

# MEMO

To:

Kevin Cook, City of Flint

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From:

Brian M. Stone, PE (NY)

Date:

June 7, 2024

Arcadis Project No.:

30215500

Subject:

RACER Trust Buick City Site – Stormwater Evaluation of Outfall 011  
Reroute

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This memorandum documents an evaluation completed by Arcadis for the reroute of a portion of the City of Flint's (the City's) storm sewer system that currently drains to Outfall 011 (the 011 system) into a main leading to Outfall 013 (the 013 system). The reroute evaluated herein is proposed by the Revitalizing Auto Communities Environmental Response Trust (RACER) Buick City Site in Flint, Michigan (Site) to address PFAS impacts currently reaching the Flint River through the 011 system.

The proposed reroute will sever the existing 011 system at the intersection of Hamilton and Industrial Avenues (**Figure 1**). The portion of the 011 system west of the intersection will be routed into the main of the 013 system, which runs north-south along Industrial Avenue and crosses beneath the 011 system at this intersection. The proposed reroute would be accomplished via the installation of a new manhole where the two systems intersect. Previous sampling of stormwater flows in the 011 system by Arcadis indicate that the portion of the 011 system east of the intersection is subject to infiltration by PFAS-impacted groundwater flowing south from the Building 04 area on the Site, and this portion of the 011 system along Hamilton Avenue will therefore be disconnected from the City's storm sewer infrastructure. New storm sewer piping is proposed in Hamilton Avenue to provide street drainage between this intersection and the railroad crossing east of the intersection, which is a drainage divide along Hamilton Avenue. This new piping will drain back to the west to discharge into the 013 system via the proposed manhole at the point of the 011 reroute (**Figure 2**). The existing 011 system between Industrial Avenue and the railroad crossing would be bulkheaded at each end and all surface drainage to the 011 system in

this section terminated. An evaluation of converting that section of the 011 system into an interim short-term groundwater collection system is under way.

### ***Evaluation Objective***

The evaluation presented herein evaluates the performance of the 013 system at the proposed reroute location and compares the existing performance with that anticipated following the proposed 011 sewer reroute. Based on experience with previous storm sewer system modifications within the City of Flint, it is understood that the City's objective is to provide capacity to convey flows from the 10-year design storm (i.e., 3.27 inches of rain in a 24-hour period) if possible. This evaluation assesses whether the rerouted system can convey the flows from the 10-year, 24-hour design storm.

### ***Model Development and Calibration***

The 013 storm sewer system and contributing watershed are modeled using the United States Environmental Protection Agency's (USEPA's) Stormwater Management Model (SWMM), a public-domain software that has been in use for decades to model hydrologic processes within watersheds and the hydraulics of conveyance features such as open channels and storm sewers. SWMM has been used previously to evaluate modifications to the City's other storm sewer systems that traverse the Site. Additionally, SWMM can perform both single rain event and continuous simulations, the latter being important in the present evaluation to calibrate the model with rainfall and flow measurement data collected for the reroute design.

The model extends approximately 2,900 linear feet (LF) upstream of the proposed 011 reroute location to a manhole at Leith Street and downstream to Outfall 013 at the Flint River. The remainder of the 013 main as well as smaller pipes that feed into the main are not modeled although their flows are accounted for in the model. Consequently, the model used for this evaluation does not simulate upstream hydraulics that may occur and potentially reduce the flow rates to the main (e.g., inlet flow reductions due to grate capacities and/or clogging, ponding at individual inlets, bypass of ponded inlets, and pipe flow capacity restrictions). Under more intense rainfall, the modeled inflows to the main for this evaluation may overpredict real-world conditions.

### ***Existing Conditions Model***

Arcadis previously modeled the 013 system as part of other storm sewer modifications. The model developed for the previous assessment serves as the starting point for the present evaluation. The 013 system model for existing conditions includes:

- 4 subcatchments (watersheds) representing the estimated total drainage area to the 013 system.
- 18 nodes (manholes).
- 18 conduits interconnecting the nodes and the outfall. Each conduit represents a pipe segment, with a total of 5,596 linear feet (LF) of pipe included.
- 1 outfall at the Flint River, which is typically submerged below the river water surface. For conservatism, the river stage is set to the 10-year flood stage (el. 709.7 ft). Lower river stages would exert less backwater on the 013 system and reduce the hydraulic grade line (HGL) in the system, allowing conveyance of greater flows and/or lower HGL in the system for the same flow.

The 011 system itself is not modeled for this evaluation. Because the existing 011 system is considerably shallower (higher) than the existing 013 system where the two storm sewers cross, the proposed reroute results in a free outlet condition for the 011 system at the confluence with the 013 system and is deemed

less restrictive compared to existing conditions. Consequently, the reroute is not anticipated to reduce the capacity of the 011 system upstream of the reroute location. The 011 watershed at the proposed reroute location is modeled and included in the 013 proposed conditions model.

