SCIO TOWNSHIP FIRE SERVICES GUIDANCE COMMITTEE
Regular Meeting of the FSGC
October 19, 2022
9:30 AM
Meeting Hall with Remote Participation
827 North Zeeb Road

MINUTES

1. Call to order
    a. Meeting called to order by Chief Houde
2. Roll call
    a. Present: Baird, Flintoft, Goodsitt (remote), Groden, Hyde, Perry, Read, Yaple
    b. Absent: none
3. Adoption of agenda
    a. Houde suggested adding an item to the permanent agenda between communication and old business called presentations and discussion
    b. Motion Perry, second Hyde to adopt agenda and make Houde's suggestion a permanent agenda item, motion passed by voice vote
4. Public comment
    a. No members of the public commented
5. Approval of minutes
    a. There were no minutes to approve
6. Old business
    a. There was no old business
7. Communications and/or correspondence
    a. There was no communication or correspondence
8. New business
    a. Appointment of chair, motion Perry, second Groden to appoint Read Chair. Motion passed by voice vote
    b. Appointment of vice-chair, motion Read, second Perry to appoint Groden Vice-Chair. Motion passed by voice vote
    c. Appointment of secretary, motion Read, second Hyde to appoint Yaple Secretary. Motion passed by voice vote
    d. Schedule of meetings, motion Groden, second Perry to meet at 9:30 am on Wednesdays on a weekly basis. Motion passed by voice vote
9. Read began general discussion of reason that this committee was formed, discussion covered several topics generally. Houde to bring formal presentation to next meeting to help focus on issues.
10. Public comment

    a. No members of the public commented
11. Motion to adjourn
    a. Motion Hyde, second Flintoft to adjourn at 11:02 am. Motion passed by voice vote

Cost to operate a building

Line item:		Cost:	
726	Tools and supplies	$25,000.00	
727	Office supplies	$1,500.00	
729	Building supplies	$4,000.00	
735	Medical supplies	$1,500.00	
741	Fire equipment expendable	$15,000.00	
861	Fuels and lubes	$10,000.00	2 vehicles
862	Truck maintenance	$20,000.00	2 vehicles
920	Telephone	$1,500.00	
921	Electric	$10,800.00	
922	Water	$2,000.00	
923	Gas	$3,000.00	
931	Building maintenance	$5,000.00	
931.1	Trash	$1,400.00	
932	Grounds maintenance	$7,500.00	
975	Buildings and improvements	$10,000.00	
977	Equipment replacement	$10,000.00	
980	Equipment	$10,000.00	
990	Cap equip replacement	$50,000.00	
990.1	Veh replacement	$125,000.00	1 engine 1 tanker, would be $150,(
	Cost allocation	$70,000.00	
Total		$383,200.00	

000 with ladder truck & tanker

2020-2027 CAPITAL IMPROVEMENT PLAN AGGREGATE S

	PROJECT NUMBER AND NAME	PROJECT COORDINATION	PROJECT TYPE	AVERAGE RATING	POTENTIAL FUNDING SOURCE(S)	TOTAL PROJECT COST	TOWNSHIP SHARE	TOTAL TOWNSHIP COST	FUTURE COST (2020-2026)	FYE2021 PROJECT COST	FYE2021 TOWNSHIP COST	FYE2 PROJECT COST
	Fire Equipment											
FE-1	Staff vehicle, EMS vehicle	None	Replacement		Fire Fund	75,000	100%	75,000	90000	35,000	35,000	55,000
FE-2	Brush Truck, Tanker	None	Replacement		Fire Fund	573,000	100%	573,000	573000			
	Engine, tanker		New		Undetermined				-			
	Staff vehicle-inspector		New		Fire Fund				55,000			
	Ladder truck and tanker											
	Sub-Total					648,000		648,000	718,000	35,000	35,000	55,000
									-			
	Fire Facilities								-			
FF-1	Station #1 Phase 2 Improvements				Loan from general fund	1,500,000	100%	1,500,000	1,500,000			1,500,000
	Property acquisition				Undetermined				900,000.00			
	Construction of fire station				Undetermined				4,000,000.00			
										.		
	Sub-Total					1,500,000		1,500,000	6,400,000	-	-	1,500,000
	Total					2,148,000		2,148,000	7,118,000	35,000	35,000	1,555,000

Phase two improvements can be completed within the current budget, borrowing the funds from the General Fund and repaying them. The general fund can sustain a loan for this project per anal includes current and ongoing budget line item of $70,000 (line item 206.000.975). Per our evaluation, we could afford a payback at $75,000 annually, with additional amounts based on year end b

Near term, we need to look at creating a fire inspector position. The only capital costs associated with this would be a vehicle

Long term, we have the need to additional buildings to adequately service the community. With property acquired in the SE area of the Township, the next major area off need is the west side of t This CIP considers a second station operating by the end of FYE 2025. This station was projected to be open and operating in 2020.

If Dexter were no longer to staff their downtown fire station, this may need to be ammended.

SPREADSHEET

2022	FYE2023		FYE2024		FYE2025		FYE2026		FYE2027		FYE2028	
TOWNSHIP COST	PROJECT COST	TOWNSHIP COST	PROJECT COST	TOWNSHIP COST	PROJECT COST	TOWNSHIP COST	PROJECT COST	TOWNSHIP COST	PROJECT COST	TOWNSHIP COST	PROJECT COST	TOWNSHIP COST
55,000												
	573,000	573,000										
	55,000	55,000										
			1,875,000	1,875,000								
55,000	628,000	628,000	1,875,000	1,875,000	-	-	-	-	-	-	-	-
1,500,000												
	150,000	150,000							750,000	750,000		
			4,000,000	4,000,000								
1,500,000	150,000	150,000	4,000,000	4,000,000	-	-	-	-	750,000	750,000	-	-
1,555,000	778,000	778,000	5,875,000	5,875,000	-	-	-	-	750,000	750,000	-	-

lysis by CFO Egeler and myself. Proposed payback
udget experience. Payback should be 12-15 years.

the Township along Jackson Ave

Comparison of communities in county

Community	Population	Size	Taxible value	# of stations	On duty	Total FTE FF's	FD budget	Calls
Ann Arbor City	123,851	29	6.684B	5	24 max/ 18 min	81	$18,206,900	9486
Ypsilanti Twp	55,670	32	1.482B	3	8/9 max/6 min	27	$4,503,192	5583
Pittsfield Twp	37,147	27	2.212B	3	8 max/ 6 min	26	$4,723,303	3318
Scio Township	17,552	32	1.465B	1	4 max/3 min	11	$1,982,840	1500
Superior Township	14,832	36	.693B	2	4 max/4 min	16	$2,557,535	980
Ypsilanti City	20,648	4.5	.345B	1	7 max/4 min	23	$3,022,340*	2285

*Ypsilanti city has special pension millage

Scio Township is the 58th most populus Township in Michigan (1240 total)
Scio Township is the 115th most populus community in Michigan (1520 total). 7.5% of communities in MI have more population, 92.5% have less population.

Comparison of communities out of county

Community	Population	Size	Taxible value	# of stations	On duty	Total FTE FF's	FD budget	Calls
Northville Twp	31,758	16.5	$2.406B	1	9 max/min	34	$7,641,801	3047
Harrison Twp	24,314	12.5	$1.004B	2	9 max/6 min	29	$7,221,786	3167
Commerce Twp	43,058	29.9		3	6 max/ min	20	$5,172,687	3775
Summit	22,522	30		3*	6 max/	33	$2,432,700	1655

*only 2 stations staffed, the third is a "training" station

In county millage rates

Augusta Twp	Fire	2	
	Fire station	1	
Bridgewater	Fire	0.5	
Dexter Twp*	Fire	2.4	
Manchester Twp	Fire eq	0.14	
	Fire operating	0.64	
Northfield	Fire/med	1.94	
Pittsfield*	Public safety	2.95	Most of cost for police/fire comes from general fund
Scio*	Fire	1.35	
Superior*	Fire	3.49	
Webster Twp*	Public safety	3.33	
York*	Public safety	1.42	
Ypsilanti Twp*	Fire prot	3.12	
	Fire cap	0.49	

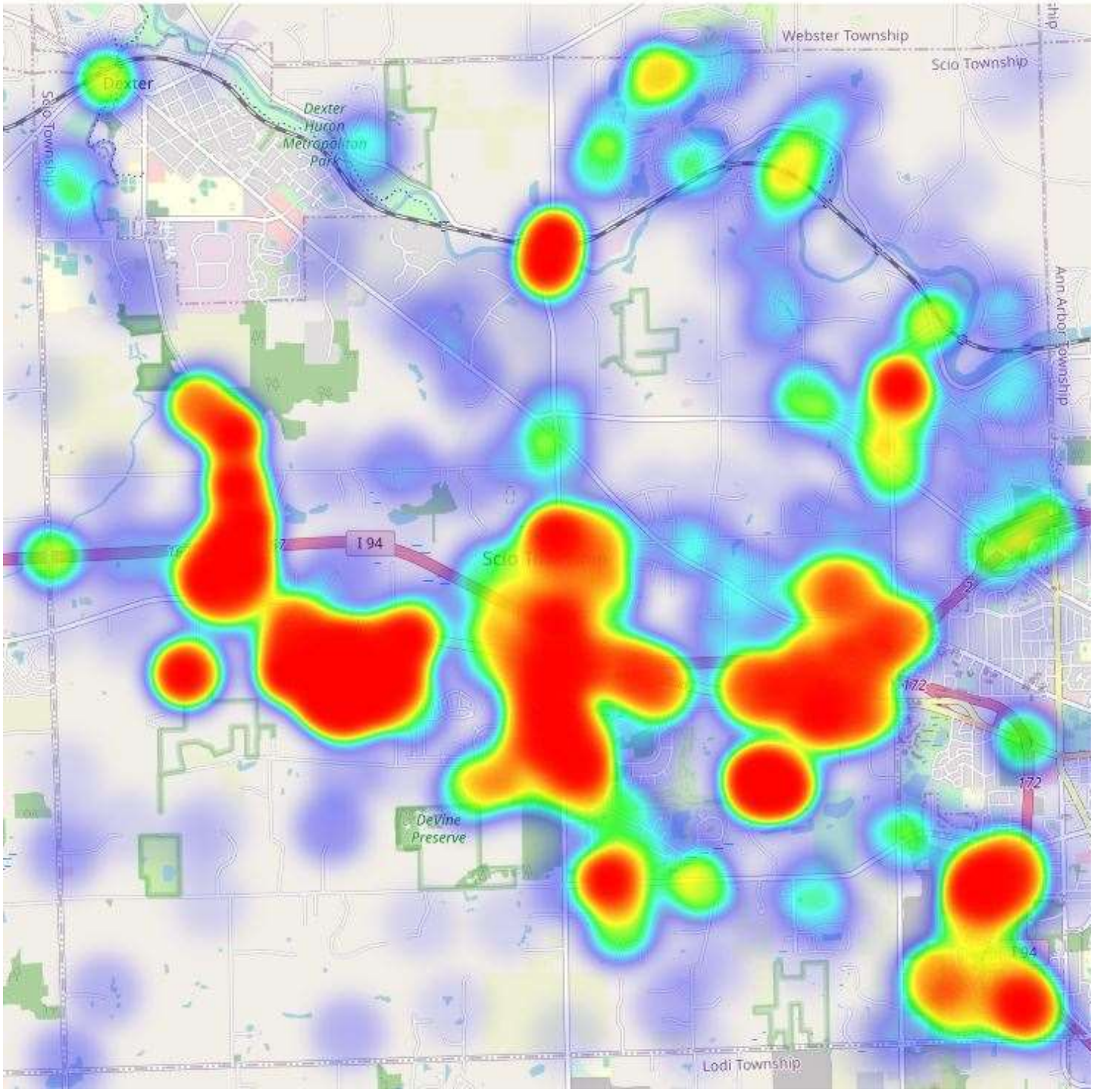
* communities protected by full-time firefighters

Equipment	Life expectancy	How Many?	Unit Cost	Current Cost	Years Left to Replace	Annual Replacement Savings	2021-22 Savings	2022-23 Savings	2023-24 Savings	2024-25 Savings	2025-26 Savings
Engine	12.5/12.5	1	$ 650,000	$ 650,000	10	$ 65,000	65,000	65,000	65,000	65,000	65,000
Ladder truck	15/15	1	$ 1,250,000	$ 1,250,000	15	$ 83,333	83,333	83,333	83,333	83,333	83,333
Tanker	15/15	1	$ 550,000	$ 550,000	2	$ 275,000	275,000	275,000			
Rescue-already budgeted in FY22	10	1	$ 55,000	$ 55,000	1	$ 55,000					
Chief Vehicle	10	1	$ 35,000	$ 35,000	10	$ 3,500	3,500	3,500	3,500	3,500	3,500
Inspectors vehicle	10	1	$ 35,000	$ 35,000	10	$ 3,500	3,500	3,500	3,500	3,500	3,500
SCBA	15 (NFPA)	20	$ 8,500	$ 170,000	10	$ 17,000	17,000	17,000	17,000	17,000	17,000
Thermal imaging cameras	10	1	$ 3,500	$ 3,500	1	$ 3,500	3,500				
Thermal imaging cameras	10	2	$ 9,750	$ 19,500	3	$ 6,500	6,500	6,500	6,500		
CPR machines	10	1	$ 16,000	$ 16,000	5	$ 3,200	3,200	3,200	3,200	3,200	3,200
Extrication equipment	15	1	$ 45,000	$ 45,000	14	$ 3,214	3,214	3,214	3,214	3,214	3,214
Airbags	15	1	$ 9,000	$ 9,000	14	$ 643	643	643	643	643	643
Tanker (bought in 2023)	15	1	$ 550,000	$ 550,000	15	$ 36,667			36,667	36,667	36,667
Rescue (bought in 2022)	10	1	$ 55,000	$ 55,000	10	$ 5,500		5,500	5,500	5,500	5,500
Thermal imaging cameras (bought in 2022)	10	1	$ 9,750	$ 9,750	10	$ 975		975	975	975	975
Thermal imaging cameras (bought in 2023)	10	2	$ 9,750	$ 19,500	10	$ 1,950			-	1,950	1,950
CPR machines	10	1	$ 15,000	$ 15,000	10	$ 1,500					
Total						$ 502,333	$ 464,390	$ 467,365	$ 229,032	$ 224,482	$ 224,482
Cumulative Savings							$ 460,890	$ 378,256	$ 587,788	$ 812,270	$ 1,020,752

Expenditure Plan:

Engine					
Ladder truck					
Tanker		(550,000)			
Chief Vehicle					
Inspectors vehicle					
SCBA					
Thermal imaging cameras	(3,500)				
Thermal imaging cameras			(19,500)		
CPR machines					(16,000)
Extrication equipment					
Airbags					
Tanker (bought in 2023)					
Rescue (bought in 2022)					
Thermal imaging cameras (bought in 2022)					
Thermal imaging cameras (bought in 2023)					
CPR machines					
Total Costs	(3,500)	(550,000)	(19,500)	-	(16,000)

2026-27 Savings	2027-28 Savings	2028-29 Savings	2029-30 Savings	2030-31 Savings	2031-32 Savings	2032-33 Savings	2033-34 Savings	2034-35 Savings	2035-36 Savings
65,000	65,000	65,000	65,000	65,000					
83,333	83,333	83,333	83,333	83,333	83,333	83,333	83,333	83,333	83,333
3,500	3,500	3,500	3,500	3,500					
3,500	3,500	3,500	3,500	3,500					
17,000	17,000	17,000	17,000	17,000					
3,214	3,214	3,214	3,214	3,214	3,214	3,214	3,214	3,214	
643	643	643	643	643	643	643	643	643	
36,667	36,667	36,667	36,667	36,667	36,667	36,667	36,667	36,667	36,667
5,500	5,500	5,500	5,500	5,500	5,500				
975	975	975	975	975	975				
1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950		
1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
$ 222,782	$ 222,782	$ 222,782	$ 222,782	$ 222,782	$ 133,782	$ 127,307	$ 127,307	$ 125,357	$ 121,500
$ 1,243,535	$ 1,466,317	$ 1,689,099	$ 1,911,881	$ 1,244,663	$ 1,313,695	$ 1,441,002	$ 1,548,810	$ 1,620,167	$ 476,667
				(650,000)					
									(1,250,000)
				(35,000)					
				(35,000)					
				(170,000)					
								(45,000)	
								(9,000)	
					(55,000)				
					(9,750)				
							(19,500)		
			-						(15,000)
-	-	-	-	(890,000)	(64,750)	-	(19,500)	(54,000)	(1,265,000)


Webster Township
Scio Township
Dexter
Dexter Huron Metropolitan Park
Scio Township
Ann Arbor Township
I 94
DeVine Preserve
Lodi Township

HOMEOWNERS INSURANCE

Advertiser Disclosure

How ISO fire ratings impact your home insurance

SHARE:

7 MINUTE READ
July 18, 2022

Expert verified

Written by **Elizabeth Rivelli** Edited by **Angelica Leicht** Reviewed by **Mark Friedlander**

The Bankrate promise More info

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of more than 74% from 2010. In addition, wildfires have become much more prevalent in recent years due to widespread droughts and the effect that global warming has had on the entire world.

Incident Type Summary

Basic Incident Type Code And Description (FD1.21)	Total Incidents	Total Incidents Percent of Incidents	Total Property Loss	Total Content Loss	Total Loss	Total Loss Percent of Total
Incident Type Category (FD1.21): 1 - Fire						
111 - Building fire	33	2.36%	631501.00	957101.00	1588602.00	97.25%
112 - Fires in structure other than in a building	1	0.07%				
113 - Cooking fire, confined to container	3	0.21%	1000.00	100.00	1100.00	0.07%
114 - Chimney or flue fire, confined to chimney or flue	1	0.07%				
130 - Mobile property (vehicle) fire, other	3	0.21%	10.00	10.00	20.00	0.00%
131 - Passenger vehicle fire	6	0.43%	34500.00	8600.00	43100.00	2.64%
132 - Road freight or transport vehicle fire	2	0.14%	501.00	1.00	502.00	0.03%
140 - Natural vegetation fire, other	2	0.14%	0.00	0.00	0.00	0.00%
141 - Forest, woods or wildland fire	2	0.14%		0.00	0.00	0.00%
142 - Brush or brush-and-grass mixture fire	6	0.43%	50.00	0.00	50.00	0.00%
143 - Grass fire	2	0.14%	100.00	0.00	100.00	0.01%
151 - Outside rubbish, trash or waste fire	2	0.14%				
153 - Construction or demolition landfill fire	2	0.14%	0.00	0.00	0.00	0.00%
154 - Dumpster or other outside trash receptacle fire	1	0.07%	0.00	0.00	0.00	0.00%
	Total: 66	**Total: 4.71%**	**Total: 667662.00**	**Total: 965812.00**	**Total: 1633474.00**	**Total: 100.00%**
Incident Type Category (FD1.21): 2 - Overpressure Rupture, Explosion, Overheat (No Fire)						
251 - Excessive heat, scorch burns with no ignition	1	0.07%				
	Total: 1	**Total: 0.07%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**
Incident Type Category (FD1.21): 3 - Rescue & Emergency Medical Service Incident						
300 - Rescue, EMS incident, other	7	0.50%				
311 - Medical assist, assist EMS crew	553	39.47%				
320 - Emergency medical service, other	10	0.71%				
321 - EMS call, excluding vehicle accident with injury	48	3.43%				
322 - Motor vehicle accident with injuries	52	3.71%				
323 - Motor vehicle/pedestrian accident (MV Ped)	4	0.29%				
324 - Motor vehicle accident with no injuries.	96	6.85%				
341 - Search for person on land	1	0.07%				
352 - Extrication of victim(s) from vehicle	3	0.21%				
363 - Swift water rescue	2	0.14%				
	Total: 776	**Total: 55.39%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**
Incident Type Category (FD1.21): 4 - Hazardous Condition (No Fire)						
400 - Hazardous condition, other	2	0.14%				
410 - Combustible/flammable gas/liquid condition, other	1	0.07%				
412 - Gas leak (natural gas or LPG)	16	1.14%				
424 - Carbon monoxide incident	5	0.36%				
440 - Electrical wiring/equipment problem, other	19	1.36%				
442 - Overheated motor	1	0.07%				
444 - Power line down	16	1.14%				
445 - Arcing, shorted electrical equipment	6	0.43%				
480 - Attempted burning, illegal action, other	1	0.07%				
	Total: 67	**Total: 4.78%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**

Basic Incident Type Code And Description (FD1.21)	Total Incidents	Total Incidents Percent of Incidents	Total Property Loss	Total Content Loss	Total Loss	Total Loss Percent of Total
Incident Type Category (FD1.21): 5 - Service Call						
500 - Service call, other	1	0.07%				
511 - Lock-out	4	0.29%				
520 - Water problem, other	1	0.07%				
522 - Water or steam leak	1	0.07%				
531 - Smoke or odor removal	3	0.21%				
542 - Animal rescue	1	0.07%				
551 - Assist police or other governmental agency	1	0.07%				
553 - Public service	2	0.14%				
554 - Assist invalid	24	1.71%				
561 - Unauthorized burning	12	0.86%				
571 - Cover assignment, standby, moveup	5	0.36%				
	Total: 55	**Total: 3.93%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**
Incident Type Category (FD1.21): 6 - Good Intent Call						
600 - Good intent call, other	32	2.28%				
611 - Dispatched and cancelled en route	197	14.06%				
622 - No incident found on arrival at dispatch address	24	1.71%				
631 - Authorized controlled burning	12	0.86%				
650 - Steam, other gas mistaken for smoke, other	1	0.07%				
651 - Smoke scare, odor of smoke	5	0.36%				
671 - HazMat release investigation w/no HazMat	1	0.07%				
	Total: 272	**Total: 19.41%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**
Incident Type Category (FD1.21): 7 - False Alarm & False Call						
700 - False alarm or false call, other	50	3.57%				
714 - Central station, malicious false alarm	1	0.07%				
730 - System malfunction, other	6	0.43%				
731 - Sprinkler activation due to malfunction	3	0.21%				
733 - Smoke detector activation due to malfunction	19	1.36%				
734 - Heat detector activation due to malfunction	1	0.07%				
735 - Alarm system sounded due to malfunction	20	1.43%				
736 - CO detector activation due to malfunction	2	0.14%				
740 - Unintentional transmission of alarm, other	3	0.21%				
741 - Sprinkler activation, no fire - unintentional	3	0.21%				
743 - Smoke detector activation, no fire - unintentional	18	1.28%				
744 - Detector activation, no fire - unintentional	7	0.50%				
745 - Alarm system activation, no fire - unintentional	20	1.43%				
746 - Carbon monoxide detector activation, no CO	6	0.43%				
	Total: 159	**Total: 11.35%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**
Incident Type Category (FD1.21): 9 - Special Incident Type						
900 - Special type of incident, other	3	0.21%				
911 - Citizen complaint	2	0.14%				
	Total: 5	**Total: 0.36%**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00**	**Total: 0.00%**

Basic Incident Type Code And Description (FD1.21)	Total Incidents	Total Incidents Percent of Incidents	Total Property Loss	Total Content Loss	Total Loss	Total Loss Percent of Total
	Total: 1,401	Total: 100.00%	Total: 667662.00	Total: 965812.00	Total: 1633474.00	Total: 100.00%

MIOSHA-STD-1208 (4/21)
32 Pages

For further information
Ph: 517-284-7740
www.michigan.gov/mioshastandards

DEPARTMENT OF LABOR AND ECONOMIC OPPORTUNITY

DIRECTOR'S OFFICE

GENERAL INDUSTRY AND CONSTRUCTION SAFETY AND HEALTH STANDARD

Filed with the Secretary of State on April 5, 1999 (as amended April 12, 2005)
(as amended February 8, 2007) (as amended January 13, 2014) **(as amended April 26, 2021)**

These rules take effect immediately upon filing with the secretary of state unless adopted under section 33, 44, or 45a(6) of the administrative procedures act of 1969, 1969 PA 306, MCL 24.233, 24.244, or 24.245a.

Rules adopted under these sections become effective 7 days after filing with the Secretary of State.

(By authority conferred on the director of the department of labor and economic opportunity by sections 14 and 24 of the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1014 and 408.1024, and Executive Reorganization Order Nos. 1996-1, 1996-2, 2003-1, 2008-4, 2011-4, and 2019-3, MCL 330.3101, 445.2001, 445.2011, 445.2025, 445.2030, and 125.1998)

R 325.60051 of the Michigan Administrative Code is amended, and R 325.60052 is rescinded, as follows:

PART 451. RESPIRATORY PROTECTION

Table of Contents:

R 325.60051 Scope and application.

Rule 1. (1) In the control of occupational diseases caused by breathing air contaminated with harmful dusts, fog, fumes, mists, gases, smokes, spray, or vapors, the primary objective shall be to prevent atmospheric contamination. The prevention of atmospheric contamination shall be accomplished, as far as feasible, by accepted engineering control measures. When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to these rules.

(2) The federal Occupational Safety and Health Administration's regulations on respiratory protection promulgated by the United States Department of Labor and codified at 29 CFR 1910.134, "Respiratory Protection," as amended on September 26, 2019, are adopted by reference in these rules.

(3) The adopted federal regulations shall have the same force and effect as a rule promulgated under the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1001 to 408.1094.

(4) The OSHA regulations adopted by reference in subrule (2) of this rule are available from the United States Department of Labor, Occupational Safety and Health Administration, via the internet at website

www.osha.gov, at no charge as of the time of adoption of these rules.

(5) The standards adopted in subrule (2) of this rule are also available for inspection at the Department of Labor and Economic Opportunity, MIOSHA, Standards and FOIA Section, 530 W. Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909-8143.

(6) Copies of the standards adopted in subrule (2) of this rule may be obtained from the publisher or may also be obtained from the Department of Labor and Economic Opportunity, MIOSHA, Standards and FOIA Section, 530 W. Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909-8143, at the cost charged in this rule, plus $20.00 for shipping and handling.

R 325.60052 Rescinded.

1910.134 RESPIRATORY PROTECTION

This section applies to General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926).

1910.134(a) Permissible practice.

1910.134(a)(1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

1910.134(a)(2) A respirator shall be provided to each employee when such equipment is necessary to protect the health of such employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program, which shall include the requirements outlined in paragraph (c) of this section. The program shall cover each employee required by this section to use a respirator.

1910.134(b) Definitions.

The following definitions are important terms used in the respiratory protection standard in this section.

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Assigned protection factor (APF) means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Canister or cartridge means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

Emergency situation means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Filtering facepiece (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

Helmet means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

High efficiency particulate air (HEPA) filter means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Hood means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

Immediately dangerous to life or health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Interior structural firefighting means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)

Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face.

Maximum use concentration (MUC) means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the required OSHA permissible exposure limit, short-term exposure limit, or ceiling limit. When no OSHA exposure limit is available for a hazardous substance, an employer must determine an MUC on the basis of relevant available information and informed professional judgment.

Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

Respiratory inlet covering means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

This section means this respiratory protection standard.

Tight-fitting facepiece means a respiratory inlet covering that forms a complete seal with the face.

User seal check means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

1910.134(c) Respiratory protection program.

This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator. The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

1910.134(c)(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

1910.134(c)(1)(i) Procedures for selecting respirators for use in the workplace;

1910.134(c)(1)(ii) Medical evaluations of employees required to use respirators;

1910.134(c)(1)(iii) Fit testing procedures for tight-fitting respirators;

1910.134(c)(1)(iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

1910.134(c)(1)(v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;

1910.134(c)(1)(vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

1910.134(c)(1)(vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;

1910.134(c)(1)(viii) Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and

1910.134(c)(1)(ix) Procedures for regularly evaluating the effectiveness of the program.

1910.134(c)(2) Where respirator use is not required:

1910.134(c)(2)(i) An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section ("Information for Employees Using Respirators When Not Required Under the Standard"); and

1910.134(c)(2)(ii) In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

1910.134(c)(3) The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

1910.134(c)(4) The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

1910.134(d) Selection of respirators.

This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

1910.134(d)(1) General requirements.

1910.134(d)(1)(i) The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

1910.134(d)(1)(ii) The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

1910.134(d)(1)(iii) The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

1910.134(d)(1)(iv) The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

1910.134(d)(2) Respirators for IDLH atmospheres.

1910.134(d)(2)(i) The employer shall provide the following respirators for employee use in IDLH atmospheres:

1910.134(d)(2)(i)(A) A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

1910.134(d)(2)(i)(B) A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

1910.134(d)(2)(ii) Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

1910.134(d)(2)(iii) All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

1910.134(d)(3) Respirators for atmospheres that are not IDLH.

1910.134(d)(3)(i) The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

1910.134(d)(3)(i)(A) Assigned Protection Factors (APFs) Employers must use the assigned protection factors listed in Table 1 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

TABLE 1.
ASSIGNED PROTECTION FACTORS [5]

Type of respirator [1,2]	Quarter mask	Half mask	Full face-piece	Helmet/ hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	[3]10	50	-	-
2. Powered Air-Purifying Respirator (PAPR)	-	50	1,000	[4]25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	-	10	50	-	-
• Continuous flow mode	-	50	1,000	[4]25/1,000	25
• Pressure-demand or other positive-pressure mode	-	50	1,000	-	-
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	-	10	50	50	-
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	-	-	10,000	10,000	-

Notes:

[1] Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

[2] The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

[3] This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

[4] The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

[5] These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

1910.134(d)(3)(i)(B) Maximum Use Concentration (MUC)

1910.134(d)(3)(i)(B)(1) The employer must select a respirator for employee use that maintains the employee's exposure to the hazardous substance, when measured outside the respirator, at or below the MUC.

1910.134(d)(3)(i)(B)(2) Employers must not apply MUCs to conditions that are immediately dangerous to life or health (IDLH); instead, they must use respirators listed for IDLH conditions in paragraph (d)(2) of this standard.

1910.134(d)(3)(i)(B)(3) When the calculated MUC exceeds the IDLH level for a hazardous substance, or the performance limits of the cartridge or canister, then employers must set the maximum MUC at that lower limit.

1910.134(d)(3)(ii) The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

1910.134(d)(3)(iii) For protection against gases and vapors, the employer shall provide:

1910.134(d)(3)(iii)(A) An atmosphere-supplying respirator, or

1910.134(d)(3)(iii)(B) An air-purifying respirator, provided that:

1910.134(d)(3)(iii)(B)(1) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

1910.134(d)(3)(iii)(B)(2) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data.

1910.134(d)(3)(iv) For protection against particulates, the employer shall provide:

1910.134(d)(3)(iv)(A) An atmosphere-supplying respirator; or

1910.134(d)(3)(iv)(B) An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

1910.134(d)(3)(iv)(C) For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

TABLE I. -- ASSIGNED PROTECTION FACTORS [RESERVED]

TABLE II.

Altitude (ft.)	**Oxygen deficient Atmospheres (% O_2) for which the employer may rely on atmosphere-supplying respirators.**
Less than 3,001	16.0-19.5
3,001-4,000	16.4-19.5
4,001-5,000	17.1-19.5
5,001-6,000	17.8-19.5
6,001-7,000	18.5-19.5
7,001-8,000[1]	19.3-19.5

[1]Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet.

1910.134(e) Medical evaluation.

Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.

1910.134(e)(1) General. The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

1910.134(e)(2) Medical evaluation procedures.

1910.134(e)(2)(i) The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

1910.134(e)(2)(ii) The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

1910.134(e)(3) Follow-up medical examination.

1910.134(e)(3)(i) The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

1910.134(e)(3)(ii) The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

1910.134(e)(4) Administration of the medical questionnaire and examinations.

1910.134(e)(4)(i) The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

1910.134(e)(4)(ii) The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

1910.134(e)(5) Supplemental information for the PLHCP.

1910.134(e)(5)(i) The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

1910.134(e)(5)(i)(A) The type and weight of the respirator to be used by the employee;

1910.134(e)(5)(i)(B) The duration and frequency of respirator use (including use for rescue and escape);

1910.134(e)(5)(i)(C) The expected physical work effort;

1910.134(e)(5)(i)(D) Additional protective clothing and equipment to be worn; and

1910.134(e)(5)(i)(E) Temperature and humidity extremes that may be encountered.

1910.134(e)(5)(ii) Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

1910.134(e)(5)(iii) The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

Note to Paragraph (e)(5)(iii): When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

1910.134(e)(6) Medical determination. In determining the employee's ability to use a respirator, the employer shall:

1910.134(e)(6)(i) Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:

1910.134(e)(6)(i)(A) Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

1910.134(e)(6)(i)(B) The need, if any, for follow-up medical evaluations; and

1910.134(e)(6)(i)(C) A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

1910.134(e)(6)(ii) If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

1910.134(e)(7) Additional medical evaluations. At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

1910.134(e)(7)(i) An employee reports medical signs or symptoms that are related to ability to use a respirator;

1910.134(e)(7)(ii) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

1910.134(e)(7)(iii) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

1910.134(e)(7)(iv) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

1910.134(f) Fit testing.

This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

1910.134(f)(1) The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

1910.134(f)(2) The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

1910.134(f)(3) The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

1910.134(f)(4) If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

1910.134(f)(5) The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

1910.134(f)(6) QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

1910.134(f)(7) If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

1910.134(f)(8) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

1910.134(f)(8)(i) Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

1910.134(f)(8)(ii) Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

1910.134(f)(8)(iii) Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

1910.134(g) Use of respirators.

This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

1910.134(g)(1) Facepiece seal protection.

1910.134(g)(1)(i) The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

1910.134(g)(1)(i)(A) Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

1910.134(g)(1)(i)(B) Any condition that interferes with the face-to-facepiece seal or valve function.

1910.134(g)(1)(ii) If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

1910.134(g)(1)(iii) For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B-1 of this section.

1910.134(g)(2) Continuing respirator effectiveness.

1910.134(g)(2)(i) Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

1910.134(g)(2)(ii) The employer shall ensure that employees leave the respirator use area:

1910.134(g)(2)(ii)(A) To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or

1910.134(g)(2)(ii)(B) If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or

1910.134(g)(2)(ii)(C) To replace the respirator or the filter, cartridge, or canister elements.

1910.134(g)(2)(iii) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.

1910.134(g)(3) Procedures for IDLH atmospheres. For all IDLH atmospheres, the employer shall ensure that:

1910.134(g)(3)(i) One employee or, when needed, more than one employee is located outside the IDLH atmosphere;

1910.134(g)(3)(ii) Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;

1910.134(g)(3)(iii) The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;

1910.134(g)(3)(iv) The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;

1910.134(g)(3)(v) The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;

1910.134(g)(3)(vi) Employee(s) located outside the IDLH atmospheres are equipped with:

1910.134(g)(3)(vi)(A) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either

1910.134(g)(3)(vi)(B) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or

1910.134(g)(3)(vi)(C) Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).

1910.134(g)(4) Procedures for interior structural firefighting. In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:

1910.134(g)(4)(i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

1910.134(g)(4)(ii) At least two employees are located outside the IDLH atmosphere; and

1910.134(g)(4)(iii) All employees engaged in interior structural firefighting use SCBAs.

Note 1 to paragraph (g): One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

Note 2 to paragraph (g): Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

1910.134(h) Maintenance and care of respirators.

This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

1910.134(h)(1) Cleaning and disinfecting. The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

1910.134(h)(1)(i) Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

1910.134(h)(1)(ii) Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

1910.134(h)(1)(iii) Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

1910.134(h)(1)(iv) Respirators used in fit testing and training shall be cleaned and disinfected after each use.

1910.134(h)(2) Storage. The employer shall ensure that respirators are stored as follows:

1910.134(h)(2)(i) All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

1910.134(h)(2)(ii) In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

1910.134(h)(2)(ii)(A) Kept accessible to the work area;

1910.134(h)(2)(ii)(B) Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

1910.134(h)(2)(ii)(C) Stored in accordance with any applicable manufacturer instructions.

1910.134(h)(3) Inspection.

1910.134(h)(3)(i) The employer shall ensure that respirators are inspected as follows:

1910.134(h)(3)(i)(A) All respirators used in routine situations shall be inspected before each use and during cleaning;

1910.134(h)(3)(i)(B) All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

1910.134(h)(3)(i)(C) Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

1910.134(h)(3)(ii) The employer shall ensure that respirator inspections include the following:

1910.134(h)(3)(ii)(A) A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and

1910.134(h)(3)(ii)(B) A check of elastomeric parts for pliability and signs of deterioration.

1910.134(h)(3)(iii) In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

1910.134(h)(3)(iv) For respirators maintained for emergency use, the employer shall:

1910.134(h)(3)(iv)(A) Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

1910.134(h)(3)(iv)(B) Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

1910.134(h)(4) Repairs. The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

1910.134(h)(4)(i) Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

1910.134(h)(4)(ii) Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

1910.134(h)(4)(iii) Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

1910.134(i) Breathing air quality and use.

This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

1910.134(i)(1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

1910.134(i)(1)(i) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

1910.134(i)(1)(ii) Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

1910.134(i)(1)(ii)(A) Oxygen content (v/v) of 19.5-23.5%;

1910.134(i)(1)(ii)(B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

1910.134(i)(1)(ii)(C) Carbon monoxide (CO) content of 10 ppm or less;

1910.134(i)(1)(ii)(D) Carbon dioxide content of 1,000 ppm or less; and

1910.134(i)(1)(ii)(E) Lack of noticeable odor.

1910.134(i)(2) The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

1910.134(i)(3) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

1910.134(i)(4) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

1910.134(i)(4)(i) Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 180);

1910.134(i)(4)(ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

1910.134(i)(4)(iii) The moisture content in the cylinder does not exceed a dew point of -50 deg.F (-45.6 deg.C) at 1 atmosphere pressure.

1910.134(i)(5) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

1910.134(i)(5)(i) Prevent entry of contaminated air into the air-supply system;

1910.134(i)(5)(ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 deg.C) below the ambient temperature;

1910.134(i)(5)(iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

1910.134(i)(5)(iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

1910.134(i)(6) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

1910.134(i)(7) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

1910.134(i)(8) The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

1910.134(i)(9) The employer shall use only the respirator manufacturer's NIOSH-approved breathing-gas containers, marked and maintained in accordance with the Quality Assurance provisions of the NIOSH approval for the SCBA as issued in accordance with the NIOSH respirator-certification standard at 42 CFR part 84.

1910.134(j) Identification of filters, cartridges, and canisters.

The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

1910.134(k) Training and information.

This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

1910.134(k)(1) The employer shall ensure that each employee can demonstrate knowledge of at least the following:

1910.134(k)(1)(i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

1910.134(k)(1)(ii) What the limitations and capabilities of the respirator are;

1910.134(k)(1)(iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

1910.134(k)(1)(iv) How to inspect, put on and remove, use, and check the seals of the respirator;

1910.134(k)(1)(v) What the procedures are for maintenance and storage of the respirator;

1910.134(k)(1)(vi) How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

1910.134(k)(1)(vii) The general requirements of this section.

1910.134(k)(2) The training shall be conducted in a manner that is understandable to the employee.

1910.134(k)(3) The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

1910.134(k)(4) An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.

1910.134(k)(5) Retraining shall be administered annually, and when the following situations occur:

1910.134(k)(5)(i) Changes in the workplace or the type of respirator render previous training obsolete;

1910.134(k)(5)(ii) Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or

1910.134(k)(5)(iii) Any other situation arises in which retraining appears necessary to ensure safe respirator use.

1910.134(k)(6) The basic advisory information on respirators, as presented in Appendix D of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

1910.134(l) Program evaluation.

This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

1910.134(l)(1) The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

1910.134(l)(2) The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

1910.134(l)(2)(i) Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);

1910.134(l)(2)(ii) Appropriate respirator selection for the hazards to which the employee is exposed;

1910.134(l)(2)(iii) Proper respirator use under the workplace conditions the employee encounters; and

1910.134(l)(2)(iv) Proper respirator maintenance.

1910.134(m) Recordkeeping.

This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

1910.134(m)(1) Medical evaluation. Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.1020.

1910.134(m)(2) Fit testing.

1910.134(m)(2)(i) The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

1910.134(m)(2)(i)(A) The name or identification of the employee tested;

1910.134(m)(2)(i)(B) Type of fit test performed;

1910.134(m)(2)(i)(C) Specific make, model, style, and size of respirator tested;

1910.134(m)(2)(i)(D) Date of test; and

1910.134(m)(2)(i)(E) The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

1910.134(m)(2)(ii) Fit test records shall be retained for respirator users until the next fit test is administered.

1910.134(m)(3) A written copy of the current respirator program shall be retained by the employer.

1910.134(m)(4) Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

1910.134(n) Effective date.

Paragraphs (d)(3)(i)(A) and (d)(3)(i)(B) of this section become effective November 22, 2006.

1910.134(o) Appendices.

Compliance with Appendix A, Appendix B-1, Appendix B-2, Appendix C, and Appendix D to this section are mandatory.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998; 71 FR 16672, April 3, 2006; 71 FR 50187, August 24, 2006; 73 FR 75584, Dec. 12, 2008; 76 FR 33606, June 8, 2011]

1910.134 Appendix A
Fit Testing Procedures (Mandatory).

Part I. OSHA-Accepted Fit Test Protocols

A. Fit Testing Procedures -- General Requirements

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.

5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

(a) Position of the mask on the nose

(b) Room for eye protection

(c) Room to talk

(d) Position of mask on face and cheeks

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

(a) Chin properly placed;

(b) Adequate strap tension, not overly tightened;

(c) Fit across nose bridge;

(d) Respirator of proper size to span distance from nose to chin;

(e) Tendency of respirator to slip;

(f) Self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in appendix B-1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in appendix B-1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.

11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.

12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.

14. Test Exercises.

(a) Employers must perform the following test exercises for all fit testing methods prescribed in this appendix, except for the two modified ambient aerosol CNC quantitative fit testing protocols, the CNP quantitative fit testing protocol, and the CNP REDON quantitative fit testing protocol. For the modified ambient aerosol CNC quantitative fit testing protocols, employers shall ensure that the test subjects (*i.e.*, employees) perform the exercise procedure specified in Part I.C.4(b) of this appendix for full-facepiece and half-mask elastomeric respirators, or the exercise procedure specified in Part I.C.5(b) for filtering facepiece respirators. Employers shall ensure that the test subjects (i.e., employees) perform the exercise procedure specified in Part I.C.6(b) of this appendix for the CNP quantitative fit testing protocol, or the exercise procedure described in Part I.C.7(b) of this appendix for the CNP REDON quantitative fit testing protocol. For the remaining fit testing methods, employers shall ensure that the test exercises are performed in the appropriate test environment in the following manner:

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)

(7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.

(8) Normal breathing. Same as exercise (1).

(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

B. Qualitative Fit Test (QLFT) Protocols

1. General

(a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

2. Isoamyl Acetate Protocol

Note: This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

(a) Odor Threshold Screening

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

(1) Three 1 liter glass jars with metal lids are required.

(2) Odor-free water (e.g., distilled or spring water) at approximately 25 deg. C (77 deg. F) shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known at isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.

(7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

(b) Isoamyl Acetate Fit Test

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste threshold screening.

The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

Note to paragraph 3. (a): If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

4. Bitrex™ (Denatonium Benzoate) Solution Aerosol Qualitative Fit Test Protocol

The Bitrex™ (Denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste Threshold Screening.

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a \3/4\ inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Bitrex Solution Aerosol Fit Test Procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in 4. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.

(11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

5. Irritant Smoke (Stannic Chloride) Protocol

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

(a) General Requirements and Precautions

(1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Only stannic chloride smoke tubes shall be used for this protocol.

(3) No form of test enclosure or hood for the test subject shall be used.

(4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

(5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

(b) Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

(1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.

(3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

(c) Irritant Smoke Fit Test Procedure

(1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).

(2) The test subject shall be instructed to keep his/her eyes closed.

(3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the faceseal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.

(6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

(7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.

(8) If a response is produced during this second sensitivity check, then the fit test is passed.

C. Quantitative Fit Test (QNFT) Protocols

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

1. General

(a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

2. Generated Aerosol Quantitative Fit Testing Protocol

(a) Apparatus.

(1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

(2) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.

(6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.

(7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.

(8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

(b) Procedural Requirements.

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(A) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(B) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(C) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

(D) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$\text{Overall Fit Factor} = \frac{\text{Number of exercises}}{1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_6 + 1/ff_7 + 1/ff_8}$$

Where ff_1, ff_2, ff_3, etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount ™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Portacount Fit Test Requirements.

(1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.

(2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.

(6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

(b) Portacount Test Instrument.

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.

(3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

4. Modified ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol for Full Facepiece and Half-Mask Elastomeric Respirators.

(a) When administering this protocol to test subjects, employers shall comply with the requirements specified in Part I.C.3 of this appendix (ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol), except they shall use the test exercises described below in paragraph (b) of this protocol instead of the test exercises specified in section I.C.3(a)(6) of this appendix.

(b) Employers shall ensure that each test subject being fit tested using this protocol follows the exercise and duration procedures, including the order of administration, described in Table A-1 of this appendix.

Table A-1.
MODIFIED PROTOCOL FOR FULL FACEPIECE AND HALF-MASK ELASTOMERIC RESPIRATORS

Exercises[1]	Exercise procedure	Measurement procedure
Bending Over	The test subject shall bend at the waist, as if going to touch his/her toes for 50 seconds and inhale 2 times at the bottom[2]	A 20 second ambient sample, followed by a 30 second mask sample
Jogging-in-Place	The test subject shall jog in place comfortably for 30 seconds	A 30 second mask sample
Head Side-to-Side	The test subject shall stand in place, slowly turning his/her head from side to side for 30 seconds and inhale 2 times at each extreme[2]	A 30 second mask sample
Head Up-and-Down	The test subject shall stand in place, slowly moving his/her head up and down for 39 seconds and inhale 2 times at each	A 30 second mask sample followed by a 9 second ambient sample

[1]Exercises are listed in the order in which they are to be administered.

[2]It is optional for test subjects to take additional breaths at other times during this exercise.

5. Modified ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol for filtering facepiece respirators.

(a) When administering this protocol to test subjects, employers shall comply with the requirements specified in Part I.C.3 of this appendix (ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol), except they shall use the test exercises described below in paragraph (b) of this protocol instead of the test exercises specified in section I.C.3(a)(6) of this appendix.

(b) Employers shall ensure that each test subject being fit tested using this protocol follows the exercise and duration procedures, including the order of administration, described in Table A–2 of this appendix

Table A-2. MODIFIED AMBIENT AERSOL CNC QUANTATIVE FIT TESTING PROTOCOL FOR FILTERING FACEPIECE RESPIRATORS		
Exercises[1]	**Exercise procedure**	**Measurement procedure**
Bending Over	The test subject shall bend at the waist, as if going to touch his/her toes for 50 seconds and inhale 2 times at the bottom[2]	A 20 second ambient sample, followed by a 30 second mask sample
Talking	The test subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor for 30 seconds. He/she will either read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.	A 30 second mask sample
Head Side-to-Side	The test subject shall stand in place, slowly turning his/her head from side to side for 30 seconds and inhale 2 times at each extreme[2]	A 30 second mask sample
Head Up-and-Down	The test subject shall stand in place, slowly moving his/her head up and down for 39 seconds and inhale 2 times at each	A 30 second mask sample followed by a 9 second ambient sample

[1]Exercises are listed in the order in which they are to be administered.

[2]It is optional for test subjects to take additional breaths at other times during this exercise.

6. Controlled negative pressure (CNP) quantitative fit testing protocol.

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Occupational Health Dynamics of Birmingham, Alabama also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) CNP Fit Test Requirements.

(1) The instrument shall have a non adjustable test pressure of 15.0 mm water pressure.

(2) The CNP system defaults selected for test pressure shall be set at 15 mm of water (0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

(Note: CNP systems have built in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low moderate work rate, will allow inter test comparison of the respirator fit.)

(3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.

(4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.

(5) The employer must train the test subject to hold his or her breath for at least 10 seconds.

(6) The test subject must don the test respirator without any assistance from the test administrator who is conducting the CNP fit test. The respirator must not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the test subject must repeat the fit test.

(7) The QNFT protocol shall be followed according to section I. C. 1. of this appendix with an exception for the CNP test exercises.

(b) CNP Test Exercises.

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.

(4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.

(7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(8) Normal Breathing. The test subject shall remove and re don the respirator within a one minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

(c) CNP Test Instrument.

(1) The test instrument must have an effective audio warning device, or a visual warning device in the form of a screen tracing, that indicates when the test subject fails to hold his or her breath during the test. The test must be terminated and restarted from the beginning when the test subject fails to hold his or her breath during the test. The test subject then may be refitted and retested.

(2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

7. Controlled negative pressure (CNP) REDON quantitative fit testing protocol.

(a) When administering this protocol to test subjects, employers must comply with the requirements specified in paragraphs (a) and (c) of part I.C.6 of this appendix (``Controlled negative pressure (CNP) quantitative fit testing protocol,'') as well as use the test exercises described below in paragraph (b) of this protocol instead of the test exercises specified in paragraph (b) of part I.C.6 of this appendix.

(b) Employers must ensure that each test subject being fit tested using this protocol follows the exercise and measurement procedures, including the order of administration described in Table A-3 of this appendix.

(c) After completing the test exercises, the test administrator must question each test subject regarding the comfort of the respirator. When a test subject states that the respirator is unacceptable, the employer must ensure that the test administrator repeats the protocol using another respirator model.

(d) Employers must determine the overall fit factor for each test subject by calculating the harmonic mean of the fit testing exercises as follows:

$$\text{Overall Fit Factor} = \frac{N}{[1/FF_1 + 1/FF_2 + \ldots 1/FF_N]}$$

Where:

N = The number of exercises;

FF_1 = The fit factor for the first exercise;

FF_2 = The fit factor for the second exercise; and

FF_N = The fit factor for the nth exercise.

Part II. New Fit Test Protocols

A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.

B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or

2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.

C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

[63 FR 20098, April 23, 1998; 69 FR 46993, August 4, 2004]

Appendix B-1
User Seal Check Procedures (Mandatory)

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

I. Facepiece Positive and/or Negative Pressure Checks

A. Positive pressure check. Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

B. Negative pressure check. Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

II. Manufacturer's Recommended User Seal Check Procedures

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the manufacturer's procedures are equally effective.

[63 FR 1152, Jan. 8, 1998]

Appendix B-2
Respirator Cleaning Procedures (Mandatory)

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B-2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

I. Procedures for Cleaning Respirators

A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure- demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

B. Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

C. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain.

