NEW JERSEY STATE TRANSPORTATION INNOVATION COUNCIL

www.NJDOTtechtransfer.net/NJ-STIC

2nd Quarter Meeting
June 14, 2023

WELCOME

Michael Russo

Assistant Commissioner

NJDOT Planning, Multimodal & Grant Administration

WELCOME

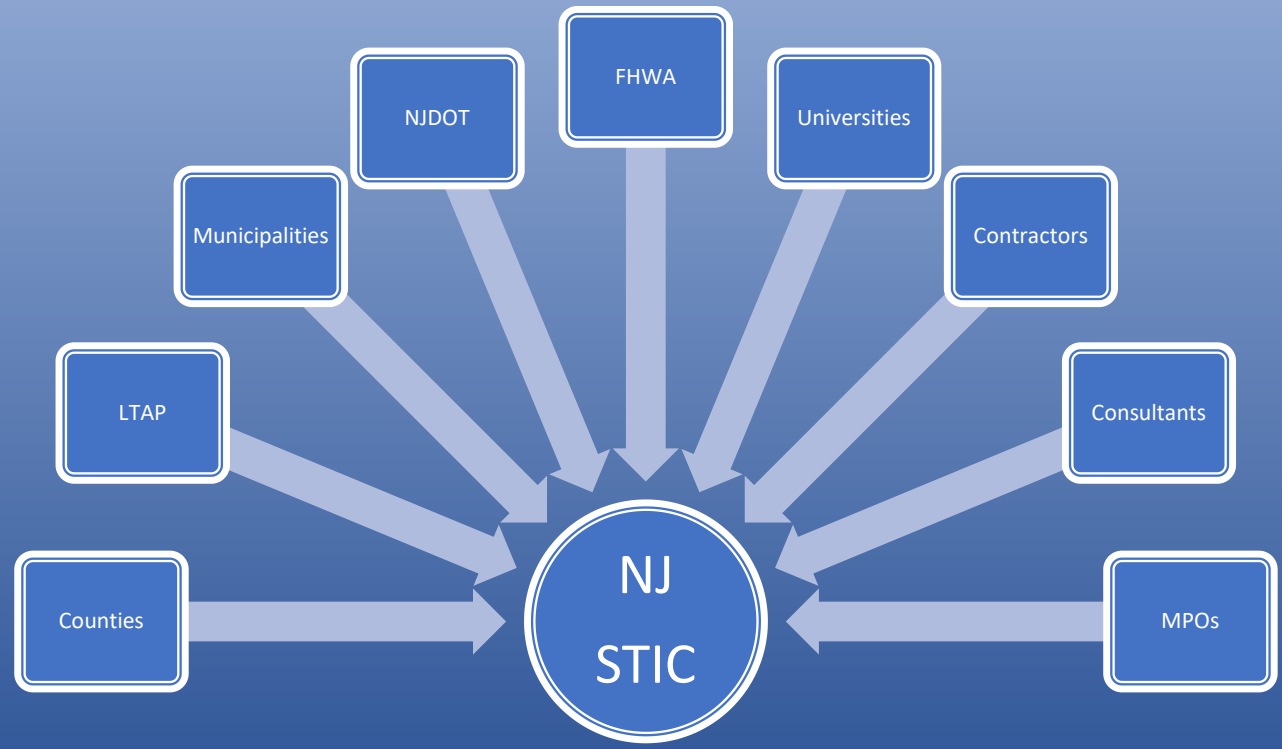
ATTENDEES & SPECIAL GUESTS

NJDOT Sustainability Initiatives

Kimberly Sharp, *Supervising Engineer*
NJDOT Bureau of Geotechnical Engineering

Robert Blight, *Executive Manager*
NJDOT Bureau of Pavement & Drainage
Management and Technology

Mansi Shah, *Research Project Manager*
Kamal Patel, *Research Project Manager*
NJDOT Bureau of Research



Mobility &
Operations

Vandana Mathur

FHWA UPDATES

Christopher Paige

Innovation Coordinator & Community Planner

FHWA, NJ Division Office

CIA TEAM

SAFETY

NJDOT – Dan LiSanti

FHWA – Amy Kaminski

CIA TEAM

PLANNING & ENVIRONMENT

NJDOT – Andy Swords

FHWA – Sutapa Bandyopadhyay

CIA TEAM

INFRASTRUCTURE PRESERVATION

NJDOT – Shivani Patel

FHWA – Nunzio Merla

CIA TEAM

MOBILITY & OPERATIONS

NJDOT – Vandana Mathur

FHWA – Ek Phomsavath

CIA TEAM

ORGANIZATIONAL SUPPORT & IMPROVEMENT

NJDOT – Kristal Walker

FHWA – Christopher Paige

CIA TEAM

SAFETY

NJDOT – Dan LiSanti

FHWA – Amy Kaminski

Task	Status
Literature review of relationship between lighting and safety of vulnerable road users	Initial scan complete
Literature review summarizing best practice in design guidance for pedestrian-scale lighting	Current task (ongoing)
Lighting guide highlighting best practices in the types of lighting, luminaire placement, and ways to reduce fatalities and serious injuries	Upcoming

LIFE-SAVING LIGHTING RESEARCH & GUIDE

Rutgers Edward J. Bloustein School of Planning and Public Policy

Rowan University

NIGHTTIME VISIBILITY FOR SAFETY

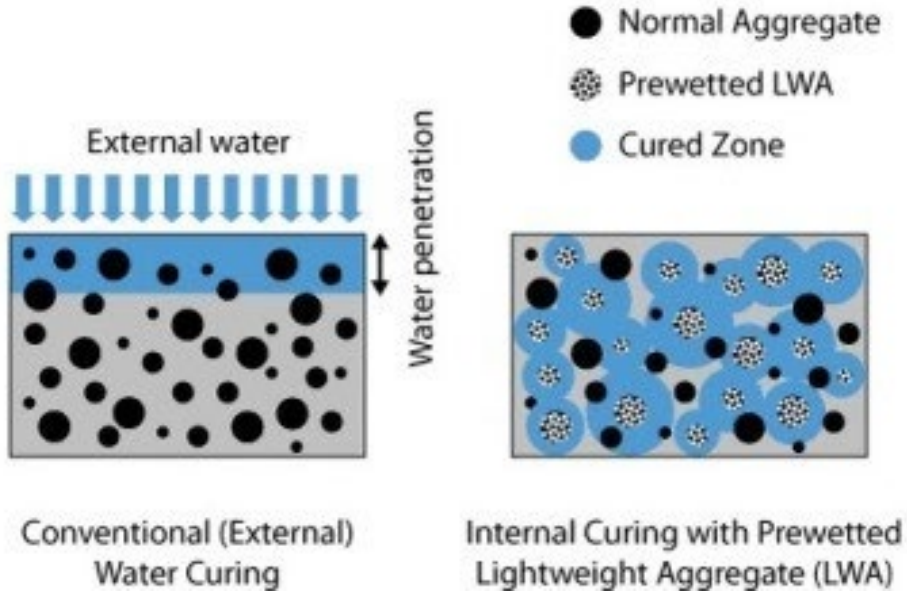
- Developing Traffic Signal Pole and Mast Arm Details for signalized intersection installations
- Backplates with Retroreflective Tape on Signal Indications

CIA TEAM

INFRASTRUCTURE PRESERVATION

NJDOT – Shivani Patel

FHWA – Nunzio Merla



EDC-7

Enhancing Performance with Internally Cured Concrete (EPIC^2)

Purpose:

To implement the use of internally cured concrete to reduce shrinkage cracking and achieve long-term performance in concrete bridges, roads and repairs.

Benefits:

- Improved structural longevity
- Compatible with current concrete practice
- Economical solution
- Reduction in curing time
- Reduced embodied carbon

Status:

- Team assembled (NJDOT and FHWA)
- Submitted Baseline Report
- Held meeting to discuss responsibilities
- Working on implementation plan activities

EDC-7

Environmental Product Declarations (EPDs) for Sustainable Project Delivery

Purpose:

To identify and understand the environmental impacts from resource use, energy, and emissions in construction and consider alternatives using third party verified reports.

Benefits:

- Sustainable procurement
- Sustainable design
- Guided decision-making

Status:

- Change in Core Innovation Area
- Submitted Baseline Report
- In the process of developing a team

CIA TEAM

ORGANIZATIONAL SUPPORT & IMPROVEMENT

NJDOT – Kristal Walker

FHWA – Chris Paige

EDC-7 Initiative Statement

The demand for highway workers is growing, and emerging technologies require new skills.

*This innovation helps stakeholders improve their ability to **identify, train, and place** highway construction workers.*

The focus will expand to rural and Tribal communities to increase career opportunities.

Implementation Plans

Development Stage

Meeting with the Unions and Vocational schools	Vicki Tilghman-Ansley meeting with the Unions
Finalizing program proposals and appointing Program Coordinator	Vicki Tilghman-Ansley meeting with the Unions
Exploring resource opportunities through the Department of Labor and established programs/grants	Title 23, section 504e Federal- Aid Program for Workforce Development, Training, and Education
Developing a Strategic Action Plan for short- and long-term activities Identifying roles and responsibilities to keep track of the initiative	
Identifying solutions for workforce recruitment and retention	

CIA TEAM

MOBILITY & OPERATIONS

NJDOT – Vandana Mathur

FHWA – Ek Phomsavath

Next-Generation TIM (NextGen TIM): Technology for Savings Lives

- Continue to evaluate the effectiveness of TIM technologies:
  - Using LED flares at incident scenes
  - Light towers on Incident Management Response Trucks (IMRT) for scene lighting
  - Real-time stopped queue and slowdown notifications to commercial truck drivers (Drivewyze)
- Assessment Stage:
  - Incorporate activities into the ITS/Traffic Operations work programs.
  - Review responses collected from the TIM QR Code (SurveyMonkey) survey.
  - Provide the drivers with real-time slowdown and congestion alerts.
  - “No Trucks in Left Lane” alerts to avoid traffic congestion.




CIA TEAM

PLANNING & ENVIRONMENT

NJDOT – Andy Swords

FHWA – Sutapa Bandyopadhyay

CORE INNOVATION AREA UPDATE
PLANNING & ENVIRONMENT

JUNE 14, 2023

Sudhir Joshi – NJDOT

Presentation Prepared by Sushant A. Darji

Speakers' Topics

- **Update on Every Day Count (EDC) -7 Baseline Report**
  i. Baseline Questions
  ii. Innovation Implementation Team Members
  iii. State Innovation Goal
  iv. Obstacles
  v. Implementation Plan Activities

- **Update on Carbon Reduction Program**
  i. Background
  ii. NJDOT Approach to Carbon Reduction Strategy
  iii. Sample Projects Types
  iv. Key Milestones
  v. Current Status

Baseline Questions

- April 2023 Baseline: What stage of implementation is the State currently at?
  - Development Stage

- Current state of practice to support the development stage –
  - Analyzing the air quality benefits of projects and programs through the Congestion Mitigation and Air Quality Improvement (CMAQ) program and expect to leverage this experience during the demonstration stage in developing the capability to analyze GHG reduction benefits.
  - NJDOT and its partners will benefit from the work on the carbon reduction strategy.

- What is the State goal in two years? - Demonstration Stage

Update on EDC-7 Baseline Report

- Proposed activities the State and their partners intends to perform to attain their goal –

  - Development of a carbon reduction strategy
  - NJDOT intends to support eligible projects and programs while also considering cost effectiveness in this strategy. Provide analytical support to the National Electric Vehicle Infrastructure (NEVI) program.
  - Consider the use of drone technology for bridge inspection and traffic congestion analysis.
  - Both applications have the potential to reduce traffic congestion and greenhouse gas emissions.
  - Our transportation partners want to have a better idea of the scale of carbon reduction benefits and use this information in modeling and for decision-making.
  - The second goal is to reduce VMT and improve vehicle performance through electrification and sustainable energy.
  - Third, we consider Green House Gas (GHG) reduction policy holistically, including planning, target setting, and funding to educate, deliver programs, and assess outcomes, as well as funding to prioritize programs.

Update on EDC-7 Baseline Report

- Can the Innovation Deployment Team provide assistance to help the State and their partners reach its goal within two years?
  - Training
  - Technical Support on specific projects/issues
  - Workshops or Peer Exchanges
  - Case Studies

Update on EDC-7 Baseline Report

- **Innovation Implementation Team Members** - NJDOT: Andrew Swords and Sushant A. Darji and from FHWA: Sutapa Bandyopadhyay

- **State Innovation Goal (Benefit Goal):** Currently, transportation accounts for 42% of GHG emissions in the state and 29% of GHG emissions nationally.

- **Obstacles:** State DOT is facing difficulty generalizing the effect of projects to the entire transportation sector and needs to develop a process for understanding the GHG impacts of construction.

- **Implementation Plan Activities:** Development of Carbon Reduction Strategy and NEVI Program Support

Update on Carbon Reduction Program

Background

- The Bipartisan Infrastructure Law establishes the Carbon Reduction Program (CRP), which provides funds for the projects designed to reduce transportation emissions, defined as carbon dioxide (CO2) emissions from on-road highway sources
- Funds apportioned to each state
- Eligible project types
- Coordination and consultation
- Completion of State Carbon Reduction Strategy by November 15, 2023

NJDOT Approach to Carbon Reduction Strategy

- **Purpose:** Identify projects and strategies that will contribute to helping New Jersey reduce its transportation-related emissions and serve as a basis for the state's decision-making on the use of CRP funds.

- **Consultation with other Agencies:** Conducted a survey involving multiple agencies to determine the types of projects being pursued by the state, establish a strategy that considers present plans without excluding future plans, and develop a strategy that may serve as a resource for other agencies.

