VILLANOVA UNIVERSITY
COLLEGE OF ENGINEERING

VILLANOVA URBAN
STORMWATER PARTNERSHIP

# An Integrated Vegetated Roof People Hub

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Second Annual All Partners Meeting of the Delaware River Urban Waters Federal Partnership
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# Project Overview

- Design, construct and monitor small-scale green roofs to manage frequently occurring rainfall events

- "…Creates **living laboratory** space used for **community education**, **stormwater performance research**, and **product development** by companies creating green technology."

Buffalo, NY

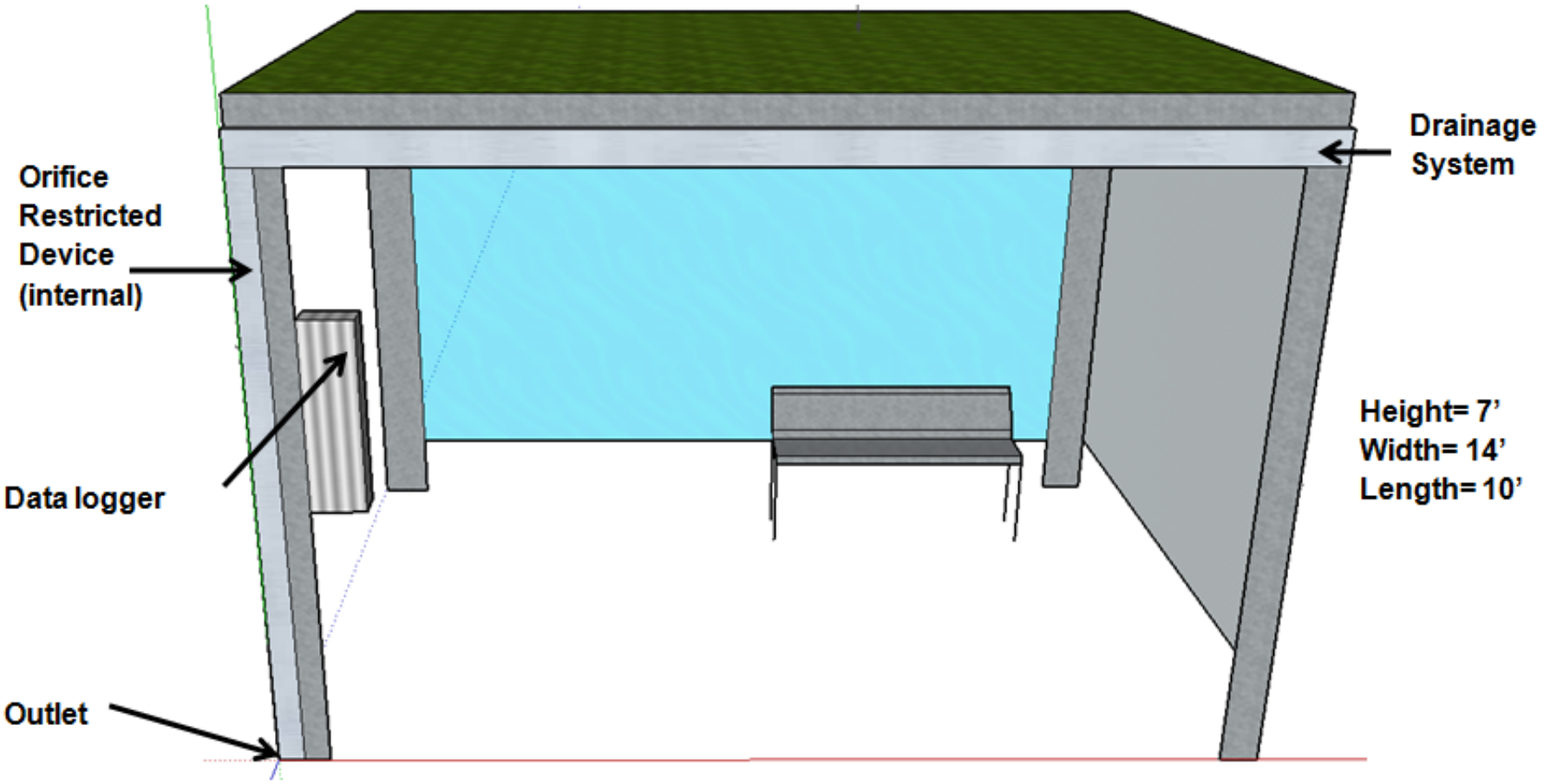
Philadelphia, PA

