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# Utilizing Natural Channel Design Principles for Infrastructure Protection: A Resilient Approach to Reducing Utility Infrastructure Risk in Stream Environments

**Presented by:**
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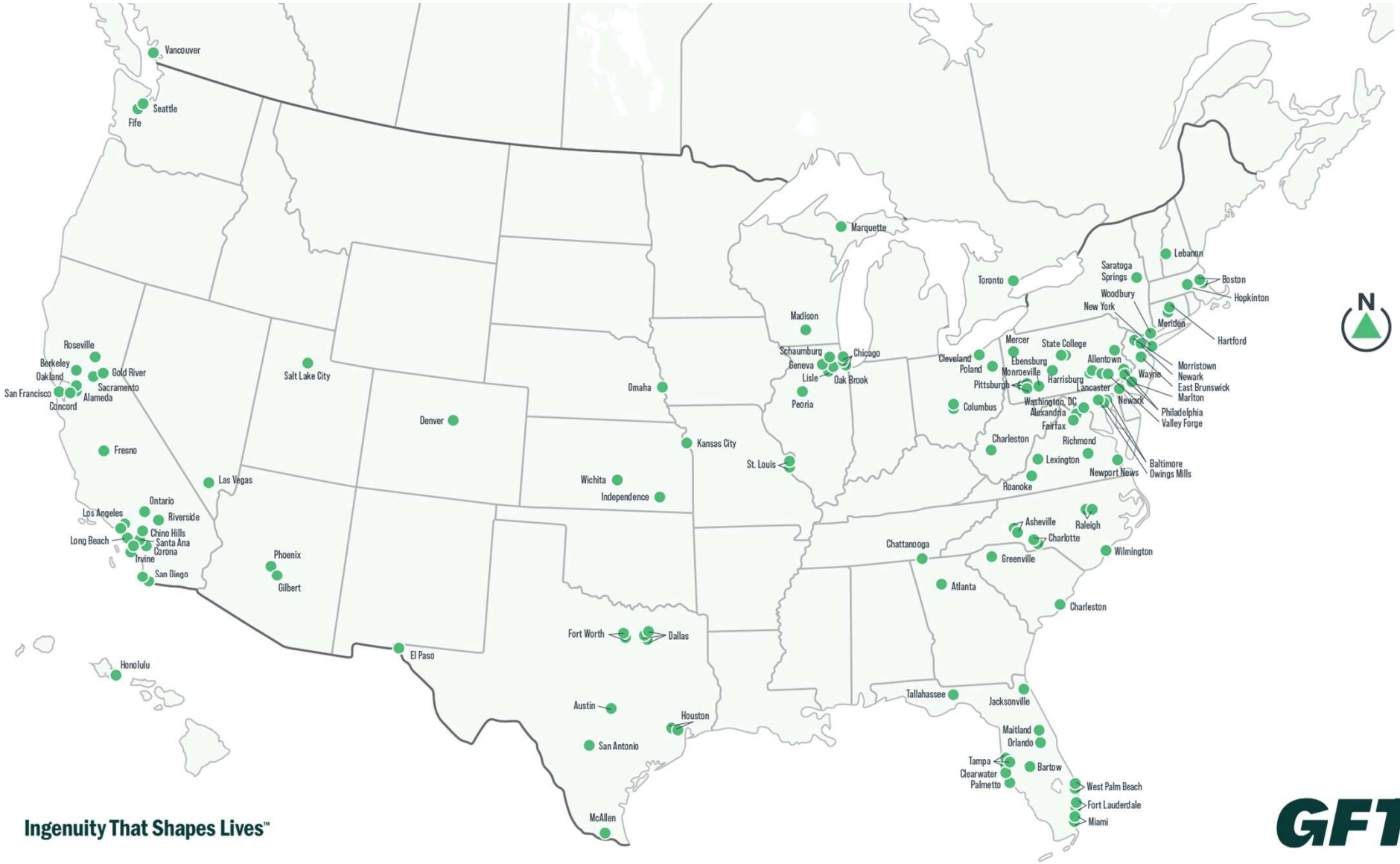
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# Presentation Outline

- Causes of Stream Instability and the Impact on Utility Infrastructure
- Overview of Natural Channel Design (NCD) Principles
- Benefits of Using a NCD Approach for Utility Protection
- Project Spotlights
- Practice Insights