D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,

2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,

3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

E. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

F. Components should be hand-dried with a clean lint-free cloth or air-dried.

G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

H. Test the respirator to ensure that all components work properly.

[63 FR 1152, Jan. 8, 1998]

Appendix C
OSHA Respirator Medical Evaluation Questionnaire (Mandatory)

To the employer:
Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:
Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Part A. Section 1. (Mandatory) The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1.	Today's date:			
2.	Your name:			
3.	Your age (to nearest year):			
4.	Sex (circle one):	Male	Female	
5.	Your height:	ft.	in.	
6.	Your weight:	lbs.		
7.	Your job title:			
8.	A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code):			
9.	The best time to phone you at this number:			
10.	Has your employer told you how to contact the health care professional who will review this questionnaire (circle one):		Yes	No
11.	Check the type of respirator you will use (you can check more than one category):			
	a.		N, R, or P disposable respirator (filter-mask, non-cartridge type only).	
	b.		Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).	
12.	Have you worn a respirator (circle one):		Yes	No
	If "yes," what type(s):			

Part A. Section 2. (Mandatory) Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

1.	Do you *currently* smoke tobacco, or have you smoked tobacco in the last month:	Yes	No
2.	Have you *ever had* any of the following conditions?		
a.	Seizures:	Yes	No
b.	Diabetes (sugar disease):	Yes	No
c.	Allergic reactions that interfere with your breathing:	Yes	No
d.	Claustrophobia (fear of closed-in places):	Yes	No
e.	Trouble smelling odors:	Yes	No

Appendix C OSHA Respirator Medical Evaluation Questionnaire (Mandatory)				
3.	Have you *ever had* any of the following pulmonary or lung problems?			
a.	Asbestosis:		Yes	No
b.	Asthma:		Yes	No
c.	Chronic bronchitis:		Yes	No
d.	Emphysema:		Yes	No
e.	Pneumonia:		Yes	No
f.	Tuberculosis:		Yes	No
g.	Silicosis:		Yes	No
h.	Pneumothorax (collapsed lung):		Yes	No
i.	Lung cancer:		Yes	No
j.	Broken ribs:		Yes	No
k.	Any chest injuries or surgeries:		Yes	No
l.	Any other lung problem that you've been told about:		Yes	No
4.	Do you *currently* have any of the following symptoms of pulmonary or lung illness?			
a.	Shortness of breath:		Yes	No
b.	Shortness of breath when walking fast on level ground or walking up a slight hill or incline:		Yes	No
c.	Shortness of breath when walking with other people at an ordinary pace on level ground:		Yes	No
d.	Have to stop for breath when walking at your own pace on level ground:		Yes	No
e.	Shortness of breath when washing or dressing yourself:		Yes	No
f.	Shortness of breath that interferes with your job:		Yes	No
g.	Coughing that produces phlegm (thick sputum):		Yes	No
h.	Coughing that wakes you early in the morning:		Yes	No
i.	Coughing that occurs mostly when you are lying down:		Yes	No
j.	Coughing up blood in the last month:		Yes	No
k.	Wheezing:		Yes	No
l.	Wheezing that interferes with your job:		Yes	No
m.	Chest pain when you breathe deeply:		Yes	No
n.	Any other symptoms that you think may be related to lung problems:		Yes	No
5.	Have you *ever had* any of the following cardiovascular or heart problems?			
a.	Heart attack:		Yes	No
b.	Stroke:		Yes	No
c.	Angina:		Yes	No
d.	Heart failure:		Yes	No
e.	Swelling in your legs or feet (not caused by walking):		Yes	No
f.	Heart arrhythmia (heart beating irregularly):		Yes	No
g.	High blood pressure:		Yes	No
h.	Any other heart problem that you've been told about:		Yes	No

Appendix C OSHA Respirator Medical Evaluation Questionnaire (Mandatory)				
6.	Have you *ever had* any of the following cardiovascular or heart symptoms?			
a.	Frequent pain or tightness in your chest:		Yes	No
b.	Pain or tightness in your chest during physical activity:		Yes	No
c.	Pain or tightness in your chest that interferes with your job:		Yes	No
d.	In the past two years, have you noticed your heart skipping or missing a beat:		Yes	No
e.	Heartburn or indigestion that is not related to eating:		Yes	No
f.	Any other symptoms that you think may be related to heart or circulation problems:		Yes	No
7.	Do you *currently* take medication for any of the following problems?			
a.	. Breathing or lung problems:		Yes	No
b.	Heart trouble:		Yes	No
c.	Blood pressure:		Yes	No
d.	Seizures:		Yes	No
8.	If you've used a respirator, have you *ever had* any of the following problems? (If you've never used a respirator, check the following space and go to question 9:)			
a.	Eye irritation:		Yes	No
b.	Skin allergies or rashes:		Yes	No
c.	Anxiety:		Yes	No
d.	General weakness or fatigue:		Yes	No
e.	Any other problem that interferes with your use of a respirator:		Yes	No
9.	Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire:		Yes	No
Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.				
10.	Have you *ever lost* vision in either eye (temporarily or permanently):		Yes	No
11.	Do you *currently* have any of the following vision problems?			
a.	Wear contact lenses:		Yes	No
b.	. Wear glasses:		Yes	No
c.	Color blind:		Yes	No
d.	Any other eye or vision problem:		Yes	No
12.	Have you *ever had* an injury to your ears, including a broken ear drum:		Yes	No
13.	Do you *currently* have any of the following hearing problems?			
a.	Difficulty hearing:		Yes	No
b.	Wear a hearing aid:		Yes	No
c.	Any other hearing or ear problem:		Yes	No
14.	Have you *ever had* a back injury:		Yes	No

Appendix C OSHA Respirator Medical Evaluation Questionnaire (Mandatory)				
15.	Do you *currently* have any of the following musculoskeletal problems?			
a.	Weakness in any of your arms, hands, legs, or feet:		Yes	No
b.	Back pain:		Yes	No
c.	Difficulty fully moving your arms and legs:		Yes	No
d.	Pain or stiffness when you lean forward or backward at the waist:		Yes	No
e.	Difficulty fully moving your head up or down:		Yes	No
f.	Difficulty fully moving your head side to side:		Yes	No
g.	Difficulty bending at your knees:		Yes	No
h.	Difficulty squatting to the ground:		Yes	No
i.	Climbing a flight of stairs or a ladder carrying more than 25 lbs:		Yes	No
j.	Any other muscle or skeletal problem that interferes with using a respirator:		Yes	No
Part B. Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.				
1.	In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen:		Yes	No
	If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions:		Yes	No
2.	At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals:		Yes	No
	If "yes," name the chemicals if you know them:			
3.	Have you ever worked with any of the materials, or under any of the conditions, listed below:			
a.	Asbestos:		Yes	No
b.	Silica (*e.g.*, in sandblasting):		Yes	No
c.	Tungsten/cobalt (e.g., grinding or welding this material):		Yes	No
d.	Beryllium:		Yes	No
e.	Aluminum:		Yes	No
f.	Coal (for example, mining):		Yes	No
g.	Iron:		Yes	No
h.	Tin:		Yes	No
i.	Dusty environments:		Yes	No
j.	Any other hazardous exposures:		Yes	No
	If "yes," describe these exposures:			
4.	List any second jobs or side businesses you have:			
5.	List your previous occupations:			
6.	List your current and previous hobbies:			

Appendix C OSHA Respirator Medical Evaluation Questionnaire (Mandatory)				
7.	Have you been in the military services?		Yes	No
	If "yes," were you exposed to biological or chemical agents (either in training or combat):		Yes	No
8.	Have you ever worked on a HAZMAT team?		Yes	No
9.	Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications):		Yes	No
	If "yes," name the medications if you know them			
10.	Will you be using any of the following items with your respirator(s)?			
a.	HEPA Filters:		Yes	No
b.	Canisters (for example, gas masks):		Yes	No
c.	Cartridges:		Yes	No
11.	How often are you expected to use the respirator(s) (circle "yes" or "no" for all answers that apply to you)?:			
a.	Escape only (no rescue):		Yes	No
b.	Emergency rescue only:		Yes	No
c.	Less than 5 hours *per week:*		Yes	No
d.	Less than 2 hours *per day:*		Yes	No
e.	. 2 to 4 hours per day:		Yes	No
f.	Over 4 hours per day:		Yes	No
12.	During the period you are using the respirator(s), is your work effort:			
a.	*Light* (less than 200 kcal per hour):		Yes	No
	If "yes," how long does this period last during the average shift:		hrs	mins
	Examples of a light work effort are *sitting* while writing, typing, drafting, or performing light assembly work; or *standing* while operating a drill press (1-3 lbs.) or controlling machines.			
b.	*Moderate* (200 to 350 kcal per hour): Yes/No		Yes	No
	If "yes," how long does this period last during the average shift:		hrs	mins
	Examples of moderate work effort are *sitting* while nailing or filing; *driving* a truck or bus in urban traffic; *standing* while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; *walking* on a level surface about 2 mph or down a 5-degree grade about 3 mph; or *pushing* a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.			
c.	*Heavy* (above 350 kcal per hour):		Yes	No
	If "yes," how long does this period last during the average shift:		hrs	mins
	Examples of heavy work are *lifting* a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; *shoveling; standing* while bricklaying or chipping castings; *walking* up an 8-degree grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.).			
13.	Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator:		Yes	No
	If "yes," describe this protective clothing and/or equipment:			
14.	Will you be working under hot conditions (temperature exceeding 77 deg. F):		Yes	No
15.	Will you be working under humid conditions:		Yes	No
16.	Describe the work you'll be doing while you're using your respirator(s):			

Appendix C OSHA Respirator Medical Evaluation Questionnaire (Mandatory)		
17.	Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):	
18.	Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s)	
	Name of the first toxic substance:	
		Estimated maximum exposure level per shift:
		Duration of exposure per shift:
	Name of the second toxic substance:	
		Estimated maximum exposure level per shift:
		Duration of exposure per shift:
	Name of the third toxic substance:	
		Estimated maximum exposure level per shift:
		Duration of exposure per shift:
	The name of any other toxic substances that you'll be exposed to while using your respirator:	
19.	Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security):	

Appendix D
Information for Employees Using Respirators When Not Required Under the Standard (Mandatory)

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

Michigan Occupational Safety and Health Administration
PO Box 30643
Lansing, Michigan 48909-8143
For technical questions of this standard – Ph: 517-284-7680 (CSHD); 517-284-7750 (GISHD)
or 517-284-7720 (CETD)
To order copies of this standard – Ph: 517-284-7740

For further information
Ph: 517-284-7740
www.michigan.gov/mioshastandards

DEPARTMENT OF LABOR AND ECONOMIC OPPORTUNITY

DIRECTOR'S OFFICE

GENERAL INDUSTRY SAFETY AND HEALTH STANDARD

Filed with the Secretary of State on November 3, 1977, (as amended January 11, 1988) (as amended August 2, 1993) (as amended December 20, 1999) (as amended November 27, 2001) (as amended April 17, 2013) (as amended June 5, 2013) (as amended April 19, 2016) (as amended June 14, 2019) **(as amended June 21, 2022)**

These rules take effect immediately upon filing with the secretary of state unless adopted under section 33, 44, or 45a(9) of the administrative procedures act of 1969, 1969 PA 306, MCL 24.233, 24.244, or 24.245a.

Rules adopted under these sections become effective 7 days after filing with the secretary of state.

(By authority conferred on the director of the Michigan department of labor and economic opportunity by sections 14r, 16, and 21 of the Michigan occupational safety and health act, 1974 PA 154, MCL 408.1014r, 408.1016, and 408.1021, and Executive Reorganization Order Nos. 1996 2, 2003 1, 2008 4, 2011 4, and 2019-3, MCL 445.2001, 445.2011, 445.2025, 445.2030, and 125.1998)

R 408.17401, R 408.17402, R 408.17403, R 408.17404, R 408.17405, R 408.17411, R 408.17415, R 408.17421, R 408.17422, R 408.17423, R 408.17424, R 408.17426, R 408.17431, R 408.17432, R 408.17433, R 408.17436, R 408.17440, R 408.17443, R 408.17451, R 408.17461, and R 408.17463 of the Michigan Administrative Code are amended, R 408.17430 and R 408.17464 are added, and R 408.17434, R 408.17435, and R 408.17437 are rescinded, as follows:

GENERAL INDUSTRY SAFETY AND HEALTH STANDARD
PART 74. FIREFIGHTING

Table of Contents:

R 408.17401 Scope.

Rule 7401. This part prescribes rules for training; for the construction, care, and use of equipment; and for the safeguards to be furnished and maintained as it relates to municipal firefighters and equipment. The occupation can be full-time or part-time; for pay or volunteer status.

R 408.17402 Applicability.

Rule 7402. A person who is functioning as a municipal firefighter and who is exposed to the hazards of an emergency operation shall comply with this part.

R 408.17403 Definitions; A to M.

Rule 7403. (1) "Approved label" means a label or other identifying mark of a nationally recognized testing laboratory, such as Underwriters Laboratory, Inc., or Factory Mutual Research Corporation, that maintains a periodic inspection of production of labeled equipment or materials and by whose labeling compliance with nationally recognized standards or tests to determine suitable usage in a specified manner is indicated.

(2) "Aerial apparatus" means a fire department vehicle that is equipped with a power operated extension ladder or elevating platform used for rescue, ventilation, elevated master streams, and gaining access to upper levels and that carries ground ladders, tools, and other equipment.

(3) "Control" means the limitation of worker exposure to exhaust emissions to levels not exceeding applicable MIOSHA exposure limits.

(4) "Controlled process" means an arrangement of equipment to control exhaust emissions by means of any of the following:

(a) A point of source capture of exhaust emissions by a mechanical tailpipe exhaust ventilation system.

(b) A general mechanical exhaust ventilation system in a fire apparatus building bay or bays.

(c) A device that is permanently installed directly on the fire apparatus exhaust system.

(5) "Emergency operations" means a fire or nonfire incident, including, but not limited to, rescues, extrications, hazardous material release, and natural disasters, where fire department response can be anticipated and which subjects firefighters to personal injury or hazards. Vegetative cover fires are not included in this definition.

(6) "Exhaust emissions" means exhaust by-products of combustion, from internal combustion engines, capable of causing occupational illness or disease to a person.

(7) "Fire apparatus" means mobile firefighting equipment including, but not limited to, a pumper/engine, aerial apparatus, a tanker/tender, or any other similar equipment that has fire suppression or rescue as its primary use. A vehicle not designed, equipped, or utilized for emergency operations is not fire apparatus.

(8) "Firefighter" means a member of an organized fire department who is responsible for, or is in a capacity that includes responsibility for, the extinguishment of fires, the directing of the extinguishment of fires, the directing or management of emergency response activities, fire safety prevention inspection, plans examination, fire investigation, hazardous materials response, technical rescue response, airport rescue response, airport rescue firefighting, fire service instruction, and the enforcement of the general fire laws of this state and the community where he or she serves.

(9) "Fire station" means a structure in which fire service equipment is housed and employees may be quartered.

(10) "Foam containing PFAS" means firefighting foam containing intentionally added perfluoroalkyl or polyfluoroalkyl substance.

(11) "Ladder pipe" means a large capacity water delivery device attached to an aerial ladder.

(12) "Municipal" means any public entity.

R 408.17404 Definitions; O to V.

Rule 7404. (1) "Operator's control station" means a work station where the operator of an apparatus, such as an aerial ladder or pumper, is stationed.

(2) "Personal alert safety systems" or "PASS" means a device that is certified as complying with these rules, that senses movement or lack of movement, and that automatically activates an audible alarm signal, which can also be manually activated to alert and to assist others in locating a firefighter or emergency services person who is in danger.

(3) "PFAS" means a perfluoroalkyl or polyfluoroalkyl substance.

(4) "Platform control station" means a work station where the rider of an elevating platform is stationed.

(5) "Physician or other licensed health care professional" or "PLHCP" means an individual whose legally permitted scope of practice based on their license, registration, or certification, allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services.

(6) "Primary control station" means a work station where the operator of apparatus that has an aerial ladder or platform is stationed.

(7) "Protective ensemble" means multiple elements of clothing and equipment designed to provide a degree of protection for firefighters from adverse exposures to the inherent risks of structural firefighting operations and other emergency operations.

(8) "Qualified" means a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

(9) "Structural firefighting" means activities of rescue, fire suppression, and property conservation in buildings, enclosed structures, aircraft, vehicles, vessels, or like properties that are involved in a fire.

(10) "Training" means the process of making firefighters proficient through instruction or hands-on practice, or both, in the operation and care of equipment that is expected to be used and in the performance of assigned duties.

R 408.17405 Adopted and referenced standards.

Rule 7405. (1) The following National Fire Protection Association (NFPA) standards are adopted by reference in these rules and are available from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts, 02169-7471, or via the internet at the following website: www.nfpa.org, at a cost as of the time of adoption of these amendments, as stated in these rules:

(a) NFPA 1901: "Standard for Automotive Fire Apparatus," 2009 edition. Cost: $96.60.

(b) NFPA 1983: "Standard on Life Safety Rope and Equipment for Emergency Services," 2001 edition. Cost: $68.50.

(c) NFPA 1971: "Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting," 2007 edition. Cost: $79.50.

(d) NFPA 1971: "Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting," 2013 edition. Cost: $74.00.

(e) NFPA 1981: "Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services," 1997 edition. Cost: $68.50.

(f) NFPA 1981: "Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services," 2007 edition. Cost: $63.50.

(g) NFPA 1982: "Standard on Personal Alert Safety Systems (PASS)," 1998 edition. Cost: $68.50.

(h) NFPA 1982: "Standard on Personal Alert Safety Systems (PASS)," 2007 edition. Cost: $68.50.

(i) NFPA 1403: "Standard on Live Fire Training Evolutions," 2018 edition. Cost: $57.00.

(j) NFPA 1931: "Standard for Manufacturer's Design of Fire Department Ground Ladders," 1994 edition. Cost: $31.00.

(k) NFPA 1932: "Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders," 2015 edition. Cost: $49.50.

(2) The standards adopted in these rules are available for inspection at the Department of Labor and Economic Opportunity, MIOSHA Standards and FOIA Section, 530 West Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909 8143.

(3) Copies of the standards adopted in these rules may be obtained from the publisher or may be obtained from the Michigan Department of Labor and Economic Opportunity, MIOSHA Standards and FOIA Section, 530 West Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909 8143, at the cost charged in these rules plus $20.00 for shipping and handling.

(4) The Michigan Occupational Safety and Health Administration (MIOSHA) standards may be obtained at no charge from the Michigan Department of Labor and Economic Opportunity, MIOSHA Standards and FOIA Section, 530 West Allegan Street, P.O. Box 30643, Lansing, Michigan, 48909 8143 or via the internet at the following website:www.michigan.gov/mioshastandards. For quantities greater than 5, the cost, as of the time of adoption of these rules, is 4 cents per page.

R 408.17411 Duties of employer.

Rule 7411. (1) An employer shall comply with all of the following requirements:

(a) Ensure that prospective firefighters receive a pre-employment physical conducted by a PLHCP to ensure they have the ability to perform assigned emergency operations.

(b) Ensure that job-required equipment and tools are maintained free of recognized defects that could cause an injury.

(c) Develop a written procedure that covers the treatment and transport of injured employees from the emergency scene to a medical facility.

(d) Comply with the requirements of this part, review with, and make available a copy of this part for employees.

(2) An employer shall prepare and maintain a written policy that establishes its basic organizational structure. The organizational structure must be available for inspection by the director of the department of labor and economic opportunity or his or her authorized representative and by an employee or his or her authorized representative.

R 408.17412 Duties of employee.

Rule 7412. An employee shall do all of the following:

(a) Use personal protective equipment as prescribed by this part.

(b) Report defective equipment, tools, and hazardous conditions to a supervisor.

(c) Not remove safeguards from equipment except when necessary to service. The safeguard or equivalent shall be replaced before returning the equipment to operation.

(d) Not use equipment and tools unless trained in their use and authorized to do so.

(e) Only perform those duties that he or she is trained to do.

R 408.17415 Fire station safety.

Rule 7415. (1) The area within 3 feet of the slide pole on all sides must be maintained free of any obstruction. A floor-to-ceiling wall shall not be construed to be an obstruction.

(2) A cushioned mat, not less than 3 feet in diameter, must be located around the base of the slide pole at all times.

(3) A dormitory and any means of egress from the dormitory, apparatus bay, and aisleways must be equipped with an emergency lighting system that must be automatically activated in case of power failure. The system may be operated by battery or generator.

(4) Switches and electrical equipment located in the shower or other areas subject to hazards created by moisture must be approved for the location or removed to a nonhazardous area.

(5) All sleeping quarters must be equipped with an operational smoke detection device and an operational carbon monoxide detection device.

(6) Effective January 1, 2025, all new construction or significantly remodeled facilities (50% or more area) that house a fire apparatus must install a controlled process exhaust ventilation system that will effectively control

exhaust emissions created by the fire apparatus. If a general mechanical exhaust ventilation system is utilized, a mechanical air supply system must be provided if its absence will result in building negative pressures sufficient to cause back drafting of vents from fuel-fired equipment.

(7) All equipment used for the control of exhaust emissions from fire apparatus must be used, inspected, and maintained in accordance with the manufacturer's recommendations.

R 408.17421 Fire apparatus generally.

Rule 7421. (1) A fire apparatus must be able to stop within 30 feet after application of the brakes at 20 miles per hour.

(2) A fire apparatus must be equipped with all of the following items:

(a) Windshield wipers.

(b) Head, tail, stop, and backup lights and a backup alarm.

(c) Horn and siren.

(d) Slip-resistant steps, tailboard, and work platforms.

(3) Any employee riding on or in a fire apparatus shall be safely secured by a seat belt or safety harness any time the fire apparatus is in motion. No employee may stand or ride on the tail steps, sidesteps, running boards, or other exposed part of a fire apparatus while the fire apparatus is in motion, except for hose loading operations as provided in this subrule. Hose loading operations may be performed on a moving fire apparatus only when all of the following conditions are met:

(a) Hose loading operations must be specified in a written procedure that includes the conditions set forth in this subdivision. All employees involved in the hose loading operation must be trained in these procedures.

(b) There must be an employee, other than those employees loading the hose, assigned as a safety observer. The safety observer shall have an unobstructed view of the hose loading operation and be in visual and voice contact with the fire apparatus driver.

(c) All vehicular traffic must be excluded from the area or be under the direction of qualified traffic control individuals.

(d) The fire apparatus must be driven at a speed of 5 mph or less.

(e) No employee may stand on the tail step, sidesteps, running boards, or any other location on the fire apparatus while the fire apparatus is in motion unless otherwise allowed by the manufacturer's specifications.

(f) Employees using a travel restraint system or appropriate fall protection may be in the hose bed, but no employee may stand while the fire apparatus is in motion.

(g) Before each hose loading operation, the situation must be evaluated to ensure compliance with the written procedure. If the written procedure cannot be followed, or if there is any question as to the safety of the operation for the specific situation, the hose may not be loaded on a moving fire apparatus.

(4) Any fire apparatus manufactured and purchased after April 17, 2013, must meet or exceed the requirements of the NFPA 1901: "Standard for Automotive Fire Apparatus," 2009 edition, as adopted in R 408.17405.

(5) Except on instructions of a designated signalperson, an operator of the fire apparatus shall not move the fire apparatus when his or her vision is obstructed.

(6) A minimum distance of 10 feet from unprotected energized equipment or high-voltage transmission lines, as distinguished from low voltage secondary lines and series streetlight construction, must be maintained when using fire apparatus. The training of firefighters must include development of the ability to recognize and identify primary, high-voltage transmission lines and series street lighting construction.

R 408.17422 Fire apparatus tires and rims.

Rule 7422. (1) A thorough visual inspection of the tread and sidewall areas of fire apparatus tires for cuts, cracks, splits, or bruises, including a tread depth measurement, must be made at least annually. A record of this inspection must be maintained for a minimum of 10 years.

(2) A tire must be replaced if 1 of the following occurs:

(a) The average tread depth is worn to 5/32 of an inch or less.

(b) The tread depth at any 1 location is 2/32 of an inch, or less.

(c) A cut or crack exposes the cord fabric.

(3) A replacement tire must meet or exceed the standards of the original tire furnished with the apparatus.

(4) Fire apparatus tires and rims must be inspected inside at least once every 10 years.

R 408.17423 Fire apparatus with elevating platforms.

Rule 7423. (1) When an aerial apparatus platform is elevated, parking brakes must be set and stabilizing jacks or outriggers and safety locks must be used. When needed, ground plates must be used under the jack or outriggers.

(2) An instructional information plate, which is clearly visible to the operator, must be located at the operator's control station. If the aerial is equipped with a platform, then a plate must also be located at the platform control station. The plate must contain all of the following information:

(a) Rated capacity of the aerial tip or platform.

(b) Operating controls identified for motion.

(c) Cautions or restrictions of operation.

(3) An operator shall comply with all of the following provisions:

(a) Remain at the primary control station when the aerial ladder or platform is occupied.

(b) Not move the apparatus unless the ladder or platform is in the bed of the apparatus.

(c) Maintain clearances as required in R 408.17421(6).

R 408.17424 Aerial apparatus.

Rule 7424. (1) An aerial apparatus that is equipped with a ladder must not have the ladder extended or retracted when an employee is positioned on the ladder unless otherwise allowed by the manufacturer's specifications.

(2) While working in a fixed position from an aerial apparatus ladder, an employee shall be secured with a ladder belt system that meets or exceeds the requirements of NFPA 1983: "Standard on Life Safety Rope and Equipment for Emergency Services," 2001 edition, as adopted in R 408.17405.

(3) The tip of the aerial ladder must not be forcefully extended against a solid object or used to support the ladder.

(4) The steps and rungs of an aerial apparatus must have a slip-resistant surface.

(5) Jacks, outriggers, and safety locks must be used as required in R 408.17423(1).

(6) The rated capacity for an aerial apparatus must not be exceeded.

(7) The operator of an aerial ladder shall comply with all of the following provisions:

(a) Remain at the primary control station when the ladder is occupied.

(b) Communicate to the occupant of the ladder before movement.

(c) Not move the apparatus unless the ladder is in the bed.

(8) The operator of an aerial ladder shall maintain clearances as required in R 408.17421(6).

(9) The controls for the operation of an aerial apparatus must be of a type that returns to a neutral position when released.

(10) Tools or equipment mounted or installed on the turntable must be installed or approved by the manufacturer.

(11) A 2-way voice communication system must be provided between the employee on the raised portion of the equipment and the operator control station.

(12) Detachable ladder pipes must be operated in the direction the ladder is facing.

(13) Ladder pipes must be secured to the ladder so that the pipe cannot be accidentally dislodged while in operation.

(14) An employer shall follow the manufacturer's instructions and recommendations for the use, testing, and maintenance of aerial apparatus.

R 408.17426 Portable ladders.

Rule 7426. (1) Effective January 1, 2025, portable ground ladders used in structural firefighting or training for these operations must meet or exceed the requirements of both of the following:

(a) NFPA 1931: "Standard for Manufacturer's Design of Fire Department Ground Ladders," 1994 edition.

(b) NFPA 1932: "Standard on Use, Maintenance, and Service Testing of In-service Fire Department Ground Ladders," 2015 edition.

(2) Portable ladders that are mounted more than 4 feet in height and less than 7 feet in height on a fire apparatus, and that have ends that extend beyond the ladder's mounting surface or compartment must be protected from contact.

R 408.17427 Line throwing guns.

Rule 7427. (1) A line throwing gun shall:

(a) Be loaded just prior to firing time.

(b) Not be pointed, loaded or unloaded, at any person.

(c) Not be left unattended or stored while loaded.

(d) Be stored in a box with the cleaning kit and breakdown tools.

(2) The storage box shall have the words, "Explosive Tool", conspicuously printed on the top of the box.

R 408.17428 Storage of equipment.

Rule 7428. All equipment shall be stored in or on the fire apparatus in a safe manner.

R 408.17430 Proper use, handling, storage, and containment of firefighting foam concentrate.

Rule 7430. (1) An employer must follow the specific, manufacturer provided safety data sheets (SDSs) for all firefighting foam concentrate that employees may be exposed to and follow best practices regarding the proper use, handling, and storage information.

(2) An employer must prevent intentionally added PFAS containing foam concentrate or foam solution from entering ground water, surface water, or storm drains, as soon as possible. Manual containment strategies used for spills involving a hazardous liquid should be employed. These include blocking storm drains to prevent the contaminated foam/water solution from entering the wastewater system or the environment. Defensive tactics such as damming, diking, and diverting should be employed to get the foam/water solution to an area suitable for containment until it can be removed in accordance with local, state, and federal regulations. Immediately after the end of a fire or other incident at which an organized fire department uses firefighting foam containing intentionally added PFAS, the fire chief shall report the incident to the Michigan pollution emergency alert system.

(3) An employer must dispose of materials contaminated by foam containing PFAS pursuant to the natural resources and environmental protection act, 1994 PA 451, MCL 324.101 to 324.90106.

(4) An employer must ensure the decontamination of a firefighter's body and equipment as follows:

(a) Post fire response contaminated personal protective equipment (PPE) must be decontaminated as soon as practical. A mild detergent, with a pH of not less than 6 and not greater than 10.5, must be used. The use of chlorine bleach, chlorinated solvents, or solvents is not permitted. Follow manufacturer's recommended cleaning procedures.

(b) A firefighter's exposed skin, including the neck, face, and hands, must be decontaminated, post fire response and whenever exposed to firefighting foam. Employees must wash exposed skin with a mild soap and rinse thoroughly with water.

(5) An employer must prohibit the use of firefighting foam concentrate containing intentionally added PFAS, by a firefighter, for training purposes.

(6) An employer must prohibit the use of firefighting foam concentrate containing intentionally added PFAS, by a firefighter, for equipment calibration purposes, unless required by law or facility where the calibration takes place has implemented appropriate measures.

R 408.17431 Personal protective equipment.

Rule 7431. (1) An employer shall ensure that all emergency service personnel use PPE appropriate for the hazards involved when performing emergency operations.

(2) Personal protective equipment must be provided by the employer at no cost to the employee and comply with the requirements of this part.

(3) An employer shall ensure that PPE protects the head, body, and extremities and consists of at least all of the following components:

(a) Foot and leg protection.

(b) Hand protection.

(c) Body protection.

(d) Face, eye, and head protection.

(4) Personal protective equipment that is required by these rules to comply with the requirements of a nationally recognized standard must either bear an approved label of, or be certified in writing by, the manufacturer as being in compliance with the applicable standard.

(5) Personal protective equipment must be inspected and cleaned after each use.

(6) An employer shall implement procedures for the inspecting and servicing of PPE according to manufacturer's recommendations.

(7) An employer shall implement a procedure for determining whether PPE must be repaired or replaced. All repairs must be made in compliance with the manufacturer's recommendations.

R 408.17432 Protective ensemble for structural firefighting.

Rule 7432. An employer shall provide a protective ensemble, to all employees who engage in or are exposed to structural firefighting. The protective ensemble must meet or exceed the requirements of NFPA 1971: "Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting," 2007 edition, as adopted in R 408.17405. Effective January 1, 2025, the protective ensemble must meet or exceed the requirements of NFPA 1971: "Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting," 2013 edition, as adopted in R 408.17405.

R 408.17433 Eye and face protection for emergency operations.

Rule 7433. While conducting emergency operations, if there is a potential exposure to eye and face hazards, the requirement of face and eye protection must be met by 1 of the following:

(a) Helmet face shield, if equipped, and primary eye protection.

(b) Breathing apparatus face piece.

(c) Primary eye protection and secondary means of face protection.

R 408.17434 Rescinded.

R 408.17435 Rescinded.

R 408.17436 Respirator protection devices.

Rule 7436. Any self-contained breathing apparatus currently in use must meet or exceed the requirements of NFPA 1981: "Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services," 1997 edition, as adopted in R 408.17405. Effective January 1, 2025, any self-contained breathing apparatus currently in use must meet or exceed the requirements of NFPA 1981: "Standard on Open Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services," 2007 edition, as adopted in R 408.17405.

R 408.17437 Rescinded.

R 408.17440 Personal alert safety system (PASS).

Rule 7440. An employer shall provide and enforce the use of a PASS device to each employee utilizing a self-contained breathing apparatus while engaged in structural firefighting operations. PASS devices shall meet or exceed the requirements of NFPA 1982: "Standard on Personal Alert Safety Systems (PASS)," 1998 edition, as adopted in R 408.17405. Effective January 1, 2025, PASS devices must meet or exceed the requirements of NFPA 1982: "Standard on Personal Alert Safety Systems (PASS)," 2007 edition, as adopted in R 408.17405.

R 408.17441 Explosive devices.

Rule 7441. (1) An explosive device shall not be used in an explosive or flammable atmosphere.

(2) A fire service which uses an explosive device shall develop a procedure for protecting the employees and general public.

R 408.17442 Using, covering, or protecting tools.

Rule 7442. (1) Chain saws that are specifically designed for firefighting operations to cut holes in roofs, floors, and walls shall be used where cutting operations are performed. If a chain saw is not in use, then the cutting teeth of the chain saw shall be covered to prevent inadvertent contact.

(2) An axe or other sharp-edged or pointed tool shall be protected when stored or carried on the apparatus. A rounded tipped pike pole is excluded from the requirements of this subrule.

R 408.17443 Air moving equipment.

Rule 7443. Air-moving equipment exposed to hazardous levels of flammable gases, flammable vapors, or combustible dust must be approved as intrinsically safe.

R 408.17451 Management of emergency operations.

Rule 7451. (1) Each fire department shall establish and implement written procedures for emergency operations. The written procedures must include all of the following:

(a) A requirement that a recognized incident management system providing structure and coordination to the management of emergency operations is implemented at each emergency.

(b) A requirement that a personnel accountability system is implemented at each emergency.

(c) A written assessment of the types of emergency operations the fire department is expected to perform, for example, fire suppression, trench rescue, and rope rescue, and the employees authorized to perform the identified operations.

(2) A qualified employee shall function as the incident commander at each emergency.

R 408.17461 Inspection of fire apparatus and equipment; record of repair or replacement; lifeline guns and explosive devices; apparatus and equipment involved in accident; equipment testing.

Rule 7461. (1) All of the following items of the fire apparatus, if so equipped, must be inspected for proper operation and for defects at least once a month:

(a) Windshield washers and wipers.

(b) Defroster and heater.

(c) Head, tail, stop, backup, and flasher lights.

(d) Backup alarm.

(e) Horn and siren.

(f) Slip-resistant steps and platforms.

(g) Tires, rims, and suspension system.

(h) Steering mechanism.

(i) Braking system.

(j) Operational controls.

(2) Inspection records must be maintained for a minimum period of 24 months for the apparatus.

(3) Records of repair or replacement must be maintained for the life of the apparatus.

(4) Lifeline guns and explosive devices must be cleaned and made ready for operation after each use.

(5) All portable equipment carried on a fire apparatus must be inspected for operation and for defects at least monthly and within 24 hours after any use. Inspection records must be maintained for a minimum period of 24 months for portable equipment.

(6) All equipment carried on fire apparatus or designated for training must be tested at least annually in accordance with manufacturers' instructions and applicable standards.

(7) Firefighting apparatus and equipment found to be defective or in unserviceable condition must be removed from service or repaired or replaced.

R 408.17463 General utility ropes, life safety ropes, harnesses, and auxiliary equipment.

Rule 7463. (1) Life safety rope, harnesses, and auxiliary equipment dedicated for the purpose of supporting people during emergency operations or training for these operations must be used and meet or exceed the requirements of NFPA 1983: "Standard on Life Safety Rope and Equipment for Emergency Services," 2001 edition, as adopted in R 408.17405.

(2) General utility ropes must comply with the following conditions:

(a) A rope must be inspected after each use for all of the following:

(i) Externally for abrasions, cut or broken fibers, decay, burns, lack of strength, softness, variation in size or roundness of the strands, and for mildew or mold.

(ii) Natural fiber ropes must be inspected internally annually, by separating the strands at 3-foot intervals, for broken fibers, presence of grit, mildew or mold, color change of the fibers, or powdering and short, loose fibers.

(b) A rope that has any of the conditions described in subdivision (a) of this subrule must be replaced or repaired.

(c) Ropes must be stored in a dry location.

R 408.17464 Training and education program.

Rule 7464. (1) Each fire department shall establish and maintain an employee training and education program. The training and education program must include all of the following:

(a) A written policy that establishes the type, amount, and frequency of training to be provided to firefighters. Training records must be maintained and be made available for inspection by the director of the department of labor and economic opportunity or his or her authorized representative and by an employee or his or her authorized representative.

(b) Assurance that the training and education provided under this section are based upon the fire department's written policies or procedures.

(c) Assurance that the training and education required under this section are provided by a qualified person.

(d) Assurance that an employee receives initial and continuing training and education commensurate with and specific to the duties and functions that the employee is expected to perform. The training and education must be provided before the employee is permitted to perform emergency operations.

(e) Assurance that firefighters receive annual training and education on incident management and personnel accountability systems.

(f) Assurance that firefighters receive and maintain certification in first aid, cardiopulmonary resuscitation, and automated external defibrillator.

(2) All live fire training must meet or exceed the requirements of the NFPA 1403: "Standard on Live Fire Training Evolutions," 2018 edition, as adopted in R 408.17405.

(3) An employer shall provide additional training in relevant topics to an employee under any of the following conditions:

(a) An employee has been involved in an accident or near miss incident.

(b) An employee has been observed operating in an unsafe manner.

Michigan Occupational Safety and Health Administration
PO Box 30643
Lansing, Michigan 48909-8143
For technical questions of this standard – Ph: 517-284-7750 (GISHD) or 517-284-7720 (CETD)
To order copies of this standard – Ph: 517-284-7740

Personnel cost estimator

Rank:	Hourly rate:	Straight time:	Overtime:	Bene OT:	FICA:	Pension:	Clothing:	Health:	Dental/eye:	Retiree HC:	Life/disability:	Workers comp:	Base pay:	Pay with OT:	Total benefit:	Total cost:
		2756	156	240	7.65%	8%	$750	$14,100	$2,000	3.50%	$3,350	$4,125				
		2080	50													
Fire Chief	$45.18	$93,974.40			$7,189.04	$7,517.95	$0	$0	$0		$3,350	$4,125	$93,974.40	$93,974.40	$22,181.99	$116,156.39
Asst Chief*	$42.81	$89,038.56			$6,811.45	$7,123.08	$0	$14,100	$2,000	$3,116	$3,350	$4,125	$89,038.56	$89,038.56	$40,625.88	$129,664.44
Fire inspector*	$37.29	$80,134.70	$2,796.75		$6,344.26	$6,634.52	$750	$14,100	$2,000	$2,903	$3,350	$4,125	$80,134.70	$82,931.45	$40,206.37	$123,137.83
Captain	$27.31	$75,266.36	$6,390.54	$9,831.60	$6,998.87	$7,319.08	$750	$14,100	$2,000	$3,202	$3,350	$4,125	$81,656.90	$91,488.50	$51,676.65	$143,165.15
Leiutentant	$26.42	$72,813.52	$6,182.28	$9,511.20	$6,770.79	$7,080.56	$750	$14,100	$2,000	$3,098	$3,350	$4,125	$78,995.80	$88,507.00	$50,785.29	$139,292.29
FP Firefighter	$24.75	$68,211.00	$5,791.50	$8,910.00	$6,342.81	$6,633.00	$750	$14,100	$2,000	$2,902	$3,350	$4,125	$74,002.50	$82,912.50	$49,112.74	$132,025.24
S1 Firefighter	$18.71	$51,564.76	$4,378.14	$6,735.60	$4,794.91	$5,014.28	$750	$14,100	$2,000	$2,194	$3,350	$4,125	$55,942.90	$62,678.50	$43,063.53	$105,742.03

Cost to staff 1 station with 1 Capt, 1 LT, and 2 ff for 3 shifts: $1,639,523.78

Cost to staff 1 station with 1 Lt and 2 FF for 3 shifts: $1,210,028.33

Cost to staff 1 station with 1 Lt and 3 FF for 3 shifts: $1,606,104.07

cost to add 1 ff/shift: $396,075.73 Pay: $204,633.00 OT: $44,104.50 Benefit: $147,338.23

* A/C 5% less than Fire Chief, inspector 10% less than A/C

Cost to staff 2 stations with 1 Capt, 2 Lt, and 5 FF $3,245,627.84

Public Protection Classification

(PPC™)

Summary Report

Scio TS

MICHIGAN

Prepared by

Insurance Services Office, Inc.
1000 Bishops Gate Blvd., Ste. 300
P.O. Box 5404
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Report Created March 25, 2019

Effective July 1, 2019

Background Information

Introduction

ISO collects and evaluates information from communities in the United States on their structure fire suppression capabilities. The data is analyzed using our Fire Suppression Rating Schedule (FSRS) and then a Public Protection Classification (PPC™) grade is assigned to the community. The surveys are conducted whenever it appears that there is a possibility of a PPC change. As such, the PPC program provides important, up-to-date information about fire protection services throughout the country.

The FSRS recognizes fire protection features only as they relate to suppression of first alarm structure fires. In many communities, fire suppression may be only a small part of the fire department's overall responsibility. ISO recognizes the dynamic and comprehensive duties of a community's fire service, and understands the complex decisions a community must make in planning and delivering emergency services. However, in developing a community's PPC grade, only features related to reducing property losses from structural fires are evaluated. Multiple alarms, simultaneous incidents and life safety are not considered in this evaluation. The PPC program evaluates the fire protection for small to average size buildings. Specific properties with a Needed Fire Flow in excess of 3,500 gpm are evaluated separately and assigned an individual PPC grade.

A community's investment in fire mitigation is a proven and reliable predictor of future fire losses. Statistical data on insurance losses bears out the relationship between excellent fire protection – as measured by the PPC program – and low fire losses. So, insurance companies use PPC information for marketing, underwriting, and to help establish fair premiums for homeowners and commercial fire insurance. In general, the price of fire insurance in a community with a good PPC grade is substantially lower than in a community with a poor PPC grade, assuming all other factors are equal.

ISO is an independent company that serves insurance companies, communities, fire departments, insurance regulators, and others by providing information about risk. ISO's expert staff collects information about municipal fire suppression efforts in communities throughout the United States. In each of those communities, ISO analyzes the relevant data and assigns a PPC grade – a number from 1 to 10. Class 1 represents an exemplary fire suppression program, and Class 10 indicates that the area's fire suppression program does not meet ISO's minimum criteria.

ISO's PPC program evaluates communities according to a uniform set of criteria, incorporating nationally recognized standards developed by the National Fire Protection Association and the American Water Works Association. A community's PPC grade depends on:

- **Needed Fire Flows**, which are representative building locations used to determine the theoretical amount of water necessary for fire suppression purposes.
- **Emergency Communications**, including emergency reporting, telecommunicators, and dispatching systems.
- **Fire Department**, including equipment, staffing, training, geographic distribution of fire companies, operational considerations, and community risk reduction.
- **Water Supply**, including inspection and flow testing of hydrants, alternative water supply operations, and a careful evaluation of the amount of available water compared with the amount needed to suppress fires up to 3,500 gpm.

Data Collection and Analysis

ISO has evaluated and classified over 46,000 fire protection areas across the United States using its FSRS. A combination of meetings between trained ISO field representatives and the dispatch center coordinator, community fire official, and water superintendent is used in conjunction with a comprehensive questionnaire to collect the data necessary to determine the PPC grade. In order for a community to obtain a grade better than a Class 9, three elements of fire suppression features are reviewed. These three elements are Emergency Communications, Fire Department, and Water Supply.

A review of the **Emergency Communications** accounts for 10% of the total classification. This section is weighted at **10 points,** as follows:

- Emergency Reporting 3 points
- Telecommunicators 4 points
- Dispatch Circuits 3 points

A review of the **Fire Department** accounts for 50% of the total classification. ISO focuses on a fire department's first alarm response and initial attack to minimize potential loss. The fire department section is weighted at **50 points,** as follows:

- Engine Companies 6 points
- Reserve Pumpers 0.5 points
- Pump Capacity 3 points
- Ladder/Service Companies 4 points
- Reserve Ladder/Service Trucks 0.5 points
- Deployment Analysis 10 points
- Company Personnel 15 points
- Training 9 points
- Operational considerations 2 points
- Community Risk Reduction 5.5 points (in addition to the 50 points above)

A review of the **Water Supply** system accounts for 40% of the total classification. ISO reviews the water supply a community uses to determine the adequacy for fire suppression purposes. The water supply system is weighted at **40 points,** as follows:

- Credit for Supply System 30 points
- Hydrant Size, Type & Installation 3 points
- Inspection & Flow Testing of Hydrants 7 points

There is one additional factor considered in calculating the final score – **Divergence**.

Even the best fire department will be less than fully effective if it has an inadequate water supply. Similarly, even a superior water supply will be less than fully effective if the fire department lacks the equipment or personnel to use the water. The FSRS score is subject to modification by a divergence factor, which recognizes disparity between the effectiveness of the fire department and the water supply.

The Divergence factor mathematically reduces the score based upon the relative difference between the fire department and water supply scores. The factor is introduced in the final equation.

PPC Grade

The PPC grade assigned to the community will depend on the community's score on a 100-point scale:

PPC	Points
1	90.00 or more
2	80.00 to 89.99
3	70.00 to 79.99
4	60.00 to 69.99
5	50.00 to 59.99
6	40.00 to 49.99
7	30.00 to 39.99
8	20.00 to 29.99
9	10.00 to 19.99
10	0.00 to 9.99

The classification numbers are interpreted as follows:

- Class 1 through (and including) Class 8 represents a fire suppression system that includes an FSRS creditable dispatch center, fire department, and water supply.
- Class 8B is a special classification that recognizes a superior level of fire protection in otherwise Class 9 areas. It is designed to represent a fire protection delivery system that is superior except for a lack of a water supply system capable of the minimum FSRS fire flow criteria of 250 gpm for 2 hours.
- Class 9 is a fire suppression system that includes a creditable dispatch center, fire department but no FSRS creditable water supply.
- Class 10 does not meet minimum FSRS criteria for recognition, including areas that are beyond five road miles of a recognized fire station.

New PPC program changes effective July 1, 2014

We have revised the PPC program to capture the effects of enhanced fire protection capabilities that reduce fire loss and fire severity in Split Class 9 and Split Class 8B areas (as outlined below). This new structure benefits the fire service, community, and property owner.

New classifications
Through ongoing research and loss experience analysis, we identified additional differentiation in fire loss experience within our PPC program, which resulted in the revised classifications. We based the differing fire loss experience on the fire suppression capabilities of each community. The new PPC classes will improve the predictive value for insurers while benefiting both commercial and residential property owners. Here are the new classifications and what they mean.

Split classifications
When we develop a split classification for a community — for example 5/9 — the first number is the class that applies to properties within 5 road miles of the responding fire station and 1,000 feet of a creditable water supply, such as a fire hydrant, suction point, or dry hydrant. The second number is the class that applies to properties within 5 road miles of a fire station but beyond 1,000 feet of a creditable water supply. We have revised the classification to reflect more precisely the risk of loss in a community, replacing Class 9 and 8B in the second part of a split classification with revised designations.

What's changed with the new classifications?
We've published the new classifications as "X" and "Y" — formerly the "9" and "8B" portion of the split classification, respectively. For example:

- A community currently displayed as a split 6/9 classification will now be a split 6/6X classification; with the "6X" denoting what was formerly classified as "9".
- Similarly, a community currently graded as a split 6/8B classification will now be a split 6/6Y classification, the "6Y" denoting what was formerly classified as "8B".
- Communities graded with single "9" or "8B" classifications will remain intact.

Prior Classification	New Classification
1/9	1/1X
2/9	2/2X
3/9	3/3X
4/9	4/4X
5/9	5/5X
6/9	6/6X
7/9	7/7X
8/9	8/8X
9	9

Prior Classification	New Classification
1/8B	1/1Y
2/8B	2/2Y
3/8B	3/3Y
4/8B	4/4Y
5/8B	5/5Y
6/8B	6/6Y
7/8B	7/7Y
8/8B	8/8Y
8B	8B

What's changed?
As you can see, we're still maintaining split classes, but it's how we represent them to insurers that's changed. The new designations reflect a reduction in fire severity and loss and have the potential to reduce property insurance premiums.

Benefits of the revised split class designations

- To the fire service, the revised designations identify enhanced fire suppression capabilities used throughout the fire protection area
- To the community, the new classes reward a community's fire suppression efforts by showing a more reflective designation
- To the individual property owner, the revisions offer the potential for decreased property insurance premiums

New water class
Our data also shows that risks located more than 5 but less than 7 road miles from a responding fire station with a creditable water source within 1,000 feet had better loss experience than those farther than 5 road miles from a responding fire station with no creditable water source. We've introduced a new classification —10W — to recognize the reduced loss potential of such properties.

What's changed with Class 10W?
Class 10W is property-specific. Not all properties in the 5-to-7-mile area around the responding fire station will qualify. The difference between Class 10 and 10W is that the 10W-graded risk or property is within 1,000 feet of a creditable water supply. Creditable water supplies include fire protection systems using hauled water in any of the split classification areas.

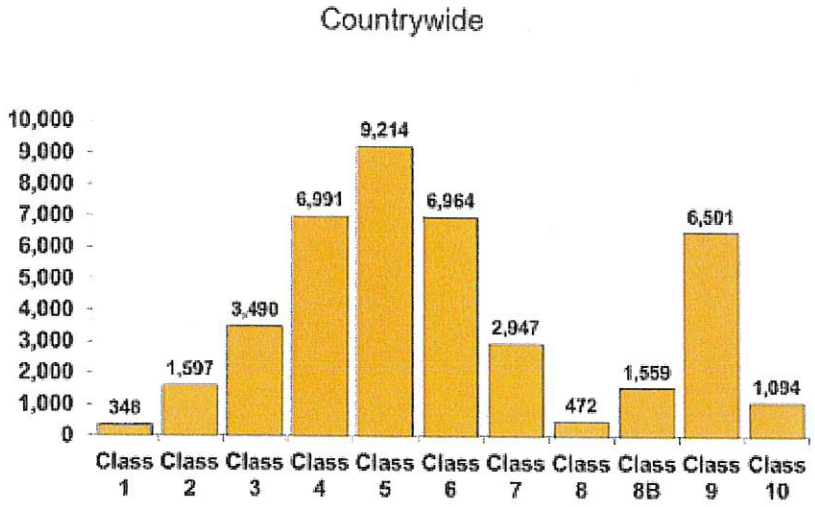
What's the benefit of Class 10W?
10W gives credit to risks within 5 to 7 road miles of the responding fire station and within 1,000 feet of a creditable water supply. That's reflective of the potential for reduced property insurance premiums.

What does the fire chief have to do?
Fire chiefs don't have to do anything at all. The revised classifications went in place automatically effective July 1, 2014 (July 1, 2015 for Texas).

What if I have additional questions?
Feel free to contact ISO at 800.444.4554 or email us at PPC-Cust-Serv@iso.com.

Distribution of PPC Grades

The 2017 published countrywide distribution of communities by the PPC grade is as follows:



Assistance

The PPC program offers help to communities, fire departments, and other public officials as they plan for, budget, and justify improvements. ISO is also available to assist in the understanding of the details of this evaluation.

The PPC program representatives can be reached by telephone at (800) 444-4554. The technical specialists at this telephone number have access to the details of this evaluation and can effectively speak with you about your questions regarding the PPC program. What's more, we can be reached via the internet at www.isomitigation.com/talk/.

We also have a website dedicated to our Community Hazard Mitigation Classification programs at www.isomitigation.com. Here, fire chiefs, building code officials, community leaders and other interested citizens can access a wealth of data describing the criteria used in evaluating how cities and towns are protecting residents from fire and other natural hazards. This website will allow you to learn more about the PPC program. The website provides important background information, insights about the PPC grading processes and technical documents. ISO is also pleased to offer Fire Chiefs Online — a special, secured website with information and features that can help improve your PPC grade, including a list of the Needed Fire Flows for all the commercial occupancies ISO has on file for your community. Visitors to the site can download information, see statistical results and also contact ISO for assistance.

