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The Choice for Collection System Solutions

February 3, 2017

Ms. Brigitte Berger-Raish, P.E.
Director of Engineering and Public Works
Village of Wilmette
711 Laramie Avenue
Wilmette, Illinois 60091

Subject: Village of Wilmette
2016 Princeton Basin SSES – Final Report
RJN Project No: 11-3035-00

Dear Ms. Berger-Raish:

It has been our pleasure to perform dyed water flooding services for the Village of Wilmette. This past November, 2016, RJN Group, Inc. (RJN) teamed up with Michels Pipe Services to perform dyed water flooding over an eleven (11) day period in the Kenilworth Gardens subdivision, which is a sub-area at the north-east end of the Princeton Place basin, to pinpoint locations of inflow and infiltration (I/I) and quantify these flows into the sanitary sewer collection system. Forty-eight (48) locations were recommended as dyed water flooding setup sites after smoke testing investigations performed in the Village in October of 2013 by RJN found eighty-two (82) total storm defects. During smoke testing, these locations indicated that flow could migrate from the storm sewer to the sanitary sewer. These sources of I/I are likely to be significant contributors of I/I to the sanitary sewer collection system. Ten (10) of these setups were performed in April of 2014, thus leaving thirty-eight (38) setups to be performed in 2016.


Kenilworth Gardens Subdivision

200 West Front Street • Wheaton, IL 60187 • 630.682.4700 • fax 630.682.4754

FIELD ACTIVITIES


Dyed Water Flooding Setup

Dyed water flooding is typically performed as a follow-up to smoke testing. Smoking storm structures can be indications of cross-connections between the storm system and the sanitary system. These connections are usually indirect, where storm and sanitary sewers cross one another or are parallel and are close enough that water migrates between the two. Dyed water flooding is the follow-up technique used to locate and quantify these flows into the sanitary sewer and is performed in conjunction with closed circuit televising (CCTV) to identify locations where I/I enters the system within the mainline sewer, manhole or service lateral.

Procedures for dyed water flooding include plugging the storm sewer with a pneumatic plug at each location and then completely filling the storm sewer with water and brightly colored fluorescent green dye. Plugs are used to conserve water and to isolate the specific storm sewer segment being tested. Flow measurements are taken in the downstream sanitary sewer manhole before flooding and then again at peak flood conditions to quantify the extraneous flows coming from the cross connections. During testing, digital photos of each setup are taken and manholes are checked frequently for the appearance of green dye.

At peak flooding conditions, a CCTV camera is inserted into the sanitary sewer and is used to televise the locations where green dyed water is observed flowing into the sanitary sewer. Any noticeable instance of dyed water infiltrating the sanitary sewer is recorded, and an estimated value of flow is assigned to each defect. Manholes adjacent to the flooded storm sewer are also inspected for defects, such as leaky frame seals, lifting holes, wall joints and pipe seals. Results of dyed water flooding can be significant, especially when a large number of storm inlet structures smoke with high or medium intensity.


Pipe Plug Setup

Dyed water flooding field investigations began on November 9, 2016 and continued through November 23, 2016. RJN crews worked in conjunction with Michels Pipe Services and Village of Wilmette Public Works staff. RJN

crews were responsible for planning each setup, installing the pneumatic pipe plugs, opening the fire hydrant, flooding the storm sewers, traffic control and data collection. Michels Pipe Services operated the CCTV camera/truck and Village staff cleaned and jetted the sanitary sewers.

After completing ten (10) dyed water flooding setups in April of 2014, thirty-eight (38) additional dyed water flooding setups were necessary to address the forty-eight (48) storm inlets and thirty-four (34) storm manholes with smoke defects that had been identified for follow-up testing in the Kenilworth Gardens subdivision.

Once in the field, two (2) of the setups were eliminated and one (1) was added, for a total of thirty-seven (37) setups. The additional setup was a segment in which we found dye in the upstream manhole of another setup. One of the setups eliminated was on a 120" interceptor sewer/48" storm sewer on Hunter Road in which we did not have the necessary equipment for sewers that large. The other setup which was eliminated was inaccessible for the CCTV truck and to flood as it was located in backyards of homes in the Indian Hill Golf Club community. In some setups, the sewer was filled with too much debris and the CCTV camera got stuck. These setups needed to be redone after the Village crews cleaned the sewers with a jetter. The 38 original setups along with the one additional setup are shown on Table A-1 in Appendix A. The locations are shown on Exhibits 1 and 1-2 in Appendix B.

FINDINGS

Dye Observed in Sanitary Manhole

Evidence of water leaking from the storm sewer into the sanitary sewer system was observed at thirty-four (34) of the thirty-seven (37) completed setups. The increase in flow for each setup was calculated from the pre-test and peak flow depth and velocity measurements. The locations of dyed water sources within the manholes could be seen from the surface. Defects within the sanitary sewer main are typically seen with the TV camera, where each defect was assigned an estimated gallons per minute (gpm) flow rate. However, during several dyed water flooding setups, the quantity of inflow and infiltration entering the sanitary sewer was large enough to fill the pipe over 80%. At these locations of high flow, there were portions of the pipe segment which were not able to be fully visualized because the CCTV camera was completely under water. For these setups, a jetter was used to help reduce the flow just downstream of the camera, but in many instances it was still difficult to see all defects. However, while some individual defects may not have been seen, the total increase of flow was still able to be calculated for the segment. A summary of the excess flow and defects identified during the testing for each setup is contained in Table A-2 in Appendix A.

All of the sanitary sewers in the Kenilworth Gardens subdivision were either lined, in great condition or were PVC, so no mainline defects were identified. In addition, all sanitary manholes appeared to be recently rehabbed or in great condition and no manhole defects were found. All defects found in this area were the laterals or lateral connections to the sanitary mainline.

Setups #1 and #2 were both eliminated. Setup #1 was inaccessible for the CCTV truck and to flood as it was in backyards, so it is not known if any major defects were present in this area. It should be noted that this segment was not lined as it was inaccessible for the lining truck, so mainline, manhole or lateral defects may be present. Setup #2 was not able to be completed because it was on a 120" interceptor flowing to the North along Hunter Road. Since this interceptor appeared to be in good condition, it is not likely that there are any mainline defects. The defects are likely lateral defects.

One of the biggest problems we encountered in this project was large sags in the lined sewer resulting in high flow levels, submerging the CCTV camera. In Setup #9, no defects were found. However, the CCTV camera was submerged from 100'-118', 136'-140' and 156'-165', so it's possible that there are lateral defects within these ranges. Since there was already dye in the sewer from upstream Setup #10, no dye can be seen entering the sewer in the video, but according to our initial/final flow and depth measurements, there was about a 20 gpm increase in flow. The camera was also submerged in Setup #8 from 90'-104' and in Setup #14 from 25'-40' and 67'-90'. In these spots of submerged flow, lots of turbulence can be seen at some points while the camera is submerged, so it's likely that there are lateral infiltration defects. It is recommended to T-line all laterals in these ranges of submerged flow.

Dye in Sanitary Manhole 1-67 Before & After

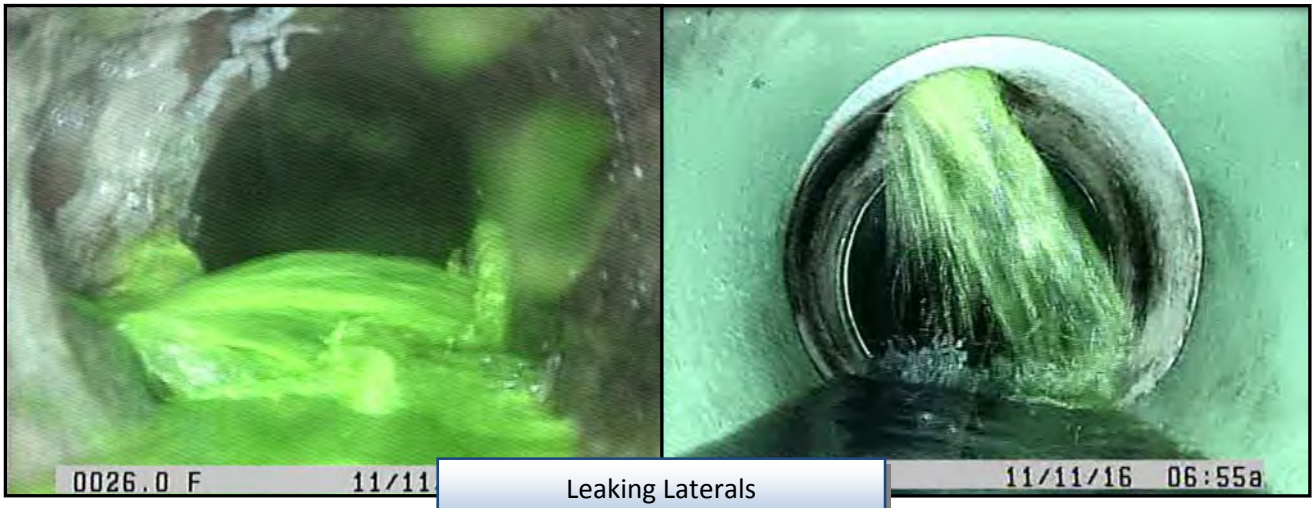
The dyed water flooding process is performed to simulate a rainfall event which completely inundates the storm sewer system. Therefore, the increased flows measured within the sanitary sewer are an actual simulation of what could be observed during an extreme rainfall event.

Flow measurements taken are a good indicator of the peak I/I that could be entering into the sanitary sewer collection system from the storm sewer. At each location, dyed water flooding setups differ due to unique sewer configurations and other site characteristics, such as soil saturation, groundwater levels, soil porosity, rate of water discharge from fire hydrant, hydrostatic forces, etc. Based on these factors and the varying levels of flooding at each site, specific storm intensities cannot be assigned to each dyed water setup. It can, however, be inferred that at each individual location, a

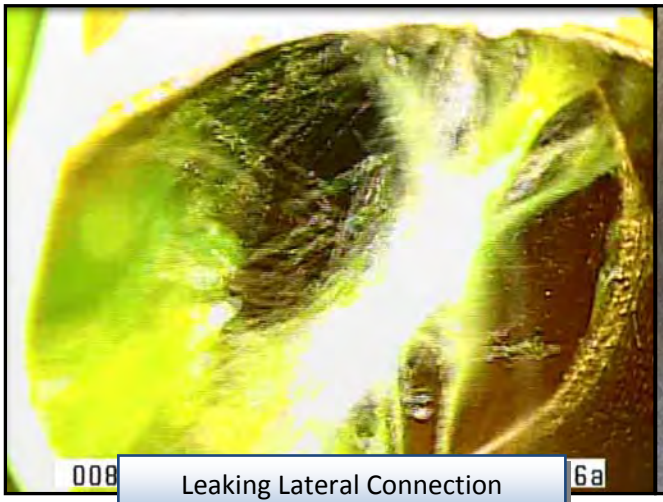
peak rainfall event was reproduced which allowed storm water to leak out of the storm water system and enter into the sanitary sewer collection system, where it was pinpointed and quantified. This flow rate indicates the maximum amount of clear water which could infiltrate into the sanitary sewer during a peak storm event which would fully flood the adjacent storm sewer system. It is important to note that dyed water flooding simulates a rain storm for which the storm sewer system is completely inundated. Therefore, these flow values cannot be directly compared to a typical 1-year, 60-minute rain event for which a flow balance is quantified.

This project is unique in that there is such a large number of segments with multiple defects within the same subdivision of the same basin, and within these are multiple stretches of segments with multiple defects in line with each other. Let's look at, for example, Greenwood Avenue from Hunter Road to 21st Street. At Setup #29, a 35 gpm increase was found from the six (6) defects between manholes 1-65 and 1-64. However, during a large storm, not only will the additional flow from the six (6) defects in that segment affect the flow in that pipe, but the additional flow from the seventeen (17) defects from the four (4) segments directly upstream also affect the flow. So, from manhole 1-64 to manhole 1-69, an excess of 213 gallons per minute are added to this line from the storm sewer during large storms. That adds up to 306,720 gallons per day of additional flow for those 5 segments alone. Now, once the infiltrated flow from the hundreds of other defects in the subdivision are inserted into the sanitary system, over 2 million gallons per day total are added to the system.

Significant sources such as leaking laterals and leaking lateral connections identified during the televising are shown in the pictures below.



Leaking Laterals



Leaking Lateral Connection

Turbulent Flow in Downstream Sanitary MH

For quantifying the total increase in flow into the sanitary sewer from cross connections, the quantity of individual defects found during dyed water flooding is noted. As shown in Table A-2 in Appendix A, most of the sewers tested showed multiple defects contributing I/I into the sanitary sewer system. The dyed water flooding setups and results are shown in Exhibits 1-41 in Appendix B. These exhibits depict the storm sewer segment that was flooded, the sanitary sewer segment televised, and the location and description of each identified defect.

As a result of this project, it was found that over 1.5 million gallons per day of flow was infiltrating into the sanitary system from the storm system through 123 different defects. This number doesn't take into account the 2 setups which were eliminated, any defects in sags at spots where the CCTV camera was submerged, any rain water infiltrating into the laterals through the ground or the previous 10 setups which were completed in April, 2014 (which resulted in over .5 million gallons per day itself). Note that this is a peak flow rate that can occur during a major flow event. This rate will decrease as the level of flow in the storm sewer decreases.

The results from the 10 dyed water flooding completed in April of 2014 are shown in Table A-3 in Appendix A and Exhibits 42-52 in Appendix B.

RECOMMENDATIONS

Reducing non-sanitary flows in the sanitary system will reduce the severity and frequency of sewer backups. It is highly recommended that the Kenilworth Gardens subdivision is rehabilitated as it was concluded that a peak flow rate of over 2 million gallons of non-sanitary flow per day can infiltrate from the storm system to the sanitary system as a result of the 47 completed setups. For each of the defects identified during dyed water flooding, a recommended rehabilitation technique was assigned. T-liners are recommended for leaking service laterals. Grouting of the lateral connection at the main is recommended for areas of lateral connection defects. It is also recommended that any laterals that are

located in locations where the CCTV camera was submerged are rehabilitated with T-Liners. The recommendations and locations for these defects that were part of each dye flood setup can be found in Table A-2 in Appendix A. The High Priority Deficiencies document that is part of the MWRD Inflow and Infiltration Control Program (IICP) only requires the mainline and manhole defects to be identified. This dye flooding does not add new defects to the list. The lateral defects are to be addressed in the Private Sector Plan (PSP).

Since rehabilitation has yet to be completed to the defects found in the ten (10) setups completed in 2014, these recommendations have been included Table A-3 in Appendix A.

The Village has had a sewer televising and lining program for many years. We recommend that this program continue with the following potential enhancements (if not used already):

1. Add the lateral locations from the televising to the Village GIS. Use this to identify potential dead laterals that can be sealed.
2. Use end seals at the ends of each lined segment to prevent interstitial flow (flow between liner and host pipe) from entering the manholes.
3. Grout each manhole connection to prevent interstitial flow and flow entering at the connection itself.

The service laterals within the Village of Wilmette are considered private and are the maintenance responsibility of the building property owner to the connection with the Village sewer. Therefore, it would be the property owner's responsibility for rehabilitation of defective laterals.

It is our recommendation that the Village take responsibility to correct the service connection defects found during dye flooding. The cost for grouting a service connection is typically $600-$700 each when there is sufficient quantity for a contractor to provide competitive pricing. This grouting can be done at the time of lining and would seal the connections from interstitial flow that often occurs between the liner and the host pipe. The Village may want to consider adding service connection grouting to the annual lining program specification and may want to have a program to grout service connections where lining has already occurred.

Due to the quantity of lateral defects in a relative small area and the associated high excess flow during a rain event indicates, we recommend that the Village evaluate options to address these lateral defects. As a first step in the process, it is our recommendation that the Village select a pilot area for televising service laterals. The Village should consider including dye flooding of the grass surface above the lateral to provide a better indication of the lateral condition. This would provide the Village a better understanding of the extent of the lateral defect issue.

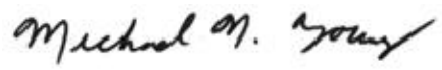
There are many options for a lateral program. The most effective programs have an annual amount spent on lateral rehabilitation that is similar to mainline lining programs. Although the direct funding

source for a program can be the Village, the property owner or some combination, the ultimate funding source is still the Village residents. As in any program, the benefits of the program have to be evaluated compared to the costs. Due to the high excess flows from laterals found during this project, it is our opinion that there is enough benefit to warrant such an evaluation.

The Village my also want to consider televising storm sewers to locate defects in the storm system.

It has been a pleasure to work with the Village of Wilmette on this project. Thank you for the opportunity, and please feel free to call if there are any questions.

Sincerely,
RJN Group, Inc.



Michael Young, P.E.
Principal

Ryan Johnson, E.I.T.
Design Engineer

APPENDIX A – DYE TEST RESULTS, REHABILITATION RECOMMENDATIONS

TABLE A-1
DYED WATER FLOODING SETUP SITES

Setup No.	U/S Sanitary	D/S Sanitary	Sanitary Size (in)	Sanitary Sewer Length (ft)	Street Name
1	1-40	1-39	8	244	Indian Hill Rd.
2	1-24	1-26A	120	194	Hunter Rd.
3	1-105	1-37	10	225	Beechwood Ave.
4	1-37	1-36	10	232	Beechwood Ave.
5	1-36	1-35	10	219	Beechwood Ave.
6	1-35	1-34	10	229	Beechwood Ave.
7	1-33	1-25	10	225	Beechwood Ave.
7.1	1-34	1-33	10	225	Beechwood Ave.
8	1-26	1-25	8	217	Beechwood Ave.
9	1-27	1-26	8	215	Beechwood Ave.
10	1-28	1-27	8	265	Beechwood Ave.
11	1-32	1-31	8	277	Ridge Rd.
12	1-18	1-17	8	105	Kenilworth Ave.
13	1-17	1-16	8	153	Kenilworth Ave.
14	1-16	1-15	8	239	Kenilworth Ave.
15	1-19	1-20	15	247	Kenilworth Ave.
16	1-20	1-21	15	294	Kenilworth Ave.
17	1-3	1-2	12	238	Chestnut Ave.
18	1-4	1-3	12	228	Chestnut Ave.
19	1-5	1-4	12	235	Chestnut Ave.
20	1-8	1-7	12	217	Chestnut Ave.
21	1-9	1-8	8	205	Chestnut Ave.
22	1-58	1-57	8	223	Thornwood Ave.
23	1-57	1-56	10	222	Thornwood Ave.
24	1-56	1-55	10	234	Thornwood Ave.
25	1-55	1-54	10	222	Thornwood Ave.
26	1-54	1-53	10	226	Thornwood Ave.
27	1-53	1-52	10	224	Thornwood Ave.
28	1-52	1-52-RJN A	10	227	Thornwood Ave.
29	1-65	1-64	10	221	Greenwood Ave.
30	1-66	1-65	10	223	Greenwood Ave.
31	1-67	1-66	10	221	Greenwood Ave.
32	1-68	1-67	10	223	Greenwood Ave.
33	1-69	1-68	10	222	Greenwood Ave.
34	1-70	1-69	10	224	Greenwood Ave.
35	1-71	1-70	8	214	Greenwood Ave.
36	1-81	1-80	10	219	Elmwood Ave.
37	1-78	1-77	10	220	Elmwood Ave.
38	1-101	1-100	8	214	Timber Ln.

Indicates Additional Setup

Indicates Eliminated Setup

TABLE A-2
DYED WATER FLOODING DEFECTS & REHABILITATION RECOMMENDATIONS

Setup No.	U/S Sanitary	D/S Sanitary	Street Name	Sanitary Diameter (in.)	Sanitary Material	Segment Flow Increase (gpm)	Segment Flow Increase (gpd)	Station (ft)	Station From	Clock Position	Defect Type	Estimated gpm at Defect	Estimated gpd at Defect	Rehabilitation	Rehabilitation Cost	Ratio of Cost: Flow ($/GPD)
1	1-40	1-39	Indian Hill	8	Unknown	-	-	Setup Eliminated - Inaccessible						-	-	-
2	1-24	1-26A	Hunter	120	Unknown	-	-	Setup Eliminated - Large Diameter Sewers. Defect likely Laterals						-	-	-
3	1-105	1-37	Beechwood	10	CIPP	11	684	149	Upstream	10	Lateral	3	4320	T-Liner	$8,000	$1.85
								201	Upstream	2	Lateral	8	11520	T-Liner	$8,000	$0.69
4	1-37	1-36	Beechwood	10	CIPP	21	30240	27	Upstream	2	Lateral	15	21600	T-Liner	$8,000	$0.37
								76	Upstream	2	Lateral	6	8640	T-Liner	$8,000	$0.93
5	1-36	1-35	Beechwood	10	CIPP	18	25920	45	Upstream	3	Lateral	6	8640	T-Liner	$8,000	$0.93
								95	Upstream	3	Lateral Connection	3	4320	Grout Connection	$600	$0.14
								21	Downstream	2	Lateral Connection	3	4320	Grout Connection	$600	$0.14
								69	Downstream	10	Lateral	3	4320	T-Liner	$8,000	$1.85
								70	Downstream	2	Lateral	3	4320	T-Liner	$8,000	$1.85
6	1-35	1-34	Beechwood	10	CIPP	57	82080	22	Upstream	10	Lateral	5	7200	T-Liner	$8,000	$1.11
								24	Upstream	2	Lateral	9	12960	T-Liner	$8,000	$0.62
								72	Upstream	9	Lateral	15	21600	T-Liner	$8,000	$0.37
								124	Upstream	9	Lateral	20	28800	T-Liner	$8,000	$0.28
								172	Upstream	9	Lateral Connection	1	1440	Grout Connection	$600	$0.42
								174	Upstream	3	Lateral	7	10080	T-Liner	$8,000	$0.79
7	1-33	1-25	Beechwood	10	CIPP	56	80640	21	Upstream	3	Lateral	25	36000	T-Liner	$8,000	$0.22
								23	Upstream	9	Lateral	15	21600	T-Liner	$8,000	$0.37
								69	Upstream	1	Lateral	10	14400	T-Liner	$8,000	$0.56
								124	Upstream	3	Lateral	2	2880	T-Liner	$8,000	$2.78
								172	Upstream	9	Lateral	2	2880	T-Liner	$8,000	$2.78
								174	Upstream	3	Lateral	2	2880	T-Liner	$8,000	$2.78
7.1	1-34	1-33	Beechwood	10	CIPP	34	48960	48	Upstream	3	Lateral	15	21600	T-Liner	$8,000	$0.37
								95	Upstream	9	Lateral Connection	2	2880	Grout Connection	$600	$0.21
								145	Upstream	10	Lateral	10	14400	T-Liner	$8,000	$0.56
								195	Upstream	9	Lateral	7	10080	T-Liner	$8,000	$0.79
8	1-26	1-25	Beechwood	8	CIPP	29	41760	6	Upstream	9	Lateral	3	4320	T-Liner	$8,000	$1.85
								52	Upstream	9	Lateral	3	4320	T-Liner	$8,000	$1.85
								102	Upstream	10	Lateral	20	28800	T-Liner	$8,000	$0.28
								152	Upstream	3	Lateral	3	4320	T-Liner	$8,000	$1.85
								Camera Submerged at Sags 90'-104'						T-Liner to any laterals 90'-104'		
9	1-27	1-26	Beechwood	8	CIPP	-	-	Camera Submerged at Sags 100'-118', 136'-140', 156'-165'						T-Liner to any laterals 100'-118', 136'-140', 156'-165'		
10	1-28	1-27	Beechwood	8	CIPP	10	14400	234	Upstream	10	Lateral	10	14400	T-Liner	$8,000	$0.56
11	1-32	1-31	Kenilworth	8	VCP	-	-	No Dye Observed						-	-	-
12	1-18	1-17	Kenilworth	8	CIPP	-	-	No Dye Observed						-	-	-
13	1-17	1-16	Kenilworth	8	CIPP	55	79200	25	Downstream	3	Lateral	18	25920	T-Liner	$8,000	$0.31
								28	Downstream	10	Lateral	15	21600	T-Liner	$8,000	$0.37
								81	Downstream	3	Lateral	11	15840	T-Liner	$8,000	$0.51
								83	Downstream	10	Lateral	11	15840	T-Liner	$8,000	$0.51
14	1-16	1-15	Kenilworth	8	CIPP	44	63360	18	Downstream	3	Lateral	7	10080	T-Liner	$8,000	$1.39
								118	Downstream	3	Lateral	5	7200	T-Liner	$8,000	$0.35
								120	Downstream	10	Lateral Connection	4	5760	Grout Connection	$600	$0.10
								168	Downstream	3	Lateral	16	23040	T-Liner	$8,000	$0.35
								221	Downstream	3	Lateral	12	17280	T-Liner	$8,000	$0.46
								Camera Submerged at Sags 25'-40', 67'-90'						T-Liner to any laterals 25'-40', 67'-90'		

TABLE A-2
DYED WATER FLOODING DEFECTS & REHABILITATION RECOMMENDATIONS

Setup No.	U/S Sanitary	D/S Sanitary	Street Name	Sanitary Diameter (in.)	Sanitary Material	Segment Flow Increase (gpm)	Segment Flow Increase (gpd)	Station (ft)	Station From	Clock Position	Defect Type	Estimated gpm at Defect	Estimated gpd at Defect	Rehabilitation	Rehabilitation Cost	Ratio of Cost: Flow ($/GPD)
15	1-19	1-20	Kenilworth	15	PVC	26	37440	10	Upstream	11	Lateral	14	20160	T-Liner	$8,000	$0.40
								210	Upstream	11	Lateral	8	11520	T-Liner	$8,000	$0.69
								213	Upstream	1	Lateral	4	5760	T-Liner	$8,000	$1.39
16	1-20	1-21	Kenilworth	15	PVC	14	20160	63	Upstream	11	Lateral	10	14400	T-Liner	$8,000	$0.56
								217	Upstream	11	Lateral	4	5760	T-Liner	$8,000	$1.39
17	1-3	1-2	Chestnut	12	CIPP	60	86400	15	Upstream	10	Lateral	2	2880	T-Liner	$8,000	$2.78
								63	Upstream	2	Lateral Connection	5	7200	Grout Connection	$600	$0.08
								65	Upstream	10	Lateral	16	23040	T-Liner	$8,000	$0.35
								115	Upstream	10	Lateral	20	28800	T-Liner	$8,000	$0.28
								167	Upstream	2	Lateral	1	1440	T-Liner	$8,000	$5.56
								169	Upstream	10	Lateral	16	23040	T-Liner	$8,000	$0.35
18	1-4	1-3	Chestnut	12	CIPP	47	67680	41	Upstream	1	Lateral Connection	1	1440	Grout Connection	$600	$0.42
								43	Upstream	10	Lateral	12	17280	T-Liner	$8,000	$0.46
								93	Upstream	10	Lateral	12	17280	T-Liner	$8,000	$0.46
								143	Upstream	10	Lateral	10	14400	T-Liner	$8,000	$0.56
								192	Upstream	2	Lateral Connection	2	2880	Grout Connection	$600	$0.21
								194	Upstream	10	Lateral	10	14400	T-Liner	$8,000	$0.56
19	1-5	1-4	Chestnut	12	CIPP	16	23040	4	Downstream	2	Lateral	14	20160	T-Liner	$8,000	$0.40
								53	Downstream	2	Lateral	2	2880	T-Liner	$8,000	$2.78
20	1-8	1-7	Chestnut	12	CIPP	31	44640	52	Upstream	2	Lateral Connection	1	1440	Grout Connection	$600	$0.42
								54	Upstream	9	Lateral	14	20160	T-Liner	$8,000	$0.40
								104	Upstream	9	Lateral	10	14400	T-Liner	$8,000	$0.56
								149	Upstream	10	Lateral	6	8640	T-Liner	$8,000	$0.93
21	1-9	1-8	Chestnut	8	CIPP	44	63360	57	Upstream	2	Lateral	16	23040	T-Liner	$8,000	$0.35
								59	Upstream	10	Lateral	3	4320	T-Liner	$8,000	$1.85
								139	Upstream	2	Lateral	25	36000	T-Liner	$8,000	$0.22
22	1-58	1-57	Thornwood	8	CIPP	60	86400	9	Upstream	10	Lateral	5	7200	T-Liner	$8,000	$1.11
								40	Upstream	9	Lateral	30	43200	T-Liner	$8,000	$0.19
								162	Upstream	3	Lateral	25	36000	T-Liner	$8,000	$0.22
23	1-57	1-56	Thornwood	10	CIPP	45	64800	86	Upstream	2	Lateral Connection	8	11520	Grout Connection	$600	$0.05
								88	Upstream	9	Lateral	10	14400	T-Liner	$8,000	$0.56
								117	Upstream	9	Lateral	10	14400	T-Liner	$8,000	$0.56
								138	Upstream	3	Lateral	15	21600	T-Liner	$8,000	$0.37
								189	Upstream	2	Lateral	2	2880	T-Liner	$8,000	$2.78
24	1-56	1-55	Thornwood	10	CIPP	31	44640	18	Upstream	3	Lateral	10	14400	T-Liner	$8,000	$0.56
								69	Upstream	2	Lateral	3	4320	T-Liner	$8,000	$1.85
								118	Upstream	2	Lateral	3	4320	T-Liner	$8,000	$1.85
								121	Upstream	10	Lateral	3	4320	T-Liner	$8,000	$1.85
								150	Upstream	10	Lateral	3	4320	T-Liner	$8,000	$1.85
								168	Upstream	2	Lateral	3	4320	T-Liner	$8,000	$1.85
								219	Upstream	2	Lateral	3	4320	T-Liner	$8,000	$1.85
								220	Upstream	10	Lateral	3	4320	T-Liner	$8,000	$1.85

