Monroe County
BOCC WORKSHOP

RESILIANCE AND ROADS ADAPTATION WORKSHOP

Key Largo Government Center
December 12, 2023

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Judy Clarke  Director Engineering Svsc & Roads
Resilience is the ability to prepare for and adapt to changing conditions and to withstand and recover rapidly from disruptions.

(National Institute of Standards and Technology (NIST), National Academies of Science, Engineering and Medicine (NASEM))
Presentation Outline

- Twin Lakes Roads Adaptation Update
- Road Adaptation Program Update
- Stormwater Regulations
- Stillwright Point Alternatives Technical Evaluation
  - Alternative 1 (Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage)
  - Alternative 2 (No Adaptation Project with Continued Maintenance)
  - Alternative 3 (Add asphalt 1 to 6 inches, No Drainage)
  - Alternative 4 (Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps)
  - Alternative 5 Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps)
- Policy Recommendations for Alternatives
- Funding
- Public Comment
- Commission Discussion and Next Steps
Twin Lakes Project Update

- Status
- Bid Phase
- Construction Phase
**SLR Related Planning Efforts**

**In Process**

**Roads Adaptation Plan**
- Monroe County Pilot Roads Project, The Sands and Twin Lakes Community (January 2017)
- Un-incorporated County Roadway Vulnerability Study and Implementation Plan (May 2019 - February 2023)

**Comprehensive Plan**
- Peril of Flood amendments to address State requirements (drafted, RPG 2019)
- Adaptation Action Areas (drafted RPG 2021)
- Other amendments as necessary

**Vulnerability Assessment for County non-Road Assets**
- Assessment is being updated separately for habitat, buildings, and infrastructure.
- This has been funded by Resilience Grants in 2020 & 2022

**Grants and Projects awarded and to be completed**
- Award: Twin Lakes construction
- Award: Sands construction
- Award: Stillwright Point design and permitting
- Award: Natural Areas Adaptation Plan (State)
County Roadway Vulnerability Analysis

Evaluation of:
- Projected Water Levels for Years 2025, 2030, 2035, 2040, 2045, 2060, and 2100.
- Sea Level Rise and King Tide Predictions
- Roadway LiDAR
- Storm surge
- Wind waves
- Extreme events

Data allows us to:
- Project water surface elevations
- Conduct Vulnerability/Prioritization evaluation
- Identify areas of concern
- When will areas be impacted
- Define improvement projects limits
- Assess environmental impacts/permitting
- Develop preliminary cost estimates
National Oceanic and Atmospheric Administration (NOAA) 2017 Sea Level Rise Scenario

Sea Level Rise Projections for Monroe County, Florida

SLR Condition: NOAA 2017 Intermediate-High

A Total of 5.5 ft in 78 Years

Year 2023 Water Level
State Stormwater Regulations

- Performance based evaluation, i.e. each project (any road modification) needs to be evaluated to determine drainage parameters so as to not cause adverse impacts to surrounding properties.

- SFWMD permit review and authorization will be required for any modifications to a drainage system, and/or changes to elevations impacting flow patterns or impervious surface of the road increases requiring analysis of:
  - Water quality impacts (treatment required)
  - Pre-project compared to post-project impacts from rainfall
  - Impacts to offsite properties

- Types of permits to be evaluated include:
  - Exemption
  - General
  - Individual
State Stormwater Regulations Cont.

**Water Quantity:**

- Determine water movement across the project area and identify low elevation points for capture, treatment and movement of rainfall.

- Land use and soil conditions such as developed properties, vacant properties, pavement, grass, rock affect the movement of the rainfall across the project area that gets incorporated into the Hydraulic models.

- Groundwater table conditions (King Tide and Sea Level Rise) to determine water storage capacity below the ground

- Rainfall storm events to be evaluated (100-year and 25-year, 3 day and 5-year and 2-year, 1 day)

- Hydraulic Model (Pre vs. Post)

- **No adverse impacts to offsite properties (i.e. can’t flood neighbors' properties or houses)**
State Stormwater Regulations Cont. - Modeling
Stormwater Management

- Management Process
  - Collection
  - Treatment
  - Disposal
- Design Criteria
  - Proper Road longitudinal slope
  - Proper Road cross sectional slope
  - Capacity and quality analysis
- Ground Surface to ground water table elevation difference
- Right of Way Width
- Two Stormwater Management Systems:
  - Gravity System
  - Pressurized System
Available Right of Way makes a difference!

