RESOLUTION NO. 2018-89

A RESOLUTION BY THE BOARD OF COUNTY COMMISSIONERS OF ST. JOHNS COUNTY, FLORIDA, APPROVING AND ADOPTING THE COMMUNITY RATING SYSTEM WATERSHED MASTER PLAN FOR THE MILL CREEK WATERSHED, AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, St. Johns County ("County") participates in the National Flood Insurance Program ("NFIP") Community Rating System ("CRS"), a voluntary incentive program administered by the Federal Emergency Management Agency that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements; and

WHEREAS, as of 2016, the County has a CRS rating of 5, on a scale from 9 to 1; and

WHEREAS, the County intends to fulfill the requirements to achieve a rating of 4, reflecting the County's proactive approach to flood preparedness and resulting in a savings on flood insurance premiums paid by landowners in the County; and

WHEREAS, the County is developing a CRS Watershed Master Plan to characterize existing flood risks and assess the potential effects of future development in the County; and

WHEREAS, a subset of the greater CRS Wastershed Master Plan is a model for the Mill Creek Watershed, attached hereto as Exhibit A and incorporated herein; and

WHEREAS, approval and adoption of the CRS Watershed Master Plan for the Mill Creek Watershed by the Board of County Commissioners will help to improve floodplain management in this area of the County and allow the County to obtain credits under the NFIP CRS Coordinator's Manual Section 450 – Stormwater Management; and

WHEREAS, approval and adoption of the CRS Watershed Master Plan for the Mill Creek Watershed serves the interest of the public and the County.

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF ST. JOHNS COUNTY, FLORIDA, AS FOLLOWS:

<u>Section 1</u>. The above Recitals are incorporated by reference into the body of this Resolution, and such Recitals are adopted as findings of fact.

Section 2. The Board of County Commissioners hereby approves and adopts the CRS Watershed Master Plan for the Mill Creek Watershed attached hereto.

Section 3. This Resolution shall be effective upon its adoption by the Board of County Commissioners.

Section 4. To the extent that there are typographical and/or administrative errors and/or omissions that do not change the tone, tenor, or content of this Resolution, this Resolution may be revised without subsequent approval of the Board of County Commissioners.

PASSED AND ADOPTED by the Board of County Commissioners of St. Johns County, State of Florida, this 20 day of March, 2018.

BOARD OF COUNTY COMMISSIONERS
OF ST. JOHNS COUNTY, FLORIDA

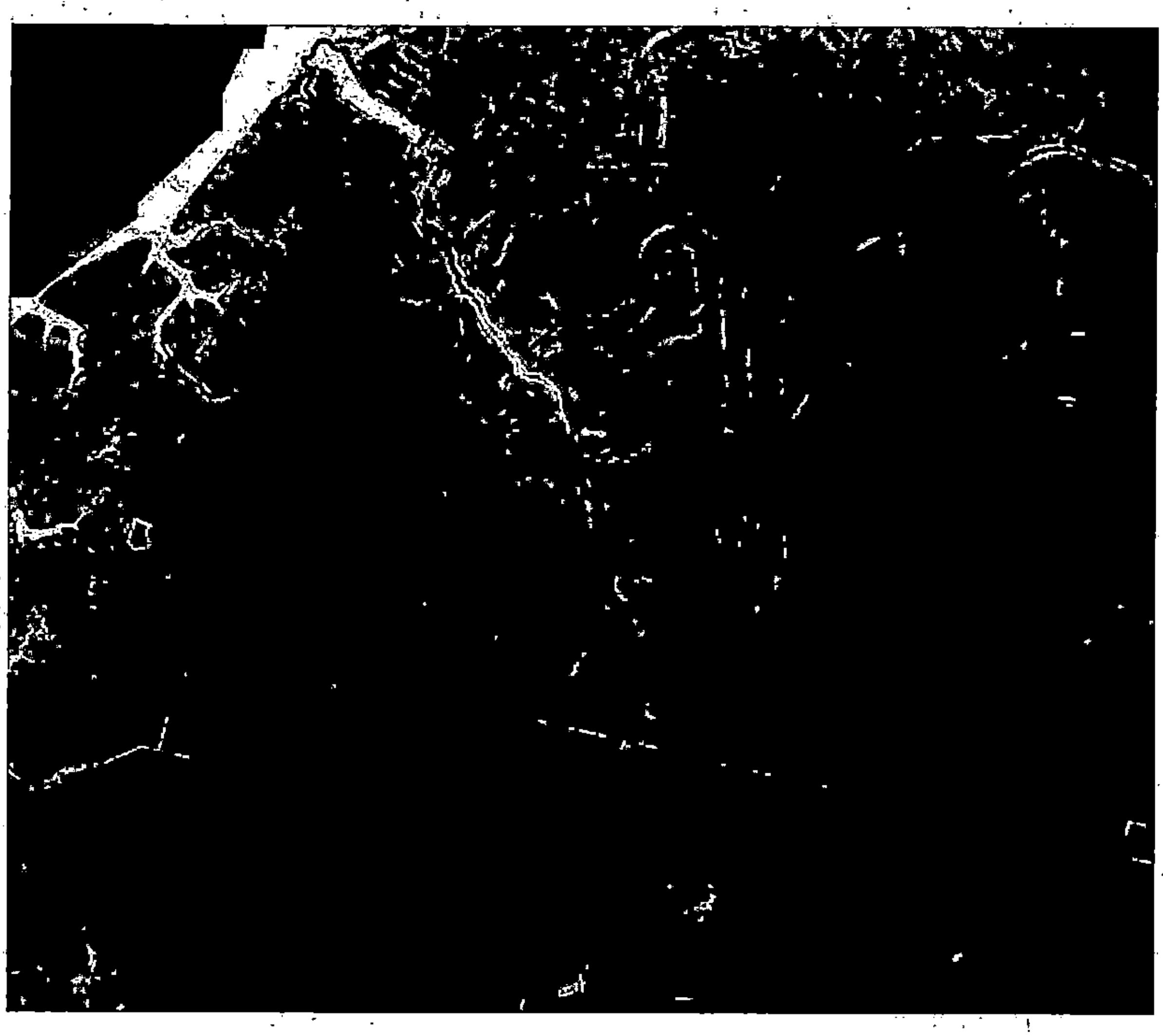
By: [signature]
Henry Dean, Chair

ATTEST: Hunter S. Conrad, Clerk

By: Pam Halterman
Deputy Clerk

RENDITION DATE MAR 22 2018

COUNTY OF ST. JOHNS FLORIDA



Community Rating System Watershed Master Plan

St. Johns County Board of County Commissioners | December 2016

COMMUNITY RATING SYSTEM

WATERSHED MASTER PLAN

Prepared for

St Johns County, Florida

Public Works Engineering

2740 Industry Center Road

St. Augustine, FL 32084

Prepared by

Jones Edmunds & Associates, Inc.

730 NE Waldo Road

Gainesville, Florida 32641

Certificate of Authorization #1841

December 2016

12/16/16 Alan Foley, PE

Florida PE No. 6983

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1 PURPOSE AND OBJECTIVES

This report documents an evaluation of the watershed master plan approach used by St. Johns County to characterize existing flood risks and assess the potential effects of future development. St. Johns County participates in the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency (FEMA). As of 2016, the County has a Community Rating System (CRS) ranking of 5 and intends to fulfill the requirements to achieve a ranking of 4. The higher ranking (lower number) reflects the County's proactive approach to flood preparedness and results in a savings on flood insurance premiums paid by landowners in the County. The watershed master plan evaluation will help to improve floodplain management in St. Johns County, and will allow the County to obtain credits under the NFIP CRS Coordinator's Manual Section 450 – Stormwater Management.

