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## *Clow Creek Farm Addition (Naperville, Illinois) Existing Conditions Floodplain Analysis*

Kimley-Horn prepared an existing conditions floodplain analysis for the proposed Clow Creek Farm Addition development located in the City of Naperville and within Will County, Illinois.

The project site consists of 31.5 acres of farmland and farmstead. The site is bounded by 103rd Street to the north, DuPage River Tributary to the east, and residential subdivisions to the west and south. The existing land cover consists of row crops and a farmstead. The site drains southeast towards the DuPage River Tributary. The DuPage River Tributary is mapped as a FEMA Zone A (Approximate) special flood hazard area and therefore requires further study to determine the base flood elevations.

A regulatory floodway is not defined on the effective FEMA Flood Insurance Rate Map (FIRM). However, the upstream drainage area is greater than 640 acres, which will require coordination with the state Office of Water Resources (OWR). The existing conditions analysis will be used to evaluate the proposed development and ensure that all of the Naperville, Will County, and state floodplain and floodway regulatory requirements are met. The proposed project will be designed to maintain the conveyance and flood storage capacity; flood velocities; and flood elevations upstream or downstream of the property.

## HYDROLOGY

A HEC-HMS model was developed for the DuPage River Tributary watershed to simulate the rainfall-to-runoff process. Bulletin 70 rainfall values along with the TR-55 hydrologic methodology were used to estimate runoff hydrographs for each subbasin within the watershed. HEC-HMS reach routings and storage areas were also used to more accurately model the hydrology of the watershed.

LiDAR data was downloaded from the Illinois Height Modernization (ILHMP) dataset and mosaiced with onsite surveyed elevation data to create an existing conditions gridded surface. Stormwater inventory GIS data was downloaded from the City of Naperville Open Data Portal and was used in conjunction with topographic data to delineate the DuPage River Tributary watershed.

Once the watershed was delineated, it was divided into subbasins (**Figure 1**) to be routed through the watershed using the HEC-HMS routing methodology. The hydrologic modeling approach for the HEC-HMS model includes:

- Rainfall (Bulletin 70 and Huff Distribution)
- Infiltration (SCS Curve Number method)
- Lag time (SCS Segmental method)
- Storage Areas (Level-Pool Routing method)
- Reach Routings (Muskingum-Cunge)

## Rainfall

The Illinois State Water Survey Bulletin 70 was used to assign rainfall depths in the model, using values for the northeastern portion of the state. The Huff rainfall distribution was applied to the 10- and 100-Year return interval rainfall depths for the 30-min, 1-, 2-, 3-, 6-, 12-, 18-, 24-, 48-, 72-, 120-, and 240-hour duration rainfall events. The scenario which produced the highest peak flow rate in the model was chosen as the critical duration storm and was used as the design storm for the hydraulic analysis. See **Table 1** below for the critical duration analysis.

*Table 1. Critical Duration Analysis*

| Storm Duration | 10-Year Rainfall | 100-Year Rainfall | Huff Distribution Quartile | Upstream End of Site | | Downstream End of Site | |
|---|---|---|---|---|---|---|---|
| | | | | 10-Year Peak Flow | 100-Year Peak Flow | 10-Year Peak Flow | 100-Year Peak Flow |
| | (in) | (in) | | (cfs) | (cfs) | (cfs) | (cfs) |
| 30 minutes | 1.65 | 2.8 | First | 9.2 | 23.3 | 28.6 | 65.8 |
| 1 hour | 2.1 | 3.56 | First | 78.6 | 152 | 82.1 | 190.1 |
| 2hr | 2.64 | 4.47 | First | 204.6 | 414.7 | 210 | 428 |
| 3hr* | 2.86 | 4.85 | First | **219.3** | 435.5 | **232.6** | 461.4 |
| 6hr | 3.35 | 5.68 | First | 206.1 | 406.3 | 219.7 | 434.1 |
| 12hr | 3.89 | 6.59 | Second | 194.6 | 443 | 208.1 | 455.9 |
| 18hr | 4.11 | 6.97 | Third | 179 | 464.9 | 191.1 | 476.5 |
| 24hr** | 4.47 | 7.58 | Third | 165 | **474.8** | 176.5 | **487** |
| 48hr | 4.81 | 8.16 | Fourth | 124.6 | 399.9 | 128.1 | 411.2 |
| 72hr | 5.18 | 8.78 | Fourth | 121.5 | 322.2 | 124.7 | 332.3 |
| 120hr | 5.7 | 9.96 | Fourth | 97.9 | 246.8 | 100.6 | 254.9 |
| 240hr | 6.89 | 11.14 | Fourth | 66.4 | 144.4 | 68.2 | 148.8 |