Sample Project Types

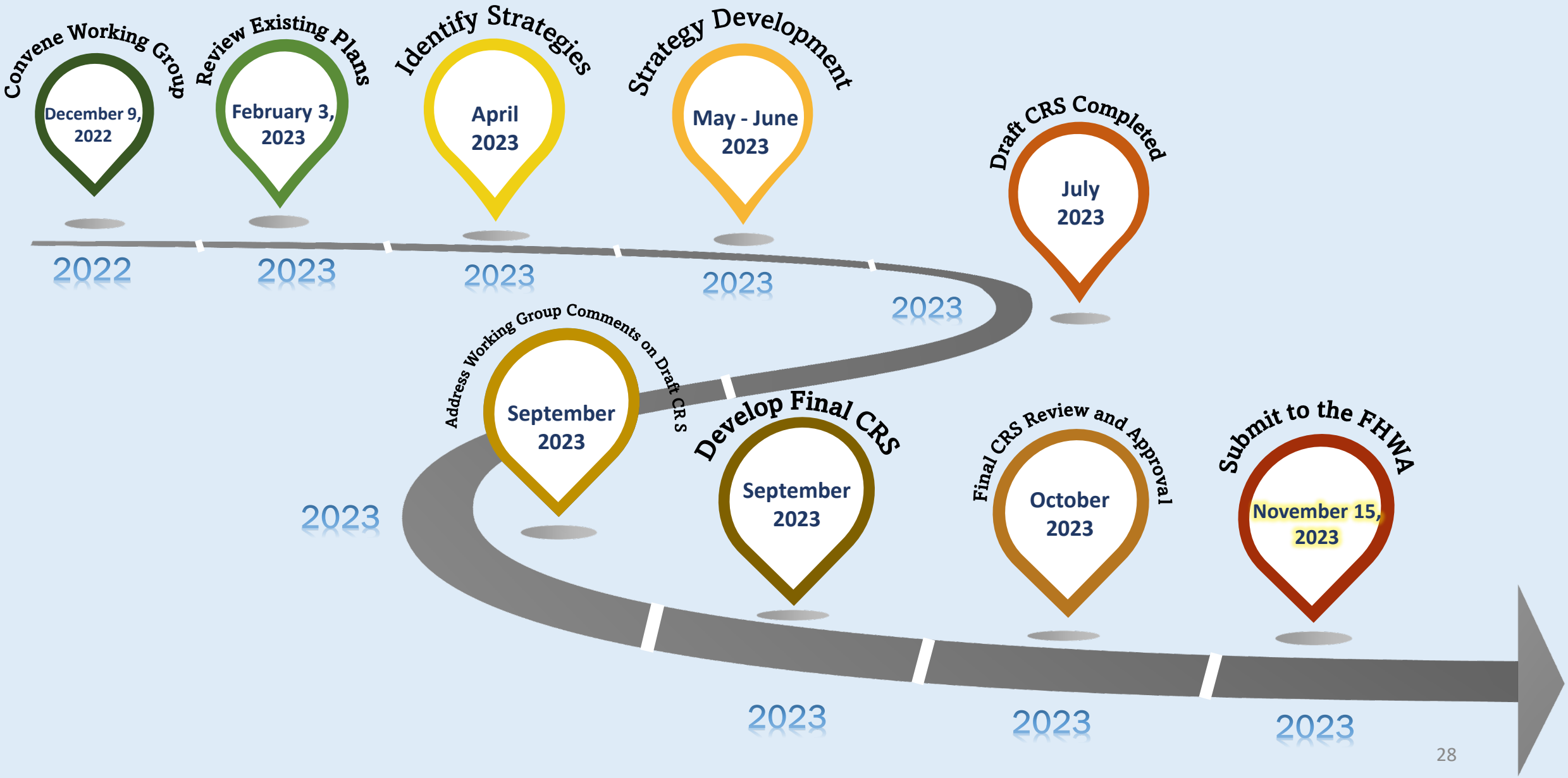
➢ Projects Types:

- ✓ Replace medium duty trucks
- ✓ Replace diesel offroad equipment
- ✓ New active transportation facility
- ✓ Expanded Transit Bus Service
- ✓ Signal synchronization along corridor
- ✓ Construction methods
- ✓ Replace Lighting with LED
- ✓ Install public EV charging stations
- ✓ Replace diesel buses
- ✓ New Vanpool Service
- ✓ Expanded Light Rail Service
- ✓ Projects to relieve highway congestion
- ✓ Innovative technologies
- ✓ Replace heavy duty trucks

➢ Project Example: Sustainable construction materials like Glass Foam Aggregate

- ✓ 50% less CO_2 than other lightweight aggregates
- ✓ 1 Truck of FGA ≈ 7 Trucks Of Regular Backfill Trucks Off the Road
- ✓ NJDOT Construction has used ~ 35,000 Cubic Yard of FGA, which equates to over 30 million bottles not placed in landfills
- ✓ NJDOT has projects in design soon to go into construction that will use over 50 million bottles

Milestones: Carbon Reduction Strategy



Current Status

- Currently, we are establishing the strategies by soliciting feedback from all other agencies and analyzing the approaches developed by other states to develop strategies for their states.

Thank you for your Participation.

Feature Presentation

NJDOT Sustainability Initiatives

Kimberly Sharp

Bureau of Geotechnical Engineering

Foam Glass Aggregate (FGA)

made from **100% RECYCLED** container glass

What Makes FGA Innovative

- Cost-effective engineering solution that is environmentally friendly
- Reduces landfill waste by repurposing glass into an innovative engineering material
- Alleviates the burden on waste management infrastructure and promotes a more sustainable approach to waste handling.
- Less energy to make and generates fewer carbon emissions compared to other materials.

Benefits of FGA

- Extremely Lightweight
  - 85-90% lighter than quarried aggregates
  - 55-60% lighter than lightweight aggregates
- Excellent Engineering Properties
  - Highly frictional
- Exceptional Insulating Properties
- Environmental Properties
  - Non-leaching, rot-resistant, non-flammable and durable
- Manufactured From 100% Recycled Glass

Crushed glass from recycling plant and after washing

Manufacturing

- The manufacturing process takes recycled glass powder and mixes it with a foaming agent, where it is then sent through a kiln and softened.
- During this process, bubbles are created within the softened glass due to the foaming agent creating foamed glass aggregates.

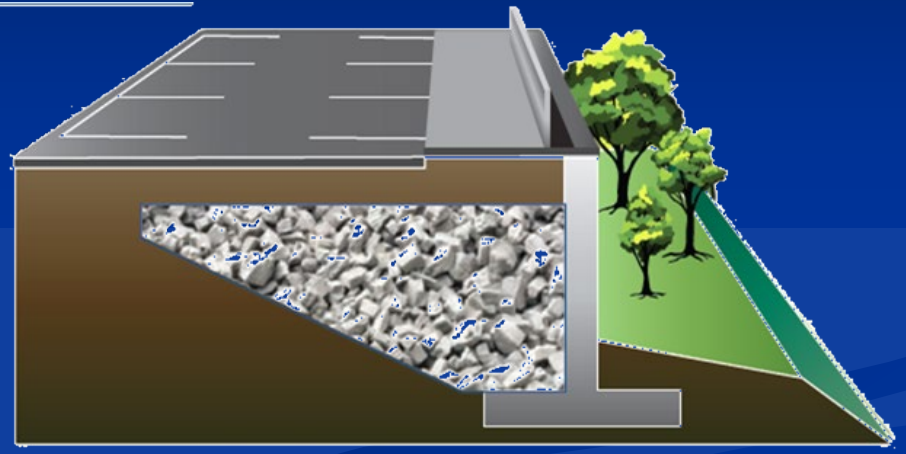
Manufacturing

- After the Foam Glass Aggregate cools, it cracks and forms the aggregate pieces seen here coming off the conveyor belt.

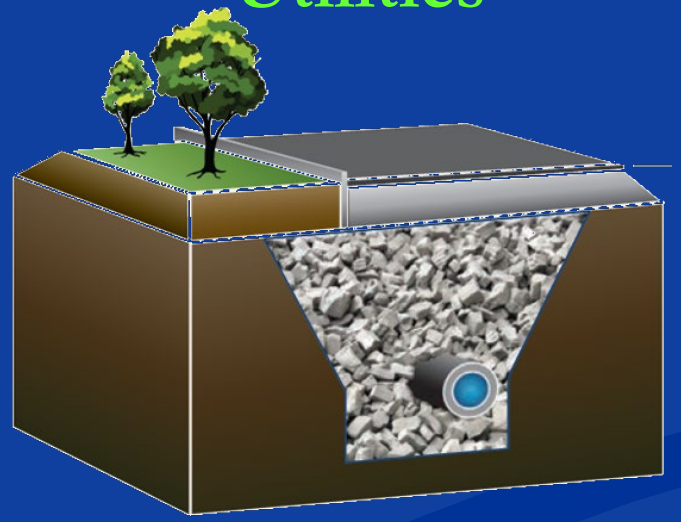
Transportation Applications

Embankments

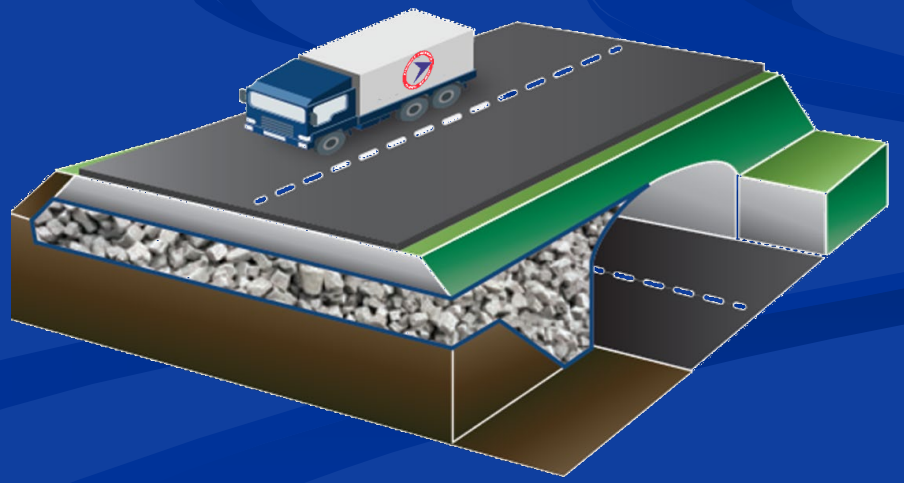
Retaining Walls & Abutments



Utilities



Tunnels & Culverts



Route 7 Wittpenn Roadway Installation

Route 7 Wittpenn Bridge
Kearny, NJ

Behind Abutment on I-80 over Rockway River
Denville, NJ

Behind Wire Wall On Fish House Road Kearny

NJDOT Projects

- Route 7 Wittpenn Bridge

  32,000 cy **27.6 Million Bottles**

- I-80 over Rockaway River

  2,147 cy **1.9 Million Bottles**

- Route 1&9 New Road, Contract 1

  873 cy **0.8 Million Bottles**

- Route 322 Mullica Hill

  24 cy **21,000 Bottles**

NJDOT Projects

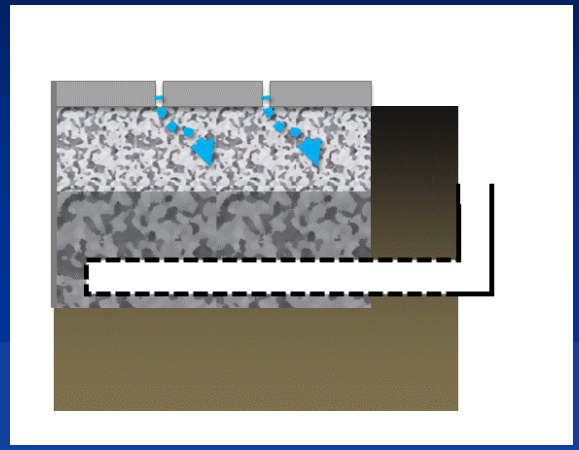
- Route 40 & 322 Atlantic City
  35,000 cy **30 Million Bottles**
- Route 47 Widening
  8,000 cy **7 Million Bottles**
- Route 29 Cass Street Drainage
  6,375 cy **5.5 Million Bottles**
- Fish House Road Kearny
  12,904 cy **11 Million Bottles**

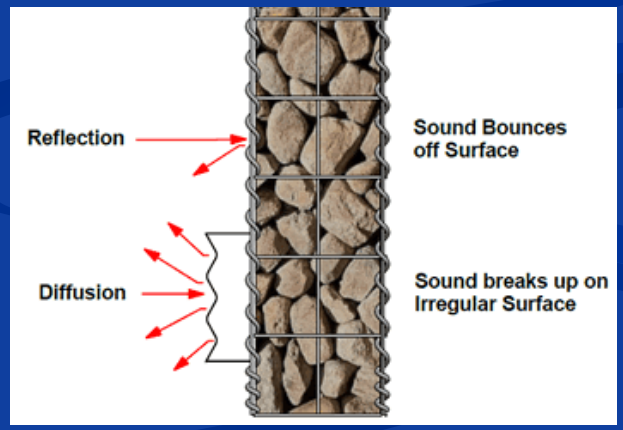
Resiliency

- Production Emission and Energy
  - 50% less CO_2 than other lightweight aggregates
- Transportation Emission and Congestion
  - 1 Truck of FGA ≈ 7 Trucks Of Regular Backfill Trucks Off the Road
  - Locally Recycled and Manufactured Material
- Material Reduction
  - Less Weight → Smaller Walls → Less Materials (i.e., Concrete, Steel) → Less Emissions

Future Applications

- Flood Mitigation
  - Underground Reservoirs
- Noise Reduction
  - Noise Walls
- MSE Walls
  - FGA Backfill
- Rehabilitation Projects
  - Abutment and Wall Reconstruction





Questions?

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Feature Presentation

NJDOT Sustainability Initiatives

Robert Blight

Bureau of Pavement & Drainage
Management and Technology

NJDOT INITIATIVES FOR SUSTAINABILITY IN PAVEMENTS

NJ STIC 2nd Quarterly Meeting

June 14, 2023

ACKNOWLEDGEMENTS

- Thomas Bennert, Ph.D.
  Research Professor
  Center for Advanced Infrastructure and Transportation – Rutgers University
- Prashant Ram, P.E.
  Pavement Engineer
  Applied Pavement Technology, Inc.
- Greg Duncan, P.E.
  Senior Engineer
  Applied Pavement Technology, Inc.

OVERVIEW

- Sustainability in Pavements
- Recycled Scrap Rubber Tires
- Recycling Reclaimed Asphalt Pavement (RAP)
- Recycled Plastic Waste
- Summary

SUSTAINABILITY

SUSTAINABLE PAVEMENTS DEFINED

- Achieve the engineering goals.
- Preserve and (ideally) restore surrounding ecosystems.
- Use financial, human, and environmental resources wisely.
- Meet basic human needs such as health, safety, equity, employment, comfort, and happiness.