TABLE A-2
DYED WATER FLOODING DEFECTS & REHABILITATION RECOMMENDATIONS

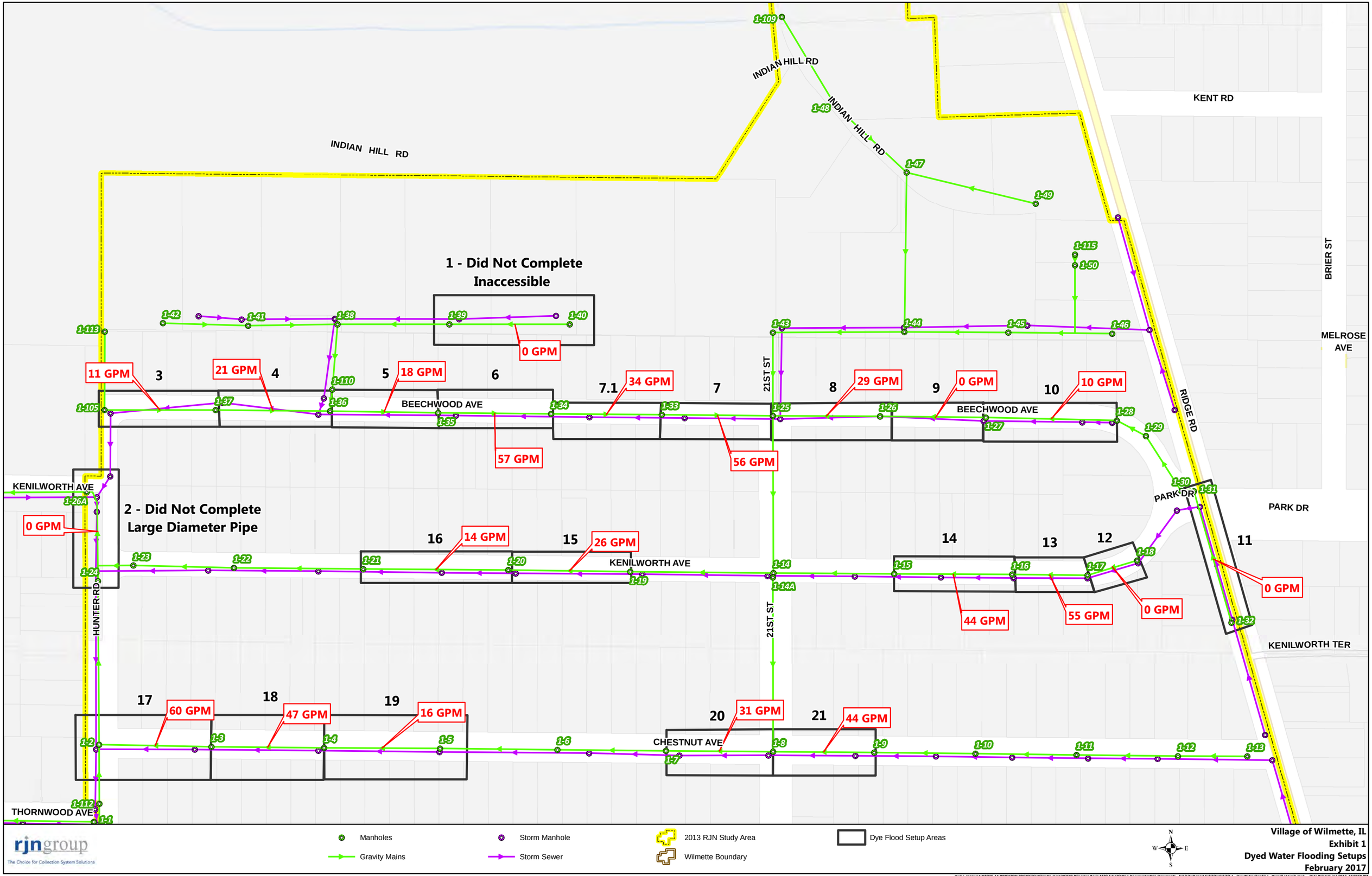
Setup No.	U/S Sanitary	D/S Sanitary	Street Name	Sanitary Diameter (in.)	Sanitary Material	Segment Flow Increase (gpm)	Segment Flow Increase (gpd)	Station (ft)	Station From	Clock Position	Defect Type	Estimated gpm at Defect	Estimated gpd at Defect	Rehabilitation	Rehabilitation Cost	Ratio of Cost: Flow ($/GPD)
25	1-55	1-54	Thornwood	10	CIPP	27	38880	34	Upstream	2	Lateral	2	2880	T-Liner	$8,000	$2.78
								36	Upstream	10	Lateral	2	2880	T-Liner	$8,000	$2.78
								87	Upstream	2	Lateral Connection	3	4320	Grout Connection	$600	$0.14
								89	Upstream	10	Lateral	12	17280	T-Liner	$8,000	$0.46
								185	Upstream	2	Lateral	8	11520	T-Liner	$8,000	$0.69
26	1-54	1-53	Thornwood	10	CIPP	16	23040	159	Upstream	3	Lateral Connection	1	1440	Grout Connection	$600	$0.42
								161	Upstream	9	Lateral	13	18720	T-Liner	$8,000	$0.43
								211	Upstream	9	Lateral Connection	2	2880	Grout Connection	$600	$0.21
27	1-53	1-52	Thornwood	10	CIPP	25	36000	136	Upstream	3	Lateral	12	17280	T-Liner	$8,000	$0.46
								138	Upstream	9	Lateral Connection	5	7200	Grout Connection	$600	$0.08
								189	Upstream	11	Lateral Connection	8	11520	Grout Connection	$600	$0.05
28	1-52	1-52-RJN A	Thornwood	10	CIPP	35	50400	104	Upstream	3	Lateral Connection	1	1440	Grout Connection	$600	$0.42
								111	Upstream	11	Lateral	19	27360	T-Liner	$8,000	$0.29
								164	Upstream	9	Lateral	15	21600	T-Liner	$8,000	$0.37
29	1-65	1-64	Greenwood	10	CIPP	35	50400	10	Upstream	9	Lateral	15	21600	T-Liner	$8,000	$0.37
								60	Upstream	9	Lateral	4	5760	T-Liner	$8,000	$1.39
								107	Upstream	3	Lateral	3	4320	T-Liner	$8,000	$1.85
								109	Upstream	9	Lateral	1	1440	T-Liner	$8,000	$5.56
								157	Upstream	3	Lateral	8	11520	T-Liner	$8,000	$0.69
								159	Upstream	9	Lateral	4	5760	T-Liner	$8,000	$1.39
30	1-66	1-65	Greenwood	10	CIPP	58	83520	30	Upstream	3	Lateral	5	7200	T-Liner	$8,000	$1.11
								80	Upstream	3	Lateral Connection	2	2880	Grout Connection	$600	$0.21
								82	Upstream	9	Lateral	12	17280	T-Liner	$8,000	$0.46
								130	Upstream	3	Lateral	10	14400	T-Liner	$8,000	$0.56
								132	Upstream	9	Lateral	16	23040	T-Liner	$8,000	$0.35
								181	Upstream	9	Lateral	13	18720	T-Liner	$8,000	$0.43
31	1-67	1-66	Greenwood	10	CIPP	29	41760	104	Upstream	10	Lateral	18	25920	T-Liner	$8,000	$0.31
								152	Upstream	3	Lateral Connection	2	2880	Grout Connection	$600	$0.21
								154	Upstream	9	Lateral Connection	9	12960	Grout Connection	$600	$0.05
32	1-68	1-67	Greenwood	10	CIPP	79	113760	22	Upstream	3	Lateral Connection	2	2880	Grout Connection	$600	$0.21
								24	Upstream	10	Lateral	11	15840	T-Liner	$8,000	$0.51
								77	Upstream	9	Lateral	15	21600	T-Liner	$8,000	$0.37
								124	Upstream	3	Lateral	3	4320	T-Liner	$8,000	$1.85
								126	Upstream	9	Lateral	22	31680	T-Liner	$8,000	$0.25
								174	Upstream	3	Lateral	10	14400	T-Liner	$8,000	$0.56
								176	Upstream	9	Lateral	16	23040	T-Liner	$8,000	$0.35
33	1-69	1-68	Greenwood	10	CIPP	12	17280	146	Upstream	9	Lateral	12	17280	T-Liner	$8,000	$0.46
34	1-70	1-69	Greenwood	10	CIPP	-	-	No Dye Observed						-	-	-
35	1-71	1-70	Greenwood	8	CIPP	3	4320	134	Upstream	3	Lateral	3	4320	T-Liner	$8,000	$1.85
36	1-81	1-80	Elmwood	10	CIPP	6	8640	127	Upstream	3	Lateral Connection	1	1440	Grout Connection	$600	$0.42
								152	Upstream	3	Lateral	5	7200	T-Liner	$8,000	$1.11
37	1-78	1-77	Elmwood	10	CIPP	20	28800	87	Upstream	9	Lateral	20	28800	T-Liner	$8,000	$0.28
38	1-101	1-100	Timber	8	CIPP	1	1440	129	Upstream	9	Lateral	1	1440	T-Liner	$8,000	$5.56
					Totals:	**1,055**	**1,504,044**								**$ 828,600**	

plus rehab for submerged lateral defects in setups 8,9,14

TABLE A-3
10 DYED WATER FLOODING SETUPS FROM APRIL 2014

Setup No.	USMH	DSMH	Location	Dye Observed at Defect	Rehabilitation	At Distance	GPM	GPD	Cost*	Ratio of Cost: Flow ($/GPD)
1	1-108	1-90		Manhole Leak	MH Lining	at 200'	2.5	3,600	$1,938	$0.54
2	1-108	1-62		Lateral Leak	T-Liner	at 66.0'	2.2	3,168	$7,000	$2.21
				Mainline Joint Leak	CIPP	at 68.0	0.1	144	$4,560	$31.67
						at 89.1'	2.1	3,024		$1.51
3	1-90	1-107		Mainline Joint Leak	CIPP	at 161.0'	1.5	2,160	$7,800	$3.61
				Lateral Leak	T-Liner	at 81.0'	1.5	2,160	$7,000	$3.24
				Manhole Leak	MH Lining	at MH 1-107	7.9	11,376	$1,996	$0.18
4	1-107	1-89		Manhole Leak	MH Lining	at MH 1-89	0.5	720	$1,940	$2.69
5	1-89	1-88		Manhole Leak	Frame and Cover		1.5	2,160	$1,500	$0.69
6	2-192	1-88		Mainline Joint Leak	CIPP	at 19.5'	0.3	432	$0	$0.00
				Mainline Joint Leak	CIPP	at 15.5'	0.3	432	$0	$0.00
				Mainline Joint Leak	CIPP	at 12.5'	0.3	432	$0	$0.00
				Mainline Joint Leak	CIPP	at 10.0'	0.3	432	$0	$0.00
				Mainline Joint Leak	CIPP	at 7.3'	0.3	432	$0	$0.00
				Mainline Joint Leak	CIPP	at 1.0'	0.3	432	$0	$0.00
7	1-88	1-87		Lateral Leak	T-Liner	at 78.6'	7	10,080	$7,000	$0.69
				Lateral Leak	T-Liner	at 161.0'	7	10,080	$7,000	$0.69
				Manhole Leak	MH Lining	at MH 1-88	1	1,440	$2,016	$1.40
8	1-87	1-86	1914 Elmwood	Lateral Leak	T-Liner	at 16.2'	25	36,000	$7,000	$0.19
			1918 Elmwood	Lateral Leak	T-Liner	at 42.1'	15	21,600	$7,000	$0.32
			1922 Elmwood	Lateral Leak	T-Liner	at 66.2'	20	28,800	$7,000	$0.24
			1926 Elmwood	Lateral Leak	T-Liner	at 118.7'	4.2	6,048	$7,000	$1.16
9	1-58	1-57	2033 Thornwood	Lateral Leak	T-Liner	at 10.1'	110	158,400	$7,000	$0.04
			2035 Thornwood	Lateral Leak	T-Liner	at 41.5'	200	288,000	$7,000	$0.02
			2041 Thornwood	Lateral Leak	T-Liner	at 62.3'	1.2	1,728	$7,000	$4.05
10	1-59	1-58	2022 Thornwood	Lateral Leak	T-Liner	at 139.5'	5	7,200	$7,000	$0.97
			2029 Thornwood	Lateral Leak	T-Liner	at 142.0'	1.5	2,160	$7,000	$3.24
			2033 Thornwood	Lateral Leak	T-Liner	at 190.0'	20	28,800	$7,000	$0.24
			2034 Thornwood	Lateral Leak	T-Liner	at 192.1'	22	31,680	$7,000	$0.22
	Total						**460.5**	**663,120**	**$126,750**	

APPENDIX B – EXHIBITS



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Manholes
Gravity Mains
Storm Manhole
Storm Sewer
2013 RJN Study Area
Wilmette Boundary
Dye Flood Setup Areas

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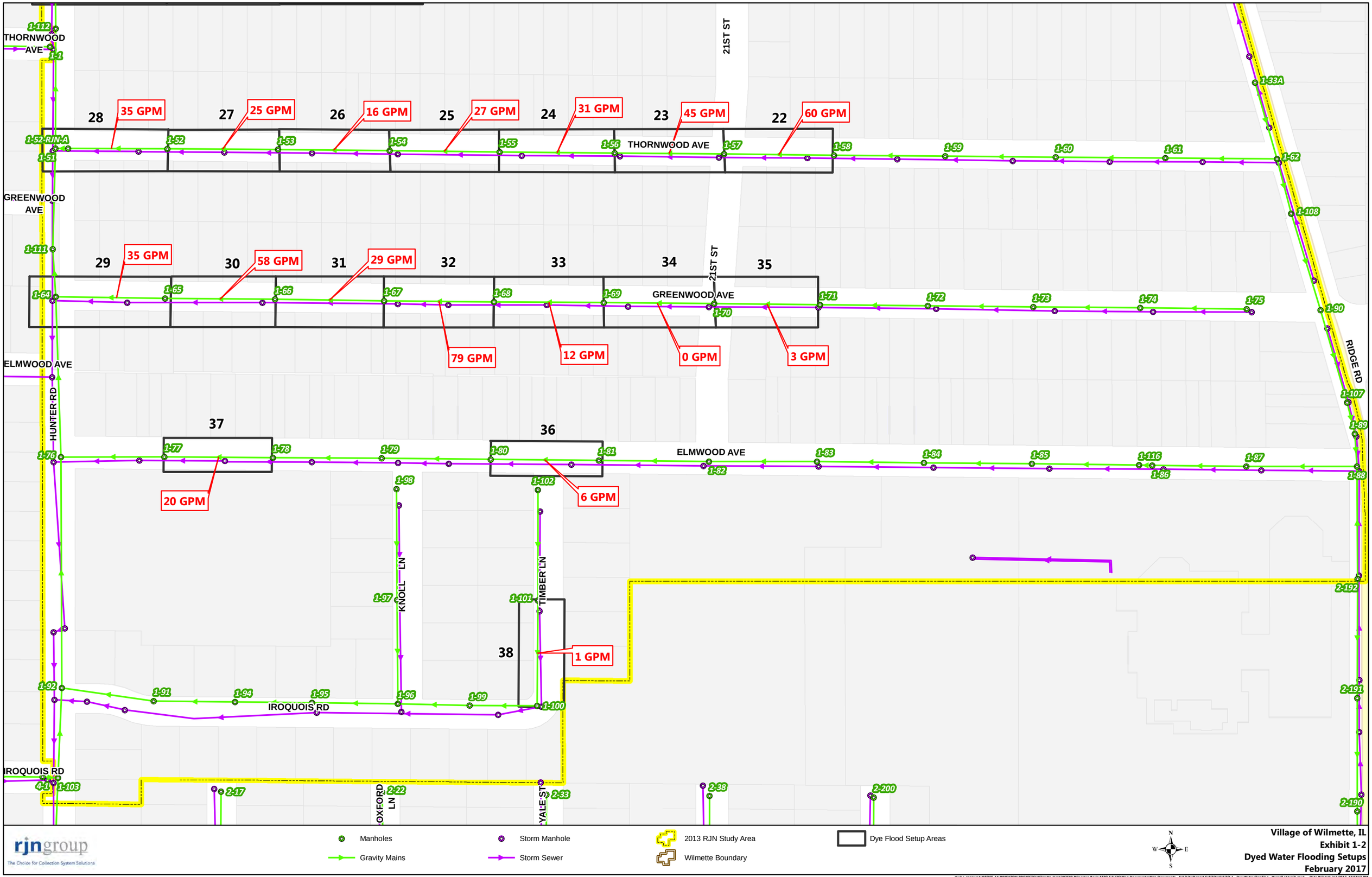
Village of Wilmette, IL
Exhibit 1
Dyed Water Flooding Setups
February 2017

\\wlne-panzura1\OFFICE-11\WHEATON\PROJECTS\Wilmette,IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 1 - Dye Water Flooding - Overall (11x17).mxd - Date Printed: 2/2/2017 12:00:59 PM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ELMWOOD AVE
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HUNTER RD
KNOLL LN
TIMBER LN
OXFORD LN
YALE ST
RIDGE RD
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27
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6 GPM
1 GPM
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1-100
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2-190
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1-103
2-17
2-22
2-33
2-38
2-200
Manholes
Storm Manhole
2013 RJN Study Area
Dye Flood Setup Areas
Gravity Mains
Storm Sewer
Wilmette Boundary
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Village of Wilmette, IL
Exhibit 1-2
Dyed Water Flooding Setups
February 2017
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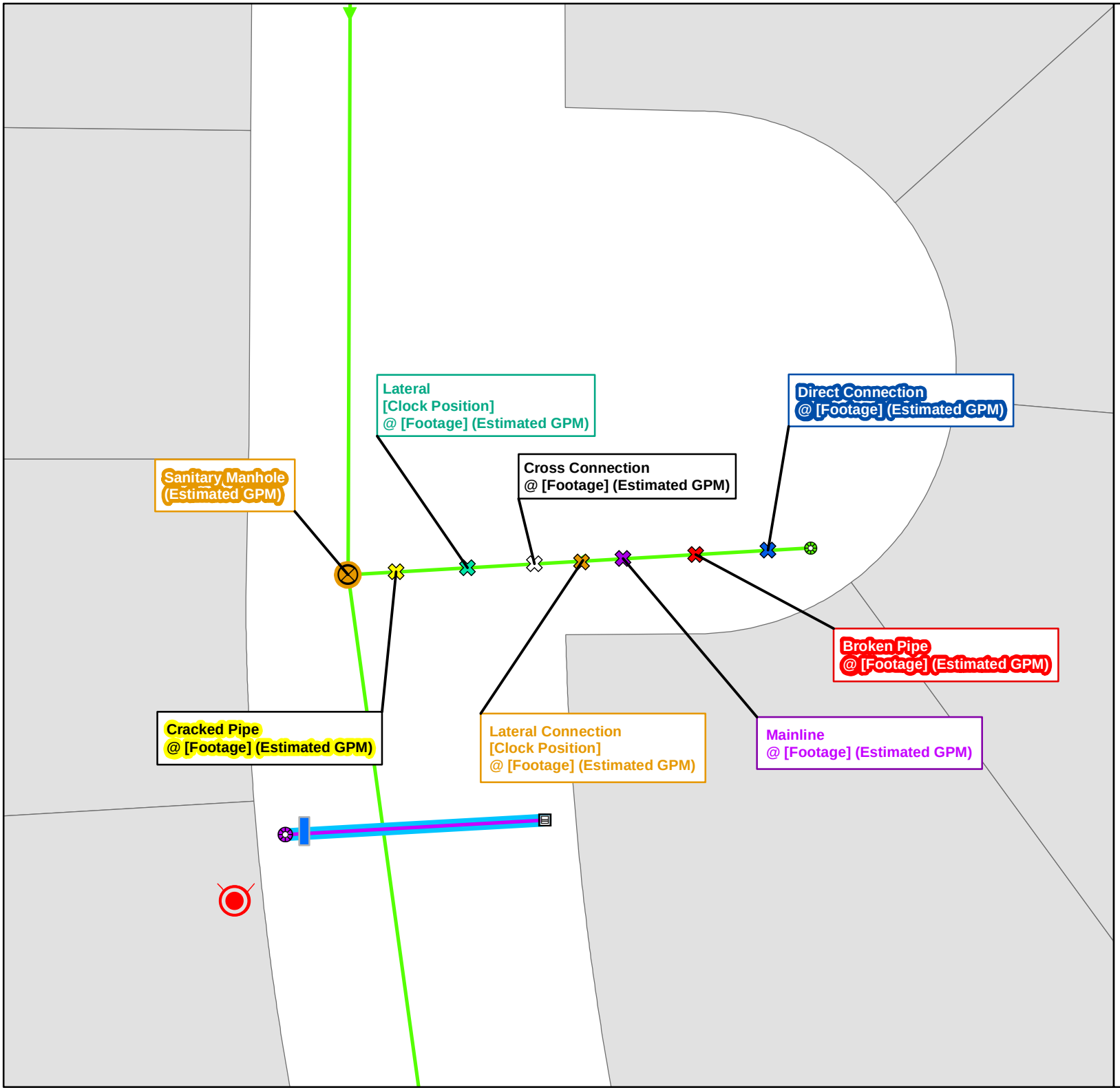

Wilmette, IL
Dyed Water Flooding
Legend

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- Hydrant
- Plug
- Sanitary Structure
- Sanitary Gravity Main
- Storm Catch Basin/Inlet
- Storm Manhole
- Storm Sewer
- Storm Line Flooded With Dye
- Sewer Televising

Dye Water Flooding Defects

- BROKEN PIPE
- CRACKED PIPE
- CROSS CONNECTION
- DIRECT CONNECTION
- LATERAL CONNECTION
- LATERAL
- MAINLINE JOINT LEAK
- MANHOLE LEAK

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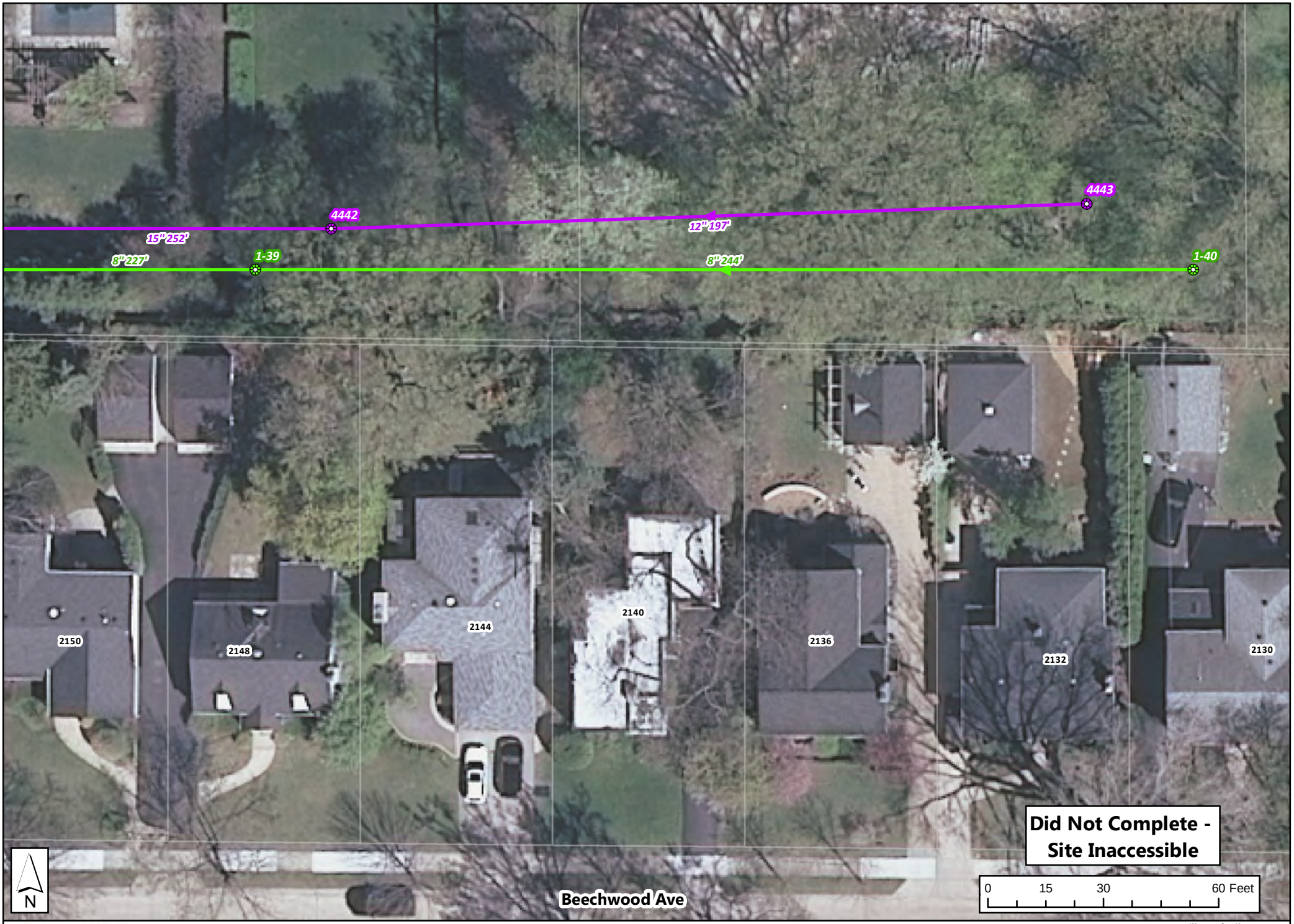
Village of Wilmette, IL
Exibit 2
Example Setup
Legend
February 2017



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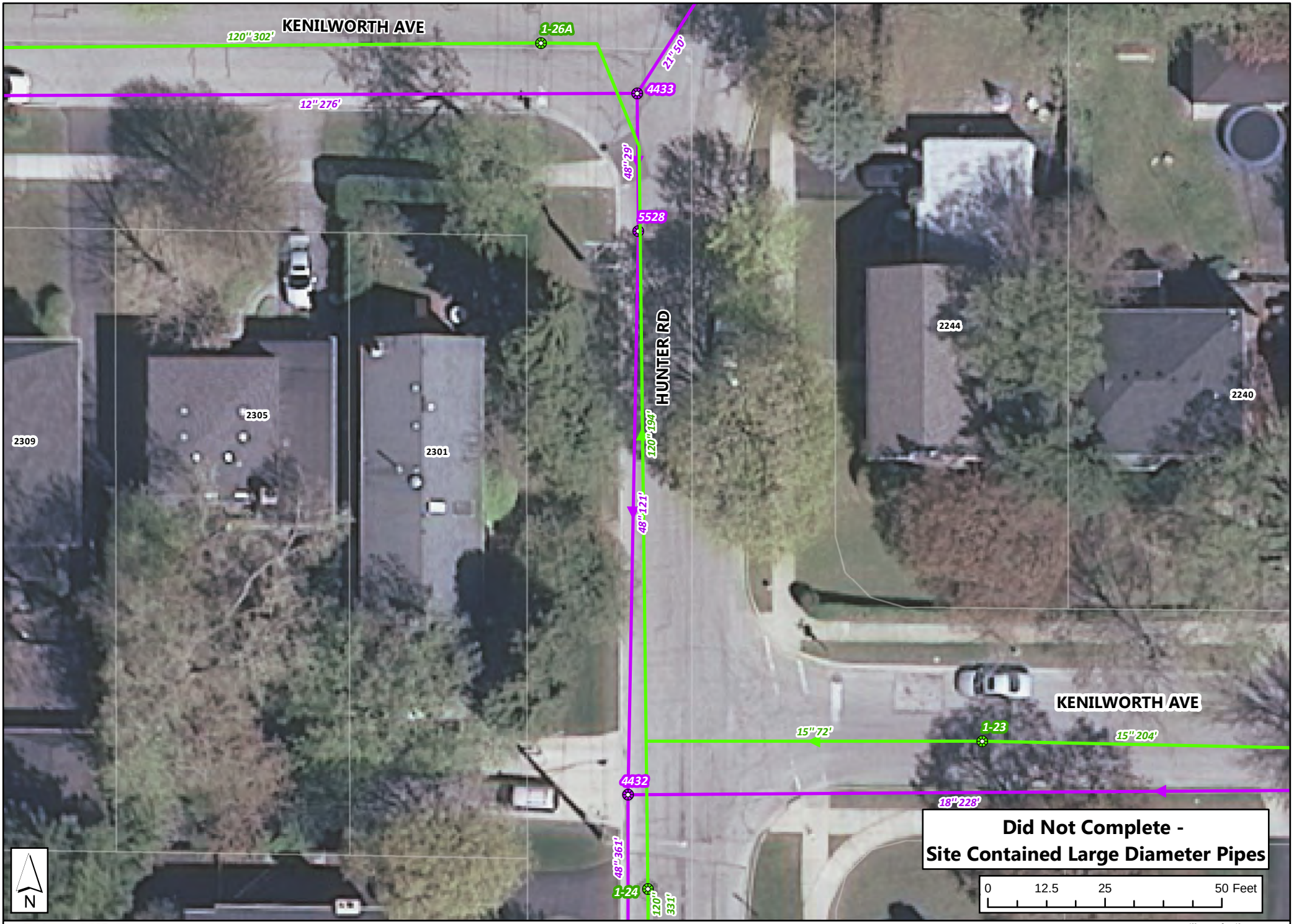
2016 Wilmette Dyed Water Flooding