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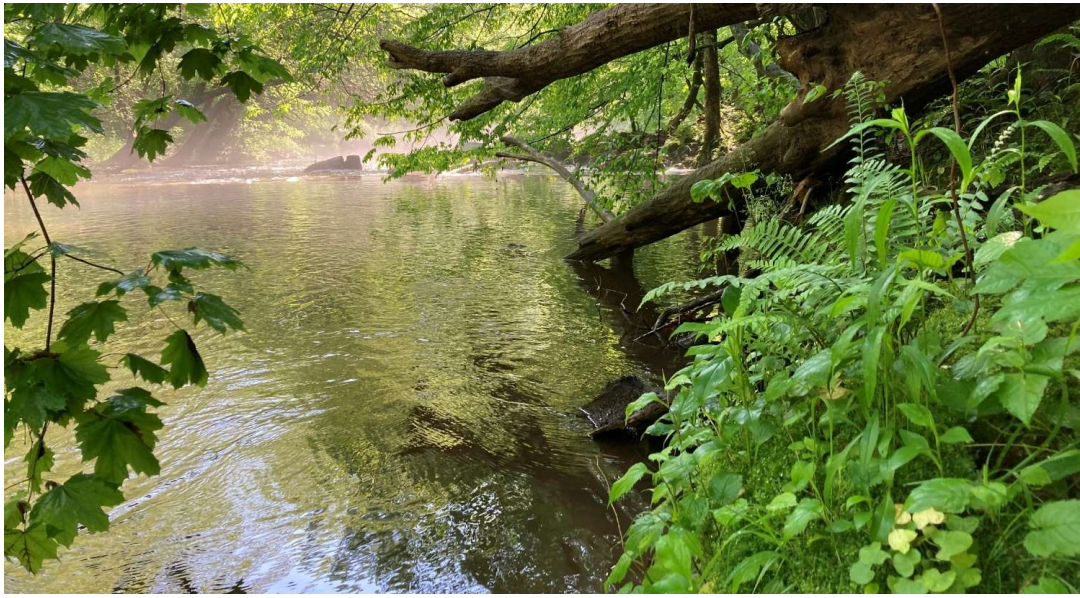
## Factors Influencing Stream Stability

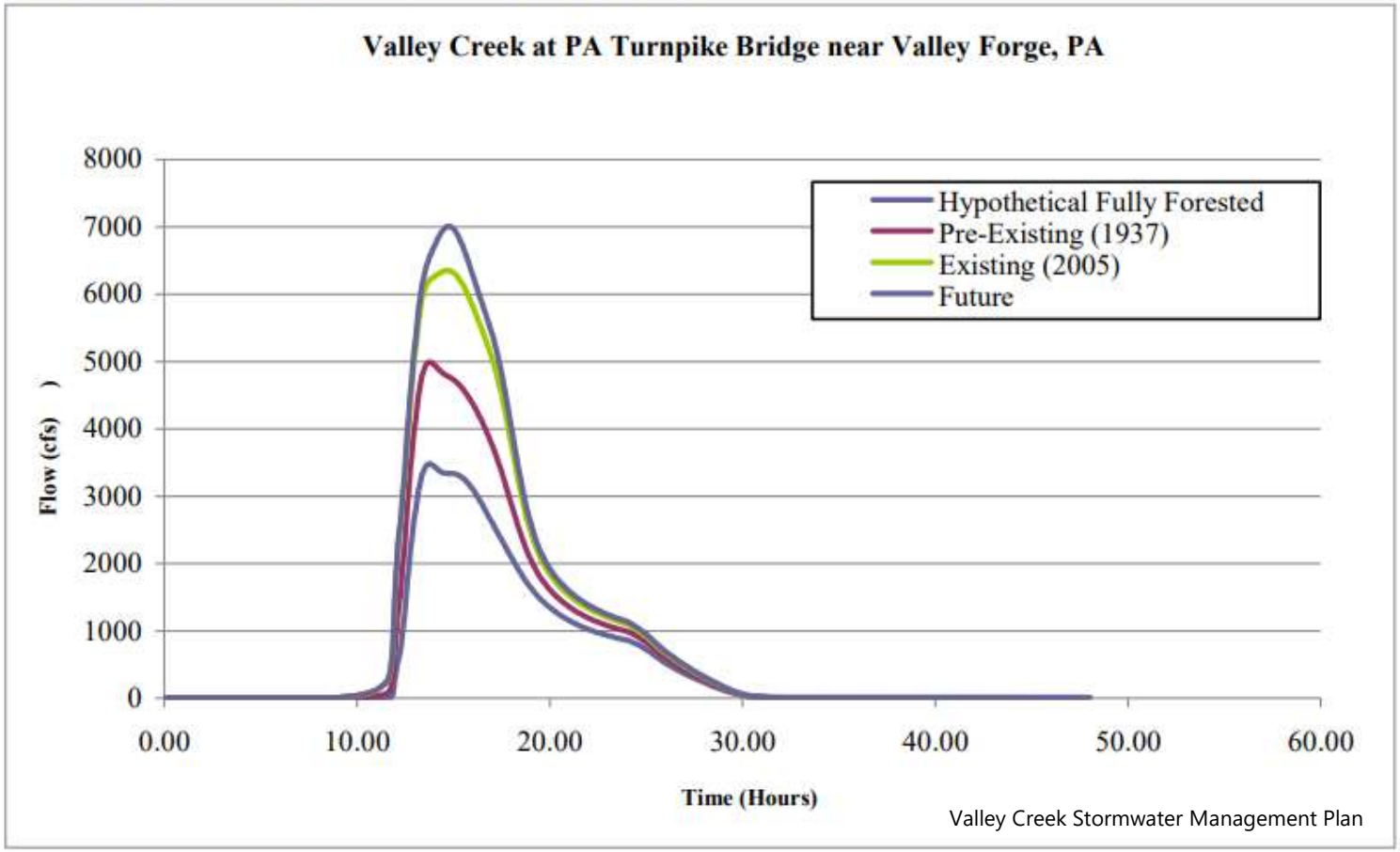
A stable natural stream system supports a consistent channel morphology (slope, width, and depth), neither aggrades nor degrades, has good floodplain connectivity, diverse habitat features, balanced sediment loads, and is resilient to disturbance



