M.D. Walker & Associates
Land Surveying / Civil Engineering / Structural Engineering

May 7, 2020

Mr. Saidou Wane
City of Cincinnati, SMU

Re: Brookfield Lane Subdivision (CPRE200034) Stormwater Report

Mr. Wane,

Please accept contained herein the stormwater report for the above referenced project. Following, please find the report information:

Background
The proposed project consists of 6 new single family homes on property from Parcel ID's 44-05-03 and 44-05-115. The new lots and associated improvements are sited on a portion of two (2) existing parcels totaling 2.96 acres. The total of the property acreage for the subdivision is 1.598 acres, however, due to some improvements being completed both in the Brookfield Lane R/W as well as the remainder portions of the existing parcels (through the use of easements), the actual improved site acreage is measured as 2.46 acres (see Site Area plan sheet 2/3).

The site is generally located on a hillside north of the existing residences on the properties, with the property sloping from south to north. A swale is generally located along the northern boundary of the site. Said swale being located near or within the Brookfield Lane Paper R/W. The swale is fed by a 21.8 acre watershed (see attached Watershed Area plan sheet 1/3). The watershed flows from east to west and flows to an existing 24" culvert near the northwest corner of the proposed site. Said Culvert is within the Brookfield Lane Paper R/W.

Methodology and Analysis

-Existing Upstream Watershed
Based upon the characteristics of the site and overall watershed, we first reviewed the existing drainage characteristics of the watershed and the capacity of the 24" culvert mentioned above. Our analysis included estimation of runoff and flow rates based upon the TR-55 method for the entire 21.8 acres watershed, as well as the calculation of the existing culvert capacity. We found the existing 24" culvert to be undersized, with the 100 year runoff from the existing watershed to be approximately 80 cfs, and the capacity of the culvert to be approximately 50 cfs (see calculations and Chart 2b).

We then calculated the required storage capacity due to the difference in outfow vs inflow for the 100 year event, based upon the TR-55 method (worksheet 6a included) and obtained a volume of 56,500 cubic feet of storage.

A grading plan was completed and included in proposed drawing set. The proposed grading plan shows a levee behind the culvert at 644, and an emergency flood route elevation of

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642.50. The elevation 642.50 was used in conjunction with the existing/proposed site grades to determine the storage volume available under proposed conditions, and ensure that the storage volume available is greater than that required for the 100 year event (56,500 c.f. noted above). Per our measurements and calculations, the available volume at 642.50 is approximately 61,287 c.f. Note that the 100 year elevation (642.50) has been highlighted on the plan to ensure that floodwaters do not encroach into the proposed homes.

-Proposed Site Stormwater detention
Stormwater detention requirement were calculated using the Stormwater Management Utility, Rules and Regulation, Part 1 Technical Reference Manual using the site acreage of 2.46 acres. Based primarily upon the Runoff Coefficient (C) values obtained from Table 6-1 of the text, we found no increase in runoff from the development of the site. This is based upon a C value for the existing site of 0.50 (Steep Wood Hillside) as well as a proposed C value for the site of 0.50 (Single Family Residential).

I would note that the proposed grading and site configuration provides over 4700 c.f. of storage more than is required due to the overall characteristics of the upstream watershed.

-Proposed Storm Sewer System
The proposed storm sewer system was analyzed using the rational method for runoff as well as Mannings Equations for the pipe sizing. The pipes have been size for the 25 year storm event (see attached storm sewer computation sheet).

Should you have any questions or need any additional information, please do not hesitate to contact me at (513)284-3232.

Best regards,
MD Walker & Associates
Mark D. Walker, P.E., P.S
President

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21 ACRE EXISTING WATERSHED

Rainfall	in/ hour from SMU	CN	S=(1000/ CN)-10	Q = (P-0.20*S)^2/ (P+0.8*S) inches	Ia = 0.20 s	Ia/p	Tc min	qu from chart Type II	Area Am mi2	Peak Q cfs qu x Am x Q
P2	2.9	75	3.33	0.90	0.67	0.23	12	780	0.032	22.36
P5	3.6	75	3.33	1.37	0.67	0.19	12	785	0.032	34.49
P10	4.1	75	3.33	1.74	0.67	0.16	12	790	0.032	44.04
P25	4.8	75	3.33	2.29	0.67	0.14	12	794	0.032	58.14
P50	5.3	75	3.33	2.69	0.67	0.13	12	797	0.032	68.73
P100	5.8	75	3.33	3.11	0.67	0.11	12	800	0.032	79.68

Calculate to the Capacity of the Existing / Proposed 24" Culvert

Emergency Flood Route Elevation = 642.50
Invert of existing 24" = 631.35
Allowable Head = 11.15'

Inlet Capacity to Elevation 642.50 = HW/D = 5.6

From BPR Chart 2B, Culvert Capacity = 50 CFS

Obtain Volume of backup for 100 year flow of 80 cfs from TR-55 Method
Yields 56,500 c.f. of storage for offsite culvert.

