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Mr. Joseph Morgan, AIA
KMF Architects
839 N. Magnolia Avenue
Orlando, FL 32803

RE: Report of Nuclear Roof Moisture Survey
Orlando Public Library
Roof Section 1
101 E. Central Boulevard
Orlando, FL 32801

Dear Mr. Morgan:

In general accordance with your request and your authorization of our proposal (Number 273623R0 dated June 15, 2022) and authorized August 9, 2022), Intertek is pleased to submit the following roof nuclear moisture survey report for the above-referenced property. Included in this report is an outline of the project information, performed scope of services, results and conclusions.

**PROJECT UNDERSTANDING**

The project site consists of the Orlando Public Library building located at the above referenced address. Intertek was requested to perform a nuclear roof moisture scan of the roof sections in order to investigate potentially moisture impacted areas within the roof system. The survey included eleven separate roof sections. This report specifically pertains to Roof Section 1. Please refer to the appended annotated aerial map for roof designations. Roof Sections 2 and 3 are provided under a separate report cover; and Roof Sections 4-11 are provided under a separate report cover also.

The roof system at Roof Section 1 is comprised of low slope built-up roof system with a modified bitumen membrane. The roof system components are as follows (as viewed from the deck up): lightweight insulating concrete (with EPS foam), two modified bitumen inner plies, polyisocyanurate insulation, Securock cover board, two modified bitumen inner plies with a granule surfaced capsheet membrane. Roof Section 1 totals approximately 6,100 SF.

**SCOPE OF SERVICES**

On August 31, 2022, Intertek performed a nuclear moisture survey of the referenced roof section. The survey was performed in general accordance with TAS 126-95. This protocol covers the procedures for non-destructive testing for the presence of moisture, in a roof system assembly. The survey at this roof section was performed on a 5x5 foot grid pattern. Roof core samples were extracted and patched by others.

Weather conditions at the time of the scan were partially cloudy with a temperature range of 85-90°F and average wind speeds up to 5 mph.

**METHODOLOGY**

*Nuclear Roof Moisture Survey*

Intertek utilized a Troxler Model 3216 nuclear scanner to survey the roof assemblies. The roof was surveyed on a 5x5-foot pattern. The nuclear scanning meter emits neutrons from a radiation source within the scanning meter downward into the roof system assembly. Neutrons which encounter hydrogen atoms are slowed down; a portion of which "bounce back" to be counted by a detector within the scanning meter. Since water contains a significant amount of hydrogen atoms, areas of moisture within the roofing plies and/or insulation record higher levels of slowed neutrons. Gauge readings are inherently unitless and are resultant of a statistical function performed by the gauge based on emitted and measured reflected radiation and known properties of the element hydrogen.

Areas of isolated obstructions due to permanent mechanical appurtenances and drainage structures were not directly scanned; however, the immediately adjacent roof area was scanned, where applicable. Moisture readings were not obtained on roof top equipment, roof areas very close to wall edges and near equipment penetrations; scanning these areas can produce elevated readings compared to the typical roof readings due to hydrogen present within the additional layers of asphaltic materials or due to metallic flashing materials at walls and penetrations. However, the immediate adjacent areas were scanned, where applicable.

In order to calibrate unitless gauge readings to actual moisture content, core samples were obtained as part of the survey. A total of three investigative core samples were obtained during the performance of the moisture survey. The core locations were spread out throughout the roof. Core locations were selected after the nuke reading histogram was formed on the basis of moisture scan results, generally corresponding to areas of relatively low, mid and high readings as interpreted in the field. Coring of the roof system was performed and patched by others during the site visit.

