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# The White River Tunnel Vision for Capturing CSO

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## Presentation Overview

- Indianapolis' CSO LTCP
- Overview of Planned Tunnel System
- Fall Creek / White River Tunnel System (FCWRTS)
- Geotechnical Investigation Summary
- Groundwater Management Plan (GWMP)
- Value Engineering
- Next Steps



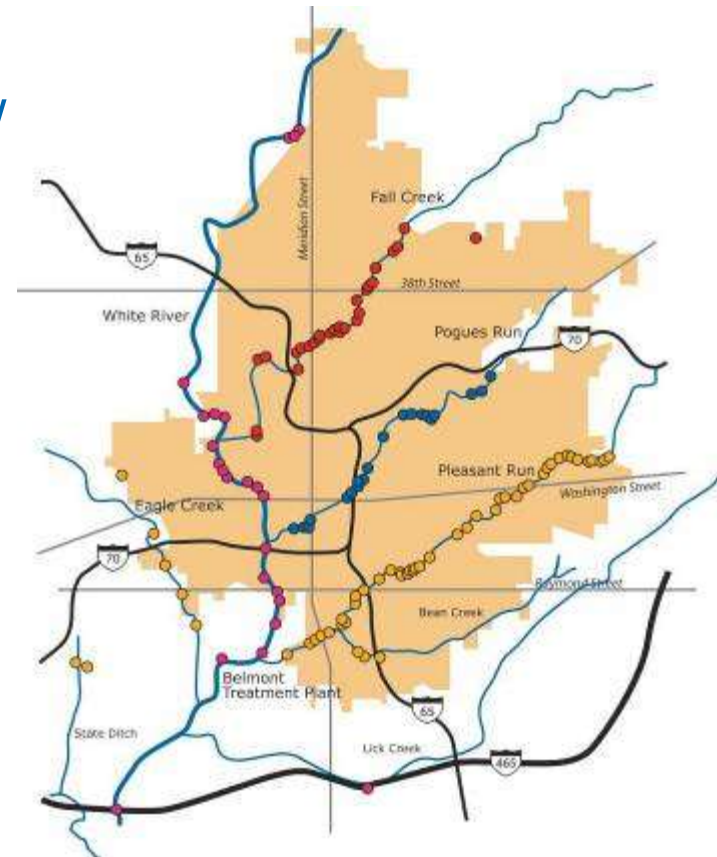
CSO Outfall on Fall Creek



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## Indianapolis' CSO LTCP Overview

- Each year, an average of 7.87 billion gallons of combined sewage overflow into Indianapolis streams
- 45-80 times a year, overflows send bacteria, pathogens and untreated waste into:
  - White River
  - Fall Creek
  - Pogues Run
  - Pleasant Run & Bean Creek
  - Eagle Creek
  - Lick Creek & State Ditch





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## Indianapolis' CSO LTCP Overview

- City's CSO Long Term Control Plan is Multi-Faceted and includes:
  - Using Existing System Capacity
    - Inflatable Dams and Pinch Valves
  - Constructing New Storage and Conveyance
    - Deep Rock Tunnel System
    - Storage Tanks
  - Expanding and Upgrading Treatment Facilities
    - Belmont AWTP
    - Southport AWTP



