



MEMORANDUM

DATE: September 10, 2018
TO: Joe Grande, Madison Water Utility
FROM: Bob Nauta
SUBJECT: Unit Well 15 Modeling Study

The Dane County Groundwater Flow Model (“Model,” Wisconsin Geological & Natural History Survey (WGNHS), 2014) was used to simulate the advective travel time from potential sources of perfluorinated compounds (“PFCs”) to City of Madison Unit Well 15. The Model was developed and rigorously calibrated and tested by the WGNHS with assistance from modeling experts at the United States Geological Survey.

Perfluorinated compounds have several primary sources, including Teflon, water- and stain-resistant textiles and fire-fighting foam. A survey of the Unit Well 15 area by the Madison Water Utility (“Utility”) found several potential sources of PFCs from fire-fighting foams. These potential sources are shown on Figure 1. Source points TW1, TW2 and TW3 represent monitoring wells at the Wisconsin Air National Guard in which PFCs have been detected.

At the direction of the Utility, RJN simulated pumping rates of 1,006 gallons per minute (“gpm”), 1,337 gpm and 1,762 gpm. These rates correspond to the five-year (2011 through 2015) average annual pumping rate, the average annual pumping rate (2002 through 2017) and the 90th percentile annual pumping rate (2002 through 2017) for Unit Well 15, respectively. They reflect a range of historic pumping rates at Unit Well 15 and illustrate how the capture zones expand or contract, based on the magnitude of annual pumping.

Figures 2, 3 and 4 present the 5-year, 50-year and 100-year travel times to Unit Well 15 for pumping rates of 1,006 gpm, 1,337 gpm and 1,762 gpm, respectively. Madison Fire Station 8 lies within the 5-year zone of capture for all three scenarios. Wisconsin Air National Guard wells TW1 and TW2 are within the capture zones for all pumping scenarios; however, potential sources more distant from Unit Well 15 have a much more limited capture potential. Additionally, the former burn pit, located west of the airport, and the former Truax Landfill are not within the 100-year zone of capture for any of the pumping scenarios.

Table 1 provides a summary of the simulated travel times from the various sources to Unit Well 15 at the three simulated pumping rates. Although the model was rigorously calibrated and tested, it should be assumed that the potential for error increases with distance from the well,

possibly varying by 5 to 10 years; however, the tabulated data show most of the potential sources to be within the capture zone of the well.

Figure 5 is a plot of the proposed revision to the wellhead protection area. It was developed based on a 1,762-gpm simulation. To set up the simulation, rings of 20 particles were placed around the well. The rings of particles were placed at the bottom, center and top of each layer in the production zone (model layers 9, 10, 11 and 12). The particle tracking model (MODPATH) was run in reverse mode for 1,825 days. The 1,200-foot radius circle is also shown on Figure 5. This distance corresponds to the minimum separation distance between a municipal water supply well and certain contaminant sources specified in Wisconsin Administrative Code Chapter NR 811.12(5)(d). As the figure shows, the wellhead protection area observed by the Utility extends beyond the circle. The only recognized potential source of PFC contamination within the wellhead protection area is Madison Fire Station 8.

Finally, at the request of the Utility, a plot was made of the groundwater flow path between Wisconsin Air National Guard monitoring wells TW1 and TW2, to Unit Well 15, for particles placed in layers 9 and 10. That plot is presented on Figure 6. The estimated travel time to Unit Well 15 from TW1 is 50 years and from TW2 is 35 years.