The previously estimated watersheds to the 011 and 013 systems were validated/adjusted using rainfall and flow monitoring data collected between April 17 and May 30, 2024 by a subcontractor to Arcadis at the following three locations:

- FM-01 installed in a manhole in Hamilton Avenue along the 011 system just east of the proposed reroute location. This manhole is "011MH-5" in the SWMM model. Flows exit from this manhole to the east via a 24-inch-diameter pipe. Flows at this location, combined with additional street drainage from Hamilton Avenue between the reroute location and the railroad crossing to the east represent the addition to the 013 system due to the proposed reroute.
- FM-02 installed in a manhole in Industrial Avenue along the 013 system just north of the proposed reroute location. This manhole is "Node8" in the SWMM model. Flows exit from this manhole to the south via a 72-inch-diameter pipe.
- FM-03 installed in a manhole in East Wood Street along the 013 system just upstream of the 013 outfall. This manhole is "Node16" in the SWMM model. Flows exit from this manhole to the east-southeast via a 78-inch-diameter pipe.

Two rain gauges were established to record site-specific rainfall at 10 to 15-minute intervals (depending on conditions). During the flow monitoring period, a total of 5.65 inches of rainfall was measured at rain gauge RG1. (The second rain gauge [RG2] experienced random data dropout and was not used for this evaluation.) Plots of recorded rainfall (presented on a cumulative basis) and recorded flow rates at each of the three flow monitoring locations over the duration of the flow monitoring period are presented in **Figures 3A, 3B, and 3C**.

The following three rain events were simulated in the SWMM model and compared to the measured flows in the 011 and 013 systems to calibrate the subcatchment parameters in the SWMM model:

- 0.58 inches recorded from 1:15am to 10:30am on May 3, 2024.
- 0.76 inches recorded from 4:20pm on May 26, 2024 to 9:20pm on May 27, 2024.
- 1.38 inches recorded from 1:50pm to 8:00pm on May 28, 2024. This rainfall produced both the most intense rainfall (inches per hour) and total rainfall (inches) of any event during the monitoring period. Portions of this event had rainfall intensities that approximately equal the 1-year storm.

Model calibration consisted of:

- Estimating base flow (if any) at each flow monitoring location. From the flow data, base flows of 0.04 and 0.25 cubic feet per second (cfs), were determined for the 011 and 013 systems, respectively.
- Adjusting subcatchment parameters to achieve agreement with recorded runoff volumes, which were computed as the product of flow and time over the duration of the storm-related flows. Base flows are subtracted from the recorded flows and the resulting storm-related volumes are compared to the model-predicted runoff volumes.
- Adjusting subcatchment parameters to achieve agreement with recorded peak flow rates and overall hydrograph shape.

It is noted that it generally is not possible to calibrate a model to exactly duplicate recorded data, especially when there are multiple calibration events (the three rainfalls noted above). Instead, the objective of calibration is to achieve a best fit across the data set and the parameters of interest (runoff volumes, peak flow rates, and overall hydrograph shape). Because the May 28, 2004 rainfall was the most severe that occurred during the flow monitoring period, greater emphasis was placed on achieving agreement with that event.

The calibrated subcatchment parameters are provided in **Table 1**. Also included in this table are the subcatchment parameters selected for 0.9 acres of street drainage from Hamilton Avenue east of the reroute location and extending to the drainage divide created by the railroad track crossing. Because this subcatchment is downstream of the FM-01 flow meter location, it was unable to be calibrated. However, it is a small area compared to the other subcatchments and, because it is street drainage, there are fewer uncertainties regarding runoff parameters. Under existing conditions, the calibrated SWMM model for the 013 system includes a total watershed of 190.3 acres.

#### *Proposed Conditions Model*

Following calibration, Arcadis created a proposed conditions model for the 013 system reflective of the 011 reroute. The proposed conditions model includes a new manhole at the crossing of the 011 and 013 systems. The 011 watershed west of the new manhole will discharge into the 013 system at this location. The proposed conditions model includes the additional 0.9-acres of street drainage from Hamilton Avenue discussed above. This street drainage is currently conveyed by the 011 system but is downstream of the reroute location and therefore will be captured and conveyed back to the west to the 013 system by a run of new piping totaling approximately 570 LF in Hamilton Avenue. A preliminary layout for this new piping is depicted in **Figure 2**.

Under proposed conditions, an additional 18.9 acres of watershed would be added to the 013 system, including 18.0 acres from the existing 011 system at the reroute location ("011-West" subcatchment in the SWMM model) and 0.9 acres from Hamilton Avenue east of the reroute location ("011-East" subcatchment in the SWMM model). With this additional acres, the proposed conditions SWMM model for the 013 system includes a total watershed of 209.2 acres, which is a 10% increase relative to existing conditions. Note that the calibrated subcatchment properties presented in Table 1 are assumed to remain unchanged under proposed conditions.

#### **Model Results**

The existing conditions SWMM model indicates a peak flow rate of 150.1 cfs at the 013 outfall and that the 013 system can convey the runoff from the 10-year, 24-hour storm with limited surcharging in 7 of the downstream most manholes. The degree of surcharging is predicted to be contained within the structures and not rise to grade (i.e., not create flooding), except for the last manhole before the outfall. It is noted that this manhole's rim elevation is only 1.12 ft above the 10-year flood stage of the Flint River, meaning that without any flow in the 013 system, that structure is close to overtopping due to the river's flood stage.