OPPORTUNITIES FOR IMPROVING SUSTAINABILITY

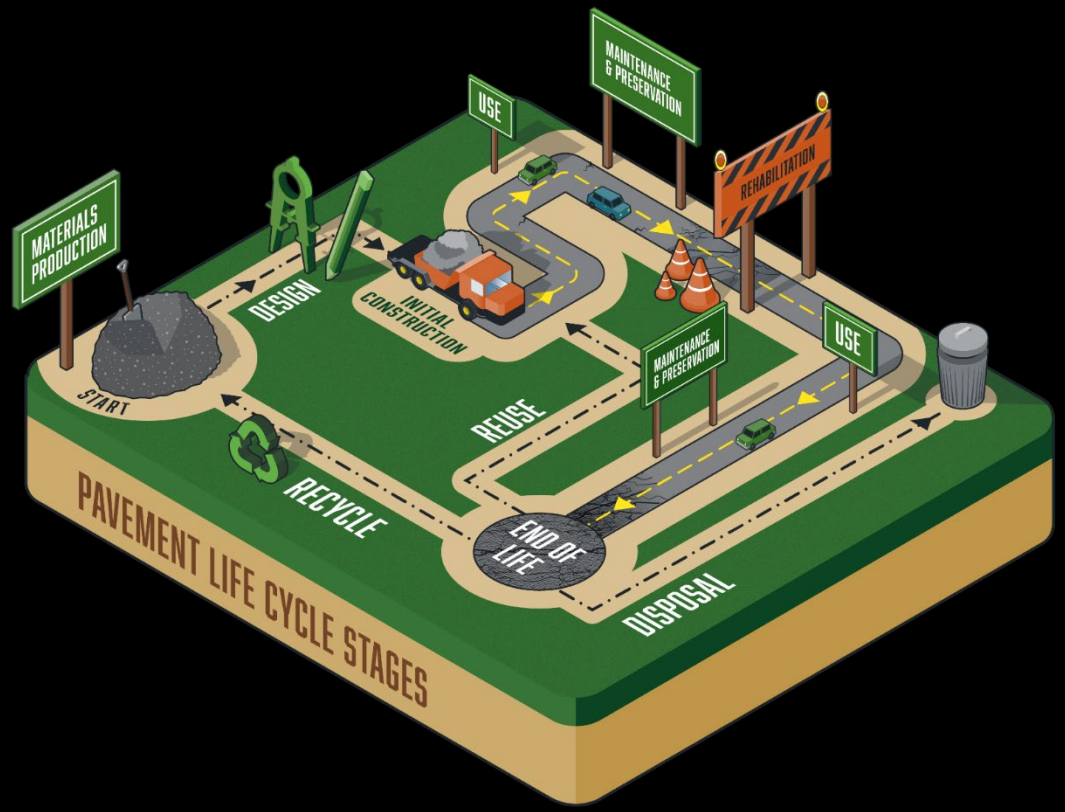


Image Source: FHWA/APTech

Pavement Life Cycle Stages

- Materials
- Design
- Construction
- Use
- Maintenance/Preservation
- End of Life

BENEFITS OF BEING MORE SUSTAINABLE

- Reduced pavement life-cycle costs

- Reduction in greenhouse gas emissions
- Reduced energy
- Reduced noise

- Improved safety
- Improved ride quality
- Conservation of resources

RECYCLED SCRAP RUBBER TIRES

WHY RUBBER IN PAVEMENTS?

- Engineered waste product
- Tire rubber contains polymers
  - Increase asphalt binder viscosity
  - Increase film thickness on aggregates
  - Increase durability, rutting resistance, and cracking resistance

WHY RUBBER IN PAVEMENTS?

Image Source: Pixabay

- Reduce landfill (11% goes to landfill)
- Prevent pollution
  - Water
  - Air – tire fires, methane gas
- Prevent Diseases from Pests
  - Mosquitoes
  - Rodents

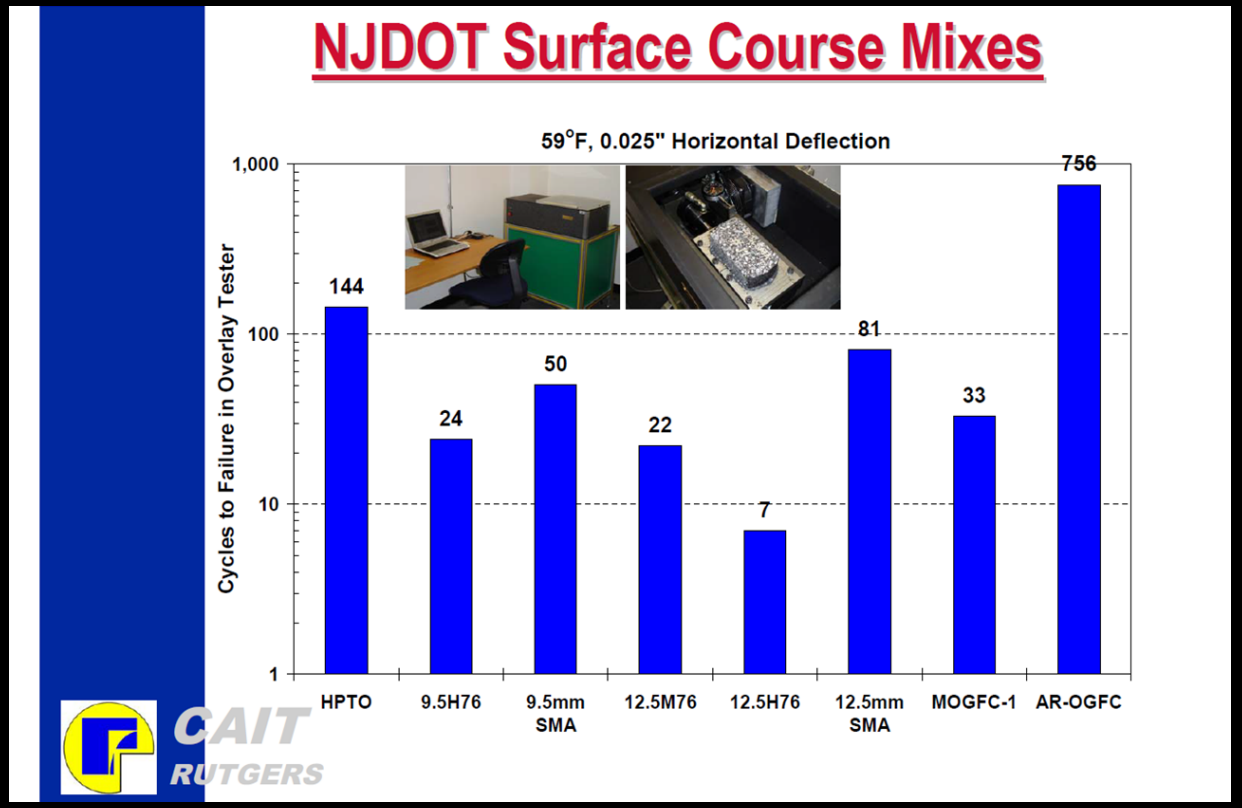
ASPHALT RUBBER

- "Wet" Process of blending ground recycled tire rubber (GTR)
- ASTM D 6114 (15% minimum GTR)
- **Asphalt Rubber Open Graded Friction Course (AR-OGFC)**
- **Asphalt Rubber Gap Graded Courses**
- **Asphalt Rubber Chip Seal**
- **<u>Can recycle up to 1,000 tires per lane mile</u>**

ASPHALT RUBBER "WET" PROCESS

ASPHALT RUBBER "WET" PROCESS

I-295 MERCER COUNTY ASPHALT RUBBER-OPEN GRADED FRICTION COURSE (2007)



ROUTE 72 OCEAN COUNTY ASPHALT RUBBER GAP GRADED (2014)

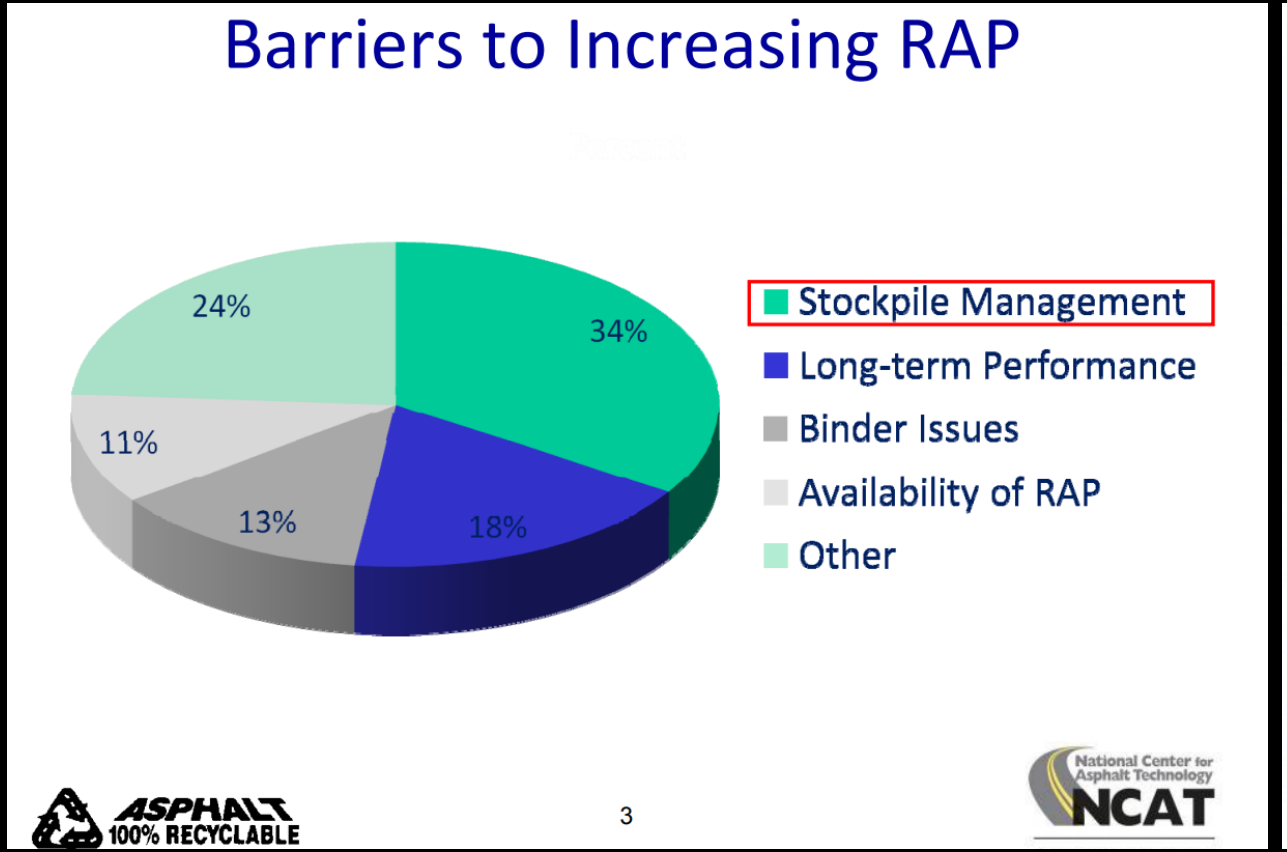
ROUTE 68 BURLINGTON COUNTY ASPHALT RUBBER CHIP SEAL (2018)

RECYCLING RECLAIMED ASPHALT PAVEMENT (RAP)

WHY HIGH RECLAIMED ASPHALT PAVEMENT (RAP)?

- Engineered waste product
- Reduce virgin material use
- Reduce energy consumption and emissions
- If done correctly
  - Economically Sustainable
  - Environmentally Sustainable
  - Long Term Performance

WHY HIGH RECLAIMED ASPHALT PAVEMENT (RAP)?



Source: Randy West, NCAT

I-295 SOUTHBOUND GLOUCESTER COUNTY HOT MIX ASPHALT (HMA) HIGH RAP (2012)

- NJDOT HMA High RAP Specification
  - Minimum 20% RAP Surface Course
  - Minimum 30% RAP Intermediate/Base Course
  - HMA High RAP must meet performance testing
- Successful pilot project
- High RAP can be done, IF IT IS DONE THE RIGHT WAY
- QUALITY AND LONG-TERM PERFORMANCE

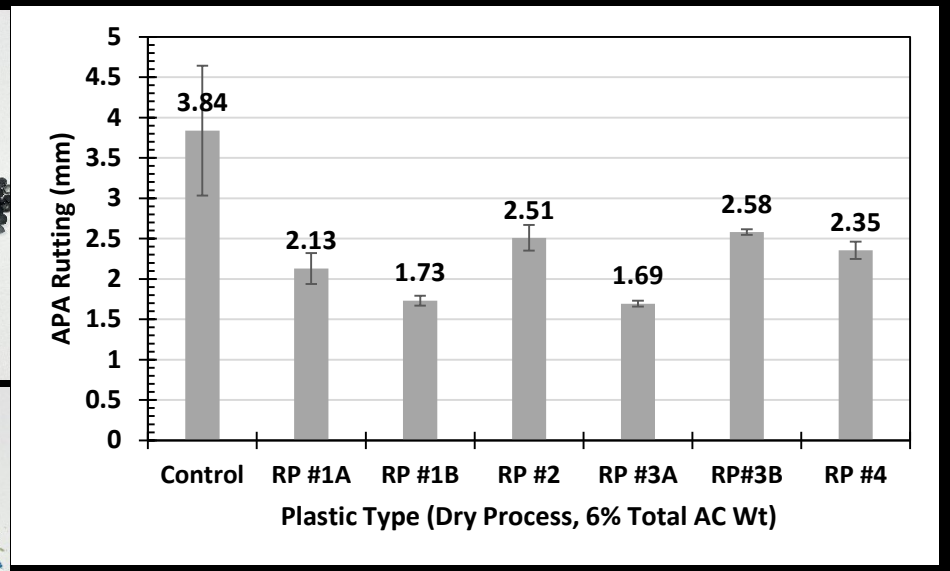
RECYCLED PLASTIC WASTE

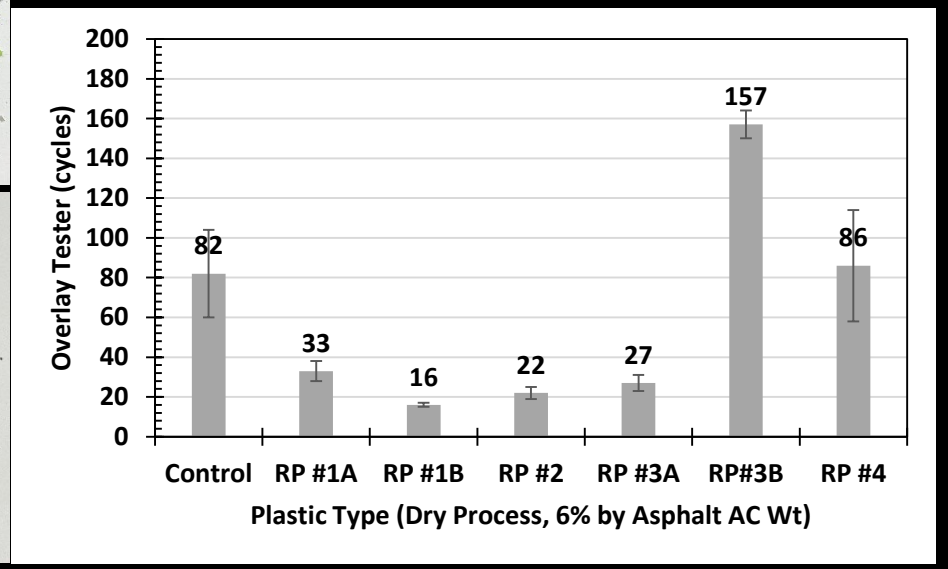
WHY RECYCLED PLASTIC IN PAVEMENT?

