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SEWER DEMAND REPORT

for

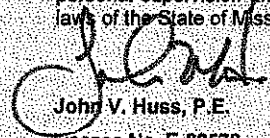
Townsend Capital, LLC

**Summit Orchard
Lee's Summit, MO**

March 2016



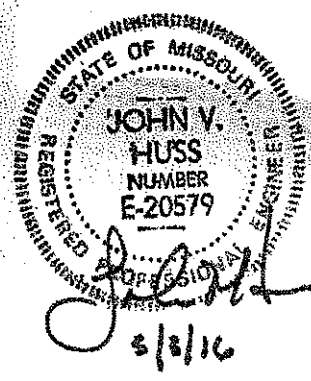
I hereby certify this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Missouri.


John V. Huss, P.E.

License No. E-20579

My renewal date is December 31, 2017

3/3/16
Date:



-2016-039-

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Planning & Codes Admin

PREPARED BY



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Introduction

This report details the preliminary design of the sewer system to support the Summit Orchard Preliminary Development Plan (PDP), a mixed-use development, at the Summit Technology Campus (STC) located in Lee's Summit, Missouri. See Figure 1 for a site location map.

Project Description

The Summit Orchard is located southeast of the Interstate-470/State Highway 50 interchange. The entire STC development covers approximately 367 acres, and is bordered to the south by Chipman Road, to the north by I-470, to the west by Blue Parkway, and to the east by the Union Pacific Railroad. The Summit Technology Campus is split by Ward Road which was opened to traffic in October 2008.

Townsend Capital LLC proposes improvements to the existing Summit Technology Campus, including the addition of a variety of mixed business commercial and residential uses along Ward Road. In this report, the site for these improvements will be referred to as the "50 Acre Tract." The current proposed building layout for the 50 Acre Tract can be found in the PDP.

Existing Sewer System

There is an existing sewer connection available along the South edge of Tudor Road, while the sewer is deep enough to serve the proposed development, extending the sewer would require existing sewer to have nearly thirty feet of cover.

The sewer demand for the existing development, within the Little Cedar Creek Watershed, was evaluated. In this analysis, it is assumed the projected flow pumped from the Tudor Road Pump Station to the Little Cedar Creek Interceptor is capped at 4 MGD. This analysis can be seen in Table ~~2~~² located in the Appendix.

Proposed Sewer Facilities:

To serve this development, we propose a new 8" PVC sewer line. The proposed 8" sewer will extend from an existing connection point East of the 50 Acre Tract at Manhole 23-120. The new sewer will run Westerly beneath existing railroad to a new manhole on Lot 4, West of the 50 Acre Tract property line.

The system includes two 8" PVC sewer lines extending from the new manhole located in Lot 4. One line runs Northerly and turns Westerly to Lot 1 to serve future development on the 50 Acre Tract. A second 8" PVC sewer line runs Southwesterly across the proposed Donovan Road onto and across Lot 3 to serve future developments on the 50 Acre Tract.

All sewer facilities will be constructed in accordance with MoDNR and Lee's Summit standards and specifications.

Design and Methodology:

The total peak flow from the developed 50 Acre Tract is calculated using methods outlined in section 6500 of the City of Lee's Summit, Missouri Design Criteria. Once PBF is determined, additional demand is added to account for inflow & infiltration. Peak infiltration is assumed to be 250-gpd/acre for non-residential land use and 500-gpd/acre for residential areas. Peak inflow is calculated using the $Q=KiA$ method.

Table 1 shows the peak flows that are estimated for development of the 50 Acre Tract.

Table 1: Estimated Sewer Peak Flow 40 Acre Tract

Tract/Lot	Peak Base Flow (GPD)	Peak Infiltration (GPD)	Sewer Inflow (GPD)	Peak Flow (GPD)
Lot 1	9,450	2,025	77,543	89,018
Lot 2	17,426	2,153	95,636	115,215
Lot 3	32,970	1,870	87,236	122,076
Lot 4	20,415	6,805	245,552	272,772
Lot 5	5,400	1,165	45,233	51,798
Total Estimated Peak Flow				650,879

*See Figure 2 for tract/lot locations

** Sewer Inflow Interpolated from the table in Section 6501.C.1.d of the City of Lee's Summit, Missouri Design Criteria

Results of Analysis:

Combining the results of Table 1 yields a peak flow of 650,879 gpd, or 1.0 cfs. This peak flow is added to the existing system downstream analysis shown in Table 3 and the resulting analysis is shown in Table 4 also located in the Appendix. The existing conditions plus the proposed development downstream analysis indicate that no pipes will be operating under surcharge.