**Belmont AWTP**



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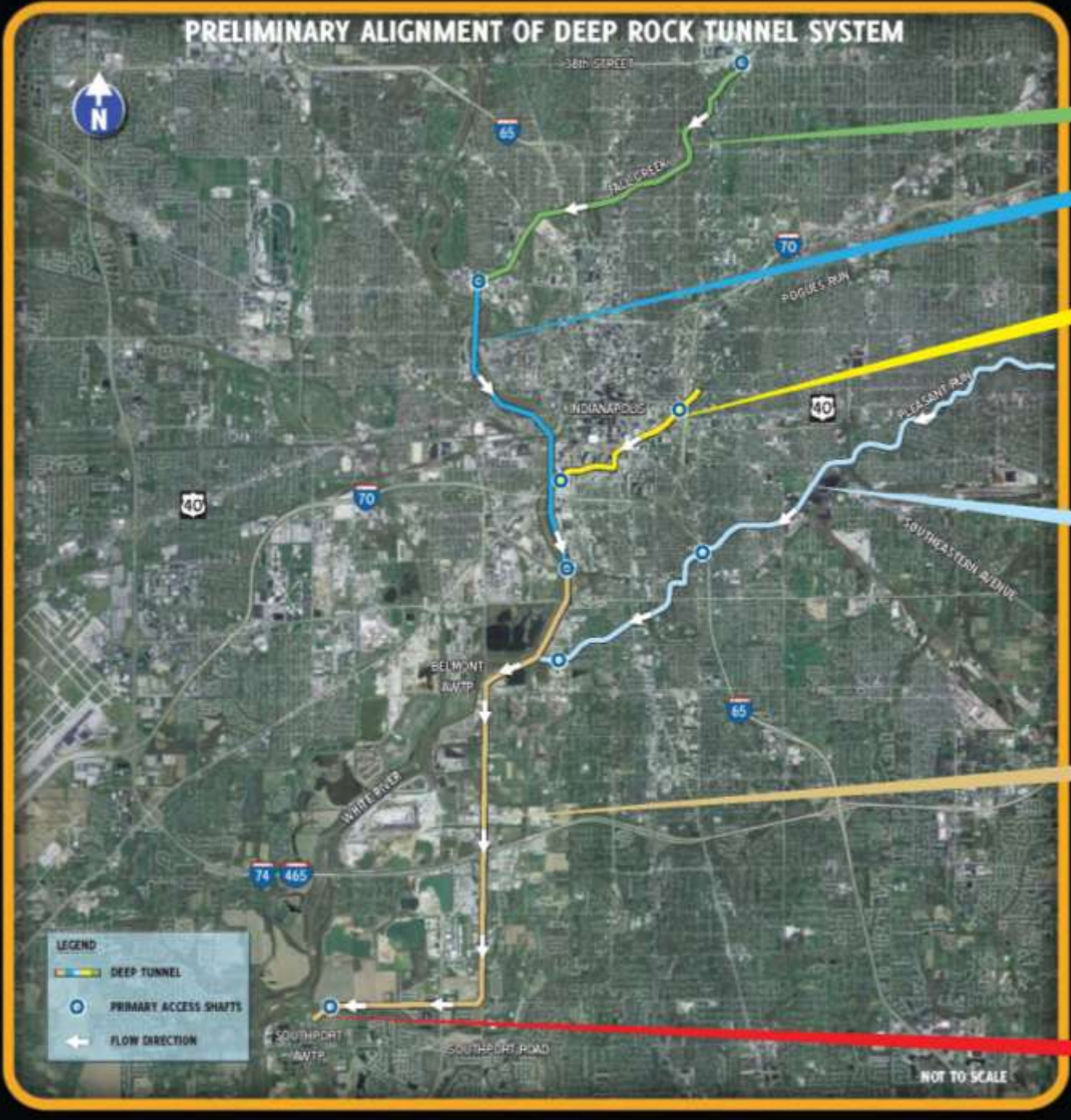
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## **Development of Deep Rock Tunnel System**

- City Initially Planned a Deep Bedrock Tunnel Only for the Fall Creek and White River Segments
- Lower White River Segment was Originally a Pipeline and Soft Ground Tunnel for the Interconnection of Both of City's AWTPs
- Near Surface Pipelines and Soft Ground Tunnel Planned for Other Creek CSOs
- Plan Morphed into Deep Rock Tunnel System

# PRELIMINARY ALIGNMENT OF DEEP ROCK TUNNEL SYSTEM



## DEEP TUNNEL SYSTEM SEGMENTS AND KEY PRELIMINARY DETAILS

**FALL CREEK / WHITE RIVER TUNNEL SYSTEM (FCWRTS)**

FCWRTS is anticipated to be an 18-foot finished diameter tunnel approximately 46,000 feet in length.

FCWRTS consists of two segments: 1) Fall Creek Tunnel Segment, length approximately 27,000 feet; and 2) White River Tunnel Segment, length approximately 19,000 feet.

Tunnel will be an average of 270 feet deep and is anticipated to be constructed in limestone and dolomite using a main beam tunnel boring machine (TBM).

Deep tunnel access shafts are anticipated to be up to 35 feet finished diameter.

Up to 20 drop shaft vortex and baffle structures will be constructed to drop flows into the tunnel capable of conveying combined sewer overflows up to 400 MGD.