# Project Overview

- 2 locations (vegetated roof area ~ 100-200 $ft^2$)
  - Upper Darby High School -> Bus shelter
  - Villanova University -> Picnic pavilion
- Construction: April 2015-June 2015
- Project Partners
  - Villanova University Facilities Management Office
    - Structural Engineering, Mechanical Engineering, Electrical Engineering, Parking and Transportation
    - Administration and Staff
  - Weston Solutions, Inc.
  - Eastern Delaware County Stormwater Cooperative -> Upper Darby Township
  - Upper Darby High School

# Living Laboratory

Total Module Surface Area = 140 ft$^2$
48 2'x2' GreenGrid modules

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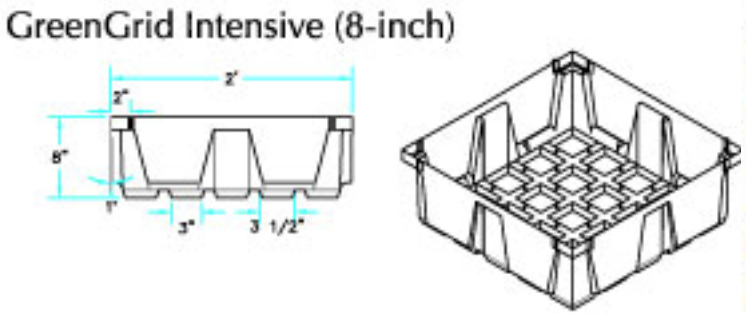
# Living Laboratory