2 EXISTING CONDITIONS MODEL

Jones Edmunds & Associates, Inc. developed the Northwest Regional Model (NWRM) – a hydrologic and hydraulic (H&H) model – for a portion of St. Johns County (Jones Edmunds, 2014). Exhibit 1 shows the NWRM area of interest (AOI) and the Mill Creek watershed. The NWRM AOI is approximately 125 square miles. The Mill Creek watershed consists of 124 basins covering approximately 5.5 square miles within the NWRM AOI (Exhibit 2). Mill Creek drains to Beluthahatchee Pond south of County Road (CR) 13.

The NWRM reflects ground conditions from about 2009 and characterizes H&H processes at a spatial scale on the order of tens of acres. Jones Edmunds developed the NWRM H&H model using Interconnected Channel and Pond Routing (ICPR) modeling software v3.10 service pack 11. An ICPR model consists of three main elements (basins, links, and nodes) and two sets of model controls (H&H routing). Tables 1 through 3 present summary statistics for the model elements in the Mill Creek watershed.

Table 1 Summary Statistics of Basin Sizes in the Mill Creek Watershed

Tributary	Count	Total Acreage	Total Square Miles	Minimum	Maximum	Average	Standard Deviation
Mill Creek	124	3,530.5	5.5	1.0	177.4	28.5	34.8

Table 2 Summary Statistics of Node Initial Conditions in the Mill Creek Watershed

Tributary	Count	Minimum	Maximum	Average	Standard Deviation
Mill Creek	130	0.4	30.0	22.0	5.9

Table 3 Summary Statistics of Link Type in the Mill Creek Watershed

Tributary	Count	Weir	Culvert	Channel	Drop Structure	Bridge
Mill Creek	408	246	120	19	23	0

Elevations within the Mill Creek watershed range from -1.5 feet to 48 feet based on 2008 Light Detection and Ranging (LiDAR) coverage. The LiDAR dataset references the North American Vertical Datum of 1988 (NAVD88). Exhibit 3 shows the topography of the Mill Creek watershed.

The existing landscape within the Mill Creek watershed is predominantly upland pine forests (30%), residential (25%), and wetlands (20%). Coniferous pine and pine flatwoods are located along the south portion of the Mill Creek watershed, and residential areas exist along the east and west sides of Mill Creek. Exhibit 4 shows the existing land uses in the Mill Creek watershed.

The NWRM results compared well to stage data collected with the County stage recorders and to stage-discharge data from the US Geological Survey (USGS) gauge (USGS 02246200, Durbin Creek near Durbin, Florida), though the limited dataset prevented a more robust comparison. Similarly, the NWRM compares well to known flooding locations throughout the watershed although exact peak stages were not available for comparison. The NWRM results also compared well to FEMA's detailed modeling results and were within the range of error for our regional regression calculations.

3 FUTURE CONDITIONS MODEL

3.1 DESCRIPTION AND METHODOLOGY

Jones Edmunds prepared a future conditions model for the Mill Creek watershed draining to Beluthahatchee Pond. We developed the future conditions model by updating the existing conditions model to reflect full buildout within the Mill Creek watershed. The full buildout condition was based on the future land use shapefile and zoning shapefiles downloaded from the St. Johns County Data Depot website on April 19, 2016. The County's future land use dataset is at a lower level of detail relative to the St. Johns River Water Management District (SJRWMD) 2009 land use layer used to develop the existing conditions model. For example, isolated wetlands and water bodies delineated in the SJRWMD 2009 land use layer were not typically delineated in the County's future land use.

We made the following assumptions when updating the existing conditions land use to reflect the County's future land use:

- Existing wetlands and water bodies would remain unchanged.
- Undeveloped land uses intersecting the future land use designation of Residential-A were typically updated to be low-density residential.
- Undeveloped land uses intersecting the future land use designation of Residential-B were typically updated to be medium-density residential.
- Undeveloped land uses intersecting the future land use designation of Residential-B were typically updated to be high-density residential.
- Undeveloped land uses intersecting the future land use designation of Mixed Use District were typically updated to be low-intensity commercial.

Exhibit 5 shows the updated land use based on our assumptions. The updated land use layer is predominantly residential (56%), wetlands (20%), and pine forests (9%).

We made the following adjustments to drainage basin hydrologic parameters to reflect typical built-out conditions:

- Updated curve numbers (CN) to reflect drained conditions (addition of fill to enhance drainage is a common construction practice in the County).
- Updated directly connected impervious area (DCIA) to values typical of developed areas that incorporate addition of pavement and stormwater wet detention ponds.
- Updated time of concentration (Tc) values to typical values that reflect developed conditions and attenuation in stormwater ponds. We reviewed stormwater pond outfall hydrograph for five basins in the existing conditions model. We modeled only the basin runoff response and adjusted Tc values to match the outfall link hydrograph from the existing conditions model. Calibrated Tc values ranged from 91 minutes to 284 minutes. We applied a Tc value of 180 minutes to all basins with a future land use of medium-density residential or commercial.
- Updated unit hydrographs to represent developed conditions.

Jones Edmunds did not update the model hydraulic parameters for the future conditions model. We assumed hydraulic conveyances such as channels and culvert crossings would remain unchanged relative to existing conditions.

Jones Edmunds ran the updated future conditions model for the mean annual, 10-, 25-, and 100-year 24-hour design storm events.

3.2 COMPARISON TO EXISTING CONDITIONS MODEL

Table 4 compares the existing and future conditions model CN and DCIA values across the Mill Creek watershed. Table 5 summarizes the Tc updates between models:

- The area-weighted CN for the Mill Creek watershed in the existing model was 75.1. The area-weighted CN in the future conditions model was 79.7, an approximately 6% increase.
- The area-weighted DCIA percentage for the Mill Creek watershed in the existing conditions model was 20.2%. The area-weighted DCIA in the future conditions model was 31.2%, a 54% increase for the watershed.
- The minimum and maximum Tc values across the Mill Creek watershed in the existing conditions model were 10 and 243 minutes, respectively. The minimum and maximum Tc values in the post-conditions model were 10 and 236 minutes, respectively. The average percent decrease in time of concentration was 25.5% across all basins in the Mill Creek watershed.

Table 4 Summary of Existing and Future Conditions Model CN/DCIA Values

Hydrologic Parameters	ECM	FCM	Difference	Percent Difference
CN	75.1	79.7	4.6	6.1
DCIA	20.2	31.2	11	54.5

Table 5 Summary of Existing and Future Conditions Model Tc

Model	Minimum (minutes)	Maximum (minutes)
ECM	10	243
FCM	10	236

Jones Edmunds used a test model to analyze the differences in basin runoff response between different land uses. We parameterized a 1-acre basin for each of the following land uses: upland forest, medium-density residential, and commercial. We assumed soil hydrologic Group B to develop non-DCIA CN values. Table 6 summarizes the hydrology results between the three land-uses.

