Memorandum

To: Patrick Beane, City of Des Moines **Date:** 02/12/2020

From: Mark A. Land, P.E, CFM, Snyder and Associates

CC: Kate Klavon, E.I., CFM, Snyder and Associates

RE: Brook Run Stormwater Improvements

At the request of the City of Des Moines, Snyder & Associates, Inc. has provided engineering and design services to update and expand upon a 2012 stormwater plan previously developed for the Brook Run development. The update included limited topographic survey, a channel assessment, hydrologic and hydraulic model updates, prioritized concept designs, and preliminary cost estimates. Additionally, the update was to include a bathometric survey of the two ponds. Frozen field conditions have set this item back to a future date.

CHANNEL ASSESSMENT

An *in situ* channel assessment was performed on Tuesday December 3, 2019 of the project area. The assessment covered the length of stream included in the previous assessment in order to compare channel changes and stream conditions. The assessment included a rapid geomorphic assessments of approximately 3,500 linear feet of stream using mobile GIS data collection application in order to evaluate channel stability and prioritize reaches needing stabilization.

Rapid Geomorphic Assessments are a tool used to prioritize areas of a channel needing to be stabilized. They provide a relatively quick characterization of stream reaches, defined as segments of a stream with similar streambank characteristics in terms of bank height and stability. The scores from several stability metrics are summed to create an aggregate score that is used to categorize each stream reach into a stability category: ≤10 is considered stable, between 10 and 20 is considered moderately unstable, and ≥20 is considered highly unstable. The following describes the stability metrics and scoring guidelines that contribute to the aggregate score:

1. *PRIMARY BED MATERIAL:* The bed material is determined based on the average particle grain size of the sediment from the stream bed. Silt clay consists of particles with a median diameter less than 0.63 mm and receives a score of 4 (i.e. has the most potential to erode). Sand consists of particles with a median diameter ranging between 2.00 – 0.63 mm and receives a score of 3. Gravel consists of particles with a median diameter ranging between 64.0 – 2.00 mm and receives a score of 2. Boulder Cobble consists of particles with a median diameter greater than between 64.0 mm and receives a score of 1. In general the

larger a particle is the more shear stress is needed to dislodge the material via fluvial erosion. Therefore, the larger particle diameters receive lower scores.

2. *BED AND BANK PROTECTION:* Bed protection measures the risk of bed scour or incision. If the bed is protected a score of 0 is assigned to the reach. Alternatively if the bed is not protected a score of 1 is assigned. Bank protection indicates if the bank is artificially protected with engineering products such as riprap. A score of 2 is assigned if one bank is protected and 3 if two banks are protected. A higher score is given for bank protection without bed protection because the energy that is not dissipated on the bank is transferred to the bed.

3. DEGREE OF INCISION: Degree of incision is calculated by measuring the water depth at the deepest point across the channel and dividing that measurement by the bank height measured from the top of the bank to the bank base (i.e. where the slope breaks to become the channel bed often referred to as the toe of the cross section). Steep vertical banks are considered more incised and more likely to erode and therefore receive higher scores. Reaches with 0-10%, 11-25%, 26-50%, 51-75%, and 76-100% degree of incision receive scores of 4, 3, 2, 1, and 0 respectively.

4. *DEGREE OF CONSTRICTION:* Degree of constriction is the relative decrease in the channel width from upstream to downstream. Less constricted reaches receive a lower score. Reaches with 0-10%, 11-25%, 26-50%, 51-75%, and 76-100% degree of constriction receive scores of 0, 1, 2, 3, and 4 respectively.

5. *STREAM BANK EROSION*: The dominant form of bank erosion, fluvial or mass wasting, is determined separately for each the left and right bank (looking downstream). Each bank is scored accordingly with no erosion, fluvial erosion, and mass wasting receiving scores of 0, 1, and 2 respectively.

6. *STREAM BANK INSTABILITY*: The bank instability is simply a percent of each bank experiencing erosion. Each bank is scored separately and banks with 0-10%, 11-25%, 26-50%, 51-75%, and 76-100% percent failure receive scores of 0, 0.5, 1, 1.5, and 2 respectively.

7. *ESTABLISHED RIPARIAN WOODY-VEGETATIVE COVER:* Riparian woody vegetation includes permanent vegetation that grows on the stream bank that protects the bank from both fluvial erosion by reducing the applied shear stress and mass wasting by increasing the cohesive strength of the soil. Each bank is scored separately and banks with 0-10%, 11-25%, 26-50%, 51-75%, and 76-100% cover receive scores of 2, 1.5, 1, 0.5, and 0 respectively.

8. *OCCURRENCE OF BANK ACCRETION:* Bank accretion, or fluvial deposition, was based on a percent of the reach length that contained signs of accretion. Signs of accretion include

gravel or other small sediment bars adjacent to the banks. Each bank is scored separately and banks with 0-10%, 11-25%, 26-50%, 51-75%, and 76-100% fluvial deposition receive scores of 2, 1.5, 1, 0.5, and 0 respectively.

9. *STAGE OF CHANNEL EVOLUTION*: Each reach was assigned a stage in the channel evolution model proposed by Simon and Klimetz (2008). Stage I is a pre-modified channel with stable banks, no mass wasting, short banks, established woody vegetation, and low bank angles. Stage I reaches receive a score of 0. Stage II is a constructed channel with artificial reshaping of the banks, minimal vegetation, and steep banks. Stage II receives a score of 1. Stage III channels are experiencing degradation or lowering of the channel bed and consequently have high bank heights. High incision is present without widening. Stage III reaches receive a score of 2. Stage IV consists of degradation and channel widening. Mass wasting and excessive undercutting is present with minimal vegetation and vertical banks. Stage IV receives a score of 4 as it has the highest potential for instability. Stage V reaches are experiencing aggradation or the deposition of material on the bed. Stage V channels receive a score of 3. Stage VI channels are in the restabilization phase. Bank heights are low, aggradation is present, and there is ample floodplain connection. Stage VI reaches receive a score of 1.5.

In total, thirty reaches were assessed within the project area. The average, minimum, and maximum Rapid Geomorphic Assessment scores were 21.2, 15, and 26.5, respectively. Approximately 43% of the stream reaches were considered moderately unstable and 57% of the reaches were considered highly unstable. The worst stability was in Segment1 Reaches 1 – 6 and Segment 3 Reaches 1 and 2. Fifty percent of the stream banks were experiencing mass wasting and 87% were experiencing fluvial erosion. More detailed results of the assessment are provided both visually and in table format in Appendix A-C.

HYDROLOGIC AND HYDRAULIC MODEL UPDATES

The existing conditions XPSWMM model was updated with the following:

- Channel Geometry based on Survey
- Future Development Conditions in Adjacent Neighborhoods
- Reduced Flows due to Storage from the E. Douglas Roadway Improvement Project

Results of the modeling show erosive velocities in several segments of the creek for both the 10 and 100 year 24 hour storm events. Additionally, the modeling shows flooding north of Village Run Drive. Impacting 1 house for the 100 year 24 hour storm event. Stormwater infrastructure upgrades are needed in order to prevent this flooding from impacting structures.

CONCEPT DESIGN AND COST ESTIMATES

Based on information from the site visit, channel assessment, hydrologic and hydraulic modeling, and survey the original 2012 conceptual design was updated. Updates included adjusting the priority project areas and recommended order of project completion. New priority segments along with concept plans are shown in Appendix E. Note that much of the channel portions from Village Run Drive to E. Douglas Ave. (2012 Priority 4 and Priority 5 segments) were eliminated as priority areas. This is because the erosion in this area has minimal impact to property and not much has changed since the last assessment in 2012. It appears that the cost and impact of a channel stabilization project in this area may outweigh the benefits.

The priority segments include design components of storm sewer infrastructure updates, channel stabilization, and pond improvements. The following techniques are proposed:

- **Grade Control Riprap Weirs** are proposed to reduce the overall slope of the channel and therefore reduce velocities and channel degradation. The approximate location of the weirs is show in both the plan and profile view of the figures in Appendix E.

- **Riprap Toe Protection** is proposed on the outer meanders of the channel in order to reduce fluvial erosion. Minimal earth work beyond the toe rock will be used to tie into the existing top of bank and eliminate vertical banks. The figures in Appendix E show approximate locations of toe rock.

