	2035	2040	2045	2050	
Primary Crop	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Dry MGD**
Citrus	305	303	297	292	286	279	272	401
Field Crops	142	141	140	140	139	138	136	178
Fruit (Non-citrus)	78	78	75	73	72	70	68	87
Greenhouse/Nursery	137	155	176	173	173	176	177	197
Hay	114	109	106	108	108	107	108	153
Potatoes	33	33	32	32	32	31	31	45
Sod	62	62	61	61	59	59	59	72
Sugarcane	634	634	628	626	625	625	624	861
Vegetables (Fresh Market)	261	264	261	259	256	253	249	315
Total	**1,767**	**1,778**	**1,776**	**1,762**	**1,749**	**1,738**	**1,724**	**2,308**

Table ES- 5. Projected Irrigated Acreage by Water Management District, 2023-2045

WMD	2023	2025	2030	2035	2040	2045	2050	2023-2050	2023-2050
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Change	% Change
NWFWMD	55,746	56,129	57,085	58,072	59,005	59,932	60,868	5,122	9%
SFWMD	1,014,825	1,014,594	1,009,420	1,003,946	997,653	991,789	986,079	(28,746)	-3%
SJRWMD	116,357	116,253	114,097	111,898	109,338	107,458	105,000	(11,357)	-10%
SRWMD	155,459	157,109	161,136	165,287	169,587	173,454	177,538	22,080	14%
SWFWMD	313,247	310,075	302,782	295,219	288,249	281,472	274,422	(38,825)	-12%
Total	**1,655,634**	**1,654,161**	**1,644,520**	**1,634,424**	**1,623,832**	**1,614,106**	**1,603,908**	**(51,727)**	**-3%**

Historical records from USDA survey data indicate that Florida farmers have improved efficiency on average about 1% per year, overall. A long-term record of producer-reported acreage and water use was used to develop trends to project future irrigation conservation[2]. **Table ES-6** provides the future conservation results, which project irrigation efficiency improvements of about 6% of the total average year irrigation demand by 2050. Detailed information on conservation methods and data sources are provided in **Appendix E**.

Table ES- 6. Estimated Cumulative Water Savings Due to Efficiency Improvements

WMD	2025	2030	2035	2040	2045	2050
NWFWMD	0.7	2.2	3.2	3.6	4.0	4.3
SFWMD	10.5	27.4	38.6	45.9	51.8	57.2
SJRWMD	2.2	6.7	9.8	12.0	13.8	15.1
SRWMD	3.2	10.2	16.7	22.1	24.4	25.5
SWFWMD	2.3	6.5	8.7	10.2	11.5	12.5
Total	**18.9**	**53.0**	**77.0**	**93.8**	**105.5**	**114.6**

Amounts are cumulative over time; i.e. 18.9 mgd from 2025 is included in 53.0 mgd in 2030

Citrus and sugarcane operations are the crops with the most significant area and irrigation demand in Florida. Due to high fixed costs, shocks to the system affect profits long before they affect acreage and water use. Some portion of producer response to systemic shocks are embedded in the underlying model that has been trained by many years of permit level water use from the WMDs. The historical dataset incorporates housing boom and bust years, wild swings in energy prices, rapid spread of citrus greening, COVID-19, and numerous years of major natural disasters which have affected agriculture. The heavy investments in capital and labor arrangements inject an inherent lag to changes in agricultural practices, which is likely to be evident within water use as well.

The FSAID model incorporates both agronomic and economic factors that affect irrigation water demand. The model's ability to capture the variation in water use by profitability across crops and by crops over time provides an enhanced estimate of future irrigation demands. A number of factors present uncertainty in future projections for Florida agricultural irrigation demand: environmental and land use changes, changes in trade relations and market conditions, emerging crops or diseases, among others. In

[2] USDA Irrigation and Water Management Survey, Florida data

Appendix E, the results of four agricultural water demand alternative scenarios are presented to show potential outcomes related to 1) western U.S. to eastern U.S. irrigated area shifts, 2) possible trade improvements for Florida producers, 3) potential citrus greening resolution and bounce-back in citrus area, and 4) increased conversion to non-agricultural land uses. These four scenarios had MGD changes (differences from the expected 43 MGD decrease in demand by 2050) ranging from -8 to 49 MGD. Additionally, the possible impacts from currently evolving agricultural trade relations are discussed in Appendix E: “Global Agriculture Market Changes and Scenario Analysis” section.

The latest FSAID irrigation water demand projections estimate a roughly 52,000-acre decrease in statewide irrigated agricultural area through 2050, accompanied by a reduction of about 43 MGD in average-year water demand.

Introduction

The Florida Department of Agriculture and Consumer Services (FDACS) is charged with developing estimates of statewide agricultural water demand[3]. The process is described as the Florida Statewide Agricultural Irrigation Demand project, or FSAID; this report is the ninth annual update of FSAID water use estimates prepared by FDACS. The current and projected agricultural water use estimates are based on a model fitted to 2007 to 2023 metered or reported permit-level water use data from all Water Management Districts (WMDs) and have utilized updated spatial data to improve the representation of irrigated and non-irrigated agricultural lands.

The current baseline acreage and water use estimates are for the year 2023, which is the most recent year of available water use data provided by the WMDs. This report includes estimates of irrigated agricultural areas and water demands for 2023 and projections for 2025 – 2050, in five-year increments. The estimates herein are provided to the WMDs for their review and comment and ultimately for consideration in development of their respective water supply plans. This report describes the agricultural land acreage estimates and methodology, followed by the water use estimates and methodology. Following the water and land use estimates, frost-freeze protection estimates, irrigation conservation estimates, and livestock and aquaculture water demand estimates are provided.

This iteration of the FSAID agricultural water demand projections can be referenced as FSAID XII (FDACS 2025). Previous FSAID reports or datasets can be referenced similarly (i.e. FSAID III; FDACS 2016).

Methodology and Agricultural Land Acreage Estimates

Two spatial datasets of Florida's agricultural lands were created for the FSAID project. The Agricultural Lands Geodatabase (ALG) includes all agricultural land, while the Irrigated Lands Geodatabase (ILG) includes only irrigated agricultural land, as well as the estimated current and projected irrigation water use for each field.

A. ALG: Refinement of Agricultural Lands Geodatabase

The original FSAID ALG was developed in 2014 as part of the initial establishment of the FSAID program and underlying datasets. The following primary spatial data sources were used:

- Florida Statewide Land Use/Land Cover and Forms Classification System (FLUCCS) from the WMDs and DEP,
- Consumptive Use Permit (CUP) polygons from the WMDs,
- well locations,
- United States Department of Agriculture (USDA) Cropland Data Layer (CDL) data,
- USDA National Agricultural Imagery Program (NAIP)
- aerial imagery, and
- Irrigated Areas layers from SJRWMD and SWFWMD.

[3] Florida Statute 570.93. Department of Agriculture and Consumer Services; agricultural water conservation and agricultural water supply planning.

Substantial spatial data processing was completed to develop Florida's ALG and ILG to model current and projected agricultural water demands. The annual refinement to the ALG is based on the historical sources listed above plus:

- Stakeholder input,
- FDACS field staff reviews and Best Management Practices (BMP) enrollment data,
- Florida Department of Revenue (FDOR) property appraisal data (parcel data),
- the most current field-verified data from United States Geological Survey (USGS) and
- County comprehensive plan update areas are reviewed to evaluate for recent agricultural land changes.

Cropland Data Layer Crop Classification

The 2023 CDL was used to update crop types for instances in which the dominant CDL crop represented at least 40% of the area of an ALG field area (the threshold established based on detailed review of > 500 example fields). This CDL crop update occurred only for selected agronomic (field crops) and grazing land crop types. The goal of this process is to efficiently update crop types and to replace non-specific crop names like "FieldCrops" or "Cropland_Pastureland". The following dominant CDL crop type list was utilized for updating ALG crop types to ensure that uncommon or unusual CDL crops are not incorrectly used for ALG crop classification: Corn, Cotton, Dry Beans, Grass_Pasture, Oats, Peanuts, Rye, or Soybeans. This process resulted in 5,113 features (about 266,000 acres) having a revised crop type using the 2023 CDL crops (most commonly updated to Peanuts, Corn or Cotton).

Removal of Agricultural Lands

Changes to non-agricultural lands (removed features from the ALG) were identified from a combination of stakeholder feedback, aerial imagery reviews and parcel and land use data reviews. The net change in total agricultural lands was about 70,000 acres of decline. The most common reason for ALG features to be removed from the dataset was fields being identified as converted to residential areas (about 18,000 acres). Solar power generation was another other major reason for conversion from agricultural areas; about 5,500 acres were removed from the ALG for areas identified to be solar power conversion. For context, in the prior year of ALG revisions, about 31,000 acres of the ALG were removed for residential development and about 13,000 acres were removed for solar power areas. These two land use changes have been the dominant reasons for declines in agricultural lands in the last five years.