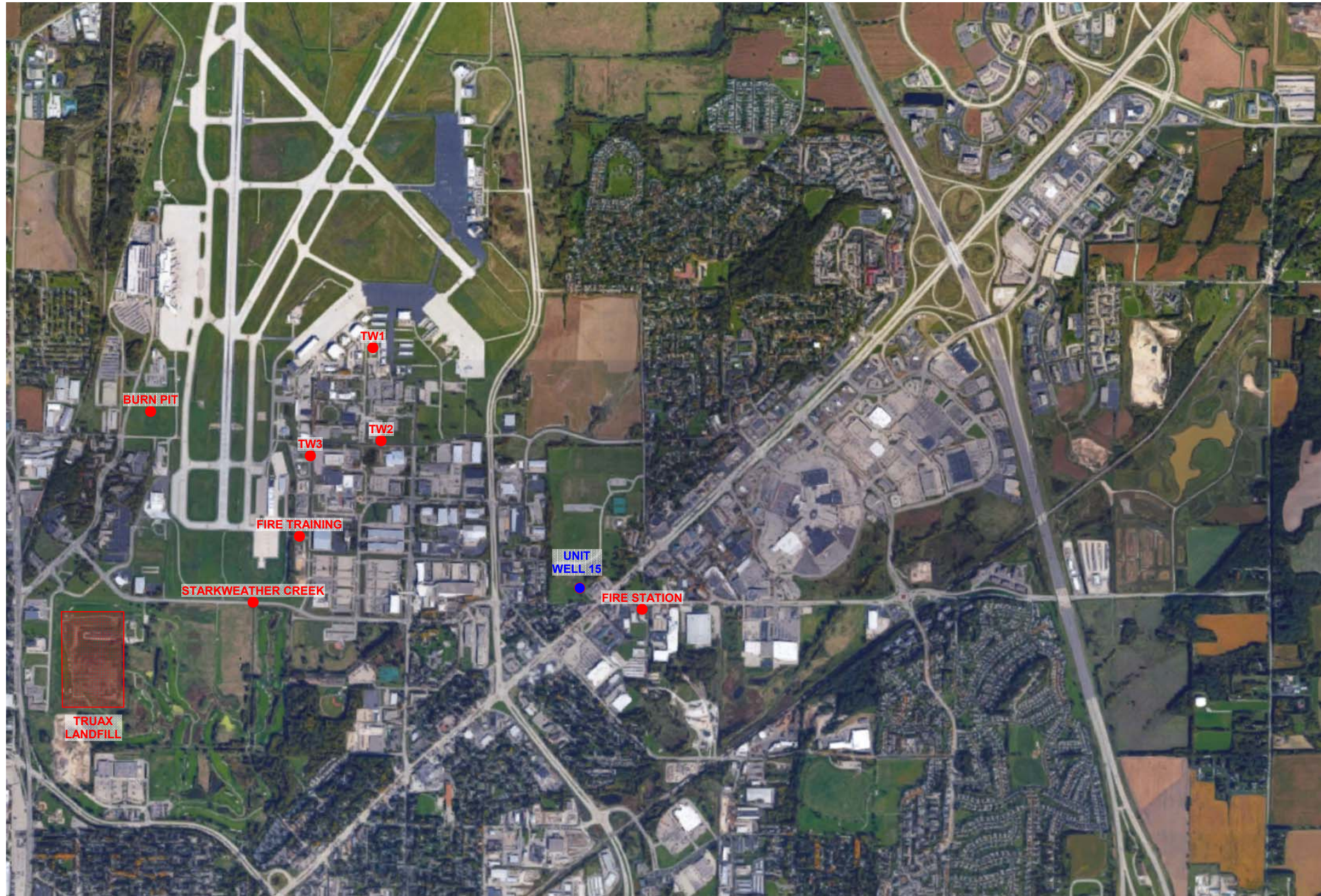
TABLE

MADISON WATER UTILITY
 PERFLUORINATED COMPOUND STUDY
 SIMULATED TRAVEL TIME (YEARS)
 FROM POTENTIAL SOURCES TO UNT WELL 15

POTENTIAL SOURCE	SIMULATED PUMPING RATE (GPM)		
	1006	1337	1762
TW1	90	60	50
TW2	60	40	35
TW3	X	75	50
STARKWEATHER CREEK CROSSING OF ANDERSON STREET	X	X	95
FIRE STATION	4	3	1
FIRE TRAINING CENTER	X	75	55

X - NOT WITHIN CAPTURE ZONE AT THE GIVEN PUMPING RATE.