In addition, on-line access to the FSRS and its commentaries is available to registered customers for a fee. However, fire chiefs and community chief administrative officials are given access privileges to this information without charge.

To become a registered fire chief or community chief administrative official, register at www.isomitigation.com.

PPC Review

ISO concluded its review of the fire suppression features being provided for Scio TS. The resulting community classification is **Class 06/6X**.

If the classification is a single class, the classification applies to properties with a Needed Fire Flow of 3,500 gpm or less in the community. If the classification is a split class (e.g., 6/XX):

- The first class (e.g., "6" in a 6/XX) applies to properties within 5 road miles of a recognized fire station and within 1,000 feet of a fire hydrant or alternate water supply.
- The second class (XX or XY) applies to properties beyond 1,000 feet of a fire hydrant but within 5 road miles of a recognized fire station.
- Alternative Water Supply: The first class (e.g., "6" in a 6/10) applies to properties within 5 road miles of a recognized fire station with no hydrant distance requirement.
- Class 10 applies to properties over 5 road miles of a recognized fire station.
- Class 10W applies to properties within 5 to 7 road miles of a recognized fire station with a recognized water supply within 1,000 feet.
- Specific properties with a Needed Fire Flow in excess of 3,500 gpm are evaluated separately and assigned an individual classification.

FSRS Feature	Earned Credit	Credit Available
Emergency Communications		
414. Credit for Emergency Reporting	**1.80**	**3**
422. Credit for Telecommunicators	**3.62**	**4**
432. Credit for Dispatch Circuits	**1.36**	**3**
440. Credit for Emergency Communications	**6.78**	**10**
Fire Department		
513. Credit for Engine Companies	**3.91**	**6**
523. Credit for Reserve Pumpers	**0.39**	**0.50**
532. Credit for Pump Capacity	**3.00**	**3**
549. Credit for Ladder Service	**0.60**	**4**
553. Credit for Reserve Ladder and Service Trucks	**0.03**	**0.50**
561. Credit for Deployment Analysis	**1.42**	**10**
571. Credit for Company Personnel	**3.79**	**15**
581. Credit for Training	**1.26**	**9**
730. Credit for Operational Considerations	**2.00**	**2**
590. Credit for Fire Department	**16.40**	**50**
Water Supply		
616. Credit for Supply System	**28.17**	**30**
621. Credit for Hydrants	**3.00**	**3**
631. Credit for Inspection and Flow Testing	**2.40**	**7**
640. Credit for Water Supply	**33.57**	**40**
Divergence	**-10.23**	**--**
1050. Community Risk Reduction	**2.04**	**5.50**
Total Credit	**48.56**	**105.50**

Emergency Communications

Ten percent of a community's overall score is based on how well the communications center receives and dispatches fire alarms. Our field representative evaluated:

- Communications facilities provided for the general public to report structure fires
- Enhanced 9-1-1 Telephone Service including wireless
- Computer-aided dispatch (CAD) facilities
- Alarm receipt and processing at the communication center
- Training and certification of telecommunicators
- Facilities used to dispatch fire department companies to reported structure fires

	Earned Credit	Credit Available
414. Credit Emergency Reporting	**1.80**	3
422. Credit for Telecommunicators	**3.62**	4
432. Credit for Dispatch Circuits	**1.36**	3
Item 440. Credit for Emergency Communications:	**6.78**	**10**

Item 414 - Credit for Emergency Reporting (3 points)

The first item reviewed is Item 414 "Credit for Emergency Reporting (CER)". This item reviews the emergency communication center facilities provided for the public to report fires including 911 systems (Basic or Enhanced), Wireless Phase I and Phase II, Voice over Internet Protocol, Computer Aided Dispatch and Geographic Information Systems for automatic vehicle location. ISO uses National Fire Protection Association (NFPA) 1221, *Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems* as the reference for this section.

Item 410. Emergency Reporting (CER)	Earned Credit	Credit Available
A./B. Basic 9-1-1, Enhanced 9-1-1 or No 9-1-1 For maximum credit, there should be an Enhanced 9-1-1 system, Basic 9-1-1 and No 9-1-1 will receive partial credit.	**20.00**	**20**
1. E9-1-1 Wireless Wireless Phase I using Static ALI (automatic location identification) Functionality (10 points); Wireless Phase II using Dynamic ALI Functionality (15 points); Both available will be 25 points	**25.00**	**25**
2. E9-1-1 Voice over Internet Protocol (VoIP) Static VoIP using Static ALI Functionality (10 points); Nomadic VoIP using Dynamic ALI Functionality (15 points); Both available will be 25 points	**10.00**	**25**
3. Computer Aided Dispatch Basic CAD (5 points); CAD with Management Information System (5 points); CAD with Interoperability (5 points)	**5.00**	**15**
4. Geographic Information System (GIS/AVL) The PSAP uses a fully integrated CAD/GIS management system with automatic vehicle location (AVL) integrated with a CAD system providing dispatch assignments. The individual fire departments being dispatched do not need GIS/AVL capability to obtain this credit.	**0.00**	**15**
Review of Emergency Reporting total:	**60.00**	**100**

Item 422- Credit for Telecommunicators (4 points)

The second item reviewed is Item 422 "Credit for Telecommunicators (TC)". This item reviews the number of Telecommunicators on duty at the center to handle fire calls and other emergencies. All emergency calls including those calls that do not require fire department action are reviewed to determine the proper staffing to answer emergency calls and dispatch the appropriate emergency response. The 2013 Edition of NFPA 1221, *Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems,* recommends that ninety-five percent of emergency calls shall be answered within 15 seconds and ninety-nine percent of emergency calls shall be answered within 40 seconds. In addition, NFPA recommends that eighty percent of emergency alarm processing shall be completed within 60 seconds and ninety-five percent of alarm processing shall be completed within 106 seconds of answering the call.

To receive full credit for operators on duty, ISO must review documentation to show that the communication center meets NFPA 1221 call answering and dispatch time performance measurement standards. This documentation may be in the form of performance statistics or other performance measurements compiled by the 9-1-1 software or other software programs that are currently in use such as Computer Aided Dispatch (CAD) or Management Information System (MIS).

Item 420. Telecommunicators (CTC)	Earned Credit	Credit Available
A1. Alarm Receipt (AR) Receipt of alarms shall meet the requirements in accordance with the criteria of NFPA 1221	**19.48**	**20**
A2. Alarm Processing (AP) Processing of alarms shall meet the requirements in accordance with the criteria of NFPA 1221	**18.43**	**20**
B. Emergency Dispatch Protocols (EDP) Telecommunicators have emergency dispatch protocols (EDP) containing questions and a decision-support process to facilitate correct call categorization and prioritization.	**20.00**	**20**
C. Telecommunicator Training and Certification (TTC) Telecommunicators meet the qualification requirements referenced in NFPA 1061, *Standard for Professional Qualifications for Public Safety Telecommunicator,* and/or the Association of Public-Safety Communications Officials - International (APCO) *Project 33.* Telecommunicators are certified in the knowledge, skills, and abilities corresponding to their job functions.	**17.50**	**20**
D. Telecommunicator Continuing Education and Quality Assurance (TQA) Telecommunicators participate in continuing education and/or in-service training and quality-assurance programs as appropriate for their positions	**15.00**	**20**
Review of Telecommunicators total:	**90.41**	**100**

Item 432 - Credit for Dispatch Circuits (3 points)

The third item reviewed is Item 432 "Credit for Dispatch Circuits (CDC)". This item reviews the dispatch circuit facilities used to transmit alarms to fire department members. A "Dispatch Circuit" is defined in NFPA 1221 as "A circuit over which an alarm is transmitted from the communications center to an emergency response facility (ERF) or emergency response units (ERUs) to notify ERUs to respond to an emergency". All fire departments (except single fire station departments with full-time firefighter personnel receiving alarms directly at the fire station) need adequate means of notifying all firefighter personnel of the location of reported structure fires. The dispatch circuit facilities should be in accordance with the general criteria of NFPA 1221. "Alarms" are defined in this Standard as "A signal or message from a person or device indicating the existence of an emergency or other situation that requires action by an emergency response agency".

There are two different levels of dispatch circuit facilities provided for in the Standard – a primary dispatch circuit and a secondary dispatch circuit. In jurisdictions that receive 730 alarms or more per year (average of two alarms per 24-hour period), two separate and dedicated dispatch circuits, a primary and a secondary, are needed. In jurisdictions receiving fewer than 730 alarms per year, a second dedicated dispatch circuit is not needed. Dispatch circuit facilities installed but not used or tested (in accordance with the NFPA Standard) receive no credit.

The score for Credit for Dispatch Circuits (CDC) is influenced by monitoring for integrity of the primary dispatch circuit. There are up to 0.90 points available for this Item. Monitoring for integrity involves installing automatic systems that will detect faults and failures and send visual and audible indications to appropriate communications center (or dispatch center) personnel. ISO uses NFPA 1221 to guide the evaluation of this item. ISO's evaluation also includes a review of the communication system's emergency power supplies.

Item 432 "Credit for Dispatch Circuits (CDC)" = 1.36 points

Fire Department

Fifty percent of a community's overall score is based upon the fire department's structure fire suppression system. ISO's field representative evaluated:

- Engine and ladder/service vehicles including reserve apparatus
- Equipment carried
- Response to reported structure fires
- Deployment analysis of companies
- Available and/or responding firefighters
- Training

	Earned Credit	Credit Available
513. Credit for Engine Companies	**3.91**	6
523. Credit for Reserve Pumpers	**0.39**	0.5
532. Credit for Pumper Capacity	**3.00**	3
549. Credit for Ladder Service	**0.60**	4
553. Credit for Reserve Ladder and Service Trucks	**0.03**	0.5
561. Credit for Deployment Analysis	**1.42**	10
571. Credit for Company Personnel	**3.79**	15
581. Credit for Training	**1.26**	9
730. Credit for Operational Considerations	**2.00**	2
Item 590. Credit for Fire Department:	**16.40**	**50**

Basic Fire Flow

The Basic Fire Flow for the community is determined by the review of the Needed Fire Flows for selected buildings in the community. The fifth largest Needed Fire Flow is determined to be the Basic Fire Flow. The Basic Fire Flow has been determined to be 3500 gpm.

Item 513 - Credit for Engine Companies (6 points)

The first item reviewed is Item 513 "Credit for Engine Companies (CEC)". This item reviews the number of engine companies, their pump capacity, hose testing, pump testing and the equipment carried on the in-service pumpers. To be recognized, pumper apparatus must meet the general criteria of NFPA 1901, *Standard for Automotive Fire Apparatus* which include a minimum 250 gpm pump, an emergency warning system, a 300 gallon water tank, and hose. At least 1 apparatus must have a permanently mounted pump rated at 750 gpm or more at 150 psi.

The review of the number of needed pumpers considers the response distance to built-upon areas; the Basic Fire Flow; and the method of operation. Multiple alarms, simultaneous incidents, and life safety are not considered.

The greatest value of A, B, or C below is needed in the fire district to suppress fires in structures with a Needed Fire Flow of 3,500 gpm or less: **3 engine companies**

a) **1 engine companies** to provide fire suppression services to areas to meet NFPA 1710 criteria or within 1½ miles.

b) **3 engine companies** to support a Basic Fire Flow of 3500 gpm.

c) **3 engine companies** based upon the fire department's method of operation to provide a minimum two engine response to all first alarm structure fires.

The FSRS recognizes that there are **2 engine companies** in service.

The FSRS also reviews Automatic Aid. Automatic Aid is considered in the review as assistance dispatched automatically by contractual agreement between two communities or fire districts. That differs from mutual aid or assistance arranged case by case. ISO will recognize an Automatic Aid plan under the following conditions:

- It must be prearranged for first alarm response according to a definite plan. It is preferable to have a written agreement, but ISO may recognize demonstrated performance.
- The aid must be dispatched to all reported structure fires on the initial alarm.
- The aid must be provided 24 hours a day, 365 days a year.

FSRS Item 512.D "Automatic Aid Engine Companies" responding on first alarm and meeting the needs of the city for basic fire flow and/or distribution of companies are factored based upon the value of the Automatic Aid plan (up to 1.00 can be used as the factor). The Automatic Aid factor is determined by a review of the Automatic Aid provider's communication facilities, how they receive alarms from the graded area, inter-department training between fire departments, and the fire ground communications capability between departments.

For each engine company, the credited Pump Capacity (PC), the Hose Carried (HC), the Equipment Carried (EC) all contribute to the calculation for the percent of credit the FSRS provides to that engine company.

Item 513 "Credit for Engine Companies (CEC)" = 3.91 points

Item 523 - Credit for Reserve Pumpers (0.50 points)

The item is Item 523 "Credit for Reserve Pumpers (CRP)". This item reviews the number and adequacy of the pumpers and their equipment. The number of needed reserve pumpers is 1 for each 8 needed engine companies determined in Item 513, or any fraction thereof.

Item 523 "Credit for Reserve Pumpers (CRP)" = 0.39 points

Item 532 – Credit for Pumper Capacity (3 points)

The next item reviewed is Item 532 "Credit for Pumper Capacity (CPC)". The total pump capacity available should be sufficient for the Basic Fire Flow of 3500 gpm. The maximum needed pump capacity credited is the Basic Fire Flow of the community.

Item 532 "Credit for Pumper Capacity (CPC)" = 3.00 points

Item 549 – Credit for Ladder Service (4 points)

The next item reviewed is Item 549 "Credit for Ladder Service (CLS)". This item reviews the number of response areas within the city with 5 buildings that are 3 or more stories or 35 feet or more in height, or with 5 buildings that have a Needed Fire Flow greater than 3,500 gpm, or any combination of these criteria. The height of all buildings in the city, including those protected by automatic sprinklers, is considered when determining the number of needed ladder companies. Response areas not needing a ladder company should have a service company. Ladders, tools and equipment normally carried on ladder trucks are needed not only for ladder operations but also for forcible entry, ventilation, salvage, overhaul, lighting and utility control.

The number of ladder or service companies, the height of the aerial ladder, aerial ladder testing and the equipment carried on the in-service ladder trucks and service trucks is compared with the number of needed ladder trucks and service trucks and an FSRS equipment list. Ladder trucks must meet the general criteria of NFPA 1901, *Standard for Automotive Fire Apparatus* to be recognized.

The number of needed ladder-service trucks is dependent upon the number of buildings 3 stories or 35 feet or more in height, buildings with a Needed Fire Flow greater than 3,500 gpm, and the method of operation.

The FSRS recognizes that there are **1 ladder companies** in service. These companies are needed to provide fire suppression services to areas to meet NFPA 1710 criteria or within 2½ miles and the number of buildings with a Needed Fire Flow over 3,500 gpm or 3 stories or more in height, or the method of operation.

The FSRS recognizes that there are **0 service companies** in service.

Item 549 "Credit for Ladder Service (CLS)" = 0.60 points

Item 553 – Credit for Reserve Ladder and Service Trucks (0.50 points)

The next item reviewed is Item 553 "Credit for Reserve Ladder and Service Trucks (CRLS)". This item considers the adequacy of ladder and service apparatus when one (or more in larger communities) of these apparatus are out of service. The number of needed reserve ladder and service trucks is 1 for each 8 needed ladder and service companies that were determined to be needed in Item 540, or any fraction thereof.

Item 553 "Credit for Reserve Ladder and Service Trucks (CRLS)" = 0.03 points

Item 561 – Deployment Analysis (10 points)

Next, Item 561 "Deployment Analysis (DA)" is reviewed. This Item examines the number and adequacy of existing engine and ladder-service companies to cover built-upon areas of the city.

To determine the Credit for Distribution, first the Existing Engine Company (EC) points and the Existing Engine Companies (EE) determined in Item 513 are considered along with Ladder Company Equipment (LCE) points, Service Company Equipment (SCE) points, Engine-Ladder Company Equipment (ELCE) points, and Engine-Service Company Equipment (ESCE) points determined in Item 549.

Secondly, as an alternative to determining the number of needed engine and ladder/service companies through the road-mile analysis, a fire protection area may use the results of a systematic performance evaluation. This type of evaluation analyzes computer-aided dispatch (CAD) history to demonstrate that, with its current deployment of companies, the fire department meets the time constraints for initial arriving engine and initial full alarm assignment in accordance with the general criteria of in NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments.*

A determination is made of the percentage of built upon area within 1½ miles of a first-due engine company and within 2½ miles of a first-due ladder-service company.

Item 561 "Credit Deployment Analysis (DA)" = 1.42 points

Item 571 – Credit for Company Personnel (15 points)

Item 571 "Credit for Company Personnel (CCP)" reviews the average number of existing firefighters and company officers available to respond to reported first alarm structure fires in the city.

The on-duty strength is determined by the yearly average of total firefighters and company officers on-duty considering vacations, sick leave, holidays, "Kelley" days and other absences. When a fire department operates under a minimum staffing policy, this may be used in lieu of determining the yearly average of on-duty company personnel.

Firefighters on apparatus not credited under Items 513 and 549 that regularly respond to reported first alarms to aid engine, ladder, and service companies are included in this item as increasing the total company strength.

Firefighters staffing ambulances or other units serving the general public are credited if they participate in fire-fighting operations, the number depending upon the extent to which they are available and are used for response to first alarms of fire.

On-Call members are credited on the basis of the average number staffing apparatus on first alarms. Off-shift career firefighters and company officers responding on first alarms are considered on the same basis as on-call personnel. For personnel not normally at the fire station, the number of responding firefighters and company officers is divided by 3 to reflect the time needed to assemble at the fire scene and the reduced ability to act as a team due to the various arrival times at the fire location when compared to the personnel on-duty at the fire station during the receipt of an alarm.

The number of Public Safety Officers who are positioned in emergency vehicles within the jurisdiction boundaries may be credited based on availability to respond to first alarm structure fires. In recognition of this increased response capability the number of responding Public Safety Officers is divided by 2.

The average number of firefighters and company officers responding with those companies credited as Automatic Aid under Items 513 and 549 are considered for either on-duty or on-call company personnel as is appropriate. The actual number is calculated as the average number of company personnel responding multiplied by the value of AA Plan determined in Item 512.D.

The maximum creditable response of on-duty and on-call firefighters is 12, including company officers, for each existing engine and ladder company and 6 for each existing service company.

Chief Officers are not creditable except when more than one chief officer responds to alarms; then extra chief officers may be credited as firefighters if they perform company duties.

The FSRS recognizes **2.88 on-duty personnel** and an average of **5.00 on-call personnel** responding on first alarm structure fires.

Item 571 "Credit for Company Personnel (CCP)" = 3.79 points

Item 581 – Credit for Training (9 points)

Training	Earned Credit	Credit Available
A. Facilities, and Use For maximum credit, each firefighter should receive 18 hours per year in structure fire related subjects as outlined in NFPA 1001.	0.00	35
B. Company Training For maximum credit, each firefighter should receive 16 hours per month in structure fire related subjects as outlined in NFPA 1001.	3.91	25
C. Classes for Officers For maximum credit, each officer should be certified in accordance with the general criteria of NFPA 1021. Additionally, each officer should receive 12 hours of continuing education on or off site.	2.25	12
D. New Driver and Operator Training For maximum credit, each new driver and operator should receive 60 hours of driver/operator training per year in accordance with NFPA 1002 and NFPA 1451.	2.50	5
E. Existing Driver and Operator Training For maximum credit, each existing driver and operator should receive 12 hours of driver/operator training per year in accordance with NFPA 1002 and NFPA 1451.	1.67	5
F. Training on Hazardous Materials For maximum credit, each firefighter should receive 6 hours of training for incidents involving hazardous materials in accordance with NFPA 472.	0.38	1
G. Recruit Training For maximum credit, each firefighter should receive 240 hours of structure fire related training in accordance with NFPA 1001 within the first year of employment or tenure.	2.50	5
H. Pre-Fire Planning Inspections For maximum credit, pre-fire planning inspections of each commercial, industrial, institutional, and other similar type building (all buildings except 1-4 family dwellings) should be made annually by company members. Records of inspections should include up-to date notes and sketches.	0.75	12

Item 580 "Credit for Training (CT)" = 1.26 points

Item 730 – Operational Considerations (2 points)

Item 730 "Credit for Operational Considerations (COC)" evaluates fire department standard operating procedures and incident management systems for emergency operations involving structure fires.

Operational Considerations	Earned Credit	Credit Available
Standard Operating Procedures The department should have established SOPs for fire department general emergency operations	50	50
Incident Management Systems The department should use an established incident management system (IMS)	50	50
Operational Considerations total:	100	100

Item 730 "Credit for Operational Considerations (COC)" = 2.00 points

Water Supply

Forty percent of a community's overall score is based on the adequacy of the water supply system. The ISO field representative evaluated:

- the capability of the water distribution system to meet the Needed Fire Flows at selected locations up to 3,500 gpm.
- size, type and installation of fire hydrants.
- inspection and flow testing of fire hydrants.

	Earned Credit	Credit Available
616. Credit for Supply System	**28.17**	30
621. Credit for Hydrants	**3.00**	3
631. Credit for Inspection and Flow Testing	**2.40**	7
Item 640. Credit for Water Supply:	**33.57**	**40**

Item 616 – Credit for Supply System (30 points)

The first item reviewed is Item 616 "Credit for Supply System (CSS)". This item reviews the rate of flow that can be credited at each of the Needed Fire Flow test locations considering the supply works capacity, the main capacity and the hydrant distribution. The lowest flow rate of these items is credited for each representative location. A water system capable of delivering 250 gpm or more for a period of two hours plus consumption at the maximum daily rate at the fire location is considered minimum in the ISO review.

Where there are 2 or more systems or services distributing water at the same location, credit is given on the basis of the joint protection provided by all systems and services available.

The supply works capacity is calculated for each representative Needed Fire Flow test location, considering a variety of water supply sources. These include public water supplies, emergency supplies (usually accessed from neighboring water systems), suction supplies (usually evidenced by dry hydrant installations near a river, lake or other body of water), and supplies developed by a fire department using large diameter hose or vehicles to shuttle water from a source of supply to a fire site. The result is expressed in gallons per minute (gpm).

The normal ability of the distribution system to deliver Needed Fire Flows at the selected building locations is reviewed. The results of a flow test at a representative test location will indicate the ability of the water mains (or fire department in the case of fire department supplies) to carry water to that location.

The hydrant distribution is reviewed within 1,000 feet of representative test locations measured as hose can be laid by apparatus.

For maximum credit, the Needed Fire Flows should be available at each location in the district. Needed Fire Flows of 2,500 gpm or less should be available for 2 hours; and Needed Fire Flows of 3,000 and 3,500 gpm should be obtainable for 3 hours.

Item 616 "Credit for Supply System (CSS)" = 28.17 points

Item 621 – Credit for Hydrants (3 points)

The second item reviewed is Item 621 "Credit for Hydrants (CH)". This item reviews the number of fire hydrants of each type compared with the total number of hydrants.

There are a total of 699 hydrants in the graded area.

620. Hydrants, - Size, Type and Installation	Number of Hydrants
A. With a 6 -inch or larger branch and a pumper outlet with or without 2½ -inch outlets	699
B. With a 6 -inch or larger branch and no pumper outlet but two or more 2½ -inch outlets, or with a small foot valve, or with a small barrel	0
C./D. With only a 2½ -inch outlet or with less than a 6 -inch branch	0
E./F. Flush Type, Cistern, or Suction Point	0

Item 621 "Credit for Hydrants (CH)" = 3.00 points

Item 630 – Credit for Inspection and Flow Testing (7 points)

The third item reviewed is Item 630 "Credit for Inspection and Flow Testing (CIT)". This item reviews the fire hydrant inspection frequency, and the completeness of the inspections. Inspection of hydrants should be in accordance with AWWA M-17, *Installation, Field Testing and Maintenance of Fire Hydrants.*

Frequency of Inspection (FI): Average interval between the 3 most recent inspections.

Frequency	Points
1 year	30
2 years	20
3 years	10
4 years	5
5 years or more	No Credit

Note: The points for inspection frequency are reduced by 10 points if the inspections are incomplete or do not include a flushing program. An additional reduction of 10 points are made if hydrants are not subjected to full system pressure during inspections. If the inspection of cisterns or suction points does not include actual drafting with a pumper, or back-flushing for dry hydrants, 20 points are deducted.

Total points for Inspections = 2.40 points

Frequency of Fire Flow Testing (FF): Average interval between the 3 most recent inspections.

Frequency	Points
5 years	40
6 years	30
7 years	20
8 years	10
9 years	5
10 years or more	No Credit

Total points for Fire Flow Testing = 0.00 points

Item 631 "Credit for Inspection and Fire Flow Testing (CIT)" = 2.40 points

Divergence = -10.23

The Divergence factor mathematically reduces the score based upon the relative difference between the fire department and water supply scores. The factor is introduced in the final equation.

Community Risk Reduction

	Earned Credit	Credit Available
1025. Credit for Fire Prevention and Code Enforcement (CPCE)	**0.38**	2.2
1033. Credit for Public Fire Safety Education (CFSE)	**0.79**	2.2
1044. Credit for Fire Investigation Programs (CIP)	**0.87**	1.1
Item 1050. Credit for Community Risk Reduction	**2.04**	**5.50**

Item 1025 – Credit for Fire Prevention Code Adoption and Enforcement (2.2 points)	Earned Credit	Credit Available
Fire Prevention Code Regulations (PCR) Evaluation of fire prevention code regulations in effect.	1.06	10
Fire Prevention Staffing (PS) Evaluation of staffing for fire prevention activities.	0.00	8
Fire Prevention Certification and Training (PCT) Evaluation of the certification and training of fire prevention code enforcement personnel.	5.50	6
Fire Prevention Programs (PCP) Evaluation of fire prevention programs.	0.40	16
Review of Fire Prevention Code and Enforcement (CPCE) subtotal:	6.96	40

Item 1033 – Credit for Public Fire Safety Education (2.2 points)	Earned Credit	Credit Available
Public Fire Safety Educators Qualifications and Training (FSQT) Evaluation of public fire safety education personnel training and qualification as specified by the authority having jurisdiction.	5.00	10
Public Fire Safety Education Programs (FSP) Evaluation of programs for public fire safety education.	9.28	30
Review of Public Safety Education Programs (CFSE) subtotal:.	14.28	40

Item 1044 – Credit for Fire Investigation Programs (1.1 points)	Earned Credit	Credit Available
Fire Investigation Organization and Staffing (IOS) Evaluation of organization and staffing for fire investigations.	6.00	8
Fire Investigator Certification and Training (IQT) Evaluation of fire investigator certification and training.	3.75	6
Use of National Fire Incident Reporting System (IRS) Evaluation of the use of the National Fire Incident Reporting System (NFIRS) for the 3 years before the evaluation.	6.00	6
Review of Fire Investigation Programs (CIP) subtotal:	15.75	20

Summary of PPC Review
for
Scio TS

FSRS Item	Earned Credit	Credit Available
Emergency Communications		
414. Credit for Emergency Reporting	1.80	3
422. Credit for Telecommunicators	3.62	4
432. Credit for Dispatch Circuits	1.36	3
440. Credit for Emergency Communications	6.78	10
Fire Department		
513. Credit for Engine Companies	3.91	6
523. Credit for Reserve Pumpers	0.39	0.5
532. Credit for Pumper Capacity	3.00	3
549. Credit for Ladder Service	0.60	4
553. Credit for Reserve Ladder and Service Trucks	0.03	0.5
561. Credit for Deployment Analysis	1.42	10
571. Credit for Company Personnel	3.79	15
581. Credit for Training	1.26	9
730. Credit for Operational Considerations	2.00	2
590. Credit for Fire Department	16.40	50
Water Supply		
616. Credit for Supply System	28.17	30
621. Credit for Hydrants	3.00	3
631. Credit for Inspection and Flow Testing	2.40	7
640. Credit for Water Supply	33.57	40
Divergence	-10.23	--
1050. Community Risk Reduction	2.04	5.50
Total Credit	48.56	105.5

Final Community Classification = 06/6X

INSURANCE SERVICES OFFICE, INC.

HYDRANT FLOW DATA SUMMARY

City Scio Ts

County Michigan(Washtenaw), State MICHIGAN (21) Witnessed by: Insurance Services Office Date: Dec 17, 2018

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM $Q=(29.83(C(d^2)p^{0.5}))$ INDIVIDUAL HYDRANTS			TOTAL	PRESSURE PSI STATIC	RESID.	FLOW -AT 20 PSI NEEDED **	AVAIL.	REMARKS***	MODEL TYPE
1		Jackson, 5th W of Dino	Scio TS Water Department, Main	0	0	0	7700	57	20	3000	7700		CNMP
10		N Cambridge Club Circle, W of Zeeb	Scio TS Water Department, Main	0	0	0	4100	66	20	4500	4100		CNMP
10.1		N Cambridge Club Circle, W of Zeeb	Scio TS Water Department, Main	0	0	0	4100	66	20	3500	4100		CNMP
11		Polo Fields & Dornich	Scio TS Water Department, Main	1890	0	0	1890	62	45	1500	3100		
12		Jackson s/s, & Burton	Scio TS Water Department, Main	0	0	0	8000	75	20	4500	8000		CNMP
12.1		Jackson s/s, & Burton	Scio TS Water Department, Main	0	0	0	8000	75	20	3500	8000		CNMP
13		Parkland Plaza & Little Lake	Scio TS Water Department, Main	0	0	0	5900	57	20	5000	5900		CNMP
13.1		Parkland Plaza & Little Lake	Scio TS Water Department, Main	0	0	0	5900	57	20	3500	5900		CNMP
14		Jackson s/s, & jackson Plaza	Scio TS Water Department, Main	1520	0	0	1520	50	30	4500	1900		
14.1		Jackson s/s, & jackson Plaza	Scio TS Water Department, Main	1520	0	0	1520	50	30	4000	1900		
14.2		Jackson s/s, & jackson Plaza	Scio TS Water Department, Main	1520	0	0	1520	50	30	3000	1900		
15		Liberty, 2nd W of Wagner	Scio TS Water Department, Main	0	0	0	3600	89	20	3000	3600		CNMP
16		Liberty & Scio Ridge	Scio TS Water Department, Main	1520	0	0	1520	75	35	4000	1800		
16.1		Liberty & Scio Ridge	Scio TS Water Department, Main	1520	0	0	1520	75	35	3500	1800		
16.2		Liberty & Scio Ridge	Scio TS Water Department, Main	1520	0	0	1520	75	35	1000	1800		
17		E of Wagner, SW corner of High School	Scio TS Water Department, Main	0	0	0	3300	52	20	3500	3300		CNMP

THE ABOVE LISTED NEEDED FIRE FLOWS ARE FOR PROPERTY INSURANCE PREMIUM CALCULATIONS ONLY AND ARE *NOT* INTENDED TO PREDICT THE MAXIMUM AMOUNT OF WATER REQUIRED FOR A LARGE SCALE FIRE CONDITION.

THE AVAILABLE FLOWS ONLY INDICATE THE CONDITIONS THAT EXISTED AT THE TIME AND AT THE LOCATION WHERE TESTS WERE WITNESSED.

*Comm = Commercial; Res = Residential.

**Needed is the rate of flow for a specific duration for a full credit condition. Needed Fire Flows greater than 3,500 gpm are not considered in determining the classification of the city when using the Fire Suppression Rating Schedule.

*** (A)-Limited by available hydrants to gpm shown. Available facilities limit flow to gpm shown plus consumption for the needed duration of (B)-2 hours, (C)-3 hours or (D)-4 hours.

INSURANCE SERVICES OFFICE, INC.

HYDRANT FLOW DATA SUMMARY

City Scio Ts

County Michigan(Washtenaw), State MICHIGAN (21) Witnessed by: Insurance Services Office Date: Dec 17, 2018

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM				PRESSURE PSI		FLOW -AT 20 PSI		REMARKS***	MODEL TYPE
				INDIVIDUAL HYDRANTS			TOTAL	STATIC	RESID.	NEEDED **	AVAIL.		
18		Auburn Hill	Scio TS Water Department, Walnut Ridge	0	0	0	1300	64	20	4500	1300	(D)-(1718 gpm)	CNMP
18.1		Auburn Hill	Scio TS Water Department, Walnut Ridge	0	0	0	1300	64	20	1000	1300		CNMP
19		Crestline Dr & Loch Alpine	Scio TS Water Department, Loch Alpine	610	0	0	610	59	27	1000	700		
2		Dino, 4th S of Jackson	Scio TS Water Department, Main	1810	0	0	1810	69	57	3500	3900		
3		Jackson n/s, 3rd E ofBaker	Scio TS Water Department, Main	0	0	0	8200	60	20	4500	8200		CNMP
3.1		Jackson n/s, 3rd E ofBaker	Scio TS Water Department, Main	0	0	0	8200	60	20	3000	8200		CNMP
4		Baker, 3rd N of marshall	Scio TS Water Department, Main	0	0	0	9400	59	20	1750	9400		CNMP
5		Metty, N of Jackson	Scio TS Water Department, Main	1930	0	0	1930	71	55	3000	3600		
6		Steabler, 2nd N of Jackson	Scio TS Water Department, Main	0	0	0	7100	73	20	2250	7100		CNMP
7		Jackson n/s, 3rd W of Jackson Industrial	Scio TS Water Department, Main	0	0	0	8600	76	20	6000	8600		CNMP
7.1		Jackson n/s, 3rd W of Jackson Industrial	Scio TS Water Department, Main	0	0	0	8600	76	20	6000	8600		CNMP
7.2		Jackson n/s, 3rd W of Jackson Industrial	Scio TS Water Department, Main	0	0	0	8600	76	20	4500	8600		CNMP
7.3		Jackson n/s, 3rd W of Jackson Industrial	Scio TS Water Department, Main	0	0	0	8600	76	20	3000	8600		CNMP
8		Interface, W of Jackson	Scio TS Water Department, Main	0	0	0	5000	74	20	3500	5000		CNMP
9		Zeeb, S of Pratt	Scio TS Water Department, Main	0	0	0	5200	71	20	4000	5200		CNMP
9.1		Zeeb, S of Pratt	Scio TS Water Department, Main	0	0	0	5200	71	20	3000	5200		CNMP

THE ABOVE LISTED NEEDED FIRE FLOWS ARE FOR PROPERTY INSURANCE PREMIUM CALCULATIONS ONLY AND ARE *NOT* INTENDED TO PREDICT THE MAXIMUM AMOUNT OF WATER REQUIRED FOR A LARGE SCALE FIRE CONDITION.

THE AVAILABLE FLOWS ONLY INDICATE THE CONDITIONS THAT EXISTED AT THE TIME AND AT THE LOCATION WHERE TESTS WERE WITNESSED.

*Comm = Commercial; Res = Residential.

**Needed is the rate of flow for a specific duration for a full credit condition. Needed Fire Flows greater than 3,500 gpm are not considered in determining the classification of the city when using the Fire Suppression Rating Schedule.

*** (A)-Limited by available hydrants to gpm shown. Available facilities limit flow to gpm shown plus consumption for the needed duration of (B)-2 hours, (C)-3 hours or (D)-4 hours.

GEOGRAPHIC INFORMATION SYSTEM EMERGENCY SERVICES RESPONSE CAPABILITIES ANALYSIS

Maps

International Association of Fire Fighters
1750 New York Avenue, N.W.
Washington, DC 20006

Scio Township Fire Department

Scio Township, Michigan

July 2021

Mapping Analysis of the Scio Township Fire Department

In creating this document, it was important to ascertain where stations were located and if they were located to provide fair and equitable coverage to the citizens. In order to make this assessment, the IAFF created maps of the department's response area and plotted the fire stations.

Computer modeling was then used to determine the distance apparatus could travel in four, eight, and ten minutes ten seconds. The following table specifies the current locations of the department's fire stations.

Travel times were modeled using ESRI StreetMap Premium Custom Roads version 2020.3. This dataset is derived from an average of the last two years of traffic data. Traffic volume decreased in 2020 compared to previous years due to the COVID-19 pandemic. Thus, when restrictions lift and traffic increases, the coverages shown may be reduced and travel times shown in the following maps may increase.

Fire stations were identified on Geographic Information System (GIS) maps as starting points with vehicles traveling at posted road speeds. GIS software from ESRI ArcGIS Pro version 2.7.3 was used for the analysis.

When generating the maps, several assumptions needed to be addressed prior to drawing conclusions from the analysis. These assumptions are as follows:

- Modeled travel speeds are based on reasonable and prudent historical traffic speeds using Wednesdays at 5:00 pm. Actual response speeds may be slower, and the associated travel times greater, with any unpredictable impedances including, but not limited to:
    - Traffic Incidents: Collisions and vehicle breakdowns causing lane blockages and driver distractions.
    - Work Zones: Construction and maintenance activity that can cause added travel time in locations and times where congestion is not normally present.
    - Weather: Reduced visibility--road surface problems and uncertain waiting conditions result in extra travel time and altered trip patterns.
    - Special Events: Demand may change due to identifiable and predictable causes.
    - Traffic Control Devices: Poorly timed or inoperable traffic signals, railroad grade crossings, speed control systems, and traveler information signs contribute to irregularities in travel time.

- Inadequate Road or Transit Capacity: The interaction of capacity problems with the aforementioned sources causes travel time to expand much faster than demand.[1]

In addition, it is reasonable to suggest that because larger emergency vehicles are generally more cumbersome and require greater skill to maneuver, their response may be more negatively affected by their weight, size, and in some cases, inability to travel narrow surface streets.

As discussed, computer modeling only considers travel time of apparatus. Decision makers should understand that once apparatus and personnel arrive on the incident scene there are other essential tasks that must be completed which require additional time before access, rescue, and suppression can take place. Tasks such as establishing a water supply, forcible entry (access), and deployment of an attack line are not considered in the computer modeling. Other additional factors also include:

- The time from arrival of the apparatus to the onset of interior fire operations (access interval) must be considered when analyzing response system capabilities.
  - The access interval is dependent upon factors such as distance from the apparatus to the task location and the elevation of the incident and locked doors or security bars which must be breached.
  - Impediments like these may add to the delay between discovery of a fire and the initiation of an actual fire attack.
- The reliability of a community's hydrant system to supply water to fire apparatus.

- Weather conditions

[1] David Shrank and Tim Lomax, The 2003 Urban Mobility Report, (Illinois Transportation Institute, Illinois A&M University: September 2003).

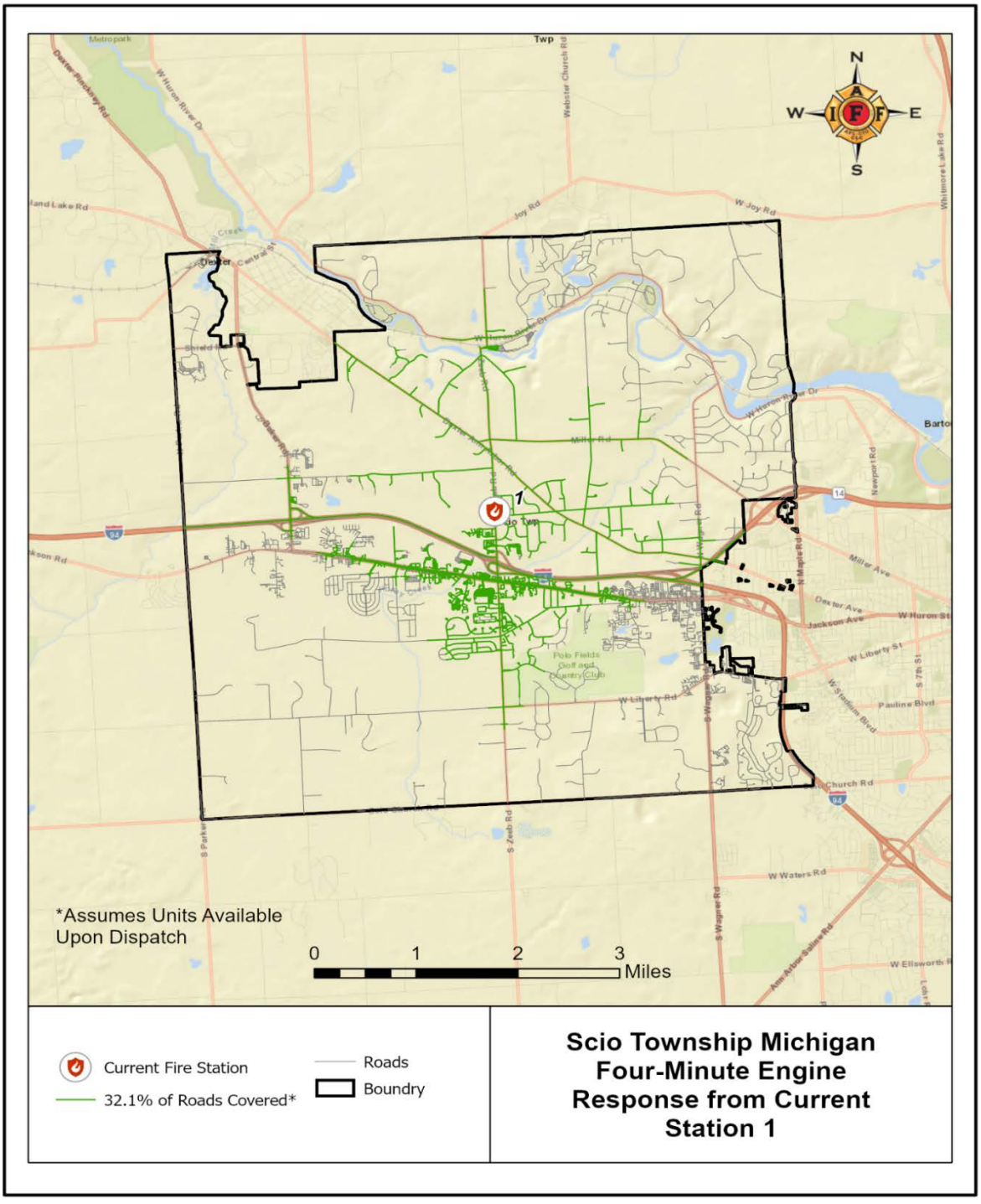
Current Emergency Response Capabilities – Scio Township Fire Department

The table below lists the department's current fire station, apparatus, and minimum staffing on each apparatus.

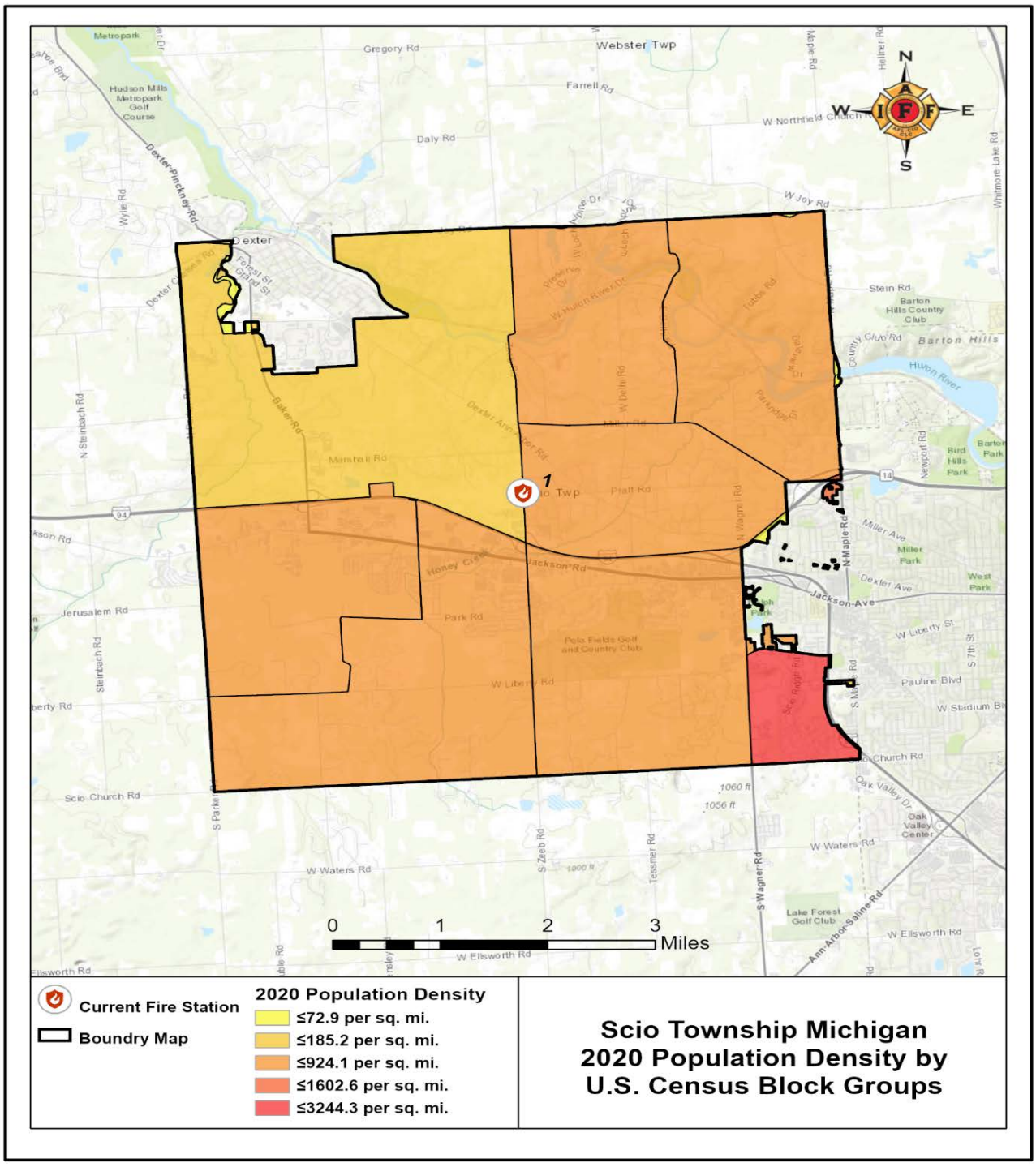
Fire Station	Address	Apparatus	Staffing
Station 1	1055 N Zeeb	Engine 1	3/4

Table 1: Current Fire Station Location and Staffing. The above table displays where apparatus are housed and how units are typically staffed.[2]

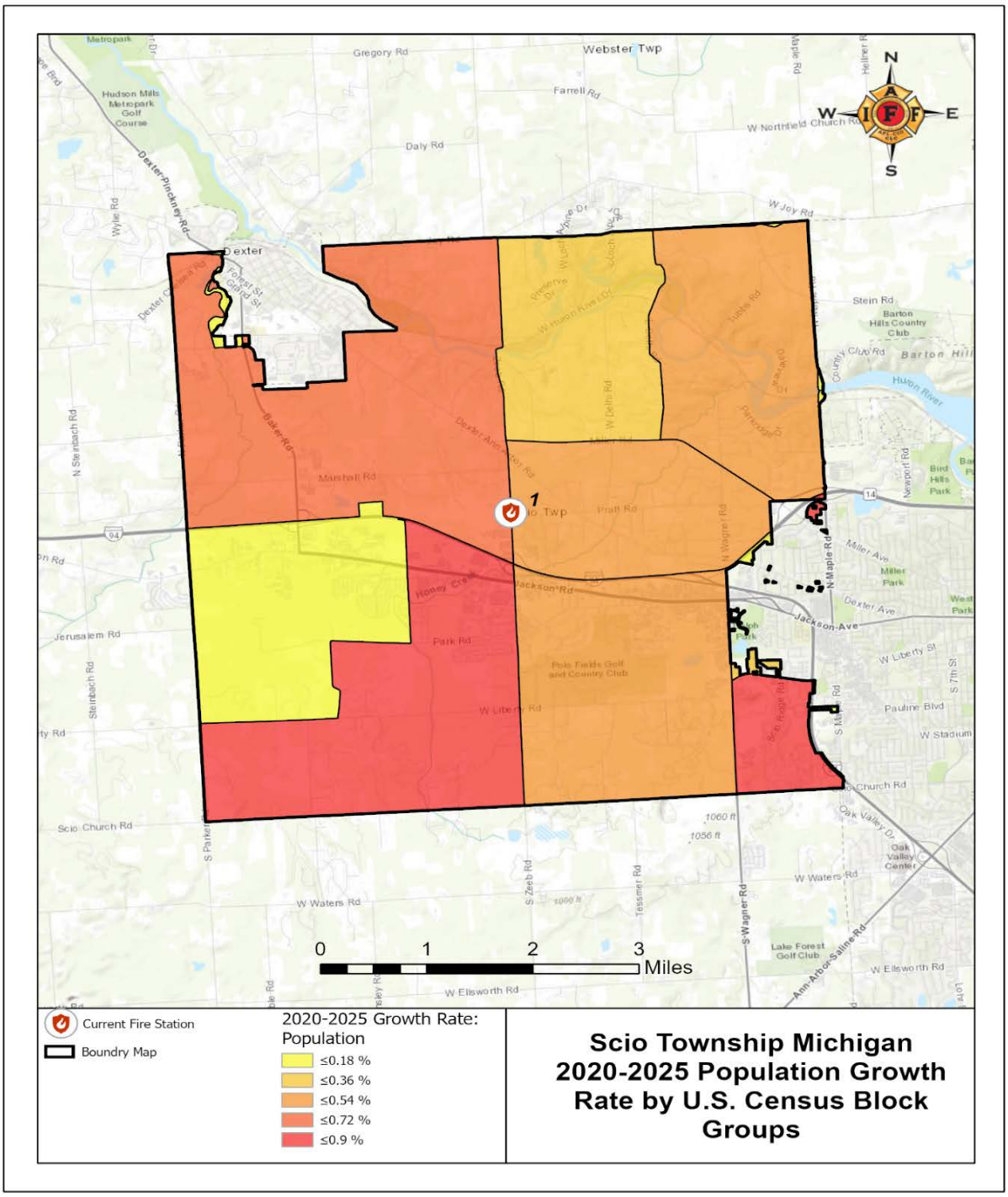
[2] Data provided by Local 4891



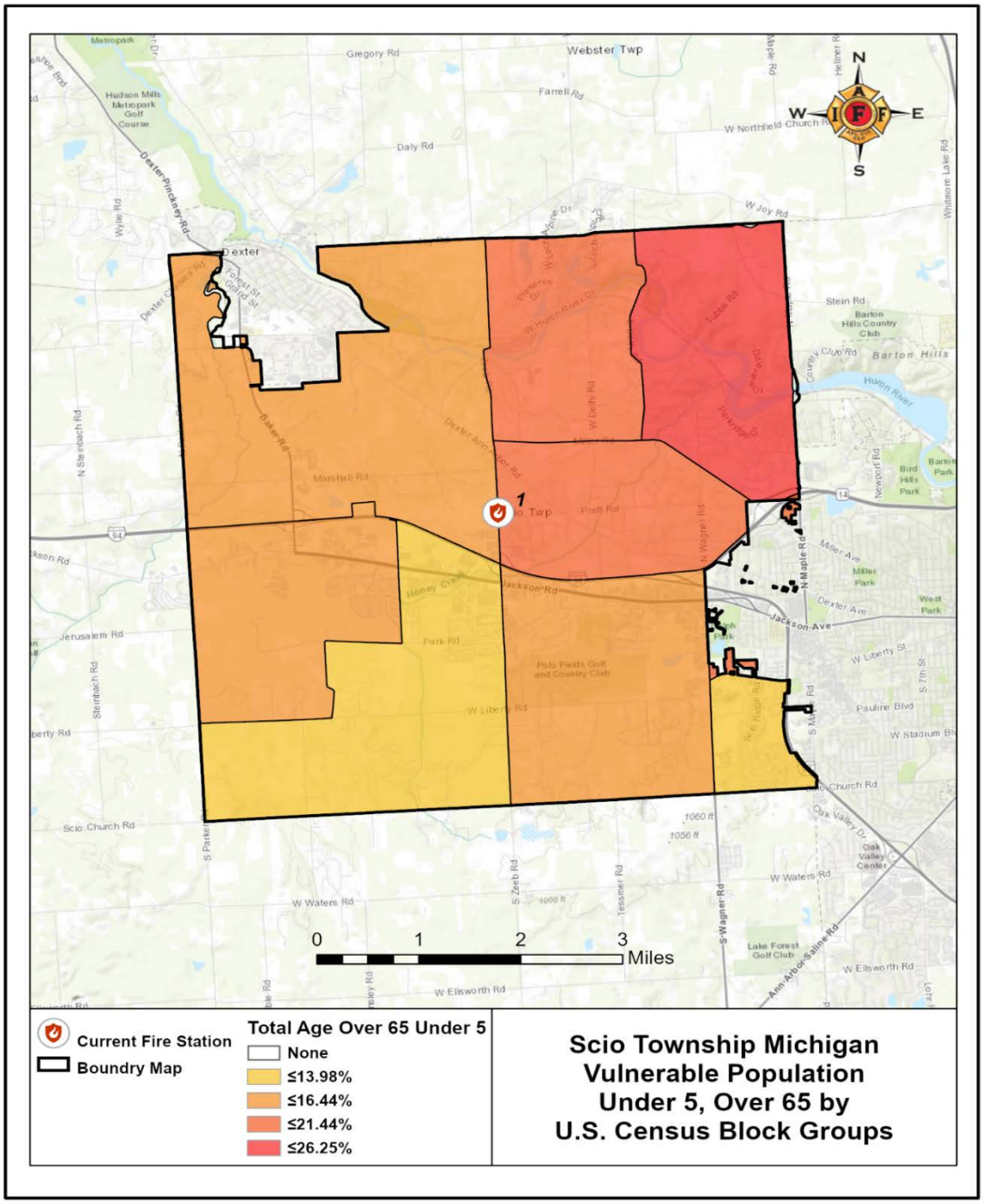
Map 1: Four-Minute Engine Response from Current Station 1. Currently, Scio Township Fire Department can cover 32.1% of all roads within four minutes. When staffed with 3 fire fighters, Scio Township can not assemble four fire fighters within four minutes to meet industry standard or OSHA regulations.