*Gravimetric Laboratory Analysis of Roof Samples*

Laboratory testing was performed on the three test core samples obtained in the field from the noted roof areas. Core samples were weighed, oven dried, then reweighed to determine the approximate percentage of moisture by dry weight. The standard formula used to determine the percentage of moisture by dry weight is as follows:

$$\%\ Moisture\ by\ Dry\ Weight = \frac{Weight_{(wet)} - Weight_{(dry)}}{Weight_{(dry)}} \times 100\%$$

All samples were stored in individual, labeled and sealed plastic zipper storage bags immediately after extraction from the roof assembly. Once gathered, the field samples were transported to the Intertek laboratory and weighed to establish their wet weight. Samples were then chamber dried for a minimum of 24 hours. Each specimen was cooled to room temperature and its weight measured. The process was repeated, and this weight was recorded as the specimen's dry weight.

At the conclusion of the moisture survey and laboratory analysis of core samples obtained, the moisture content value for the roofs membrane and perlite cover board of each core sample was plotted on a linear graph versus the corresponding moisture scan reading. A best-fit linear regression curve and corresponding best-fit line slope equation were developed. The line slope equation describes average moisture percentage by dry weight as a function of the moisture scan readings. This function was compared to the histogram of gauge readings and statistical analysis as well as the visual survey of the cores in the field

**SURVEY RESULTS**

*Nuclear Roof Moisture Survey*

Based on the data obtained in the field, a normal distribution curve of the sampled readings was formed. Please refer to the attached documents for results. The mean and standard deviation of the sample set were calculated. As stated in TAS 126-95, Section 13.5.2: Statistically, 99.7% of the measurement counts for the dry areas of the roof will fall between one to three standard deviation limits with the different varying levels of moisture. This is further calibrated via the gravimetric analysis and roof core sample analysis performed.

The following observations were made during coring of the roof system:

| Core Location / Nuke Reading | Core Thickness | Observation |
|---|---|---|
| C6 / 6 | 9.5” | Roofing components dry |
| AC5 / 8 | 9” | Roofing components dry |
| R3 / 20 | 9” | Insulation and Securock boards moist |

It should be noted that the interpretation of the results is based on the combination of the statistical analysis, gravimetric analysis, and field conditions of the cores; and these factors are dependent on one another and should not be interpreted exclusively. Moisture migration throughout a roof system is possible due to thermal solar loading and live traffic loads on the roof system.

Based on the data obtained, statistical analysis, and visual observations of roof samples and our analysis, the results of the nuclear moisture scan are summarized as follows:

| *Roof Section* | *Approximate Roof Area* | *Suspect Moisture Roof Area* | *Wet Area* | *Total Area of Concern* |
|---|---|---|---|---|
| 1 | 6,100 SF | 75 SF | 175 SF | **250 SF (4.1%)** |

A representative roof grid (moisture map) showing the location of moisture gauge readings, and roof cores obtained is presented in the Appendix, along with the histograms depicting the frequency of gauge readings and the linear regression curve with the statistical analysis results. Photographs of the roof sections and cores are also appended to this report.

The Florida Building Code, Chapter 15, Section 1511.1.1, mandates that not more than 25% of a total roof area or roof section of any existing building or structure shall be repaired, replaced or recovered in any 12-month period unless the entire existing roofing system or roof section is replaced to conform to requirements of this code.

Any moisture within the roof system has the ability to impact wind uplift performance. Per The FBC 1521.12: “All existing lightweight insulating concrete, gypsum and cementitious wood fiber roof decks shall be tested in accordance with Section 1521.7 to confirm compliance with wind load requirements of Chapter 16 (High-Velocity Hurricane Zones).”

**LIMITATIONS**

The observations and results presented in this report are time dependent, and conditions may have changed since our site visit. This report speaks only as of the dates of our site visit. Many factors, including solar loading and foot traffic can cause any entrapped moisture to migrate/move throughout the roofing system. Any moisture trapped in between the modified membrane system and the lightweight insulating concrete may eventually find its way to the lower portions of the roof assembly and down to the structural concrete deck where the penetrations for drains are located. This survey should not be interpreted as a code/safety compliance survey or an as-built survey.