FIGURES



NORTH

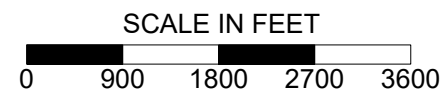


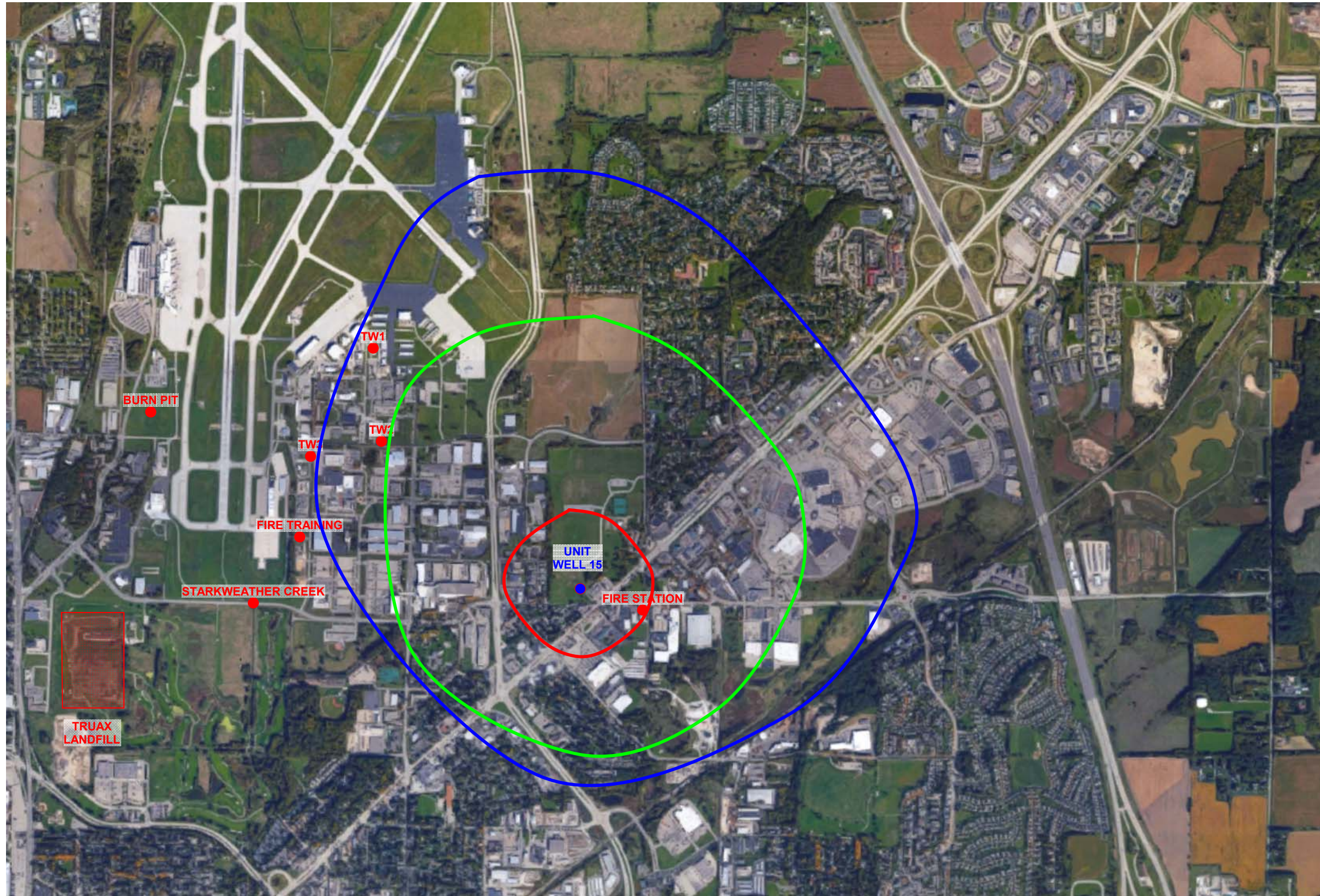
Figure developed by RJN Environmental Services, LLC



