SR 46/ Wekiva Parkway
Wekiva River Bridge Shade Study
Lake and Seminole Counties, Florida
FPID #238275-7-32-02

February 2014

Prepared for:

Florida Department of Transportation - District Five
719 South Woodland Boulevard
DeLand, FL 32720

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1.0 INTRODUCTION

The Florida Department of Transportation, District Five, is in the design phase for the proposed construction of the Wekiva Parkway in Lake and Seminole Counties, Florida. E Sciences, Incorporated (E Sciences) has evaluated the potential effects of shading to vegetation associated with the proposed replacement of the SR 46 Bridge over the Wekiva River (**Figure 1**). The specific area of evaluation is an approximate 1.48 acre island consisting predominantly of deciduous trees located within the Wekiva River, immediately north of the existing SR 46 Bridge (**Figure 2**). Of the 1.48 acre island, approximately 0.03 acres of the island falls within the northern extent of the proposed SR 46 bridge project and was evaluated for both potential direct and indirect effects. An additional 0.40 acres north of the edge of the proposed bridge was also evaluated for indirect effects. The Wekiva River is designated a Wild and Scenic River under the Wild and Scenic Rivers Act (WSRA) of 1968 and changes to the Wekiva River resulting from construction of the proposed project must be coordinated with and approved by the National Park Service, Southeast Regional Office under Section 7(a) of the WSRA.

2.0 EXISTING CONDITIONS

On January 8, 2014 E Sciences conducted a site visit to observe the island and its vegetative community. The area of direct affect is the approximately 55-foot (0.03 acre) southern portion of the 1.48 acre island and is predominantly vegetated with deciduous trees. The southern tip of the island is approximately 12 feet north of the existing SR 46 Bridge. The island extends in a linear fashion north to south and is approximately 600 feet long. Based on the trees surveyed in the study area, it is estimated that there are 1400 trees on the entire island.

The banks of the study area consist of soil and roots from both living and dead trees. Saplings were observed along the banks and immediately waterward of the island. Vegetation at the site is dominated by tree canopy composed of laurel oak (*Quercus virginiana*), red maple (*Acer rubrum*), cabbage palm (*Sabal palmetto*), sweetgum (*Liquidambar styraciflua*), dahoon holly (*Ilex cassine*) and American elm (*Ulmus americana*). Each of these species is considered to be shade tolerant. There is no midstory canopy with the exception of red maple and sweetgum saplings along and just waterward of the banks of the island and cabbage palms within the island itself. Shrub cover was limited to blackberry (*Rubus* spp.) shrubs on the east side of the island north of the study area. The ground was covered with leaf litter at the time of observation; herbaceous groundcover was not observed. Trees within the study area were observed to have health and structural conditions typical of forest trees. There are approximately 30 deciduous trees and palms within the study area below the edge of the proposed bridge. These numbers do not include saplings smaller than three inches diameter at breast height (DBH). Tree heights at the southern end of the study area ranged from 15 to 20 feet. Tree heights from the edge of the proposed bridge to the northern end of the study area were generally 50 to 60 feet tall, which is

consistent with the height of the canopy within the central portion of the island. Dead and fallen trees were observed throughout the island. Branch structure was sparse below the upper canopy. Canopy coverage was estimated to be 80 percent; minimal direct sunlight was observed to reach the ground. Because of the absence of groundcover, canopy closure during the growing season is expected to result in less light reaching the ground during growing season months.

3.0 PROPOSED BRIDGE IMPROVEMENTS

Changes proposed to the roadway and bridge includes elevating the bridge from its current height of 22 feet 6 inches to a new bridge deck height of 61 feet 6 inches. The proposed bridge will be 2,068 feet long and span the river and island with a 360-foot span unit with footers on the east and west sides of the river. The new bridge will be wider, extending north to the existing FDOT ROW limit. The low member elevation of the bridge will be 38 feet above the ground elevation on the west side of the river and 42 feet above the ground elevation on the east side of the river. The greatest bridge clearance will exist over the island. **Figure 3** depicts the proposed bridge profile and plan view in relation to the existing bridge at the river. SR 46 will include three separate bridge structures all measuring 60 feet, one inch in width, including a westbound bridge, an eastbound bridge and a service road. Gaps of 9 feet 11 inches and 12 feet 11 inches respectively, will exist between the structures.

