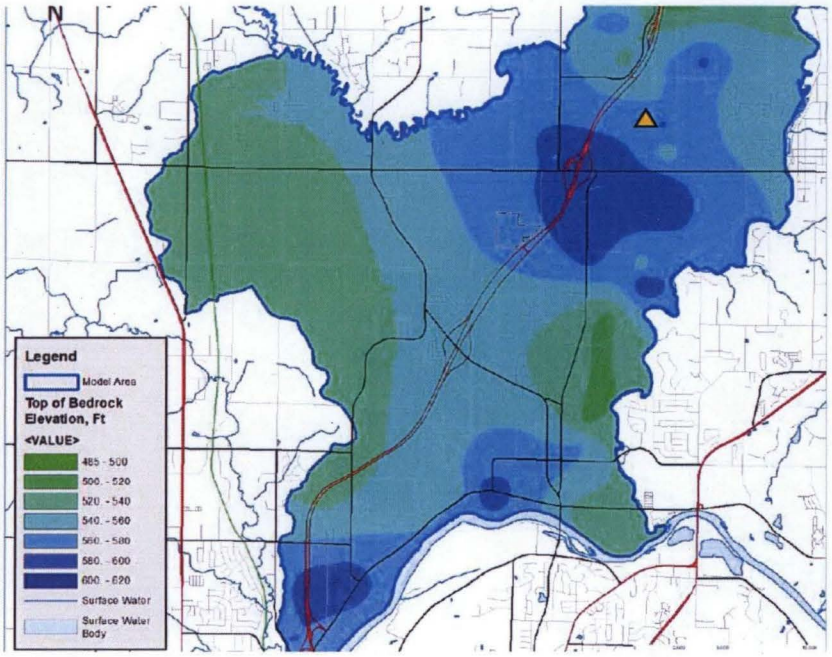
Geologic Review

DEQ-RRD Grand Rapids District

Perfluoroalkyl and Polyfluoroalkyl Substances Plume Evaluation of the Southeast Wolven Study Area and the North Childsdale Study Area 11-2018

This evaluation of perfluoroalkyl and polyfluoroalkyl substances (PFAS) impact encompasses this area southeast of the Wellington Ridge disposal area southeast to the Rogue River. It includes the Bent Tree, Stoneridge, and Windstone neighborhoods and uses residential well data collected by Wolverine World Wide (WWW) and the DEQ-RRD as well as DEQ-RRD monitor wells.

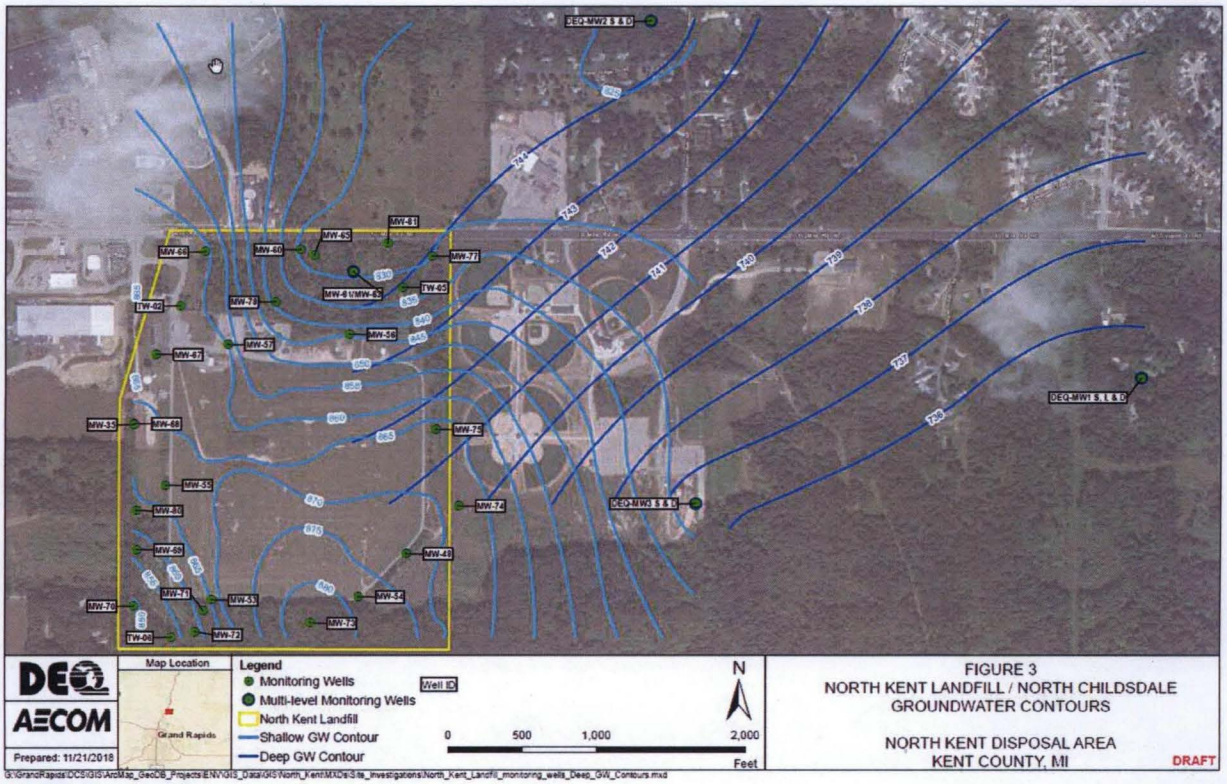
This area is a kettle and kame glacial depositional environment that overlies bedrock of higher elevation with a bedrock high immediately southwest of the modeled area (see GZA figure below).



