ACTUAL EVAPOTRANSPIRATION ANALYSIS
April 2021

Prepared for

Eastern Tule Groundwater Sustainability Agency

Prepared by

LAND IQ

2020 L Street, Ste 210
Sacramento, CA
Contact: Joel Kimmelshue
916.265.6330

MAY 27, 2021

INTRODUCTION

The Eastern Tule Groundwater Sustainability Agency (ETGSA) has partnered with Land IQ to develop spatial datasets of monthly actual evapotranspiration (ETa) within their district boundaries. In this analysis, remotely sensed data from satellites are calibrated against in-situ measurements from ground-based climate stations to create a spatially continuous map of ETa within ETGSA for the month.

ANALYSIS

Consumptive use analysis is done in in two main parts:

1. Ground truthing measurements and calibration
2. Remotely sensed analysis and summarization

GROUND TRUTHING

Table 1 shows stations that were active and used in the ET model, and Table 2 shows the daily precipitation totals for the month measured by Land IQ stations and California Department of Water Resources CIMIS stations. A current map of the stations showing all locations along with the crop distribution across the district (Figure 1) demonstrates the variety of calibration data available for model building. The precipitation for the entire area is shown in Figure 2.

TABLE 1. SENSORS USED IN DAILY AND MONTHLY ETA ANALYSIS BY CROP CATEGORY

	Number of Active Stations	Number of Used Stations in model
Alfalfa	9	8
Almonds	21	18
Annuals	3	0
Citrus	14	13
Fallow/Native	4	4
Grapes	9	5
Olives	1	1
Pistachios	10	4
Pomegranates	1	1
Walnuts	1	1

TABLE 2. PRECIPITATION MEASURED BY FIELD STATIONS

Month	Almonds (in)	Murcotts (in)	Walnuts (in)	Fallow (in)	CIMIS #5: Shafter (in)	CIMIS #169: Porterville (in)	CIMIS #182: Delano (in)	CIMIS #258: Lemon Cove (in)
April	0.1	0.1	0.3	0.2	0.2	0.2	0.1	0.1