* Critical Duration for 10-Year Return Interval
** Critical Duration for 100-Year Return Interval

## Infiltration

Soil infiltration was estimated using the NRCS/SCS TR-55 Curve Number method. The method uses hydraulic soil group (A, B, C, or D) along with land use designations to assign infiltrative capacity to the watershed. The NRCS SSURGO soils database for Will County was used to determine the hydraulic soil groups within the watershed. 2016 Aerial photography from the City of Naperville was used to assign land use types within the watershed. Curve numbers and percent impervious cover were calculated for each subbasin in the watershed and input into the HEC-HMS model. **Table 2** summarizes the results of this analysis.

*Table 2. HEC-HMS Infiltration Parameters*

| Subbasin Name | Area (acres) | Area (sq. mi.) | CN | Percent Impervious (%) |
|---|---|---|---|---|
| W01 | 51.9 | 0.0811 | 78 | 26.9 |
| W02 | 41.6 | 0.0651 | 79.7 | 27.5 |
| W03 | 117.3 | 0.1833 | 80.9 | 30.7 |
| W04 | 13.2 | 0.0222 | 80.1 | 27.7 |
| W05 | 31.5 | 0.0492 | 82.8 | 5.2 |
| W06 | 10.4 | 0.0147 | 88.6 | 61.9 |
| W07 | 205.0 | 0.3204 | 81.2 | 20.7 |
| W08 | 139.7 | 0.2183 | 83.7 | 14.7 |
| W09 | 39.3 | 0.0615 | 80.5 | 25.9 |
| W10 | 40.9 | 0.0638 | 82.8 | 37.8 |
| W11 | 23.8 | 0.0373 | 79.3 | 23.8 |
| W12 | 189.5 | 0.2961 | 81.5 | 33.9 |
| W13 | 49.8 | 0.0777 | 79.6 | 21.8 |
| W14 | 94.8 | 0.1481 | 88.9 | 63.8 |
| W15 | 44.8 | 0.07 | 82.1 | 32.7 |
| W16 | 66.5 | 0.1038 | 84.3 | 43.6 |
| W17 | 39.7 | 0.062 | 92.8 | 76.0 |
| W18 | 99.3 | 0.1551 | 82.4 | 37.5 |
| W19 | 46.1 | 0.0721 | 86.5 | 52.7 |
| W20 | 86.1 | 0.1346 | 87.1 | 54.6 |
| W21 | 28.7 | 0.0448 | 82.9 | 39.9 |
| W22 | 12.6 | 0.0197 | 82 | 34.7 |
| W23 | 33.2 | 0.0519 | 90.7 | 70.7 |
| W24 | 44.5 | 0.0695 | 82.1 | 33.7 |
| W25 | 25.0 | 0.039 | 91.5 | 73.4 |
| W26 | 44.7 | 0.0592 | 94 | 84.3 |
| W27 | 14.8 | 0.0231 | 89.8 | 64.9 |
| W28 | 59.1 | 0.103 | 90.7 | 67.4 |

### Lag Time

The SCS Segmental Method, also outlined in NRCS TR-55, was used to calculate lag times for each of the subbasins included in the model. The hydraulically longest flow path was identified for each basin and broken into overland (sheet), shallow concentrated, pipe, and channel flow. A maximum length of 100 feet was determined for the overland flow sections. Travel times were calculated for each segment and compiled before being entered into the HEC-HMS model. **Table 3** summarizes the results of this analysis.

