



# St. Joseph Creek Streambank Study

Village of Downers Grove, Illinois



CBBEL Project No. 150068

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## 1. INTRODUCTION

At the request of the Village of Downers Grove, Christopher B. Burke Engineering, Ltd. (CBBEL) evaluated the condition of the streambanks of St. Joseph Creek. The purpose is to provide an assessment of existing stream conditions as baseline information for potential use in obtaining grant monies for future maintenance repairs, streambank stabilization, invasive species management, or water quality improvement projects. This field evaluation was completed over three days May 14, 19 and 28, 2015, within the village limits of Downers Grove, DuPage County, Illinois. The evaluation started from the west (downstream) limit at I-355 to the east (upstream) limit at Carpenter Street. The location of St. Joseph Creek within the Village limits is shown in the Location Map under Tab 1. In addition to erosional areas, locations with invasive species and maintenance issues were also mapped.

This document provides planning level recommendations for corrective actions where erosion is severe enough to compromise property and/or negatively impact stream water quality. The report emphasizes priority repair locations where maintenance is recommended, and also contains notes regarding moderate and minor erosional areas and general stream characteristics. Locations where erosion repairs are recommended (found at Tab 2, Sheets 1-13) are designated as "S" (for slope), and include areas that typically exhibited two or more feet of near vertical streambank erosion or were located near residences, roads or infrastructure. Locations having severe erosion (typically  $\geq 4$  feet of eroding bank) (indicated in RED) were identified for priority repair consideration. Locations having moderate erosion (2 feet to 4 feet) (indicated in ORANGE) were ranked next highest priority. Locations having minor erosion ( $\leq 2$  feet) (indicated in YELLOW) were lowest priority, but were noted where erosion was greater than the typical or adjacent streambank reach.

Maintenance items were ranked similarly to erosion items, as severe, moderate, or minor. Locations where maintenance such as debris removal is recommended are designated as "M" (indicated with BLACK dots). Areas of invasive species are labeled in numeric order with abbreviations for common names, such as JK=Japanese knotweed, RCG=Reed canary grass, or BW=Bishop's weed (indicated in BLUE). Locations listed as representative stream photos are numbered by corresponding sheet number followed by A, B, C, etc. For example, representative stream photos for Sheet 4 are marked as 4A, 4B, etc. with BLACK arrows.

Plan sheets identifying locations that require stabilization, maintenance, and vegetation management practices are shown on aerial exhibits 1-13 in Tab 2. Photograph exhibits that correspond to the stabilization, maintenance, and vegetation management practices shown on the plan sheets are located at Tab 3. Photo numbers also correspond to the action numbers of recommended practices and costs listed in Tab 4, page 13. Please note that not all locations have photographs.

Stationing was set from downstream to upstream, going west to east beginning at I-355 (Station 0+00) west to Carpenter Street (Sta. 147+00). The study area was confined to St. Joseph Creek and 9 tributaries within a distance of approximately five miles. All identified tributaries were evaluated for erosion, maintenance issues and invasive species. Any previously completed repairs are shown on the plan sheets. The descriptions follow plan sheet numbers in Tab 2. A

description of existing conditions is under Section 2, EXISTING CONDITIONS. Recommended corrective actions are in Section 3, RECOMMENDED ACTIONS AND ESTIMATED COSTS.

The objectives of the recommended actions are the following:

- Stabilization of severe erosion areas to prevent further erosion of the creek banks.
- Reduce the coverage of non-native and invasive plant species occurring within the creek corridor.
- Reduce non-point source pollutants, including streambank erosion and instream sedimentation.
- Enhance water quality and improve aquatic habitat to sustain or increase wildlife including macro-invertebrate populations and quality/diversity of fish species.

## 2. EXISTING CONDITIONS

During the time frame of the assessment St. Joseph Creek discharge rates appeared to be near median or below median daily statistic for St. Joseph Creek (the closest stream gage was at Route 34 in Lisle – USGS Streamflow website) and most tributaries contained flowing water. Water clarity in most locations was very good during the assessment and depth ranged from 3 inches deep to approximately 3 feet deep. Average water depth was approximately 1.6 feet. The bottom substrate consisted mainly gravel, cobble, sand and small amounts of silt and organic detritus. The gravel in the substrate was well embedded and the substrate was firm. The majority of the stream was relatively clear of debris and trash. Some fish were observed in deeper pools with species such as Johnny darter (*Etheostoma nigrum*), creek chub (*Semotilus atromaculatus*), green sunfish (*Lepomis cyanellus*), common carp (*Cyprinus carpio*) and possibly a dace species. One location contained plant populations of the desirable submergent plant, native common waterweed (*Elodea canadensis*).

The majority of the streambank side slopes were dominated by trees (locusts, maples and cottonwoods) and invasive shrubs (honeysuckle) or the invasive Japanese knotweed (*Fallopian japonica*). The majority of the riparian corridor, that was wooded, was dominated by young to mature honeysuckle shrubs. It was so ubiquitous it was not mapped; unless found in an area mainly devoid of honeysuckle. In many areas where honeysuckle was absent, Japanese knotweed was dominant. We did not observe any Japanese stilt grass during our visits. Although the majority of the stream corridor was dominated by invasive understory and herbaceous plant species, there were some areas that contained native plants along the banks. Desirable native species observed included Virginia bluebells (*Mertensia virginica*), wild ginger (*Asarum canadense*), common violet (*Viola sp.*), jewelweed (*Impatiens capensis*), Drummond's aster (*Aster sagittaria drummondii*), Virginia waterleaf (*Hydrophyllum virginianum*), brown fox sedge (*Carex vulpinoidea*), nettle sp. (*Urtica sp.*), tickseed sp. (*Bidens sp.*), wild geranium (*Geranium maculatum*), may apple (*Podophyllum peltatum*), Virginia creeper (*Parthenoclia quinquefolia*), and black snake root (*Sanicula gregaria*).

No mussels were observed in the stream, however a couple of Asian clam shells were found. Headwater streams typically do not have mussels present and fish observed were typical pioneer species such as minnows and green sunfish.

In some areas where the floodplain was flat and broad, herbaceous vegetation consisting of graminoids (grasses, sedges, and grass-like vegetation such as cattail (*Typha sp.*) was dominant and woody vegetation was sparse. There was no significant erosion over the majority of the streambank length. Most of the streambanks were stable or were eroded below the minor ranking of 2 feet used as the threshold amount for this study. Eroded areas were minor to moderate due to the straightened channel that lacked meanders. Notable streambank erosion occurred on outside meanders, while many eroded areas were associated with scoured depressions and rills that formed at pipe discharge and culvert outlet apron areas.

### **Stream Reach Descriptions**

This section describes the erosion locations, maintenance issues, and invasive species observed within St. Joseph Creek and tributaries by **Sheet Number (1-13)(Tab 2)**. Corresponding representative photos are provided in Tab 3. Most erosional areas were photographed to document day of conditions, however, a few small or minor locations were not photographed and are denoted with an (\*). Only representative photos of invasive species locations are shown to reduce redundancy.

#### **Sheet 1: I-355 to Walnut Avenue** (Representative Photos – Tab 3, Exhibit 1)

This section contains the main stem of St. Joseph Creek (00+00 to 25+00) which is approximately 30 feet wide with water depths ranging from 3-12 inches. The substrate is firm to walk on and consisted of embedded gravel with a large cobble. The riparian vegetation is poor quality (Representative Stream views Photos 1A-1B) and is dominated by Japanese honeysuckle, Japanese knotweed, locust and maples. Where there were no shrubs in a somewhat open canopy, Japanese knotweed was observed. There were two Japanese knotweed locations (3JK and 8JK). Japanese knotweed appeared to be contained within a 10-15 foot width in the riparian zone along the banks. There were 12 areas of erosion observed (2S, 4S, 5S, 6S, 9S, 10S\*, 11S\*, 12S, 13S, 14S, 16S and 17S). Erosion varied between 2-5 feet of vertical cut. The majority of slope erosion observed on Sheet 1 was considered typical for a channelized stream and are considered minor to moderate. The exception is 6S, where surface drainage created a 10 foot drop off.. This location requires an examination of the pipe placement and capacity. It appears that the amount of water coming through during storm events along the slope at that location is causing severe erosion that should be addressed. Two maintenance items include 1M-woody debris blocking box culvert and 15M-excessive sediment accumulation. Access to this stream reach for slope repair is difficult due to mature trees, dense shrubs and fencing associated with the water treatment plant. The Tributary to St. Joseph Creek located by I-355 (400+00 to 450+00) was unreachable due to fencing associated with I-355 and was not observable from the water treatment plant. The tributary did not have any water flow at the time of the assessment.

#### **Sheet 2: East of Walnut Avenue to Curtiss Street** (Representative Photos – Tab 3, Exhibit 2)

This section contains the main stem of St. Joseph Creek (26+00 to 35+00) and was overall similar to Sheet 1. The conditions are similar, however there are more mature maple and cottonwood trees present on the banks (Representative Stream views 2A-2B). The riparian zone also

contained a moderate density of honeysuckle and was generally wider. Stream substrate was generally firm to walk on with little sedimentation. Stream depths were up to 20 inches deep in pools. Japanese knotweed was found in areas that shrubs or canopy cover was missing (areas observed were 50 to 100 feet long and were contained to approximately 10 foot width along the bank) (21JK, 23JK, 29JK, and 32JK). A 50 foot section of reed canary grass was also observed at 18RCG. Erosion is minor to moderate at various locations within the stretch. There were 6 areas of erosion observed (19S, 20S, 22S, 24S, 30S, and 35S). Erosion varied between 2-4 feet. There is one maintenance issue located at 31M, which is a concrete apron that has broken into slabs. The tributary to St. Joseph Creek had four areas of erosion (25S, 26S, 27S and 28S). Areas 25S and 26S were observed to be severely eroded with 10 foot sheer slopes. The majority of this tributary was in satisfactory condition. Access to the stream would be from the Water Treatment plant (fencing may be an issue) or through undeveloped properties adjacent to the creek.

**Sheet 3: Eastern Edge of Water Treatment Plant to Curtiss Street** (Representative Photos – Tab 3, Exhibit 3)

St. Joseph Creek main stem (35+00 to 51+00) is a straight channelized portion of the creek that also contains a dominant wooded riparian corridor (Representative Stream View - 3A). Water depths ranged from 8-18 inches. The riparian corridor is wider to the north of the stream. The south portion abuts light industry. The east end of the creek south of Curtiss Street has a concrete slope on the south side and the north slope was vegetated with Japanese knotweed. Noteworthy is a population of waterweed (*Elodea, sp.*) that was established in the stream south of Curtiss Street. There are 10 areas populated by Japanese knotweed (36JK, 37JK, 38JK, 39JK, 40JK, 43JK, 44JK, 45JK, 48JK, and 50JK) ranging from 25 feet to 300 feet long. This stream reach has three erosional areas (41S, 46S and 47S). A small tributary contained dense shrubs and erosion area 42S. A maintenance issue was observed at 49M, which is sedimentation. Access to the creek would be most possible from the parking lot north of Curtiss Street.

**Sheet 4: South of Curtiss Street to Belmont Road** (Representative Photos – Tab 3, Exhibit 4)

On Sheet 4 the main stem St. Joseph Creek continues as a channelized stream (51+00 to 68+00) south of Curtiss Street and under Belmont Road (Representative Stream Views 4A-4B and 4C). This stream reach is located within a narrow wooded riparian corridor west of Belmont Road. Water depth ranged from 10 inches to 3 feet deep. Water depths upstream of the dam were observed to be greater than 2 feet. Long stretches of Japanese knotweed from 200 feet to 825 feet long were observed (51JK, 52JK, 56JK). Japanese knotweed is well established along the stream east of Belmont Road on residential property (62JK, 63JK and 64JK). There is a lowhead dam made of sheetpiling just east of the Belmont Road bridge (Tab 2 -Sheet 4)(60M). There were five erosional areas observed (53S\*, 54S, 55S\*, 57S, and 61S) ranging from 50 feet to 150 feet long. Three maintenance items are shown (58M-broken concrete slopes, 59M-sediment deposit in culvert and 60M-wood debris in dam). There is no fence along the stream and access would be from industrial business parking lots and turf areas to the west of Belmont Road. Access to the East of Belmont Road would be through individual homeowner lots.

**Sheet 5: East of Belmont to West of Cornell Avenue** (Representative Photos – Tab 3, Exhibit 5)

This section of St. Joseph Creek (68+00 to 86+00) resembles a more naturalized stream with a few meanders. Representative stream views are 5A, 5B and 5C. Extensive amounts of Japanese knotweed were present (63JK, 64JK, 65JK, 68JK, 74JK, 76JK, 78JK, 79JK, 80JK and 83JK). Stream depths were between 12 – 15 inches deep. There are, however, long stretches of eroded slope mainly minor to moderate (from 50 feet to 400 feet and 3 – 5 foot cuts, and include areas 66S, 69S, 71S, 72S, 73S, 75S, and 77S\*). Maintenance issues included 70M-wood debris, 81M-exposed and disconnected pipe and 82M-downed tree over creek. Access to a large section of the stream would be through an access road off Curtiss Street, a continuation of Glenview Avenue.

**Sheet 6: Cornell to Lee Avenue (N) and South of Elmore Avenue (S)** (Representative Photos – Tab 3, Sheet 6)

This sheet shows the main stem of St. Joseph Creek (85+00 to 95+00) follows a natural morphology (non-channelized) with bends, riffles runs and pools and water depths of 8 – 18 inches deep. Representative stream views are shown at 6A and 6B. This section flows through private wooded property. A view of the tributary is shown on 6C. Although surrounded by residential, the wooded riparian corridor is relatively narrow. The main stem has four erosion areas observed: 77S\*, 87S, 89S and 92S, between 1-3 feet of cut. Japanese knotweed was extensive in this section with 9 locations: 80JK, 83JK, 84JK, 85JK, 86JK, 88JK, 90JK, 91JK and 93JK. A small area of reed canary grass was observed (101RCG). One maintenance issue 82M is covered on Sheet 5. The tributary to St. Joseph Creek (700+00 to 713+00) was observed to be in relatively stable condition. Erosional areas were observed south of Elmore Street at 97S\*, 98S, 99S and 100S\*. Maintenance issues include 95M-flared culvert bottom rusting out and 96M-old timber wall has gaps. Access to the stream would be through private property.

**Sheet 7: South of Elmore Avenue to Maple Avenue** (Representative Photos – Tab 3, Exhibit 7)

Three headwater tributaries to St. Joseph Creek, located North of Maple Avenue, were assessed (100+00 to 103+00 - West, 713+00 to 725+00 - Central, 1000+00 to 1006+00 - East). Representative photos include 7A-C. The riparian corridor was poorly developed and only small sections were wooded. Slope erosion was only found near Maple Avenue due to steep slopes (105S\*, 106S, 107S). The east tributary was a dry shallow turf swale east of Fairhaven Court, and had little to no water flow at the time of the assessment. No erosion was observed on this tributary. The central tributary has observable water flow with water depths between 3-6 inches deep. Three small sections of the tributary had pockets of reed canary grass in the ditch (102RCG, 103 RCG and 104RCG). The west tributary has two issues one erosion area 109S (in turf) and invasive weeds (reed canary grass, thistle, and teasel) at the northwest corner of 55<sup>th</sup> and Stonewall Avenue (108RCG). There was no water in this tributary. There is a very small area of reed canary grass on a property located along Fairhaven Ct. Repaired stream banks using hardscaping are

shown on 7D and 7E. Maintenance point 107.1M consists of a stream bottom washout. Access to many of the tributary section are close to roads and all are on residential property.

**Sheet 8: Lee Avenue to Maple Grove Forest Preserve** (Representative Photos – Tab 3, Exhibit 8)

The majority of these headwater tributaries through residential property to St. Joseph Creek are located north of Maple Avenue near Lee Avenue follow a natural meandering course and include (South 204+00 to 223+00) (East 1300+00 to 1306+00, 1600+00 to 1604+00) (West-1400+00 to 1404+00) some locations have the toe of slope stabilized with boulders, wood pilings, stone or flatrock. Representative photos are 8A, 8B and 8C. No Japanese knotweed was observed in this area. There were two “No Access” areas on the sheet and were not assessed. Erosional locations were observed at 112S-117S, 200S-205S and ranged from minor to 5 feet in cut. One maintenance area was observed, 111M (inlet blocked by leaf debris). Access is through residential properties only off Lee Avenue or Maple at the park.

