



# *NDCEE*

National Defense Center for Energy and Environment

## Demonstration of Vegetative Roofing at Army Installations

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**DoD Executive Agent**

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# Report Documentation Page

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# Presentation Highlights

- What is Vegetative Roofing?
- Demonstration approach?
- What are demonstration findings to date?

# Vegetative Roof



Viking Village



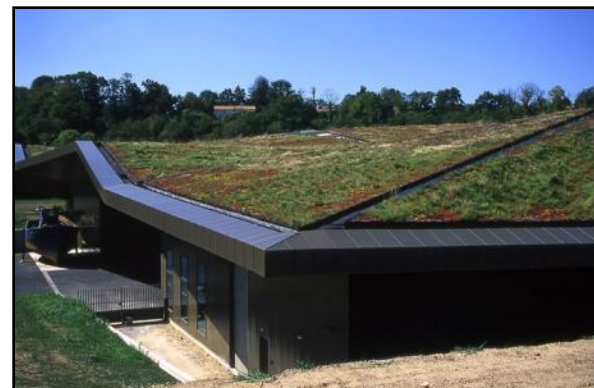
Faroe Islands



New York



Chicago City Hall



Museum in France

# Background

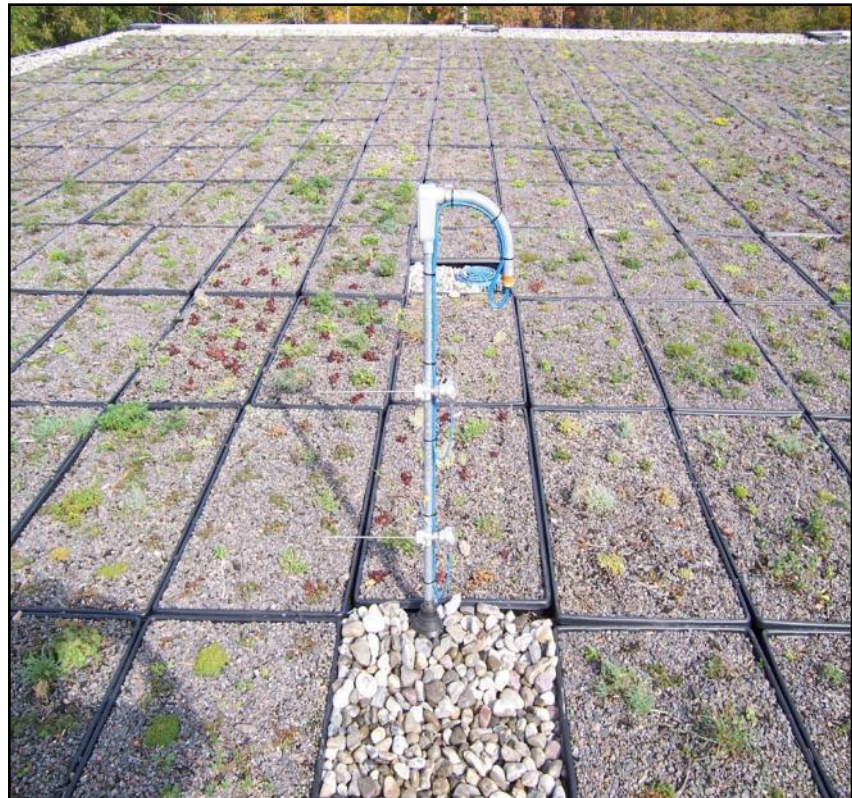
- Objective: Demonstrate and validate vegetative roof technology at Tobyhanna Army Depot
- Department of Army Green Building Requirements
  - FY08 LEED Silver Standard
- DoD Trends
  - Energy efficiency
  - Green building
- Green Roof
  - Sustainable technology
  - Enhance visual character
- Installation Challenges
  - Stormwater runoff
  - Energy efficiency





# Technical Approach

- Monitoring System
  - Thermocouples
    - Energy Consumption
    - Temperature Differential
  - Vertical Flow Meters
    - Runoff Quantity
  - Grab Samples
    - Runoff Quality



Thermocouple Array

## Technical Approach (cont'd)

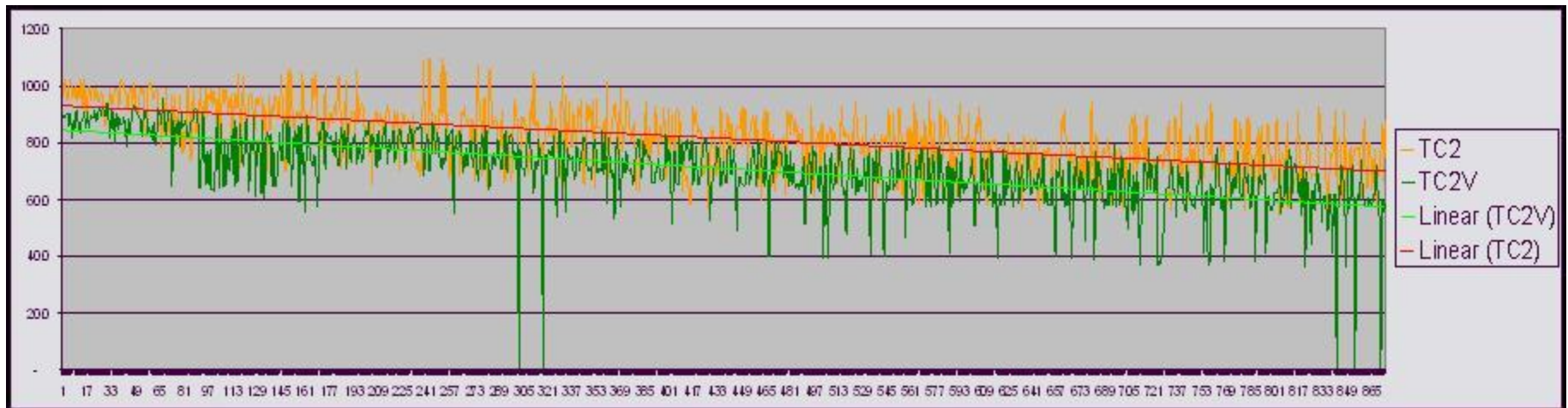
- Modular System
  - Easy maintenance
  - Adaptable (e.g., equipment installation)
  - 14,007 ft<sup>2</sup>
- Net Increase of 4 lbs/ft<sup>2</sup>
  - Rock Ballast removed- 8 lbs/ ft<sup>2</sup>
  - Roof Modules- 12 lbs/ft<sup>2</sup> fully saturated
- 64 Species of Plants
  - Mostly Sedum
  - Some Alpine Species