*Table 3. HEC-HMS Lag Times*

| Subbasin Name | Lag Time (min) |
|---|---|
| W01 | 25.5 |
| W02 | 22.1 |
| W03 | 38.9 |
| W04 | 33 |
| W05 | 29.1 |
| W06 | 35.9 |
| W07 | 75.3 |
| W08 | 95.5 |
| W09 | 31.1 |
| W10 | 28.8 |
| W11 | 33.9 |
| W12 | 32.8 |
| W13 | 37.1 |
| W14 | 35.1 |
| W15 | 46.6 |
| W16 | 57.8 |
| W17 | 20.4 |
| W18 | 36.9 |
| W19 | 45.7 |
| W20 | 41.7 |
| W21 | 44 |
| W22 | 29.1 |
| W23 | 46.5 |
| W24 | 30.8 |
| W25 | 21.7 |
| W26 | 17 |
| W27 | 19.4 |
| W28 | 36.4 |

### Storage Areas

Since the watershed includes several large detention ponds, the most hydrologically impactful ones were included in the HEC-HMS model. The elevation-area relationships for eight large detention facilities were calculated from the LiDAR data and entered in the model as storage areas. The outlet structures were estimated using the stormwater inventory data downloaded from the City website.

### Reach Routings

Channel and pipe routings were modeled in HEC-HMS using the Muskingum-Cunge methodology. Upstream pipe routing lengths and inverts were estimated using the stormwater inventory data downloaded from the City website. In the DuPage River Tributary section of the model, 8-point cross-sections were developed from the LiDAR data and entered for several reach routings along the stream.

## HYDRAULICS

A HEC-RAS model was developed for the DuPage River Tributary to estimate 10- and 100-year flood elevations along the stream. After runoff hydrographs were obtained from HEC-HMS, the peak flows were applied to the HEC-RAS model at locations along the tributary where significant flow changes occur.

Cross-sections were cut from the existing conditions surface that was developed from Will County LiDAR and the onsite surveyed elevation data. Bridges and culverts along the tributary were modeled using surveyed elevation, size, and material information. Ineffective flow areas were added where appropriate, and coefficients of contraction and expansion were set at 0.3 and 0.5 respectively surrounding culvert and bridge openings.

The water surface elevation results at each cross-section of the HEC-RAS model were exported and used to map the 10- and 100-year flood inundation areas based on the existing ground surface. **Table 4** below summarizes the 10- and 100-year water surface elevation results at several selected HEC-RAS cross-sections. See **Figure 2** for cross-section locations.

*Table 4. HEC-RAS Results*

| Cross-Section Station | 10-Year WSEL (ft) | 100-Year WSEL (ft) |
|---|---|---|
| 7236 | 653.4 | 656.3 |
| 6525 | 653.2 | 656.2 |
| 5813 | 653.2 | 656.1 |
| 5481* | 652.1 | 652.7 |
| 4950 | 651.9 | 652.2 |
| 4091 | 644.8 | 646.4 |
| 3655** | 643.6 | 646.2 |
| 3067 | 640.4 | 641.2 |
| 1651 | 637.4 | 638.2 |
| 49 | 631.3 | 632.1 |

* Northern (Upstream) Boundary of Site
** Southern (Downstream) Boundary of Site

## SUMMARY

A preliminary existing conditions floodplain analysis was completed for the proposed Clow Creek Farm Addition development in Naperville (Will County), Illinois. The preliminary results outlined above will be used as a basis for designing proposed conditions. Additional modeling is expected and planned to ensure no adverse impacts to the floodplain.