B. ILG: Refinement of the Irrigated Lands Geodatabase

The Irrigated Lands Geodatabase (ILG) was updated to 2023 conditions based on manual review and evaluation using 2023/2024 aerial imagery, new or modified Water Use Permits (WUPs), 2023 CDL, FDACS field staff spatial data input, FDACS Division of Plant Industry (DPI) citrus layer, USGS field verification, and WMD-provided spatial data on irrigated area changes. All these datasets were used to target manual review of ILG features compared to aerial imagery and ancillary datasets. Updates were made to field geometry, crop type, irrigation system, and irrigation status (fallow or irrigated).

Table 1. FSAID data layers for spatial data refinements

DATA SOURCE	DESCRIPTION
Aerial Imagery (2023-2024)	Aerial Imagery used for manual evaluation of crop type and irrigation status
FDEP Statewide Land Cover (2023)	Statewide land cover data used to identify new agricultural areas and non-agricultural areas to be removed from the ALG and ILG.
Water Use Permits (WUPs; recent new and revised were reviewed)	WUPs typically provide information on crop type and irrigation system; any new or modified WUPs from 2023 or more recent were manually reviewed.
FDACS OAWP field staff spatial data	Near real-time comments in spatial data identifying ILG and ALG edits based on field visits or aerial reviews or producer input.
FDACS BMP enrollment data	Spatial coverage of properties enrolled in FDACS BMPs.
USDA Cropland Data Layer (CDL; 2023)	The CDL is a gridded dataset (30-meter resolution) that classifies crop type based on satellite data and ground-truth data from the Farm Service Agency (FSA) field reports at the Common Land Unit (CLU) scale. The dataset is updated annually based on satellite data collected from April to September.
U.S. Geological Survey irrigated areas field verification (USGS; 2023-2024)	U.S. Geological Survey (USGS) field verification in NWFWMD.
FDACS Division of Plant Industry (DPI) active citrus layer; 2024	Statewide dataset of citrus areas, with attributes indicating survey date and classification that describes active production or abandonment.
water use data; 2023 annual water use totals	Adjusted irrigated coverage based on WMD water use data for permits with 0 or low (< 3in/yr) water use.
Property Appraiser Data	Parcel data was used to identify areas in the ALG that overlap with non-agriculture parcels.

Updates to the ILG were reviewed with personnel at each WMD. Draft ILG shapefiles were provided to each WMD during February of 2025, and meetings with the FSAID team staff in each WMD were conducted to collaborate on spatial data improvements. In some WMDs, staff provided GIS data for recommended changes. In other WMDs, comments were provided via email and were researched as part of continued ILG updates. In all cases, input was acknowledged and addressed.

Field verification was completed by USGS in 2024 in parts of the SFWMD (Glades, Highlands, Martin, Okeechobee, and St. Lucie Counties). This field verification involved reviews of agricultural lands from publicly accessible roads to identify irrigation status, irrigation system, and crop type. The USGS spatial data updates were reviewed manually to edit the ILG where irrigated features in the ILG were missing or should be changed to not irrigated, where crop types were different, or where boundary adjustments were needed.

DPI's latest citrus dataset[4] was used statewide to review irrigated citrus features in the ILG. This was done by reviewing imagery at locations of irrigated citrus from the ILG that were inactive or missing in the DPI citrus layer. About 26,000 acres of citrus lands were converted to fallow citrus through those reviews.

[4] As of September 6th 2024

Table 2 provides a summary of the total acreage in the current ALG and ILG.

Table 3 provides the irrigated cropland acres by Primary Crop statewide. **Appendix C** provides detailed tables by WMD and county, with estimates for split WMD counties available in **Table C- 28**.

Table 2. Summary of ALG and ILG for 2023 baseline

WMD	ALG fields	ALG area	ILG fields	ILG area
	Parcels	Acres	Parcels	Acres
NWFWMD	31,502	713,703	1,001	55,746
SFWMD	37,873	2,909,260	6,997	1,014,825
SJRWMD	34,203	1,165,581	4,077	116,357
SRWMD	28,216	805,527	2,425	155,459
SWFWMD	39,341	1,784,862	8,271	313,247
Total FSAID	**171,135**	**7,378,931**	**22,771**	**1,655,634**

Table 3. 2023 Florida Irrigated Cropland Acreage by Primary Crop

Primary Crop	2023 Acres	Share of total
Citrus	370,481	22%
Field Crops	172,742	10%
Fruit (Non-citrus)	37,231	2%
Greenhouse/Nursery	57,000	3%
Hay	151,983	9%
Potatoes	31,142	2%
Sod	63,606	4%
Sugarcane	569,318	34%
Vegetables (Fresh Market)	202,131	12%
Total	**1,655,634**	**100%**

C. Projections of Future Irrigated Areas

The following sections describe how changes in irrigated areas in Florida counties are estimated and spatially distributed.

Trend Analysis from Historical FSAID Spatial Data

Long-term projections of irrigated agricultural lands were developed using historical, county totals of irrigated lands for each Florida county based on recent annual updates to the FSAID data. The ILG acreage from 2015 to 2023 was used to develop a trend analysis for each County; **Appendix A** provides graphs of historical and projected irrigated acreage for each of Florida's 67 counties. This methodology is an improvement to the original approach in FSAID[5], which relied on long-term USDA Ag Census data, as there was no reliable, long term record of ground-truthed and annually-updated irrigated areas at the time. With the established history of the FSAID ILG's being annually updated, there is now a long enough recent historical time series to develop credible trends reflective of recent market and land use changes.

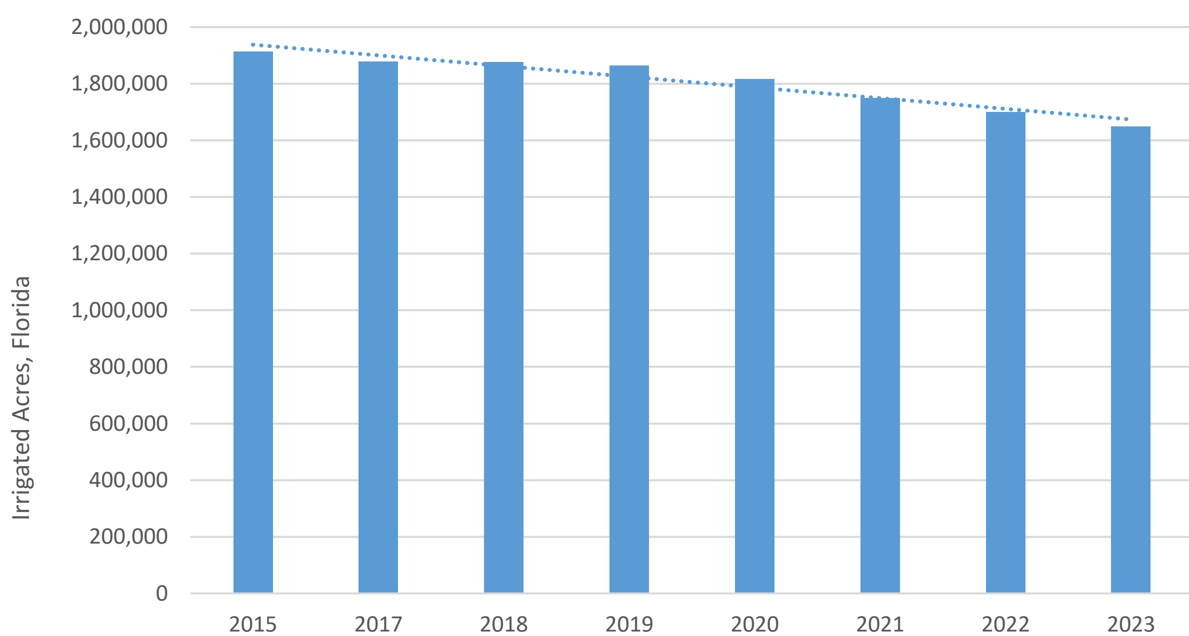
[5] prior to availability of yearly time series of irrigated areas

Regression procedures were used to forecast county-specific trends in irrigated area based on statistical fit. The functional form of each regression was selected based on best-fit criteria from logarithmic, linear, exponential, and power forms. The projected irrigated area changes were reviewed with FDACS and WMD personnel to evaluate the direction and amounts of irrigated acreage changes. In some counties, trend type was selected manually based on stakeholder input or reasonableness of the projected future acreage. For trend projections in SRWMD Counties, the 2019 to 2023 portion of the historical ILG time series was used for trend-fitting in order to avoid having long-term trends being influenced by the major 2015 to 2019 acreage increases that have since plateaued in SRWMD.

