Fire Station Location Planning
San Marcos, TX
By Emilee Freeman, Karl Kuhlman, & Jess Neuner
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San Marcos & Our Fire Department
The City of San Marcos

A Little About Us

1. Over 70,000 current residents, along with thousands of seasonal visitors

2. 247 multi-family properties including regular and high-rise apartments condos, etc.

3. 5,000+ new single family residences expected within the city in coming years

4. 188 projects identified for the FY 2023 10 Year CIP
Our Geography
Growing City Limits
San Marcos Fire Department

- 6 Fire Stations spread across 39.6 square miles
- 110 full-time staff members in Prevention, Operations, and Support centered roles
- 90 out of those staff members dedicated solely to operations
Coverage Analysis
Coverage Analysis

- Understand percentage of City covered by at least one station
- Various combinations of station locations
- With and without train present
- Fire truck average speeds
- Thoroughfare master plan
Standards of Cover

1. What makes San Marcos unique?

Community Risk

At-Risk Populations
Natural Hazards
Technological Hazards
Transportation Hazards
Structural Fire Hazards
Target-Hazard Locations...
Standards of Cover

1. What makes San Marcos unique?

2. Risk Assessment

<table>
<thead>
<tr>
<th>Score</th>
<th>Probability</th>
<th>Consequence</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Rarely (annual or longer)</td>
<td>No life or property loss</td>
<td>&lt; 4 personnel</td>
</tr>
<tr>
<td>4</td>
<td>Quarterly</td>
<td>Life or property impaired</td>
<td>4–7 personnel</td>
</tr>
<tr>
<td>6</td>
<td>Monthly</td>
<td>Life or property loss</td>
<td>8–11 personnel</td>
</tr>
<tr>
<td>8</td>
<td>Weekly</td>
<td>Loss &gt; 1 life or property loss</td>
<td>12–17 personnel</td>
</tr>
<tr>
<td>10</td>
<td>Daily</td>
<td>Loss of &gt; 3 lives or major building</td>
<td>&gt; 17 personnel</td>
</tr>
</tbody>
</table>
Standards of Cover

1. What makes San Marcos unique?

2. Risk Assessment

<table>
<thead>
<tr>
<th>Description</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Score Range</td>
<td>0 to 24.99</td>
<td>25 to 49.99</td>
<td>50 to 69.99</td>
<td>70 to 100</td>
</tr>
<tr>
<td>Incident Type:</td>
<td>Dumpster Fire</td>
<td>House Fire</td>
<td>Apartment Fire</td>
<td>High-Rise Fire</td>
</tr>
<tr>
<td>Risk Score</td>
<td>P</td>
<td>C</td>
<td>I</td>
<td>P</td>
</tr>
<tr>
<td>Score Assigned</td>
<td>12.33</td>
<td>44.18</td>
<td>55.43</td>
<td>73.48</td>
</tr>
<tr>
<td>Max/Min Staffing</td>
<td>20</td>
<td>17</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>ERF Assigned:</td>
<td>6</td>
<td>17</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>ERF Remaining:</td>
<td>14</td>
<td>11</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Standards of Cover

1. What makes San Marcos unique?

2. Risk Assessment

<table>
<thead>
<tr>
<th>High</th>
<th>50 to 69.99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartment Fire</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>28</td>
<td></td>
</tr>
<tr>
<td>-8</td>
<td>-11</td>
</tr>
</tbody>
</table>

*E.1.21 CPSE Center for Public Safety Excellence, Inc., 4501 Singer Court, Suite 180, Chantilly, VA 20151. 
Community Risk Assessment: Standards of Cover, 6th edition, 2016*
Standards of Cover

1. What makes San Marcos unique?
2. Risk Assessment
3. Defines performance objectives

Benchmark Performance Objectives

Fire Suppression Benchmarks

For 90% of High-Risk fires, the minimum effective response force (ERF) staffing shall be **28 firefighters** that arrive within 10 minutes, 20 seconds.
Ask an expert

Cascade of Events

Geographic Challenges
Calculating Station Service Areas

Larson Boxes

Drive Times

ArcGIS Network Analyst: Service Areas
Station Service Area

Larson Boxes

Drive Times
Larson Boxes
Building the network

Data sources
- City centerline
- County NG911 roads
- Thoroughfare masterplan

Data engineering
- Topology
- Filling null values
- Average truck speed
- Correcting elevations
- Road blocks and slow down points
Drive Times

- Stations

- Drive Times
  - Cutoff Range: 0 - 4
  - Cutoff Range: 4 - 6
The Maps
Make It Interactive
Interactive Maps

• Static maps were great for a report, but not that great for story telling
  • We could see the coverage – but how do we communicate it effectively?

• What would an interactive experience be like?

• Oh, and also include effective force scenarios?
Effective Force

An effective response force is defined as the minimum number of firefighters and equipment that must reach a specific emergency incident location within a maximum prescribed travel [driving] time.*

Demonstration
Reference Data

- Planned developments and annexations
- Calls for service
- Population and structure density
What’s Next
Where are we going?

- Network analysis on the fly
- Point to point distance and drive time
- Service area generation
- Call for Service ETL to GIS
- New information products
Redistricting Processes
Incident Analysis

ArcGIS Insights Reports

• Provides easy to configure overview of calls for service data

• See when and where calls for service are in high or low demand

• Manipulate data for different scenarios
Fire AVL
in GIS
Thank You!

Connect with us!

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