### Attachments

Figure 1. Drainage Area Map

Figure 2. HEC-RAS Cross-Sections

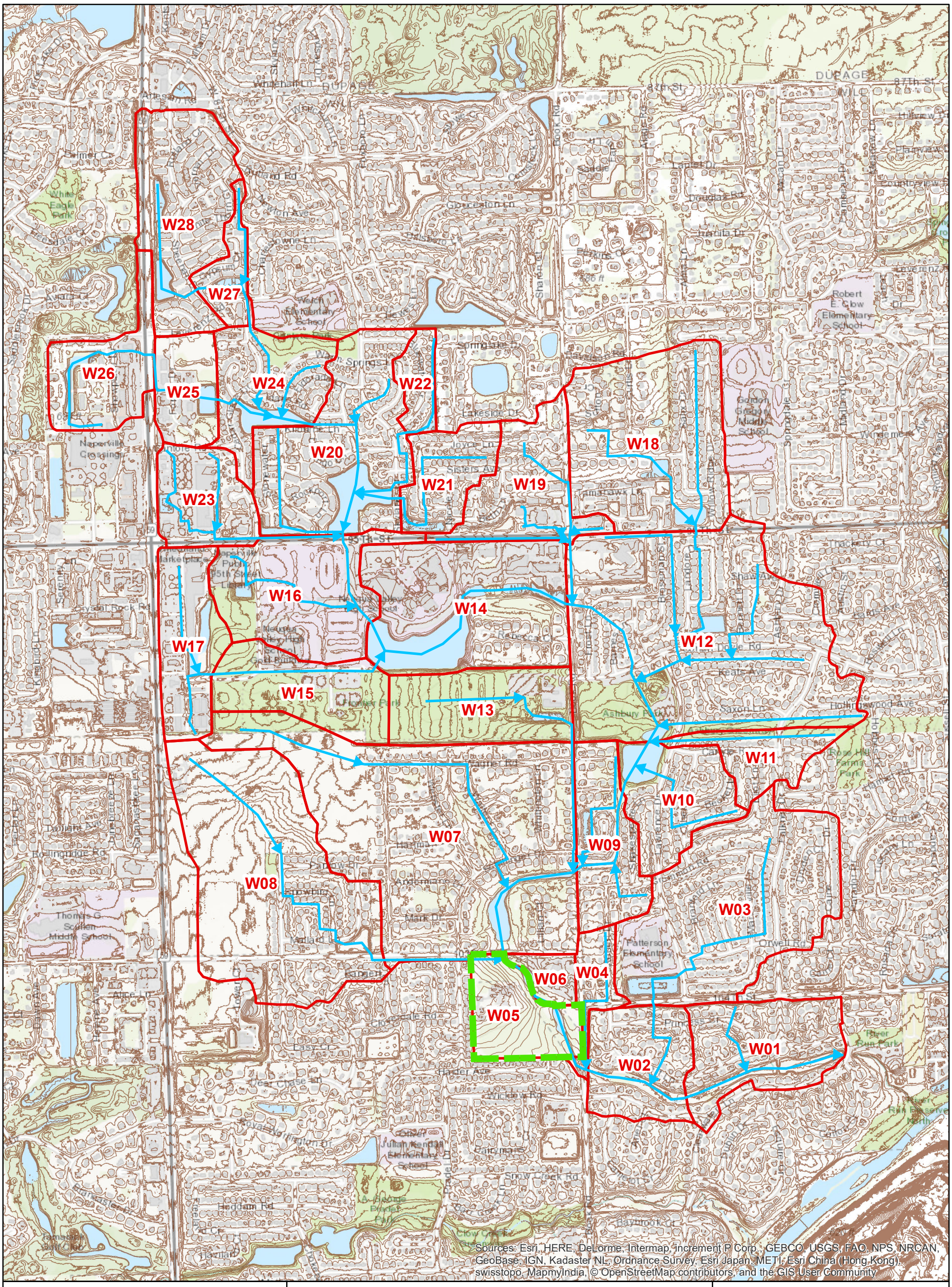


**Figure 1.**
**Drainage Area Map**

Clow Creek Farm Addition

City of Naperville
Will County, Illinois

**Legend**

- Project Location
- Flow Path
- Subbasins
- 2-Foot Contours

N

Feet
0 600 1,200