Table 6 Summary of Hydrologic Response for Select Land Uses

Basin Type	Basin Size (acre)	Peak Discharge (cfs)	Runoff Volume (acre-feet)	CN	DCIA
Upland Forest	1.0	2.0	0.53	60	0
Medium-Density Residential	1.0	4.2	0.69	69	13
Commercial and Services	1.0	5.1	0.92	61	85

Note: cfs = cubic feet per second.

A change in land use from upland forest to medium-density residential yields a 110% increase in peak discharge and a 30% increase in runoff volume. A change from upland forest to commercial yields a 155% increase in peak discharge and a 74% increase in runoff volume. The results of the test model indicate representative changes to basin runoff responses in the Mill Creek watershed based on changes to the existing land use.

4 RESULTS

Jones Edmunds reviewed and compared model output results between the existing conditions model and the future conditions model for the mean annual-, 10-, 25-, and 100-year return period 24-hour duration synthetic storm events. We reviewed the changes in peak water-surface elevations, peak flows and velocities, and level-pool inundation area extents between the two models. We also evaluated impacts to road and structure flooding.

4.1 PEAK WATER SURFACE ELEVATIONS

Exhibit 6 shows changes in peak water-surface elevations between the existing conditions models and future condition models. The largest increases in peak water-surface elevations were in Beluthahatchee Pond south of CR 13. Table 7 summarizes the nodes with peak water-surface elevation increases for the modeled storm events. Increased hydrologic runoff volumes in the future conditions model resulted in increases of peak water-surface elevation for over 116 nodes across the different model events. The majority of model nodes had increases in peak water-surface elevation of less than 0.5 foot (Exhibit 6).

Table 7 Summary of Impacts to Node Peak Water Surface Elevations

Model Design Event	Nodes with Increase of Peak WSE Less than 0.5 Foot	Nodes with Increase of Peak WSE Greater than 0.5 Foot and Less than 1.0 Foot	Nodes with Increase of Peak WSE Greater than 1.0 Foot
Mean Annual, 24-hour	116	12	2
10-year 24-hour	118	11	1
25-year 24-hour	116	12	2
100-year 24-hour	118	7	5

4.2 PEAK FLOWS AND VELOCITIES

Increased runoff responses in the future conditions model resulted in higher peak flows than the existing conditions model across the different model events. Table 8 summarizes the links with increased peak flow for the modeled events. The largest increases in peak flow were observed along the Mill Creek channel system. Nine of the 11 channel links along Mill Creek north of Greenbriar Road increased by over 100 cfs in the 100-year 24-hour event.

Table 8 Summary of Impacts to Link Peak Flows

Model Design Event	Links with Increase in Peak Flow Less than 10 cfs	Links with Increase in Peak Flow Less than 50 cfs and Greater than 10 cfs	Links with Increase in Peak Flow Greater than 50 cfs
Mean Annual, 24-hour	102	14	13
10-year 24-hour	110	17	19
25-year 24-hour	112	20	21
100-year 24-hour	138	28	22

Table 9 summarizes the links with increases in peak velocity for the 100-year 24-hour event. The majority of the links had increases in peak velocity of less than 0.5 foot per second. Exhibit 7 shows changes in link peak velocities between the existing conditions model and future conditions model. The largest increase in peak velocity was 2.5 feet per second through the culverts under CR 13 downstream of Beluthahatchee Pond (15.4 feet per second under existing conditions to 17.9 feet per second under future buildout conditions models). Velocities along the Mill Creek channel system typically increased by about 0.1 foot per second, which indicates the channel system has sufficient storage and capacity to convey larger flows with little change in velocity.

Table 9 Summary of Impacts to Link Peak Velocities

Model Design Event	Links With Increase of Peak Velocity Less Than 0.5 Foot per Second	Links With Increase of Peak Velocity Greater Than 0.5 Foot per Second
100-year 24-hour	362	13

4.3 Impacts to Inundation Extents

Exhibit 8 shows the changes in level-pool inundation between the existing conditions models and future conditions models. Significant increases in inundation extent for the future conditions models were along Greenbriar Road and in portions of the Mill Creek channel system. Table 10 summarizes the total inundation areas for the existing conditions and future conditions models.

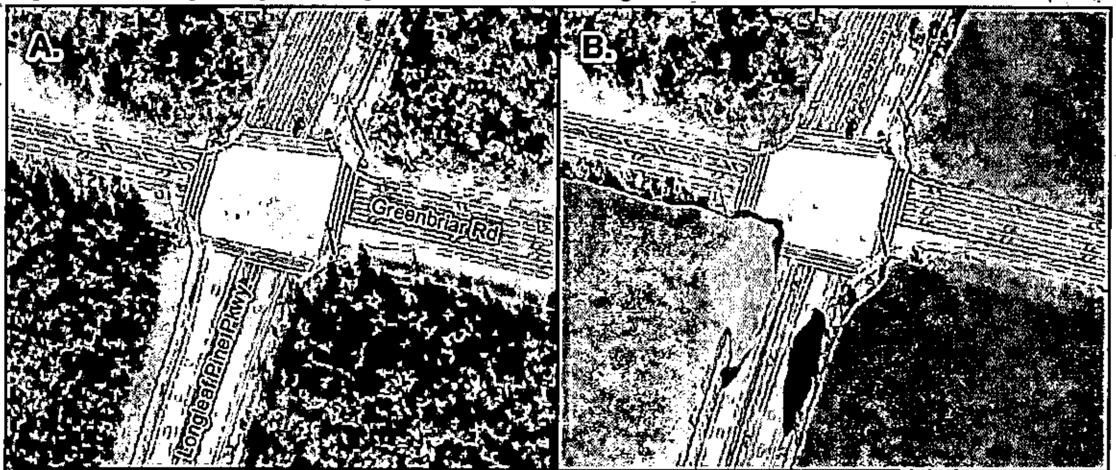
Table 10 Summary of Impacts to Level Pool Inundation Extents

Event	Existing Conditions Model (acre)	Future Conditions Model (acre)	Increase (acre)
Mean Annual, 24-hour	615.8	748.9	133.1
10-year 24-hour	835.0	953.8	118.8
25-year 24-hour	949.4	1,063.0	113.6
100-year 24-hour	1,151.2	1,235.5	84.3

4.4 Impacts to Road Flooding

Jones Edmunds reviewed the impacts to road flooding for the future conditions models. Figure 1 provides an example of an adverse drainage impact to a road. Inundation from the existing conditions 100-year model (light blue polygons in the figure) already extends onto a portion of Longleaf Pine Parkway near the intersection of Greenbriar Road. The peak water-surface elevation from the future conditions model only increases 0.2 foot in the 100-year 24-hour event (dark blue polygons in the figure), but is enough to block additional road lanes on Longleaf Pine Parkway.

Figure 1 Example of Impact to Road Flooding



A. With St. Johns County 2014 Aerial Imagery.
B. With ECM and PCM 100-year, 24-hour Level Pool Inundation

0 100 200
Feet

4.5 IMPACTS TO STRUCTURE FLOODING

Jones Edmunds reviewed impacts to structure flooding for the future conditions models. We used the St. Johns County 2013 building footprints dataset to evaluate impacts to structures. We identified 58 structures in the existing conditions 100-year inundation extents and 105 structures in the future conditions model. Figure 2 provides an example of potential adverse drainage impacts to structures adjacent to Beluthahatchee Pond. There are four building footprints within the existing conditions 100-year inundation polygons and six within the future conditions inundation polygons. We were unable to confirm whether the structures are on an elevated foundation or stilts.