Bedrock elevations from GZA document dated 2-8-18. Orange triangle marks the disposal site in the Wellington Ridge Neighborhood.

Potentiometric data from the DEQ-RRD monitor wells and monitor wells at the North Kent Landfill indicates a shallow aquifer that flows south to north and this direction is also consistent with contaminant distribution. A deeper aquifer has a northwest to southeast flow direction (based on three monitor wells) that is consistent with expected regional flow; this data was

derived from DEQ-RRD monitor wells and is consistent with contaminant distribution. A draft map generated by AECOM is below. From evaluating screen elevations of wells verses PFAS impact, this area has four distinct elevational zones of impact appear to be present and groundwater flow is in three directions.



First Zone of Impact

A very shallow zone of impact (illustrated in brown on the attached DEQ-RRD Figures 3 and 4) ranging from approximately 875 ft to 850 ft impacts the residential drinking water wells at 8620, 8540 and 8520 Wolven. Due to the elevation of these well screens, PFAS impact is originating to the northeast in elevated topography immediately east of these residences. This distribution of impact would indicate a flow southwest from this highland and this groundwater elevation would daylight just west of the Wolven Avenue – 10 Mile Road intersection. The impacts from this plume do not currently exceed 70ppt combined PFOA/PFOS. Installation of a number of monitor well locations are necessary to fully understand this PFAS plume.

Second Zone of Impact

A zone of shallow impact affects aquifer material from approximately 820 ft to 795 ft and based on the limited data has an orientation of southwest to the northeast. If the shallow potentiometric data collected from the DEQ-RRD monitor wells is correct of a northernly flow the source area for this zone of impact could possibly be the North Kent Landfill facility. This plume is

illustrated in blue on the attached Figures 3 and 5. Drinking water wells that may be impacted by this plume include: 8475 Windstone Dr., 8497 Windstone Dr., 3232 Stoneridge Dr., 3261 Stoneridge Dr., 3256 Stoneridge Dr., 3383 Stoneridge Dr., 8655 Wolven Ave., 8686 Windstone Dr., 8697 Windstone Dr., and 8767 Windstone Dr. Impact from the North Kent Landfill at this depth is supported by data generated by monitoring at that location which shows impact at similar elevations and groundwater flow to the north-northeast. LIDAR of the area illustrates that this flow would be consistent with a low-lying area northeast of the landfill and west of Wolven Avenue as well as a narrow low-lying area that terminates south of the Hopewell Neighborhood. Additional monitor well locations are necessary to understand this plume both between the impacted neighborhood and the North Kent Landfill as well as throughout the modeled plume.

LIDAR of the area around the North Kent Landfill. The blue arrows are the direction of groundwater flow from the area of the landfill.