- Grassy Rd - Lake Surprise Estates
  - 50’ R/W

- SR 5/Oversea Highway - Sea Oats Beach
  - 105’ R/W

- North Dr - Stillwright Point
  - 30’ R/W*

- Stillwright Point Community Right-of-Way
  - width varies from 15’ to 30’

* Stillwright Point Community Right-of-Way width varies from 15’ to 30’
Available Right of Way makes a difference!
Stormwater Management - Gravity System

Key Factor: Ground Surface to ground water table elevation difference.

Florida’s limestone foundation

sea wall

salt water seeps under sea wall through limestone

(sealevelrise.org)
Stormwater Management - Gravity System

French Drain / Exfiltration Trench
French Drain/Exfiltration Trench Design

EXAMPLE

FRENCH DRAIN DESIGN & TREATMENT VOLUMES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Drain (ICPR Link Name)</td>
<td>PfFD2</td>
</tr>
<tr>
<td>Location</td>
<td>Sta. 35+53.40 RT</td>
</tr>
<tr>
<td>Pipe Size (in)</td>
<td>3</td>
</tr>
<tr>
<td>Length of French Drain, L (ft)</td>
<td>18000</td>
</tr>
<tr>
<td>Pipe Thickness (in)</td>
<td>3.0</td>
</tr>
<tr>
<td>Pipe Invert EL (R-NAV)</td>
<td>-1.16</td>
</tr>
<tr>
<td>Top of Trench EL (R-NAV)</td>
<td>1.59</td>
</tr>
<tr>
<td>Bottom of Trench EL (R-NAV)</td>
<td>-13.41</td>
</tr>
<tr>
<td>Trench Height, H (ft)</td>
<td>15.00</td>
</tr>
<tr>
<td>Trench Width, W (ft)</td>
<td>4.50</td>
</tr>
<tr>
<td>Average Hydraulic Conductivity, ( K_w ) (ft/ft)</td>
<td>1.160E-06</td>
</tr>
<tr>
<td>Depth to Water Table, ( H_W ) (ft)</td>
<td>0.59</td>
</tr>
<tr>
<td>Non-Saturated Trench Depth, ( D_s ) (ft)</td>
<td>0.59</td>
</tr>
<tr>
<td>Saturated Trench Depth, ( D_s ) (ft)</td>
<td>2.66</td>
</tr>
<tr>
<td>Perforated Pipe Diameter, ( d_p ) (ft)</td>
<td>0.70</td>
</tr>
<tr>
<td>Elevation, ( E ) (ft)</td>
<td>0.35</td>
</tr>
<tr>
<td>Permeability, ( K ) (ft/ft)</td>
<td>17.00</td>
</tr>
<tr>
<td>Treatment Volume Provided, V (Ac-ft)</td>
<td>3.57</td>
</tr>
</tbody>
</table>

Analysis yields FD requirements:
- Length
- Trench Depth and Height
- Diameter Perforated pipe

French Drain / Exfiltration Trench Design:
- Meets SFWMD Criteria
- How much water is being removed?
- What is the Ground water elevation?
- How quickly can the ground absorb the water? (Percolation rate)
Stormwater Management - Pressurized/Pump Station System

Pump Station and Backup Generator

Hydrodynamic Separator

Catch Basins / Inlets (Gravity Collection System)
Stormwater Management - Pressurized/Pump Station System
<table>
<thead>
<tr>
<th></th>
<th>Gravity (French Drain)</th>
<th>Pressurized (Pump Station)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to move surface water under High Ground Water Level conditions</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Increased Flexibility to expand or improve system</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Dependency on existing topography (ground elevation)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Initial Investment Cost ($)</td>
<td>Medium ($$$)</td>
<td>High ($$$$)</td>
</tr>
<tr>
<td>Operation &amp; Maintenance Cost ($)</td>
<td>Low ($)</td>
<td>High ($$$)</td>
</tr>
</tbody>
</table>
Stillwright Point Roadway Components

