



SERVICE DELIVERY AND STAFFING STUDY

VOLUME 3 OF 3: RISK ASSESSMENT

PORTLAND FIRE & RESCUE

MAY 17, 2022



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VOLUME 3—RISK ASSESSMENT

1.1 COMMUNITY RISK ASSESSMENT

The third element of the Standards of Coverage (SOC) process is a community risk assessment. Within the context of an SOC study, the objectives of a community risk assessment are to:

SOC ELEMENT 3 OF 8
COMMUNITY RISK
ASSESSMENT

- ◆ Identify the values at risk to be protected within the community or service area.
- ◆ Identify the specific hazards with the potential to adversely impact the community or service area.
- ◆ Quantify the overall risk associated with each hazard.
- ◆ Establish a foundation for current/future deployment decisions and risk-reduction/hazard-mitigation planning and evaluation.

A hazard is broadly defined as a situation or condition that can cause or contribute to harm. Examples include fire, medical emergency, vehicle collision, earthquake, flood, etc. Risk is broadly defined as the *probability of hazard occurrence* in combination with the *likely severity of resultant impacts* to people, property, and the community as a whole.

1.1.1 Risk Assessment Methodology

The methodology employed by Citygate to assess community risks as an integral element of an SOC deployment analysis incorporates the following elements:

- ◆ Identification of geographic planning sub-zones (risk zones) appropriate to the community or jurisdiction.
- ◆ Identification and quantification, to the extent data is available, of the specific values to be protected within the community or service area.
- ◆ Identification of the fire and non-fire hazards to be evaluated.
- ◆ Determination of the *probability of occurrence* for each hazard.
- ◆ Determination of the *probable consequence severity* of a hazard occurrence.
- ◆ Determination of the impact severity of a hazard occurrence on the fire agency's overall response capacity.

- ◆ Quantification of overall risk for each hazard based on probability of occurrence in combination with probable consequence severity and agency impact.

For this assessment, Citygate used the following data sources to understand the hazards and values to be protected in the City of Portland (City):

- ◆ Esri and US Census Bureau population and demographic data
- ◆ City Geographical Information Systems (GIS) data
- ◆ City General Plan and Zoning information
- ◆ City and County Hazard Mitigation Plans
- ◆ Portland Fire & Rescue (PF&R) and other City data and information.

1.1.2 Risk Assessment Summary

Citygate’s evaluation of the values at risk and hazards likely to impact the City of Portland yields the following:

1. PF&R serves a very diverse urban population with densities ranging from less than 3,000 to more than 30,000 people per square mile over a varied urban land use pattern.
2. The City’s population is projected to grow approximately 40 percent by 2035.
3. The City has a large inventory of residential and non-residential buildings to protect.
4. The City also has significant economic and other resource values to be protected, as identified in this assessment.
5. The Portland Bureau of Emergency Management has multiple mass emergency notification options available to effectively communicate emergency information to the public in a timely manner.
6. The City’s risk for six hazards related to emergency services provided by PF&R range from **Low** to **Extreme** as summarized in the following table.

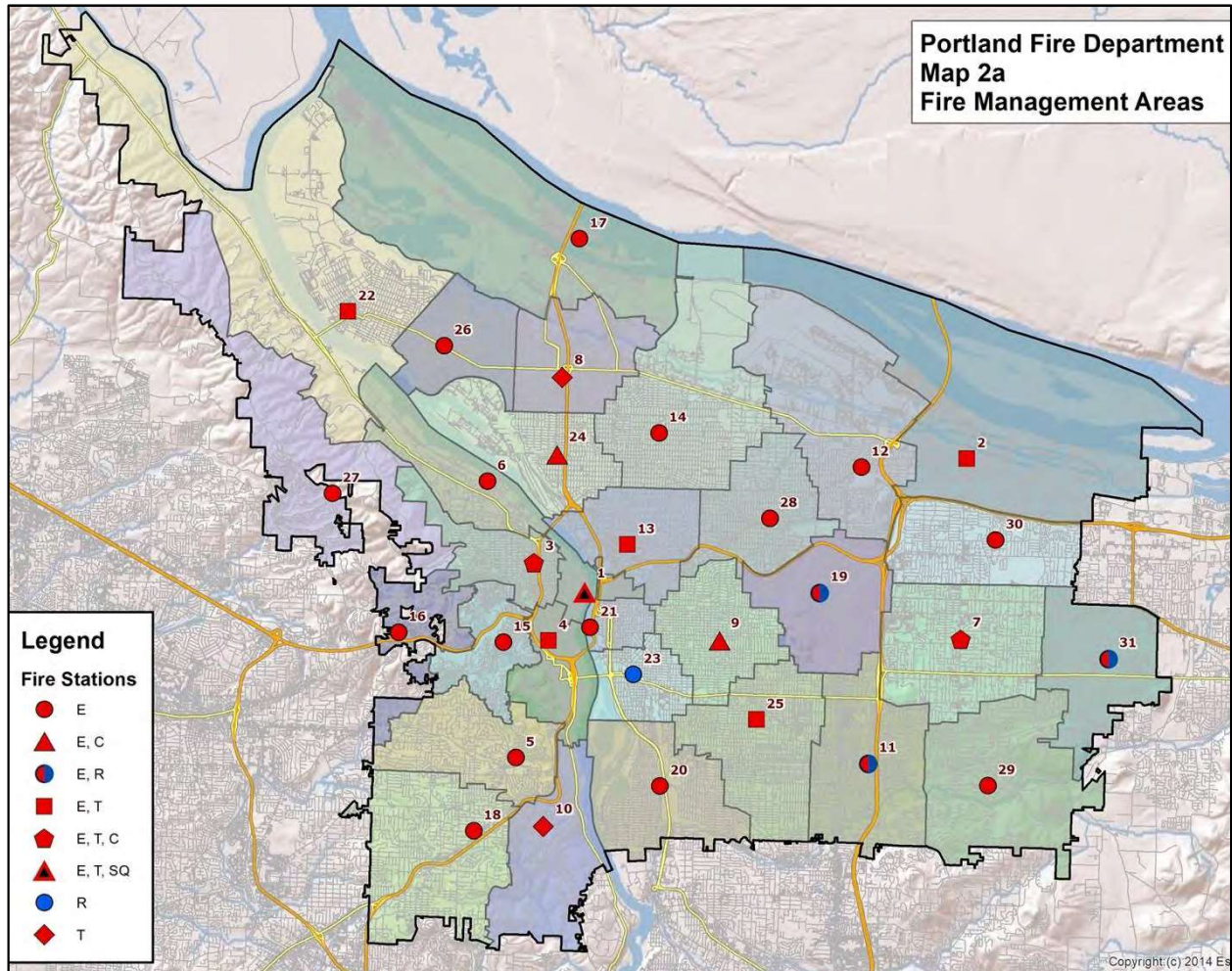
Table 1—Overall Risk by Incident Type

Hazard		Sub-Hazard Type	Risk Rating
1	Building Fire	Chimney/Fireplace/Stove	Low
		Single-Family Residential	High
		Multi-Family Residential	High
		Commercial	High
2	Vegetation/ Wildland Fire	Grass/Bark Dust/Tree	Low
		Brush (<5 acres)	Moderate
		Wildfire/WUI (5–25 acres)	High
		Wildfire/WUI (>25 acres)	High
3	Medical Emergency	BLS only	Low
		BLS/ALS	High
		ALS	High
		Mass Casualty Incident	High
		Weapon of Mass Destruction	Extreme
4	Hazardous Materials	Alarm/Odor Investigation	Low
		HazMat Level 1	Moderate
		HazMat Level 2 Biological/Chemical Threat Natural Gas Leak	High
		HazMat Level 3 Biological/Chemical Release Railroad incident	High
		Explosion / Weapon of Mass Destruction	Extreme
5	Technical Rescue	Elevator Rescue	Low
		Trauma / Pin-In / Potential Jumper Rope Rescue	Moderate
		Confined Space / Trench / Water Rescue	Moderate
		Building Collapse / Natural Disaster	Extreme
6	Marine Risk	Water Rescue	High
		Small Boat Fire/Rescue	Low
		Large Pleasure Craft Fire/ Rescue	Moderate
		Ship Fire	High
		Marina Fire	High

1.1.3 Risk Planning Zones

The Commission on Fire Accreditation International (CFAI) recommends that jurisdictions establish geographic risk planning zones to better understand risk at a sub-jurisdictional level. For example, portions of a jurisdiction may contain predominantly moderate risk building occupancies, such as detached single-family residences, while other areas contain high- or maximum-risk occupancies, such as commercial and industrial buildings with a high hazard fire load. If risk was to be evaluated on a jurisdiction-wide basis, the predominant moderate risk could outweigh the high or maximum risk and may not be a significant factor in an overall assessment of risk. If, however, those high- or maximum-risk occupancies are a larger percentage of the risk in a smaller planning zone, then it becomes a more significant risk factor. Another consideration in establishing planning zones is that the jurisdiction's record management system must also track the specific zone for each incident to be able to appropriately evaluate service demand and response performance relative to each specific zone. For this assessment, Citygate utilized 31 planning zones corresponding with established City Fire Management Areas (FMA) and fire station first-due response areas as shown on the following map.

Figure 1—Risk Planning Zones



1.1.3.1 Fire Management Area Risk Profiles

Following is a map and risk profile of each FMA. Annual service demand is the average annual call volume from January 1, 2016, through December 31, 2020.

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Figure 2—FMA 1

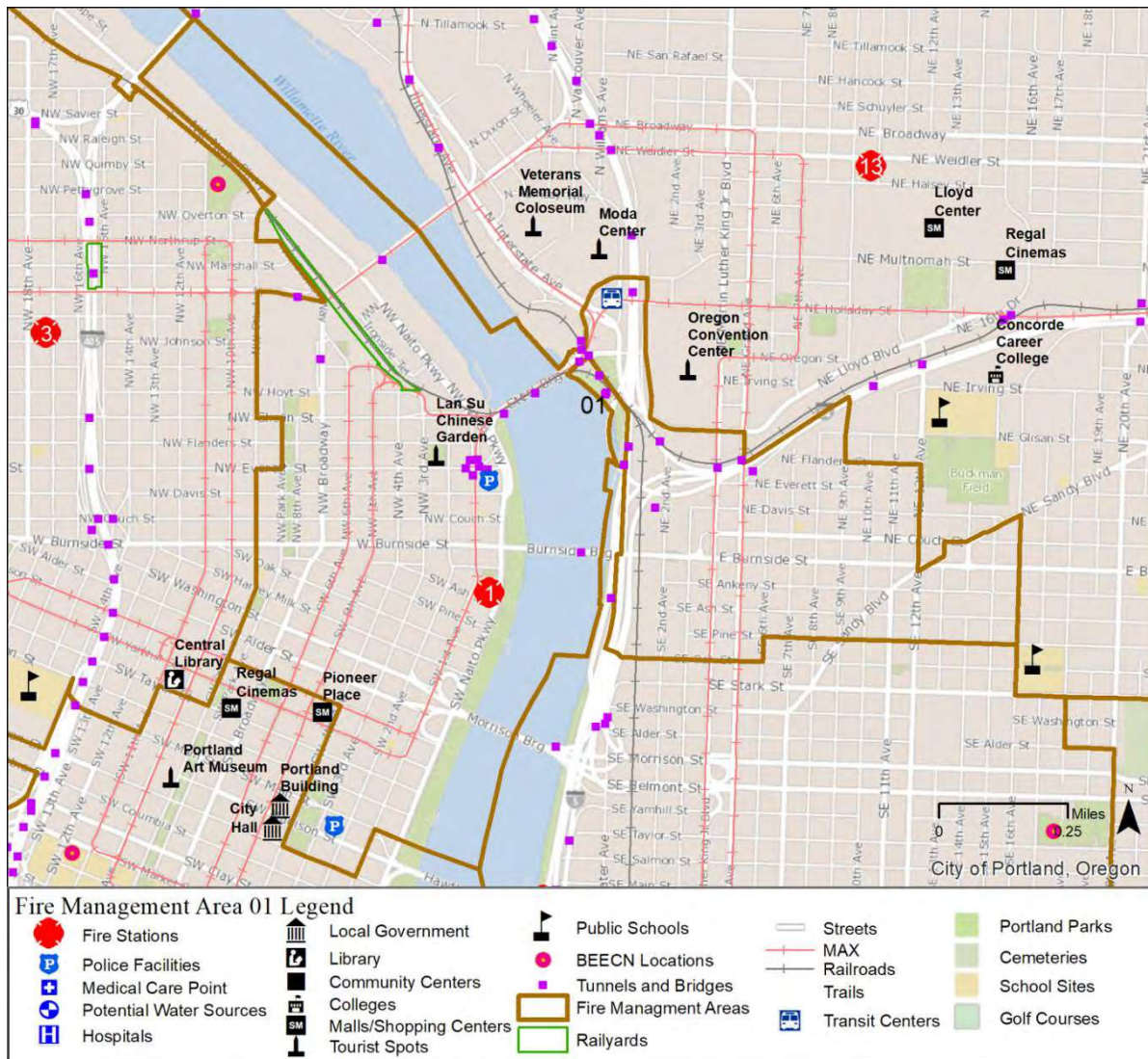


Table 2—Risk Profile – FMA 1

Risk Factors			
Total Area	1.02 sq. mi.	Total Number of Buildings	756
Resident Population	8,550	Residential	24.1%
Daytime Population	33,198	Commercial/Industrial	56.2%
Population Density – Daytime	32,347	Other	19.7%
Population Density – Night	8,329	High-Rise (>75 feet)	99
Critical Facilities/Infrastructure	51	Building Density	945 per sq. mi.
Hazardous Substance Sites	58	Assessed Valuation – Buildings	\$3.9 Billion
Annual Service Demand	7,315		

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Figure 3—FMA 2

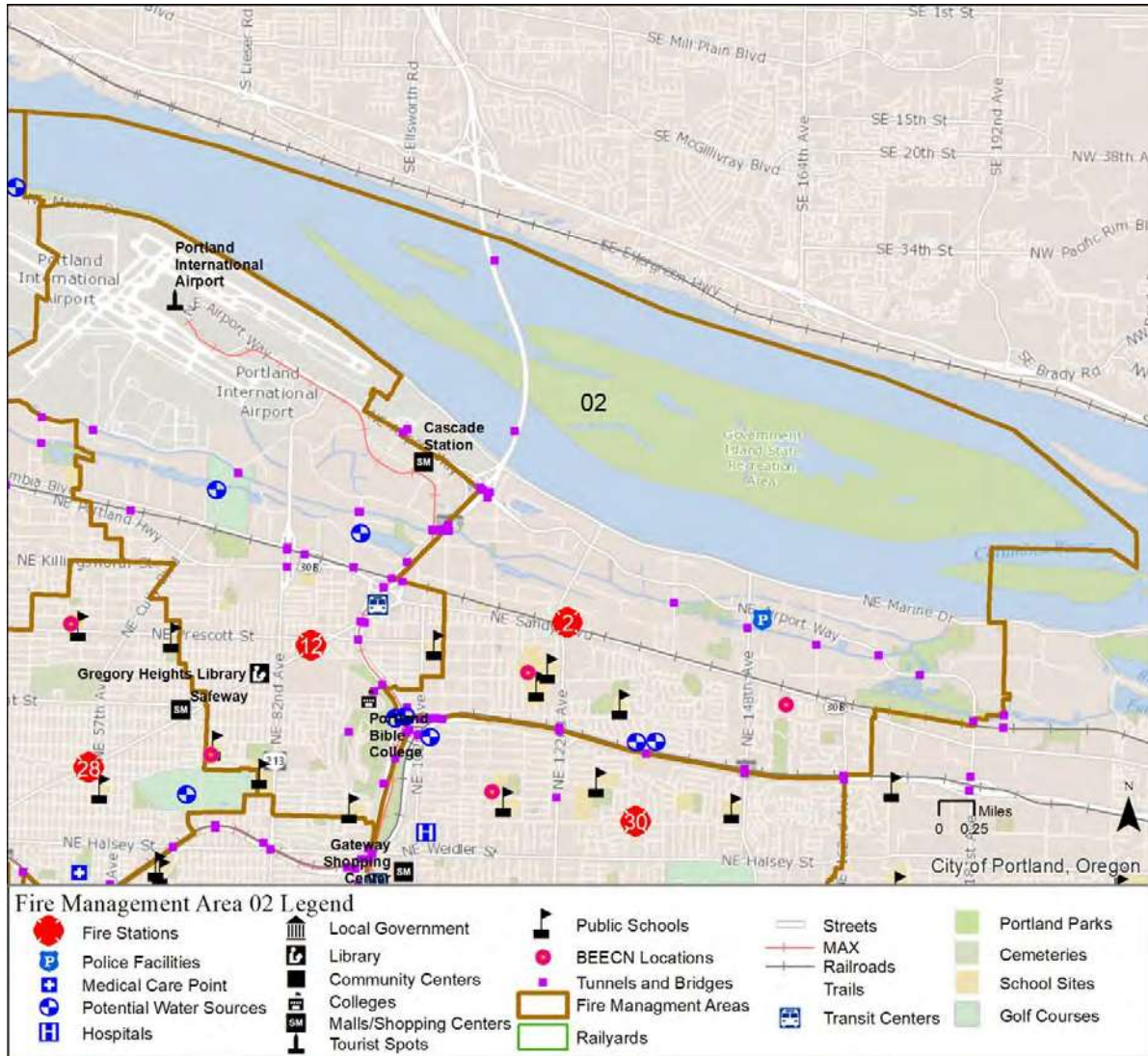


Table 3—Risk Profile – FMA 2

Risk Factors			
Total Area	14.24 sq. mi.	Total Number of Buildings	5,425
Resident Population	15,212	Residential	77.95%
Daytime Population	21,143	Commercial/Industrial	0.04%
Population Density – Daytime	1,410	Other	22.01%
Population Density – Night	1,015	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	176	Building Density	638 per sq. mi.
Hazardous Substance Sites	169	Assessed Valuation – Buildings	\$2.2 Billion
Annual Service Demand	2,071		

Figure 4—FMA 3

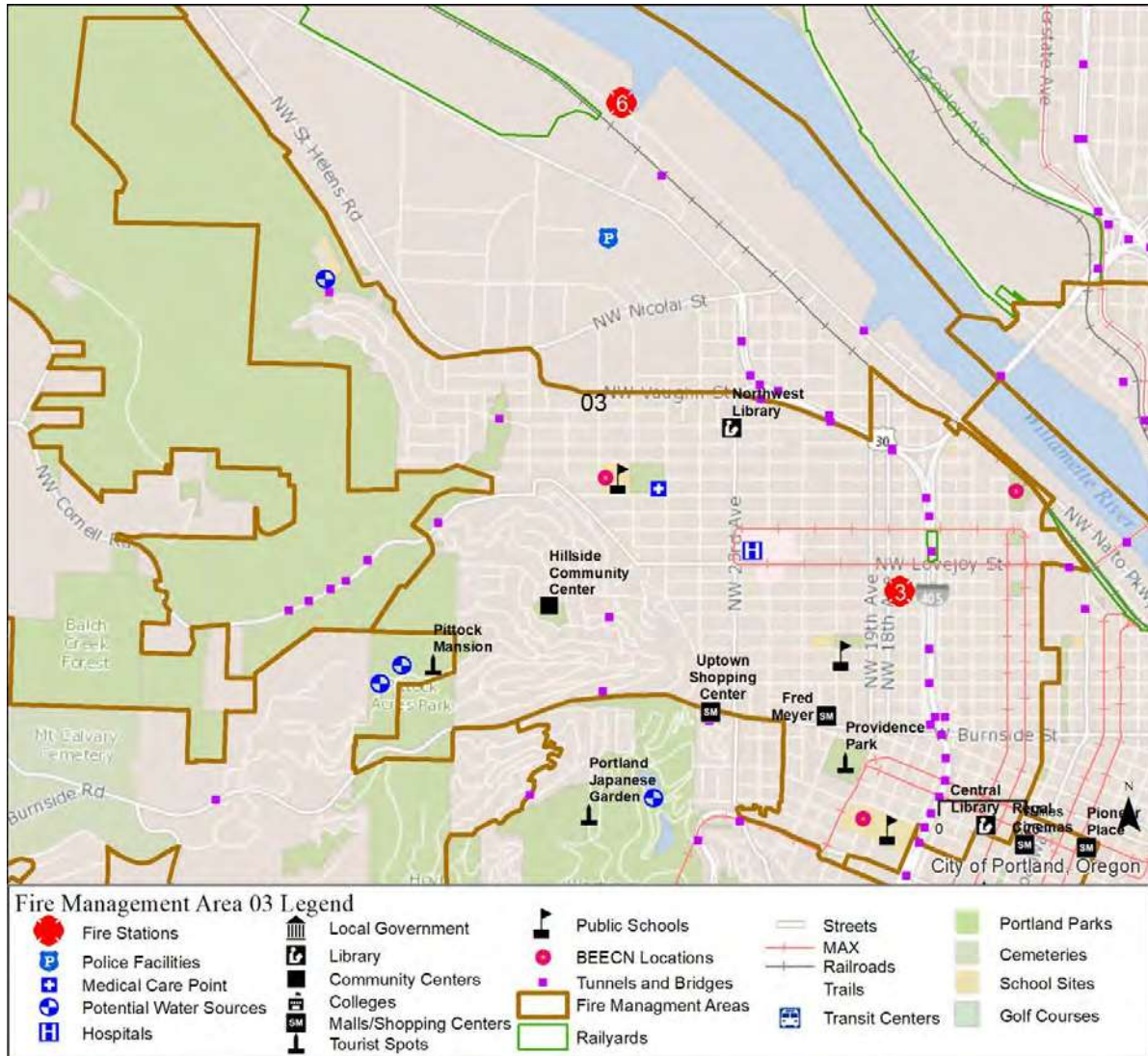


Table 4—Risk Profile – FMA 3

Risk Factors			
Total Area	2.44 sq. mi.	Total Number of Buildings	3,501
Resident Population	31,866	Residential	70.1%
Daytime Population	49,020	Commercial/Industrial	12.9%
Population Density – Daytime	20,109	Other	16.0%
Population Density – Night	13,070	High-Rise (>75 feet)	63
Critical Facilities/Infrastructure	27	Building Density	1,459 per sq. mi.
Hazardous Substance Sites	64	Assessed Valuation – Buildings	\$7.1 Billion
Annual Service Demand	5,098		

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Figure 5—FMA 4

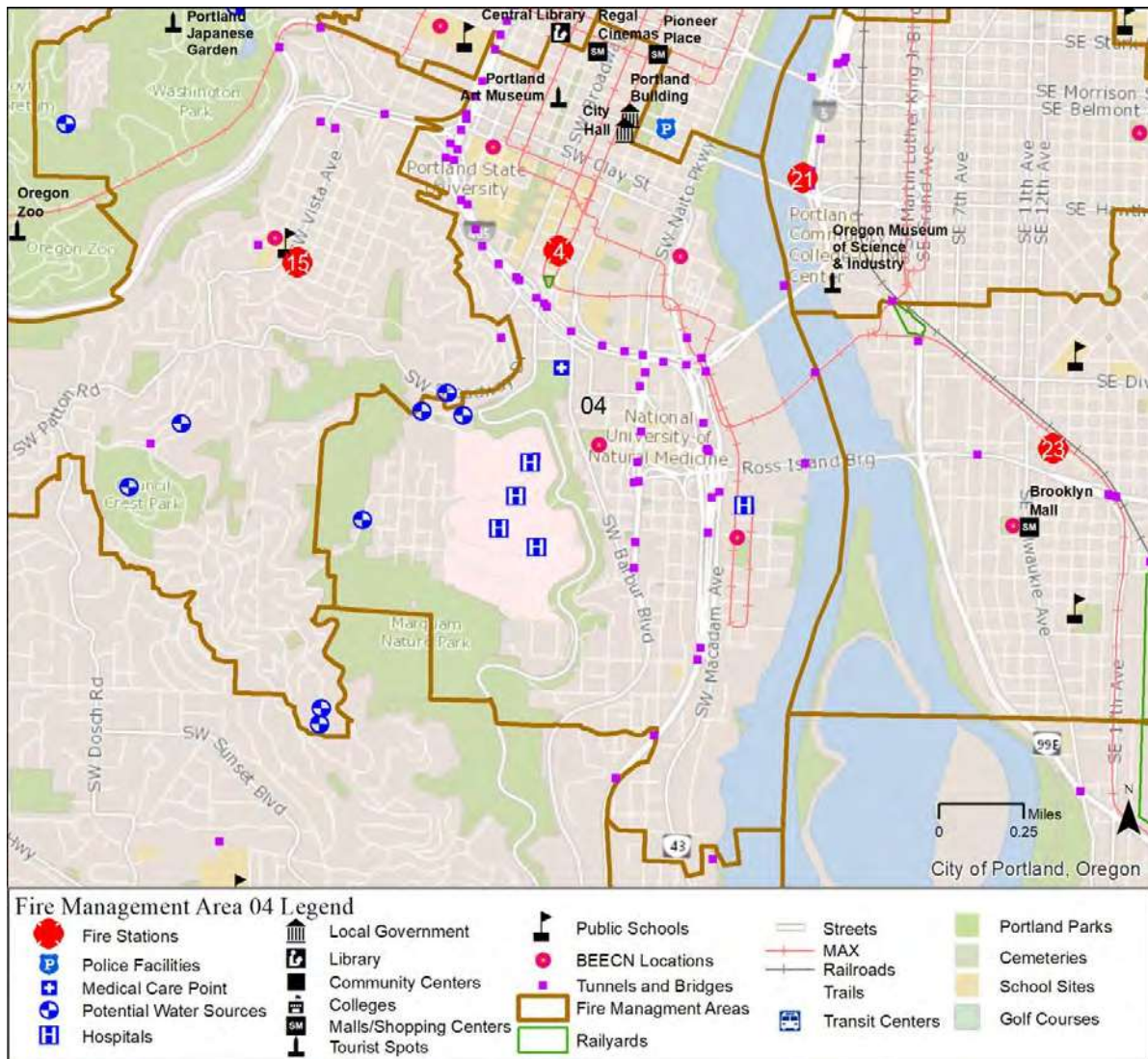


Table 5—Risk Profile – FMA 4

Risk Factors			
Total Area	2.37 sq. mi.	Total Number of Buildings	1,726
Resident Population	21,448	Residential	63.3%
Daytime Population	71,448	Commercial/Industrial	14.4%
Population Density – Daytime	30,168	Other	22.4%
Population Density – Night	9,054	High-Rise (>75 feet)	89
Critical Facilities/Infrastructure	60	Building Density	822 per sq. mi.
Hazardous Substance Sites	54	Assessed Valuation – Buildings	\$8.8 Billion
Annual Service Demand	5,163		