Setup 1 (0 GPM)

Village of Wilmette, IL
Exhibit 3
Dyed Water Flooding:
Setup 1: 1-40 to 1-39
January 2017

\\Whe-panzura1\office-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 3 - Setup 1 (1-40 to 1-39) (8.5x11).mxd - Date Printed: 1/31/2017 3:21:11 PM



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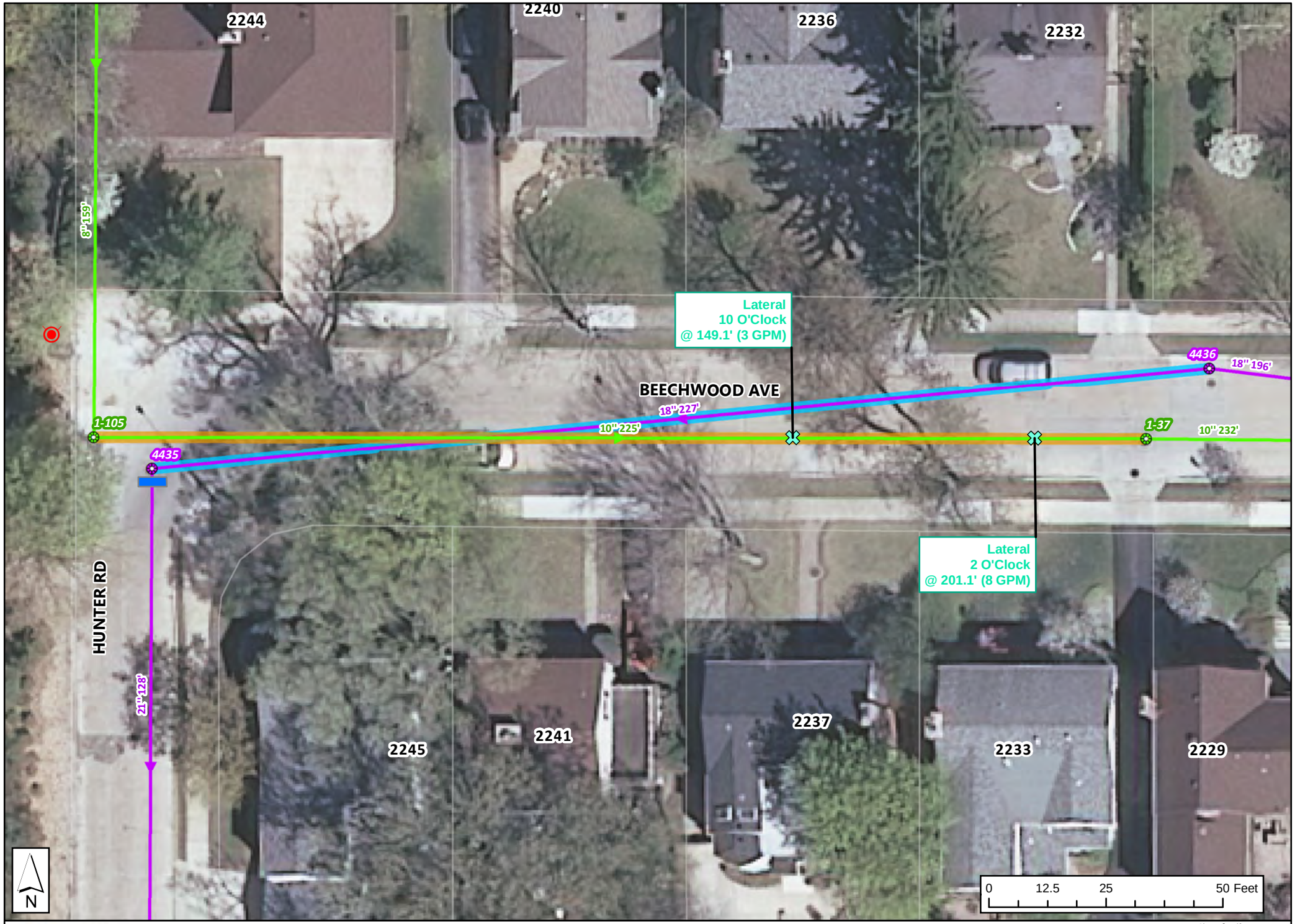
2016 Wilmette Dyed Water Flooding

Setup 2 (0 GPM)

Village of Wilmette, IL
Exhibit 4
Dyed Water Flooding:
Setup 2: 1-24 to 1-26A
January 2017

\\Whe-panzura1\office-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 4 - Setup 2 (1-24 to 1-26A) (8.5x11).mxd - Date Printed: 1/31/2017 3:32:14 PM



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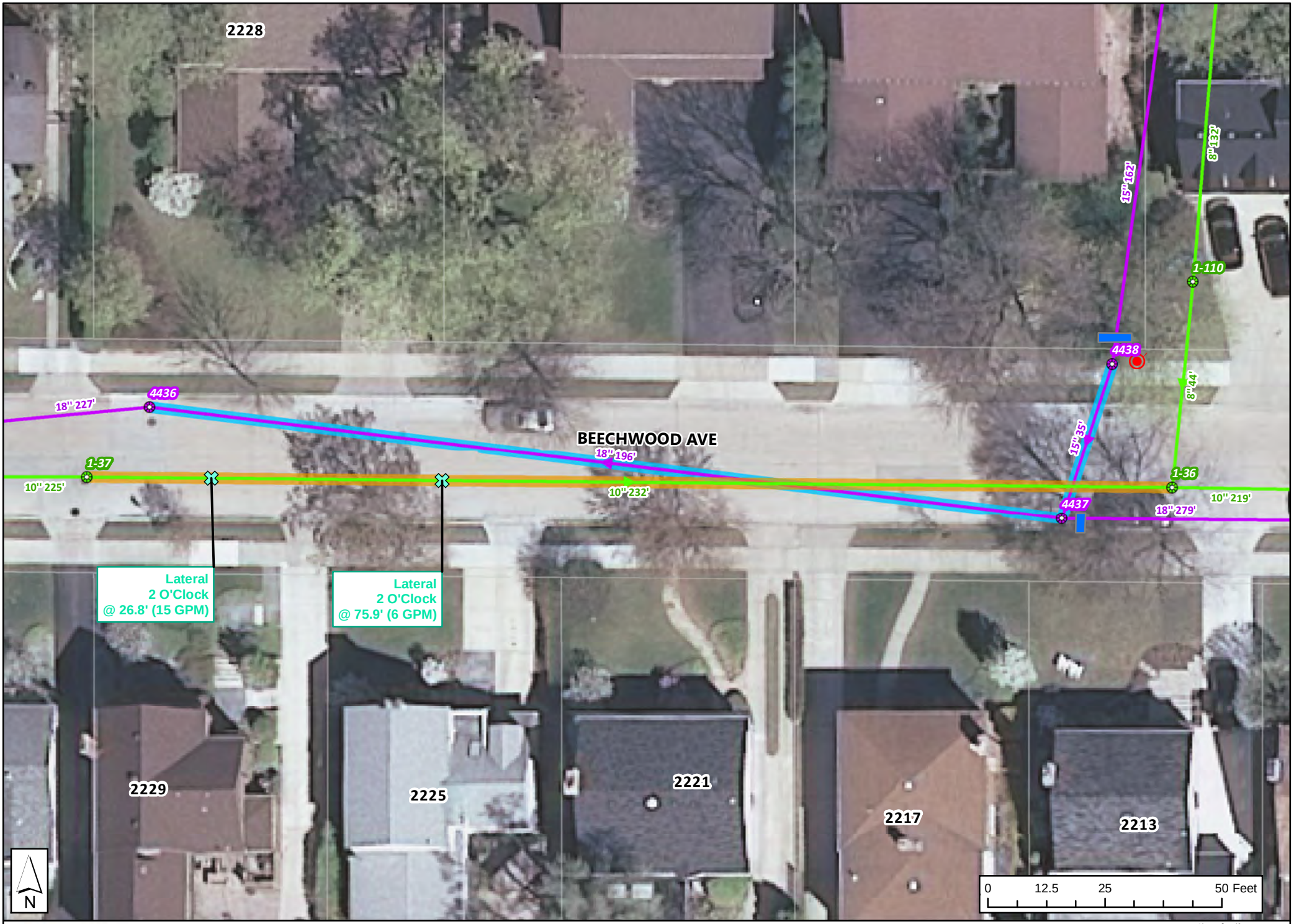
2016 Wilmette Dyed Water Flooding

Setup 3 (11 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 5
Dyed Water Flooding:
Setup 3: 1-105 to 1-37
February 2017

\\Whe-panzura1\office-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 5 - Setup 3 (1-105 to 1-37) (8.5x11).mxd - Date Printed: 2/2/2017 11:08:17 AM



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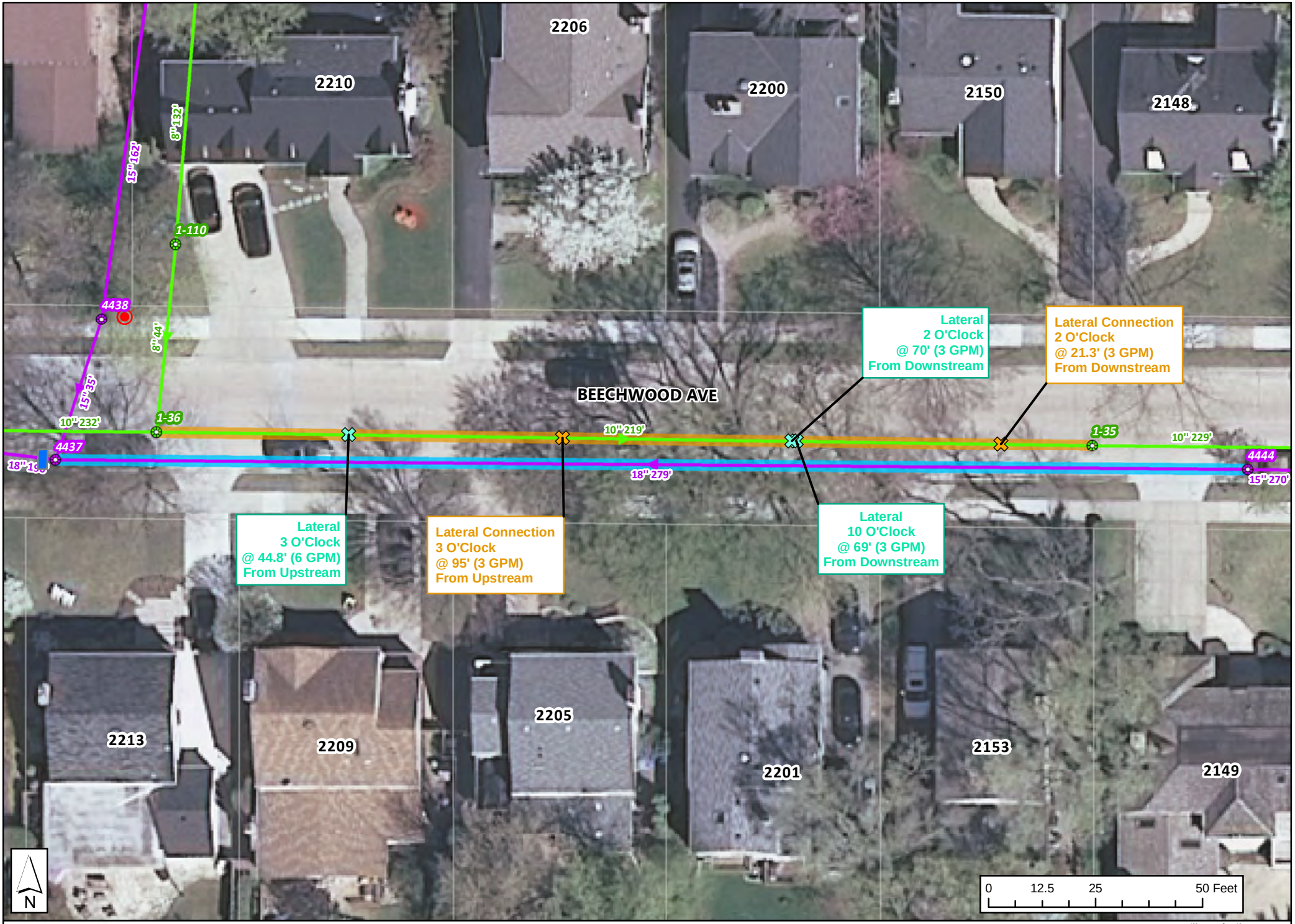
2016 Wilmette Dyed Water Flooding

Setup 4 (21 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 6
Dyed Water Flooding:
Setup 4: 1-37 to 1-36
February 2017

\\Whe-panzura1\office-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 6 - Setup 4 (1-37 to 1-36) (8.5x11).mxd - Date Printed: 2/2/2017 11:15:56 AM



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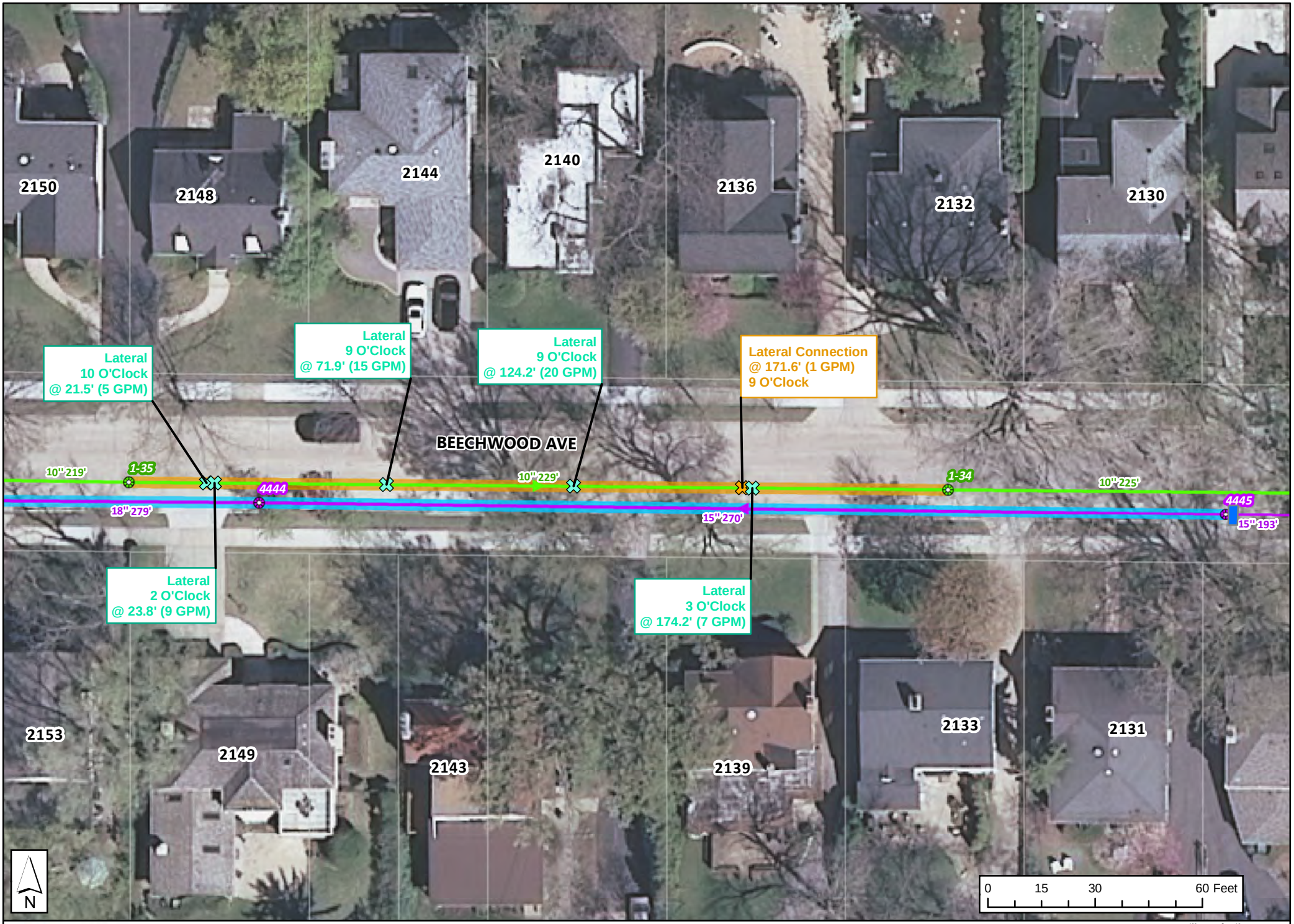
2016 Wilmette Dyed Water Flooding

Setup 5 (18 GPM)

Station From: **Upstream and Downstream**

Village of Wilmette, IL
Exhibit 7
Dyed Water Flooding:
Setup 5: 1-36 to 1-35
February 2017

\\whe-panzura1\OFFICE-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 7 - Setup 5 (1-36 to 1-35) (8.5x11).mxd - Date Printed: 2/2/2017 12:16:09 PM



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2016 Wilmette Dyed Water Flooding

Setup 6 (57 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 8
Dyed Water Flooding:
Setup 6: 1-35 to 1-34
February 2017

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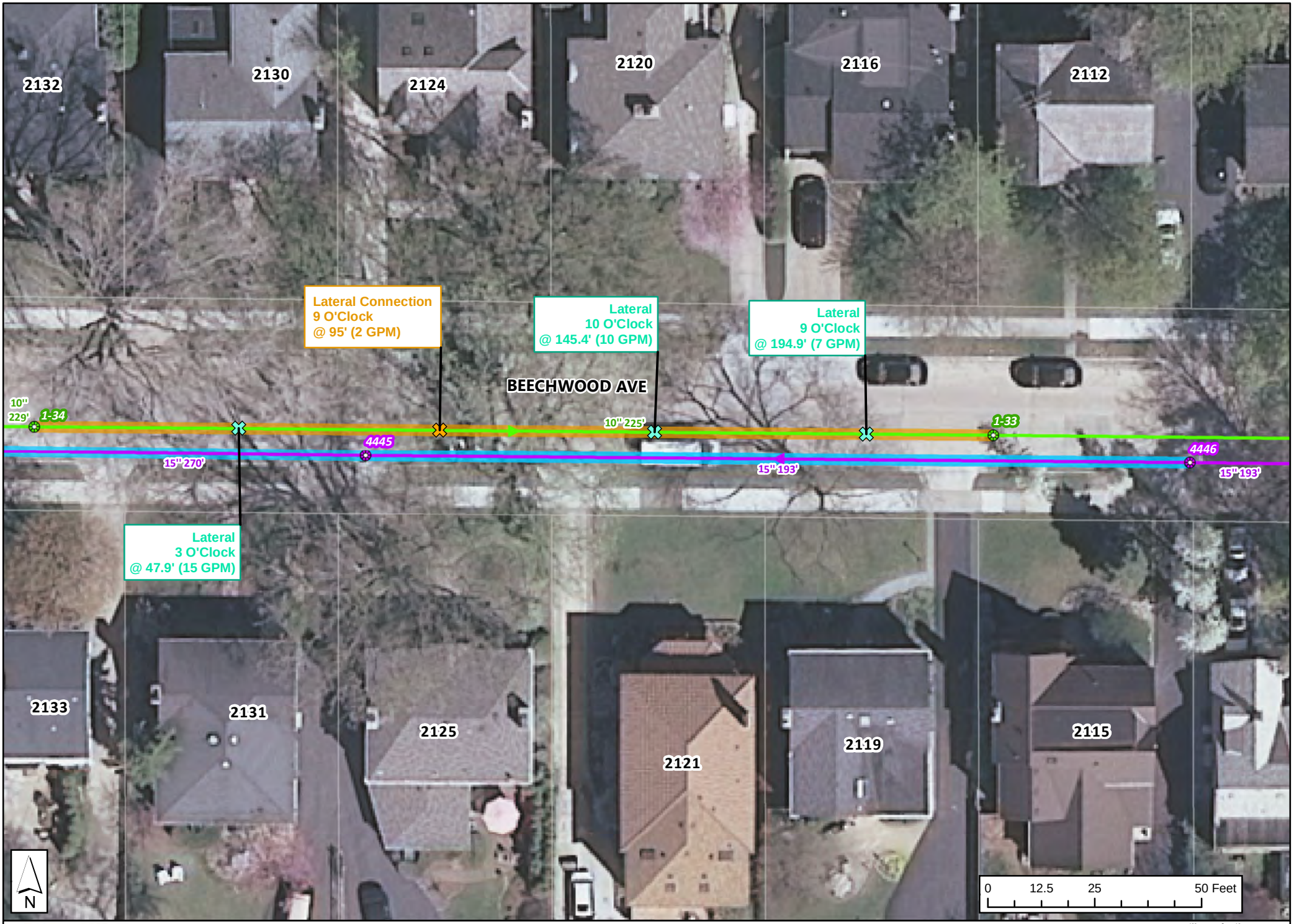

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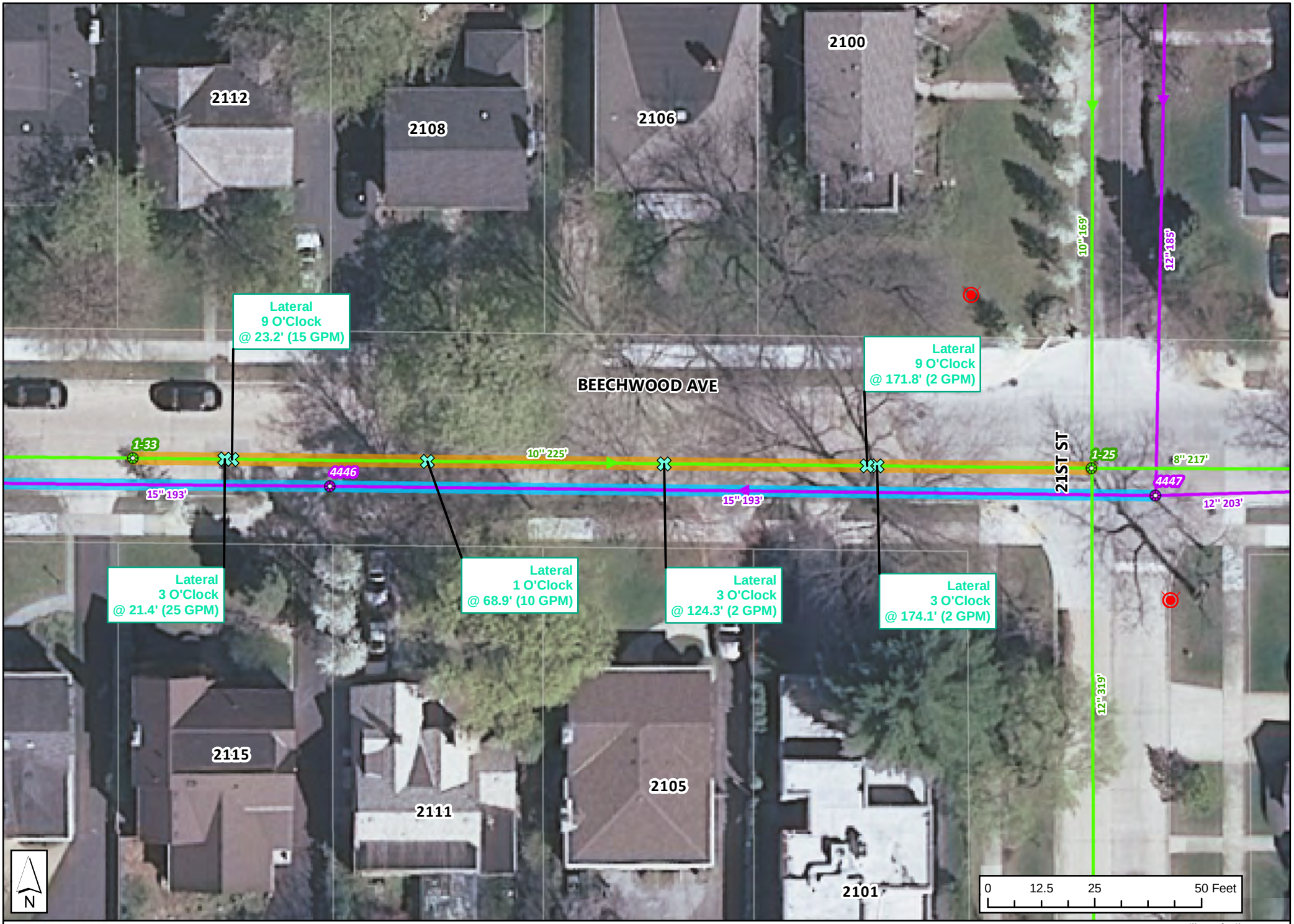
2016 Wilmette Dyed Water Flooding

Setup 7.1 (34 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 9
Dyed Water Flooding:
Setup 7.1: 1-34 to 1-33
February 2017

\\whe-panzura1\OFFICE-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 9 - Setup 7.1 (1-34 to 1-33) (8.5x11).mxd - Date Printed: 2/2/2017 12:38:51 PM



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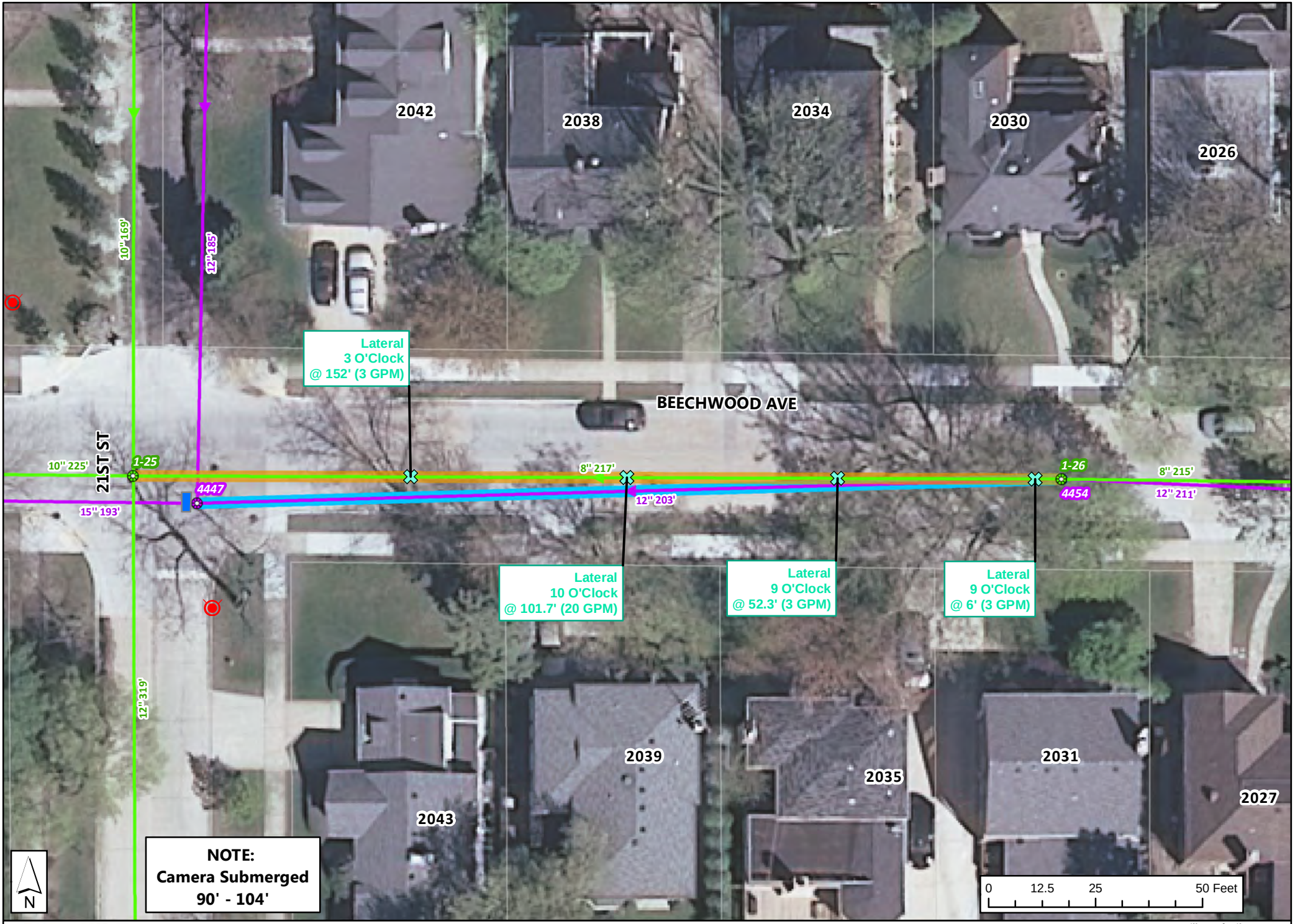
2016 Wilmette Dyed Water Flooding