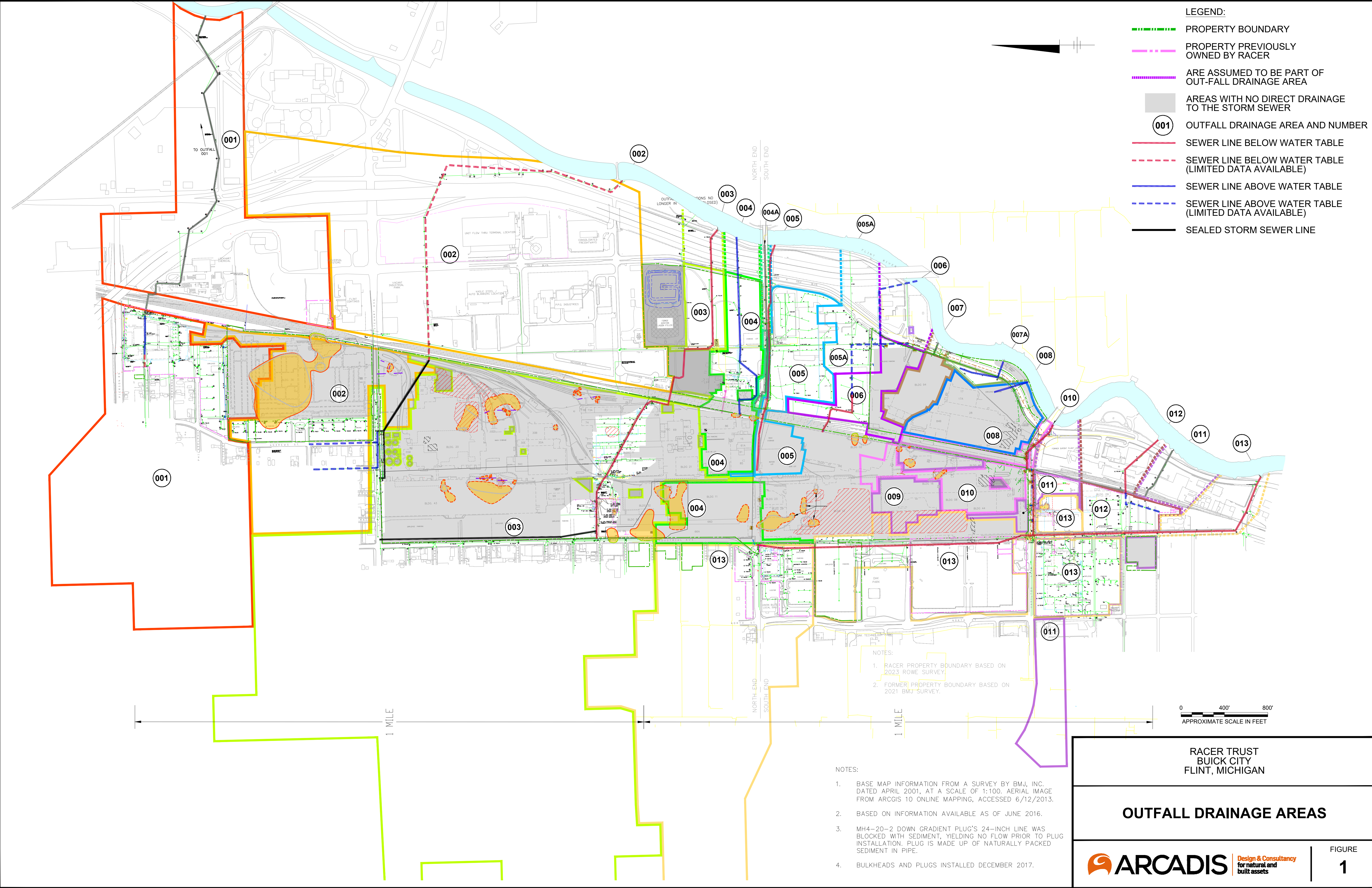
The proposed conditions SWMM model indicates a peak flow rate of 166.5 cfs at the 013 outfall and that the majority of the 013 system can convey the runoff from the 10-year, 24-hour storm with the 011 reroute in place. The surcharging noted in the existing conditions model increase under proposed conditions due to the additional flow from the 011 reroute but are still predicted to be contained within the structures and not rise to grade, except for the last manhole before the outfall. This is the same manhole that exhibits very little freeboard (elevation difference between HGL and rim elevation) under existing conditions due to the rim elevation being close to the river's assumed stage during the simulation. Adequate containment at

this last manhole would require raising the rim elevation 0.04 ft (1/2 inch). An adjustment this small is considered to be within the error range of the model.

A summary of the predicted HGL and freeboard at the modeled drainage structures for the 013 system under existing and proposed (e.g., with the 011 reroute in place) conditions is provided in **Table 2**. As indicated in the table, the maximum predicted increase in HGL is 1.78 ft and occurs at “Node8” in the SWMM model, which is the first manhole upstream of the proposed reroute location.