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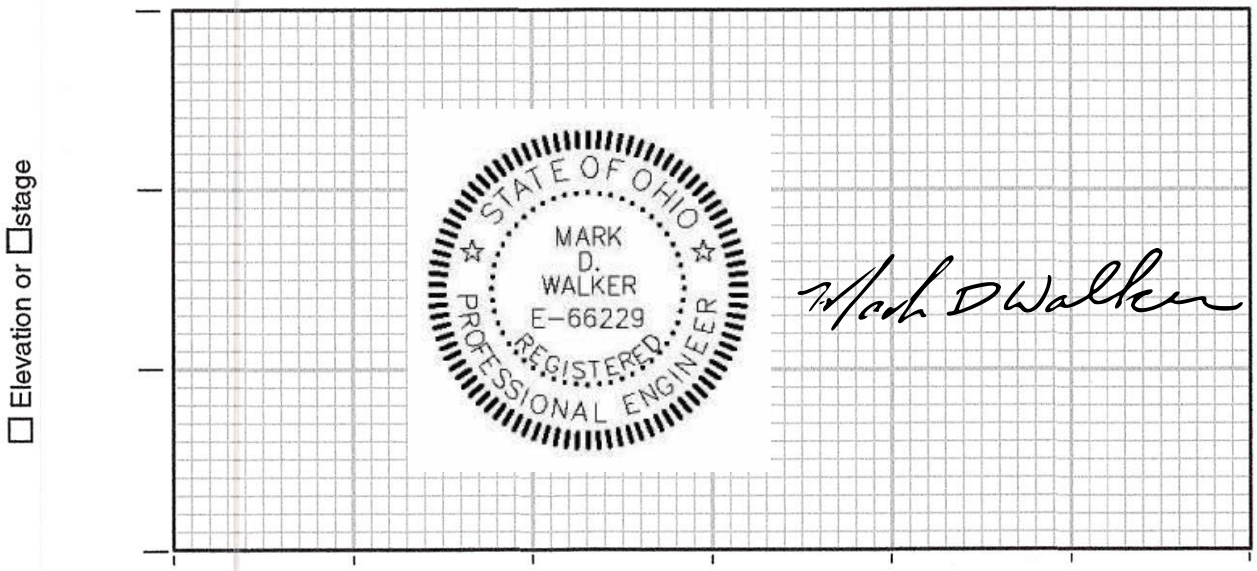
Worksheet 6a: Detention basin storage, peak outflow discharge (q_o) known

Project	By	Date
Location	Checked	Date

Check one: ☐ Present ☐ Developed



Detention basin storage (acre feet)