**Sheet 9: Lee Avenue (S) to Lee Avenue (N)** (Representative Photos – Tab 3, Exhibit 9)

This section of the main stem of St. Joseph Creek flows mainly through residential property (95+00 to 112+00). Representational photographs are shown as 9A and 9B. This section has extensive amounts of Japanese knotweed (122JK, 123JK, 126JK, 131JK, and 133JK). There were two areas noted where Japanese knotweed has been treated with herbicides (118JKMGT and 121JKMGT). A majority of this section has erosional issues and long sections of eroded slopes were observed (119S, 119.1S, 120S\*, 124S, 125S, 127S, 130S, 132S, 132.1S, 134S and 135S). Erosion varied from 2-5 feet vertical cuts. Maintenance issues were noted at 128M (wood debris at bridge) and 129M (wood debris at bridge). Access to this stream reach is through private residential property. Some access is possible from Gilbert Avenue and off Lee Avenue.

**Sheet 10: Gilbert Avenue to East of Jacqueline Court** (Representative Photos – Tab 3, Exhibit 10)

This section of the main stem of St. Joseph Creek is located south of Gilbert Avenue. Part of the stream flows through Maple Gove Preserve and the remainder through residential properties (112+00 to 129+00). Representative photos are shown as 10A, 10B and 10C on Exhibit 10 (Tab 3). Japanese knotweed was present at the following locations: 143JK, 145JK, 147JK, and 149JK. There were two Japanese knotweed management areas (146JKMGT and 151JKMGT). Most of the erosional issues are associated with Maple Grove Preserve (135S, 137S, 137.1S, 139S, 141S, 142S (erosion 3 foot vertical cut) while the remainder was observed on residential property (144S, 148S, 150S and 152S (3-4 foot vertical cut)). Maintenance issues were noted at 136M and 146.1 M (wood debris at bridge). Some sections in the preserve were observed to have pervious work completed such as the stabilization with Ajax and gabions. Access is limited to locations near Gilbert Avenue, Forest Preserve Trails and Jacqueline Drive within residential properties.

**Sheet 11: South of DeWitt Lane to Carpenter Street** (Representative Photos – Tab 3, Exhibits 11A-11B)

This is the most upstream section of the main stem of St. Joseph Creek (129+00 to 147+00) within the project study area. There are three tributaries to St. Joseph Creek at this location (North 300+00 to 312+00, Southwest 1800+00 to 1803+00 and Southeast 1900+00 to 1902+00). Representative photographs of the stream include 11A-F (Exhibit 11, Tab 3). The two southern tributaries continue onto sheets 12 and 13. This reach has extensive amounts of Japanese knotweed (153JK, 157JK, 160JK, 167JK, 170JK, 171JK, 172JK, 173 JK, 177JK and 178JK). There were two Japanese knotweed management areas (160JKMGT and the east end of 172JK). Erosional areas included 154S\*, 155S\*, 156S, 158S, 159S, 161S, 162S, 163S, 164S, 165S, 166S, 168S, 169S, 174S, 175S\*, 176S, and 179S\* (3-4 feet vertical cut). No maintenance locations were found in this reach. Access to the stream is through residential property with some road crossings at Turvey Road and Gilbert Avenue.

**Sheet 12: North of Turvey Road to South of Turvey Court** (Representative Photos – Tab 3, Exhibit 12)

Sheet 12 shows the southwest tributary to St. Joseph Creek (1801+00 to 1817+00) from Sheet 11. This headwater tributary originates at a pond on private residential property. Representative photos are 12A-D. Only one Japanese knotweed location was observed at 209JK. Only one erosional issue was observed at 207S with minimal erosion. Only one maintenance issue was observed at 208M. Access to this tributary is through residential property.

**Sheet 13: North of Curtiss Street to Brookbank Road** (Representative Photos – Tab 3, Exhibits 13A-13B)

The southeastern tributaries to St. Joseph Creek (Central 1901+00 to 1918+00, West 2100+00 to 2102+00 and East 2000+00 to 2005+00) are in relatively good condition regarding slope erosion. Representative photos are 13A-F. No Japanese knot weed was observed in this reach. Five Bishop's weed areas were observed (208BW-212BW). Erosional areas were observed to be relatively short lengths and include: 179S\*, 180S, 181S, 183S, 184S, 185S, 187S, 188S\*, 189S, 190S, 191S\*, 193S, 194S, and 197S and erosion ranged from 2-6 foot vertical cut. Maintenance issues included 182M-poor concrete placement at culvert, 186M (partially collapsing stone wall at culvert), 191M (pipe exposed crossing stream 2-3 feet above stream bottom), 195M (loss of soil/flared end rusting out), 196M (retaining wall losing vertical integrity), 198M (plunge pool developed and needs rock) and 199M (excessive sediment buildup in front of culvert). Access to erosional locations is mainly through residential properties. Section of the tributary are located in common area properties between road ways along Turvey Road.

### 3. RECOMMENDED ACTIONS AND ESTIMATED COSTS

Each location in Tab 2 has an action item found in Tab 4. The table contains information such as location by station, sheet number, the erosion control practice, and quantity, unit of measurement, and estimated cost based on the recommended actions. The approximate locations of recommended remedial actions, the type of erosion control, maintenance, or vegetation management proposed, and the approximate costs are found in Tab 4 and corresponding aerial exhibits (Tab 2, Plan Sheets 1-13).

CBBEL observed two main erosional types within St. Joseph Creek that were recorded while walking west to east, upstream in St. Joseph Creek:

- 1) Streambank/slope erosion.
- 2) Pipe outfall related erosion.

Following the action number is an “S” for Slope erosion or an “M” for Maintenance. Slope erosion is defined as near vertical, sloughing soil, that may have exposed tree roots or lacking vegetation that is 2 feet in height or greater along the streambanks or on upper slope areas located adjacent to a roadway or structure. Pipe erosion is defined as scoured depressions, toe of slope erosion, or rills formed on slopes near stormwater structure/pipe drainage outfalls. Maintenance action items include debris removal, such as accumulated sediment, snags and tree removal, repair of pipes, or adding stone aprons at pipe discharges.

#### Recommended Erosion Repairs

The four general corrective actions for erosion repairs recommended in Tab 4 are summarized below. *Note that agency/permitting requirements are not addressed.*

1. Stone/Boulder Toe:
  - Clear trees: Remove and dispose of trees/shrubs for installation of practice and access. Chip or cut and dispose of off-site, or use chips for path/trail. Grub stumps where necessary. Herbicide cut stumps to help prevent re-growth.
  - Re-grade: Eroded slopes should be re-graded to 2 to 1 or flatter depending on the available work area or structural limitations within the adjacent property. A fiber encapsulate slope is recommended to help stabilize and vegetate the re-graded slope consisting of fill soil. In some cases, trees will need to be cleared so that re-grading can be completed.
  - Stone toe: The toe of the slope requires protection with appropriately sized rip rap or boulders, generally 12” or larger diameter in St. Joseph Creek and 6” or larger in tributaries. Irregular shaped riprap is generally recommended because it is less likely to move; however, granite boulders, flagstone, landscape blocks, or other material may be used in some areas to match the adjacent existing landscape. The imbedded stone toe should extend from 1’ below base flow surface water

elevation to 0.5'-1' above the scour line, which is approximately 2' above the base flow water elevation at St. Joseph Creek.

- Vegetate: The re-graded slope above the stone toe should be seeded with cover crop and deep rooted native vegetation (shoreline wetland and shade-tolerant riparian species) and erosion control blanket to help establish and maintain herbaceous cover on the re-graded slopes. Native shrubs can be densely planted in shady areas having canopy trees in an effort to prevent non-native honeysuckle or buckthorn from establishing.

## 2. Gabion:

- Clear trees: Remove and dispose of trees/shrubs for installation of practice and access. Chip or cut and dispose of off-site, or use chips for path/trail. Grub stumps where necessary. Herbicide cut stumps to help prevent re-growth.
- Excavate: Excavate at base and slope of severely eroding banks in order to install gabion baskets in close proximity to structures or where area to re-grade the slope is not available. Wire gabion baskets filled with stone should be installed to protect the stream toe of slope and structures near the creek, and contain the upper bank that can be graded to a stable angle of repose for vegetative stabilization. A fiber encapsulate slope is recommended to help stabilize and vegetate the fill soil placed above gabions.
- Vegetate: The re-graded slope above the gabion should be seeded with cover crop and deep rooted native vegetation (such as prairie/savanna grass species in open areas or shade tolerant riparian species under tree canopy) and erosion control blanket to help establish and maintain herbaceous cover on the re-graded slope.

## 3. Re-grade Slope and Stabilize with Vegetation (Re-grade Slope):

- Clear trees: Remove and dispose of trees/shrubs for installation of practice and access. Chip or cut and dispose of off-site, or use chips for path/trail. Grub stumps where necessary. Herbicide cut stumps to help prevent re-growth.
- Re-grade: Eroded slopes should be re-graded to 2 to 1 or flatter depending on the available work area or structural limitations within the adjacent property. Upper and lower reaches of the re-graded areas should match the grade of adjacent existing streambanks. In some cases, trees will need to be cleared so that re-grading can be completed.
- Vegetate: The re-graded slope above the gabion should be seeded with cover crop and deep rooted native vegetation (such as prairie/savanna grass species in open areas or shade tolerant riparian species under tree canopy). Bio-degradable erosion control blanket containing coir and straw fibers should be installed to help

vegetation quickly establish and maintain season-long stabilization of the re-graded slope. Native shrubs can be planted in shady areas having canopy trees in an effort to prevent non-native honeysuckle or buckthorn from establishing.

4. Erosion Repair at Pipe Discharge Areas (Pipe Erosion):

- Install stone: Install riprap (or granite boulders/cobble to match adjacent) at pipe/culvert outfalls, in apron areas and scour holes where pipes discharge and in slope rills/gullies where pipes discharge on upper slopes. The apron area and stone size should be based on IDOT “Figure 41-2.E” for “Minimum IDOT Rock Sizes and Apron Length for Maximum and Minimum Tailwater Conditions” (excerpt attached in Tab 5, referenced from [http://www.dot.state.il.us/desenv/bde/manual/bde/pdf/Chapter 41 Construction Site Storm Water Pollution Control.pdf](http://www.dot.state.il.us/desenv/bde/manual/bde/pdf/Chapter_41_Construction_Site_Storm_Water_Pollution_Control.pdf)).
- Repair rills: Rills/gullies on upper slopes should be shaped to form a concave chute, lined with fabric liner, and filled with riprap (or boulders) to direct flows down the center of the chute.
- Vegetate: The disturbed soil area adjacent to the repaired pipe erosion area/stone chute should be shaped to grade and seeded with cover crop and deep rooted native vegetation (shoreline wetland and shade-tolerant riparian grass species). Erosion control blanket should be installed to help establish and maintain stabilizing herbaceous cover on the disturbed soil.

### **Recommended Maintenance Items**

Three general corrective actions for maintenance items recommended in Tab 4 are summarized below.

1. Debris Removal:

- Remove cultural debris such as trash, metal objects, or other debris periodically throughout the stream reach and tributaries. Organize an annual community stream clean-up day, if possible.

2. Pipe Repair:

- Repair or replace broken, non-functioning pipes or end sections that can contribute to erosion or drainage problems within the creek or tributaries.

3. Tree/Snag Removal:

- Remove dead fallen trees and accumulated woody branches/debris within the channel near bridge culverts, stormwater discharge pipes, retaining walls, and other structures. Cut, remove, and herbicide cut stumps of live trees that are blocking, severely leaning, or causing bank erosion. Do not grub stumps, but leave in place to help hold bank soils in place.

## Vegetation Management Items

The two general vegetation maintenance items recommended in Tab 4 are summarized below.

### 1. Invasive Weed Control:

- Reduce coverage of invasive weed species including Japanese knotweed, reed canary grass, honeysuckles, buckthorn, Bishop's weed, garlic mustard, and others by herbiciding, using selective herbicides where possible.
  - Provide annual weed control before weed species flower and produce viable seed (varies by species). Several seasons of treatment will likely be needed to reduce the weed seedbanks.
  - Selectively herbicide Japanese knotweed using the broadleaf specific herbicide Element, Garlon 3A, or equivalent with active ingredient Triclopyr as an alternative to a non-selective active ingredient Glyphosate product such as Rodeo, Roundup, Aquaneat, or equivalent that kills nearly all vegetation including non-target species that may be intermingled. Follow label directions for suitable application times, rates, and restrictions.
  - Cut, remove, and herbicide cut stumps of invasive honeysuckle and buckthorn shrubs. We recommend targeting invasive shrubs in erosion repair areas and surrounding areas where clearing will occur. Other target locations are high visibility or traffic areas with good access, or perhaps in areas where neighbor's good stewardship of creek side property is known.

### 2. Native Planting:

- Once weed species are reduced or eliminated, which may take several growing seasons to exhaust the weed seed bank, native plantings are recommended. Follow-up weed control maintenance is important during the native species' early establishment period. Based on our May observations of desirable native species present and experience in riparian restoration, the following species are proposed:
  - Wood reed (*Cinna arundinacea*)
  - Jewelweed (*Impatiens capensis*)
  - Riverbank rye (*Elymus riparius*)
  - Silky wild rye (*Elymus villosus*)
  - Bottlebrush grass (*Hystrix patula*)
  - Wild golden glow (*Rudbeckia laciniata*)
  - Tall agrimony (*Agrimonia gryposepala*)
  - Clearweed (*Pilea pumila*)
  - Wild black currant (*Ribes americanum*)
  - Bloodroot (*Sanguinaria canadensis*)
  - Bedstraw (*Galium aparine*)
  - Wild geranium (*Geranium maculatum*)
  - Golden alexanders (*Zizia aurea*)
  - Mayapple (*Podophyllum peltatum*)
  - Virginia bluebells (*Mertensia virginica*)
  - wild ginger (*Asarum canadense*)

- common violet (*Viola sp.*)
- Drummond's aster (*Aster sagittaria drummondii*)
- Virginia waterleaf (*Hydrophyllum virginianum*)
- brown fox sedge (*Carex vulpinoidea*)
- tickseed (*Bidens sp.*)
- Virginia creeper (*Parthenafovia quinquefolia*)
- Black snake root (*Sanicula gregaria*)