Typical Roadway Layers

- **Surface Course**
- **Base Course**
- **Subbase Course**

**Ground water clearance**

**Edge of Pavement**
Existing Conditions in Stillwright Point

Challenging Existing Conditions:

- All water front properties
- Low roadway and private property elevation with high ground water elevations
- Limited Right-of-Way and number/location of Utilities
- Close proximity of residential structures to the roadway
- Ineffective existing gravity drainage system (Seepage Trenches)
- Increasing Sea Level Rise conditions
Existing Conditions in Stillwright Point

Existing Conditions / King Tide Flooding

- Blackwater Sound NOAA tidal BUOY. Station that measures real time oceanographic and rain data.
- Mean Sea Level (MSL) recorded at -0.62’ NAVD88
  - Approximately 9” below the lowest road elevation point in Sexton Way.
- On October 8, 2019 it reached 1.03’ NAVD88.
  - Approximately 11” above the lowest road elevation point in Sexton Way.

Pink highlighted areas denote areas that currently flood
Existing Conditions in Stillwright Point

King Tide Flooding today vs consistent impacts from projected SLR (NOAA Intermediate-High)

Perimeter Elevation Analysis

- **2023** - King Tide conditions. Vacant parcels, natural areas, and b/w homes with EL. below ±1.5’ NAVD88.
- **2025** - Consistent inflow of sea water through Vacant parcels, natural areas, and b/w homes with EL. below 1.37’ NAVD88. (20 locations)
- **2035** - Consistent inflow of sea water through Vacant parcels, natural areas, and b/w homes with EL. below 1.79’ NAVD88. (66 locations)
- **2045** - Consistent inflow of sea water through Vacant parcels, natural areas, and b/w homes with EL. below 2.26’ NAVD88. (112 locations)
Alternative 1
Stillwright Point Current Project Update

- Design Contract Plans and Permitting (2045 SLR / KT Projections)
- Currently in the Design Phase preparing the 30% Plans (March 2024)
- Anticipated Permitting Date: June 2024 - February 2025
- Anticipated Design Completion: February 2025
Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Max Elevation amount being raised</td>
<td>2.18’</td>
</tr>
<tr>
<td>Potential Front Yard Encroachment</td>
<td>0’ to 8.5’</td>
</tr>
<tr>
<td>Initial Investment (2023-$)</td>
<td>$41,033,686.42*</td>
</tr>
</tbody>
</table>

*2020-$ = $20,195,708.31

UNIT COSTS OBTAINED FROM THE FDOT ITEM AVERAGE UNIT COST DATA BASE 12 MONTH AVERAGE FROM AUGUST 1, 2022 TO JULY 31, 2023.
Alternative 1 - Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

**Center Lane** - Existing roadway crown elevation 0.62 FT (NAVD88)

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

Edge Of Pavement Elevation raised by approximately 15” above existing ground with pressurized stormwater system to mitigate King Tides.
Alternative 1 - Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 7.5” of water above edge of roadway.

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 1 - Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

Right Of Way
Alternative 2
Alternative 2- No Adaptation Project with continued maintenance

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 2 - No Adaptation Project with continued maintenance

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 22.5” of water above edge of roadway.

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 3
Alternative 3 - Add asphalt from 1” - 6”, no drainage

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 3- Add asphalt from 1”- 6”, no drainage

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

Edge Of Pavement Elevation raised by up to 6” above existing ground with no drainage
Alternative 3 - Add asphalt from 1” - 6”, no drainage

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 17” of water above edge of roadway.
Alternative 4- Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 4- Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps

Edge Of Pavement Elevation raised by approximately 11.5" above existing ground with French Drains

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 4 - Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 11” of water above edge of roadway.