## Streams reflect the conditions of the watersheds through which they flow

- Urbanized or developed watersheds are characterized by….
  - Increased stormwater runoff
  - "Flashy flows" and higher peak flows
  - Streambank erosion and channel instability

**FIGURE 3-1**
**100 – YEAR HYDROGRAPH COMPARISON –**
**HYPOTHETICAL FULLY FORESTED, PRE-EXISTING (1937),**
**EXISTING (2005), AND FUTURE BUILD-OUT CONDITION**





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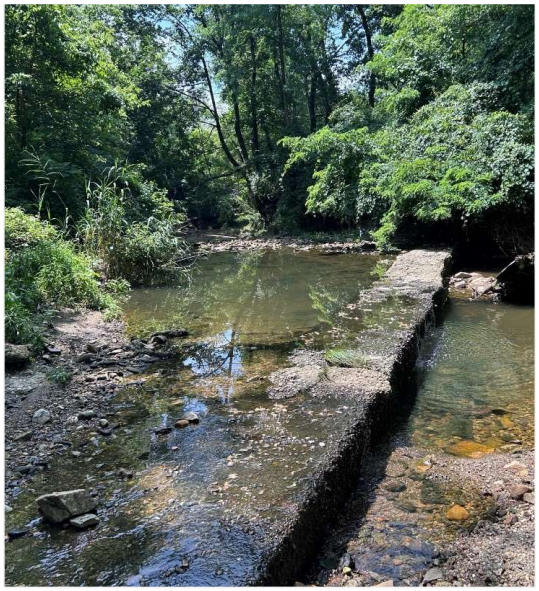
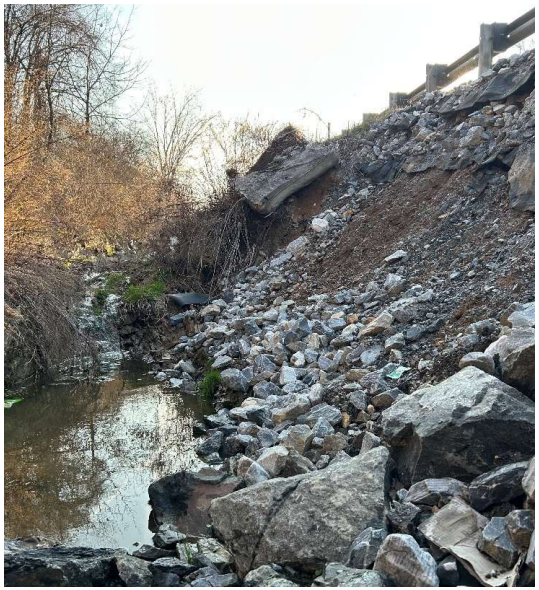
# Channel Instability Increases Risks to Adjacent Utilities