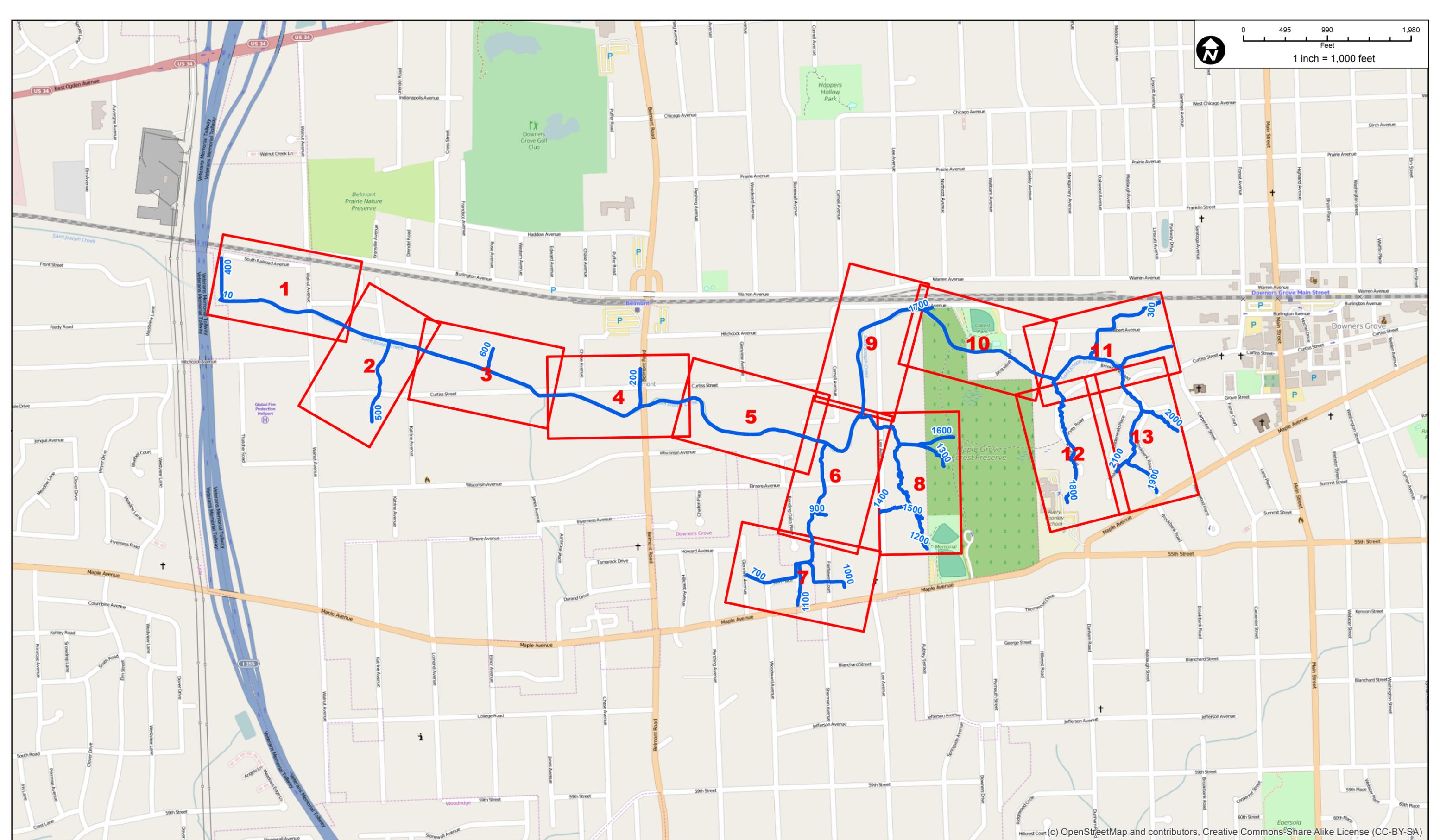
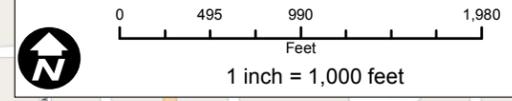
### **General Recommendations**

We recommend evaluating the streambank conditions every five years to monitor for new, excessive, or accelerated erosion and update the findings presented in this study. Periodic evaluations can help to pinpoint erosion problem areas, assess the effectiveness of repaired areas, and guide future maintenance needs and fiscal decisions. We recommend that the Village of Downers Grove implement an annual maintenance program to remove woody debris and trash, and maintain stone aprons at pipe outlets.

N:\DownersGrove\150068\Env\Docs\St Josephs Streambank Report.072315.docx

# **TAB 1**

St. Joseph Creek and Tributaries Streambank  
Study Location Map and Sheet Index



Hillcrest Court (c) OpenStreetMap and contributors, Creative Commons Share Alike License (CC-BY-SA)

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 Rosemont, Illinois 60018  
 (847) 823-0500

CLIENT:  
**VILLAGE OF DOWNERS GROVE**

NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	PLT DATE
				ArcGIS 10	7/24/2015
FILE NAME		COMPREHENSIVE STUDY SHEET INDEX			
PATH		N:\DownersGrove\150068\GIS\Exhibits\COMPREHENSIVE STUDY SHEET INDEX.mxd			

TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY  
 SHEET INDEX**

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 1 OF 1  
 DRAWING NO.  
**1**

# **TAB 2**

St. Joseph Creek and Tributaries  
Streambank Study  
(Sheets 1-13)

**Legend**

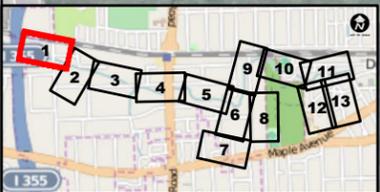
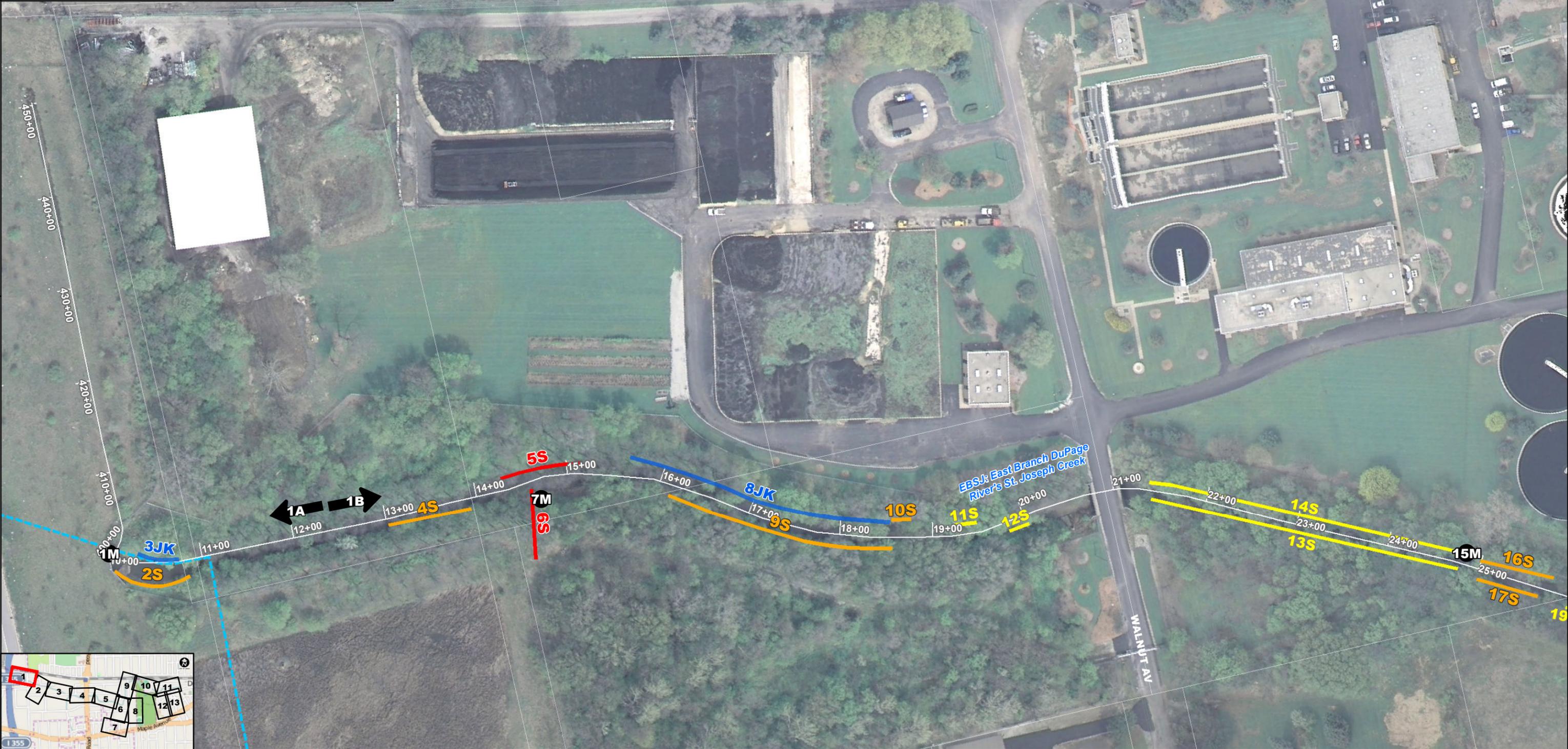
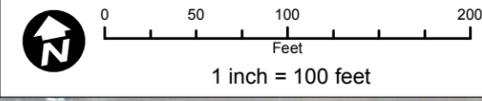
- ◀ STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- ▬ INVASIVE SPECIES LOCATION
- ▬ EXISTING WEED MANAGEMENT AREA
- ▬ EXISTING STABILIZED AREAS

**EROSION LOCATION**

- ▬ MINOR
- ▬ MODERATE
- ▬ SEVERE

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
 RCG: Reed Canary Grass  
 BW: Bishop's Weed  
 GM: Garlic Mustard  
 HS: Honeysuckle  
 JKMG: Japanese Knotweed Management Area

▬ VILLAGE OF DOWNERS GROVE BOUNDARY  
 ▬ NO ACCESS  
 ▬ PROPERTY BOUNDARY



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NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	PLT DATE
				ArcGIS 10	7/22/2015
FILE NAME		COMPREHENSIVE STUDY			
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 STREAMBANK STABILITY STUDY**  
 STA 10+00 TO STA 25+00  
 STA 400+00 TO STA 450+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 1 OF 13  
 DRAWING NO. **1**

**Legend**

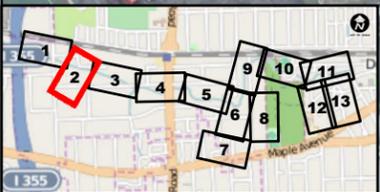
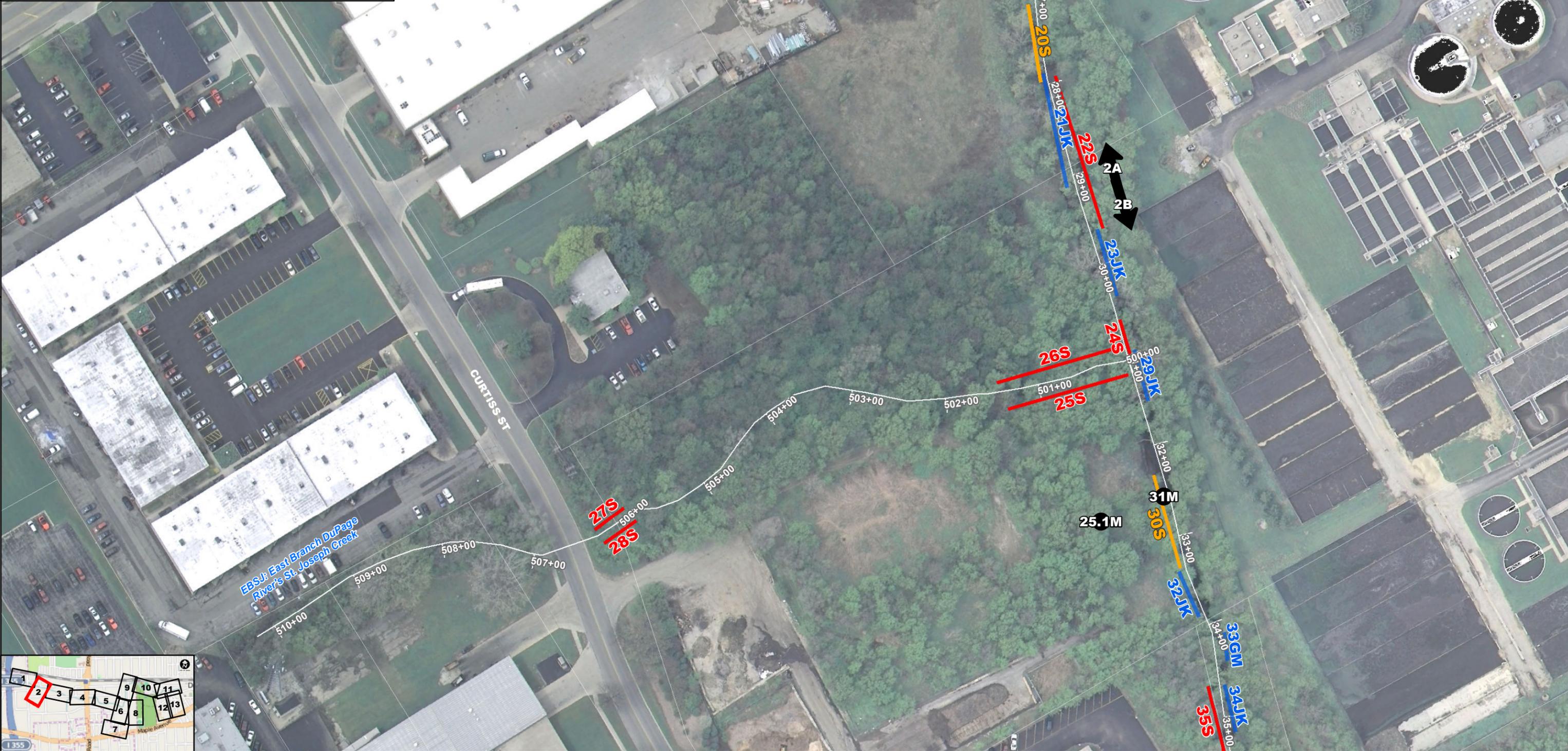
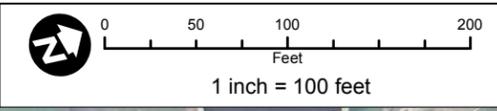
- ◀ STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

- MINOR
- MODERATE
- SEVERE

1-212: Location  
 S: Slope Erosion  
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 RCG: Reed Canary Grass  
 BW: Bishop's Weed  
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VILLAGE OF DOWNERS GROVE BOUNDARY  
 NO ACCESS  
 PROPERTY BOUNDARY



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NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	ArcGIS 10
FILE NAME	COMPREHENSIVE STUDY				
PATH	N:\DownersGrove\150068\GIS\Exhibits\COMPREHENSIVE STUDY.mxd				

TITLE: **ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 26+00 TO STA 35+00  
 STA 500+00 TO STA 510+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 2 OF 13  
 DRAWING NO. **2**

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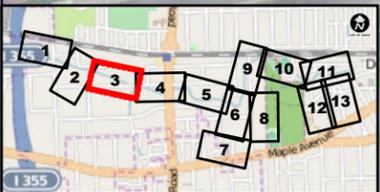
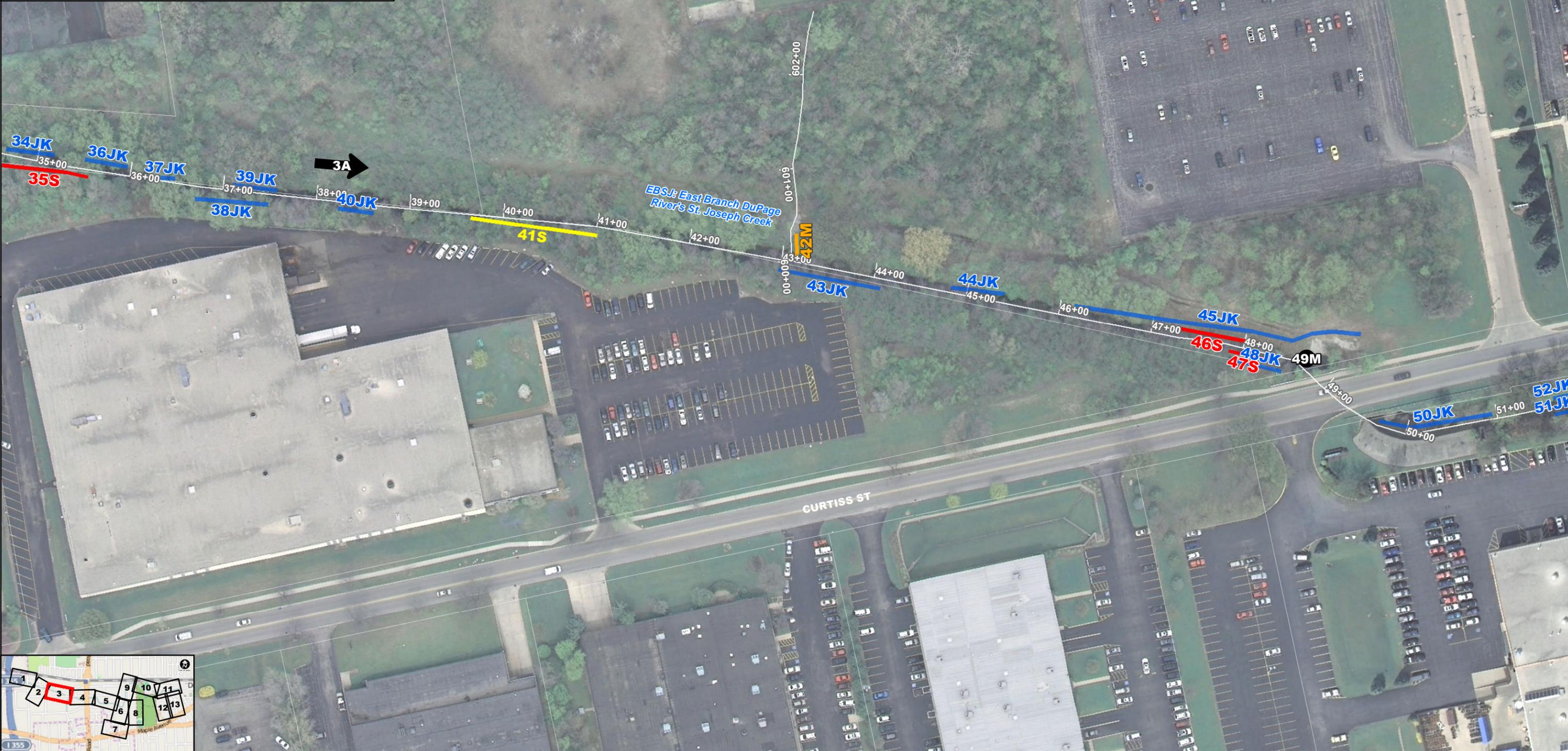
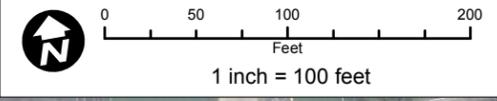
- ◀ STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- ▬ INVASIVE SPECIES LOCATION
- ▬ EXISTING WEED MANAGEMENT AREA
- ▬ EXISTING STABILIZED AREAS