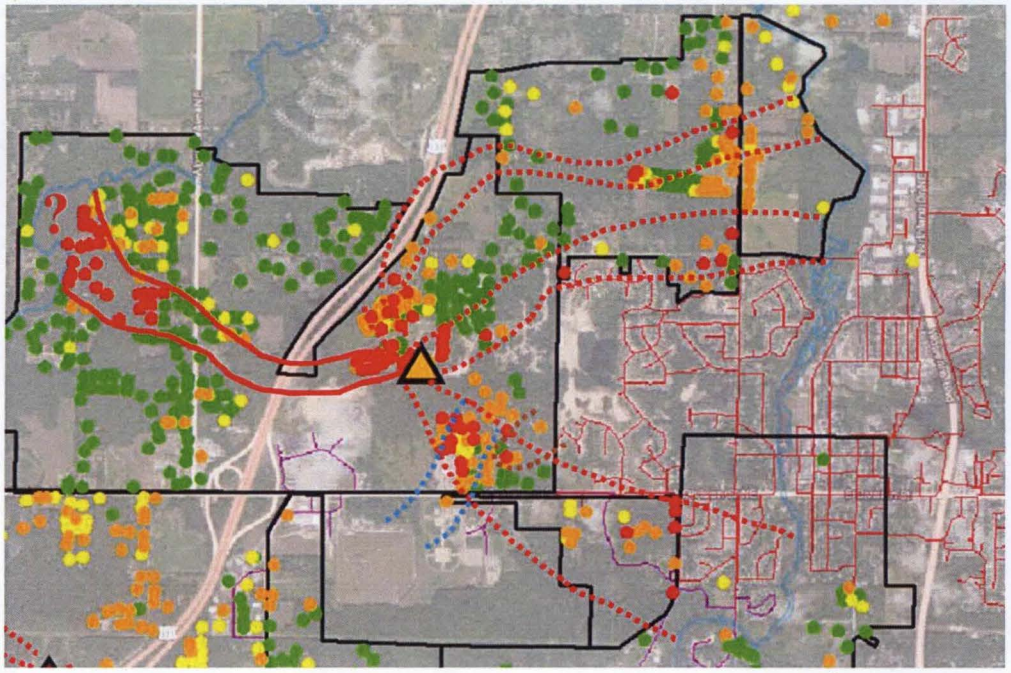
Third Zone of Impact

An area of lower aquifer PFAS impact is present from approximately 740 feet to 705 feet and is orientated from the northwest to the southeast and may be in two narrow channels. This distribution of contamination would be consistent with a groundwater flow to the southeast from the disposal area in Wellington Ridge that is the source for the majority of impact in the Wolven Jewell sampling area and supported by potentiometric data from the DEQ-RRD monitor well network. These plumes are illustrated in black on the attached Figures 3 and 6. The impact from this PFAS plume impacts several drinking water wells in the Bent Tree and Stone Ridge neighborhoods as well as houses on Windstone Dr., Wolven Ave., 10 Mile Rd., and Childsdale

Ave. Additionally, this plume is oriented with stream valleys that run from the highlands/disposal area southeast to the Rogue River (this can be seen on the LIDAR images). This along with the plume described below (Fourth Zone) are secondary plumes from the source area in Wellington Ridge (the other Wolven-Jewell PFAS plumes are illustrated on a figure later in the document). Numerous monitor well locations are necessary throughout the modeled plume area to better understand the risk from this plume and the plume's interaction with the Rogue River.

Fourth Zone of Impact

The deepest impact is approximately located from an elevation from 695 ft to 650 ft. and this PFAS plume is orientated form the northwest to the southeast and potentially be in two narrow channels. This distribution of contamination would be consistent with a groundwater flow to the southeast from the disposal area in Wellington Ridge that is the source for the majority of impact in the Wolven Jewell sampling area and supported by potentiometric data from the DEQ-RRD monitor well network. These plumes are illustrated in red on the attached maps. This portion of the PFAS impacted aquifer affects drinking water wells for residences off Childsdale Avenue. Several monitor well locations are necessary throughout the plume to fully understand the risk from this plume and fully map the plume's extent including vertically and the plume's interaction with the Rogue River.