- Channel downcutting and lateral migration can often result in exposure of utility infrastructure
- Increased vulnerability during flood events



# Effectiveness of traditional bank armoring is limited

- Protect a limited area and can cause downstream erosion
- Does not reduce channel velocities or shear stress
- Typically requires ongoing maintenance
- Does not improve floodplain connectivity or improve flood water retention
- Little benefit to aquatic habitat



# Natural Channel Design Principles

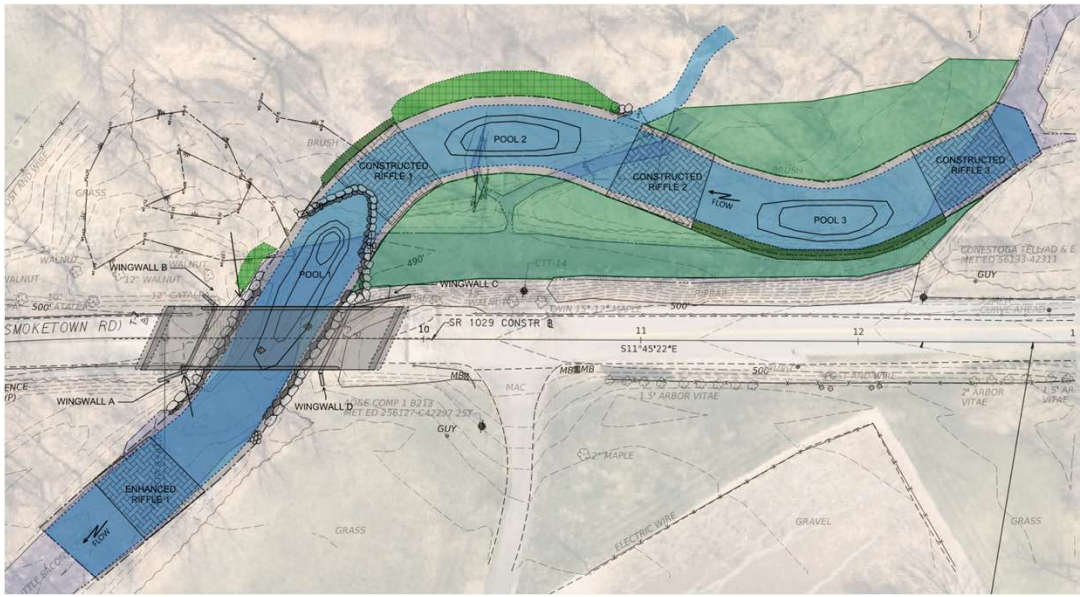
Natural Channel Design: A stream restoration method that reconstructs degraded watercourses to mimic their stable, natural forms, balancing hydraulic, geomorphic, and ecological functions

# Natural Channel Design Principles

- Design parameters derived from stable reference reaches
- Bankfull flow (channel forming discharge) used to establish channel width, depth, and cross sectional area

# Natural Channel Design Principles

- Mimics reference planform geometry: meander wavelength, riffle-pool spacing, slope, radius of curvature, sinuosity, etc.
- Ensures sediment transport competence
- Heavier reliance on utilizing natural materials and bioengineering practices



# Benefits of Using Natural Channel Design

## Long term stream stability

NCD addresses the root causes of channel instability to offer long-term infrastructure protection



## Improved channel hydraulics and geomorphology

Improved channel dimension and pattern dissipates energy and improves sediment transport



## Ecological Uplift

Incorporation of natural materials and bioengineering practices with native materials improves habitat and water quality



## Permitting Considerations

Natural approaches to repairing stream instability is gaining traction among permitting agencies