**EROSION LOCATION**

- ▬ MINOR
- ▬ MODERATE
- ▬ SEVERE

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
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▬ VILLAGE OF DOWNERS GROVE BOUNDARY  
 ▬ NO ACCESS  
 ▬ PROPERTY BOUNDARY



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				ArcGIS 10	7/22/2015
FILE NAME		COMPREHENSIVE STUDY			
PATH		N:\DownersGrove\150068\GIS\Exhibits\COMPREHENSIVE STUDY.mxd			

TITLE: **ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**

STA 35+00 TO STA 51+00  
 STA 600+00 TO STA 602+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 3 OF 13  
 DRAWING NO. **3**

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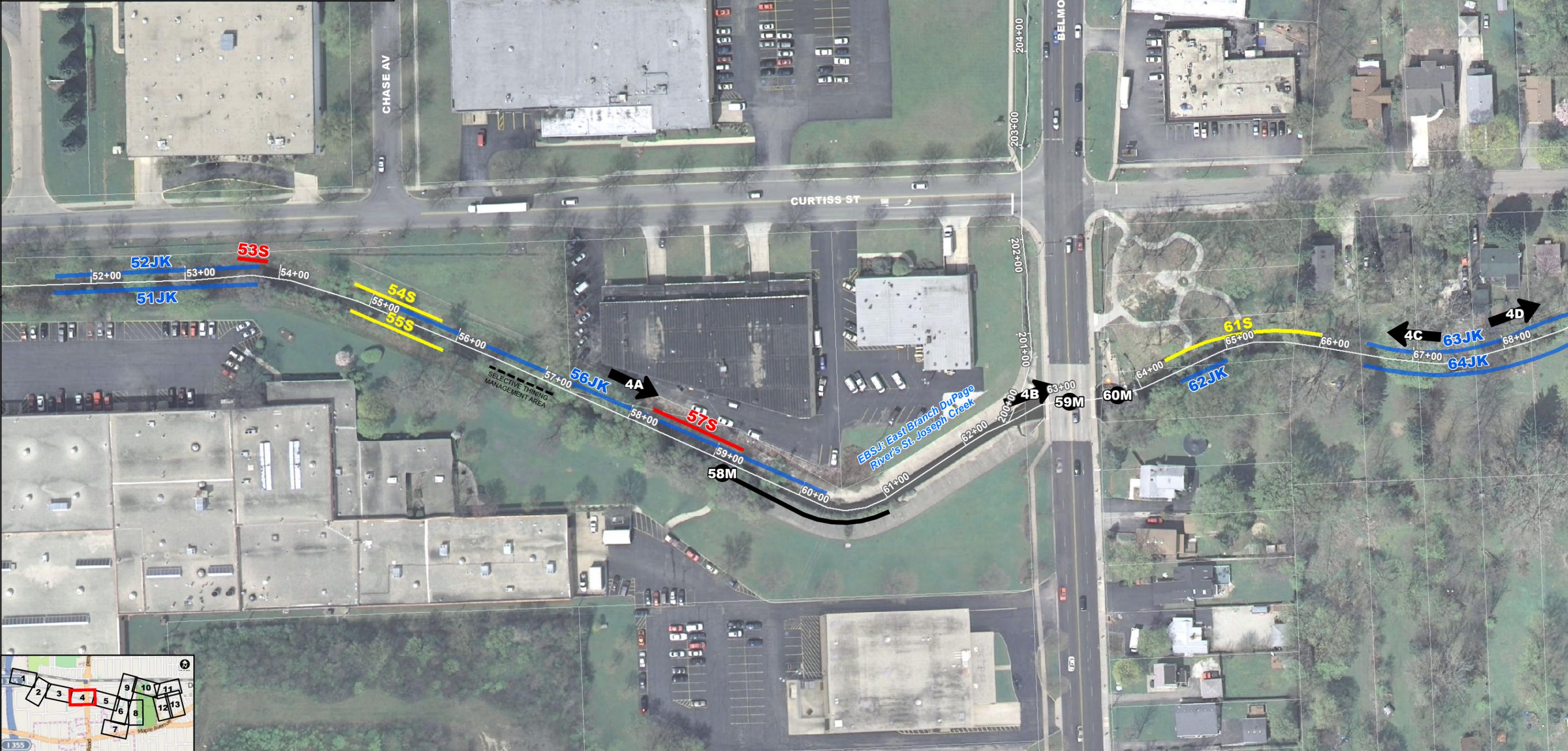
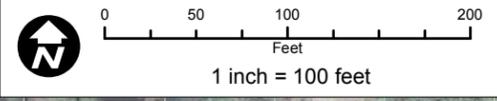
- STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

- MINOR
- MODERATE
- SEVERE

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
 RCG: Reed Canary Grass  
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 HS: Honeysuckle  
 JKMG: Japanese Knotweed Management Area

VILLAGE OF DOWNERS GROVE BOUNDARY  
 NO ACCESS  
 PROPERTY BOUNDARY



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TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 52+00 TO STA 68+00  
 STA 200+00 TO STA 204+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 4 OF 13  
 DRAWING NO.  
**4**

**Legend**

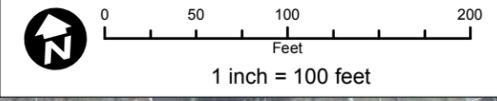
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- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

- MINOR
- MODERATE
- SEVERE

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
 RCG: Reed Canary Grass  
 BW: Bishop's Weed  
 GM: Garlic Mustard  
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[Blue dashed line] VILLAGE OF DOWNERS GROVE BOUNDARY  
 [Green dashed line] NO ACCESS  
 [Grey dashed line] PROPERTY BOUNDARY



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TITLE: **ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 68+00 TO STA 86+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 5 OF 13  
 DRAWING NO. **5**

**Legend**

- STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

- MINOR
- MODERATE
- SEVERE

**VILLAGE OF DOWNERS GROVE BOUNDARY**

- NO ACCESS
- PROPERTY BOUNDARY

**1-212:** Location

**S:** Slope Erosion

**P:** Pipe Erosion

**M:** Maintenance Item

**JK:** Japanese Knotweed

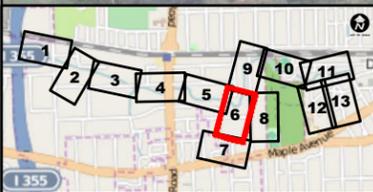
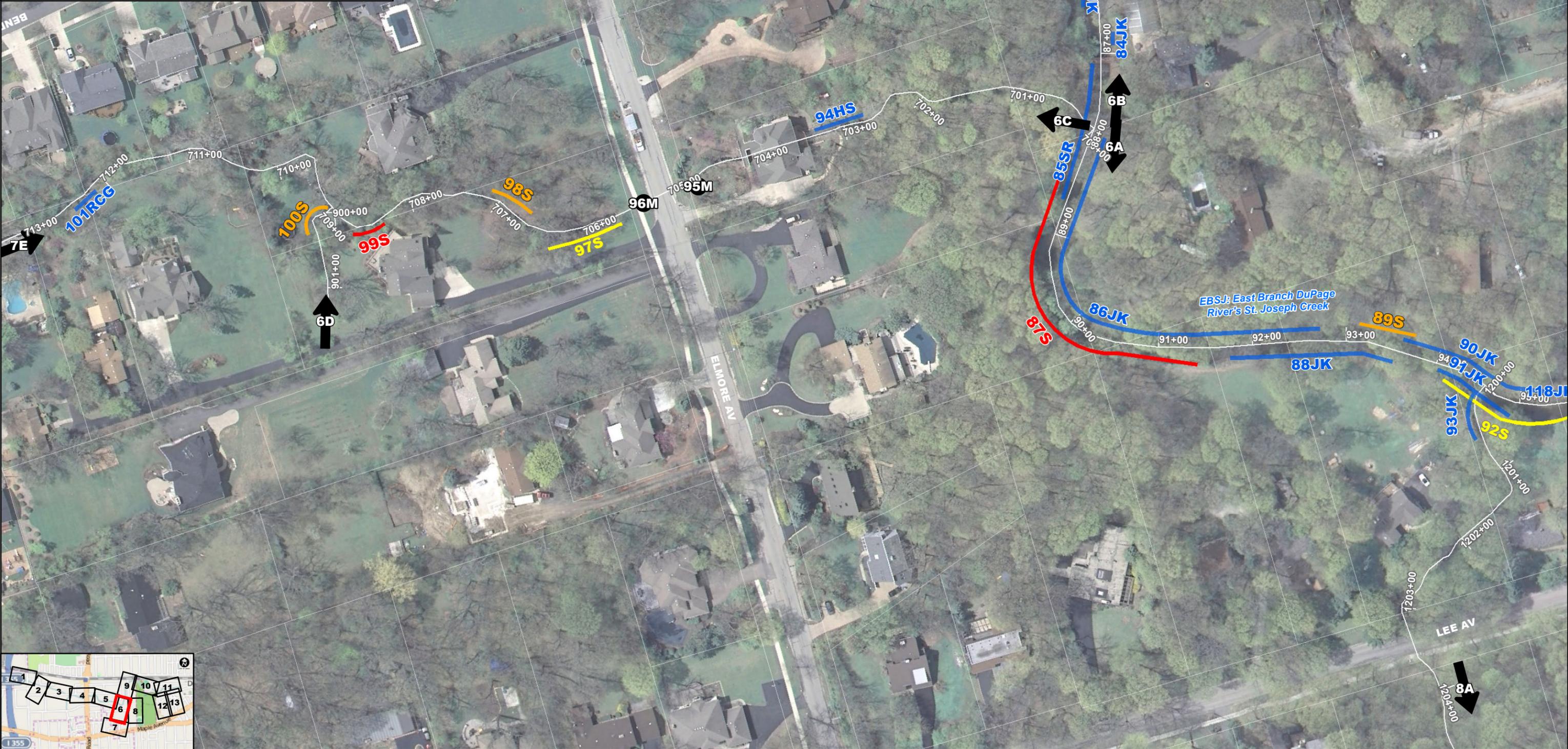
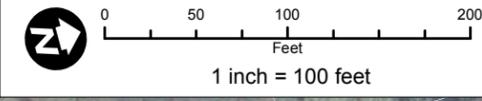
**RCG:** Reed Canary Grass

**BW:** Bishop's Weed

**GM:** Garlic Mustard

**HS:** Honeysuckle

**JKMGT:** Japanese Knotweed Management Area



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TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 85+00 TO STA 95+00, STA 1200+00 TO STA 1204+00  
 700+00 TO 713+00, 900+00 TO 901+100

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 6 OF 13  
 DRAWING NO.  
**6**

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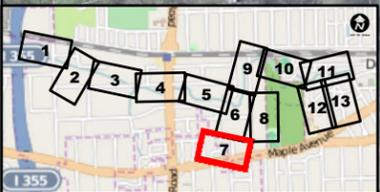
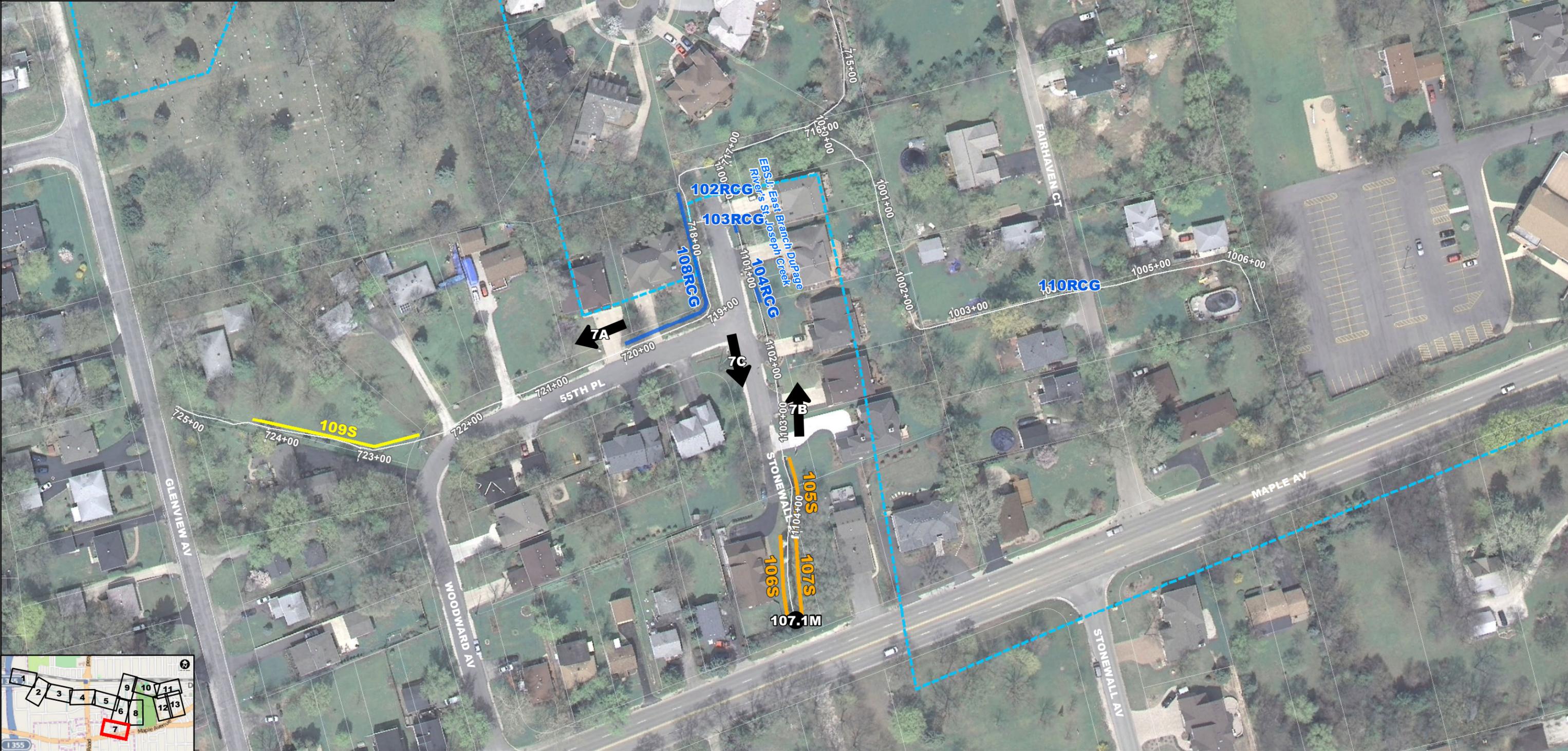
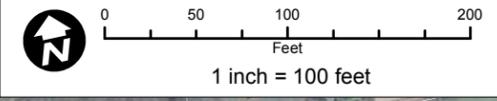
- STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