Nuclear moisture roof gauge scans generally have depth limitations of around 8-10" which could limit the accuracy of the scans at areas of extra material thickness. It should be noted that most of the cores obtained were within the above listed range.

Intertek was not required to provide intrusive services to investigate or detect the presence of mold or other biological contaminates in or around any structure. Intertek did not provide any services that were designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. Intertek was not required to inspect for mold. Client acknowledges that mold is ubiquitous to the environment with mold amplification occurring when the building materials are impacted by moisture. Client further acknowledges that site conditions are outside of Intertek's control and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, Intertek cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

**CLOSURE**

Intertek appreciates that opportunity to have been of service to you. If you have any questions regarding this report, or if we may be of further service, please feel free to contact this office at your convenience.

Respectfully submitted,
***Intertek***

Milan Nikolic
Senior Project Manager
Building Science Solutions

Craig Williams, R.R.C.
Principal Consultant
Building Science Solutions

Appendixes:

- Representative Photographs
- Moisture Survey Results - Sketches and Figures
- Gravimetric Analysis Results
- Overall Annotated Roof Aerial Map

**Photo 1:**Core location C6, nuke reading 6 – relatively dry.

**Photo 2:** Core location C6, nuke reading 6 – relatively dry.

**Photo 3:** Core location C6, nuke reading 6 – core thickness.

**Photo 4:** Core location C6, nuke reading 6 – polyiso insulation.

**Photo 5:** Core location AC5, nuke reading 8 – relatively dry roof components.

**Photo 6:** Core location AC5, nuke reading 8 – core thickness.

**Photo 7:** Core location R3, nuke reading 20 – cover board discoloration.

**Photo 8:** Core location R3, nuke reading 20 – polyiso insulation board.

**Photo 9:** Core location R3, nuke reading 20 – moist conditions at Securock cover board and polyiso insulation boards.

**Photo 10:** Core location R3, nuke reading 20 – core thickness.

# MOISTURE SCAN RESULTS

Location: Orlando Public Library
Address: 101 E. Central Blvd., Orlando FL
Date of Scan: 8/31/2022
Field Consultant(s): Shawn Wallace, Jason Salle

Roof Type: Low-slope modified bitumen BUR
Grid Type: 5-ft x 5-ft
Gauge Type: Troxler 3216
Roof Section: 1