- **Bank Shaping** of the inner bend to flatter slopes (2:1 to 3:1) and possible floodplain benches, where space is available, will allow the water to spread out and slow down therefore reducing erosive forces and minimalizing future bank failures. The figures in Appendix E show the approximate grading limits needed for minimal bank shaping.

- **Outfall Stabilization (Stilling Basins)** will be used to control erosion in areas where stormwater discharges into the channel. Locations of the stilling basins are shown in the figures in Appendix E.

- **Channel Re-Alignment** may be needed in areas where banks are high and close to property infrastructure. This item is not shown in the concept plans but is to be expected in final design.

- **Establishing Native Vegetation** on the banks will reduce the erosive velocities applied to the bank and decrease the risk of mass wasting by providing additional soil strength.

- **Forebay Construction** at the locations where the stormwater discharges into the ponds will create areas for sediment to accumulate that is easy to access and maintain. Sediment

can be removed from the ponds without the expense of dredging an entire pond. Forebay locations are shown in the figures in Appendix E.

- **Pond Dredging** is needed to remove the accumulated silt within the three ponds and improve water quality. It is recommended that dredging happen after all channel work as banks will continue to erode until stabilization is complete.

- **Pipe Modifications** are proposed to decrease channel slopes in Priority Area 2 and to address flooding north of Village Run Drive in Priority Area 4. The location of the pipe modifications are shown in the figures in Appendix E.

The following prioritization is recommended for the drainage improvements with detailed costs breakdowns provided in Appendix D.

- **Priority 1 (Assessment Segment 3)** includes channel improvements from the Upper Pond east to Brook Ridge Court. This segment of channel is experiencing some of the worst erosion with the potential to impact residential property. However, due to the short distance of channel needing stabilized this project can be completed for relatively minimal costs ($316,500).

- **Priority 2 (Assessment Segment 2)** includes channel improvements below the middle pond and east to Brook View Drive. This segment is not experiencing the worst erosion within the study area but the project can be completed for relatively minimal costs ($229,500).

- **Priority 3 (Assessment Segment 1)** includes channel improvements from the middle pond north to Brook View Drive. This segment is experiencing some of the worst erosion with potential to impact residential property, especially within the upstream most portion of the channel. This is the longest segment of channel needing stabilized and therefore is the highest priced segment ($787,000)

- **Priority 4** included infrastructure upgrades crossing Village Run Drive. Modeling of these upgrades showed that the peak of flows from channel segment 5 does not overlap the peak flows from channel segment 1. Therefore, increasing the size of the pipe crossing Village Run Drive will significantly decrease flooding upstream but will maintain peak elevations within the middle pond. A pipe size of 4’ x 4’ RCB or equivalent is recommended. Additionally, adjustments to the intake structure are suggested ($255,000).

- **Priority 5** includes dredging the lower pond and constructing 1 forebay. Dredging was prioritized from low to high cost. Because no channel improvements are recommended upstream of this priority area, the City may choose to complete this project at any time ($98,000).

- **Priority 6** includes dredging the upper pond and constructing 2 forebays. Dredging was prioritized from low to high cost ($192,000).
- **Priority 7** includes dredging the middle pond and constructing 2 forebays. Dredging was prioritized from low to high cost ($352,500).
- **Priority 8 (Optional, Assessment Segment 4 Reach 5)** includes channel improvements for a very small segment of the channel north of the upper pond. This area was the only unstable area in assessment segment 4 and erosion could impact residential property. However the impact to property is not as critical as other areas within the study area. This area may be difficult to access and may not be worth the stabilization effort if homeowners adjacent to the improvements are not adamant about stabilization ($120,500).

APPENDIX A

RAPID GEOMORPHIC ASSESSMENT RESULTS - TABULAR DATA

Segment	Reach	Primary Bed Material	Bed Protection	Bank Protection	Degree of Incision (%)	Degree of Constriction (%)	LB Instability	RB Instability	LB Vegetation (%)	RB Vegetation (%)	LB Bank Accretion (%)	RB Bank Accretion (%)	Stage of Channel Evolution	Score	Stability	Image
S1	R1	Silt Clay	No	No	0-10	26-50	Mass Wasting	Mass Wasting	26-50	11-25	11-25	11-25	3	25.5	Highly Unstable	2019-12-03_SA-00004.jpg
S1	R2	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	11-25	0-10	0-10	11-25	3	25.5	Highly Unstable	2019-12-03_SA-00006.jpg
S1	R3	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	0-10	11-25	0-10	0-10	3	26.5	Highly Unstable	2019-12-03_SA-00007.jpg
S1	R4	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	0-10	11-25	0-10	0-10	3	26.5	Highly Unstable	2019-12-03_SA-00009.jpg
S1	R5	Silt Clay	No	No	0-10	11-25	Mass Wasting	Mass Wasting	0-10	11-25	0-10	11-25	3	25.5	Highly Unstable	2019-12-03_SA-00013.jpg
S1	R6	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	11-25	11-25	11-25	26-50	3	23.5	Highly Unstable	2019-12-03_SA-00014.jpg
S1	R7	Silt Clay	No	No	0-10	11-25	Mass Wasting	Mass Wasting	11-25	11-25	11-25	51-75	3	24	Highly Unstable	2019-12-03_SA-00017.jpg
S1	R8	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	26-50	26-50	11-25	11-25	3	22	Highly Unstable	2019-12-03_SA-00020.jpg
S1	R9	Silt Clay	No	No	0-10	11-25	Fluvial	Fluvial	26-50	26-50	51-75	51-75	3	19	Moderately Unstable	2019-12-03_SA-00022.jpg
S1	R10	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	26-50	26-50	11-25	11-25	3	23	Highly Unstable	2019-12-03_SA-00023.jpg
S1	R11	Silt Clay	No	No	11-25	0-10	Mass Wasting	Fluvial	26-50	11-25	51-75	11-25	3	19.5	Moderately Unstable	2019-12-03_SA-00024.jpg
S1	R12	Silt Clay	No	No	0-10	0-10	Mass Wasting	Fluvial	11-25	11-25	11-25	26-50	3	21	Highly Unstable	2019-12-03_SA-00025.jpg
S1	R13	Silt Clay	No	No	11-25	26-50	Fluvial	Fluvial	26-50	26-50	26-50	26-50	3	19	Moderately Unstable	2019-12-03_SA-00026.jpg
S1	R14	Silt Clay	No	No	11-25	0-10	Fluvial	Fluvial	0-10	0-10	11-25	0-10	3	20.5	Highly Unstable	2019-12-03_SA-00029.jpg
S1	R15	Silt Clay	No	No	11-25	11-25	Fluvial	Fluvial	26-50	26-50	0-10	11-25	3	19.5	Moderately Unstable	2019-12-03_SA-00030.jpg
S2	R1	Boulder_Cobb	Yes	2 Bank	0-10	0-10	None	None	0-10	26-50	0-10	0-10	2	16	Moderately Unstable	2019-12-03_SA-00035.jpg
S2	R2	Boulder_Cobb	No	1 Bank	0-10	0-10	Mass Wasting	Fluvial	0-10	11-25	0-10	0-10	3	22.5	Highly Unstable	2019-12-03_SA-00037.jpg
S2	R3	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	11-25	11-25	11-25	11-25	3	24.5	Highly Unstable	2019-12-03_SA-00039.jpg
S3	R1	Silt Clay	No	No	0-10	0-10	Mass Wasting	Mass Wasting	0-10	0-10	11-25	11-25	3	26	Highly Unstable	2019-12-03_SA-00078.jpg
S3	R2	Silt Clay	No	No	0-10	11-25	Mass Wasting	Mass Wasting	26-50	26-50	0-10	0-10	3	26	Highly Unstable	2019-12-03_SA-00081.jpg
S4	R1	Sand	No	No	26-50	11-25	Fluvial	Fluvial	11-25	11-25	11-25	0-10	1	15.5	Moderately Unstable	2019-12-03_SA-00046.jpg
S4	R2	Boulder_Cobb	Yes	2 Bank	26-50	0-10	None	Fluvial	0-10	0-10	0-10	0-10	2	16.5	Moderately Unstable	2019-12-03_SA-00047.jpg
S4	R3	Boulder_Cobb	No	1 Bank	26-50	26-50	Fluvial	Fluvial	0-10	0-10	0-10	0-10	2	19	Moderately Unstable	2019-12-03_SA-00055.jpg
S4	R4	Gravel	No	No	26-50	0-10	Fluvial	Fluvial	0-10	11-25	11-25	11-25	3	17.5	Moderately Unstable	2019-12-03_SA-00057.jpg
S4	R5	Silt Clay	No	No	0-10	11-25	Mass Wasting	Mass Wasting	11-25	11-25	26-50	26-50	3	24	Highly Unstable	2019-12-03_SA-00061.jpg
S4	R6	Silt Clay	No	No	26-50	26-50	Fluvial	Fluvial	26-50	26-50	0-10	0-10	1	17	Moderately Unstable	2019-12-03_SA-00063.jpg
S5	R1	Boulder_Cobb	Yes	2 Bank	0-10	0-10	None	None	11-25	0-10	0-10	0-10	2	16.5	Moderately Unstable	2019-12-03_SA-00069.jpg
S5	R2	Silt Clay	No	No	51-75	26-50	Mass Wasting	Fluvial	0-10	11-25	11-25	11-25	3	22	Highly Unstable	2019-12-03_SA-00071.jpg
S5	R3	Silt Clay	No	No	76-100	0-10	Fluvial	Fluvial	0-10	0-10	0-10	0-10	1	15	Moderately Unstable	2019-12-03_SA-00073.jpg
S5	R4	Boulder_Cobb	Yes	2 Bank	0-10	0-10	None	None	0-10	0-10	0-10	0-10	2	17	Moderately Unstable	2019-12-03_SA-00074.jpg