- China stopped accepting plastic waste in 2018
  - 45% of global plastic
  - Greater than 100 million metric tons annually
- Reduce landfill/pollution
- Challenges
  - Not all plastics are suitable for asphalt
  - Safety and environmental risks

Image source: https://www.greenqueen.com.hk/china-india-philippines-among-top-asian-countries-record-sharpest-decline-of-refillables-report-finds/

WHY RECYCLED PLASTIC IN PAVEMENT?





- Ongoing global research
  - Asphalt Institute, National Asphalt Pavement Association, and National Center for Asphalt Technology
  - Complex waste stream
  - Many knowledge gaps
- Evaluation of the Potential Use of Recycled Plastics as an Asphalt Mixture Modifier
  - Rutgers - CAIT Pavement Support Program (PSP)

"PLASTIC IS NOT THE FIRST WASTE PRODUCT THAT HAS BEEN RESEARCHED AS AN ADDITIVE OR MODIFIER TO ASPHALT (I.E. [RAP,] SHINGLES, CRUMB RUBBER, ETC.). LIKE ALL OF THEM, **ENGINEERING AND SCIENCE MUST LEAD THE WAY IN DETERMINING THE MOST COST-EFFECTIVE AND SUSTAINABLE SOLUTION WHICH CERTAINLY INCLUDES LONG-TERM PERFORMANCE.**"

Dr. Mark Buncher, Ph.D., P.E.

Asphalt Institute Direct of Engineering

SUMMARY

- We can use recycled products in pavements, but we **must** make sure engineering experts and scientists drive logical decisions based on sound and thorough research to avoid unintended failures.
- Research, standards, and governance
- Quality
- Health, safety, and environmental stewardship
- Long-term performance
- Sustainability

THANK YOU!

QUESTIONS

Robert Blight

Robert.blight@dot.nj.gov

Feature Presentation

NJDOT Sustainability Initiatives

Mansi Shah & Kamal Patel

Bureau of Research

SUSTAINABLE RESEARCH PROJECTS-NJDOT BUREAU OF RESEARCH

Mansi Shah
Research Project Manager

Kamal Patel
Research Project Manager

OUTLINE:

- Materials
  - Porous concrete
  - Rubber concrete
- Energy Harvesting

IMPLEMENTATION OF PERVIOUS CONCRETE IN SIDEWALKS IN NEW JERSEY

- What is pervious (porous) concrete?
- Phase I : Evaluation of various mixes for mechanical properties, workability, and durability
- Phase II : Implementation in sidewalks

WHAT IS PERVIOUS (POROUS) CONCRETE?

'PERVIOUS CONCRETE IS A PERMEABLE MATERIAL, TYPICALLY MADE FROM CEMENT, AGGREGATES, WATER AND ADMIXTURES, OFTEN BUILT WITH AN UNDERLYING STONE RESERVOIR THAT TEMPORARILY STORES SURFACE RUNOFF BEFORE IT INFILTRATES INTO THE SUBSOIL

THERE ARE SEVERAL BENEFITS FOR USING PERVIOUS CONCRETE IN PAVEMENTS. ONE OF THE MOST IMPORTANT BENEFITS IS ITS EFFECTIVENESS IN ELIMINATING SURFACE RUNOFF FROM STORM WATER- THUS REDUCING POTENTIAL FOR FLOODING, PUDDLING, EROSION AND HAZARDS'

PHASE I

EVALUATION OF VARIOUS MIXES FOR MECHANICAL PROPERTIES, WORKABILITY, AND DURABILITY

Recommended Mix Proportions for Porous Concrete (per cubic yard)

550 – 650 lbs. of cement type I/II
2500-2800 lbs. of 3/8 in aggregates
Fine aggregates (maximum 7% of the total weight of aggregates)
Fly ash (maximum 15% weight of cement)
Slag (maximum 20% weight of cement)
0.27- 0.33 water/binder ratio
High Range Water Reducer (1.8 to 2.0 lbs)
Viscosity modifier (1.8 to 2.0 lbs)
Hydration stabilizer (1.8 to 2.0 lbs.)
Air entrainer (0.78 lb.)

Recommended Properties for Porous Concrete

15% to 25% air void content
105 to 125 lb/ft^3 unit weight
2000 to 3000 psi strength
Drainage rate 3-5 gal/min/ft^2 (equivalent of 100- 300 in/hr)

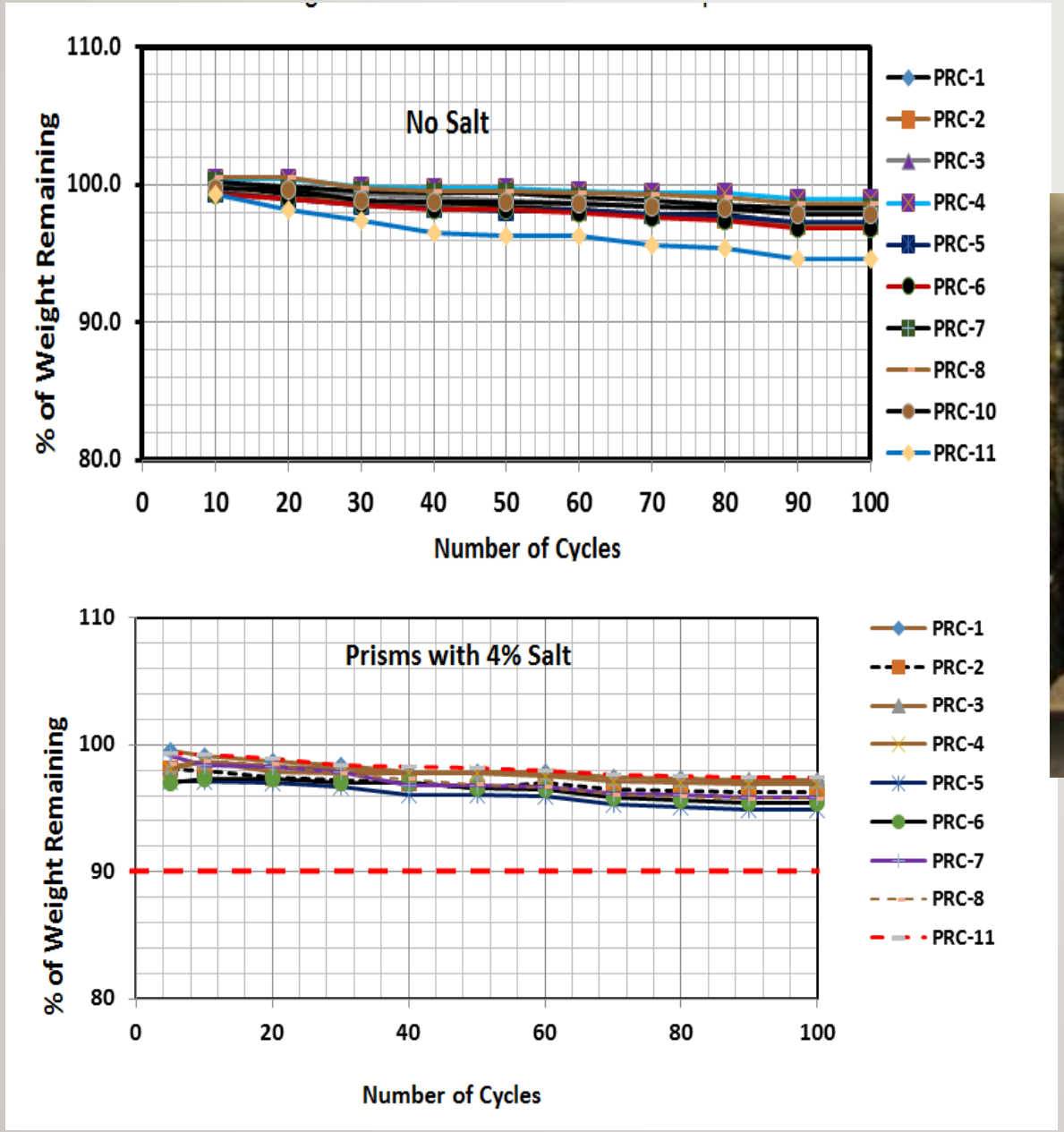
(NRMCA, NJDEP, NJDOT, PCA, NJDOT,TDOT)

EXPERIMENTAL PROGRAM

Mix	Cement	3/8 Agg	1/4 Agg	Sand	Fly Ash	Slag	Water	W/CM Ratio	MRWR (SP)	HS	VMA	AE
PRC-1	635	2430	---	224	---	---	209	0.33	---	---	---	---
PRC-2	864	2430	---	---	---	---	236	0.27	1.9	1.9	---	0.8
PRC-3	600	2835	---	---	---	---	162	0.27	1.9	1.9	---	0.8
PRC-4	620	2700	---	---	---	---	168	0.27	1.9	1.9	---	0.8
PRC-5	620	2700	---	---	---	---	168	0.27	1.9	1.9	2	0.8
PRC-6	620	1380	1380	---	---	---	168	0.27	1.9	1.9	---	0.8
PRC-7	525	2500	---	---	95	---	168	0.27	1.9	1.9	---	0.8
PRC-8	465	2500	---	---	---	155	168	0.27	1.9	1.9	---	0.8
PRC-9	500		2700	---	---	---	165	0.33	1.9	1.9	---	0.8
PRC-10 (gravel)	600	2700	---	---	---	---	180	0.3	1.9	1.9	---	0.8
PRC-11 (gravel)	600		2700	---	---	---	180	0.3	1.9	1.9	---	0.8

POROUS CONCRETE-LAB TESTING

Freeze-thaw tests

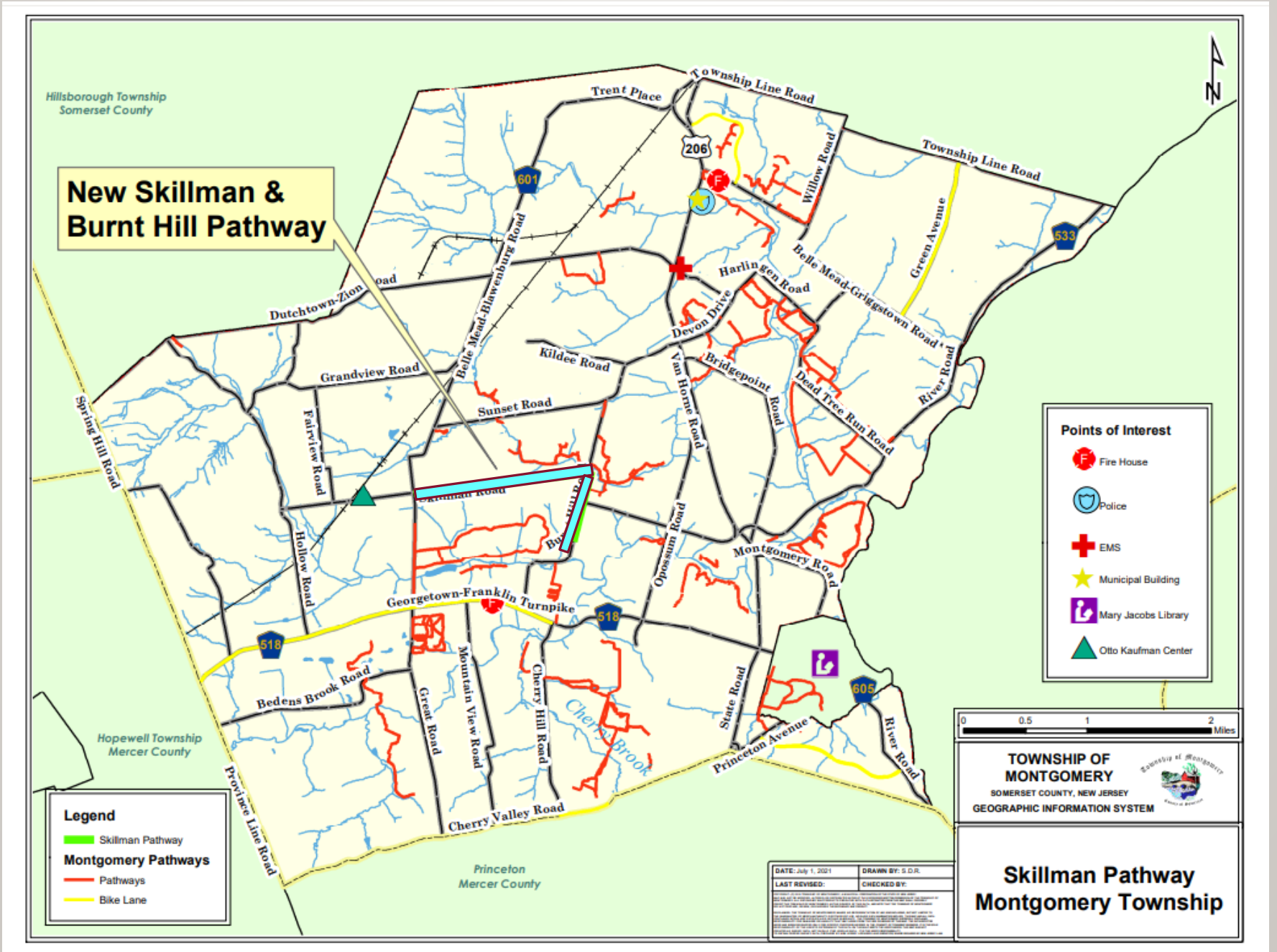


POROUS CONCRETE-FIELD TESTING

PHASE II

IMPLEMENTATION

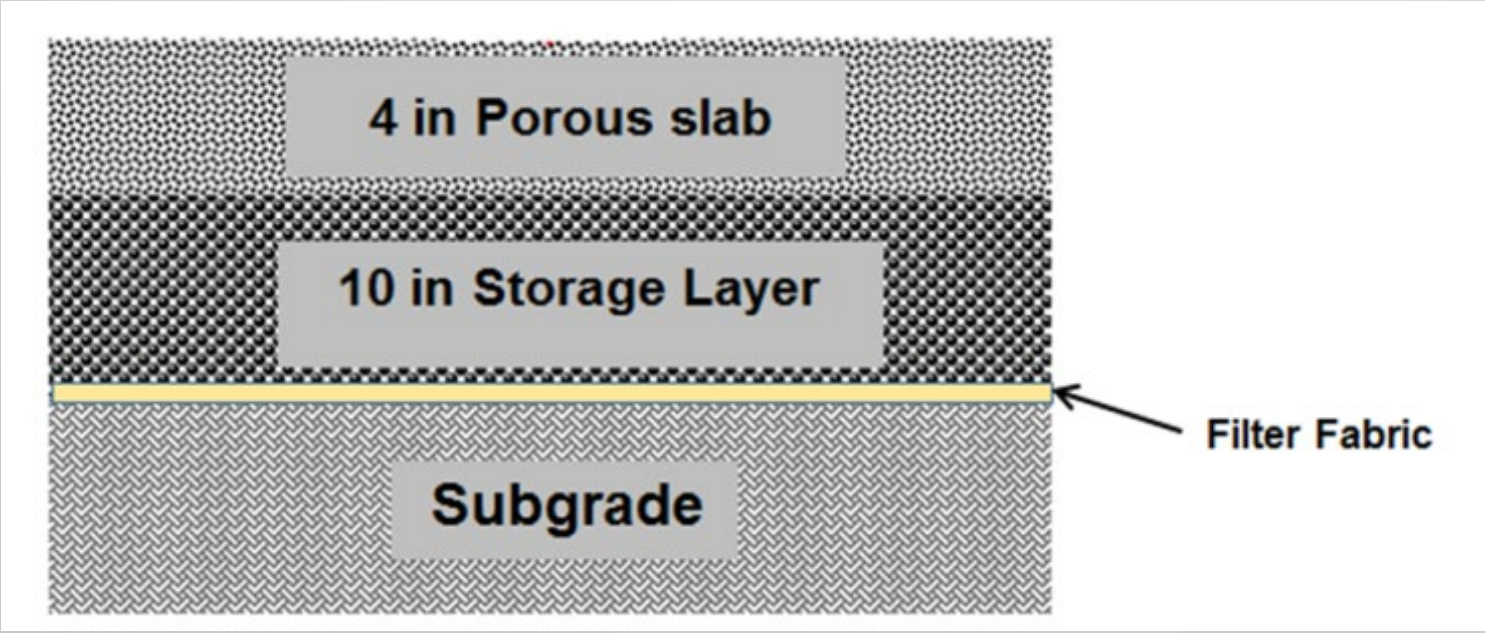
SIDEWALK LOCATION- MONTGOMERY TOWNSHIP



STRUCTURAL AND HYDROLOGICAL DESIGN

THE NRCS AND CURVE NUMBER (CN) METHOD WAS USED FOR DESIGN OF THE STORAGE LAYER

4 IN MINIMUM THICKNESS FOR SIDEWALKS
10 IN OPEN-GRADE STONE STORAGE LAYER
STORAGE LAYER (NO. 2 AND NO. 57 COARSE AGG , ASTM C33)
NON-WOVEN GEOTEXTILE FILTER FABRIC
MINIMALLY COMPACTED SUBGRADE (92% +/- 2%)
1/2 IN EXPANSION JOINT WITH JOINT FILLER EVERY 20 FT



