Shrinking the Difference Between the Storms We Design for and the Storms We Get!

TRA MCRWS Design Storm Analysis

Wastewater Treatment • Water Treatment • Water Storage • Lake Livingston • Recreation
Trinity River Authority created in 1955
Promote and protect the natural resources of the Trinity River basin
Provide services to more than 60 cites in the Trinity River basin
Mountain Creek Regional Wastewater System (MCRWS) is a wholesale provider to four customer cities

- One regional wastewater treatment plant
- Four regional lift stations
- Approx. 92,254 LF of force main and 13,346 LF of gravity main
Background
Scope of Project

- Develop dynamic hydraulic model
- Capacity assessment and capital improvement plan for MCRWS system
- Temporary flow monitoring
- Radar rainfall analysis
Traditional Modeling Approach

- Rainfall equally distributed across the area
- I/I response at a flow meter is caused by rainfall at assigned rain gauge

Uniform vs. Non-Uniform Rainfall Coverage

Rainfall Intensity

Low  High
- SCS Type II hyetograph
- Stationary storm
- 5-Year, 6-Hour
- High intensity
- Conservative
Traditional Approach

- Assign standard SCS Type II hyetograph

Very little documentation is available that describes the development of the Type II and other legacy rainfall distributions. Study of what is available leads to the conclusion that their use be discontinued in areas covered by NOAA Atlas 14 data. The Type II was assigned as the design storm distribution for much of the 48 contiguous United States.
Field Data Dilemma

- Review Q vs i curve to determine an estimated amount of I/I volume.
- Adjust contributing area as needed to bring flows in line.
Innovative Design
Storm Approach
Rainfall Data Sources

- **Hyetograph** – Hourly NOAA Rain Gauges
- **Storm Motion** – NEXRAD Radar (KFWS)
## Rain Gauge Selection

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<th>COOP ID</th>
<th>Name</th>
<th>Start</th>
<th>End</th>
<th>POR (years)</th>
<th>% missing data</th>
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KFWS Radar used for Design Storm Analysis

Midlothian Rain Gauge used for Analysis
Distribution of Rain Events

- Maximum recorded 6-HR event = 4.8 inches
- Rainfall events are typically between 1.1 and 2.86 inches from 1974 to present

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<tr>
<th>Threshold</th>
<th>Number</th>
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Maximum 6-hr Event Depth = 4.8 in
Hyetograph Analysis

- Cumulative hyetographs of recorded rain events
- Reviewed over 300 historical rainfall events
- Historical hyetograph analysis utilized to develop local specific design storm hyetograph
• 79% of qualifying rain events recorded the highest accumulation in the first quarter of the event

• Quartile distribution impacts design storm hyetograph
Hyetograph Comparison

- Comparison of SCS Type II and Average hyetographs
- SCS Type II peak intensity = 5.96 in/hr
- Design local peak intensity = 2.6 in/hr
Radar Motion Analysis

- Median Speed = 23.48 mph
- Median Direction = 49.3°
Radar Motion Analysis

**Speed (km/hr)**

- Median Speed: 37.8 km/h (23.48 mph)

**Azimuth**

- Median Direction: 49.3°
Local Design Storm Development

- Utilized Storm Builder to apply rainfall intensity to pixel grid
- GIS deliverable with intensity by pixel
Application of Local Design Storm
Application of Local Design Storm
Design Storm Sensitivity Analysis

- Total event depth is the same (3.6-inches)
- SCS applied to all subcatchments simultaneously
- Local design storm applied across system through time
- Higher intensity from SCS storm resulted in higher I/I volume and peaking factor
Design Storm Sensitivity Analysis

- Existing system analysis with moving storm shows less capacity restrictions compared to SCS stationary event.
- Moving event results are similar to flow monitoring observations.
- Reduces short-term CIP needs.
Design Storm Sensitivity Analysis

- Lower peak flow
- Smaller CIP sizing based on 2070 analysis

SCS Type II
Stationary

Local Moving
Design Storm

Proposed 30-inch Interceptor
**Design Storm Comparison**

**SCS Stationary**
- Traditional approach
- Conservative results
- Generic shape used for most of the country

**Local Moving Design Storm**
- Defendable Level of Service
- Representative peak flows
- Requires additional analysis to develop
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