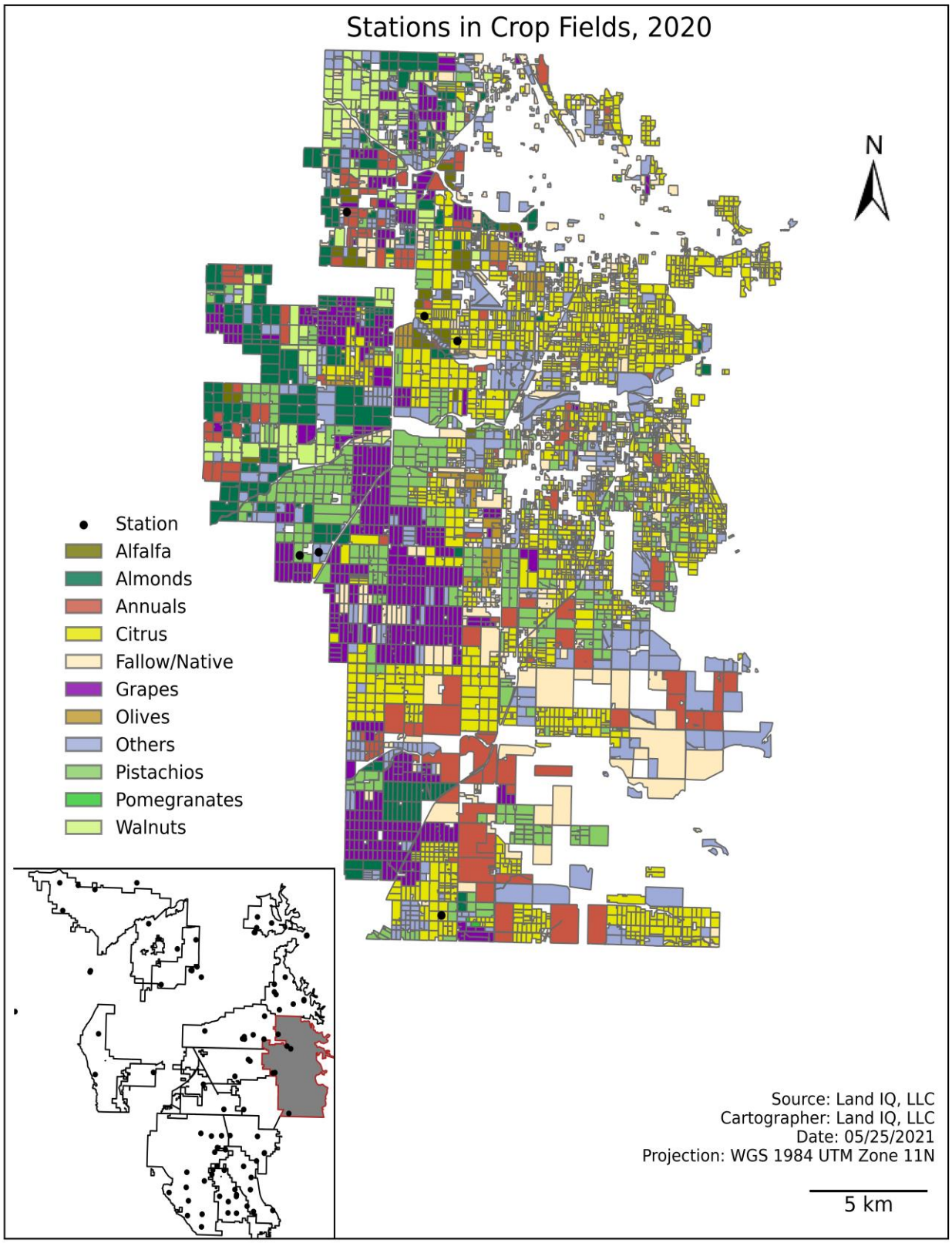

FIGURE 1. MAP OF CROP DISTRIBUTION AND STATION LOCATIONS

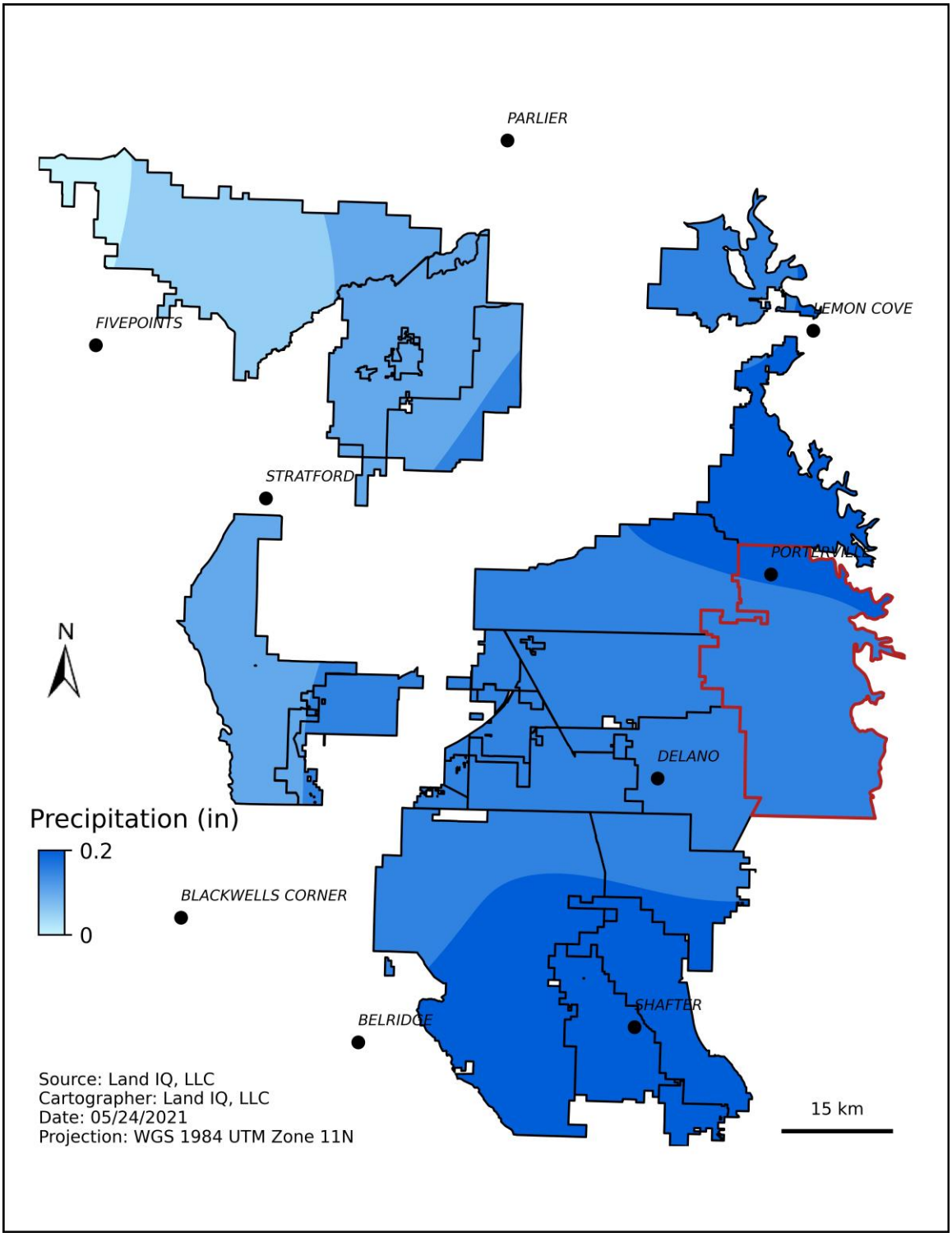

FIGURE 2. PRECIPITATION DURING THE MONTH WITHIN THE ENTIRE ANALYSIS AREA

REMOTE SENSING RESULTS

For this specific analysis, the image analysis dates and sources are shown in Table 3. Other imagery could not be used in the analysis because of cloud cover on the overpass dates. The actual ET image is shown in Figure 4 (at the end of this report). Monthly district-wide actual ET for the entire 161,257 acres including depth and volume is shown in Table 4, and the monthly actual ET by field is shown in Table 5. Monthly district-wide precipitation generated from kriging interpolation is shown in Table 6.

TABLE 3. IMAGE DATES AND SOURCES

Date	Image Source
April 06, 2021	Sentinel 2
April 08, 2021	Landsat 8
April 16, 2021	Sentinel 2
May 01, 2021	Sentinel 2

TABLE 4. MONTHLY DISTRICT ET_A

Unit	JAN	FEB	MAR	APR
(mm)	16.9	17.8	36.9	53.6
(in)	0.7	0.7	1.5	2.1
(AF)	8,936	9,013	19,535	28,376

TABLE 5. MONTHLY FIELD ET_A

ETa (in)					
	Field Size (ac)	JAN	FEB	MAR	APR
Maximum	814.6	1.6	2.2	3.8	5.4
Minimum	0.1	0.3	0.0	0.5	0.4
Average	19.1	0.8	0.9	1.6	2.5

TABLE 6. MONTHLY DISTRICT PRECIPITATION

Precipitation Unit	JAN	FEB	MAR	APR
(mm)	31.0	3.1	27.0	3.7
(in)	1.2	0.1	1.1	0.1
(AF)	16,418	1,631	14,262	1,961

ACCURACY OF REMOTE SENSING RESULTS

Measured versus predicted monthly ETa is presented in Figure 3. Measured values represent data from field stations, whereas predicted values represented those generated by the Land IQ ET model. Stations are displayed as different symbols by crop types. For instance, all square symbols represent fallow/native stations. And these stations are also organized in different colors by station type. Black symbols represent "Full" stations, green ones are "WIQ" stations, and red ones are "Tule Tech" stations. Therefore, green circle symbols represent measurements and predictions of WIQ citrus stations.