Dugouts USA –
Steve Taylor

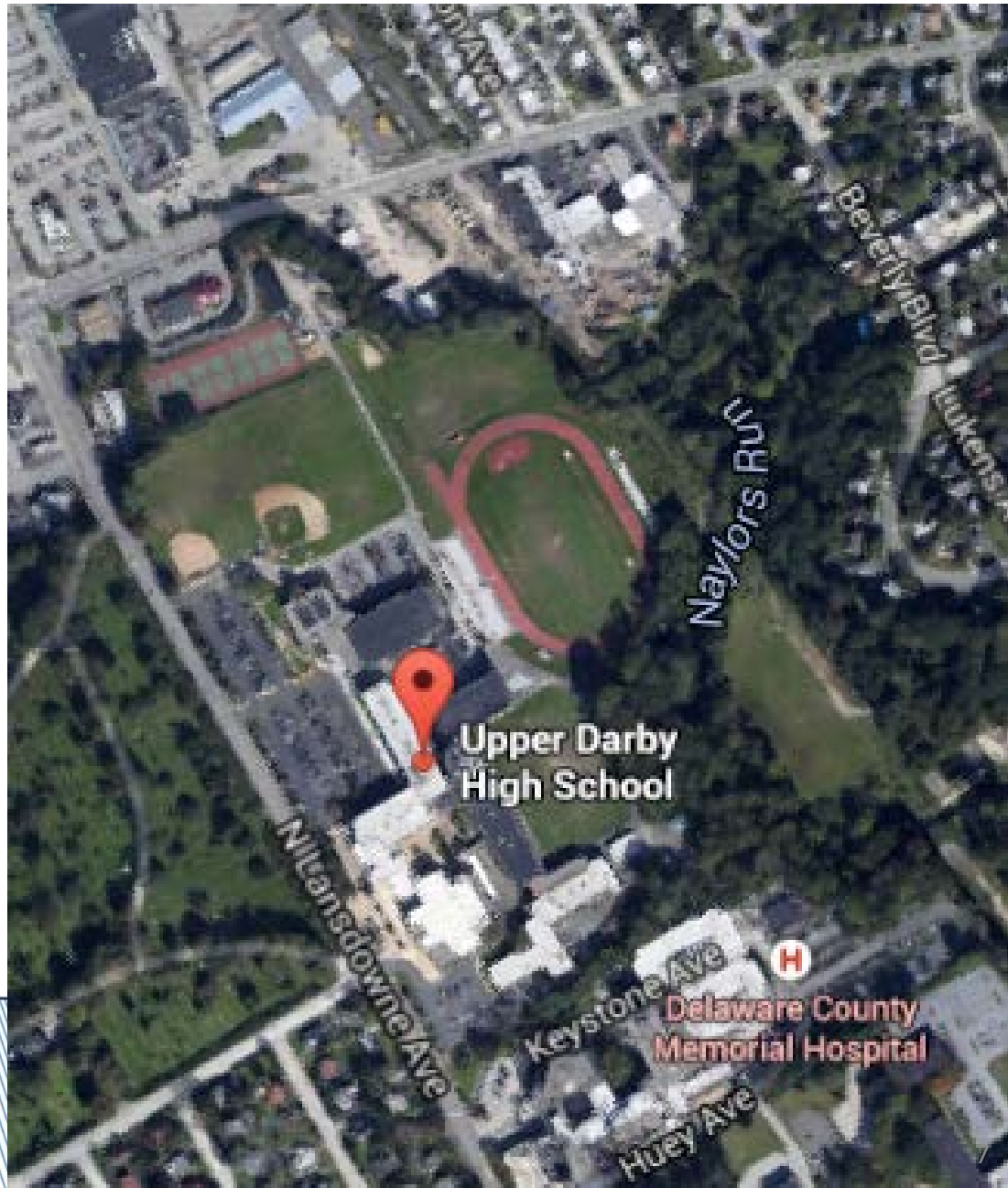



# Living Laboratory: Villanova

- ~10 miles outside of Philadelphia
- Suburban campus?
  - >50% impervious area
  - Building covenants on 2/3 of campus area, so restricted land space

# Living Laboratory: Upper Darby High School (UDHS)

- On border of Philadelphia
- Watershed ~45% impervious area
- Naylor's Run through campus



# Stormwater Performance Research

**Monitoring Equipment**

- Weather Station
  - Precipitation
  - Air temperature
  - Relative humidity
  - Wind speed
  - Solar radiation
- Data logger
  - Low cost options
  - Collaborate with Villanova Mechanical Engineering
- Rain Gage
- Outflow Measurement
  - Campbell Scientific CS450 submersible pressure transducer
  - ***Custom built Orifice Restricted Device (ORD)***

