DUNAWAY

Dunaway No. 4481.001

July 10, 2018

Ms. Jil Launay
1515 Mount Gilead Road
Keller, TX 76262

Via e-mail: jila519@aol.com

Reference: Drainage Study for Platting – Launay Property

Dear Ms. Launay:

We have completed our drainage study of the creek through your property and have evaluated the effect of splitting your property into three lots, and that of the recent Liberty Hills Farm Estates development, on the flood extents across your property. The findings of our analysis are presented herein.

Previous Studies

At the onset of the study, the data developed in 2008/2009 for a study performed at the time of the Launay residence expansion was resurrected from the Dunaway archives. The methodologies used for the original study were the Rational Method for estimating the peak 100-year discharge, and the US Army Corps of Engineers' (USACE's) HEC-RAS hydraulic modeling software for estimating the corresponding 100-year flood elevations and extents. The hydraulic model developed for the original study was used in this study to compute the flood profile and extents for the creek across the Launay property. The hydrologic computations from the original study were not used (see discussion in next section).

Current Study

A review of the Keller Unified Development Code (UDC) criteria revealed that the Rational Method is only applicable for watersheds less than one hundred acres. Since the watershed contributing storm water runoff to your property exceeds 100 acres (Figure 1), the unit hydrograph method within the USACE HEC-HMS software was used for this study to determine the anticipated peak flow through the property.

Per the City of Keller criteria, the unit hydrograph method is based on three factors: soil types, percent impervious cover (defined by land use), and lag time.

Soils Data

The soils data was obtained from the U.S. Natural Resource Conservation Service (NRCS) soil survey for Tarrant County. Most of the soils within the watershed were found to belong to Hydrologic Groups B and C, with a lesser amount in Group A

(Figure 2). Very little soils in Group D are within the watershed. A detailed breakdown of the hydrologic soil groups within the watershed is presented in Table 1.

Table 1 – Watershed Soil Types

Hydrologic Soil Group	Percentage of Watershed
Soil Group A - Sands / Loamy-Sand Mix	17.6%
Soil Group B - Loam / Silty Loam	42.2%
Soil Group C - Sandy Clay Loam	39.3%
Soil Group D - Clay Loam/Clays	0.9%

Curve Number

Per the Keller UDC, the unit hydrograph method runoff curve numbers are defined by assigning a valued based on the soil type. Therefore, a weighted curve number for the watershed was determined using the percentages of each hydrologic soil group within the watershed and the following curve numbers listed in the Keller UDC:

Group A	CN = 39
Group B	CN = 61
Group C	CN = 74
Group D	CN = 80

For the watershed of this study, the weighted CN value was computed to be 62.4.

Land Use

Land use for existing conditions (base scenario) was determined from current aerial photographs of the watershed. It appears from the photographs that the watershed is comprised of single-family residential development, with the predominant types being lots of 36,000 square feet or greater (Figure 3). For the scenarios that consider the Liberty Hills Farm Estates and splitting your property, the land use within the Liberty Hills Farm Estates and within your property were changed from lots greater than 2 acres to 36,000 square foot lots (Figures 4 and 5). A summary of the land use breakdown for each scenario is presented in Table 2.

Table 2 – Land Use Breakdown

Zoning	Description	Existing Conditions	Exist. Cond. w/ Liberty Hills	Proposed Launay w/ Liberty Hills
SF-15	SF Residential - 15,000 sq-ft lots	0.9%	0.9%	0.9%
SF-20	SF Residential - 20,000 sq-ft lots	0.9%	0.9%	0.9%
SF-30	SF Residential - 30,000 sq-ft lots	2.0%	2.0%	2.0%
SF-36	SF Residential - 36,000 sq-ft lots	50.9%	54.9%	60.0%
> 2 Ac.	SF Residential - > 87,120 sq-ft lots	45.3%	41.2%	36.2%

Percent Imperviousness

Per the Keller UDC, the percentage of impervious areas are to be used with the unit hydrograph method. The weighted percentage of the watershed assumed to be impervious was determined using the percentages of each hydrologic soil group within the watershed and the following curve numbers listed in the Keller UDC:

SF Residential - 15,000 sq-ft lots	30%
SF Residential - 20,000 sq-ft lots	25%
SF Residential - 30,000 sq-ft lots	20%
SF Residential - 36,000 sq-ft lots	20%
SF Residential - > 87,120 sq-ft lots	12%

Applying the percent imperviousness for each land use to the amount of each land use within the watershed yields the weighted percent imperviousness for the watershed for the various development scenarios (Table 3).