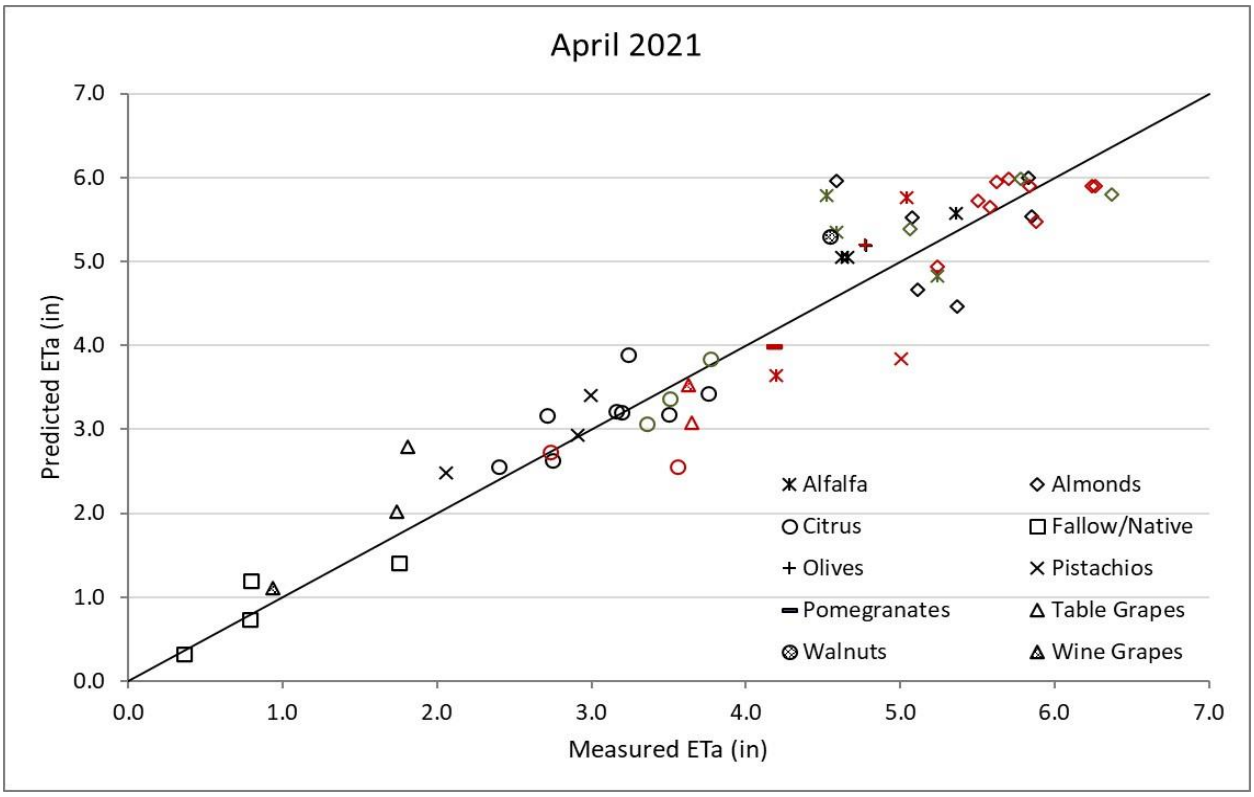

FIGURE 3. MEASURED VERSUS PREDICTED ET_A FOR THE MONTH. SYMBOL COLORS REPRESENT THE STATION TYPES (BLACK = FULL, GREEN = WATER IQ (WIQ), RED = TULE TECH)

Table 7 shows the accuracy results for this month. The R^2 value is the relative measure of fit of the observed data to the predicted result, where a value of 1 indicates a perfect fit. RMSE can be interpreted as the standard deviation, where a value of 0 in would indicate perfect fit to the observed data.