*** LB = Left Bank

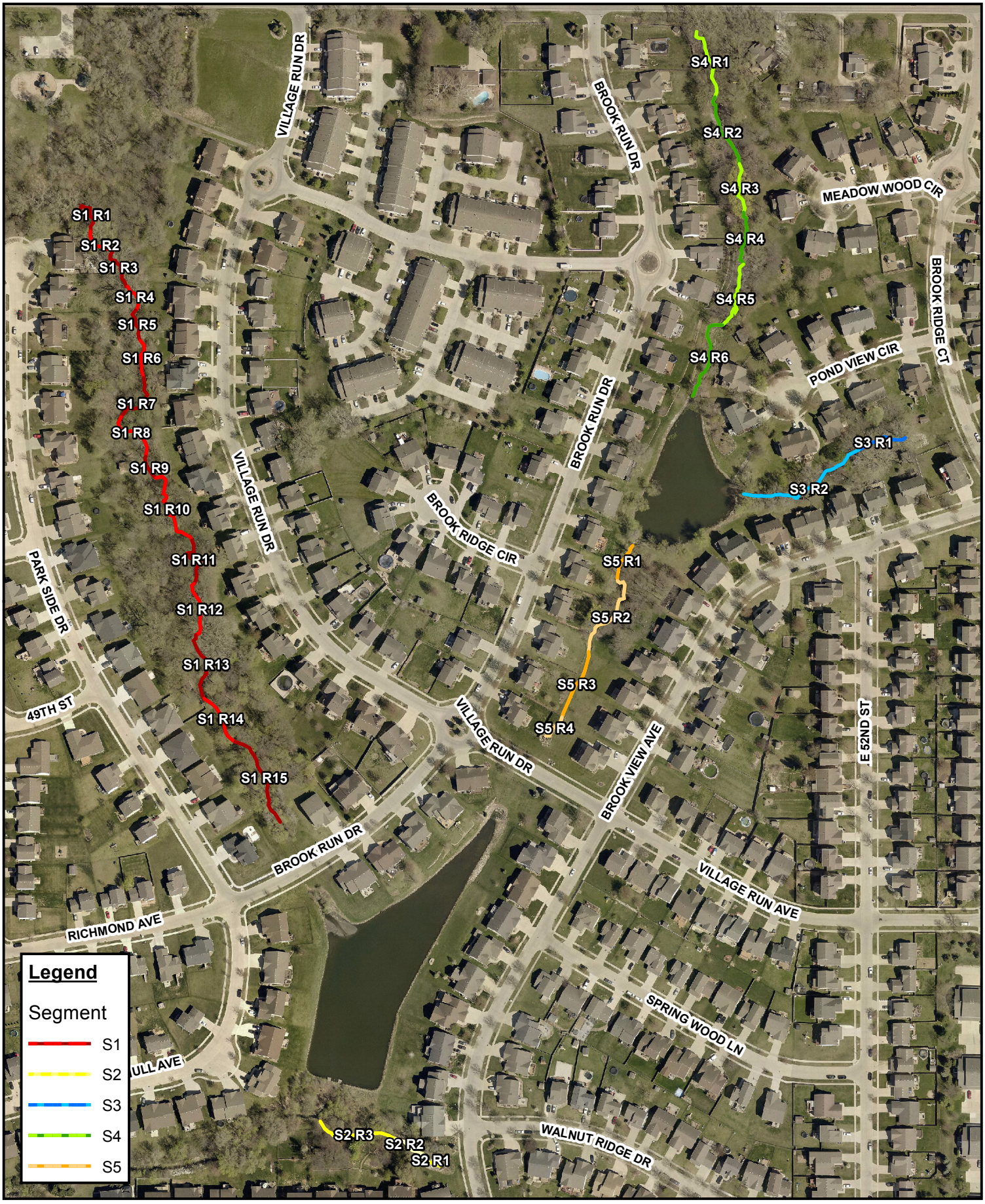
*** RB = Right Bank

APPENDIX B

ASSESSMENT EXHIBITS

FILE PATH: \\orion\volume\Projects\2019\119.1108.01\GIS\20191209_DS_Ex1_Segments.mxd

SOURCES:



SNYDER & ASSOCIATES

0 125 250

Feet

Exhibit 1 - Segment Location Map

Brook Run Drainage Study | Des Moines, IA | 1/22/2020

FILE PATH: \\orion\volume\Projects\2019\119.1108.01\GIS\20191209_DS_Ex2_SegmentScore.mxd

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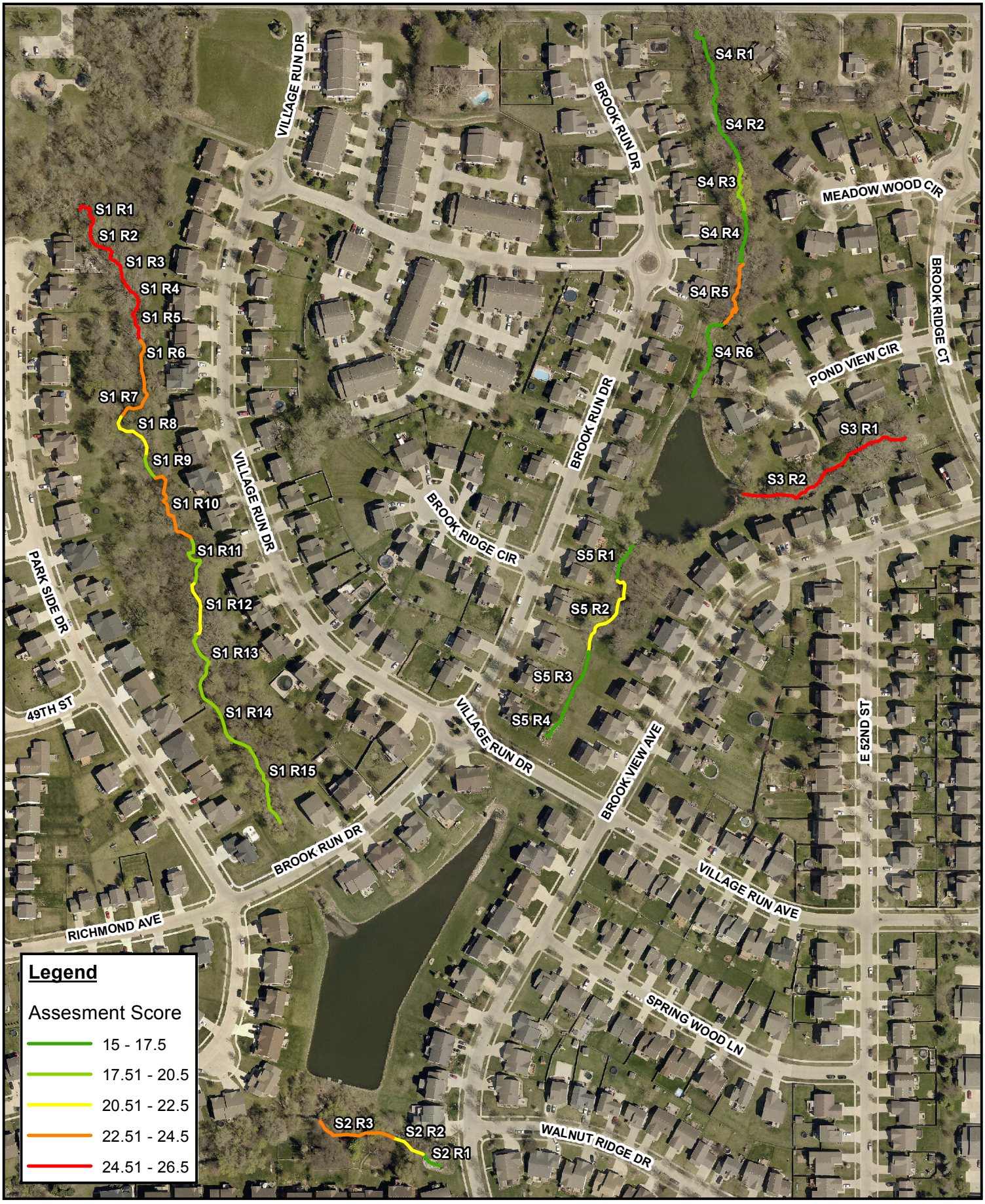