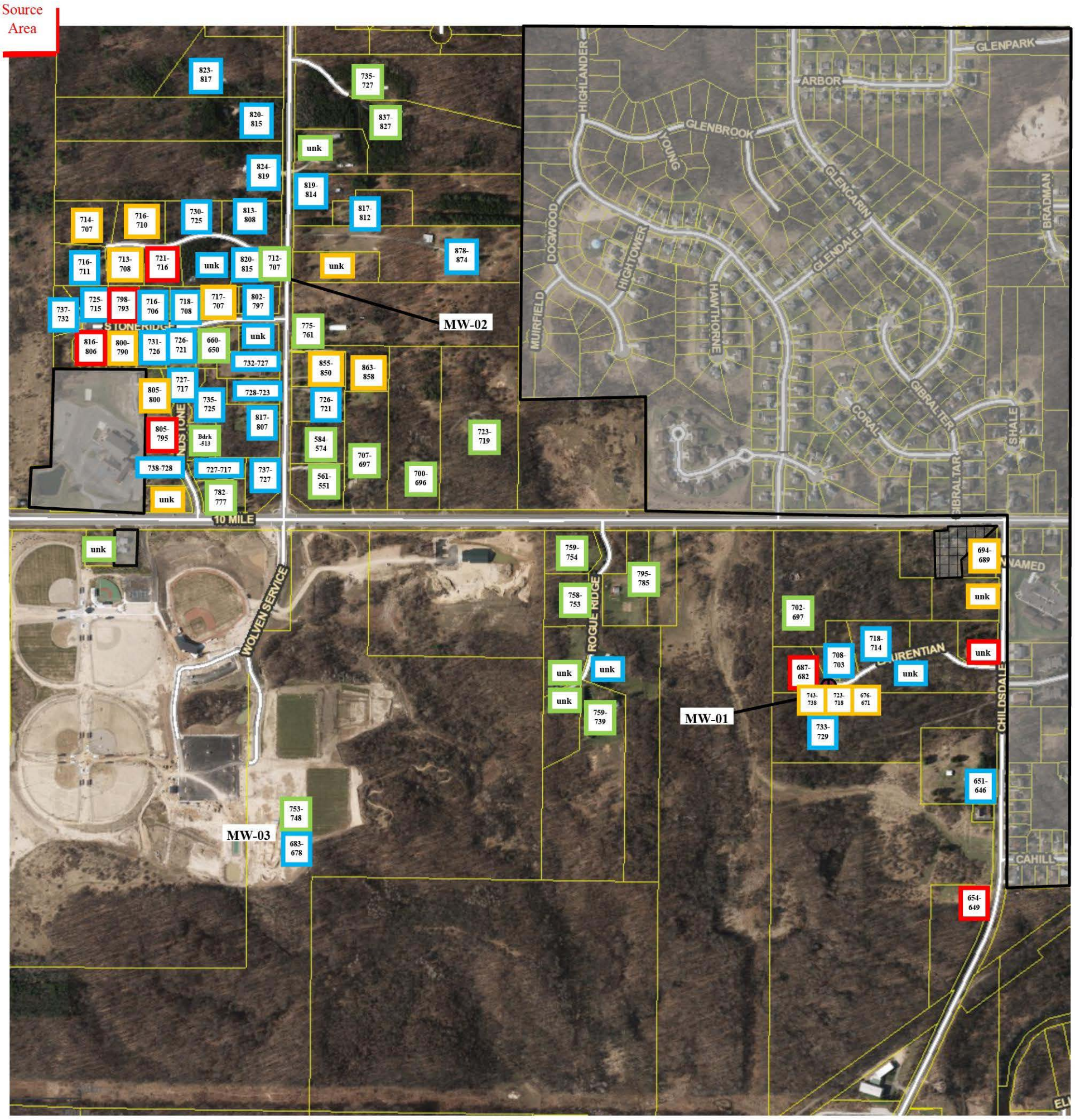
PFAS groundwater plumes emanating from the Wolven-Jewell source area in Wellington Ridge. The source area is illustrated by the orange triangle; the principle PFAS groundwater plume is illustrated by the solid lines and the secondary PFAS groundwater plumes are illustrated by the dashed lines.

Attachments:

- Figure 1 - PFOS/PFOA for the North Childsdale Area
- Figure 2 – Total PFAS for the North Childsdale Area
- Figure 3 - Total PFAS for the North Childsdale Area Showing all Plumes
- Figure 4 – Total PFAS for the North Childsdale Area Showing Shallowest Plume
- Figure 5 – Total PFAS for the North Childsdale Area Showing Shallow Intermediate Plume
- Figure 6 – Total PFAS for the North Childsdale Area Showing Deep Intermediate Plume
- Figure 7 – Total PFAS for the North Childsdale Area Showing Deepest Plume

Geologist Signature: _____ Date: 12-4-18

Wolven-Jewell Source Area



709-704 Below Method Detection Level

736-731 PFOS/PFOA: <20ppt

703-693 PFOS/PFOA: 20 to 70ppt

704-695 PFOS/PFOA: >70ppt

704-695 PFOS/PFOA: >1,000ppt

Note - Well depths have been placed over where the residences are.

Note - Results are the initial sample results for the drinking water well

663-658 Elevation of Well Screen (Top of Screen-Bottom of Screen)