Table 3 – Weighted Watershed Percent Imperviousness

Development Scenario	Percentage Imperviousness
Existing Watershed Conditions	16.5%
Existing Watershed Conditions w/ Liberty Hills Farm Estates	16.8%
Proposed Launay Property Split w/ Liberty Hills Farm Estates	17.2%

Basin Lag Time

The basin lag time is the delay between the time runoff from a rainfall event over a watershed begins until the runoff reaches is maximum peak. The lag time is computed as 0.6 times the basin's time of concentration, which is the amount of time it takes for runoff to travel from the most hydraulically remote part of the watershed to the watershed outfall. The City of Keller criteria stipulate the time of concentration be computed as the summary of sheet flow, shallow concentrated flow, and channelized flow within the basin.

For Sheet Flow, T_{SF},

$$T_{SF} = \frac{(1.8 \times (1.1 - C) \times L^{0.5})}{S^{0.33}}$$

where

L = sheet flow travel path length = 207 feet

C = surface runoff coefficient = 0.60 (for wooded areas)

S = sheet flow travel path slope = 7.73%

Solving for the Sheet Flow travel time,

$$T_{SF} = \frac{(1.8 \times (1.1 - 0.60) \times 207^{0.5})}{7.73^{0.33}} = 6.6\ minutes$$

For Shallow Concentrated Flow, T_{SCF}, in unpaved areas,

$$T_{SCF} = \frac{L}{60 \times (16.1345 \times S^{0.5})}$$

where

L = shallow concentrated flow travel path length = 2,457 feet

S = shallow concentrated flow travel path slope = 2.56%

Solving for the Shallow Concentrated Flow travel time,

$$T_{SCF} = \frac{2{,}457}{60 \times (16.1345 \times 2.56^{0.5})} = 15.9\ minutes$$

Travel times for Concentrated Flow is computed using either Manning's equation or a hydraulic model to compute average flow velocity. For this study, the average channel velocities reported in the original HEC-RAS hydraulic model from 2009 were used to compute an overall average velocity, then the travel time was computed by dividing the distance traveled by the average velocity. This procedure was reapplied after the initial HEC-RAS model for this study was computed and the average channel flow was computed as 6.3 feet/second. Thus, the Channelized Flow travel time was computed as,

$$T_{CF} = \frac{L}{60 \times V_{AVE}} = \frac{1{,}976\ ft}{60 \times (6.3\ fps)} = 5.3\ minutes$$

Summing the travel times for sheet, shallow concentrated, and channelized flow, the time of concentration was computed to be 27.7 minutes. Therefore, the basin lag time was computed as,

$$T_{LAG} = T_C \times 0.6 = 27.7 \times 0.6 = 16.6\ minutes$$

Hydrologic Model

The basin area, runoff curve number, weighted percent imperviousness and the basin lag time were used in the hydrologic model to compute the anticipated peak discharge at the basin outlet (i.e., downstream side of the Launay property). Peak discharges were computed for the following scenarios:

- Existing watershed conditions
- Existing watershed conditions with Liberty Hills Farm Estates developed
- Proposed Launay property divided into three and developed, and the Liberty Hills Farm Estates developed

Table 4 summarizes the peak 100-year discharges at the downstream side of the Launay property for each scenario.

Table 4 – Peak Discharge Comparison

Scenario	100-Year Peak Discharge
Existing Conditions	549.1 cfs
Exist. Cond. w/ Liberty Hills Farm Estates	550.2 cfs
Launay Property Divided w/ Liberty Hills Farm Estates	551.6 cfs

The hydrologic modeling suggests that development of both the Liberty Farms Hill Estates and the Launay property will increase the 100-year peak flow at the downstream side of the Launay property by only 2.5 cfs, or roughly 0.46%. The effects of the Launay property being subdivided into three lots, each being developed as 36,000 square foot lots, will increase the 100-year peak flow by only 1.4 cfs, or roughly 0.25%.