**LOWER POGUES RUN TUNNEL (LPgRT)**

LPgRT will be a deep rock tunnel in limestone and dolomite, and approximately 11,000 feet long, 250 feet deep and 18-foot finished diameter.

Utilization of trenchless technology to install 20 to 50 feet deep consolidation sewers approximately eight feet in diameter.

Anticipate up to three drop shafts that will convey flow into the tunnel from eight combined sewer overflows that currently discharge into Lower Pogue's Run and ultimately into the White River.

**PLEASANT RUN DEEP TUNNEL (PRDT)**

PRDT will be an 18-foot finished diameter tunnel, nearly 34,000 feet long and approximately 250 ft deep.

PRDT is anticipated to be constructed in limestone and dolomite using a main beam TBM.

Tunnel alignment will have two 35-foot finished diameter shafts, one tunnel working shaft and one TBM retrieval shaft.

Upstream reach is expected to include a 4-foot finished diameter soft ground microtunnel, nearly 6,000 feet long and an average of 35 feet deep.

Up to eight drop shaft vortex structures will be constructed to drop flows into the tunnel capable of conveying combined sewer overflows up to 260 MGD.

**DEEP ROCK TUNNEL CONNECTOR (DRTC)**

DRTC will terminate at the Southpart AWTP and is anticipated to be an 18-foot finished diameter tunnel nearly 40,000 feet in length.

Tunnel will be an average of 270 feet deep and is anticipated to be constructed in limestone and dolomite using a main beam TBM.

Deep tunnel access shafts are anticipated to be constructed up to 35 feet finished diameter.

Three vortex shaft structures are planned to be constructed to drop flows into the tunnel capable of conveying total combined sewer overflows up to 530 MGD.

**DEEP ROCK TUNNEL CONNECTOR PUMP STATION (DRTCPS)**

A 130 MGD dewatering pump station will be constructed in the bedrock at the downstream terminus of the tunnel system.

Pump station is anticipated to be constructed as a cavern approximately 270 feet below ground surface, and sized at approximately 115 feet long by 70 feet wide by 80 feet high.

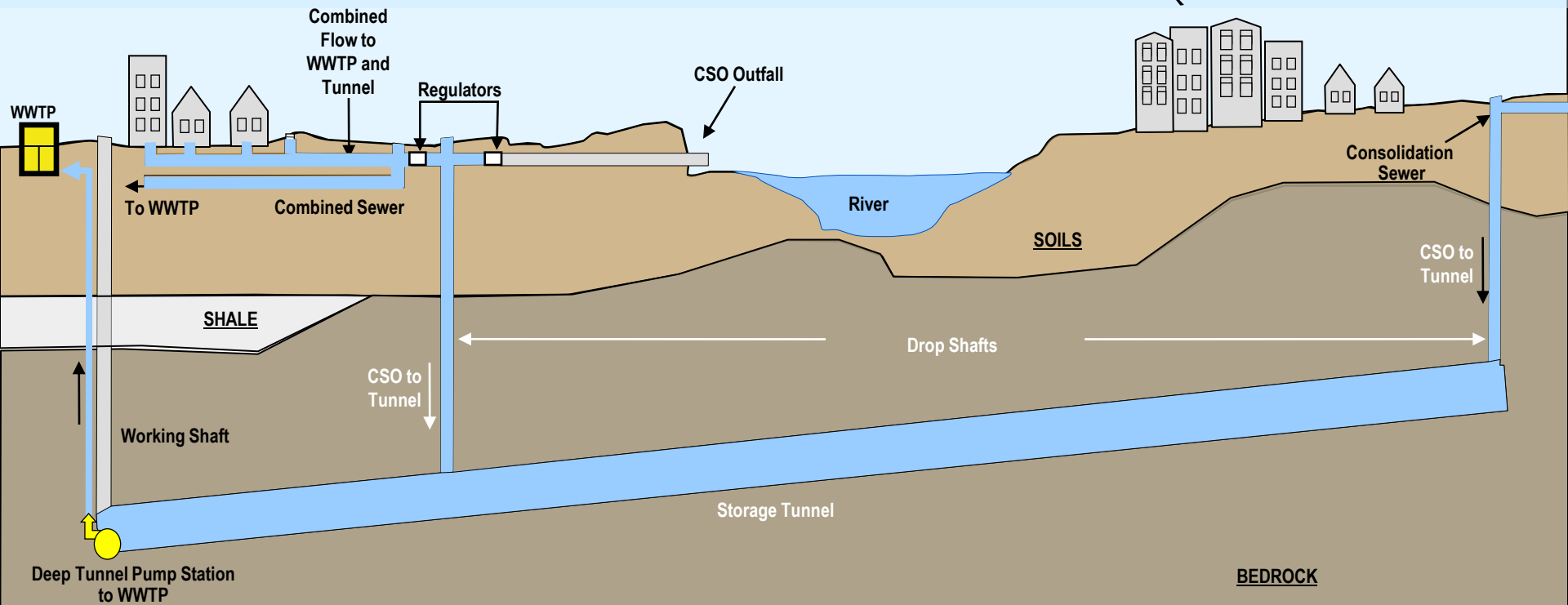
Pump station is expected to have a 35-foot finished diameter access shaft, and a 25-foot finished diameter discharge shaft.