- MINOR
- MODERATE
- SEVERE

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
 RCG: Reed Canary Grass  
 BW: Bishop's Weed  
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 HS: Honeysuckle  
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VILLAGE OF DOWNERS GROVE BOUNDARY  
 NO ACCESS  
 PROPERTY BOUNDARY



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NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	PLT DATE
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TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 713+00 TO STA 725+00  
 STA 1000+00 TO STA 1006+00, 1100+00 TO 1104+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 7 OF 13  
 DRAWING NO.  
**7**

**Legend**

- STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

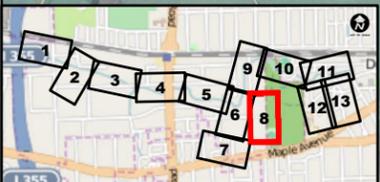
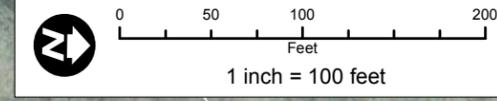
- MINOR
- MODERATE
- SEVERE

VILLAGE OF DOWNERS GROVE BOUNDARY

NO ACCESS

PROPERTY BOUNDARY

1-212: Location  
 S: Slope Erosion  
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NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	ARC GIS 10
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CHKD.					
SCALE:	1:0				
PLOT DATE	7/22/2015				

TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 1204+00 TO STA 1222+00, STA 1300+00 TO STA 1306+00  
 STA 1400+00 TO STA 1403+00, 1500+00, 1600+00 TO 1604+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 8 OF 13  
 DRAWING NO.  
**8**

**Legend**

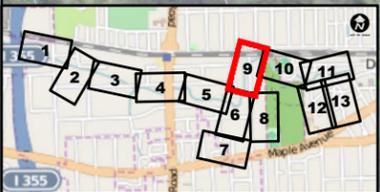
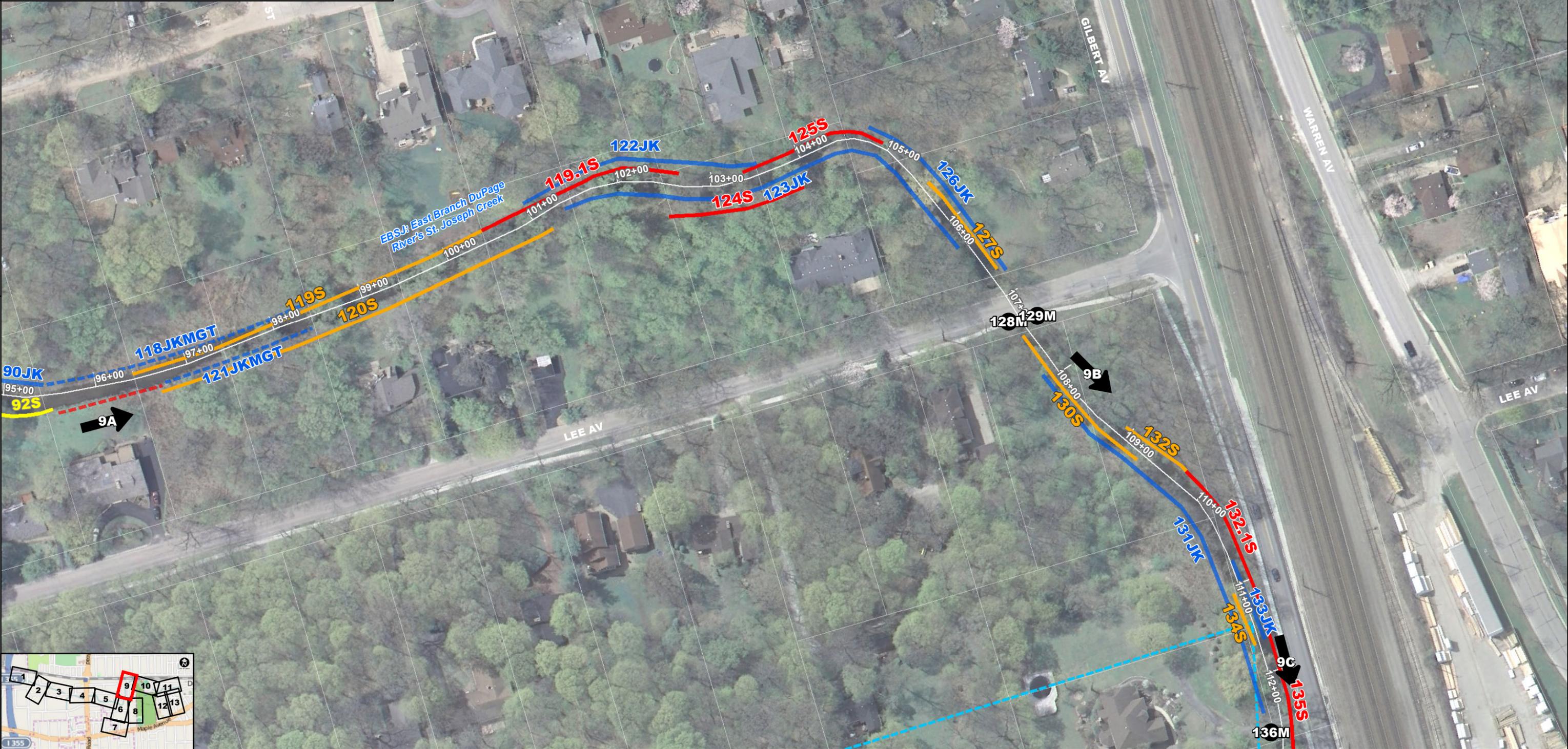
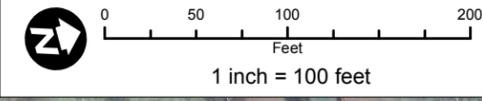
- ◀ STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- ▬ INVASIVE SPECIES LOCATION
- ▬ EXISTING WEED MANAGEMENT AREA
- ▬ EXISTING STABILIZED AREAS

**EROSION LOCATION**

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1-212: Location  
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 GM: Garlic Mustard  
 HS: Honeysuckle  
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[Blue dashed line] VILLAGE OF DOWNERS GROVE BOUNDARY  
 [Green dashed line] NO ACCESS  
 [Grey dashed line] PROPERTY BOUNDARY



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NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	ArcGIS 10
FILE NAME	COMPREHENSIVE STUDY				
PATH	N:\DownersGrove\150068\GIS\Exhibits\COMPREHENSIVE STUDY.mxd				
DSGN.					
DWN.					
CHKD.					
SCALE:	1:10				
PLOT DATE	7/22/2015				

TITLE: **ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY  
 STA 95+00 TO STA 112+00**

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 9 OF 13  
 DRAWING NO. **9**



**Legend**

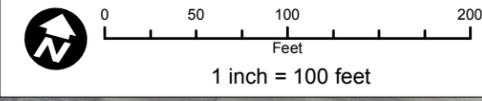
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- PIPE EROSION OR MAINTENANCE LOCATION
- INVASIVE SPECIES LOCATION
- EXISTING WEED MANAGEMENT AREA
- EXISTING STABILIZED AREAS

**EROSION LOCATION**

- MINOR
- MODERATE
- SEVERE

VILLAGE OF DOWNERS GROVE BOUNDARY  
NO ACCESS  
PROPERTY BOUNDARY

1-212: Location  
S: Slope Erosion  
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FILE NAME		COMPREHENSIVE STUDY			
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TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 130+00 TO STA 147+00, STA 300+00 TO STA 312+00  
 STA 1800+00 TO STA 1803+00, 1900+00 TO 1902+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 11 OF 13  
 DRAWING NO.  
**11**

**Legend**

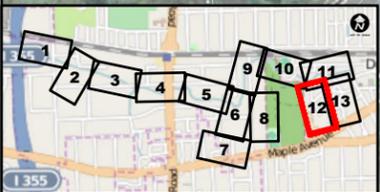
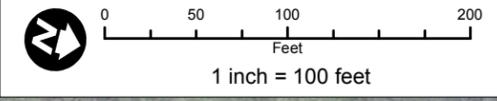
- ◀ STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- ▬ INVASIVE SPECIES LOCATION
- ▬ EXISTING WEED MANAGEMENT AREA
- ▬ EXISTING STABILIZED AREAS

**EROSION LOCATION**

- ▬ MINOR
- ▬ MODERATE
- ▬ SEVERE

- ▬ VILLAGE OF DOWNERS GROVE BOUNDARY
- ▬ NO ACCESS
- ▬ PROPERTY BOUNDARY

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
 RCG: Reed Canary Grass  
 BW: Bishop's Weed  
 GM: Garlic Mustard  
 HS: Honeysuckle  
 JKMG: Japanese Knotweed Management Area



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 Rosemont, Illinois 60018  
 (847) 823-0500

CLIENT:  
**VILLAGE OF DOWNERS GROVE**

NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	7/22/2015
FILE NAME	COMPREHENSIVE STUDY				
PATH	N:\DownersGrove\150068\GIS\Exhibits\COMPREHENSIVE STUDY.mxd				

TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 1801+00 TO STA 1817+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 12 OF 13  
 DRAWING NO.  
**12**

**Legend**

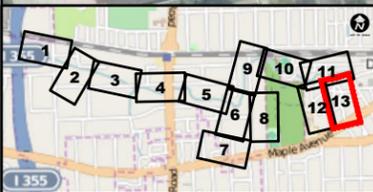
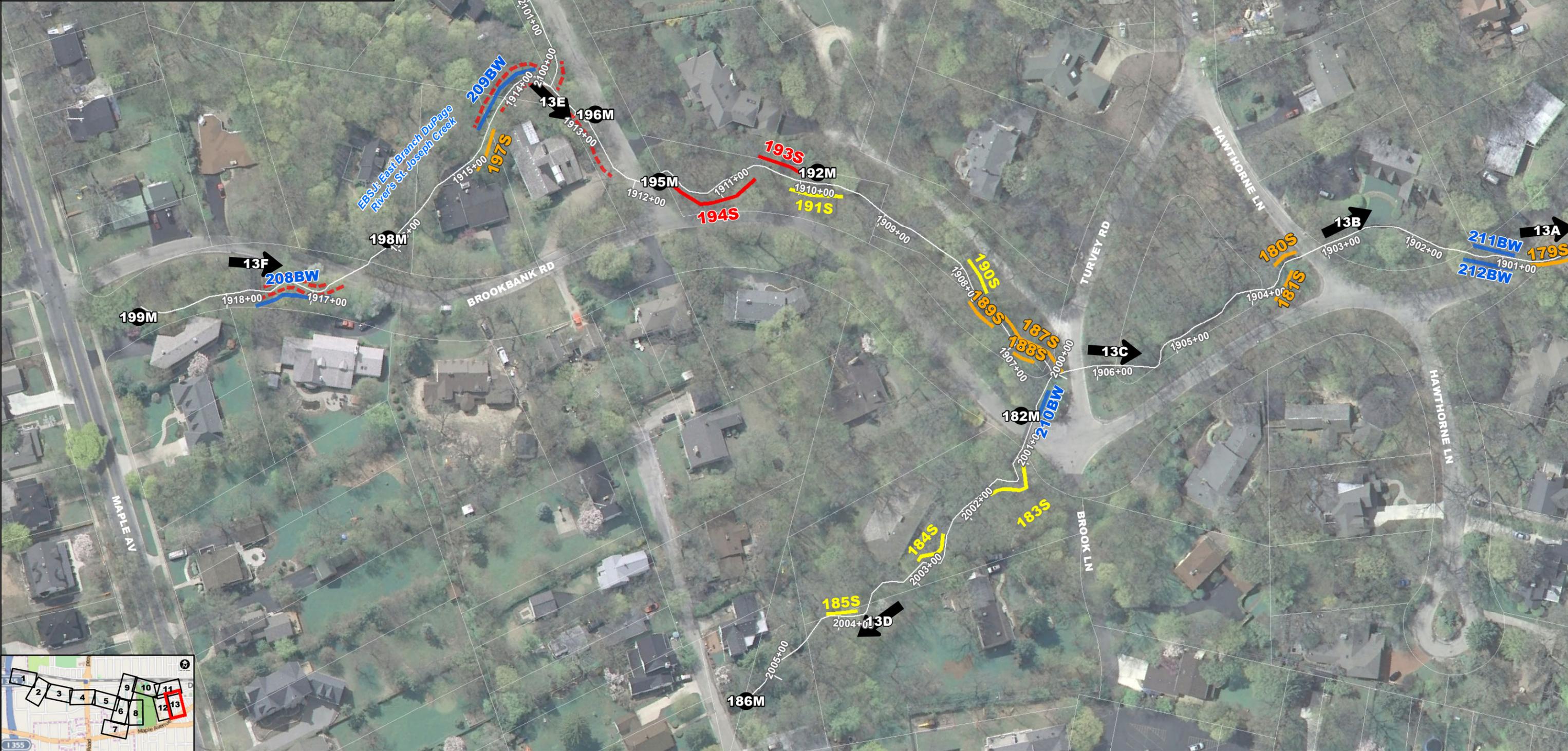
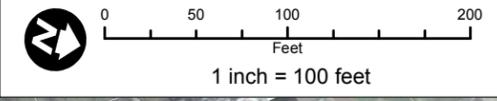
- ◀ STREAM VIEW REPRESENTATIVE PHOTO
- PIPE EROSION OR MAINTENANCE LOCATION
- ▬ INVASIVE SPECIES LOCATION
- ▬ EXISTING WEED MANAGEMENT AREA
- ▬ EXISTING STABILIZED AREAS

**EROSION LOCATION**

- ▬ MINOR
- ▬ MODERATE
- ▬ SEVERE

1-212: Location  
 S: Slope Erosion  
 P: Pipe Erosion  
 M: Maintenance Item  
 JK: Japanese Knotweed  
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 BW: Bishop's Weed  
 GM: Garlic Mustard  
 HS: Honeysuckle  
 JKMG: Japanese Knotweed Management Area

▬ VILLAGE OF DOWNERS GROVE BOUNDARY  
 ▬ NO ACCESS  
 ▬ PROPERTY BOUNDARY



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**VILLAGE OF DOWNERS GROVE**

NO.	DATE	NATURE OF REVISION	CHKD.	MODEL:	ARC GIS 10
FILE NAME	COMPREHENSIVE STUDY				
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DSGN.					
DWN.					
CHKD.					
SCALE:	1:10				
PLOT DATE	7/22/2015				

TITLE:  
**ST JOSEPH CREEK & TRIBUTARIES  
 STREAMBANK STABILITY STUDY**  
 STA 1901+00 TO STA 1918+00, STA 2000+00 TO STA 2005+00  
 STA 2100+00 TO STA 2101+00

PROJ. NO. 150068  
 DATE: 5/08/2015  
 SHEET 13 OF 13  
 DRAWING NO.  
**13**

# **TAB 3**

St. Joseph Creek Streambank Study Photos  
(Exhibits 1-13B)



1A



1B



1M



2S



3JK



4S



7M



9S



10S



11S



12S



13S



14S



15M



17S



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 1)