MSL: -0.62’ NAVD88

Right Of Way
Alternative 5
Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)
Alternative 5 - Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

Edge Of Pavement Elevation raised by approximately 15” above existing ground with French Drains
Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps

Center Lane - Existing roadway crown elevation 0.62 FT (NAVD88)

Right Of Way

MSL: -0.62' NAVD88

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 7.5” of water above edge of roadway.
## Stillwright Point Design Options: Comparative Analysis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage</th>
<th>Alt. 2 - No Adaptation Project with continued maintenance</th>
<th>Alternative 3- Add asphalt from 1”- 6”, no drainage</th>
<th>Alternative 4- Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps</th>
<th>Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Max Elevation amount being raised</td>
<td>2.18’</td>
<td>N/A</td>
<td>0.5’</td>
<td>1.38’</td>
<td>2.18’</td>
</tr>
<tr>
<td>Front Yard (ROW) Encroachment</td>
<td>0’ to 8.5’</td>
<td>N/A</td>
<td>No Impact</td>
<td>0’ to 4.75’</td>
<td>0’ to 9.5’</td>
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<tr>
<td>Initial Investment (2023-$)</td>
<td>$41,033,686.42</td>
<td>N/A</td>
<td>$2,587,062.17</td>
<td>$24,727,289.48</td>
<td>$26,418,101.77</td>
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<tr>
<td>Annual O&amp;M Cost</td>
<td>$ 17,662.00</td>
<td>--</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Roadway Storm Runoff contributing to Private Property Flooding</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low (Short Term and Non-KT Season) High (Long Term and during KT Season)</td>
<td>Low (Short Term and Non-KT Season) High (Long Term and during KT Season)</td>
</tr>
<tr>
<td>Roadway flooding</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low (Short Term and Non-KT Season) High (Long Term and during KT Season)</td>
<td>Low (Short Term and Non-KT Season) High (Long Term and during KT Season)</td>
</tr>
</tbody>
</table>
Policy Recommendation for Alternatives
Example of Existing Policies Shaping Roads Adaptation

Policy 1502.1.1: Prior to incorporating a new project to the Capital Improvements Element, Monroe County shall assure that it is reviewed for recommendations to increase resiliency and account for the impacts from climate change, including but not limited to, sea level rise and storm surge. Monroe County shall evaluate financial expenditures to fund repairs, reconditioning of deteriorating infrastructure and new infrastructure improvements within or proximate to vulnerable areas to manage public investments appropriately. Monroe County shall focus on level of service standards and financial costs and benefits for adaptation, as points of analysis, to assure that infrastructure useful life and service expectations can be met in the face of climate change impacts. (Ord. No. 013-2022, § 2 (Exh. 1), 8-17-2022)
Example of Existing Policies Shaping Roads Adaptation

- **Policy 1502.1.5**: By 2025, Monroe County shall initiate an inventory of existing and planned infrastructure up to the 2045 horizon, based upon the vulnerability mapping, updated elevation data, the Countywide Roads and Stormwater Vulnerability Assessment, the Watershed Management Plan, the GreenKeys Plan and other appropriate vulnerability information for capacity to accommodate projected sea-level rise over the life expectancy of that infrastructure. Monroe County shall identify the infrastructure within those areas, its useful life and any retrofits or capital projects necessary to address the impacts of sea level rise. These strategies may include defense, accommodation, or and relocation projects, or not building planned infrastructure in vulnerable locations, to address the impacts of sea level rise. Monroe County will consider developing design criteria, in conjunction with a broader asset management planning process. (Ord. No. 013-2022 , § 2 (Exh. 1), 8-17-2022)
Example of Existing Policies Shaping Roads Adaptation

- **Policy 1502.1.7**: Monroe County shall ensure that new, renovated and replacement public facilities and infrastructure, such as streets and bridges, water and wastewater treatment plants, police stations and fire stations, and any other public facilities that the County has authority over, are designed in a manner which considers the useful life of public facilities and infrastructure. The County shall also consider the potential impacts from flood risk, climate change, including rising sea levels and shoreline stabilization needs, on its infrastructure and public facilities. (Ord. No. 013-2022, § 2 (Exh. 1), 8-17-2022)
What Design Will Work? Site and Policy Factors to Consider in Deciding on Flood Mitigation Projects for Roads