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Exhibit 2 - Assesment Scores

Brook Run Drainage Study | Des Moines, IA | 1/22/2020

FILE PATH: \\orion\volume\Projects\2019\119.1108.01\GIS\20191209_DS_Ex3_PhotoLocation.mxd

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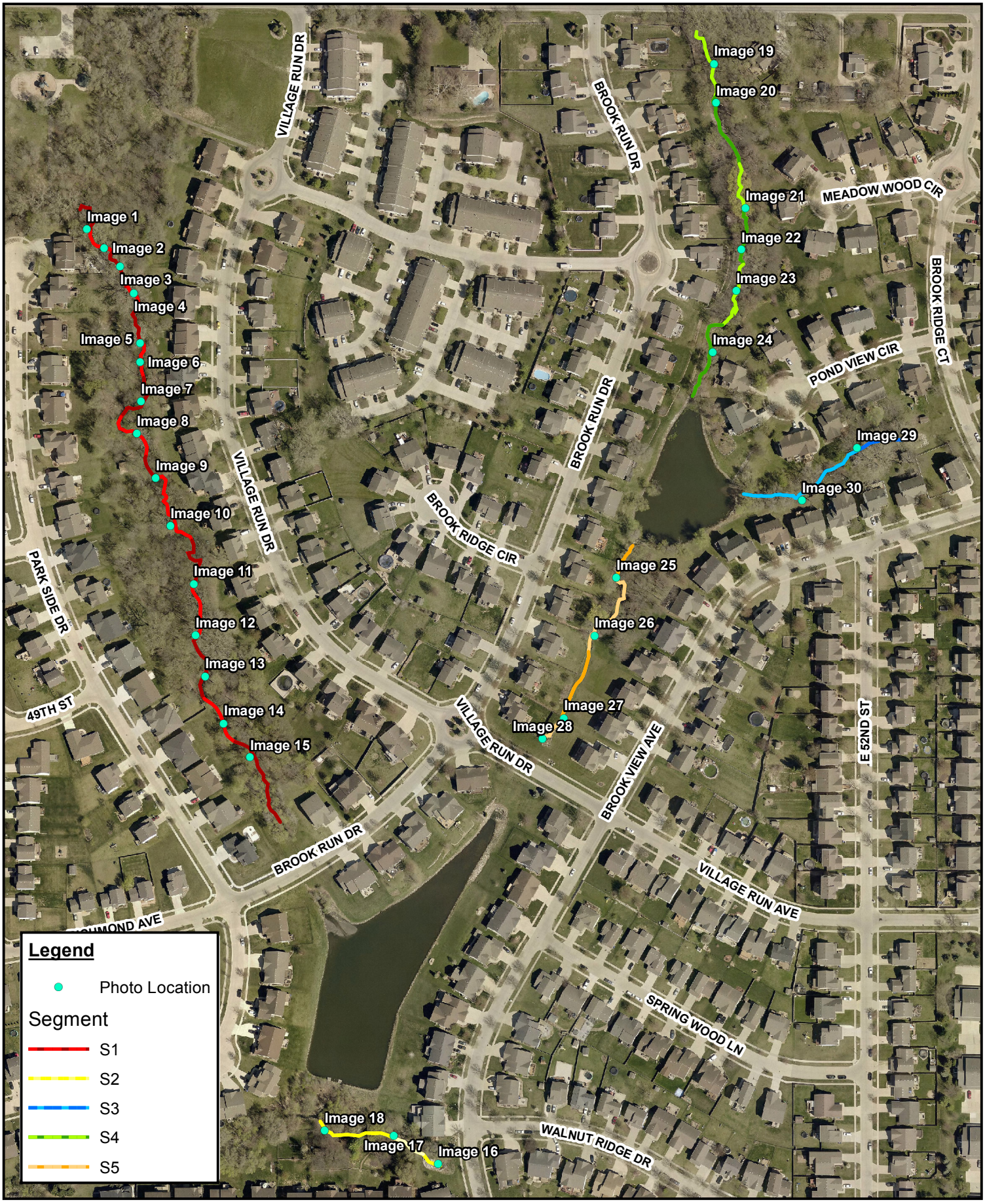

SNYDER & ASSOCIATES

0 125 250

Feet

Exhibit 3 - Photo Locations

Brook Run Drainage Study | Des Moines, IA | 1/22/2020

APPENDIX C

ASSESSMENT PHOTOS

Figure 1: 2019-12-03_SA-00004.jpg

Figure 2: 2019-12-03_SA-00006.jpg

Figure 3: 2019-12-03_SA-00007.jpg

Figure 4: 2019-12-03_SA-00009

Figure 5: 2019-12-03_SA-00013.jpg

Figure 6: 2019-12-03_SA-00014.jpg

Figure 7: 2019-12-03_SA-00017.jpg

Figure 8: 2019-12-03_SA-00020.jpg

Figure 9: 2019-12-03_SA-00022.jpg

Figure 10: 2019-12-03_SA-00023.jpg

Figure 11: 2019-12-03_SA-00024.jpg

Figure 12: 2019-12-03_SA-00025.jpg

Figure 13: 2019-12-03_SA-00026.jpg

Figure 14: 2019-12-03_SA-00029

Figure 15: 2019-12-03_SA-00030.jpg

Figure 16: 2019-12-03_SA-00035.jpg

Figure 17: 2019-12-03_SA-00037.jpg

Figure 18: 2019-12-03_SA-00039.jpg

Figure 19: 2019-12-03_SA-00046.jpg

Figure 20: 2019-12-03_SA-00047.jpg

Figure 21: 2019-12-03_SA-00055.jpg

Figure 22: 2019-12-03_SA-00057.jpg

Figure 23: 2019-12-03_SA-00061.jpg

Figure 24: 2019-12-03_SA-00063.jpg

Figure 25: 2019-12-03_SA-00069.jpg

Figure 26: 2019-12-03_SA-00071.jpg

Figure 27: 2019-12-03_SA-00073.jpg

Figure 28: 2019-12-03_SA-00074.jpg

Figure 29: 2019-12-03_SA-00078.jpg

Figure 30: 2019-12-03_SA-00081.jpg

APPENDIX D

PRELIMINARY OPINION OF PROBABLE COSTS

PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

SUMMARY

PRIORITY	TOTAL COST	TOTAL ROUNDED
Priority 1 - Channel from Upper Pond east to Brook Ridge Court	$316,290	$316,500
Priority 2 - Channel from below middle pond east to Brook View Drive	$229,340	$229,500
Priority 3 - Channel from Middle Pond north to Brook Run Park	$787,100	$787,000
Priority 4 - Infrastructure Upgrades Crossing Village Run Drive	$255,005	$255,000
Priority 5 - Dredge lower pond and construct forebay	$98,040	$98,000
Priority 6 - Dredge upper pond and construct forebays	$191,840	$192,000
Priority 7 - Dredge middle pond and construct forebays	$352,540	$352,500
Priority 8 - Channel from Upper Pond to the north to East Douglas Avenue	$120,200	$120,500
TOTAL PROJECTED CONSTRUCTION COST	**$2,350,355**	**$2,351,000**

This opinion of probable cost was completed using a conceptual design layout. Snyder and Associates, Inc is not responsible for any discrepancies between this assumed layout and quantities and the actual bids of the final plans and final quantities.