Manning's Equation supports that a 8" PVC pipe at minimum grade has sufficient pipe flow capacity to carry this flow. The remainder of sewer lines serving various future developments is sized at 8" PVC.

Figure 3 in the Appendix shows the proposed route of the main 8" PVC sewer as well as the additional 8" PVC sewer services.

APPENDIX

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Table 2 - Existing Little Cedar Creek Watershed Downstream Sewer Analysis

Upstream MH	Downstream MH	Diameter (in.)	Slope (ft/ft)	Capacity (mgd)	Projected Flow (MGD)	Q/q	Capacity (cfs)	Projected Flow (cfs)
23-120	23-036	10	0.01	1.53	0.46	0.299	2.37	0.71
23-036	23-035	10	0.016	1.94	0.46	0.236	3.00	0.71
23-035	23-034	10	0.02	2.17	0.46	0.211	3.36	0.71
23-034	23-024	12	0.02	3.53	0.46	0.130	5.46	0.71
23-024	23-023	12	0.01	2.49	0.92	0.368	3.86	1.42
23-023	23-022	12	0.02	3.53	0.92	0.260	5.46	1.42
23-022	23-021	12	0.02	3.53	0.92	0.260	5.46	1.42
23-021	23-007	12	0.01	2.49	0.92	0.368	3.86	1.42
23-007	23-006	30	0.035	53.73	8.14	0.151	83.13	12.59
23-006	23-118	36	0.0034	27.23	8.14	0.299	42.13	12.59
23-118	23-117	24	0.0058	19.06	8.14	0.623	20.21	12.59
23-117	23-002	36	0.0061	36.47	8.14	0.223	56.43	12.59
23-002	23-001	36	0.0061	36.47	8.14	0.223	56.43	12.59
23-001	22-044	36	0.018	62.65	8.14	0.130	98.94	12.59
22-044	22-043	36	0.0315	82.88	8.14	0.098	128.24	12.59
22-043	22-042	36	0.0088	43.81	10.41	0.238	67.78	16.11
22-042	22-041	36	0.0043	30.82	10.41	0.340	47.38	16.11
22-041	22-040	36	0.038	91.03	10.41	0.114	140.85	16.11
22-040	22-039	36	0.0091	44.55	10.41	0.234	68.93	16.11
22-039	22-038	36	0.0118	50.73	10.41	0.205	78.49	16.11
22-038	00-001	36	0.0106	48.08	10.41	0.217	74.39	16.11
00-001	00-002	36	0.0138	54.86	10.41	0.190	84.88	16.11
00-002	00-003	36	0.076	178.74	10.41	0.081	199.19	16.11
00-003	00-004	36	0.0285	78.84	14.95	0.190	121.98	23.13
00-004	00-005	30	0.024	44.49	14.95	0.336	68.84	23.13
00-005	00-006	30	0.0074	24.70	14.95	0.605	38.22	23.13
00-006	00-007	30	0.0082	27.55	14.95	0.543	42.62	23.13
00-007	00-008	30	0.0043	18.83	14.95	0.794	29.14	23.13