Preparation of the sidewalk

Preparation of the sidewalk

Placement of expansion joint filler

CONCRETE PLACEMENT

Concrete Placement and finishing

Finished section

FINISHED SURFACE

COLLECTION OF FIELD SAMPLES (BEAMS AND CYLINDERS)

After Hurricane Ida

Maintenance

- Visual Inspection
- Infiltration Tests
- Air Blowers to remove debris
- Vacuum Cleaning for more effective cleaning
- Pressure Washing to remove clogging

Visual Inspection of Existing sidewalk

Well maintained

Visual Inspection of Existing sidewalk

Somewhat Maintained

Visual Inspection of Existing sidewalk

Poorly Maintained
Moderate to Severe Raveling and Clogging

Infiltration Test (ASTM 1701)

Air Blowers

Pressure washing is needed when there is clogging

Water pressure of 2000 psi is sufficient to removed minor to moderate clogging

Pressure washing is needed when there is clogging

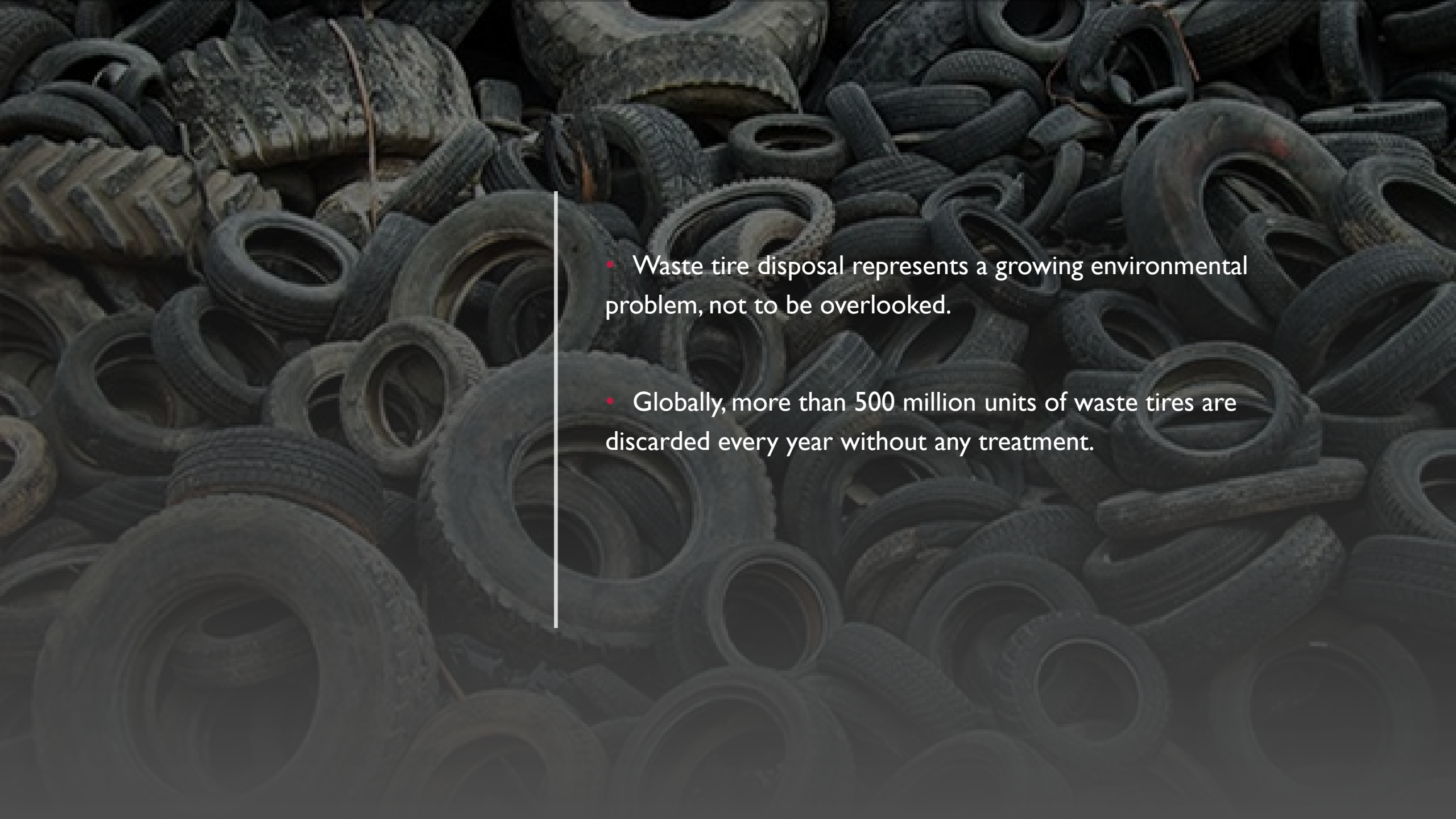
Water pressure of 3000 psi to 3500 psi is sufficient to remove moderate to severe clogging

Pressure washing is needed when there is clogging

Water pressure of 3000 psi to 3500 psi is sufficient to remove moderate to severe clogging

Sidewalk after pressure washing with 3000 psi water pressure

RUBBER CONCRETE



- Waste tire disposal represents a growing environmental problem, not to be overlooked.

- Globally, more than 500 million units of waste tires are discarded every year without any treatment.

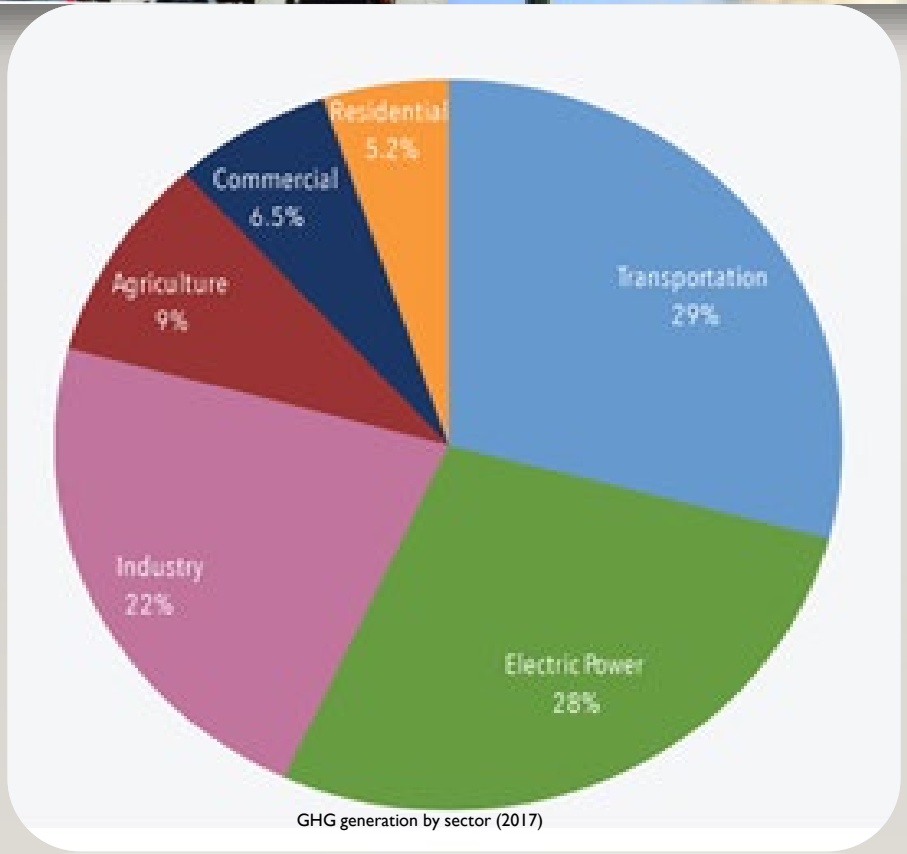
- Their increasing number has raised concerns worldwide due to the threat they pose directly and indirectly to human health and the environment. For this reason, recycling of waste tires has been implemented in many countries.

The possibility of recycling scrap tires as aggregates in concrete/asphalt gained acceptance worldwide in the engineering sector, and positive results have already been achieved, preserving natural resources, and helping to maintain ecological balance. NJDOT Bureau of Research is currently looking into this material for possible applicability on roadway applications.

Sidewalks

Asphalt road

ENERGY HARVESTING FROM ROADWAY AND BRIDGE



GHG generation by sector (2017)

CHALLENGE AND MOTIVATION

Growth of traffic and deterioration of infrastructure

- Transportation agencies are under a great challenge to monitor roadway network condition and traffic operations

More than 80% of energy production from fossil fuels (IEA)

- Release of large amount of CO_2 and cause climate change issues

Energy harvesting can provide renewable energy solutions for different transportation applications

RESEARCH MOTIVATION

- Traditional solar farms (ground-mounted solar panels) require a large amount of land, especially when targeting high energy production.
- Photovoltaic noise barriers (PVNBs) use photovoltaic technology to produce renewable energy and simultaneously abate the noise generated from traffic.
- Few studies have been conducted to evaluate the design of PVNBs and the practical issues and challenges for real implementation

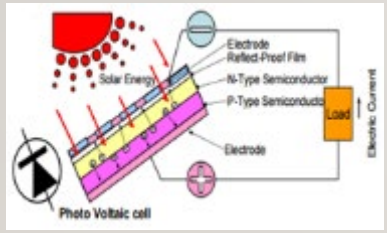
ENERGY HARVESTING AND BENEFITS

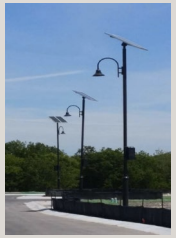
- Harvesting waste energy from transportation infrastructure and use it for sustainable and smart transportation.

- **Large-scale application:**
- Provide clean and renewable energy solutions for different uses, especially at remote off-grid regions.
- Reduce environmental impact of generating the amount of harvested energy.
- **Micro-scale application:**
- Provide continuous power supply for lighting, self-powered sensor device, and wireless data transfer.
- Serve as smart sensor at the same me to monitor traffic data and infrastructure condition.

PHOTOVOLTAIC ENERGY HARVESTING

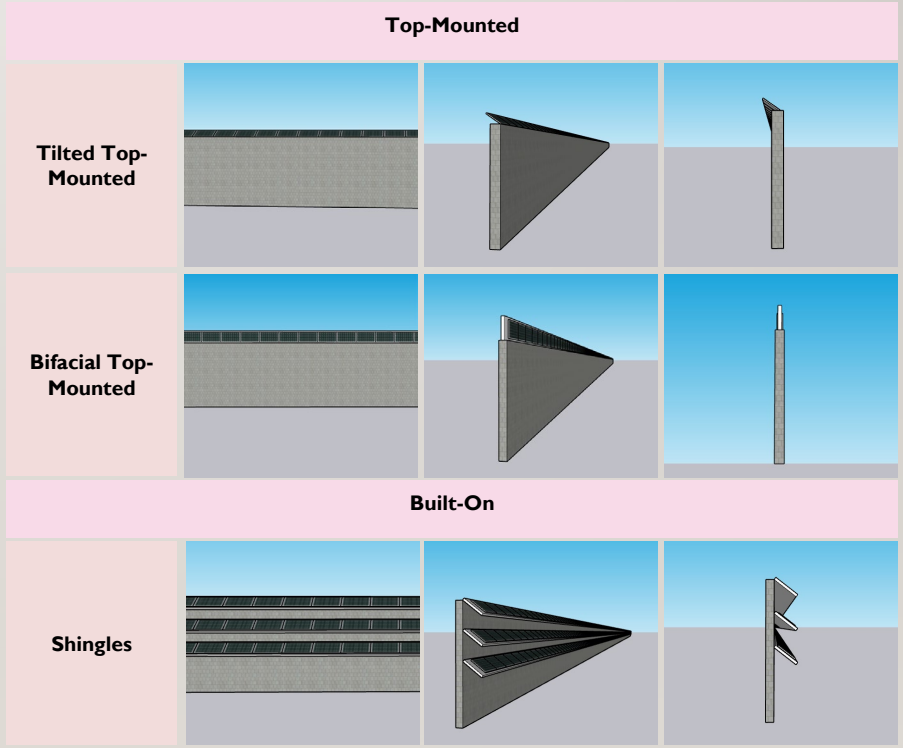
- Photovoltaic materials generate electricity with application of light.
- Polycrystalline panels made of silicon crystals are the most common solar panel.
- Wide applications on different types of roadway assets.