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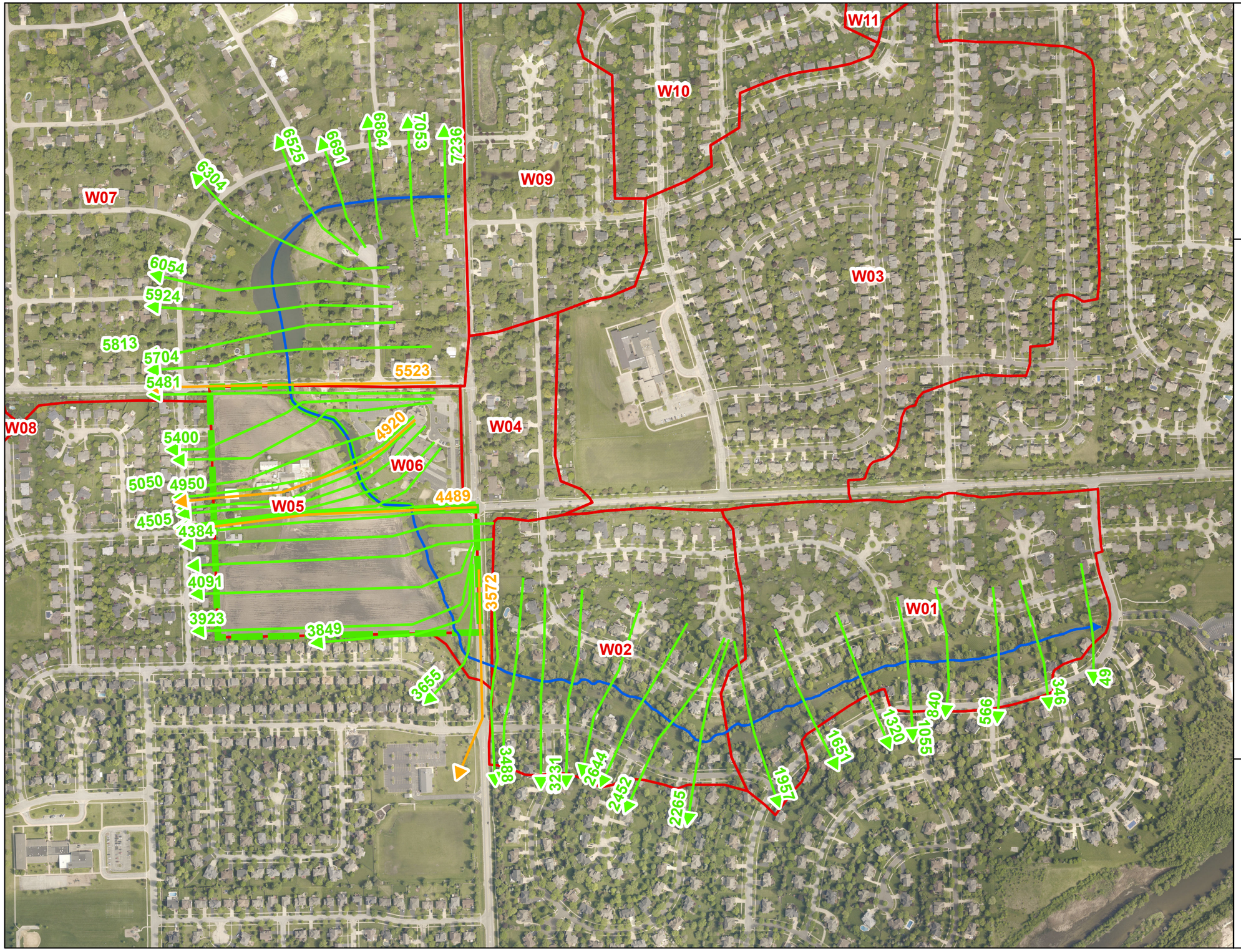
# Figure 2.
# HEC-RAS
# Cross-Sections

Clow Creek Farm Addition

City of Naperville
Will County, Illinois




**Legend**

- HEC-RAS XSCutLines
- HEC-RAS Bridges
- HEC-RAS River
- Project Location
- Subbasins

N

0 300 600 Feet

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