EXHIBIT: 1



2A



2B



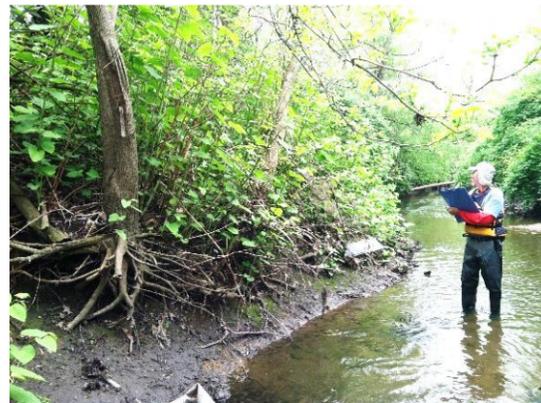
16S



19S



20S



22S



23JK



24S



25S



26S



27S / 28S



30S



31M



32JK



35S



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 2)

EXHIBIT: 2



3A



Pipe



41S



42M



42P - DETAIL



45JK / 46S



47S



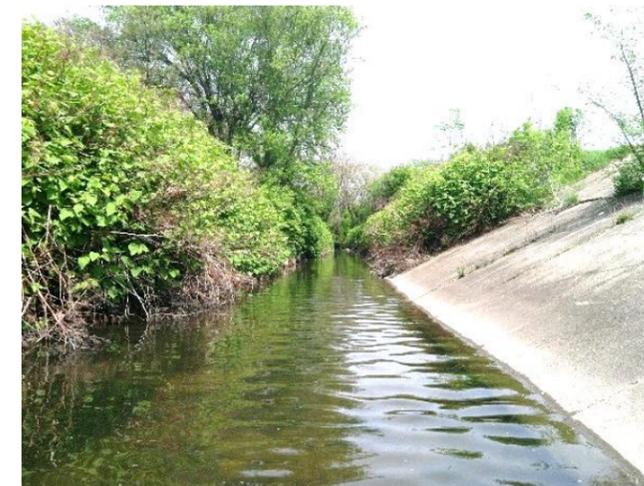
48JK



48JK



49M



50JK



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 3)

EXHIBIT: 3



51JK



54S



4A



58M



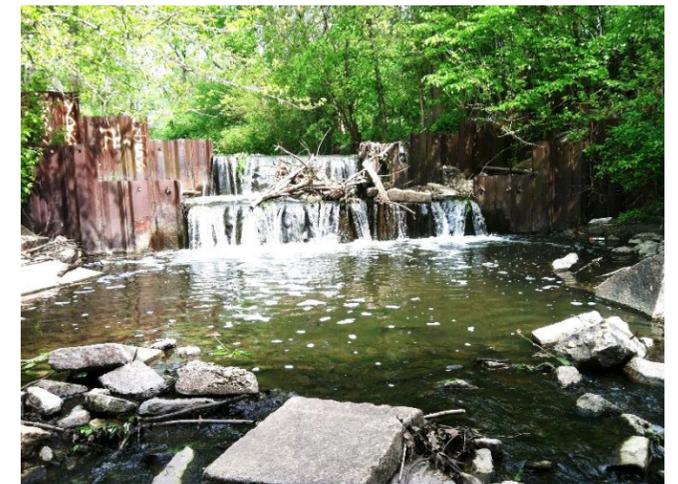
58M



4B



59M



60M



61S



62JK



4C / 64JK



4D / 65JK



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 4)

EXHIBIT: 4



5A



66S



67M



5B



69S



69S



70M



70M



71S



72S



73S



73S



73S



75S



80JK



81M



82M



5C



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 5)

EXHIBIT: 5



6A



6B



86JK



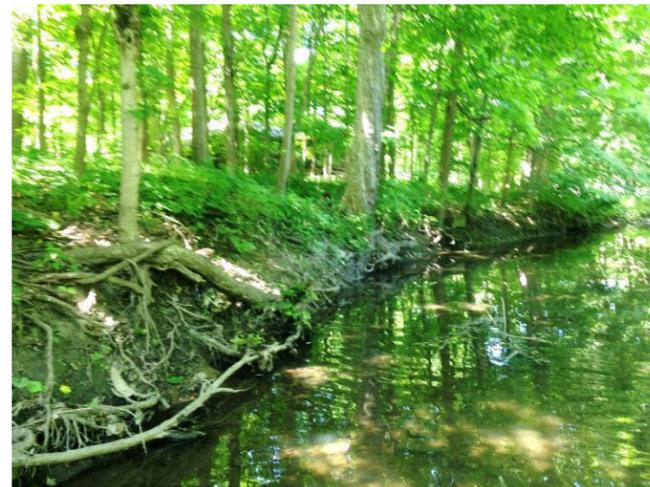
87S



87S



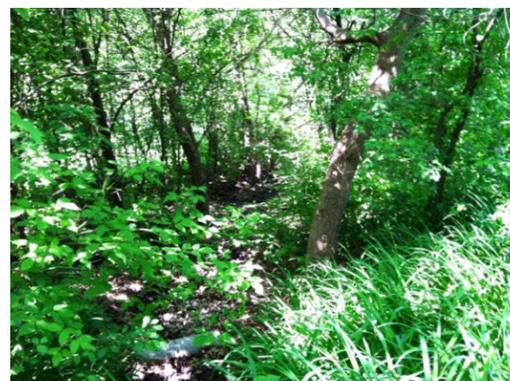
89S



92S / 91JK



6C – West Tributary



6D – Honeysuckle/Buckthorn



95S



96M



98S



99S



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**St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 6)**

**EXHIBIT: 6**



7A



7B



106S / 107S



106S / 107S



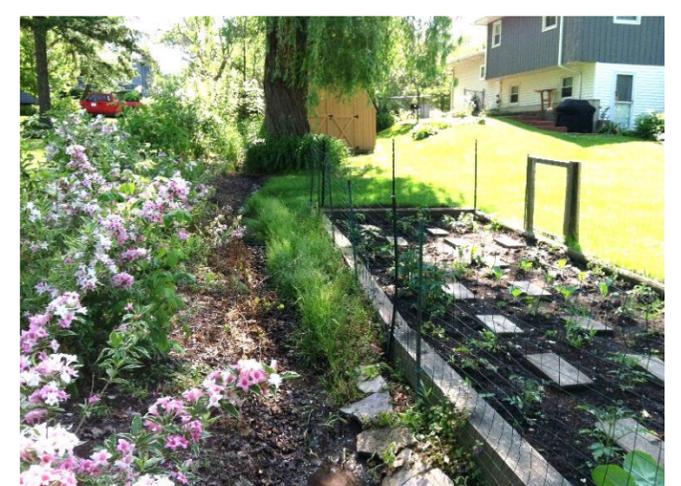
108RCG



109S



7C



110RCG (In Background)



7D



7E



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 7)

EXHIBIT: 7



8A



8B



111M



112S



113M



114S



8C



115S



116S



200S



201S / 202S



203S



204S



205S



206S



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 8)

EXHIBIT: 8



9A



118JK MGT



118JK MGT / 119S



119S



123 JK / 124 S



125S



127S



128M / 129M



9B



130S



132S



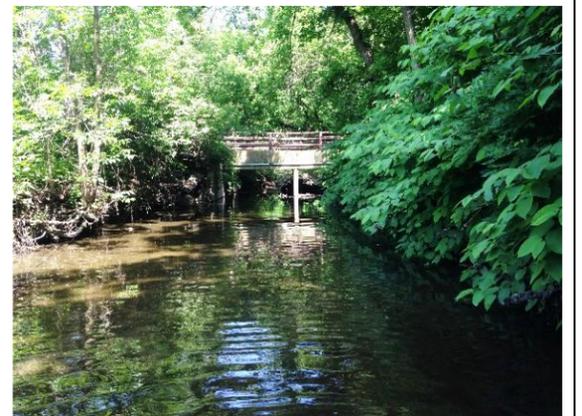
132S



134S



135S



9C



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 9)

EXHIBIT: 9



10A



136M



137S



138S



139S



140S



141S



141.1M



142S



10B – View of Ajax



10B – View of Gabion Baskets



144S



144S



10C



146.1M



148S



149JK



150S



150S



152S



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 10)

EXHIBIT: 10



156S



11A



11B



159S



160JK MGT



11C



161S



162S



163S / 164S



11D



165S



166S



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 11)

EXHIBIT: 11A



168S



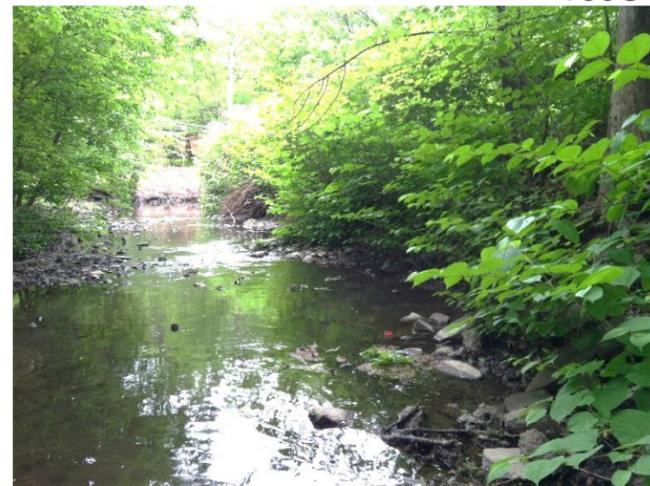
169S



169S



172JK



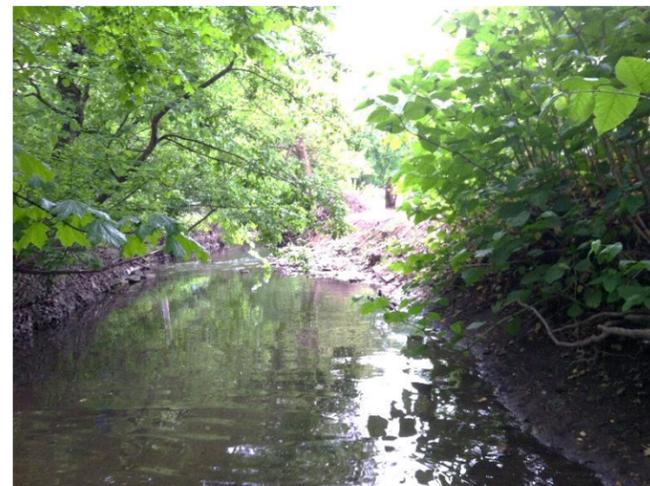
173JK



174S



174S



11E



11F



11G



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 11)

EXHIBIT: 11B



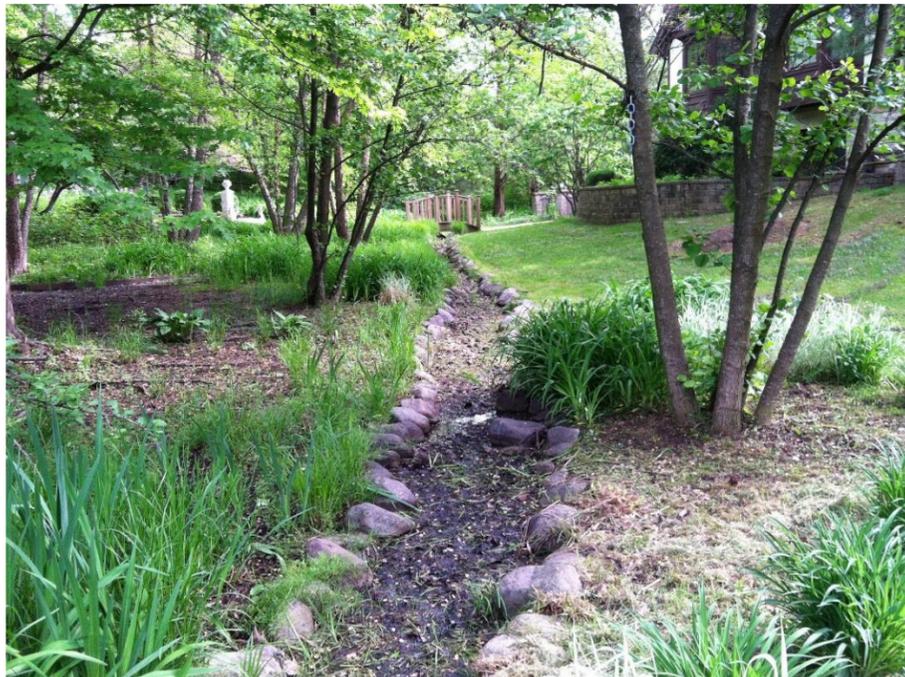
207S



208M



12A



12B



12C



12D



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 12)

EXHIBIT: 12



13A



13B



13C



180S / 181S



182M



183S



184S



184S



185S



13D



186M



187S



189S



190S



193S



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 13)

EXHIBIT: 13A



192M



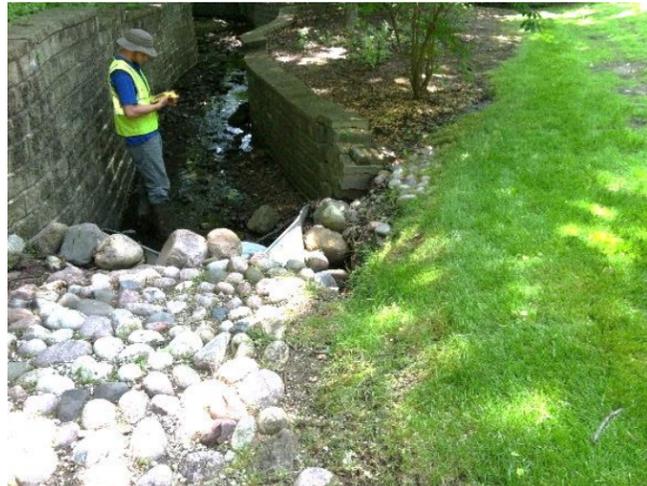
193S



194S



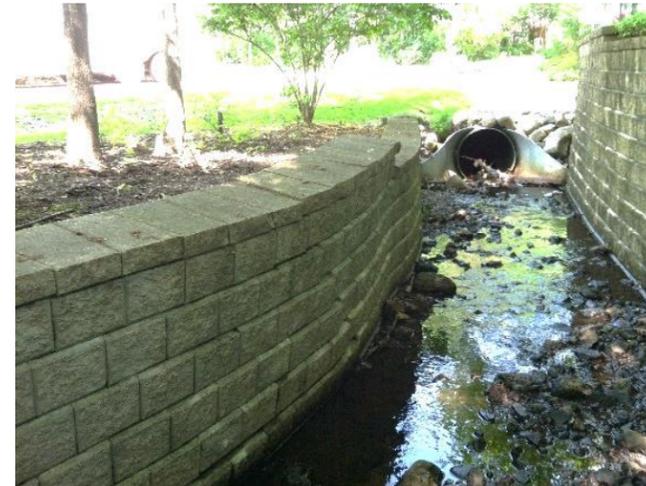
195M



196M



196M



196M



13E



197S



198M



198M



199M



13F



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St. Joseph Creek & Tributaries  
Streambank Stability Study Photos (for Sheet 13)

EXHIBIT: 13B

## **TAB 4**

St. Joseph Creek Streambank Study  
Action Locations, Recommended Practices  
and Estimated Costs

St. Joseph Creek Streambank Study, Action Locations, Recommended Practices, and Estimated Costs  
July 2015 (CBBEL Project No. 150068)