MADISON UNIT WELL 15
POTENTIAL PFC SOURCES

DRAWN BY	PROJ. No.	DATE	FILE
RN	15-204	26 AUG 18	PFC SOURCES

FIGURE
1



NORTH

- 5-YEAR CAPTURE ZONE
- 50-YEAR CAPTURE ZONE
- 100-YEAR CAPTURE ZONE

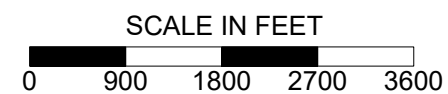


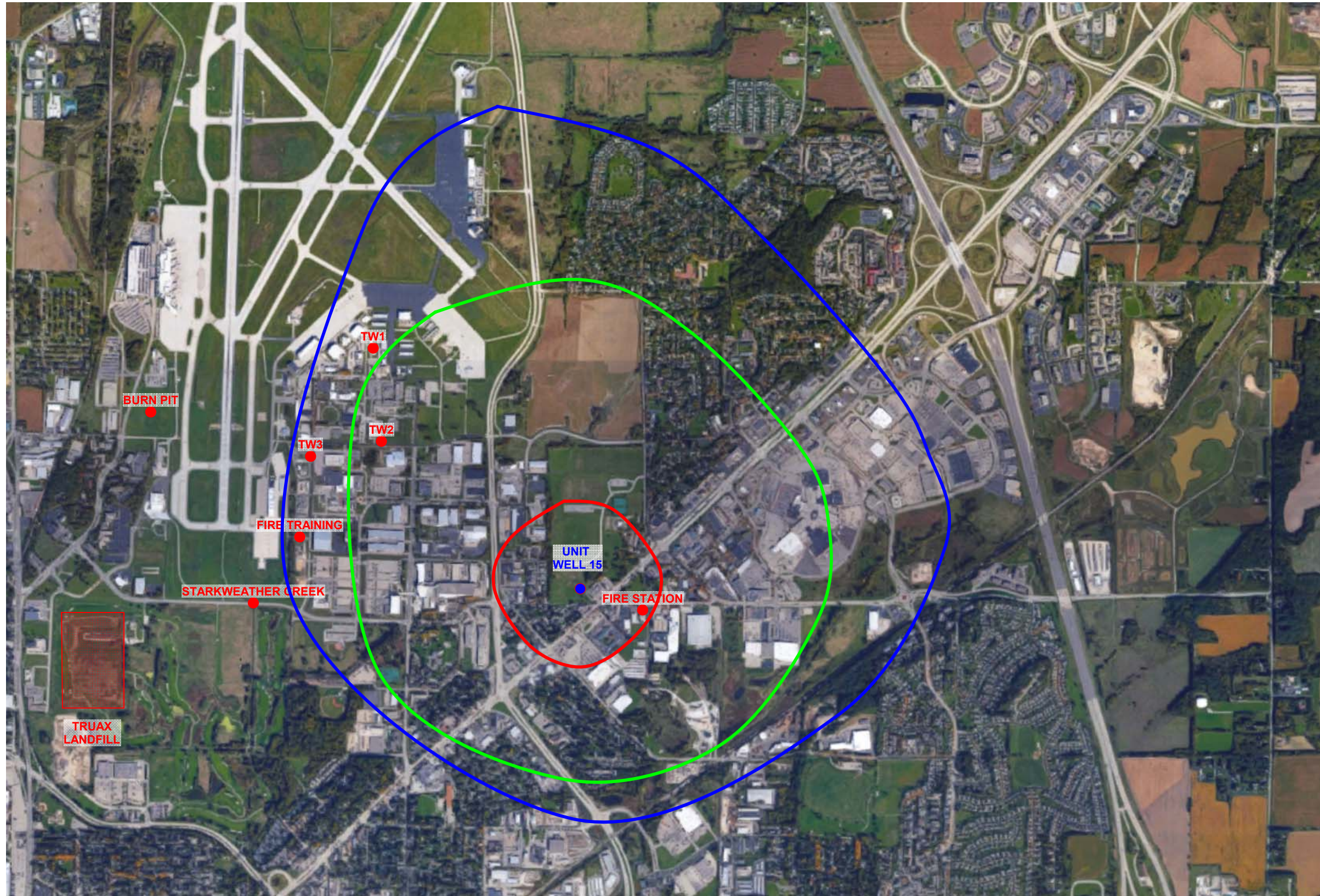
Figure developed by RJN Environmental Services, LLC