1. Data:
   Drainage area ..... A_m = 0.034 mi²
   Rainfall distribution type (I, IA, II, III) = II

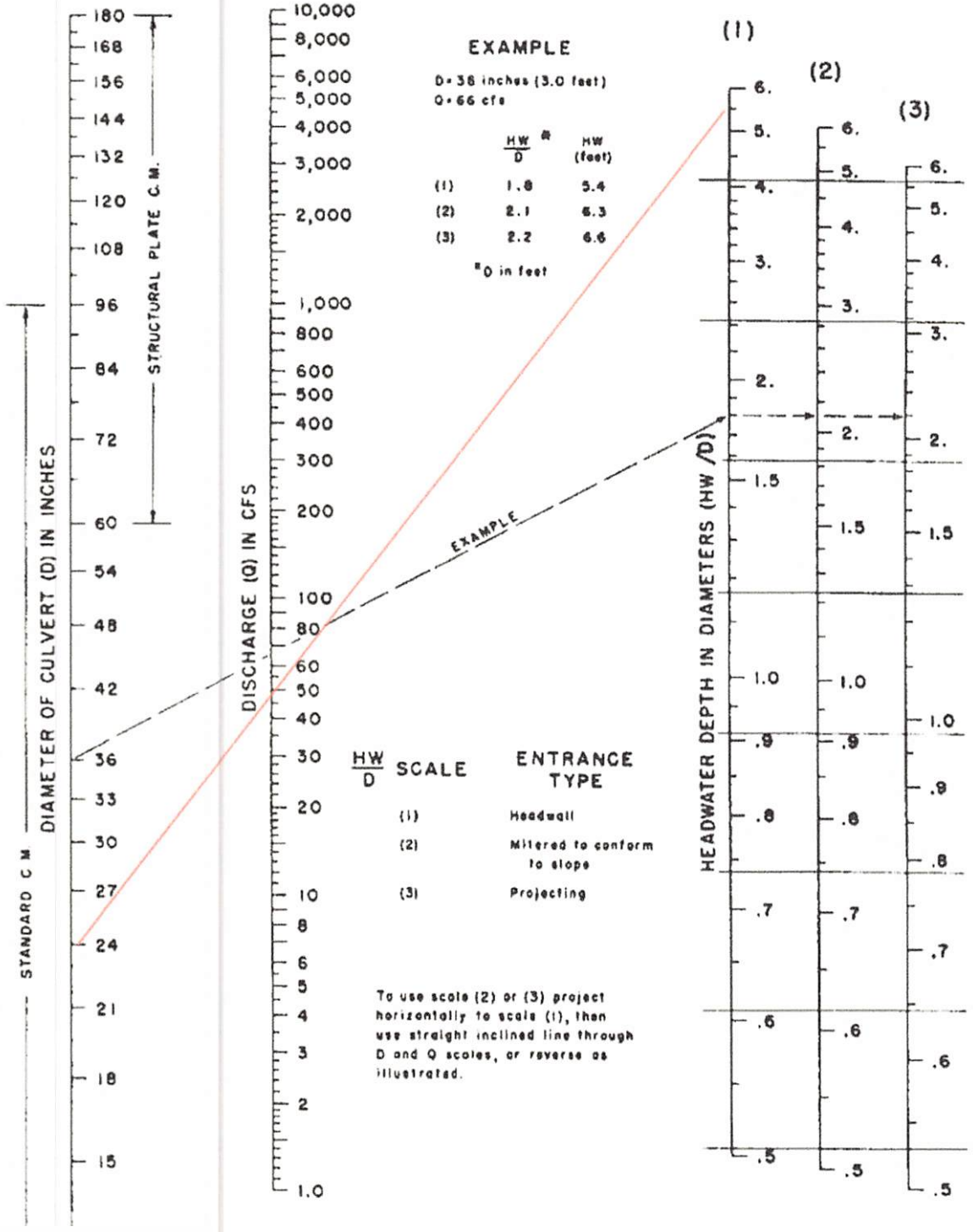
	1st Stage	2nd Stage
2. Frequency ..... yr		100
3. Peak inflow discharge q_i ..... ft³/s (from worksheet 4 or 5b)		40
4. Peak outflow discharge q_u ..... ft³/s 1/		50
5. Compute $\frac{q_o}{q_i}$		0.63

1/ 2nd stage q_o includes 1st stage q_o.

6. $\frac{V_s}{V_r}$ ..... (Use $\frac{q_o}{q_i}$ with figure 6-1)	0.23
7. Runoff, Q ..... in (From worksheet 2)	3.11
8. Runoff volume V_r ..... ac ft ($V_r = QA_m$ 53.33)	5.64
9. Storage volume, V_s ..... ac-ft ($V_s = V_r (\frac{V_s}{V_r})$)	1.29
10. Maximum storage E_{max} (from plot)	

1.29 × 43560 = 56,497 S.F.
or 2092 C.Y.

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

AN. 1963

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Input requirements and procedures