00-008	00-009	30	0.0047	19.69	14.95	0.759	30.46	23.13
00-009	00-010	30	0.0033	16.50	14.95	0.906	25.53	23.13
00-010	00-011	30	0.0115	30.80	14.95	0.485	47.65	23.13
00-011	00-012	30	0.0084	26.32	14.95	0.569	40.72	23.13
00-012	00-013	30	0.0084	26.32	16.34	0.621	40.72	25.28
00-013	00-014	30	0.0144	34.46	16.34	0.474	53.32	25.28
00-014	00-015	30	0.0093	27.70	16.34	0.590	42.85	25.28
00-015	00-016	30	0.0099	28.57	16.34	0.572	44.21	25.28
00-016	00-017	30	0.0101	28.86	16.34	0.566	44.66	25.28
00-017	00-018	30	0.0184	38.96	16.34	0.419	60.27	25.28
00-018	00-019	30	0.0053	20.91	16.34	0.781	32.35	25.28
00-019	00-020	30	0.0053	20.91	16.34	0.781	32.35	25.28
00-020	00-021	30	0.0161	36.44	16.34	0.448	56.38	25.28
00-021	00-022	30	0.0222	42.79	16.34	0.382	66.21	25.28
00-022	00-023	30	0.0169	37.33	16.34	0.438	57.76	25.28
00-023	00-024	30	0.0096	28.14	16.34	0.581	43.54	25.28
00-024	00-025	30	0.0096	28.14	16.34	0.581	43.54	25.28
00-025	00-026	30	0.0096	28.14	16.34	0.581	43.54	25.28
00-026	00-027	30	0.0099	28.57	16.34	0.572	44.21	25.28
00-027	00-028	36	0.0047	32.02	16.34	0.510	49.54	25.28
00-028	00-030	36	0.0037	28.41	16.34	0.575	43.95	25.28
00-030	00-031	36	0.0039	29.16	16.34	0.560	45.12	25.28
00-031	00-032	36	0.0086	43.31	16.34	0.577	67.01	25.28
00-032	00-033	36	0.0258	75.01	16.34	0.218	116.06	25.28
00-033	00-034	36	0.0128	52.83	16.34	0.309	81.75	25.28
00-034	00-035	36	0.0044	30.98	16.34	0.527	47.93	25.28
00-035	00-036	36	0.0045	31.33	16.34	0.521	48.47	25.28
00-036	00-037	36	0.0043	30.62	16.34	0.533	47.98	25.28
00-037	00-038	42	0.002	31.50	16.34	0.519	48.74	25.28
00-038	00-039	42	0.0022	33.04	16.34	0.494	51.12	25.28
00-039	00-040	42	0.002	31.50	16.34	0.519	48.74	25.28
00-040	00-041	42	0.0022	33.04	16.34	0.494	51.12	25.28
00-041	00-042	42	0.002	31.50	16.34	0.519	48.74	25.28
00-042	00-043	42	0.0019	30.71	16.34	0.532	47.51	25.28
00-043	00-044	42	0.002	31.50	16.34	0.519	48.74	25.28
00-044	00-045	42	0.002	31.50	16.34	0.519	48.74	25.28
00-045	00-046	42	0.002	31.50	16.34	0.519	48.74	25.28
00-046	00-001MS	42	0.0019	30.71	16.34	0.532	47.51	25.28