Acreage projections were adjusted for Glades County to accommodate expected losses in irrigated area due to surface water projects. Additionally, Glades County projections were adjusted to align with Seminole lands projections for the Brighton property; this was determined from coordination with SFWMD. Previously projected declines in Palm Beach County due to a planned surface water project no longer occur in the projection period as these changes are reflected in base year 2023 ILG. Osceola County irrigated acreage trends were adjusted to align with planned irrigated area increases of the North Ranch Sector Plan. Counties having total acreage change by 2050 of 500 acres or less (based on best-fit trend functions) were manually set to not change irrigated acreage over the projection period.

The annually updated, historical irrigated areas from FSAID are shown in **Figure 1**.

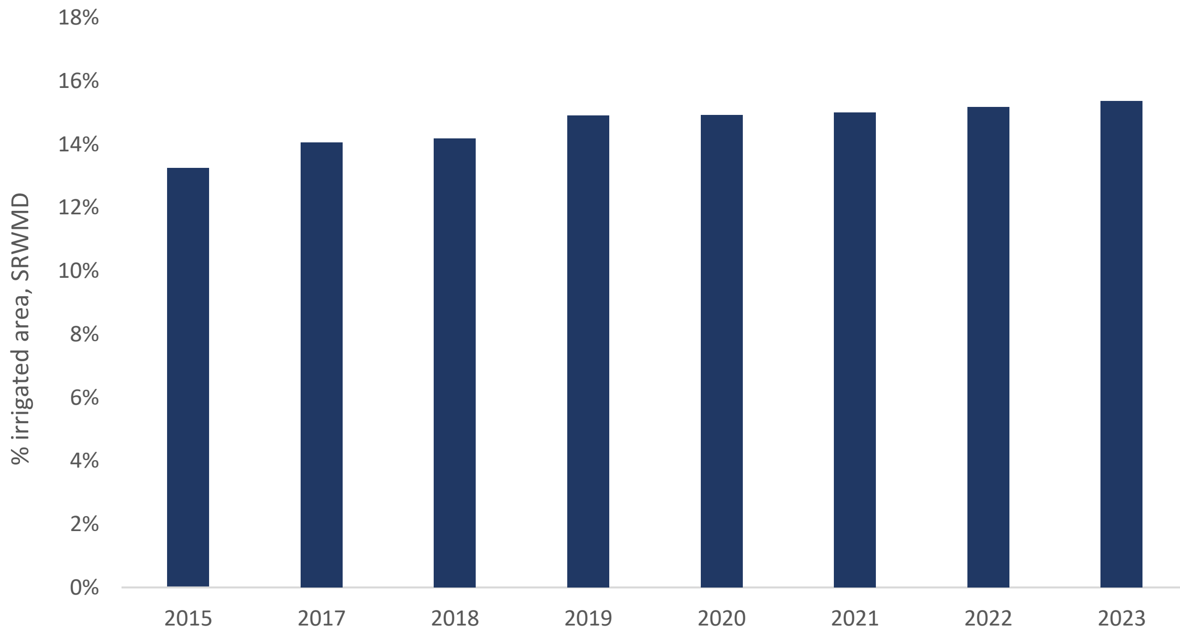
Figure 1. Statewide Irrigated Land, acres - Florida



To illustrate the increasing share of irrigation on agricultural lands in WMDs with recent irrigated area expansion (example: SRWMD) see **Figure 2**. Note the share of land irrigated increased from 13% to 15%

from 2015 to 2023, during which over 30,000 irrigated acres were added in the WMD. It is also notable that irrigated acreage increases in SRWMD have moderated in the last five years.

Figure 2. SRWMD Trend in % irrigated land 2015 to 2023



Spatial Distribution of Projected Irrigated Area Changes

The county-level additions or declines in irrigated area were spatially distributed in the projections ILG using numerous decision rules for selecting ALG fields to become irrigated or ILG fields to become not irrigated. In counties with projected increases in irrigated acreage, R routines were used to select non-irrigated ALG fields to become irrigated until sufficient acreage is added in each 5-year projection period. The following conditions were used to constrain irrigated area additions, meaning if an ALG field was any of the following, it would not be a candidate for irrigation in a future period:

- Overlaps Florida Natural Areas Inventory (FNAI)
- NRCS Land Capability Classification > 5 (indicates lower quality soils)
- Overlaps a SFWMD planned surface water project.

Areas added to the ILG were prioritized based on having an active WUP and being near roads. Additionally, features within each group were also sorted by the development suitability index (least to most likely to develop based on the FL2070 development suitability index (FL2070, 2023). This means that the routine for ALG fields becoming irrigated, first looks at ALG fields overlapping an existing WUP for agricultural use, then looks at ALG fields with a distance to roadways less than half the county-average distance of ALG fields to roads, then looks at unpermitted ALG fields with above-average distance to roads, and each subset group is sorted lowest to highest by development suitability index (FL2070, 2023).

Similarly, in counties with project irrigated acreage declines, ILG features are identified first within urban boundaries (US Census), and fields are then sorted by development suitability index (FL2070, 2023) from least to greatest. This process looks first within urban boundaries (sorted lowest to highest by development suitability index) and then looks beyond urban boundaries in the County (also sorted by development suitability).

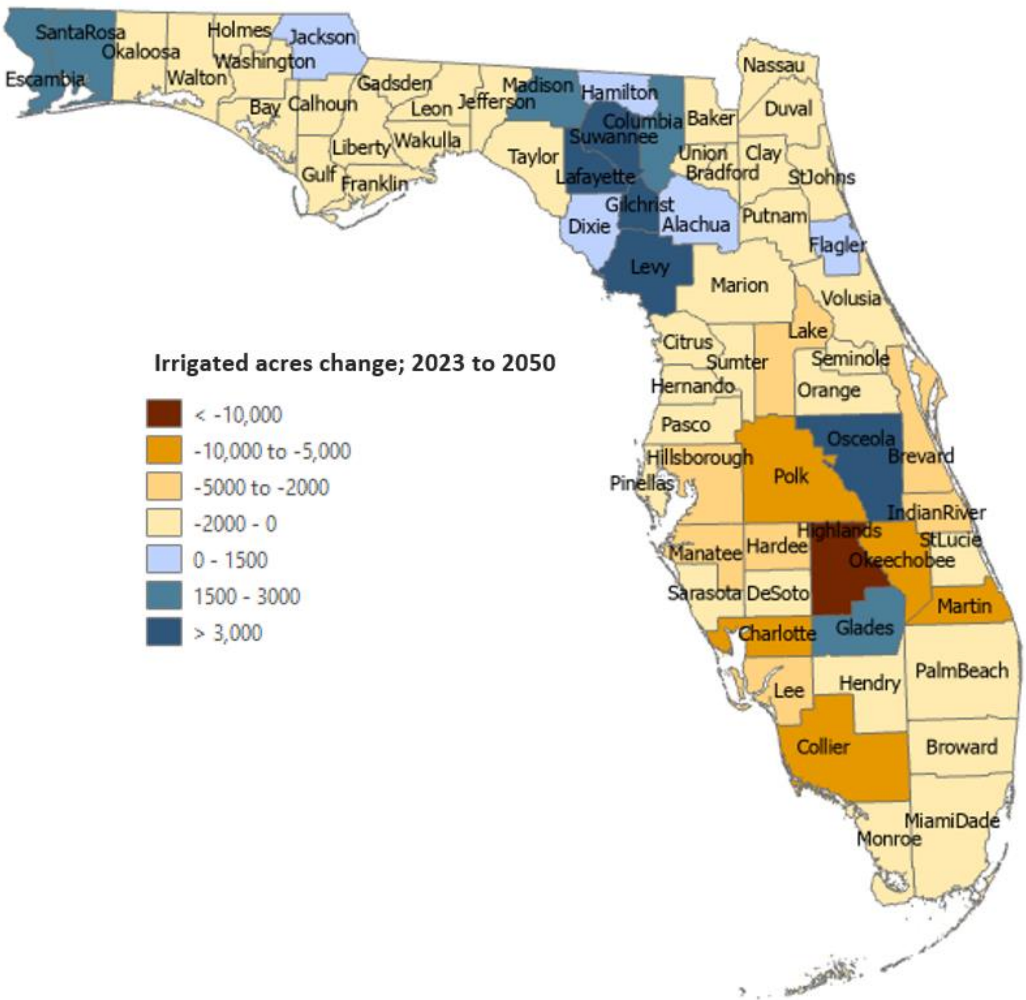
Acreage increases in Osceola County were adjusted manually to account for the additional irrigated acres specified in the North Ranch Sector Plan. For counties with a projected decrease in irrigated area, those decreases were required to occur in non-Everglades Agricultural Area (EAA) regions, as the EAA is assumed to remain stable. In Glades County, acreage projections were adjusted manually to add some irrigated areas to align with Seminole lands projections for the Brighton area; this increased irrigated acreage through 2030. Loss of irrigated areas in Glades County was completed manually (about 3,300 acres) to accommodate a SFWMD surface water project (Lake Hicpochee Hydrologic Enhancement – FEB expansion planned for near-term 2025; note base year of FSAID for this iteration is 2023). Future updates to FSAID will likely capture the FEB expansion in base year conditions of the ILG.