- Current and projected flooding more as future conditions change due to seasonal high tide flooding and/or sea level rise
- The average elevations of adjacent property and if they are higher or lower than the road
- Whether there is adequate County-owned right-of-way to implement the project
- Previous maintenance activity / costs as compared to similarly situated road segments
- The number of vacant parcels where flooding will occur on them or they will be a conduit for flooding on the road
- The amount of county-owned property in the neighborhood
- Whether it is cost effective to complete the road project in the community
- Future performance/effectiveness of solution given a potential design’s limitations (gravity systems may be currently failing or will fail in the future)
- Future ownership and maintenance of the road, the County or adjacent property owners?
- Community views on project design
Summary of Policy Recommendations for Road Design

- **Flowage/ROW Easement to accommodate a higher/wider road (recorded):** A right to flood privately owned land typically held by a government agency provided to county and recorded, that will allow the land to be flooded because roads without a drainage system, or a minimal drainage system, can flood nearby ROW during rain events. County controls activities within the easement area (no fill or physical structures, no swales or drainage structures privately constructed). **Why?** Provide more County right-of-way where roadway stormwater run-off will drain and provide the County protection from future lawsuits alleging road design with limited drainage system (or NO drainage system) floods adjacent properties (site-specific). ROW (not flowage) easement may be needed to potentially accommodate higher/wider road.

- **Adjacent Property and Easement Fill Policy:** People will not be able to park, improve or fill property in easement areas and will need to limit to certain slopes any fill they place on their property to harmonize elevations with easement areas. **Why?** Those areas need to be free of cars, improvements, fill and landscaping to provide drainage/water storage function.

- **Signage:** Signage indicating potential flooding hazards. **Why?** Warns residents and visitors of hazardous flooding conditions.

- **Real Estate Flood Disclosure:** A required real estate disclosure for property sales where the seller discloses to the buyer that the roads may flood, may only receive maintenance (no guarantee of future elevation) and that an easement (where needed) has been provided to the County. **Why?** Puts future buyers on notice managing expectations related to increased tidal flooding and other issues related to limitation of road design.

- **County Road Abandonment:** Abandon the road to the abutting property owners. **Why?** Allows private property owners to build a road project and maintain it based on a permitted design.
A Keys Policy Tool & Recommendation: Environmentally Challenging Locations

- **What is it?** A designation of areas where elevations are low, right of way is constrained, flooding conditions are occurring now, routinely, and road designs (elevation and drainage) may not be able to meet service expectations.

- **Why do it?** A tool that was used in another community to manage expectations and clarify how the County will evaluate projects in those “constrained” areas and manage future obligations and liability.

- **Where would it apply?** In locations where the properties are low elevation and the ROW is constrained (estimated less than 10 areas countywide).
Examples of How ECL Policy Would be Implemented

- **New Policy** defining what ECLs are (characteristics of low elevations, existing and predicted flood risk, limited right of way, etc.)

- **Policy 1502.1.5**: By 2025, Monroe County shall initiate an inventory of existing and planned infrastructure up to the 2045 horizon, based upon the vulnerability mapping, updated elevation data, the Countywide Roads and Stormwater Vulnerability Assessment, the Watershed Management Plan, the GreenKeys Plan and other appropriate vulnerability information for capacity to accommodate projected sea-level rise over the life expectancy of that infrastructure. Monroe County shall identify the infrastructure within those areas, its useful life and any retrofits or capital projects necessary to address the impacts of sea level rise. These strategies may include defense, accommodation, or and relocation projects, or not building planned infrastructure in vulnerable locations, to address the impacts of sea level rise. Monroe County will consider developing design criteria, in conjunction with a broader asset management planning process. (Ord. No. 013-2022, § 2(Exh. 1), 8-17-2022).