Table 3 - Existing Little Cedar Creek Watershed Downstream Sewer Analysis

Upstream MH	Downstream MH	Diameter (in.)	Slope (ft/ft)	Capacity (mgd)	Projected Flow (MGD)	Q/q	Capacity (cfs)	Projected Flow (cfs)
23-120	23-036	10	0.01	1.53	1.10	0.720	2.37	1.71
23-036	23-035	10	0.016	1.94	1.10	0.569	3.00	1.71
23-035	23-034	10	0.02	2.17	1.10	0.509	3.36	1.71
23-034	23-024	12	0.02	3.53	1.10	0.313	5.46	1.71
23-024	23-023	12	0.01	2.49	1.56	0.627	3.86	2.42
23-023	23-022	12	0.02	3.53	1.56	0.443	5.46	2.42
23-022	23-021	12	0.02	3.53	1.56	0.443	5.46	2.42
23-021	23-007	12	0.01	2.49	1.56	0.627	3.86	2.42
23-007	23-006	30	0.035	53.73	8.78	0.163	83.13	13.59
23-006	23-118	36	0.0034	27.23	8.78	0.323	42.13	13.59
23-118	23-117	24	0.0068	13.06	8.78	0.672	20.21	13.59
23-117	23-002	36	0.0061	36.47	8.78	0.241	56.43	13.59
23-002	23-001	36	0.0061	36.47	8.78	0.241	56.43	13.59
23-001	22-044	36	0.018	62.65	8.78	0.140	96.94	13.59
22-044	22-043	36	0.0315	82.88	8.78	0.106	128.24	13.59
22-043	22-042	36	0.0088	43.81	11.06	0.252	67.78	17.11
22-042	22-041	36	0.0043	30.62	11.06	0.361	47.38	17.11
22-041	22-040	36	0.038	91.03	11.06	0.121	140.85	17.11
22-040	22-039	36	0.0091	44.55	11.06	0.248	68.93	17.11
22-039	22-038	36	0.0118	50.73	11.06	0.218	78.49	17.11
22-038	00-001	36	0.0106	48.08	11.06	0.230	74.39	17.11
00-001	00-002	36	0.0138	54.86	11.06	0.202	84.88	17.11
00-002	00-003	36	0.076	128.74	11.06	0.086	199.19	17.11
00-003	00-004	36	0.0285	78.84	15.59	0.198	121.98	24.13
00-004	00-005	30	0.024	44.49	15.59	0.350	68.84	24.13
00-005	00-006	30	0.0074	24.70	15.59	0.631	38.22	24.13
00-006	00-007	30	0.0092	27.55	15.59	0.566	42.62	24.13
00-007	00-008	30	0.0043	18.83	15.59	0.828	29.14	24.13
00-008	00-009	30	0.0047	19.69	15.59	0.792	30.46	24.13
00-009	00-010	30	0.0093	16.50	15.59	0.945	25.53	24.13
00-010	00-011	30	0.0115	30.80	15.59	0.506	47.65	24.13
00-011	00-012	30	0.0084	26.32	15.59	0.592	40.72	24.13
00-012	00-013	30	0.0084	26.32	16.98	0.645	40.72	26.28
00-013	00-014	30	0.0144	34.46	16.98	0.493	53.32	26.28
00-014	00-015	30	0.0093	27.70	16.98	0.613	42.85	26.28
00-015	00-016	30	0.0099	28.57	16.98	0.594	44.21	26.28
00-016	00-017	30	0.0101	28.86	16.98	0.598	44.66	26.28
00-017	00-018	30	0.0184	38.96	16.98	0.436	60.27	26.28
00-018	00-019	30	0.0053	20.91	16.98	0.812	32.35	26.28
00-019	00-020	30	0.0053	20.91	16.98	0.812	32.35	26.28
00-020	00-021	30	0.0161	36.44	16.98	0.466	56.38	26.28
00-021	00-022	30	0.0222	42.79	16.98	0.397	66.21	26.28
00-022	00-023	30	0.0169	37.33	16.98	0.455	57.76	26.28
00-023	00-024	30	0.0096	28.14	16.98	0.604	43.54	26.28
00-024	00-025	30	0.0096	28.14	16.98	0.604	43.54	26.28
00-025	00-026	30	0.0096	28.14	16.98	0.604	43.54	26.28
00-026	00-027	30	0.0099	28.57	16.98	0.594	44.21	26.28
00-027	00-028	36	0.0047	32.02	16.98	0.530	49.54	26.28
00-028	00-030	36	0.0037	28.41	16.98	0.598	43.95	26.28
00-030	00-031	36	0.0039	29.16	16.98	0.582	45.12	26.28
00-031	00-032	36	0.0086	43.31	16.98	0.392	67.01	26.28
00-032	00-033	36	0.0258	75.01	16.98	0.226	116.06	26.28
00-033	00-034	36	0.0128	52.83	16.98	0.321	81.75	26.28
00-034	00-035	36	0.0044	30.98	16.98	0.548	47.93	26.28
00-035	00-036	36	0.0045	31.33	16.98	0.542	48.47	26.28
00-036	00-037	36	0.0043	30.62	16.98	0.555	47.38	26.28
00-037	00-038	42	0.002	31.50	16.98	0.539	48.74	26.28
00-038	00-039	42	0.0022	33.04	16.98	0.514	51.12	26.28
00-039	00-040	42	0.002	31.50	16.98	0.539	48.74	26.28
00-040	00-041	42	0.0022	33.04	16.98	0.514	51.12	26.28
00-041	00-042	42	0.002	31.50	16.98	0.539	48.74	26.28
00-042	00-043	42	0.0019	30.71	16.98	0.553	47.51	26.28
00-043	00-044	42	0.002	31.50	16.98	0.539	48.74	26.28
00-044	00-045	42	0.002	31.50	16.98	0.539	48.74	26.28
00-045	00-046	42	0.002	31.50	16.98	0.539	48.74	26.28
00-046	00-001M5	42	0.0019	30.71	16.98	0.553	47.51	26.28