Setup 7 (56 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 10
Dyed Water Flooding:
Setup 7: 1-33 to 1-25
February 2017

\\whe-panzura1\OFFICE-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 10 - Setup 7 (1-33 to 1-25) (8.5x11).mxd - Date Printed: 2/2/2017 12:52:23 PM



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The Choice for Collection System Solutions

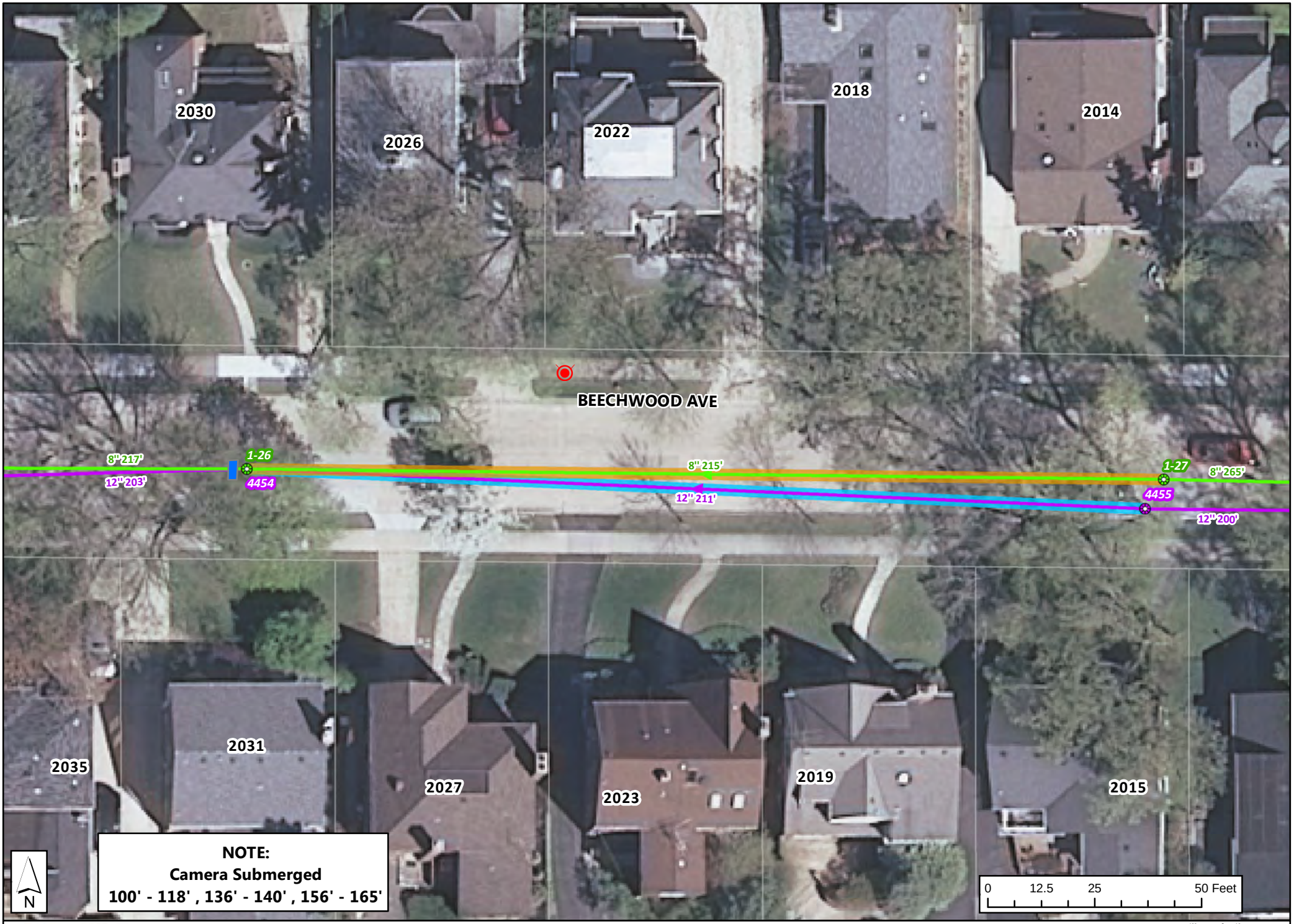
2016 Wilmette Dyed Water Flooding

Setup 8 (29 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 11
Dyed Water Flooding:
Setup 8: 1-26 to 1-25
February 2017

\\whe-panzura1\OFFICE-11\WHEATON\PROJECTS\Wilmette_IL\11303500 Princeton Basin SSES\5.0 GIS\Map Documents\Map Documents - Exhibits\Report Exhibits\Exhibit 11 - Setup 8 (1-26 to 1-25) (8.5x11).mxd - Date Printed: 2/2/2017 1:03:41 PM



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2016 Wilmette Dyed Water Flooding

Setup 9 (0 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 12
Dyed Water Flooding:
Setup 9: 1-27 to 1-26
February 2017

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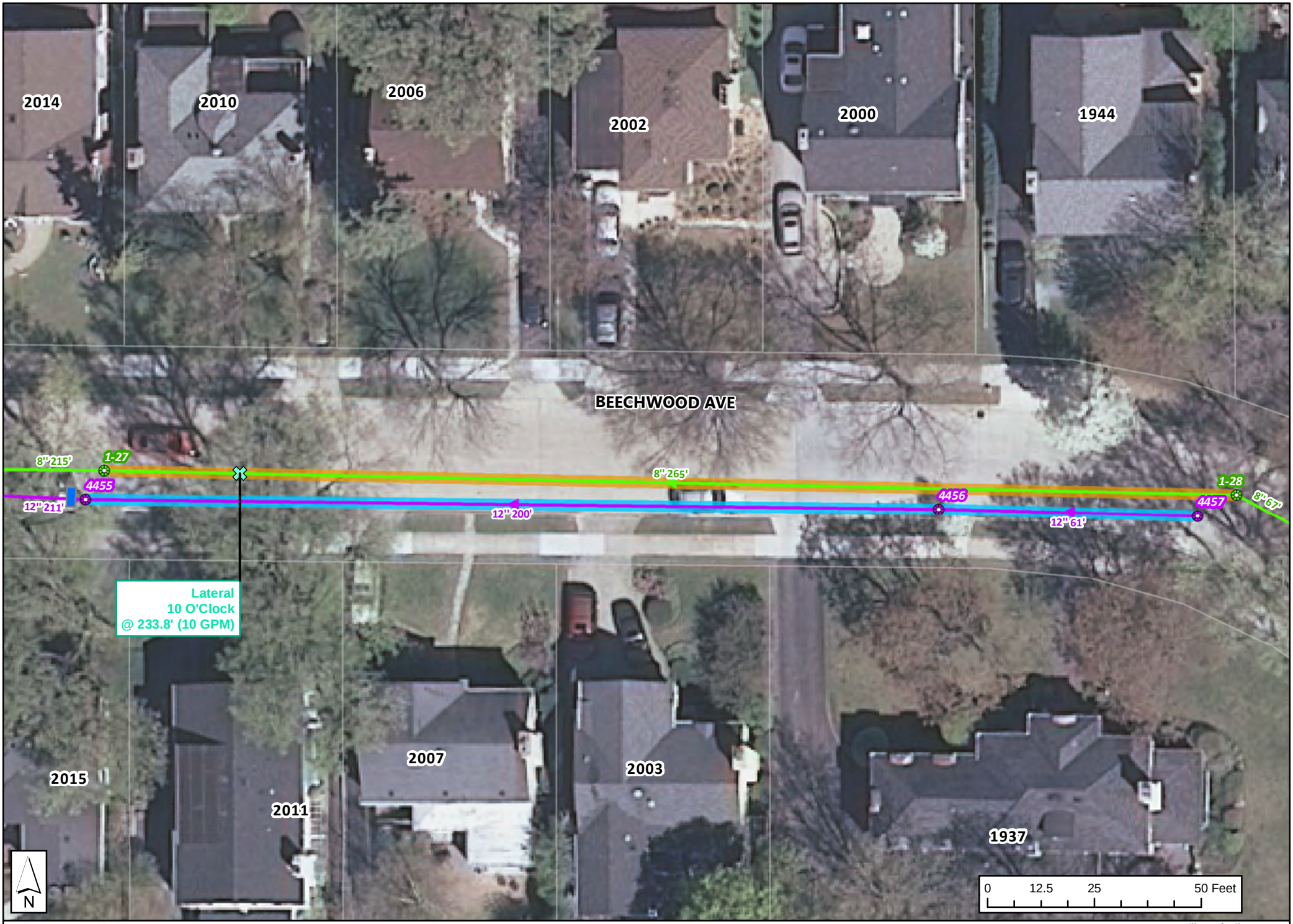

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2016 Wilmette Dyed Water Flooding

Setup 10 (10 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 13
Dyed Water Flooding:
Setup 10: 1-28 to 1-27
February 2017

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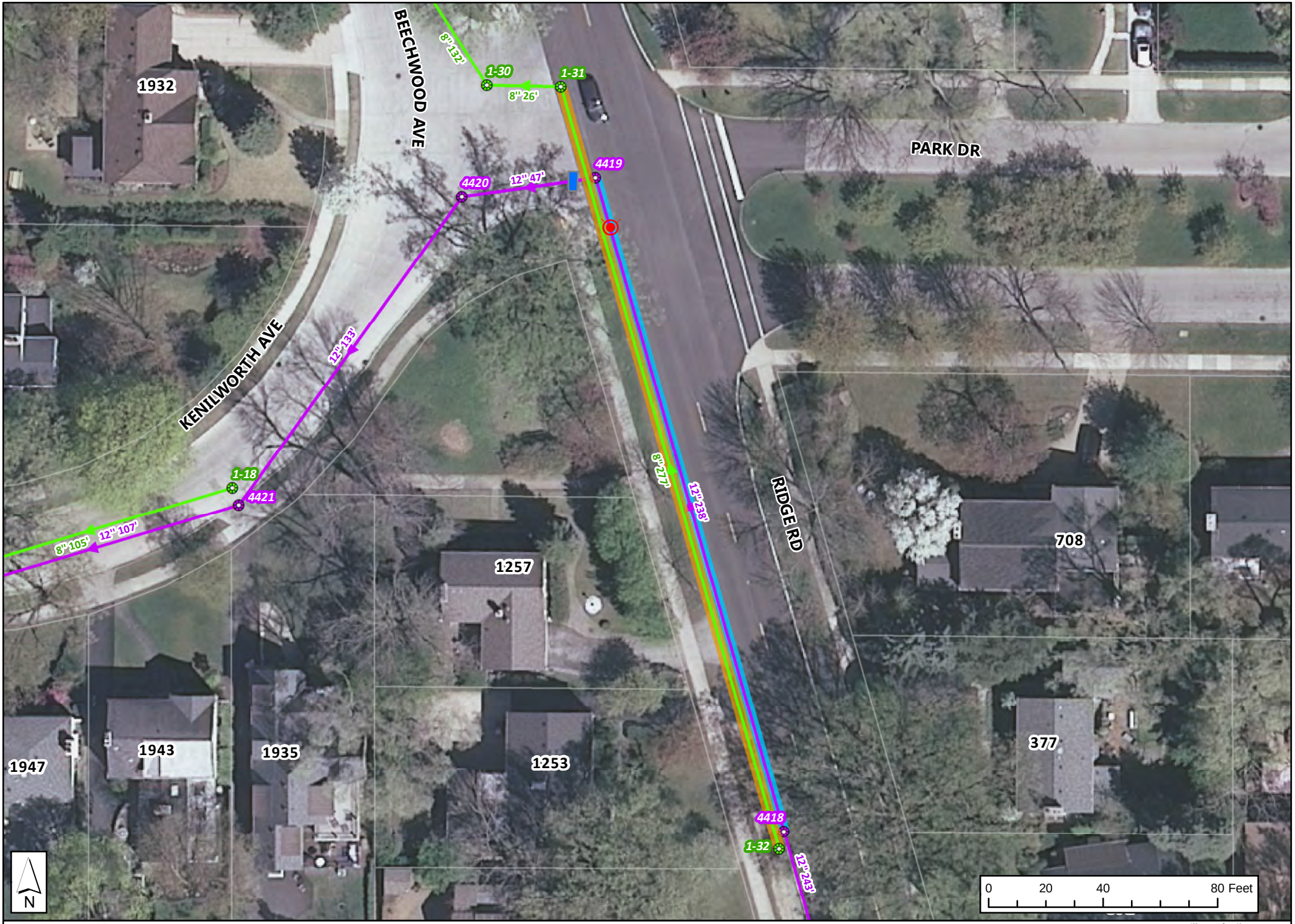

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2016 Wilmette Dyed Water Flooding

Setup 11 (0 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 14
Dyed Water Flooding:
Setup 11: 1-32 to 1-31
February 2017

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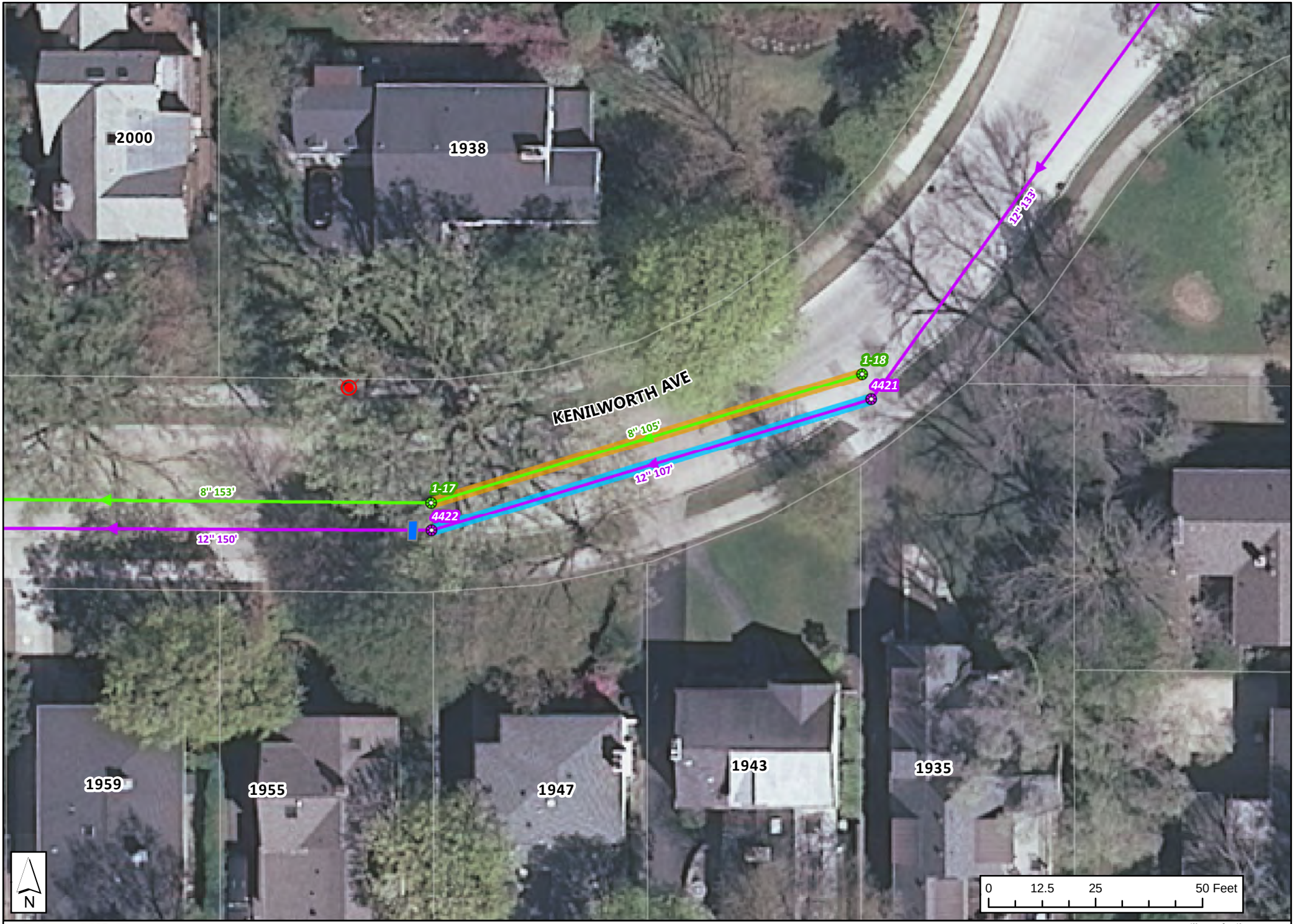

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2016 Wilmette Dyed Water Flooding

Setup 12 (0 GPM)

Station From: **Downstream**

Village of Wilmette, IL
Exhibit 15
Dyed Water Flooding:
Setup 12: 1-18 to 1-17
February 2017

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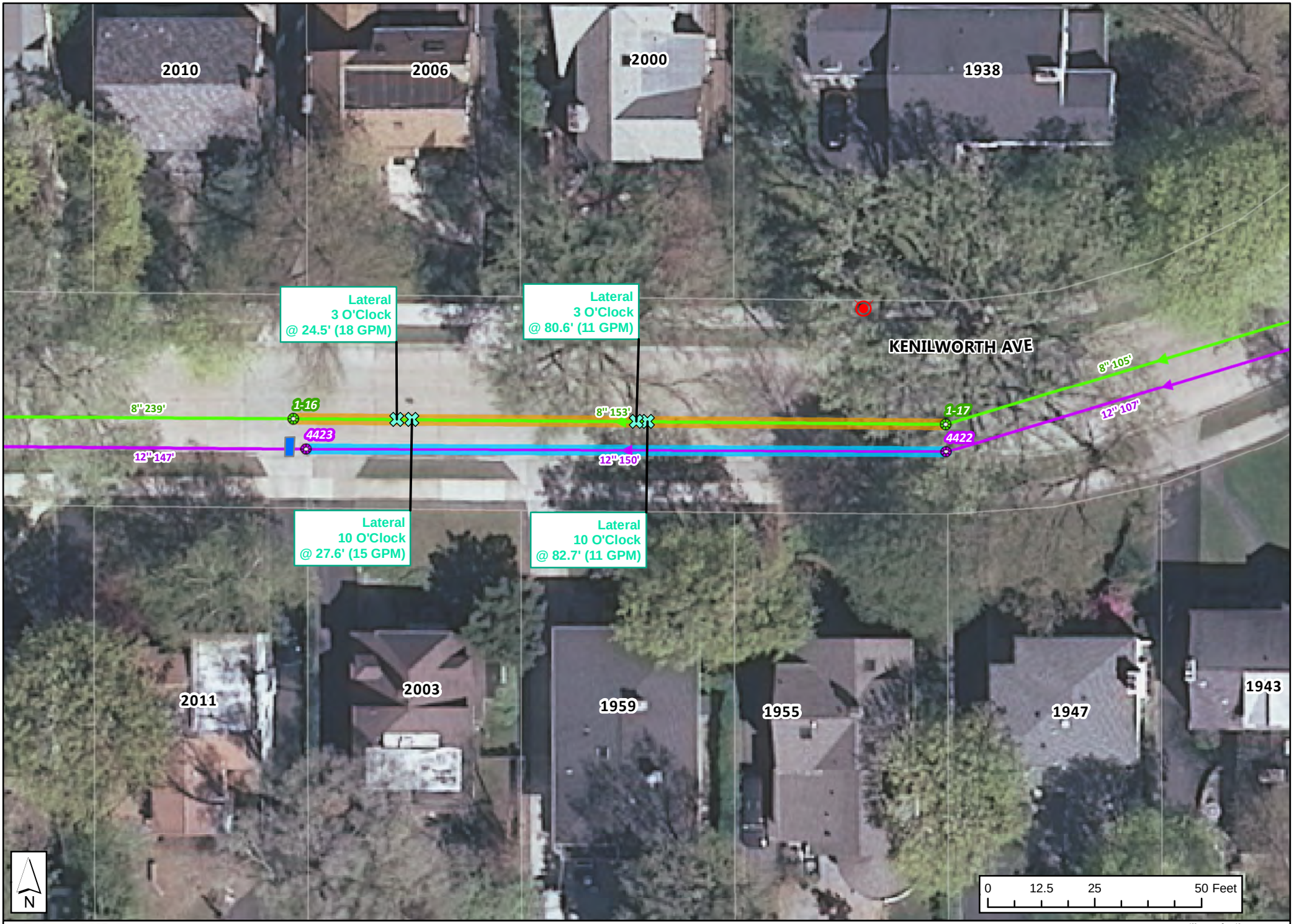

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2016 Wilmette Dyed Water Flooding

Setup 13 (55 GPM)

Station From: **Downstream**

Village of Wilmette, IL
Exhibit 16
Dyed Water Flooding:
Setup 13: 1-17 to 1-16
February 2017

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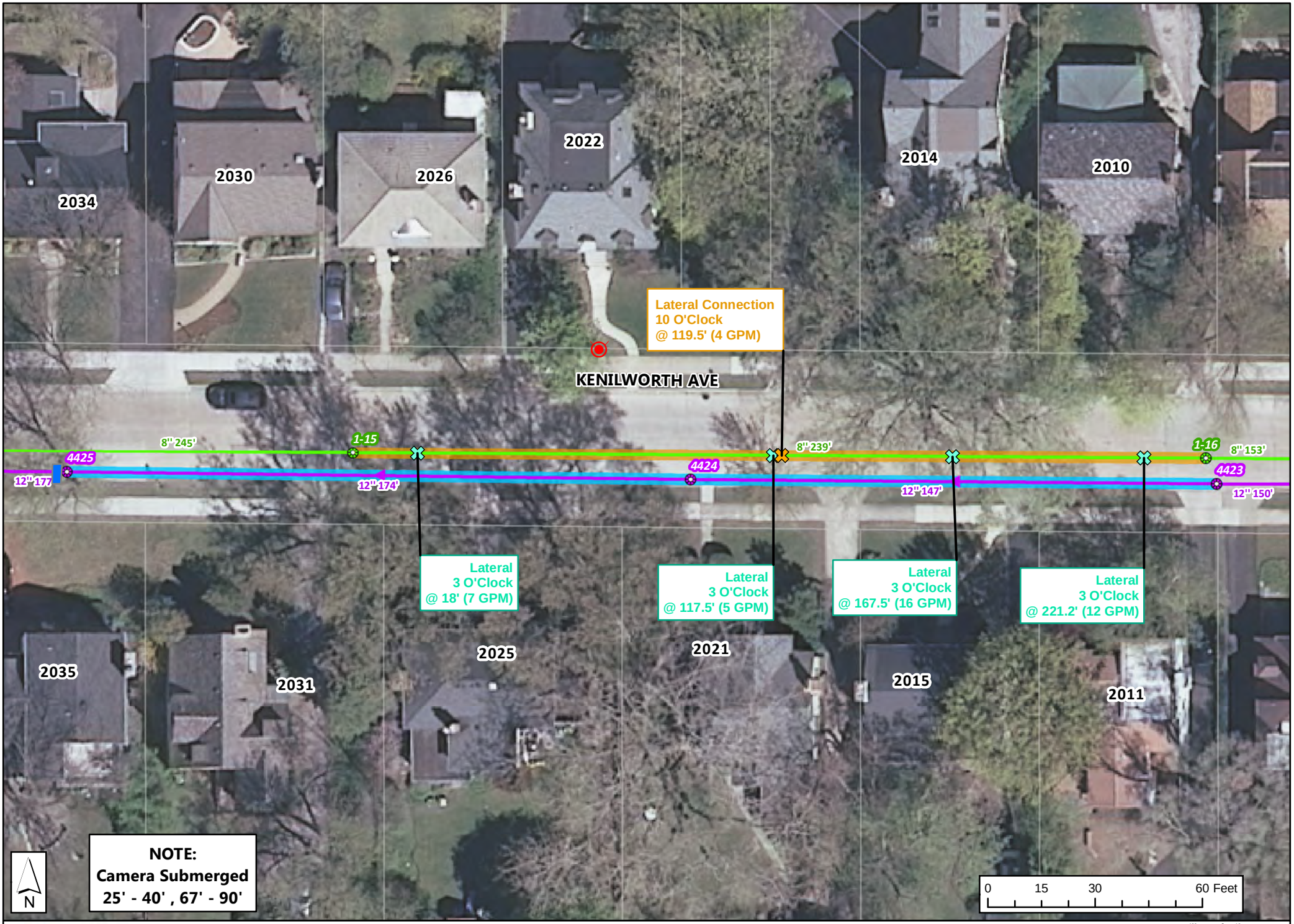

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2016 Wilmette Dyed Water Flooding

Setup 14 (44 GPM)

Station From: **Downstream**

Village of Wilmette, IL
Exhibit 17
Dyed Water Flooding:
Setup 14: 1-16 to 1-15
February 2017

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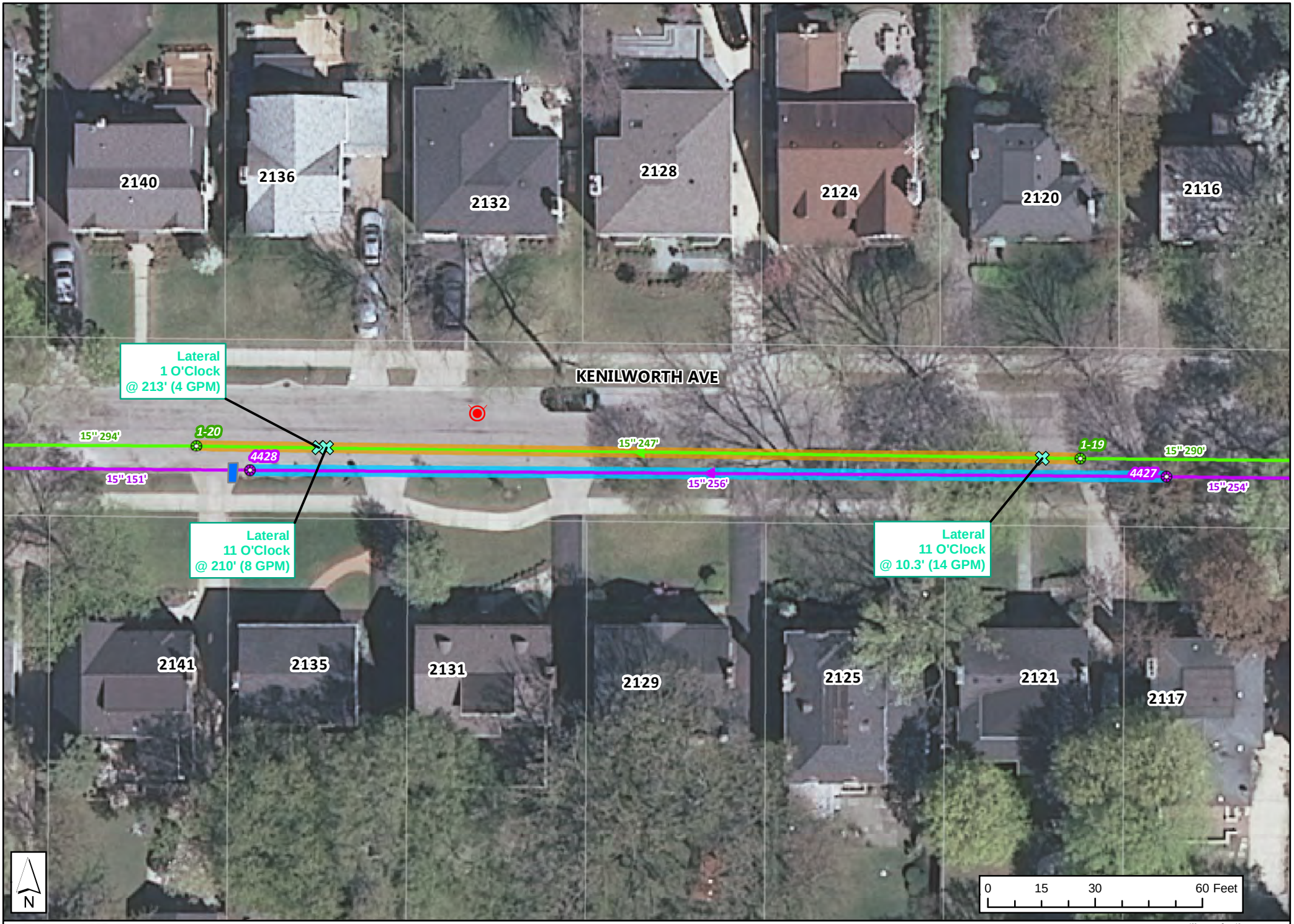