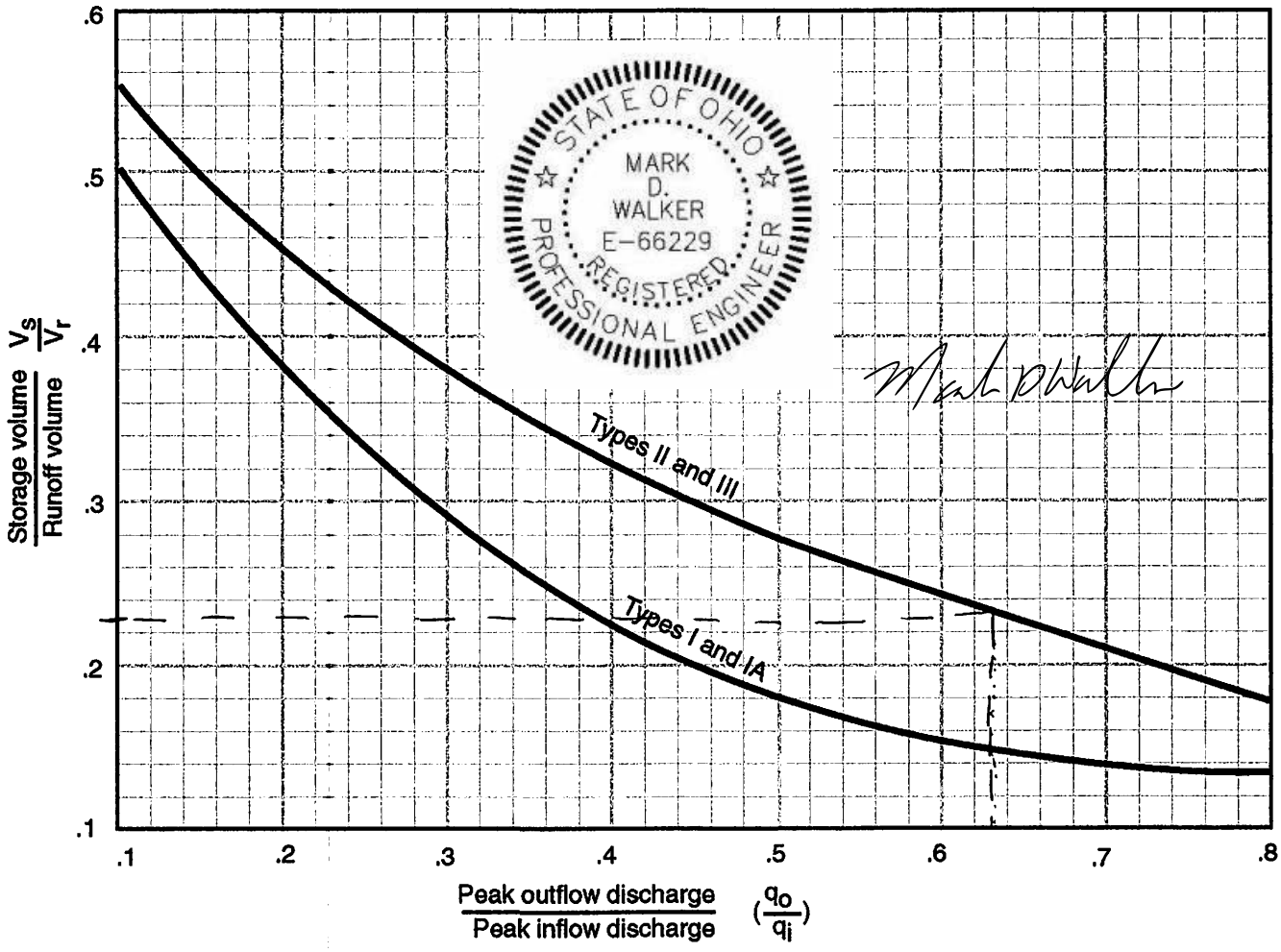
Use figure 6-1 estimate storage volume (V_s) required or peak outflow discharge (q_o). The most frequent application is to estimate V_s, for which the required inputs are runoff volume (V_r), q_o, and peak inflow discharge (q_i). To estimate q_o, the required inputs are V_r, V_s, and q_i.

Estimating V_s

Use worksheet 6a to estimate V_s, storage volume required, by the following procedure.

1. Determine q_o. Many factors may dictate the selection of peak outflow discharge. The most common is to limit downstream discharges to a desired level, such as predevelopment discharge. Another factor may be that the outflow device has already been selected.
2. Estimate q_i by procedures in chapters 4 or 5. Do not use peak discharges developed by other procedure. When using the Tabular Hydrograph method to estimate q_i for a subarea, only use peak discharge associated with $T_t = 0$.