TABLE 7. MEASURED VS. PREDICTED MONTHLY ETA

R^2	RMSE (IN)
0.9	0.5

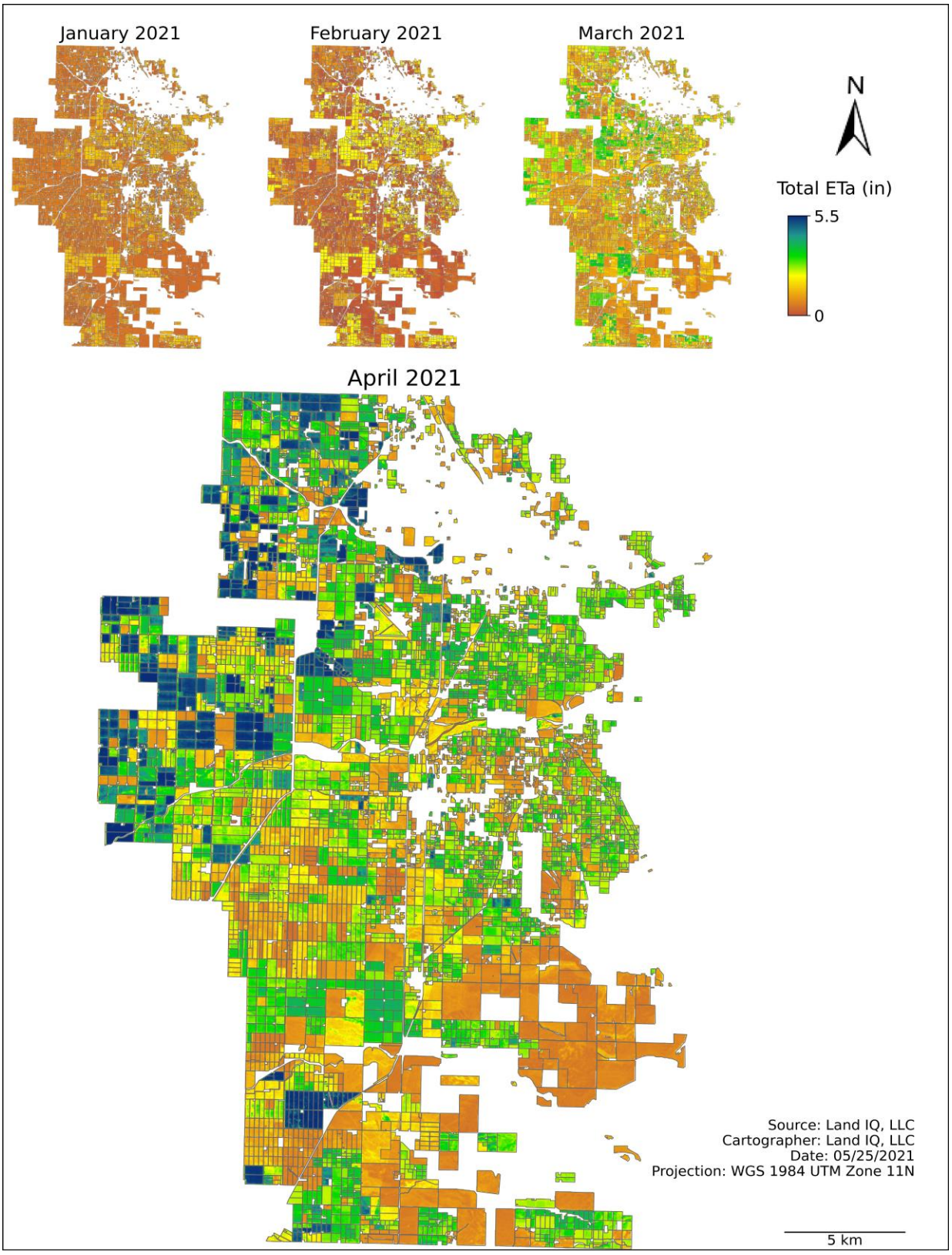

FIGURE 4. PIXEL LEVEL TOTAL ET[A] (in) FOR THE MONTH