SITE LOCATION MAP

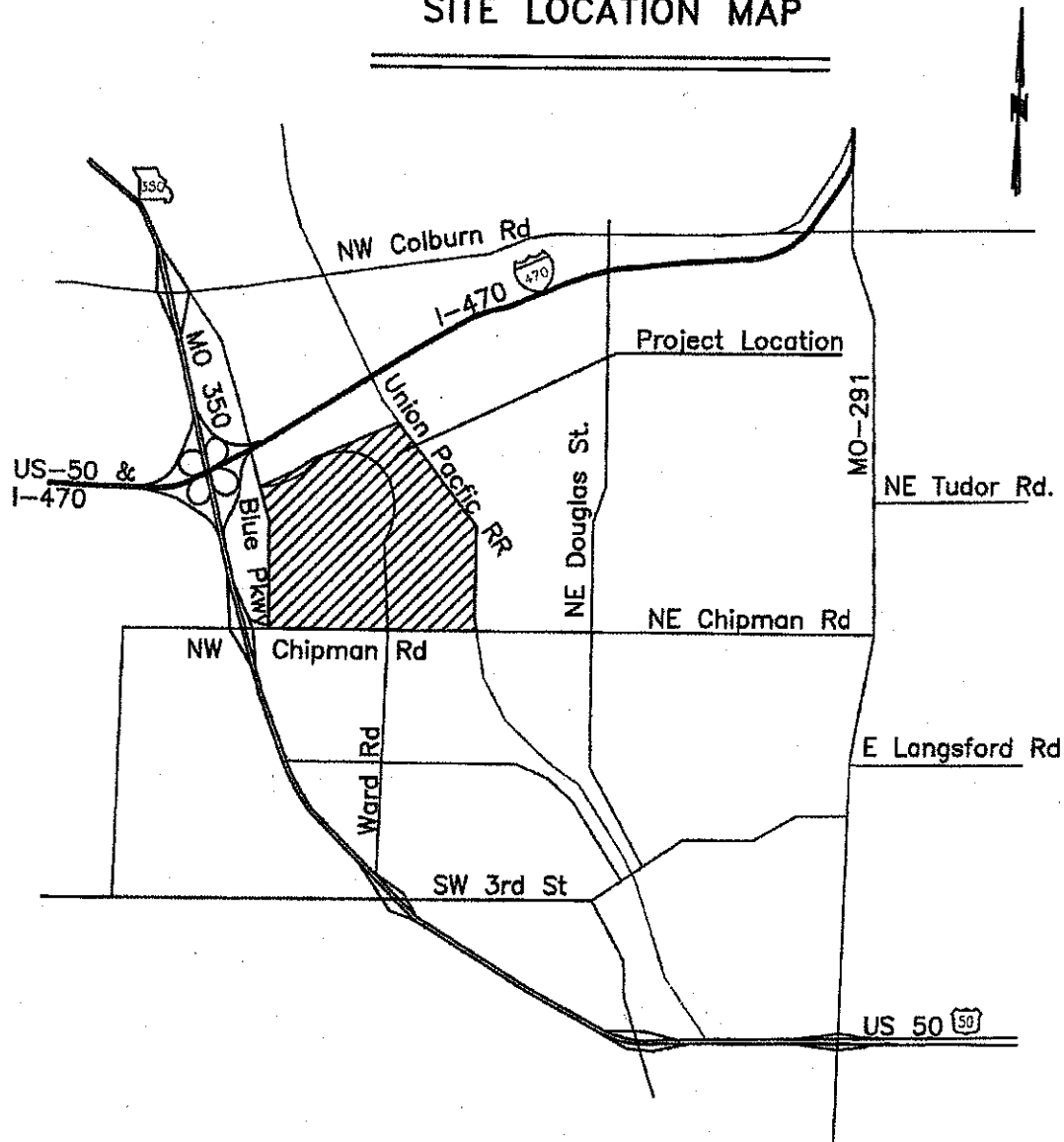