4.0 METHODS

E Sciences was provided a tree survey prepared by McKim and Creed on January 16, 2014, Information included in the tree survey was verified and updated based on observations made during the site evaluation. Diameter at breast height (DBH) was recorded for trees expected to fall within the shadow of the proposed bridge. Heights of trees on the southern extent of the island were estimated with a laser clinometer. General habitat information including canopy density, species, groundcover density, and health and age classes was noted.

Plan details of the proposed Wekiva River Bridge were used to create a three dimensional model in Sketchup Pro (Trimble Navigation, Ltd.) software. The three dimensional model of the Wekiva River Bridge was then used to simulate shadow patterns on an hourly basis during the winter solstice, summer solstice, vernal equinox, and autumnal equinox. Hourly shade patterns for each day were migrated into ArcGIS ArcMap (ESRI) and appropriately georeferenced. Calculations were completed to determine total amount of direct sunlight that would fall on the island based on the modeled shade pattern. The bridge model was also used to overlay the proposed bridge design over the location of the study area to evaluate the need for tree trimming and potential impact to canopy trees adjacent to the proposed bridge.

5.0 RESULTS

5.1 Direct Effects on Trees

The proposed bridge deck will directly conflict with four of the existing trees including two red maples, one sweetgum and one laurel oak. An additional laurel oak just outside the bridge deck will likely need to have a large limb on the southern side removed as it extends within the proposed limits of the bridge. Depending on construction methods, additional trimming may be required to create a buffer zone of approximately 8 to 10 feet to accommodate maintenance needs. Because this is a forested system, non-traditional pruning/trimming techniques can be utilized where trimming trees with American National Standards Institute (ANSI) A300 standard pruning techniques cannot be applied. The construction contractor should use an International Society of Arboriculture (ISA) Certified Arborist to supervise tree trimming activities.

5.2 Shading Evaluation

The new bridge will result in shading that will decrease the amount of direct sunlight available to trees within the study area and trees directly adjacent to the study area. **Figure 4** depicts the study area and the approximate number of hours of direct sunlight available during the summer solstice. Most of the island will continue to receive the maximum amount of direct sunlight available during the summer months while areas beneath the bridge will continue to receive more than four hours and as much as ten to thirteen hours of direct sunlight during the summer. **Figure 5** depicts the study area and the approximate number of hours of direct sunlight available during the winter solstice. Again, most of the island will continue to receive the maximum amount of direct sunlight available during the winter months. However, approximately 55 feet of the southern tip of the island will be shaded by the bridge structure during the winter solstice. This represents an affected area of only 0.03 acres of the 1.48 acre island or approximately 2%. Computer modeling of shading also indicates that as much as four hours of direct sunlight will reach the trees under the bridge over the course of the winter months due to the angle of the sun on the horizon. Indirect sunlight is also expected to reach trees on the island under the bridge or through the narrow gaps between bridge structures due to atmospheric refraction and reflection.

5.3 Tree Evaluation

As noted above, tree species within the study area consist of red maple, laurel oaks, sweetgum, dahoon holly, American elm and cabbage palms. These species have varying documented ability to survive in shaded conditions. E Sciences reviewed information collected in the United States Department of Agriculture's (USDA) Agriculture Handbook 654, *Silvics of Forest Trees of the United States* as well as references more specific to the State of Florida (Floridata database, http://www.floridata.com), to anticipate the response of the trees to the proposed conditions. Shade intolerant trees towards the southern tip and throughout the study area are likely to react to the increased shade by slowing growth rates. The least tolerant trees may eventually fail. Recruitment by more shade tolerant species is likely to occur. If this fails to occur, supplemental

planting of shade tolerant species could be used to minimize losses. A brief description of each tree species observed and their shade tolerance is provided below.

Red Maple

Red maple is considered a shade tolerant tree species. Red maple trees generally produce numerous seedlings, as is evident within the study area where saplings were observed at the southern fringe of the island. Often seedlings fail when they don't receive access to the main crown canopy, but more seedlings are produced. While some saplings at the southern end of the island are likely to fail if all access to sun is removed, the new bridge configuration may result in other opportunities for new red maple saplings to recruit into openings in the canopy.

Laurel Oak

Laurel oaks are present in different age classes within the study area. Mature oaks towards the northern end of the study area will require severe pruning but will likely continue to receive direct sunlight, particularly during the growing season. Smaller oaks towards the southern end of the island will be shaded from much of the direct sunlight they experience now. Laurel oaks are considered shade tolerant but cannot survive without some direct sunlight. Some of the oaks at the southern tip of the island are in poor condition due to issues such as decay within wounds and/or poor growth structure; these trees may decline more quickly than healthy trees. While some failure of oaks fully shaded by the bridge may be anticipated, failure will be gradual and dying and/or dead oaks will continue to provide habitat services to the island.