These anticipated changes in peak flow are extremely small and can be considered negligible when compared to the overall 100-year flow in the channel. To confirm the limited effects of the Launay property development, hydraulic modeling was performed to quantify the anticipated changes in flood elevations resulting from the proposed Launay development.

Hydraulic Modeling

The peak discharges computed for the three development scenarios were input into the hydraulic model of the creek across the Launay property and the corresponding flood profiles of the creek were computed.

As noted above, the hydraulic model prepared for the original 2008/2009 flood study for the Launay property was used for this study. The cross-section data in the original model was based on a 2008 topographic survey of the Launay property. The only changes from the original hydraulic model was to upgrade it to the current version of the hydraulic software (HEC-RAS v.5.0.3) and to use 2015 LIDAR contour data for the portions of the cross sections that extend beyond the limits of the 2008 topographic survey.

Using the hydraulic model to compute the anticipated flood elevations along the channel for the above-described development scenarios, the differences in flood elevations for each scenario were determined:

- Comparing the existing conditions scenario to the scenario with the Liberty Hills Farm Estates, there are increases of 0.01 feet at three of the thirteen cross sections in the model.

- There is an increase of 0.01 foot observed at four cross sections when comparing the existing conditions scenario with the Liberty Hills Farm Estates development to the same scenario with the additional development proposed by splitting the Launay property into three properties.
- Comparing the existing conditions scenario to the scenario with both the Liberty Hills Farm Estates and the proposed Launay development, there are increases of 0.01 feet at seven of the thirteen cross sections in the model.

A graphical representation of the computed flood limits is presented in Figure 6.

Conclusion

With such small increases (0.01-foot) in flood elevations at only a few cross sections, the reported differences in flood elevations between the various scenarios evaluated for this study are insignificant. **Therefore, it is the conclusion of this study that the proposed Launay development will not adversely affect the flood elevations along the creek across the Launay property, and as such, satisfies the City of Keller criteria.**

A copy of this report, along with the hydrologic and hydraulic models, will be sent to Tim Welch, P.E. to be included with his submittal to the City of Keller.

I would be happy to discuss the findings of our study should you have any questions.