### ***Conclusions***

The data indicates that the rerouting of the 011 system flow into the existing system will not negatively impact the existing 013 system. The additional flow from the rerouted portions of the 011 system can be conveyed without overtopping the manholes along the 013 system, with the exception of the downstream most manhole, the rim elevation of which is only slightly above the river’s 10-year flood stage. Based on this modeling and analysis conclusions, RACER proposes to move forward with design of the reroute of 011 system into the 013 system. Construction drawings will be submitted to the City for review and approval prior to implementation.



- LEGEND:**
- PROPERTY BOUNDARY
  - - - PROPERTY PREVIOUSLY OWNED BY RACER
  - - - ARE ASSUMED TO BE PART OF OUT-FALL DRAINAGE AREA
  - AREAS WITH NO DIRECT DRAINAGE TO THE STORM SEWER
  - 001 OUTFALL DRAINAGE AREA AND NUMBER
  - SEWER LINE BELOW WATER TABLE
  - - - SEWER LINE BELOW WATER TABLE (LIMITED DATA AVAILABLE)
  - SEWER LINE ABOVE WATER TABLE
  - - - SEWER LINE ABOVE WATER TABLE (LIMITED DATA AVAILABLE)
  - SEALED STORM SEWER LINE

- NOTES:**
1. BASE MAP INFORMATION FROM A SURVEY BY BMJ, INC. DATED APRIL 2001, AT A SCALE OF 1:100. AERIAL IMAGE FROM ARCGIS 10 ONLINE MAPPING, ACCESSED 6/12/2013.
  2. BASED ON INFORMATION AVAILABLE AS OF JUNE 2016.
  3. MH4-20-2 DOWN GRADIENT PLUG'S 24-INCH LINE WAS BLOCKED WITH SEDIMENT, YIELDING NO FLOW PRIOR TO PLUG INSTALLATION. PLUG IS MADE UP OF NATURALLY PACKED SEDIMENT IN PIPE.
  4. BULKHEADS AND PLUGS INSTALLED DECEMBER 2017.

0 400' 800'  
APPROXIMATE SCALE IN FEET

RACER TRUST  
BUICK CITY  
FLINT, MICHIGAN

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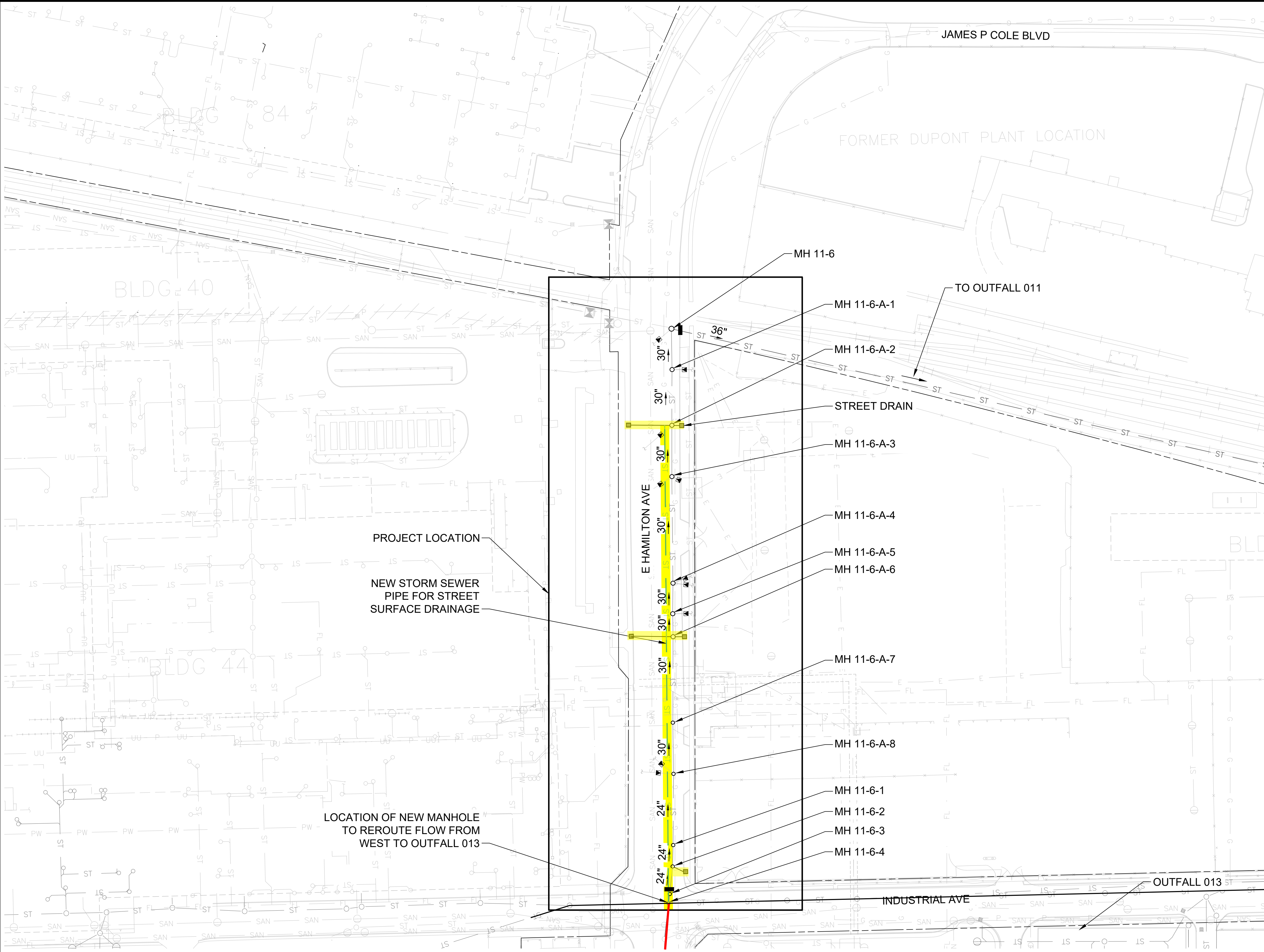
**OUTFALL DRAINAGE AREAS**