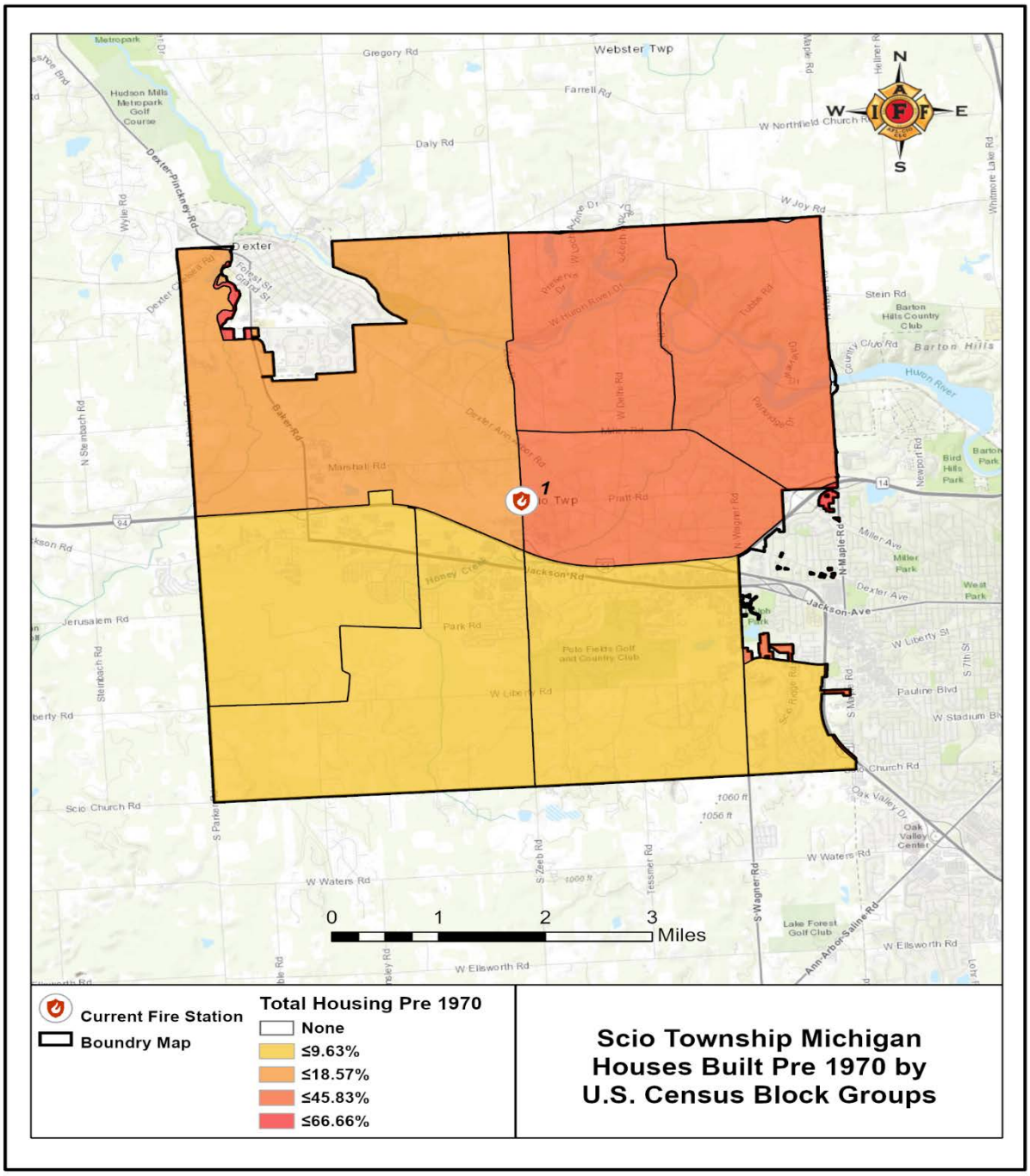
Map 2: 2020 Population Density by U.S. Census Block Groups. Map 2 depicts Scio Townships population density in 2020. Areas with high population density are likely to have a high volume of emergency incidents, resulting in a larger demand placed on the department in these areas.



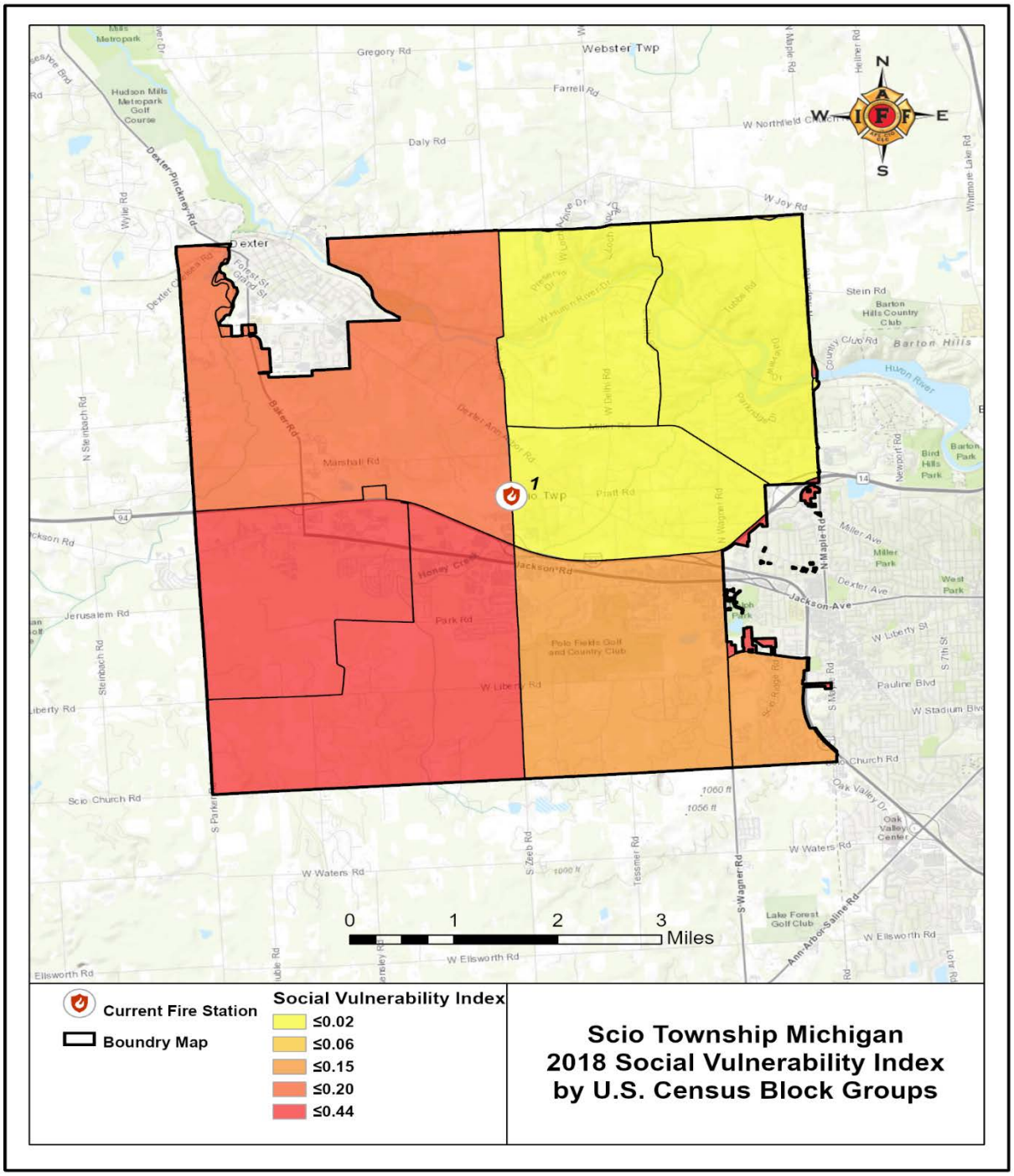
Map 3: 2020-2025 Population Growth Rate by U.S. Census Block Groups. Map 3 depicts the estimated annual population growth rate from 2020-2025. Areas that have a positive estimated population growth rate will likely experience an increase in emergency services requests. Typically, as population increases, so does demand.



Map 4: Vulnerable Population Under 5, Over 65 by U.S. Census Block Groups. Map 4 depicts the percentage of the population under 5 and over 65 years of age. Typically, these populatons are at a higher risk for injury or death because of their inability or reduced ability to evacuate in an emergency.



Map 5: Houses Built Pre 1970 by U.S. Census Block Groups. Map 5 depicts the percentage o fhousing units built before 1970. Tpically, when there are high numbers of older buildings constructed before many current fire codes were developed and poorly maintained properties, there is an increased demand on emergency services.



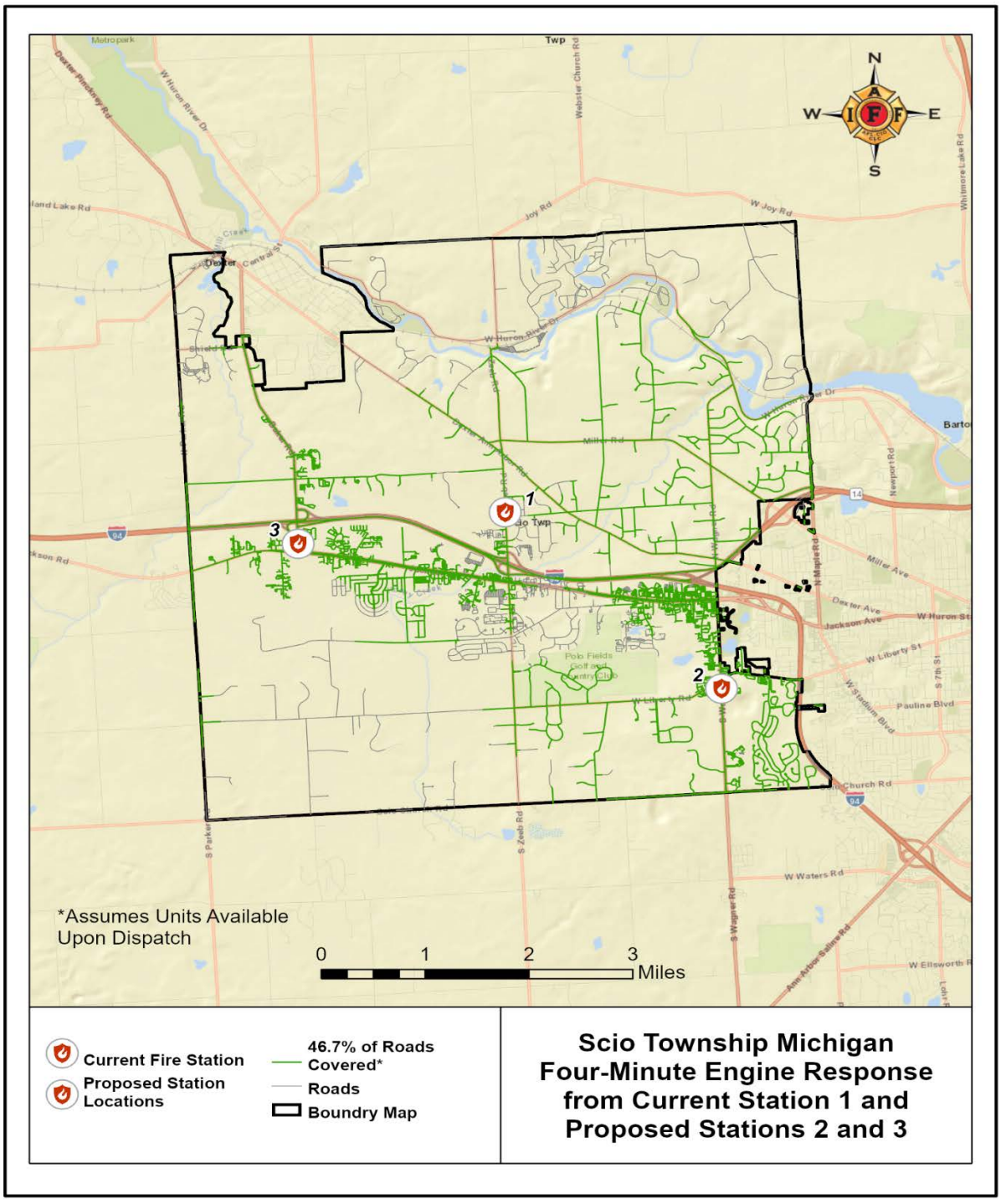
Map 6: 2018 Social Vulnerability Index by U.S. Census Block Groups. Map 6 identifies the percentage of the 2018 population living in social vulnerability broken down by census block groups for Scio Township. Social vulnerability combined census data categories of persons living with a disability, persons without health insurance, persons without the use of a vehicle, and where English is not the primary language spoken in households. The social vulnerability categories can increase the demand on emergency services and medical transportation

Table 2 below lists current station and proposed stations 2 and 3, apparatus, and minimum staffing on each apparatus.

Fire Station	Address	Apparatus	Staffing
Station 1	1055 N Zeeb	Engine 1	3
Proposed 2	Next to 857 S Wagner	Engine 2	3
Proposed 3	Next to 98 Baker Rd	Engine 3	3

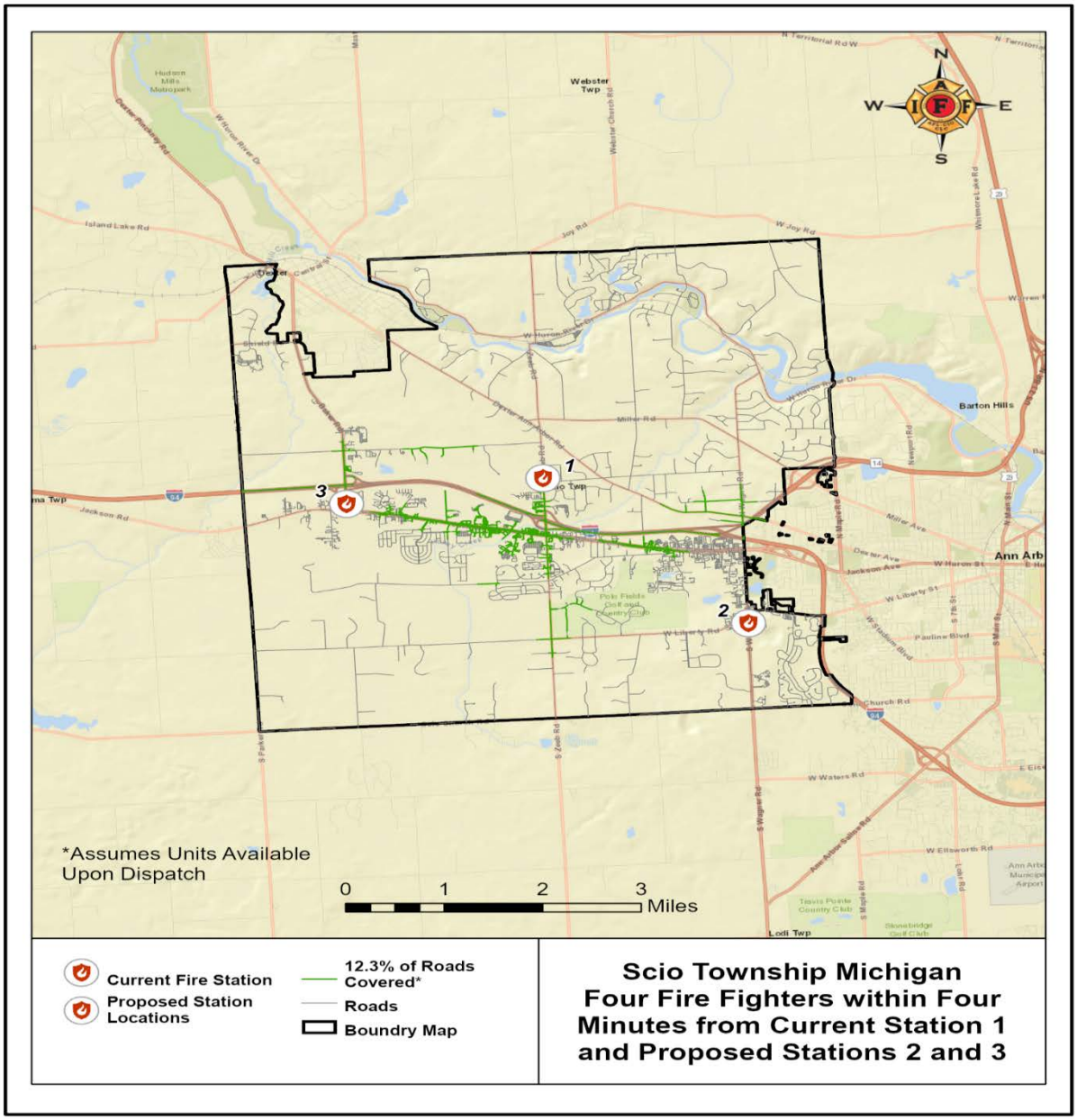
Table 2: Current and Proposed Staffed Fire Station Locations and Staffing. The above table displays where apparatus would be housed and how units would be staffed.[3]

[3] Data provided by Local 4891



Map 7: Four-Minute Engine Response from Current Station 1 and Proposed Stations 2 and 3. Map 7 identifies the roads Scio Township Fire Department could reach within four minutes of travel. NFPA 1710 requires that the first unit be on scen within four minutes of travel to 90% of incidents.[4] Units would be capable of responding on 46.7% of roads within the response area, assuming they are available to respond immediately upon dispatch.

[4] NFPA 1710 §4.1.2.1.3 and §4.1.2.1.7



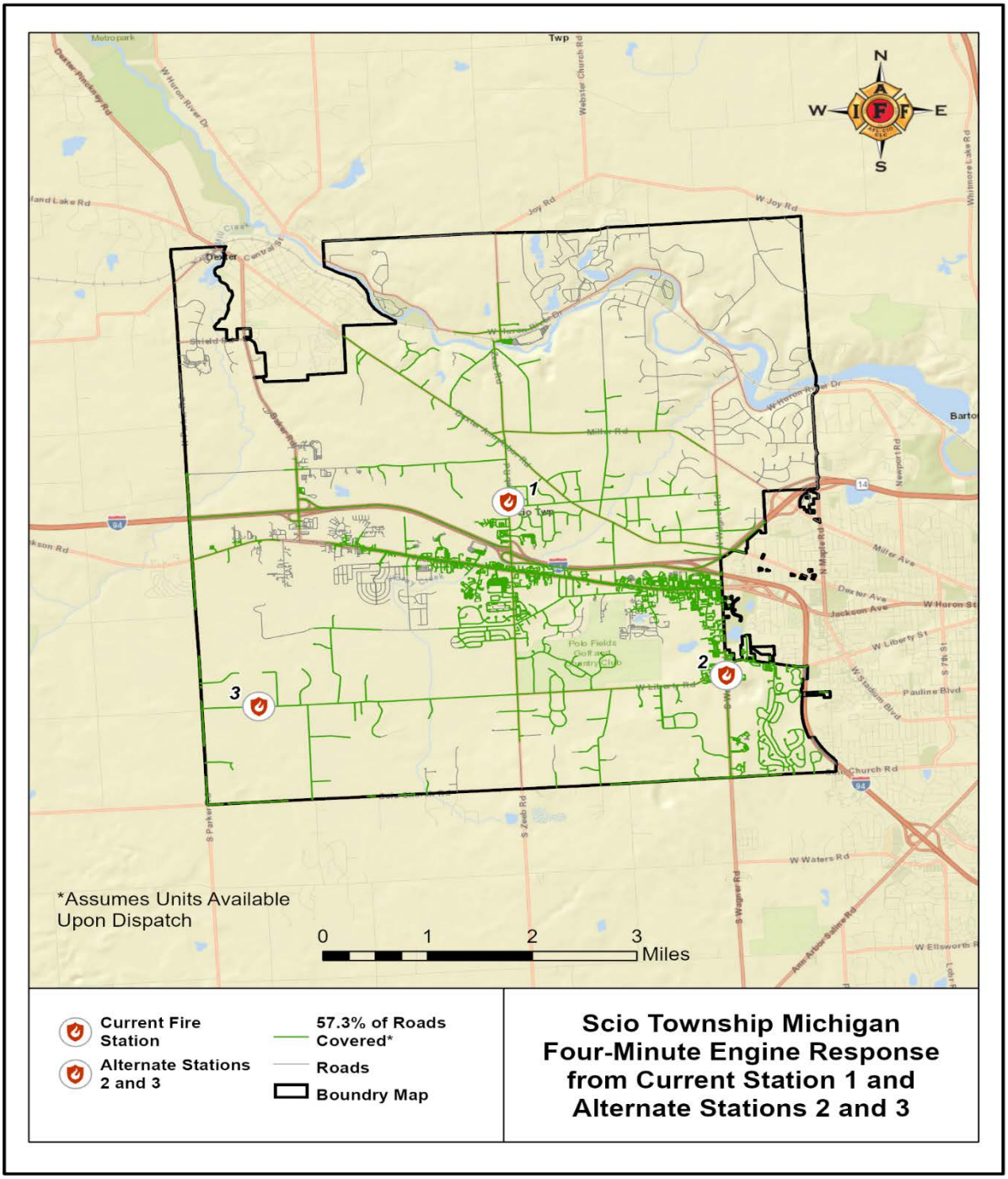
Map 8: Four Fire Fighters within Four Minutes from Current Station 1 and Proposed Stations 2 and 3. Map 8 identifies those roads where a minimum of four fire fighters can assemble on scene within four minutes of travel. The department would be capable of assembling a minimum of four fire fighters on 12.3% of the roads within four minutes. Since it is the intent to staff each station with three fire fighters, fire fighters must rely on supplemental personnel arriving later before making entry into environment that areimmediately dangerous to life and health, such as structure fires, in order to meet objectives outlined in industry standards and OSHA rules and regulations.[5]

[5] 29 CFR 1910.134(g)(4).

Table 3 below lists current station, proposed station 2, and alternate station 3, apparatus, and minimum staffing on each apparatus.

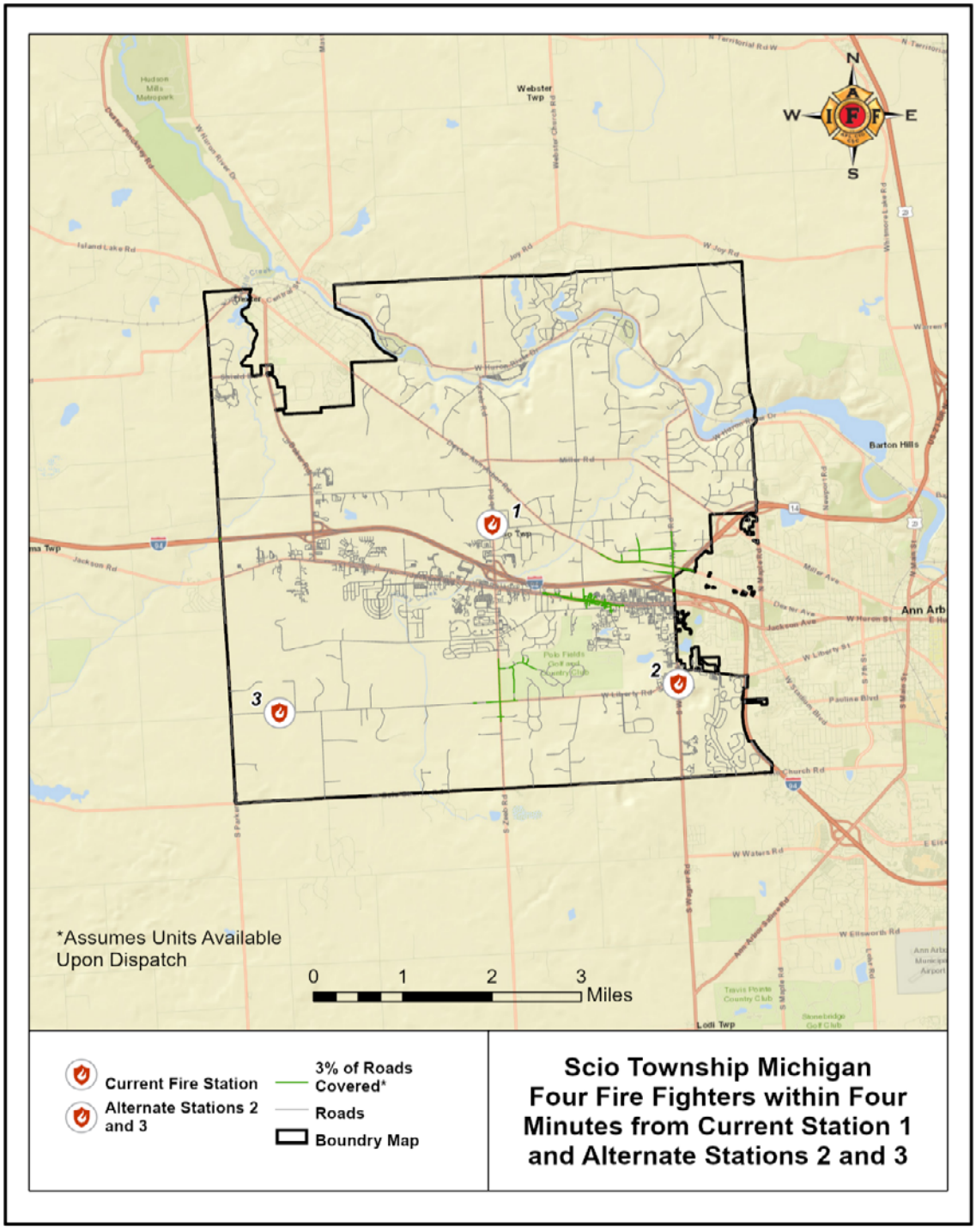
Fire Station	Address	Apparatus	Staffing
Station 1	1055 N Zeeb	Engine 1	3
Proposed 2	Next to 857 S Wagner	Engine 2	3
Alternate 3	Next to 7970 Liberty	Engine 3	3

Table 3: Current, Proposed Station 2, and Alternate Station 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and how units would be staffed.



Map 9: Four-Minute Engine Response from Current Station 1 and Alternate Stations 2 and 3. Map 9 identifies the roads Scio Township Fire Department could reach within four minutes of travel. NFPA 1710 requires that the first unit be on scen within four minutes of travel to 90% of incidents.[6] Under this scenario, units would be capable of responding on 57.3% of roads within the response area, assuming they are available to respond immediately upon dispatch.

[6] NFPA 1710 §4.1.2.1.3 and §4.1.2.1.7

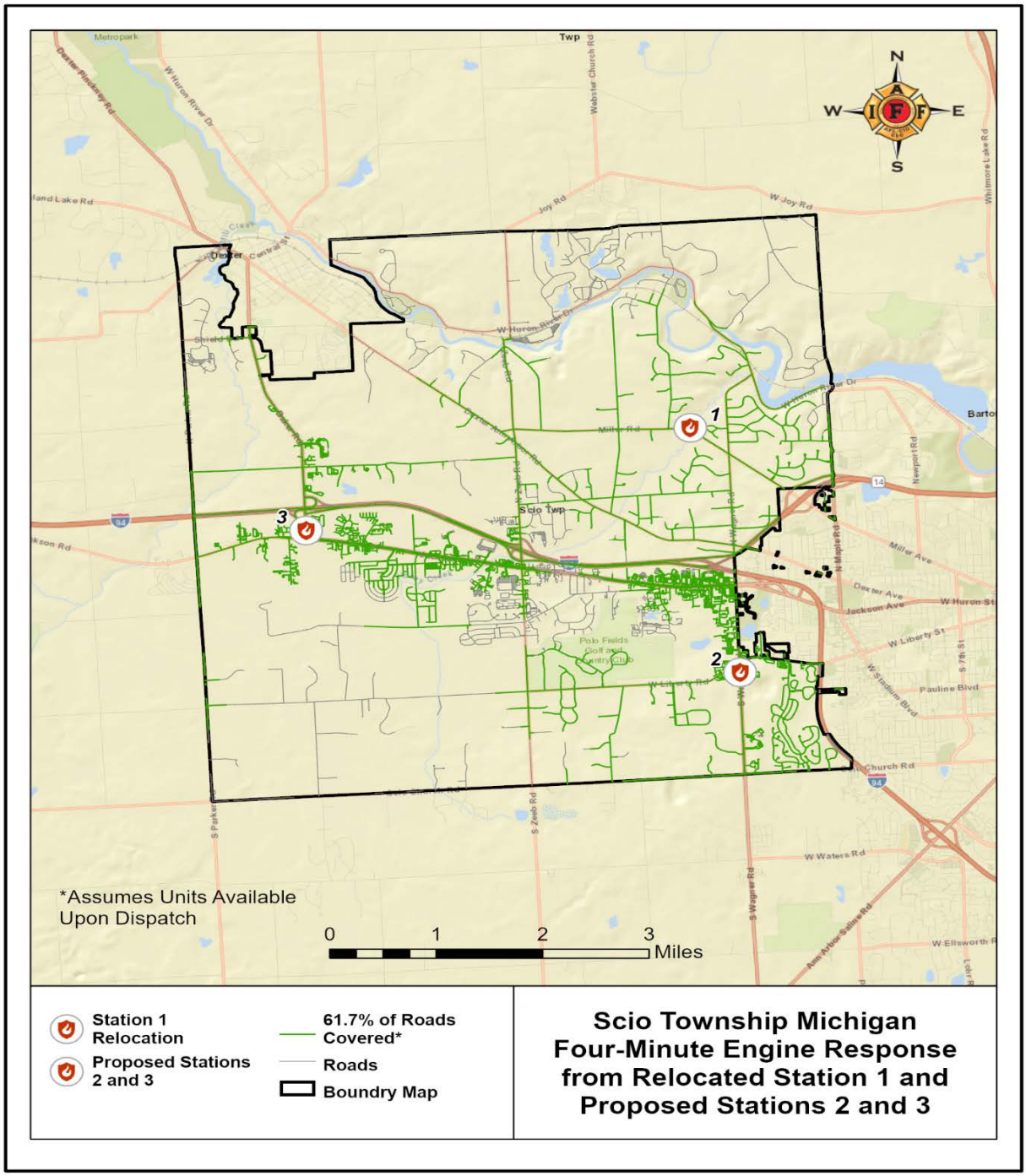


Map 10: Four Fire Fighters within Four Minutes from Current Station 1 and Alternate Stations 2 and 3. Map 10 identifies those roads within the department's response area where a minimum of four fire fighters can assemble on scene within four minutes of travel from alternate fire stations. The fire department would be capable of assembling at least four fire fighters on 3 % of roads within the response area within four minutes, assuming all apparatus are staffed, in the station, and available to respond immediately upon dispatch.

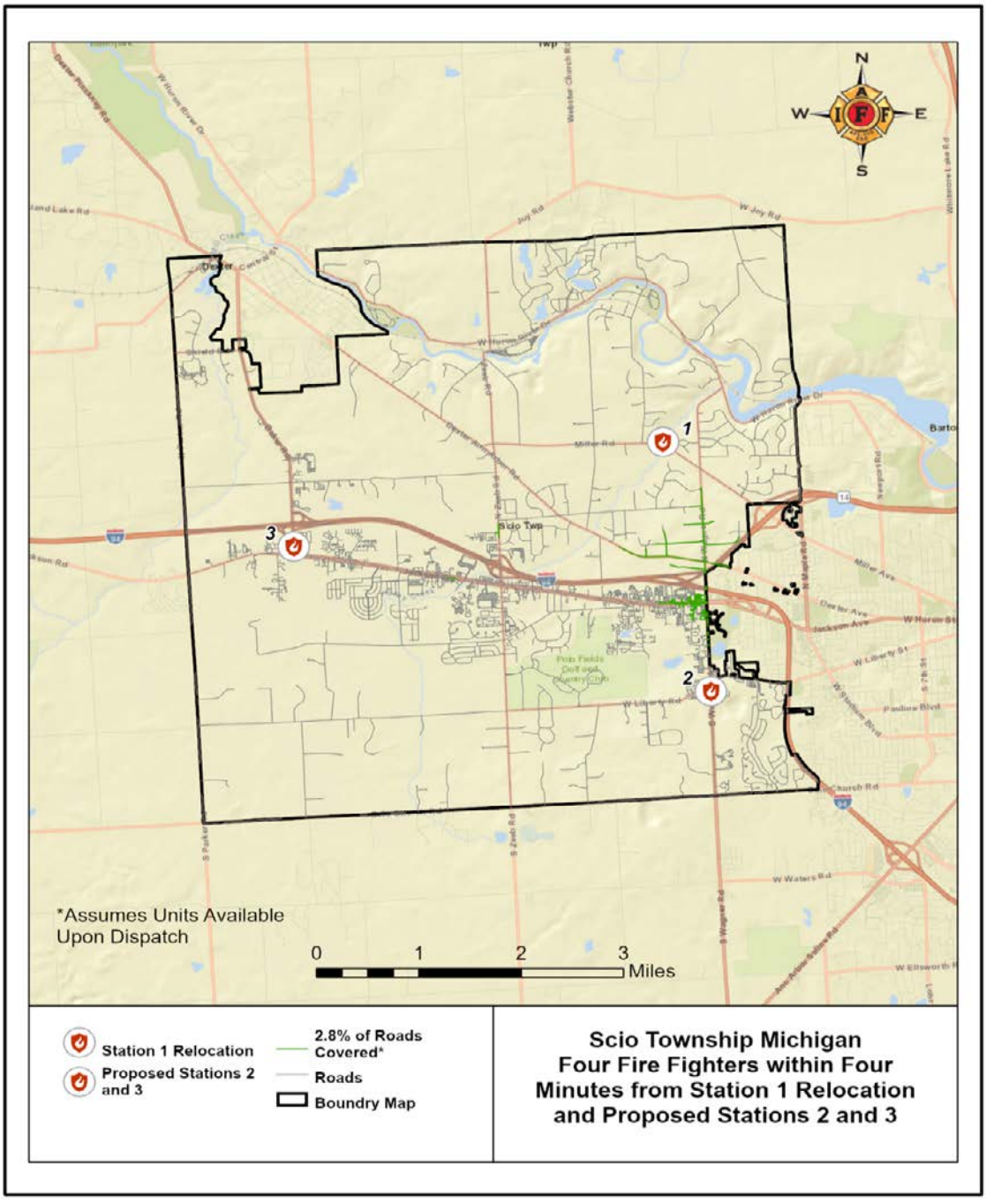
Table 4 below lists relocated station 1 and proposed stations 2 and 3, apparatus, and minimum staffing on each apparatus.

Fire Station	Address	Apparatus	Staffing
Relocated Station 1	42.309796, -83.820708	Engine 1	3
Proposed 2	Next to 857 S Wagner	Engine 2	3
Proposed 3	Next to 98 Baker Rd	Engine 3	3

Table 4: Relocated Station 1, Proposed Stations 2 and 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and how units would be staffed.



Map 11: Four-Minute Engine Response from Relocated Station 1 and Proposed Stations 2 and 3. Map 11 identifies the roads Scio Township Fire Department could reach within four minutes of travel with this station configuration. NFPA 1710 requires that the first unit be on scen within four minutes of travel to 90% of incidents.[7] Under this scenario, units would be capable of responding on 61.7% of roads within the response area, assuming they are available to respond immediately upon dispatch.



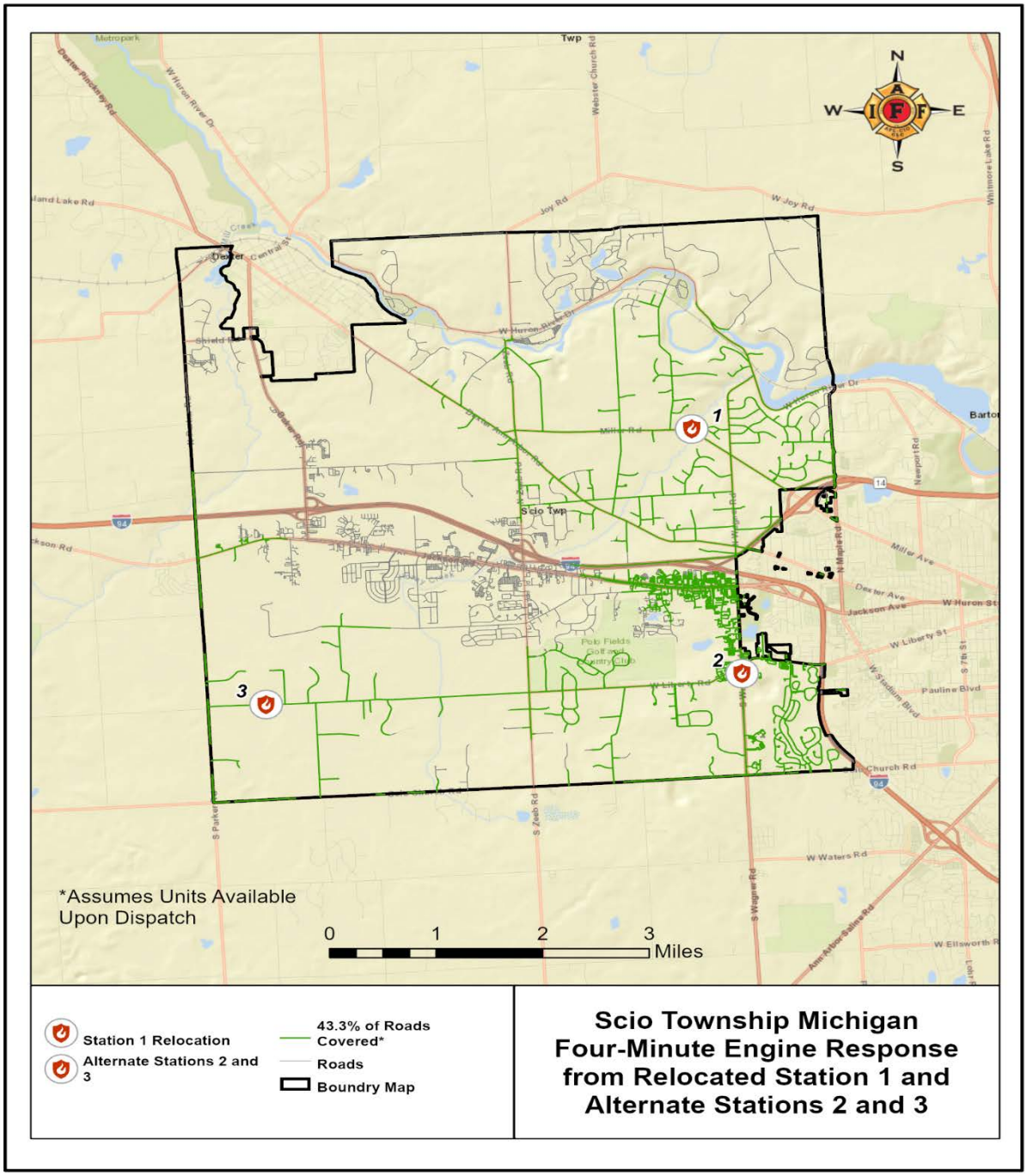
Map 12: Four Fire Fighters within Four Minutes from Station 1 Relocation and Proposed Stations 2 and 3. Map 12 identifies those roads within the department's response area where a minimum of four fire fighters could assemble on scene within four minutes of travel from relocated station 1 and proposed stations 2 and 3. The fire department would be capable of assembling at least four fire fighters on 2.8% of roads within the response area within four minutes, assuming all units are staffed, in the station, and available to respond immediately upon dispatch.

[7] NFPA 1710 §4.1.2.1.3 and §4.1.2.1.7

Table 5 below lists relocated station 1, proposed station 2, and alternate station 3, apparatus, and minimum staffing on each apparatus.

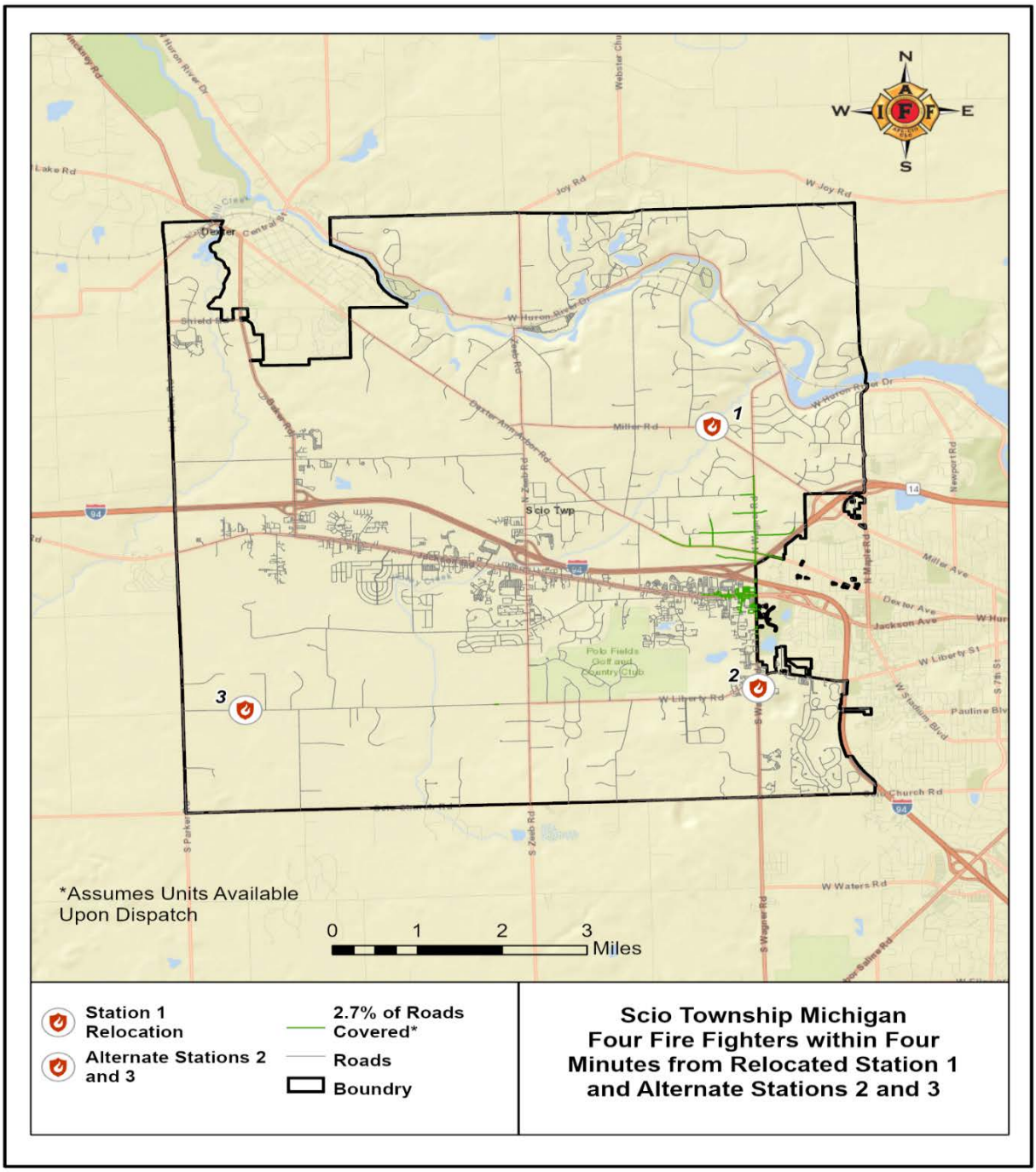
Fire Station	Address	Apparatus	Staffing
Relocated Station 1	42.309796, -83.820708	Engine 1	3
Proposed 2	Next to 857 S Wagner	Engine 2	3
Alternate 3	Next to 7970 Liberty	Engine 3	3

Table 5: Relocated Station 1, Proposed Station 2, and Alternate Station 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and how units would be staffed.

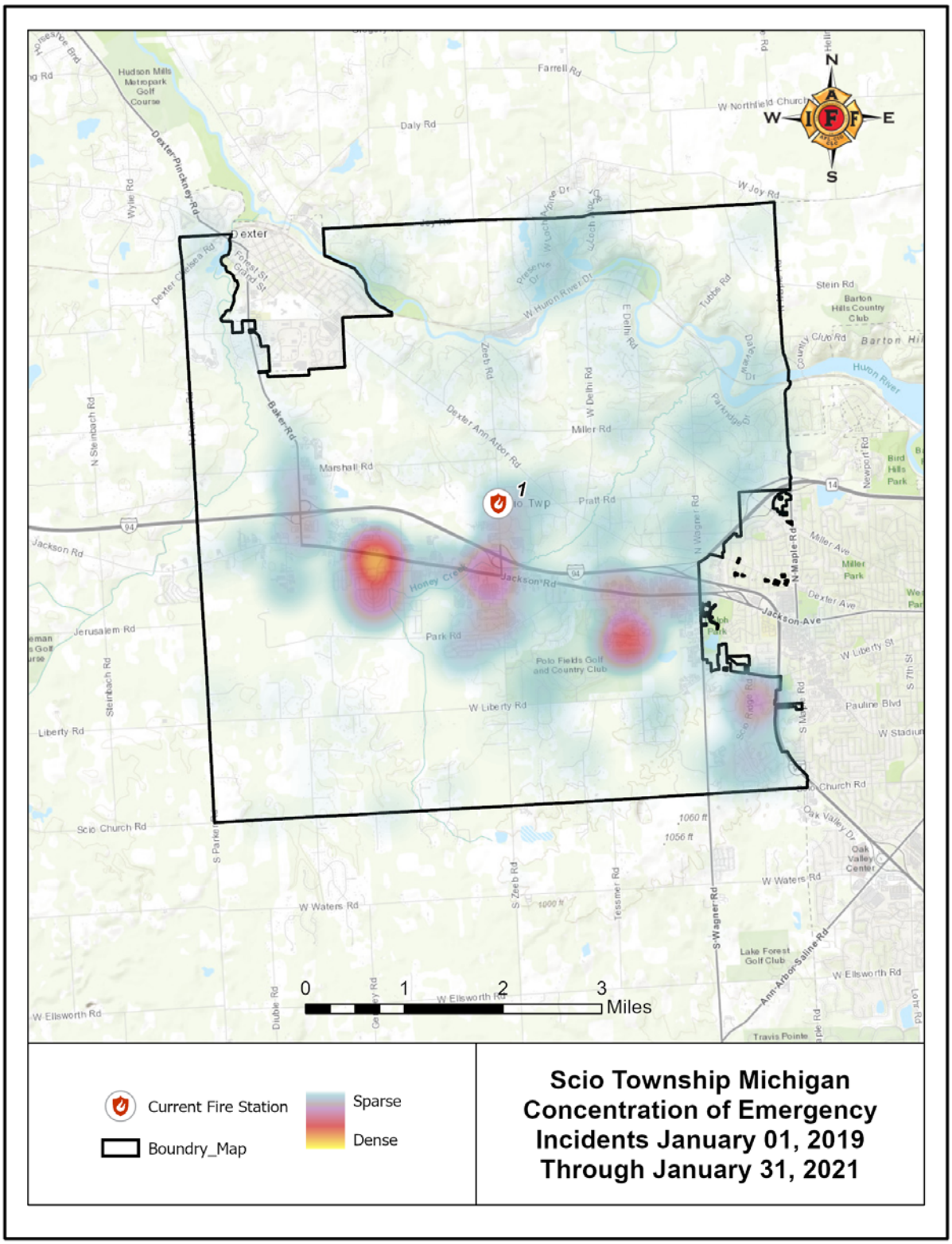


Map 13: Four-Minute Engine Response from Relocated Station 1 and Alternate Stations 2 and 3. Map 13 identifies the roads Scio Township Fire Department could reach within four minutes of travel. NFPA 1710 requires that the first unit be on scen within four minutes of travel to 90% of incidents.[8] Under this scenario, units would be capable of responding on 43.3% of roads within the response area, assuming they are available to respond immediately upon dispatch.

[8] NFPA 1710 §4.1.2.1.3 and §4.1.2.1.7



Map 14: Four Fire Fighters within Four Minutes from Station 1 Relocation and Alternate Stations 2 and 3. Map 14 identifies those roads within the department's response area where a minimum of four fire fighters could assemble on scene within four minutes of travel from relocated station 1 and alternate stations 2 and 3. The fire department would be capable of assembling at least four fire fighters on 2.7% of roads within the response area within four minutes, assuming all units are staffed, in the station, and available to respond immediately upon dispatch.



Map 15: Concentration of Emergency Incidents January 1, 2019 Through January 31, 2021. Map 15 depicts the concentration of incidents from January 01, 2019 to January 31, 2021. The highest concentration of incidents would be best covered from the current station 1 and proposed station 2 and 3.