Figure 6-1 Approximate detention basin routing for rainfall types I, IA, II, and III



Onsite Stormwater Storage Requirement

$$TF = (2-C)A - 10C + 20$$

$C = 0.50$

$A = 107{,}113$ S.F. $\rightarrow$ 2.46 Ac.

$$TF = (2-0.5)\,2.46\,Ac - (10 \times 0.5) + 20$$
$$= 3.69 - 5 + 20$$
$$= 18.69 \text{ (18.5 in chart)}$$

$I_2 = 3.01$ in/h
$I_{10} = 4.16$ in/h
$I_{25} = 4.82$ in/h
$I_{100} = 5.95$ in/h

$Q_{2\,Post} = q_{2\,pre} = 3.82$ cfs

$Q_{10\,Post} = q_{10\,Pre} = 5.24$ cfs

$Q_{25\,Post} = q_{25\,Pre} = 6.07$ cfs

$Q_{100\,Post} = q_{100\,Pre} = 7.5$ cfs

$C_{pre} = 0.50$ Wooded Hillside

$C_{post} = 0.50$ Single Family

No Detention Required for onsite Development.

Mark D Walker

On Site to Detention For Storage Calc											
Event	Acreage	Cpre	TC.pre	I Equation TC 18.5 from SMU Calc	I.pre value	q = C x I x A (CFS)	Cpost	TC.post	I.Post Value	Q = C x I x A	
2	2.56	0.5	18.5	106/(Tc+17)	2.99	3.82	0.5	18.5	2.99	3.82	
10	2.56	0.5	18.5	170/(Tc+23)	4.10	5.24	0.5	18.5	4.10	5.24	
25	2.56	0.5	18.5	230/(Tc+30)	4.74	6.07	0.5	18.5	4.74	6.07	
100	2.56	0.5	18.5	290/(Tc+31)	5.86	7.50	0.5	18.5	5.86	7.50	

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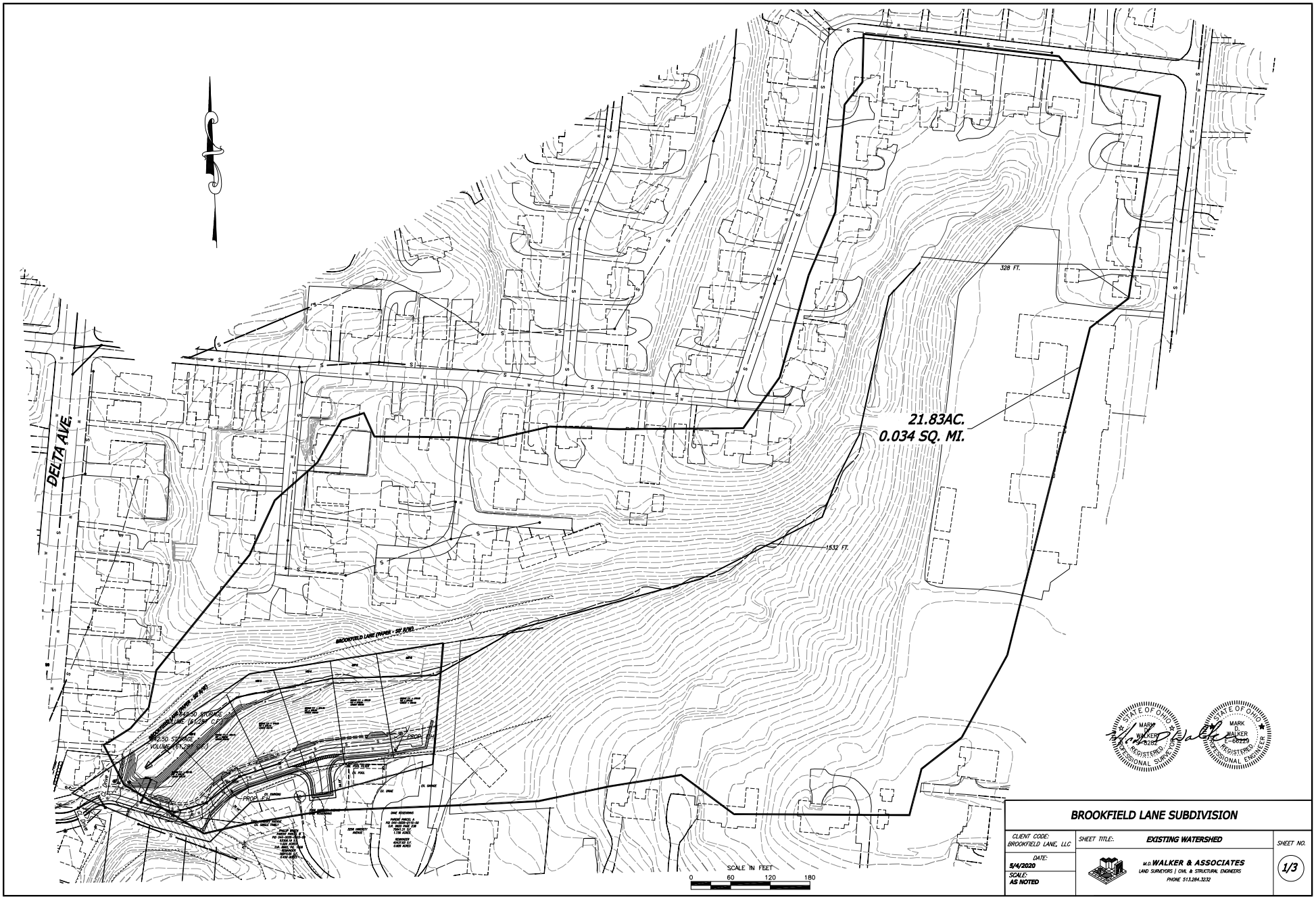
BROOKFIELD SUBDIVISION
5/7/2020