Figure 2 Example of Impact to Structure Flooding

A. With St. Johns County 2014 Aerial Imagery
B. With ECM and PCM 100-year, 24-hour Level Pool Inundation and St. Johns County 2015 Building Footprints

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5 DISCUSSION

5.1 MODEL RESULTS

For this analysis, the future buildout conditions were modeled with parameters reflective of current stormwater permitting criteria. Those criteria were developed by St. Johns County to address both water quantity and water quality. From a water quantity perspective, the County requires a permit for "Any activity which alters or disrupts the natural flow patterns of stormwater runoff, or would result in an increase in stormwater discharge or rate" (Section 6.04.06.B – Activities Requiring a Permit). It is noteworthy that a County permit is required for any activity, regardless of project size or area affected.

Our comparison of model results indicates a generally low potential for adverse drainage impacts to roads or structures under the potential future buildout conditions; however, structures located close to water bodies and wetlands could be at greater risk of flooding. Flooding risk appeared to increase in a few locations under the modeled future buildout conditions.

Our conclusion is that the current County permitting criteria generally provide an adequate level of flooding protection – although increased flooding risks will largely depend on finer-scale, site-specific factors. These factors include the configuration of hydraulic elements such as pipes and ditches that may be added to a site or that interact with existing infrastructure. This analysis did not consider the various site development methods and site-level detailed hydraulic changes that could alter points of discharge from sites. Consideration of these factors would require more site-specific data and assumptions regarding how sites would be developed.

5.2 REGULATORY IMPLICATIONS

St. Johns County wants to facilitate landowner property use while protecting the rights and interests of adjacent landowners. Historically, approximately 50% of the County was either water or wetland. Much of the well-drained land within the County was previously modified or developed. This means that future development will increasingly occur in less well-drained areas adjacent to existing residential and commercial developments. In many cases, developing these areas will be more challenging because of site drainage conditions.

St. Johns County is implementing a stormwater review program to prevent adverse offsite impacts caused by such site-specific hydraulic alterations. This review includes standard processes and tools for applicant use of the regional model data to support and expedite land development review. This review program is using regional surface water models similar to the NWRM used for this analysis. Pursuant to Section 6.04.06 in *Stormwater Management* in Article VI of the County's Land Development Code, County staff will review land development applications to determine that the proposed land or drainage modifications will cause no adverse offsite drainage impacts.

The County's review will be in addition to meeting applicable site development criteria such as acquiring an SJRWMD Environmental Resource Permit (ERP) and complying with Federal Emergency Management Agency (FEMA) floodplain conditions. The applicant may need to independently notify FEMA of site modifications affecting a FEMA–designated special flood hazard.

For the County review, the permit applicant must demonstrate that the proposed land modifications will have no adverse offsite drainage impacts by providing an H&H analysis that compares the pre-development and the proposed post-development conditions for the project site. The analysis must include consideration of the offsite areas that are hydrologically or hydraulically influenced by drainage passing through the site up to the 100-year rainfall event and extend far enough downstream to verify that no adverse impacts exist beyond the site boundary.

The H&H analysis must comply with generally accepted engineering practices and County standards. The area to be considered will be defined by hydrologic divides (drainage basin divides), not by property boundaries. Drainage characteristics such as drainage basin boundaries, hydraulic connections, CNs, tailwater conditions, and boundary conditions must be approved by the County.

Based on the results of this analysis, existing County permitting criteria appear to provide a generally adequate level of flood protection – relative to existing conditions – for areas undergoing, or adjacent to, new site development. The County's planned site-specific review will enhance the existing County criteria by more explicitly considering offsite hydraulic factors. The County's review process also provides for maintaining up-to-date drainage information that is accessible to County staff and to landowners. We believe that these review processes will provide an excellent level of flood protection for the residents and visitors to St. Johns County.

6 REFERENCES

Jones Edmunds & Associates, Inc. 2009. *Northwest Regional Model Digital Terrain Development*. October 30, 2009.

Jones Edmunds & Associates, Inc. 2010. *Northwest Regional Model Field Reconnaissance and Immediate Maintenance*. February 26, 2010.

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Jones Edmunds & Associates, Inc. 2010. *Northwest Regional Model Schematic Development*. May 26, 2010.

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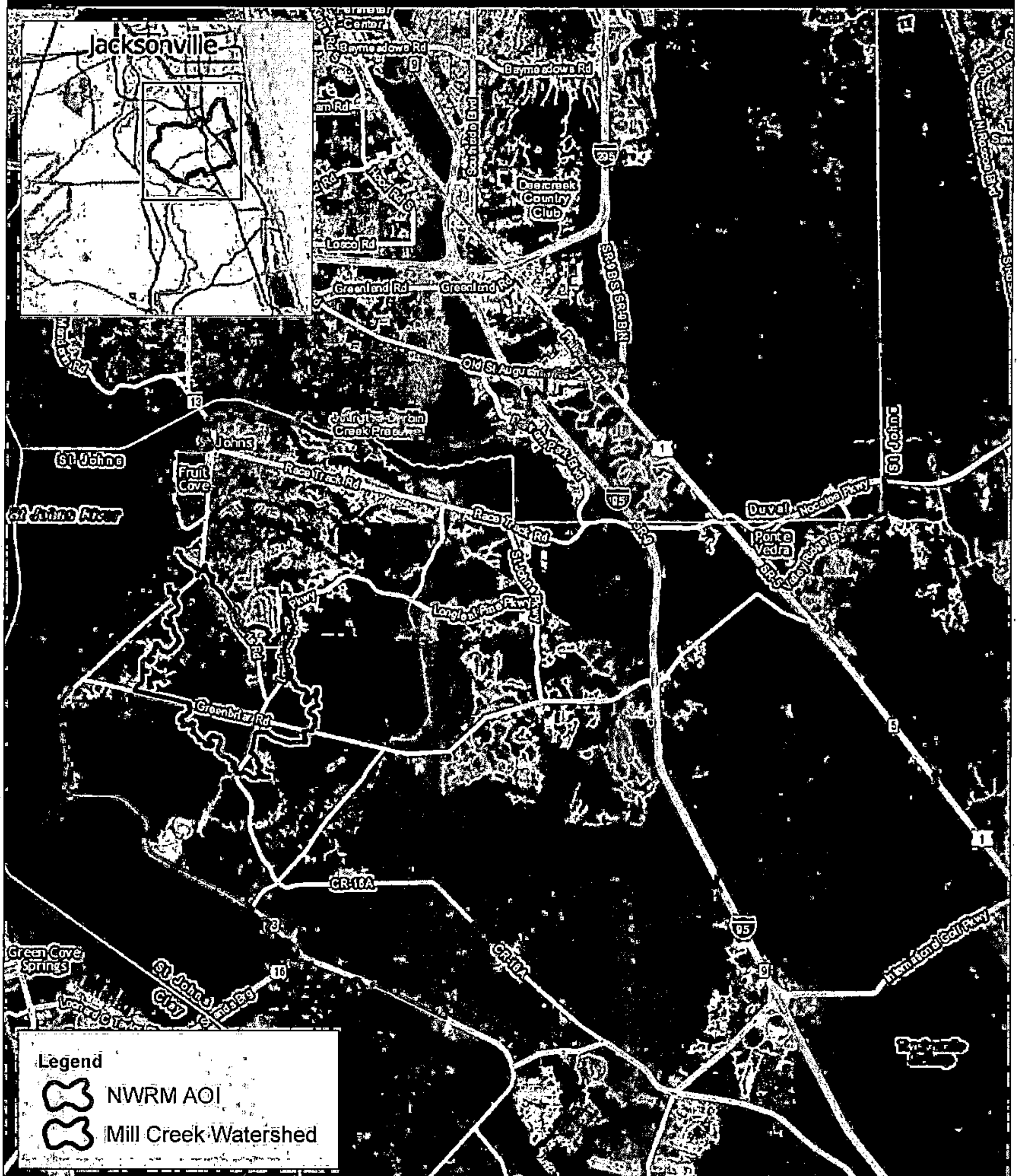
Jones Edmunds & Associates, Inc. 2012. *Northwest Regional Model Survey Procedures and Quality Control*. December 10, 2012.