Sweetgum

Sweetgum is not considered a shade-tolerant tree species. Saplings at the existing fringe will likely fail when removed from direct light. The one mature sweetgum is located toward the northern end of the study area and is in a position where it will likely receive some direct sunlight, particularly in summer months. This mature tree will require crown reduction or topping due to conflict with the proposed bridge deck. This reduced condition will not be abnormal for a mature sweetgum, which often have broken or stag headed tops within forested systems.

Dahoon Holly

Dahoon holly, like most *Ilex* species, grows in varied conditions, including partial to heavy shade. Growth is known to slow in shaded conditions. The dahoon holly trees within the study area may continue to receive some direct sunlight; those that do not may slow in growth and eventually decline. This would likely occur gradually. This species is represented elsewhere on the island.

American Elm

American elm is considered an intermediate shade tolerant tree. There is only one within the study area and this tree is in a location where sunlight will be limited, especially during the winter

months. This may lead to decline in this tree. Any changes to this tree would be gradual. Other trees of this species exist within the portion of the island outside of the project ROW.

Cabbage Palm

Cabbage palms are hardy and considered a shade tolerant palm. They are plentiful within the study area and throughout the island and many of the palms are well below the upper canopy in shade conditions. Cabbage palms also adapt to seek sunlight; cabbage palms are often observed with bent or curved trunks when obstructions are present. While some cabbage palms may fail if cut off from all direct sunlight, cabbage palms are abundant and opportunistic, and others will replace those lost.