Sincerely,

DUNAWAY ASSOCIATES, L.P.
a Texas limited partnership

Michael J. Dellies, P.E., CFM
Associate / Sr. Technical Engineer

STATE OF TEXAS
MICHAEL DELLIES
65938
REGISTERED PROFESSIONAL ENGINEER

07/10/2018

MJD/mjd

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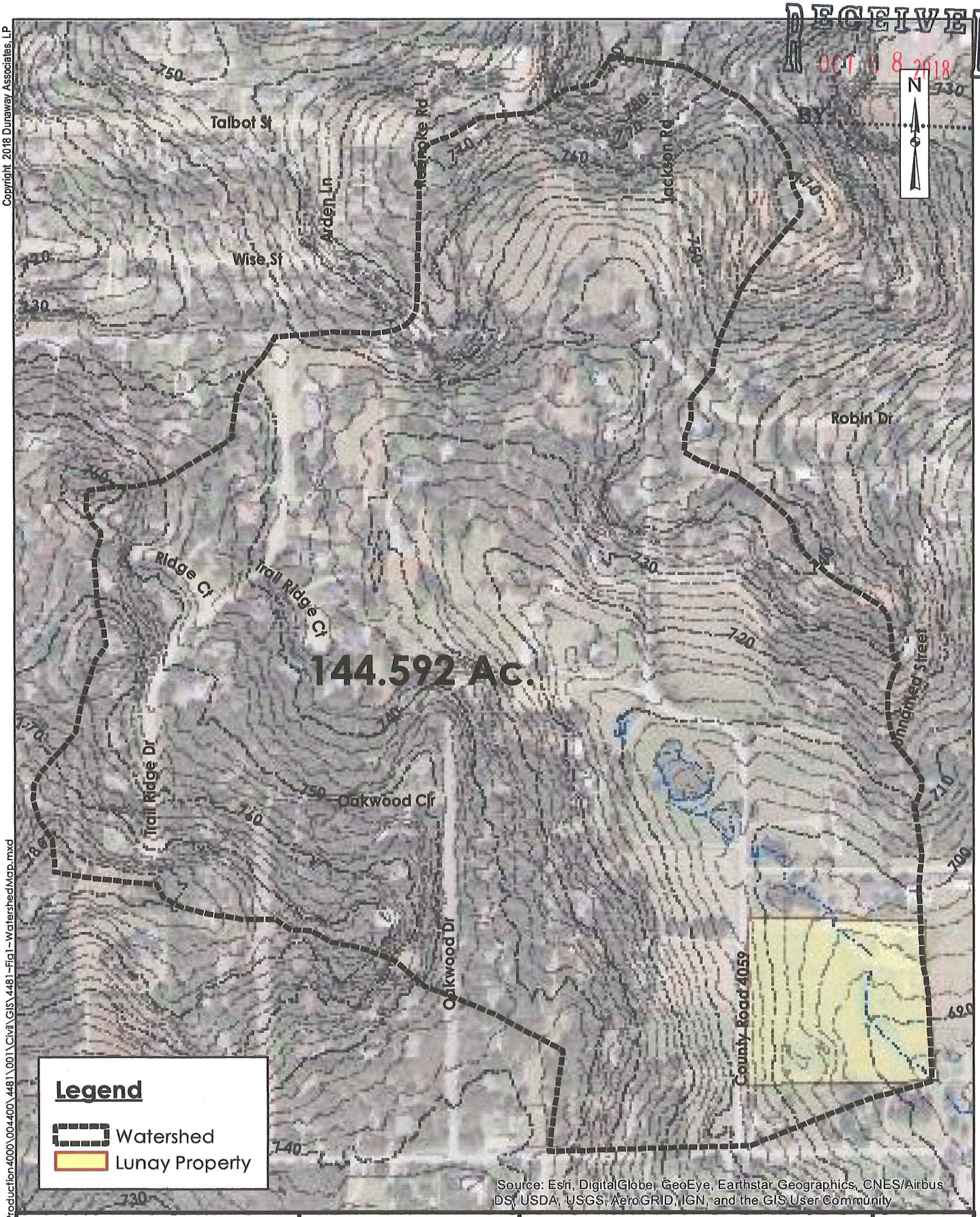
Enclosure

cc: Tim Welch, Welch Engineering, Inc.