Figure 6—FMA 5

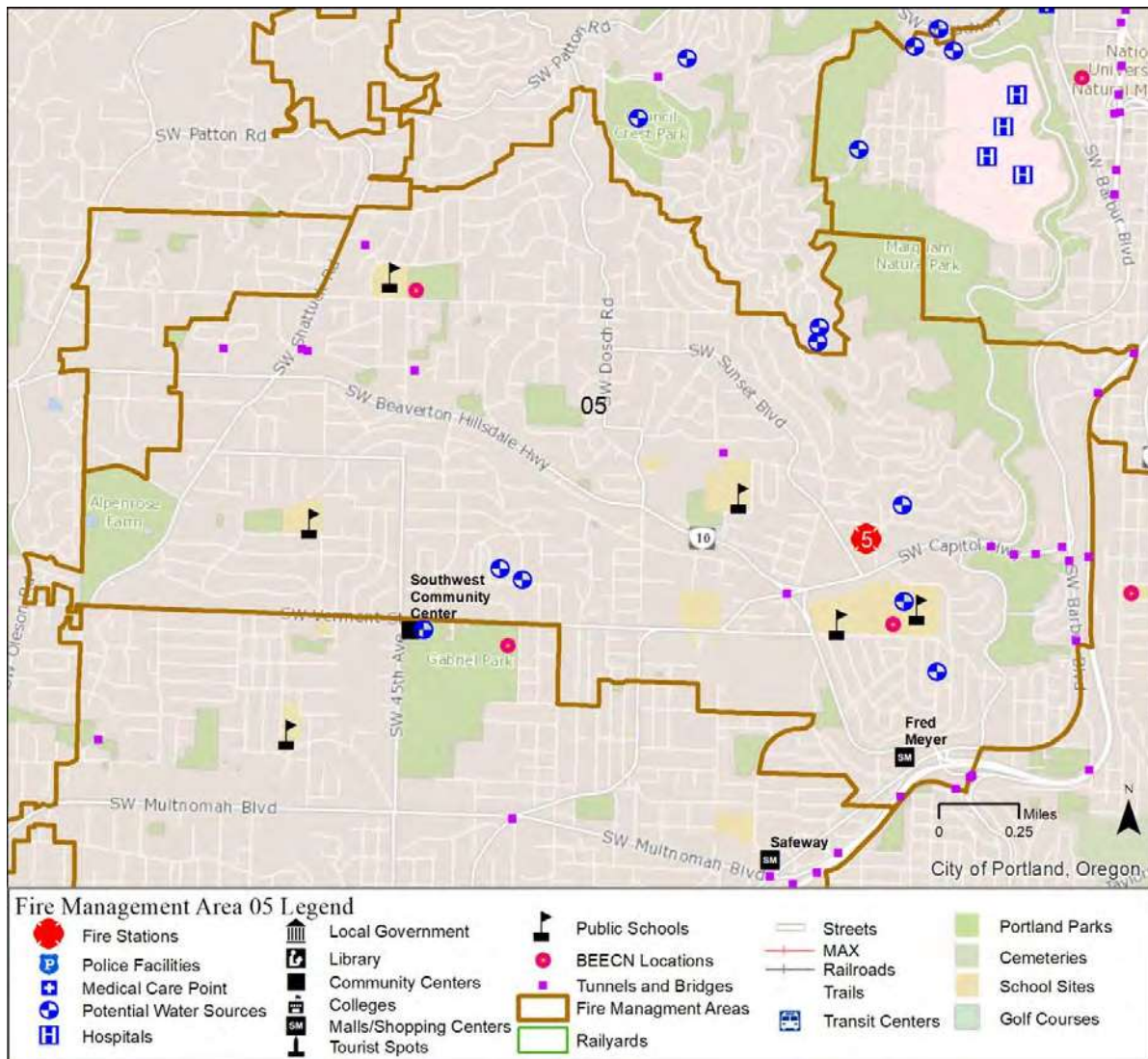


Table 6—Risk Profile – FMA 5

Risk Factors			
Total Area	4.05 sq. mi.	Total Number of Buildings	6,478
Resident Population	18,513	Residential	92.7%
Daytime Population	16,796	Commercial/Industrial	0%
Population Density – Daytime	4,151	Other	7.3%
Population Density – Night	4,574	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	31	Building Density	1,620 per sq. mi.
Hazardous Substance Sites	21	Assessed Valuation – Buildings	\$2.2 Billion
Annual Service Demand	1,186		

Figure 7—FMA 6

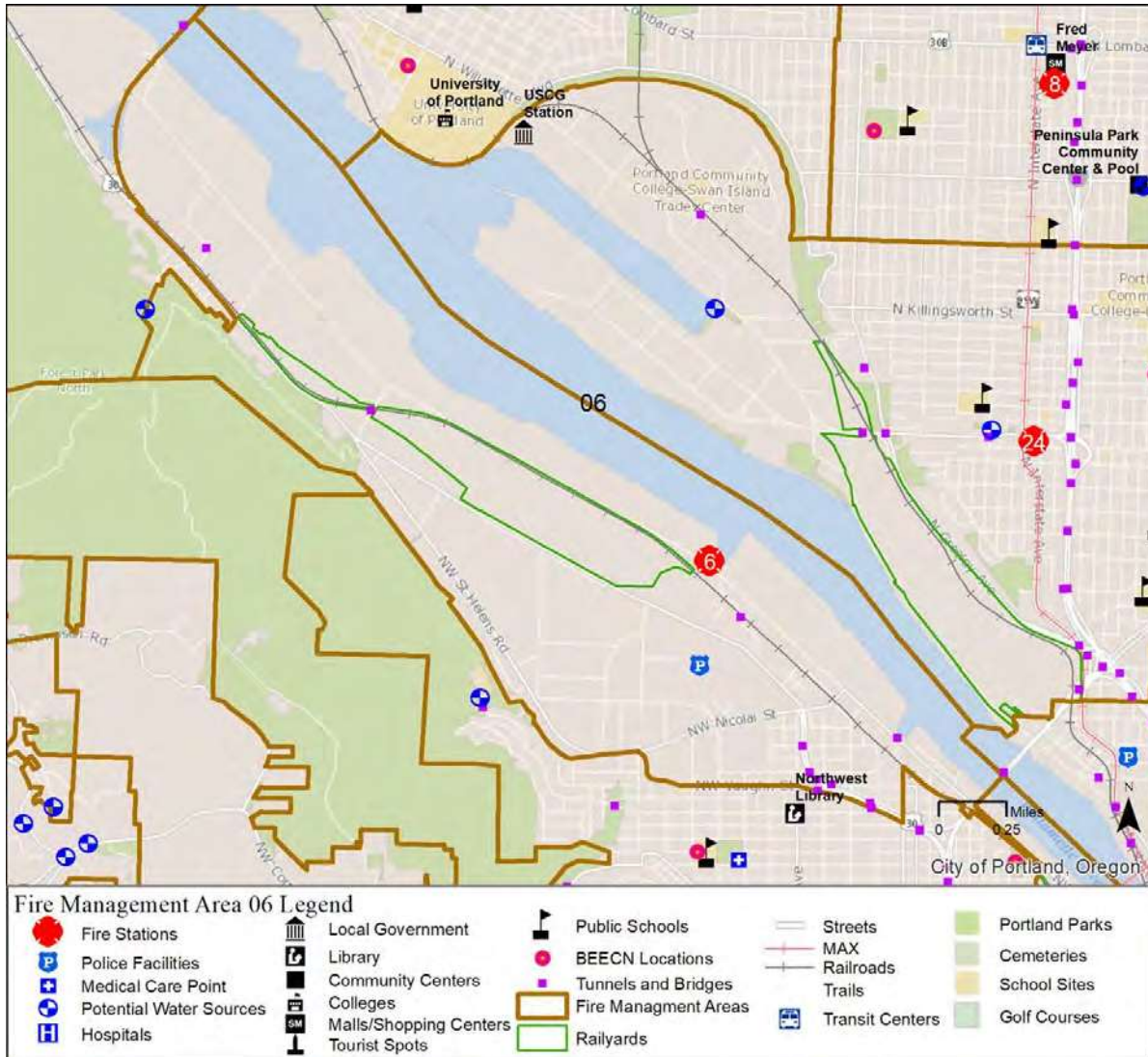


Table 7—Risk Profile – FMA 6

Risk Factors			
Total Area	3.30 sq. mi.	Total Number of Buildings	860
Resident Population	1,444	Residential	6.8%
Daytime Population	8,913	Commercial/Industrial	1.7%
Population Density – Daytime	2,699	Other	91.5%
Population Density – Night	437	High-Rise (>75 feet)	4
Critical Facilities/Infrastructure	235	Building Density	331 per sq. mi.
Hazardous Substance Sites	121	Assessed Valuation – Buildings	\$1.1 Billion
Annual Service Demand	416		

Figure 8—FMA 7

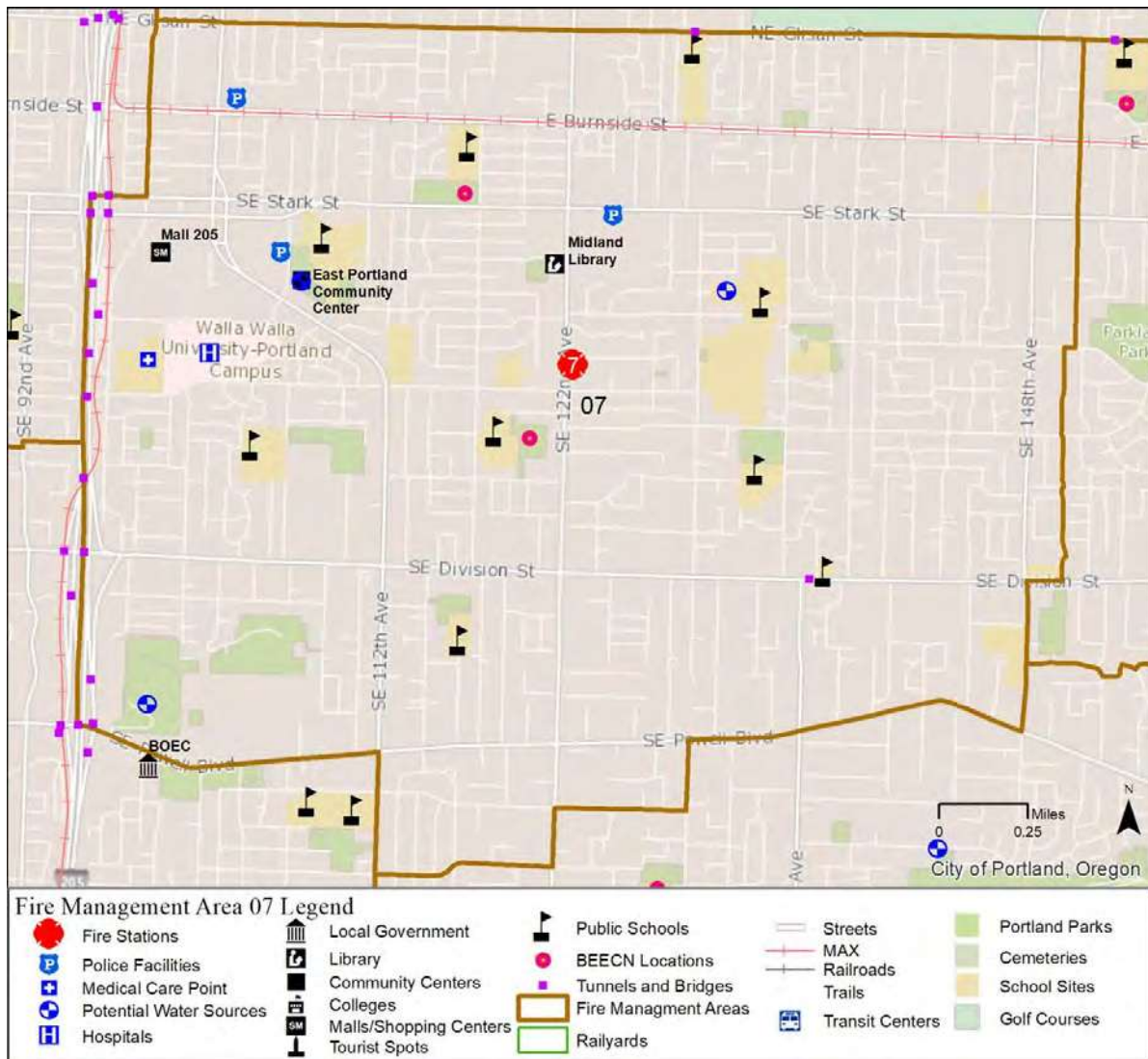


Table 8—Risk Profile – FMA 7

Risk Factors			
Total Area	5.70 sq. mi.	Total Number of Buildings	13,069
Resident Population	46,427	Residential	83.3%
Daytime Population	41,181	Commercial/Industrial	0%
Population Density – Daytime	7,220	Other	16.7%
Population Density – Night	8,139	High-Rise (>75 feet)	1
Critical Facilities/Infrastructure	47	Building Density	2,293 per sq. mi.
Hazardous Substance Sites	58	Assessed Valuation – Buildings	\$2.9 Billion
Annual Service Demand	7,060		

Figure 9—FMA 8

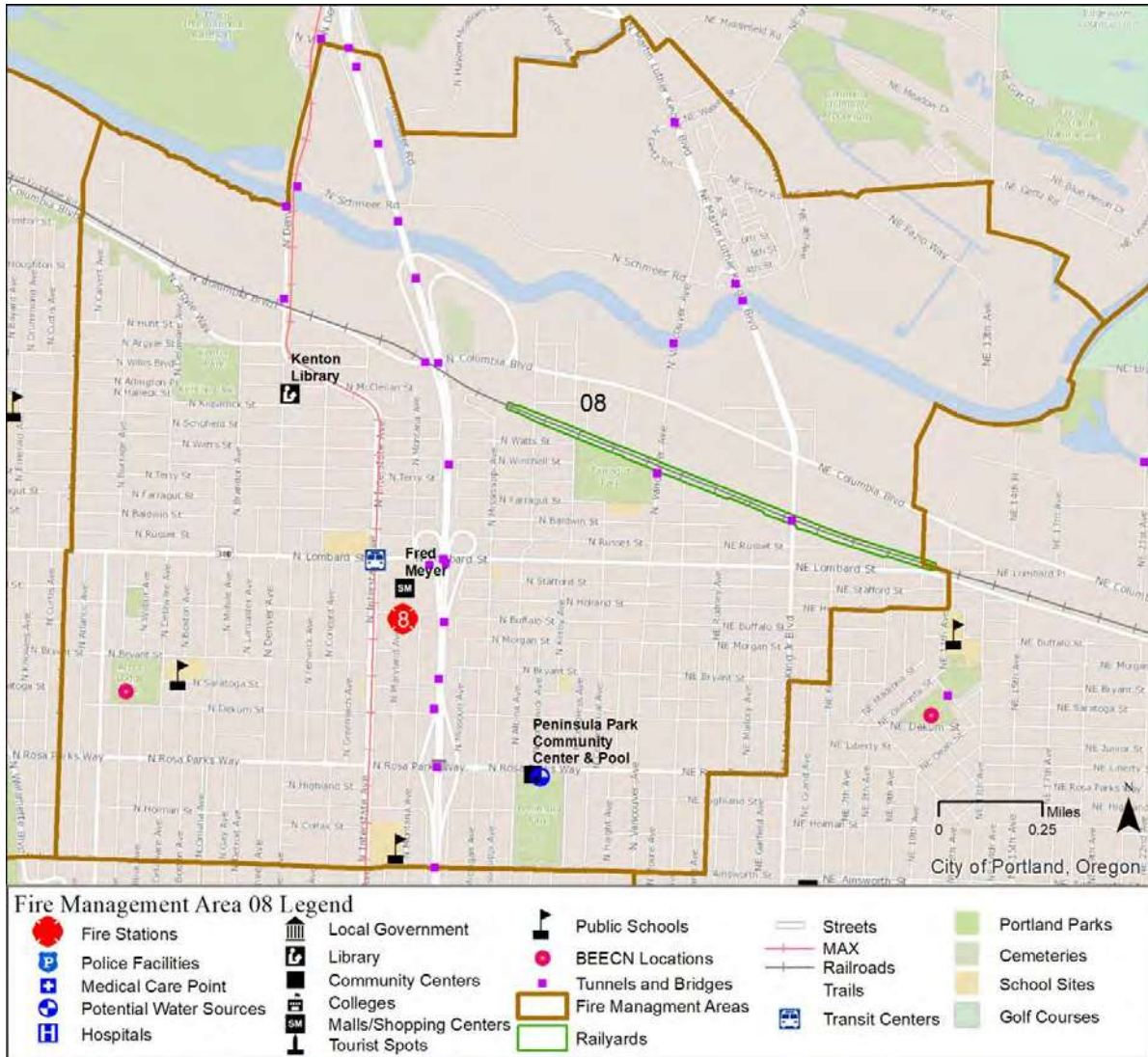


Table 9—Risk Profile – FMA 8

Risk Factors			
Total Area	3.68 sq. mi.	Total Number of Buildings	9,315
Resident Population	18,487	Residential	87.4%
Daytime Population	17,886	Commercial/Industrial	0%
Population Density – Daytime	4,900	Other	12.6%
Population Density – Night	5,064	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	28	Building Density	2,588 per sq. mi.
Hazardous Substance Sites	74	Assessed Valuation – Buildings	\$1.8 Billion
Annual Service Demand	2,082		

Figure 10—FMA 9

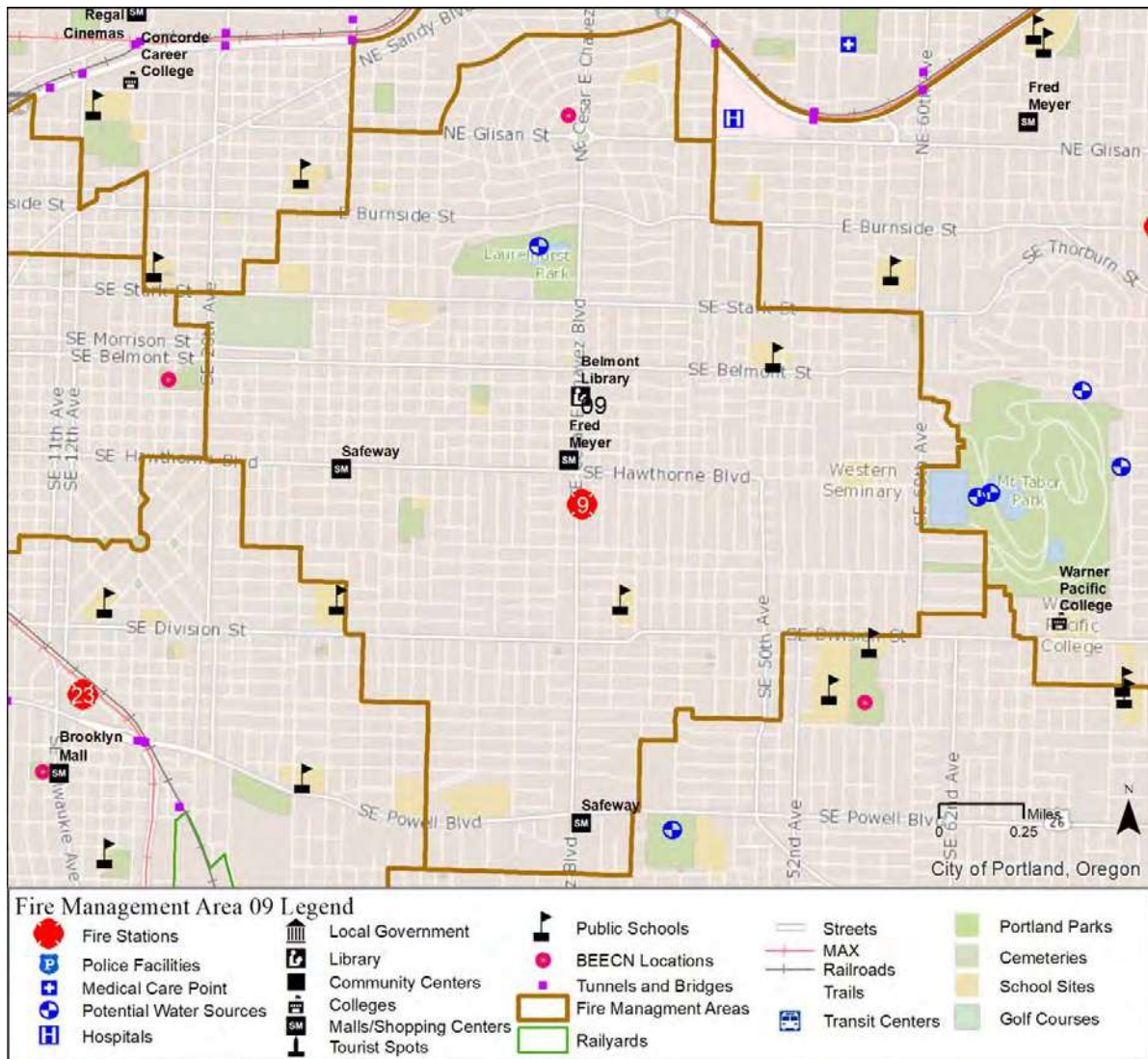


Table 10—Risk Profile – FMA 9

Risk Factors			
Total Area	3.45 sq. mi.	Total Number of Buildings	14,814
Resident Population	37,635	Residential	91.1%
Daytime Population	32,445	Commercial/Industrial	0.01%
Population Density – Daytime	9,401	Other	8.9%
Population Density – Night	10,903	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	22	Building Density	4,357 per sq. mi.
Hazardous Substance Sites	27	Assessed Valuation – Buildings	\$4.6 Billion
Annual Service Demand	2,776		

Figure 11—FMA 10

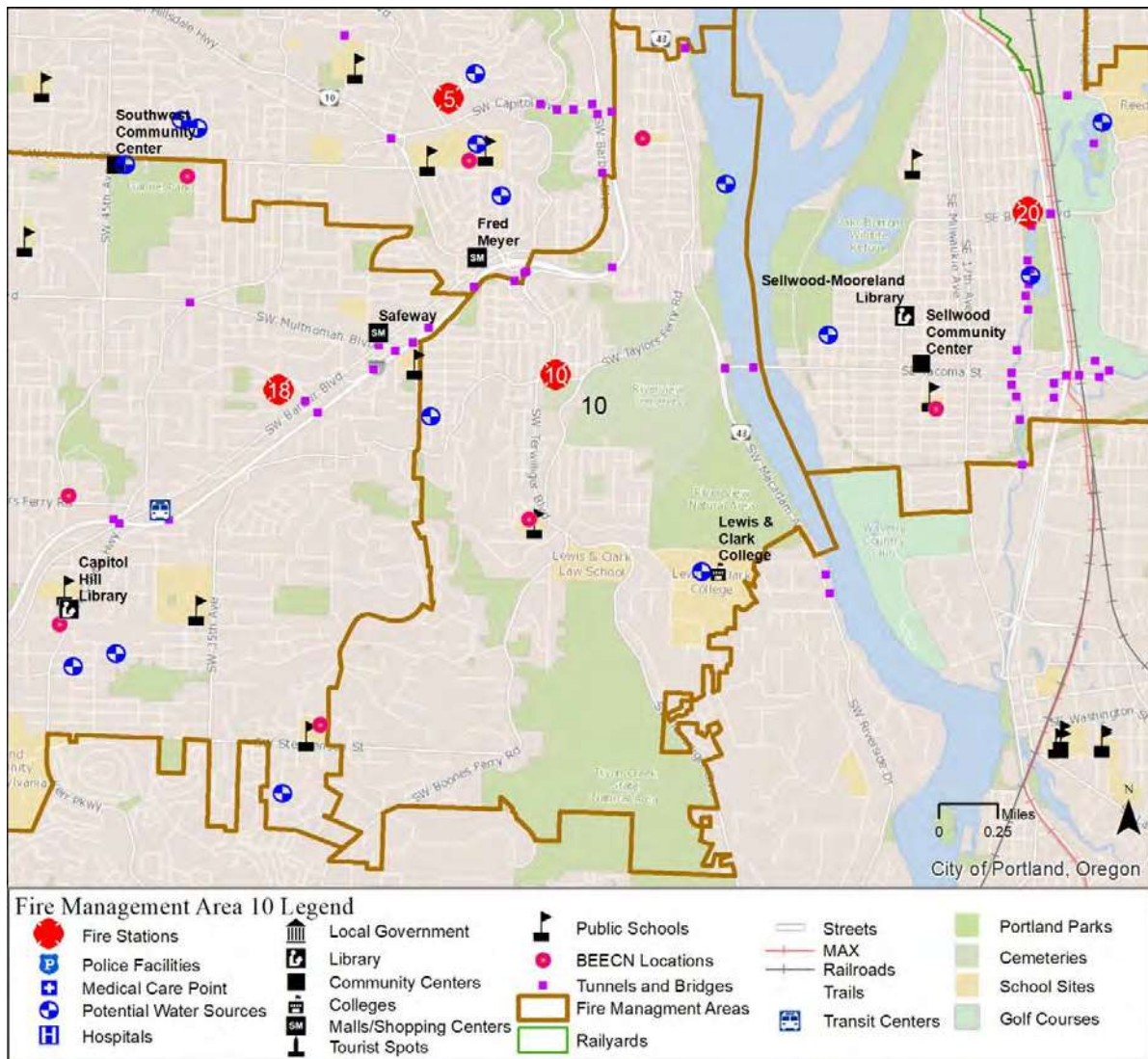


Table 11—Risk Profile – FMA 10

Risk Factors			
Total Area	4.25 sq. mi.	Total Number of Buildings	4,057
Resident Population	10,552	Residential	88.0%
Daytime Population	10,684	Commercial/Industrial	0.01%
Population Density – Daytime	2,512	Other	12.0%
Population Density – Night	2,481	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	15	Building Density	1,040 per sq. mi.
Hazardous Substance Sites	15	Assessed Valuation – Buildings	\$1.5 Billion
Annual Service Demand	570		

Figure 12—FMA 11

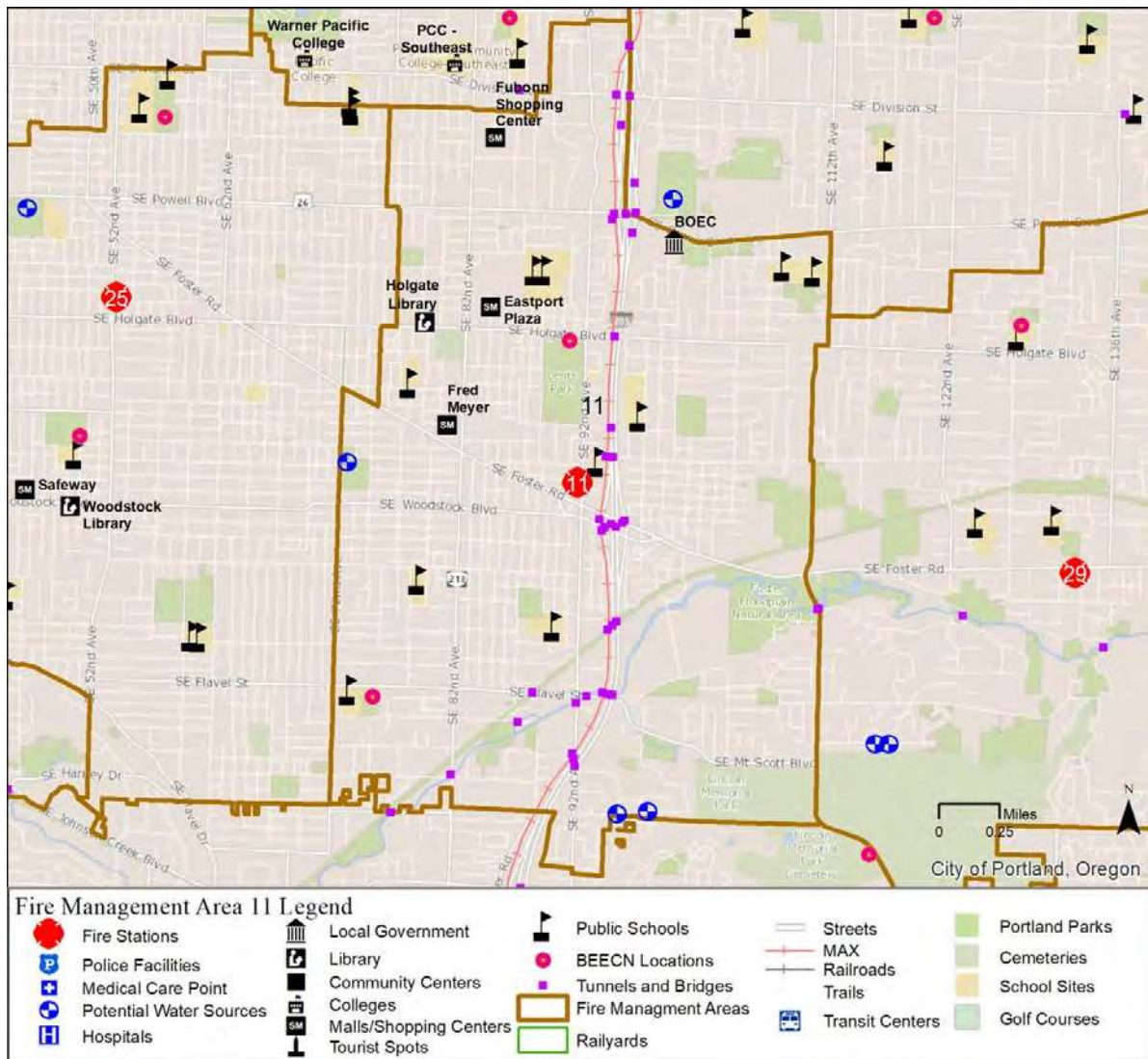


Table 12—Risk Profile – FMA 11

Risk Factors			
Total Area	5.31 sq. mi.	Total Number of Buildings	12,888
Resident Population	36,793	Residential	85.8%
Daytime Population	28,848	Commercial/Industrial	0%
Population Density – Daytime	5,436	Other	14.2%
Population Density – Night	6,932	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	35	Building Density	2,432 per sq. mi.
Hazardous Substance Sites	45	Assessed Valuation – Buildings	\$2.2 Billion
Annual Service Demand	4,905		