**Collaboration with Weston Solutions, Inc.**

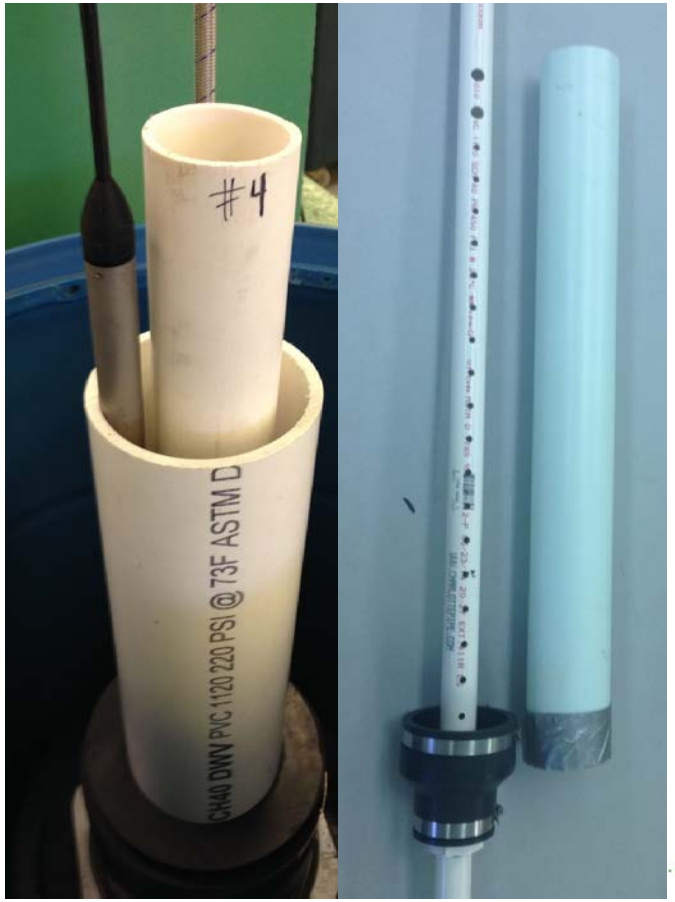
- Plant type
  - Sedums vs grasses
  - Potentially work with UDHS Horticultural Department
- Soil media (depth and type)

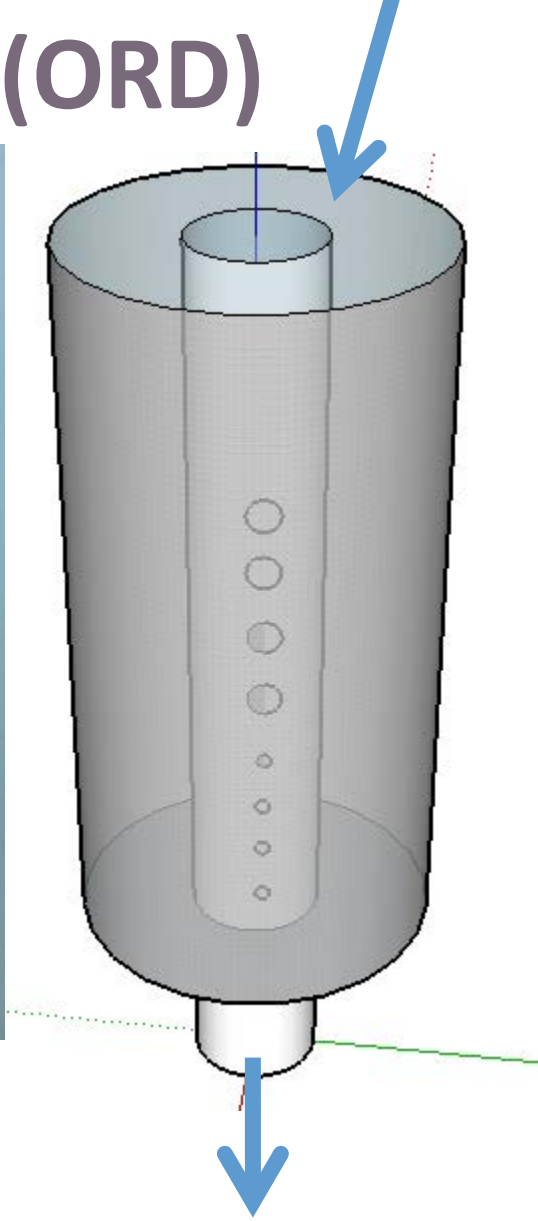
**Solar panel effects and/or shade effects**

- Need to find project partner
- Collaborate with:
  - Villanova Electrical Engineering
  - Villanova Sustainability Manager