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2016 Wilmette Dyed Water Flooding

Setup 15 (26 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 18
Dyed Water Flooding:
Setup 15: 1-19 to 1-20
February 2017

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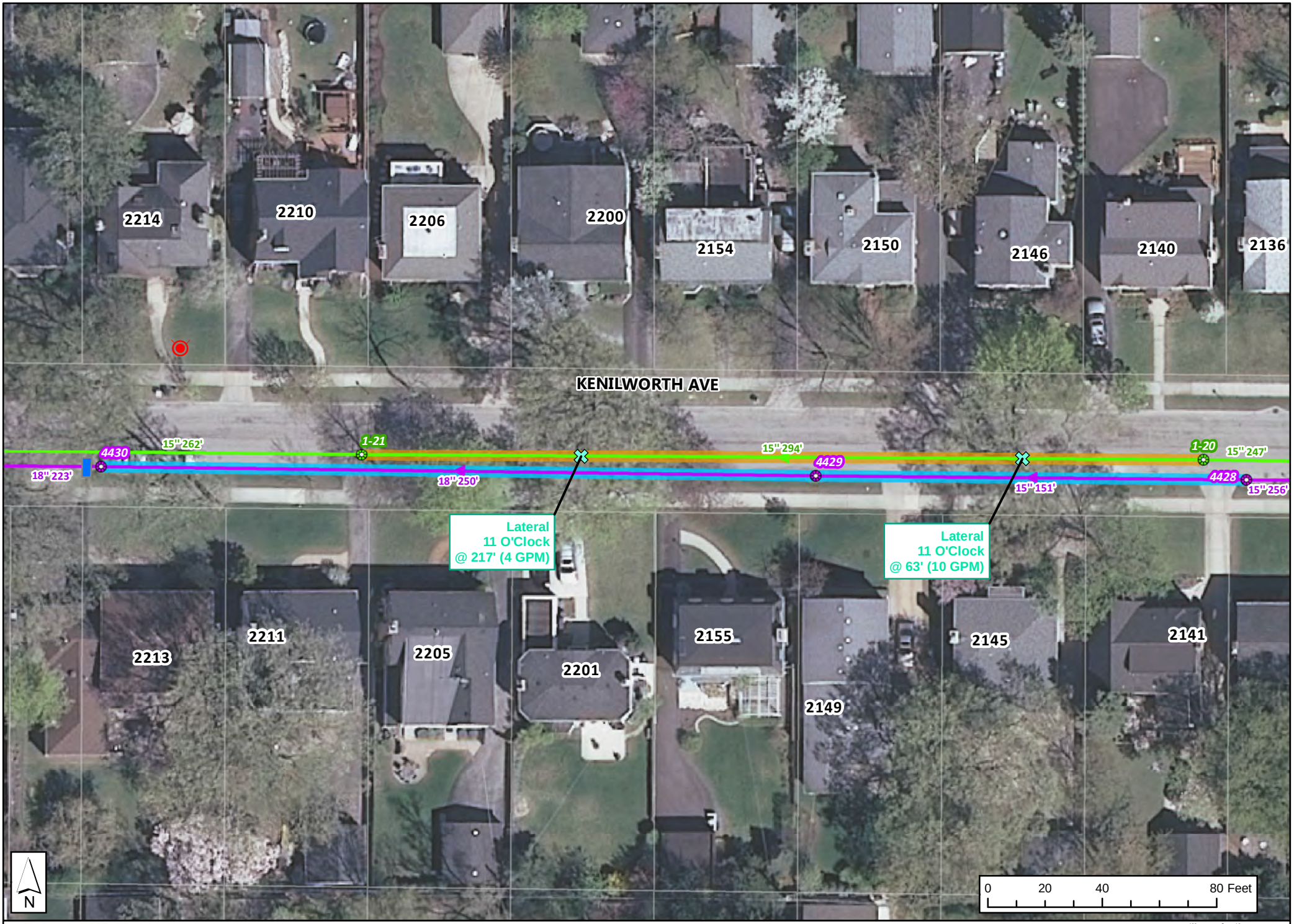

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2016 Wilmette Dyed Water Flooding

Setup 16 (14 GPM)

Station From: **Upstream**

Village of Wilmette, IL
Exhibit 19
Dyed Water Flooding:
Setup 16: 1-20 to 1-21
February 2017

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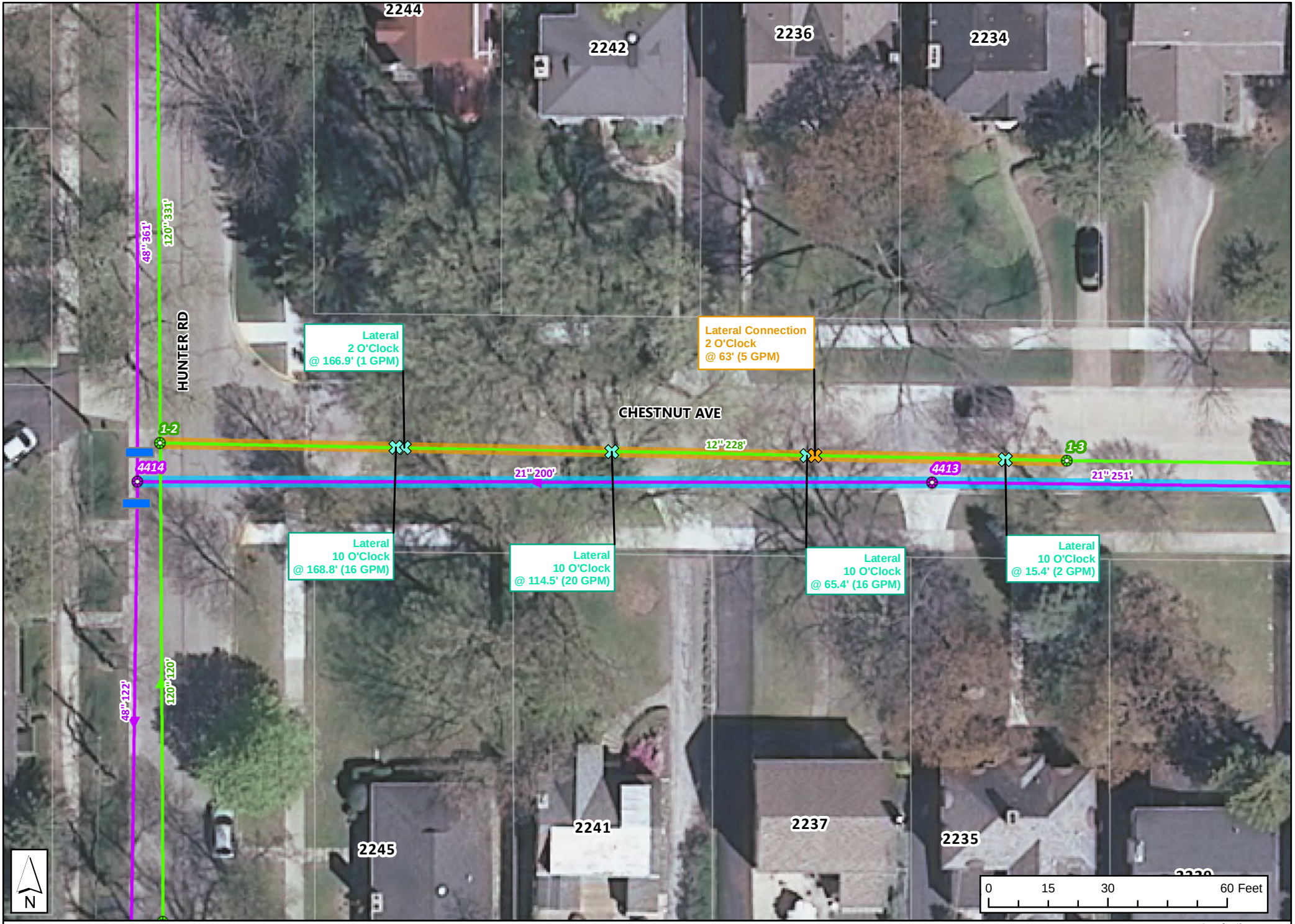

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2016 Wilmette Dyed Water Flooding

Setup 17 (60 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 20
Dyed Water Flooding:
Setup 17: 1-3 to 1-2
February 2017

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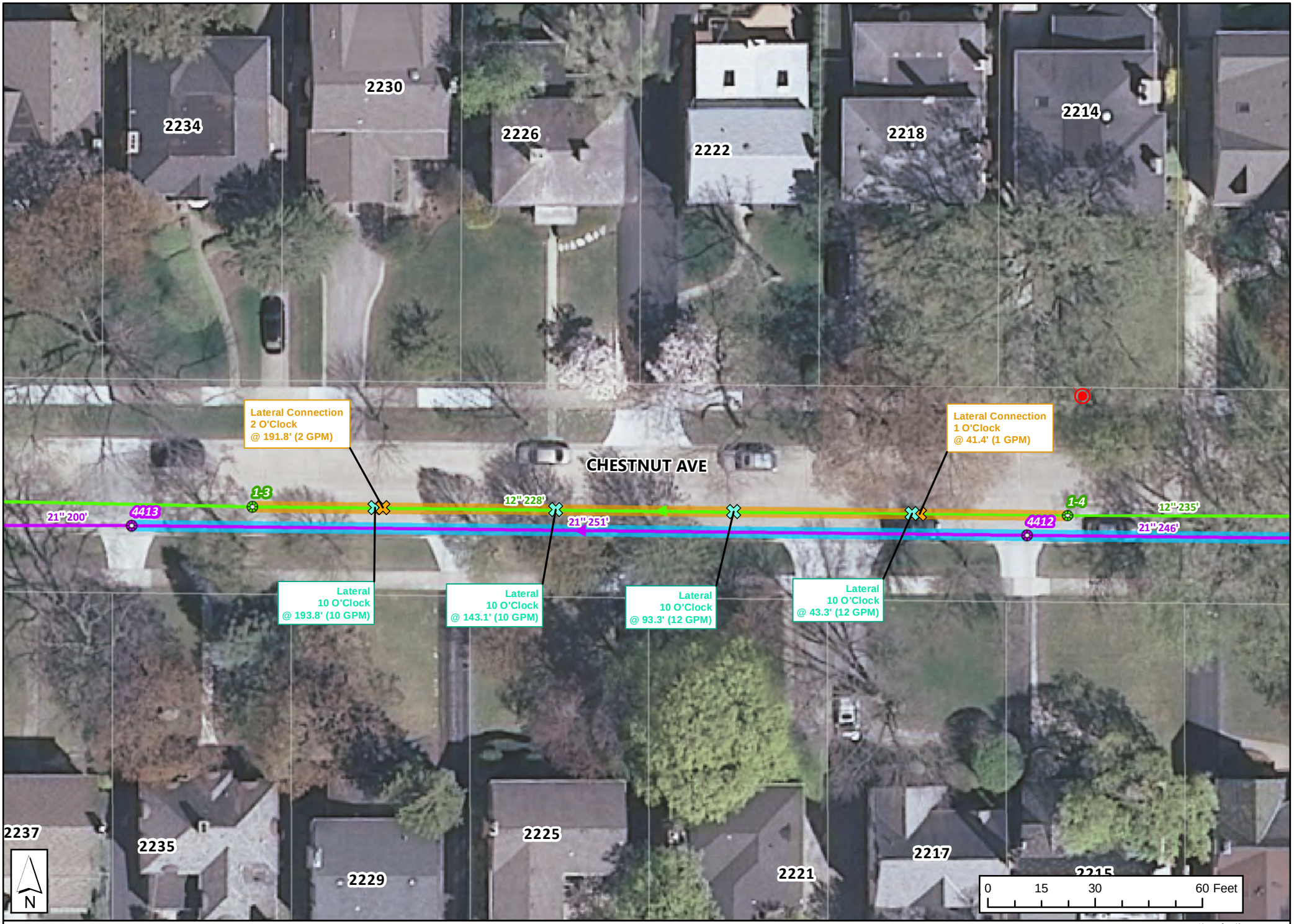

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2016 Wilmette Dyed Water Flooding

Setup 18 (47 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 21
Dyed Water Flooding:
Setup 18: 1-4 to 1-3
February 2017

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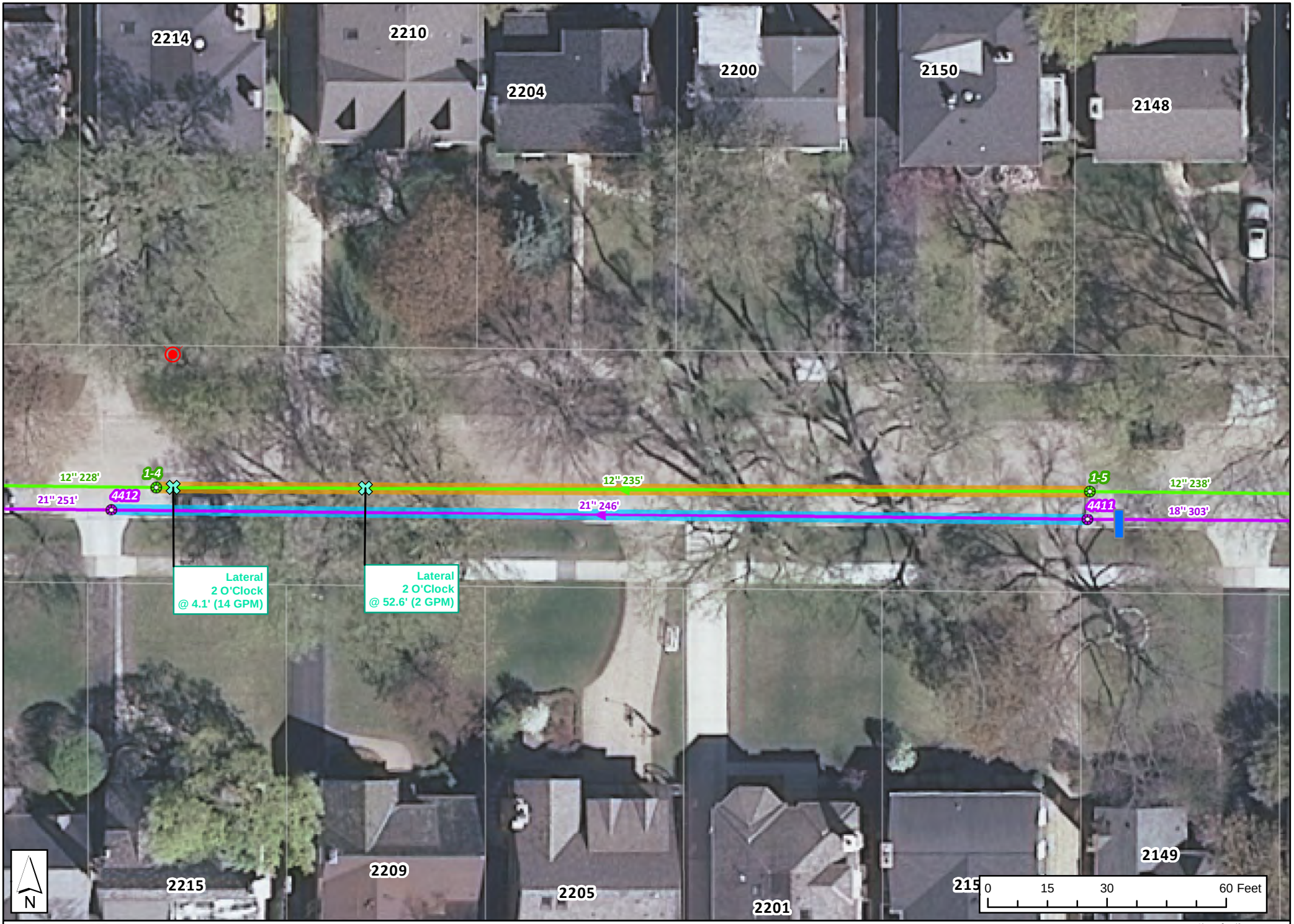

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2016 Wilmette Dyed Water Flooding

Setup 19 (16 GPM)

Station From: **Downstream**

City of Wilmette, IL
Exhibit 22
Dyed Water Flooding:
Setup 19: 1-5 to 1-4
February 2017

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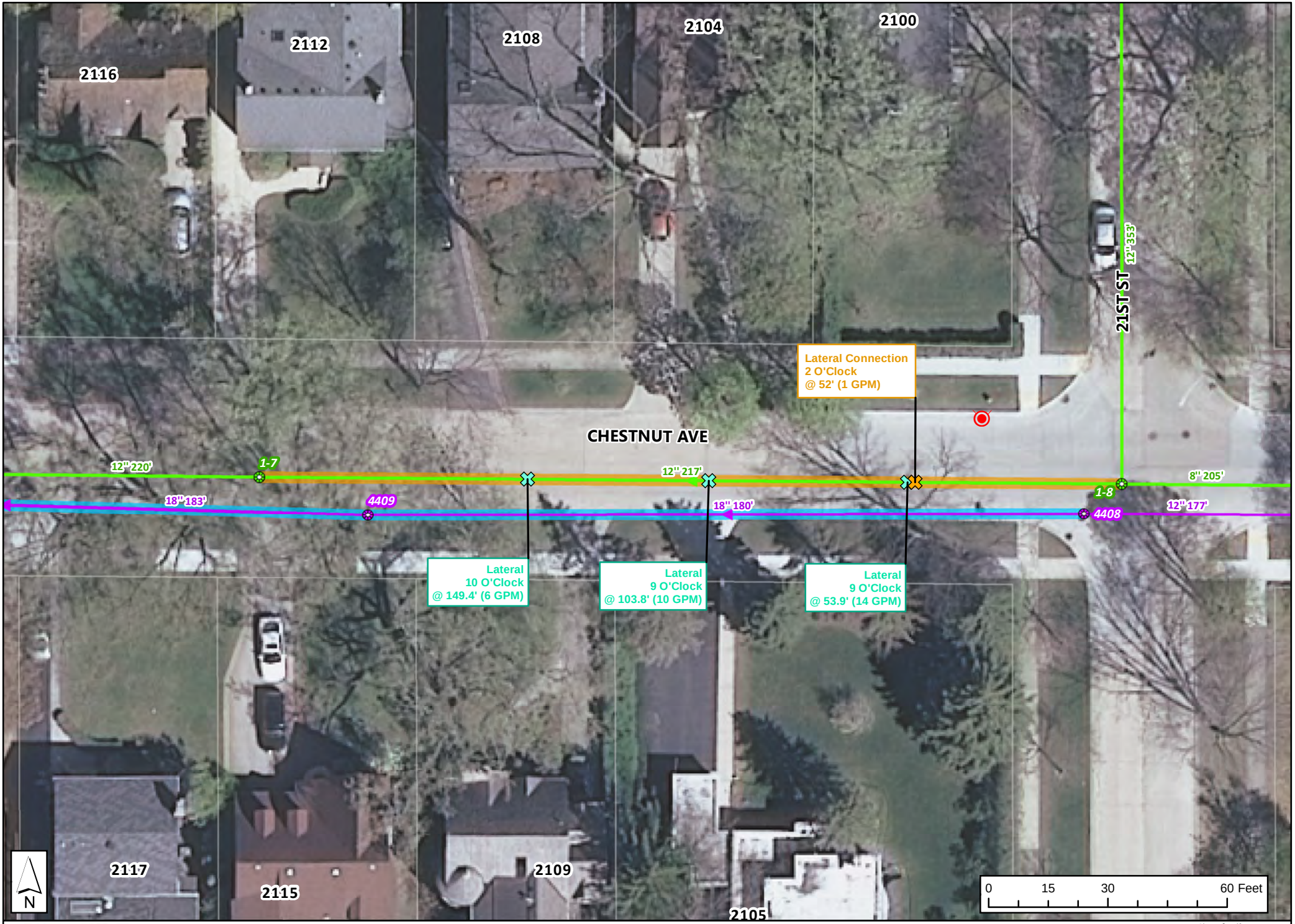

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2016 Wilmette Dyed Water Flooding

Setup 20 (31 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 23
Dyed Water Flooding:
Setup 20: 1-8 to 1-7
February 2017

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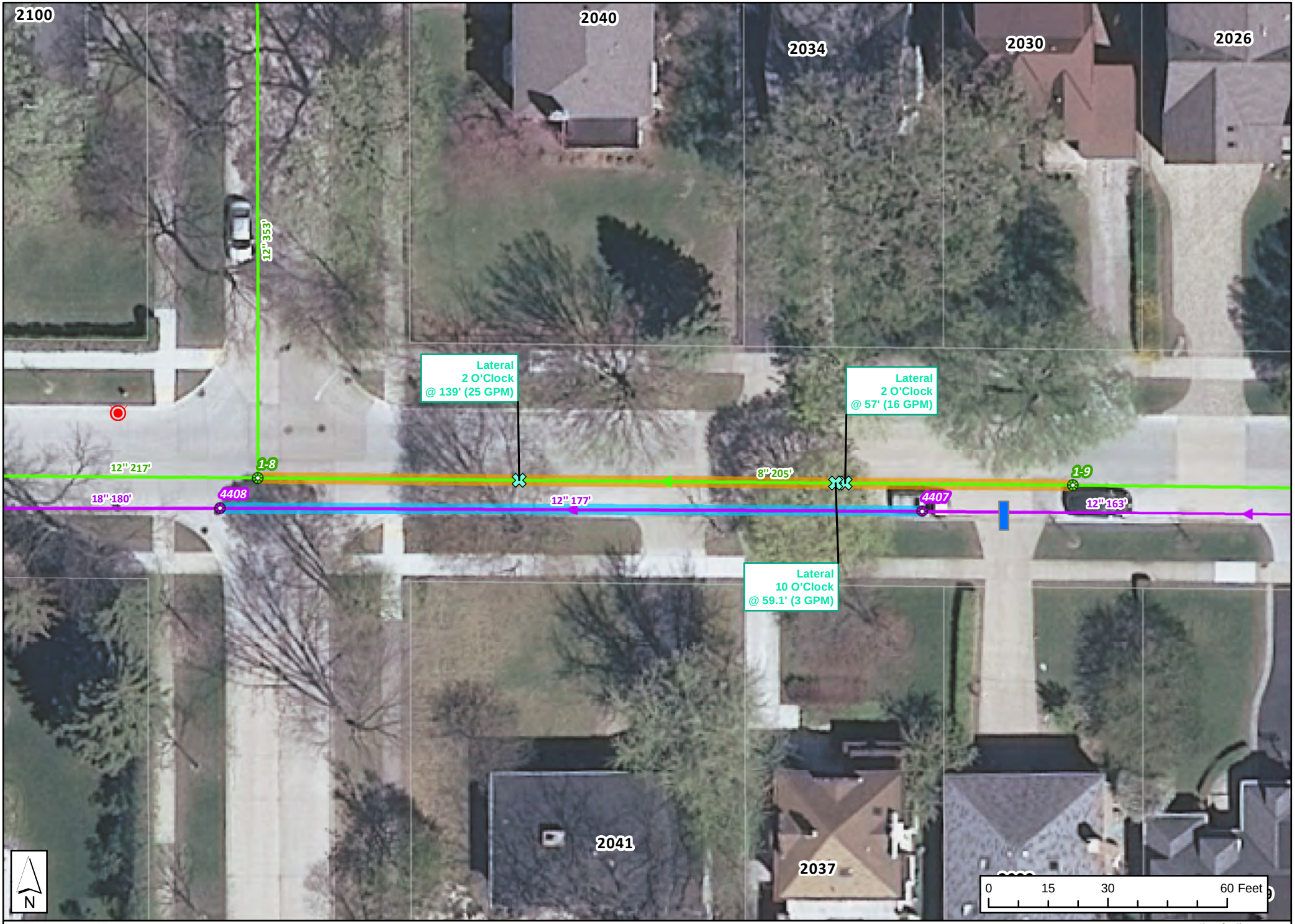

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2016 Wilmette Dyed Water Flooding

Setup 21 (44 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 24
Dyed Water Flooding:
Setup 21: 1-9 to 1-8
February 2017

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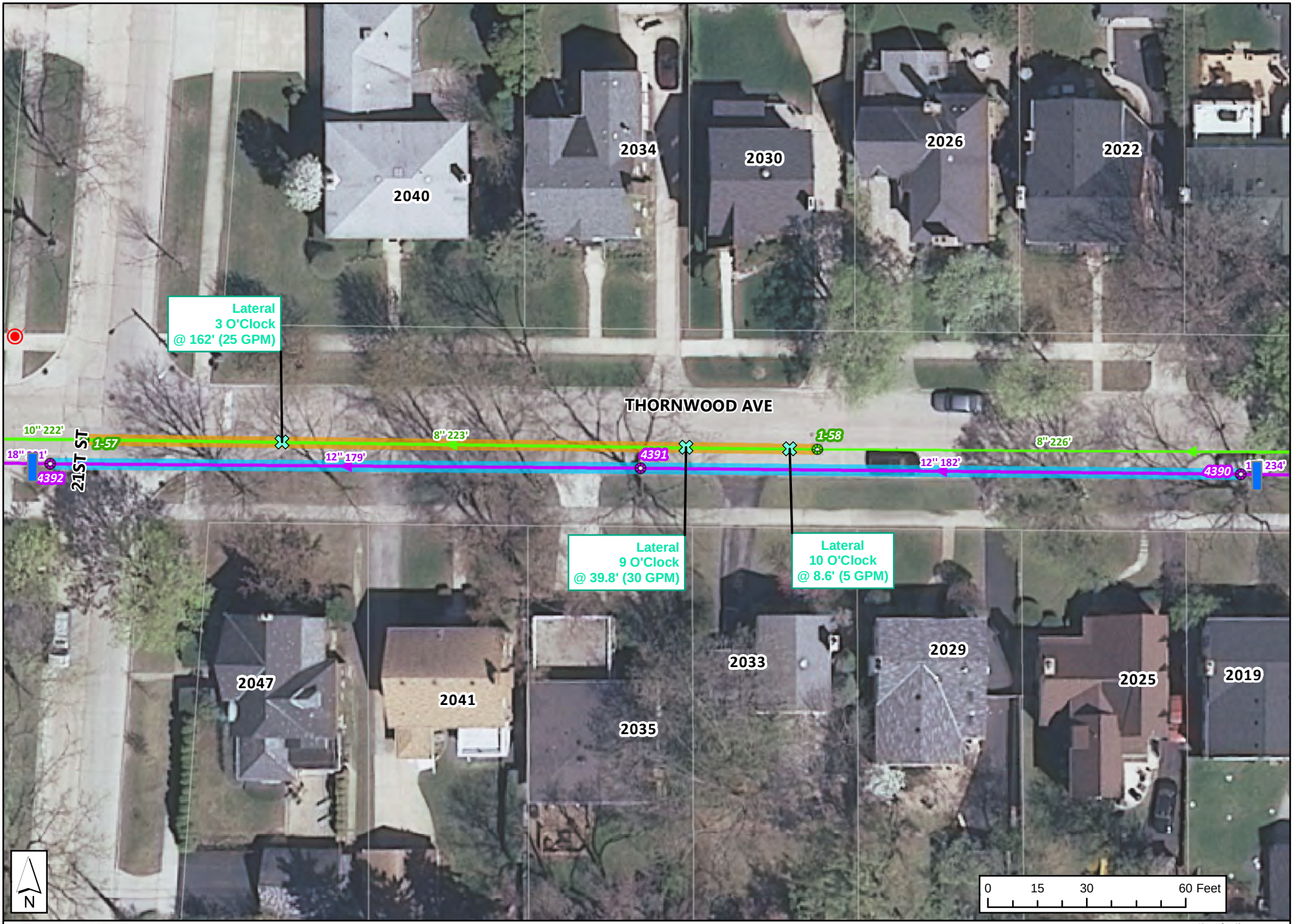