Figure 13—FMA 12

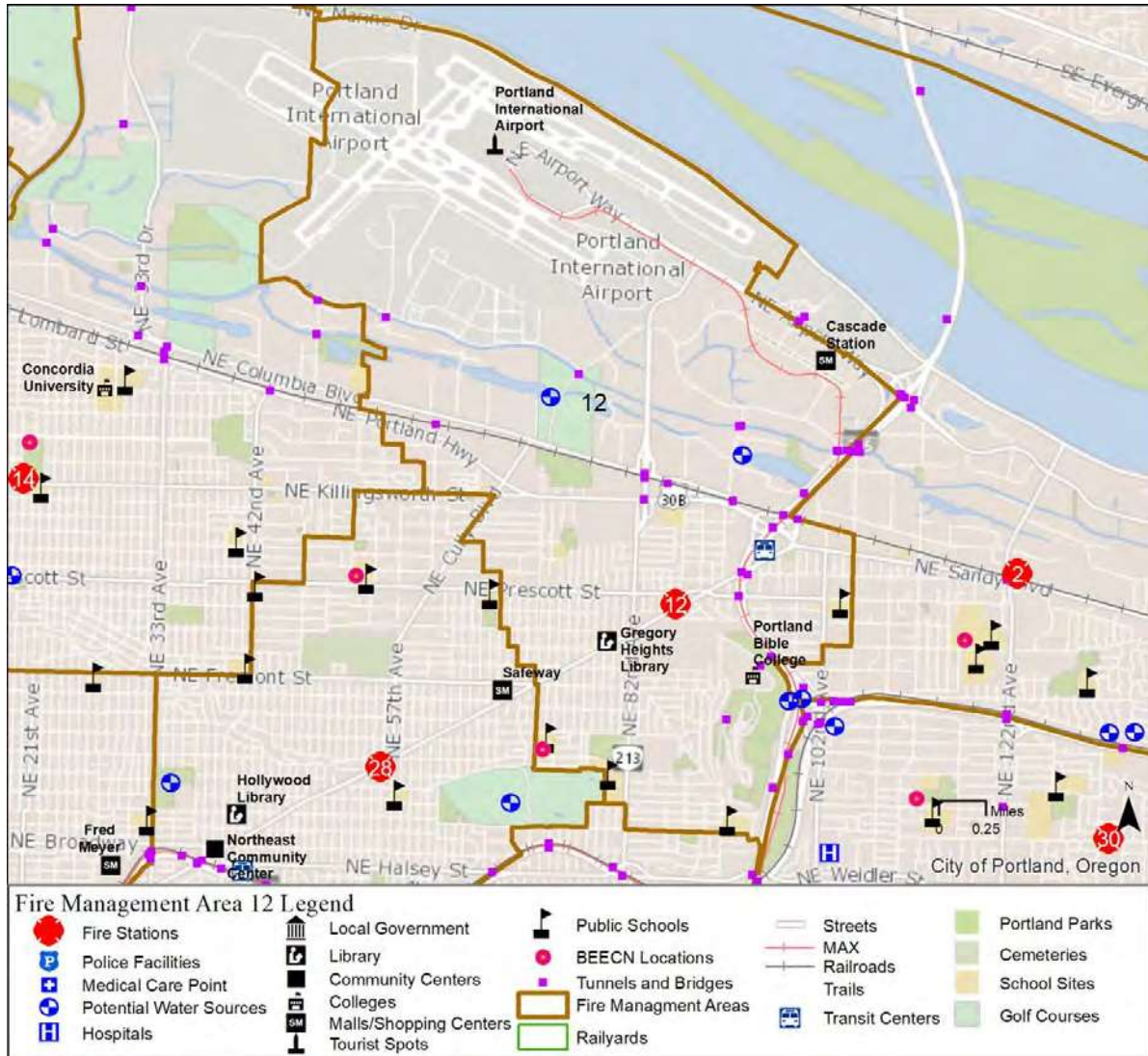


Table 13—Risk Profile – FMA 12

Risk Factors			
Total Area	8.23 sq. mi.	Total Number of Buildings	8,531
Resident Population	17,106	Residential	82.8%
Daytime Population	23,670	Commercial/Industrial	0.1%
Population Density – Daytime	2,934	Other	17.1%
Population Density – Night	2,120	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	86	Building Density	1,053 per sq. mi.
Hazardous Substance Sites	120	Assessed Valuation – Buildings	\$3.0 Billion
Annual Service Demand	2,810		

Figure 14—FMA 13

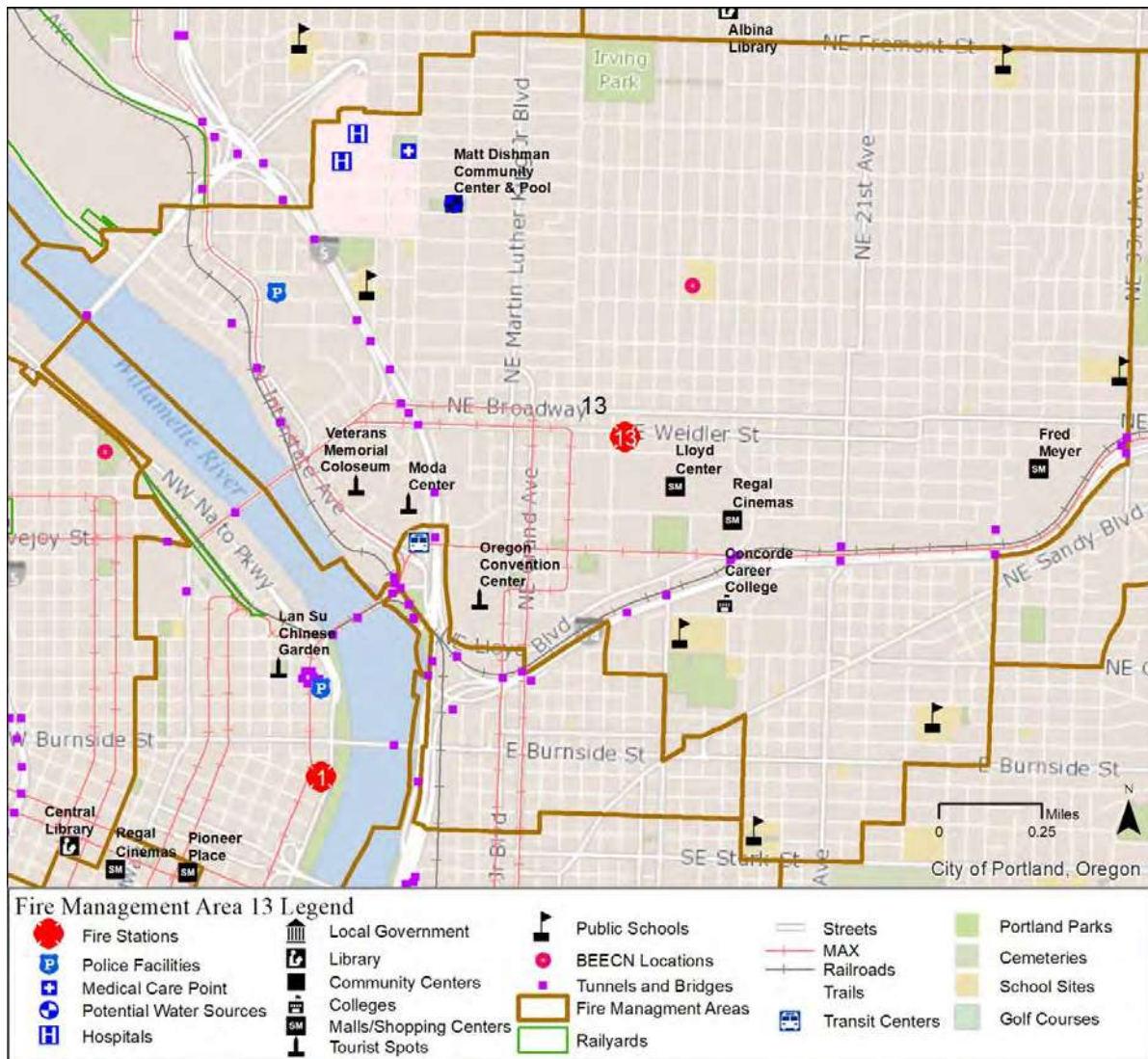


Table 14—Risk Profile – FMA 13

Risk Factors			
Total Area	3.34 sq. mi.	Total Number of Buildings	8,598
Resident Population	27,505	Residential	84.9%
Daytime Population	43,858	Commercial/Industrial	4.0%
Population Density – Daytime	13,152	Other	11.1%
Population Density – Night	8,247	High-Rise (>75 feet)	20
Critical Facilities/Infrastructure	50	Building Density	2,687 per sq. mi.
Hazardous Substance Sites	84	Assessed Valuation – Buildings	\$6.3 Billion
Annual Service Demand	4,962		

Figure 15—FMA 14

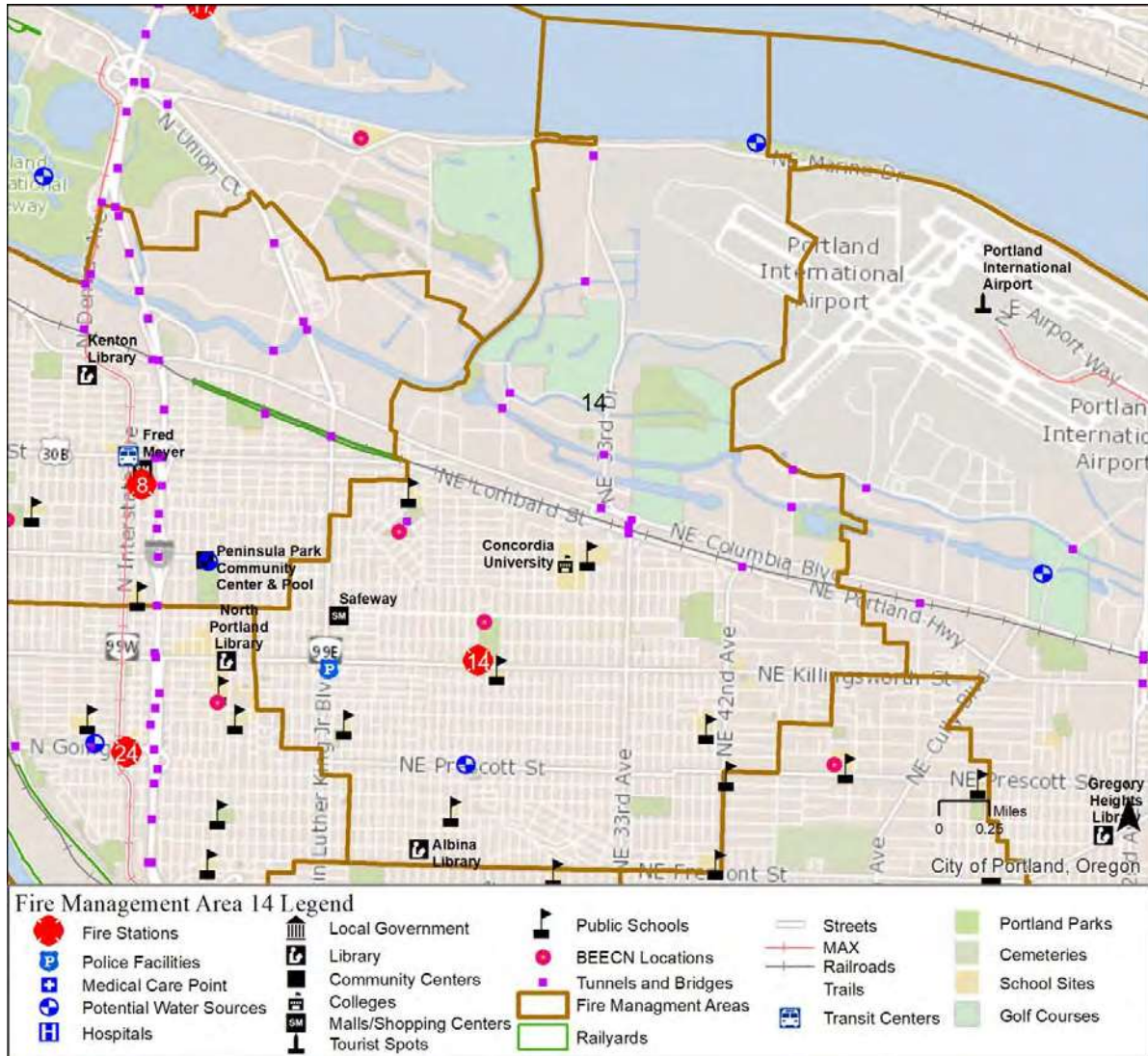


Table 15—Risk Profile – FMA 14

Risk Factors			
Total Area	8.04 sq. mi.	Total Number of Buildings	19,376
Resident Population	38,383	Residential	87.8%
Daytime Population	35,428	Commercial/Industrial	.01%
Population Density – Daytime	4,459	Other	12.2%
Population Density – Night	4,830	High-Rise (>75 feet)	2
Critical Facilities/Infrastructure	41	Building Density	2,691 per sq. mi.
Hazardous Substance Sites	97	Assessed Valuation – Buildings	\$4.5 Billion
Annual Service Demand	2,840		

Figure 16—FMA 15

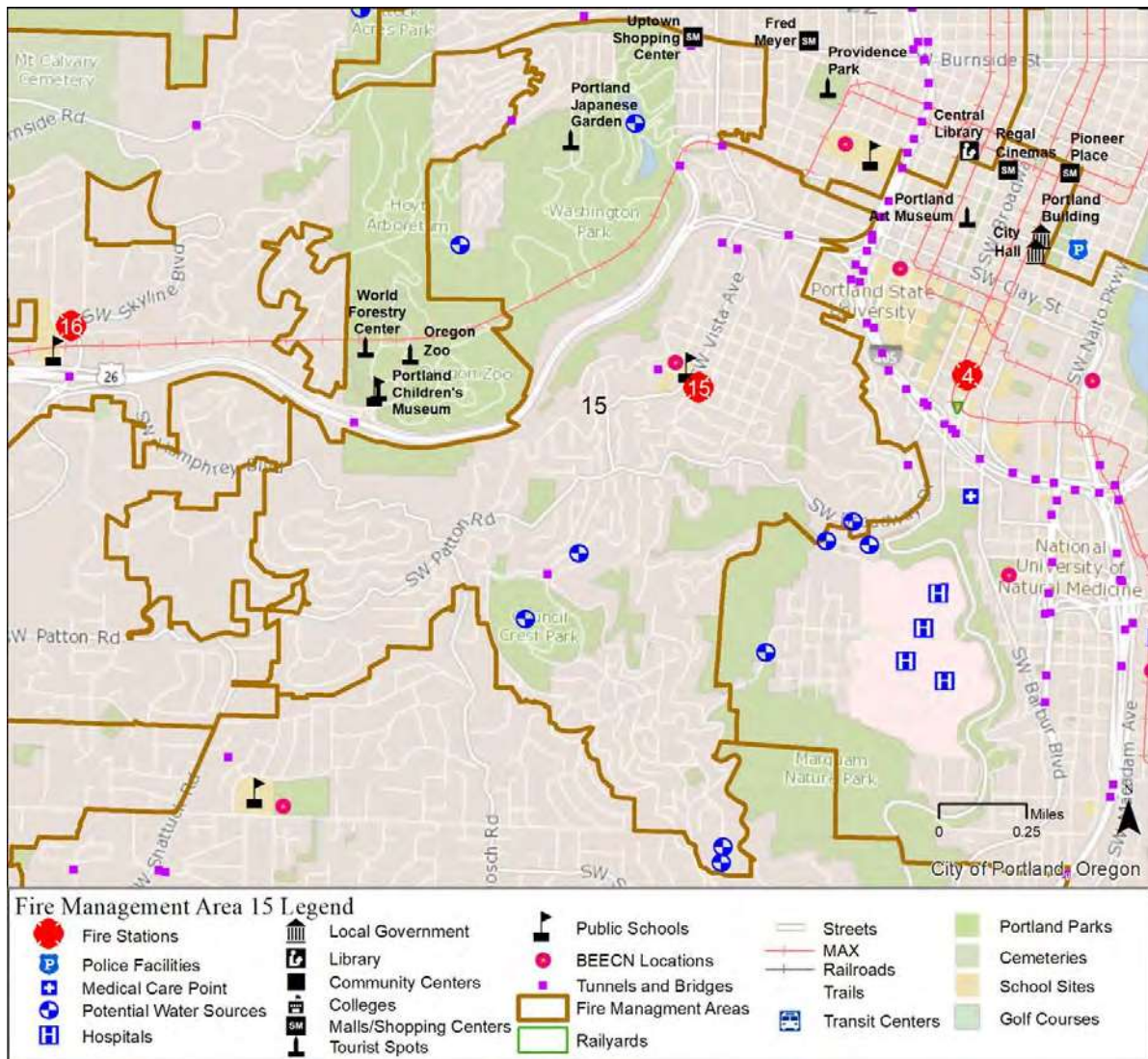


Table 16—Risk Profile – FMA 15

Risk Factors			
Total Area	2.32 sq. mi.	Total Number of Buildings	2,912
Resident Population	9,998	Residential	91.2%
Daytime Population	8,663	Commercial/Industrial	0.7%
Population Density – Daytime	3,730	Other	8.1%
Population Density – Night	4,304	High-Rise (>75 feet)	4
Critical Facilities/Infrastructure	20	Building Density	1,266 per sq. mi.
Hazardous Substance Sites	13	Assessed Valuation – Buildings	\$2.0 Billion
Annual Service Demand	527		

Figure 17—FMA 16

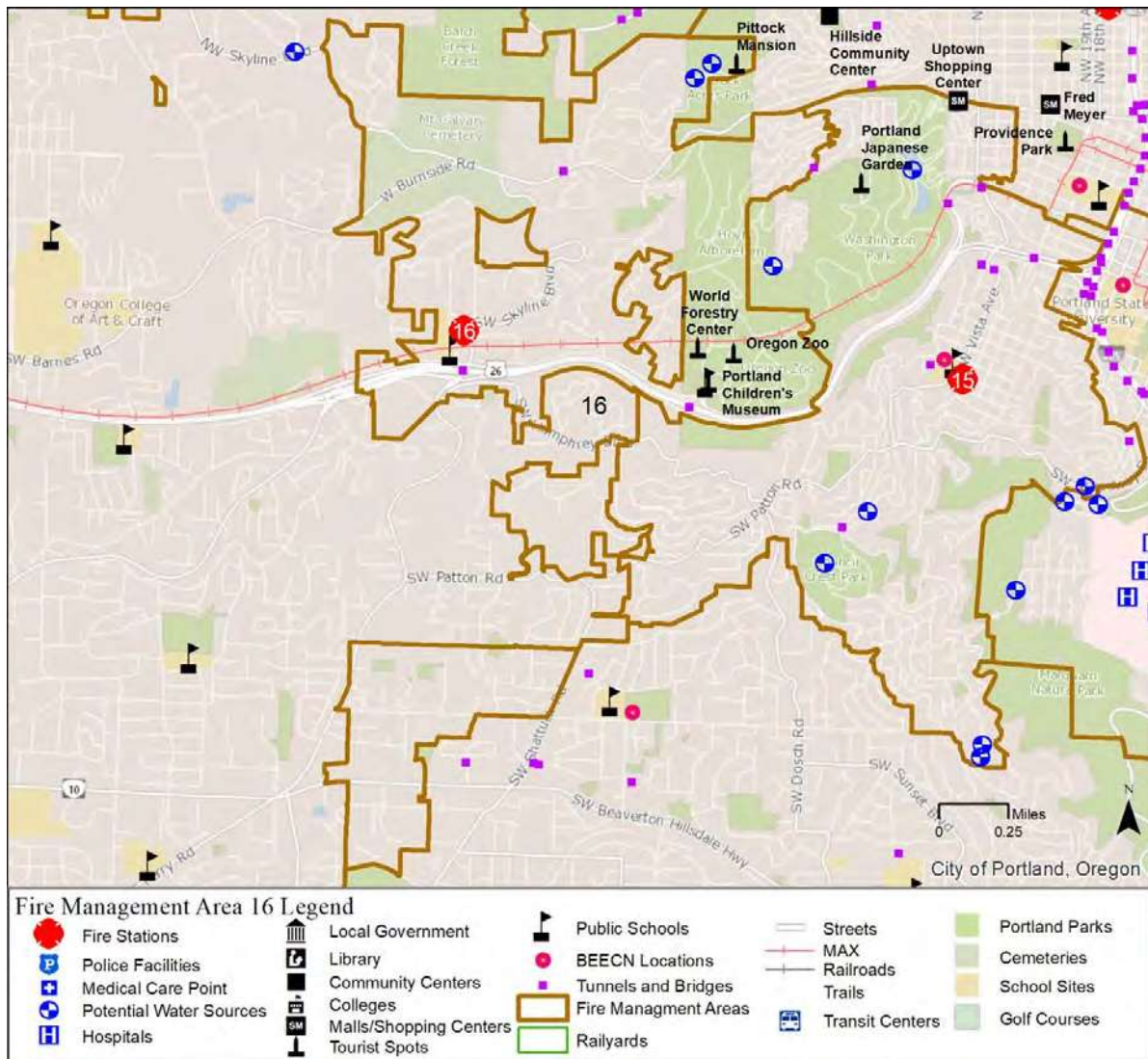


Table 17—Risk Profile – FMA 16

Risk Factors			
Total Area	2.18 sq. mi.	Total Number of Buildings	1,587
Resident Population	3,327	Residential	82.5%
Daytime Population	3,793	Commercial/Industrial	0%
Population Density – Daytime	1,742	Other	17.5%
Population Density – Night	1,528	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	17	Building Density	721 per sq. mi.
Hazardous Substance Sites	16	Assessed Valuation – Buildings	\$0.9 Billion
Annual Service Demand	726		

Figure 18—FMA 17

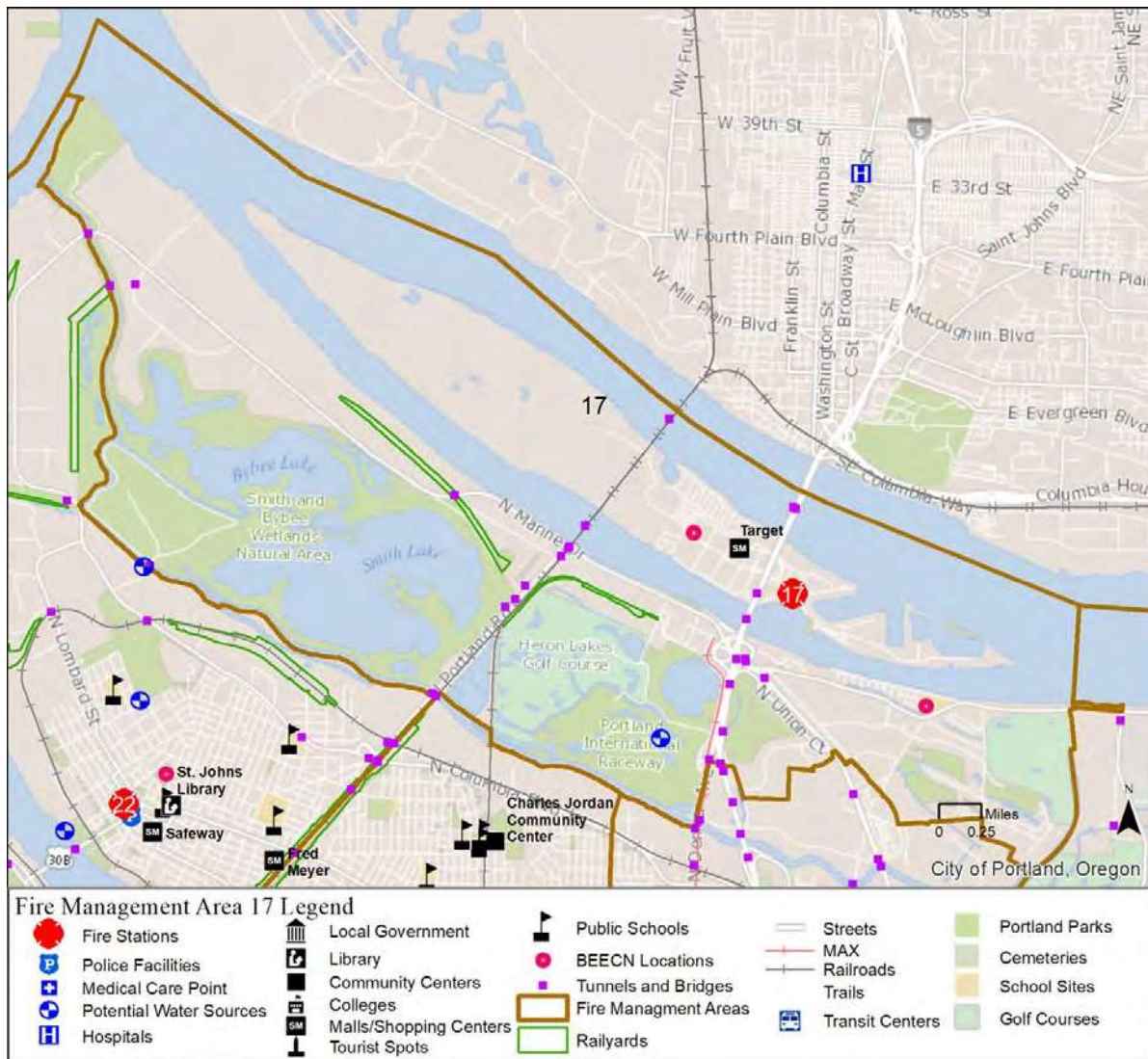


Table 18—Risk Profile – FMA 17

Risk Factors			
Total Area	13.70 sq. mi.	Total Number of Buildings	3,023
Resident Population	5,067	Residential	25.6%
Daytime Population	9,288	Commercial/Industrial	0%
Population Density – Daytime	672	Other	74.4%
Population Density – Night	367	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	67	Building Density	364 per sq. mi.
Hazardous Substance Sites	78	Assessed Valuation – Buildings	\$1.1 Billion
Annual Service Demand	1,485		