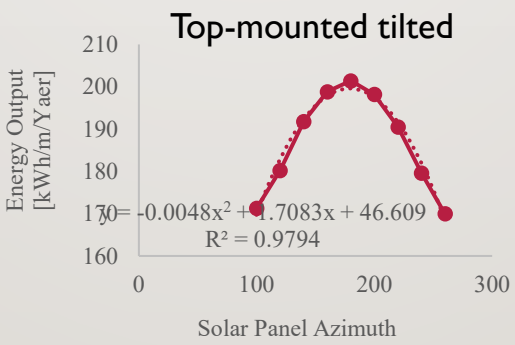
RESEARCH OBJECTIVE AND SCOPE

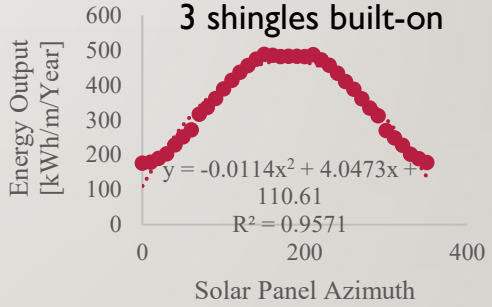
- Conduct comprehensive study of PVNBs for evaluation of design configurations and discussion of implementation issues.
  - Three retrofitting designs of PVNB were compared and evaluated through site-specific analysis.
  - Energy simulation was conducted to develop simplified models for state-level estimation in NJ.
  - Business models and implementation challenges.

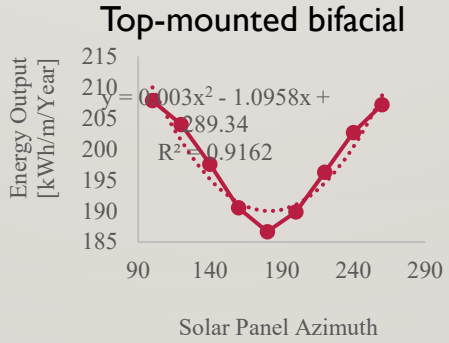


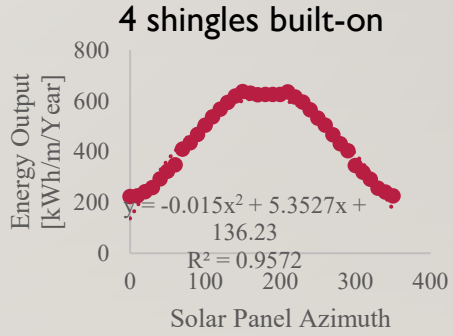
EFFECT OF PVNB DESIGNS AND ORIENTATIONS

- Analysis tool: Sketchup with Skelion plug-in that uses PVWatts (NREL) for estimation of solar energy production.
- Optimum configuration of solar panels were considered.









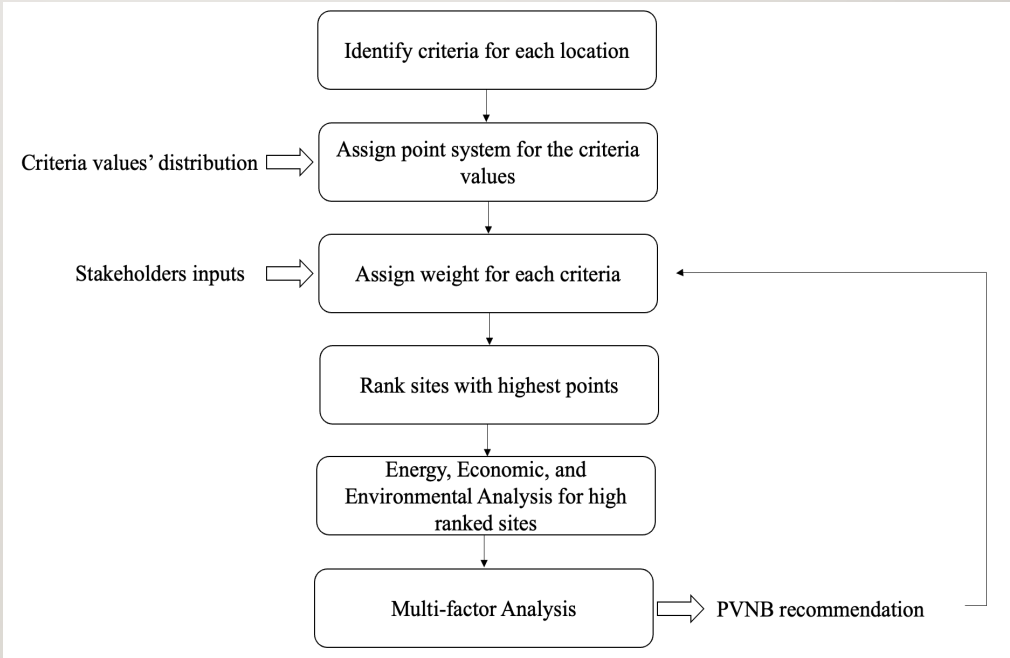
STATE-LEVEL ENERGY ESTIMATION

- Currently, there are 72 noise barriers in New Jersey totaled 10,268,832 square feet along 106.3 miles. The average height of noise barrier is 17 ft.
- The beginning and ending latitude and longitude of each barrier segment were used to find average orientation and length of each segment.

PVNB Configuration	Energy Output (MWh/Year)
Top-mounted Tilted	27,196
Top-Mounted Bifacial	21,246
Built-on 3-shingles	48,934
Built-on 4-shingles	56,164

SITE SELECTION OF PVNB

- **Economic**
  - Solar Irradiation
  - Barrier direction
  - Distance to power grid
  - Accessibility for maintenance
- **Environmental**
  - Solar Irradiance
  - Barrier direction
  - Region electricity source
- **Social**
  - Highway traffic
  - Electricity rate
  - Electricity availability
  - Distance from barrier to highway shoulder

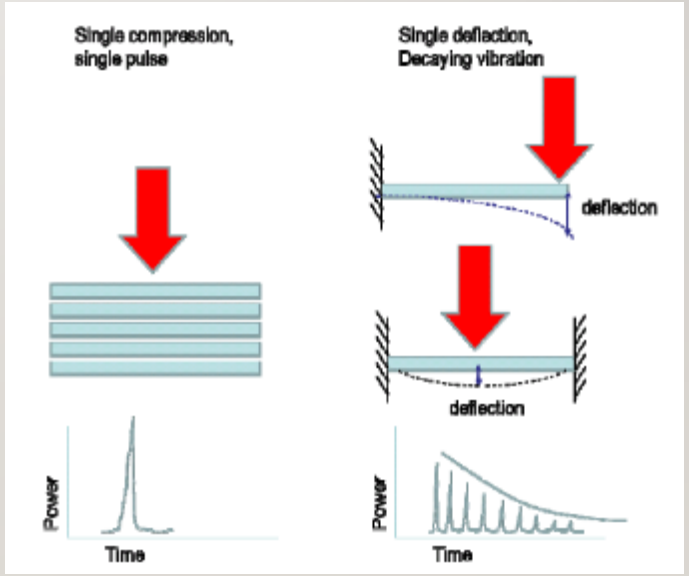


CONCLUSIONS

- In the project level, the design configuration with shingles has the highest energy output; while the energy outputs of top-mounted configurations vary depending on barrier orientation.
- The simplified regression models provide a quick way to estimate total energy output for each design configuration considering different orientations of noise barriers.
- The proposed decision-making framework for site selection includes factors that impact these three categories to increase monetary gains, decrease environmental impacts, or increase public welfare.

PIEZOELECTRIC ENERGY HARVESTING

- Piezoelectric materials generate electric charges when subjected to mechanical stresses or change geometric dimensions when an electric field is applied.
- Common piezo materials include lead zirconate titanate (PZT), Polyvinylidene fluoride (PVDF), and piezoelectric composite.
- The energy harvesting performance of piezoelectric transducer is affected by material, geometry design of transducer, and external loading.



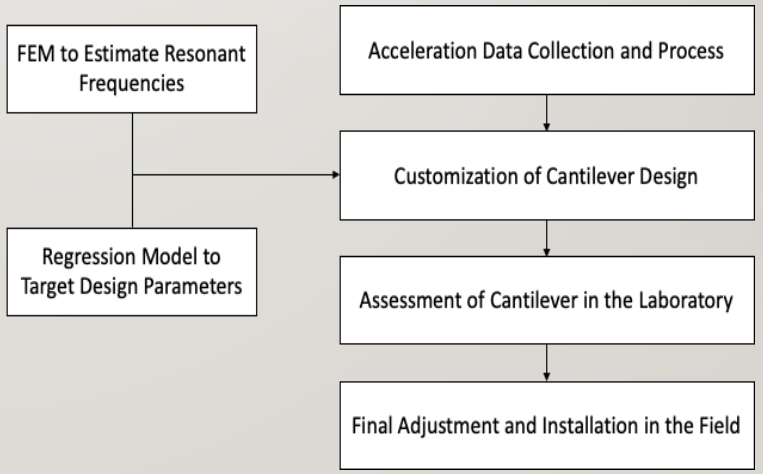
Energy harvesting + Sensing

RESEARCH MOTIVATION

- For piezoelectric energy harvesting on pavements, most relevant designs are compression-based and require structural integration with the existing pavement structures.
- Vibration-based energy harvesters have less impact on host structure without embedment needed and require less effort in installation.
- The power outputs from vibration-based energy harvesters are strongly affected by the host structural vibration, which may be uncertain with multiple vibration frequencies.

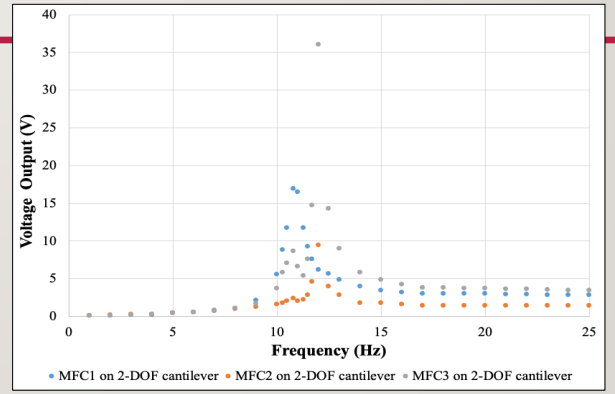
RESEARCH OBJECTIVE AND SCOPE

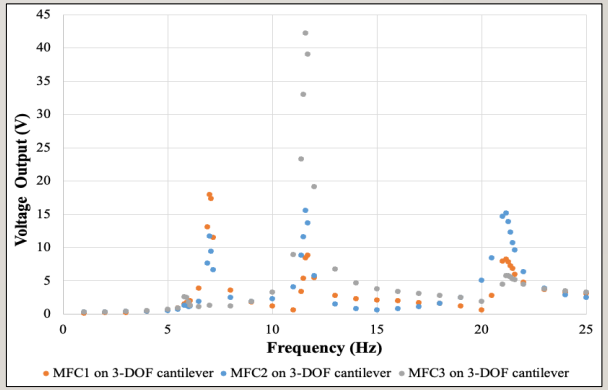
- Develop novel piezoelectric cantilevers to generate power from bridge structure vibration.
- Propose an optimization approach for customizing the design to maximize power outputs due to bridge vibrations.
- Laboratory testing, numerical simulation, and full-scale test.



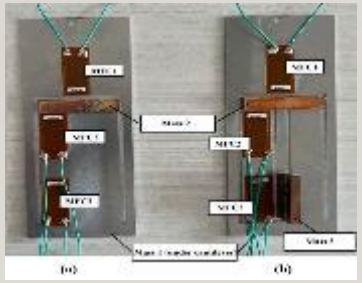
LABORATORY TESTING

- Cantilever designs with multiple degree of freedom (DOF)
- The voltage outputs under different vibration frequencies were collected and the resonant frequencies and the corresponding voltage outputs were determined



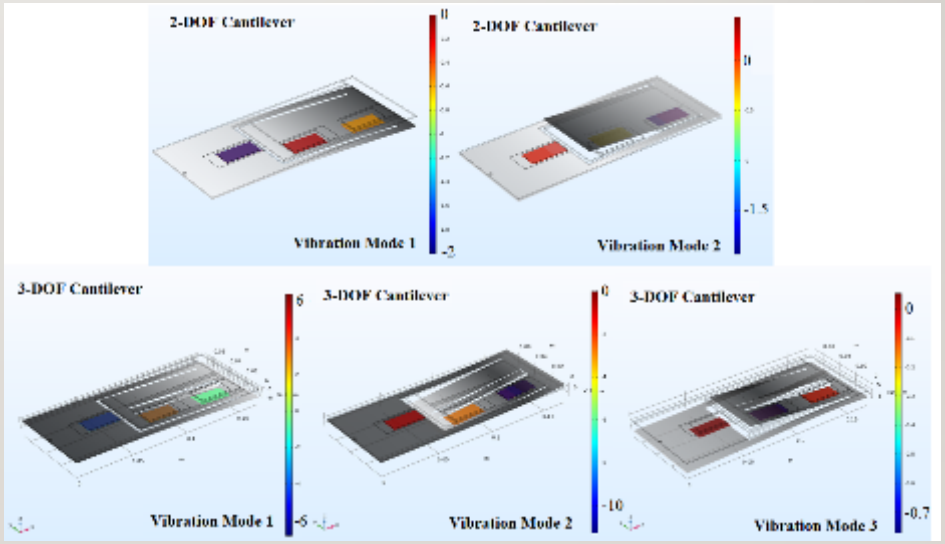


2-DOF and 3-DOF Cantilevers



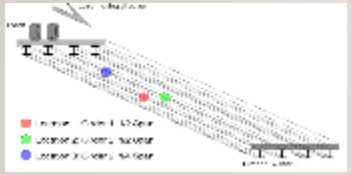
NUMERICAL MODELING

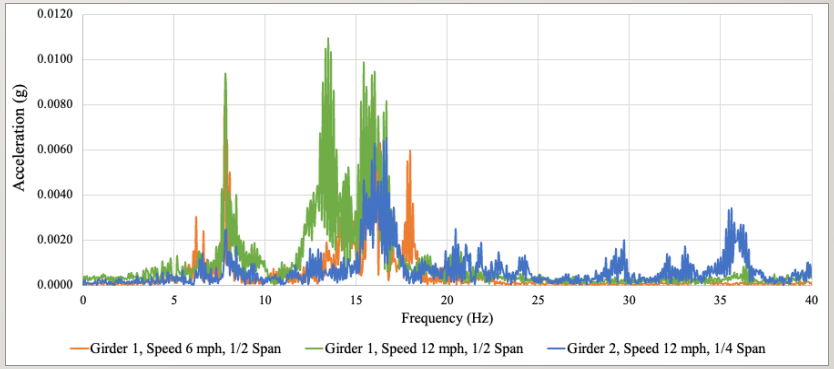
- Multi-physics models are developed to predict the resonant frequency under frequency sweep simulation and verified with laboratory tests.
- FEM cases were run to develop the regression models between resonant frequencies and mass combinations.