Pump station will include four 1,000 horsepower dewatering pumps, each sized for 30 MGD at 270 feet total dynamic head.

Pump station will include a separate 25-foot finished diameter screening and grit removal shaft.



# Deep Tunnel System - How it Works

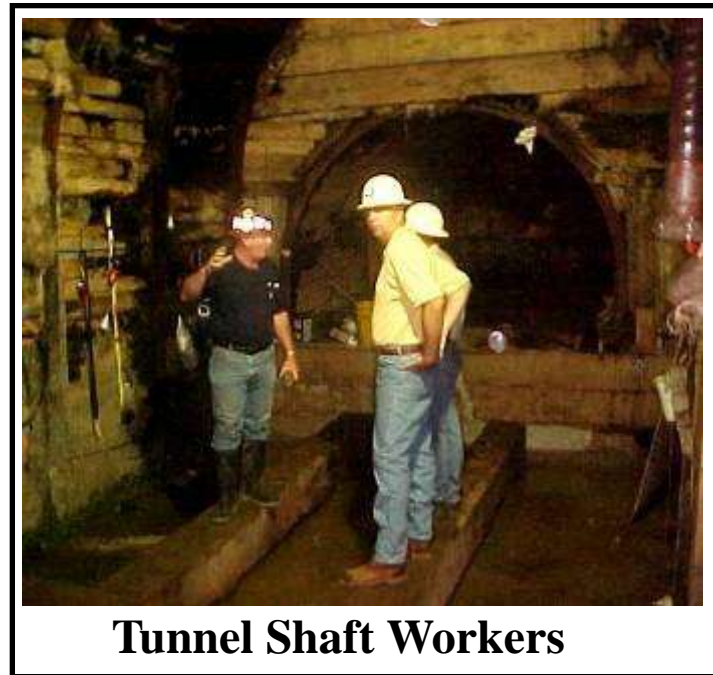




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## FCWRTS Components

- Alignments to Capture CSOs from 39 Outfalls
  - 27 along Fall Creek, 12 along White River
- Main Tunnel
- Connection Tunnels
- Working and Retrieval Shafts
- Consolidation Sewers
- Drop Shafts
- DRTC Interface
- LPgRT Interface



**Tunnel Shaft Workers**



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## FCWRTS Details

- ~11 miles long
  - ~8.5 mile Main Tunnel
  - ~2.5 miles Connection Tunnels
- ~18-foot diameter
- ~120 MG capacity
- ~200-250 feet deep in bedrock
- ~19 drop shafts
- Up to 150 MGD Deep Tunnel PS at Southport AWT (DRTC)



Rock Tunnel Cutter Head



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## Geotechnical Investigations

- Over 150 Borings Drilled to Date Up to 300 Feet Below Ground Surface
- Vertical and Inclined Deep Rock Borings Drilled
- Piezometers and Cluster Monitoring Wells Set in Vertical Borings
- Sampling and Testing of Physical Rock and Soil Characteristics
- Soil and Groundwater Environmental Screening and Sampling
- Hydraulic Packer Testing of Bedrock Permeability



**Track mounted CME-55 drill rig onsite**



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## **Summary of Geotechnical Findings**

- Alluvial (Surficial) Soils Range from approximately 75 – 100 Feet Thick
- Alluvial Soils are Primarily Sand with some Clay and Silt Units
- Groundwater Table Generally within 25 feet of Ground Surface
- Fairly High Permeabilities in Alluvium
- Slug Testing and Pump Testing Being Performed