Projected agricultural acreage and irrigated acreage through 2050 by county are provided in **Table A-1** in the **Appendix A**. **Figure 3** illustrates the changes in irrigated areas from 2023 to 2050 by county; the majority of counties with large percent increases in irrigated area are in the northern portion of the state. Resulting acreage projections by WMD are provided in **Table 4.**

Table 4. Projected Irrigated Acreage by WMD

WMD	2023	2025	2030	2035	2040	2045	2050	2023-2050	2023-2050
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Change	% Change
NWFWMD	55,746	56,129	57,085	58,072	59,005	59,932	60,868	5,122	9%
SFWMD	1,014,825	1,014,594	1,009,420	1,003,946	997,653	991,789	986,079	(28,746)	-3%
SJRWMD	116,357	116,253	114,097	111,898	109,338	107,458	105,000	(11,357)	-10%
SRWMD	155,459	157,109	161,136	165,287	169,587	173,454	177,538	22,080	14%
SWFWMD	313,247	310,075	302,782	295,219	288,249	281,472	274,422	(38,825)	-12%
Total	**1,655,634**	**1,654,161**	**1,644,520**	**1,634,424**	**1,623,832**	**1,614,106**	**1,603,908**	**(51,727)**	**-3%**

Figure 3. County level projected change in irrigated area: 2023 to 2050



D. Estimated Water Use

As required by Florida Statute, observations of irrigation water use are the basis for the FSAID estimates of spatially distributed statewide irrigation demand. Metered and reported water use data is collected each year from the WMDs. Historical metered/reported data extends from 2007 to 2023, and these data were used to develop an econometric model to estimate irrigation water demand. The model specification is estimated using Ordinary Least Squares regression analysis to generate coefficients from the actual water use for each field-level variable. Variables include agronomic variables (crop choice, location, climate), engineering or physical factors (irrigation equipment, field size) and economic or behavioral factors (crop prices); the dependent variable is actual water use, derived from metered or reported water use data (hereafter, "metered data").

The model was initially developed based on published literature reflecting national trends in agricultural irrigation, and has been refined each year based on feedback from WMDs, producers and academics[6]. In the FSAID XII model, approximately 93,800 field-scale observations (from 2007-2023) are included in the dataset used to generate model coefficients. The R^2 or statistical "fit" of the model output to actual data is 0.78. **Appendix E** provides further detail on the model inputs, a detailed example of the model and discussion of specific elements of the model including price, costs and soils data.

i. Metered Data Records

The existing dataset of metered data records across WMDs includes 16 years of permit-level water use from years 2007-2023. Input data was thoroughly evaluated for outliers, infeasible estimates based on irrigated area, and statistical heterogeneity. Multiple thresholds for inclusion in the dataset were tested including multiple standard deviations from the mean by crop by WMD - 10th and 90th percentile by crop by WMD; and hard upper bounds (e.g.; 100 inches/year). Repeated statistical testing determined that the 25th and 90th percentile thresholds had values most representative of typical irrigation practice, and these thresholds were used to cull data for input to the water demand model.

Table 5 provides a summary by Primary Crop of metered data records, which includes field-level observations for each year from 2007-2023. Therefore, the total acreage of metered data in the input dataset greatly exceeds the current ILG, which represents only current, baseline irrigated area. **Appendix E** provides additional detail on screening of input data and distribution by WMD.

Table 5. Metered Data Records Summary by Primary Crop

Primary Crop	Metered Data Acres	Sample size, n
Citrus	3,580,395	34,782
Field Crops	650,444	7,637
Fruit (Non-citrus)	104,297	6,944
Greenhouse/Nursery	154,906	12,132
Hay	727,964	4,032
Potatoes	177,844	2,149
Sod	319,221	2,924
Sugarcane	1,118,391	4,081
Vegetables (Fresh Market)	1,294,170	19,080
Total	**8,127,631**	**93,761**

For context, **Table 7** provides statewide average inches/year by crop as calculated by the Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) Model for FSAID I, metered or reported data for the previous FSAID XI, and the current FSAID XII (metered) dataset. The AFSIRS model is a crop water requirements irrigation model that uses detailed crop, soil, daily weather, and irrigation management parameters to estimate irrigation requirements; it is used by some Districts to support water use permitting.

[6] See de Bodisco, C. (2007); Livanis, G., et al (2006); Moss, C. (1998); Schoengold, K., et al (2006); Chalfant, James A. (1984); Edwards, B. et al (1996).

Table 6. Statewide Average inches /year by Primary Crop

Primary Crop	FSAID I AFSIRS results	FSAID XI Metered or Reported Usage Input	FSAID XII Metered or Reported Usage Input
Citrus	14.4	11.5	11.5
Field Crops	10.2	10.9	11.1
Fruit (Non-citrus)	16.6	27.5	28.0
Greenhouse/Nursery	48.6	28.8	29.0
Hay	15.1	10.2	10.2
Potatoes	12.5	14.1	13.7
Sod	37.5	12.6	12.8
Sugarcane	24.6	17.3	17.1
Vegetables (Fresh Market)	11.9	17.5	17.6
Total	**19.5**	**13.7**	**13.7**

ii. Current Water Use Estimates

The resulting current water use estimates for the base year (2023) reflect a 2.6% decrease in overall irrigated acreage over the prior year (2022) and a 2.4% decrease in overall water use as measured in MGD; see **Table 7** for the current FSAID XII values. Current baseline year 2023 irrigation water demand and the projected water demand for periods 2025-2050 were modeled using the average of rainfall and ET from 2005-2023.

Table 7. Estimated Statewide Water Use, 2023

Crop	Acres	MGD	in/yr
Citrus	370,481	305	11.1
Field Crops	172,742	142	11.0
Fruit (Non-citrus)	37,231	78	28.3
Greenhouse/Nursery	57,000	137	32.3
Hay	151,983	114	10.1
Potatoes	31,142	33	14.3
Sod	63,606	62	13.1
Sugarcane	569,318	634	15.0
Vegetables (Fresh Market)	202,131	261	17.4
Total	**1,655,634**	**1,767**	**14.3**

Source: SFWMD and TBG Work Product *Everglades Agricultural Area (EAA) area of 433,170 acres is held constant for the at 461 MGD.

E. Projected Water Use Methodology

Projected water use for the period from 2023-2050 is estimated by simulating future conditions using coefficients from the econometric model, and substituting forecast future values for each explanatory variable. Since location and climate-related variables are either fixed or long-term averages, the simulation is driven mainly by price and cost forecasts and future land area, which are discussed in turn.