Recommendations

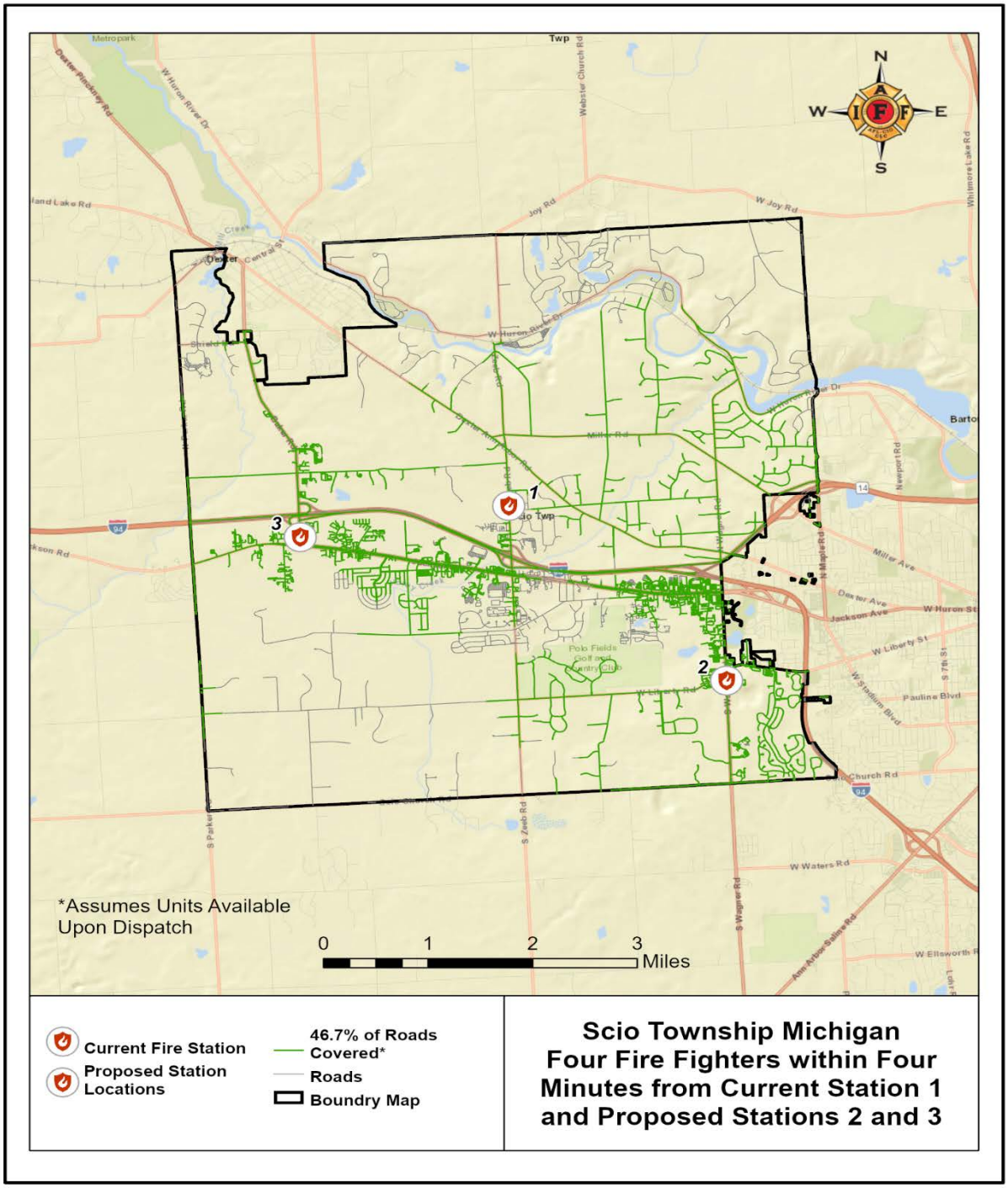
According to NFPA® 1710 engine companies shall be staffed with a minimum of four on-duty members.[9] It was expressed that the intent of Scio Township Fire Department was to staff each engine with three members, which does not meet the standard set forth by NFPA®. Therefore, the IAFF recommends staffing each engine to the standard, four fire fighters, not only to provide better response to the community, but also to ensure that fire fighters are able to mitigate emergencies safely.

By increasing staffing on each engine from three to four fire fighters, Scio Township will be able to assemble four fire fighters, and cover a greater percentage of the roads within four minutes. The current proposal of three fire fighters per engine, only allows for Scio Township assemble four fire fighters within four minutes on 2.7% to 12.3% of the roads. Increasing staffing on each engine, to four fire fighters, will allow for assembly of four fire fighters within four minutes on 43.3% to 61.7% of the roads.

[9] NFPA 1710 5.2.3.1.2

Fire Station	Address	Apparatus	Staffing
Station 1	1055 N Zeeb	Engine 1	4
Proposed 2	Next to 857 S Wagner	Engine 2	4
Proposed 3	Next to 98 Baker Rd	Engine 3	4

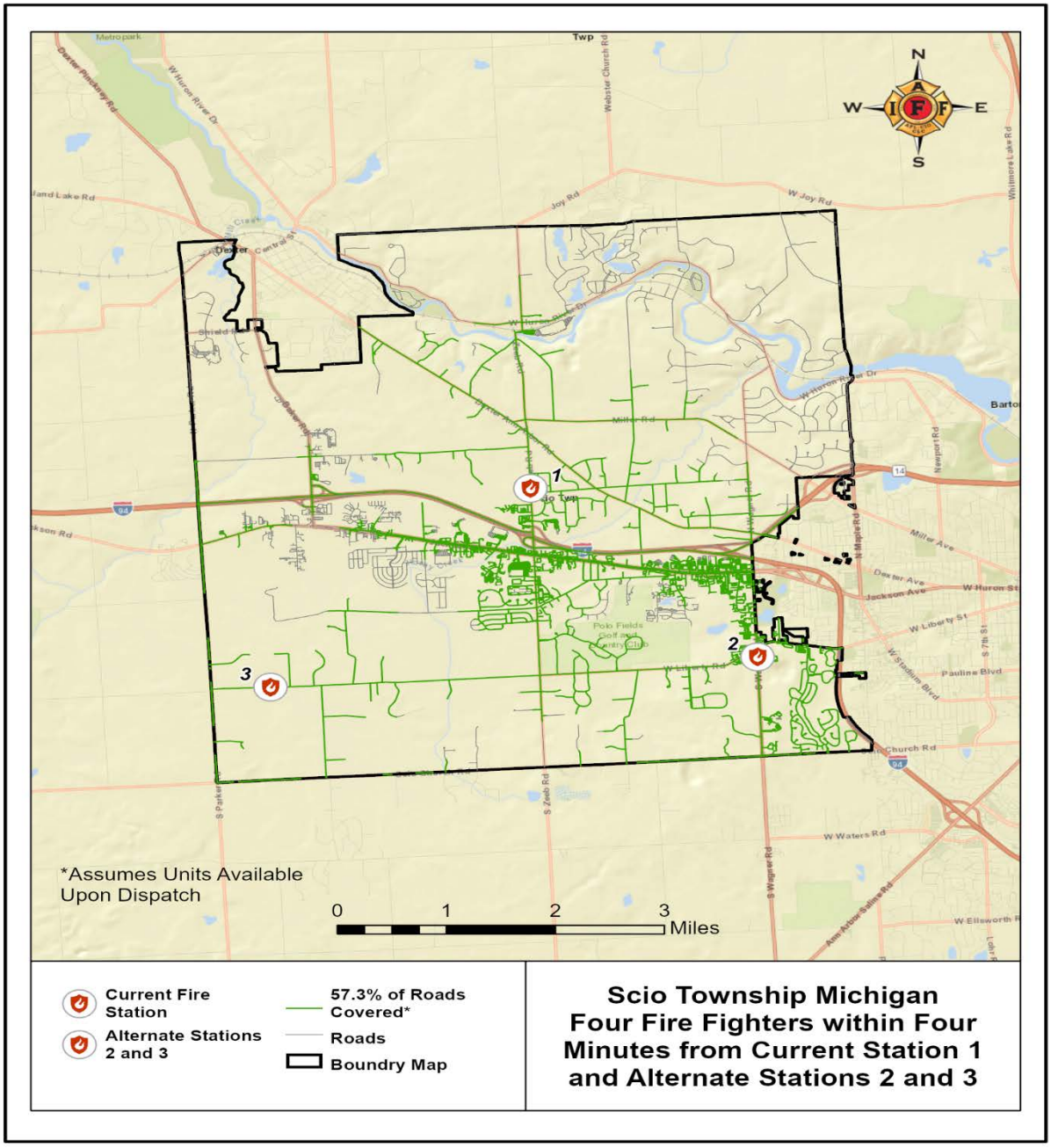
Table 6: Current Station 1, Proposed Stations 2 and 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and recommended staffing for each unit.



Map 16: Four Fire Fighters within Four Minutes from Current Station 1 and Proposed Stations 2 and 3. Map 16 identifies those roads where a minimum of four fire fighters can assemble on scene within four minutes of travel, when each engine is staffed with four fire fighters. The department would be capable of assembling a minimum of four fire fighters on 46.7% of the roads within four minutes.

Fire Station	Address	Apparatus	Staffing
Station 1	1055 N Zeeb	Engine 1	4
Proposed 2	Next to 857 S Wagner	Engine 2	4
Alternate 3	Next to 7970 Liberty	Engine 3	4

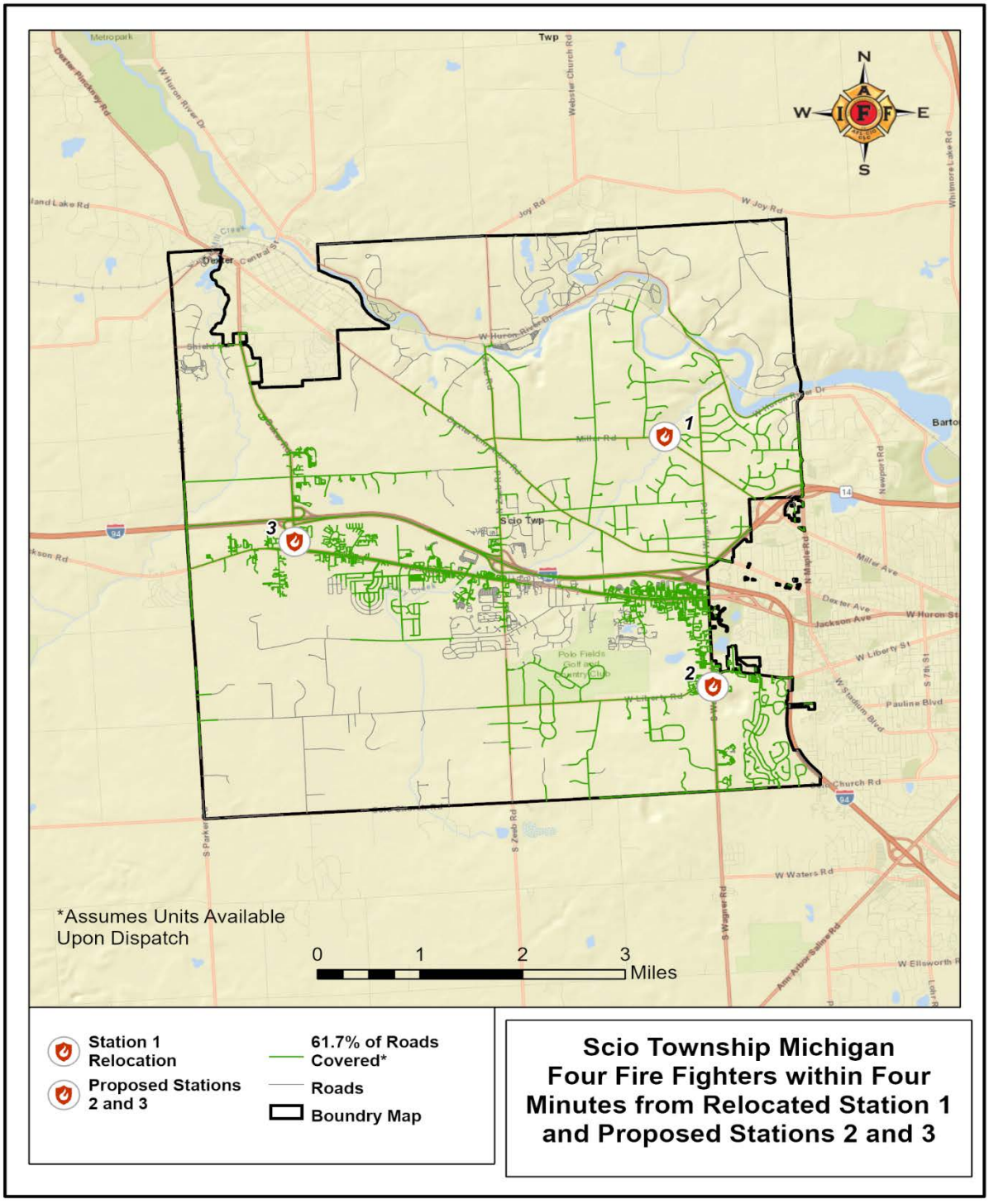
Table 7: Current Station 1, Proposed Station 2, and Alternate Station 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and recommended staffing for each unit.



Map 17: Four Fire Fighters within Four Minutes from Current Station 1 and Proposed Stations 2 and 3. Map 17 identifies those roads where a minimum of four fire fighters can assemble on scene within four minutes of travel, when each engine is staffed with four firefighers. The department would be capable of assembling a minimum of four fire fighters on 57.3% of the roads within four minutes.

Fire Station	Address	Apparatus	Staffing
Relocated Station 1	42.309796, -83.820708	Engine 1	4
Proposed 2	Next to 857 S Wagner	Engine 2	4
Proposed 3	Next to 98 Baker Rd	Engine 3	4

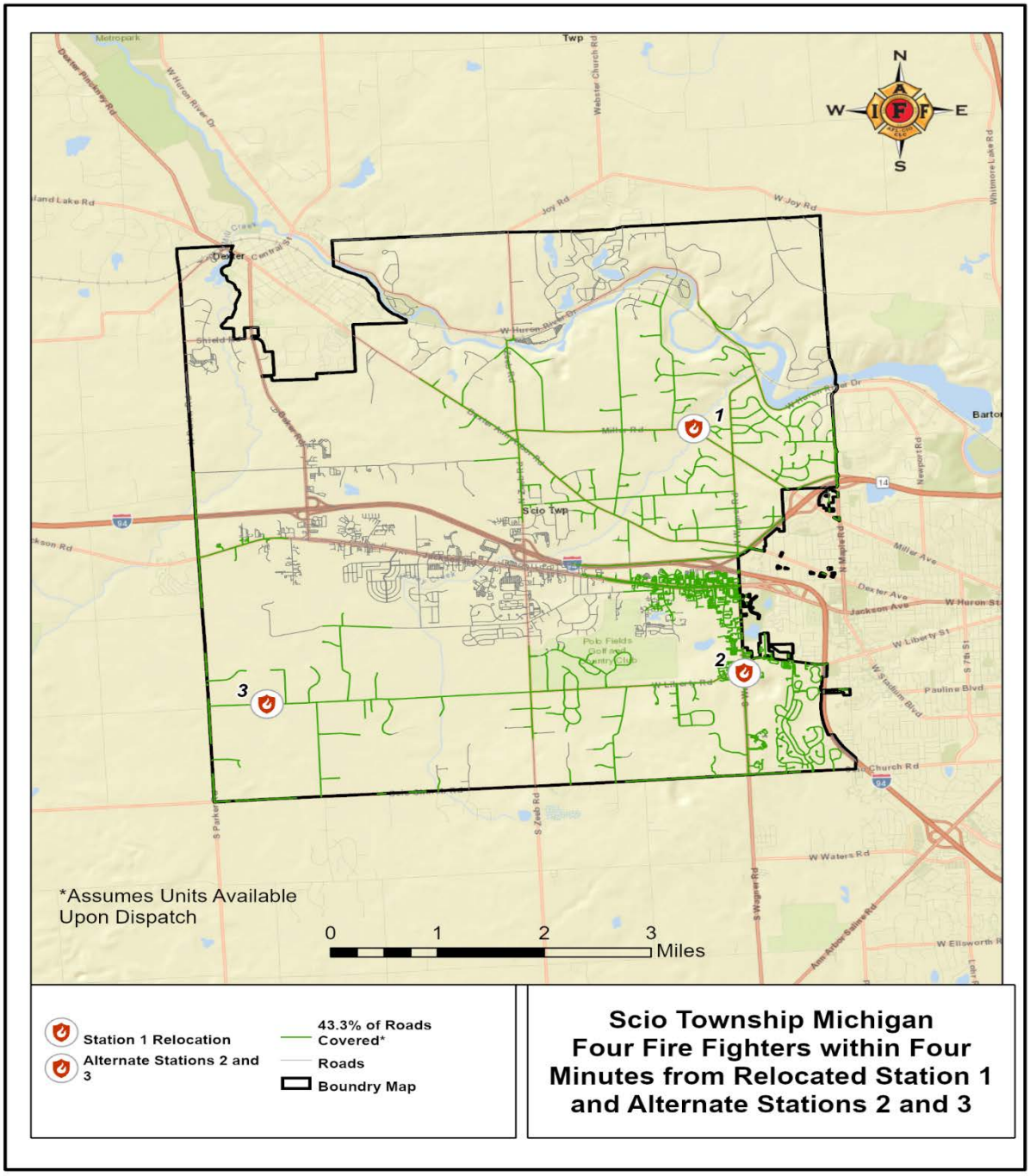
Table 8: Relocated Station 1, Proposed Stations 2 and 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and recommended staffing for each unit.



Map 18: Four Fire Fighters within Four Minutes from Current Station 1 and Proposed Stations 2 and 3. Map 18 identifies those roads where a minimum of four fire fighters can assemble on scene within four minutes of travel, when each engine is staffed with four fire fighters. The department would be capable of assembling a minimum of four fire fighters on 61.7% of the roads within four minutes.

Fire Station	Address	Apparatus	Staffing
Relocated Station 1	42.309796, -83.820708	Engine 1	4
Proposed 2	Next to 857 S Wagner	Engine 2	4
Alternate 3	Next to 7970 Liberty	Engine 3	4

Table 9: Relocated Station 1, Proposed Station 2, and Alternate Station 3 Fire Station Locations and Staffing. The above table displays where apparatus would be housed and recommended staffing for each unit.



Map 19: Four Fire Fighters within Four Minutes from Current Station 1 and Proposed Stations 2 and 3. Map 19 identifies those roads where a minimum of four fire fighters can assemble on scene within four minutes of travel, when each engine is staffed with four fire fighters. The department would be capable of assembling a minimum of four fire fighters on 43.3% of the roads within four minutes.

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Printed in-house OPEIU by OPEIU Local 2

EMERGENCY SERVICES CONSULTING INTERNATIONAL

Scio Township, Michigan

FIRE DEPARTMENT STAFFING NEEDS AND DEPLOYMENT ASSESSMENT

May 2018

Emergency Services Consulting International

25030 SW Parkway Avenue, Suite 330 • Wilsonville, OR 97070 • 1.800. 757.3724
www.esci.us

CONTENTS

ACKNOWLEDGEMENTS

Emergency Services Consulting International (ESCI) would like to acknowledge that without the assistance and support of the Scio Township elected officials, administrative team, and personnel of the Scio Township Fire Department this project could not have been successfully completed.

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Scio Township Fire Department

Jon Ichesco, Director of Fire Services
Doug Armstrong, Interim Fire Chief

EXECUTIVE SUMMARY

Emergency Services Consulting International (ESCI) was engaged by the Scio Township Fire Department (STFD) to conduct an assessment of the department's current and future staffing and deployment needs. As with other surrounding communities in the Ann Arbor suburban region, the STFD has experienced a loss of participation by paid-on-call firefighters and has insufficient career staff to make up the deficit; particularly during weekday response. As call volume has increased and with several large housing developments and new businesses preparing to begin building in the Township, safe and effective service delivery has been increasingly compromised by the lack of manpower.

The beginning is the most important part of the work.

An evaluation of the current conditions and capabilities of STFD was conducted, and the results used to provide an evaluation of the organization, staffing, and service delivery capabilities. This report serves as the culmination of the project and provides an evaluation of service level and financial impact of additional staffing. Additionally, a narrative example for the Assistance to Firefighters SAFER Grant application is provided.

Using organizational, operational, staffing, and geographic information system (GIS) models, an evaluation of existing fire and rescue operations and recommendations for improvement in current services delivered to the community. The evaluation and analysis of data and other information is based on National Fire Protection Association (NFPA) standards, the Center for Public Safety Excellence/Commission on Fire Accreditation International (CPSE/CFAI) *Standards of Cover*, 6th edition, health and safety requirements, federal and state mandates relative to emergency services, and generally accepted best practices within the emergency services community; where applicable.

Each section in the following report provides the reader with general information about that element, as well as observations and analyses of any significant issues or conditions. Observations are supported by data provided by each organization and collected as part of the review and interview process. Finally, specific recommendations are included to address identified issues or to take advantage of opportunities that may exist.

It is important to bear in mind that these were the current conditions at the time of the data collection and on-site visit. The agency is continuing to change and improve over the time required to write the report, therefore not every current condition remains as stated here.

Major Findings

- Scio Township Fire Department is unable to meet NFPA 1720 standards for staffing and deployment. The current staffing of two firefighters per shift is half the recommended staffing for an engine company and does not allow for the department to satisfy Michigan statute regarding on scene personnel requirements for interior firefighting operations without the assistance of neighboring agencies. The department's dependence on mutual aid response for interior firefighting and other operations requiring more than two personnel dramatically impact the department's ability to provide effective fire and rescue services and potentially increase the likelihood of accidents and injuries due to low staffing levels.
- The practice of relying on paid-on-call personnel responding from home or work to increase staffing levels for emergency response is no longer a viable option for the department. Based on staffing and run report records, additional staffing from unscheduled staff to incident scenes is nearly nonexistent.

- The current staffing and deployment model used by the fire department prevents effective interoperability with neighboring agencies, reducing the likelihood of the seamless integration of resources on emergency scenes, and the potential for automatic aid agreements that could dramatically enhance on scene staffing levels.
- The current organizational design of the fire department is ineffective as it does not align with national recommendations for rank and structure, is ambiguous in regard to which position is in charge during daily operations and emergency scenes, and does not align with neighboring agencies. This reduces the department's efficiency, effectiveness, and firefighter safety.
- The department should investigate options for increasing staffing levels and modify its current organizational design to align with national consensus standards.

Summary

The Scio Township Fire Department possesses multiple opportunities for improvements to organizational design and deployment. Key areas of improvement included: a lack of adequate operational, training, prevention, and administrative staff; response metrics that exceed national consensus standards; and standard operational guidelines for medium and high-risk mutual and automatic aid responses.

ESCI thanks the Board of Trustees, the Township Manager, Director of Fire Services, Interim Fire Chief, and personnel from the Scio Township Fire Department for their outstanding cooperation in the preparation of this report. All involved were candid in their comments and provided a tremendous amount of essential information.

EVALUATION OF CURRENT CONDITIONS

Organizational Overview

The Organizational Overview component provides a review of the organization, discussing the agency's configuration and the services that it provides. Data provided by the Scio Township Fire Department (STFD) leadership and Washtenaw County emergency services partners was combined with information collected in the course of ESCI's fieldwork to develop the following overview.

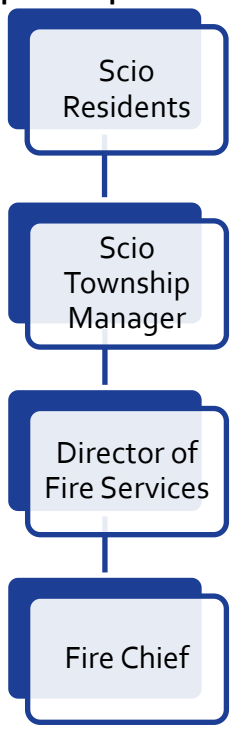
The purpose of this section is two-fold. First, it verifies ESCI's understanding of the agency's composition and operation. This provides the foundation from which the *Staffing Needs and Deployment Assessment* is developed.

Secondly, the overview serves as a reference for any reader who may not be entirely familiar with the details of the agency's operations. Where appropriate, ESCI includes recommended modifications to current observations based on industry standards and best practices.

Governance

The very basis of any service provided by governmental or quasi-governmental agencies lies within the policies that give that agency the responsibility and authority upon which to act. In most governmental agencies, including Scio Township, those policies lie within the charters, ordinances, and other governing documents adopted by the agency. The following figure provides a general overview of Scio's governing structure and lines of authority elements.

Figure 1: Scio Township Fire Department Governing Structure



DISCUSSION

Scio Township is a legally established government under the laws of the State of Michigan and as such is recognized as a "local government." The authorities of Scio Township are provided under the Constitution of the State of Michigan, and as such Scio Township has the ability to establish and operate the fire-rescue services. Scio Township established Scio Township Fire Department in 1998. The Township Board consists of seven elected members: the Township Supervisor—the official head of government, the Clerk, and Treasurer, and four Trustees. The Supervisor convenes a formal Board meeting twice per month. The Township's daily operations are under the direction of a Township Manager who reports directly to the Township Board.

Organizational Design

The structural design of an emergency services agency is vitally important to its ability to deliver service in an efficient and timely manner while providing the necessary level of safety and security to the employees of the organization, whether career, paid-on-call, or volunteer. During an emergency, an individual's ability to supervise multiple personnel is diminished due to the risk consequences associated with emergency incidents. As a result, industry standards recommend a span of control of four to six personnel under high-risk situations. This is an operational concept carried forward from military history and has shown to be effective in emergency services situations.

Additionally, employees tend to be more efficient when they know to whom they report and have a single point of contact for supervision and direction. A recent research project conducted by the Columbia University, Northwestern University, and University of Queensland, Australia, found that,

> …when there are tasks that require teamwork, people get more done when there are leaders and followers. Without a clear chain of command, members often become sidetracked with grabbing power and lose track of the task at hand.[1]

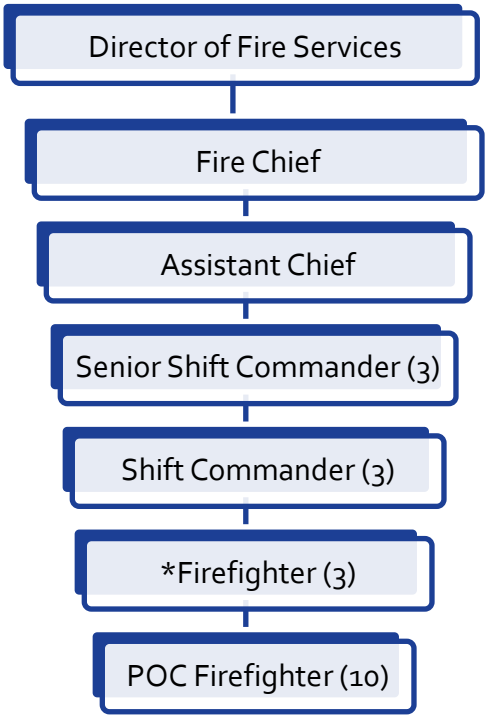
Organizational Structure

To operate effectively, the structure of a fire department needs to be clearly defined in the form of an organizational chart. The chart institutionalizes the agency's hierarchy, identifies roles and, most importantly, reporting authority. An organizational chart also helps to assure that communication flows appropriately and limits opportunities to circumvent the reporting structure.

At the initiation of the report, Scio had not formally adopted an organizational chart that achieved this purpose; however, since that time, work commenced to adopt an effective operational structure and is illustrated in the next figure.

[1] "Why Hierarchies are Good for Productivity," Inc. September 2012, p 26.

Figure 2: STFD Organizational Structure



* Future Position

DISCUSSION

While not formally adopted, the operating structure observed by the ESCI during the site visit is representative of most other fire departments across the United States. The department operates in a traditional top-down manner and lines of authority are clear. However, the position of Shift Commander does not have a defined correlating rank and in interviews with many members of the department there is much confusion about specific roles and responsibilities. Typically, the shift commander is a "function" of a single individual holding the rank of a promoted position. The formal adoption of an organizational structure, such as the structure suggested by NFPA 1720, would provide several benefits to the organization and its membership, as well as enhance the interoperability of the STFD with neighboring agencies who currently operate using the NFPA 1720 model.

The lines of authority of the department should be carefully protected against communications external to the chain of command except in unusual circumstances. When the chain of command is violated, it can cause a great deal of disruption to the organization. Additionally, since the initiation of the report, Scio Township Fire Department has contracted with ESCI's Human Capital Division to conduct a formal job task analysis of all positions within the organization and establish a reporting structure resulting from a formal promotional process.

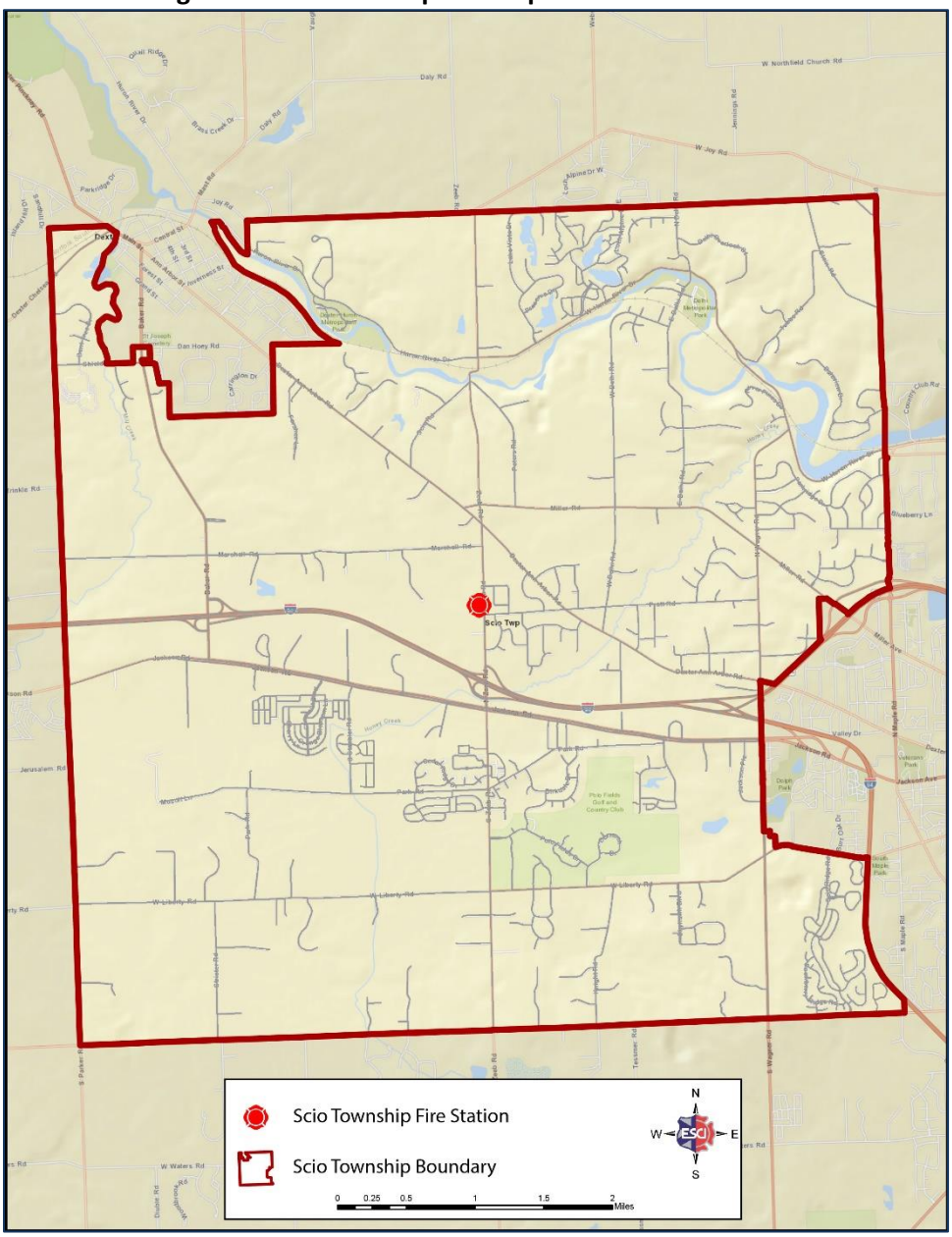
History, Formation, and General Description of the Scio Township Fire Department

The Scio Township Fire Department was formed in 1988 after separating from the Dexter Area Fire Department. The current fire station was constructed in 1986 by Scio Township and operated by Dexter Area Fire Department. At the time of this report, the Scio Township Fire Department operates a three-platoon career department augmented by paid-on-call staff. The department is under the direction of the Fire Services Director who in turn is responsible to the Township Manager.

Service Area Population and Demographics

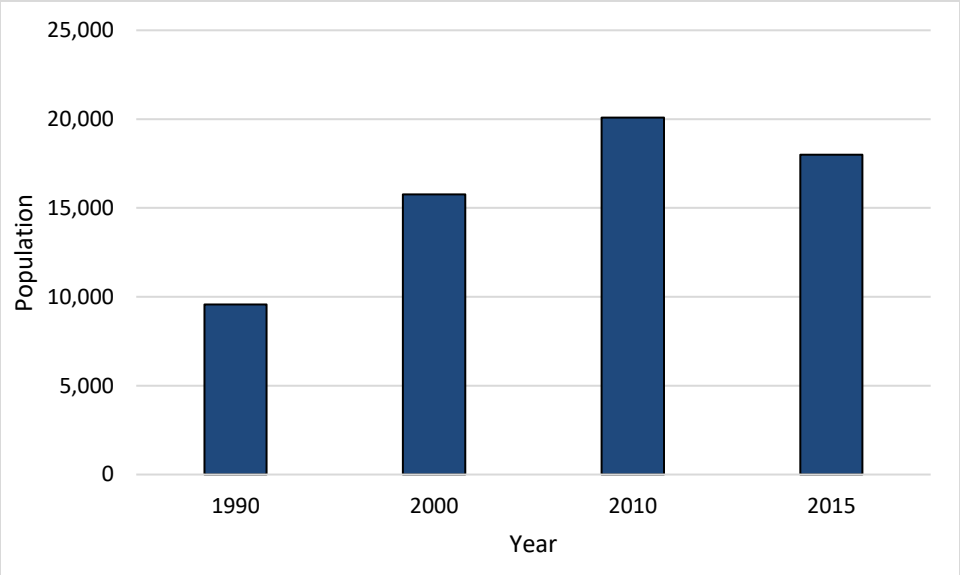
The size and composition of a fire department's service area affects the type and number of personnel, fire stations, and vehicles needed to provide services efficiently. Sometimes complex decisions need to be made regarding deployment strategies employed to properly position resources based on land area, geography, risk, and similar factors. The following is a summary of the Scio service area and service infrastructure resources.

Figure 3: Scio Township Fire Department Service Area



In the following figure, the historical population totals for Scio Township based upon U.S. Census data is displayed.

Figure 4: Scio Township Historical Population



DISCUSSION

Scio Township Fire Department serves a 34 square mile jurisdiction from a single fire station located in the geographical center of the Township serving areas that can be defined urban, suburban, and rural as classified by NFPA 1720. Decisions on deployment define the response capability of the fire department. These decisions need to weigh multiple considerations including risk exposure, response times, access challenges, deployment, community expectations, personnel safety, and fire department capacity while maintaining balance with the organization's financial considerations. Finally, these decisions are strategic and are in the purview of the STFD Board in consultation with the Fire Services Director and Fire Chief. Ultimately these individuals are responsible to the public to provide the level of service the citizens desire and for which they are willing to pay.

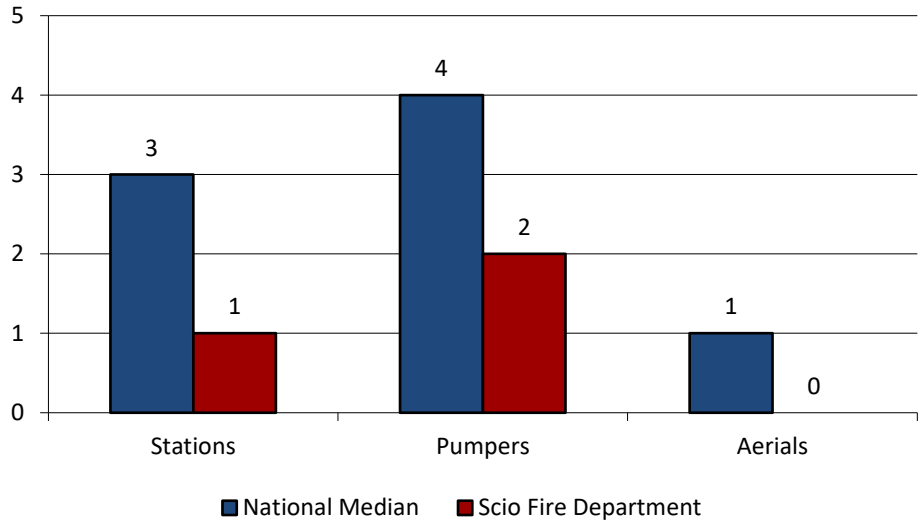
A full range of options should be considered to properly establish an appropriate deployment model. On the one end of the spectrum would be the current arrangement with one fire station covering the entire jurisdiction. This single station deployment model requires the department to house enough apparatus and personnel to support all calls simultaneously within the Township. Obviously to reach an incident on the outer edges of the service area requires the time to travel from the single station. On the other extreme is one station serving a one (1) square mile area. The time to arrive on the scene would be very short, but the apparatus and personnel would need to be replicated in each station to be able to provide the service, but at a significantly higher cost. The governing body's responsibility as representatives of the citizens is to determine how quickly an effective crew should arrive to handle the emergency. This process must provide an analysis of the risk tolerance of the community, types of risks, accessibility obstacles, and financial capability. There are standards and industry accepted norms that can help with the decision but ultimately it is the governing body's decision. This report will describe factors that should be considered to define the desired response performance.

The area served by Scio Township Fire Department is in transition as the economy improves and businesses have begun to relocate to the area. The fire department provides traditional fire-based services to the community, including first responder emergency medical service, but does not offer ambulance transport. Scio's most recent ISO grading resulted in a split rating of Class 5/8b. It is reasonable to expect any changes in the response area make-up will have an impact on this and should be considered in future planning efforts.

Current Service Delivery Infrastructure

The Scio Township Fire Department operates from a single station located in the center of the community with two fire engines (pumpers). The following figure provides a graphical representation of the number of stations, engines (pumpers), and aerials operated by STFD. The graphic does not serve as a definitive answer as to the numbers of stations, engines, and aerials required as part of a fire department's operation, but it is intended to serve as a frame of reference for the reader and policy makers to understand resource inventories of similarly sized communities.

Figure 5: Comparison of Resources to Similar Sized Communities



Generally, similar sized communities utilize three stations, with four fire engines and one aerial (ladder) units to serve their communities. There are a variety of factors that typically establish the number of stations a community utilizes to provide fire protection services. More often than not, the inventory of fire stations and associated fleet have evolved over a period of time where different volunteer fire departments have existed and eventually morphed into a common system. In these types of situations, no data analysis has been conducted to determine the number or location of fire stations. Without the supporting data analysis, policy makers have been reluctant to reduce or even reallocate the quantity of stations necessary to provide services.

Figure 6 that follows provides a graphical representation of the cost per capita Scio Township expends in providing fire protection services. The graphic also serves to provide a comparison of cost per capita with other fire departments in Michigan. Overall, the cost per capita for providing fire protection services to the Township are consistent with other Michigan fire departments. As with the previous analysis, this data does not serve as an answer to establishing funding levels for fire departments, but does serve as a point of reference for planning purposes. The funding of an emergency services operation should be established in conjunction with an effective risk analysis with an understanding of citizen expectations.

Figure 6: Costs per Capita

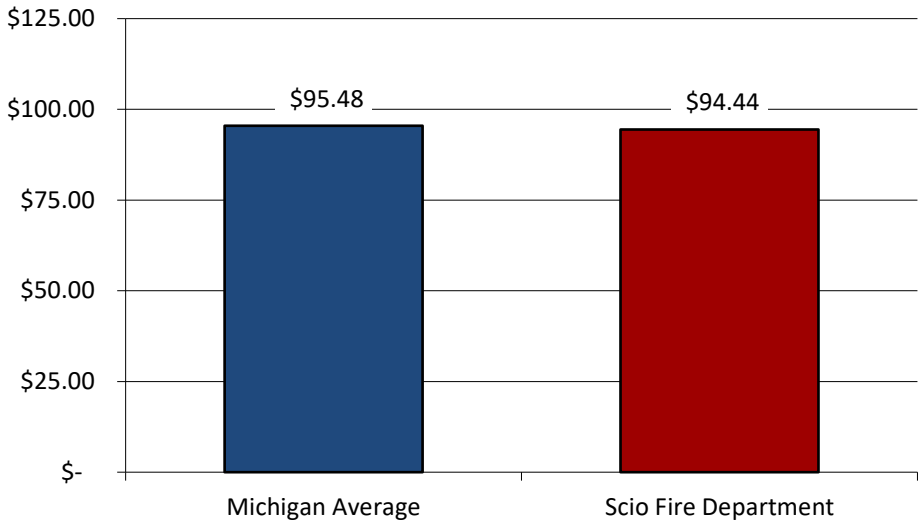


Figure 6 provides a graphical representation of costs per capita for Scio Township's provision of fire services. The Township is in-line with other fire departments within the State of Michigan.

Figure 7: Comparison of Incidents per 1,000

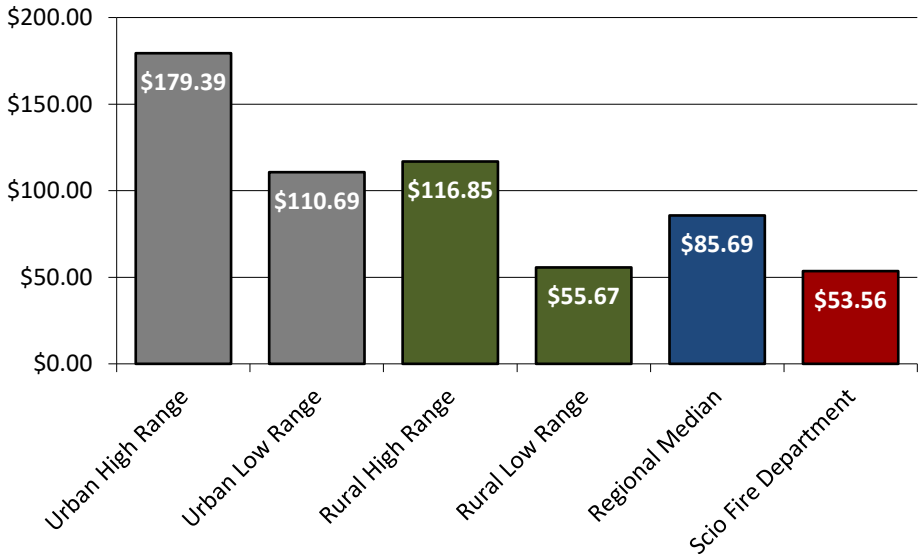
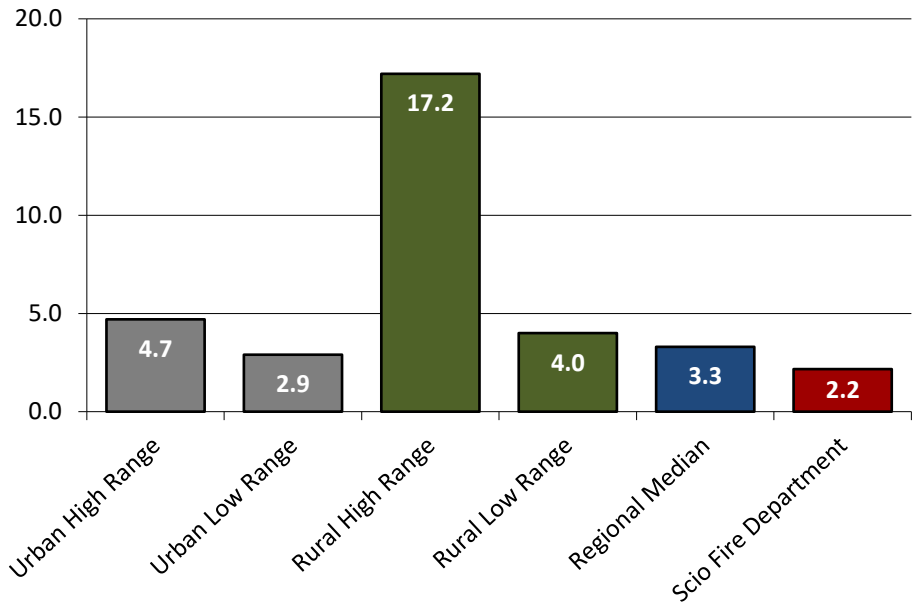


Figure 7 reflects NFPA's data collection from fire departments across the nation. Scio is lower than both the urban and rural categories. The department is also lower than regional departments at incidents per 1,000 at only 53.6 incidents per population. This regional number represents departments in the Midwestern region of the country and may differ due the fact that Scio does not provide EMS transport services as reported in some comparably-sized jurisdictions. This figure does not lend itself to decision-making relative to specific types of services to provide the community, but is intended to help understand the emergency response workload of the department and its personnel.

Figure 8: Comparison of Fires per 1,000 Population



Scio's incidents of 2.2 fires per 1,000 in population is slightly below other agencies within the Midwestern region. The rate is also slightly below the "low" range of fires for other departments protecting urban populations and below the "low" range of departments protecting rural population.

Financial Overview

Revenue and expenses of the Scio Township Fire Department are budgeted and maintained in a self-contained fund (Fund 206) with its own millage, other revenues, expenditures, and fund balance. While a detailed historical analysis and future projection of revenue and expenditure line items is not within the scope of this project, some understanding of the fund is required to project and fully appreciate the impact that adding additional staff will have, with or without grant funding.

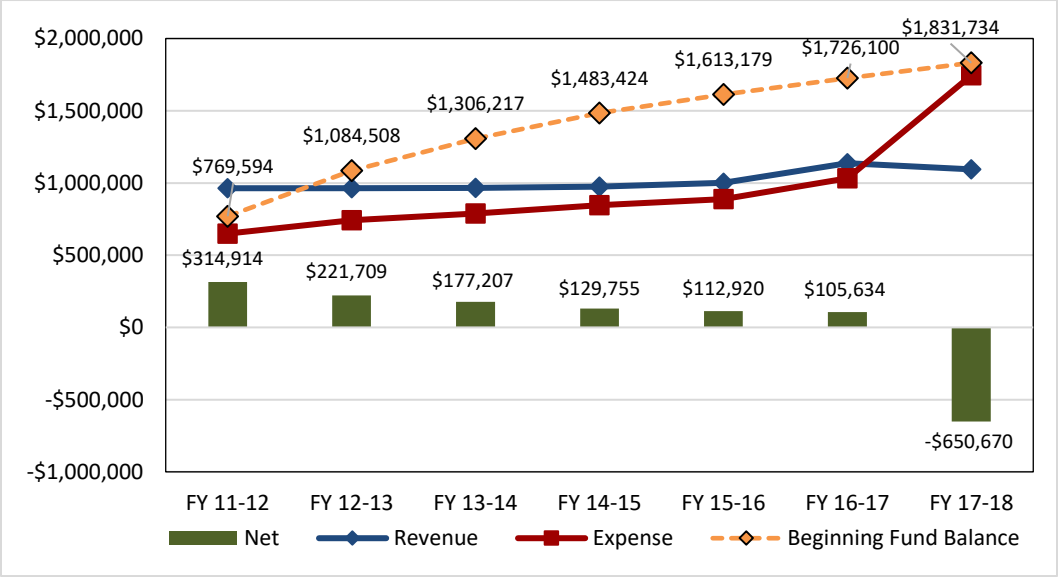
Figure 9: Historical Revenue, Expense, and Fund Balance—Fund 206

Financial Element	FY 11–12 Actual	FY 12–13 Actual	FY 13–14 Actual	FY 14–15 Actual	FY 15–16 Actual	FY 16–17 Estimated	FY 17–18 Amended
Revenue	$964,397	$963,692	$966,235	$974,913	$1,000,380	$1,136,783	$1,094,030
Expense	$649,483	$741,983	$789,029	$845,158	$887,460	$1,031,149	$1,744,700
Net	$314,914	$221,709	$177,207	$129,755	$112,920	$105,634	-$650,670
Beginning Fund Balance	$769,594	$1,084,508	$1,306,217	$1,483,424	$1,613,179	$1,726,100	$1,831,734
Ending Fund Balance	$1,084,508	$1,306,217	$1,483,424	$1,613,179	$1,726,100	$1,831,734	$1,181,064

In Figure 9, total revenue and expense are shown for FY 12 through FY 16 actual with estimated and amended values for FY 17 and FY 18; respectively. Expenses have grown at a steady rate of approximately 8% annually from FY 11–12 through FY 15–16 actual, driven primarily by increases in personal services costs of 8.3% in the wage category and 8.7% in the benefit category. During that same time frame, overall revenue only grew at an average annual rate of 1%. While revenues during the period exceeded expenses leading to annual net increases in fund balance, the gap between revenue and expense has been decreasing as shown in the following figure.

Thus, while beginning fund balance has continued to increase from $769,594 in FY 11–12 to $1,613,179 in FY 15–16, the rate of increase has been decreasing steadily. As long as revenue (shown in blue) has exceeded expense (shown in red) there has been an annual net gain (green bars) and fund balance (gold dashed line) has increased. However, with the increase in expenditures well above revenue, as shown in amended FY 17–18 budget a negative net will result in the use of fund balance to cover expenditures. If the expenditures are recurring, such as through the addition of staff, revenue will need to be increased at some future point to maintain the minimum fund balance necessary for operation of the fund (typically at least 25% of recurring expenditure budget in any given fiscal year). At this point, the fund has sufficient fund balance to cover expenses exceeding recurring revenues for several years before either a reduction in expense or an increase in revenue is required to maintain the health of the fund.