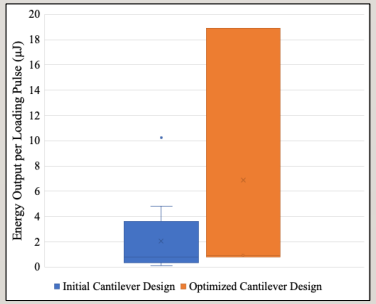


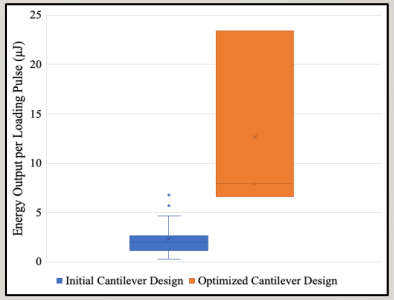
Voltage outputs from MFCs on 2-DOF and 3-DOF cantilevers under different vibration modes

FULL-SCALE BRIDGE TEST





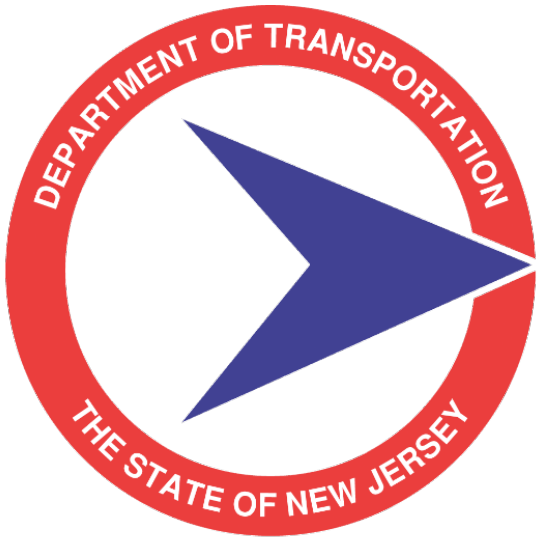




2-DOF and 3-DOF Cantilevers at ½ span of girder 1

ThankYou

ANNOUNCEMENTS & REMINDERS



Bordentown Training Center

Bordentown Training Center

TOS&S' Vision 2020

"A workforce that is….

Right Sized	Properly Trained	Properly Equipped
		

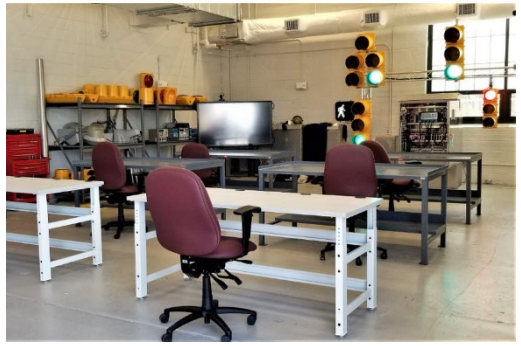
Bordentown Training Center

Properly trained….how?

By establishing a first-class training facility in New Jersey that meets the needs of the Department

And creating a business area dedicated to training a technical professional workforce

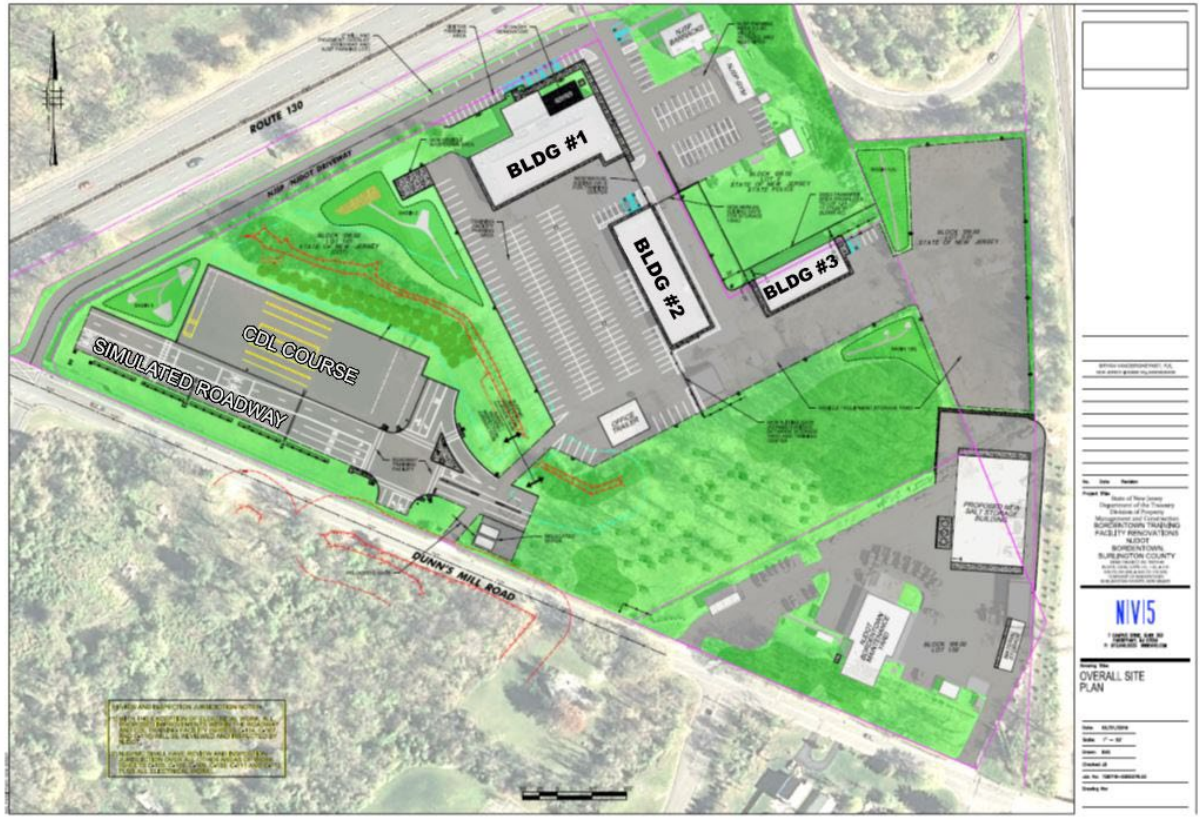
Bordentown Training Center



Bordentown Training Center

Formerly the NJ National Guard - Bordentown Combined Support Maintenance Shop

NJDOT acquired the property with three buildings from the Department of Military and Veterans Affairs on April 5, 2016

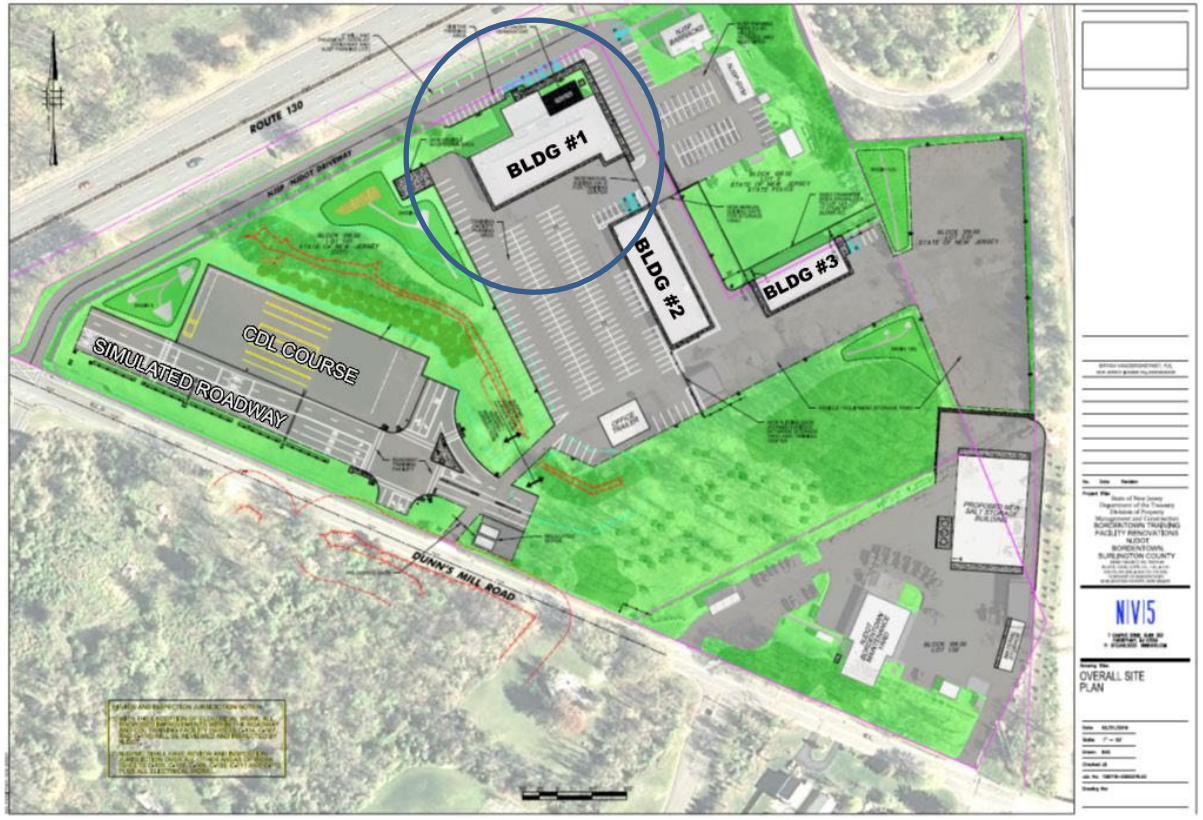


Bordentown Training Center

Building 1

A single story and mezzanine level with interior floor area of 18,871 sf.

Offices
training classrooms, conference rooms, lunch/break room, lecture hall assembly, and vehicle maintenance garage bays.

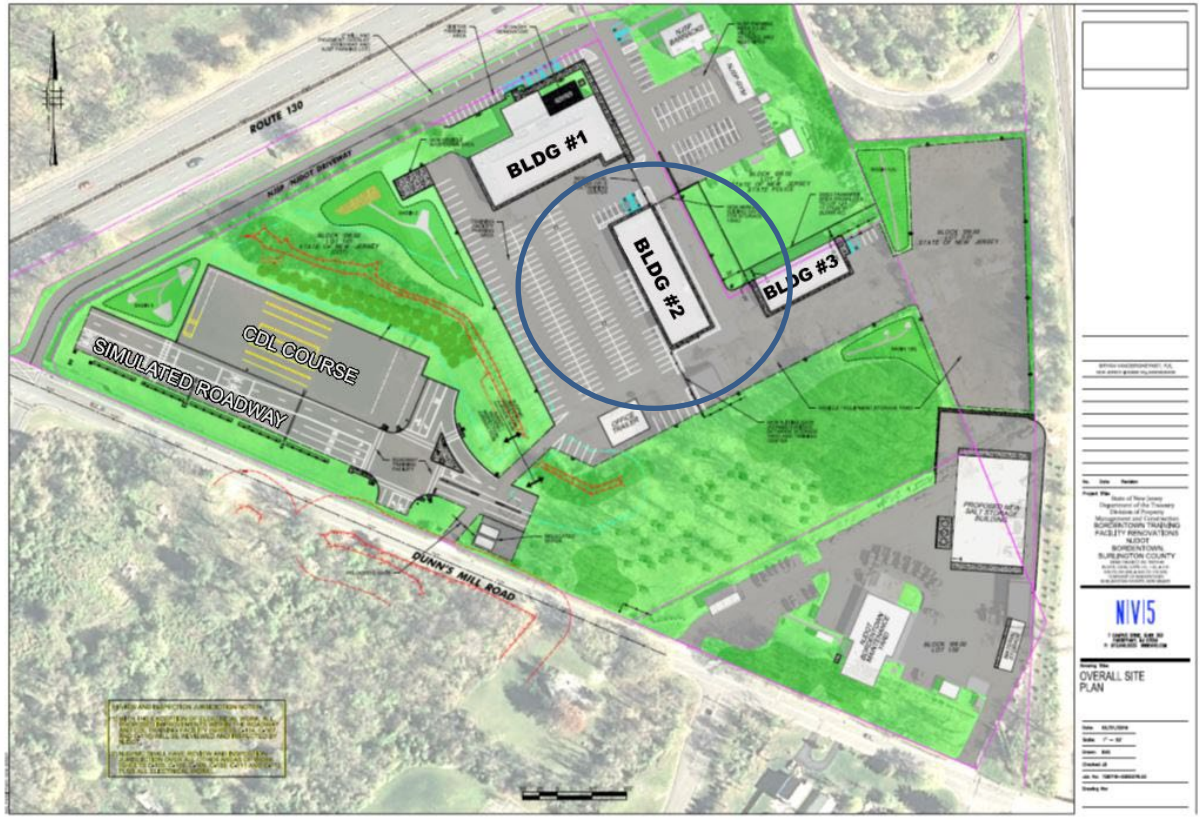


Bordentown Training Center

Building 2

A single story with interior floor area of 11,915 sf.

Offices, training classrooms, conference room, lunch/break room, and hands-on training bays.

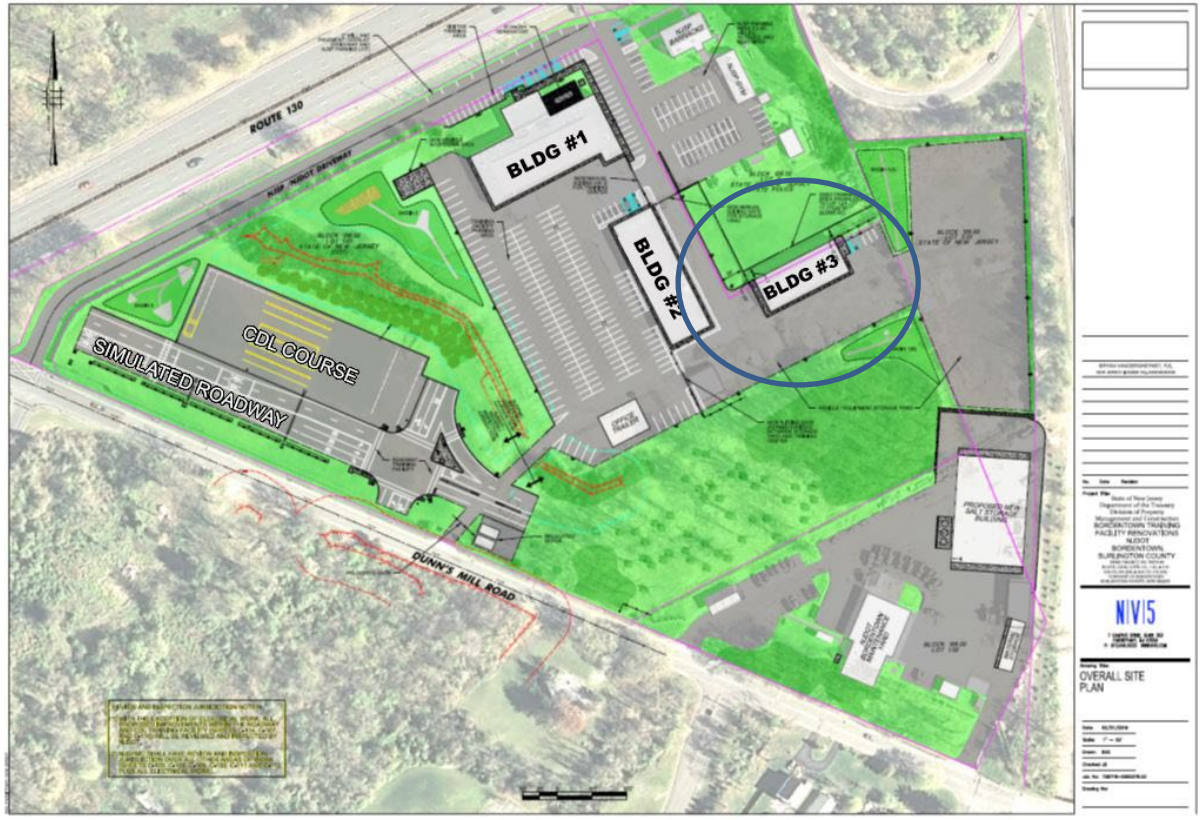


Bordentown Training Center

Building 3

A single story with interior floor area of 6,226 sf.