Jones Edmunds & Associates, Inc. 2014. *Northwest Regional Model Development Procedures*. February 28, 2014.

Exhibits

Exhibit 1

Existing Conditions AOI
St. Johns County CRS Watershed Management Plan



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Miles
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JONES EDMUNDS

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Exhibit 2

Mill Creek Watershed and Basins
St. Johns County CRS Watershed Management Plan

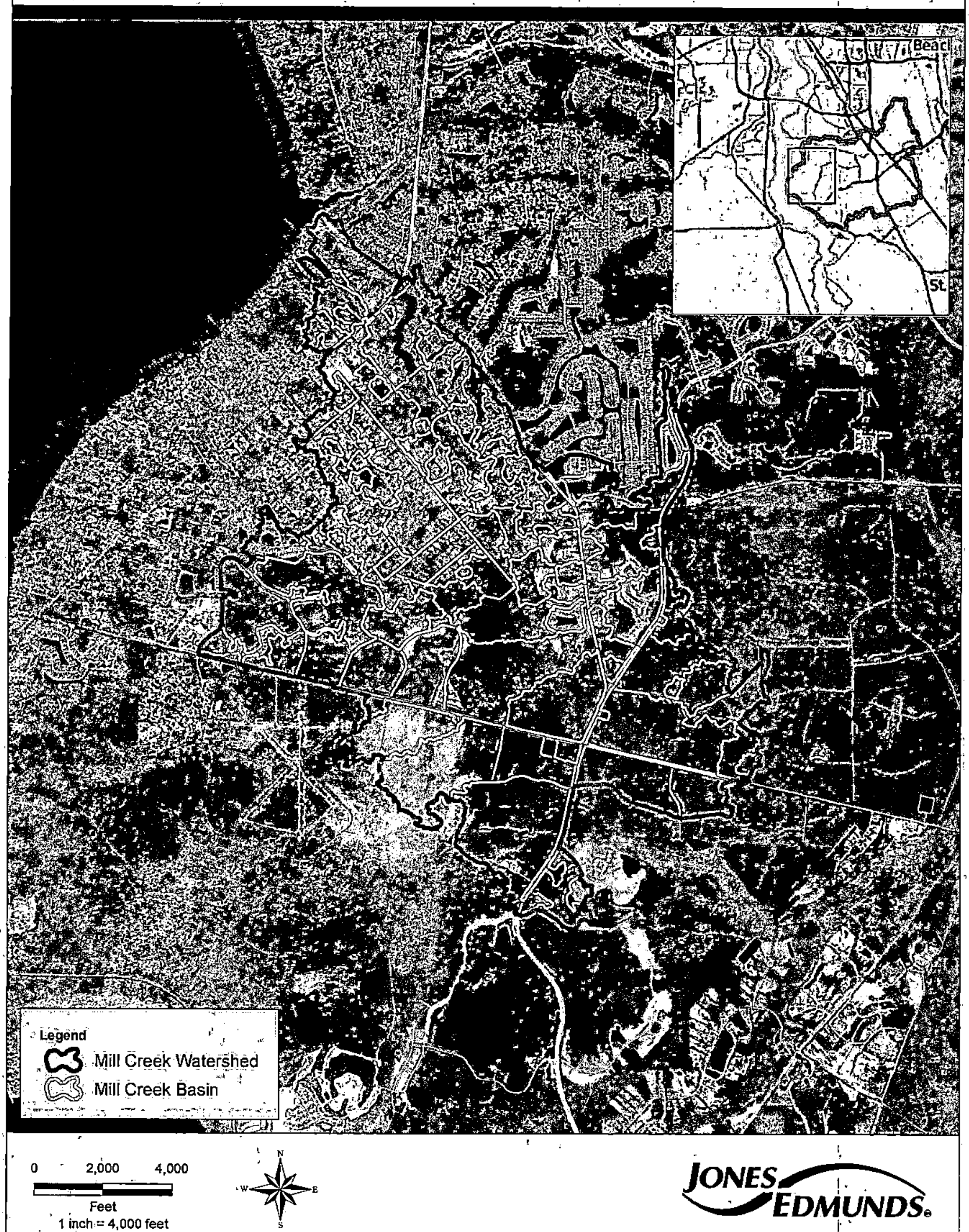

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Exhibit 3

Topography

St. Johns County CRS Watershed Management Plan

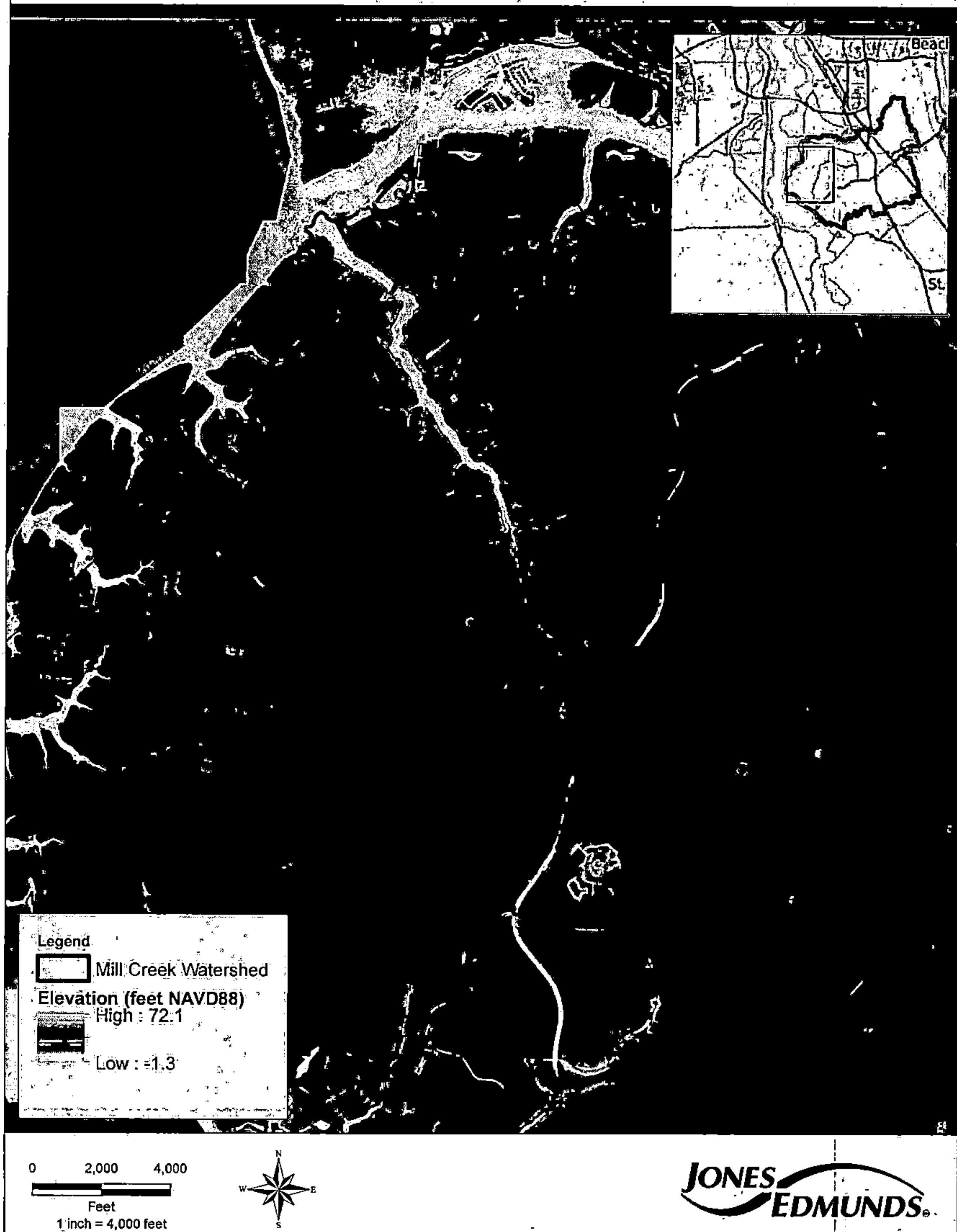

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Exhibit 4

Existing Conditions Land Use
St. Johns County CRS Watershed Management Plan

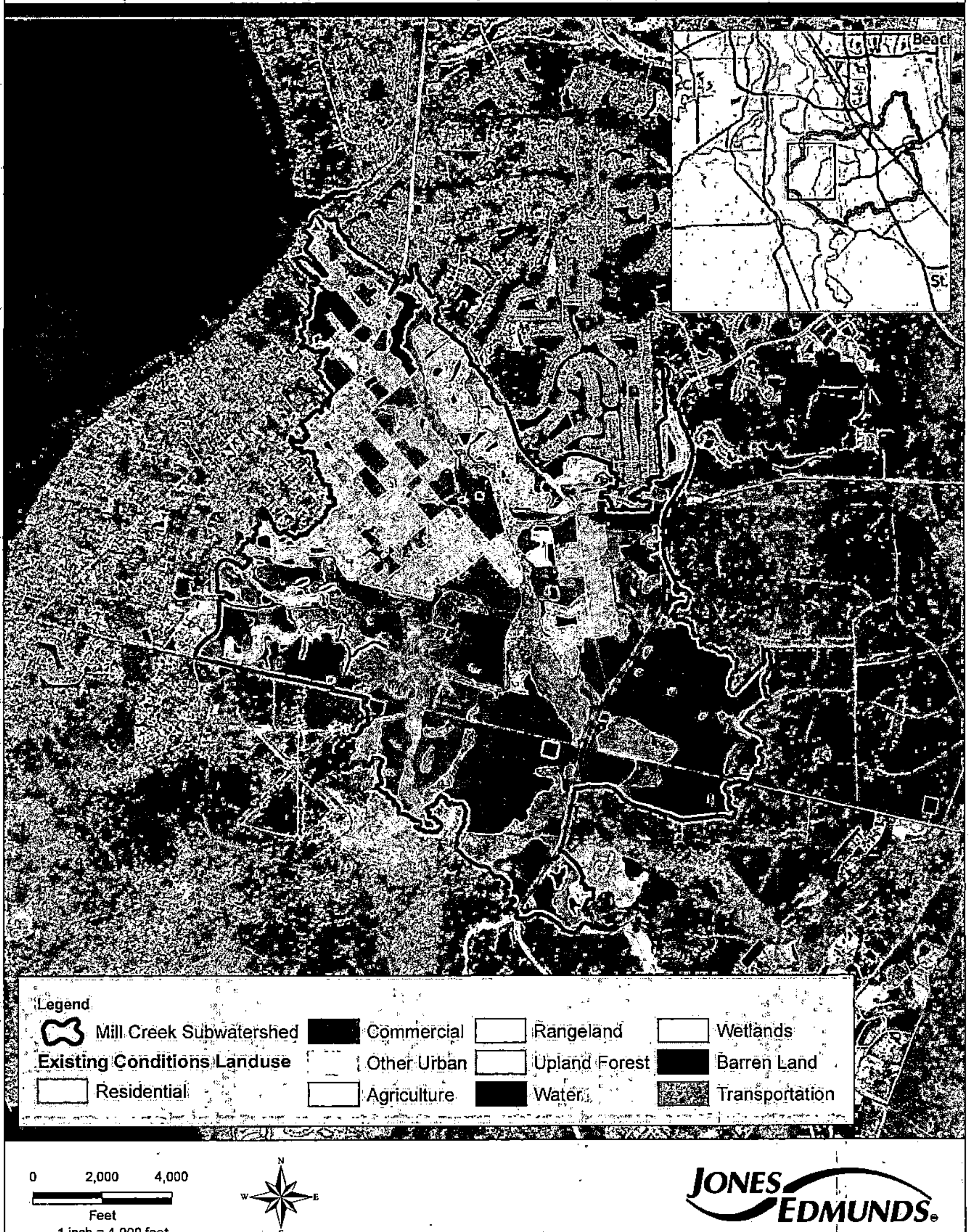

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Exhibit 5

Future Conditions Land Use