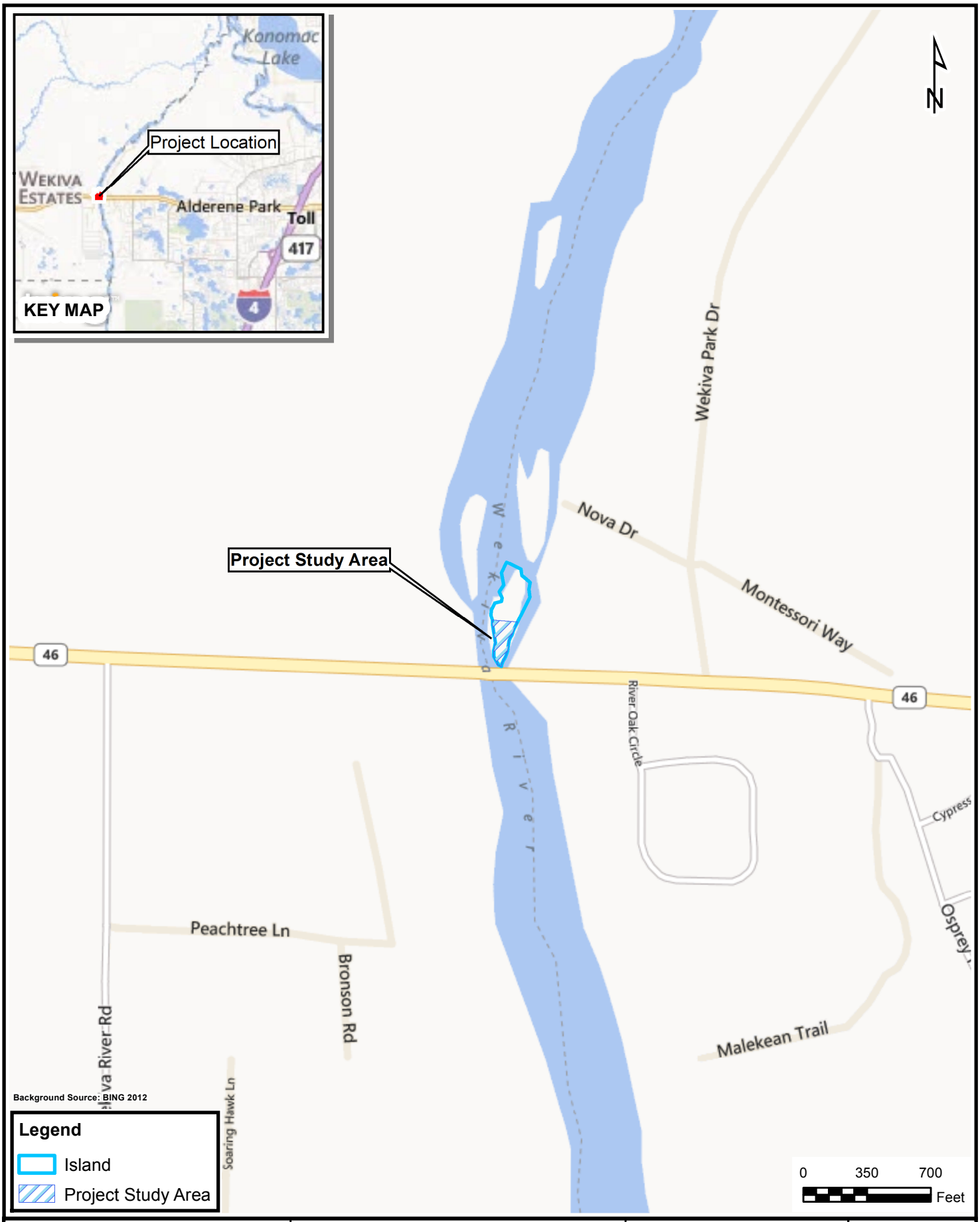
6.0 SUMMARY

E Sciences evaluated potential shading by the proposed SR 46 Bridge replacement on trees within the southern portion of an island in the Wekiva River. **Figure 6** depicts a rendering of the proposed bridge over the southern portion of the study area as viewed from the east. Approximately 55 feet of the southern tip of the island will be shaded by the bridge structure. The area affected is approximately 0.03 acre of the 1.48 acre island or approximately 2%. There are 30 trees located within that 0.03 acre area of effect: 15 cabbage palms, 5 laurel oaks, 6 red maples, 2 dahoon hollies, 1 sweetgum and 1 elm. Except for sweetgum, all of these species are shade tolerant. Of the 30 trees, 4 will be trimmed and 26 can remain in place with no alteration. It is estimated that 1400 trees cover the 1.48 acre island and based on this number the bridge project would directly affect 0.29% of those trees. Impacts will include direct impacts associated with the bridge structure and indirect impacts associated with increased shading. Direct impacts are anticipated to be minimal and will result in severe pruning of four trees. Indirect impacts are anticipated to a larger number of trees; however these impacts will be gradual and will not result in significant changes to the island's habitat or aesthetic value.

7.0 REFERENCES

Burns, Russell M., and Barbara H. Honkala, tech. coords. 1990. *Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654*, U.S. Department of Agriculture, Forest Service, Washington, DC. Vol.2, 877 p.

Floridata, http://www.floridata.com



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SR 46
Wekiva River Bridge Shade Study

Location Map

SCALE: 1 "=700 '	DATE: 2/14/2014

FIGURE
1

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SR 46
Wekiva River Bridge Shade Study

Study Area Map

FIGURE
2

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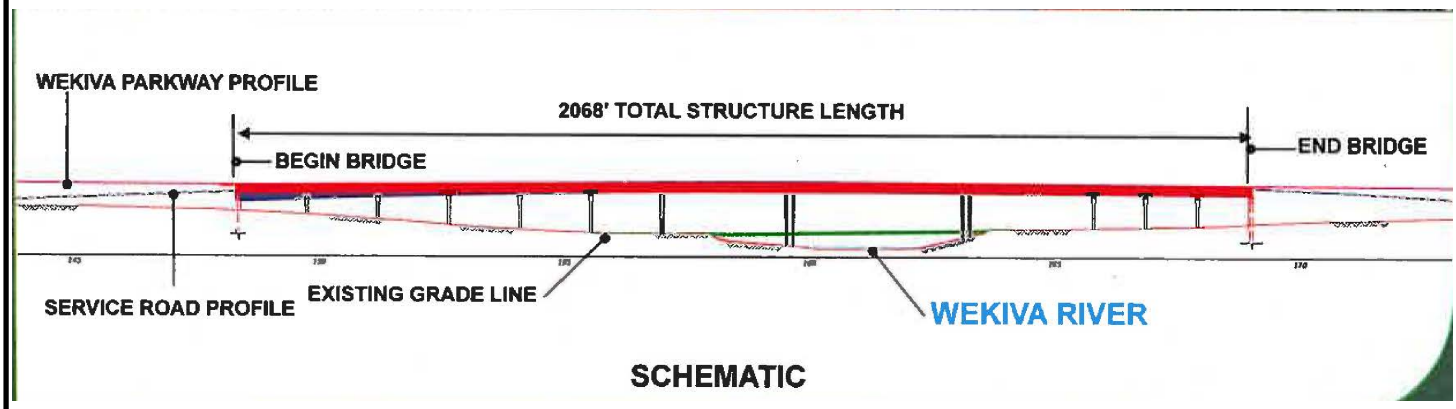
Proposed Bridge Profile