i. Price Simulation

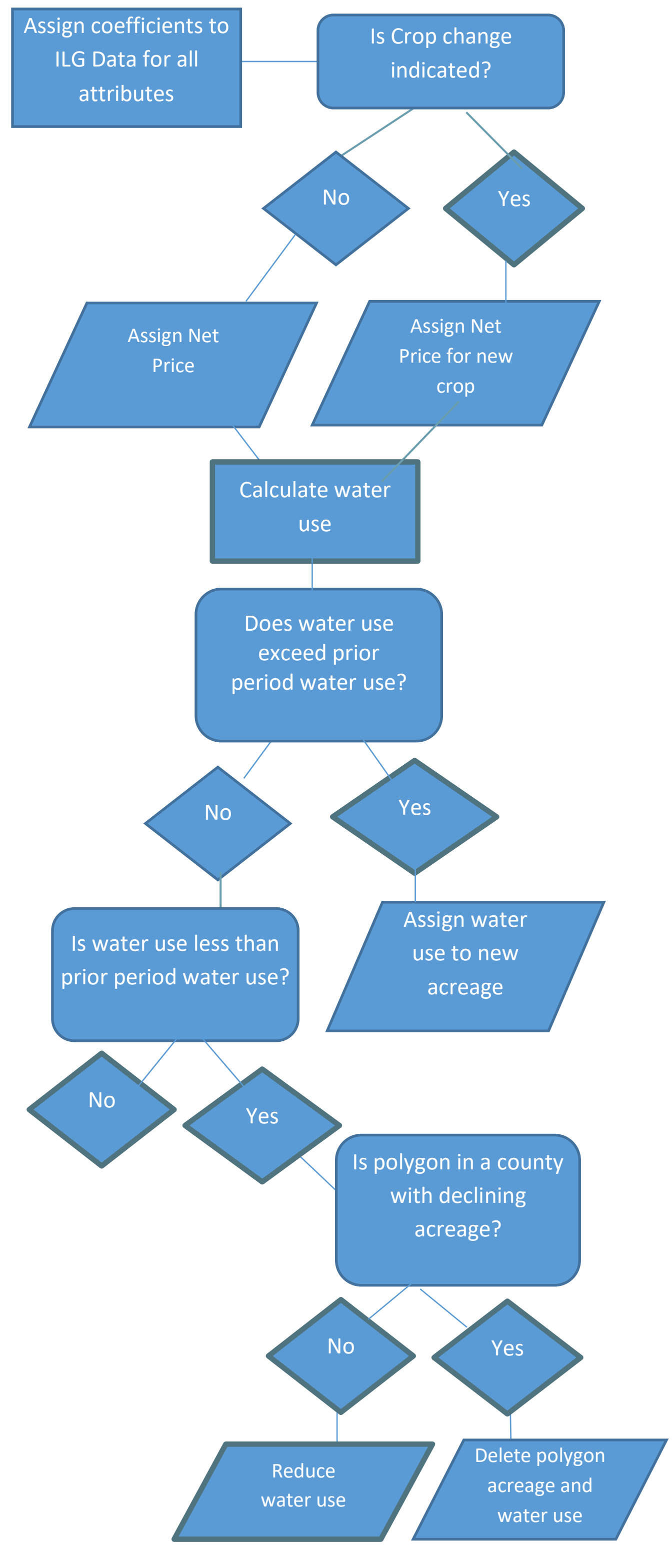
Future water use estimates were simulated by updating each explanatory variable in the econometric model, and using the regression equation to estimate future water use. Each variable was estimated as follows:

1. Prices and costs were forecast for five-year periods from 2025 to 2050 using 10-year crop price forecasts from USDA, Food and Agricultural Policy Research Institute (FAPRI) extended using a crop specific growth trend.
2. The irrigated acreage changes were used to identify irrigated acreage for each five-year interval, as described in **Section C: Projections of Future Irrigated and Agricultural Land Area**. The net revenue variable was calculated by applying updated net revenue values to forecasted acreage.
3. Evapotranspiration (ET) and rainfall variables were updated by calculating mean historical values for an average year (2005-2023), assigned at the ALG feature level.
4. Estimated coefficients from the regression model were applied to explanatory variables to simulate projected water use. The change in total water use was estimated at the ALG feature level, and applied to the acreage increase or decrease in each county.

ii. Spatial Distribution of Future Water Use

Spatial distribution of water use was applied according to the process outlined in **Figure 4**. Future water use changes that exceed water applied to current acreage were allocated across fields that were added to the ILG in future periods.

Figure 4. Spatial Distribution of Water Use Process



In some counties, agricultural acreage might not be sufficient to absorb the projected irrigated acreage after the constraints were applied, and if so, the acreage would be capped once the available land identified in the ALG was used. Conversely, if a county indicated fewer irrigated acres in future, the algorithm identified fields to remove from the ILG, with accordant water use. Crops were assigned based on the indicated crop mix from modeling results - i.e.

the “excess” water from crops (crops that show higher water use for increased acreage). The predominant irrigation system used in the county for the crop was assigned. Rainfall and ET were assigned in the same manner as the rest of the ILG.

iii. Sensitivity Analysis

A number of model iterations were run to test the sensitivity of various parameters and alternative approaches to measuring variables. Sensitivity analysis was conducted to compare the impacts of truncating outliers through several approaches as detailed in **Appendix E**. A variety of scenarios affecting possible acreage and water demand results are summarized in **Appendix E**.

Water Use Projection Results

F. Average Year Estimates

The resulting statewide water use estimates for each five-year period are provided in **Table 8** by Primary Crop, and **Table 9** by WMD. The total decrease in statewide irrigated area of 51,727 acres over the period through 2050 is accompanied by a net decrease in irrigation volume of 43 MGD for an average year. The effects are unevenly distributed by WMD, with a 13% increase in irrigation demand expected in SRWMD by 2050 and a 9% increase in irrigation demand in NWFWMD (although the latter comprises only about 4 MGD). Detailed breakdowns of county-level acreage by crop and WMD are included in **Appendix C**. **Figure 5** illustrates the percent change in irrigation water demand by county from 2023 to 2050.

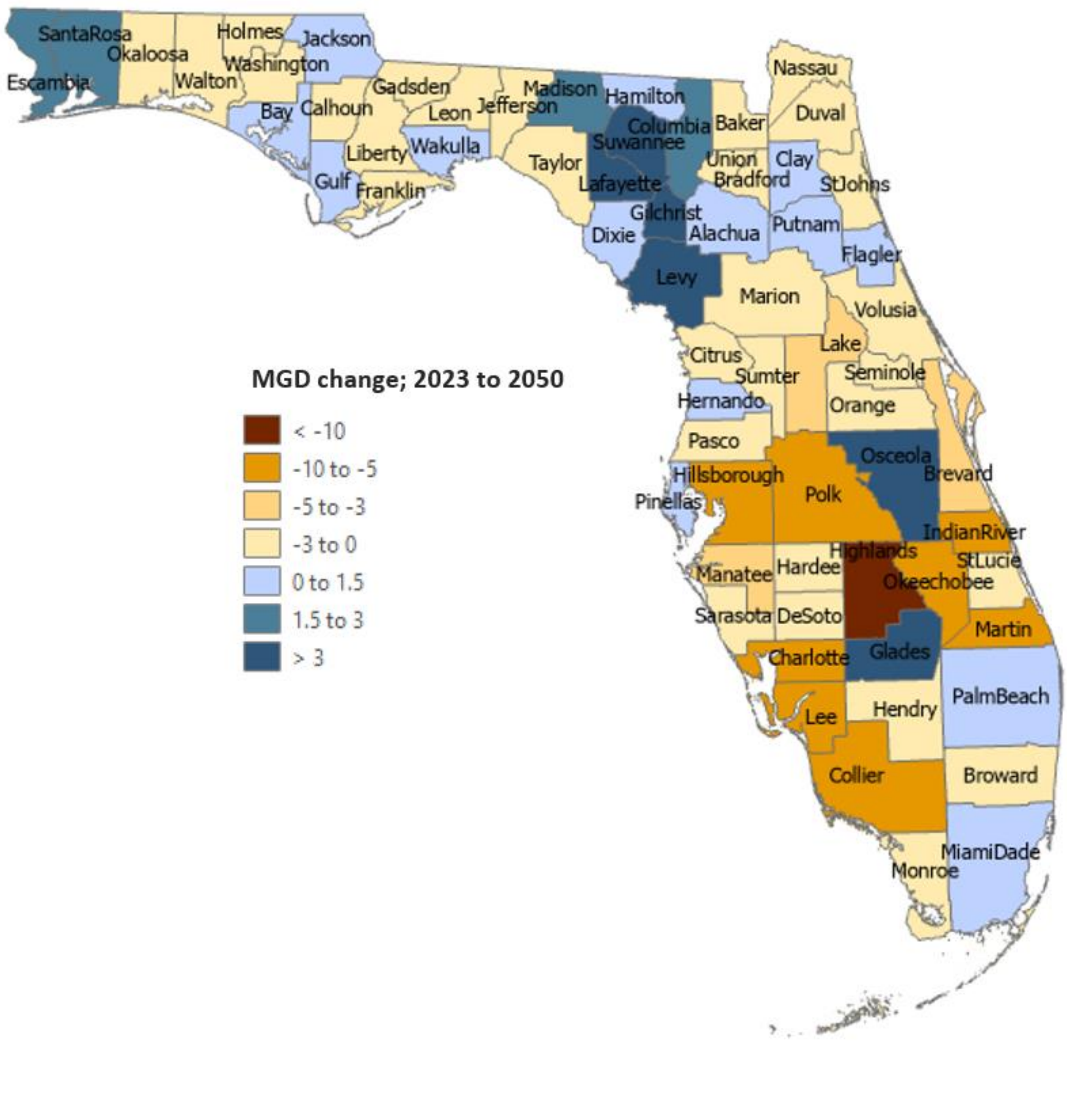
Table 8. Water Use Estimates by Primary Crop Average Year

Statewide	**2023**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Primary Crop	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**	**Avg MGD**
Citrus	305	303	297	292	286	279	272
Field Crops	142	141	140	140	139	138	136
Fruit (Non-citrus)	78	78	75	73	72	70	68
Greenhouse/Nursery	137	155	176	173	173	176	177
Hay	114	109	106	108	108	107	108
Potatoes	33	33	32	32	32	31	31
Sod	62	62	61	61	59	59	59
Sugarcane	634	634	628	626	625	625	624
Vegetables (Fresh Market)	261	264	261	259	256	253	249
Total	**1,767**	**1,778**	**1,776**	**1,762**	**1,749**	**1,738**	**1,724**