In environmentally challenging locations the County shall evaluate the following in considering road projects: requiring additional right of way, limiting fill placement on property, specific real estate flood disclosures, possible abandonment of roads and limits on future adaptation projects.
Policy Recommendations for Road Projects

Generally, on road projects Countywide:

- Policy on “site and policy factors” considered in road design project evaluation & modify current Code on road design standards
- Real Estate Flood disclosure language included in Code
- Road Flood Signage Program
- Modify road abandonment ordinance
- Modify fill policy to address harmonizing with right of way needs for road design
- Flowage easement policy

Environmentally Challenging Locations Designation (in approx. 10 locations throughout County) & Comp Plan Policies for what will be evaluated in these locations

In these areas, the policy recommendations listed above would be more specific to address elevation, right of way needs and design limitations

Policy Recommendations for Current project
Pumped System and Elevation to 2045 (Alt. 1)

Existing Conditions:
- Prolonged flooding during rain events and seasonal King Tides
- Periodic Flooding during high tides
- Conditions will degrade

Design Elements:
- Road base may be modified
- Elevation as designed for a 2045 future flood condition
- Pumped system to manage stormwater

Pros and Cons:
- Regulatory triggers, pumped drainage requires additional cost, avoids flooding adjacent properties and manages stormwater

Consequences and Challenges | Policy Needs | Why are Policies Needed?
--- | --- | ---
- Road designed not flood outside of existing County right of way (2045) | Real estate disclosure | Policy recognizes design may be impacted in the long term and manages expectations
- Addresses high and seasonal King Tides (2045), but declining over a longer period of time as sea levels increase | Fill policy | Right of way easement to accommodate higher/wider road
- Return on investment achieved for a longer period of time | ROW Easement (maybe not flowage) | Private property fill prohibited in easement area (if needed)

Real estate disclosure manages transparency so future buyers understand the future flooding risks and possible long-term impacts to project design over time.
Policy Recommendations for No Adaptation Project (Alt. 2)

Existing Conditions:
- Prolonged flooding during rain events & seasonal King Tides
- Periodic Flooding during high tides
- Conditions will degrade

Design Elements:
- Road not modified
- Maintenance only (cracks, potholes, resurfacing) will be needed more often (if County does not abandon road maintenance cost will increase over time)

Pros and Cons:
- No regulatory triggers, cheaper (maintenance only), could create runoff issues on adjacent properties requiring flowage easements on some properties

<table>
<thead>
<tr>
<th>Consequences/Challenges</th>
<th>Policy Needs</th>
<th>Why are Policies Needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Road may flood outside existing County right of way</td>
<td>• Environmentally Challenging Designation (possibly abandon road)</td>
<td>• 1) County implements no adaptation response &amp; continues to maintain the road OR 2) County can abandon it to adjacent property owners (future adaptation project design and cost determined by community because it will be a private road).</td>
</tr>
<tr>
<td>• No benefits addressing rainfall, routine high and seasonal King Tides flooding now</td>
<td>• Flowage easement need is uncertain</td>
<td>• Flowage easement need and status is uncertain</td>
</tr>
<tr>
<td></td>
<td>• Real estate disclosure</td>
<td>• Private property fill prohibited in existing right-of-way</td>
</tr>
<tr>
<td></td>
<td>• Fill policy</td>
<td>• Real estate disclosure manages transparency so future buyers understand there is no expectation for any level of service beyond routine maintenance, it advises of current and future tidal flooding risks and increasing flooding over time.</td>
</tr>
<tr>
<td></td>
<td>• Signage</td>
<td></td>
</tr>
</tbody>
</table>
Policy Recommendations for 1 - 6 Inches of Pavement (Alt. 3)

Existing Conditions:
- Prolonged flooding during rain events & seasonal King Tides
- Periodic Flooding during high tides
- Conditions will degrade

Design Elements:
- Road base not modified
- Some pavement elevation varying 1-6” of pavement depending on adjacent property elevation

Pros and Cons:
- Faster, minimal regulatory triggers, cheaper, could create runoff issues on adjacent properties requiring flowage easements on some properties