Three Bridge Structures

FDOT			SR 46 Wekiva River Bridge Shade Study	Bridge Profile and Structures	FIGURE 3
PREPARED BY: HC	CHECKED BY:	PROJECT NUMBER: 1-0403-049		SCALE: NTS	DATE: 2/14/2014

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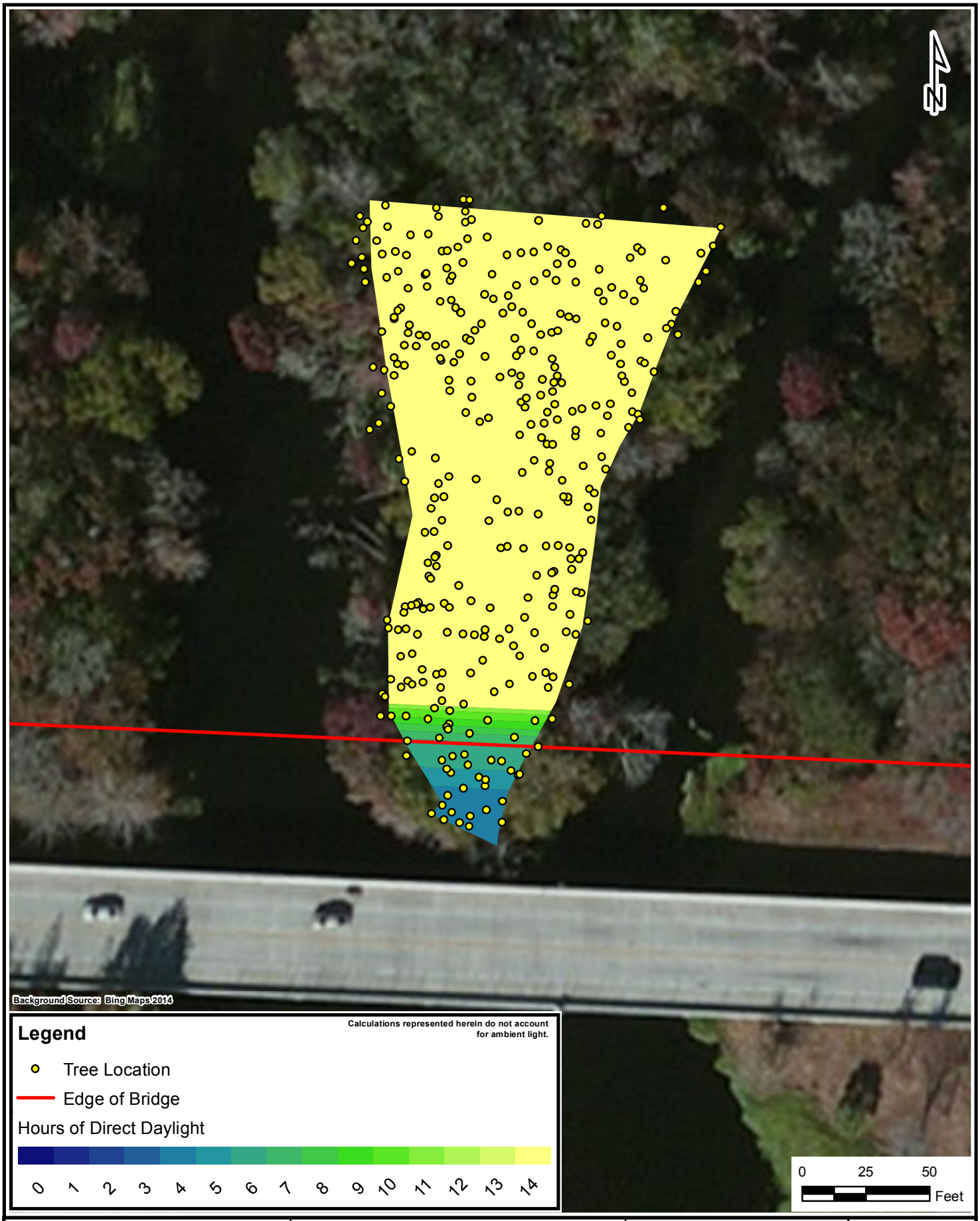