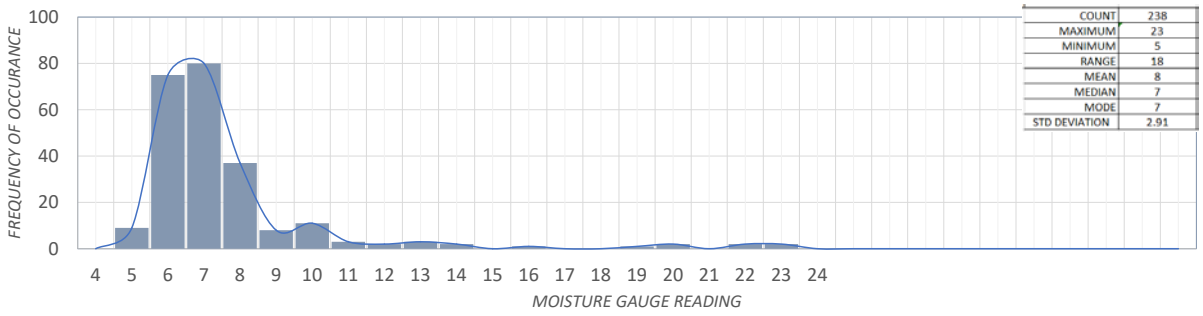
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| A | 8 | 6 | 6 | 7 | 6 | 7 | 6 | 7 |
| B | 8 | 6 | 6 | 6 | 7 | 6 | 7 | 6 |
| C | 7 | 8 | 6 | 7 | 7 | 6 | 5 | 8 |
| D | 6 | 6 | 7 | 6 | 6 | 7 | 6 | 6 |
| E | 6 | 6 | 7 | 6 | 8 | 6 | 5 | 6 |
| F | 6 | 7 | 8 | 8 | 7 | 7 | 6 | 7 |
| G | 8 | 7 | 8 | 20 | 10 | 7 | 6 | 7 |
| H | 7 | 7 | 8 | 14 | 13 | 8 | 7 | 6 |
| I | 10 | 10 | 11 | 9 | 7 | 7 | 7 | 7 |
| J | | | 9 | 8 | 7 | 8 | 7 | 7 |
| K | | | 10 | 9 | 6 | 6 | 5 | 6 |
| L | | | 13 | 7 | 7 | 5 | 5 | 6 |
| M | | | 23 | 10 | 8 | 6 | 6 | 7 |
| N | | | 23 | 14 | 8 | 6 | 6 | 6 |
| O | | | 19 | 22 | 13 | 7 | 7 | 6 |
| P | | | 12 | | 22 | 10 | 6 | 7 |
| Q | 11 | 9 | 10 | 11 | 10 | 10 | 6 | 6 |
| R | 12 | 20 | | 9 | 10 | 7 | 8 | 7 |
| S | 7 | 7 | | 8 | 8 | 7 | 7 | 7 |
| T | 7 | 7 | 6 | 5 | 6 | 16 | 7 | 7 |
| U | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 7 |
| V | 6 | 7 | 7 | 7 | 6 | 5 | 8 | 8 |
| W | 7 | 6 | 8 | 6 | 7 | 7 | 6 | 8 |
| X | 8 | 7 | 9 | 8 | 8 | 8 | 6 | 6 |
| Y | 6 | 7 | 7 | 9 | | 7 | 6 | 6 |
| Z | 6 | 6 | 7 | 8 | 7 | 8 | 7 | 6 |
| AA | 6 | 6 | 6 | 6 | 6 | 7 | 6 | 6 |
| AB | 6 | 7 | 6 | 7 | 6 | 8 | 7 | 7 |
| AC | 6 | 7 | 7 | 7 | 8 | 7 | 7 | 8 |
| AD | 7 | 6 | 7 | 7 | 7 | 7 | 8 | 8 |
| AE | 7 | 6 | 6 | 7 | 5 | 5 | 8 | 10 |
| AF | 9 | 6 | 7 | 6 | 6 | 7 | 6 | 8 |

**KEY:**

| | |
|---|---|
| | Not Scanned (Due to penthouse/material/drain/mechanical/etc.) |
| # | Core Location |
| | Suspect Wet Reading |
| | Dry Reading |
| | Wet Reading |

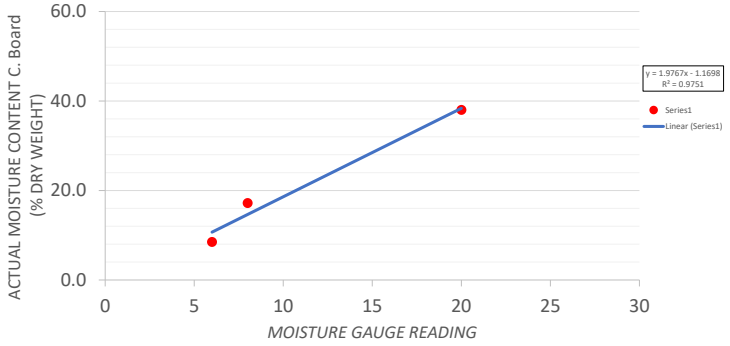
NUMBERS SHOWN REPRESENT GAUGE READINGS. INTERPRETATION OF MOISTURE CONTENT BASED ON STATISTICAL ANALYSIS AND OF GRAVIMETRIC ANALYSIS AND GAUGE READINGS.