<table>
<thead>
<tr>
<th>Consequences/Challenges</th>
<th>Policy Needs</th>
<th>Why are Policies Needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Road may flood outside existing County right of way</td>
<td>• Environmentally Challenging Designation (possibly abandon road)</td>
<td>• Policy recognizes limited design now/manages expectations where 1) County limits adaptation response to this project only &amp; continues to maintain the road OR 2) County can improve road now and abandon it to adjacent property owners (future adaptation project design and cost determined by community because it will be a private road).</td>
</tr>
<tr>
<td>• Minimal benefits addressing rainfall, routine high and seasonal King Tides flooding now</td>
<td>• May need Flowage easement based on site-specific conditions</td>
<td></td>
</tr>
<tr>
<td>• Return on investment may not be realized at all upon construction completion (road may still flood that same year)</td>
<td>• Real estate disclosure</td>
<td>• Flowage easement allows stormwater run-off to be accommodated in expanded County right-of-way where necessary (site specific, maybe not all properties)</td>
</tr>
<tr>
<td></td>
<td>• Fill policy</td>
<td>• Private property fill prohibited in flowage easement area (if easement needed)</td>
</tr>
</tbody>
</table>
|                                  | • Signage                                        | • Real estate disclosure manages transparency so future buyers understand the adopted design constraints, **but for this design**, it advises of current and future tidal flooding risks and diminishing effectiveness of 1-6” pavement design over time.

12/12/2023
Policy Recommendations for French Drains and Elevation to 2030 / 2045 (Alt 4/5)

Existing Conditions:
- Prolonged flooding during rain events and seasonal King Tides
- Periodic Flooding during high tides
- Conditions will degrade

Design Elements:
- Road base may be modified
- Elevation as designed for a 2030 or 2045 future flood condition
- French drains to manage stormwater

Pros and Cons:
- French drains require additional costs, regulatory triggers, cheaper than pumped system, could create runoff issues on adjacent properties requiring flowage easements on some properties

<table>
<thead>
<tr>
<th>Consequences and Challenges</th>
<th>Policy Needs</th>
<th>Why are Policies Needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Road may flood outside of existing County right of way</td>
<td>• Environmentally Challenging Designation (possibly)</td>
<td>• Policy recognizes limited design/manages expectations where County limits adaptation response to this project only &amp; continues to maintain the road</td>
</tr>
<tr>
<td>• Some benefits addressing high and seasonal King Tides, but declining over a mid range periods of time as sea levels increase</td>
<td>• May need Flowage easement based on site-specific conditions</td>
<td></td>
</tr>
<tr>
<td>• Return on investment for a significant construction project diminishes quickly</td>
<td>• Real estate disclosure</td>
<td>• Flowage easement allows stormwater run-off to be accommodated on expanded County right-of-way where necessary (site specific, maybe not all properties)</td>
</tr>
<tr>
<td>• Fill policy</td>
<td>• Signage</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• Real estate disclosure manages transparency so future buyers understand the adopted design constraints, but for this design, it advises of current and future tidal flooding risks and diminishing effectiveness of French Drain design over time.</td>
</tr>
</tbody>
</table>
# Recommended Policies and Their Application to Design Alternatives

<table>
<thead>
<tr>
<th>Option</th>
<th>Flood Hazard Signage</th>
<th>Environmentally Challenging Designation</th>
<th>Flowage or ROW Easement</th>
<th>Real Estate Disclosure</th>
<th>Adjacent property fill limitations</th>
<th>County Road Abandonment (becomes private Road)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt. 1: Current project Pumped System</td>
<td>No</td>
<td>No</td>
<td>Possible ROW easement- flowage easements unlikely</td>
<td>Yes- advises of long-term flooding impacts</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Alt. 2: No Adaptation Project</td>
<td>Yes</td>
<td>Yes</td>
<td>Uncertain</td>
<td>Yes- advises of current/future flood impacts and road design limitations</td>
<td>Yes</td>
<td>Possible</td>
</tr>
<tr>
<td>Alt. 3: 1-6” of Pavement</td>
<td>Yes</td>
<td>Yes</td>
<td>Flowage on numerous properties</td>
<td>Yes- advises of current/future flood impacts and road design limitations</td>
<td>Yes</td>
<td>Possible</td>
</tr>
<tr>
<td>Alt. 4/5: French Drains</td>
<td>Yes</td>
<td>Yes</td>
<td>Possible flowage easement on some properties</td>
<td>Yes- advises of current/future flood impacts and road design limitations</td>
<td>Yes</td>
<td>Possible</td>
</tr>
</tbody>
</table>
Funding
Funding Challenge