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**ARCADIS** Design & Consultancy  
for natural and built assets

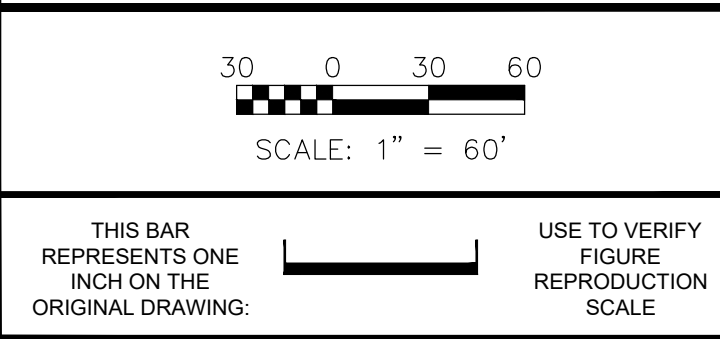
FIGURE  
**1**

CITY OF BUICK CITY, MI, 2022-02-28 10:10 AM, CADDSERVER, 24.28 (LMS TECH), PAGES: 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.



- LEGEND:**
- PROPERTY BOUNDARY
  - CONTOUR LINE
  - BUILDING OUTLINE
  - FORMER BUILDING OUTLINE
  - BASEMENT/TUNNEL AREA
  - FENCE
  - RAILROAD
  - UNSURVEYED EXISTING UTILITIES (FROM HISTORICAL MAPPING)
  - BULKHEAD
  - PLUG
  - CATCH BASIN
  - MANHOLE
  - ST --- STORM LINE
  - SAN --- SANITARY LINE
  - E --- ELECTRIC LINE
  - FL --- FIRE WATER LINE
  - G --- GAS LINE
  - W --- POTABLE WATER LINE
  - P --- PROCESS LINE
  - PW --- PROCESS WASTE LINE
  - UU --- UNKNOWN UTILITY LINE
  - STRUCTURES / UTILITIES
  - BULKHEAD
  - CATCH BASIN
  - MANHOLE
  - PLUG
  - ST --- STORM LINE
  - ST --- PROPOSED ABANDONED STORM LINE
  - SAN --- SANITARY LINE
  - X --- FENCE

- NOTES:**
- REFER TO DRAWING G-3 FOR ADDITIONAL NOTES AND INFORMATION.
  - THE SURVEYED EXISTING AND UNSURVEYED (HISTORICAL) EXISTING UTILITIES MAY NOT CORRESPOND PRECISELY IN ALL LOCATIONS. THE UNSURVEYED UTILITIES ARE MEANT TO BE USED AS A GUIDE AND MAY NOT ACCURATELY DEPICT FIELD CONDITIONS. PROPOSED UTILITIES/MODIFICATIONS ARE BASED ON SURVEYED LOCATIONS OF EXISTING UTILITIES.
  - PROPOSED BULKHEADS AND EXISTING MANHOLES, CATCH BASINS, AND BULKHEADS ARE SHOWN AT AN EXAGGERATED SIZE FOR CLARITY. PROPOSED MANHOLES ARE DRAWN TO SCALE.



No.	Date	Revisions	By	Ckd

Professional Engineer's Name  
**BRAD A. SAUNDERS**  
 Professional Engineer's No.  
 6201050540  
 State  
 MI  
 Date Signed  
 Project Mgr.  
 TM  
 Designed by  
 GG/KG/OH  
 Drawn by  
 ALS  
 Checked by  
 BMS