Table 9. Water Use Estimates by WMD, Average Year

WMD	2023	2025	2030	2035	2040	2045	2050
	Avg MGD	Avg MGD	Avg MGD	Avg MGD	Avg MGD	Avg MGD	Avg MGD
NWFWMD	45	45	46	47	47	48	49
SFWMD	1,129	1,141	1,147	1,140	1,133	1,126	1,119
SJRWMD	132	132	129	125	122	119	116
SRWMD	157	158	162	165	169	174	177
SWFWMD	304	301	292	285	278	271	264
Total	**1,767**	**1,778**	**1,776**	**1,762**	**1,749**	**1,738**	**1,724**

Figure 5. County level projections of change in irrigation demand: 2023 to 2050



G. Dry Year Estimates

Dry year estimates were calculated using crop and WMD-specific ratios of average irrigation water use to 1-in-10 use. The FSAID dry year estimates represent the irrigation demand that would be expected in 1 out of 10 years. Statewide, the overall average ratio is 1.34, but this varies widely by WMD and crop. The WMDs with the highest ratios are in NWFWMD and SJRWMD. Crops show a larger range in the ratios. Greenhouse/Nursery (1.13) show the smallest variation compared to the average year, while Citrus shows the highest ratio (1.5). **Table E- 9** in **Appendix E** provides the ratios by crop and WMD and **Appendix E** also provides a more detailed description of how the average-to-dry ratios were developed. **Table 10** provides Dry Year Estimates by WMD, and **Table 11** shows Dry Year Estimates by Primary Crop.

Table 10. Water Use Estimates by WMD, Dry Year (1-in-10)

WMD	2023	2025	2030	2035	2040	2045	2050	
	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry/Avg Year Ratio
NWFWMD	63	63	64	65	66	67	68	**1.44**
SFWMD	1,505	1,517	1,520	1,511	1,502	1,493	1,484	**1.27**
SJRWMD	184	184	180	175	170	167	162	**1.41**
SRWMD	201	202	207	211	216	222	225	**1.33**
SWFWMD	425	421	407	398	388	378	368	**1.30**
Total	**2,377**	**2,387**	**2,378**	**2,361**	**2,342**	**2,327**	**2,308**	**1.34**

Table 11. Water Use Estimates by Primary Crop, Dry Year (1-in-10)

Primary Crop	2023	2025	2030	2035	2040	2045	2050	
	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry MGD	Dry/Avg Year Ratio
Citrus	451	448	437	430	421	412	401	**1.50**
Field Crops	186	184	184	183	182	180	178	**1.35**
Fruit (Non-citrus)	100	99	96	93	91	89	87	**1.31**
Greenhouse/Nursery	153	172	196	192	192	196	197	**1.13**
Hay	161	154	150	152	153	152	153	**1.46**
Potatoes	48	48	47	47	46	45	45	**1.45**
Sod	75	75	74	74	72	72	72	**1.22**
Sugarcane	875	875	866	864	862	862	861	**1.38**
Vegetables (Fresh Market)	330	332	329	326	323	319	315	**1.28**
Total	**2,377**	**2,387**	**2,378**	**2,361**	**2,342**	**2,327**	**2,308**	**1.34**

H. Frost and Freeze Protection Estimates

Irrigation for freeze protection is used on a variety of cold-sensitive crops in Florida. Freeze protection water volumes are a small percentage of the total statewide demand for normal irrigation (about 5%), but the withdrawals happen over a brief period, meaning that the impacts from these withdrawals can be significant. Frost protection water use in FSAID is limited to the major crops commonly requiring freeze protection: strawberries, blueberries, peaches, citrus, and ferns. Freeze-related irrigation events were estimated to occur on days with minimum temperature at or below freezing for fields in the ILG where crop type matched one of those listed above.

The USGS gridded ET data (from GOES platform) from 1996 to 2023 were used for estimating the average number of annual freeze events at ILG fields with a crop type that would be freeze protected. The dataset includes minimum temperature at 2km grid resolution, which was used to count the annual number of freeze events at the locations of ILG fields which would likely be freeze protected. The annual freeze events at ILG locations were then averaged at the county level for the 27-year period. The average number of freeze events for a county was combined with information on crop type and irrigation system to calculate annual average amounts of freeze protection water use. To calculate the amounts of freeze-protection water, the following irrigation intensities were used: 0.07 inches/hour for micro-spray irrigated citrus, 0.2 inches/hour for blueberries, strawberries, or peaches, and 0.3 inches/hour for ferns. A 14-hour freeze event duration was used. Frost/freeze water demand for future projections of the ILG varies from the current frost/freeze demands due to the additions or deletions of ILG polygons classified as Non-Citrus Fruit (which would include strawberry, blueberries, and peaches) and Citrus. It was assumed that all additional acres of Non-Citrus Fruit and Citrus in the ILG projection periods would be irrigated for freeze protection.

The average annual frost protection demand for the current ILG was about 53 MGD on an average annual daily flow (AADF) basis. This declined by about 9 MGD from the prior year FSAID estimates due to the substantial reductions in irrigated citrus in the base year ILG. Freeze protection irrigation demand decreases to about 46 MGD by 2050 due to declines in irrigated areas with crop types that would be freeze protected. **Table 12** summarizes freeze protection estimates at the WMD level.

Table 12. Estimated Freeze Protection Estimates by Year

WMD	2023	2025	2030	2035	2040	2045	2050
	MGD	MGD	MGD	MGD	MGD	MGD	MGD
NWFWMD	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SFWMD	9.6	9.6	9.5	9.4	9.3	9.2	9.2
SJRWMD	9.3	9.2	8.9	8.6	8.3	8.0	7.7
SRWMD	1.3	1.3	1.3	1.3	1.3	1.3	1.3
SWFWMD	32.5	32.1	31.2	30.3	29.5	28.6	27.9
Total	**52.7**	**52.2**	**51.0**	**49.7**	**48.5**	**47.2**	**46.2**

In **Appendix D, Table D-1** provides a breakdown by Crop by WMD for freeze protection estimates, and **Table D-2** provides the county-level breakdown.

I. Conservation Estimates: Irrigation Efficiency Improvements

Under Florida Statute 570.93, "projected future water demands must incorporate appropriate potential water conservation factors". For purposes of incorporating potential water conservation factors, estimates of improvements in irrigation efficiency that can reasonably be expected over the planning period have been developed.

Two main datasets were explored for the purpose of estimating future irrigation efficiency improvements: Mobile Irrigation Labs (MIL) actual water savings (AWS) data and the USDA's Farm and Ranch Irrigation Surveys (FRIS), now known as the Irrigation and Water Management (IWM) Survey. The documented actual water savings through the MIL program are based largely on improvements in irrigation system distribution uniformity. The data available for MIL-based irrigation improvements from scheduling changes and sensor-based automation and other management improvements were determined to be of insufficient length to develop long-term future projections in conservation. Additionally, there is challenge in accurately estimating long-term participation rates from MIL data or other conservation cost-share efforts that might increase irrigation efficiency.

Data reflecting changes in farmers' use of irrigation water over the past 45 years is available from the USDA's IWM Survey. Using long-term trends avoids the uncertainty of estimating at the field level exactly what type of management change would be made and how many farms or fields would be expected to make that change. The IWM estimates show that over the entire time period for which data is available (1978-2023), the average farmer in Florida has decreased the amount of water used by 6,000 gallons/acre/year (which declines to about 3,800 gallons/acre/year for the projection period of 2025-2050).

Some of the efficiency improvements will be due to irrigation system changes that have already been mostly implemented in many areas of the state (primarily a shift from gravity systems to drip and micro-spray systems); therefore, remaining improvements are likely to come from management changes through better scheduling and/or sensor-based automation. Evaluation of the IWM data for the period from 2003-2023 shows approximately 5,800 gallons/acre/year in improvement, which is likely more representative of future improvements in irrigation efficiency on newly irrigated land and for fields irrigated with drip or microsprinkler systems. Based on exponential trend extrapolated to the future periods, this decline in water per area is about 3,700 gallons/acre/year for the projection period of 2025-2050. Two exponential trends from the IWM dataset were used to estimate future irrigation efficiency improvement based on current status and irrigation system. The trend from 1978-2023 is used for currently irrigated fields that are not drip or microsprinkler irrigated (providing a slightly elevated conservation for those fields), and the trend from 2003-2023 is used for newly irrigated fields or those irrigated with drip or microsprinkler (providing a lower slope, more conservative trend as newly irrigated or micro irrigated systems are likely to realize less efficiency improvements). **Appendix E** provides more detail on the calculations used to derive the efficiency estimates.