MADISON UNIT WELL 15
SIMULATED CAPTURE ZONES
1006 GALLONS PER MINUTE

FIGURE
2

DRAWN BY	PROJ. No.	DATE	FILE
RN	15-204	21 AUG 18	1006 GPM



NORTH

- 5-YEAR CAPTURE ZONE
- 50-YEAR CAPTURE ZONE
- 100-YEAR CAPTURE ZONE

SCALE IN FEET

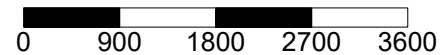


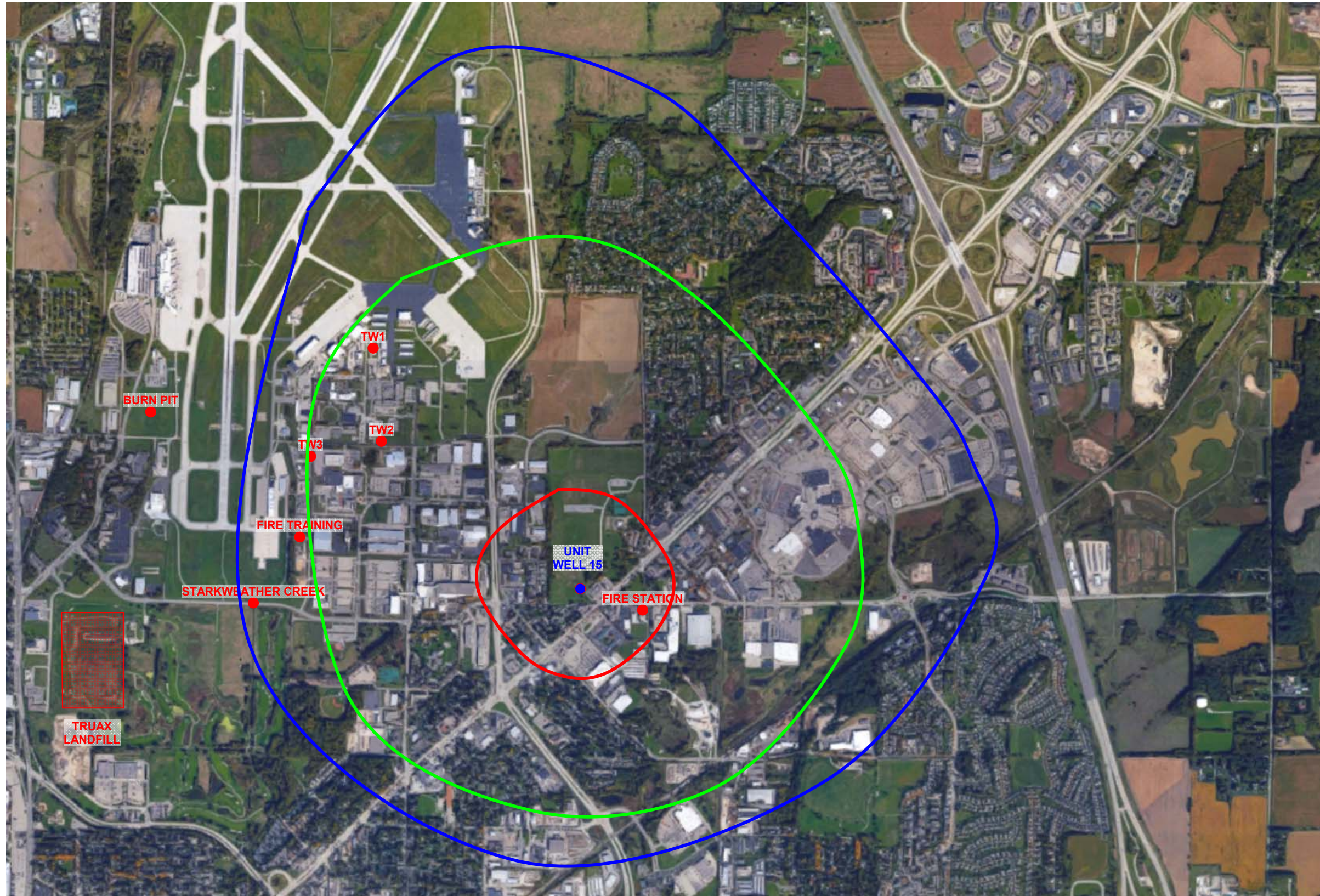
Figure developed by RJN Environmental Services, LLC