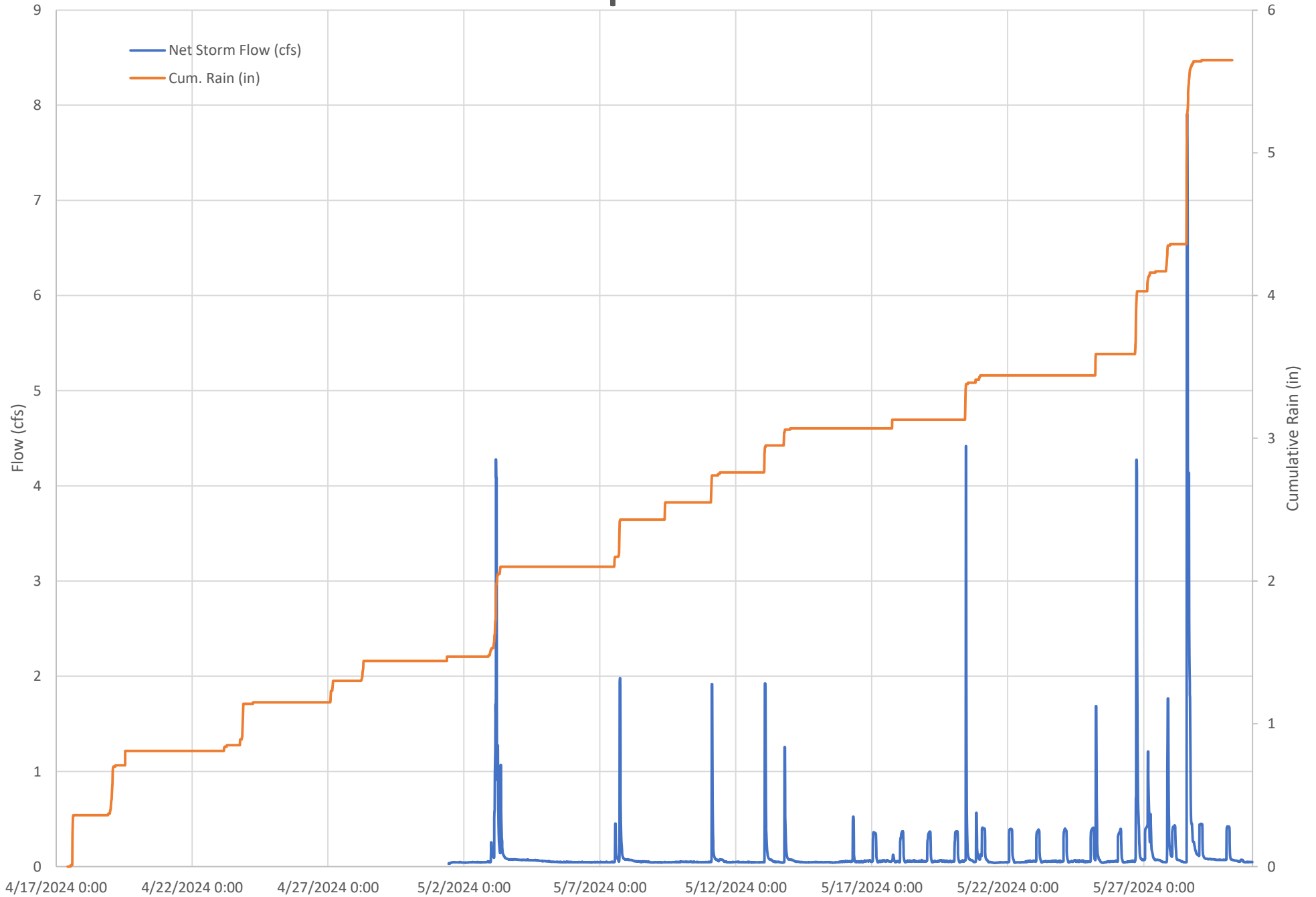
THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.