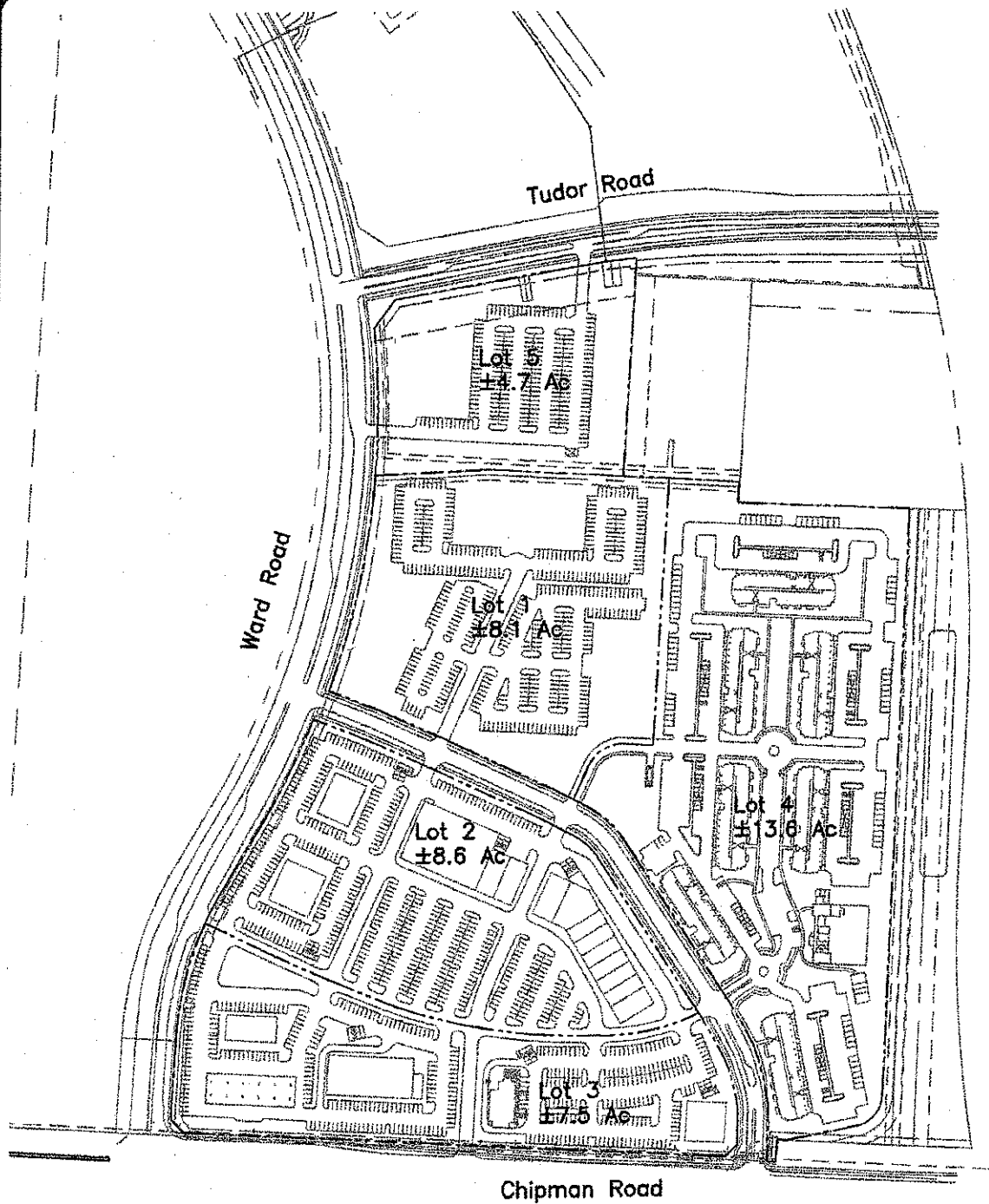