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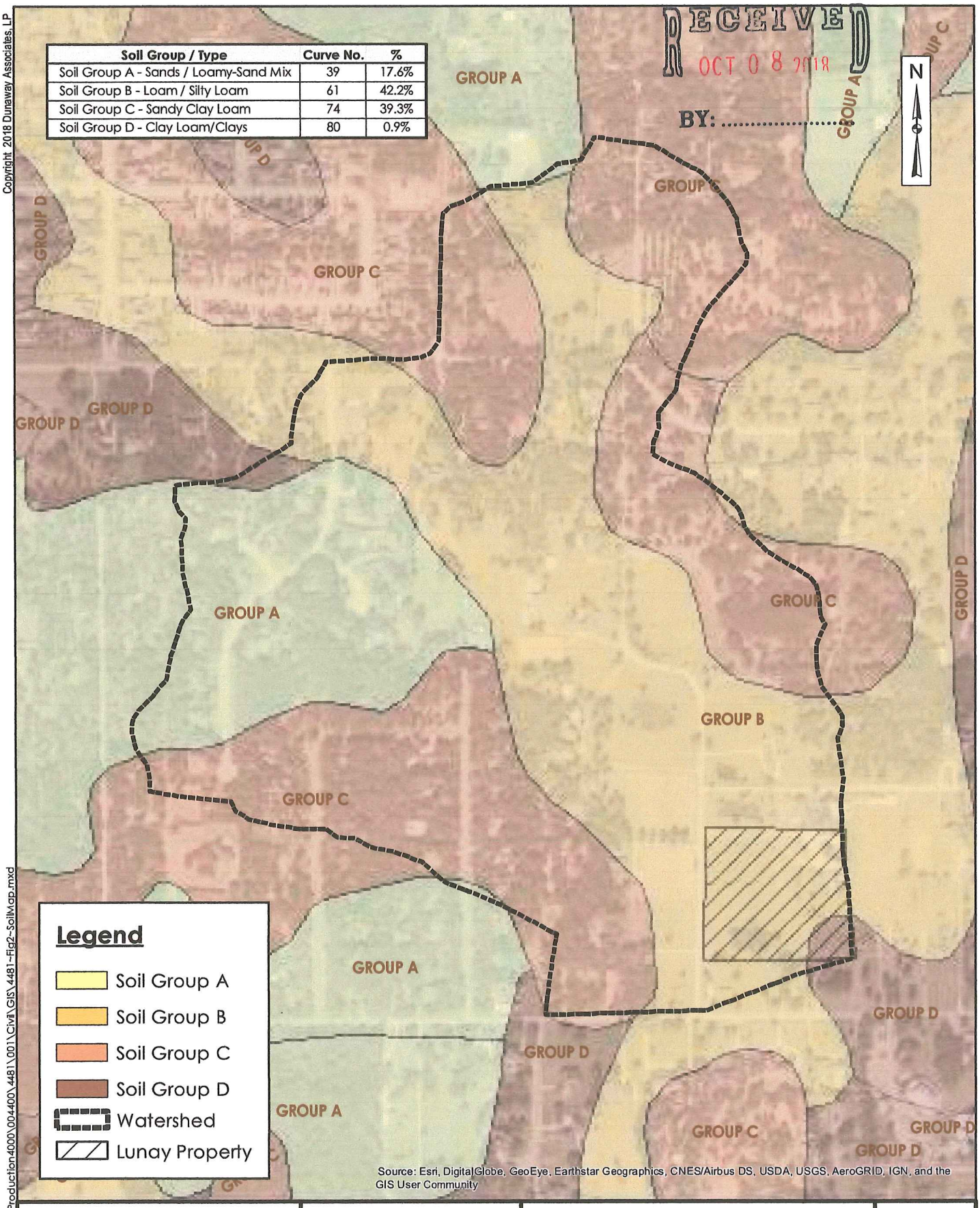
0 400
1 inch = 400 feet

WATERSHED MAP
Launay Flood Study
Keller, Texas
DALP Project No. 4481.001

Figure
1

Soil Group / Type	Curve No.	%
Soil Group A - Sands / Loamy-Sand Mix	39	17.6%
Soil Group B - Loam / Silty Loam	61	42.2%
Soil Group C - Sandy Clay Loam	74	39.3%
Soil Group D - Clay Loam/Clays	80	0.9%



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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0 500
1 inch = 500 feet

SOIL MAP
Launay Flood Study
Keller, Texas
DALP Project No. 4481.001

Figure 2

Zoning	Description	Percentage of Watershed
SF-15	SF Residential - 15,000 sq-ft lots	0.9%
SF-20	SF Residential - 20,000 sq-ft lots	0.9%
SF-30	SF Residential - 30,000 sq-ft lots	2.0%
SF-36	SF Residential - 36,000 sq-ft lots	50.9%
> 2 Ac.	SF Residential - > 87,120 sq-ft lots	45.3%

N

Legend

- SF Residential - 15,000 sq-ft lots
- SF Residential - 20,000 sq-ft lots
- SF Residential - 30,000 sq-ft lots
- SF Residential - 36,000 sq-ft lots
- SF Residential - > 87,120 sq-ft lots
- Lunay Property
- Watershed

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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0 500
1 inch = 500 feet

EXISTING (2018) LAND USE
Launay Flood Study
Keller, Texas
DALP Project No. 4481.001