STORM SEWER COMPUTATION SHEET

1	2	3	4		5		6			7	8		9			10	11	12		13	14	15	16	17		18	19	20	21
M.H. OR C.B. OR INLET		Additional Area from other Run	DRAINAGE AREA IN ACRES		TIME OF CONCENTRATION IN MINUTE		RAINFALL IN INCHES/ HOUR			RUNOFF COFFICIENT			DISCHARGE IN CFS			SIZE OF PIPE INCHES	LENGTH OF PIPE FEET	Min SLOPE OF PIPE FT./FT. (Discharge)	Use SLOPE OF PIPE FT./FT.	INLET F/L OF PIPE	OUTLET F/L OF PIPE	MEAN VELOCITY FT./SEC.	JUST FULL CAPACITY	Min. FRICTION SLOPE FT./FT. (100 YR Slope)	Use 100 year Friction Slope	HEAD LOSSES FEET	ELEVATION OF HYDRAULIC GRAD (FOR 100 YR.Q)	GRATE OR COVER ELEVATION	Crown to structure Rim
NO.			ΔA	ΣA	ΔT	ΣT	I 10	I 25	I100	C	ΔCA	ΣCA	Q 10	Q 25	Q100	$\varnothing$	L	Σ_O	Σ_O	ELEV.	ELEV.	V_M	CFS	S_F		H	ELEV.	ELEV.	
														X															
Storm Structure 8			0.20	0.20	10	10	5.15	5.75	7.07	0.80	0.16	0.16	0.82	0.92	1.13					636.03							636.03	642.07	5.04
					0.45											12	35.00	0.09%	0.970%			1.29	3.04	0.13%	0.97%	0.34			
Storm Structure 12																					635.69						635.69		
														X															
Storm Structure 6			1.19	1.19	10	10	5.15	5.75	7.07	0.80	0.95	0.95	4.89	5.46	6.72					665.00							665.07	668.70	2.70
					0.28											12	63.90	3.13%	8.540%			3.83	9.02	4.74%	8.54%	5.46			
Storm Structure 5			0.22	1.41	10	10.28	5.11	5.71	7.03	0.80	0.18	1.13	5.75	6.43	7.91					659.54	659.54						659.61	664.44	3.90
					0.29											12	64.00	4.34%	7.820%			3.67	8.63	6.57%	7.82%	5.00			
Storm Structure 4			0.17	1.58	10	10.57	5.06	5.67	6.98	0.80	0.14	1.26	6.39	7.15	8.80					654.53	654.53						654.61	659.39	3.86
					0.18											12	50.40	5.37%	12.100%			4.56	10.74	8.14%	12.10%	6.10			
Storm Structure 3			0.10	1.68	10	10.75	5.04	5.64	6.95	0.80	0.08	1.34	6.76	7.57	9.32					648.44	648.44						648.51	653.15	3.71
					0.17											12	52.60	6.02%	14.680%			5.02	11.83	9.12%	14.68%	7.72			
Storm Structure 2			0.05	1.73	10	10.93	5.01	5.62	6.92	0.80	0.04	1.38	6.92	7.77	9.56					640.71	640.71						640.79	646.67	4.96
					0.15											12	36.90	6.33%	9.390%			4.02	9.46	9.59%	9.59%	3.54			
Storm Structure 1																					637.25						637.25		