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## **Summary of Geotechnical Findings**

- Bedrock Consists Primarily of Competent Limestone and Dolomite
- Shale Underlying the Alluvial Soil on Southern End of FCWRTS and Entire DRTC Alignment
- Shale Ranges from 6 – 30 Feet Thick
- Bedrock was Weathered Near Soil/Rock Interface
- Bedrock Permeability Fairly Consistent Throughout Deep Bedrock Layers (150'+)
- No High Permeability Zones Encountered in Proposed Tunnel Envelope



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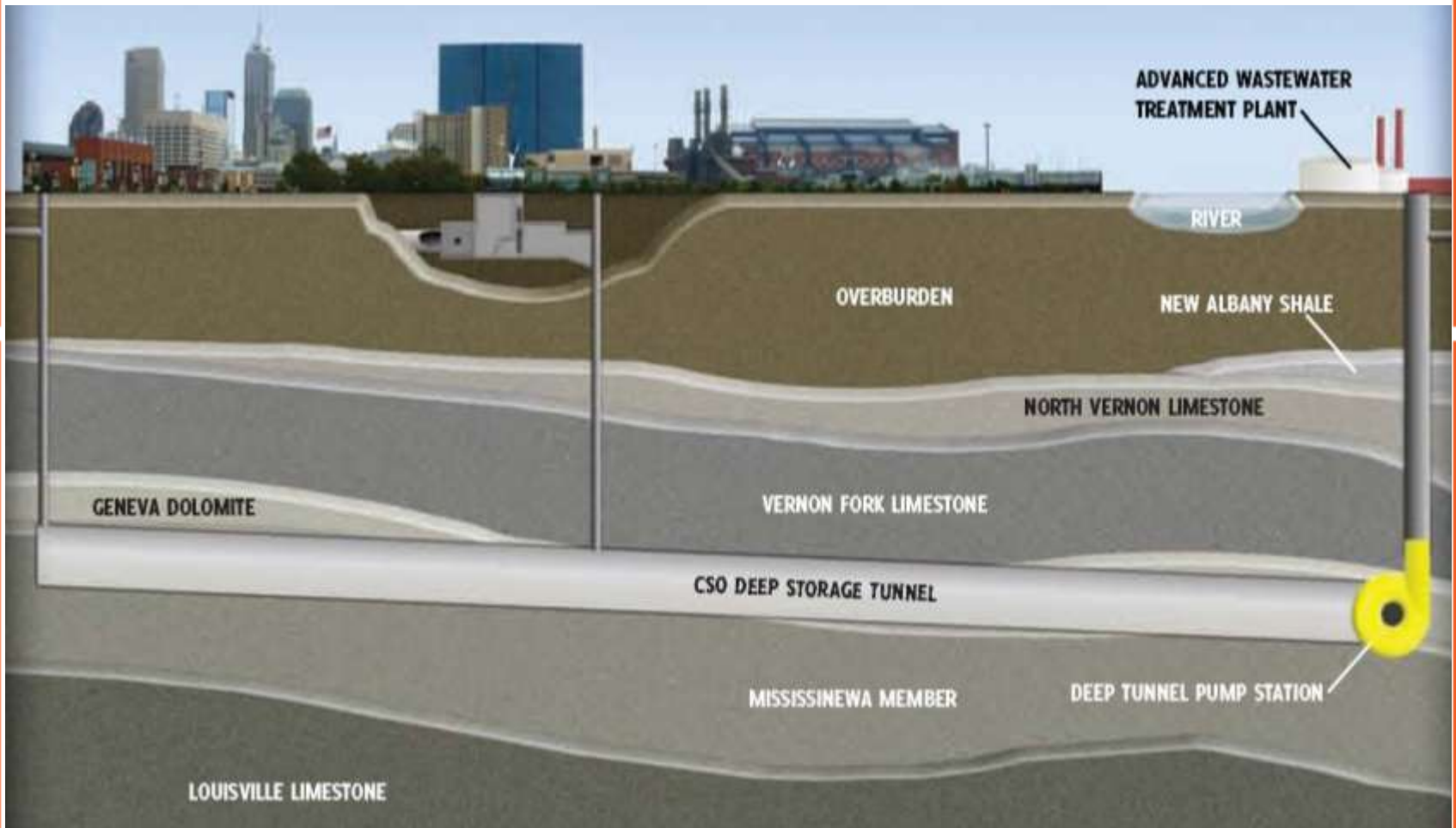
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## **Summary of Geotechnical Findings**