Manager office, lunch/break room, and vehicle maintenance garage bays

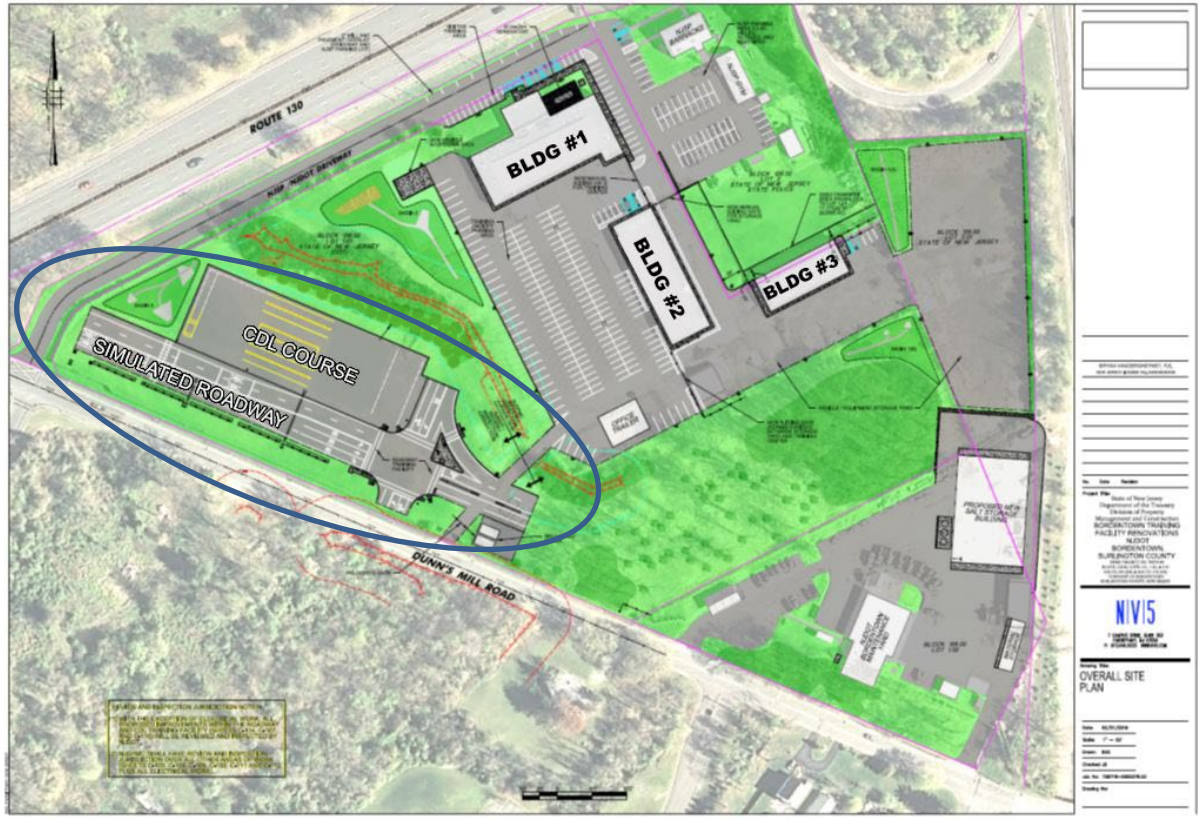


Bordentown Training Center

Training Field

A simulated roadway and training area

Fully functional roadway equipment, (traffic signals, lights, pedestrian crossing equipment, camera systems, overhead signs, dynamic message signs, drainage structures and CDL training and testing area.



Bordentown Training Center

Training Field

Bordentown Training Center

Managed by the Division of Support Services and Division of Operations Administrative Support – Training & Equipment Inspection Unit

Bordentown Training Center

<u>Constructed at a cost of $21,011,201</u>

Building exteriors including windows, doors, roofs, and brickwork were repaired or replaced.

The interior of the buildings were completely renovated.

Other improvements to the site included…

- full utility upgrades for gas, electric, and water
- significant upgrades to stormwater management/drainage
- sanitary sewer pump station for NJDOT & NJSP buildings

Operations Training Unit Mission

To institute a training continuum culture throughout an employee's career that creates a more professional, knowledgeable, and proud workforce.

The Unit oversees a robust formal training program, combining classroom training and specific, measurable field training staffed with an internal training cadre of subject matter experts (20 staff) who develop and teach technical content for all levels.

Bordentown Training Center

Operations Training Unit Course Listing

- Introduction to Highway Operations
- HOT 2 Advancement Training
- HOT 3 Advancement Training
- Transitioning to Assistant Crew Foreman
- Pesticide Core
- Advanced Pesticide Category 6B
- Advanced Pesticide Category 3A-Ornamentals
- Advanced Pesticide Category 3B-Turf
- Pesticide Applicator License Recertification
- Driver Awareness (3 hr. class)
- Lift Truck Training (Forklift)
- Entry Level Driver Training (ELDT) CDL Permit
- CDL Vehicle Simulator Training
- CDL Road Test Training
- Running A Snow Shift
- Snow Representative Training
- Volunteer Driver Training
- Tandem Belly Plow and Wing Plow Training
- Introduction to Highway Mechanics
- Introduction to Highway Electrical
- Sign Shop Training
- Sign Shop Cross Training
- New Hire Engineering Training
- Job Order Contracting (JOC) Training
- Field Training:
  - Sign Installation & Mark Out, Permanent Patch, Inlet Repair/Reconstruction, Torch Training, Bucket Truck & Tree Trimming, Equipment Operation, Setting Safety and Safety Refresher, Fence Repair, Concrete Mixing, and other training as requested.

Bordentown Training Center

A Facility Available To The Entire Department

Bordentown Training Center

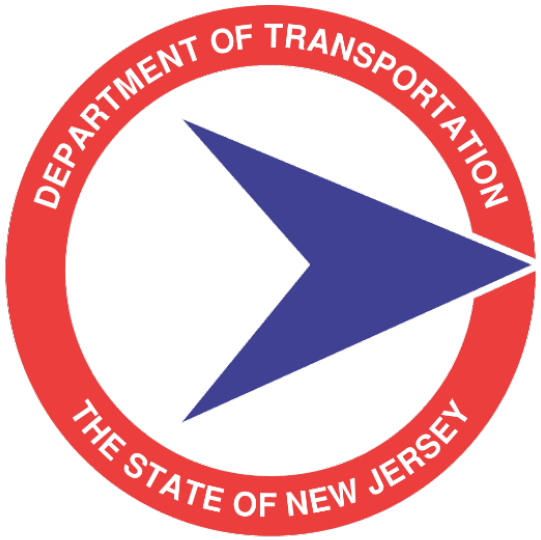
"The New Jersey Department of Transportation recognizes the critical importance of a well-trained, highly skilled workforce to build, maintain and improve our transportation infrastructure,"

"The skills taught at this innovative and modern facility will directly impact motorists throughout New Jersey, because excellence in training translates to expertise, efficiency, and enhanced safety on the job. Today marks an exciting milestone as we continue to invest in NJDOT's most valuable asset, its employees."

NJDOT Commissioner Diane Gutierrez-Scaccetti

Bordentown Training Center

Officially Opened on May 31, 2023



Thank You


DESIGN SUMMIT
10
YEARS
2023
DESIGN SUMMIT
SAVE THE DATE!
Wednesday, May 17, 2023
Sponsored by NJDOT, FHWA and ACECNJ
Forsgate Country Club • Highland Room
375 Forsgate Drive, Monroe Township, NJ
Registration begins at 8:00 a.m.
DEPARTMENT OF TRANSPORTATION
THE STATE OF NEW JERSEY
ACEC New Jersey
American Council of Engineering Companies
DEPARTMENT OF TRANSPORTATION
UNITED STATES GOVERNMENT


Brandee
Sullivan
NJ DOT
Table 2
2


10 Year Anniversary
23


What is CV?
ACEC

Upcoming EDC Related Training Opportunities

- **June 21:** Federal-aid Responsible Charge (Piscataway)
- **July 25:** Federal-aid Responsible Charge (Newark)
- **August 8**: Federal-aid Responsible Charge (Bordentown)
- **September 13**: Traffic Incident Management for First Responders (Virtual)
- **November 1-2**: TRB Emergency Responder Transportation Safety Research Summit (Piscataway)
- **December 8**: Traffic Incident Management for First Responders Train-the-Trainer (Piscataway)

*Additional topical offerings will be added for the Fall of 2023**

All are offered free of charge to attendees

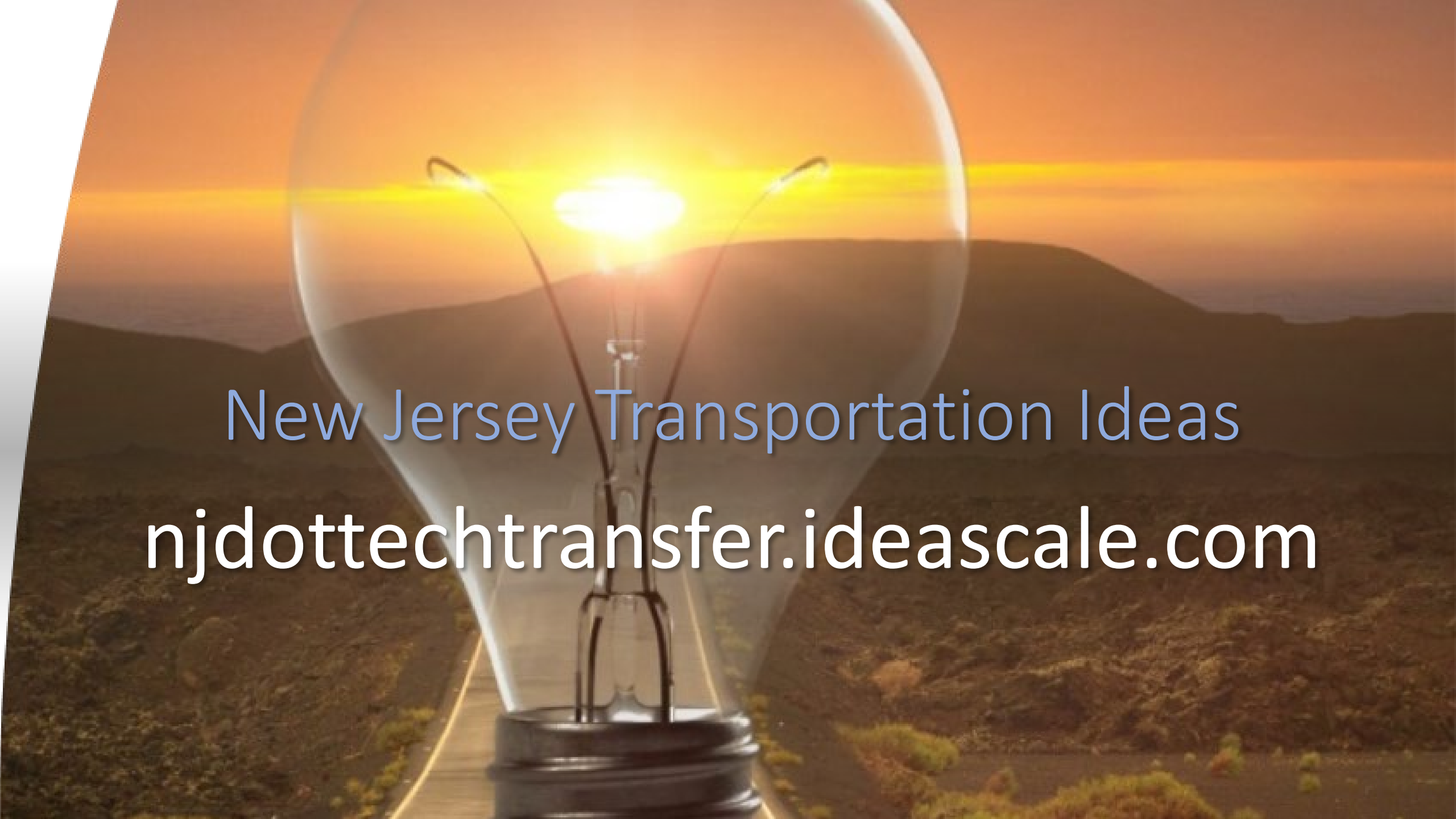
https://cait.rutgers.edu/events/

NJ Transportation Ideas Portal

Welcome! The New Jersey Department of Transportation's Bureau of Research uses this website to gather and share ideas from NJDOT's research customers and other transportation stakeholders.

Research Ideas. We seek to fund research that leads to implementation – to the testing and adoption of new materials and technologies, to better specifications and to greater efficiency. We strive to discover and advance feasible solutions for more durable infrastructure, greater environmental protection and resilience, and improved mobility and safety for residents, workers and visitors.

Innovation Ideas. We encourage the deployment of innovations and knowledge transfer. We work with the New Jersey State Transportation Innovation Council (NJ STIC) whose mission is to identify, evaluate, and where possible, rapidly deploy new technologies and process improvements that will accelerate project delivery and improve the quality of NJ's transportation network.



New Jersey Transportation Ideas

njdottechtransfer.ideascale.com

REMINDERS & ANNOUNCEMENTS

NJDOT Tech Transfer Website
www.njdottechtransfer.net

NJ STIC Website
www.njdottechtransfer.net/nj-stic/

STIC INCENTIVE PROGRAM

NJDOT Tech Transfer Website
https://www.njdottechtransfer.net/new-jersey-stic-requests/

Selection Criteria
Eligible Projects/Activities
How to Apply
List of Projects

THANK YOU!

www.NJDOTtechtransfer.net/NJ-STIC

NJDOT Bureau of Research
(609) 963-2242