**FIGURE 1**
MOISTURE READINGS HISTOGRAM
Roof Section 1




| | |
|---|---|
| COUNT | 238 |
| MAXIMUM | 23 |
| MINIMUM | 5 |
| RANGE | 18 |
| MEAN | 8 |
| MEDIAN | 7 |
| MODE | 7 |
| STD DEVIATION | 2.91 |

**FIGURE 2**
ACTUAL MOISTURE CONTENT VS. MOISTURE GAUGE READING
LINEAR REGRESSION CURVE
Roof Section 1



# ROOF CORE GRAVIMETRIC ANALYSIS RESULTS

**PSI Laboratory**

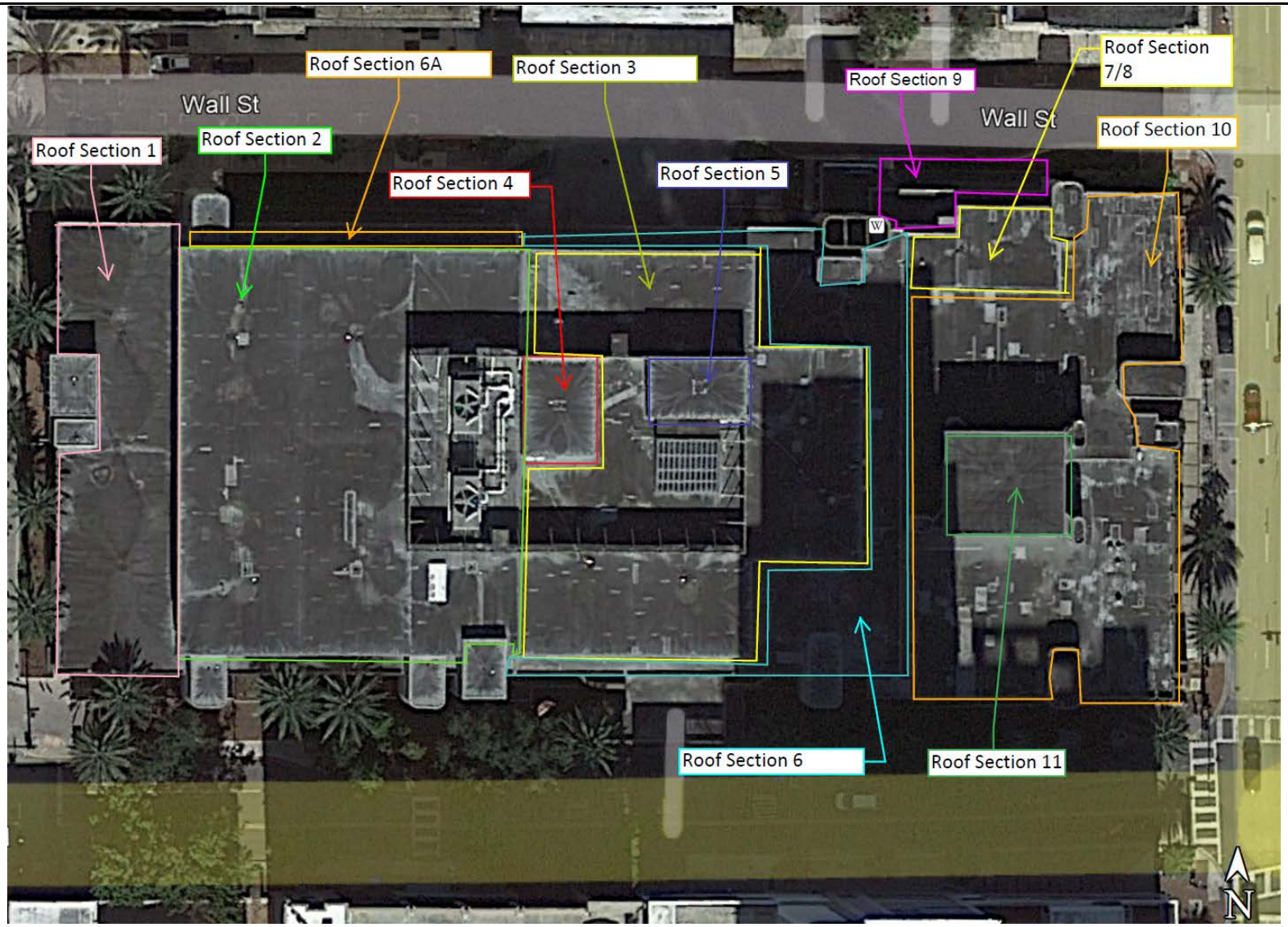
**1748 33rd St, Orlando, FL 32839**

| | | | |
|---|---|---|---|
| PSI Project No. | P0891.01 | TESTED BY | P50010082 |
| Project Name: | ORLANDO PUBLIC LIBRARY | DATE TEST | 9/2/2022 |
| Project Manager: | MILAN NIKOLIC | REF # | N0891.01 |

**SAMPLE CHARACTERISTICS:** Roof Section 1

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Membrane type: | Asphalt: | X | Single-ply: | | | | |
| Insulation type (check all that apply): | Foam board: | X | Cementitious Board: | X | LW Concrete: | X | |

| Sample Name | Layer Type | Tare Weight (g) | Tare + Sample (g) | Tare + Sample "Dried" (g) | Weight of Original Sample (g) | Weight of Dried Sample (g) | Weight of Moisture (g) | Percent Moisture by Dry Weight (Sample Layer) (g) |
|---|---|---|---|---|---|---|---|---|
| ROOF 1 LOC C6 LOW6 | ASPAHLT | 92.15 | 190.5 | 188.64 | 98.35 | 96.49 | 1.86 | 1.9% |