Sheet No.	Action / Photo No.	Approximate Location	Priority	Management Practice	Quantity	Unit	Estimated Unit Cost	Total Cost
1	1M	0+00	Sev	Snag Removal	1	Lump Sum	\$1,200	\$1,200
1	2S	0+10 - 0+90	Mod	Stone Toe (2 Feet)	80	Linear Feet	\$250	\$20,000
1	3JK	0+30 - 0+70		Weed Control	0.018	Acre	\$5,000	\$92
1	4S	13+00 - 14+00	Mod	Stone Toe (4 Feet)	100	Linear Feet	\$375	\$37,500
1	5S	14+30 - 15+20	Sev	Stone Toe (6 Feet)	90	Linear Feet	\$500	\$45,000
1	6S	14+60 (75' south)	Sev	Re-grade Slope	75	Linear Feet	\$100	\$7,500
1	7M	14+60	Sev	Pipe Repair (14" CM)	100	Linear Feet	\$50	\$5,000
1	8JK	15+60 - 18+50		Weed Control	0.133	Acre	\$5,000	\$666
1	9S	16+10 - 18+50	Mod	Re-grade Slope	240	Linear Feet	\$100	\$24,000
1	10S	18+50 - 18+70	Mod	Stone Toe (4 Feet)	20	Linear Feet	\$375	\$7,500
1	11S	19+20 - 19+50	Min	Stone Toe (2 Feet)	30	Linear Feet	\$250	\$7,500
1	12S	19+80 - 20+00	Min	Stone Toe (2 Feet)	20	Linear Feet	\$250	\$5,000
1	13S	21+30 - 24+70	Min	Stone Toe (2 Feet)	340	Linear Feet	\$250	\$85,000
1	14S	21+30 - 24+70	Min	Stone Toe (2 Feet)	340	Linear Feet	\$250	\$85,000
1	15M	24+80	Mod	Debris Removal (Sediment)	6	Cubic Yards	\$300	\$1,800
1/2	16S	25+00 - 26+80	Mod	Stone Toe (4 Feet)	180	Linear Feet	\$375	\$67,500
1/2	17S	25+00 - 26+70	Mod	Stone Toe (4 Feet)	170	Linear Feet	\$500	\$85,000
2	18RCG	27+40 - 28+00		Weed Control	0.055	Acre	\$5,000	\$275
2	19S	28+10 - 29+00	Min	Re-grade Slope	90	Linear Feet	\$100	\$9,000
2	20S	28+90 - 30+10	Mod	Stone Toe (2 Feet)	120	Linear Feet	\$250	\$30,000
2	21JK	27+90 - 29+15		Weed Control	0.057	Acre	\$5,000	\$287
2	22S	28+90 - 30+60	Sev	Stone Toe (6 Feet)	170	Linear Feet	\$500	\$85,000
2	23JK	30+60 - 31+30		Weed Control	0.008	Acre	\$5,000	\$40
2	24S	31+60 - 32+10	Sev	Gabion (3 high)	50	Linear Feet	\$750	\$37,500
2	25S	500+00 - 501+40	Sev	Re-grade Slope	140	Linear Feet	\$100	\$14,000
2	25.1M	500+00	Sev	Pipe Repair (14" CM)	120	Linear Feet	\$60	\$7,200
2	26S	500+00 - 501+60	Sev	Re-grade Slope	160	Linear Feet	\$100	\$16,000
2	27S	505+80 - 506+30	Sev	Re-grade Slope	50	Linear Feet	\$100	\$5,000
2	28S	505+80 - 506+30	Sev	Re-grade Slope	50	Linear Feet	\$100	\$5,000
2	29JK	30+60 - 31+30		Weed Control	0.016	Acre	\$5,000	\$80
2	30S	33+30 - 34+30	Mod	Stone Toe (4 Feet)	100	Linear Feet	\$375	\$37,500
2	31M	33+60	Min	Pipe Repair (Conc. apron)	1	Lump Sum	\$1,000	\$1,000
2	32JK	34+30 - 34+80		Weed Control	0.017	Acre	\$5,000	\$86
2	33GM	33+90 - 34+40		Weed Control	0.034	Acre	\$5,000	\$172
2	34JK	34+60 - 35+20		Weed Control	0.004	Acre	\$5,000	\$21
2/3	35S	34+70 - 35+60	Sev	Gabion (2 high)	90	Linear Feet	\$500	\$45,000
3	36JK	34+70 - 35+10		Weed Control	0.009	Acre	\$5,000	\$46
3	37JK	36+20 - 36+50		Weed Control	0.007	Acre	\$5,000	\$34
3	38JK	36+70 - 37+50		Weed Control	0.018	Acre	\$5,000	\$92
3	39JK	37+10 - 37+50		Weed Control	0.009	Acre	\$5,000	\$46
3	40JK	38+20 - 38+60		Weed Control	0.018	Acre	\$5,000	\$92
3	41S	39+60 - 41+00	Min	Re-grade Slope	40	Linear Feet	\$100	\$4,000
3	42M/S	600+00 - 60+40	Mod	Pipe repair conc. & re-grade	40	Linear Feet	\$200	\$8,000
3	43JK	43+00 - 44+10		Weed Control	0.038	Acre	\$5,000	\$189
3	44JK	44+90 - 45+30		Weed Control	0.014	Acre	\$5,000	\$69
3	45JK	46+10 - 48+90		Weed Control	0.257	Acre	\$5,000	\$1,286
3	46S	47+20 - 48+20	Sev	Gabion (2 high)	100	Linear Feet	\$500	\$50,000
3	47S	47+80 - 48+20	Sev	Gabion (2 high) - to wingwall	40	Linear Feet	\$500	\$20,000
3	48JK	47+80 - 48+40		Weed Control	0.028	Acre	\$5,000	\$138
3	49M	48+80 (North culvert)	Mod	Debris Removal (Sediment)	40	Cubic Yards	\$300	\$12,000
3	50JK	49+70 - 51+00		Weed Control	0.090	Acre	\$5,000	\$448
4	51JK	50+70 - 53+70		Weed Control	0.138	Acre	\$5,000	\$689
4	52JK	51+60 - 53+70		Weed Control	0.121	Acre	\$5,000	\$603
4	53S	53+50 - 54+00	Sev	Gabion (3 high)	50	Linear Feet	\$750	\$37,500
4	54S	54+80 - 55+80	Min	Re-grade Slope	100	Linear Feet	\$60	\$6,000
4	55S	54+80 - 55+80	Min	Re-grade Slope	100	Linear Feet	\$60	\$6,000
4	56JK	55+10 - 60+20		Weed Control	0.234	Acre	\$5,000	\$1,171
4	57S	58+20 - 59+20	Sev	Gabion (3 high)	100	Linear Feet	\$750	\$75,000

St. Joseph Creek Streambank Study, Action Locations, Recommended Practices, and Estimated Costs  
July 2015 (CBBEL Project No. 150068)

Sheet No.	Action / Photo No.	Approximate Location	Priority	Management Practice	Quantity	Unit	Estimated Unit Cost	Total Cost
4	58M	59+10 - 61+00	Sev	Tree Removal (Conc. bank)	190	Linear Feet	\$25	\$4,750
4	59M	63+00	Min	Debris Removal (Sediment)	7	Cubic Yards	\$300	\$2,100
4	60M	63+70	Min	Snag Removal (waterfall)	1	Lump Sum	\$300	\$300
4	61S	64+30 - 66+00	Min	Re-grade Slope	170	Linear Feet	\$60	\$10,200
4	62JK	64+40 - 64+90		Weed Control	0.011	Acre	\$5,000	\$57
4/5	63JK	66+50 - 71+00		Weed Control	0.103	Acre	\$5,000	\$517
4/5	64JK	66+50 - 71+00		Weed Control	0.052	Acre	\$5,000	\$258
5	65JK	70+90 - 71+20		Weed Control	0.007	Acre	\$5,000	\$34
5	66S	71+00 - 72+80	Mod	Stone toe (4 Feet)	180	Linear Feet	\$375	\$67,500
5	67M	72+10 (Jet Out Culvert)	Sev	Debris Removal (Sediment)	1	Lump Sum	\$3,000	\$3,000
5	68JK	72+40 - 74+50		Weed Control	0.072	Acre	\$5,000	\$362
5	69S	73+20 - 73+80	Sev	Gabion (abutment erosion)	60	Linear Feet	\$500	\$30,000
5	70M	73+80	Mod	Snag Removal	1	Lump Sum	\$1,000	\$1,000
5	71S	74+00 - 75+20	Sev	Stone toe (4 Feet)	120	Linear Feet	\$375	\$45,000
5	72S	75+10 - 75+40	Mod	Stone toe (4 Feet)	30	Linear Feet	\$375	\$11,250
5	73S	75+40 - 79+60	Mod	Stone toe (4 Feet)	420	Linear Feet	\$375	\$157,500
5	74JK	78+00 - 78+90		Weed Control	0.03099	Acre	\$5,000	\$155
5	75S	79+40 - 81+20	Mod	Stone toe (4 Feet)	180	Linear Feet	\$375	\$67,500
5	76JK	79+70 - 80+20		Weed Control	50	Acre	\$5,000	\$250,000
5/6	77S	80+80 - 85+10	Mod	Re-grade Slope	430	Linear Feet	\$100	\$43,000
5	78JK	80+80 - 83+50		Weed Control & Native Planting	0.093	Acre	\$10,000	\$930
5	79JK	82+10 - 84+40		Weed Control	0.079	Acre	\$5,000	\$396
5	80JK	84+70 - 85+20		Weed Control	0.017	Acre	\$5,000	\$86
5	81M	84+80	Mod	Pipe Repair	1	Lump Sum	\$1,000	\$1,000
5	82M	85+60	Mod	Tree Removal	1	Lump Sum	\$600	\$600
5	83JK	86+30 - 86+50		Weed Control	0.007	Acre	\$5,000	\$34
6	84JK	86+20 - 87+00		Weed Control	0.028	Acre	\$5,000	\$138
6	85JK	87+10 - 88+60		Weed Control	0.052	Acre	\$5,000	\$258
6	86JK	87+90 - 92+60		Weed Control	0.162	Acre	\$5,000	\$809
6	87S	88+40 - 91+30	Mod/S	Stone toe (4 Feet)	290	Linear Feet	\$375	\$108,750
6	88JK	91+70 - 93+50		Weed Control	0.06198	Acre	\$5,000	\$310
6	89S	93+10 - 93+60	Mod	Stone Toe (2 Feet)	50	Linear Feet	\$200	\$10,000
6	90JK	93+50 - 95+50		Weed Control	0.069	Acre	\$5,000	\$344
6	91JK	94+00 - 94+90		Weed Control	0.031	Acre	\$5,000	\$155
6	92S	94+10 - 95+60	Min	Re-grade Slope	150	Linear Feet	\$100	\$15,000
6	93JK	1200+00 - 1200+50		Weed Control	0.017	Acre	\$5,000	\$86
6	94HS	702+80 - 703+30		Weed Control (Honeysuckle)	0.017	Acre	\$25,000	\$430
6	95M	704+70	Mod	Pipe Erosion	1	Lump Sum	\$1,500	\$1,500
6	96M	705+50	MIn	Snag Removal	1	Lump Sum	\$200	\$200
6	97S	705+60 - 706+40	Min	Re-grade Slope	60	Linear Feet	\$100	\$6,000
6	98S	706+70 - 707+10	Mod	Stone Toe (2 Feet)	40	Linear Feet	\$250	\$10,000
6	99S	708+40 - 708+60	Sev	Stone toe (4 Feet)	20	Linear Feet	\$375	\$7,500
6	100S	900+00 - 900+50	Mod	Boulder Toe (4 Feet)	50	Linear Feet	\$450	\$22,500
6	101RCG	711+70 - 712+70		Weed Control	0.011	Acre	\$5,000	\$57
7	102RCG	1100+20 - 1100+30		Weed Control	0.002	Acre	\$5,000	\$11
7	103RCG	1100+60 - 1100+70		Weed Control	0.002	Acre	\$5,000	\$11
7	104RCG	1101+20 - 1101+50		Weed Control	0.007	Acre	\$5,000	\$34
7	105S	1103+20 - 1103+90	Mod	Re-grade Slope	70	Linear Feet	\$100	\$7,000
7	106S	1104+00 - 1105+00(W)	Mod	Re-grade Slope	100	Linear Feet	\$100	\$10,000
7	107S	1104+00 - 1105+00€	Mod	Re-grade Slope	100	Linear Feet	\$100	\$10,000
7	107.1M	1105+00	Mod	Pipe Erosion	14	Cubic Yards	\$300	\$4,200
7	108RCG	717+60 - 719+90		Weed Control (Various)	0.053	Acre	\$5,000	\$264
7	109S	722+30 - 724+30	Min	Re-grade Slope	200	Linear Feet	\$60	\$12,000
7	110RCG	1104+00 - 1105+00		Weed Control	0.02296	Acre	\$5,000	\$115
8	111M	1402+00	Min	Debris Removal (Leaves)	1	Lump Sum	\$500	\$500
8	112S	1217+60 - 1217+90	Mod	Boulder Toe (4 Feet)	30	Linear Feet	\$375	\$11,250
8	113S	1217+90 - 1218+40	Mod	Boulder Toe (4 Feet)	50	Linear Feet	\$375	\$18,750
8	114S	1018+50 - 1218+80	Mod	Boulder Toe (4 Feet)	30	Linear Feet	\$375	\$11,250

St. Joseph Creek Streambank Study, Action Locations, Recommended Practices, and Estimated Costs  
 July 2015 (CBBEL Project No. 150068)

Sheet No.	Action / Photo No.	Approximate Location	Priority	Management Practice	Quantity	Unit	Estimated Unit Cost	Total Cost
8	115S	1221+20 - 1221+70	Sev	Boulder Toe (4 Feet)	50	Linear Feet	\$375	\$18,750
8	116S	1221+20 - 1221+70	Sev	Boulder Toe (4 Feet)	50	Linear Feet	\$375	\$18,750
8	117S	1221+10 - 1223+00	Mod	Boulder Toe (2 Feet)	190	Linear Feet	\$250	\$47,500
8	200S	1206+00 - 1206+30	Min	Boulder Toe (4 Feet)	30	Linear Feet	\$375	\$11,250
8	201S	1300+20 - 1300+90	Min	Re-grade Slope	70	Linear Feet	\$60	\$4,200
8	202S	1300+20 - 1300+90	Min	Re-grade Slope	70	Linear Feet	\$60	\$4,200
8	203S	1209+30 - 1210+00	MIn	Re-grade Slope	70	Linear Feet	\$75	\$5,250
8	204S	1210+00 - 1211+00	Min	Re-grade Slope	100	Linear Feet	\$75	\$7,500
8	205S	1211+00 - 1211+40	Mod	Boulder Toe (4 Feet)	40	Linear Feet	\$375	\$15,000
8	206S	1211+50 - 1211+90	Mod	Re-grade Slope	40	Linear Feet	\$75	\$3,000
9	118JK MGT	95+40 - 98+40		Weed Control & Native Planting	0.138	Acre	\$10,000	\$1,377
9	119S	96+40 - 100+40	Mod	Stone Toe (4 Feet)	400	Linear Feet	\$375	\$150,000
9	119.1S	100+40 - 102+60	Sev	Stone Toe (4 Feet)	220	Linear Feet	\$375	\$82,500
9	120S	96+70 - 101+10	Mod	Stone toe (4 Feet)	440	Linear Feet	\$375	\$165,000
9	121 JK MGT	96+70 - 98+40		Weed Control & Native Planting	0.078	Acre	\$10,000	\$781
9	122JK	101+00 - 103+60		Weed Control	0.090	Acre	\$5,000	\$448
9	123JK	101+30 - 106+30		Weed Control	0.172	Acre	\$5,000	\$861
9	124S	102+50 - 103+90	Sev	Stone Toe (4 Feet)	140	Linear Feet	\$375	\$52,500
9	125S	103+30 - 104+90	Sev	Gabion (3 high)	160	Linear Feet	\$750	\$120,000
9	126JK	104+50 - 106+70		Weed Control	0.072	Acre	\$5,000	\$362
9	127S	105+60 - 106+60	Mod	Re-grade Slope	100	Linear Feet	\$75	\$7,500
9	128M	107+30	Min	Debris Removal (Sediment)	7	Cubic Yards	\$300	\$2,100
9	129M	107+30	Min	Snag Removal	1	Lump Sum	\$300	\$300
9	130S	107+40 - 109+20	Mod	Stone Toe (2 Feet)	180	Linear Feet	\$250	\$45,000
9/10	131JK	107+90 - 112+40		Weed Control	0.15496	Acre	\$5,000	\$775
9/10	132S	108+90 - 109+80	Mod	Stone Toe (4 Feet)	90	Linear Feet	\$375	\$33,750
9/10	132.1S	109+80 - 110+90	Sev	Gabion (3 High)	110	Linear Feet	\$750	\$82,500
9/10	133JK	110+70 - 111+60		Weed Control	0.03099	Acre	\$5,000	\$155
9/10	134S	111+10 - 111+60	Mod	Stone Toe (2 Feet)	50	Linear Feet	\$250	\$12,500
9/10	135S	111+50 - 113+10	Sev	Gabion (2 High)	160	Linear Feet	\$500	\$80,000
10	136M	112+70	Min	Snag Removal	1	Lump Sum	\$300	\$300
10	137S	1700+30 - 1700+90	Mod	Stone Toe (4 Feet)	60	Linear Feet	\$375	\$22,500
10	137.1M	1701+00	Mod	Pipe Erosion	8	Cubic Yards	\$300	\$2,400
10	138S	113+30 - 116+00	Mod	Re-grade Slope	270	Linear Feet	\$75	\$20,250
10	139S	114+20 - 117+00	Mod	Re-grade Slope	280	Linear Feet	\$75	\$21,000
10	140S	117+90 - 118+40	Mod	Re-grade Slope	50	Linear Feet	\$75	\$3,750
10	141S	118+10 - 119+00	Mod	Re-grade Slope	90	Linear Feet	\$75	\$6,750
10	141.1M	118+90	Min	Snag Removal	1	Lump Sum	\$300	\$300
10	142S	119+50 - 120+60	Mod	Re-grade Slope	110	Linear Feet	\$75	\$8,250
10	143JK	121+80 - 123+00		Weed Control	0.041	Acre	\$5,000	\$207
10	144S	125+00 - 125+40	Mod	Re-grade Slope	40	Linear Feet	\$75	\$3,000
10	145JK	125+00 - 125+50		Weed Control	0.045	Acre	\$5,000	\$224
10	146JK MGT	125+80 - 127+20		Weed Control & Native Planting	0.060	Acre	\$10,000	\$597
10	146.1M	125+80	Min	Snag Removal	1	Lump Sum	\$300	\$300
10	147JK	126+00 - 129+40		Weed Control	0.156	Acre	\$5,000	\$781
10	148S	126+20 - 126+90	Mod	Stone Toe (4 Feet)	70	Linear Feet	\$375	\$26,250
10	150S	127+10 - 129+50	Sev	Stone Toe (4 Feet)	240	Linear Feet	\$375	\$90,000
10	150JKMGT	128+00 - 129+70		Weed Control & Native Planting	0.078	Acre	\$10,000	\$781
10	151JK MGT	128+10 - 129+40		Weed Control & Native Planting	0.060	Acre	\$10,000	\$597
10	152S	128+20 - 129+60	Sev	Stone Toe (4 Feet)	140	Linear Feet	\$375	\$52,500
11	153JK	129+60 - 132+90		Weed Control	0.114	Acre	\$5,000	\$568
11	154S	131+00 - 131+60	Mod	Re-grade Slope	60	Linear Feet	\$100	\$6,000
11	155S	1800+00 - 1800+60	Mod	Re-grade Slope	60	Linear Feet	\$100	\$6,000
11	156S	131+60 - 132+30	Mod	Stone Toe (4 Feet)	60	Linear Feet	\$375	\$22,500
11	157JK	133+10 - 134+40		Weed Control	0.045	Acre	\$5,000	\$224
11	158S	134+00 - 134+50	Mod	Flagstone Toe	50	Linear Feet	\$500	\$25,000
11	159S	134+50 - 135+90	Mod	Flagstone Toe	140	Linear Feet	\$500	\$70,000
11	160JK MGT	134+50 - 135+90		Weed Control & Native Planting	0.064	Acre	\$10,000	\$643