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2016 Wilmette Dyed Water Flooding

Setup 22 (60 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 25
Dyed Water Flooding:
Setup 22: 1-58 to 1-57
February 2017

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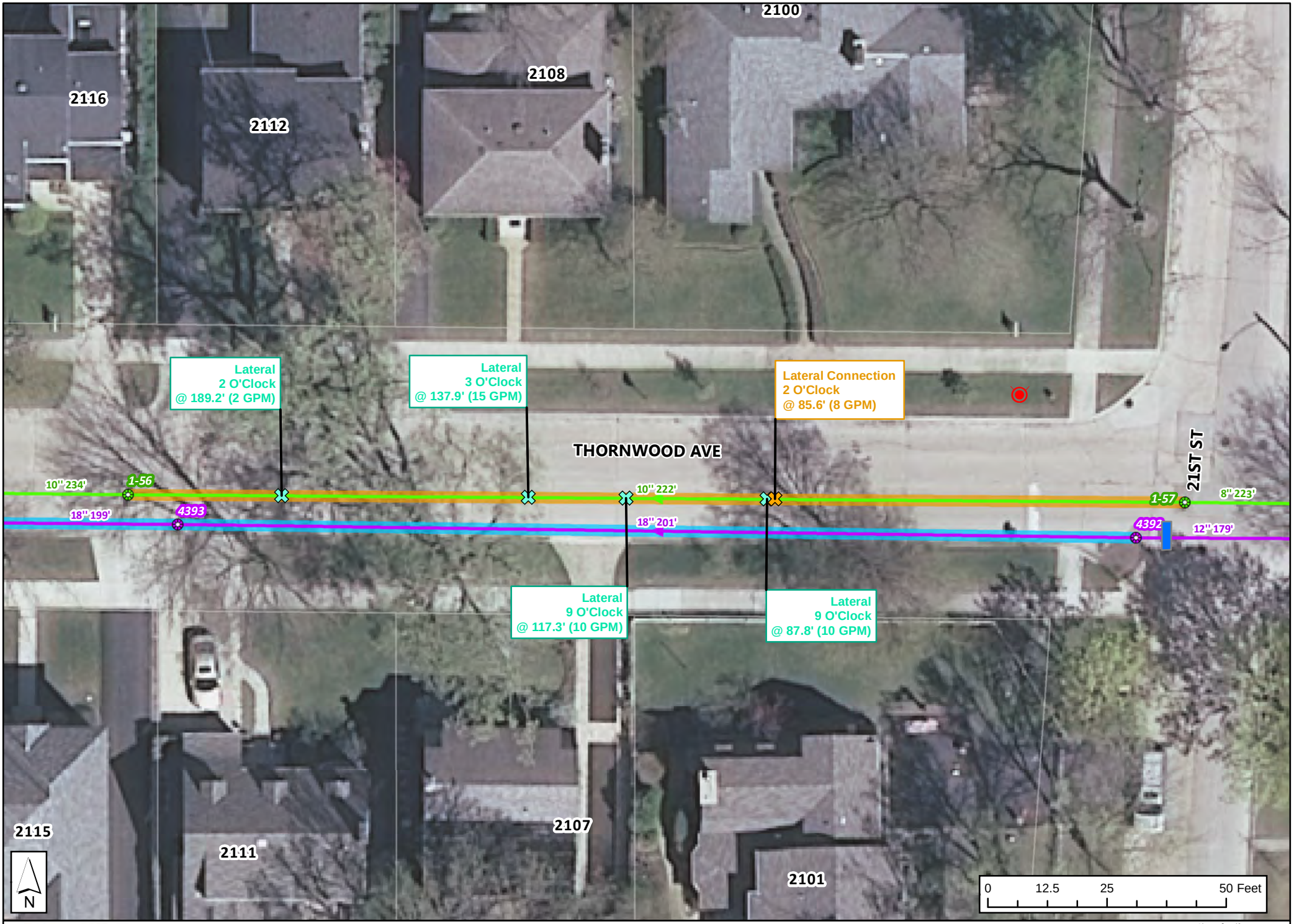

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2016 Wilmette Dyed Water Flooding

Setup 23 (45 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 26
Dyed Water Flooding:
Setup 23: 1-57 to 1-56
February 2017

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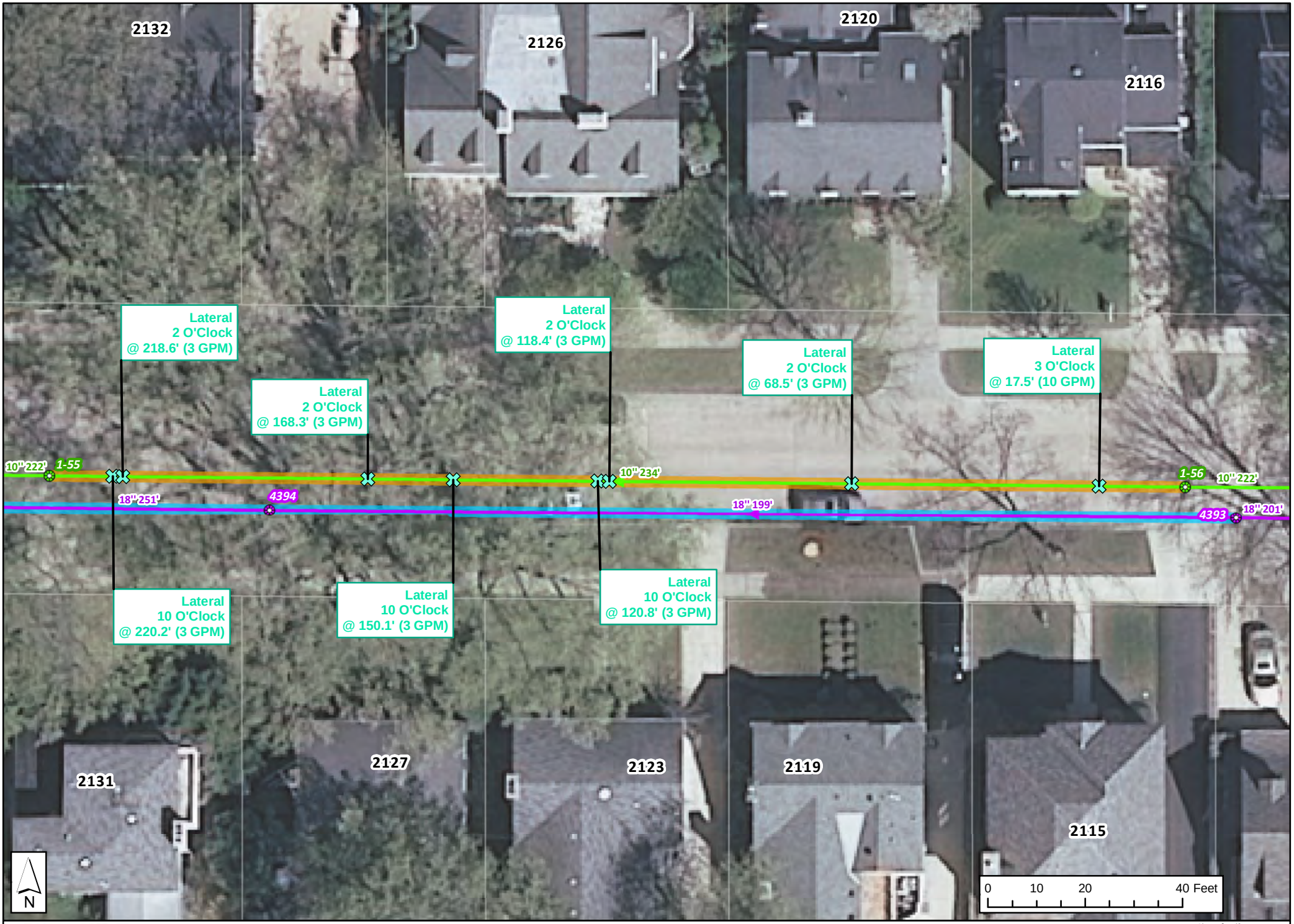

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2016 Wilmette Dyed Water Flooding

Setup 24 (31 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 27
Dyed Water Flooding:
Setup 24: 1-56 to 1-55
February 2017

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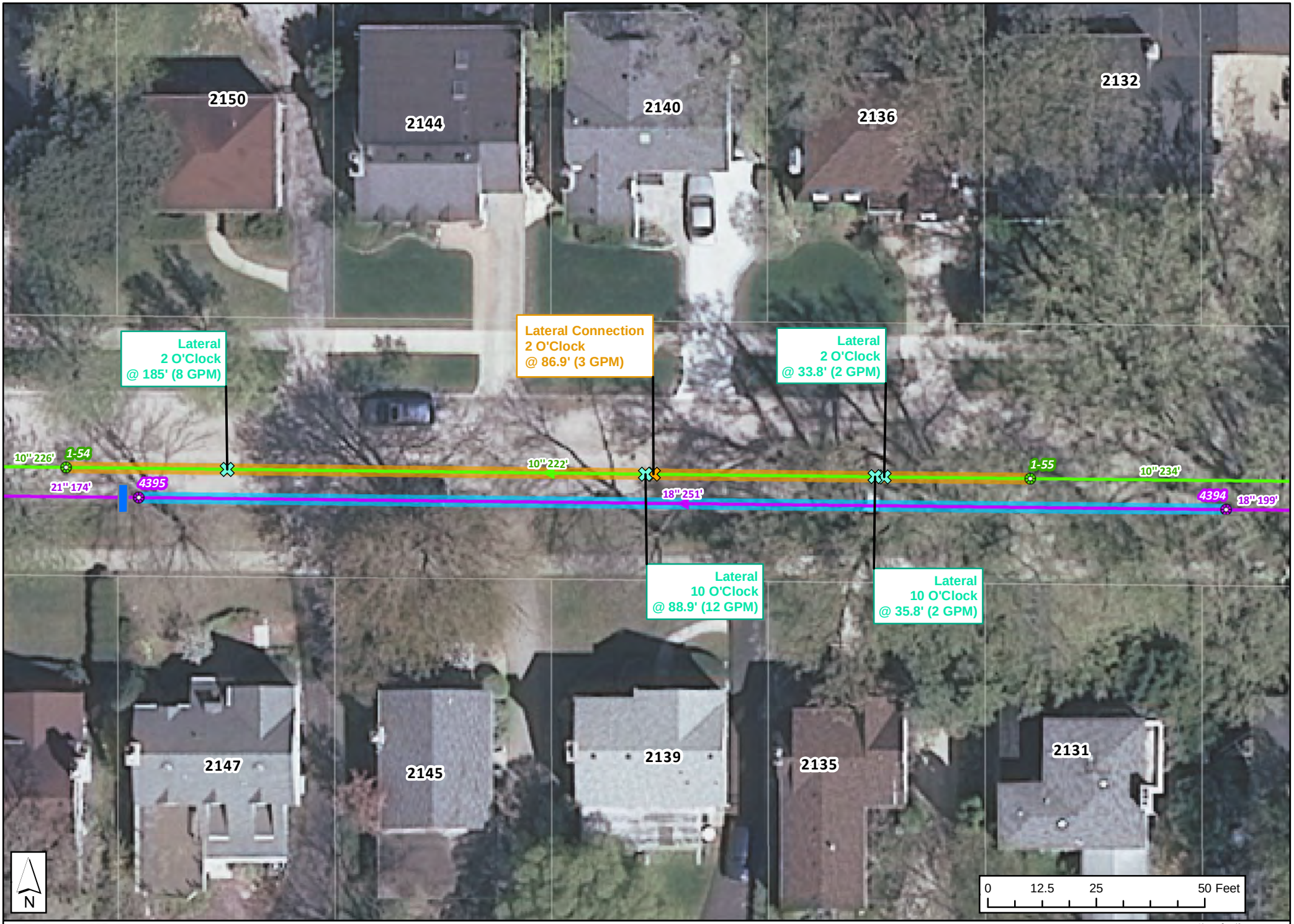

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2016 Wilmette Dyed Water Flooding

Setup 25 (27 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 28
Dyed Water Flooding:
Setup 25: 1-55 to 1-54
February 2017

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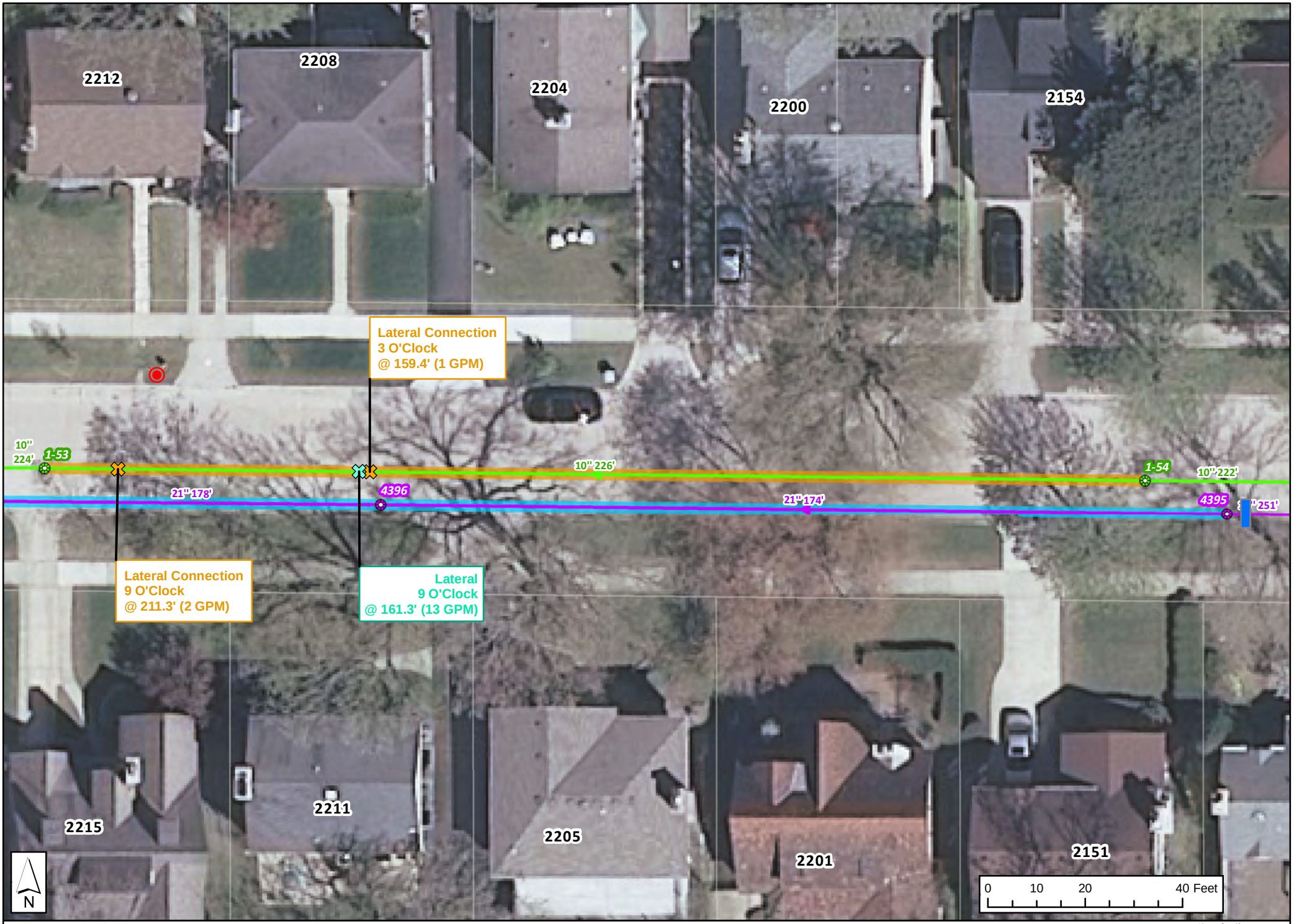

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2016 Wilmette Dyed Water Flooding

Setup 26 (16 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 29
Dyed Water Flooding:
Setup 26: 1-54 to 1-53
February 2017

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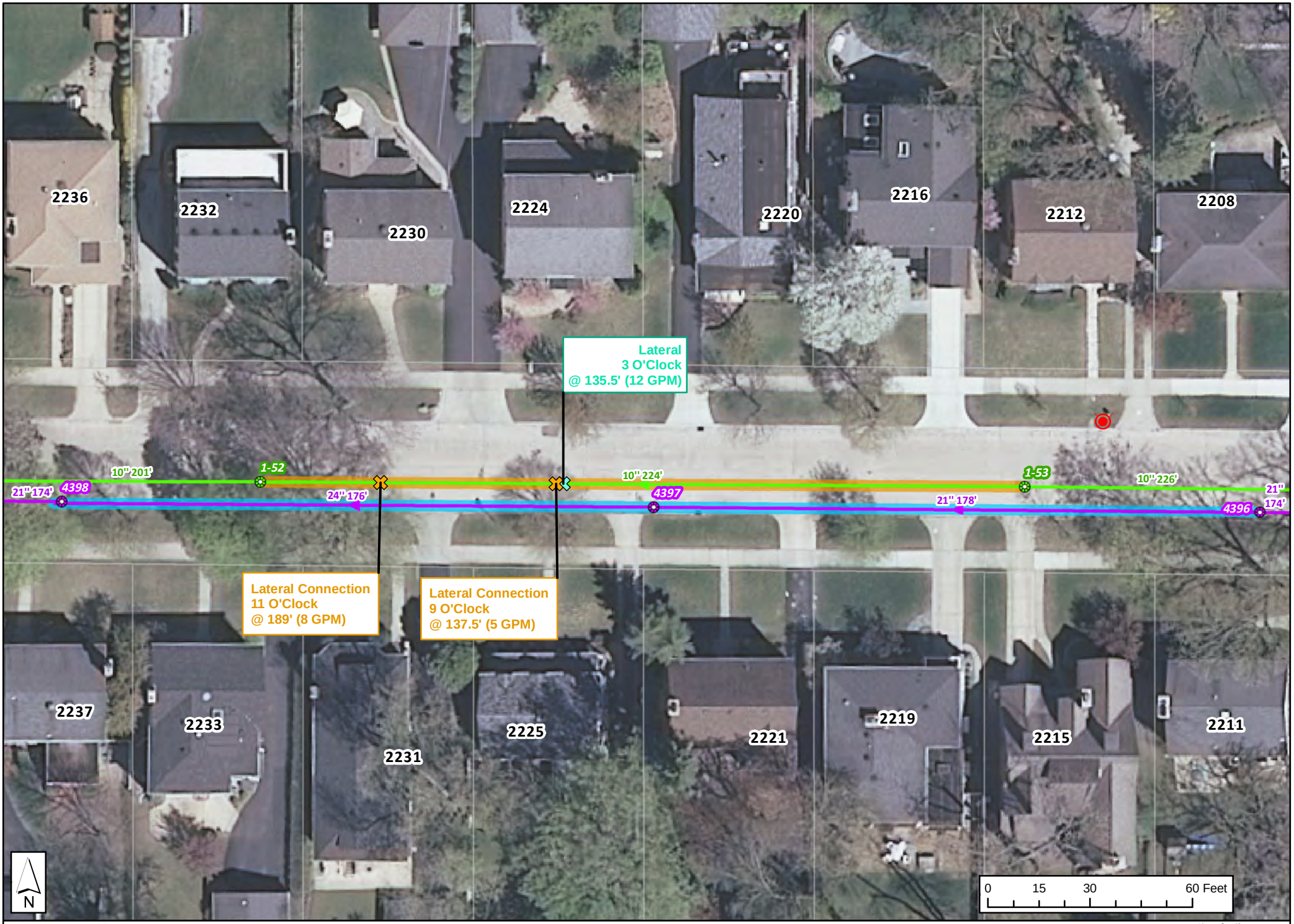

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2016 Wilmette Dyed Water Flooding

Setup 27 (25 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 30
Dyed Water Flooding:
Setup 27: 1-53 to 1-52
February 2017

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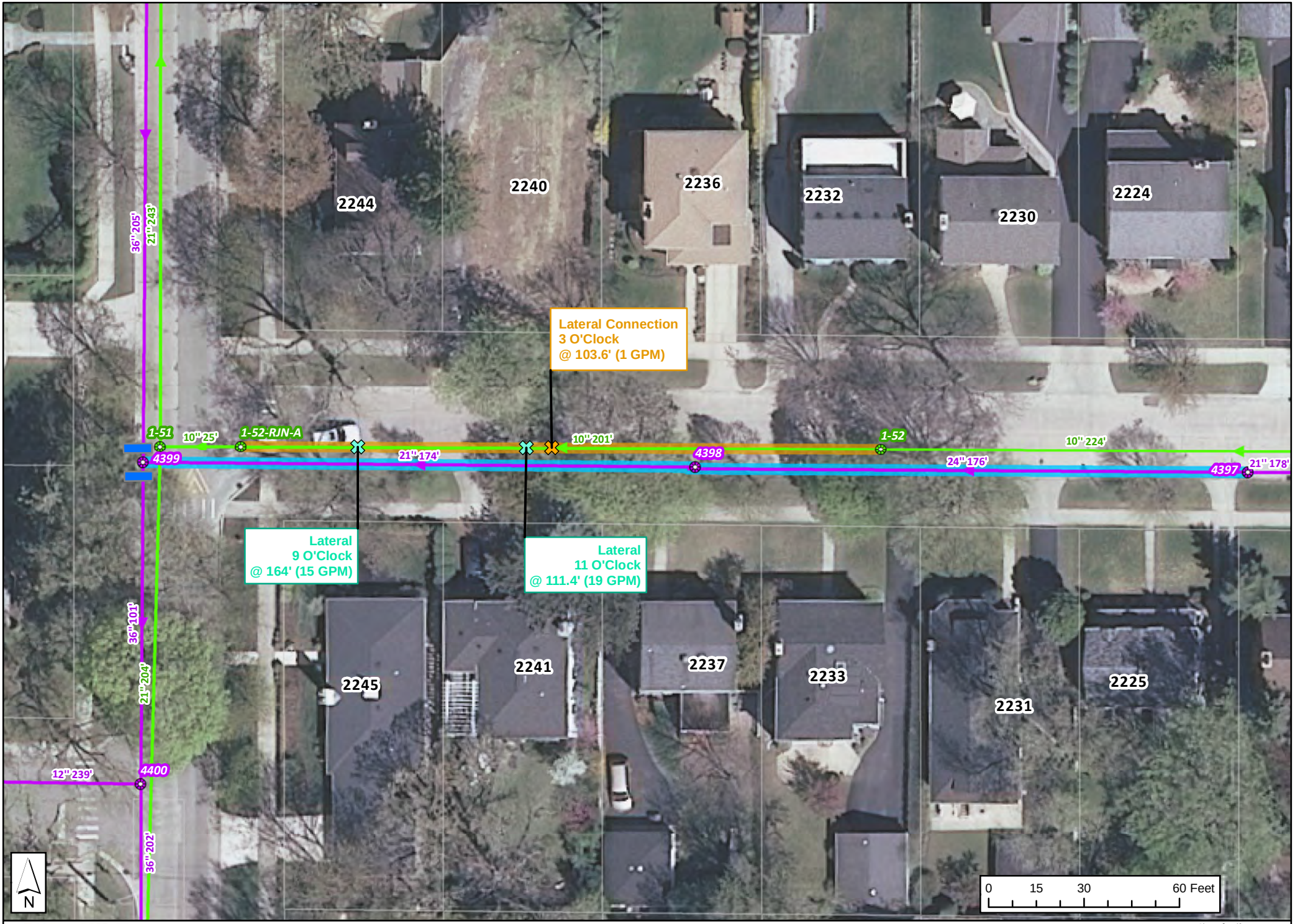

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2016 Wilmette Dyed Water Flooding

Setup 28 (35 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 31
Dyed Water Flooding:
Setup 28: 1-52 to 1-52-RJN-A
February 2017

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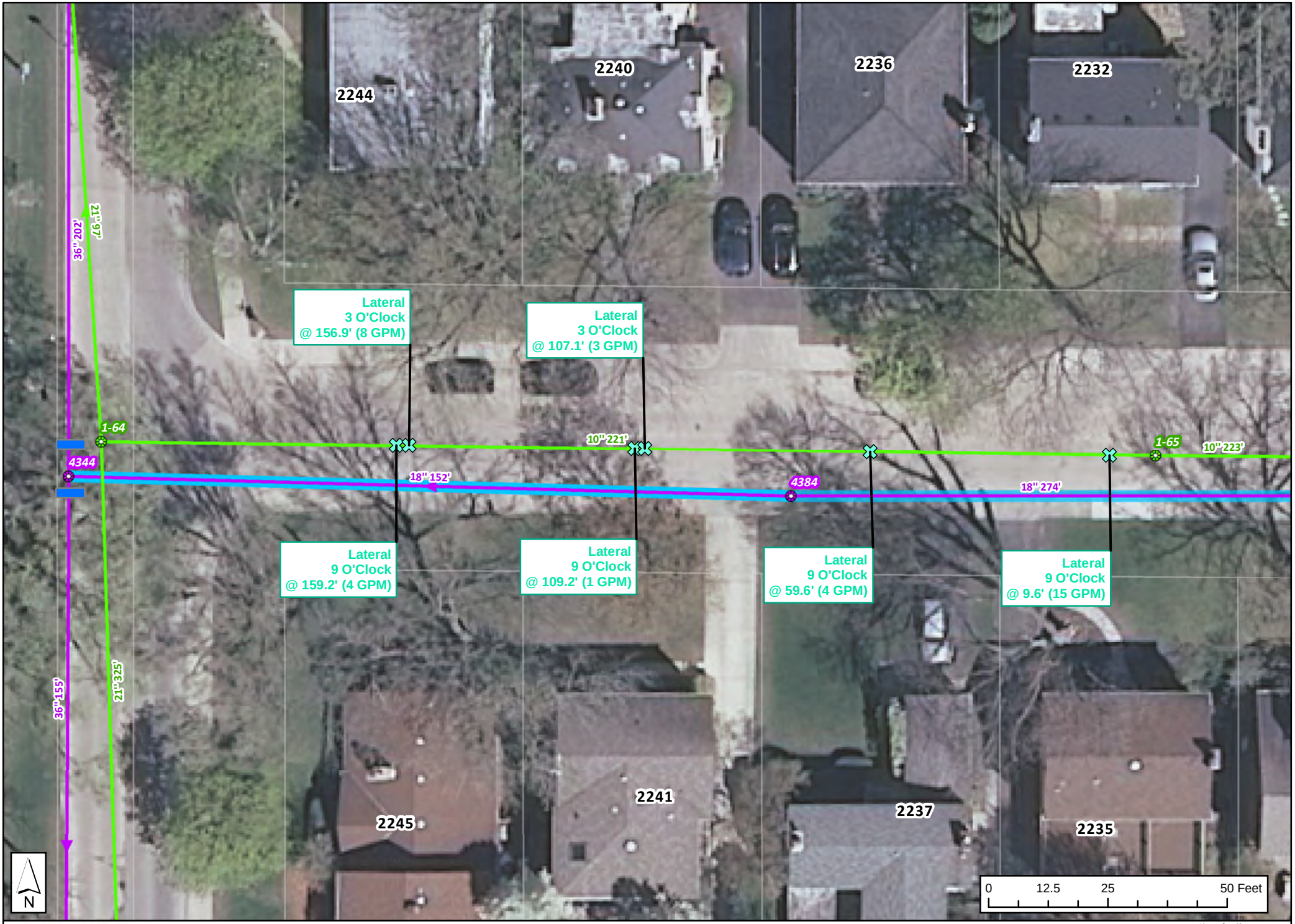

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2016 Wilmette Dyed Water Flooding

Setup 29 (35 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 32
Dyed Water Flooding:
Setup 29: 1-65 to 1-64
February 2017