| | ISO Board | 239.26 | 374.56 | 367.43 | 135.3 | 128.17 | 7.13 | 5.6% |
| | C. BOARD | 418.46 | 716.08 | 692.77 | 297.62 | 274.31 | 23.31 | 8.5% |
| | EPS FOAM | 89.34 | 101.18 | 100.61 | 11.84 | 11.27 | 0.57 | 5.1% |
| | LWI CONC | 89.95 | 237.16 | 215.4 | 147.21 | 125.45 | 21.76 | 17.3% |
| ROOF 1 LOC AC5 MID8 | ASPHALT | 353.69 | 662.35 | 661.28 | 308.66 | 307.59 | 1.07 | 0.3% |
| | C. BOARD | 89.33 | 247.77 | 224.51 | 158.44 | 135.18 | 23.26 | 17.2% |
| | ISO BOARD | 89.86 | 123.37 | 122.09 | 33.51 | 32.23 | 1.28 | 4.0% |
| | LWI CONC | 7.38 | 47.79 | 45.81 | 40.41 | 38.43 | 1.98 | 5.2% |
| | EPS FOAM | 226.59 | 244.23 | 243.3 | 17.64 | 16.71 | 0.93 | 5.6% |
| ROOF 1 LOC R2 HIGH20 | ASPHALT | 524.18 | 807.01 | 795.92 | 282.83 | 271.74 | 11.09 | 4.1% |
| | C. BOARD | 7.39 | 227.34 | 166.73 | 219.95 | 159.34 | 60.61 | 38.0% |
| | ISO BOARD | 524.3 | 968.77 | 697.59 | 444.47 | 173.29 | 271.18 | 156.5% |
| | LWI CONC | 185.29 | 474.55 | 441.17 | 289.26 | 255.88 | 33.38 | 13.0% |
| | EPS FOAM | 203.47 | 216.56 | 216.05 | 13.09 | 12.58 | 0.51 | 4.1% |




Overall Annotated Roof Aerial Map
Orlando Public Library
Orlando, FL

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