- Increased project cost
- Limited Grant Opportunities
  - Potential State Grants
  - Potential Federal Grants
- Local Funding
  - County Revenue
  - Assessments - Capital and O&M
  - New Local Revenue - Potential Additional Penny Sales Tax
Break
Public Comment
Commission Discussion
Thank You!
## Stillwright Point Design Options: Comparative Analysis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage</th>
<th>Alt. 2 - No Adaptation Project with continued maintenance</th>
<th>Alternative 3- Add asphalt from 1”- 6”, no drainage</th>
<th>Alternative 4- Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps</th>
<th>Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Max Elevation amount being raised</td>
<td>2.18’</td>
<td>N/A</td>
<td>0.5’</td>
<td>1.38’</td>
<td>2.18’</td>
</tr>
<tr>
<td>Front Yard (ROW) Encroachment</td>
<td>0’ to 8.5’</td>
<td>N/A</td>
<td>No Impact</td>
<td>0' to 4.75’</td>
<td>0' to 9.5’</td>
</tr>
<tr>
<td>Initial Investment (2023-$)</td>
<td>$41,033,686.42</td>
<td>N/A</td>
<td>$2,587,062.17</td>
<td>$24,727,289.48</td>
<td>$26,418,101.77</td>
</tr>
<tr>
<td>Annual O&amp;M Cost</td>
<td>$17,662.00</td>
<td>--</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Roadway Storm Runoff contributing to Private Property Flooding</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low (Short Term and Non-KT Season)</td>
<td>Low (Short Term and Non-KT Season)</td>
</tr>
<tr>
<td>Roadway flooding</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High (Long Term and during KT Season)</td>
<td>High (Long Term and during KT Season)</td>
</tr>
</tbody>
</table>

- **Low** (Short Term and Non-KT Season)
- **High** (Long Term and during KT Season)
Grassy Road - Gravity System
Alternative 1 - Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)
Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

Edge Of Pavement Elevation raised by approximately 5” above existing ground with pressurized stormwater system to mitigate King Tides.
Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

Right Of Way

Right Of Way

MSL: -0.62' NAVD88

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 3” of water above edge of roadway.
Alternative 1- Current Project Scope, Schedule, and Cost: Elevation using 2045 sea level rise and king tide projections, with pumped drainage

Right Of Way

Right Of Way

MSL: -0.62' NAVD88

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)
Alternative 2- No Adaptation Project with continued maintenance

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)
Alternative 2- No Adaptation Project with continued maintenance

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

2025 King Tide projected to be 2.51 FT (NAVD88). Approximately 8” of water above edge of roadway.
Alternative 3 - Add asphalt from 1” - 6”, no drainage

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)
Alternative 3 - Add asphalt from 1” - 6”, no drainage

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

Edge Of Pavement Elevation raised by up to 6” above existing ground with no drainage
Alternative 3 - Add asphalt from 1”- 6”, no drainage

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

2025 King Tide projected to be 2.51 FT (NAVD88).
Approximately 2” of water above edge of roadway.
Alternative 4- Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)
South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

Alternative 4- Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps

Edge Of Pavement Elevation not raised and matches existing ground with French Drains

12 ft. to bottom
Alternative 4 - Elevation using 2030 sea level rise and king tide projections, with gravity drainage only and no pumps.

MSL: 
-0.62’ NAVD88

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)

2025 King Tide projected to be 2.51 FT (NAVD88).
Approximately 8” of water above edge of roadway.
Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps
Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps

South Blackwater Lane - Existing roadway crown elevation 1.85 FT (NAVD88)
Alternative 5- Elevation using 2045 sea level rise and king tide projections, with gravity drainage only and no pumps.