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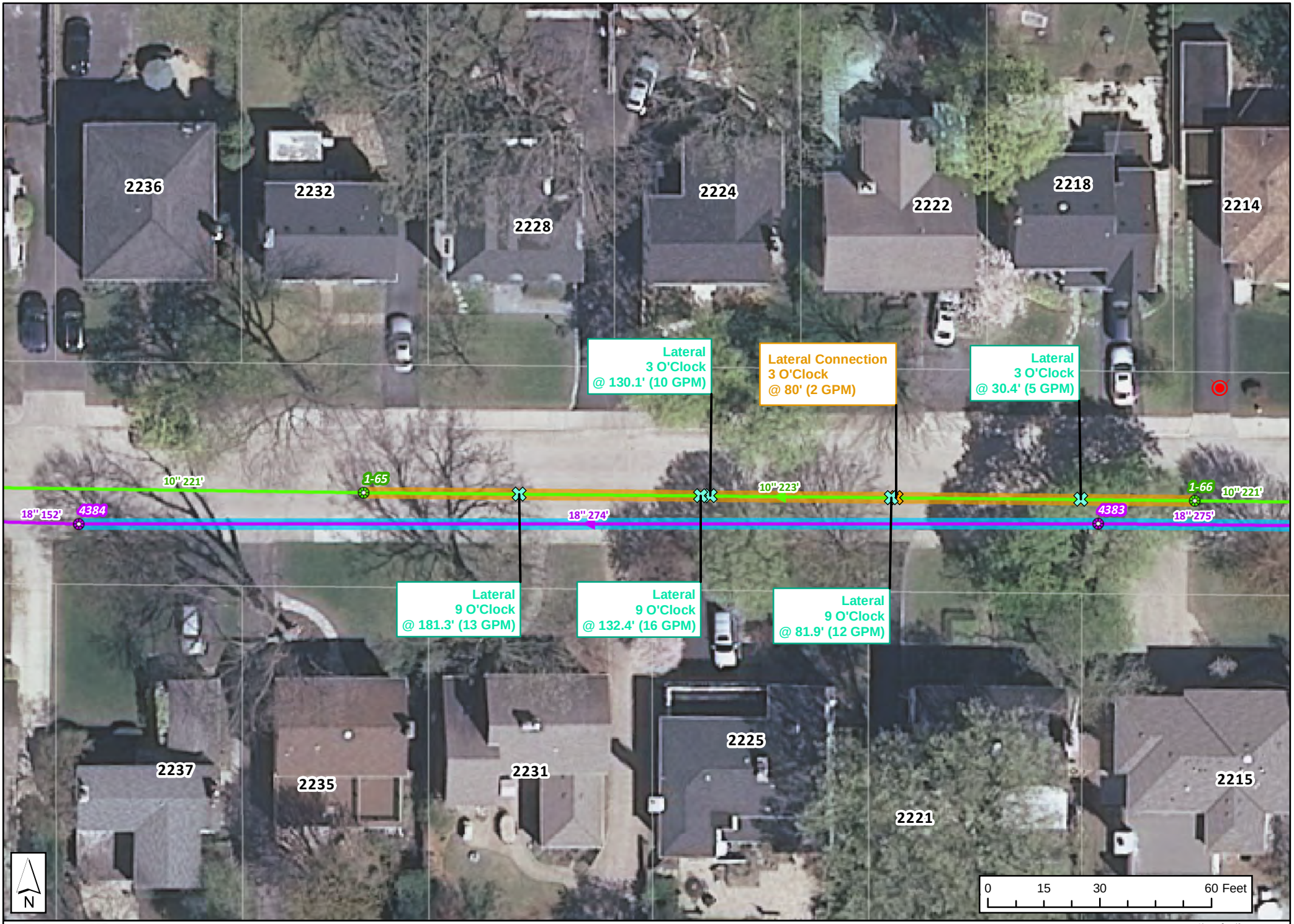

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2016 Wilmette Dyed Water Flooding

Setup 30 (58 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 33
Dyed Water Flooding:
Setup 30: 1-66 to 1-65
February 2017

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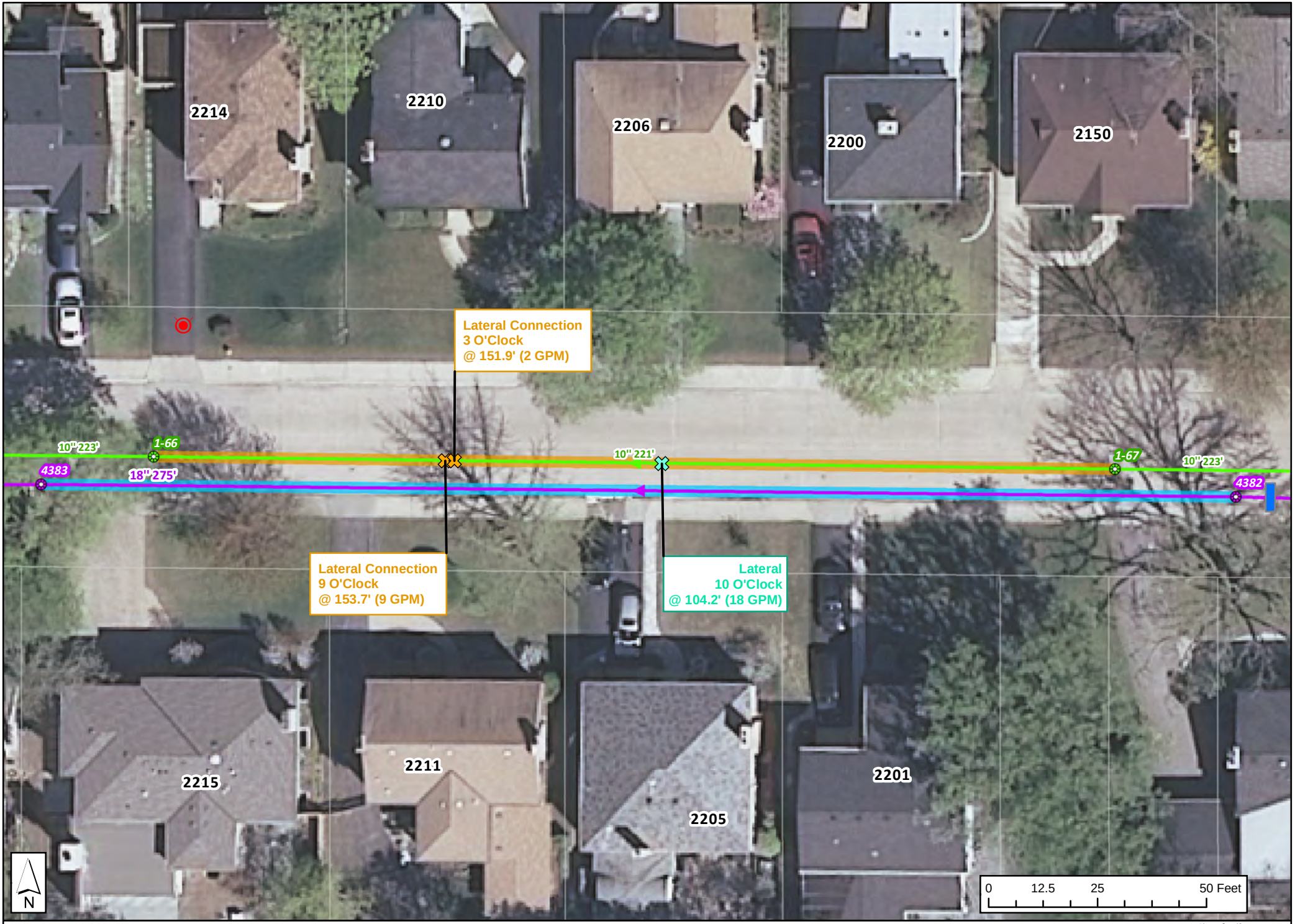

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2016 Wilmette Dyed Water Flooding

Setup 31 (29 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 34
Dyed Water Flooding:
Setup 31: 1-67 to 1-66
February 2017

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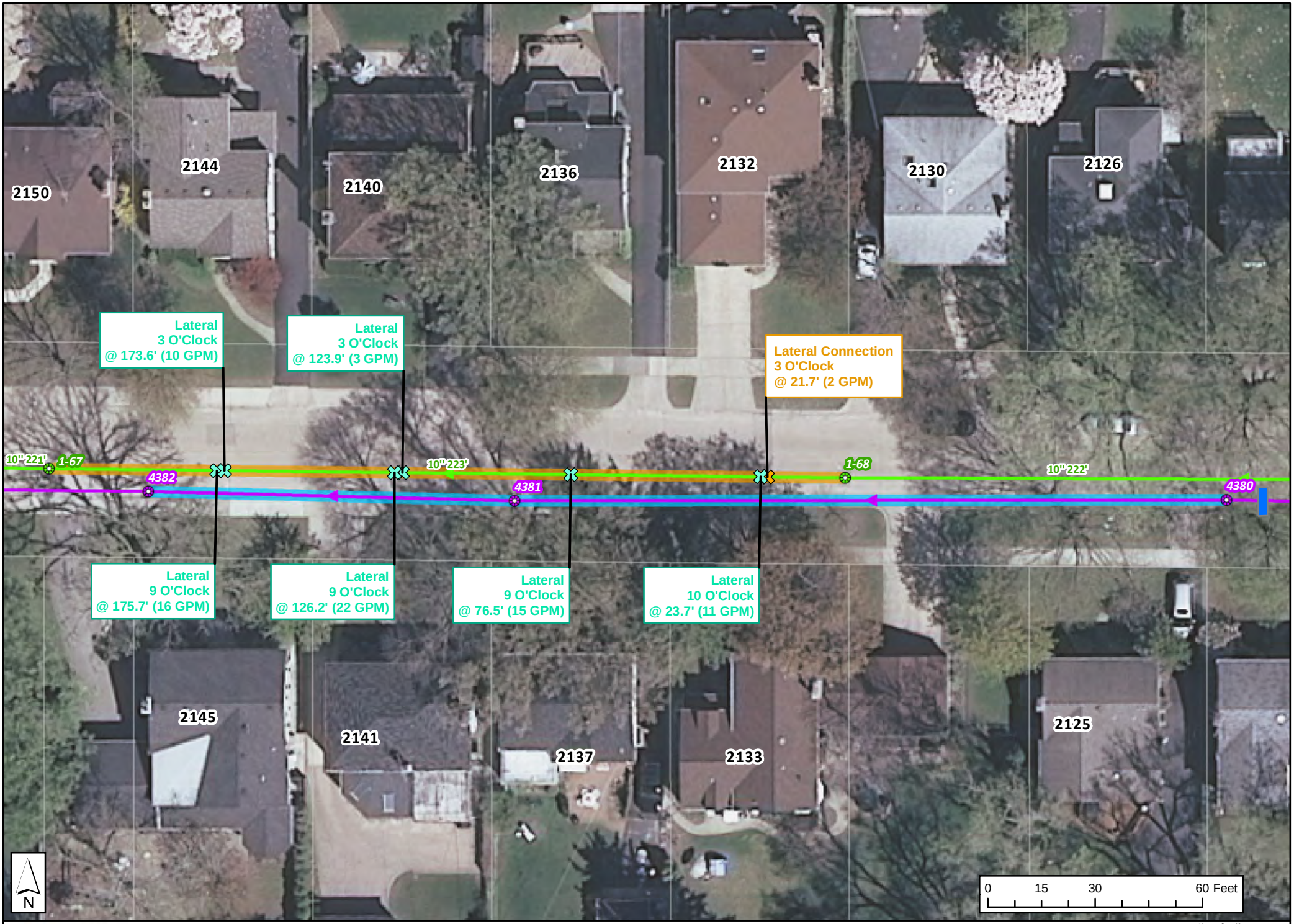

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2016 Wilmette Dyed Water Flooding

Setup 32 (79 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 35
Dyed Water Flooding:
Setup 32: 1-68 to 1-67
February 2017

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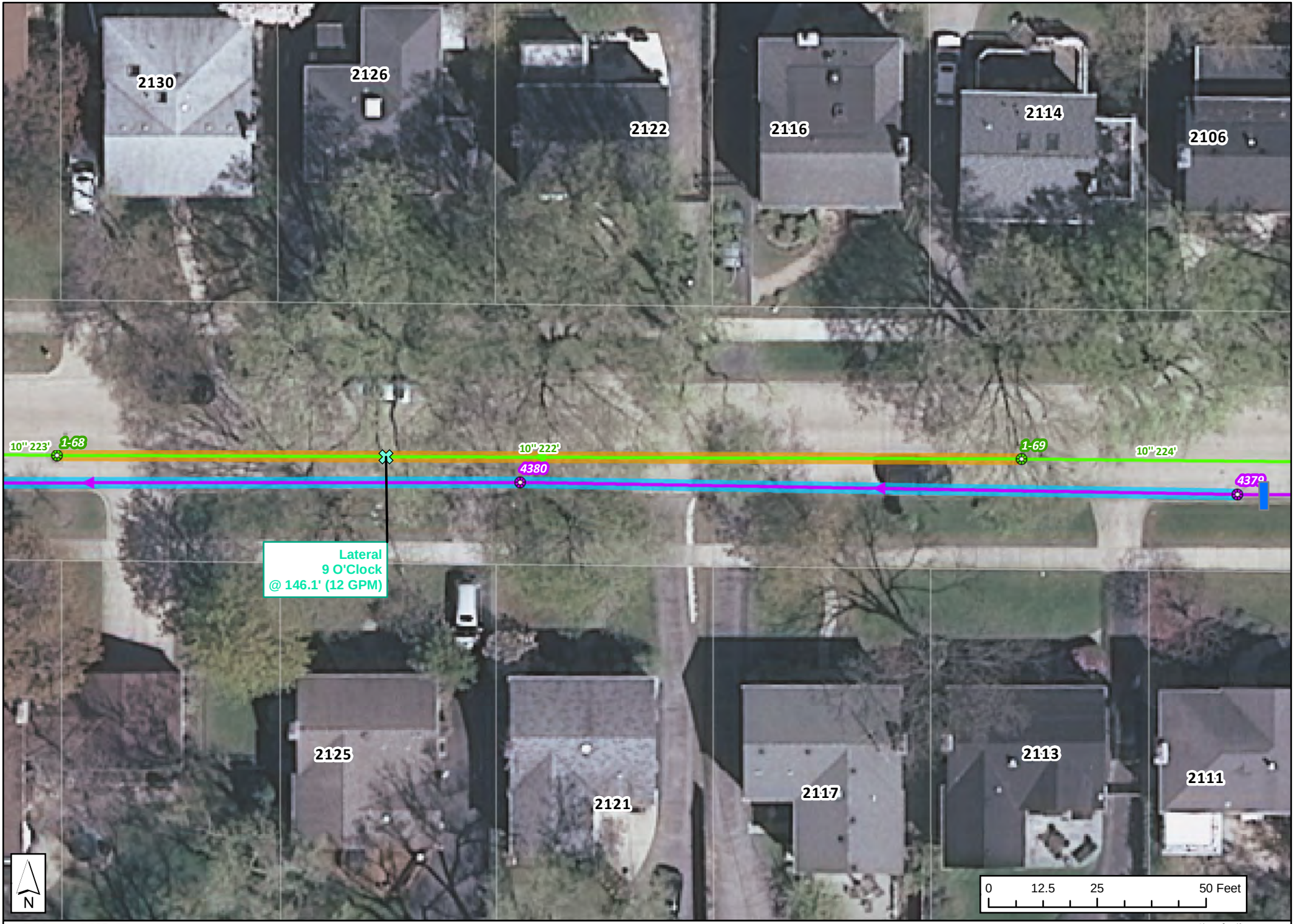

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2016 Wilmette Dyed Water Flooding

Setup 33 (12 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 36
Dyed Water Flooding:
Setup 33: 1-69 to 1-68
February 2017

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2016 Wilmette Dyed Water Flooding

Setup 34 (0 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 37
Dyed Water Flooding:
Setup 34: 1-70 to 1-69
February 2017

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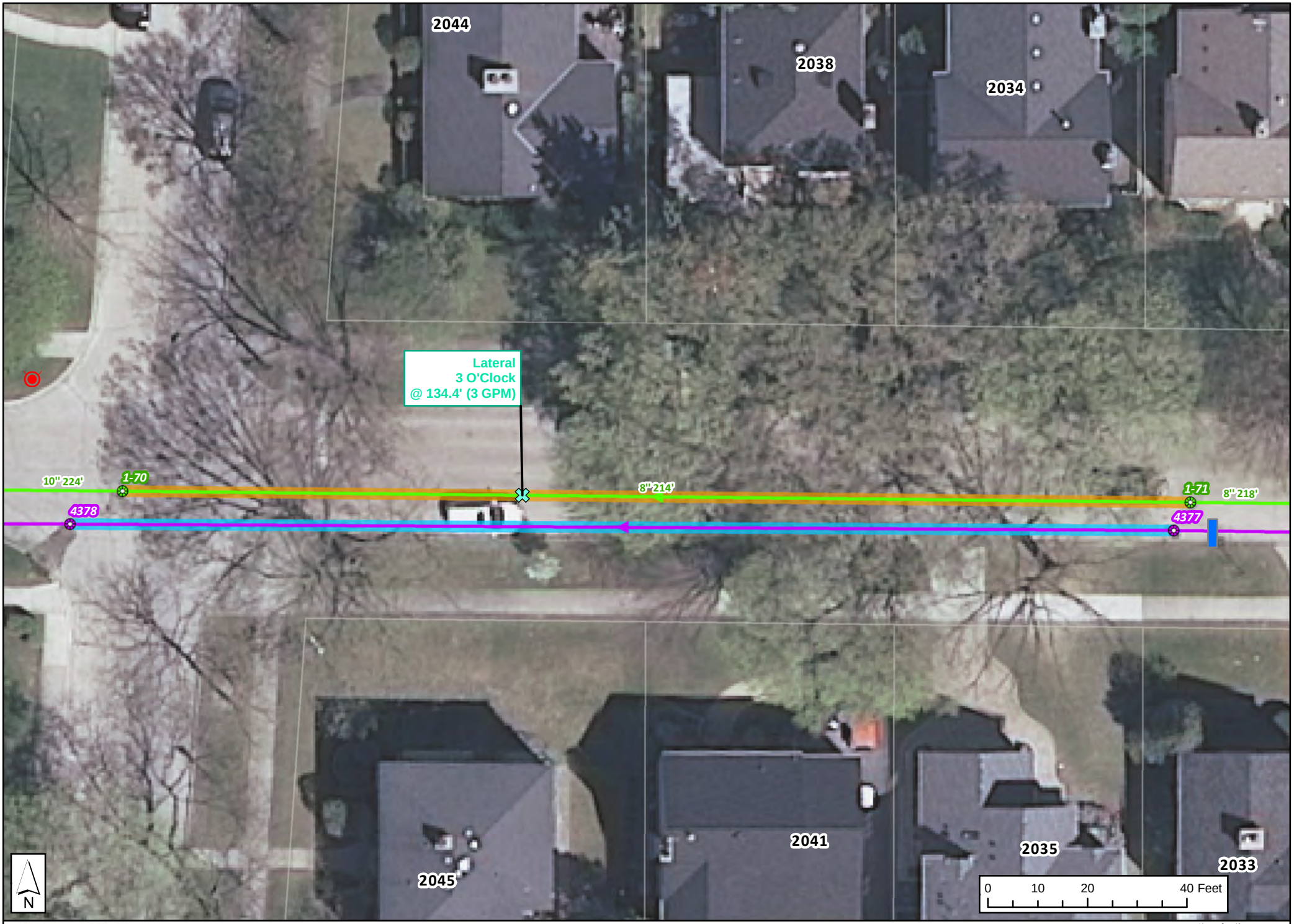

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2016 Wilmette Dyed Water Flooding

Setup 35 (3 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 38
Dyed Water Flooding:
Setup 35: 1-71 to 1-70
February 2017

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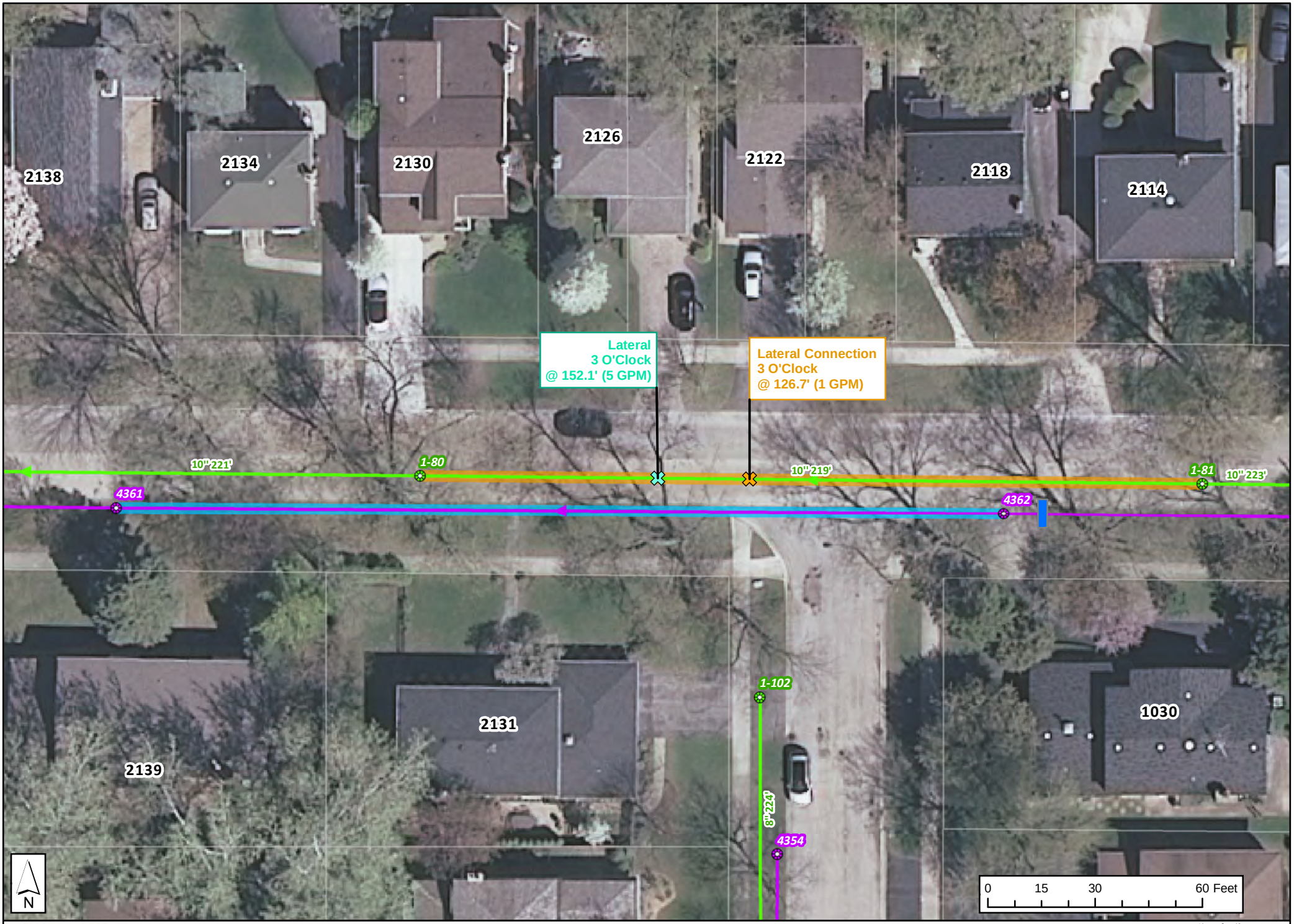

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2016 Wilmette Dyed Water Flooding

Setup 36 (6 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 39
Dyed Water Flooding:
Setup 36: 1-81 to 1-80
February 2017

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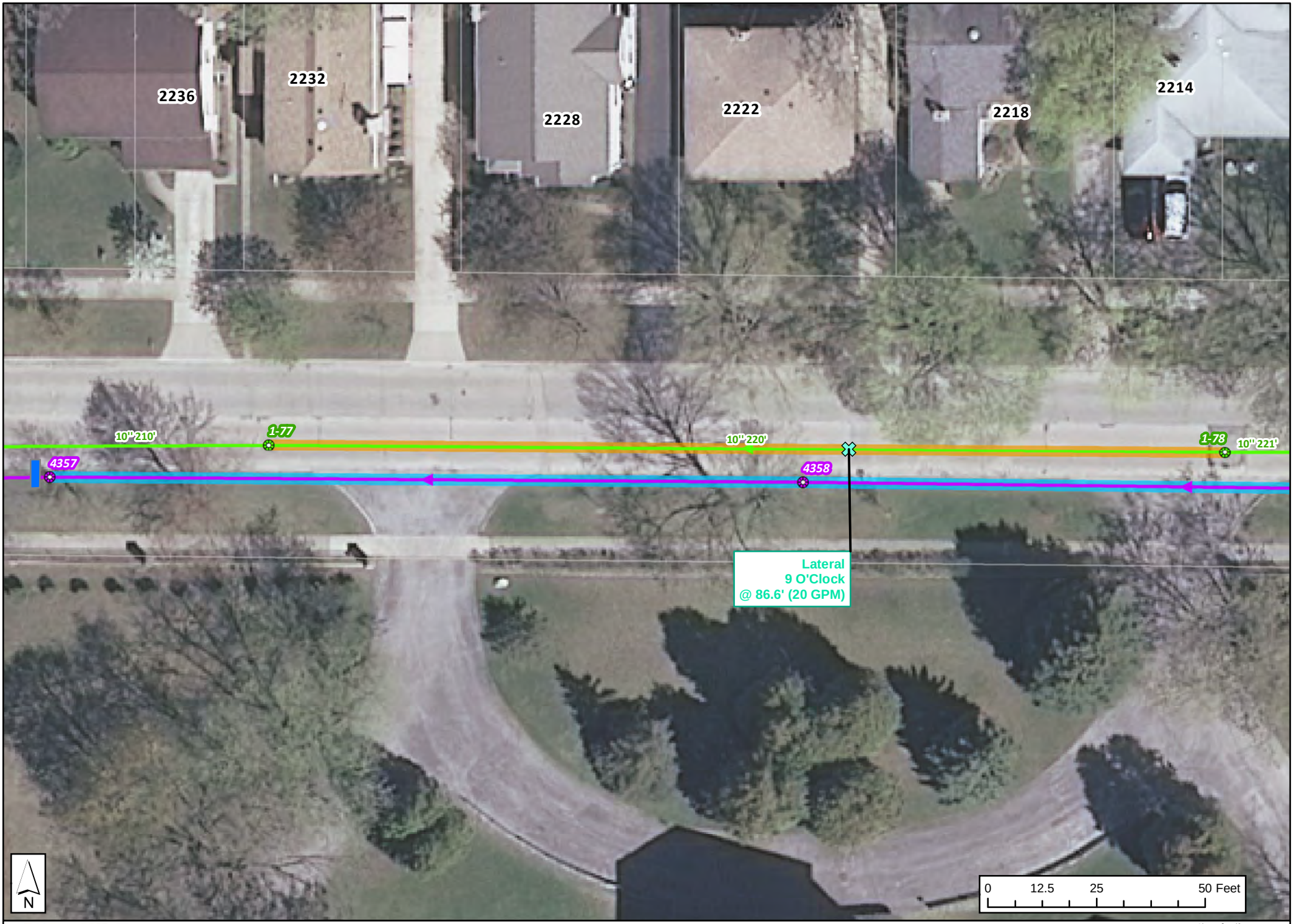

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2016 Wilmette Dyed Water Flooding

Setup 37 (20 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 40
Dyed Water Flooding:
Setup 37: 1-78 to 1-77
February 2017