St. Johns County CRS Watershed Management Plan

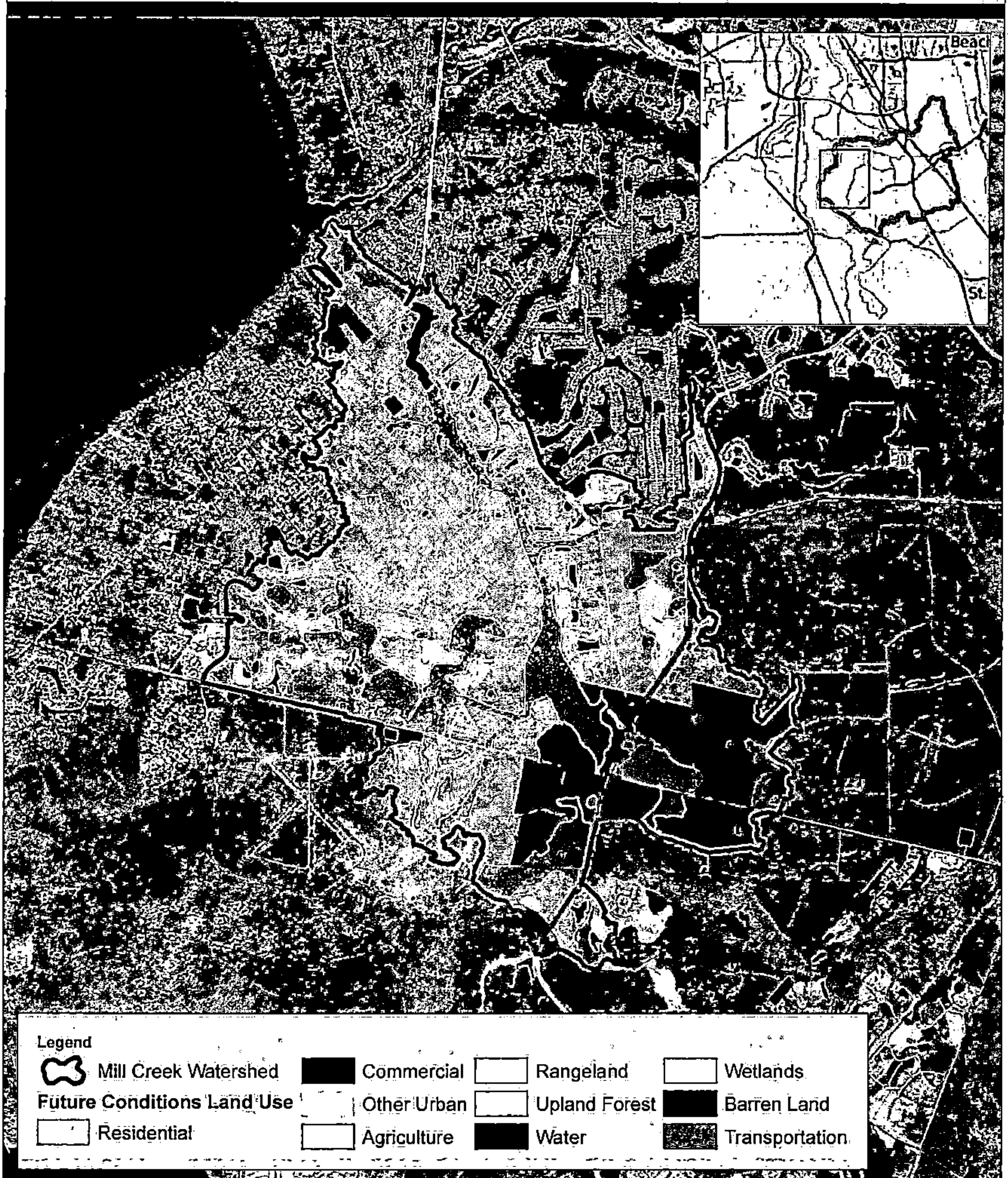

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Exhibit 6

Changes in Node Peak Water Surface Elevation for 100-year 24-hour Event
St. Johns County CRS Watershed Management Plan

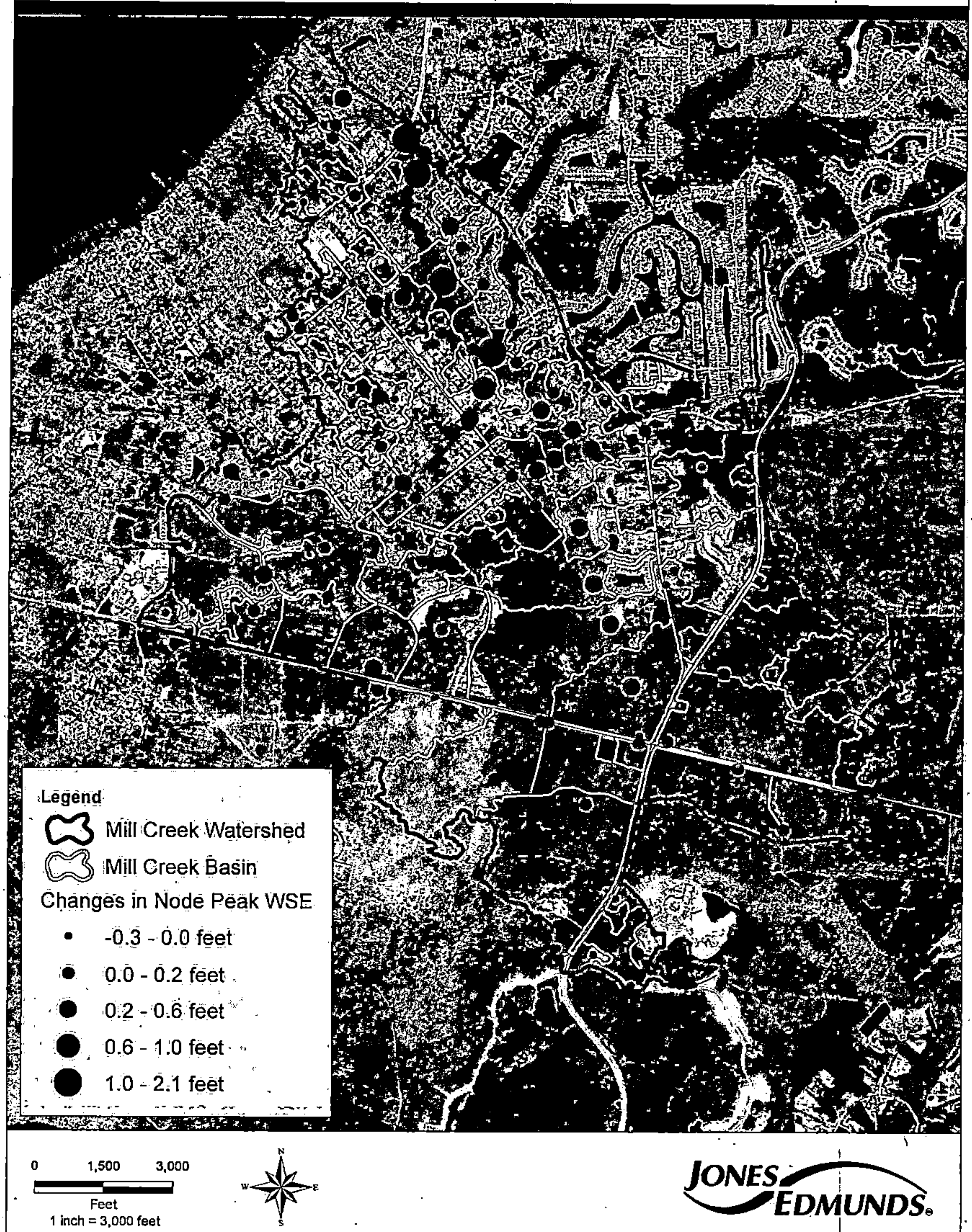

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Exhibit 7

Changes in Link Peak Velocity for 100-year 24-hour Event
St. Johns County CRS Watershed Management Plan