Figure 19—FMA 18

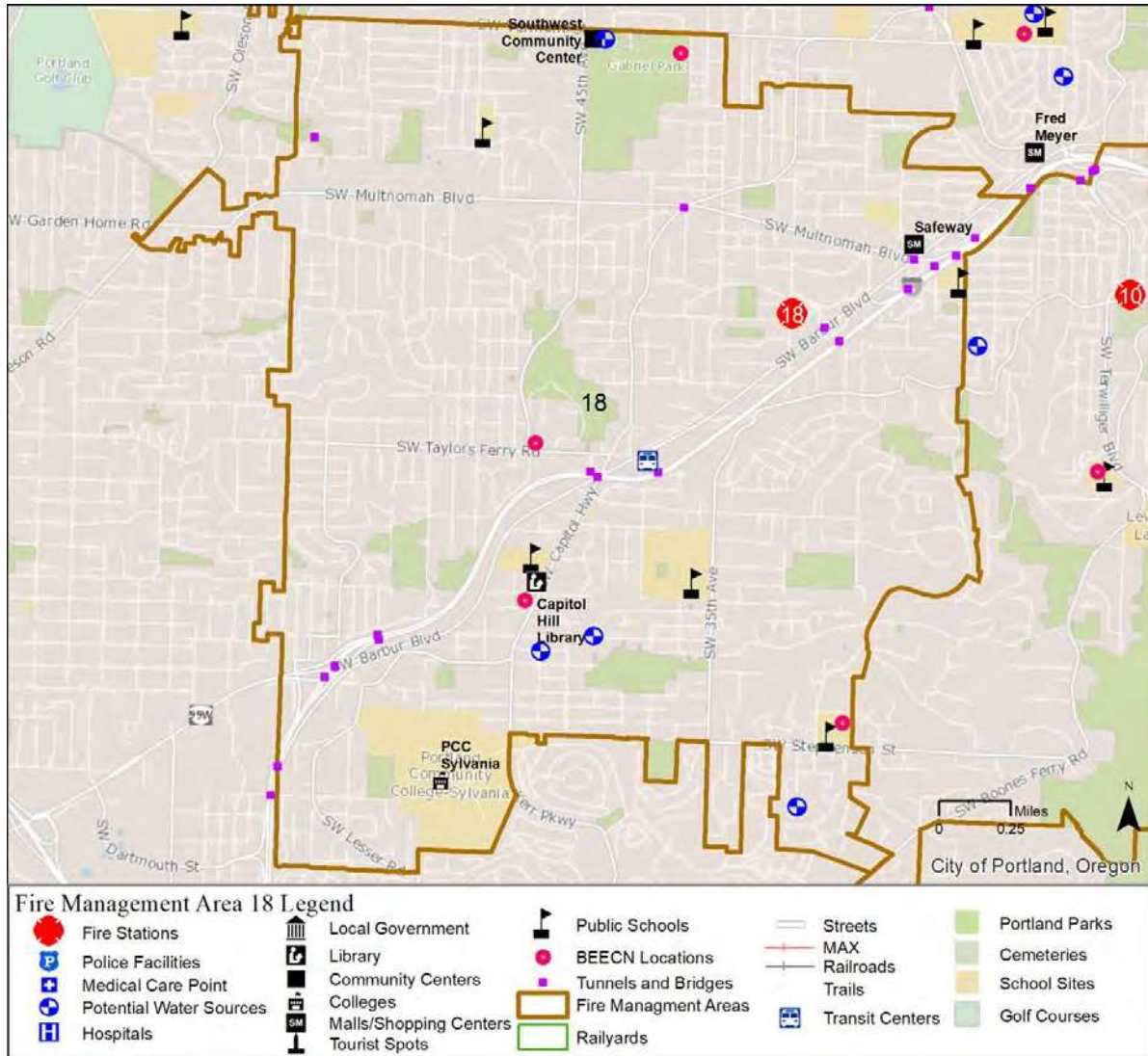


Table 19—Risk Profile – FMA 18

Risk Factors			
Total Area	6.16 sq. mi.	Total Number of Buildings	11,052
Resident Population	27,569	Residential	89.9%
Daytime Population	24,805	Commercial/Industrial	0%
Population Density – Daytime	4,026	Other	10.1%
Population Density – Night	4,474	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	42	Building Density	1,783 per sq. mi.
Hazardous Substance Sites	34	Assessed Valuation – Buildings	\$3.1 Billion
Annual Service Demand	1,920		

Figure 20—FMA 19

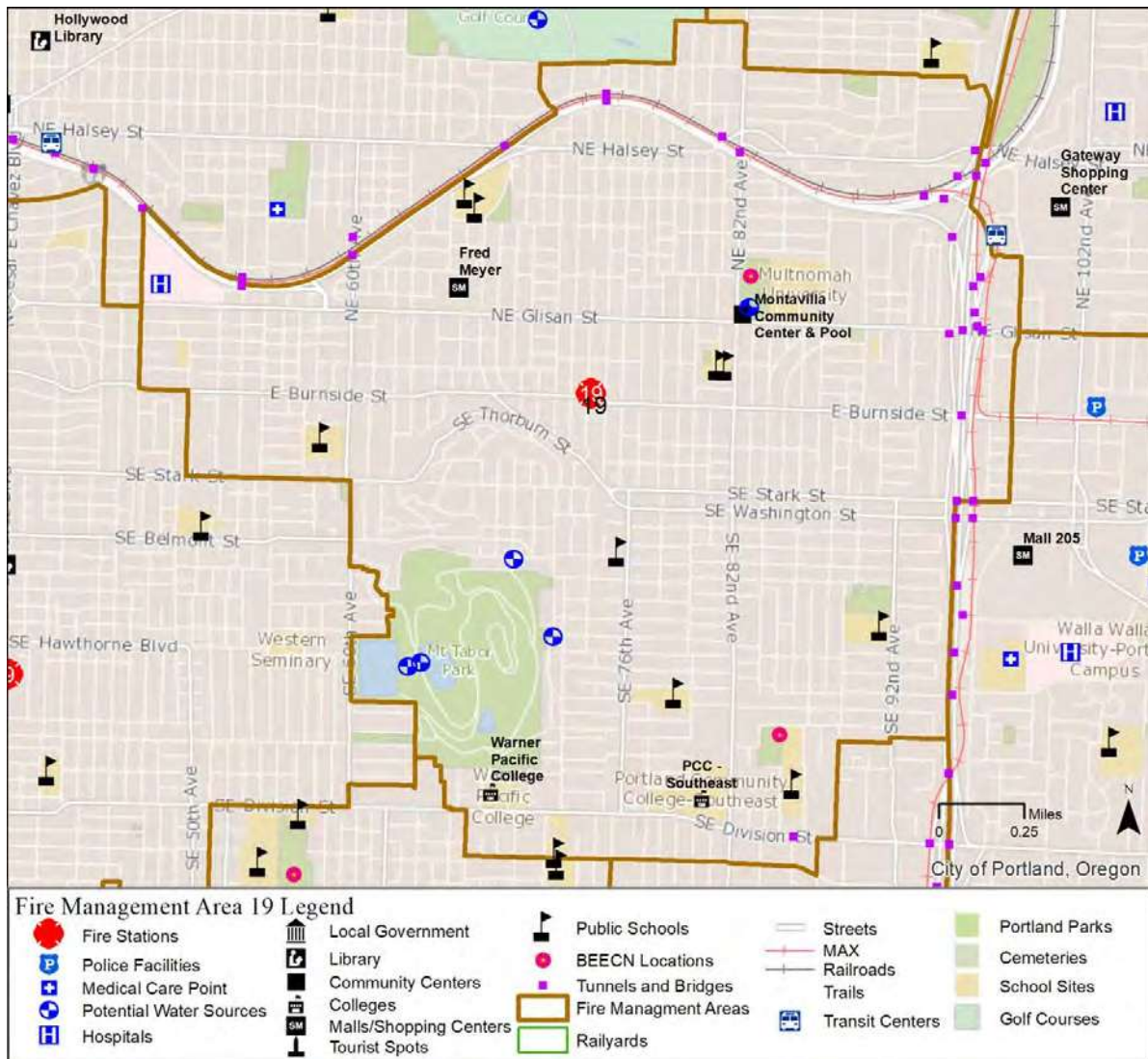


Table 20—Risk Profile – FMA 19

Risk Factors			
Total Area	4.26 sq. mi.	Total Number of Buildings	13,161
Resident Population	31,444	Residential	89.2%
Daytime Population	29,227	Commercial/Industrial	0.01%
Population Density – Daytime	6,980	Other	10.8%
Population Density – Night	7,508	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	47	Building Density	3,134 per sq. mi.
Hazardous Substance Sites	42	Assessed Valuation – Buildings	\$3.3 Billion
Annual Service Demand	3,367		

Figure 21—FMA 20

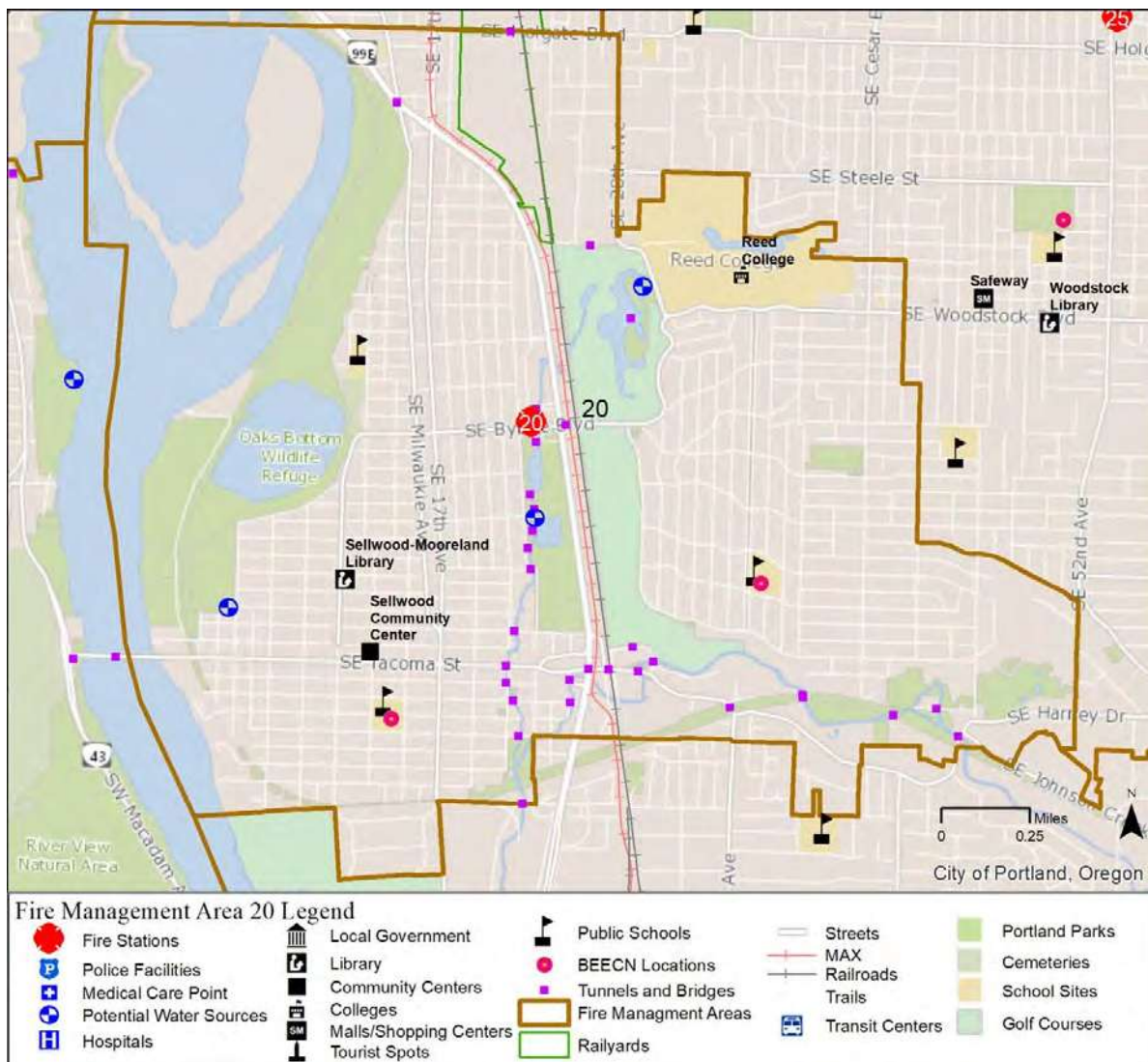


Table 21—Risk Profile – FMA 20

Risk Factors			
Total Area	4.67 sq. mi.	Total Number of Buildings	9,711
Resident Population	22,179	Residential	86.1%
Daytime Population	21,033	Commercial/Industrial	0.01%
Population Density – Daytime	4,518	Other	13.9%
Population Density – Night	4,764	High-Rise (>75 feet)	1
Critical Facilities/Infrastructure	27	Building Density	2,428 per sq. mi.
Hazardous Substance Sites	33	Assessed Valuation – Buildings	\$2.9 Billion
Annual Service Demand	1,760		

Figure 22—FMA 21

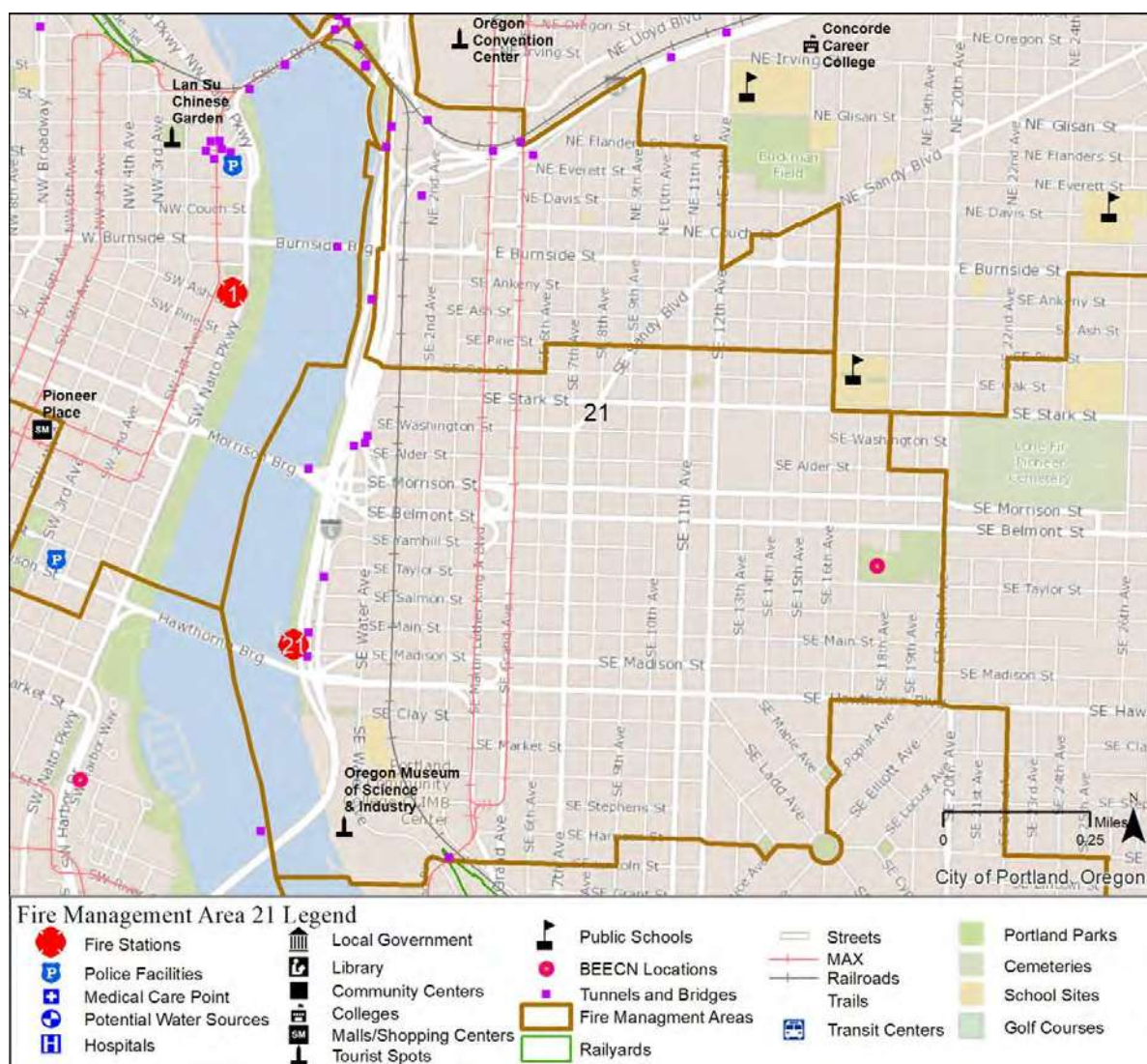


Table 22—Risk Profile – FMA 21

Risk Factors			
Total Area	0.95 sq. mi.	Total Number of Buildings	1,401
Resident Population	6,040	Residential	56.8%
Daytime Population	12,323	Commercial/Industrial	30.5%
Population Density – Daytime	12,964	Other	12.6%
Population Density – Night	6,353	High-Rise (>75 feet)	5
Critical Facilities/Infrastructure	15	Building Density	1,577 per sq. mi.
Hazardous Substance Sites	38	Assessed Valuation – Buildings	\$1.6 Billion
Annual Service Demand	2,212		

Figure 23—FMA 22

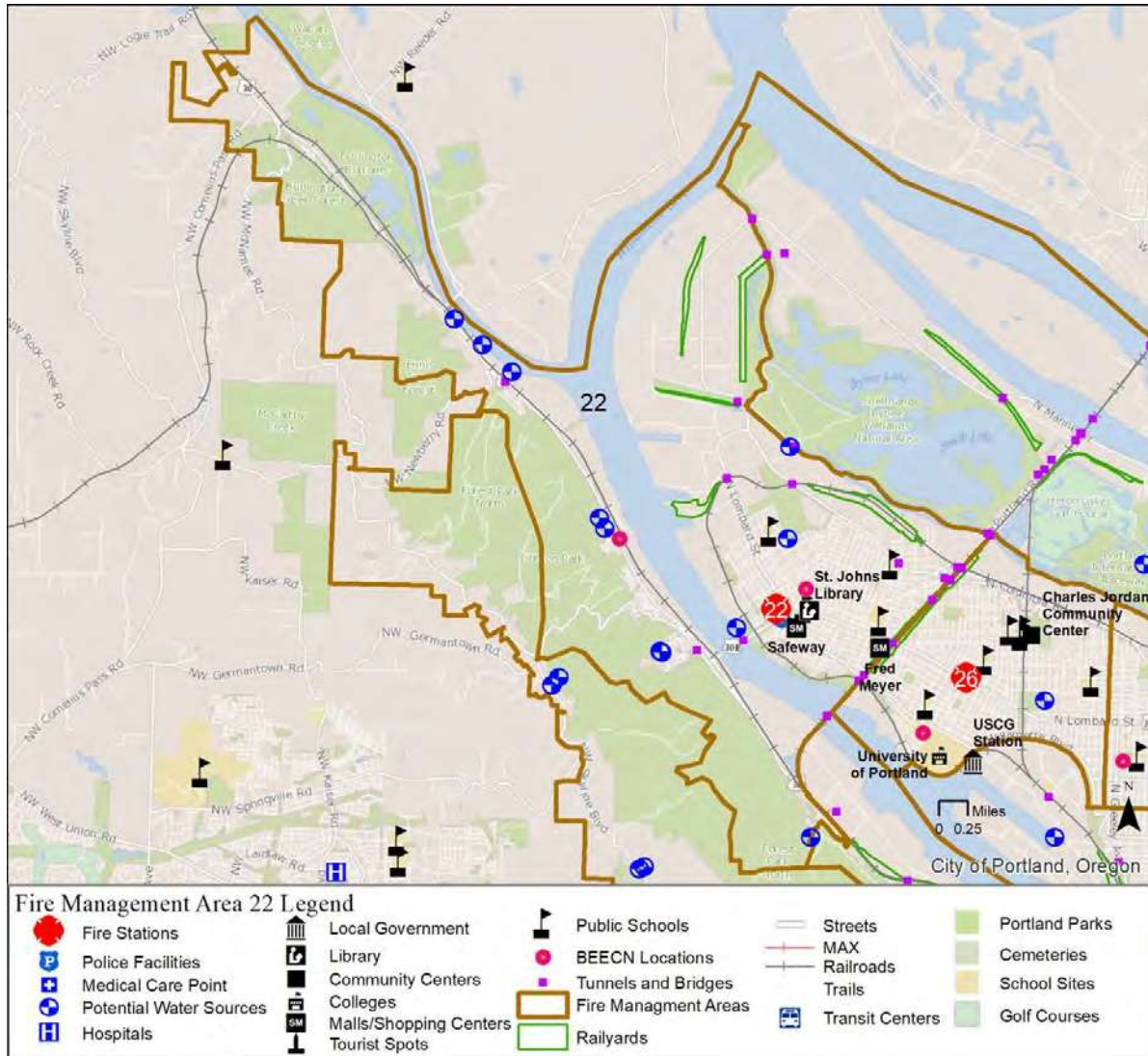


Table 23—Risk Profile – FMA 22

Risk Factors			
Total Area	15.14 sq. mi.	Total Number of Buildings	7,958
Resident Population	18,464	Residential	77.7%
Daytime Population	18,583	Commercial/Industrial	0.01%
Population Density – Daytime	1,221	Other	22.3%
Population Density – Night	1,213	High-Rise (>75 feet)	7
Critical Facilities/Infrastructure	142	Building Density	612 per sq. mi.
Hazardous Substance Sites	126	Assessed Valuation – Buildings	\$2.0 Billion
Annual Service Demand	2,118		

Figure 24—FMA 23

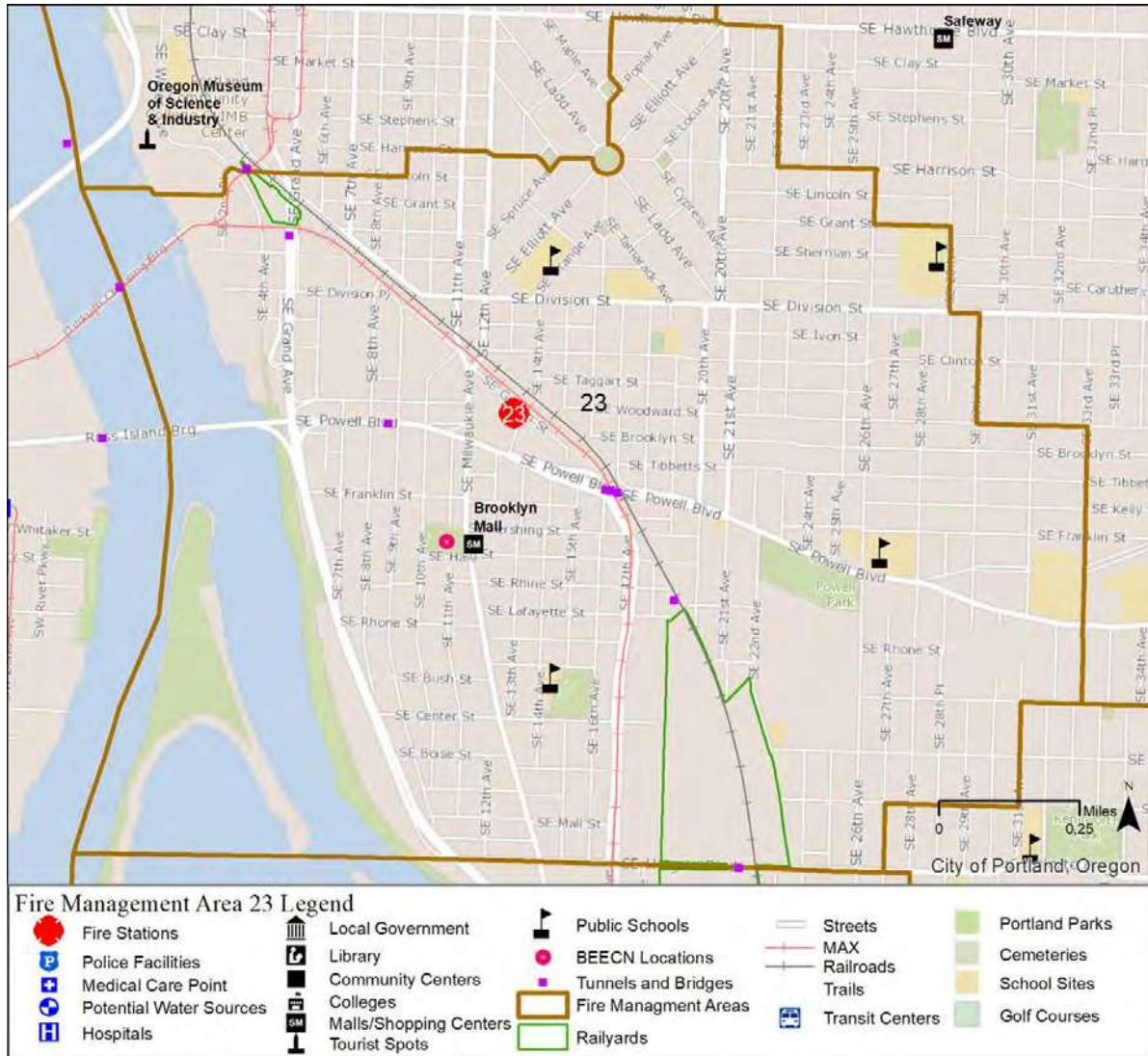


Table 24—Risk Profile – FMA 23

Risk Factors			
Total Area	2.00 sq. mi.	Total Number of Buildings	5,015
Resident Population	11,886	Residential	84.5%
Daytime Population	16,422	Commercial/Industrial	2.9%
Population Density – Daytime	8,208	Other	12.6%
Population Density – Night	5,940	High-Rise (>75 feet)	2
Critical Facilities/Infrastructure	24	Building Density	2,786 per sq. mi.
Hazardous Substance Sites	36	Assessed Valuation – Buildings	\$1.8 Billion
Annual Service Demand	1,202		

Figure 25—FMA 24

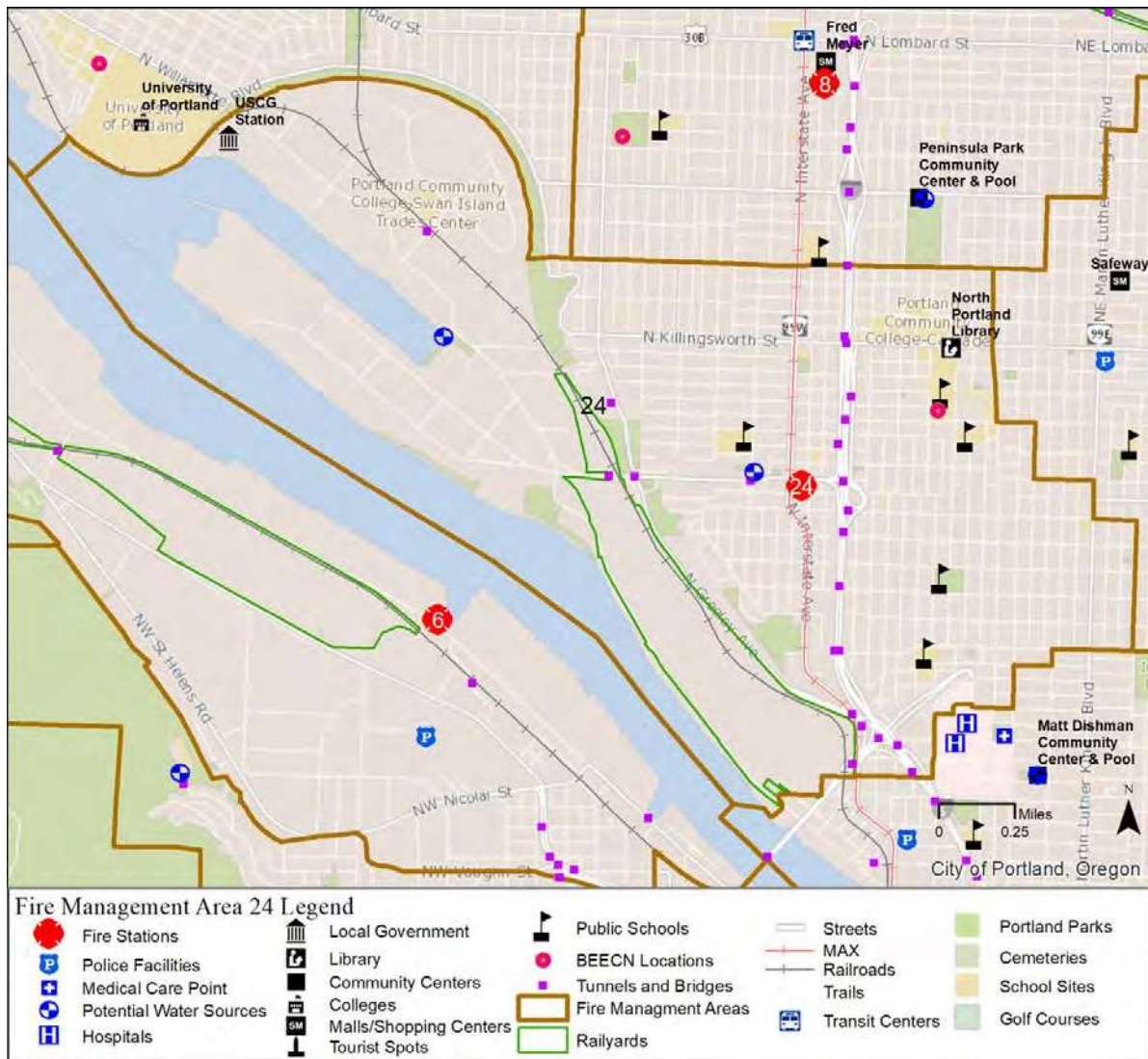


Table 25—Risk Profile – FMA 24

Risk Factors			
Total Area	4.28 sq. mi.	Total Number of Buildings	7,079
Resident Population	20,073	Residential	82.3%
Daytime Population	24,555	Commercial/Industrial	0.01%
Population Density – Daytime	5,709	Other	17.6%
Population Density – Night	4,666	High-Rise (>75 feet)	2
Critical Facilities/Infrastructure	34	Building Density	1,966 per sq. mi.
Hazardous Substance Sites	86	Assessed Valuation – Buildings	\$2.9 Billion
Annual Service Demand	2,362		