- Rock Quality Designation (RQD) indicates Bedrock is Sound and Relatively Consistent, and Not Heavily Fractured
- Unconfined Compressive Strength (UCS) averaged 9,000 to 10,000 pounds per square inch
- Limited SINTEF Testing
  - DRI – High to Extremely High (66 to 82)
  - BWI – Very Low to Extremely Low (6 to 12)
- In Summary, Rock is Very Favorable for Tunneling



# Illustrative Representation of Indianapolis' Geology





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# Limestone Geologic Contact

Contact



North  
Vernon  
Limestone

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Vernon Fork  
Limestone

FOSSIL!



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## **Solution Features Are Possible Closer to Soil-Rock Interface**



Solution  
(Karstic)  
Feature

Rare Gem!



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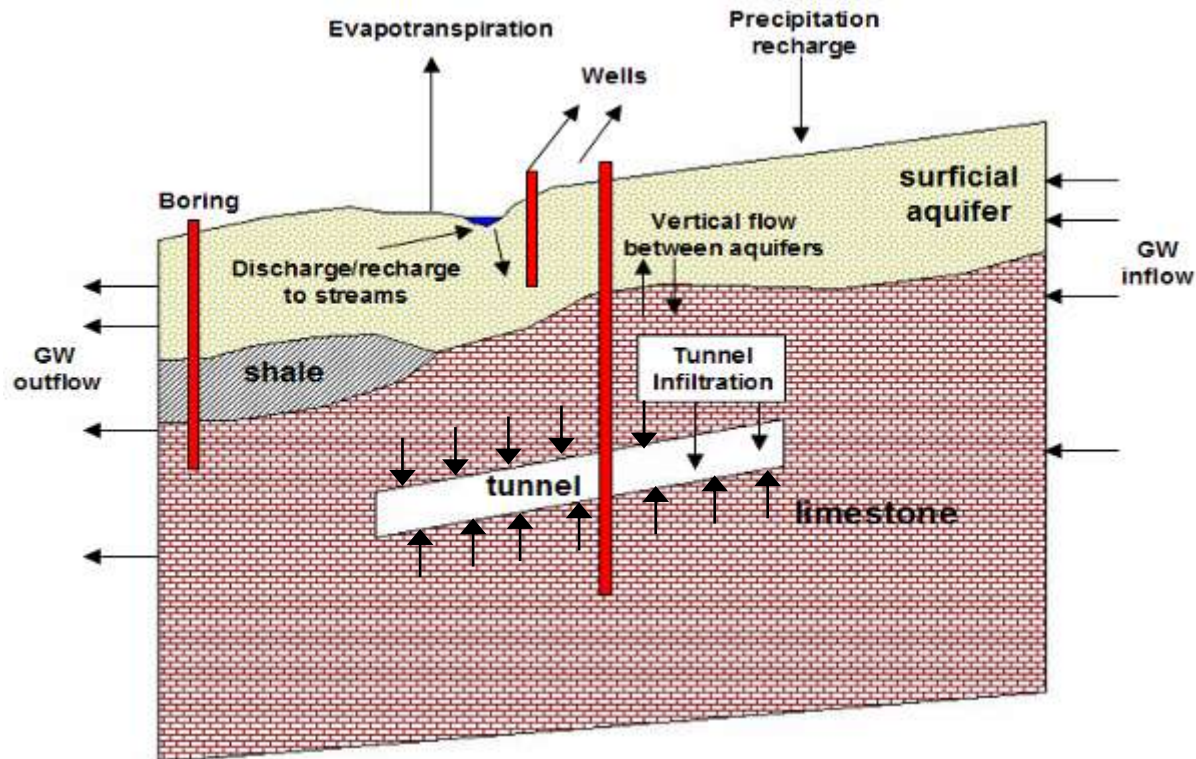
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## **Summary of the Fall Creek/White River Groundwater Management Plan (GWMP)**