Figure 10: Revenue versus Expense, Net Gain or Loss and Fund Balance—Fund 206



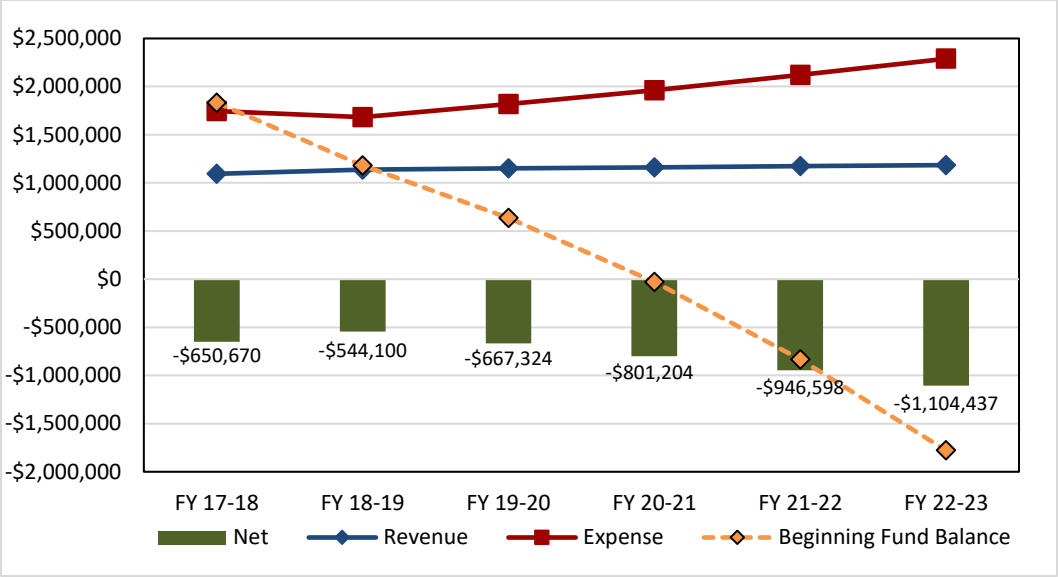
In the following figure, a forecast of revenue, expense, and fund balance has been made through FY 22–23 using the proposed FY 18–19 budget as a basis for the projection. Using the historical annual revenue and expense increases of 1% and 8%; respectively, the projection shows that fund balance is rapidly depleted.

Figure 11: Forecast Revenue versus Expense, Net Gain or Loss and Fund Balance Based on FY 18–19 Budget as Proposed—Fund 206

Financial Element	FY 17–18 Amended	FY 18–19 Proposed	FY 19–20 Forecast	FY 20–21 Forecast	FY 21–22 Forecast	FY 22–23 Forecast
Revenue	$1,094,030	$1,138,520	$1,149,905	$1,161,404	$1,173,018	$1,184,748
Expense	$1,744,700	$1,682,620	$1,817,230	$1,962,608	$2,119,617	$2,289,186
Net	-$650,670	-$544,100	-$667,324	-$801,204	-$946,598	-$1,104,437
Beginning Fund Balance	$1,831,734	$1,181,064	$636,964	-$30,361	-$831,564	-$1,778,163
Ending Fund Balance	$1,181,064	$636,964	-$30,361	-$831,564	-$1,778,163	-$2,882,600
Min Fund Bal (25% of Opex)	$436,175	$420,655	$454,307	**$490,652**	**$529,904**	**$572,296**

By the end of FY 19–20 fund balance is fully depleted. If a reserve requirement of 25% of expenses is maintained, FY 19–20 is the last year in which the fund is viable without changes in expenses or revenue. This trend is illustrated graphically in the following figure. Clearly, some measures to address this imbalance in revenue and expense will need to be taken no later than FY 18–19.

Figure 12: Forecast Revenue versus Expense, Net Gain or Loss and Fund Balance through FY 22–23—Fund 206



To evaluate the impact of adding additional firefighters, with or without grant funding, several assumptions need to be made regarding the current and future cost of employees. The following figure shows Article—Wages from the current Collective Bargaining Agreement (CBA) between the Township and IAFF Local 4891. For the base year of any forecast involving increased staffing, the study uses the yellow-highlighted hourly rate for a firefighter of $16.13.

Figure 13: IAFF Local 4891 CBA Article 14—Wages

ARTICLE 14
WAGES

	Effective as of Ratification and Board Approval in 2016 Through April 30, 2017.	Effective May 1, 2017 Through April 30, 2018	Effective May 1, 2018 Through April 30, 2019
Shift Commander 0-2 Years of Service in Classification	$18.32	$18.69	$19.06
Shift Commander 3-4 Years of Service in Classification	$19.28	$19.67	$20.06
Shift Commander over 5 Years of Service in Classification	$21.25	$21.68	$22.11
Firefighter	$15.50	$15.81	$16.13

Firefighters work a schedule of 24 hours on and 48 hours off which results in 2763 hours worked at a regular rate and 165 hours worked at an overtime rate as part of their normal schedule. This does not include any additional overtime worked in order to cover any sick or vacation leave, late calls, or off-duty training. This results in an annual salary of $50,359 for FY 2019. Benefits average 46.1% of annual salary and are comprised of the following components shown in the following figure. This equates to $23,216 annually in FY 2019. It is also assumed that there will on-boarding costs of approximately $5,000 in the initial year of hire. These costs include bunker gear, uniforms, entrance physical, and other initial Human Resource-related costs. Total costs to hire and equip and new firefighter in FY 2019 are estimated at $78,575.

Figure 14: Firefighter Benefit Calculation

Benefit Component	Percent of Annual Salary
FICA	7.65%
Health Insurance	21.3% (average of current firefighters)
Life Insurance	$40 annually
Pension	7.94%
Dental Insurance	$2,000 annually
Long-Term Disability Insurance	$336 annually
Workers Compensation	5.65%
Average Total Benefit Rate	**46.10%**

Staffing

Administrative and Support Staffing

The size and structure of an organization's staffing is dependent upon the specific needs of the agency. These needs must directly correlate to the needs of the community and a structure that works for one entity may not necessarily work for another agency. This section provides an overview of Scio's staffing configuration.

Fire department staffing can be divided into two distinctly different groups. The first group is what the citizens typically recognize and is commonly known as the operations unit, which can be generally classified as the emergency response personnel. The second group typically works behind the scenes to provide the support needed by the operation's personnel to deliver effective emergency response and is commonly known as the administrative section.

Figure 15: Administrative and Support Staff Positions

ADMINISTRATION & OTHER SUPPORT STAFF	
Director of Fire Services	1
Fire Chief	1[1]
Assistant Chief	1[2]
Fire Marshal	0
Administrative Assistant	0
Percent Administrative & Support	15.4%

[1]Director of Fire Services Operating as Fire Chief

[2]Assistant Fire Chief is a volunteer position

DISCUSSION

One of the primary responsibilities of a fire department's administration is to ensure that the operational section of the organization has the ability and means to respond to and mitigate emergencies in a safe and efficient manner. An effective administration and support services system is critical to the success of any emergency services provider.

Like any other part of a municipal fire department, administration and support need appropriate resources to function properly. By analyzing the administrative and support positions within an organization, we can create a common understanding of the relative resources committed to this function compared to industry best practices and similar organizations. The appropriate balance of administration and support compared to operational resources and service levels is a key factor to ensuring the department can accomplish its mission.

Typical responsibilities of the administration and support staff include planning, organizing, directing, coordinating, and evaluating the various programs within the department. This list of functions is not exhaustive and other functions may be added. It is also important to understand these functions do not occur in a linear fashion and can most often occur concurrently. This requires the Fire Chief and administrative support staff to focus on many different areas at the same time.

A review of staffing ratios revealed that the current level of administrative and support staffing represents 15.4 percent of Scio's total staffing and 7.7 percent when FTEs are examined. This ratio represents the department's current administrative staffing levels compared to the existing operations staffing level of 11 emergency response personnel. At the time of ESCI's site visit, the department employed six career firefighters and five paid-on-call personnel.

The department had also begun the process of hiring an additional five paid-on-call personnel. The addition of these personnel will further reduce the percentage of administrative personnel to 11.1 percent or 5.6 percent when FTEs are considered. It is our experience that typically, effective administrative staffing ratios range from 12 to 15 percent of agency totals. After reviewing the functions and responsibilities assigned to the work group, ESCI concludes that the number of full-time employees (FTEs) assigned is ineffective and the addition of an FTE position for a Fire Inspector and Administrative Assistant will be beneficial to the effective operation of the department. The incorrect staffing of the administrative and support functions creates a situation in which important organizational activities, at best, are delayed, but in worst case scenarios get completely missed.

Administration

The administrative function within the department is currently established with the position of Fire Services Director, although at some point in the future these responsibilities will return to the Fire Chief. Some of the typical responsibilities of the Director include planning, organizing, directing, and budgeting for all aspects of the department's operations. The current number of positions assigned to this activity are marginally sufficient to meet these expectations.

Fire Prevention

NFPA 1730: Standard on Organization and Deployment of Fire Prevention Inspection and Code Enforcement, Plan Review, Investigation, and Public Education Operations provides criteria for establishing and operating an effective fire prevention program. Scio does not have an established a fire prevention bureau. At the time of this report, STFD did not conduct organized fire prevention initiatives. It is recommended STFD implement a formal fire prevention program in accordance with NFPA 1730. This effort can be initiated using on-duty "shift" personnel. However, to maximize the effectiveness of a fire prevention program STFD should evaluate the feasibility of creating a full-time Fire Inspector position. It is also recommended STFD conduct a Community Risk Assessment with a subsequent Community Risk Reduction Plan in accordance with NFPA 1300.

Training

The National Fire Protection Association (NFPA) has provided criteria through which volunteer and combination fire departments should operate an effective training program. Scio does not have a formally established training program, but does utilize "on-duty" personnel for all training activities. At the time of this report, STFD conducted various levels of training. However, the training records provide a minimal understanding of the efficiency and effectiveness of the training program. It is recommended STFD implement a quality documentation program, allowing the department to ensure compliance with NFPA 1001: Standard for Firefighter Professional Qualifications, Michigan Part 74 firefighter training standards, and ISO requirements. It is also recommended the training program utilize NFPA 1410: Standard on Training for Emergency Scene Operations as the foundation for all training activities.

Emergency Management

Washtenaw County currently provides for overall management and delivery of emergency management activities. The Director of Fire Services position is responsible for emergency management activities of the department as part of "other duties" assigned. This is a typical arrangement within fire departments across the United States as the emergency management function does not specifically fall under the "fire discipline" and quite often involves other aspects of a community's risk exposure (i.e., public works, law enforcement, economic exposure).

Human Resources

The field of human resources management has become a highly specialized field requiring individuals with a significant amount of knowledge, skills, and abilities. Outside of a catastrophic event occurring within the department or community, the human resources function is the largest risk faced by a department. The effective management of a human resources program can protect the department and community from a variety of litigious situations that have the potential to devastate the department financially and/or operationally. Many fire departments across the United States do not perform the human resources function at any level due to the fact they are small and operate independently of a governmental unit. Other fire departments operating as part of a larger governmental unit have human resources support through the larger system of governmental services.

Administrative Support

Scio does not utilize an administrative assistant to support the Director of Fire Services. The value of an administrative support position cannot be overstated as it would free Scio personnel to address other areas of operation. It is recommended Scio Township evaluate the feasibility of providing the fire department with an Administrative Assistant position. Initially, the addition of this position could result from sharing these responsibilities with another Township department or from a part-time staff member.

Recommendations

- Establish a formal review process of all fire department activities.
- Implement a formal fire prevention program in accordance with NFPA 1730.
- Establish the position of Fire Inspector to implement a formal fire prevention and inspection program.
- Conduct a Community Risk Assessment with a subsequent Community Risk Reduction Plan in accordance with NFPA 1300.
- Conduct a formal job task analysis of all existing positions.
- Implement a quality documentation program allowing the department to ensure compliance with NFPA 1001.
- Utilize NFPA 1410: Standard on Training for Emergency Scene Operations as the foundation for all training activities.
- Evaluate the feasibility of providing the fire department with an Administrative Assistant position.

Emergency Response Staffing

It takes an adequate and properly trained staff of emergency responders to put the appropriate emergency apparatus and equipment to its best use in mitigating incidents. Insufficient staffing at an operational scene decreases the effectiveness of the response and increases the risk of injury to all individuals involved.

Tasks that must be performed at a fire can be broken down into two key components—life safety and fire flow. Life safety tasks are based on the number of building occupants, and their location, status, and ability to take self-preservation action. Life safety related tasks involve search, rescue, and evacuation of victims. The fire flow component involves delivering sufficient water to extinguish the fire and create an environment within the building that allows entry by firefighters.

The number and types of tasks needing simultaneous action will dictate the minimum number of firefighters required to combat different types of fires. In the absence of adequate personnel to perform concurrent action, the command officer must prioritize the tasks and complete some in chronological order, rather than concurrently. These tasks include:

- Command
- Scene safety
- Search and rescue
- Fire attack
- Water supply
- Pump operation
- Ventilation
- Back-up/rapid intervention

The first 15 minutes is the most crucial period in the suppression of a fire. How effectively and efficiently firefighters perform during this period has a significant impact on the overall outcome of the event. This general concept is applicable to fire, rescue, and medical situations. Critical tasks must be conducted in a timely manner in order to control a fire or to treat a patient. STFD is responsible for assuring that responding companies are capable of performing all of the described tasks in a prompt, efficient, and safe manner. The next figure lists STFD's emergency response staffing configuration.

Figure 16: Emergency Response Staff

EMERGENCY SERVICE STAFF	
Shift Commanders (no rank)	6
Firefighter (paid-on-call)	10
Total Operational Staff	2
Fire Department Total	**18**

DISCUSSION

Considerable ongoing national discussion and debate around large incidents of significant consequence have brought attention to the matter of firefighter staffing. Frequently, this discussion is set in the context of firefighter safety. While there are published standards regarding firefighter staffing, they generally speak in terms of the number of firefighters assigned to a particular response apparatus, often characterized as a preferred standard of "a minimum of four personnel per company." ESCI notes that the more critical issue is the number of firefighting personnel assembled in a reasonable amount of time at the scene of an emergency that can perform the required critical tasks to mitigate the emergency, regardless of the type or number of vehicles upon which they arrive.

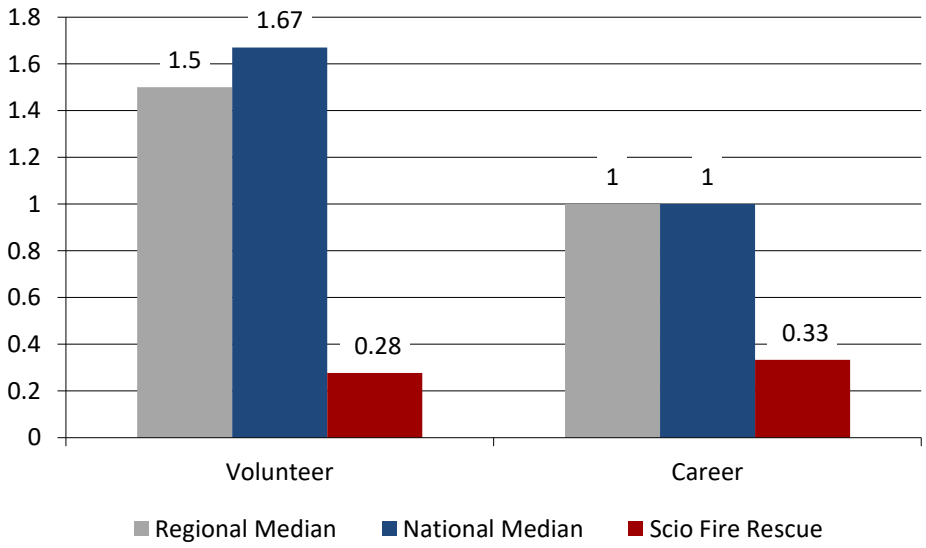
It is important to understand that the assembly of firefighters on an incident, also called an "Effective Firefighting Force" or "Effective Response Force," is a determination that is made at the community level based on risk, capability, and citizen expectations.

There is no mandated requirement for specific staffing levels, though there are standards discussed in detail in this report. In the Service Delivery section, resource concentration is evaluated in detail.

Another means of comparison is measuring the number of firefighters on staff per 1,000 population of the service area. The following figure illustrates current Scio paid-on-call and full-time staffing on a per 1,000 population-basis, with both national and regional medians presented as a comparison. Current paid-on-call staffing levels are significantly lower than the regional and national medians for similar combination fire departments. Additionally, the full-time staffing levels are lower than national and regional medians.

Scio operates a paid-on-call system utilizing personnel to cover work periods from 7 AM to 7 PM to ensure additional personnel is available in support of career staff during time periods when other paid-on-call staff are unavailable. It is important for the Township leaders to understand that under the current staffing levels and methodologies, STFD cannot initiate an initial interior fire attack and maintain "2-in/2-out" as required under MIOSHA-STD R 408.17451. *Management of Emergency Operations*. It is recommended that Scio Township either implement a staffing model ensuring STFD is in compliance Michigan state law, or ensure policies are in place ensuring interior operations are not initiated until "2-in/2-out" requirements are met. Changes in the current staffing model can be accomplished through the addition of full-time personnel or an increase in the usage of "paid-on-call" personnel.

Figure 17: Scio Current Staffing Levels Paid-on-Call (Volunteer) per 1,000 Population



Recommendations

- Evaluate the feasibility of adding either full-time or paid-on-call staff to ensure compliance with Michigan "2-in/2-out" law.
- Implement policy ensuring interior firefighting operations are not initiated until "2-in / 2-out" requirements are met.

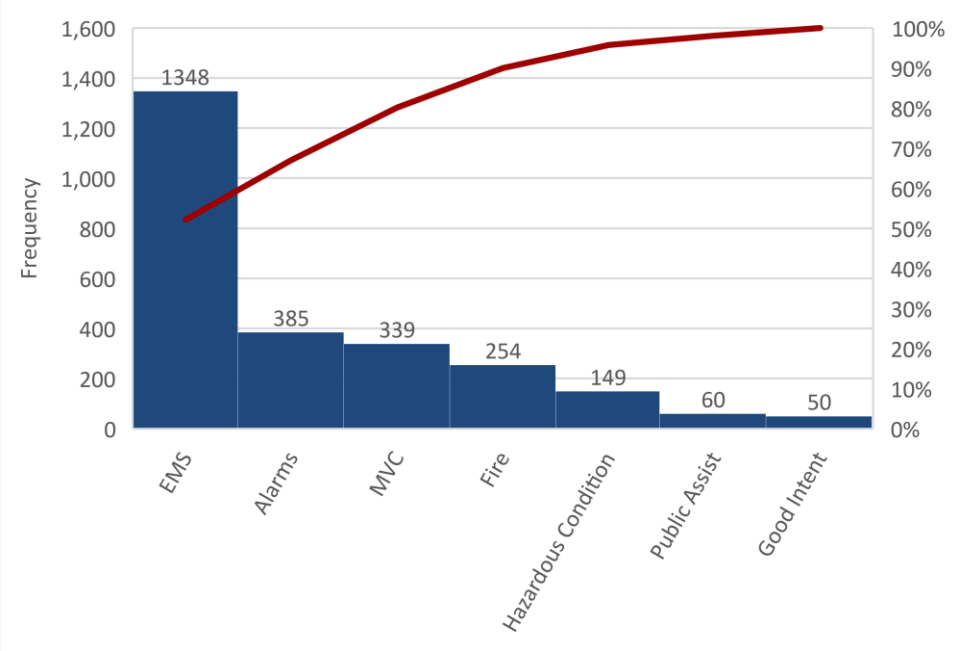
Service Delivery and Performance

The delivery of fire suppression, rescue, and emergency medical services is no more effective than the sum of its parts. It requires efficient notification of an emergency and rapid response from well-located facilities, in appropriate apparatus, with a sufficient number of well-trained personnel, following a well-practiced plan of action. This section of the report provides an analysis of the current service delivery components of Scio Township Fire Department.

Demand

In the demand analysis, ESCI reviews current and historical service demand by incident type and temporal variations for Scio Township Fire Department. GIS software is used to provide a geographic display of demand within the study area. National Fire Incident Records System (NFIRS) data, incident response data, and apparatus response data collected by the department is used in this section of the report. The following figures demonstrate historical service demand for STFD.

Figure 18: Historical Service Demand by Incident Type, 2015–2017



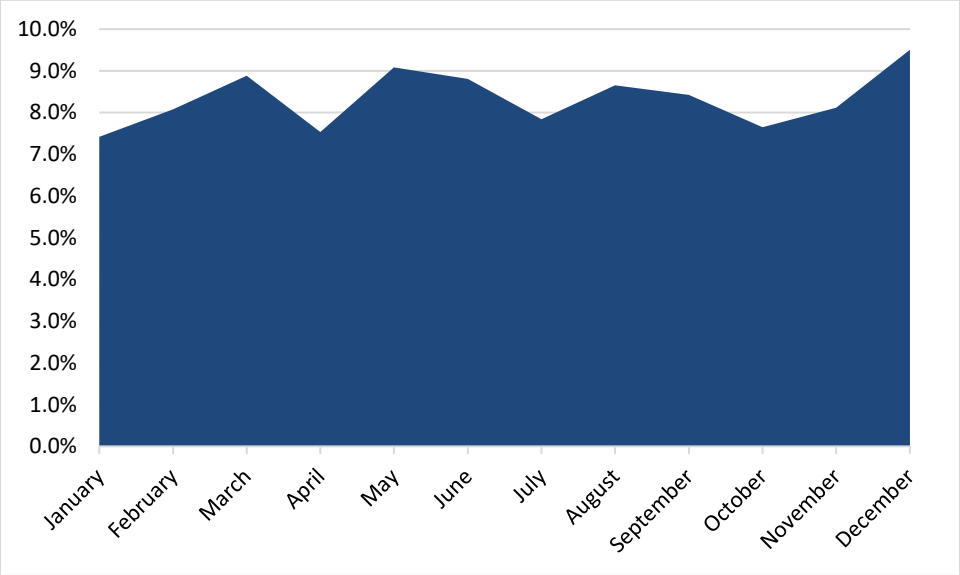
This analysis demonstrates that EMS calls for service represent the largest portion (52.1 percent) of service demand. The data displayed in this figure reflects a nationwide trend for an all-hazard fire jurisdiction. Next, calls for alarms, motor vehicle collisions (MVC), and responses for fire represent the majority of call types experienced by the department. Finally, hazardous conditions, public assists, and good intent calls make up the remainder of the call volume.

Next, call volume is analyzed based on varying timeframes to determine if service demand patterns are present for Scio Township.

Temporal Variation

It is useful to evaluate service demand temporally in order to understand any trends that may occur during certain periods of time and potentially implement changes to the current deployment model to fit the demand. The following figures display 2015 through 2017 service demand within the STFD study area; summarized by various measures of time.

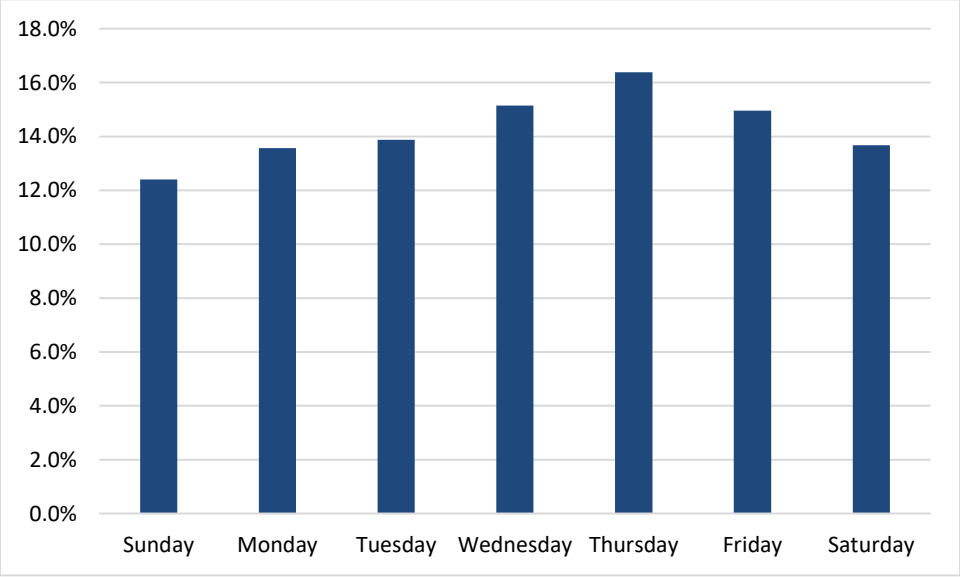
Figure 19: STFD Service Demand by Month, 2015–2017



The analysis of temporal variation by month reveals a fairly consistent pattern of service demand with monthly totals rising and falling slightly month to month. The peak demand appears to occur in December with the lowest levels of demand occurring in January. However, although this figure presents the relative percentages in which monthly demand occurred, the range from the highest to the lowest levels of service demand over a three-year period accounted for a total of 54 calls, 246 calls in December versus 192 calls in January.

Next, service demand by the day of week was analyzed for patterns in temporal variation.

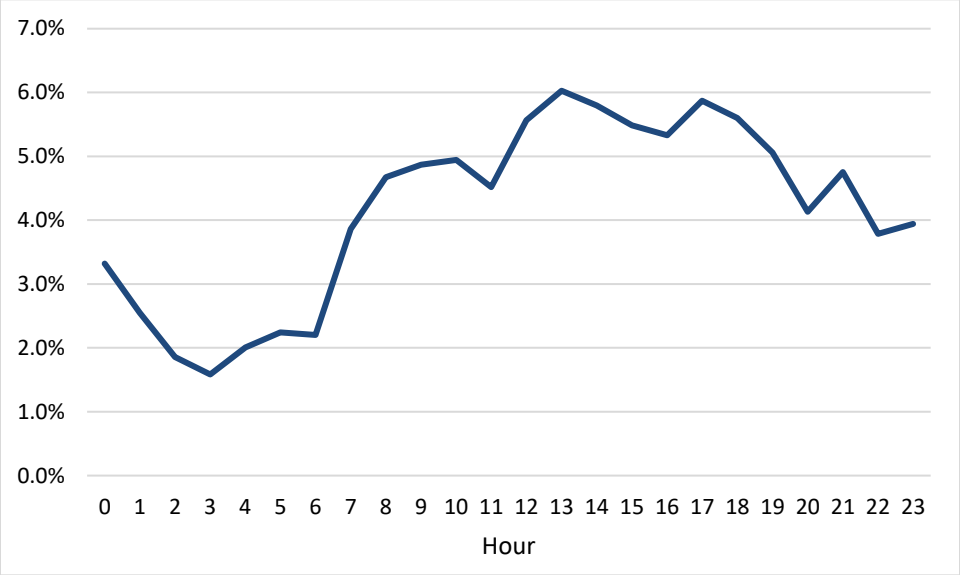
Figure 20: STFD Service Demand by Day of the Week



When demand by day is examined, incidents appear to follow a pattern of raising gradually from the low on Sunday at 12.4%, to a high on Thursday 16.4%. Demand on Friday and Saturday then declines back to the low on Sunday. This pattern may be related to an increase in demand due to commercial activities during the week and would suggest that activity on the weekends is lower than during mid-week. The range from high to low over the three-year period is 103 incidents with 424 occurring on Thursdays and 321 on Sundays.

Finally, temporal variation by hour of day is presented for review.

Figure 21: STFD Service Demand by Hour of the Day



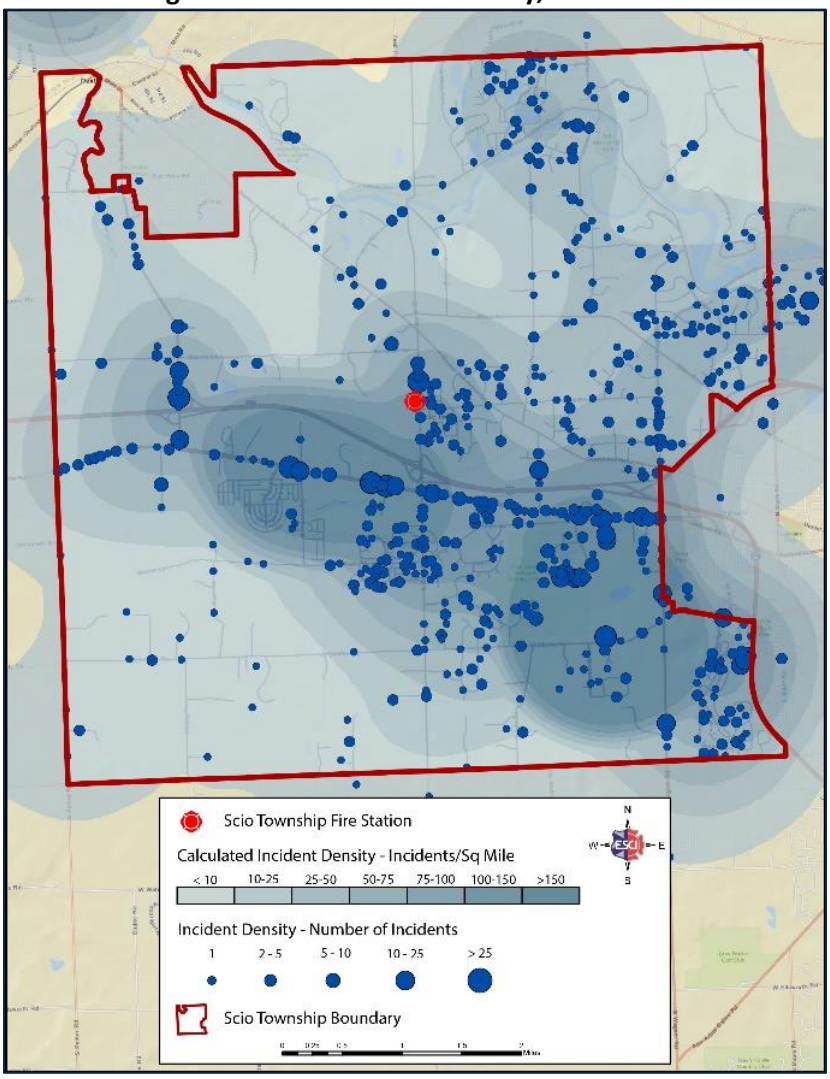
When service demand is plotted by the hour of day, the pattern illustrated follows a diurnal pattern of peak activity occurring midday and the lowest activity levels between midnight and 6 AM. The sharp rise and fall of this pattern suggests that service demand in Scio Township is closely related to human activity and normal work week patterns.

Based on the temporal variation patterns occurring during 2015 through 2017, Scio Township should anticipate its greatest service demand needs Monday through Friday from 8 AM through 5 PM.

Geographic Service Demand

In addition to the temporal analysis of service demand, it is useful to examine the geographic distribution of service demand. Using dispatch center incident location data provided by STFD, ESCI plotted incident locations and calculates the mathematical density of 2015 to 2017 service demand in the STFD service area.

Figure 22: STFD Incident Density, 2015–2017

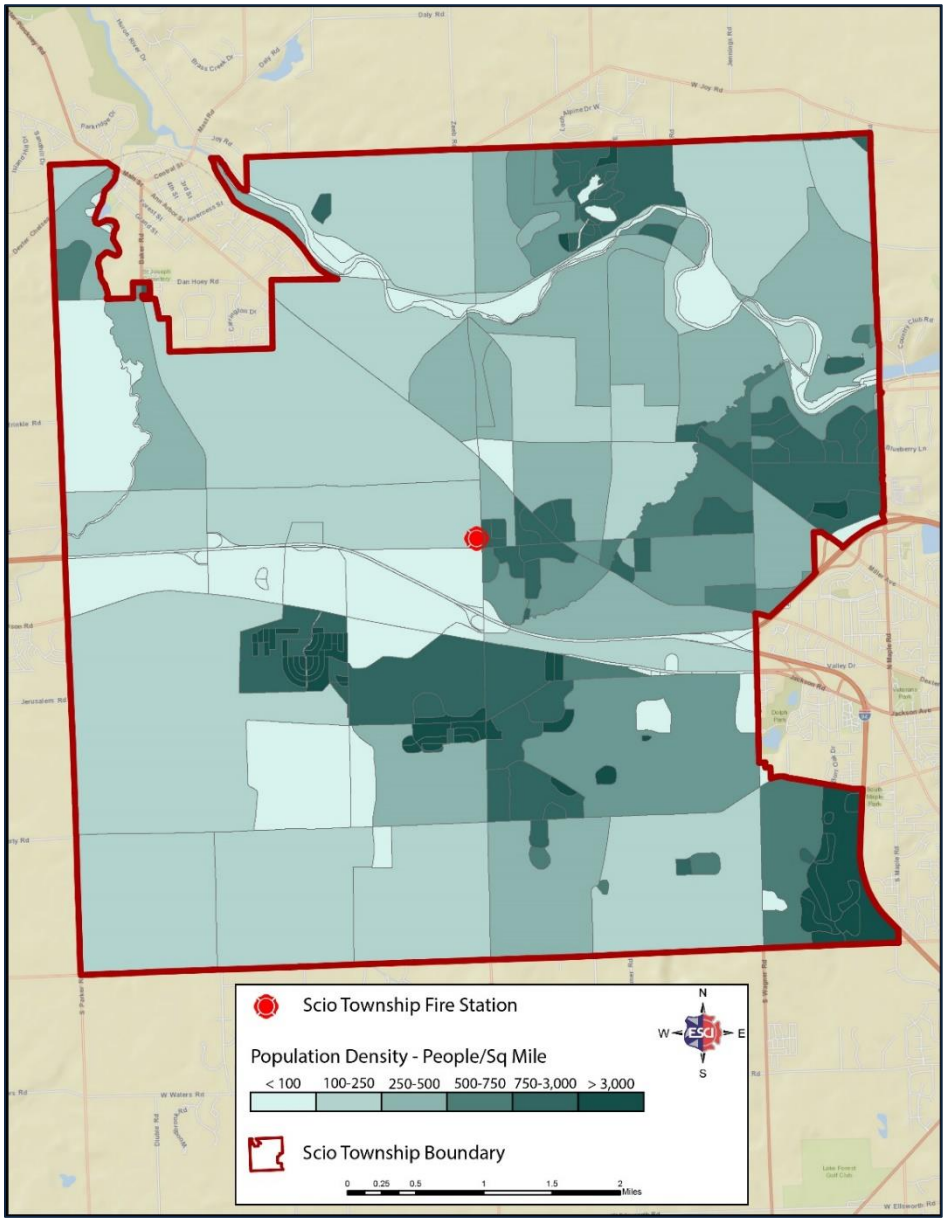


In this figure, incident density is displayed using two methods, calculated incident density, or hot spot analysis, and through a display of incident locations. The incident density analysis compares incident points based on their locations relative to each other and generates a range of densities that would occur should those density patterns extend over a square mile. This type of analysis provides insight to where areas of high and low incident frequency are located, relative to each other, and helps the reader understand where to focus resources. The second method provides the locations that incidents occurred, as well as relative frequency with larger circles representing higher service demand to the same location. A comparison of these two methods plotted together provides insight in to why hot spots are occurring in certain areas. Based on this analysis, the areas of greatest service demand occurred along Jackson Road and to its south, primarily in the southeast of the Township bordering the City of Ann Arbor. Generally speaking, demand appears greatest along the Township's eastern border and extends westward following major roadways out of Ann Arbor and towards the City of Dexter.

Distribution

The analysis of resource distribution presents an overview of the current deployment of fire department facilities, equipment, and personnel within the STFD service area. In the following figure, population density by census block is illustrated to provide an understanding of where concentrations of people are located. This is important to understand as often areas with the greatest levels of population density incur higher levels of service demand than sparsely populated areas.

Figure 23: Scio Township Population Density, 2010 U.S. Census Blocks



The major areas of population density in Scio generally extend westward from its border with Ann Arbor to the north and south of Jackson Road. A comparison of 2010 census block population densities and incident density reveal that the majority of service demand tends to occur in densely populated areas. With this trend in mind, as future development occurs in the township, the fire department should anticipate that increases to population density will most likely result in increased service demand to those areas. Scio Township Fire Department should consider monitoring development trends to ensure that current infrastructure can keep pace with future demand.

The next section evaluates Scio's performance based upon national evaluation standards and criteria. There are two standards commonly used in the fire service to determine an agency's response distribution. The first, and most common, standard is the Insurance Service Organization's (ISO) application of road miles from a fire station and water supply measurement. The second standard comes from the National Fire Protection Association's (NFPA) 1720: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments. When used in tandem, these two standards help emergency services leaders understand current service level capabilities and plan for future impacts. The following section provides an analysis of both the ISO and NFPA standards.

ISO Criteria

A jurisdiction's ISO rating is an important factor when considering fire station and apparatus distribution, as it can affect the cost of fire insurance for individuals and businesses. ISO ranks fire departments relative to their ability to provide protection to the community they serve through an analysis process that yields a final score that ranges from a 10 (indicating no fire department coverage) to a 1 (the highest level of fire department coverage). To receive maximum credit for station and apparatus distribution, ISO recommends that in urban areas, all "built upon" areas in a community be within 1.5 road miles of an engine company. Additionally, ISO states that a structure must be within five miles of a fire station to receive any fire protection rating for insurance purposes.

The next figure displays the STFD response zone with the 1.5-mile travel distance displayed. Scio Township has slightly more than 30 miles of roadway and 16 percent of the roads fall within the 1.5-mile travel distance.

Figure 24: STFD Engine Company Distribution—ISO Criteria

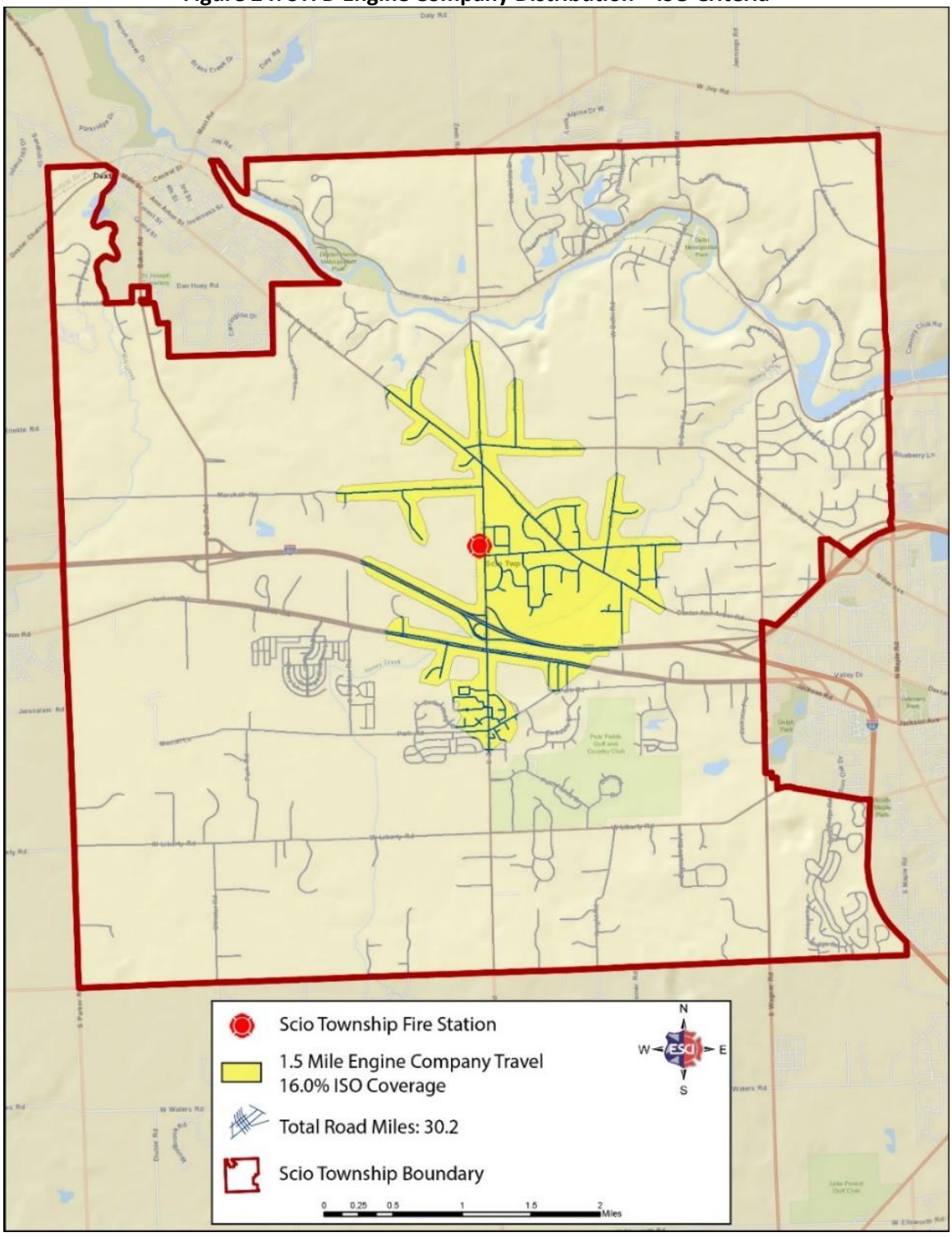


Figure 25 displays the 5-mile zone for Scio Township to be eligible for an ISO rating. Nearly all of the Township (92 percent) falls within this area. Several factors contribute to the overall rating assessed by ISO such as staffing, water supply, and equipment carried. This figure is not determinative as to whether ISO will assess higher or lower scores but is intended to provide an understanding of the current travel distance capabilities of STFD.

Figure 25: STFD 5-Mile Distribution—ISO Criteria

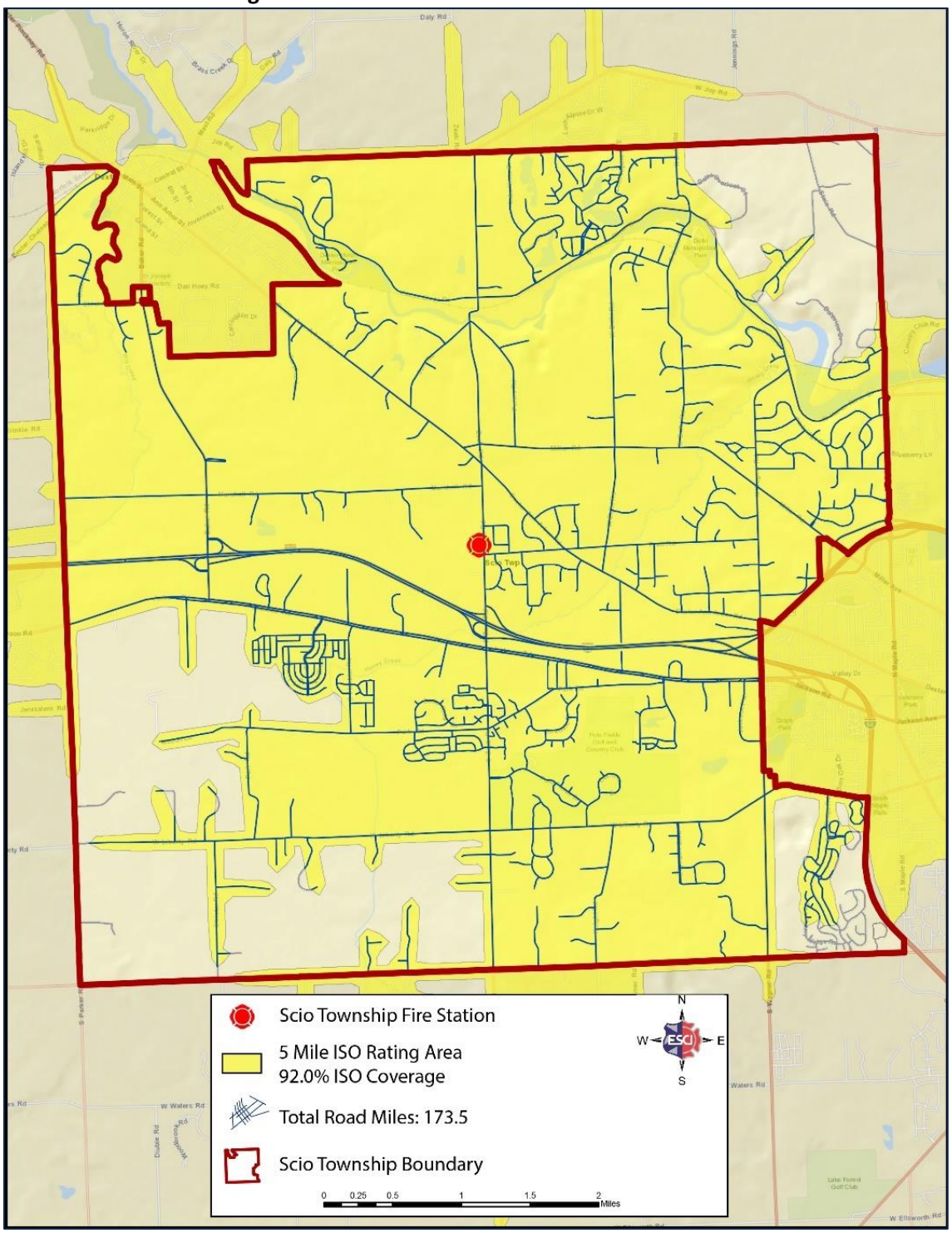
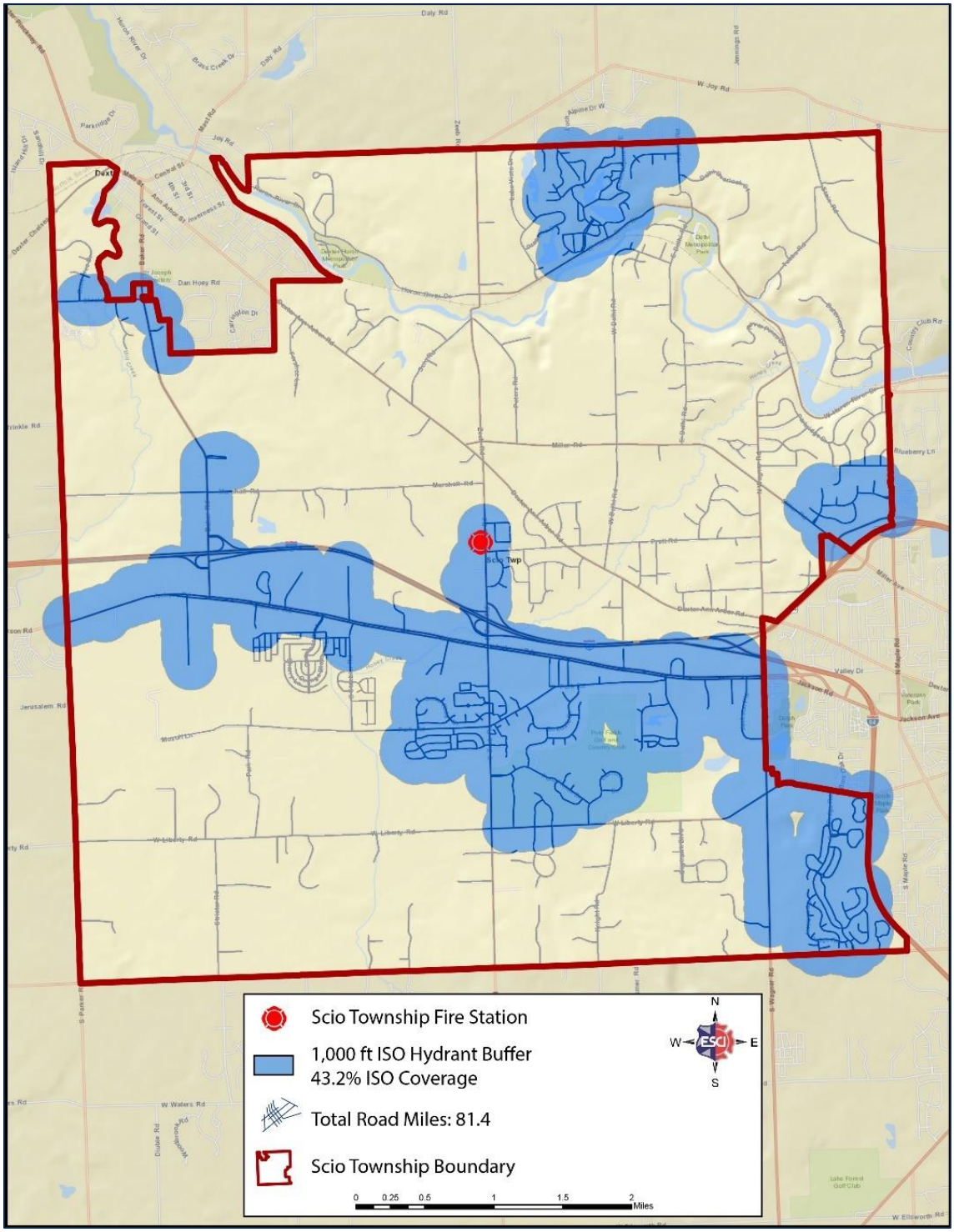


Figure 26 provides an understanding of the Scio Township within 1,000 feet of a fire hydrant. Slightly more than 43 percent of the community is within 1,000 feet of a hydrant. The areas outside of this boundary requires STFD to address water supply through extended hose lays and shuttled water. This is significant in that the movement of water using tanker operations is highly resource intensive.

Figure 26: Hydrant Distribution—ISO Criteria



The following figure displays the predicted ability for STFD to travel throughout its service area based upon travel time in minutes.

Figure 27: STFD Predicted Travel Time Capability—Current Station Location

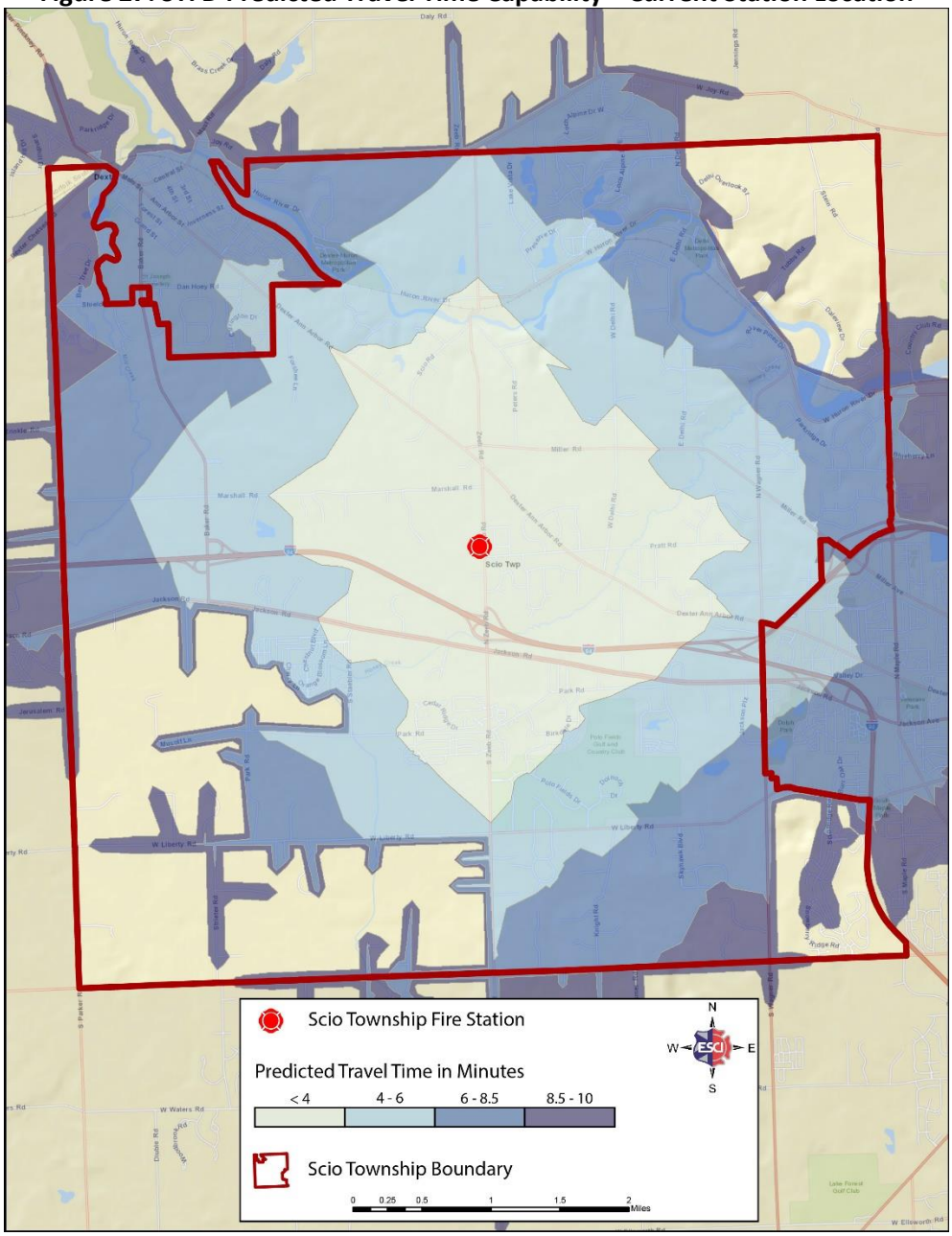


Figure 27 provides a graphical understanding of the predicted travel time for the existing Scio Township fire station. A significant majority of the Township can be reached in less than eight and a half minutes of travel time. It is also worth noting that the entire Township can be reached with a drive time of ten minutes or less. Understanding the predicted drive times of STFD emergency response units is critical in establishing expected service levels for the department.