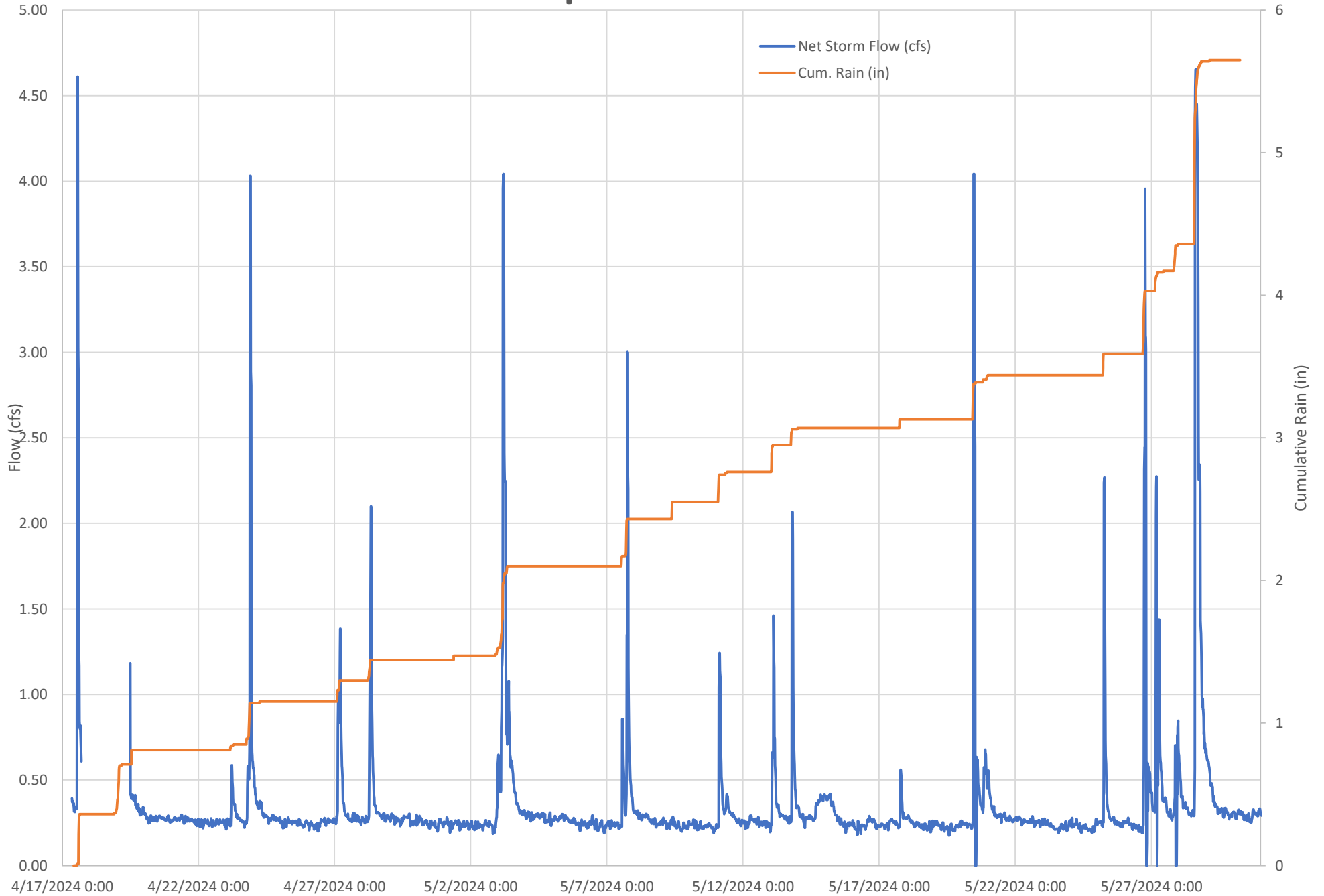
RACER TRUST • BUICK CITY, FLINT, MICHIGAN  
**OUTFALL 011 STORM SEWER REHABILITATION**  
**OVERALL KEY PLAN**  
 GENERAL

ARCADIS Project No.  
 30174223  
 Date  
 FEBRUARY 2024  
 ARCADIS OF MICHIGAN, LLC  
 28550 CABOT DRIVE  
 SUITE 500  
 NOVI, MICHIGAN 48377  
 TELEPHONE: 248.994.2240

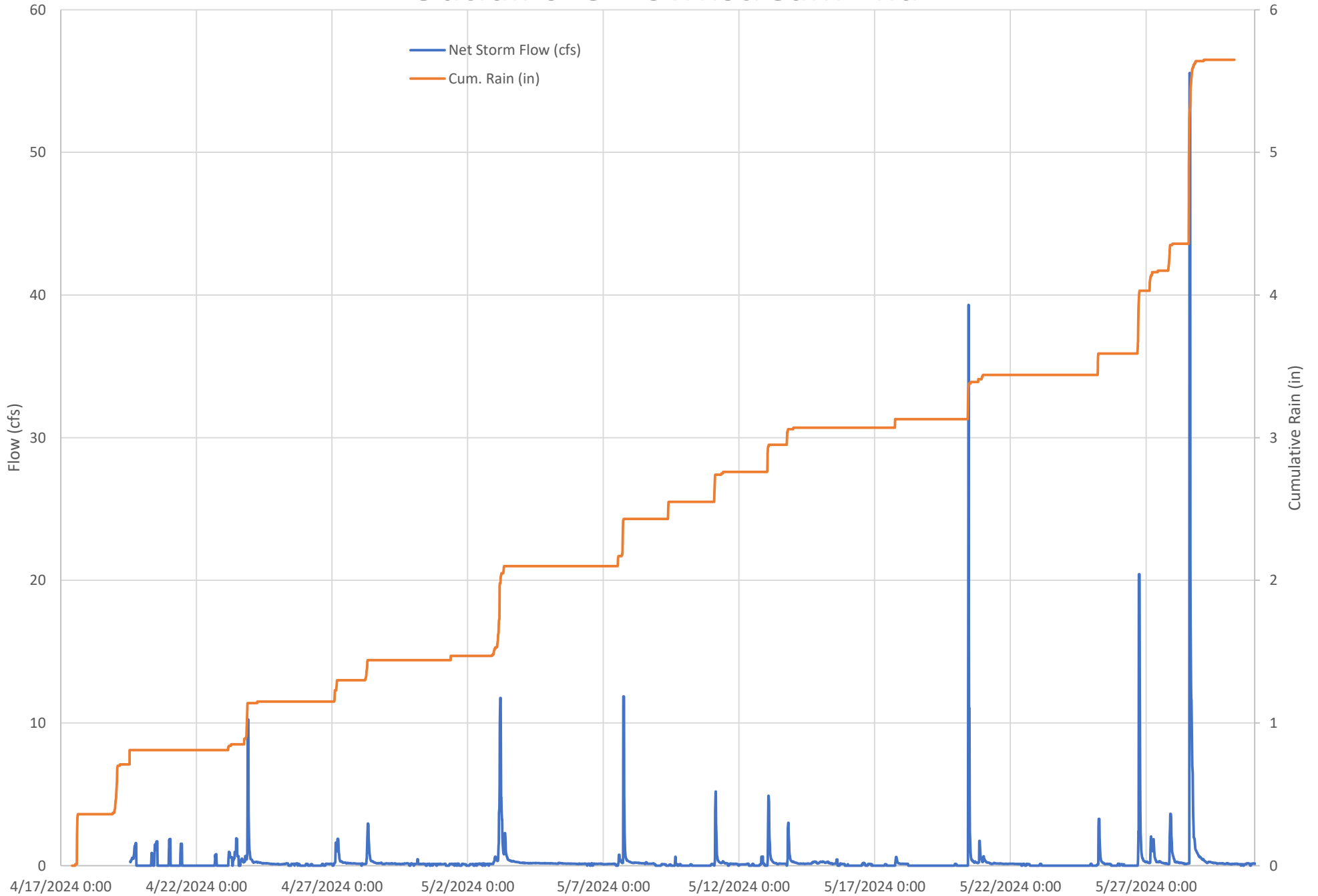
# Figure 3A: FM-01 Flows and Cumulative Rain, Outfall 011 at Proposed Reroute Location