- Overall Goal of the GWMP was to Evaluate Various Scenarios During Tunnel Construction and Future Operation to Determine Any Potential Short-term or Long-term Impacts to Groundwater resources
- Regional Cooperation to Evaluate and Monitor Groundwater Levels (Piezometer Readings)
- Development and Calibration of an Existing Conditions Groundwater Model
- Alternative Scenarios Evaluation
- Groundwater Risk Registry



# Profile of Conceptual Groundwater Model





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## **GWMP Alternative Scenarios**

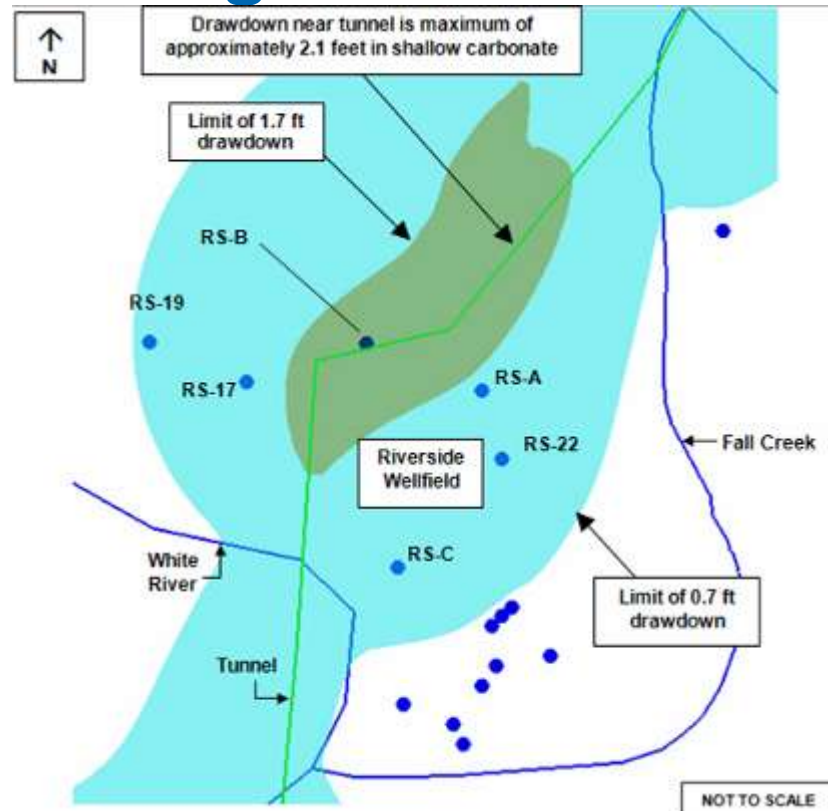
- West, Central and East Tunnel Alignments (12 Total Scenarios)
- Primary Development Considerations
  - Concerns During Construction (e.g., encountering fractures and potential solution features)
  - Long Term Operational Impacts of Groundwater
- 12 Scenarios Modeled
  - Scenarios 1-3 – Expected Conditions During Construction
  - Scenarios 4-6 – High Infiltration During Construction
  - Scenarios 7-9 – Expected Conditions During Long Term Operation
  - Scenarios 10-12 – High Infiltration During Long Term Operation





## Scenario 4 – West Tunnel Alignment, High Infiltration During Construction

- Shallow Carbonate (Layer 2)