Figure 26—FMA 25

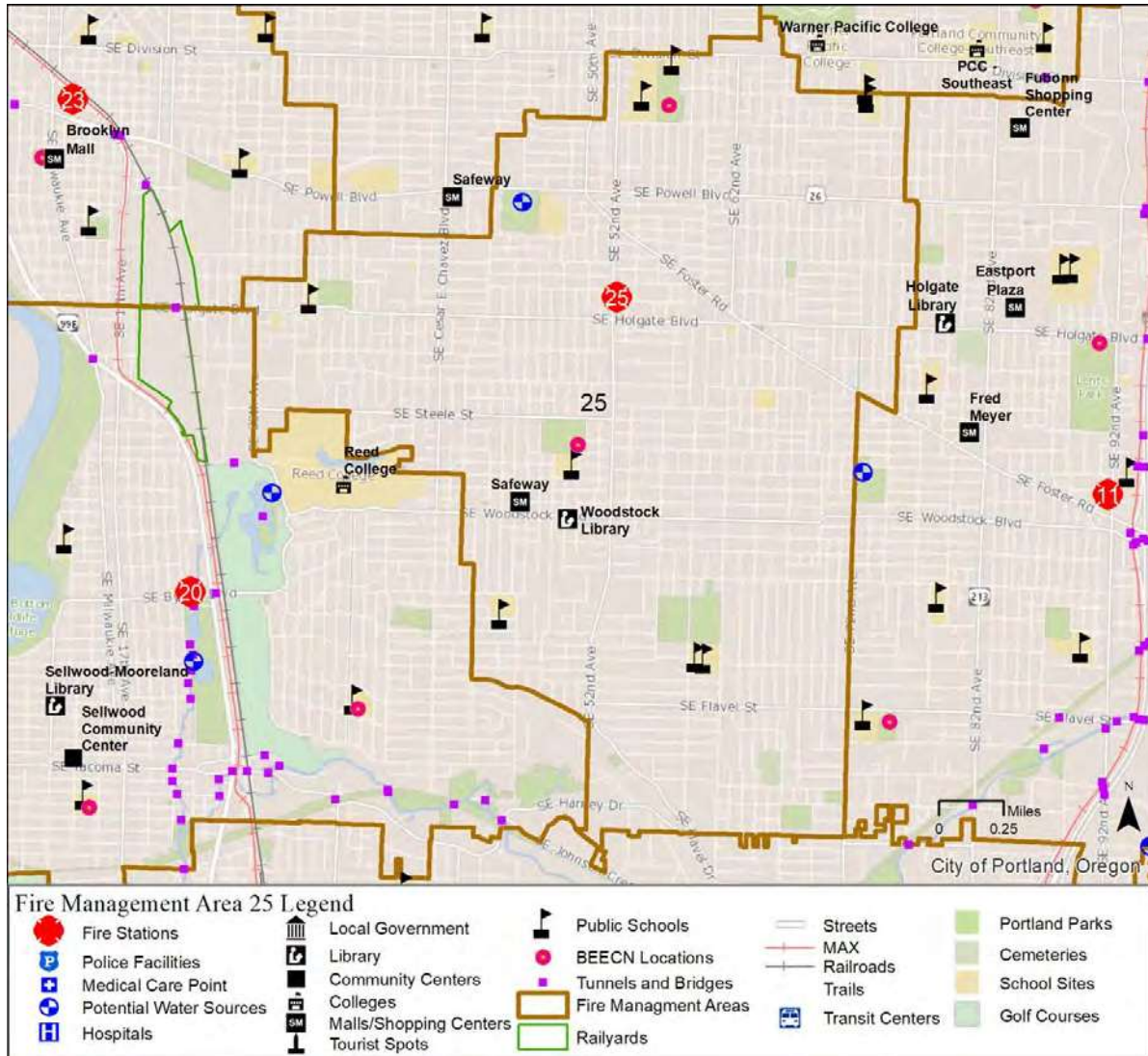


Table 26—Risk Profile – FMA 25

Risk Factors			
Total Area	5.0 sq. mi.	Total Number of Buildings	19,302
Resident Population	41,392	Residential	90.6%
Daytime Population	31,289	Commercial/Industrial	0.01%
Population Density – Daytime	6,255	Other	9.4%
Population Density – Night	8,273	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	24	Building Density	3,860 per sq. mi.
Hazardous Substance Sites	39	Assessed Valuation – Buildings	\$3.6 Billion
Annual Service Demand	3,407		

Figure 27—FMA 26

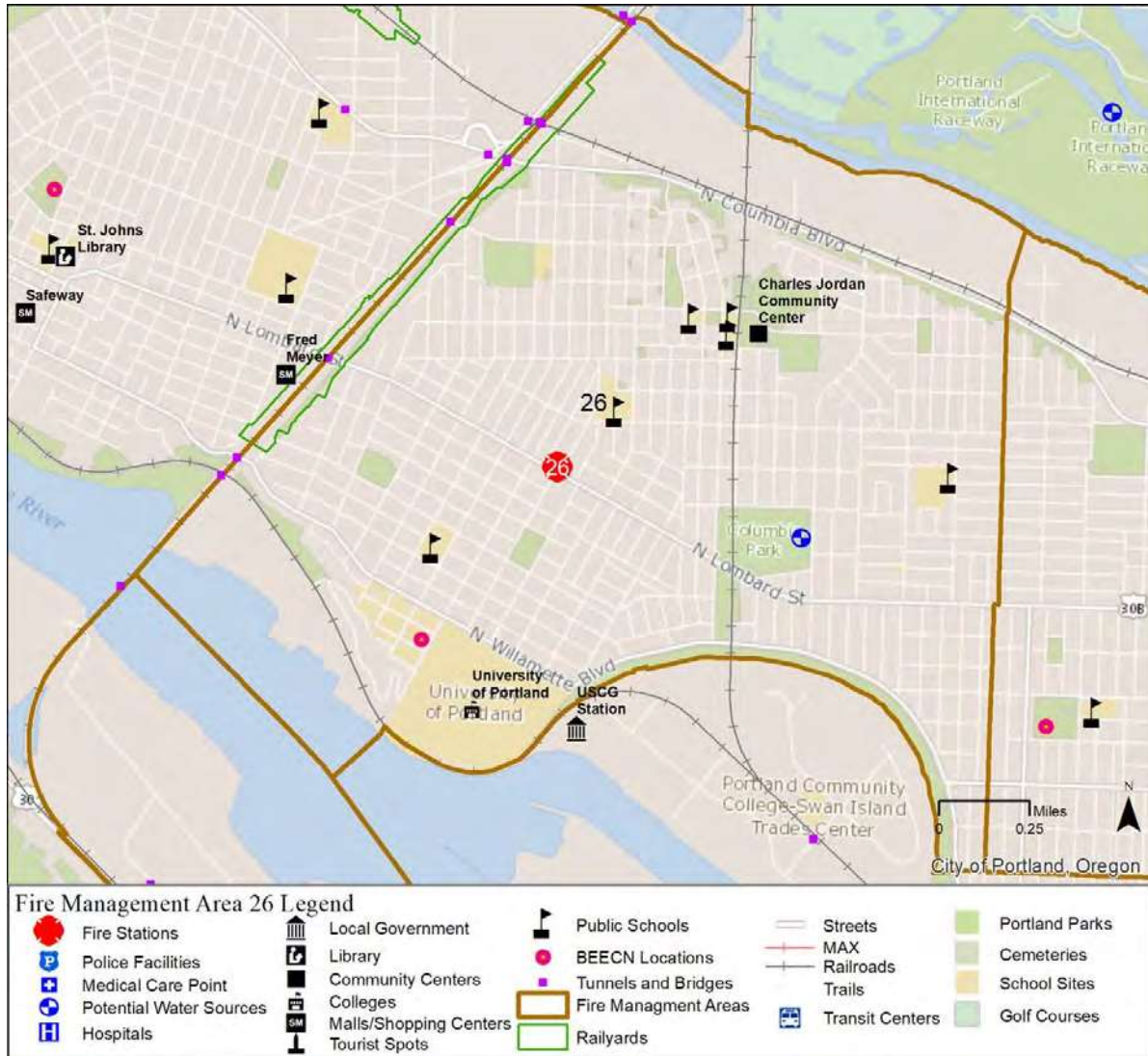


Table 27—Risk Profile – FMA 26

Risk Factors			
Total Area	3.26 sq. mi.	Total Number of Buildings	8,555
Resident Population	22,101	Residential	89.8%
Daytime Population	17,728	Commercial/Industrial	0%
Population Density – Daytime	5,750	Other	10.2%
Population Density – Night	7,167	High-Rise (>75 feet)	1
Critical Facilities/Infrastructure	20	Building Density	2,760 per sq. mi.
Hazardous Substance Sites	25	Assessed Valuation – Buildings	\$2.3 Billion
Annual Service Demand	1,714		

Figure 28—FMA 27

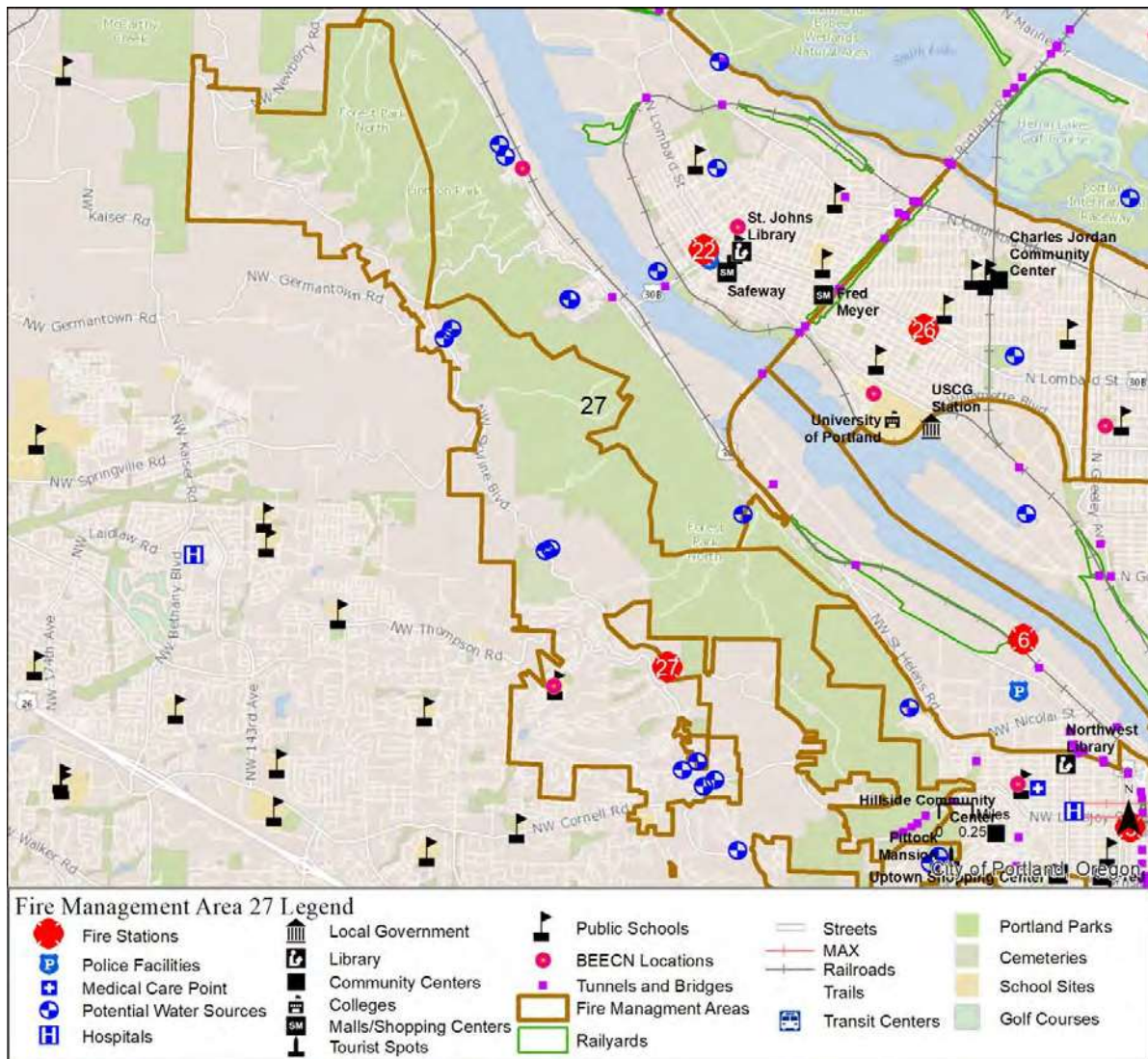


Table 28—Risk Profile – FMA 27

Risk Factors			
Total Area	8.29 sq. mi.	Total Number of Buildings	2,546
Resident Population	7,663	Residential	83.6%
Daytime Population	6,344	Commercial/Industrial	0%
Population Density – Daytime	766	Other	16.4%
Population Density – Night	925	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	7	Building Density	307 per sq. mi.
Hazardous Substance Sites	4	Assessed Valuation – Buildings	\$1.1 Billion
Annual Service Demand	253		

Figure 29—FMA 28

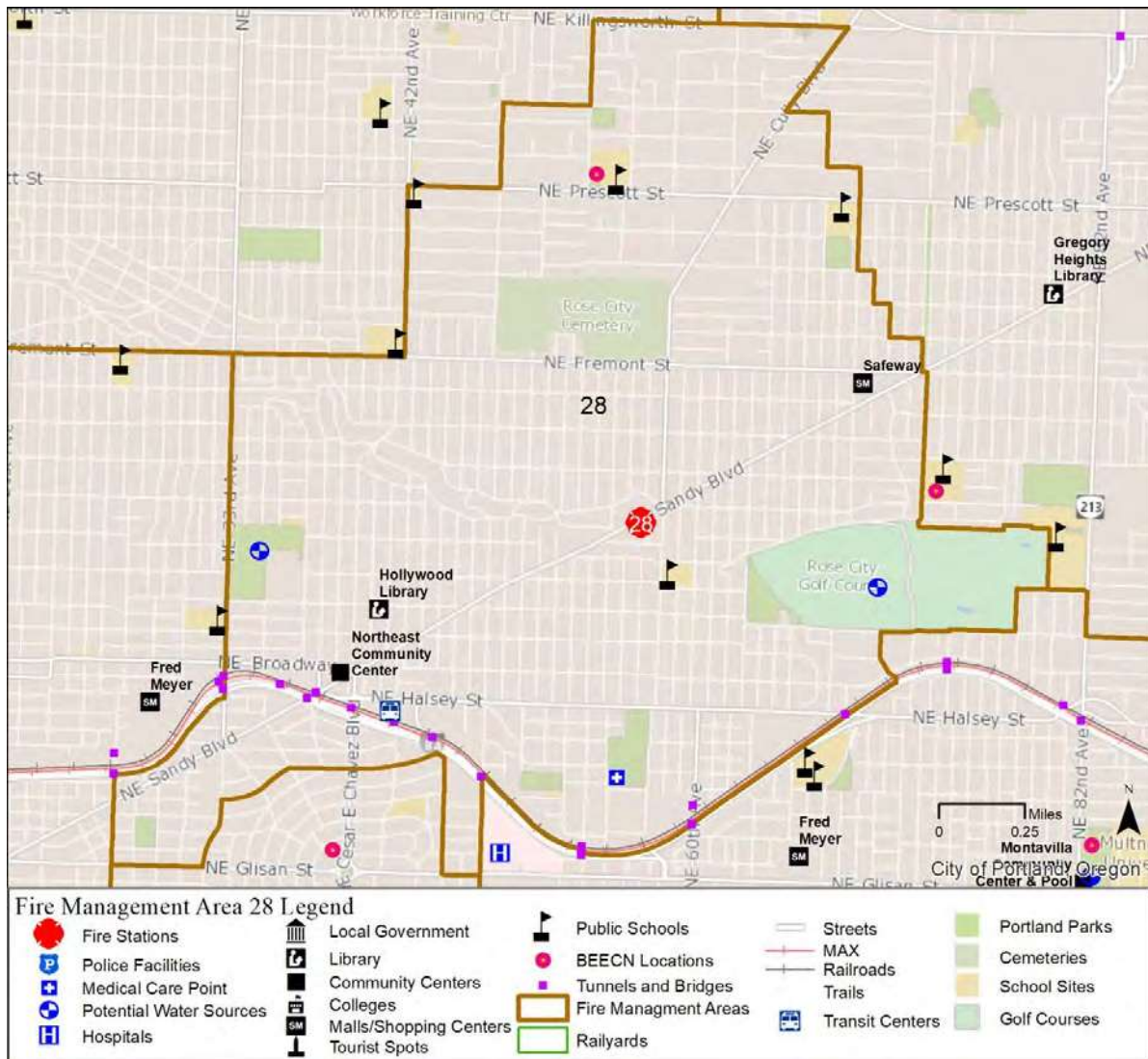


Table 29—Risk Profile – FMA 28

Risk Factors			
Total Area	3.75 sq. mi.	Total Number of Buildings	14,648
Resident Population	28,081	Residential	93.1%
Daytime Population	27,751	Commercial/Industrial	0.01%
Population Density – Daytime	7,265	Other	6.9%
Population Density – Night	7,351	High-Rise (>75 feet)	2
Critical Facilities/Infrastructure	22	Building Density	3,959 per sq. mi.
Hazardous Substance Sites	32	Assessed Valuation – Buildings	\$3.5 Billion
Annual Service Demand	2,578		

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Figure 30—FMA 29

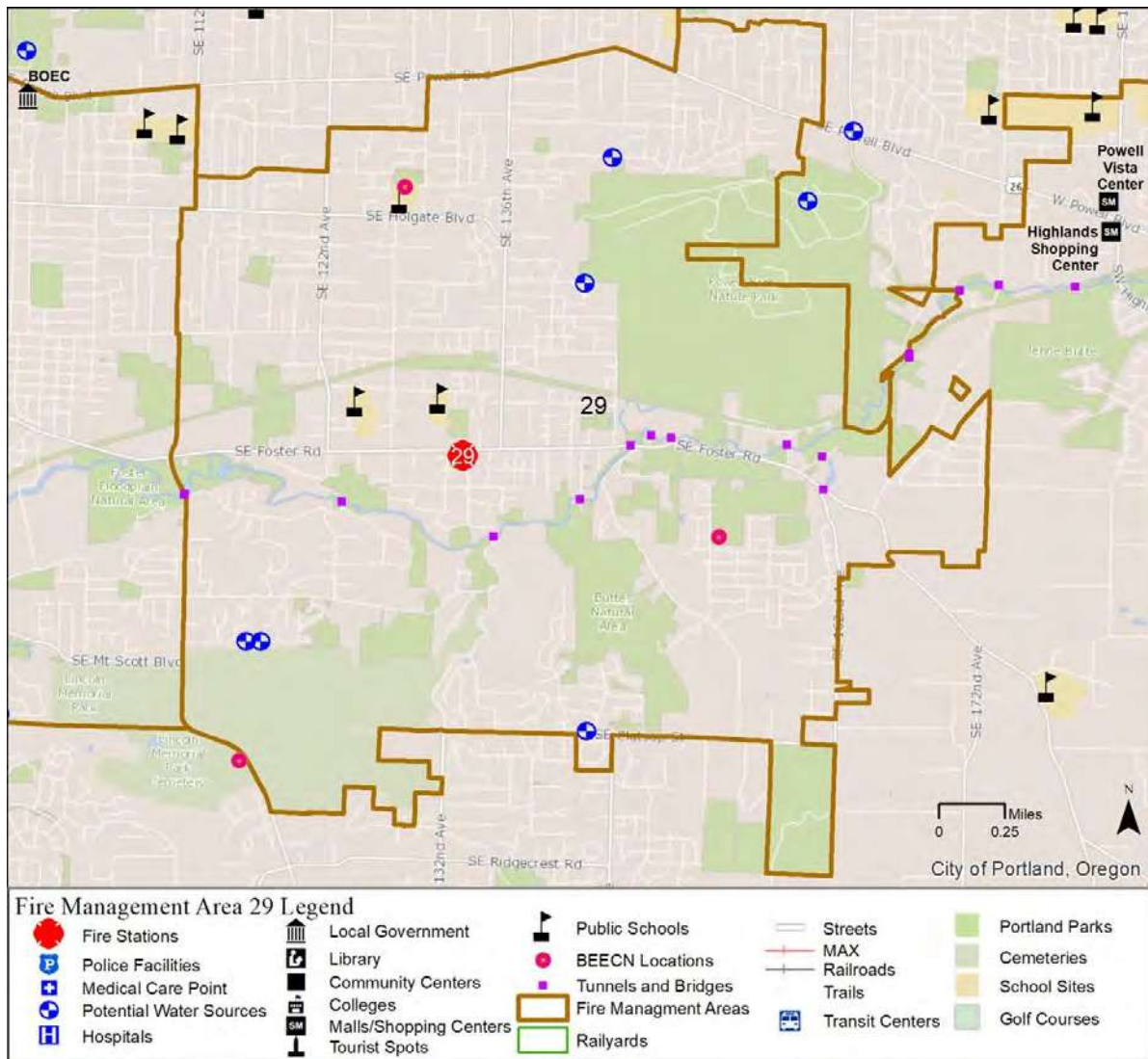


Table 30—Risk Profile – FMA 29

Risk Factors			
Total Area	6.61 sq. mi.	Total Number of Buildings	8,549
Resident Population	27,067	Residential	83.0%
Daytime Population	19,934	Commercial/Industrial	0%
Population Density – Daytime	3,018	Other	17.0%
Population Density – Night	4,097	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	38	Building Density	1,295 per sq. mi.
Hazardous Substance Sites	6	Assessed Valuation – Buildings	\$1.3 Billion
Annual Service Demand	2,280		

Figure 31—FMA 30

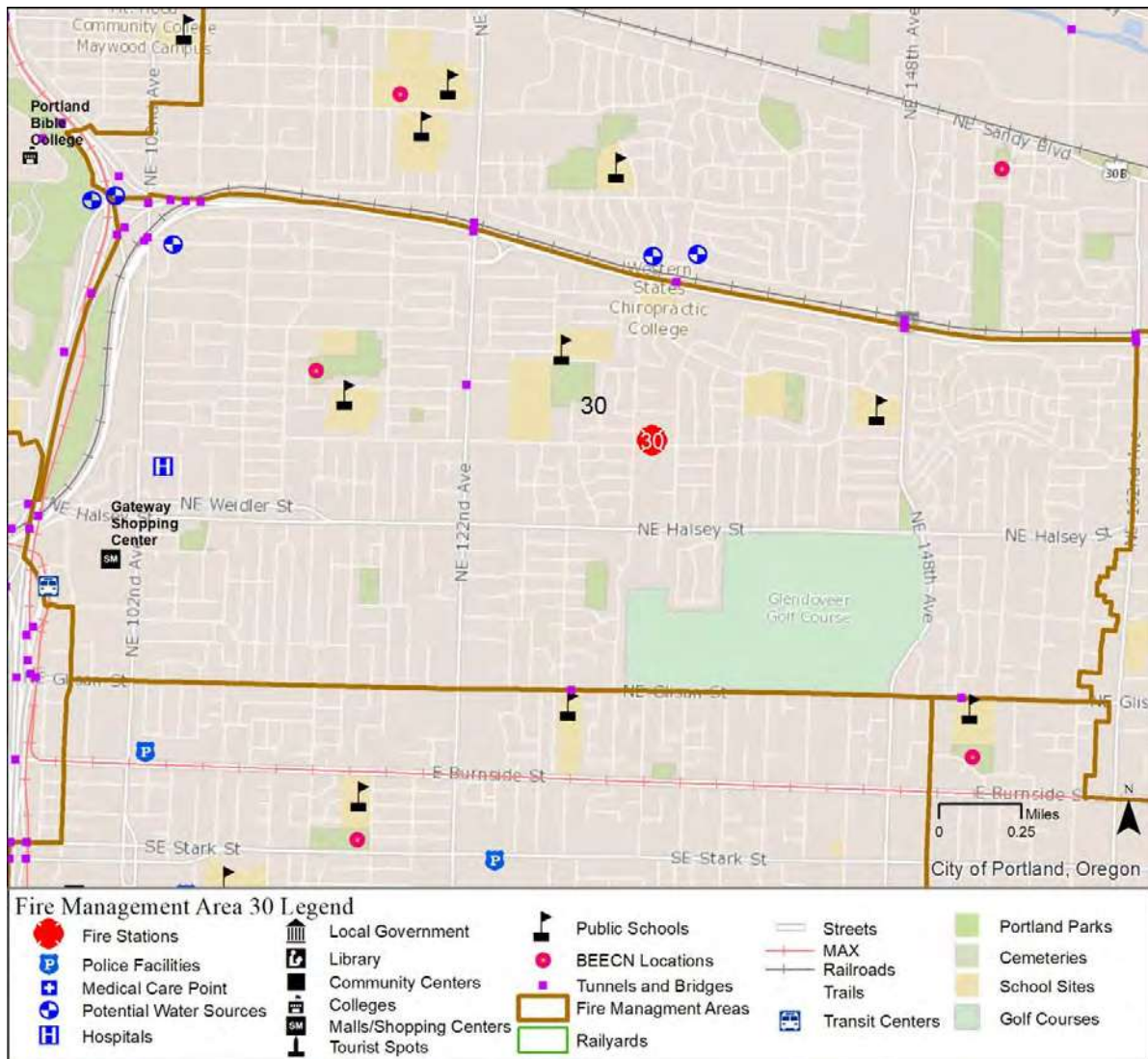


Table 31—Risk Profile – FMA 30

Risk Factors			
Total Area	4.16 sq. mi.	Total Number of Buildings	8,577
Resident Population	21,491	Residential	91.6%
Daytime Population	19,124	Commercial/Industrial	0.01%
Population Density – Daytime	4,594	Other	8.4%
Population Density – Night	5,162	High-Rise (>75 feet)	2
Critical Facilities/Infrastructure	39	Building Density	2,042 per sq. mi.
Hazardous Substance Sites	22	Assessed Valuation – Buildings	\$1.5 Billion
Annual Service Demand	3,495		

Figure 32—FMA 31

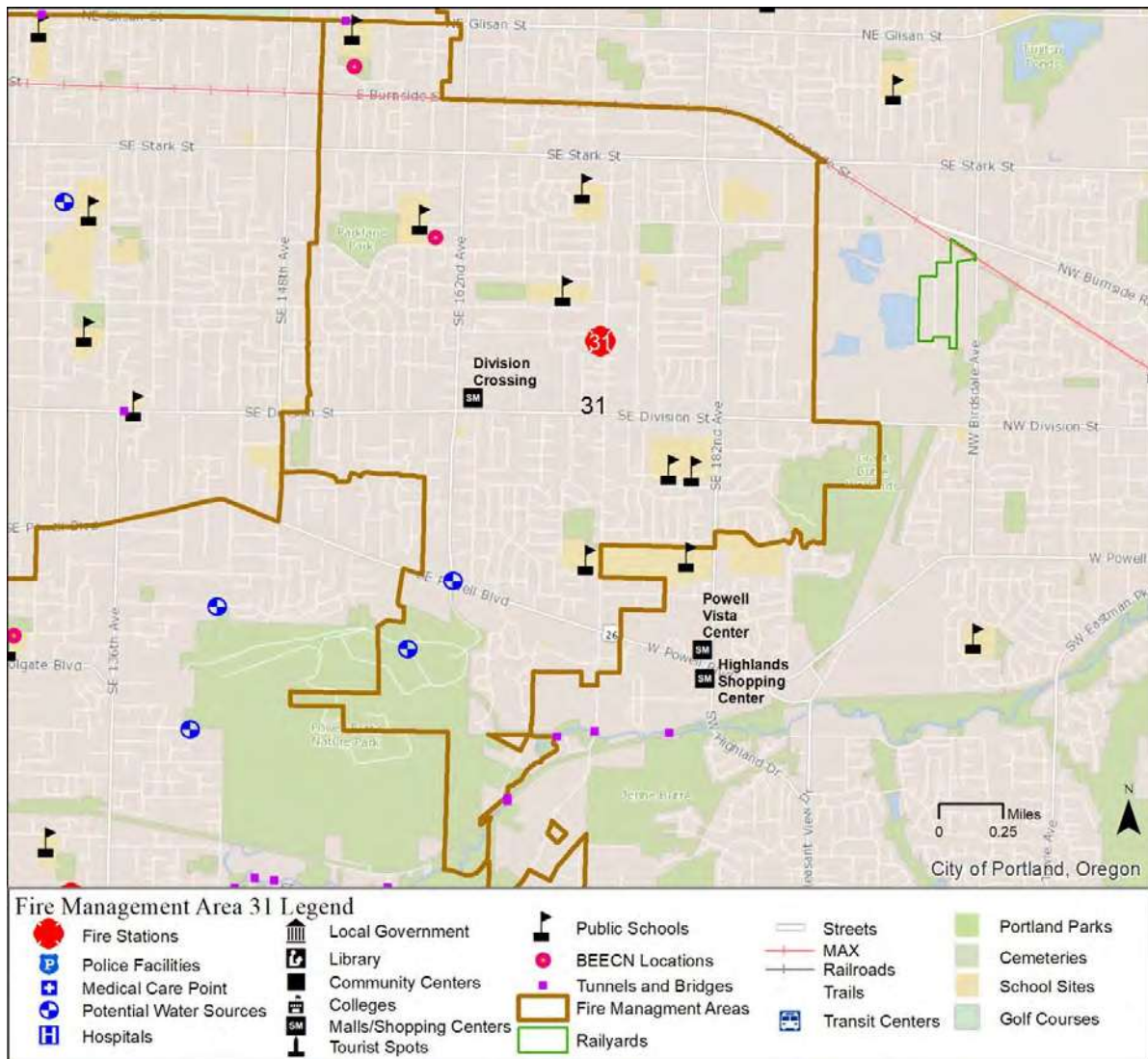


Table 32—Risk Profile – FMA 31

Risk Factors			
Total Area	4.22 sq. mi.	Total Number of Buildings	9,321
Resident Population	33,040	Residential	56.4%
Daytime Population	25,199	Commercial/Industrial	0%
Population Density – Daytime	5,973	Other	43.6%
Population Density – Night	7,831	High-Rise (>75 feet)	0
Critical Facilities/Infrastructure	21	Building Density	2,219 per sq. mi.
Hazardous Substance Sites	17	Assessed Valuation – Buildings	\$0.97 Billion
Annual Service Demand	3,924		

1.1.4 Values at Risk to Be Protected

Values at risk, broadly defined, are tangibles of significant importance or value to the community or jurisdiction potentially at risk of harm or damage from a hazard occurrence. Values at risk typically include people, critical facilities/infrastructure, buildings, and key economic, cultural, historic, or natural resources.