Sedum rubrotinctum

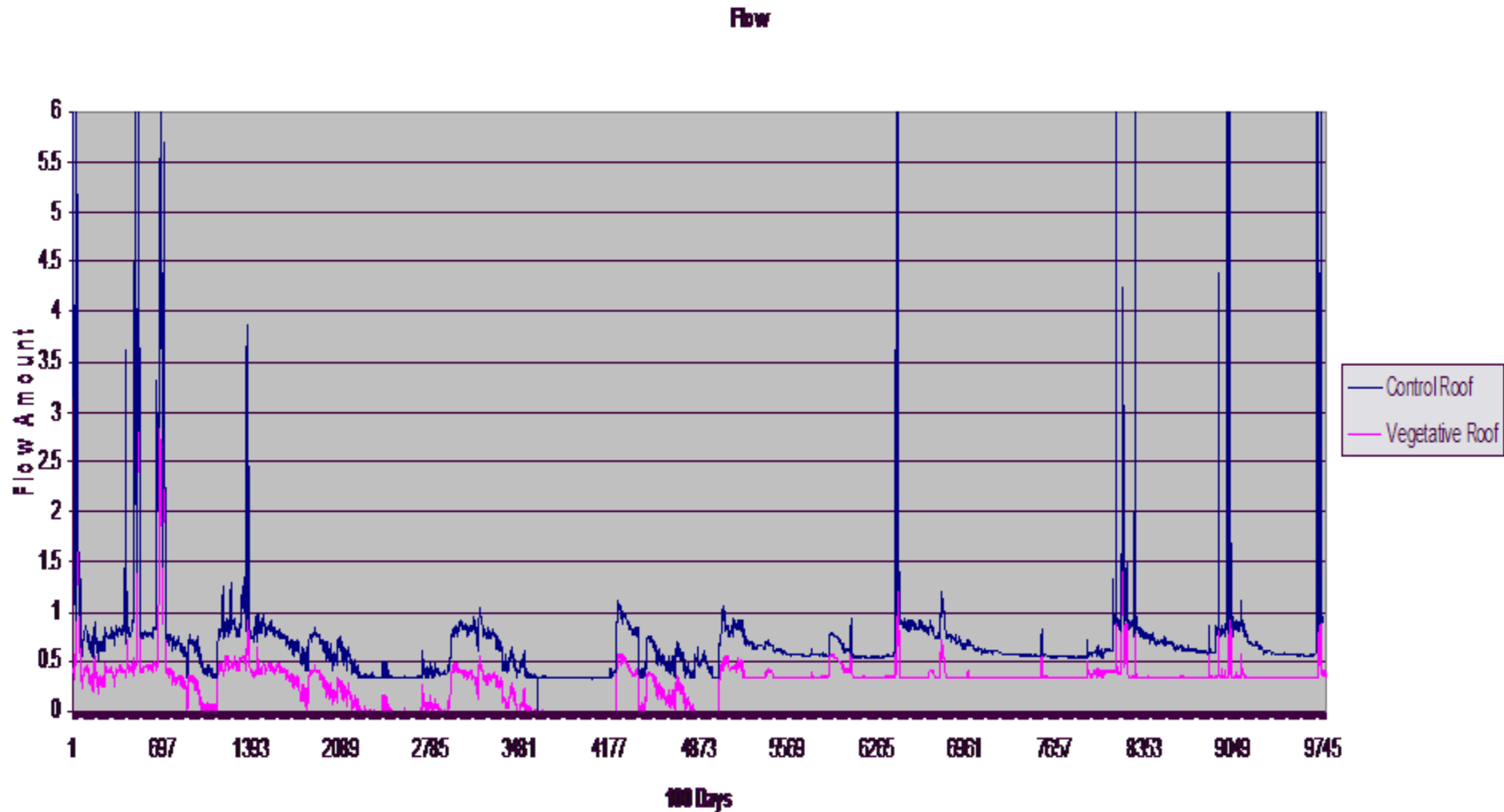
# Energy Results

- Urban Heat Island Effect
  - Average 10°F cooler (ambient temperature above 50°F)
  - Average 2°F warmer (ambient temperature below 50°F)
- Energy Savings
  - Projected 40% energy savings based on tons of air conditioning saved





# Water Quantity Results



- 10% Reduction in Flow
- 6500 Gallon Reduction

# Water Quality Results

- Components Sampled
  - Nitrogen, Phosphates, TOC, TDS and pH
- Vegetative Roof
  - Decrease in quality
  - Due to initial fertilizer use
  - Increase in quality over time
  - With organic fertilizer



Vertical Flow Meter

# Plant Growth August 2006





# Plant Growth April 2007





# Plant Growth May 2007





# Plant Growth July 2007





# Plant Growth August 2007



# Contact Information

## NDCEE Technical Monitor

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