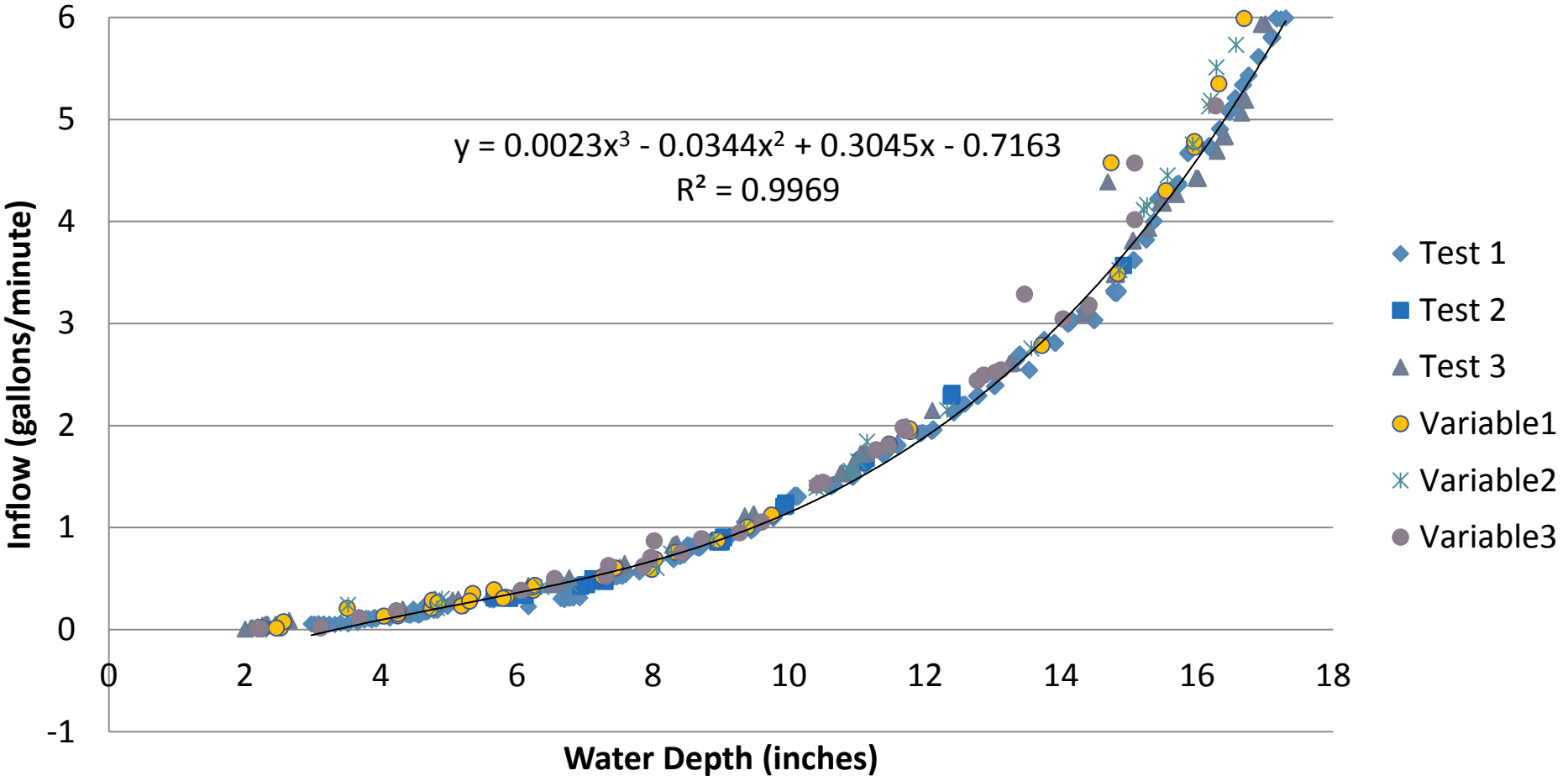
# Orifice Restricted Device (ORD)

- Implemented successfully at University of Auckland living roof
  - Voyde et al. (2010)
- Custom designed and calibrated to measurement range of flows (0.06 – 6.3 gpm)
- Pressure transducer records water depth inside the ORD to yield flow rates



# ORD Calibration



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