unk Well Screen Information Unknown

Monitor Well

Municipal Water

Figure 1—PFOS/PFOA

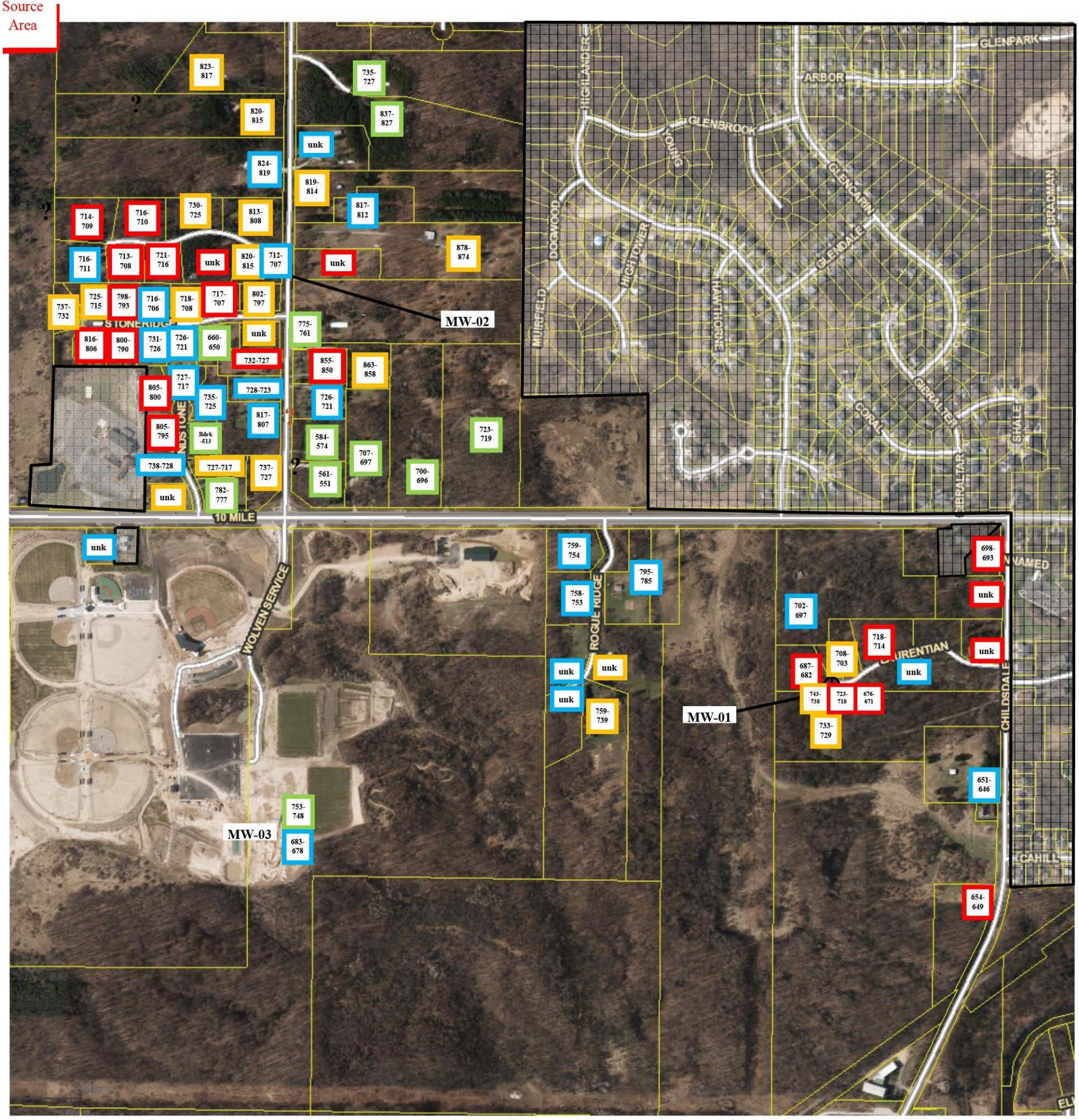
Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI

North

Updated by the MDEQ-RRD-GR 10/30/2018

Wolven-Jewell Source Area



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703-693 PFAS: 20 to 70ppt

704-695 PFAS: >70ppt

704-695 PFAS: >1,000ppt

Figure 2—Total PFAS

Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI

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Monitor Well

Municipal Water

North

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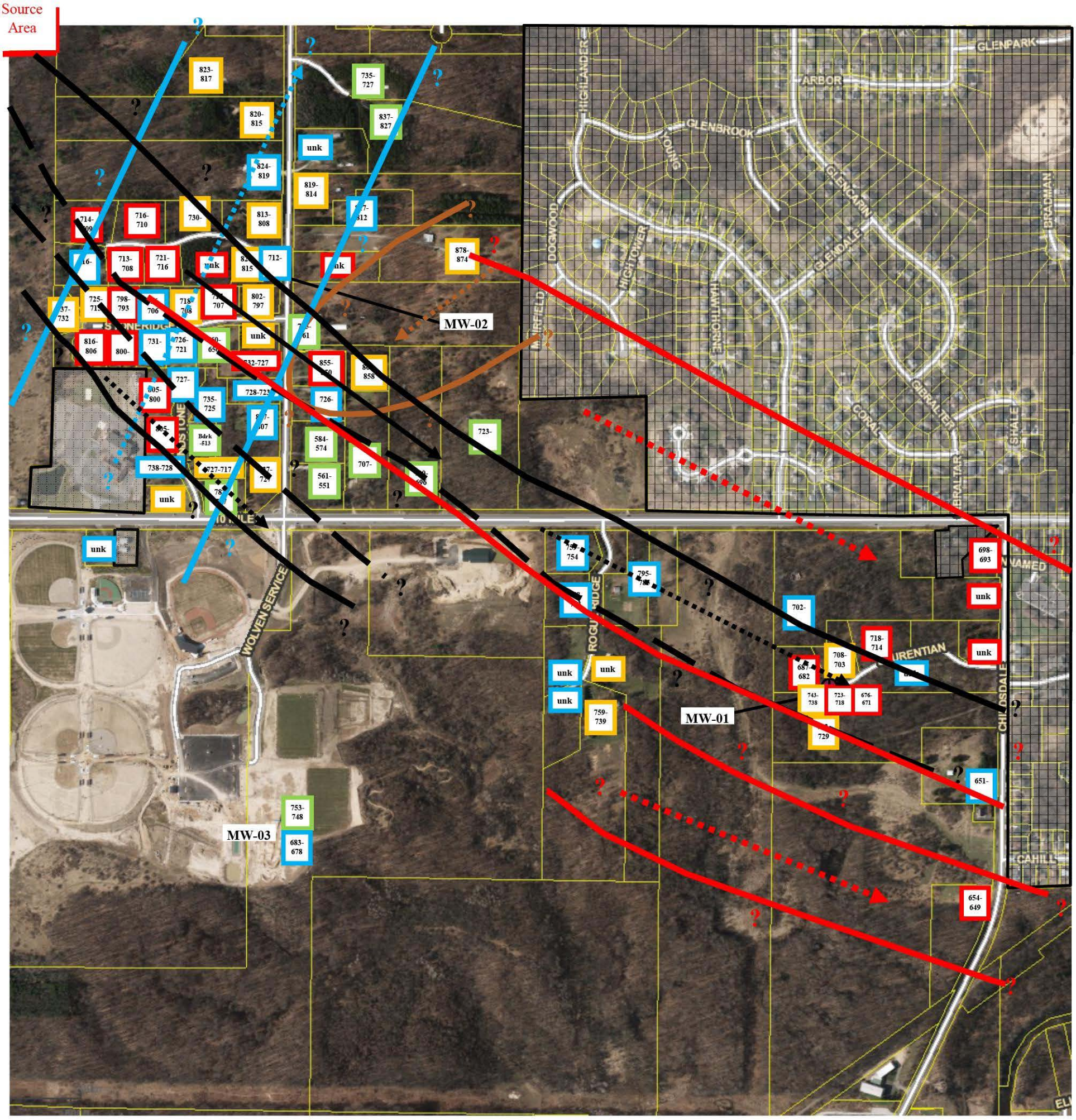
unk Well Screen Information Unknown

Updated by the MDEQ-RRD-GR 10/30/2018

Wolven-Jewell Source Area



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736-731 PFAS: <20ppt

703-693 PFAS: 20 to 70ppt

704-695 PFAS: >70ppt

704-695 PFAS: >1,000ppt

~875-850' plume

~820-795' plume

~740-705' plume

~695-650' plume

Note - Well depths have been placed over where the residences are.

Note - Results are the initial sample results for the drinking water well

Monitor Well

Municipal Water

North

663-658 Elevation of Well Screen (Top of Screen-Bottom of Screen)

unk Well Screen Information Unknown

Figure 3—Total PFAS - All Plumes

Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI

Updated by the MDEQ-RRD-GR 10/30/2018

Wolven-Jewell Source Area

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~695-650' plume

Note - Well depths have been placed over where the residences are.

Note - Results are the initial sample results for the drinking water well

Monitor Well

Municipal Water

North

663-658 Elevation of Well Screen (Top of Screen-Bottom of Screen)