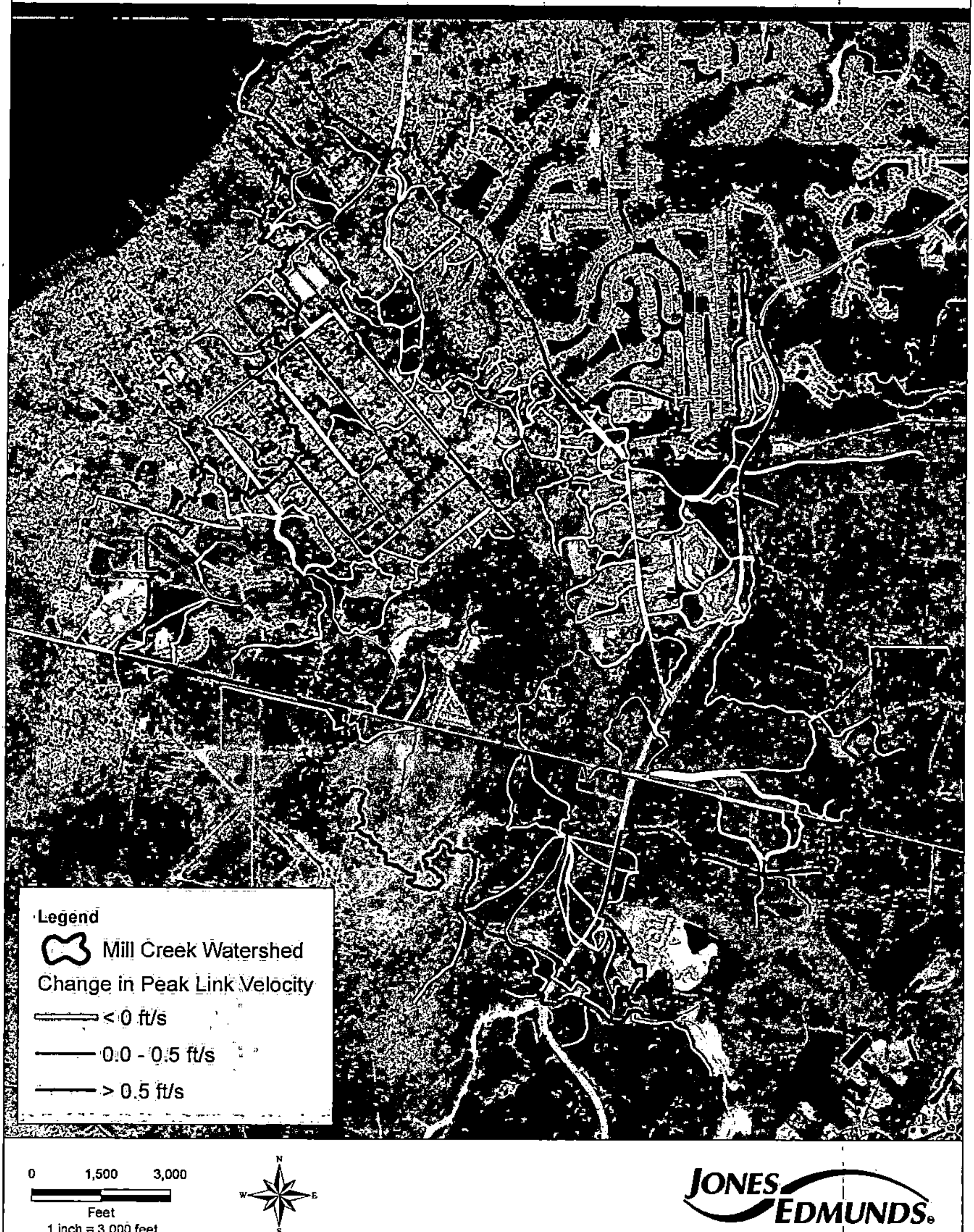
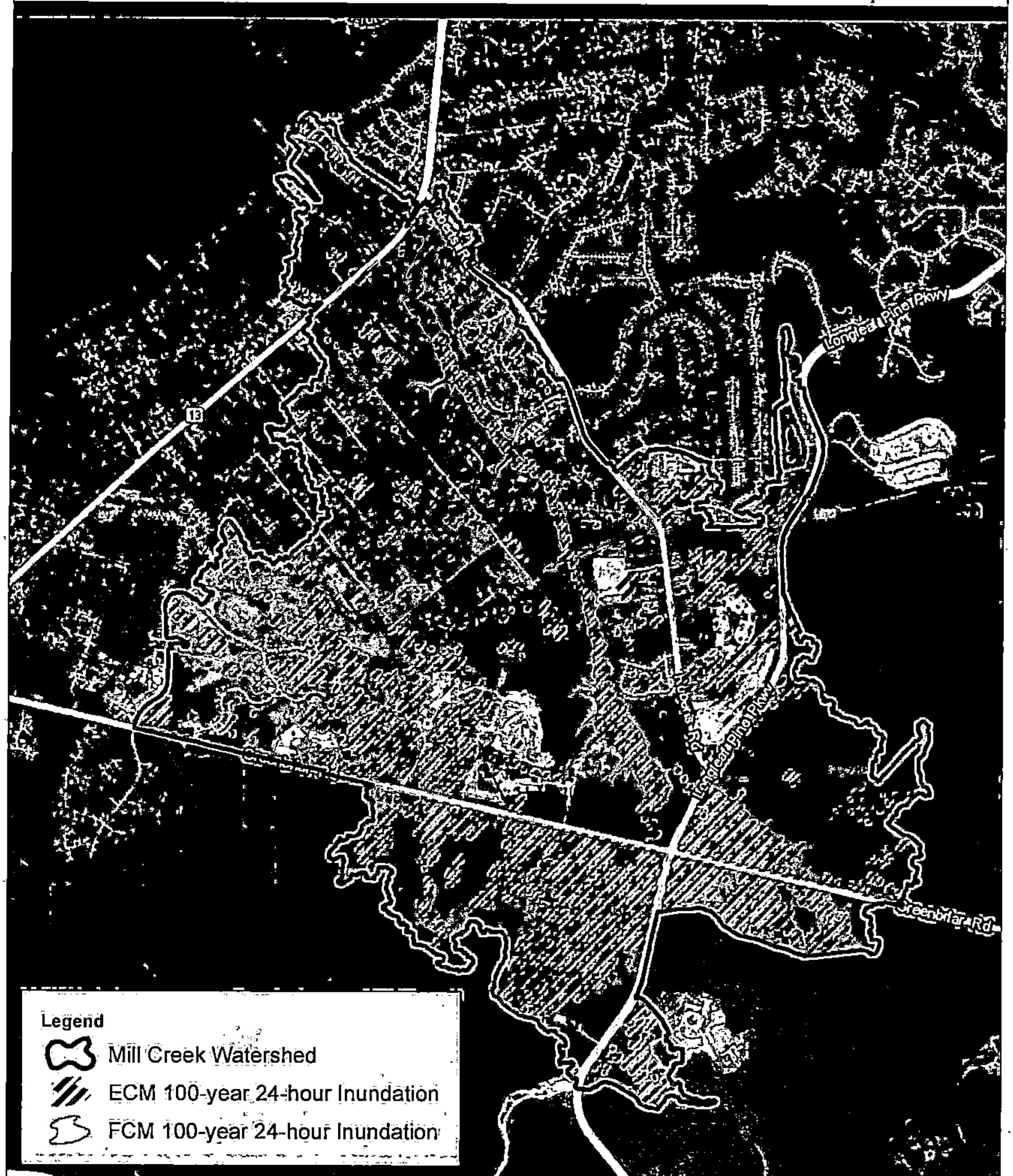


Exhibit 8

Comparison of Level Pool Inundation for 100-Year 24-hour Event

St. Johns County CRS Watershed Management Plan



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