The resulting estimate of total irrigation efficiency improvements is about 115 MGD by 2050, or about 6% of total irrigation demand. **Table 13** provides a summary of estimated efficiency improvements by WMD. It should be noted that estimated efficiency improvements are based on average year demands, and would not likely be achieved in dry years.

Table 13. Cumulative Water Savings from Estimated Efficiency Improvements

WMD	2025	2030	2035	2040	2045	2050
	MGD	MGD	MGD	MGD	MGD	MGD
NWFWMD	0.7	2.2	3.2	3.6	4.0	4.3
SFWMD	10.5	27.4	38.6	45.9	51.8	57.2
SJRWMD	2.2	6.7	9.8	12.0	13.8	15.1
SRWMD	3.2	10.2	16.7	22.1	24.4	25.5
SWFWMD	2.3	6.5	8.7	10.2	11.5	12.5
Total	**18.9**	**53.0**	**77.0**	**93.8**	**105.5**	**114.6**

Detailed efficiency improvements estimates are provided in **Appendix D** by Crop by WMD (**Tables D-3 through D-7)**, and by county (**Table D-8)**.

J. Livestock and Aquaculture Water Use

Livestock demands were determined using animal inventories from USDA Ag Census data and the typically utilized per animal daily water use. The most current Ag Census (2022) was used to define the numbers of cattle, cows, poultry, horses, and other livestock. Livestock inventories from the Ag Census have remained relatively stable in Florida for the last five censuses (2002, 2007, 2012, 2017, and 2022). The inclusion of updated Ag Census data for livestock inventories did not result in major changes in total livestock water demand estimates.

For purposes of estimating the future water use, stable livestock inventories and water use are assumed in the coming decades. This is based on stable livestock inventories in recent decades. Total statewide livestock demand for current conditions is estimated at 32.1 MGD. This is a decline of about 6 MGD from the previous year FSAID estimates, resulting from including more recent county-level livestock inventories from the 2022 Ag Census.

County-level water withdrawals for aquaculture were compiled using USGS 2015 water use data. Additionally, CUPs for several counties were found to have available metered data for aquaculture withdrawals, and these were used in conjunction with the USGS county-level aquaculture withdrawals to produce statewide aquaculture water demands. The maximum of county level sums of CUP-reported water use and USGS aquaculture water use was used. For counties with zero water use from the combination of USGS county-level aquaculture withdrawals and CUP data, aquaculture water demands may still occur if aquaculture features are present in the spatial dataset. The average statewide water demand per unit area for aquaculture features was used to estimate aquaculture water demand for features in counties with no other county total for aquaculture. Current aquaculture water use for 2023 is estimated to be 20.4 MGD. Future aquaculture demands are held constant for the planning period through 2050. Previous FSAID reports had projected increases in Miami-Dade to accommodate a large aquaculture operation there. These increases have already been observed in 2023 water use, so aquaculture demands are also held constant in Miami-Dade County through 2050.

Spatial distribution of county-level livestock and aquaculture water use at the sub-county level was achieved using ALG features with Crop2023 of Livestock or Aquaculture or Crop of ImprovedPastures.

While there are several crop types in the ALG that might have grazing livestock present, only improved pastures are included in the livestock layer for the purposes of spatially distributing the county totals of livestock water use. This provides sufficient spatial disaggregation of water demands, while reducing the size and complexity of the livestock/aquaculture spatial dataset.

The statewide livestock inventory and water use is summarized in **Table 14**, and the total livestock and aquaculture water demands by WMD are presented in **Table 15**. A table of the county totals for livestock and aquaculture water demand are provided in **Appendix D**, **Table D-9**.

Table 14. Statewide Livestock and Aquaculture Totals for Current and Projected Periods

Animal group	Estimated Number of Animals	Water Use per Animal (gpd/head)	Total Demand (mgd)
Dairy Cows	71,827	150	10.77
Beef Cattle	1,567,071	12	18.80
Poultry, chickens	14,856,526	0.09	1.33
Equine	83,063	12	1.00
Goats	53,755	2	0.11
Hogs	12,739	2	0.03
Sheep	24,285	2	0.05
Aquaculture	NA	NA	20.41
Statewide Livestock and Aquaculture Total Demand			**52.51**

Table 15. Livestock and Aquaculture Total Water Use by WMD, MGD

WMD	Livestock Water Use (mgd)	Aquaculture Water Use (mgd)
NWFWMD	1.6	4.8
SFWMD	11.4	7.2
SJRWMD	3.9	1.7
SRWMD	9.1	0.4
SWFWMD	6.1	6.3
Total	**32.1**	**20.4**

FSAID Applications and Use

While FSAID was originally developed to support regional water supply planning by the WMDs, it has evolved to support of variety of applications including: Best Management Practice (BMP) enrollment support (FDACS), estimating nutrient load impacts of cost-share projects (FDACS and DEP), hurricane loss impact estimates (University of Florida), studies of biofuels potential (Oak Ridge National Lab), Cropland Data Layer algorithm improvements (USDA), and the Florida Wildlife Corridor (analysis of potential payments for ecosystem services). The following table (**Table 16**) summarizes how the WMDs utilize FSAID for regional water supply planning.

Table 16. FSAID applications in water supply planning

WMD	FSAID application
NWFWMD	Acreage and water demand projections used directly from FSAID
SFWMD	Acreage projections used with WMD-developed water demands from AFSIRS modeled on those acres with FSAID growth rates
SJRWMD	Acreage and water demand projections used directly from FSAID
SRWMD	Acreage and water demand projections used directly from FSAID
SWFWMD	Acreage projections used, with water use projections based on WMD historical water use and FSAID growth rates

FSAID Online Interface and Geodatabase

An online user interface has been developed to allow easier access to the agricultural acreage and water demand data. It is available at:

https://datavisual.balmoralgroup.us/FDACS-FSAID12

In addition to the web-based interface, the complete FSAID XII geodatabase has been made available. This contains shapefiles of water demand to facilitate further analysis and application of spatial water demand data. All appropriate metadata has been provided in the geodatabase. The FSAID XII geodatabase includes:

- The projections ILG: 2023 to 2050 irrigated acreage, crop type, average year and dry year water demand, conservation estimates, and freeze protection estimates (based on average 2007-2023 rainfall and ET)
- The 2023 ILG: includes only the base year 2023 irrigated areas and water demands (based on 2023 actual rainfall and ET)
- The ALG, which includes both irrigated and non-irrigated agricultural areas
- Livestock and Aquaculture: water demand estimates for all livestock and aquaculture
- Climate Factors: links the 2023 ILG with attributes for rainfall and ET (both for 2023 and 2005-2023 average), and soils (mukey and land capability classification)

Conclusions and Discussion

Summary

Overall, agricultural water demand in Florida is anticipated to decrease by about 2% through 2050; irrigated lands also decrease moderately through 2050 (3% decrease in irrigated area from 2023 to 2050: about 52,000 acres).

A number of factors will influence the agricultural irrigation patterns of Florida farmers over the next 25 years. As of this writing, there are changing agricultural trade dynamics resulting from proposed tariffs or the perception of tariff risk. The impacts of changing trade relations are not expected to be well understood for at least another year. Four alternative future scenarios were modeled to represent a range of uncertainties in Florida's agricultural water use. These scenarios include: 1) western U.S. to eastern U.S. agricultural migration, 2) trade adjustments that might improve prices for Florida berry and vegetable producers, 3) potential citrus greening solutions, and 4) increased land use change to non-agricultural uses. These are described in Appendix E. The potential changes in agricultural irrigation demands in Florida range from a 48 MGD increase to an 8 MGD decrease relative the FSAID 2050 projections.

The FSAID model incorporates historical behavior, through actual water use records, as well as behavior that is forward-looking (based on projections of prices and costs and irrigated area trends developed on recent irrigated areas by County), through spatial allocation of future water demand. As urbanization encroaches on rural lands, and as western U.S. irrigation potentially migrates toward Florida, lands that traditionally were not irrigated, or irrigated for small portions of the year, could increasingly be irrigated at a greater rate.

Source Data and Literature References

Beare, Stephen C., Rosalyn Bell, and Brian S. Fisher. 1998. "Determining the Value of Water: The Role of Risk, Infrastructure Constraints, and Ownership." American Journal of Agricultural Economics. 80:916-940.

Bockstael, Nancy E. 1996. "Modeling Economics and Ecology: The importance of a Spatial Perspective." American Journal of Agricultural Economics Vol. 78, No. 5, Proceedings Issue (Dec., 1996), pp.1168-1180.