unk Well Screen Information Unknown

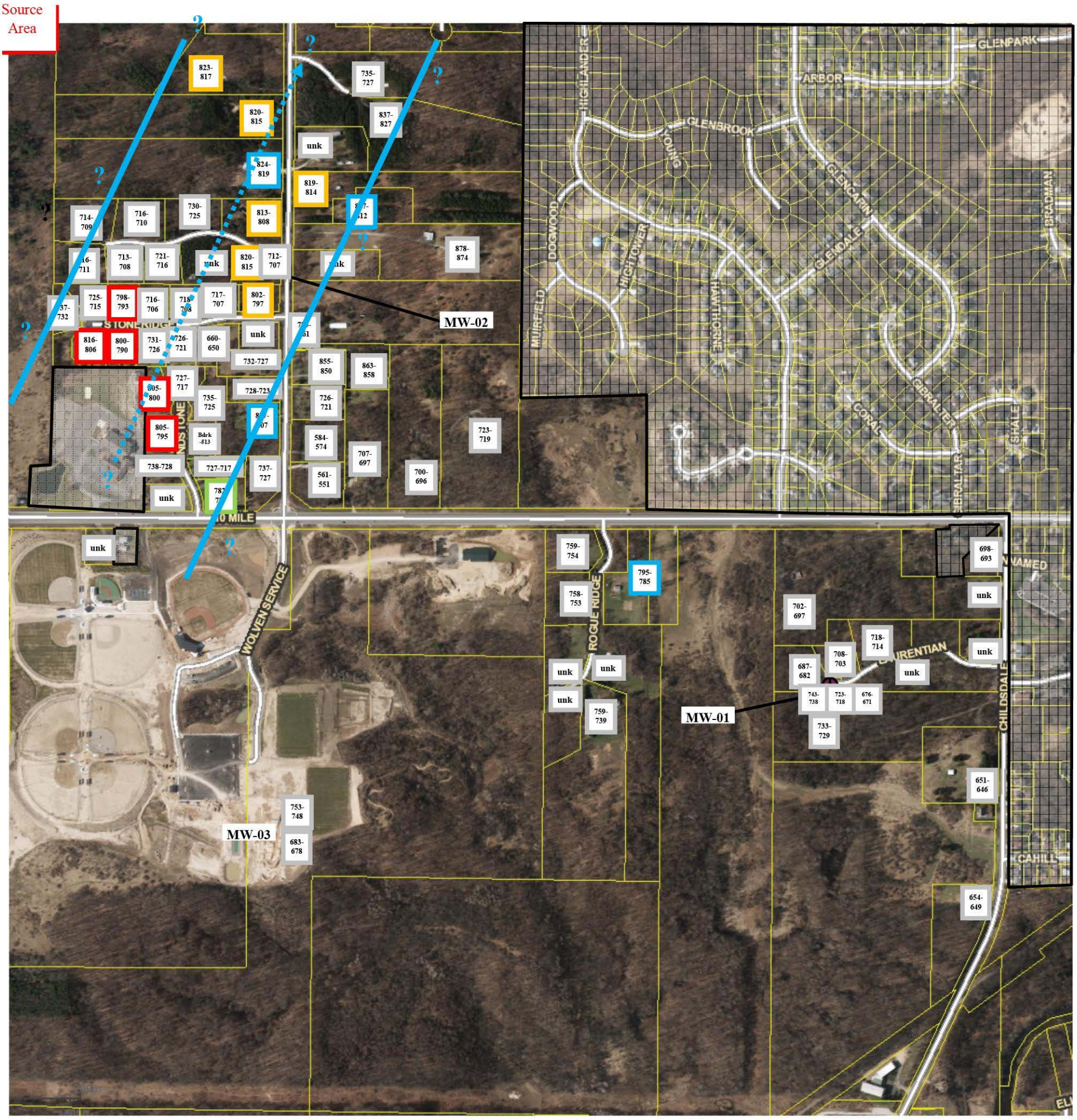
Figure 4—Total PFAS - Shallowest Plume

Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI

Updated by the MDEQ-RRD-GR 10/30/2018

Wolven-Jewell Source Area



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703-693 PFAS: 20 to 70ppt

704-695 PFAS: >70ppt

704-695 PFAS: >1,000ppt

~875-850' plume

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~740-705' plume

~695-650' plume

Note - Well depths have been placed over where the residences are.

Note - Results are the initial sample results for the drinking water well

Monitor Well

Municipal Water

North

663-658 Elevation of Well Screen (Top of Screen-Bottom of Screen)