FIGURE 1



Chipman Road

FIGURE 2

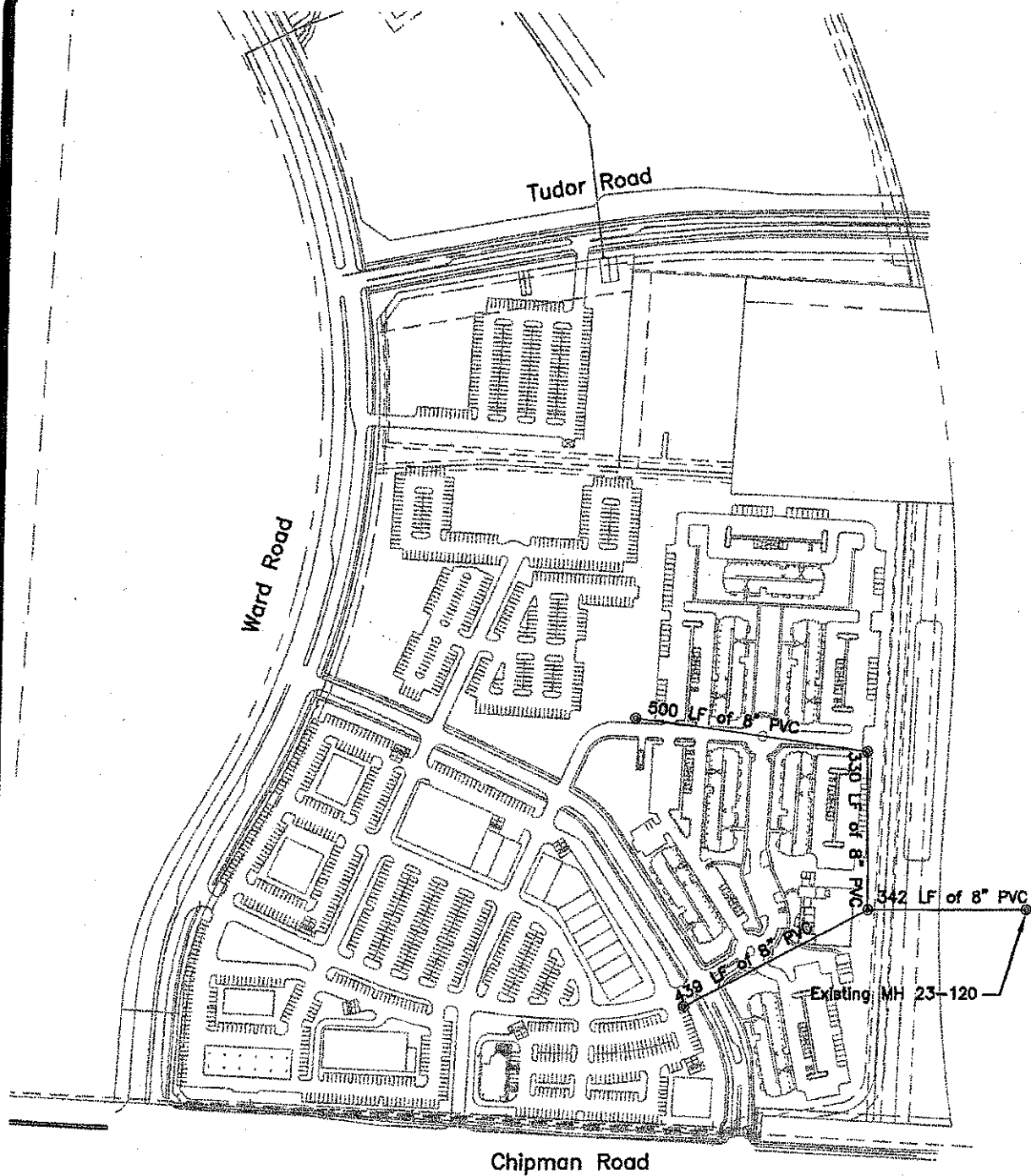


FIGURE 3