MADISON UNIT WELL 15
SIMULATED CAPTURE ZONES
1337 GALLONS PER MINUTE

FIGURE
3

DRAWN BY	PROJ. No.	DATE	FILE
RN	15-204	21 AUG 18	1337 GPM



NORTH

- 5-YEAR CAPTURE ZONE
- 50-YEAR CAPTURE ZONE
- 100-YEAR CAPTURE ZONE

SCALE IN FEET

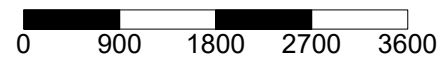


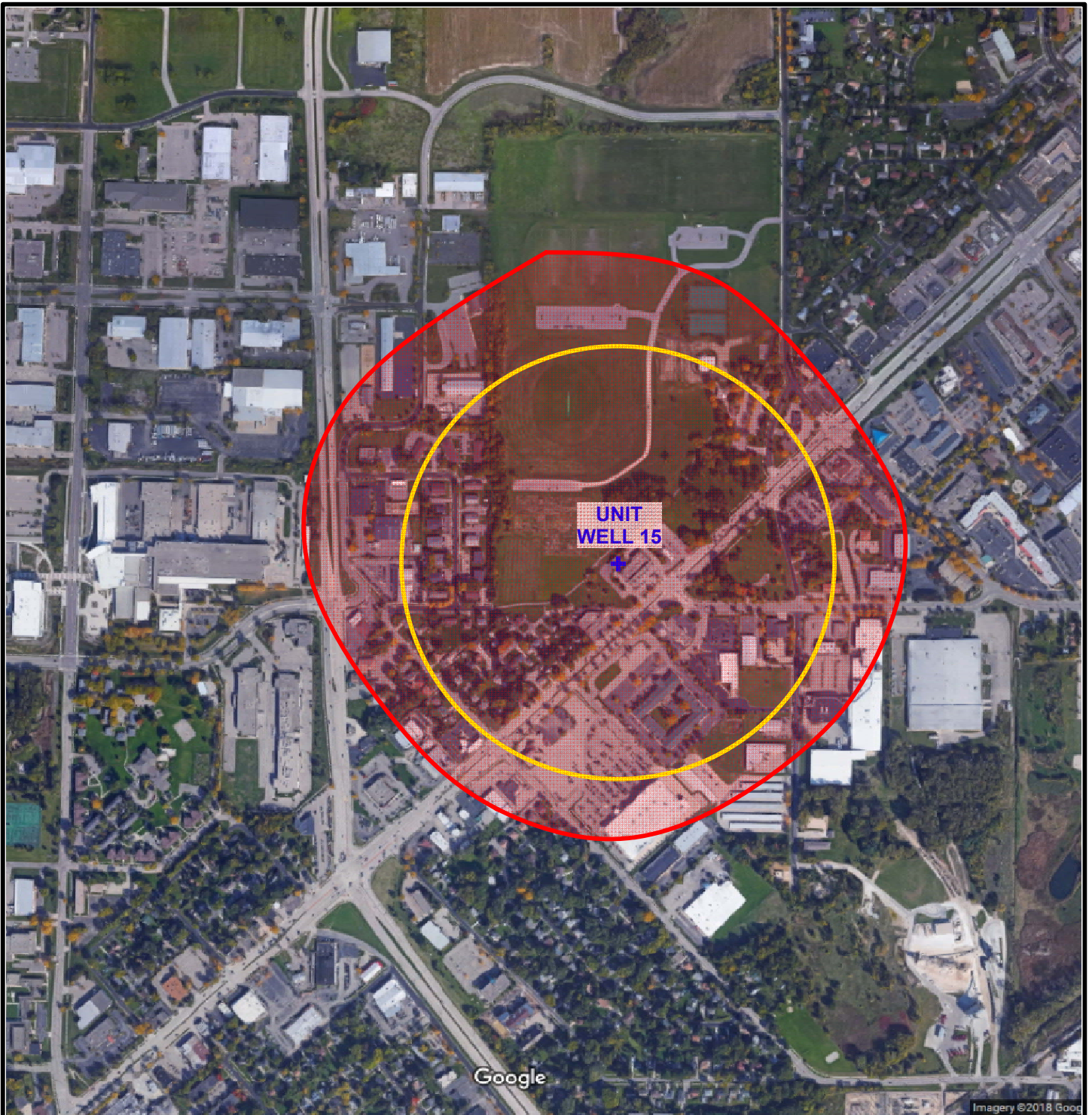
Figure developed by RJN Environmental Services, LLC