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# Case Study: Gulph Creek





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# Case Study: Gulph Creek


# Case Study: Coopers Branch





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# Case Study: Tacony Creek





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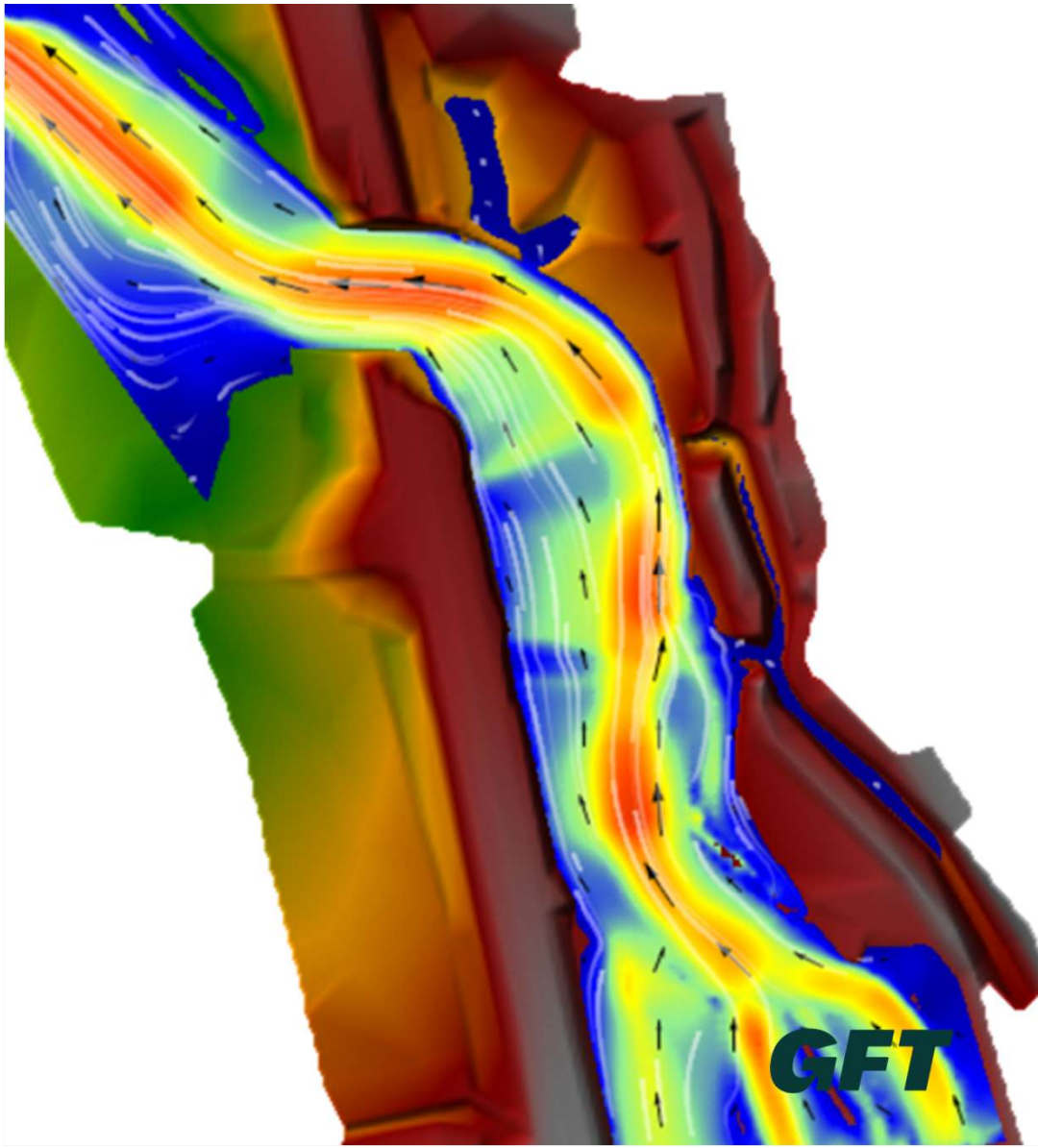
## NCD Practice Insights

- Develop a thorough understanding of the project watershed
- Evaluate the size, scope, and access required to ensure a long-term solution to addressing the problem area
- Time of year is critical: instream restrictions & planting success
- Contractor selection: finesse can be required for complicated projects

# Stream Design Science Continues to Improve at a Rapid Pace

- Significant improvements in both restoration techniques and modeling science over the past few decades
- Detailed 2D model development allows you to visualize iterations under various storm events



# Closing Take Aways

- Stream channels in urban and suburban environments are highly susceptible to hydraulic conditions that result in channel instability putting adjacent utility infrastructure at risk.
- Natural Channel Design principles allow for a more holistic approach that addresses the root causes of stream instability
- NCD principles can result in long-term utility infrastructure protection while improving channel hydraulics, increasing flood attenuation, and providing ecological uplift
- Stream restoration science has rapidly evolved over the past few decades and offers a more resilient and dynamic approach to utility protection in the face of increasing storm and precipitation intensity.

# Thank You! – Questions?

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