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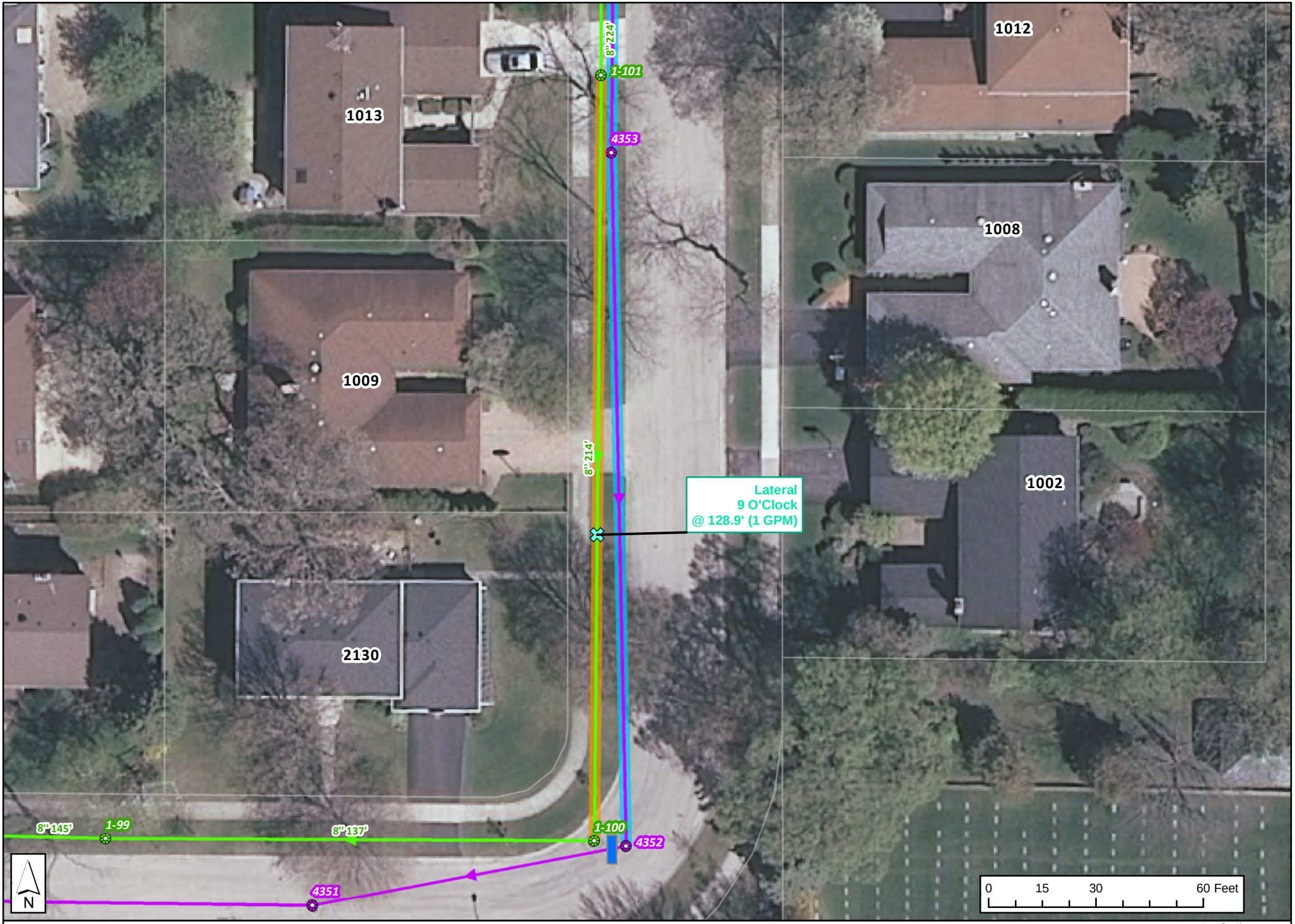

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2016 Wilmette Dyed Water Flooding

Setup 38 (1 GPM)

Station From: **Upstream**

City of Wilmette, IL
Exhibit 41
Dyed Water Flooding:
Setup 38: 1-101 to 1-100
February 2017

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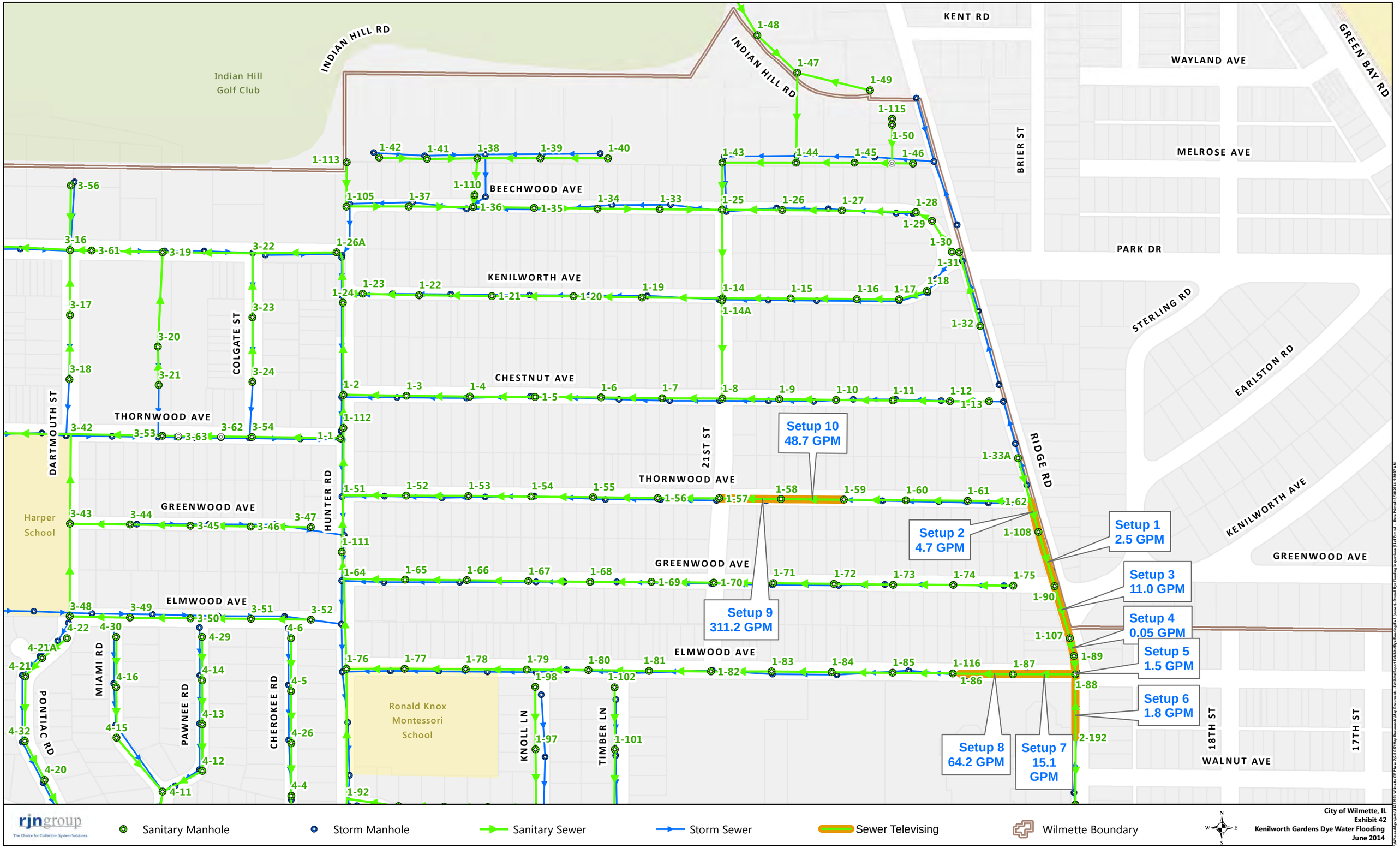
2014 KENILWORTH GARDENS DYED WATER FLOODING

OVERVIEW



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Sanitary Manhole | Storm Manhole | Sanitary Sewer | Storm Sewer | Sewer Televising | Wilmette Boundary

City of Wilmette, IL
Exhibit 42
Kenilworth Gardens Dye Water Flooding
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 1, 1-108 to 1-90 (2.5 GPM)

N
W E
S

Feet
0 20 40 80

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Storm Inlet
- Fire Hydrant

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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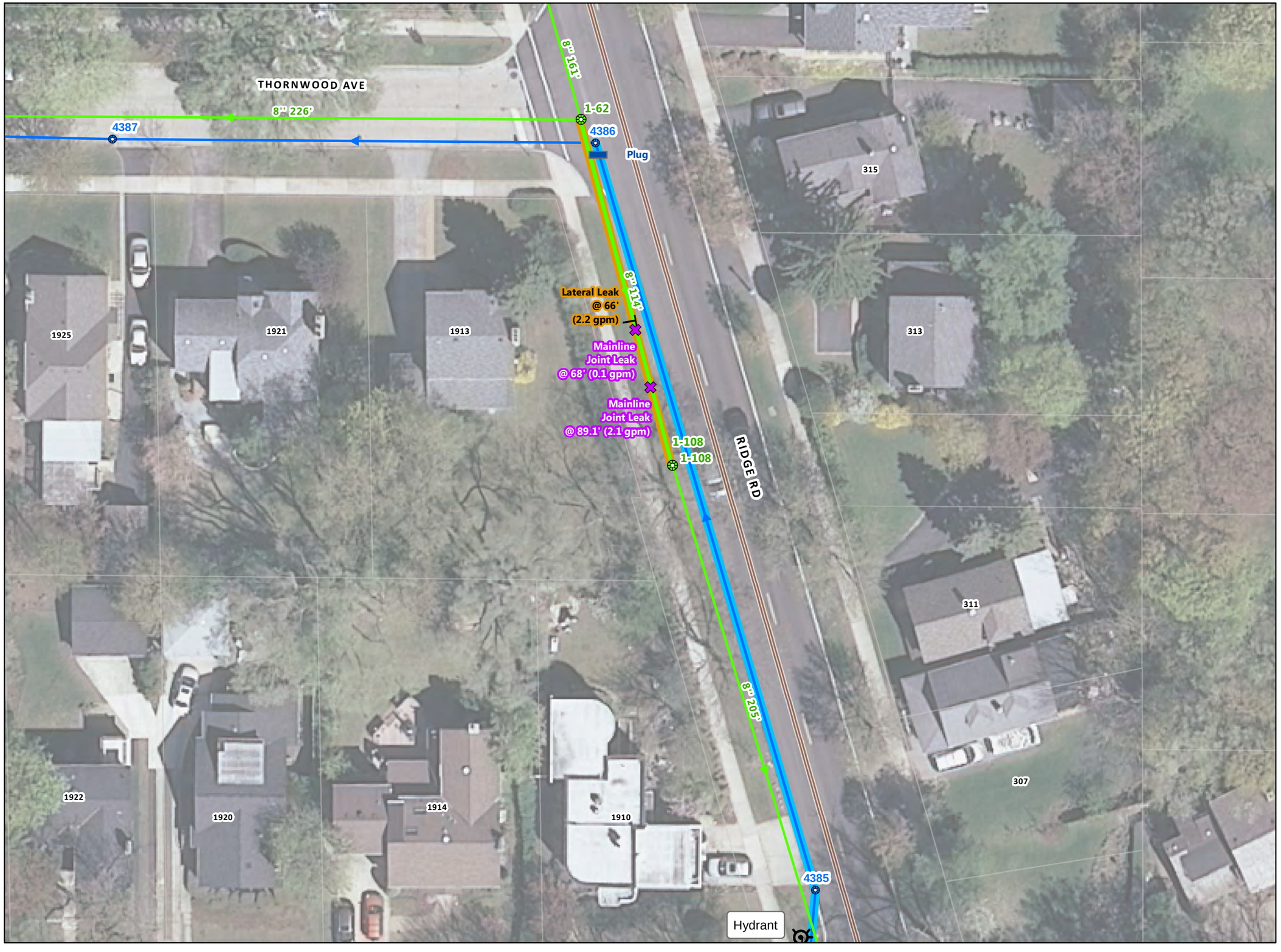
Village of Wilmette, IL
Exhibit 43
Kenilworth Gardens Dye Water Flooding:
Setup 1 Segments 1-108 to 1-90
June 2014

2014 KENILWORTH GARDENS DYE WATER FLOODING

SETUP 2, 1-62 to 1-108 (4.4 GPM)



N

W E

S

Feet

0 15 30 60

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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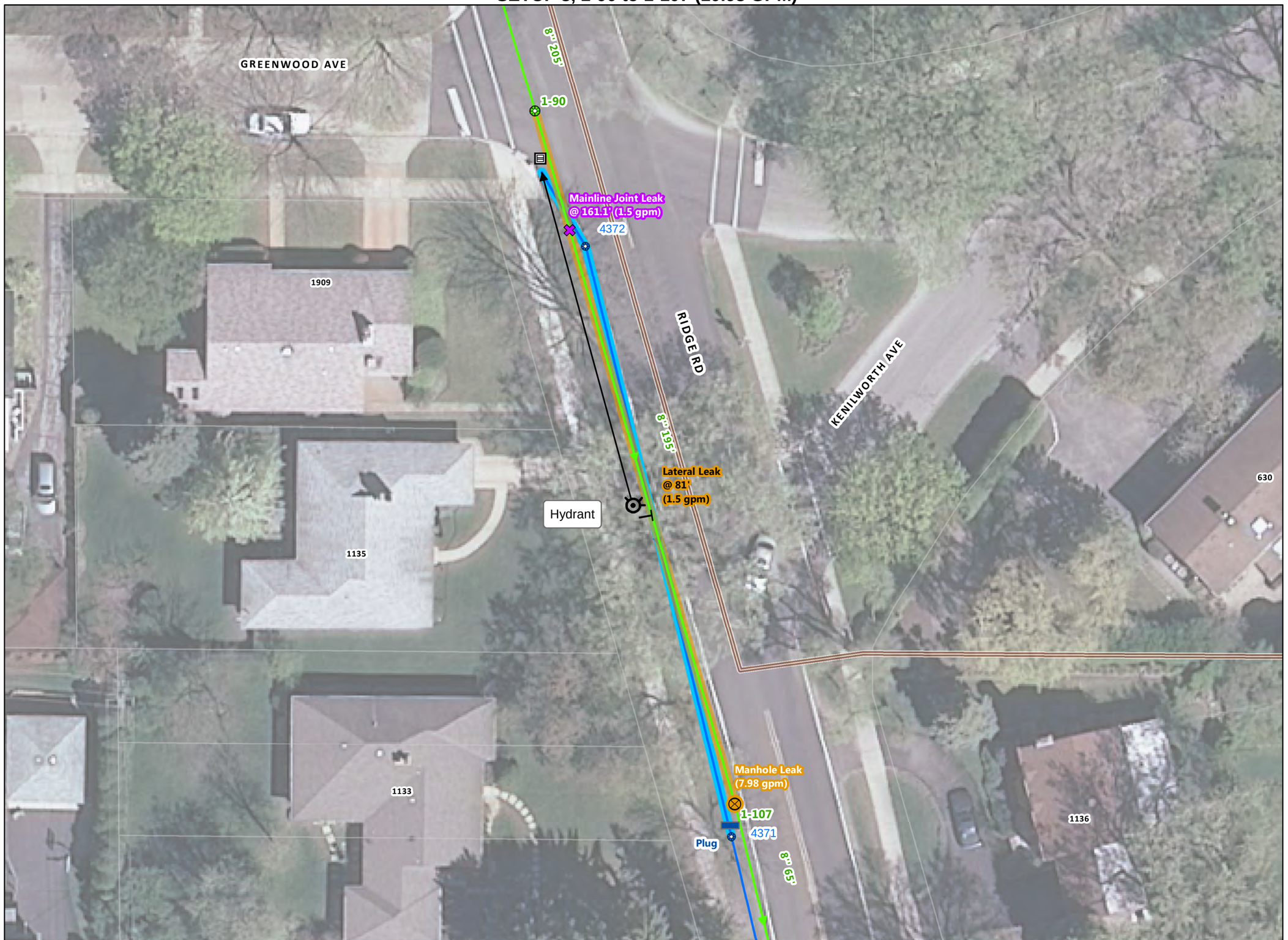
Village of Wilmette, IL
Exhibit 44
Kenilworth Gardens Dye Water Flooding:
Setup 2 Segments 1-108 to 1-62
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 3, 1-90 to 1-107 (10.98 GPM)



N

W E

S

Feet

0 15 30 60

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Storm Inlet
- Fire Hydrant

Dye Water Flooding Defects

- T Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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Village of Wilmette, IL
Exhibit 45
Kenilworth Gardens Dye Water Flooding:
Setup 3 Segments 1-90 to 1-107
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 4, 1-107 to 1-89 (0.5 GPM)

N
W E
S

Feet
0 15 30 60

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant
- Storm Inlet

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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Village of Wilmette, IL
Exhibit 46
Kenilworth Gardens Dye Water Flooding:
Setup 4 Segments 1-107 to 1-89
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 5, 1-89 to 1-88 (1.5 GPM)

N
W E
S

Feet
0 5 10 20

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant
- Storm Inlet

Dye Water Flooding Defects

- T Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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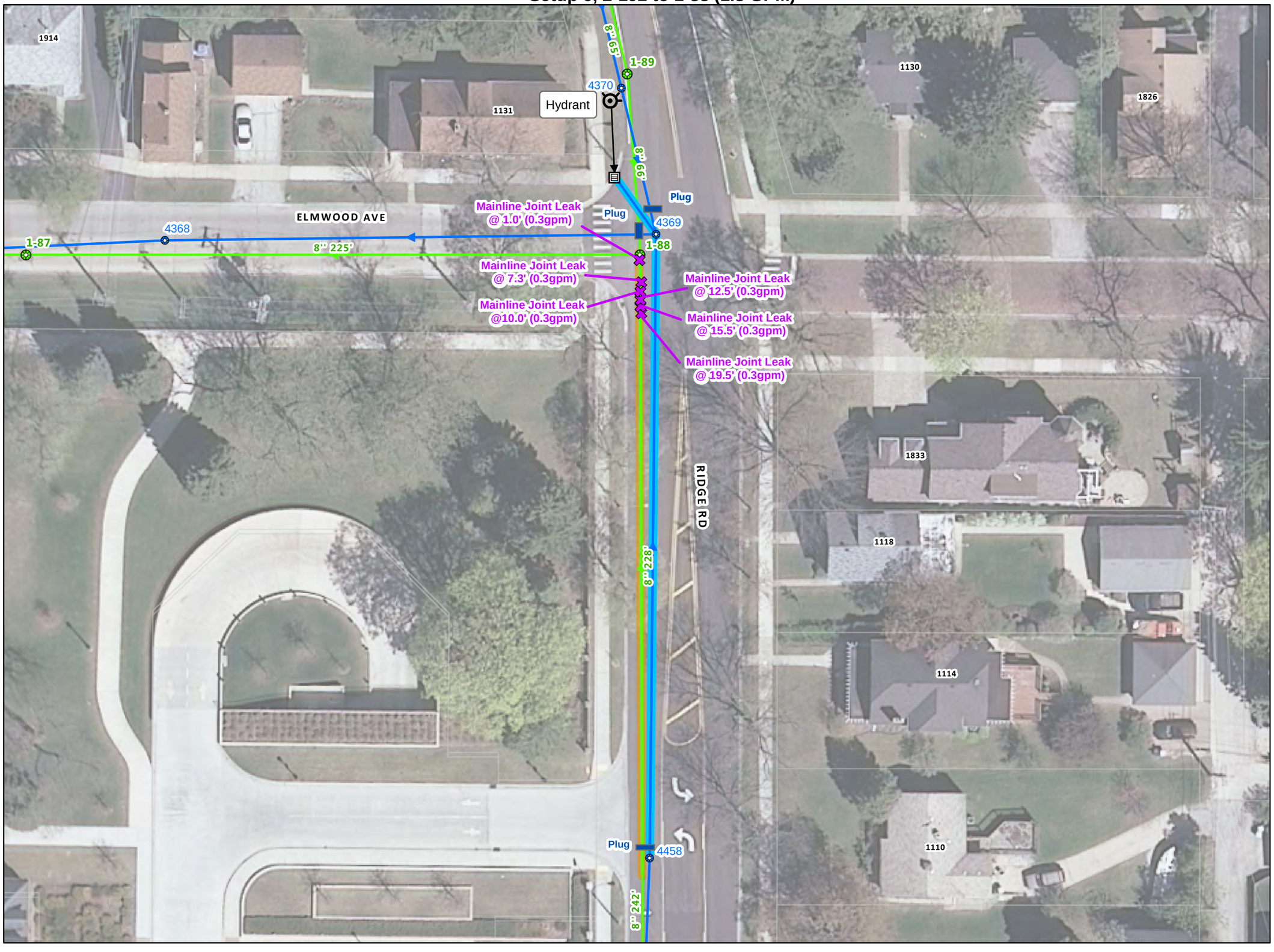
Village of Wilmette, IL
Exhibit 47
Kenilworth Gardens Dye Water Flooding:
Setup 5 Segments 1-89 to 1-88
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

Setup 6, 2-192 to 1-88 (1.8 GPM)



N
W E
S

Feet
0 15 30 60

- Standard Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant
- Storm Inlet

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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Village of Wilmette, IL
Exhibit 48
Kenilworth Gardens Dye Water Flooding:
Setup 6 Segments 2-192 to 1-88
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 7, 1-88 to 1-87 (15.0 GPM)

N
W E
S

Feet
0 10 20 40

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant
- Storm Inlet

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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Village of Wilmette, IL
Exhibit 49
Kenilworth Gardens Dye Water Flooding:
Setup 7 Segments 1-88 to 1-87
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 8, 1-87 to 1-86 (64.16 GPM)

N
W E
S

Feet
0 10 20 40

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant

Dye Water Flooding Defects

- T Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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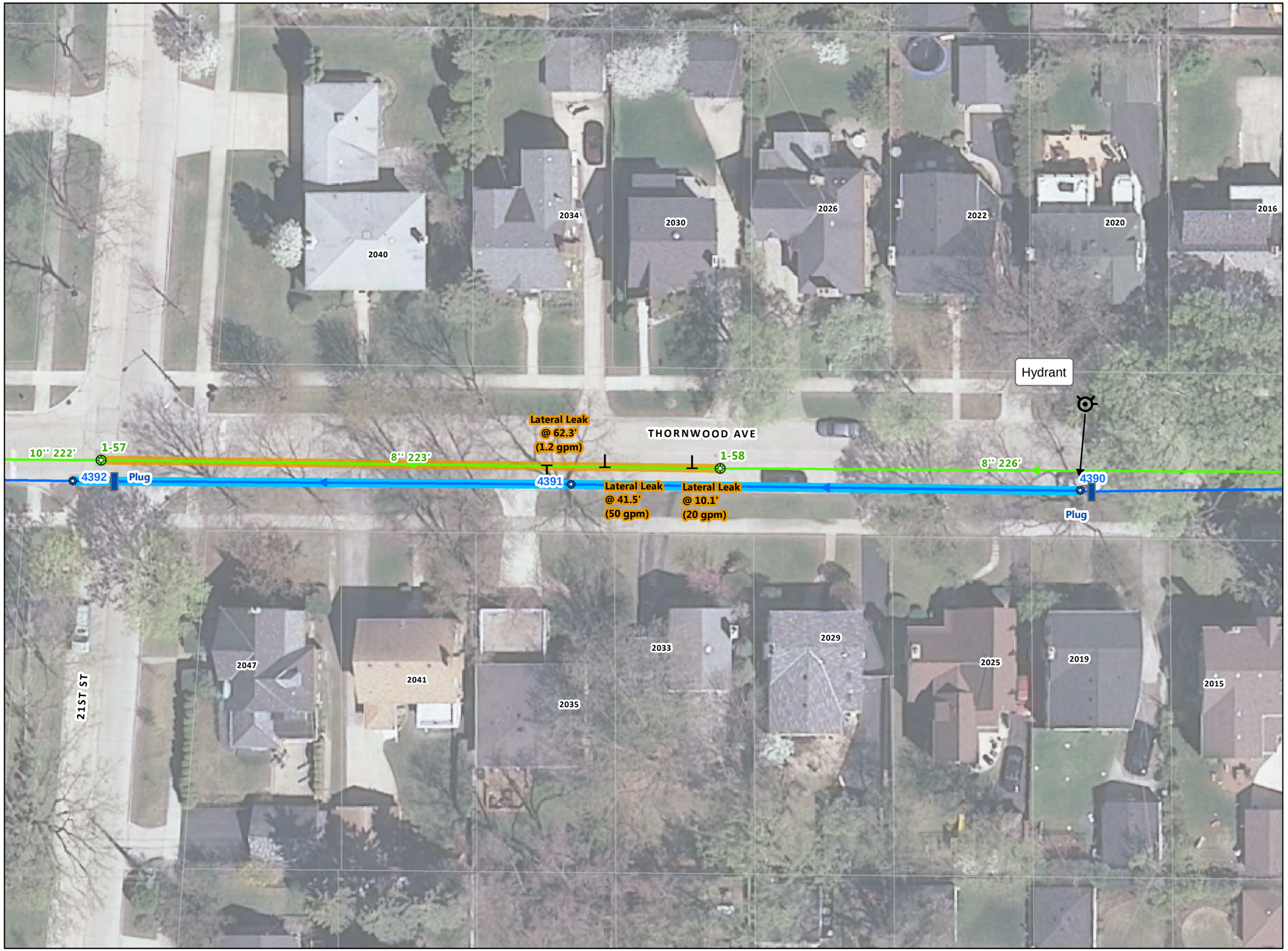
Village of Wilmette, IL
Exhibit 50
Kenilworth Gardens Dye Water Flooding:
Setup 8 Segments 1-87 to 1-86
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 9, 1-58 to 1-59 (311.2 GPM)



N
W E
S

Feet
0 15 30 60

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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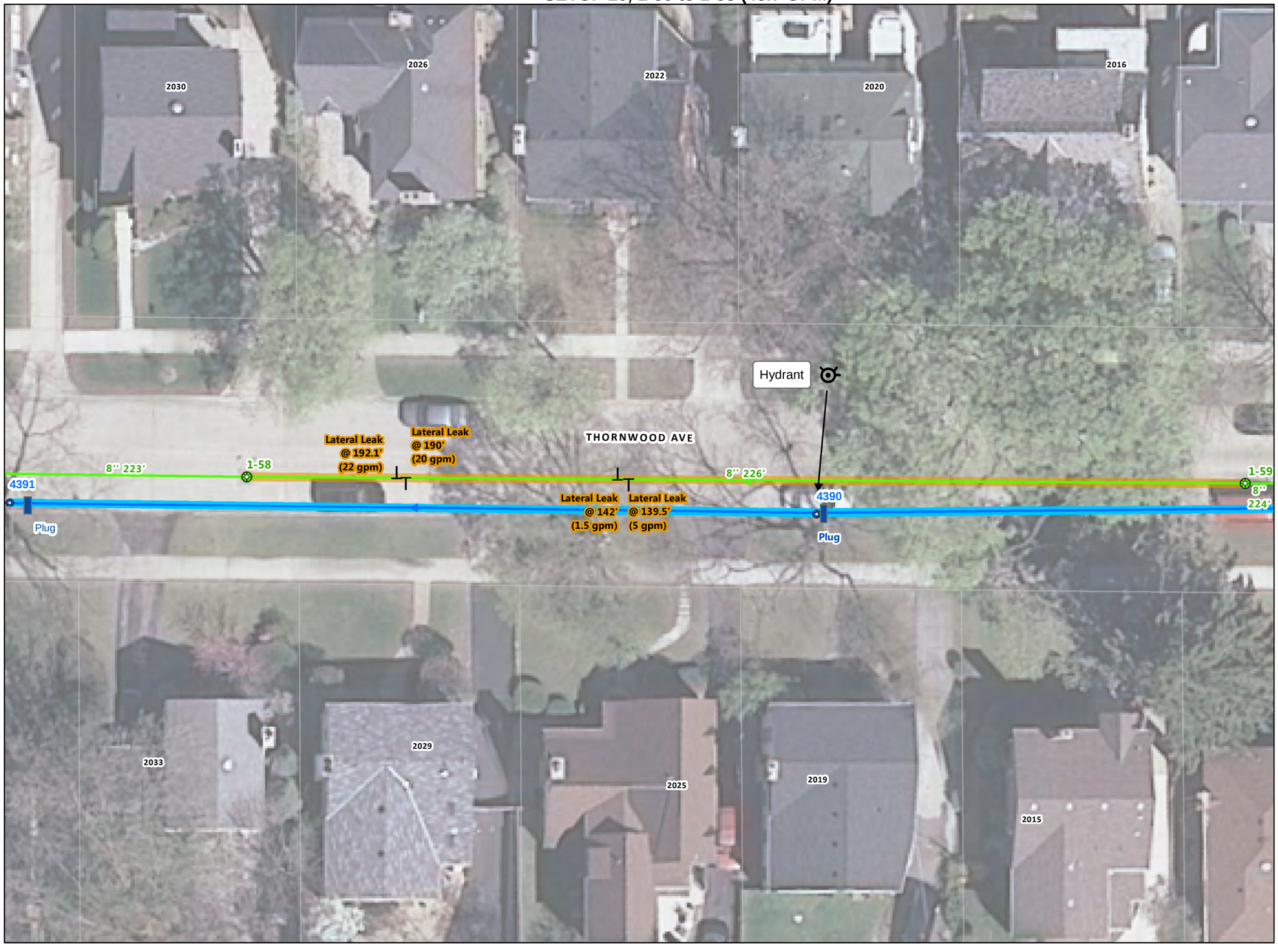
Exhibit 51
Kenilworth Gardens Dye Water Flooding:
Setup 9: Segments 1-58 to 1-57
June 2014

2014 KENILWORTH GARDENS DYED WATER FLOODING

SETUP 10, 1-59 to 1-58 (48.7 GPM)



N
W E
S

Feet
0 10 20 40

- Sanitary Manhole
- Storm Manhole
- Sanitary Sewer
- Storm Sewer
- Sewer Televising
- Area Flooded With Dye
- Water From Hydrant
- Wilmette Boundary
- Fire Hydrant

Dye Water Flooding Defects

- Lateral Leak
- Mainline Joint Leak
- Manhole Leak

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Village of Wilmette, IL
Exhibit 52
Kenilworth Gardens Dye Water Flooding:
Setup 10 Segments 1-59 to 1-58
June 2014