Figure 3

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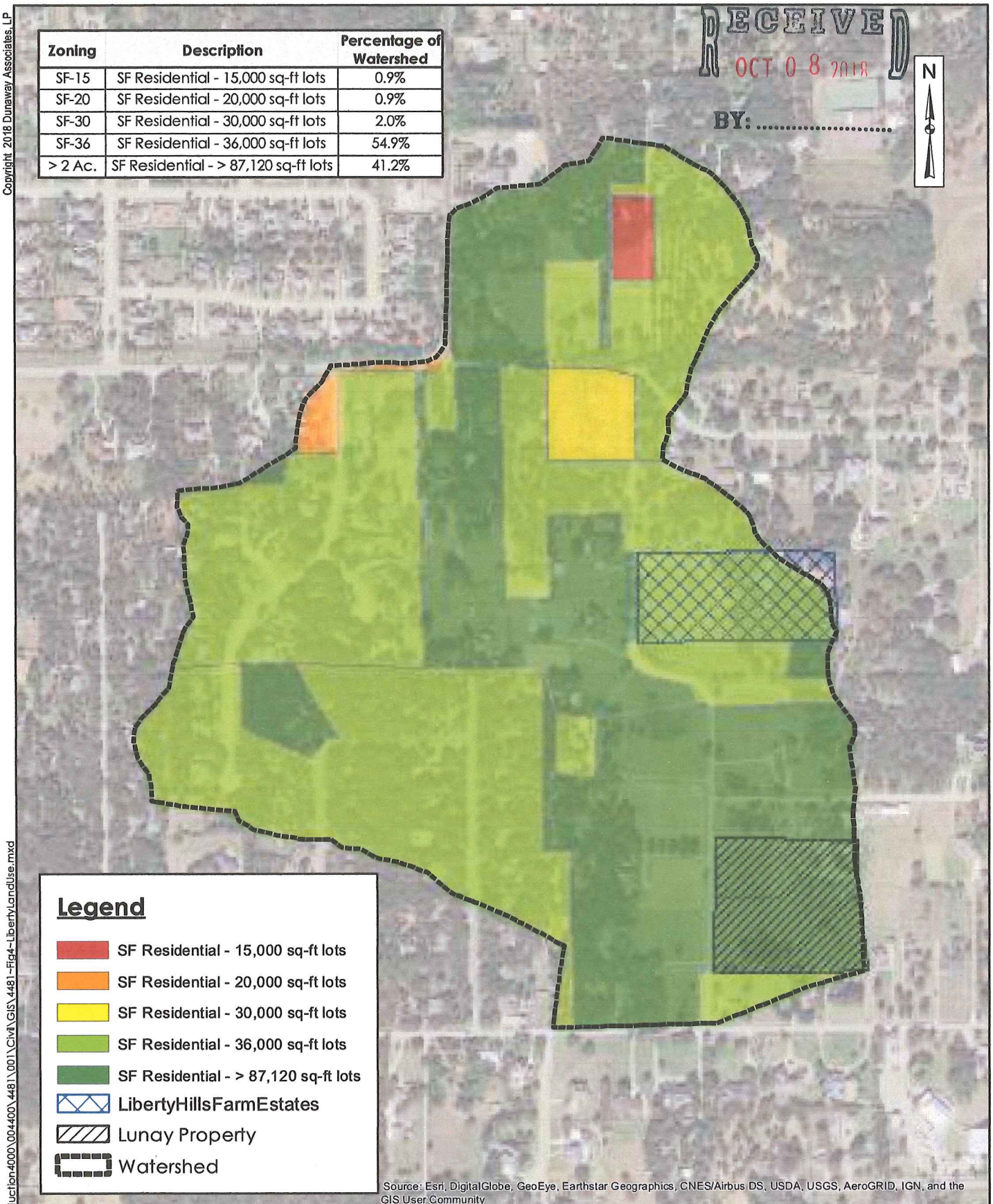
Zoning	Description	Percentage of Watershed
SF-15	SF Residential - 15,000 sq-ft lots	0.9%
SF-20	SF Residential - 20,000 sq-ft lots	0.9%
SF-30	SF Residential - 30,000 sq-ft lots	2.0%
SF-36	SF Residential - 36,000 sq-ft lots	54.9%
> 2 Ac.	SF Residential - > 87,120 sq-ft lots	41.2%