St. Joseph Creek Streambank Study, Action Locations, Recommended Practices, and Estimated Costs  
 July 2015 (CBBEL Project No. 150068)

Sheet No.	Action / Photo No.	Approximate Location	Priority	Management Practice	Quantity	Unit	Estimated Unit Cost	Total Cost
11	161S	300+30 - 300+80	Mod	Stone Toe (4 Feet)	50	Linear Feet	\$375	\$18,750
11	162S	300+70 - 301+60	Mod	Stone Toe (4 Feet)	90	Linear Feet	\$375	\$33,750
11	163S	301+95 - 302+20	Mod	Stone Toe (4 Feet)	25	Linear Feet	\$375	\$9,375
11	164S	301+95 - 302+25	Mod	Stone Toe (4 Feet)	30	Linear Feet	\$375	\$11,250
11	165S	306+20 - 306+80	Mod	Stone Toe (4 Feet)	60	Linear Feet	\$375	\$22,500
11	166S	307+30 - 307+90	Mod	Stone Toe (4 Feet)	60	Linear Feet	\$375	\$22,500
11	167JK	308+10 - 309+20		Weed Control	0.038	Acre	\$5,000	\$189
11	168S	310+40 - 310+60	Min	Re-grade Slope	20	Linear Feet	\$75	\$1,500
11	169S	311+00 - 311+90	Min	Re-grade Slope	90	Linear Feet	\$75	\$6,750
11	170JK	311+20 - 313+00		Weed Control	0.083	Acre	\$5,000	\$413
11	171JK	311+60 - 313+00		Weed Control	0.064	Acre	\$5,000	\$321
11	172JK	138+20 - 140+20		Weed Control	0.124	Acre	\$5,000	\$620
11	172JKMGT	140+20 - 140+90		Weed Control & Native Planting	0.032	Acre	\$10,000	\$321
11	173JK	139+10 - 140+30		Weed Control	0.055	Acre	\$5,000	\$275
11	174S	140+30 - 142+20	Mod	Gabion (2 High)	190	Linear Feet	\$500	\$95,000
11	175S	142+30 - 143+10	Mod	Gabion (1 High)	80	Linear Feet	\$300	\$24,000
11	176S	143+60 - 145+50	Mod	Gabion (2 High)	190	Linear Feet	\$500	\$95,000
11	177JK	145+20 - 147+10		Weed Control	0.087	Acre	\$5,000	\$436
11	178JK	145+20 - 146+70		Weed Control	0.069	Acre	\$5,000	\$344
12	207S	1807+60 - 1807+90	Mod	Stone Toe (4 Feet)	30	Linear Feet	\$375	\$11,250
12	207HS	808+70 - 810+30		Weed Control (Honeysuckle)	0.073	Acre	\$25,000	\$1,837
12	208M	1811+50		Debris Removal (Leaves)	1	Lump Sum	\$200	\$200
12	209JK	1816+40 - 1816+70		Weed Control	0.010	Acre	\$5,000	\$52
11/13	179S	1900+00 - 1900+80	Mod	Stone Toe (2 Feet)	80	Linear Feet	\$250	\$20,000
13	180S	1903+30 - 1903+70	Mod	Stone Toe (2 Feet)	40	Linear Feet	\$250	\$10,000
13	181S	1903+50 - 1903+90	Mod	Stone Toe (2 Feet)	40	Linear Feet	\$250	\$10,000
13	182M	2000+40	Mod	Pipe Repair (Rock apron)	2	Cubic Yards	\$300	\$600
13	183S	2000+90 - 2001+60	Min	Stone Toe (2 Feet)	70	Linear Feet	\$250	\$17,500
13	184S	2002+30 - 2002+80	MIn	Stone Toe (2 Feet)	50	Linear Feet	\$250	\$12,500
13	185S	2003+90 - 2004+20	Min	Stone Toe (2 Feet)	30	Linear Feet	\$250	\$7,500
13	186M	2005+40	Min	Pipe Repair (Block Wall)	1	Lump Sum	\$500	\$500
13	187S	1906+50 - 1907+30	Mod	Stone Toe (2 Feet)	80	Linear Feet	\$250	\$20,000
13	188S	1906+70 - 1907+00	Mod	Stone Toe (2 Feet)	30	Linear Feet	\$250	\$7,500
13	189S	1907+30 - 1907+70	Mod	Stone Toe (2 Feet)	40	Linear Feet	\$250	\$10,000
13	190S	1907+70 - 1908+00	Min	Re-grade Slope	30	Linear Feet	\$75	\$2,250
13	191S	1909+60 - 1910+10	Min	Re-grade Slope	50	Linear Feet	\$100	\$5,000
13	192M	1909+70	Mod	Pipe Repair (Protection)	1	Lump Sum	\$1,000	\$1,000
13	193S	1910+00 - 1910+50	Sev	Gabion (3 High)	50	Linear Feet	\$750	\$37,500
13	194S	1910+60 - 1911+70	Sev	Gabion (3 High)	110	Linear Feet	\$750	\$82,500
13	195M	1912+90	Mod	Pipe Repair (Apron rock)	3.5	Cubic Yards	\$300	\$1,050
13	196M	1913+30	Mod	Pipe Repair (FES & rock)	1	Lump Sum	\$1,000	\$1,000
13	197S	1914+40 - 1914+80	Mod	Stone Toe (2 Feet)	40	Linear Feet	\$250	\$10,000
13	198M	1916+00	Mod	Pipe Repair (Apron rock)	4	Cubic Yards	\$300	\$1,200
13	198.15	1916+50	Mod	Pipe Erosion (Slope/street)	2	Cubic Yards	\$300	\$600
13	199M	1918+90	Mod	Debris Removal (Sediment)	2	Cubic Yards	\$300	\$600
13	208BW	1918+20 - 1918+50		Weed Control (Bishop's weed)	0.010	Acre	\$5,000	\$52
13	209BW	1913+50 - 1914+50		Weed Control (Bishop's weed)	0.034	Acre	\$5,000	\$172
13	210BW	2000+25 - 2000+50		Weed Control (Bishop's weed)	0.009	Acre	\$5,000	\$43
13	211BW	1900+70 - 1901+30		Weed Control (Bishop's weed)	0.021	Acre	\$5,000	\$103
13	212BW	1900+70 - 1901+40		Weed Control (Bishop's weed)	0.024	Acre	\$5,000	\$121

\$3,950,178

Action - S=Erosion; M=Maintenance; or weed control (see Vegetation Management).

Priority - Generally, Severe erosion consists of near vertical cut slopes  $\geq 4$  feet; moderate, 2-4 feet; minor 2 feet.

Note - Estimated erosion repair total costs include tree/shrub removal, grading/excavation, materials (stone, seed, erosion control blanket, labor, etc.), but do not include engineering/design and permitting costs.

Refer to aerial streambank study sheets 1-13 and correlating photo exhibits.

## **TAB 5**

Minimum IDOT Rock Sizes and Apron Length for  
Maximum and Minimum Tailwater Conditions

Chapter Forty-one

**CONSTRUCTION SITE  
STORM WATER  
POLLUTION CONTROL**

BUREAU OF DESIGN AND ENVIRONMENT MANUAL

- Install reinforced stakes and cables at least every 10 ft (3 m) to secure conduit.
- To prevent stress and failure, install drains perpendicular to slope contours.
- Place slope drains on compacted soil that is covered with Class B geotextile filter fabric.
- Slopes drains should always drain directly, or indirectly to sediment traps or sedimentation basins; see Section 41-3.04.
- Protect the area around inlet with appropriate inlet sediment controls and outlet area with velocity dissipater; see Sections 41-3.02 and 41-2.05(a).

4. Specifications.

- District Special Provision will be required.
- See ISTHA Standard Drawing K1.

*Note: Use IDOT pay items when incorporating ISTHA Standards.*

**41-2.05 Outlet Protection Controls**

Outlet protection controls prevent erosion by slowing the velocity of concentrated flows. These measures are to be employed wherever concentrated flows are conveyed at erosive velocities (e.g., in steep swales, at pipe outlets). See Figures 41-2.E and 41-2.F.

**41-2.05(a) Velocity Dissipaters**

1. Definition and Purpose. An area or apron of rock, concrete rubble, or gabions placed at the outlet of a drainage system, intended to prevent erosion and reduce velocity of the storm water outflow.
2. Applications. Use velocity dissipaters where the discharge velocity and energy at an outlet will cause erosion to the receiving channel or area, including:
  - outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, and channels (concentrated flows);
  - outlets carrying a continuous flow of water;
  - outlets subject to short, intense flows;
  - outlets to sedimentation basins; and
  - points where lined channels discharge to unlined channels or natural waterways.

IDOT Gradation	Maximum Rock Size (lb)*	Equivalent Diameter (spherical) (in)*	Minimum Bedding Thickness (in)	Minimum Thickness (in)
RR-3	50 (22.5 kg)	10 (300 mm)	—	8 (200 mm)
RR-4	150 (67.5 kg)	15 (400 mm)	6 (150 mm)	16 (400 mm)
RR-5	400 (180 kg)	21 (500 mm)	8 (200 mm)	22 (600 mm)
RR-6	600 (270 kg)	24 (600 mm)	10 (250 mm)	26 (700 mm)
RR-7	1000 (450 kg)	28 (700 mm)	12 (300 mm)	30 (800 mm)

\* Assumes a minimum specific gravity of 2.450 and minimum unit weight of 153 lb/ft<sup>3</sup> (2,450 kg/m<sup>3</sup>).

**ROCK RIPRAP SIZE AND THICKNESS**

Figure 41-2.E

Culvert Diameter (in)	Minimum Tailwater				Maximum Tailwater			
	Max Conduit Velocity = 5 fps (1.5 mps)		Max Conduit Velocity = 10 fps (3.1 mps)		Max Conduit Velocity = 5 fps (1.5 mps)		Max Conduit Velocity = 10 fps (3.1 mps)	
	IDOT Gradation	Apron Length (ft)	IDOT Gradation	Apron Length (ft)	IDOT Gradation	Apron Length (ft)	IDOT Gradation	Apron Length (ft)
12 (0.3 m)	RR-3	10 (3.1 m)	RR-3	12 (3.7 m)	RR-3	12 (3.7 m)	RR-3	15 (4.6 m)
18 (0.5 m)	RR-3	14 (4.3 m)	RR-4	16 (4.9 m)	RR-3	12 (3.7 m)	RR-3	16 (4.9 m)
24 (0.6 m)	RR-3	16 (4.9 m)	RR-4	20 (6.1 m)	RR-3	14 (4.3 m)	RR-4	17 (5.2 m)
30 (0.8 m)	RR-3	18 (5.5 m)	RR-4	22 (6.7 m)	RR-3	16 (4.9 m)	RR-4	20 (6.1 m)
36 (0.9 m)	RR-4	20 (6.1 m)	RR-5	24 (7.3 m)	RR-3	16 (4.9 m)	RR-4	22 (6.7 m)
48 (1.2 m)	RR-4	24 (7.3 m)	RR-6	28 (8.5 m)	RR-4	20 (6.1 m)	RR-4	24 (7.3 m)
60 (1.5 m)	RR-5	32 (9.8 m)	RR-6	36 (10.9 m)	RR-4	22 (6.7 m)	RR-5	26 (7.9 m)
72 (1.8 m)	RR-6	40 (12.2 m)	RR-6	44 (13.4 m)	RR-5	24 (7.3 m)	RR-5	29 (8.8 m)
96 (2.4 m)	RR-7	50 (15.2 m)	RR-7	54 (16.5 m)	RR-5	26 (7.9 m)	RR-5	32 (9.8 m)

Notes:

1. If tailwater depth from the pipe invert is less than half of diameter of the pipe, then minimum tailwater conditions exist. Otherwise, maximum tailwater conditions exist.
2. Adapted from the Illinois Urban Manual.

**MINIMUM IDOT ROCK SIZES AND APRON LENGTH FOR MAXIMUM AND MINIMUM TAILWATER CONDITIONS**

Figure 41-2.F

3. Design Considerations.

- Velocity dissipaters are not adequate to stabilize discharges occurring at the top of a cut or a slope steeper than 1V:10H; see Section 41-2.04.
- Large storms may wash away rock or concrete, leaving the area susceptible to erosion.
- Consider using a riprap-stilling basin or plunge pool where velocities exceed 10 fps (3 mps) or where the velocity requires an apron of an excessive length.
- Riprap, gabions, or slope mattresses placed over filter fabric are the general materials used to provide temporary outlet protection. See Figure 41-2.C.

4. Specifications. See Sections 281 and 284 of the *Standard Specifications*.

**41-2.06 Erosion Control Reference Table**

Figure 41-2.G references all ECPs discussed in Section 41-2. This figure may be used by the designer as a supplemental tool to ensure that all BMP options have been considered. Note that multiple BMPs may be required from each category in order to provide comprehensive stabilization of the site.