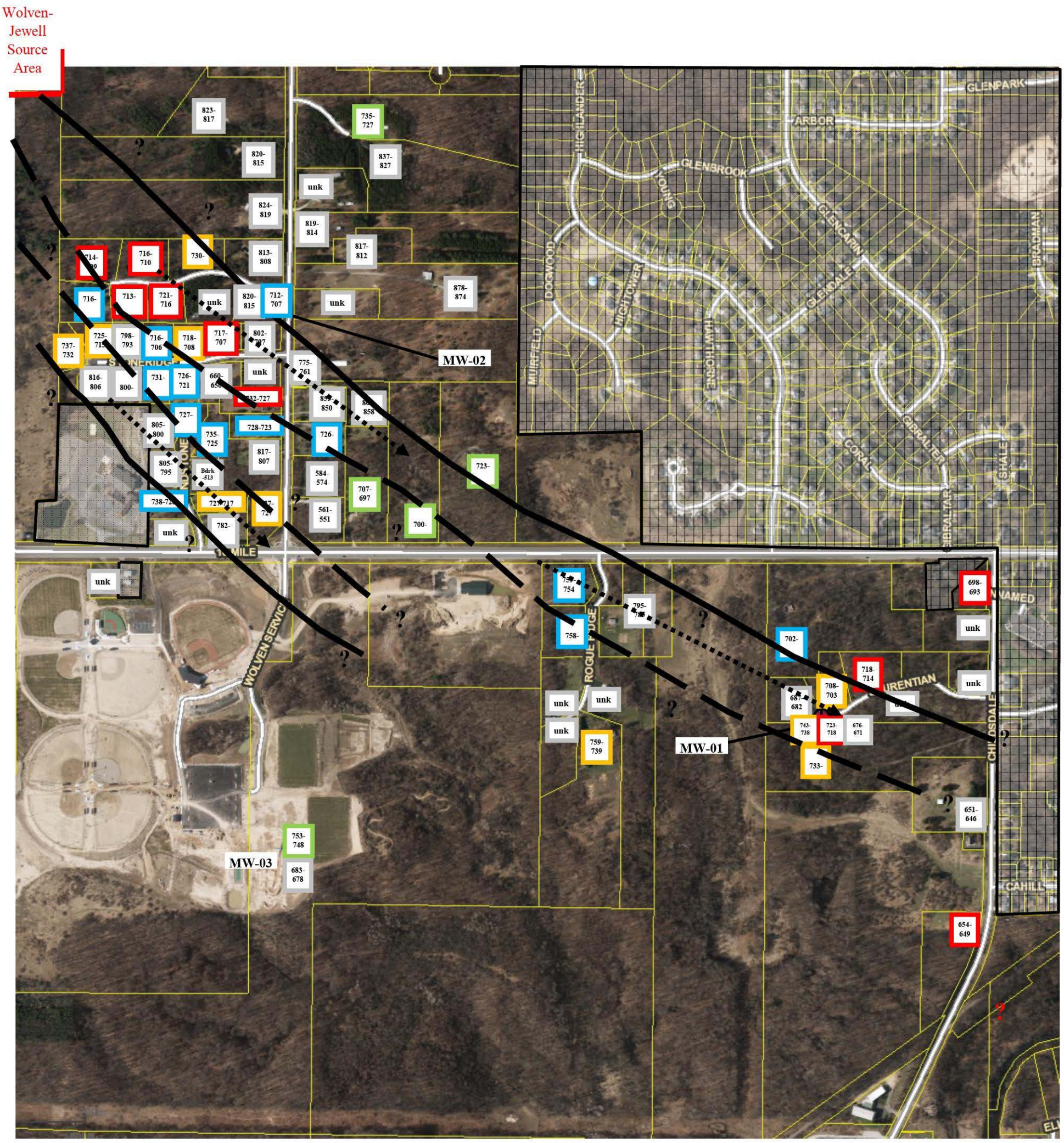
unk Well Screen Information Unknown

Figure 5—Total PFAS - Shallow Intermediate

Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI

Updated by the MDEQ-RRD-GR 10/30/2018



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703-693 PFAS: 20 to 70ppt

704-695 PFAS: >70ppt

704-695 PFAS: >1,000ppt

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~740-705' plume

~695-650' plume

Note - Well depths have been placed over where the residences are.

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Monitor Well

Municipal Water

North

663-658 Elevation of Well Screen (Top of Screen-Bottom of Screen)

unk Well Screen Information Unknown

Figure 6—Total PFAS - Deep Intermediate

Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI

Updated by the MDEQ-RRD-GR 10/30/2018

Wolven-Jewell Source Area

MW-02

MW-01

MW-03

10 MILE

STONERIDGE

WOLVEN SERVICE

ROGUE RIDGE

CHILDSDALE

GLENPARK

ARBOR

GLENBROOK

HIGHLANDER

DOGWOOD

HIGHTOWER

YOUNG

GLENCAIRN

GLENDALE

BRADMAN

MUIRFIELD

HAWTHORNE

CORAL

GIBRALTAR

SHALE

LAURENTIAN

CAHILL

823-817
735-727
820-815
837-827
unk
824-819
819-814
730-725
716-710
714-709
813-808
817-812
878-874
716-711
713-708
721-716
unk
820-815
712-707
unk
737-732
725-715
798-793
716-706
718-708
802-797
816-806
800-790
731-726
726-721
660-650
775-761
732-727
855-
863-858
805-800
727-717
735-725
728-723
817-807
805-795
Bdrk -513
584-574
726-721
723-719
738-728
727-717
737-727
561-551
707-697
700-696
unk
782-777
759-
795-785
758-753
unk
unk
unk
759-739
702-697
718-714
708-703
687-
743-738
676-
733-729
698-693
unk
unk
unk
753-748
683-678
651-646
654-649

Below Method Detection Level

709-704

PFAS: <20ppt

736-731

PFAS: 20 to 70ppt

703-693

PFAS: >70ppt

704-695

PFAS: >1,000ppt

704-695

~875-850' plume

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Monitor Well

Municipal Water

North

663-658 **Elevation of Well Screen (Top of Screen-Bottom of Screen)**

unk **Well Screen Information Unknown**

Updated by the MDEQ-RRD-GR 10/30/2018

Figure 7—Total PFAS - Deepest Plume

Analysis of Drinking Water Well Results in North Childsdale Area

Plainfield– Algoma Township MI