N



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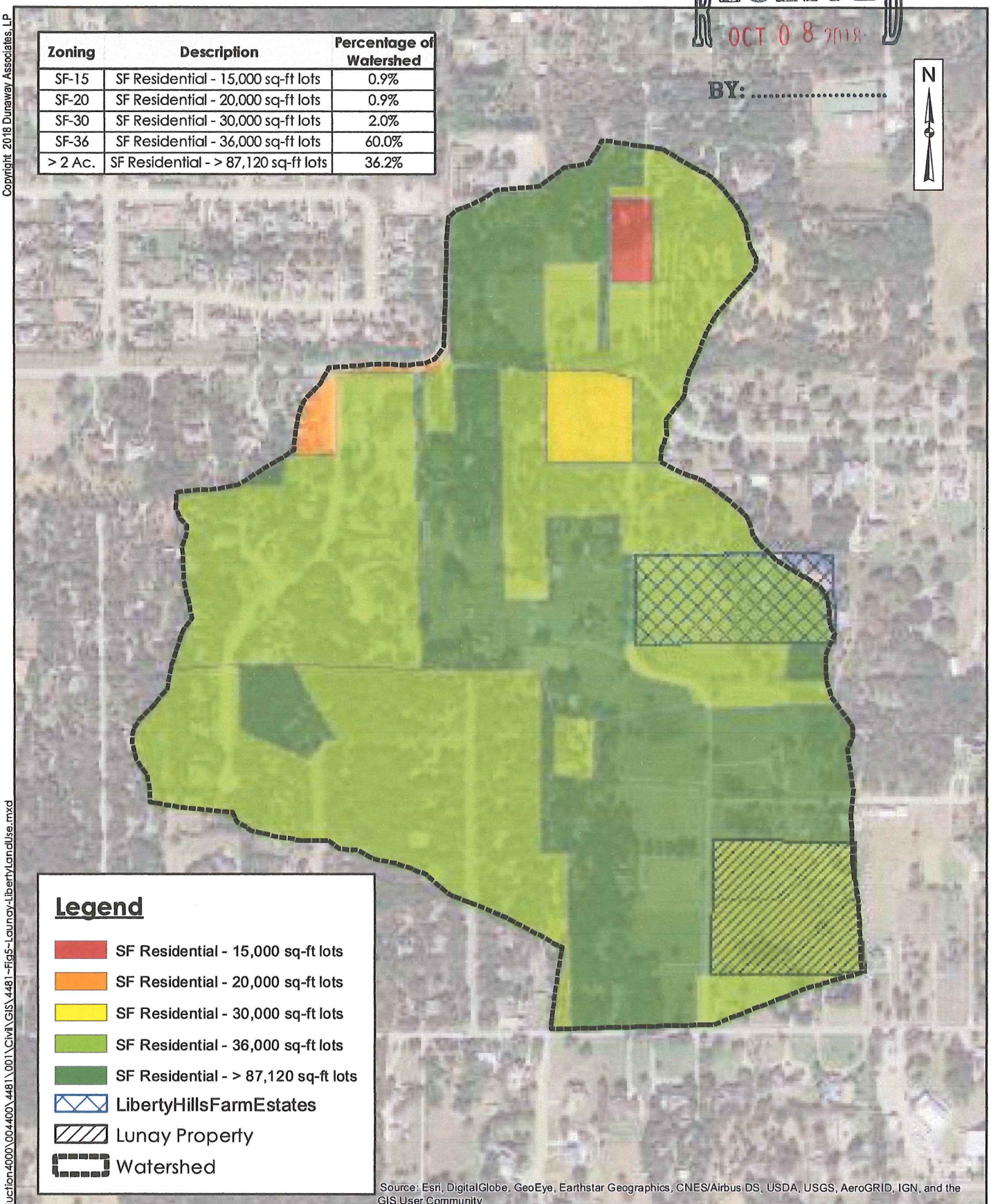
0 500
1 inch = 500 feet

EX. LAND USE w/ LIBERTY HILLS
Launay Flood Study
Keller, Texas
DALP Project No. 4481.001

Figure
4

Zoning	Description	Percentage of Watershed
SF-15	SF Residential - 15,000 sq-ft lots	0.9%
SF-20	SF Residential - 20,000 sq-ft lots	0.9%
SF-30	SF Residential - 30,000 sq-ft lots	2.0%
SF-36	SF Residential - 36,000 sq-ft lots	60.0%
> 2 Ac.	SF Residential - > 87,120 sq-ft lots	36.2%