People

Residents, employees, visitors, and travelers in a community or jurisdiction are vulnerable to harm from a hazard occurrence. Particularly vulnerable are specific at-risk populations, including those unable to care for themselves or self-evacuate in the event of an emergency. At-risk populations typically include children less than 10 years of age, the elderly, people housed in institutional settings, households below the federal poverty level, and people living unsheltered. The following table summarizes key demographic data for the City.

Table 33—Key Demographic Data – Portland

Demographic	2021
Population	653,842
Under 10 years	10.20%
10–14 years	5.00%
15–64 years	69.90%
65–74 years	9.20%
75 years and older	5.80%
Median age	38.1
Daytime population	740,513
Housing Units	298,524
Owner-Occupied	49.50%
Renter-Occupied	44.20%
Vacant	6.30%
Average Household Size	2.28
Median Home Value	\$476,132
Ethnicity	
White	72.70%
Hispanic/Latino (counted as White)	10.70%
Asian	8.90%
Black/African American	6.50%
Other	11.90%
Education (Population over 24 Years of Age)	475,810
High School Graduate or Equivalent	93.40%
Undergraduate Degree	52.70%
Graduate/Professional Degree	22.10%
Employment (Population over 15 Years of Age)	386,940
In Labor Force	93.00%
Unemployed	7.00%
Median Household Income	\$75,237
Population below Poverty Level	12.3%
Disabled Population	12.0%
Population without Health Insurance Coverage	6.6%

Source: Esri and U.S. Census Bureau

Of note from the previous table is the following:

- ◆ Slightly more than 25 percent of the population is under 10 years or over 65 years of age.
- ◆ The City’s population is predominantly White (73 percent), followed by Hispanic/Latino (11 percent and also counted as White), other ethnicities (12 percent), Asian (9 percent), and Black / African American (7 percent).
- ◆ Of the population over 24 years of age, more than 93 percent has completed high school or equivalency.
- ◆ Of the population over 24 years of age, nearly 53 percent has an undergraduate, graduate, or professional degree.
- ◆ Of the population 15 years of age or older, 93 percent is in the workforce; of those, 7 percent are unemployed.
- ◆ Median household income is slightly more than \$75,000.
- ◆ The population below the federal poverty level is slightly more than 12 percent.
- ◆ Only 6.6 percent of the population does not have health insurance coverage.

The City’s Comprehensive Plan projects slightly more than 112,000 new households by 2035.¹

Buildings

The City has nearly 300,000 residential housing units² and 38,241 other buildings³ housing manufacturing, research, technology, office, professional services, retail sales, restaurants/bars, motels, churches, schools, storage, government facilities, healthcare facilities, and other occupancies.

Building Occupancy Risk Categories

The CFAI identifies the following four risk categories that relate to building occupancy:

Low Risk – includes detached garages, storage sheds, outbuildings, and similar building occupancies that pose a relatively low risk of harm to humans or the community if damaged or destroyed by fire.

¹ Source: Portland 2035 Comprehensive Plan, Growth Scenarios Report (July 2015), Proposed Comprehensive Plan Scenario Table 10.

² Source: Esri Community Analyst – Community Profile (2021).

³ Source: Portland Fire & Rescue Community Risk Assessment (2020), Table 4.

Moderate Risk – includes detached single-family or two-family dwellings; mobile homes; commercial and industrial buildings less than 10,000 square feet without a high hazard fire load; aircraft; railroad facilities; and similar building occupancies where loss of life or property damage is limited to the single building.

High Risk – includes apartment/condominium buildings; commercial and industrial buildings more than 10,000 square feet without a high hazard fire load; low-occupant load buildings with high fuel loading or hazardous materials; and similar occupancies with potential for substantial loss of life or unusual property damage or financial impact.

Maximum Risk – includes buildings or facilities with unusually high risk requiring an Effective Response Force (ERF) involving a significant augmentation of resources and personnel and where a fire would pose the potential for a catastrophic event involving large loss of life, significant economic impact to the community, or both.

Evaluation of the City’s building inventory identified 8,818 high/maximum-risk building uses as they relate to the CFAI building fire risk categories, as summarized in the following table.

Table 34—Building Occupancy Inventory by Risk Category

Building Occupancy Classification		Number ¹	Risk Category ²
A-1	Assembly	61	High
H	Hazardous	576	Maximum
I	Institutional	165	High
R-1	Hotel/Motel	7,551	High
R-2	Multi-Family Residential	465	High
Total		8,818	

¹ Source: PF&R

² CFAI *Standards of Cover* (Fifth Edition)

Critical Infrastructure / Key Resources

The US Department of Homeland Security defines critical infrastructure / key resources as those physical assets essential to the public health and safety, economic vitality, and resilience of a community, such as lifeline utilities infrastructure, telecommunications infrastructure, essential government services facilities, public safety facilities, schools, hospitals, airports, etc. The Portland Bureau of Emergency Management identified 1,510 critical facilities and infrastructure in its 2016 Mitigation Action Plan as shown in the following maps and quantified in each preceding FMA Risk Profile. A hazard occurrence with significant consequence severity affecting one or more of these facilities would likely adversely impact critical public or community services.

Figure 33—Critical Facilities

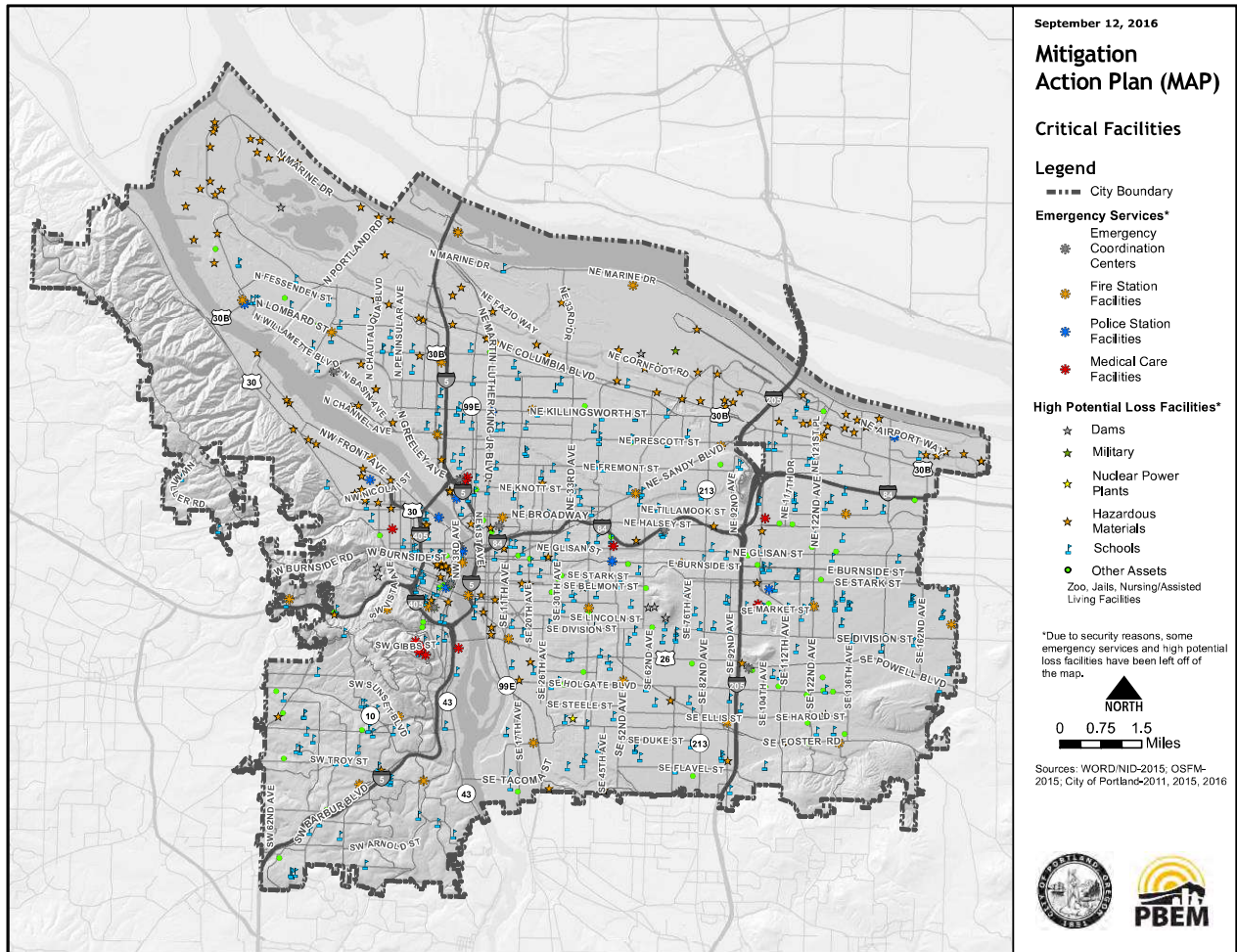
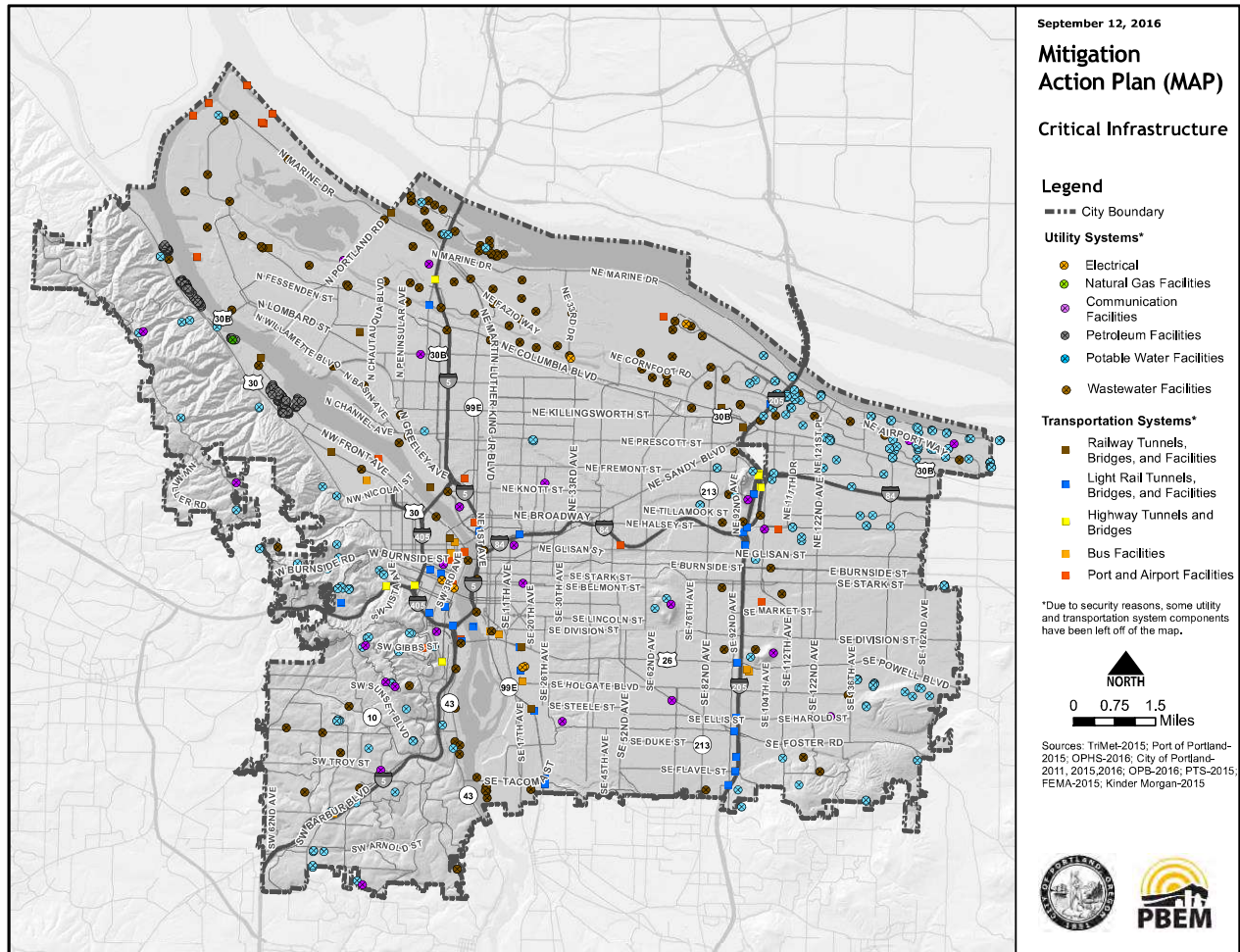


Figure 34—Critical Infrastructure



Economic Resources⁴

The City's 2035 Comprehensive Plan goals include vigorous economic growth and a healthy, diverse economy that supports prosperity and equitable access to employment opportunities for an increasingly diverse population. Major employers include:

- ◆ Intel Corporation
- ◆ Providence Health and Services
- ◆ Oregon Health and Science University
- ◆ Nike, Inc.

⁴ Source: City of Portland 2035 Comprehensive Plan and Comprehensive Annual Financial Report (June 2020).

- ◆ Legacy Health
- ◆ Kaiser Foundation Health Plan of Northwest
- ◆ Fred Meyer
- ◆ City of Portland
- ◆ Portland Public Schools
- ◆ Beaverton School District
- ◆ U.S. Government

Natural Resources⁵

Natural resources within the City include:

- ◆ 298 miles of river and open stream channels, including
 - Columbia River
 - Willamette River
- ◆ Smith Lake
- ◆ 2,520 acres of wetlands
- ◆ 8,000 acres of parks, including Forest Park
- ◆ 23,150 acres of riparian resources
- ◆ 17,840 acres of wildlife habitat
- ◆ 13,225 acres of special habitat

Cultural/Historic Resources

As a vibrant multicultural city, Portland boasts a large inventory of cultural and historic resources, including:

- ◆ Portland Art Museum
- ◆ Oregon Center for Contemporary Art
- ◆ Center for Native American Art
- ◆ Portland Theater

⁵ Source: Portland Plan, Natural Resource Inventory (December 2010).

- ◆ Portland Center Stage at the Armory
- ◆ Portland libraries

Special/Unique Resources

The following facilities are special or unique resources to be protected:

- ◆ Portland International Airport
- ◆ Tri-Met Light Rail
- ◆ Portland Aerial Tram
- ◆ University of Portland
- ◆ Oregon Health and Science University
- ◆ Port of Portland
- ◆ Riverfront risks

1.1.5 Hazard Identification

Citygate utilizes prior risk studies where available, fire and non-fire hazards as identified by the CFAI, and agency/jurisdiction-specific data and information to identify the hazards to be evaluated for this study. The 2016 Portland Mitigation Action Plan identifies the following eight hazards likely to impact the City:

1. Severe weather
2. Earthquake
3. Landslide
4. Wildfire
5. Flood
6. Volcanic activity
7. Dam failure
8. Drought

In addition, PF&R conducted a comprehensive internal Community Risk Assessment in December 2020 that evaluated the following hazards:

- ◆ Fire

- ◆ EMS
- ◆ Hazardous materials
- ◆ Technical rescue

Although PF&R has no legal authority or responsibility to mitigate any hazards other than possibly for wildfire, it does provide services related to many hazards, including fire suppression, emergency medical services, technical rescue, and hazardous materials response.

The CFAI groups hazards into fire and non-fire categories, as shown in the following figure. Identification, qualification, and quantification of the various fire and non-fire hazards are important factors in evaluating how resources are or can be deployed to mitigate those risks.

Figure 35—Commission on Fire Accreditation International Hazard Categories

Fire	EMS	Hazardous Materials	Technical Rescue	Disasters
One and Two Family Residential Structures	Medical Emergencies	Transportation	Confined Space	Natural
Multi-Family Structures			Swift-Water Rescue	
Commercial Structures	Motor Vehicle Accidents		High and Low Angle	
Mobile Property		Fixed Facilities	Structural Collapse and Trench Rescue	Man Made
Wildland	Other			

Source: CFAI *Standards of Cover* (Fifth Edition).

Subsequent to review and evaluation of the hazards identified in the City’s Mitigation Action Plan, the 2020 internal Bureau Community Risk Assessment, and the fire and non-fire hazards as identified by the CFAI as they relate to services provided by PF&R, Citygate evaluated the following six hazards for this risk assessment:

1. Building fire
2. Vegetation/wildland fire
3. Medical emergency
4. Hazardous material release/spill
5. Technical rescue
6. Marine incident

1.1.6 Service Capacity

Service capacity refers to an agency's available response force; the size, types, and condition of its response fleet and any specialized equipment; core and specialized performance capabilities and competencies; resource distribution and concentration; availability of automatic or mutual aid; and any other agency-specific factors influencing its ability to meet current and prospective future service demand and response performance relative to the risks to be protected.

PF&R's service capacity for fire and non-fire risk consists of 169 personnel on duty daily staffing 28 engines, eight aerial ladder trucks, two quints, four rescues, and one squad, plus four Battalion Chiefs and one Deputy Chief, operating from PF&R's 31 fire stations. PF&R also has five brush engines; three water tenders; one heavy squad; one hazmat; one hazmat recon; two rehab/air units; one foam unit; two chemical, biological, radiological, nuclear, and high yield explosives response units; three fire boats; two rescue boats; one trench rescue unit; one urban search and rescue (USAR) unit; one mobile command unit; and four all-terrain vehicles that can be cross-staffed with on-duty or call-back personnel as needed.

All response personnel are trained to either the Emergency Medical Technician (EMT) level, capable of providing Basic Life Support (BLS) pre-hospital emergency medical care, or EMT-Paramedic (Paramedic) level, capable of providing Advanced Life Support (ALS) pre-hospital emergency medical care. Ground paramedic ambulance service is provided by American Medical Response, a private-sector ambulance provider operating under an exclusive operating area contract administered by Multnomah County Emergency Medical Services Agency. Air ambulance services, when needed, are provided by Life Flight. Adventist Medical Center, Legacy Emanuel Medical Center, Providence Medical Center, Good Samaritan Medical Center, Oregon Health and Science University (OHSU), and Doernbecher Emergency Care Center provide emergency room services. OHSU and Legacy Emanuel Medical Center are also a Level-1 trauma centers.

Response personnel are also trained to the U.S. Department of Transportation Hazardous Material First Responder Operational (FRO) level to provide initial hazardous material incident assessment, hazard isolation, and support for PF&R's hazardous material response team. PF&R has 28

personnel trained to the Hazardous Materials Specialist or Technician level to cross-staff PF&R's Type-1 Hazardous Materials Response Unit at Station 7 as needed.

All response personnel are further trained to the Confined Space Awareness and Low Angle Rope Rescue Operations levels, with 48 personnel also trained to the Trench Rescue Technician level, Confined Space / USAR Technician level, high-angle rope rescue, heavy machinery rescue, and heavy vehicle extrication to cross-staff the heavy squad from Station 12 or the USAR/trench rescue unit from Station 1 as needed.

1.1.7 Probability of Occurrence

Probability of occurrence refers to the probability of a future hazard occurrence during a specific period. Because the CFAI agency accreditation process requires annual review of an agency's risk assessment and baseline performance measures, Citygate recommends using the 12 months following completion of an SOC study as an appropriate period for the probability of occurrence evaluation. The following table describes the five probability of occurrence categories and related general characteristics used for this analysis.

Table 35—Probability of Occurrence Categories

Category	General Characteristics	Anticipated Frequency of Occurrence
Rare	<ul style="list-style-type: none"> Hazard may occur under exceptional circumstances. 	25+ years
Unlikely	<ul style="list-style-type: none"> Hazard could occur at some time. No recorded or anecdotal evidence of occurrence. Little opportunity, reason, or means for hazard to occur. 	5–24 years
Possible	<ul style="list-style-type: none"> Hazard should occur at some time. Infrequent, random recorded or anecdotal evidence of occurrence. Some opportunity, reason, or means for hazard to occur. 	1–4 years
Probable	<ul style="list-style-type: none"> Hazard will probably occur occasionally. Regular recorded or strong anecdotal evidence of occurrence. Considerable opportunity, reason, or means for hazard to occur. 	1–12 months
Frequent	<ul style="list-style-type: none"> Hazard is expected to occur regularly. High level of recorded or anecdotal evidence of regular occurrence. Strong opportunity, reason, or means for hazard to occur. Frequent hazard recurrence. 	1–4 weeks

Citygate's SOC assessments use recent multiple-year incident response data to determine the probability of hazard occurrence for the ensuing 12-month period.

1.1.8 Consequence Severity

Consequence severity refers to the magnitude or reasonably expected loss a hazard occurrence has on people, buildings, lifeline services, the environment, and the community as a whole. The following table describes the five consequence severity categories and general characteristics used for this analysis.

Table 36—Consequence Severity Categories

Category	General Characteristics
Insignificant	<ul style="list-style-type: none"> • No injuries or fatalities • None to few persons displaced for short duration • Little or no personal support required • None to inconsequential damage • None to minimal community disruption • No measurable environmental impacts • None to minimal financial loss • No wildland Fire Hazard Severity Zones
Minor	<ul style="list-style-type: none"> • Few injuries; no fatalities; minor medical treatment only • Some displacement of persons for less than 24 hours • Some personal support required • Some minor damage • Minor community disruption of short duration • Small environmental impacts with no lasting effects • Minor financial loss • No wildland Fire Hazard Severity Zones
Moderate	<ul style="list-style-type: none"> • Medical treatment required; some hospitalizations; few fatalities • Localized displaced of persons for less than 24 hours • Personal support satisfied with local resources • Localized damage • Normal community functioning with some inconvenience • No measurable environmental impacts with no long-term effects, or small impacts with long-term effect • Moderate financial loss • Less than 25% of area in <i>Moderate or High</i> wildland FHSZ
Major	<ul style="list-style-type: none"> • Extensive injuries; significant hospitalizations; many fatalities • Large number of persons displaced for more than 24 hours • External resources required for personal support • Significant damage • Significant community disruption; some services not available • Some impact to environment with long-term effects • Major financial loss with some financial assistance required • More than 25% of area in <i>Moderate or High</i> wildland FHSZ; less than 25% in <i>Very High</i> wildland FHSZ
Extreme	<ul style="list-style-type: none"> • Large number of severe injuries requiring hospitalization; significant fatalities • General displacement for extended duration • Extensive personal support required • Extensive damage • Community unable to function without significant external support • Significant impact to environment and/or permanent damage • Catastrophic financial loss; unable to function without significant support • More than 50% of area in <i>High</i> wildland FHSZ; more than 25% of area in <i>Very High</i> wildland FHSZ

1.1.9 Agency Impact

Agency impact severity refers to the extent a hazard occurrence impacts PF&R's ability to (1) provide an Effective Response Force (ERF) appropriate to prevent escalation of the emergency incident and (2) to maintain sufficient response capacity throughout the City to control other concurrent incidents within desired response goals. The following table describes the five agency impact categories and related general characteristics used for this analysis.

Table 37—Agency Impact Categories

Category	Typical Characteristics
Insignificant	<ul style="list-style-type: none"> Hazard occurrence has minimal to no impact on the agency's ability to maintain full ERF response capacity <i>and</i> at least one minor concurrent incident response capacity within each battalion Typically requires only a single unit response committed for less than one hour Single concurrent incident rate less than 5%
Minor	<ul style="list-style-type: none"> Hazard occurrence has minor impact on the agency's ability to maintain full ERF response capacity <i>and</i> at least one minor concurrent incident response capacity within each battalion Typically requires one- or two-unit response committed for less than two hours Single concurrent incident rate less than 10%
Moderate	<ul style="list-style-type: none"> Hazard occurrence has a moderate impact on the agency's ability to maintain full ERF response capacity <i>and</i> at least one minor concurrent incident response capacity within each battalion Typically requires three- to five-unit response and/or less than 20 personnel committed for up to six hours Single concurrent incident rate less than 25%
Major	<ul style="list-style-type: none"> Hazard occurrence has a major impact on the agency's ability to maintain full ERF response capacity <i>and</i> at least one minor concurrent incident response capacity within each battalion Typically requires six- to 10-unit response and/or up to 40 personnel committed for up to 12 hours Single concurrent incident rate less than 50%
Extreme	<ul style="list-style-type: none"> Hazard occurrence has an extreme impact on the agency's ability to maintain full ERF response capacity <i>and</i> at least one minor concurrent incident response capacity within each battalion Typically requires more than a 10-unit response and/or more than 40 personnel committed for more than 12 hours Single concurrent incident rate greater than 50%

1.1.10 Overall Risk

Overall risk was determined by considering the probability of occurrence, reasonably expected consequence severity, and agency impact according to the following tables.