Property Owners adjacent to the proposed improvement areas will be responsible for removing any landscape items such as trees, shrubs, flowers, stone or rock, within the construction limits, that the Owner(s) wishes to save. Property owners will also be responsible for disconnecting any existing down spouts that outlet directly to the drainage way. All downspouts shall outlet away from the homes and be allowed to sheet flow into the drainage way.

PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 1 - Channel from Upper Pond east to Brook Ridge Court

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$19,000.00	$19,000.00
2	CLEARING AND GRUBBING	LS	1	$10,000.00	$10,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$55,000.00	$55,000.00
5	STORM SEWER REMOVAL, <36"	LF	40	$50.00	$2,000.00
6	FES REMOVAL	EA	1	$500.00	$500.00
7	STORM SEWER, CLASS III RCP, 36"	LF	150	$180.00	$27,000.00
8	PIPE APRON, RCP, 36" W/ FOOTING AND GUARD	EA	1	$4,000.00	$4,000.00
9	MANHOLE, SW-401	EA	1	$5,000.00	$5,000.00
10	SIDEWALK REMOVAL	SY	14	$20.00	$280.00
11	SIDEWALK, PCC, 4"	SY	14	$65.00	$910.00
12	RIPRAP, STILLING BASIN	LS	1	$10,000.00	$10,000.00
13	RIP RAP, GRADE CONTROL WEIR	EA	5	$7,000.00	$35,000.00
14	RIPRAP, TOE PROTECTION	LF	300	$80.00	$24,000.00
15	RIP RAP, BRIDGE PROTECTION	LS	1	$4,500.00	$4,500.00
16	SEEDING, NATIVE GRASS	AC	0.5	$2,000.00	$1,000.00
17	EROSION CONTROL	LS	1	$3,500.00	$3,500.00
	CONSTRUCTION SUBTOTAL				$202,690.00
	CONTINGENCIES (20%)				$40,600.00
	ENGINEERING AND CONSTRUCTION SERVICES				$73,000.00
	TOTAL PROJECTED CONSTRUCTION COST				**$316,290.00**

This opinion of probable cost was completed using a conceptual design layout. Snyder and Associates, Inc is not responsible for any discrepancies between this assumed layout and quantities and the actual bids of the final plans and final quantities.

Property Owners adjacent to the proposed improvement areas will be responsible for removing any landscape items such as trees, shrubs, flowers, stone or rock, within the construction limits, that the Owner(s) wishes to save. Property owners will also be responsible for disconnecting any existing down spouts that outlet directly to the drainage way. All downspouts shall outlet away from the homes and be allowed to sheet flow into the drainage way.

PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 2 - Channel from below middle pond east to Brook View Drive

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$14,000.00	$14,000.00
2	CLEARING AND GRUBBING	LS	1	$6,000.00	$6,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$40,000.00	$40,000.00
5	SIDEWALK REMOVAL	SY	14	$20.00	$280.00
6	SIDEWALK, PCC, 4"	SY	14	$65.00	$910.00
7	RIPRAP, STILLING BASIN	LS	1	$20,000.00	$20,000.00
8	RIPRAP, STEP POOL	LS	1	$13,000.00	$13,000.00
9	RIP RAP, GRADE CONTROL WEIR	EA	4	$7,000.00	$28,000.00
10	RIPRAP, TOE PROTECTION	LF	200	$80.00	$16,000.00
11	RIP RAP, BRIDGE PROTECTION	LS	1	$4,500.00	$4,500.00
12	SEEDING, NATIVE GRASS	AC	0.3	$2,500.00	$750.00
13	EROSION CONTROL	LS	1	$2,500.00	$2,500.00
	CONSTRUCTION SUBTOTAL				$146,940.00
	CONTINGENCIES (20%)				$29,400.00
	ENGINEERING AND CONSTRUCTION SERVICES				$53,000.00
	TOTAL PROJECTED CONSTRUCTION COST				**$229,340.00**

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Property Owners adjacent to the proposed improvement areas will be responsible for removing any landscape items such as trees, shrubs, flowers, stone or rock, within the construction limits, that the Owner(s) wishes to save. Property owners will also be responsible for disconnecting any existing down spouts that outlet directly to the drainage way. All downspouts shall outlet away from the homes and be allowed to sheet flow into the drainage way.

PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 3 - Channel from Middle Pond north to Brook Run Park

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$46,000.00	$46,000.00
2	CLEARING AND GRUBBING	LS	1	$34,000.00	$34,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$180,000.00	$180,000.00
5	RIPRAP, STEP POOL	LS	1	$13,000.00	$13,000.00
5	RIP RAP, GRADE CONTROL WEIR	EA	13	$7,000.00	$91,000.00
6	RIPRAP, TOE PROTECTION	LF	1,500	$80.00	$120,000.00
7	SEEDING, NATIVE GRASS	AC	1.5	$2,000.00	$3,000.00
8	LIVE STAKING	LS	1	$4,500.00	$4,500.00
9	EROSION CONTROL	LS	1	$12,000.00	$12,000.00
	CONSTRUCTION SUBTOTAL				$504,500.00
	CONTINGENCIES (20%)				$100,900.00
	ENGINEERING AND CONSTRUCTION SERVICES				$181,700.00
	TOTAL PROJECTED CONSTRUCTION COST				**$787,100.00**

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PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 4 - Infrastructure Upgrades Crossing Village Run Drive

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$15,000.00	$15,000.00
2	TRAFFIC CONTROL	LS	1	$10,000.00	$10,000.00
3	STORM SEWER REMOVAL, >36"	LF	170	$50.00	$8,500.00
4	FES REMOVAL	EA	1	$500.00	$500.00
5	STORM SEWER, CLASS III RCB, 4' X 4'	LF	170	$600.00	$102,000.00
6	Precast Concrete Box Flared End Section, 4' X 4'	EA	1	$8,000.00	$8,000.00
7	Intake, Modified SW-513	EA	1	$5,000.00	$5,000.00
8	SIDEWALK REMOVAL	SY	28	$20.00	$560.00
9	SIDEWALK, PCC, 4"	SY	28	$65.00	$1,820.00
10	CURB AND GUTTER	LF	60	$60.00	$3,600.00
11	PAVEMENT REMOVAL	SY	85	$5.00	$425.00
12	PAVEMENT REMOVAL	SY	85	$40.00	$3,400.00
13	SOD	SQ	45	$80.00	$3,600.00
14	EROSION CONTROL	LS	1	$1,000.00	$1,000.00
	CONSTRUCTION SUBTOTAL				$163,405.00
	CONTINGENCIES (20%)				$32,700.00
	ENGINEERING AND CONSTRUCTION SERVICES				$58,900.00
	TOTAL PROJECTED CONSTRUCTION COST				**$255,005.00**

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PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 5 - Dredge lower pond and construct forebay

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$6,000.00	$6,000.00
2	Dewatering	LS	1	$10,000.00	$10,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$20,000.00	$20,000.00
5	SIDEWALK REMOVAL	SY	14	$20.00	$280.00
6	SIDEWALK, PCC, 4"	SY	14	$65.00	$910.00
7	RIPRAP, FOREBAY	TN	300	$65.00	$19,500.00
8	SOD	SQ	10	$80.00	$800.00
9	SEEDING, TYPE II	AC	0.5	$2,500.00	$1,250.00
10	EROSION CONTROL	LS	1	$3,000.00	$3,000.00
	CONSTRUCTION SUBTOTAL				$62,740.00
	CONTINGENCIES (20%)				$12,600.00
	ENGINEERING AND CONSTRUCTION SERVICES (30%)				$22,700.00
	TOTAL PROJECTED CONSTRUCTION COST				**$98,040.00**

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PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 6 - Dredge upper pond and construct forebays

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$12,000.00	$12,000.00
2	Dewatering	LS	1	$20,000.00	$20,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$35,000.00	$35,000.00
5	SIDEWALK REMOVAL	SY	14	$20.00	$280.00
6	SIDEWALK, PCC, 4"	SY	14	$65.00	$910.00
7	RIPRAP, FOREBAY	TN	700	$65.00	$45,500.00
8	SOD	SQ	50	$80.00	$4,000.00
9	SEEDING, TYPE II	AC	0.5	$2,500.00	$1,250.00
10	EROSION CONTROL	LS	1	$3,000.00	$3,000.00
	CONSTRUCTION SUBTOTAL				$122,940.00
	CONTINGENCIES (20%)				$24,600.00
	ENGINEERING AND CONSTRUCTION SERVICES (30%)				$44,300.00
	TOTAL PROJECTED CONSTRUCTION COST				**$191,840.00**

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Property Owners adjacent to the proposed improvement areas will be responsible for removing any landscape items such as trees, shrubs, flowers, stone or rock, within the construction limits, that the Owner(s) wishes to save. Property owners will also be responsible for disconnecting any existing down spouts that outlet directly to the drainage way. All downspouts shall outlet away from the homes and be allowed to sheet flow into the drainage way.

PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 7 - Dredge middle pond and construct forebays

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$21,000.00	$21,000.00
2	Dewatering	LS	1	$25,000.00	$25,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$85,000.00	$85,000.00
5	SIDEWALK REMOVAL	SY	14	$20.00	$280.00
6	SIDEWALK, PCC, 4"	SY	14	$65.00	$910.00
7	RIPRAP, FOREBAY	TN	1300	$65.00	$84,500.00
8	SOD	SQ	50	$80.00	$4,000.00
9	SEEDING, TYPE II	AC	0.5	$2,500.00	$1,250.00
10	EROSION CONTROL	LS	1	$3,000.00	$3,000.00
	CONSTRUCTION SUBTOTAL				$225,940.00
	CONTINGENCIES (20%)				$45,200.00
	ENGINEERING AND CONSTRUCTION SERVICES (30%)				$81,400.00
	TOTAL PROJECTED CONSTRUCTION COST				**$352,540.00**

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PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
BROOK RUN SUBDIVISION PROPOSED STORMWATER IMPROVEMENTS
DES MOINES, IOWA
February 12, 2020

Priority 8 - Channel from Upper Pond to the north to East Douglas Avenue

ITEM	BID ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
1	MOBILIZATION	LS	1	$7,000.00	$7,000.00
2	CLEARING AND GRUBBING	LS	1	$4,000.00	$4,000.00
3	TRAFFIC CONTROL	LS	1	$1,000.00	$1,000.00
4	EARTHWORK	LS	1	$24,000.00	$24,000.00
5	RIP RAP, GRADE CONTROL WEIR	EA	3	$7,000.00	$21,000.00
6	RIPRAP, TOE PROTECTION	LF	200	$80.00	$16,000.00
7	SOD	SQ	25	$80.00	$2,000.00
8	SEEDING, NATIVE GRASS	AC	0.2	$2,500.00	$500.00
9	EROSION CONTROL	LS	1	$1,500.00	$1,500.00
	CONSTRUCTION SUBTOTAL				$77,000.00
	CONTINGENCIES (20%)				$15,400.00
	ENGINEERING AND CONSTRUCTION SERVICES				$27,800.00
	TOTAL PROJECTED CONSTRUCTION COST				**$120,200.00**

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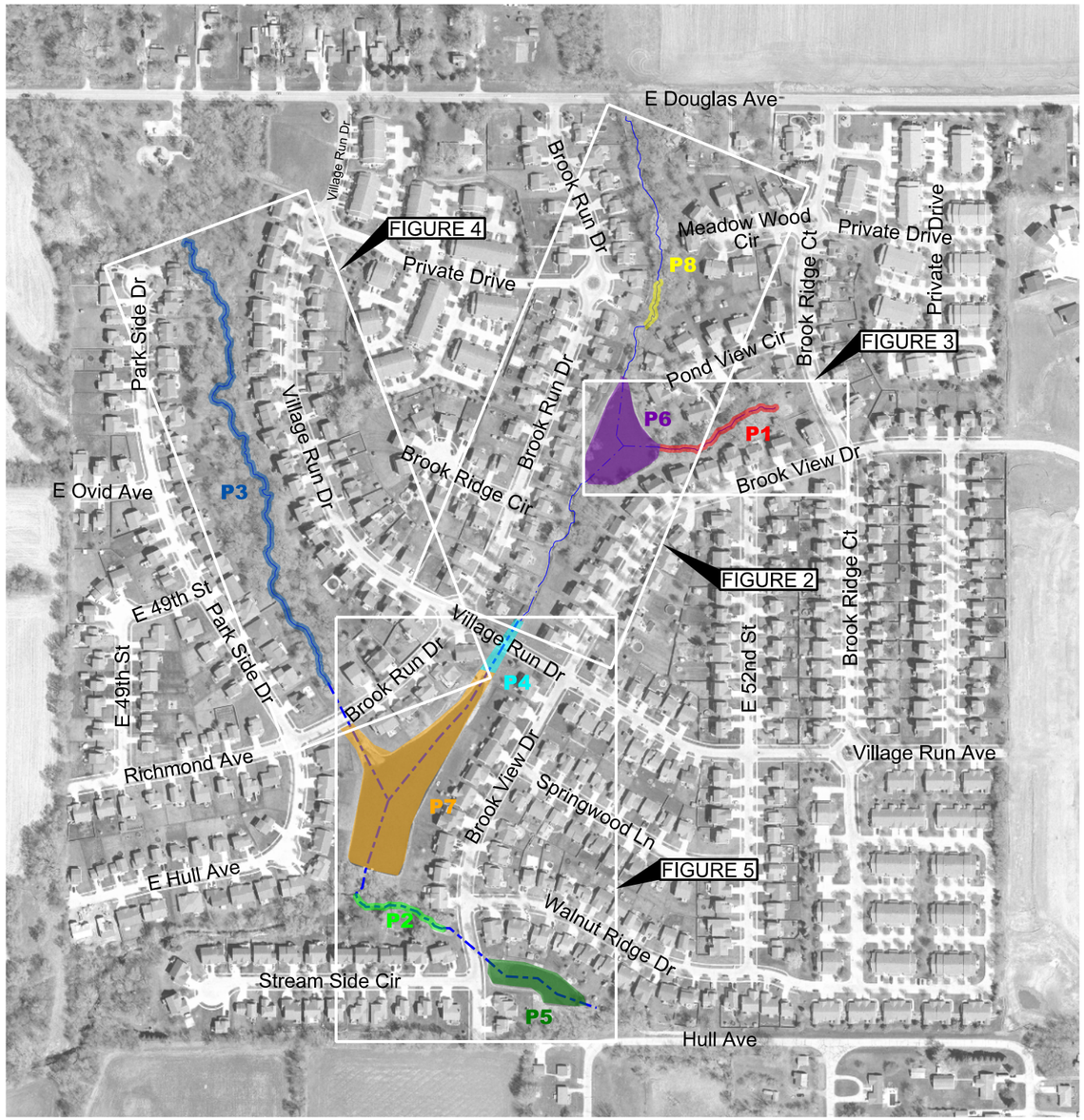
APPENDIX E

CONCEPT PLANS



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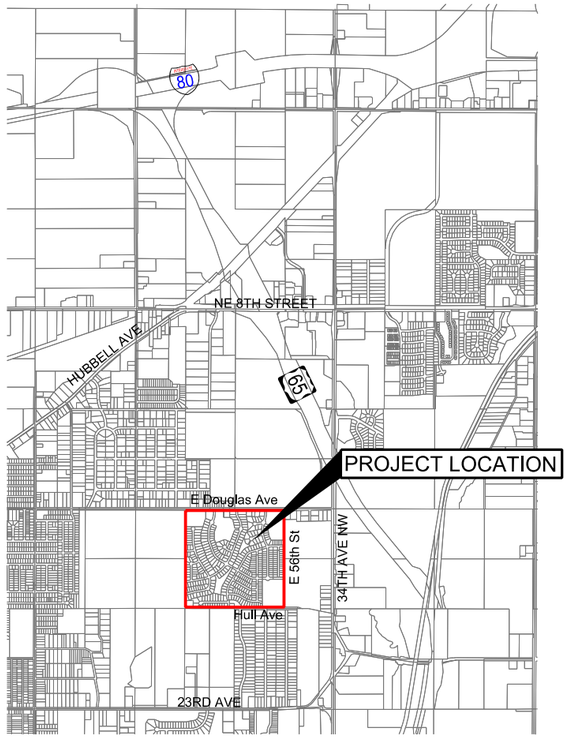