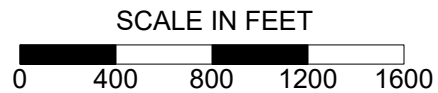
MADISON UNIT WELL 15
SIMULATED CAPTURE ZONES
1762 GALLONS PER MINUTE

FIGURE
4

DRAWN BY	PROJ. No.	DATE	FILE
RN	15-204	21 AUG 18	1762 GPM



-  5-YEAR CAPTURE ZONE
-  1200-FOOT RADIUS



NORTH

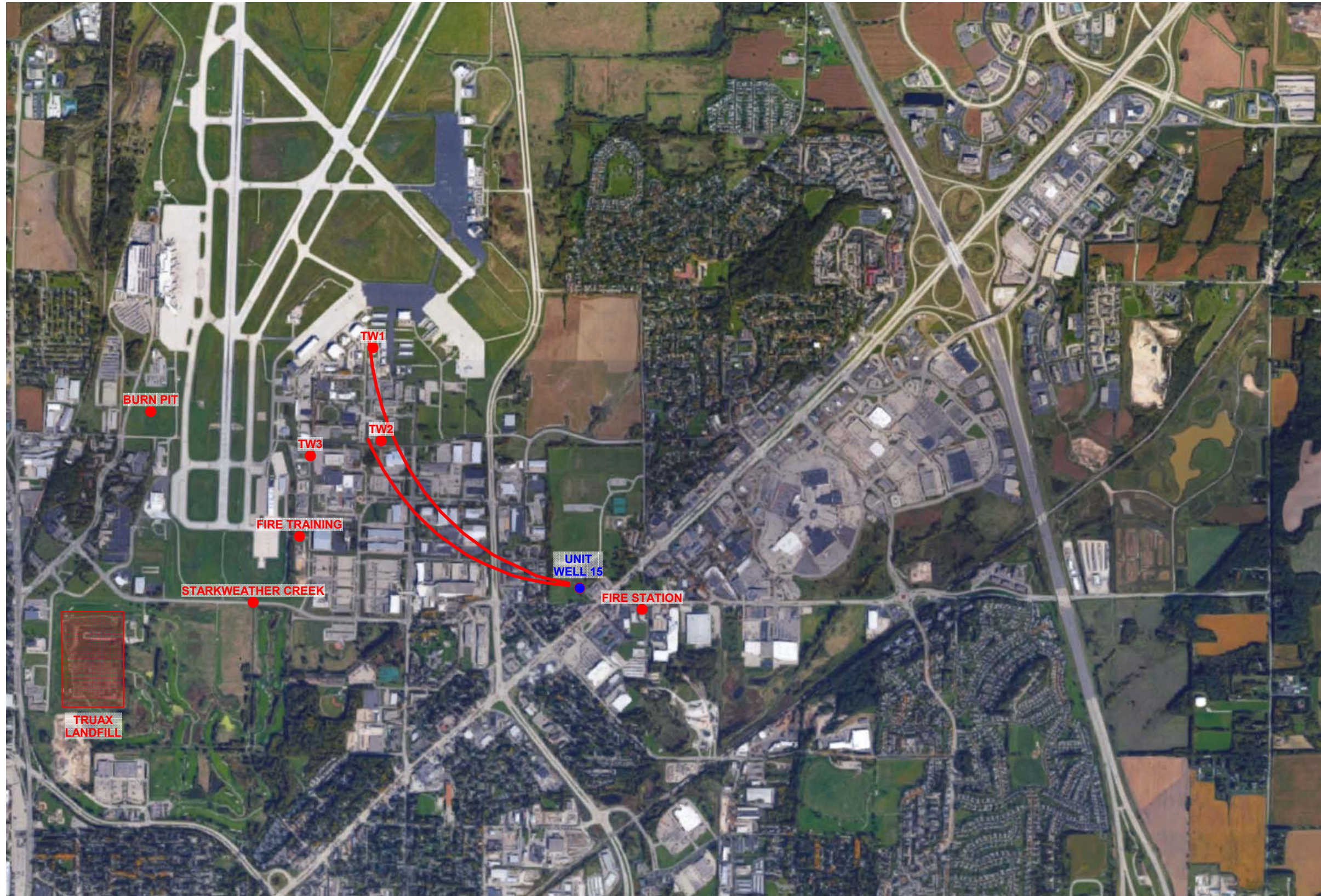
Figure developed by RJN Environmental Services, LLC



MADISON UNIT WELL 15
REVISED WELLHEAD PROTECTION
AREA

FIGURE
5

DRAWN BY	PROJ. No.	DATE	FILE
RN	18-102	21 AUG 18	WHPA



NORTH



SIMULATED TRAVEL PATH
(ORIGINATES AND ENDS IN
CENTER OF MODEL CELL)

SCALE IN FEET

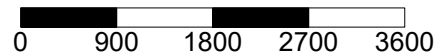


Figure developed by RJN Environmental Services, LLC



MADISON UNIT WELL 15
SIMULATED TRAVEL PATHS FROM
TW1 AND TW2 IN LAYERS 9 AND 10

DRAWN BY	PROJ. No.	DATE
RN	15-204	27 AUG 18

FIGURE
6

FILE
TW TRAVEL