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SR 46
Wekiva River Bridge Shade Study

Summer Solstice
June 21

FIGURE
4

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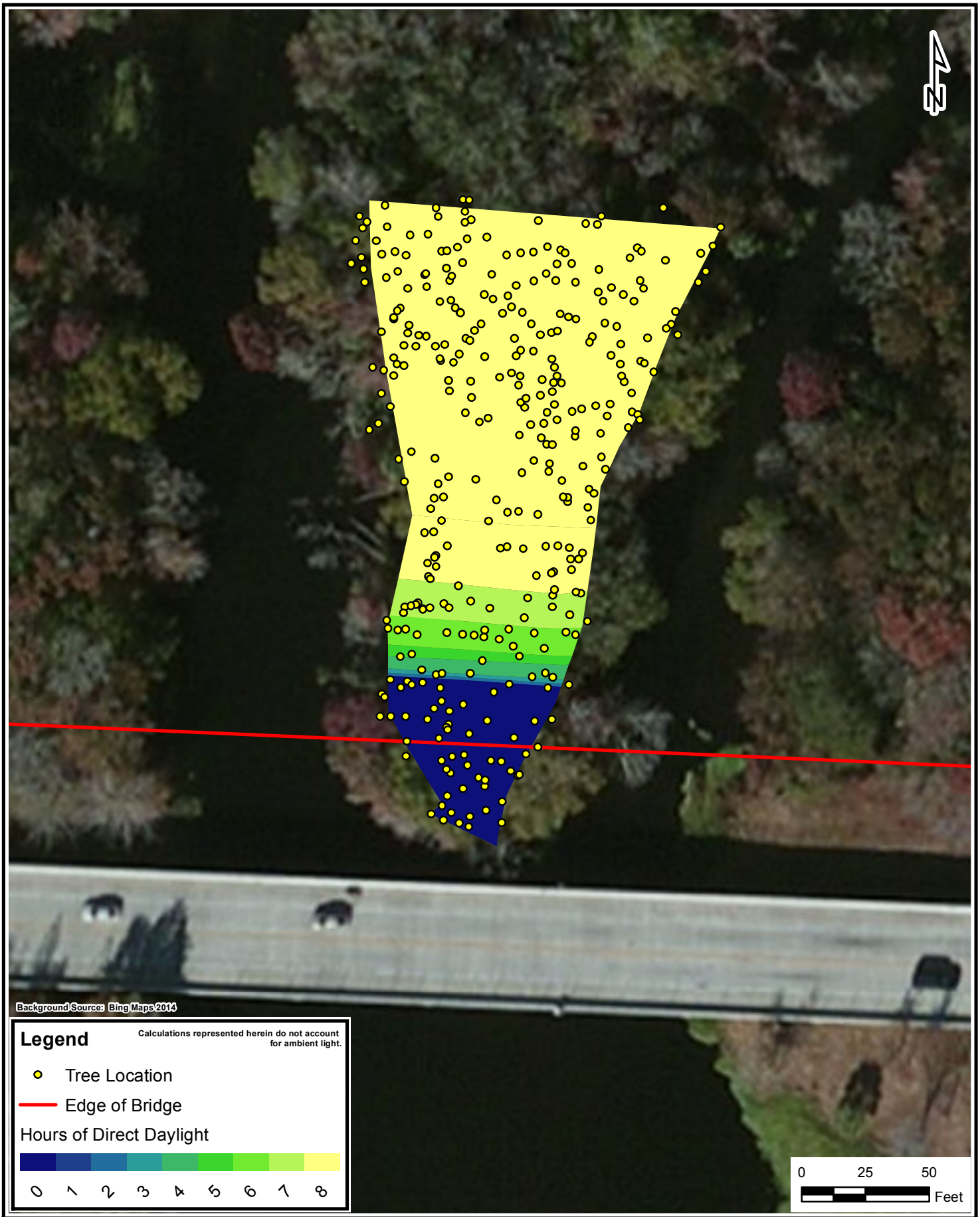

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SR 46
Wekiva River Bridge Shade Study

Winter Solstice
December 21

FIGURE
5

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FDOT			**SR 46 Wekiva River Bridge Shade Study**	Proposed Bridge Rendering (Summer)	FIGURE 6
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