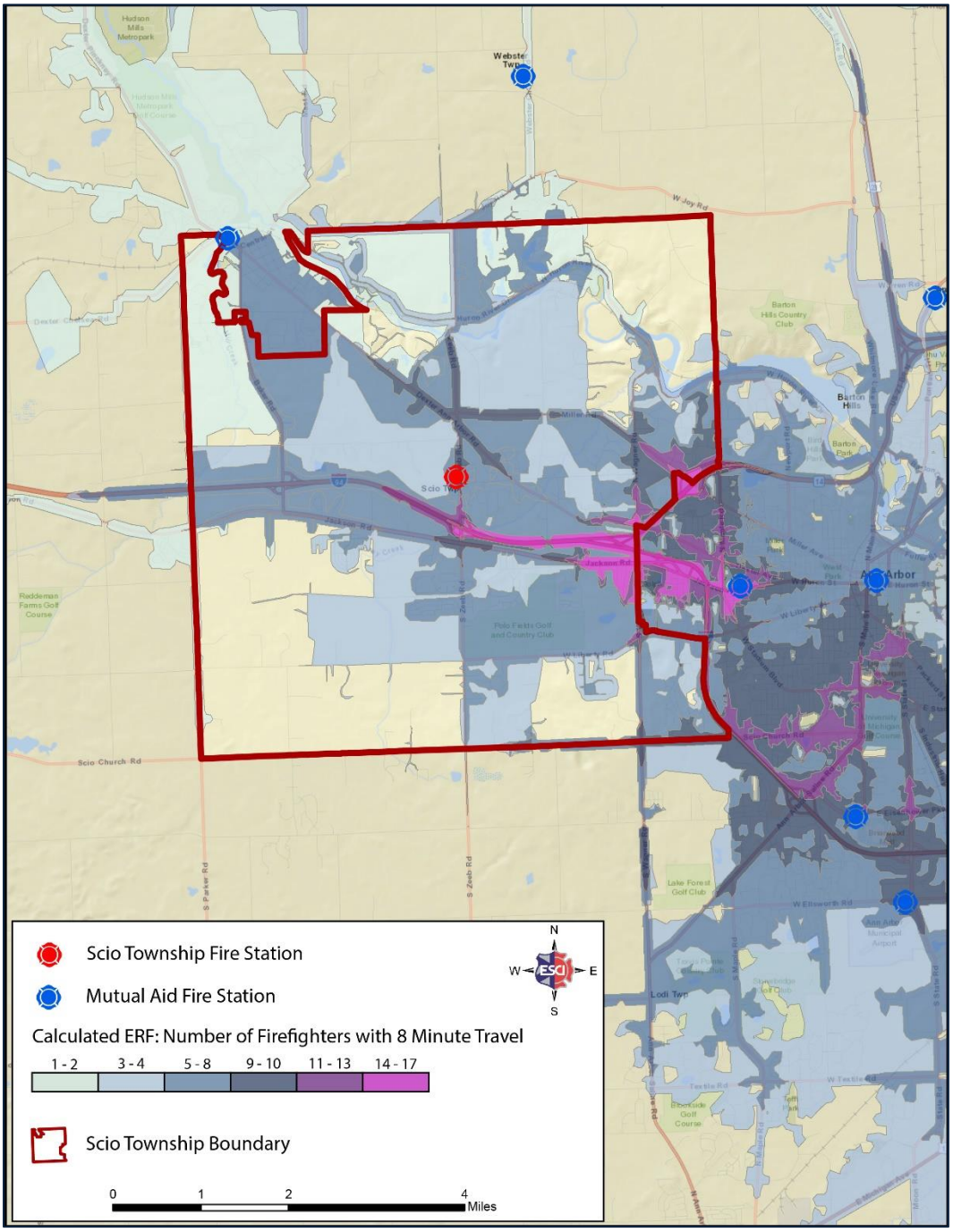
Concentration

Accepted firefighting procedures call for the arrival of the entire initial assignment or Effective Response Force (ERF) to provide sufficient apparatus and personnel to effectively deal with an emergency based on its level of risk within a reasonable amount of time. This is to ensure that enough people and equipment arrive in a timely manner to safely control a fire or mitigate any emergency before there is substantial damage or injury. In this analysis, ESCI examines the ability of STFD to assemble multiple resources across the study area.

It is important to note that in a paid-on-call system in which emergency responders must return to the station to then respond to an emergency there are many variables to the response capabilities of the department. This factor is true nearly all of STFD's aid partners, as each of them also operates paid-on-call systems. The only aid partner potentially providing assistance to STFD that is not a paid-on-call system is Ann Arbor.

As a result, ESCI utilized "expected" response normally provided by STFD and its neighboring departments to project the ability of the department to assemble an effective response force. In the following figure, the minimum staffing of each fire station capable of reaching within the Scio Township boundaries is displayed with the range of firefighters capable of reaching a given location illustrated in varying colors. In this figure, eight minutes was used as the travel time from each facility. This figure was used for several reasons: as a suburban fire department as categorized by NFPA 1720, STFD is provided 10 minutes from the initial notification to arrive on scene of a working fire. As the station is staffed, NFPA 1720 allows for a 90 second turnout time for firefighters. Because Scio Township has no established automatic aid agreements with neighboring agencies, some amount of time must be allotted to fulfill the mutual aid request, and in this scenario, it is assumed that it will take 30 seconds and happen immediately after notification. As stated earlier, the impact of potential paid-on-call responders from additional locations was not taken in to consideration as historically participation is relatively low and locations at any given time unknown, thus only minimum staffing at each fire station was considered. Finally, eight minutes is the career fire department standard for assembling an ERF (NFPA 1710). The results of the analysis are displayed in the following figure.

Figure 28: Scio Township Effective Response Force



Assuming all mutual aid partners are available to respond, Scio Township possesses a narrow avenue of territory in which firefighters could respond in sufficient numbers to effectively mitigate a working residential fire. Should a commercial fire occur, or these displayed resources be unavailable at the time of the incident, Scio Township will be unable to effectively and safely staff a working fire within the acceptable time frame to achieve a positive outcome.

Reliability

A review of workload by station and response unit can reveal much about response performance and a department's ability to assemble adequate resources to mitigate simultaneous incidents. Although fire stations and response units may be distributed in a manner to provide quick response, that level of performance can only be obtained when the response unit is available in its primary service area.

Understanding an organization's call volume (i.e., workload) is a significant factor in planning for future operations and meeting the expectations of the community. However, to truly understand an organization's workload, it is imperative to understand the amount of time units and stations are committed to emergency incidents. During the time periods units are committed to responding to and mitigating an incident, they are unavailable to respond to additional incidents or calls for service. Additionally, in a paid-on-call system, whenever employees are committed to an incident they are taken away from their full-time careers and family.

At the time of this report, the data maintained by STFD did not allow for a comprehensive analysis of the department's workload and reliability to be completed. It is recommended STFD implement effective processes and procedures to ensure future efforts to conduct a reliability analysis can be accomplished. It is critical that STFD have the ability to understand the incidents in which paid-on-call staff do not successfully respond for assistance, enumerate concurrent calls, or mutual-aid departments arrive prior to STFD units.

Response Performance

Perhaps the most publicly visible component of an emergency services delivery system is response performance. Most citizens and policymakers alike want to know how quickly they can expect to receive services. In the performance summary, ESCI examines emergency response performance for the STFD service area using incident data from Huron Valley Ambulance dispatch center, provided by STFD leadership. Non-emergency incidents, mutual or auto aid incidents outside the STFD service area, data outliers, and invalid data are removed from the data set whenever possible.

ESCI measured total response time from the time from the receipt of the alarm at the 911 center to when the first apparatus arrived on the scene of the emergency. ESCI calculated both average and 90th percentile data for these emergency incidents. The use of percentile measurement of total response time performance follows the recommendations of the NFPA standards and the Center for Public Safety Excellence (CPSE/CFAI) Standards of Cover document.

Fire department leaders and policy makers often use "average" response performance measures since the term is commonly used and widely understood. The most important reason for not using average for performance standards is that it may not accurately reflect the performance for the entire data set and can be easily skewed by data outliers. Percentile measurements are a better measure of performance since they show that the large majority of the data set has achieved a particular level of performance.

A department's total response time is composed of several components. These components, while not necessarily required by NFPA 1720, are critical pieces to the total response time and are presented as described below.

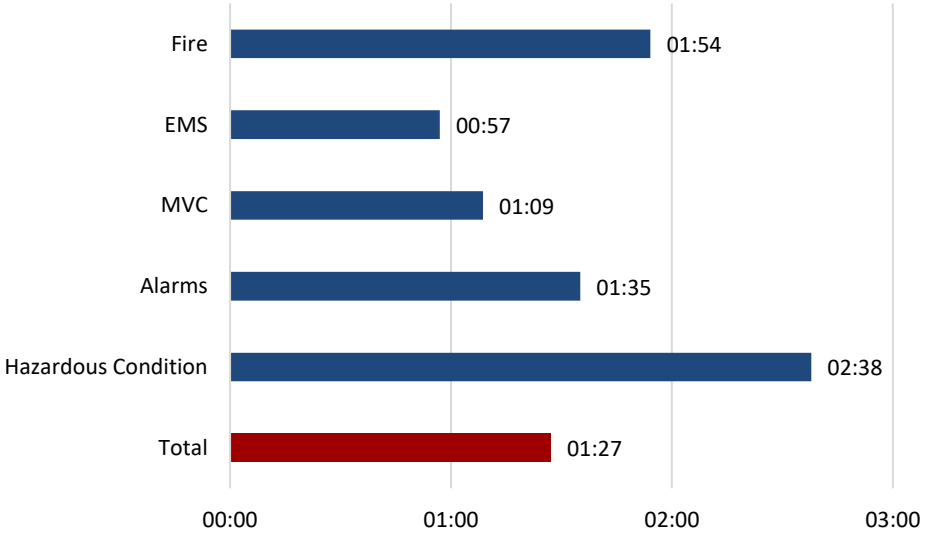
- Call Processing Time—The amount of time between when a dispatcher answers the 911 call and resources are dispatched.
- Turnout Time—The time interval between when units are notified of the incident and when the apparatus are en route.
- Travel Time—The amount of time the responding unit actually spends travelling to the incident.
- Total Response Time—Total Response Time equals the combination of "Processing Time," "Turnout Time," and "Travel Time."

In the flowing sections, each component will be examined individually to develop the key factors in Scio's total response time from 2015 through 2017.

CALL PROCESSING TIME

Understanding the individual components of an agency's total response time allows for the identification of deficiencies and potential areas for improvement. The call processing time performance criteria is applicable to NFPA 1710 and NFPA 1720 organizations as the dispatch center is staffed and capable of achieving the criteria for both organization types. The NFPA 1221: Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems standard specifies that call-processing time should not exceed 64 seconds (measured at the 90th percentile).

Figure 29: Call Processing at 90th Percentile, 2015–2017



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The previous figure provides an understanding of the Huron Valley Ambulance's (HVA) performance by incident type. Relative to "total" calls dispatched the communications center is able to process calls in 1:27. The communications center is also successful in processing calls in less than 90 seconds for emergency medical service (EMS) and motor vehicle crashes (MVC) incidents. However, fire and hazardous conditions significantly exceed the benchmark. It is recommended STFD work with HVA communications leadership to ensure compliance with NFPA 1221.

TURNOUT TIME

Unlike call processing times, turnout time, or the time from initial notification of an alarm until the unit goes enroute, is a component in which STFD has a great deal of control to influence. NFPA 1720 provides specific guidelines for staffed combination and volunteer fire department turn out times, 90 seconds at the 90th percentile, and this is an area that deserves some attention. The following figure provides STFD's turnout times at the 90th percentile.

Figure 30: Turnout at 90th Percentile, 2015–2017

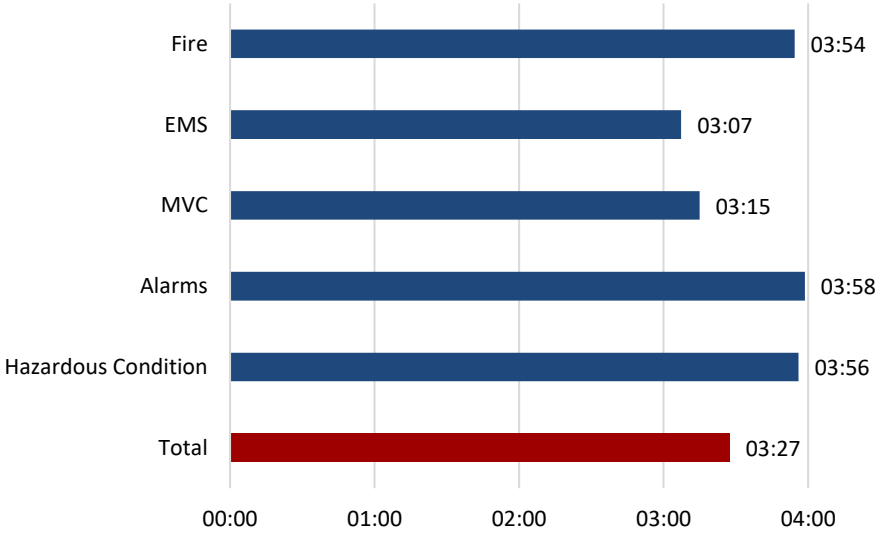
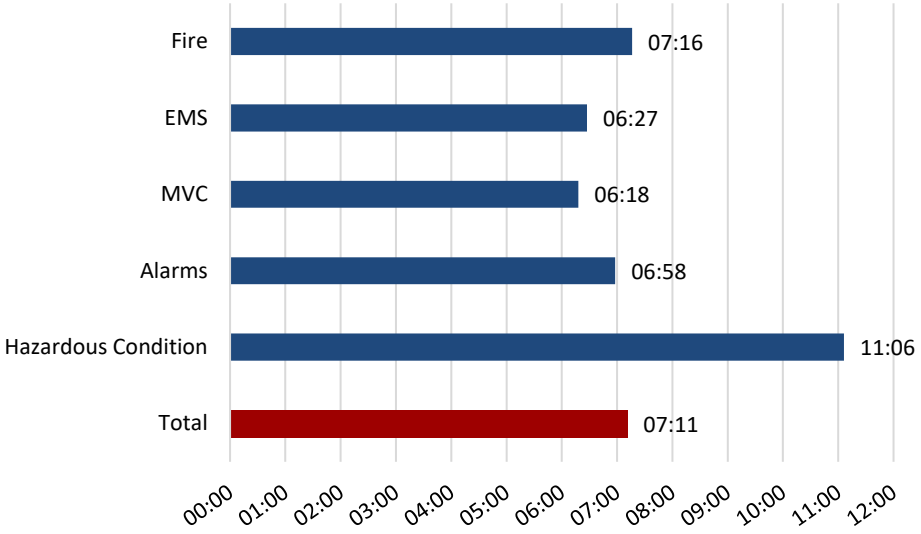


Figure 30 provides an understanding of STFD's turnout time performance by incident type at the 90th percentile. In total, STFD achieved a 3:27 turnout time 90 percent of the time. For staffed combination and volunteer fire stations, NFPA 1720 As a combination department, STFD's "career" staff have the ability to achieve turnout times established within NFPA 1710, which is 60 seconds or less for rescue calls and 80 seconds for fire and special operations calls, 90 percent of the time. STFD's performance is more than double for all metrics and nearly triple for fire related incidents. STFD should consider further examination in to these protracted turnout times to determine what improvements can be made.

TRAVEL TIME

Travel time represents the amount of time from when a unit begins traveling from its location until it arrives on the incident scene. Several factors, such as traffic and weather, can influence travel time and this element often accounts for the largest period of time when examining total response time. The following figure presents STFD's travel time at the 80th percentile.

Figure 31: Travel at 80th Percentile, 2015–2017



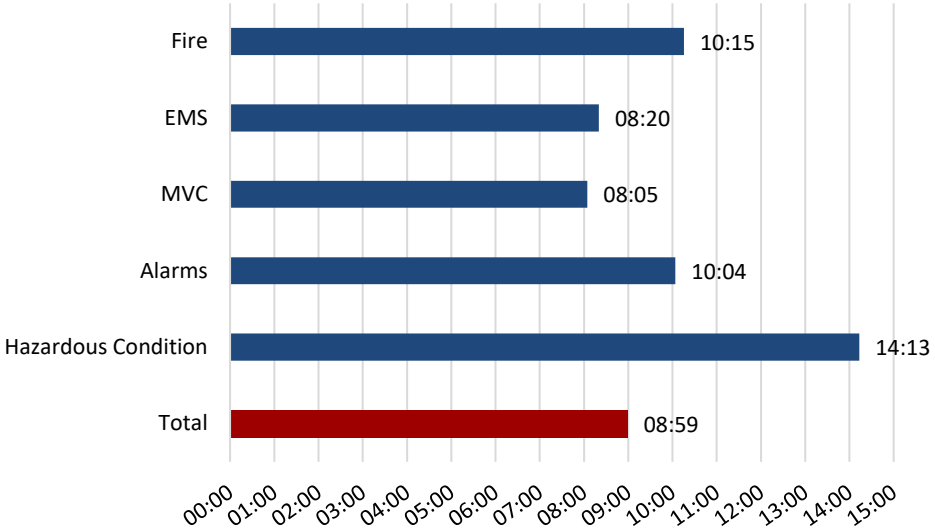
Overall, travel performance for all incidents at the 80th percentile was 7 minutes, 11 seconds. As illustrated in the figure, when travel times were examined by incident type, MVCs and EMS calls represented the quickest response times while calls involving hazardous conditions, such as fuel spills and overpressure/overheating without fire, appear excessive when compared to other incident types. STFD may consider examining how responses to these incidents are classified to separate emergency versus nonemergency responses and whether or not this impacts travel times to these incidents.

Finally, the total response time is examined, and the performance compared to NFPA 1720 standards.

TOTAL RESPONSE TIME

In this section, total response time by incident type and overall performance is illustrated. NFPA 1720 guidelines require that career and combination departments in suburban areas, those with population densities from 500 to 1,000 people per square mile, have the ability to respond 10 firefighters to fire incident scenes within 10 minutes of initial notification of the alarm, 80 percent of the time. Guidelines for responses to EMS incidents and other call types are not defined by NFPA 1720 and establishing performance standards for these incident types is left to the organization providing services. In the following figure, total response time performance is displayed.

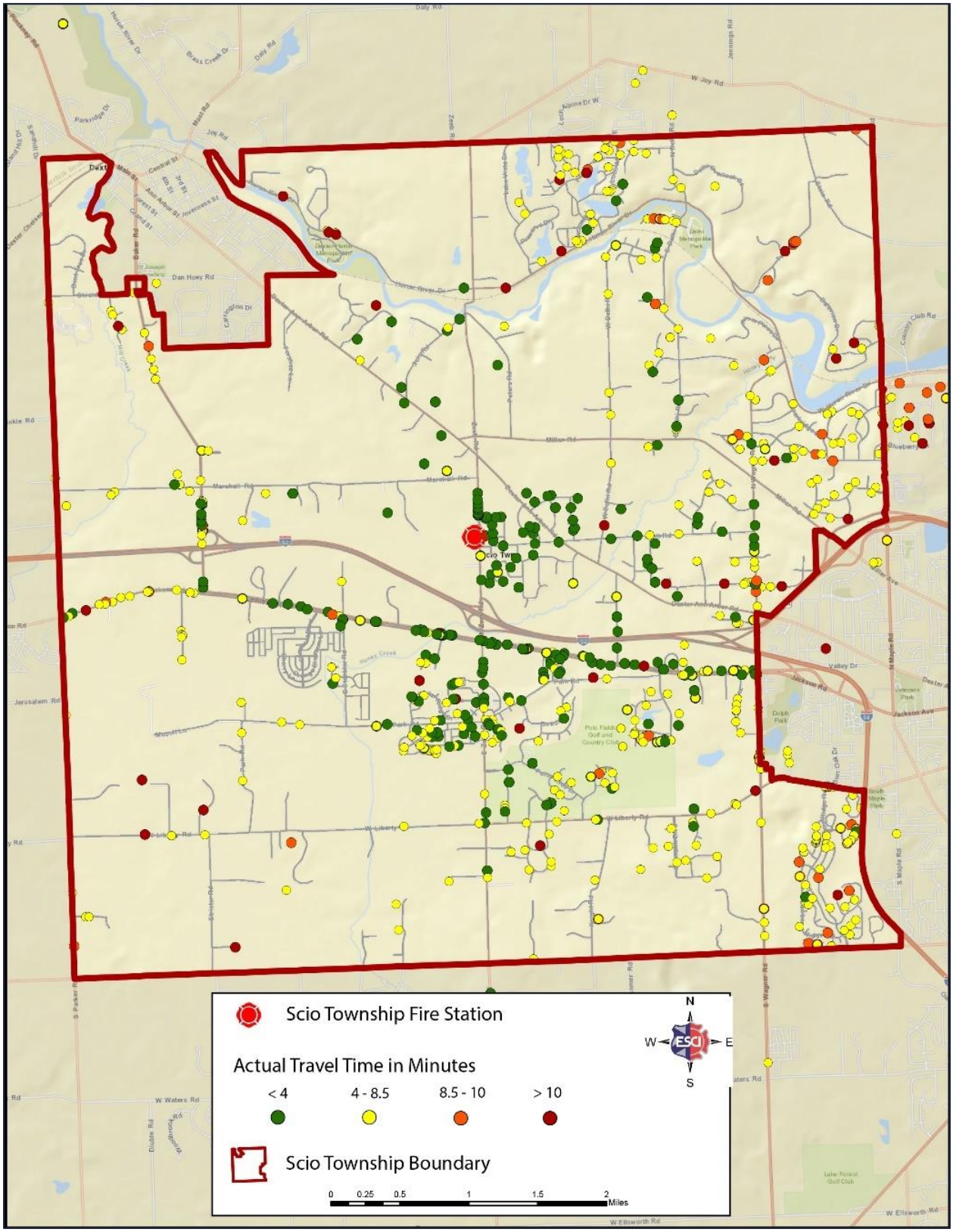
Figure 32: Total Response Time at 80th Percentile, 2015–2017



Scio Township's total response time performance at the 80th percentile for fire was 10 minutes, 15 seconds and for all incident types was 8 minutes, 59 seconds. Responses to EMS and MVC incidents represent the quickest total response performance, while responses to hazardous condition type incidents were the slowest at 14 minutes, 13 seconds. Based upon NFPA 1720 standards, Scio Township is close to meeting national response performance standards but should consider further examination in to variations in response performance by incident type.

The following figure presents a graphical representation of response performance by Scio Township Fire Department. In this figure, green dots represent response times of 4 minutes or less, yellow dots are times from 4 to 8.5 minutes, orange dots represent response times from 8.5 to 10 minutes, and red dots are response times greater than 10 minutes.

Figure 33: STFD Response Performance, 2015–2017 Emergency Incidents



The following figure displays NFPA 1720 standards based on population density.

Figure 34: NFPA 1720 Staffing/Deployment Matrix

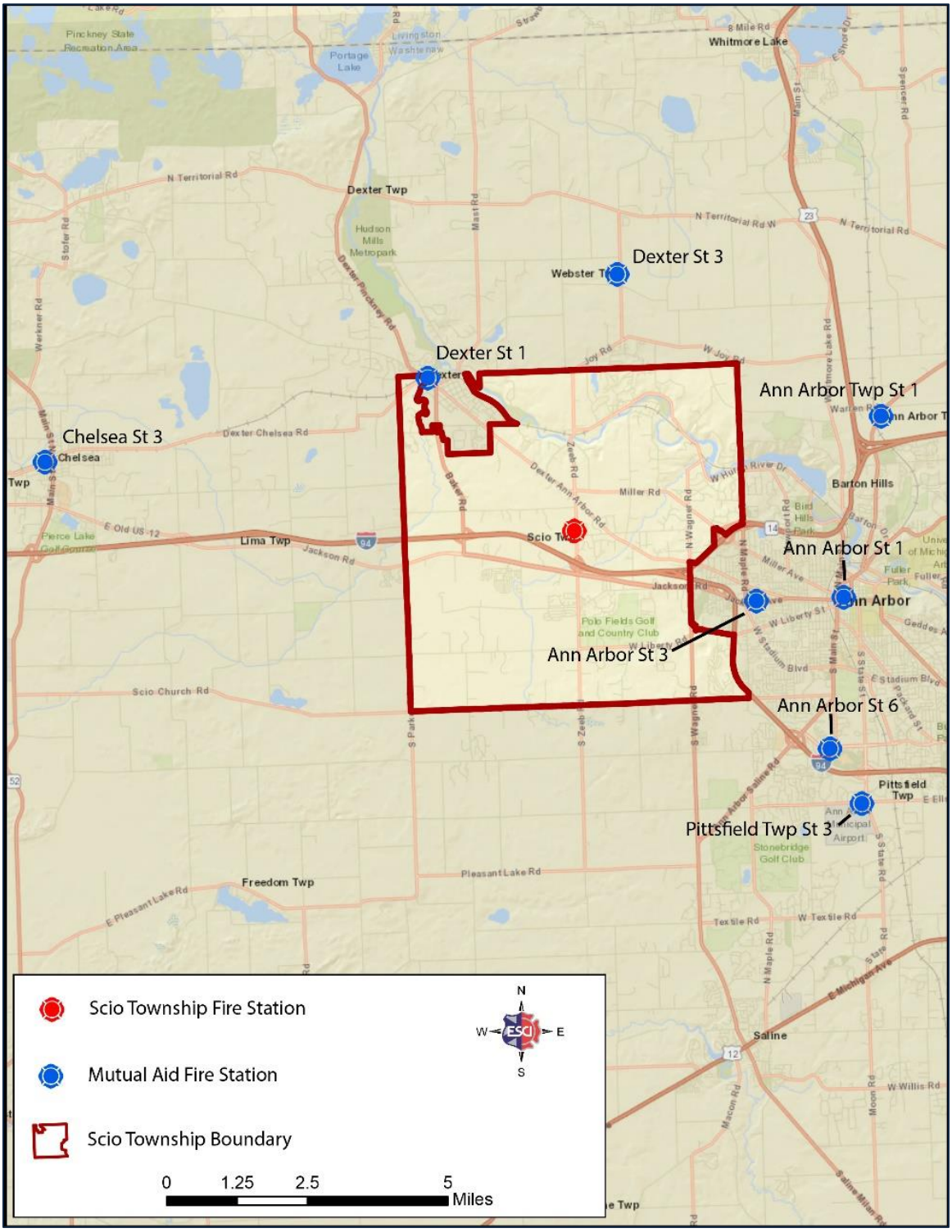
Demand Zones	Demographics	Min. Staff to Respond	Response Time (minutes)	Performance Objective
Urban	More than 1,000 people per sq. mi.	15	9	90%
Suburban	500 to 1,000 people per sq. mi.	10	10	80%
Rural	Less than 500 people per sq. mi.	6	14	80%
Remote	Travel Distance 8 miles or more	4	Dependent upon travel distance	90%
Special Risk	AHJ determines	Based on risk	AHJ determined	90%

Mutual and Automatic Aid Systems

There are existing mutual aid/automatic aid agreements in place between fire agencies within Washtenaw County. Mutual aid is typically employed on an "as needed" basis where units are called for and specified one by one through an incident commander. An enhanced aid agreement within the fire service is known as an "automatic aid" agreement which differs from mutual aid agreements in that under certain mutually agreed upon criteria, resources from the assisting agency are automatically dispatched as part of the initial response. These agreements facilitate closest unit dispatch to emergencies in previously established boundary areas and allow for the dispatch of additional apparatus and personnel to specific predefined emergencies.

The following figure displays the mutual aid agencies support STFD. It is recommended STFD work to ensure all mutual aid agreements are current. It is also recommended STFD ensure any future written automatic aid agreements are properly executed an implemented.

Figure 35: Scio Township Mutual Aid Stations



FUTURE DELIVERY SYSTEM MODELS

Although the preceding sections of this report focused primarily on the conditions that currently exist within the Scio Township Fire Department jurisdiction, the intent of this study is to combine that evaluation with a look into the future and provide policy makers with information necessary to carry the system forward. This portion of the report provides comments and recommendations related to the deployment of facilities, apparatus, and personnel with a focus on future service delivery and an improvement in overall efficiency within the system.

Development of Response Standards and Targets

ESCI emphasizes the importance of establishing response performance metrics by STFD. Once implemented, these standards establish measurable goals for service delivery, which then form the foundation upon which planning for deployment of resources is based. Absent these processes, the organization is not able to determine where it needs to go, nor is it able to know when it is achieving its goals and meeting the community's expectations.

Response standards have to be developed by each individual community, based on the expectations of elected officials and citizens balanced against the financial realities of what a community is able and willing to afford. For this reason, ESCI cannot establish these standards for STFD but rather will provide guidance and examples of what we consider to be acceptable metrics.

In the design of an operational structure for a fire department, interested parties attempt to identify some standard or "rule" that establishes staffing levels within a fire department. However, the reality is no single staffing standard exists within the United States that mandates staffing levels of a fire department. There are however NFPA standards addressing the number of firefighters that should be on-scene to accomplish specific tasks safely and effectively. These standards are known as NFPA 1710: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, and NFPA 1720: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments, and apply to either career organizations or volunteer organizations respectively. As a combination department, STFD can identify which standard it desires to follow. It is important to reiterate that this standard is not mandatory, but the reality is that not adhering to these standards will have implications should a significant event occur and staffing levels be called into question. Many fire departments in the United States recognize the NFPA standards as being the "consensus standard," as they are developed through the experiences of other fire departments, and industry experts, who have gone through various response, safety, and staffing challenges.

As part of the process for determining which standard to apply the issue surrounds the term "substantial." If a department is substantially volunteer (combination) then the organization could be recognized as falling under NFPA 1720, and if the department is substantially career then NFPA 1710 is the standard. There is no clear-cut line in determining an exact number of what "substantial" means. The reality is that this is a policy decision on the part of the Township leadership.

At the time of this study STFD does not report response times in a manner consistent with either NFPA standard. This is not a difficult issue for STFD to correct with the usage of a quality records management system capable of producing these results. ESCI recommends that STFD establish response performance objectives in compliance with NFPA 1720.

Whether the department utilizes NFPA 1710 or NFPA 1720, the reality is that time is the driving consideration in determining the success in mitigating an emergency incident. The longer a fire is allowed to grow before some form of suppression efforts is introduced into the equation the more difficult it becomes to suppress the fire. The same is true of patients in cardiac arrest or victims of traumatic injury.

Critical Tasks, Risk, and Staffing Performance

The ultimate goal of any emergency service delivery system is to provide sufficient resources (personnel, apparatus, and equipment) to the scene of an emergency in time to take effective action to minimize the impacts of the emergency. This need applies to fires, medical emergencies, and any other emergency situation to which the fire department responds.

As the actual, or potential, risk increases for any particular emergency, the need for additional numbers of personnel and apparatus also increases. With each type of incident and corresponding risk, specific critical tasks need to be accomplished.

The fire service assesses the relative risk of properties and occurrences based on a number of factors. Properties with high fire risk often require greater numbers of personnel and apparatus to effectively mitigate the fire emergency. Staffing and deployment decisions should be made with consideration of the level of risk involved. The level of risk categories used by Commission for Public Safety Excellence (CPSE) relate as follows:

- Low risk—Areas and properties used for agricultural purposes, open space, low-density residential, and other low intensity uses.
- Moderate risk—Areas and properties used for medium density single family residences, small commercial and offices uses, low intensity retail sales, and equivalently sized business activities.
- High risk—Higher density business and structures, mixed use areas, high density residential, industrial, warehousing, and large mercantile structures.

The Center for Public Safety Excellence (CPSE) has a sample critical tasking analysis for the number of personnel required on scene for various levels of risk. This information is shown in the following figure, illustrating an example of critical tasking only and is not intended to conclusively define the actual personnel necessary based on risk.

Figure 36: Sample of Critical Task Staffing by Risk[2]

Firefighter Personnel Needed Based On Level of Risk				
	Structural Maximum Risk	**Structure Significant Risk**	**Structure Moderate Risk**	**Non-Structure Low Risk**
Attack line	4	4	2	2
Back-up line	4	2	2	(2)
Support for hose lines	4	3	2	
Search and rescue	4	4	2	
Ventilation	4	2	2	
Rapid intervention team	4	4	2	
Pump Operator	2	1	1	1
2nd apparatus/ladder operator	1	1	(1)	
Command	2	1	1	1#
Safety	2	1	1#	
Salvage	4			
Rehabilitation	2			
Division/group supervisors	(2)			
Total	37–39	23	14–16	3–6

() indicates tasks may not be required at all such incidents

# indicates task may, at times, be completed concurrently with other position

The first 15 minutes is the most crucial period in the suppression of a fire. How effectively and efficiently firefighters perform during this period has a significant impact on the overall outcome of the event. This general concept is applicable to all emergencies.

Critical tasks must be conducted in a timely manner to control a fire or to treat a patient. Three scenarios of commonly encountered emergencies are routinely utilized by fire departments when conducting field validation and critical tasking: a moderate risk structure fire, a traffic collision with a trapped victim, and a cardiac arrest. Each scenario is conducted using standard operating procedures and realistic response times based on actual system performance. Each scenario is normally run multiple times with a variety of fire companies to validate and verify observations and times.

To further validate the analysis process, results are compared with records from actual working fires and similar incidents from previous years. Overall results are reviewed to determine if the actions taken within the early minutes of an incident resulted in a stop loss or not and if additional resources were required. The critical task analysis process demonstrates the rate in which the current deployment plan results in stopping loss, a high percentage of time within initial critical time goals.

[2] Based on examples provided in the publication "Creating and Evaluating Standards of Response Coverage for Fire Departments," 4th edition; Commission on Fire Accreditation International, Inc. (now Center for Public Safety Excellence).

Again, critical tasks are those activities that must be conducted in a timely manner by firefighters at emergency incidents in order to control the situation, stop loss, and to perform necessary tasks required for a medical emergency. The leadership of STFD is responsible for assuring that responding companies are capable of performing all of the described tasks in a prompt, efficient, and safe manner.

All Risk Critical Resource Tasking

Fire departments respond to many incidents other than structure fires, including hazardous materials (dangerous goods) releases, motor vehicle collisions, basic and advanced life support medical emergencies, and non-structural fires. Personnel responding to these types of incidents should be assigned tasks similar to structure fires.

The following figures are provided as an example for these types of incidents, although ESCI recommends STFD conduct its own field validation exercises with its crews, including automatic aid resources, to verify the critical tasking analysis provided. After field validation is complete, department leadership may find that the critical tasking can be adjusted appropriately upward or downward for each incident type.

Figure 37: Sample Non-Structure Fire Critical Tasking

Task	Personnel
Command	1
Pump Operator	1
Primary Attack Line	2
Total	**4**

Figure 38: Sample Hazardous Materials Incident Critical Tasking

Task	Personnel
Command	1
Pump Operator	1
Primary Attack Line	2
Back-Up Line	2
Support Personnel	7
Total	**13**

Figure 39: Sample Motor Vehicle Collision with Entrapment Critical Tasking

Task	Personnel
Command	1
Pump Operator	1
Primary Attack Line	2
Extrication	3
Patient Care	2
Total	**9**

Figure 40: Sample Emergency Medical Incident Critical Tasking

Task	Personnel
Command	1
Patient Care	2
Total	**3**

The previously mentioned minimum staffing criteria can be used as a planning tool in setting specific service level objectives for each of the incident types.

Response Time Performance Objectives

The process of setting response time performance objectives will include two primary questions:

1. What are the expectations of the community and elected officials regarding initial response times of the fire department to an emergency incident? What is the public's perception of quality emergency services where response time is concerned?
2. What response time performance would be reasonable and effective in containing fire, stopping the loss, and saving lives when considering the common types of incidents and fire risks faced by Scio Township Fire Department?

To initiate the process of considering the expectations of the customer, the historical travel time and loss history needs to be examined from the data that was submitted by STFD. Then, historical service levels are compared to known and anticipated service demand and community growth projections. Considering these projections, suggested response time standards are created to ensure the department is meeting local service demand expectations in accordance with relevant industry standards and best practices.

The first example is the "first due" response of a single unit utilizing standard reflex time from dispatch to arrival 80 to 90 percent of the time based upon the demand zone type:

Figure 41: First Due Response Standard Example

First Due, Single Unit Response	
Urban (>1,000 per square mile)	9 minutes to 90 percent of incidents
Suburban (500–1,000 per square mile)	10 minutes to 80 percent of incidents
Rural (<500 per square mile)	14 minutes to 80 percent of incidents

The next example represents a first alarm response to a moderate risk structure fire, utilizing standard reflex time from dispatch to arrival 90 percent of the time:

Figure 42: First Alarm Response Standard Example

First Alarm, Response of 3 Engines, 1 Truck, and 1 Battalion Chief	
Urban (>1,000 per square mile)	11 minutes to 90 percent of incidents
Suburban (500–1,000 per square mile)	19 minutes to 90 percent of incidents
Rural (<500 per square mile)	23 minutes to 90 percent of incidents

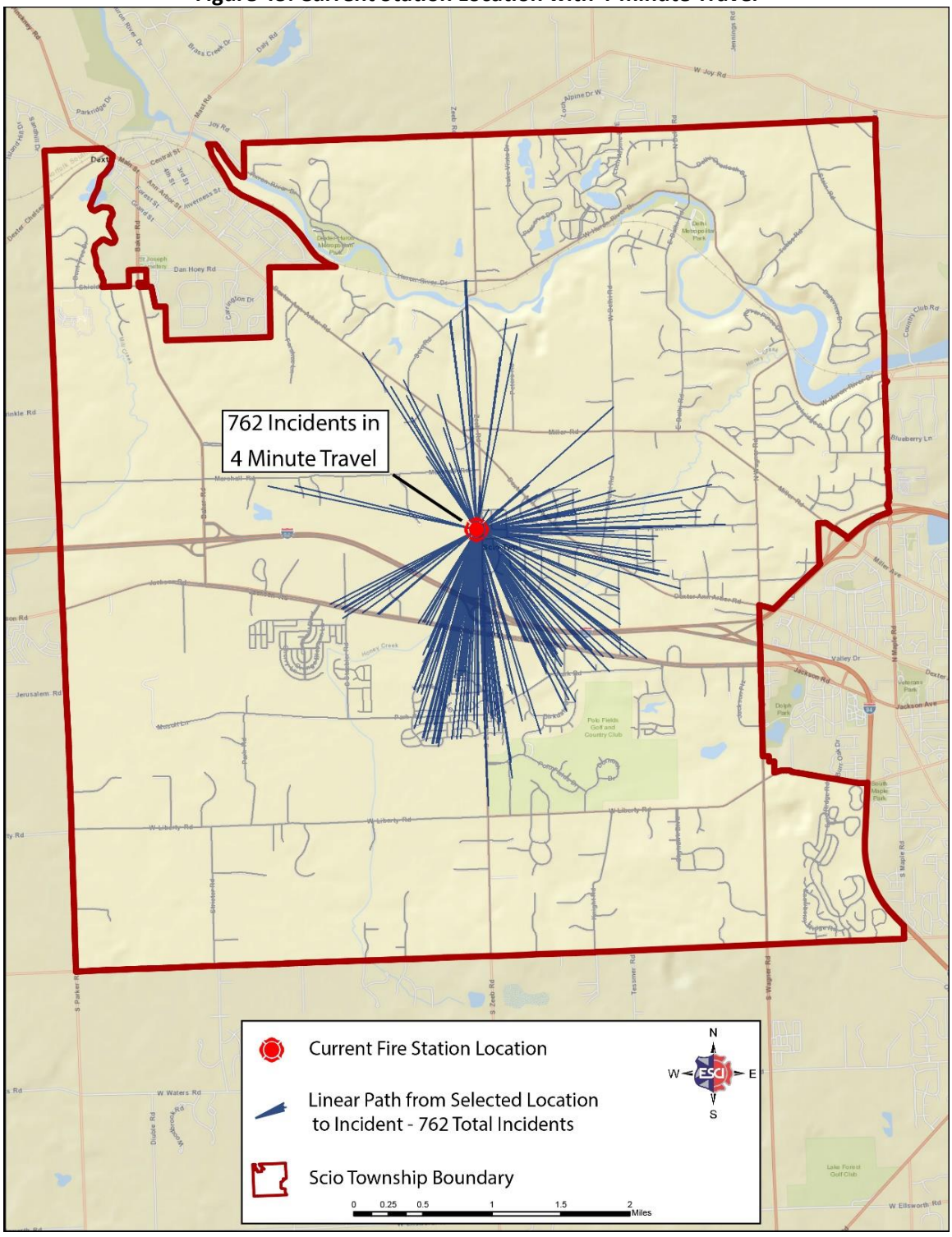
This discussion provides the department and Township with the information necessary to begin the process of establishing response standards and targets. Currently STFD does not evaluate response performance based upon a demand zone type. It is recommended that STFD begin the process of establishing demand zones as soon as possible in order to assist with future planning needs.

Analysis of Recommended Future Deployment Coverage

Consideration has been given to the location of the existing STFD fire station and potential need for future fire stations. ESCI analyzed the response coverage for a four-minute response from the existing station, and an analysis of where the best location might be for future stations. The completed analysis is discussed in this section. The following figures show the four-minute coverage of the Township. This is a computer predictive analysis based on achieving roadway speeds. Further, using the location data of incidents from the previous three years, ESCI calculated what percentage of the incidents could have been reached with a four-minute travel time.

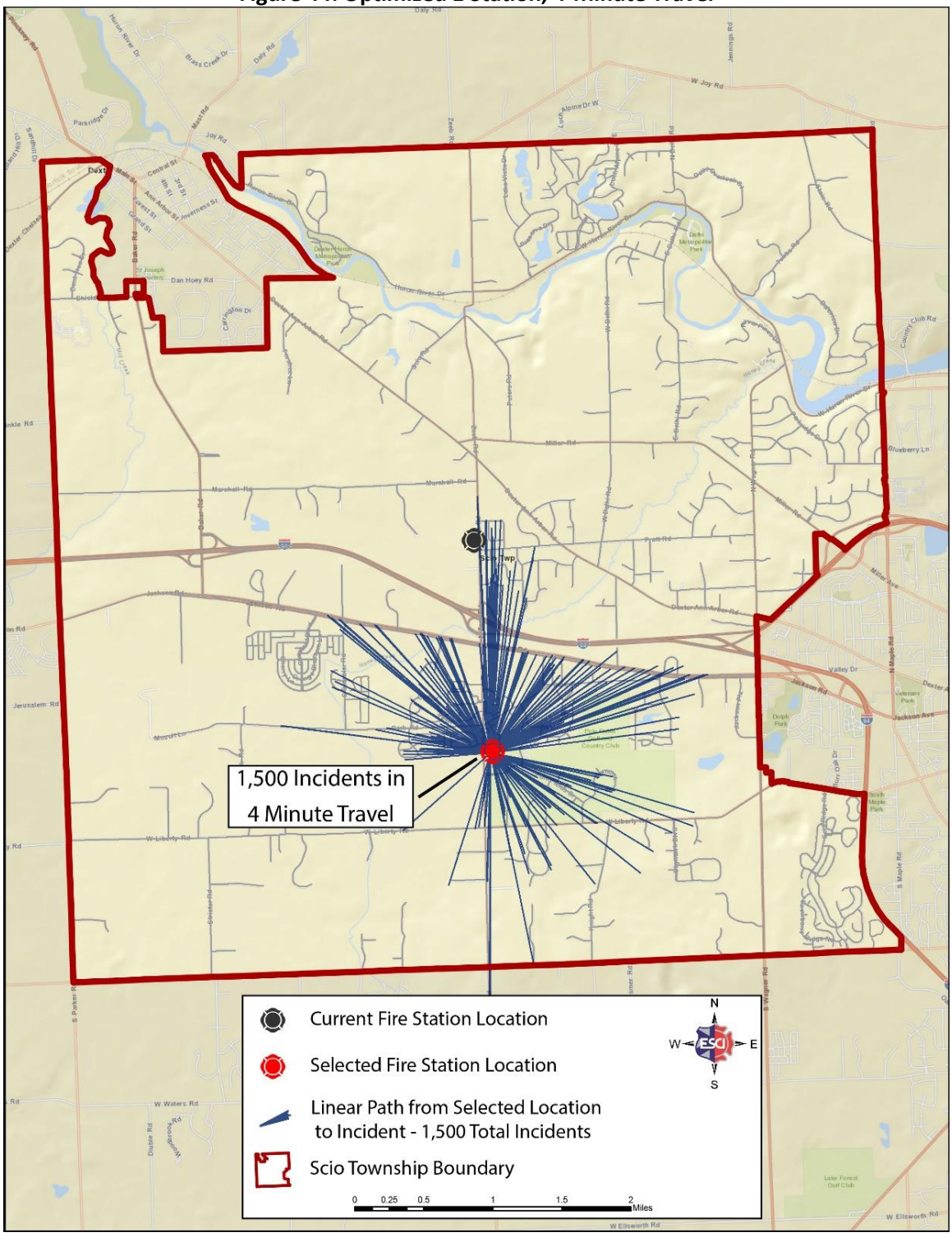
These maps are produced at posted roadway speeds. Slowing for a number of turns can cause the computer prediction to be more optimistic than actual performance. If the department's safety policies require slowing at all intersections or stopping for red lights, this will cause the actual results to be slower. Also, the use of traffic control systems for emergency response will cause the predicted to be closer to the actual performance. Therefore, ESCI recommends that STFD conduct its own analysis to verify how travel times differ for actual driving while complying with all safety policies. Additionally, there are other situations that may affect the accuracy of the predictions that do not occur on a regular frequency such as auto accidents, weather caused issues, or construction zones.

Figure 43: Current Station Location with 4-minute Travel



Based on the locations of incidents occurring from 2015–2017, Figure 43 demonstrates Scio's predicted ability to respond within a four-minute drive time. Using the current fire station location as the starting point, Scio could have traveled to 762 calls in four-minutes or less.

Figure 44: Optimized 1 Station, 4-Minute Travel



This figure provides an understanding of the potential impact should the Township decide to relocate the existing fire station to the location identified. This move would increase the ability of STFD to respond to 1,500 incidents, an increase of 738 calls, within a four-minute drive time.

Figure 45: Current Station with New Station Added

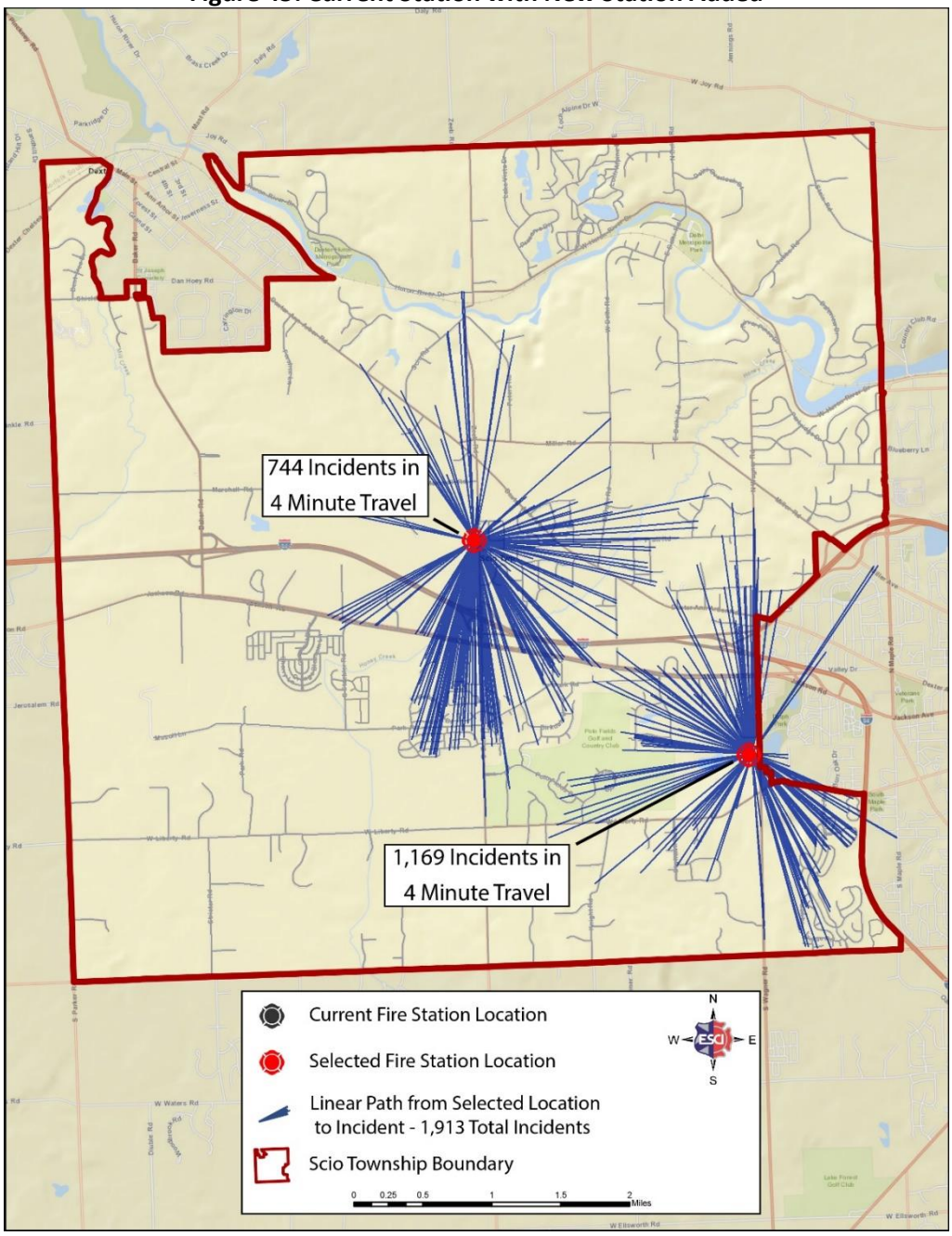


Figure 45 demonstrates the ability of STFD to reach a total of 1,913 incidents with a four-minute drive time with the addition of a fire station in the southeast portion of the Township. This location was selected solely with the usage of GIS software. In this scenario, the software selected this location when given the parameters of using a four-minute drive and reaching a maximum number of incidents with the largest service area. It is not common to recommend that a community construct a fire station so close to a municipal boundary. Should Scio Township determine this scenario to be a prime opportunity to increase the level of service to Township residents, a unique opportunity exists to construct and share the facility with Ann Arbor Fire Department. Other agencies have used similar deployment models with high degrees of success.