VICINITY MAP

FIGURE 1
BROOK RUN STORMWATER IMPROVEMENTS
CITY OF DES MOINES, POLK COUNTY, IOWA

SNYDER & ASSOCIATES
Engineers and Planners

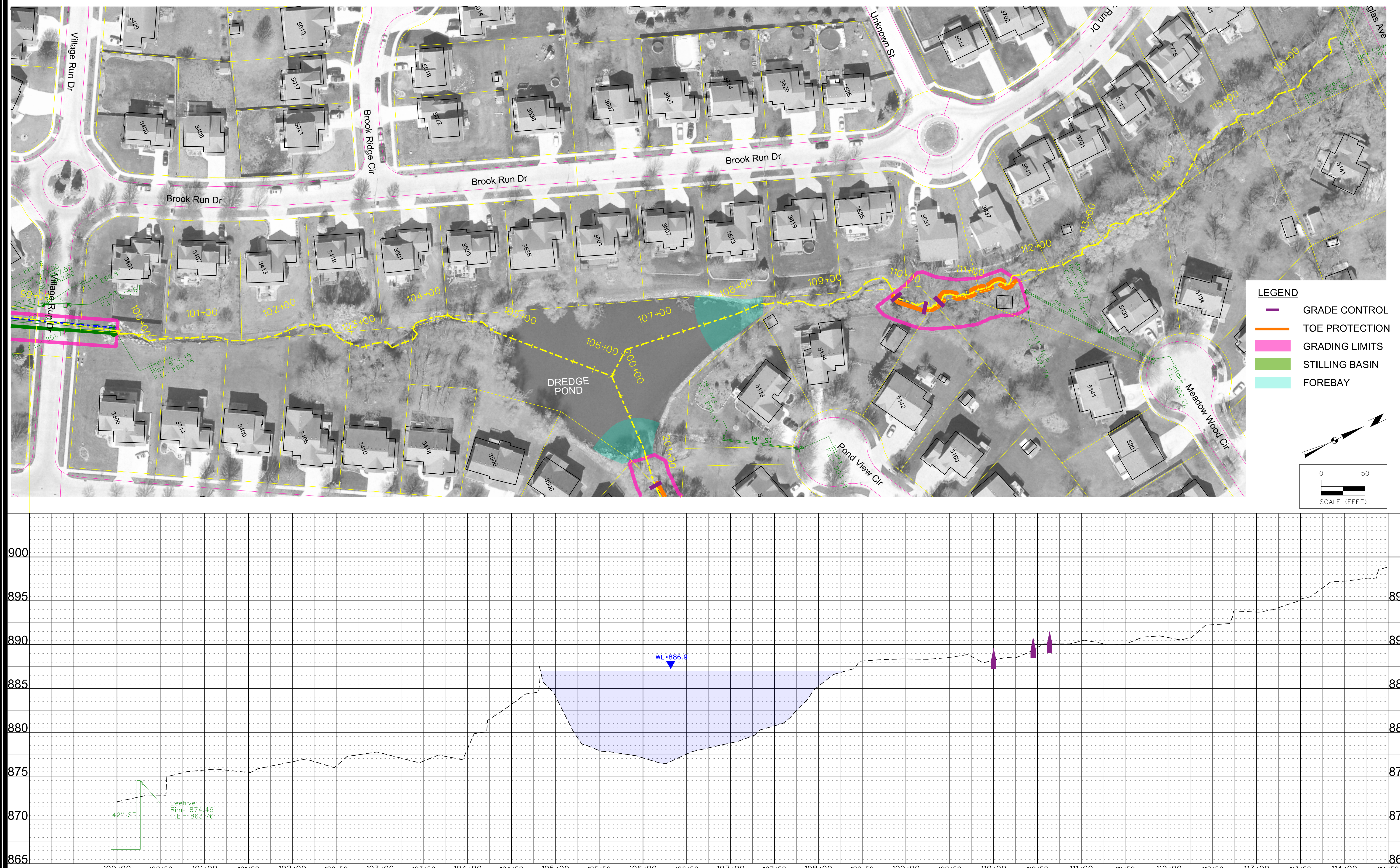
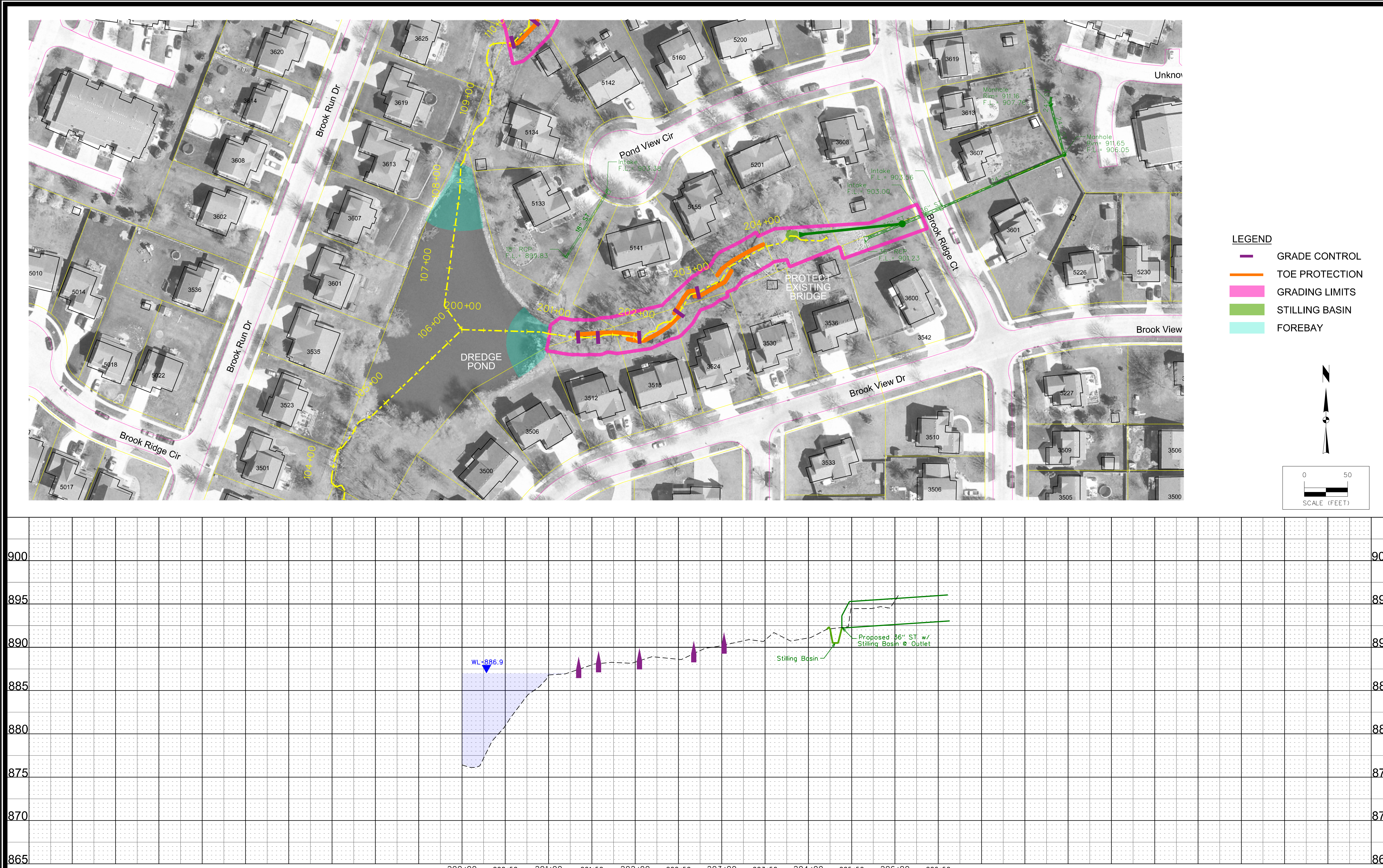