Table 38—Overall Risk Categories – Insignificant Agency Impact

Probability of Occurrence	Consequence Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Low	Low	High
Unlikely	Low	Low	Low	Low	High
Possible	Low	Low	Low	Moderate	High
Probable	Low	Low	Low	Moderate	High
Frequent	Low	Low	Low	Moderate	Extreme

Table 39—Overall Risk Categories – Minor Agency Impact

Probability of Occurrence	Consequence Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Low	Moderate	High
Unlikely	Low	Low	Low	Moderate	High
Possible	Low	Low	Moderate	High	High
Probable	Low	Low	Moderate	High	Extreme
Frequent	Low	Moderate	High	High	Extreme

Table 40—Overall Risk Categories – Moderate Agency Impact

Probability of Occurrence	Consequence Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High	High
Possible	Low	Low	Moderate	High	Extreme
Probable	Low	Moderate	Moderate	High	Extreme
Frequent	Low	Moderate	High	High	Extreme

Table 41—Overall Risk Categories – Major Agency Impact

Probability of Occurrence	Impact Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Possible	Low	Moderate	High	High	Extreme
Probable	Low	Moderate	High	High	Extreme
Frequent	Moderate	Moderate	High	High	Extreme

Table 42—Overall Risk Categories – Extreme Agency Impact

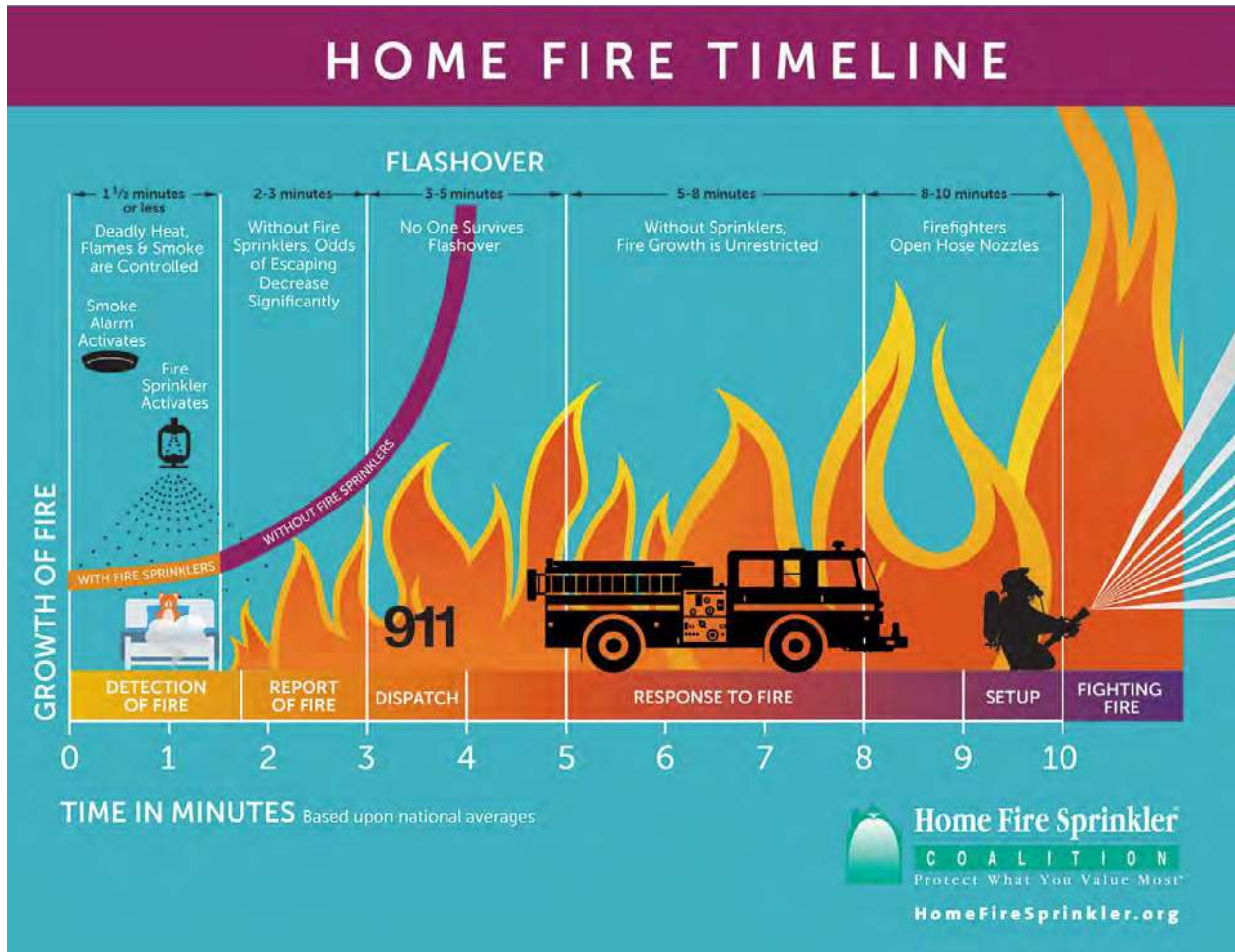
Probability of Occurrence	Impact Severity				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Moderate	High	High	Extreme
Unlikely	Low	Moderate	High	High	Extreme
Possible	Low	Moderate	High	Extreme	Extreme
Probable	Moderate	Moderate	High	Extreme	Extreme
Frequent	Moderate	Moderate	High	Extreme	Extreme

1.1.11 Building Fire Risk

One of the primary hazards in any community is building fire. Building fire risk factors include building size, age, construction type, density, occupancy, and height above ground level; required fire flow; proximity to other buildings; built-in fire protection/alarm systems; available fire suppression water supply; building fire service capacity; and fire suppression resource deployment (distribution/concentration), staffing, and response time. Citygate used available data from PF&R and the 2020 internal Community Risk Assessment in determining the City’s building fire risk.

The following figure illustrates the building fire progression timeline and shows that flashover, which is the point at which the entire room erupts into fire after all the combustible objects in that room reach their ignition temperature, can occur as early as three to five minutes from the initial ignition. Human survival in a room after flashover is extremely improbable.

Figure 36—Building Fire Progression Timeline



Source: <http://www.firesprinklerassoc.org>.

Population Density

Population density within the City ranges from less than 3,000 to more than 30,000 people per square mile. Although risk analysis across a wide spectrum of other Citygate clients shows no direct correlation between population density and building fire *occurrence*, it is reasonable to conclude that building fire *risk* relative to potential impact on human life is greater as population density increases, particularly in areas with high density, multiple-story buildings.

Water Supply

A reliable public water system providing adequate volume, pressure, and flow duration in close proximity to all buildings is a critical factor in mitigating the potential consequence severity of a community's building fire risk. Potable water is provided by the City, and according to Water Bureau staff, available fire flow is adequate throughout the City, with the possible exception of reduced flow rates in small, annexed areas affecting not more than approximately 100 customers.

Building Fire Service Demand

For the five-year period from January 1, 2016, through December 31, 2020, the City experienced 3,018 building fire incidents comprising 0.65 percent of total service demand over the same period, as summarized in the following tables.

Table 43—Building Fire Service Demand – Battalion 1

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		3	4	5	10	15	16	18	27		
Building Fire	2016	34	20	12	6	4	4	21	1	102	0.67%
	2017	41	29	11	2	7	2	15	3	110	0.69%
	2018	29	24	13	2	3	2	16	1	90	0.57%
	2019	30	24	9	3	3	5	13	0	87	0.55%
	2020	40	27	9	4	12	5	17	0	114	0.80%
Total		174	124	54	17	29	18	82	5	503	0.65%
Percent Total Station Demand		0.68%	0.48%	0.91%	0.60%	1.10%	0.50%	0.85%	0.39%		

Table 44—Building Fire Service Demand – Battalion 2

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		6	8	14	17	21	22	24	26		
Building Fire	2016	5	24	35	4	12	15	18	15	128	0.86%
	2017	5	27	34	10	21	18	16	21	152	0.97%
	2018	5	20	27	12	12	29	26	12	143	0.93%
	2019	1	17	30	8	12	11	23	18	120	0.77%
	2020	3	26	27	9	16	16	28	16	141	0.97%
Total		19	114	153	43	73	89	111	82	684	0.90%
Percent Total Station Demand		0.91%	1.10%	1.08%	0.58%	0.66%	0.84%	0.94%	0.96%		

Table 45—Building Fire Service Demand – Battalion 3

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		2	7	11	12	19	29	30	31		
Building Fire	2016	11	47	41	21	31	14	12	29	206	0.70%
	2017	15	42	50	25	24	21	18	32	227	0.75%
	2018	14	36	37	32	45	14	21	28	227	0.76%
	2019	14	31	40	17	27	13	15	24	181	0.60%
	2020	8	47	31	14	19	11	21	23	174	0.58%
Total		62	203	199	109	146	73	87	136	1,015	0.68%
Percent Total Station Demand		0.60%	0.58%	0.81%	0.78%	0.87%	0.64%	0.50%	0.69%		

Table 46—Building Fire Service Demand – Battalion 4

Hazard	Year	Risk Planning Zone (FMA)							Total	Percent Total Annual Demand
		1	9	13	20	23	25	28		
Building Fire	2016	28	23	14	20	8	30	19	142	0.60%
	2017	39	24	23	17	17	34	19	173	0.69%
	2018	19	28	39	20	11	29	28	174	0.71%
	2019	35	19	30	14	9	42	15	164	0.67%
	2020	30	26	28	5	10	36	28	163	0.73%
Total		151	120	134	76	55	171	109	816	0.68%
Percent Total Station Demand		0.41%	0.86%	0.54%	0.86%	0.92%	1.00%	0.85%		

As the previous tables illustrate, building fire service demand varies significantly by battalion and FMA, with FMA 7 having the highest total demand over the five-year study period and FMA 27 having the lowest. Overall building fire service demand is summarized by year in the following table.

Table 47—Building Fire Service Demand by Year

Hazard	Year	Total Service Demand	Percent of Total Service Demand
Building Fire	2016	578	0.68%
	2017	662	0.74%
	2018	634	0.72%
	2019	552	0.62%
	2020	592	0.71%
	Total	3,018	0.70%

As the previous table shows, annual building fire service demand fluctuated by up to nearly 15 percent over the five-year study period. Overall, building fire service demand is low at only 0.70 percent of total service demand.

Building Fire Risk Assessment

The following table summarizes Citygate’s assessment of Portland’s building fire risk by incident type.

Table 48—Building Fire Risk Assessment

Building Fire Risk	Incident Type			
	Chimney / Fireplace / Stove	Single-Family Residential	Apartment / Multi-Family Residential	Commercial
Probability of Occurrence	<i>Frequent</i>	<i>Frequent</i>	<i>Frequent</i>	<i>Frequent</i>
Consequence Severity	<i>Insignificant</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Moderate</i>
Agency Impact	<i>Minor</i>	<i>Moderate</i>	<i>Major</i>	<i>Major</i>
Overall Risk Category	Low	High	High	High

1.1.12 Vegetation/Wildfire Risk⁶

The Oregon Natural Hazard Mitigation Plan designates the Portland metropolitan area as a wildland–urban interface (WUI) community. In 2002, the City designated specific areas of the City as vulnerable to wildfire hazards including Powell Butte, the Willamette Bluffs (also known

⁶ Source: Mitigation Action Plan, Portland Bureau of Emergency Management (2016), Section 10.

as Willamette Escarpment), Marquam Nature Park, Terwilliger Wildlands, Kelly Butte Rocky Butte, and Mt. Tabor. The two largest areas are Forest Park and Powell Butte, which have been identified as high risk by the Oregon Department of Forestry and PF&R due to high-density commercial and residential development immediately adjacent to these areas. In 2006, the Oregon Department of Forestry (ODF) conducted a Statewide Forest Assessment of the communities at risk to wildfire, which was subsequently updated with a 2020 Communities at Risk Assessment that designates the City of Portland as one of the 611 Communities at Risk (CAR) to significant wildfire threat in Oregon.⁷

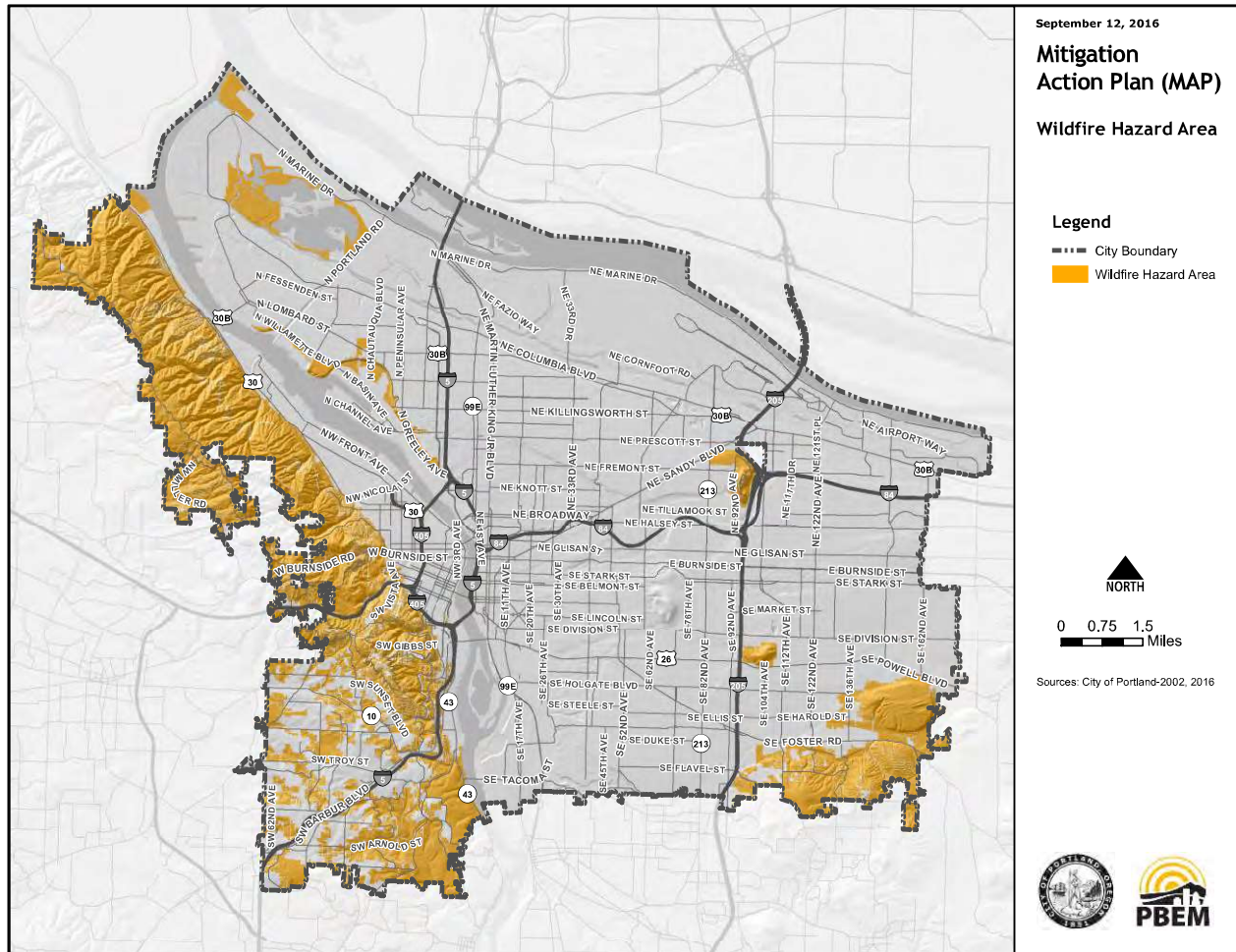
Vegetation/wildfire risk factors include vegetative fuel types and configuration, weather, topography, prior service demand, water supply, mitigation measures, and vegetation/wildfire response capacity.

Wildfire Hazard Zones

Pursuant to changes to the Oregon Building Code and designation of the Portland metropolitan area as a WUI community by the Oregon State Interagency Hazard Mitigation Team, the City of Portland designated specific areas of the City as vulnerable to wildfire hazards, as shown in the following map.

⁷ Reference: 2020 Communities at Risk Report, Oregon Department of Forestry, January 2020.

Figure 37—Wildfire Hazard Areas – Portland



Vegetative/Wildfire Fuels

Vegetative fuel factors influencing fire intensity and spread include fuel type (vegetation species), height, arrangement, density, and moisture. In addition to decorative landscape species, vegetative fuels within the City consist of a mix of annual grasses and weeds, invasive species, and mixed deciduous and conifer tree species. Once ignited, vegetation fires can burn intensely and contribute to rapid fire spread under the right fuel, weather, and topographic conditions.

Weather

Weather elements, including temperature, relative humidity, wind, and lightning, also affect vegetation/wildland fire potential and behavior. High temperatures and low relative humidity dry out vegetative fuels, creating a situation where fuels will more readily ignite and burn more intensely. Wind is the most significant weather factor influencing vegetation/wildland fire behavior, with higher wind speeds increasing fire spread and intensity. Fuel and weather conditions

most conducive to vegetation/wildfires generally occur from late June through October; however, above-normal temperatures and drought can increase that period on either end.

Topography

Vegetation/wildland fires tend to burn more intensely and spread faster when burning uphill and up-canyon, except for a wind-driven downhill or down-canyon fire. The areas of the City with hilly terrain contribute more to vegetation/wildland fire behavior and spread.

Water Supply

Another significant vegetation fire consequence severity factor is water supply immediately available for fire suppression. According to Water Bureau staff, available fire flow is adequate throughout the City, with the possible exception of reduced flow rates in small, annexed areas affecting not more than approximately 100 parcels.

Wildfire Hazard Mitigation

Hazard mitigation refers to specific actions or measures taken to prevent a hazard from occurring or to minimize the severity of impacts resulting from a hazard occurrence. While none of the hazards subject to this study can be entirely prevented, measures *can* be taken to minimize the impacts when those hazards do occur. In addition to requiring fire resistive construction materials and methods in High Fire Hazard Areas, the City and PF&R has completed or is continuing the following wildfire mitigation measures:⁸

- ◆ Procured funding for management of vegetated natural areas with high wildfire danger, including public and private properties.
- ◆ Provided wildfire management training to staff.
- ◆ Amended the Portland Plant List and other related City plant lists and landscaping guides to include/identify fire resistant native plants and planting strategies that could be encouraged or required in local landscaping.
- ◆ Integrated, as appropriate, fire prevention goals and provisions into City policies, plans, and codes.
- ◆ Identified conditions of approval and mitigation strategies that could be applied to new development or redevelopment in high-risk areas.
- ◆ Identified new construction areas subject to wildfires and communicated this information to affected landowners.

⁸ Source: 2016 City of Portland Mitigation Action Plan, Section 19.

- ◆ Adopted the National Fire Danger Rating System and installed signs at key points in the City.
- ◆ Conducted systematic review of the City’s large, publicly owned wildland tracts regarding fire safety and ecological health to ensure informed land management decisions.
- ◆ Implemented a neighborhood wildland interface disaster planning program.
- ◆ Reviewed and potentially refined the City’s contract specifications for machinery operations during Red Flag weather conditions.
- ◆ Convened a standing wildland interface fire tactical group.
- ◆ Indexed City wildfire mitigation plans and activities.
- ◆ Developed and implemented a protocol for defining and mapping WUI Zones and developed recommended policies, regulations, and landscape options for incorporation into City plans and programs.
- ◆ Identified water grid engineering requirements for firefighting in wildfire areas.
- ◆ Reviewed the feasibility of adopting portions of nationally recognized wildland interface codes to strengthen building standards in wildfire risk areas.
- ◆ Designed and conducted a study to determine the effectiveness of maintenance agreements that are established when new land divisions are approved to manage vegetation in open space tracts.
- ◆ Acted on all mitigation actions outlined in the Wildfire GAP Analysis Report.

Wildfire Response Capacity

PF&R deploys six Type-6 wildland engines cross-staffed with two on-duty personnel as needed at Stations 14, 18, 22, 27, and 29 and three 3,000-gallon water tenders cross-staffed as needed at Stations 13, 16, and 31. Additional wildland response resources are available by mutual aid from other local/regional/state fire agencies. Aerial wildland fire suppression capacity, as needed, is available through federal fire agencies from Medford, Oregon, or Olympia, Washington.

Approximately 75 percent of PF&R’s response personnel have been trained to the Oregon Department of Public Safety Standards and Training and National Wildfire Coordinating Group Wildland Firefighter Type-2 level. PF&R’s goal is to have 110 firefighters certified at the Wildland Firefighter Type-1 level, 30 officers at the Engine Boss level, and 10 Battalion Chiefs at the Strike

Team / Task Force Leader level.⁹ All response personnel are expected to complete a wildland fire refresher training course each year, coordinated through the National Wildfire Coordinating Group each October and provided to PF&R response personnel by the PF&R's Medical Services & Training Division, with assistance from others as needed.¹⁰

Vegetation/Wildfire Service Demand

Over the five-year study period, PF&R responded to 1,483 vegetation/wildfires comprising 0.34 percent of total service demand over the same period, as summarized in the following tables.

Table 49—Vegetation/Wildfire Service Demand – Battalion 1

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		3	4	5	10	15	16	18	27		
Vegetation/ Wildfire	2016	15	4	1	2	2	0	8	2	34	0.22%
	2017	12	15	5	1	3	1	3	1	41	0.26%
	2018	9	25	2	3	0	4	4	2	49	0.31%
	2019	8	13	3	4	2	2	2	0	34	0.22%
	2020	9	14	0	5	3	5	0	1	37	0.26%
Total		53	71	11	15	10	12	17	6	195	0.25%
Percent Total Station Demand		0.21%	0.28%	0.19%	0.53%	0.38%	0.33%	0.18%	0.47%		

⁹ Source: Portland Fire and Rescue Operational Guidelines Section 6.25 – Wildland Fire Planning Cycle and Response (June 2020).

¹⁰ Source: Portland Fire and Rescue Operational Guidelines Section 6.25 – Wildland Fire Training (June 2020).

Table 50—Vegetation/Wildfire Service Demand – Battalion 2

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		6	8	14	17	21	22	24	26		
Vegetation/ Wildfire	2016	2	11	13	7	3	5	7	3	51	0.34%
	2017	1	9	13	13	3	20	8	3	70	0.45%
	2018	5	19	14	19	5	18	19	13	112	0.73%
	2019	3	5	2	7	9	10	7	3	46	0.29%
	2020	2	15	11	11	5	14	5	8	71	0.49%
Total		13	59	53	57	25	67	46	30	350	0.46%
Percent Total Station Demand		0.63%	0.57%	0.37%	0.77%	0.23%	0.63%	0.39%	0.35%		

Table 51—Vegetation/Wildfire Service Demand – Battalion 3

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		2	7	11	12	19	29	30	31		
Vegetation/ Wildfire	2016	10	14	8	5	16	12	6	10	81	0.28%
	2017	16	18	28	26	18	10	7	8	131	0.43%
	2018	19	12	41	26	24	8	11	10	151	0.51%
	2019	10	16	31	31	17	7	2	4	118	0.39%
	2020	11	20	24	24	19	5	8	9	120	0.40%
Total		66	80	132	112	94	42	34	41	601	0.40%
Percent Total Station Demand		0.64%	0.23%	0.54%	0.80%	0.56%	0.37%	0.19%	0.21%		

Table 52—Vegetation/Wildfire Service Demand – Battalion 4

Hazard	Year	Risk Planning Zone (FMA)							Total	Percent Total Annual Demand
		1	9	13	20	23	25	28		
Vegetation/ Wildfire	2016	12	5	34	8	8	3	2	72	0.31%
	2017	10	6	22	7	18	11	9	83	0.33%
	2018	9	7	15	7	5	7	10	60	0.24%
	2019	11	4	19	11	3	5	8	61	0.25%
	2020	11	3	12	10	4	10	11	61	0.27%
Total		53	25	102	43	38	36	40	337	0.28%
Percent Total Station Demand		0.14%	0.18%	0.41%	0.49%	0.63%	0.21%	0.31%		

As the previous tables show, vegetation/wildfire service demand was generally consistent over the study period, with the highest demand in FMA 11 and the lowest demand in FMA 27. Overall, vegetation/wildfire service demand is very low, as summarized in the following table.

Table 53—Vegetation/Wildfire Service Demand by Year

Hazard	Year	Total Service Demand	Percent of Total Service Demand
Vegetation/Wildfire	2016	238	0.28%
	2017	325	0.36%
	2018	372	0.42%
	2019	259	0.29%
	2020	289	0.35%
	Total	1,483	0.34%

Vegetation/Wildfire Risk Assessment

The following table summarizes Citygate’s assessment of the City’s vegetation/wildfire risk by incident type.

Table 54—Vegetation/Wildfire Risk Assessment

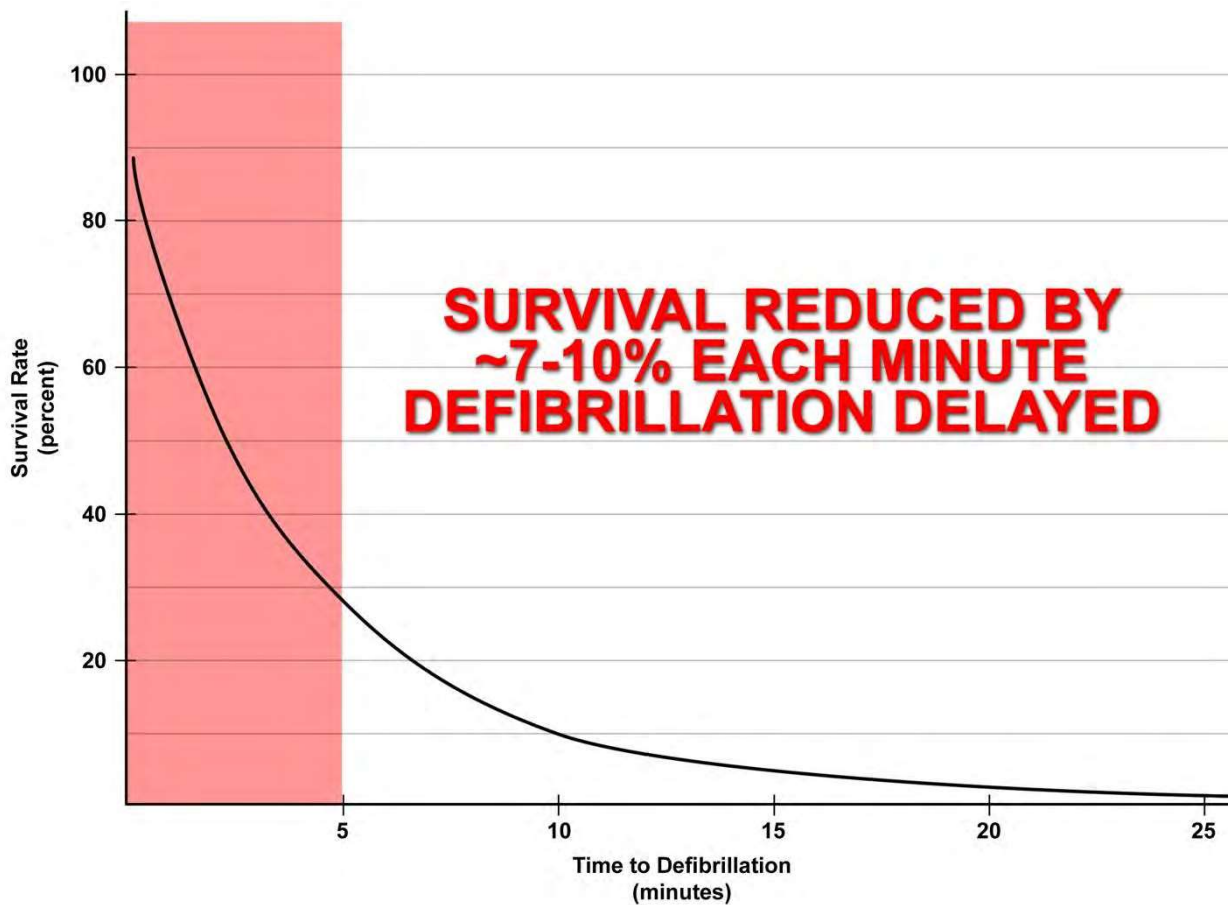
Vegetation/Wildfire Risk	Incident Type			
	Grass / Weeds / Bark Dust	Brush (< 5 Acres)	Forest/Woods/ Wildfire/WUI (5–25 Acres)	Wildfire/WUI (> 25 Acres)
Probability of Occurrence	<i>Frequent</i>	<i>Frequent</i>	<i>Frequent</i>	<i>Possible</i>
Consequence Severity	<i>Minor</i>	<i>Minor</i>	<i>Moderate</i>	<i>Major</i>
Agency Impact	<i>Insignificant</i>	<i>Minor</i>	<i>Moderate</i>	<i>Major</i>
Overall Risk	Low	Moderate	High	High

1.1.13 Medical Emergency Risk

Medical emergency risk in most communities is predominantly a function of population density, demographics, violence, health insurance coverage, and vehicle traffic.