Figure 46: Two Stations Optimized

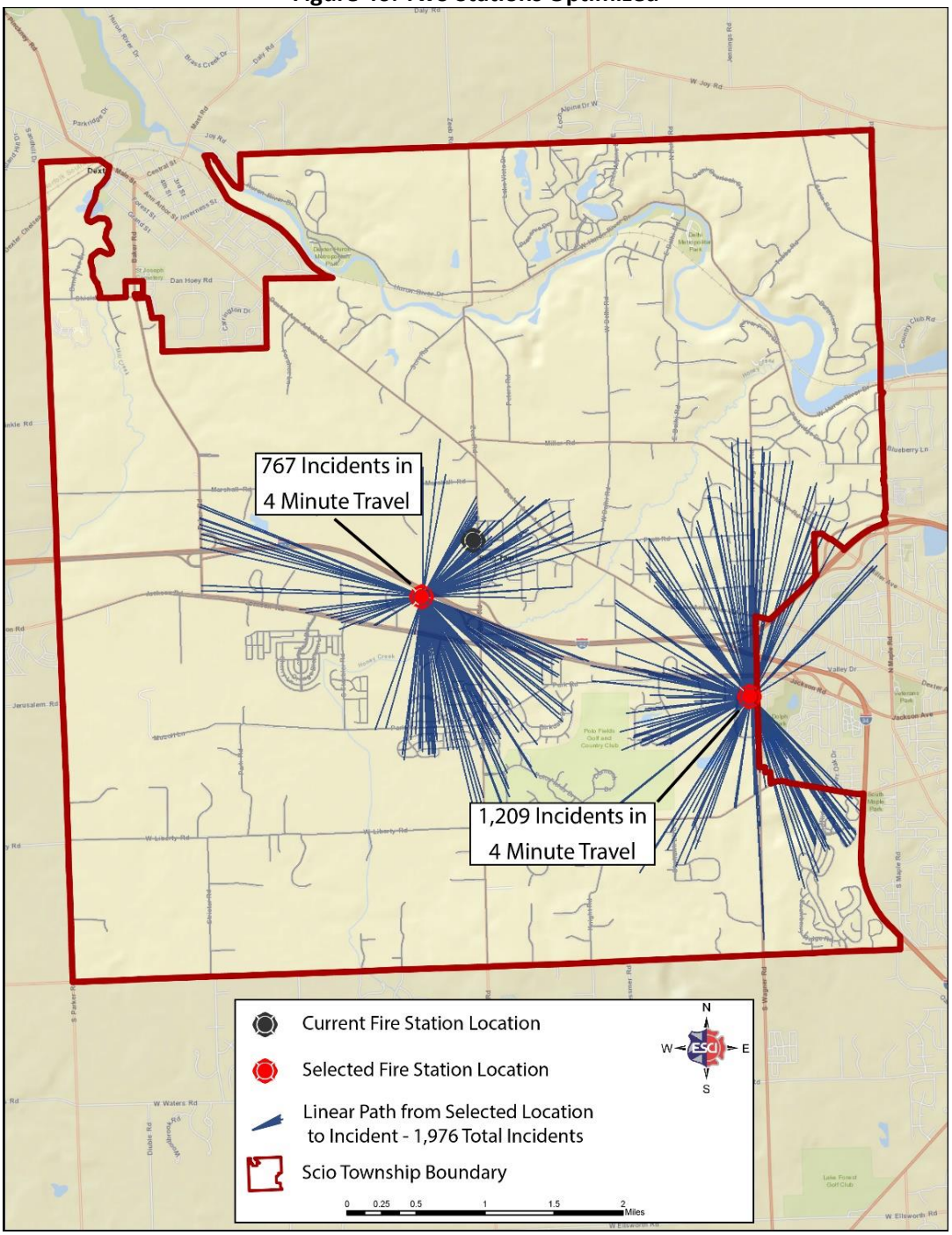
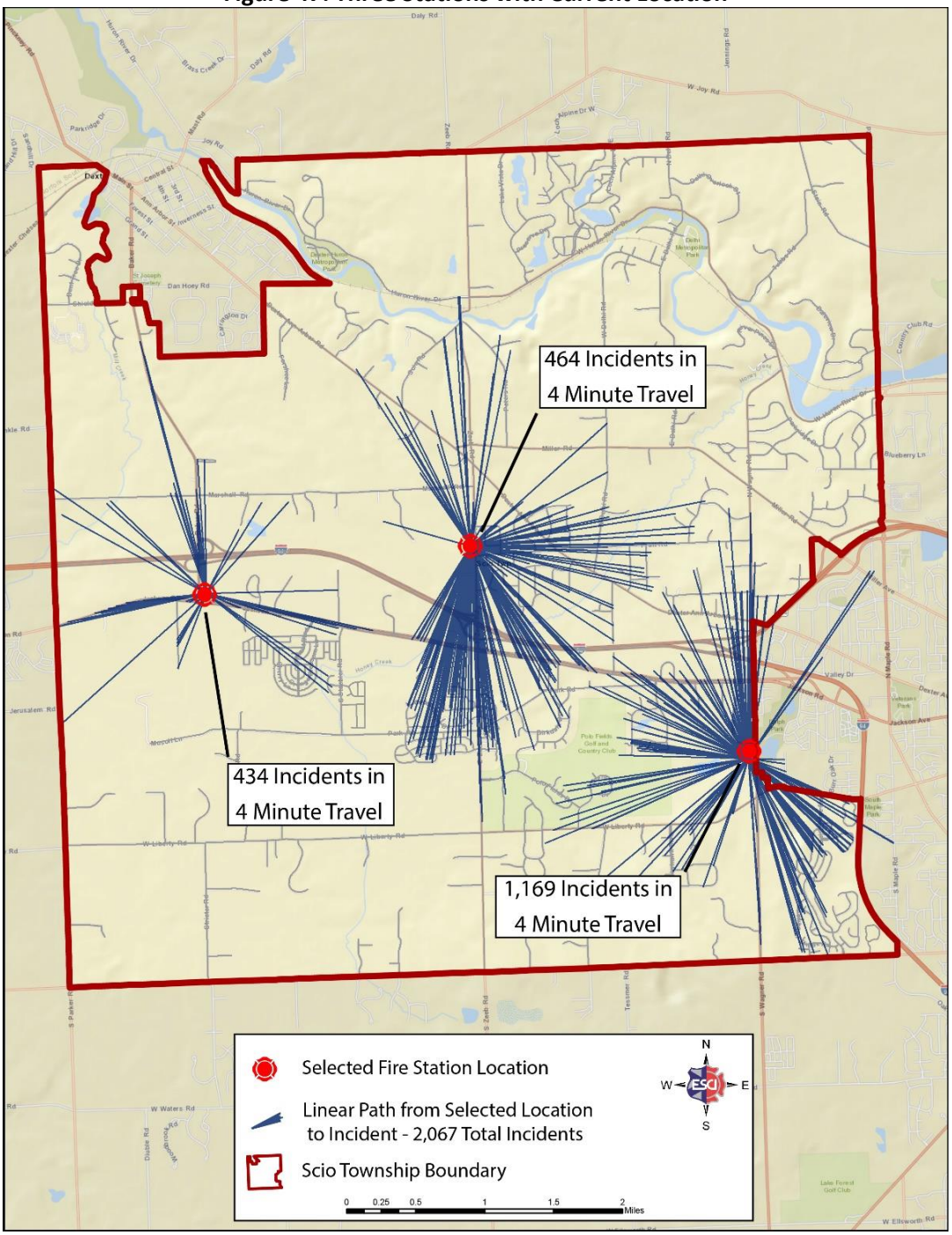


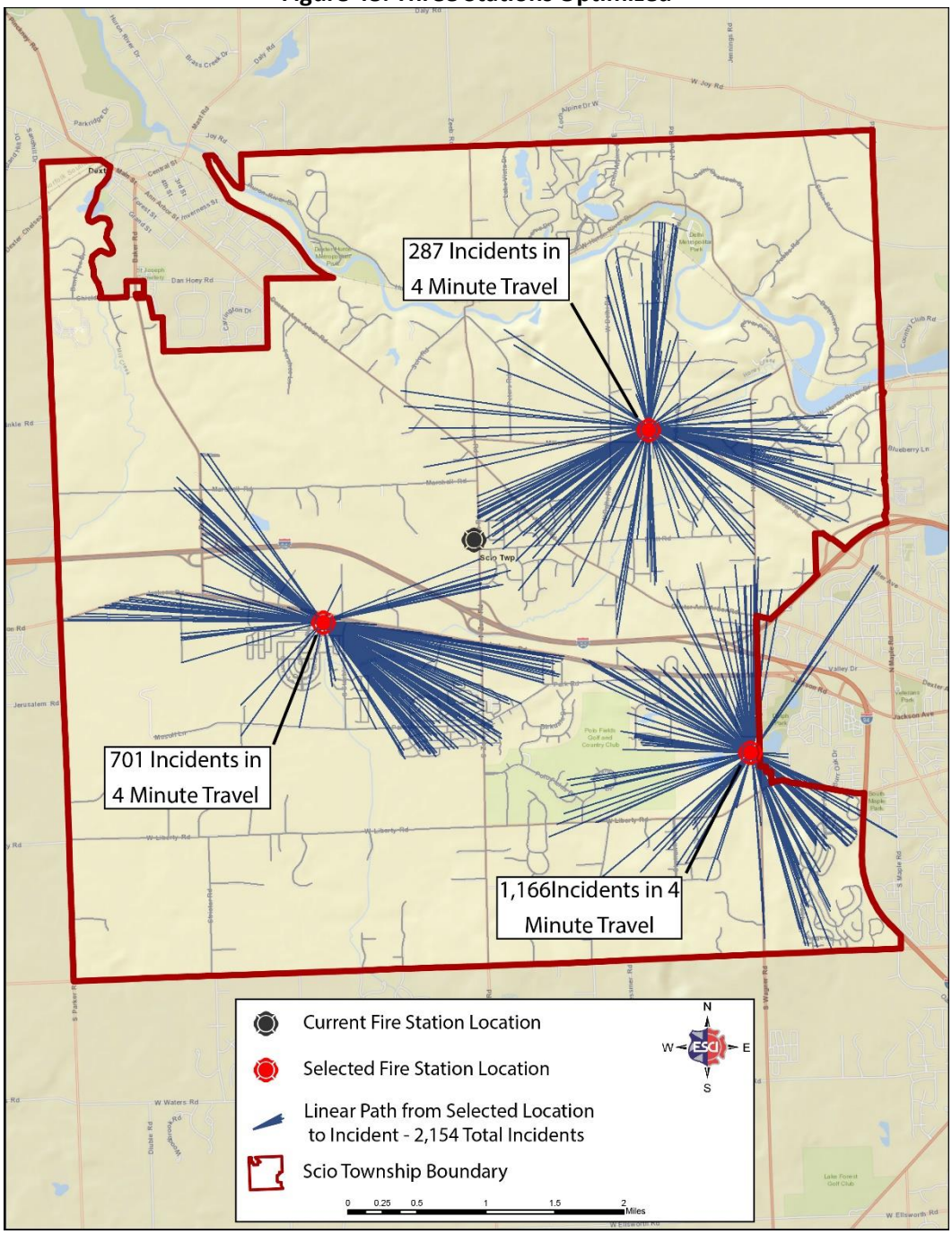
Figure 46 provides an understanding of the best locations for a two-station deployment model when the GIS software was tasked with reaching a maximum amount of calls with a four-minute drive time. In this scenario, the department was only able to reach an additional 64 calls compared to the deployment model in Figure 45. It is also noteworthy that the station previously located on the municipal boundary with Ann Arbor shifts slightly north, but remains on the municipal boundary. As a result, ESCI would not recommend this deployment model.

Figure 47: Three Stations with Current Location



When given the parameters of reaching a maximum number of calls with a four-minute drive from three fire stations, with one the existing station, the GIS software identified the locations in Figure 47. Using this three-station model, the department would be able to reach 2,067 incidents within four minutes. What is important to note is that this deployment model only results in the department reaching an additional 154 incidents in the desired drive time when compared to the deployment model in Figure 45.

Figure 48: Three Stations Optimized



When given the parameter of selecting the best locations using a three-station deployment model, the GIS software selected the locations in Figure 48. In this scenario, STFD would be able to reach 2,154 calls within the desired four-minute drive time. This would result in STFD only being able to reach an additional 241 incidents in the desired drive time. As a result, this deployment model is not considered to be in the best interest of the Township and its residents.

Conclusion

The results of the station analysis provide Scio Township with several models of station deployment configurations based upon historical incident data from 2015 through 2017. These models are intended to assist Township leadership in the decision-making process and provide projections to service demand impact based upon the model selected. Several factors must be considered when deciding the appropriate course of action, such as community expectations, timeliness of information, and limitations inherent to the development of these models. Should the Township decide to proceed with changes to the fire station deployment model at some point in the future, ESCI recommends that all factors relevant to the discussion be considered prior to making a final decision. Additional considerations may include automatic aid agreements, co-located facilities, changes to staffing, and future development in the Township.

Analysis of Recommended Future Staffing Level

The evaluation of staffing needs presented in this report reveal several personnel deficiencies within the Scio Township Fire Department. While many of these staffing needs cannot be corrected overnight, a plan should be developed to address current staffing needs and progress made toward the goal of hiring sufficient staff at defined points in the future. This may include intermediate steps such as part-time or paid-on-call employees, interlocal agreements with neighboring agencies, or other options as deemed appropriate.

The following contains ESCI's staffing recommendations for Scio Township Fire Department.

Recommendations

1. Establish a baseline daily staffing level of four persons per shift or three persons per apparatus should additional fire stations become a future consideration. This can be accomplished utilizing paid-on-call staff or the addition of career staff. A primary concern for STFD is the inability to rapidly assemble firefighters in adequate numbers to meet MIOSHA "2 in/2 out," as well as an effective response force. Additionally, a three-person engine company would provide staffing consistency when requesting or responding to mutual aid requests.

2. Replace the current organizational structure of two "shift commanders" per shift with an organizational structure that provides clear lines of authority and responsibility. While several rank and title options are available, ESCI recommends that the structure imposed complies with industry best practices, such as those provided by NFPA 1720.

3. Consider hiring a full-time Fire Chief to manage and lead the organization. ESCI recommends that the Township develop a process to establish minimum qualifications for this position and select the candidate that best meets all aspects of the position.

4. Evaluate the feasibility of establishing a full-time position to manage the department's fire prevention and inspection program.

5. Consider establishing a part-time Fire Safety Inspector position and develop a formal fire prevention and inspection program.

6. Create a full-time Administrative Assistant position for the fire department to provide support and consistency to administrative and operational activities.

In order for Scio Township to address the recommendations presented, several years are likely required to create and fund these positions. To assist Scio Township in the completion of a future Staffing for Adequate Fire and Emergency Response (SAFER) application for hiring operational firefighters, findings from this report are presented in the SAFER grant format from the most recent application cycle.

Project Description

Scio Township Fire Department is requesting federal assistance in hiring six (6) full-time firefighter positions to provide additional engine company staffing on a 24-hour basis. These positions are required so that the fire department can meet OSHA 29 CFR 1910.134(g)(4) "2 in/2 out" as adopted and required by the State of Michigan R 408.17451, Rule 7451(1)(e). With only two firefighters per day currently staffing a single engine company, marginal success in paid-on-call staff response, particularly during the work day, and reluctance by neighboring agencies to establish a formal automatic aid agreement, these positions are required to ensure firefighter safety of the first arriving unit in Scio Township, compliance with the "2 in/2 out" rule and increase the likelihood of positive mitigative outcomes and the community's quality of life.

The economic feasibility of sustaining these positions will be possible in the future; however, current revenue is insufficient to fund these positions without federal assistance. The need for these firefighter positions, as well as the economic feasibility of the Township maintaining these firefighter positions was also verified herein by ESCI.

Benefits achieved through the successful award of this grant include: meeting regulatory requirements ("2 in/2 out"), enhanced firefighter safety and efficiency, the ability to assist medical transport units without taking the engine company out of service, parity with neighboring mutual aid partners which could lead to the establishment of an automatic aid agreement with the City of Ann Arbor, enabling the department to increase its public safety education outreach and inspection programs using on duty firefighters without the need to potentially take the only unit out of service and increase the community's quality of life through additional education and inspections while enhancing responders' ability to accomplish critical tasks on emergency scenes, resulting in more effective and efficient operations. Finally, if awarded this grant the Township will have an enhanced ability to protect its critical infrastructure within Scio Township's primary response area as critical tasking will be accomplished more effectively with the addition of on scene personnel, additional apparatus may also respond as more firefighters are available, and with the assistance of mutual aid partners, the Township's ability to establish an effective response force for the most common types of emergency incidents will be achievable.

IMPACT TO DAILY OPERATIONS

Currently, the department employs six firefighters who are divided in to three crews, two persons each, on a 24 hours on/48 hours off schedule. Due to the current staffing model, Scio is unable to initiate any type of response efforts which require a "2 in/2 out" operation, such as structure fires, confined space, or hazardous materials technical operations. Additionally, should something happen to one of the firefighters on shift, the other will be alone until either another firefighter is called in or the end of their shift. This presents a dangerous situation for the department and the community as the lone firefighter would have to either respond to an emergency call alone or take the Township's only engine company out of service. The addition of two more firefighters per shift would eliminate this issue and the department would have the ability to adequately staff emergency apparatus with at least three firefighters and respond to calls even if an on-duty firefighter was forced to miss work due to an injury or illness.

COST BENEFIT ANALYSIS

The addition of six positions to the Scio Township Fire Department will benefit the department by establishing a staffing level that allows for the department to be in compliance with Michigan's "2-in/2-out" law for interior firefighter operations during an initial fire attack prior to the arrival of mutual/automatic aid partners. With the current staffing level Scio Township Fire Department must delay initial interior operations and property owners may lose additional property while the department waits to assemble the requisite "2-in/2-out." The department also benefits in creating a safer work environment in which firefighters can operate within the "immediately dangerous to life and health environment."

Under current staffing arrangements firefighters operate in an environment in which many different emergency activities must be accomplished with a limited number of resources. This reality means that a limited number of firefighters can be placed in a position of having to "multi-task" until additional help can arrive. Firefighters attempting to accomplish too many tasks in a short period of time can create a scenario where when one-thing goes wrong it begins a cascading series of events in which someone gets hurt or killed ("if its predictable its preventable").

These added positions reduce the potential for initial attack firefighters attempting to accomplish too many tasks with a limited amount of resources. This fact benefits the community in that reduced potential for firefighter injuries or death also reduce the potential fiscal impact of increased workers compensation claims. Any increase in workers compensation claims or death benefits payouts will have a negative fiscal impact on the citizens of the community served.

Surrounding communities and mutual aid partners benefit from this request by ensuring an effective number of firefighters are responding to requests for service with a staffing level similar to the requesting agency's staffing levels. This allows incident commanders to make decisions consistent with their own agency's strategic concepts without having to account for a unit that is "one-off" from their own capabilities.

If awarded this grant, Scio Township will have the ability to hire the additional six firefighters and provide for a budgeted daily staffing of four firefighters on the engine company with a minimum staffing of three. Should funding be approved and firefighters hired in the 2019 fiscal year, the estimated cost savings the Township would experience are: $331,090 in 2019; $343,561 in 2020; and $166,582 in 2021 for a total of $841,233 in grant funding.

Following the conclusion of the grant period, employee costs for the six requested positions will be $495,100 in 2022, with an estimated annual increase of 4% for salary and fringe benefits. The immediate benefits to the department and the community will be the ability to provide a safe and effective crew size to initiate interior firefighting operations and rescues and meet NFPA 1720 staffing standards. Additionally, the three-year period will allow the Township the time needed to establish the modifications to revenue sources to ensure that adequate funding is available to meet operational needs. Finally, the Township's engine company staffing will provide parity with the City of Ann Arbor, which will likely result in the establishment on an automatic aid agreement and future collaborative opportunities.

Financial Impact

For the Township to determine the financial impact, both short- and long-term, of hiring additional firefighters and making use of SAFER Act grant funding, the following analysis was performed. Several assumptions were used to develop the financial projections and are outlined below.

- Firefighters will be hired at the starting rate and will work a schedule of 24 hours on duty followed by 48 hours off duty.
- Under this schedule, firefighters are scheduled to work a total of 2,928 hours per year of which 2,763 are paid at a straight-time rate and 165 hours (which is considered scheduled or built-in overtime versus sick/vacation coverage, etc.) which are paid at an overtime (OT) rate of 1.5 times the regular rate.
- Firefighters must be paid at an overtime rate after 53 hours in any 7-day work cycle (106 hours worked in any 14-day work cycle and so on) pursuant to FLSA law.
- Additional overtime worked due to sick/vacation coverage, late calls, etc., is not included in the following analysis.
- To fill a single 24-hour firefighter position on an engine it takes a minimum of three people on a straight 24/48 schedule who will earn no less than 165 hours of "built-in" overtime to maintain that one staffed position.
- This schedule is the most cost-effective schedule used to fill any given "seat" on an apparatus, but staffing level can be reduced at the cost of service level; this is a policy decision that must be made by the Township.
- Article 14—Wages of the Township Collective Bargaining Agreement (CBA) with the firefighters (IAFF Local 4891), states that the current hourly wage for a starting firefighter is $16.13 (overtime rate is $24.20).
- The new firefighter will also earn an average of $1,800 annually pursuant to the CBA in additional holiday pay and $100 per year for each year of service in longevity pay.
- Total annual pay for a new firefighter will be $50,359 and is estimated to increase at 3% annually plus the addition of longevity pay.
- The average benefit rate for the five current firefighters who have not opted out of the medical insurance program is 46.1% which is the assumed rate for new firefighters and is forecast to increase at 5% annually.
- On-boarding costs are estimated at $5,000 per firefighter (bunker gear, uniforms, etc.)
- SAFER Act Grant covers 75% of customary salary and benefit costs of starting firefighter for first year of employment, 75% the second year, and 35% the third year after which the Township assumes full cost.
- SAFER Act Grant does not cover on-boarding costs.

Based upon the assumptions above, the following figure identifies first year and subsequent year projected costs for one full-time firefighter. The on-boarding cost of approximately $5,000 per firefighter will only be experienced during the initial year. Only salary and benefits costs will be experienced in the remaining years of the forecast period. Although, in actuality, there may be ongoing costs for uniform and equipment replacement, training and other associated employee costs, these are incremental and relatively minor compared with salary and benefits and are not included in the forecast estimates.

Figure 49: Projected Annual Cost for One Full-Time Firefighter

Single Firefighter Annual Cost					
Cost Item	**2019**	**2020**	**2021**	**2022**	**2023**
Salary	$50,359	$51,970	$53,729	$55,641	$57,710
Benefits	$23,216	$24,377	$25,596	$26,876	$28,219
Total Comp	$73,575	$76,347	$79,325	$82,517	$85,930
On-Boarding	$5,000	0	0	0	0
Total Cost	**$78,575**	**$76,347**	**$79,325**	**$82,517**	**$85,930**

Using the single firefighter costs by forecast year shown in Figure 49, the following figure illustrates estimated costs to the Township of hiring three (one 24-hour position) and six (two 24-hour positions) full-time firefighters, both without and with SAFER Act Grant funding. In 2019, the total costs including on-boarding, of hiring three firefighters is $235,726 versus $471,453 for six firefighters. If the T0wnship is successful in receiving grant funding, its share of the three- and six-firefighter scenarios would drop to $70,182 and $140,363; respectively. In each case, with grant funding, the total cost to the township is 25% of the total cost in 2019 and 2020, and 65% in 2021, after which it increases to 100% of the employee costs by 2022.

Figure 50: Projected Annual Cost for 3- and 6-Full-Time Firefighters with and without SAFER Act Funding

	2019	2020	2021	2022	2023
Three Firefighters					
Total Cost	$235,726	$229,041	$237,975	$247,550	$257,789
Cost w/ SAFER	$70,182	$57,260	$154,684	$247,550	$257,789
Six Firefighters					
Total Cost	$471,453	$458,082	$475,950	$495,100	$515,578
Cost w/ SAFER	$140,363	$114,521	$309,368	$495,100	$515,578

By obtaining grant funding, the Township would save either $420,617 or $841,234 in employee costs over the period FY 2019–2021 in the three- or six-firefighter scenarios; respectively. Obtaining the SAFER Act grant funding would enable the Township to hire the necessary firefighters and prepare to fully fund these added positions over the three-year period with additional Township revenue.

As in the forecast presented earlier using the proposed FY 18–19 budget as a basis for future projections, each of the cases discussed here with the addition of either three or six additional firefighters results in a situation where the Township will have depleted its fund balance below 25% of its annual operating budget by FY 19–20 with one exception. Adding three firefighters with a SAFER Grant still provides the Township with a beginning fund balance slightly more than 25% of its operating budget in FY 19–20. In all cases, the fund is forecast to have a negative fund balance in FY 20–21, even with SAFER grant funding.

CONCLUSION

The ESCI project team began collecting information for Scio Township, Michigan in the Spring of 2018. The team members recognize this report contains a large amount of information and ESCI would like to thank the department leadership, City staff members and employees for their efforts in bringing this project to fruition. ESCI would also like to thank the various individuals and external organizations for input, opinions, and candid conversations throughout this process. It is ESCI's sincere hope the information contained in this report is used to its fullest extent and that the emergency services provided to the citizens of Scio Township and the surrounding area will be improved by its implementation.

TABLE OF FIGURES

SCIO TOWNSHIP FIRE DEPARTMENT

STRATEGIC PLAN

2016-2020

Presented By: Carl Ferch, Fire Chief
Assisted By: Carlisle/Wortman Associates, Inc.
October, 2015

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Scio Township Fire Department
Strategic Plan
2016-2020

The Scio Township Board of Trustees has requested the Department to prepare a Strategic Plan which will provide a guide to decision-making both in the short and long term. The time frame selected for this Plan is approximately five (5) years starting in 2016.

Plan Context

Fire service in the Township is required to be provided for a sizeable geographic area with a diversity of population and land use. The Township's population is increasing. In the decade from 2000-2010, the Township's population grew by over 22%. By 2025, population is expected to increase by another 11%.

The Jackson Road subarea is a focus of commercial, industrial and high density residential land use. The availability of public utilities will also support additional growth in this vital corridor. The Jackson Road corridor also provides a significant amount of the Township taxable value. Further, it is a large source of employment which results in an increase of daytime population to well over 20,000.

The southeast portion of the Township, referred to as the Sister Lakes subarea in the Master Plan, is also an area of diverse and concentrated land use. Wagner Road includes a mix of industrial and office land uses. The extreme southeast corner of the Township in Section 36 is composed of higher density multiple and single family residential.

The balance of the Township is composed of low density single family residential spread over a large geographic area. The distances that need to be covered present special challenges for fire service, especially in areas without municipal water.

Current Department

The Department currently operates out of a single station, referred to in this Report as Station 1. The station is located on Zeeb Road, just north of the Township offices. The fire department exists for the sole purpose of providing an "Emergency Service Response". An emergency is by definition: "a sudden unforeseen **crisis** that usually involves **danger**, and **requires** immediate action" or "**a posed threat to human life or serious damage to property**".

Fire calls are separate from the Emergency Medical Service (EMS) calls. All reported structure, vehicle, grass, and transformer fires are sent directly to the Department. Gas leaks, hazardous material incidents, and down power lines are also referred to the Department.

The Department is classified as an EMS response Category 2, in that it responds to only those calls considered to be **life threatening**. Over the past twelve calendar years, the per year average call volume has been 850.

There is a more aggressive level available known as a Category 1 & 1-A. At this level, the fire department responds to medically related incidents that are not considered to be non-life threatening, unknown motor vehicle accidents and anything generated by 911. Last year there were at least 590 of this category call into Scio Township. As a result, the total EMS call volume was over 1,400 for last year.

Staffing is currently provided through a combination of six (6) full-time and ten (10) paid on-call firefighters. Personnel are supervised by a full-time Chief. The existing shift configuration is two full-time firefighters on shift 24/7.

Equipment

The fire fleet consists of five operating vehicles and one vehicle in storage. The fleet is configured so that each truck performs a specific function. Regular maintenance has extended the life of each vehicle. However, there is a significant problem when major equipment is down for repair and maintenance since there is limited backup equipment**. A more detailed discussion is found in Attachment I and is summarized below:**

- Engine 16-2: First unit purchased to bolster aging fleet. The use of Engine 16-2 is limited to structure fires within the Township and special circumstances vehicle fires and accidents. 16-2 has 90,617 miles and 7,341 engine hours. It carries 1250 gallons of water and 1500 gpm mid-ship pump.
- Tanker 16-1: Purchased to complement Engine 16-2, Tanker 16-1 is used predominantly on structure fires. It has 13,415 miles and 1,302 engine hours.
- Brush 16-1: Responds to ground cover fire, burn complaints and utility gas leaks. Brush 16-1 has 9,875 miles and is relatively low maintenance.
- Engine 16-1: Responds to motor vehicle accidents, car fires and automatic alarms. It was designed to carry a variety of special tools and equipment and carries vehicle stabilization equipment, ropes, pulleys, stokes basket, K-12 Partner Saw, AED, back boards and a medical jump kit. There is pre-connected combination cutter/spreader hydraulic rescue tool built into the front bumper, and a freestanding set in the rear compartment. It is four-wheel drive for winter operations. The odometer currently reads 9,863 miles and the engine has 742 hours.
- Rescue 16-1: Responds to our largest volume of calls, approximately 55%, including medical calls and house rescues.

Demand

The Fire Department services the entire Township as well as participates in mutual aid with surrounding communities. The calls that the Department receives can be categorized as follows:

Emergency Medical Service (EMS): EMS constitutes medical emergencies and motor vehicle accidents. This service accounts for 70% of the calls. When the duty crew arrives at these incidents, they start a patient assessment or life prolonging measures where necessary. Huron Valley Ambulance (HVA) assumes patient care upon arrival. The Department works closely with HVA to coordinate on-site management of any incident.

HVA maintains an advanced life support units at one of three staging points in or around Scio Township, Baker & I-94, Zeeb & I-94 and Jackson & I-94. A special service unit Echo-170 is permanently stationed in the Village of Dexter. This paramedic unit covers all of Dexter Township, Webster Township, and the Village of Dexter. Fifteen sections of Scio Township, along the North edge are also included in their primary response district in support of the ALS unit.

Mutual Aid: The Automatic Aid Agreement (commonly known as Mutual Aid) is a cooperative agreement among neighboring communities. Essentially, resources from neighboring departments are pre-arranged and agreed on in advance for structure fire assistance. The specific equipment to be dedicated to a call for mutual aid has been identified in advance, according to a perceived need. These groups are assigned as: second, third up to six alarms. We have included a full assist from the Dexter Area Fire with our initial response to all township sections. Based on the fire conditions observed on arrival, the clearly defined additional alarms are requested. Any other combination of specialized equipment or resources are also available through the mutual aid agreement.

Fire Other: Historically, the number of structure fire calls has been relatively low. That is not to say an increased number of structure fires won't happen in the future. Over the past twelve full calendar years, 537 calls or 5% of the total volume have been structure fires. Further differentiated, 211 calls were mutual aid requests outside the township boarders, 137 calls were limited damage or inconsequential fires, 137 calls were mistaken for structure fires and 52 calls were truly destructive. The other fire related activities; vehicle fires, ground cover fires, burning complaints, investigations of visible smoke or smoke odors, wires down and arching, fuel spills, Haz-Mat investigations and automatic fire alarms are historically 25% of the call volume.

Total Volume: The Department maintains detailed records of all calls. The total volume of calls over the past five years has remained relatively constant ranging from 726 to 825 annually. A detailed accounting of the statistical data collected by the Department is included in Attachment II.

Figure I illustrates, the geographic distribution by number and percentage of calls conducted for the past five (5) years. We would expect the geographic distribution of calls to continue in the future.

The highest incident calls occur in Section 20, which is the location of Scio Farms Estates. The next **wo** highest are in Sections 26 and 36 which are the locations of some of the more dense housing developments in the Township such as Sun Co-Housing, **Lakeshore Apartments** and the Uplands, Summerfield Glen and Woodchase Apartments. Sections 26 and 36 are also more remotely located from the current station.

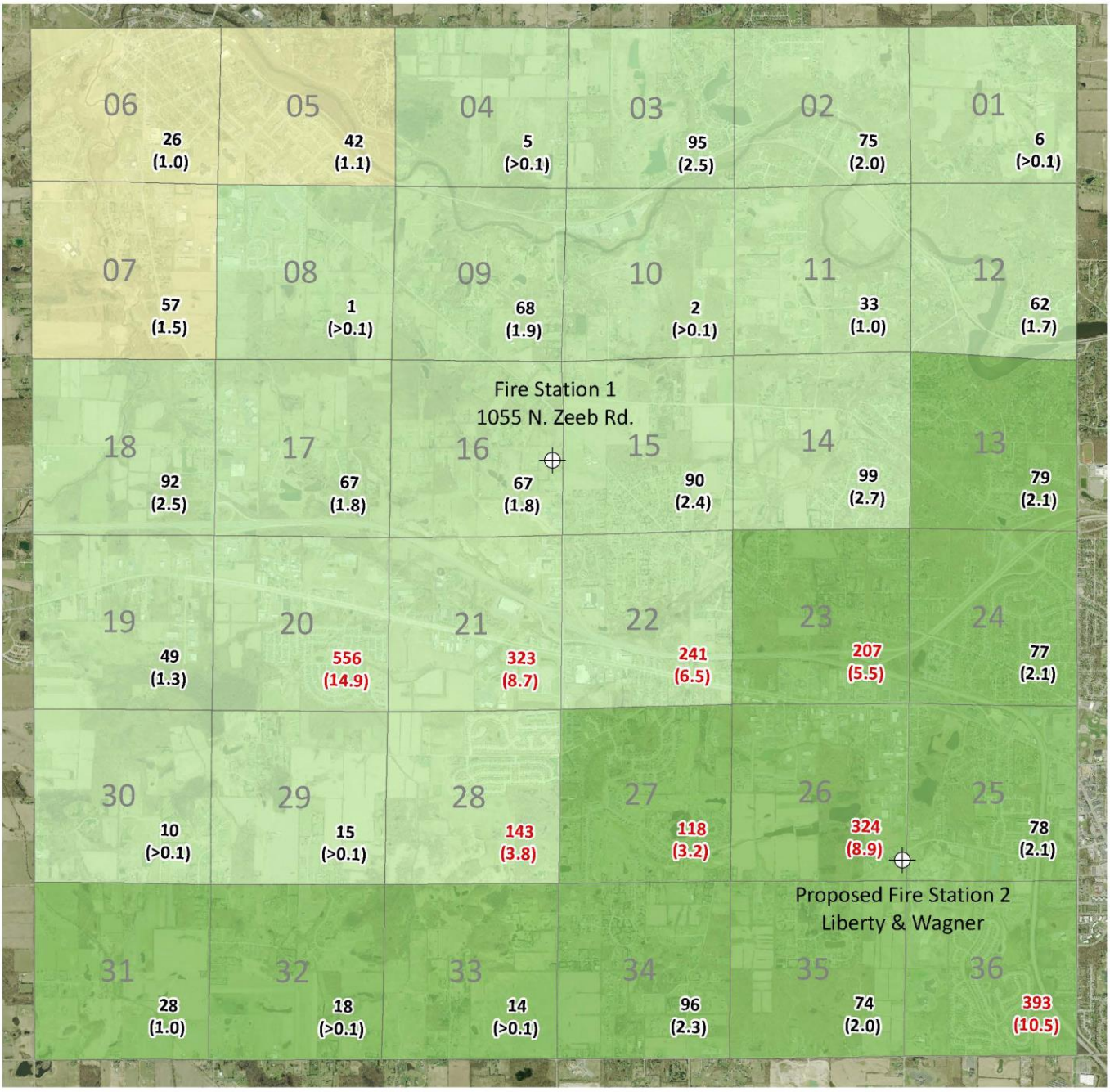

Figure 1

FIRE DEPARTMENT CALLS BY SECTION, 2010 - 2014

Scio Township
Washtenaw County

Fire Station

36 Section Number

10 Number of Calls (Red indicates triple digit volume)

(>0.1) Percentage of Calls

Proposed Response Area of Station 1

Proposed Response Area of Station 2

Served by City of Dexter

Source: Scio Township Fire Department
Washtenaw County GIS Program
Note: Five year cumulative total for each section

Carlisle/Wortman Associates
10-15-15

Budget History

The primary source of funding is through a dedicated **public safety millage**. Over the past six years, the Fire Department has consistently spent less than the revenue generated by the millage.

Year	Revenues	Expenditures	Difference
2009/10	$1,040,637	$640,375	$400,262
2010/11	$1,025,565	$656,610	$368,950
2011/12	$964,397	$649,483	$314,914
2012/13	$963,691	$741,982	$221,709
2013/14	$966,235	$785,028	$177,207
2014/15	$974,912	$845,157	$129,755

While there has been a budget surplus every year, the amount of the surplus has been declining. This can be attributed to a decline in revenue and increase in personnel expenses. However, by the end of FY2014/15, the Departmental budget has accumulated a fund balance of approximately $1.6 million.

Issues and Observation

The following issues have been identified and observations made regarding the current status of the Department.

Township Growth and Demographic Trends

- A significant amount of dense residential growth has occurred in the southeast portion of the Township. Due to proximity of the station and increased traffic volume, the result has been increases in response time.
- While continued development of the Jackson corridor has been positive for the Township, the demand for Fire and EMS services has increased. Increased traffic volumes also increase the potential responses to traffic accidents and have a negative effect on response time.
- Structure fires in the Township have been relatively low, but as housing stock in certain areas ages, the potential for structure fires will also increase.
- As with State and National trends, the "over 65" population in the Township is increasing more rapidly than other age groups. This trend will increase the potential for EMS runs.

Staffing

- Although necessary, the addition of full-time staffing has had an adverse effect on attracting paid on-call staff.
- The existing configuration of two full-time staff on duty 24/7 results in the accumulation of a significant amount of time off. The right to full vacated shifts are given to other off

duty shift commanders. There are a number of unintended consequences from this current policy:

- It creates an excessive amount of overtime.
- It exacerbates the problem of vacated shifts through the use of banked comp time.
- If full-time staff do not want to fill a vacant shift, it is difficult to fill the slot with paid on-call.
- The optimal staffing model for Fire Station 1 is three (3) full-time fire fighters on duty per day. As a result, three (3) additional fire fighters need to be hired to properly staff Station 1.
- With the optimal staffing patterns at Station 1, a future Station 2 can operate with two (2) fire fighters per day.

Facilities and Equipment

- As the Township continues to grow, serving the southeast portion of the Township is becoming increasingly difficult from Station 1.
- The life span of existing equipment will be extended if new equipment is purchased and use of existing equipment is reduced.

Miscellaneous

- Requests for assistance from neighboring communities is increasing
- The ability of neighboring communities to assist the Township is becoming more limited.

The conclusion of the strategic analysis is that the lack of redundancy in staffing, facilities and equipment prevents the Scio Township Fire Department from efficiently serving the needs of the Township.

Five-Year Plan

The Strategic Plan focuses primarily focuses on "ramping up" for a second station. Additionally, Station 2 will address many, if not most, of the aforementioned issues currently affecting the Department. Conceptual drawing of Fire Station 2 are provided as Attachment 4. During the time frame of 2016 – 2020, the following goals will be achieved:

- Design and construct a second fire station, referred to as Fire Station 2, on Township owned property at the corner of Liberty and Wagner Roads.
- Hire and train the number of full-time firefighters annually to provide reliable and trained staffing of second fire station upon completion.
- Assess serviceability of current apparatus for a split station configuration and purchase necessary replacement equipment for Fire Station 1 and new equipment for Fire Station 2.

- Evaluate response protocols for a split station configuration.
- Increase budget to meet enhanced staffing model and to operate Station 1.

In short, the thrust of the Five-Year Plan is to improve coverage through a second station and increase the number of firefighters to provide optimal staffing models at both Station 1 and 2.

The Plan is intended to be implemented over a five year period and fulfill the budgeting, staffing and equipment needs of the department. At the time Station 2 is occupied and operational, it will be staffed with a mix of existing and new personnel. Since at least three (3) existing fire fighters will be transferred between Station 1 and Station 2 in 2019, there will be a need to hire three (3) additional fire fighters at Station 1 in 2020. While this will result in a staffing gap between 2019 and 2020, this approach is intended to provide both Station 1 and Station 2 with an appropriate mix of experienced fire fighters and new hires. At the culmination of 2020, the Township will have two equipped stations and 15 full-time fire fighters.

Five-Year Plan
2016 – 2020

Year/Task	*Cost(2016 dollars)*
Year One (2016)	
1. Retain Architect to assist Board and Department in preliminary design of Station 2.	$50,000
2. Hire replacement Shift Commander for vacated 3b shift	$81,000
3. Hire three (3) additional full-time firefighters for Station 1 (salary and benefits)	$186,000
Year Two (2017)	
4. Complete final design and construction documents for Station 2.	$100,000
Year Three (2018)	
5. Construct/Equip Station 2 (to be operational by 2019).	$2,000,000
Year Four (2019)	
6. Refurbish Engine 16-2 at Fire Station 1 or Replace Engine 16-2 at Fire Station 1.	$200,000 - $400,00
7. Transfer three full-time firefighters from Station 1 to Station 2.	No cost
8. Hire three additional full-time firefighters/**shift commanders** for Station 2.	$180,000 - $200,000
Year Five (2020)	
9. Replace three (3) full-time fighters at Station 1.	$186,000

ATTACHMENT I

Apparatus: List of outstanding, deferred and/or prospective maintenance issues and suggested replacement intervals.

The fire fleet is configured so that each truck performs a specific function. By spreading the work load over five vehicles; we extend their service life. Currently, the fire fleet is in relatively good condition. National Fire Protection Association (NFPA) publishes recommended a standard for nearly all aspects of the fire service. These standards are updated every five to seven years. The Standards for Automotive Fire Apparatus (NFPA 1901) recommends a twenty year replacement interval. Generally, the standard committee does not presume either excessive or limited equipment use. Replacement recommendations are based on technological and safety system improvements.

All vehicles are checked and inspected on a rotating basis throughout each week by our in house staff. Brian Koch handles most of the light repairs on the fleet and assorted equipment; things like replacing burned out light bulbs, broken lenses oil and radiator fluid levels. The heavy vehicles, Engines and Tanker, are serviced on regular intervals by a certified emergency vehicle technician. Lube oil and filters are changed as required, tires are checked and the chassis and body are inspected. Any identified safety issues are noted and brought to our attention, these conditions are immediately rectified.

An annual Department of Transportation (DOT) inspection is required for commercial vehicles with a gross vehicle weight over 10,000 pounds. The vehicle components necessary for safe operation are checked and verified. A vehicle must pass all listed components, or be taken out of service. When all aspects have been satisfactorily corrected and the vehicle certified; it may be returned to service. Repairs to these vehicles must be completed by a certified Emergency Vehicle Repair Technician.

Engine 16-2 was purchased in _____ to bolster our aging fire fleet. It carries 1,250 gallons of water and has a 1,500 GPM mid-ship pump. During its first ten years of service it was used extensively responding to all the calls we were dispatched to. Its use is now limited to called structure fire calls within the township borders and special circumstance motor vehicle fires and accidents. The odometer currently reads 90,617 miles and the engine has 7,341 hours.

1. An existing ongoing electrical problem is present, considerable time and money has been spent trying to resolve it. This effort has been 20% diagnosis 80% guess work. The truck has had electrical issues from the day it was delivered.

2. An intermittent fuel tank leak as yet to unverified. We have experimented with and adjusted fill levels; the loss of stored fuel is comparatively insignificant about 5% or 2.5 gallons. Over filling the tank can also create this condition. This would be an elaborate and costly repair project with no clear indication of benefit.

3. The vehicle's exterior has some defects that are cosmetic; in spite of being washed dried and waxed regularly the paint is blistered and bubbled and pealing in places.

Tanker 16-1 was purchased to replace our original tanker that was no longer road worthy. It is a fraternal twin of Engine 16-2. Used predominantly on structure fire calls, it responds in tandem with Engine 2. It is first due on automatic aid / mutual aid structure fire requests. The odometer currently reads 13,415 miles and the engine has 1,302 hours.

1. The vehicle has been a relatively low maintenance vehicle; the exterior is clean and free of defects. The original equipment tires were replaced in last March at a cost of $14,400. Slightly more expensive than the other two engines, Tanker 16-1 has a dual rear axle so there are four more tires.

Brush 16-1 responds to ground cover fires, burn complaints and utility type calls gas leak, electric wire down and some water pipe related problems. This unit was showing the effects of water standing in the hose bed and on top of the tool boxes. These areas have been stripped and rhino lined to prevent further rust and deterioration. The old brush truck was retrofitted from a standard F-250 chassis and lasted in service life for seventeen years. I expect this unit will match or exceed its predecessor's longevity. The odometer currently reads 9,875 miles. This vehicle is also relatively low maintenance.

Engine-16-1 responds to motor vehicle accidents, car fires and automatic alarms. It was designed to carry our compliment of special tools and equipment. This unit carries vehicle stabilization equipment, ropes, pulleys, stokes basket, K-12 Partner Saw, AED, back boards and a medical jump kit. There is pre-connected combination cutter / spreader hydraulic rescue tool built into the front bumper, and a freestanding set in the rear compartment. It is four-wheel drive for winter operations. The odometer currently reads 9,863 miles and the engine has 742 hours.

Rescue-16-1 vehicle responds to our largest volume of calls, approximately 55%, the medicals and house rescues. Rescue 16-1 was a practical response alternative; economical to operate and maintain. The replacement cost of this unit is a small fraction of the cost of replacing a Class-A Engine. We have no experience with this vehicle configuration, but the truck was built specifically for emergency use. The odometer currently reads 24,600 miles.

Engine 16-1A: This vehicle was retired from service in 2010. It is currently being stored at the Ypsilanti Fire Museum. Although retired, this vehicle is still owned by the Township and has a depreciated value of $28,462.95.

About half of each year's Truck Maintenance budget request is allocated for general maintenance of the fire fleet. Included are the annual Lube Oil & Filter replacements, the annual Fire Pump Test and the annual Department of Transportation inspections. Since system failures often happen without warning, additional money is allocated for an unexpected major repair. Included are: pump valve reconditioning or tire replacement other unforeseen conditions. Engine 16-2 has been the work horse of the fleet so logically has been the recipient of most of the allocated maintenance budget.

ATTACHMENT II
ACCESSORY EQUIPMENT NEEDED

Accessory Equipment Needed

Mechanic's Room
- Air Compressor
- Tool Box
- Washer
- Drier
- Counter & Cupboards
- Work Bench w/ Vise
- 5" Baldor Grinder
- Slop Sink
- Flammable Storage Cabinet

Bunk Room 1
- Bed
- Wardrobe
- Night Stand

Bunk Room 2
- Bed
- Wardrobe
- Night Stand

Watch Room
- Computer
- Printer
- File Cabinet
- Radio Charger Bank

Office
- Desk
- Desk Chair
- Side Chair
- File Cabinet
- Book Shelf

Mechanical Room
- Stand By Generator
- Furnace
- Water Heater
- Onan Panel

Day Room
- Table & Chairs
- Recliner Chairs
- Television

Kitchen
- Refrigerator
- Stove
- Microwave
- Silverware
- Dishes
- Pots & Pans

Apparatus Deck
- Exhaust Capture System

Station 1 Apparatus & Staffing *

Engine 16-1	Shift Commander 1a
Tanker 16-1	Shift Commander 2a
Rescue 16-1	Shift Commander 3a
Brush 16-1	Firefighter 1 / Firefighter 4
Air Trailer 16-1	Firefighter 2 / Firefighter 5
Engine 16-1a	Firefighter 3 / Firefighter 6

Station 2 Apparatus & Staffing *

Engine 16-2	Shift Commander 1b
New Rescue 16-2	Shift Commander 2b
	Shift Commander 3b
	Firefighter 7
	Firefighter 8
	Firefighter 9

*** Carl - we don't know what this means**

ATTACHMENT III
TURN OUT GEAR

It is recommended that bunker clothes with a manufacture date greater than ten years, regardless of in service use, be replaced. The active issued clothing was replaced in January 2011. The obsolete bunker sets were disposed of. The next complete replacement is anticipated in 2021. The 2011 cost per bunker set is $1,925.00

Self-Contained Breathing Apparatus (SCBA):
Replacement SCBA were purchased in 2004; at the time we selected the Scott NX2G air packs. The purchase was made possible by a FEMA Grant. The total project cost was $148,740. FEMA infused $110,300, donations to the fire department via a fund raiser $8,000 and a General Fund cost of $30,440.

Twenty regulator and backpack assemblies and fifteen spare cylinders, purchase cost was $73,931.00. Twenty five face pieces and voice amplification attachments purchase cost was $6,795.00. Two 60-min. Rapid Intervention Packs purchase cost was $4,880.00. A Liberty II air compressor trailer (with generator and light tower) purchase cost $62,800.00. Miscellaneous small adapters and equipment purchase cost $335.00

The back pack masks and regulators are still current and serviceable. The spare cylinders are the fully wrapped carbon fiber variety. These cylinders must be hydrostatically tested every five years, as mandated by the Department of Transportation (DOT). The cylinders have a 15-year service life. We have passed or last allowable DOT service. Thirty five 45-minute cylinders and two 60-minute cylinders are due for mandatory replacement in 2019.

Other Major Equipment:
The fire department has three sets of extrication equipment (Jaws) these are basic gas driven hydraulic pumps. The hoses are the weakest component, these are subject to failure or damage during use. We have never experienced a failure of the equipment. The cutters spreaders and rams are quite sturdy and require limited attention. The air bags and rescue struts are in relatively new condition and are not called to service often. I don't anticipate a need to replace any of the extrication equipment in the predictable future. Other high cost items like ladders, vent fans, intake valves have no predictable life expectancy. The mobile and hand held radios are the property of Washtenaw County, we pay $1,500 per year user fee for these items.

Incidental Equipment
The criteria for consideration as fire department equipment inventory have fluctuated through the years. The accounting department is only concerned with items that have an acquisition cost greater than $1,000. Items less than $1,000 are considered incidental or expendable property. The department has a wide variety of tools and equipment that fall into this category. Included are fire hose, adapters, nozzles, tone pages, hand tools etc. While the accumulated expense is often extensive the individual

investment is considered insignificant. Sufficient funding for the replacement of these items, as needed, is accounted for in three separate budget account lines.