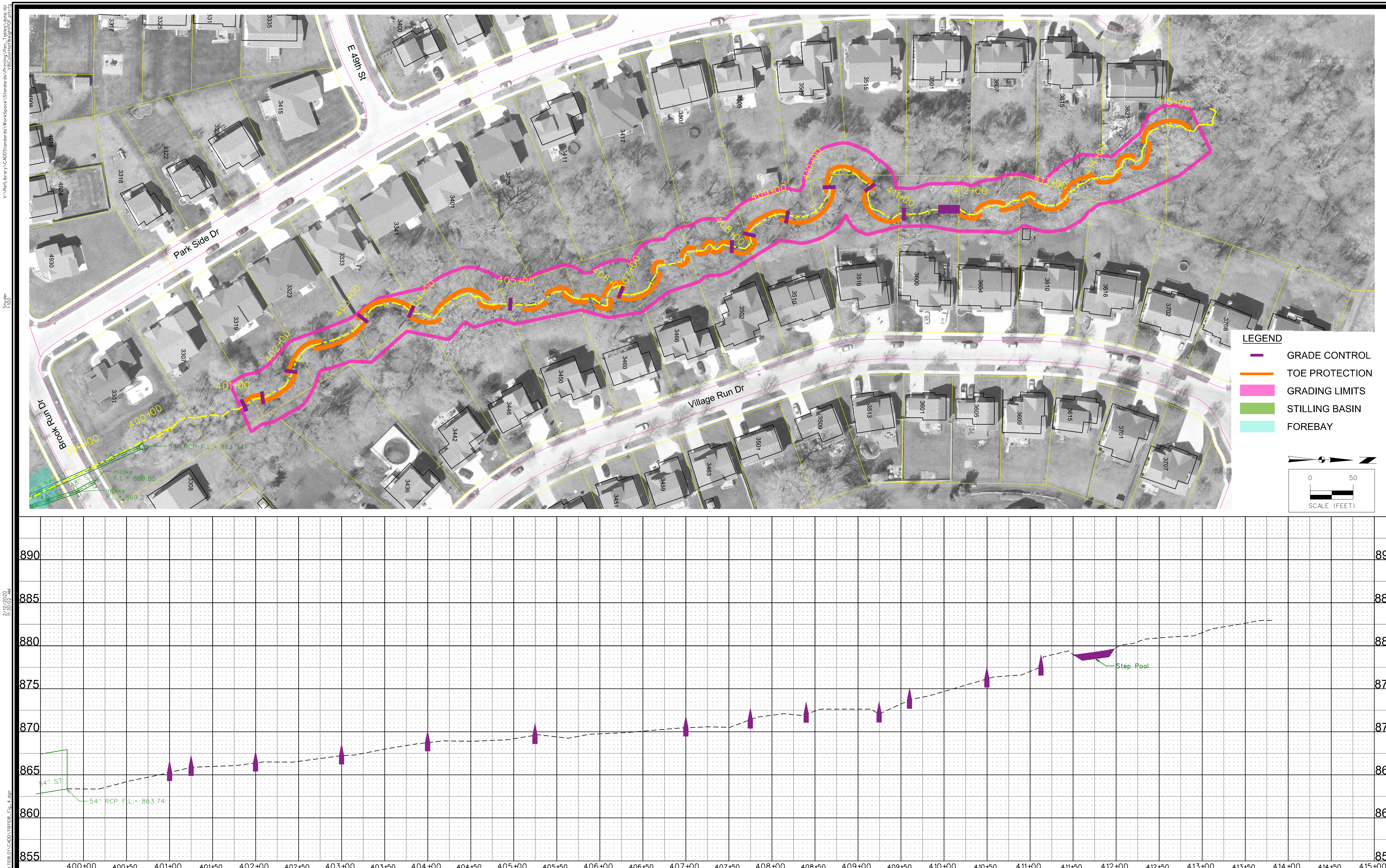
FIGURE 2
BROOK RUN STORMWATER IMPROVEMENTS
CITY OF DES MOINES, POLK COUNTY, IOWA

SNYDER & ASSOCIATES
Engineers and Planners



Snyder & Associates
Engineers and Planners

FIGURE 3
BROOK RUN STORMWATER IMPROVEMENTS
CITY OF DES MOINES, POLK COUNTY, IOWA



SNYDER & ASSOCIATES
Engineers and Planners

FIGURE 4
BROOK RUN STORMWATER IMPROVEMENTS
CITY OF DES MOINES, POLK COUNTY, IOWA

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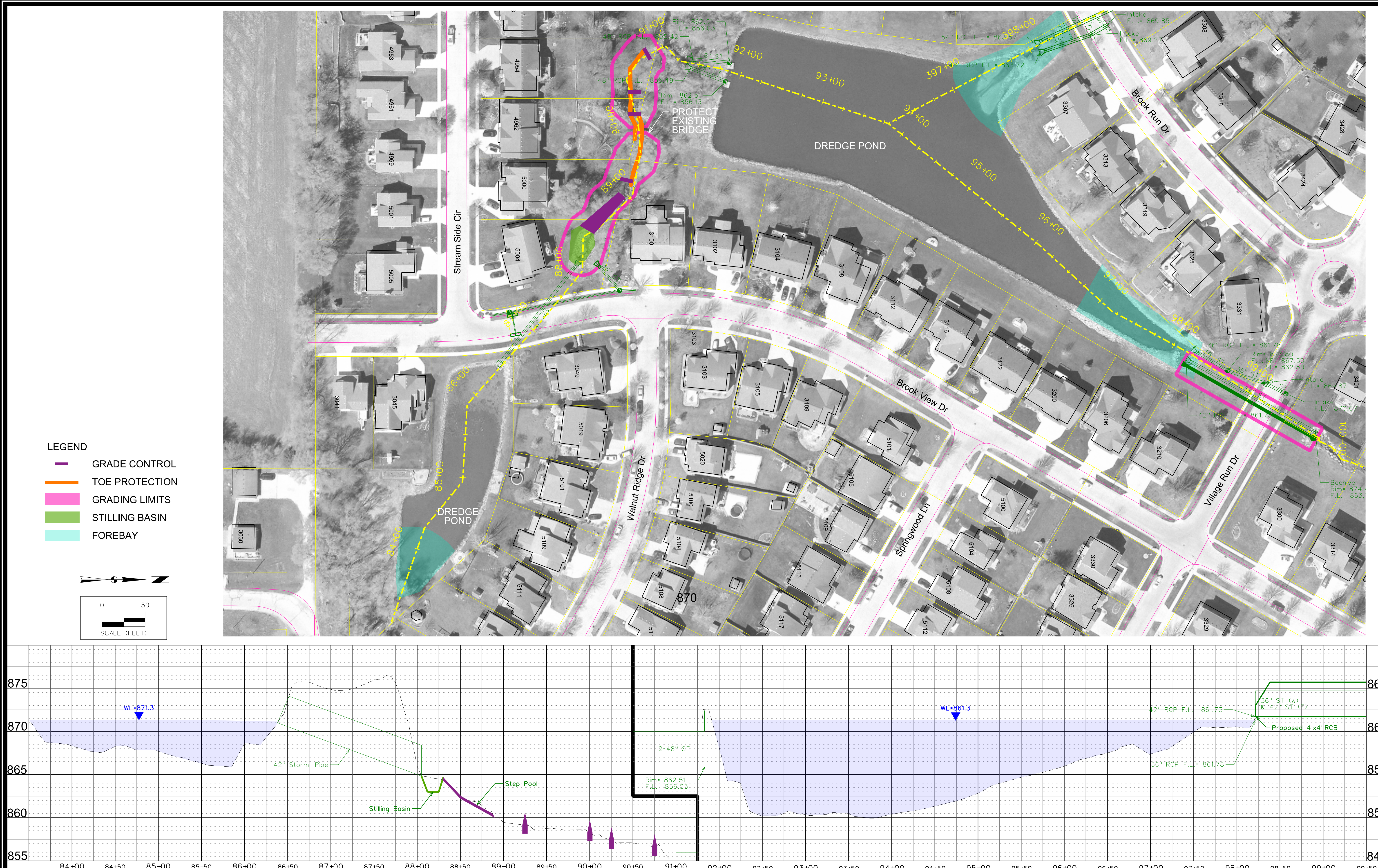

FIGURE 5
BROOK RUN STORMWATER IMPROVEMENTS
CITY OF DES MOINES, POLK COUNTY, IOWA

SNYDER & ASSOCIATES
Engineers and Planners