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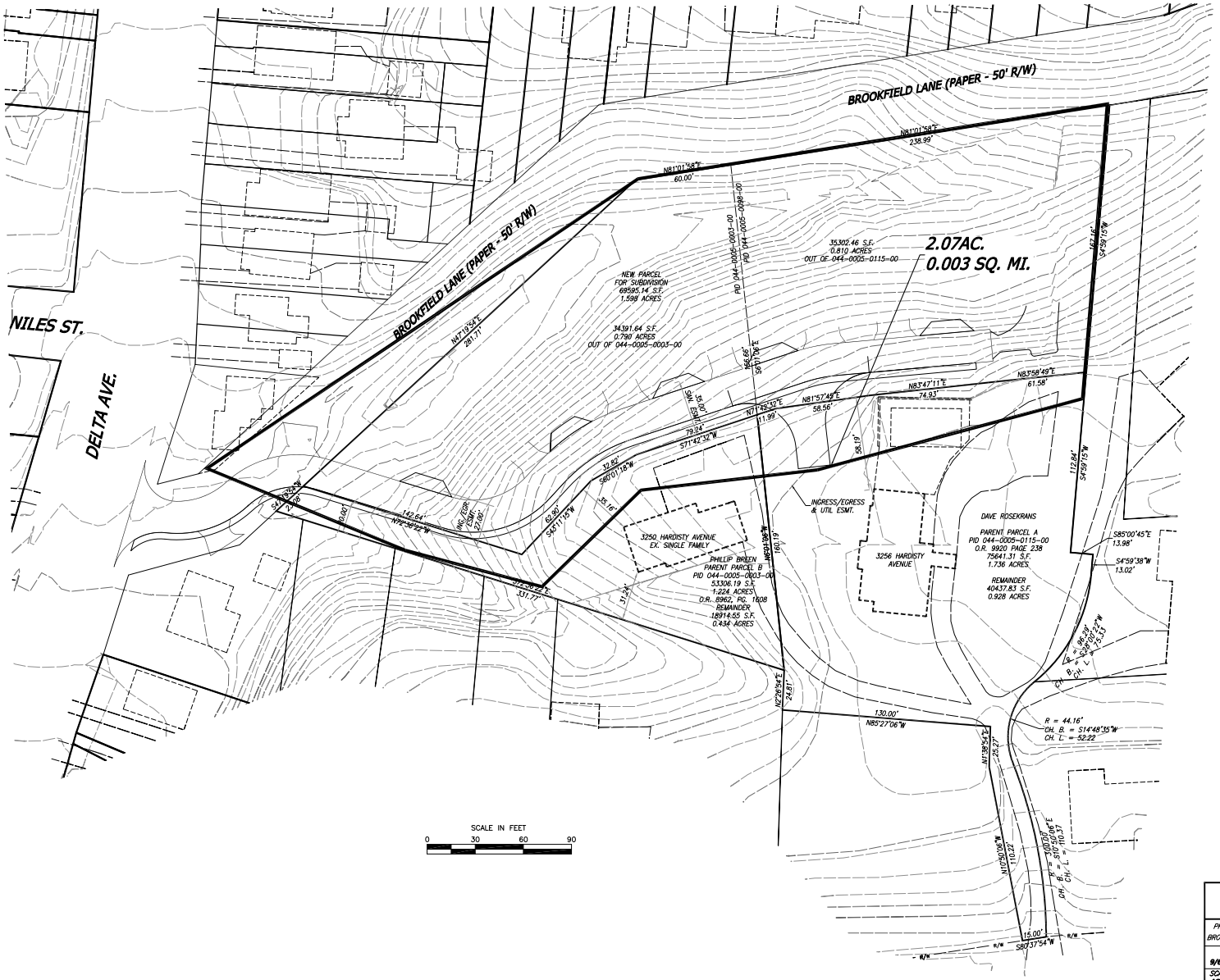
CLIENT CODE: BROOKFIELD LANE, LLC	SHEET TITLE: **EXISTING WATERSHED**	SHEET NO. 1/3
DATE: 5/4/2020	M.D. **WALKER & ASSOCIATES** LAND SURVEYORS | CIVIL & STRUCTURAL ENGINEERS PHONE 513.284.3232	
SCALE: AS NOTED		