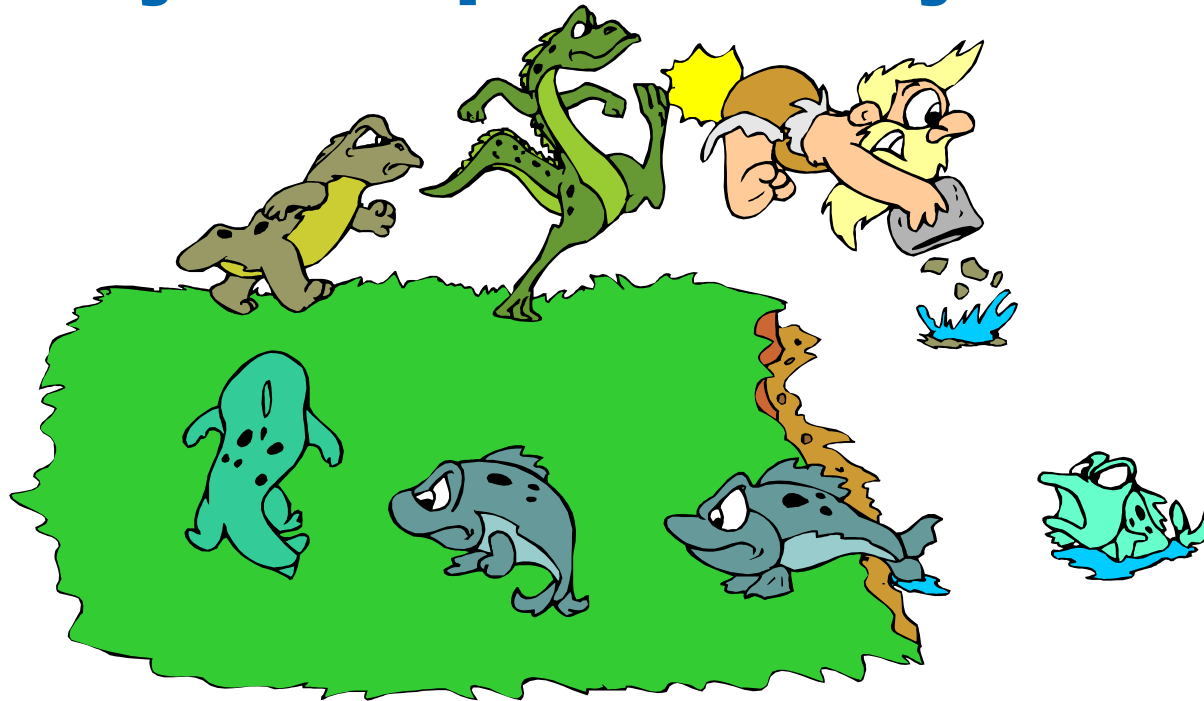


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# A Bit About the Evolution\* of the City's Deep Tunnel System...



\*Does not represent the views of the City of Indianapolis or any entity associated with the development of the FCWRTS Design, and used only for reference to the development of the project during preliminary stages. We further represent no opinion on the matter or preference thereof on any scientific or religious preferences of the Owner, presenters or audience.



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## **“The Only Thing Constant in Life is Change”**

- Value Engineering of Indianapolis’ CSO LTCP Consent Decree
  - City Embarked on a Value Engineering Program to Evaluate Technical Recommendations and Potential “Right-Size” Required Capital Improvements
  - Secondary Goal was to Reduce the Overall Estimated \$3 Billion Cost of their Long Term Control Plan
  - Planned Sewer System Upgrades and Improvements to Both AWTPs were Re-evaluated
  - Design of Interplant Connection Shallow Tunnel Re-evaluated as Extension of FCWRTS and DRTC to Southport AWTP



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## **Sustainable and Cost Effective Alternative**

- Deep Rock Tunnel Connector (DRTC) Evolved as FCWRTS Extension to Southport AWTP
  - Deferred Capital Expense as Interplant Project is Eliminated, if Relief on Schedule is Approved
  - Cost Savings - \$140M
  - System Flexibility and Redundancy
  - Potential for Flood Control with Increased Dewatering Rates
  - Less Risk in Rock Tunneling as Opposed to Soft Ground Tunneling for this Project
  - Potential Sustainable Reuse of Limestone Cuttings from Rock Tunneling



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# Combination Fall Creek / White River Tunnel and New Deep Rock Tunnel Connector (DRTC)





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## Changing the Make Up of Our City on Every Project

- Sustainable and Green Infrastructure
  - Recycled Materials
  - Permeable / Porous Pavers
  - SW Infiltration Planters
  - Bioretention Swales
  - Rain Gardens
  - Reflective Roofs/Surfaces



**Permeable Pavement to Bioretention**



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# Local and Sustainable Project Requirements

- Balancing Opportunities and Risk
  - Not just a Linear Sewer Project - Large Diameter and Complex Tunnel Alternative
  - Incorporate Sustainable Design Features and Operational Strategies
  - Green Infrastructure When and Where Appropriate
  - Begin with the End in Mind (O&M) - 100+ Year System Life Solution
  - Up to 30% MBE/WBE/Veteran Involvement and Mentoring
  - Local Execution of Work > 90%
  - Meet the Revised Consent Decree Schedule



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# Discussion / Q&A