Chalfant, James A. 1984. "Comparisons of Alternative Functional Forms with Applications to Agricultural Input Data." American Journal of Agricultural Economics, 66:216-220.

de Bodisco, Christopher. 2007. The Regional value of water in agriculture. PhD Dissertation, Vanderbilt University. Nashville, TN: Proquest/UMI (Publication No. AAT 3301032).

Edwards, Brian K., Richard E. Howitt, and Silvio J. Flaim. 1996. "Fuel, Crop, and Water Substitution in Irrigated Agriculture." Resource and Energy Economics 18: 311-31.

Faux, John and Gregory M. Perry. 1999. "Estimating Irrigation Water Value Using Hedonic Price Analysis: A Case Study in Malheur County, Oregon." Land Economics 75(3): 440-52.

Florida 2070. 2023. Florida's Rising Seas: Mapping Our Future. Sea Level 2070. University of Florida Center for Landscape Conservation Planning and 1000 Friends of Florida.

Florida Department of Agriculture and Consumer Services. (2016). 2014 Florida Agriculture by the Numbers. Retrieved from: https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Annual_Statistical_Bulletin/FL_Agriculture_Book/2014/2014%20FL%20Ag%20by%20the%20Numbers.pdf

Florida Department of Agriculture and Consumer Services. (2013). Florida Citrus Statistics 2011-2012. Retrieved from http://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Citrus/fcs/2011-12/fcs1112.pdf

Florida Department of Agriculture and Consumer Services. (2015). 2011 Florida Greenhouse/Nursery – Cash Receipts. Retrieved from http://www.freshfromflorida.com/Divisions-Offices/

Gollehon, N., 2014. Water, Irrigation and U.S. Agriculture. Presentation for AWRA. Natural Resources Conservation Service, USDA. Washington, DC.

Irwin, Elena and Bockstael Nancy E., 2007. "The evolution of urban sprawl: Evidence of spatial heterogeneity and increasing land fragmentation". Proceedings of the National of Sciences of the United States of America (PNAS).

Livanis, G., Moss, C. Breneman, V., "Urban Sprawl and Farmland Prices" American Journal of Agricultural Economics 88(4) (November 2006): 915–929.

Mishra, Ashok, C. Moss, and K. Erickson. 2004. "Valuing Farmland With Multiple Quasi-Fixed Inputs." Applied Economics, 36(1): 1669-1676.

Moss, Charles B. and Chris de Bodisco. "Projected Water Demand by Agriculture in the Northwest Florida Water Management District." Economic Information Report. Food and Resource Economics Department, IFAS, University of Florida, Gainesville, Fl., February, 1998. 77pp.

Renzetti, Steven. 2002. The Economics of Water Demands. Boston: Kluwer Academic Publishers.

Schoengold, K., D. L. Sunding, and G. Moreno (2006), Price elasticity reconsidered: Panel estimation of an agricultural water demand function, Water Resources Research, 42.

Sustaining California Agriculture in an Uncertain Future http://pacinst.org/wp-content/uploads/sites/21/2014/04/sustaining-california-agriculture-pacinst-full-report.pdf

U.S. Department of Agriculture (2014). *Crop Projections to 2023*. [Data files]. Available from http://www.usda.gov/wps/portal/usda/usdahome

U.S. Department of Agriculture, 2007 Census of Agriculture. (2009). Horticulture Production Expenses, Returns and Allowances, and Number Hired Workers: 2009; Value of Horticultural Specialty Crops Sold: 2009. Available from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Census_of_Horticulture_Specialties/

U.S. Department of Agriculture, Census of Agriculture. (2007). *Census of Horticultural Specialties*. [Data files]. Available from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Census_of_Horticulture_Specialties/

U.S. Department of Agriculture, Census of Agriculture. (2009). [Data files]. Available from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Census_of_Horticulture_Specialties/

U.S. Department of Agriculture, Economic Research Service. (2014). *Horticulture Crops Long-Term Supply and Use Projections, Calendar Years*. [Data file]. Retrieved from http://www.ers.usda.gov/Data/FoodConsumption/

U.S. Department of Agriculture, Economic Research Service. (2014). USDA Long-term Projections, February 2014 – U.S. Crops. Retrieved from http://www.ers.usda.gov/media/1279439/oce141d.pdf

U.S. Department of Agriculture, Economic Research Service. (2015). *Cost and Return Estimates*. [Data files]. Available from http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx

U.S. Department of Agriculture, Economic Research Service. *Variable Costs of Fertilizer; Average U.S. Farm Prices of Selected Fertilizers* [Data files]. Available from http://www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx#26727

U.S. Department of Agriculture, National Agricultural Statistics Service. 2007 Census of Agriculture Greenhouse, Nursery and Floriculture Operations. Retrieved from http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Fact_Sheets/Production/nursery.pdf

U.S. Department of Agriculture, National Agricultural Statistics Service. (2010). 2007 Census of Agriculture*, Census of Horticultural Specialties (2009), 3*. Retrieved from www.agcensus.usda.gov*U.S. Department of Agriculture, National Agricultural Statistics Service. (2010). Citrus Fruits 2010 Summary. Retrieved from http://www.nass.usda.gov/*

U.S. Department of Agriculture, National Agricultural Statistics Service (2014). 2012 Census of Agriculture, United States Summary and State Data, 1. Available from www.agcensus.usda.gov

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Crop Production*. Retrieved from http://www.usda.gov/nass/PUBS/TODAYRPT/crop1014.pdf

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). Floriculture Crops 2013 Summary. Retrieved from http://usda.mannlib.cornell.edu/usda/nass/FlorCrop/2010s/2014/FlorCrop-06-19-2014.pdf

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Tree Nuts, Noncitrus, and Citrus - Production, Acres Bearing, and Yield – 2007-2014* [Data files]. Available from http://www.nass.usda.gov/Statistics_by_Subject/index.php?sector=CROPS

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Acres Harvested –Various Crops* [Data files]. Available from http://quickstats.nass.usda.gov/

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Citrus Price* [Data file]. Available from http://quickstats.nass.usda.gov/

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Crop Production and Peanut Stocks and Processing*. [Data files]. Available from http://www.nass.usda.gov/

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Potato Prices* [Data file]. Available from http://quickstats.nass.usda.gov/

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Price Received - Various Crops* [Data files]. Available from http://quickstats.nass.usda.gov/

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Totals –Production, Various Crops, Florida* [Data files]. Available from http://quickstats.nass.usda.gov/

U.S. Department of Agriculture, National Agricultural Statistics Service. (2015). *Yield and Acres Harvested For Various Crops* [Data files]. Available from http://www.nass.usda.gov/Statistics_by_Subject/

U.S. Department of Agriculture. (2014). *Per Capita Meat Consumption*, *Beef Long-Term Projections; Pork Long-Term Projections; Young Chicken Long-Term Projections; Turkey Long-Term Projections; Egg Long-Term Projections.* [Data files]. Available from http://www.usda.gov/wps/portal/usda/usdahome

U.S. Department of Agriculture. (2015). USDA Agricultural Projections to 2024. Available from http://www.ers.usda.gov/publications/oce-usda-agricultural-projections/oce151.aspx

U.S. Department of Commerce, Bureau of the Census. (2015). *Horticultural Crops, Long-Term Supply and Use Projections, Calendar Years* [Data file]. Available fromhttp://www.census.gov/

U.S. Department of Commerce, U.S. Census Bureau. (2015). *Foreign Trade Statistics*. [Data files]. Available from http://www.census.gov/

U.S. Farm Irrigation Becomes More Efficient, Moves East. http://www.circleofblue.org/waternews/2014/world/u-s-farm-irrigation-becomes-efficient-moves-east/

University of Florida, International Agricultural Trade & Policy Center. *Cost of Production for Florida Vegetables 2008-2009*. [Data files]. Available from http://www.fred.ifas.ufl.edu/iatpc/budgets.php

University of Georgia College of Agricultural & Environmental Sciences. (2016). *Annual Georgia Sod Producers Survey 2002 - 2016*. [Data files]. Retrieved from http://www.commodities.caes.uga.edu/turfgrass/georgiaturf/Publicat/1700_Sod_Inventory.html

University of Georgia. The Center for Agribusiness and Economic Development. 2006-2015 Georgia Farm Reports. http://www.caes.uga.edu/center/caed/pubs/annual.html

University of Georgia. (2006-2015). Farm Gate Value Reports 2006-2015. *Georgia Nursery Acreages and Prices.* [Data files]. Available from http://www.caes.uga.edu/center/caed/pubs/annual.html

University of Missouri, Food and Agricultural Policy Research Institute (FAPRI). *FAPRI-MU Baseline Outlook*. [Data files]. Available from http://www.fapri.missouri.edu/publications/outlook/

USDA, National Agricultural Statistics Service, 2023 Irrigation and Water Management (IWM) Survey Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2022/Online_Resources/Farm_and_Ranch_Irrigation_Survey/index.php