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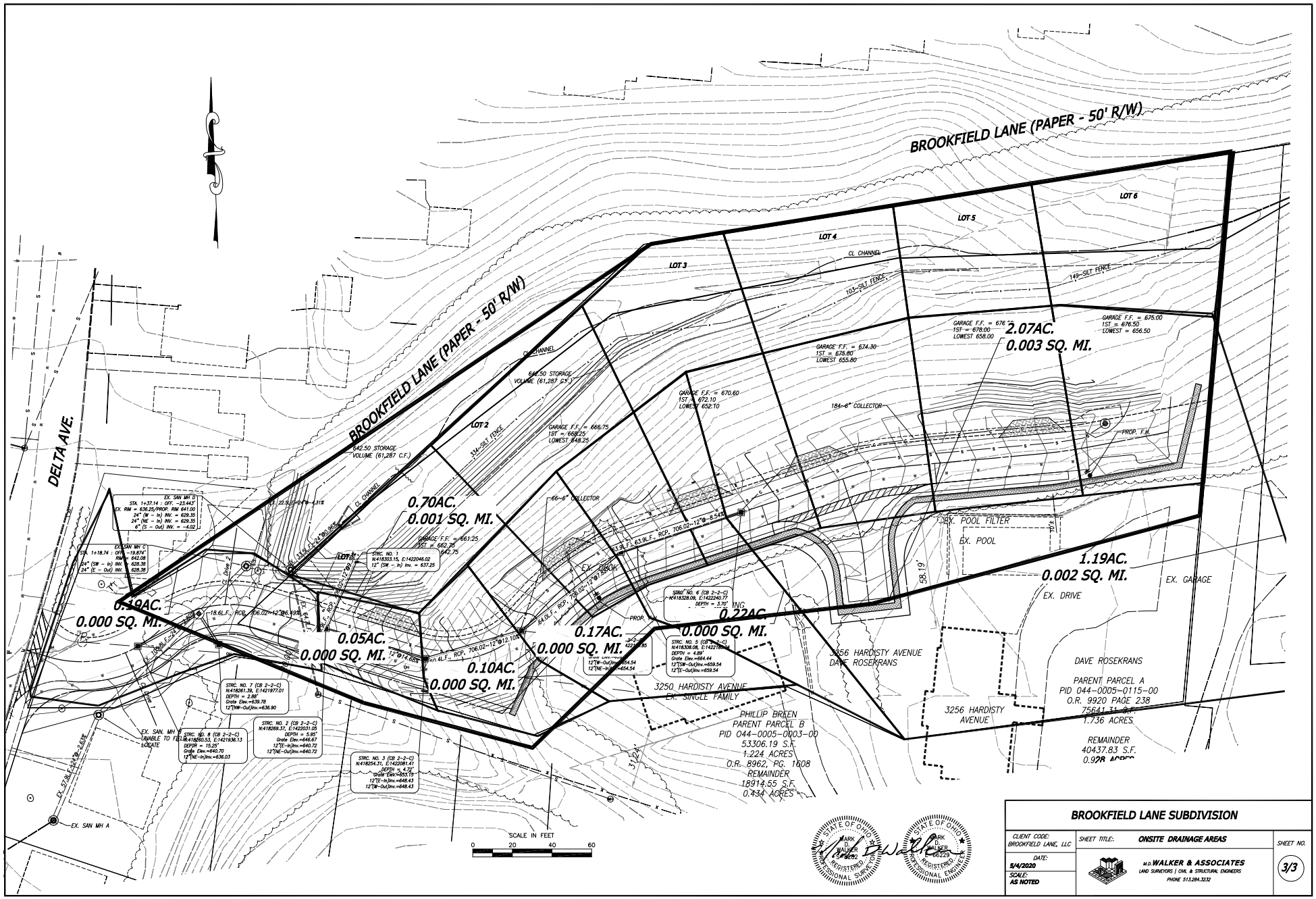
BROOKFIELD LANE SUBDIVISION

PROJECT CODE: BROOKFIELD LANE LLC	SHEET TITLE: **SITE AREA**	SHEET NO.
DATE: **9/6/2018**	M.D. **WALKER & ASSOCIATES** LAND SURVEYORS | CIVIL & STRUCTURAL ENGINEERS PHONE 513.284.3232	**2/3**
SCALE: **AS NOTED**		



BROOKFIELD LANE SUBDIVISION

CLIENT CODE: BROOKFIELD LANE, LLC	SHEET TITLE: **ONSITE DRAINAGE AREAS**	SHEET NO. 3/3
DATE: 5/4/2020	M.D. **WALKER & ASSOCIATES** LAND SURVEYORS | CIVIL & STRUCTURAL ENGINEERS PHONE 513.284.3232	
SCALE: AS NOTED		