Medical emergency risk can also be categorized as either a medical emergency resulting from a traumatic injury or a health-related condition or event. Cardiac arrest is one serious medical emergency among many where there is an interruption or blockage of oxygen to the brain.

The following figure illustrates the reduced survivability of a cardiac arrest victim as time to defibrillation increases. While early defibrillation is one factor in cardiac arrest survivability, other factors can influence survivability as well, such as early CPR and pre-hospital ALS interventions.

Figure 38—Survival Rate versus Time to Defibrillation

Source: www.suddencardiacarrest.org.

Population Density

The City's population density ranges from less than 3,000 to more than 30,000 per square mile as shown in Map #2b (**Volume 2—Map Atlas**). Risk analysis across a wide spectrum of other Citygate clients shows a direct correlation between population density and the *occurrence* of medical emergencies, particularly in high urban population density zones.

Demographics

Medical emergency risk tends to be higher among older, poorer, less educated, and uninsured populations. As shown in Table 33, 15 percent of the City's population is 65 and older; 6.6 percent of the population over 24 years of age has less than a high school education or equivalent; over 12

percent of the population is at or below poverty level; and 6.6 percent of the population does not have health insurance coverage.¹¹

Vehicle Traffic

Medical emergency risk tends to be higher in those areas of a community with high daily vehicle traffic volume, particularly those areas with high traffic volume traveling at high speeds. The City’s transportation network includes Interstate 5; US 26, 84, and 205; and State Routes 30, 30B, 99E, 99W, and 213 carrying an aggregate annual average daily traffic volume of nearly 740,000 vehicles.¹²

Medical Emergency Service Demand

Medical emergency service demand over the five-year study period includes more than 246,000 calls for service comprising nearly 57 percent of total service demand over the same period, as summarized in the following tables.

Table 55—Medical Emergency Service Demand – Battalion 1

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		3	4	5	10	15	16	18	27		
Medical Emergency	2016	2,746	2,605	751	327	215	512	1,386	126	8,668	56.67%
	2017	2,969	2,825	778	304	206	438	1,221	122	8,863	55.29%
	2018	2,922	2,784	717	298	213	503	1,206	106	8,749	54.95%
	2019	2,846	2,808	712	299	174	442	1,189	115	8,585	54.51%
	2020	2,321	2,254	631	268	221	391	1,093	104	7,283	51.22%
Total		13,804	13,276	3,589	1,496	1,029	2,286	6,095	573	42,148	54.58%
Percent Total Station Demand		54.15%	51.43%	60.50%	52.51%	39.04%	63.01%	63.50%	45.22%		

¹¹ Source: ESRI and US Census Bureau

¹² Source: Oregon Department of Transportation (2020)

Table 56—Medical Emergency Service Demand – Battalion 2

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		6	8	14	17	21	22	24	26		
Medical Emergency	2016	145	1,233	1,760	769	1,196	1,271	1,326	1,109	8,809	59.25%
	2017	166	1,292	1,804	797	1,293	1,322	1,475	1,180	9,329	59.44%
	2018	180	1,235	1,701	817	1,265	1,279	1,403	1,045	8,925	58.04%
	2019	190	1,152	1,795	830	1,112	1,147	1,395	1,102	8,723	55.88%
	2020	158	1,101	1,571	710	804	1,069	1,165	1,040	7,618	52.21%
Total		839	6,013	8,631	3,923	5,670	6,088	6,764	5,476	43,404	57.00%
Percent Total Station Demand		40.38%	57.77%	60.79%	52.84%	51.26%	57.50%	57.27%	63.88%		

Table 57—Medical Emergency Service Demand – Battalion 3

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		2	7	11	12	19	29	30	31		
Medical Emergency	2016	1,382	4,736	2,782	1,453	2,214	1,448	2,251	1,749	18,015	61.17%
	2017	1,336	4,827	2,863	1,628	2,104	1,522	2,322	1,807	18,409	60.70%
	2018	1,233	4,431	2,586	1,512	1,883	1,534	2,243	1,887	17,309	58.25%
	2019	1,272	4,530	2,831	1,512	1,896	1,614	2,181	1,833	17,669	58.28%
	2020	1,223	4,336	2,638	1,454	1,921	1,543	2,246	1,735	17,096	57.46%
Total		6,446	22,860	13,700	7,559	10,018	7,661	11,243	9,011	88,498	59.17%
Percent Total Station Demand		62.25%	64.76%	55.86%	53.80%	59.50%	67.21%	64.33%	45.92%		

Table 58—Medical Emergency Service Demand – Battalion 4

Hazard	Year	Risk Planning Zone (FMA)							Total	Percent Total Annual Demand
		1	9	13	20	23	25	28		
Medical Emergency	2016	5,057	1,671	2,882	1,010	552	1,976	1,472	14,620	61.99%
	2017	5,284	1,777	3,109	1,109	643	2,061	1,606	15,589	61.84%
	2018	4,949	1,666	3,209	1,138	607	2,047	1,579	15,195	61.95%
	2019	4,309	1,861	3,069	1,120	651	2,039	1,606	14,655	60.05%
	2020	3,367	1,573	2,708	935	575	1,958	1,581	12,697	56.99%
Total		22,966	8,548	14,977	5,312	3,028	10,081	7,844	72,756	60.63%
Percent Total Station Demand		62.79%	61.59%	60.36%	60.35%	50.38%	59.17%	60.86%		

As the previous tables show, medical emergency service demand varies significantly by FMA, and as the following table shows, overall medical emergency service demand was generally consistent from 2016 through 2019 before a 10 percent decrease in 2020. Overall, the City’s medical emergency service demand is typical of other jurisdictions with similar demographics.

Table 59—Medical Emergency Service Demand by Year

Hazard	Year	Total Service Demand	Percent of Total Service Demand
Medical Emergency	2016	50,112	59.05%
	2017	52,190	58.33%
	2018	50,178	57.18%
	2019	49,632	56.19%
	2020	44,694	53.62%
	Total	246,806	56.90%

Medical Emergency Risk Assessment

The following table summarizes Citygate’s assessment of the City’s medical emergency risk by incident type.

Table 60—Medical Emergency Risk Assessment

Medical Emergency Risk	Incident Type				
	BLS Only	BLS/ALS	ALS	Active Shooter / Mass Casualty	WMD
Probability of Occurrence	<i>Frequent</i>	<i>Frequent</i>	<i>Frequent</i>	<i>Probable</i>	<i>Possible</i>
Consequence Severity	<i>Minor</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Major</i>	<i>Catastrophic</i>
Agency Impact	<i>Insignificant</i>	<i>Minor</i>	<i>Minor</i>	<i>Major</i>	<i>Extreme</i>
Overall Risk	Low	High	High	High	Extreme

1.1.14 Hazardous Material Risk

Hazardous material risk factors include fixed facilities that store, use, or produce hazardous chemicals or waste; underground pipelines conveying hazardous materials; aviation, railroad, maritime, and vehicle transportation of hazardous commodities into or through a jurisdiction; vulnerable populations; emergency evacuation planning and related training; and specialized hazardous material service capacity.

Fixed Hazardous Materials Sites

For this study, the Portland Bureau of Emergency Management identified 1,654 sites requiring a state or county hazardous material operating permit or Hazardous Materials Business Plan. In addition, high-pressure natural gas distribution pipelines are located throughout the City.

Transportation-Related Hazardous Materials¹³

The City also has transportation-related hazardous material risk as a result of its road transportation network that includes Interstate 5; US 26, 84, and 205; and State Routes 30, 30B, 99E, 99W, and 213 carrying an aggregate annual average daily truck traffic volume of more than 57,000 vehicles, some of which are transporting hazardous materials, as summarized in the following table.¹⁴

¹³ Source: City of Portland Freight Master Plan (2006).

¹⁴ Source: Oregon Department of Transportation (2020).

Table 61—Average Annual Daily Traffic Volume

Highway	Crossing	Location ID	Total AADT ¹	Passenger Vehicles	Business / Commercial Vehicles
5	Iowa St.	10042	133,592	103,924	14,534
26	Highlands	2431	130,993	124,495	6,498
30	N. Vancouver Ave.	3153	21,582	19,545	1,519
30B	E. of NE Columbia Blvd.	18132		53,818	3,477
84	53 rd Ave.	10074	164,386	144,799	12,900
99E	Concord Rd.	174	25,546	14,579	967
99W	Hamilton St.	220	29,244	28,126	1,118
205	S. of Hwy. 26	10496	155,450	124,611	14,823
213	N. of SE Foster Rd.	2880	25,305	17,670	1,346
Total			739,916	622,502	57,182

¹ Average Annual Daily Trips.

Source: Oregon Department of Transportation (2020).

As the fourth largest freight hub on the West Coast, Portland also has transportation-related hazardous material risk due to hundreds of train movements into and through the City daily, many of which are transporting hazardous commodities. Four main rail lines operated by Burlington Northern Santa Fe (BNSF) and Union Pacific Railroad converge in the City, and each railroad has two large railyards as well as numerous branch/spur lines serving the commercial/industrial areas of the City.

In addition, the Olympic pipeline, operated by BP, carries 12.3 million gallons of gasoline, diesel, and aviation fuel into the City daily. The City is also the terminus of the Kinder Morgan pipeline, which distributes fuel products from the City throughout the Willamette Valley.

Population Density

Because hazardous material emergencies have the potential to adversely impact human health, it is logical that the higher the population density, the greater the potential population exposed to a hazardous material release or spill. As shown in Map #2b (**Volume 2 – Map Atlas**), the City’s population density ranges from less than 3,000 to more than 30,000 people per square mile.

Vulnerable Populations

Persons vulnerable to a hazardous material release/spill include those individuals or groups unable to self-evacuate, generally including children under the age of 10, the elderly, and persons confined to an institution or other setting where they are unable to leave voluntarily. The City’s Mitigation

Action Plan quantifies eight demographic indicators for social risk vulnerability, as summarized in the following table for the entire City.

Table 62—Social Risk Vulnerability Indicators

Risk Area	Percent of Total Population							
	Population under 15	Population over 65	Renter-Occupied Housing	People of Color	Families below Poverty Level	Limited English-Speaking Households	Persons with Disabilities	
							Total Population	Population under 65
Citywide	16.2%	11.2%	45.8%	22.4%	11.7%	4.3%	12.1%	9.0%

Source: Portland Mitigation Action Plan (2016), Table 4-12.

Emergency Evacuation Planning, Training, Implementation, and Effectiveness

Another significant hazardous material consequence severity factor is a jurisdiction’s shelter-in-place / emergency evacuation planning and training. In the event of a hazardous material release or spill, time can be a critical factor in notifying potentially affected persons, particularly at-risk populations, to either shelter-in-place or evacuate to a safe location. Essential to this process is an effective emergency plan that incorporates one or more mass emergency notification capabilities, as well as pre-established evacuation procedures. It is also essential to conduct regular, periodic exercises involving these two emergency plan elements to evaluate readiness and to identify and remediate any planning or training gaps to ensure ongoing emergency incident readiness and effectiveness.

The City has a formal evacuation plan, with periodic exercises to ensure familiarity and effective utilization.¹⁵ The City also has a free subscription and reverse 9-1-1-based mass emergency notification system (PublicAlerts.org) that is used to provide emergency alerts, notifications, and other emergency information to email accounts, cell phones, smartphones, tablets, and landline telephones. Federal Communications Commission Wireless Emergency Alerts and social media (Facebook, Twitter) are also used to provide emergency notifications and information to the public. The Portland Bureau of Emergency Management also conducts Emergency Operations Center training at least quarterly with at least two exercises annually.

¹⁵ Source: Annex D – Evacuation Plan, Portland Bureau of Emergency Management (2017).

Hazardous Material Service Demand

The City experienced 2,245 hazardous material incidents over the five-year study period, comprising 0.52 percent of total service demand over the same period, as summarized in the following tables.

Table 63—Hazardous Material Service Demand – Battalion 1

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		3	4	5	10	15	16	18	27		
Hazardous Material	2016	31	18	9	10	7	2	15	6	98	0.64%
	2017	38	15	4	5	9	3	11	6	91	0.57%
	2018	22	9	8	4	4	5	12	0	64	0.40%
	2019	30	14	8	7	9	4	11	2	85	0.54%
	2020	23	12	5	6	8	5	11	5	75	0.53%
Total		144	68	34	32	37	19	60	19	413	0.53%
Percent Total Station Demand		0.56%	0.26%	0.57%	1.12%	1.40%	0.52%	0.63%	1.50%		

Table 64—Hazardous Material Service Demand – Battalion 2

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		6	8	14	17	21	22	24	26		
Hazardous Material	2016	3	36	24	19	10	18	12	12	134	0.90%
	2017	3	10	23	16	7	16	16	6	97	0.62%
	2018	10	18	30	18	14	14	14	12	130	0.85%
	2019	7	25	23	10	10	22	14	12	123	0.79%
	2020	6	22	25	12	17	13	10	5	110	0.75%
Total		29	111	125	75	58	83	66	47	594	0.78%
Percent Total Station Demand		1.40%	1.07%	0.88%	1.01%	0.52%	0.78%	0.56%	0.55%		

Table 65—Hazardous Material Service Demand – Battalion 3

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		2	7	11	12	19	29	30	31		
Hazardous Material	2016	14	22	22	16	25	7	13	12	131	0.44%
	2017	13	21	16	18	15	7	10	8	108	0.36%
	2018	12	14	20	12	9	13	11	7	98	0.33%
	2019	19	19	15	13	23	6	10	2	107	0.35%
	2020	16	16	22	10	12	6	11	7	100	0.34%
Total		74	92	95	69	84	39	55	36	544	0.36%
Percent Total Station Demand		0.71%	0.26%	0.39%	0.49%	0.50%	0.34%	0.31%	0.18%		

Table 66—Hazardous Material Service Demand – Battalion 4

Hazard	Year	Risk Planning Zone (FMA)							Total	Percent Total Annual Demand
		1	9	13	20	23	25	28		
Hazardous Material	2016	12	25	30	17	11	12	27	134	0.57%
	2017	6	23	30	11	16	33	19	138	0.55%
	2018	16	19	31	14	8	26	29	143	0.58%
	2019	9	37	30	18	12	18	16	140	0.57%
	2020	12	29	31	10	14	26	17	139	0.62%
Total		55	133	152	70	61	115	108	694	0.58%
Percent Total Station Demand		0.15%	0.96%	0.61%	0.80%	1.01%	0.68%	0.84%		

As the previous tables show, hazardous material service demand also varies significantly by Fire Management Area with FMA 13 having the highest demand and FMA 16 and 27 the lowest. Overall, the City’s hazardous material service demand is low. The following table summarizes overall Citywide hazardous material service demand by year.

Table 67—Hazardous Material Service Demand by Year

Hazard	Year	Total Service Demand	Percent of Total Service Demand
Hazardous Material	2016	497	0.59%
	2017	434	0.49%
	2018	435	0.50%
	2019	455	0.52%
	2020	424	0.51%
	Total	2,245	0.52%

As the previous table shows, Citywide hazardous material service demand was generally consistent over the five-year study period, varying by less than 15 percent.

Hazardous Materials Risk Assessment

The following table summarizes Citygate’s assessment of the City’s hazardous materials risk by incident type.

Table 68—Hazardous Materials Risk Assessment

Hazardous Materials Risk	Incident Type				
	Alarm / Odor Investigation	Hazmat Level 1	Hazmat Level 2 / Biological or Chemical Threat / Natural Gas Leak	Hazmat Level 3 / Biological or Chemical Incident / Railroad Incident	Explosive Incident / WMD
Probability of Occurrence	<i>Frequent</i>	<i>Frequent</i>	<i>Frequent</i>	<i>Probable</i>	<i>Possible</i>
Consequence Severity	<i>Insignificant</i>	<i>Minor</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Major</i>
Agency Impact	<i>Minor</i>	<i>Minor</i>	<i>Moderate</i>	<i>Major</i>	<i>Extreme</i>
Overall Risk	Low	Moderate	High	High	Extreme

1.1.15 Technical Rescue Risk

Technical rescue risk factors include active construction projects; structural collapse potential; confined spaces, such as tanks and underground vaults; bodies of water, including rivers and streams; industrial machinery use; transportation volume; and earthquake, flood, and landslide potential.

Construction Activity

There is ongoing residential, commercial, industrial, and infrastructure construction activity occurring within the City.

Unreinforced Masonry Buildings¹⁶

Based on a 2016 assessment, the Portland Bureau of Development Services (BDS) estimates there are more than 1,600 buildings constructed of unreinforced masonry (URM) that are particularly vulnerable to damage or collapse from a seismic event, with less than 20 percent having been demolished or retrofitted. The BDS further estimates that approximately 65 percent of the URMs are single-story buildings averaging 90 years of age and including more than 7,000 residential units.

Confined Spaces

There are numerous confined spaces within the City, including tanks, vaults, open trenches, etc.

Bodies of Water

The City has 298 miles of river and open stream channels, including the Columbia and Willamette Rivers and Smith Lake.

Transportation Volume

Another technical rescue risk factor is transportation-related incidents requiring technical rescue. This risk factor is primarily a function of vehicle, railway, maritime, and aviation traffic. Vehicle traffic volume is the greatest of these factors within the City, with Interstate 5; US 26, 84, and 205; and State Routes 30, 30B, 99E, 99W, and 213 carrying an aggregate annual average daily traffic volume of nearly 740,000 vehicles.¹⁷

Earthquake Risk¹⁸

According to the City’s Mitigation Action Plan, the convergence of the Juan de Fuca and North American tectonic plates puts the City at risk for a catastrophic magnitude 9 or higher earthquake. Known seismic faults within the City include:

- ◆ The Oatfield fault west of the northwest hills
- ◆ The East Bank fault traversing the Willamette River into Oregon City
- ◆ The Portland Hills fault running parallel to Forest Park into downtown Portland

¹⁶ Source: Portland Bureau of Development Services website.

¹⁷ Source: Oregon Department of Transportation (2020).

¹⁸ Source: 2016 City of Portland Mitigation Action Plan, Section 8.

Flood Risk¹⁹

Areas of the City along the Columbia and Willamette Rivers, and in the south and southeast areas of the City, are subject to flooding from river overflow, as well as from local stormwater drainage, with the most severe flooding typically resulting from winter rainfall exceeding the carrying capacity of river channels and water storage and drainage facilities.

Technical Rescue Service Demand

PF&R responded to 1,169 technical rescue incidents over the five-year study period, comprising 0.27 percent of total service demand for the same period, as summarized in the following tables.

Table 69—Technical Rescue Service Demand – Battalion 1

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		3	4	5	10	15	16	18	27		
Technical Rescue	2016	50	37	2	1	1	2	4	1	98	0.64%
	2017	26	43	1	2	7	2	2	0	83	0.52%
	2018	27	43	3	3	1	3	2	0	82	0.51%
	2019	35	49	1	1	2	1	1	1	91	0.58%
	2020	27	34	0	1	5	3	0	0	70	0.49%
Total		165	206	7	8	16	11	9	2	424	0.55%
Percent Total Station Demand		0.65%	0.80%	0.12%	0.28%	0.61%	0.30%	0.09%	0.16%		

Table 70—Technical Rescue Service Demand – Battalion 2

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		6	8	14	17	21	22	24	26		
Technical Rescue	2016	0	4	5	6	7	3	7	1	33	0.22%
	2017	2	5	3	1	10	6	2	0	29	0.18%
	2018	1	2	1	4	12	6	11	3	40	0.26%
	2019	1	2	4	3	18	7	11	2	48	0.31%
	2020	0	2	3	9	5	3	8	1	31	0.21%
Total		4	15	16	23	52	25	39	7	181	0.24%

¹⁹ Reference: 2016 City of Portland Mitigation Action Plan, Section 11

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Percent Total Station Demand	0.19%	0.14%	0.11%	0.31%	0.47%	0.24%	0.33%	0.08%		
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Table 71—Technical Rescue Service Demand – Battalion 3

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		2	7	11	12	19	29	30	31		
Technical Rescue	2016	3	7	5	6	2	1	5	4	33	0.11%
	2017	2	6	3	4	4	3	2	1	25	0.08%
	2018	3	5	5	11	2	2	0	3	31	0.10%
	2019	2	9	3	5	4	3	5	3	34	0.11%
	2020	4	11	2	4	6	2	1	3	33	0.11%
Total		14	38	18	30	18	11	13	14	156	0.10%
Percent Total Station Demand		0.14%	0.11%	0.07%	0.21%	0.11%	0.10%	0.07%	0.07%		

Table 72—Technical Rescue Service Demand – Battalion 4

Hazard	Year	Risk Planning Zone (FMA)							Total	Percent Total Annual Demand
		1	9	13	20	23	25	28		
Technical Rescue	2016	31	4	10	5	3	4	2	59	0.25%
	2017	46	3	27	5	5	1	4	91	0.36%
	2018	61	1	16	9	2	6	3	98	0.40%
	2019	51	2	25	3	3	2	6	92	0.38%
	2020	32	2	21	5	3	3	2	68	0.31%
Total		221	12	99	27	16	16	17	408	0.34%
Percent Total Station Demand		0.60%	0.09%	0.40%	0.31%	0.27%	0.09%	0.13%		

As the previous tables show, technical rescue service demand also varies widely by FMA, with FMA 1 having the highest demand and FMA 27 the lowest. The following table summarizes Citywide technical rescue service demand by year.

Table 73—Technical Rescue Service Demand by Year

Hazard	Year	Total Service Demand	Percent of Total Service Demand
Technical Rescue	2016	223	0.26%
	2017	228	0.25%
	2018	251	0.29%
	2019	265	0.30%
	2020	202	0.24%
	Total	1,169	0.27%

As the previous table shows, overall Citywide technical rescue service demand is very low and was relatively constant over the five-year study period.

Technical Rescue Risk Assessment

The following table summarizes Citygate’s assessment of the City’s technical rescue risk by incident type.

Table 74—Technical Rescue Risk Assessment

Technical Rescue Risk	Incident Type			
	Elevator Rescue	Trauma / Pin-In / Potential Jumper / Rope Rescue	Confined Space / Trench Rescue	Building Collapse / Natural Disaster
Probability of Occurrence	<i>Frequent</i>	<i>Probable</i>	<i>Probable</i>	<i>Possible</i>
Consequence Severity	<i>Insignificant</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Catastrophic</i>
Agency Impact	<i>Insignificant</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Extreme</i>
Overall Risk	Low	Moderate	Moderate	Extreme

1.1.16 Marine Risk

Marine risk factors include waterway and near-shore recreational activities and watercraft storage and use in or on waterways within the City.

Waterways

Bodies of water and waterways within the City include 298 miles of river and open stream channels, including the Columbia and Willamette Rivers and Smith Lake.

Recreational Activity

The City’s waterways are popular for water recreation activities, including swimming, snorkeling, fishing, paddle boarding, kayaking, etc.

Watercraft Storage

There are numerous marinas within the City, primarily along the Columbia River.

Watercraft/Vessel Activity

In addition to smaller fishing and recreational boats and personal watercraft, more than 650 cargo ships call on the Port of Portland and other private terminals within the City annually, including bulk carriers, barges, vehicle carriers, tankers, general cargo, and container vessels.²⁰ While this large vessel traffic represents an approximately 46 percent reduction in number of ships compared to 2008, a 2005–2010 channel deepening project on the Columbia River now allows much larger vessels access to those inland ports and terminals.

Marine Incident Service Demand

Over six-year study period, PF&R responded to 129 marine incidents comprising 0.03 percent of total service demand for the same period, as summarized in the following tables.

Table 75—Marine Service Demand - Battalion 1

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		3	4	5	10	15	16	18	27		
Marine Incident	2016	1	1	0	1	0	0	0	0	3	0.02%
	2017	2	2	0	0	0	0	0	0	4	0.02%
	2018	0	2	0	1	0	0	0	0	3	0.02%
	2019	1	0	0	0	0	0	0	0	1	0.01%
	2020	0	0	0	1	0	0	0	0	1	0.01%
Total		4	5	0	3	0	0	0	0	12	0.02%
Percent Total Station Demand		0.02%	0.02%	0.00%	0.11%	0.00%	0.00%	0.00%	0.00%		

²⁰ Reference: Merchant’s Exchange 2020 Annual Report

Table 76—Marine Service Demand – Battalion 2

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		6	8	14	17	21	22	24	26		
Marine Incident	2016	0	0	1	2	3	3	0	0	9	0.06%
	2017	1	0	1	1	2	1	0	0	6	0.04%
	2018	0	0	1	3	6	1	1	0	12	0.08%
	2019	0	0	0	1	4	0	4	0	9	0.06%
	2020	0	0	1	8	0	3	0	0	12	0.08%
Total		1	0	4	15	15	8	5	0	48	0.06%
Percent Total Station Demand		0.05%	0.00%	0.03%	0.20%	0.14%	0.08%	0.04%	0.00%		

Table 77—Marine Service Demand – Battalion 3

Hazard	Year	Risk Planning Zone (FMA)								Total	Percent Total Annual Demand
		2	7	11	12	19	29	30	31		
Marine Incident	2016	0	0	0	0	0	0	0	0	0	0.00%
	2017	0	0	0	0	1	0	0	0	1	0.00%
	2018	1	0	0	3	0	0	0	0	4	0.01%
	2019	1	0	0	0	0	0	0	0	1	0.00%
	2020	5	0	0	0	0	0	0	0	5	0.02%
Total		7	0	0	3	1	0	0	0	11	0.01%
Percent Total Station Demand		0.07%	0.00%	0.00%	0.02%	0.01%	0.00%	0.00%	0.00%		

Table 78—Marine Service Demand – Battalion 4

Hazard	Year	Risk Planning Zone (FMA)							Total	Percent Total Annual Demand
		1	9	13	20	23	25	28		
Marine Incident	2016	5	0	1	1	1	0	0	8	0.03%
	2017	12	0	1	3	0	0	0	16	0.06%
	2018	12	0	1	1	1	0	0	15	0.06%
	2019	9	0	0	0	0	0	0	9	0.04%
	2020	6	0	2	0	2	0	0	10	0.04%
Total		44	0	5	5	4	0	0	58	0.05%
Percent Total Station Demand		0.12%	0.00%	0.02%	0.06%	0.07%	0.00%	0.00%		

As the previous tables show, marine service demand varies by FMA, with FMA 1 having the highest demand. The following table summarizes Citywide marine service demand by year.

Table 79—Marine Service Demand by Year

Hazard	Year	Total Service Demand	Percent of Total Service Demand
Marine Incident	2016	20	0.02%
	2017	27	0.03%
	2018	34	0.04%
	2019	20	0.02%
	2020	28	0.03%
	Total	129	0.03%

As the previous table shows, overall Citywide marine service demand is very low and was relatively constant over the five-year study period.

Marine Risk Assessment

The following table summarizes Citygate’s assessment of the City’s marine risk by incident type.

Table 80—Marine Risk Analysis

Marine Risk	Incident Type				
	Water Rescue	Small Boat Fire/Rescue	Large Pleasure Craft Fire/Rescue	Ship Fire	Marina Fire
Probability of Occurrence	<i>Frequent</i>	<i>Possible</i>	<i>Possible</i>	<i>Possible</i>	<i>Possible</i>
Consequence Severity	<i>Moderate</i>	<i>Minor</i>	<i>Moderate</i>	<i>Major</i>	<i>Major</i>
Agency Impact	<i>Moderate</i>	<i>Minor</i>	<i>Moderate</i>	<i>Major</i>	<i>Major</i>
Overall Risk	High	Low	Moderate	High	High