# Figure 3B: FM-02 Flows and Cumulative Rain, Outfall 013 Upstream of Hamilton Ave



# Figure 3C: FM-03 Flows and Cumulative Rain, Outfall 013 Downstream End



**Table 1 - SWMM Subcatchment Parameters**

Subcatchment	Receiving System (Outfall)	SWMM Parameters								
		Outlet (SWMM Node ID)	Area (ac)	Width (ft)	% Slope	% Impervious	Manning "n", Impervious	Manning "n", Pervious	Depression Storage, Impervious (in)	Depression Storage, Pervious (in)
1	013	Node1	117.0	50	1.0%	10%	0.024	0.24	0.15	0.30
5	013	Node8	31.0	50	1.0%	35%	0.024	0.24	0.15	0.30
12	013	Node12	21.3	2,000	1.0%	81%	0.01	0.09	0.05	0.20
15	013	Node15	21.0	2,000	1.0%	96%	0.01	0.09	0.05	0.20
011-West	011 (Existing) 013 (Proposed)	011MH-5 (Existing) 013-NewMH	18.0	250	0.3%	70%	0.015	0.24	0.05	0.10
011-East	013 (Proposed)	013-NewMH	0.9	800	1.0%	100%	0.015	0.24	0.05	0.10

**Notes:**

1. SWMM parameters shown reflect adjustments during model calibration, except for Subcatchment 011-East, which represents street drainage from Hamilton Avenue that is downstream of the flow monitoring equipment and is therefore uncalibrated.

**Table 2 - Summary of Predicted Existing and Proposed Conditions During 10-Year, 24-Hour Storm**

SWMM Node	MH Rim El. (ft)	Existing Conditions		Proposed Conditions		Predicted HGL Change (ft)
		Peak HGL (ft)	Min. Freeboard (ft)	Peak HGL (ft)	Min. Freeboard (ft)	
Node1	740.57	724.98	15.59	724.98	15.59	0.00
Node2	740.06	723.68	16.38	723.68	16.38	0.00
Node3	741.18	722.48	18.70	722.48	18.70	0.00
Node4	742.57	720.65	21.92	720.65	21.92	0.00
Node5	738.61	718.84	19.77	718.82	19.79	-0.02
Node6	739.26	717.71	21.55	717.75	21.51	0.04
Node7	739.28	715.01	24.27	716.62	22.66	1.61
Node8	733.00	714.84	18.16	716.62	16.38	1.78
013_New-MH	734.20			716.61	17.59	
Node9	734.84	714.71	20.13	716.42	18.42	1.71
Node10	734.00	714.70	19.30	716.28	17.72	1.58
Node11	735.08	714.60	20.48	716.05	19.03	1.45
Node19	734.14	714.57	19.57	715.90	18.24	1.33
Node12	729.38	714.50	14.88	715.80	13.58	1.30
Node13	731.65	714.14	17.51	715.32	16.33	1.18
Node14	725.41	713.81	11.60	714.84	10.57	1.03
Node15	722.75	713.50	9.25	714.34	8.41	0.84
Node16	718.68	712.19	6.49	712.73	5.95	0.54
Node17	710.88	710.69	0.19	710.88	0.00	0.19
011MH-5	733.65	733.65	0.00			
013_New-MHA	729.91			725.60	4.31	

**Notes:**

1. Conditions presented represent the peak during the 10-year, 24-hour storm, which produces 3.27 inches of rainfall. The peak HGL values do not necessarily occur at the same time along the system.
2. Nodes along the 013 main are presented in order beginning at the upstream end and proceeding downstream towards the outfall.
3. Certain nodes are nonexistent under existing or proposed conditions, and no HGLs are presented for those structures.
4. Node "011MH-5" is along the 011 system and downstream of the proposed reroute location. This structure will be eliminated as part of the proposed reroute.
5. Nodes "013\_New-MH" and "013\_New-MHA" are proposed to manage street drainage from Hamilton Avenue east of the reroute location.