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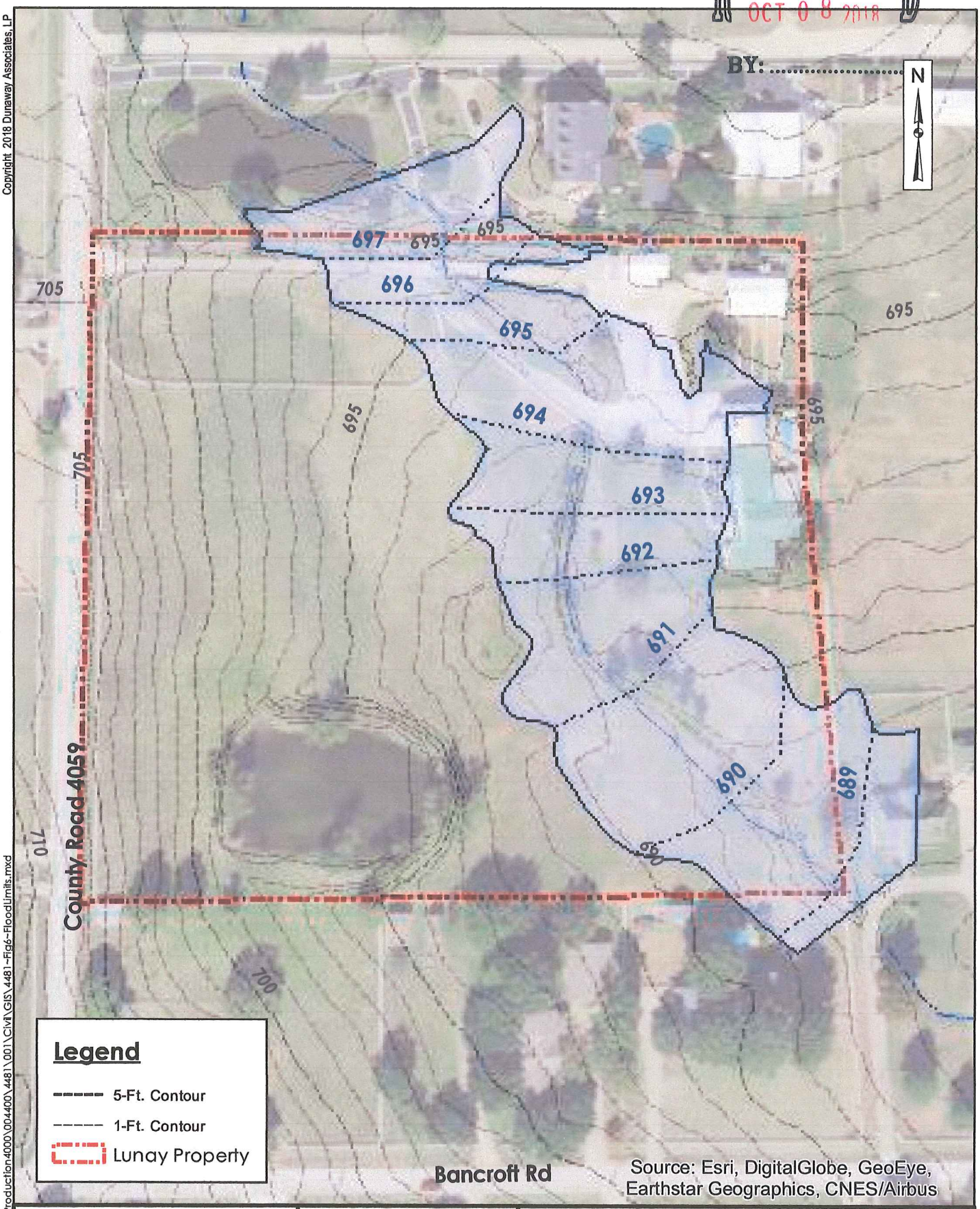
Date: July 2018

0 500
1 inch = 500 feet

LAUNAY & LIBERTY HILLS LAND USE
Launay Flood Study
Keller, Texas
DALP Project No. 4481.001

Figure 5



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Date: July 2018

0 100
1 inch = 100 feet

100-YEAR FLOOD LIMITS
Launay Flood Study
Keller, Texas
DALP Project No. 4481.001

Figure
6