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May 30th, 2024

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RE: 3131 Fernbrook Development Sanitary Sewer Analysis

Project Background

The redevelopment of 3131 Fernbrook Lane into two apartment buildings has been proposed to the City of Plymouth. The change and intensification of land use on the site requires review of the impacts on the sanitary sewer collection system. The City of Plymouth contracted with Bolton & Menk for review of estimated sanitary sewer collection system impacts through the site and along a portion of Fernbrook Lane. The results of the study may be used to identify sanitary sewer improvements, if any, that are necessary to facilitate redevelopment.

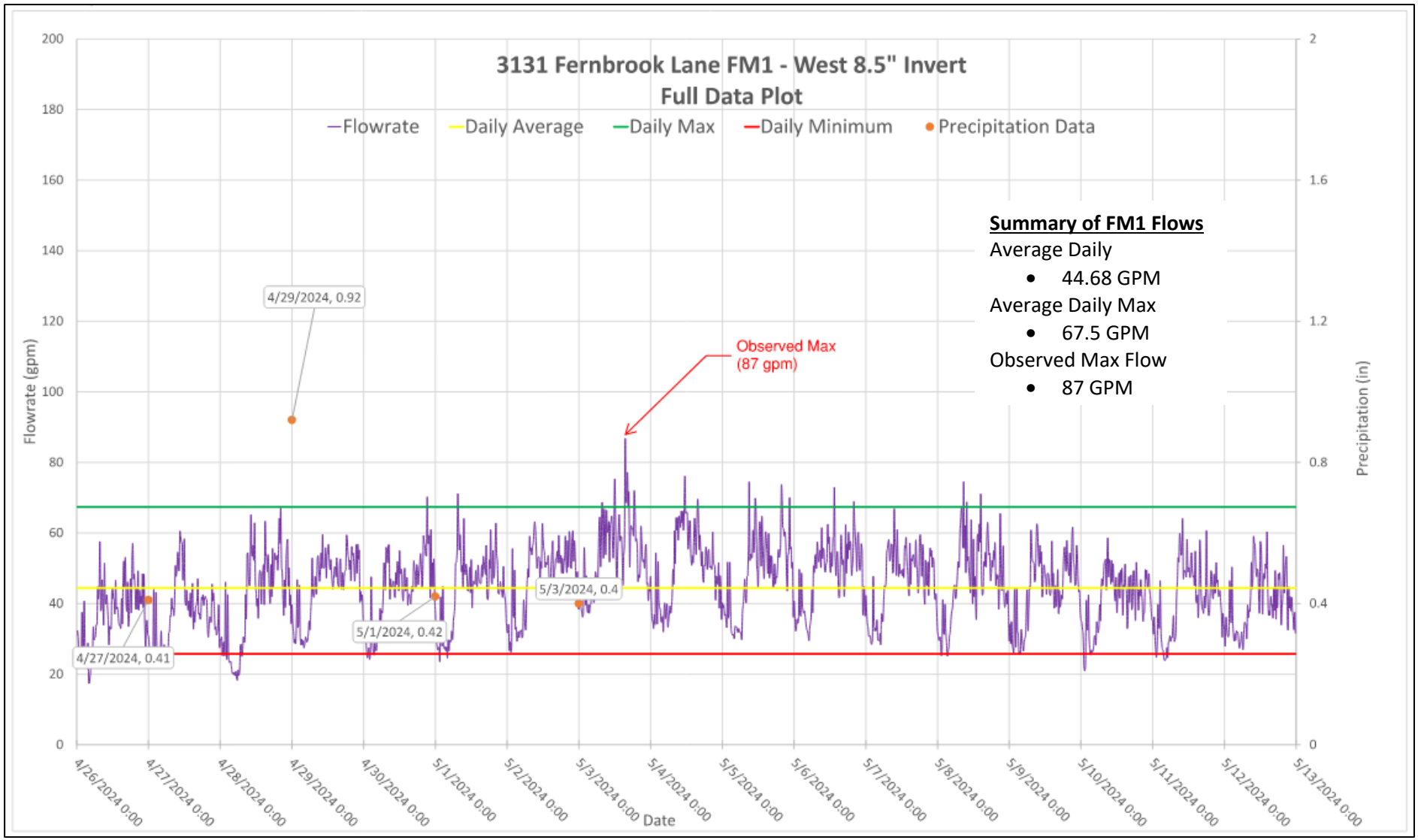
Existing Flow Metering

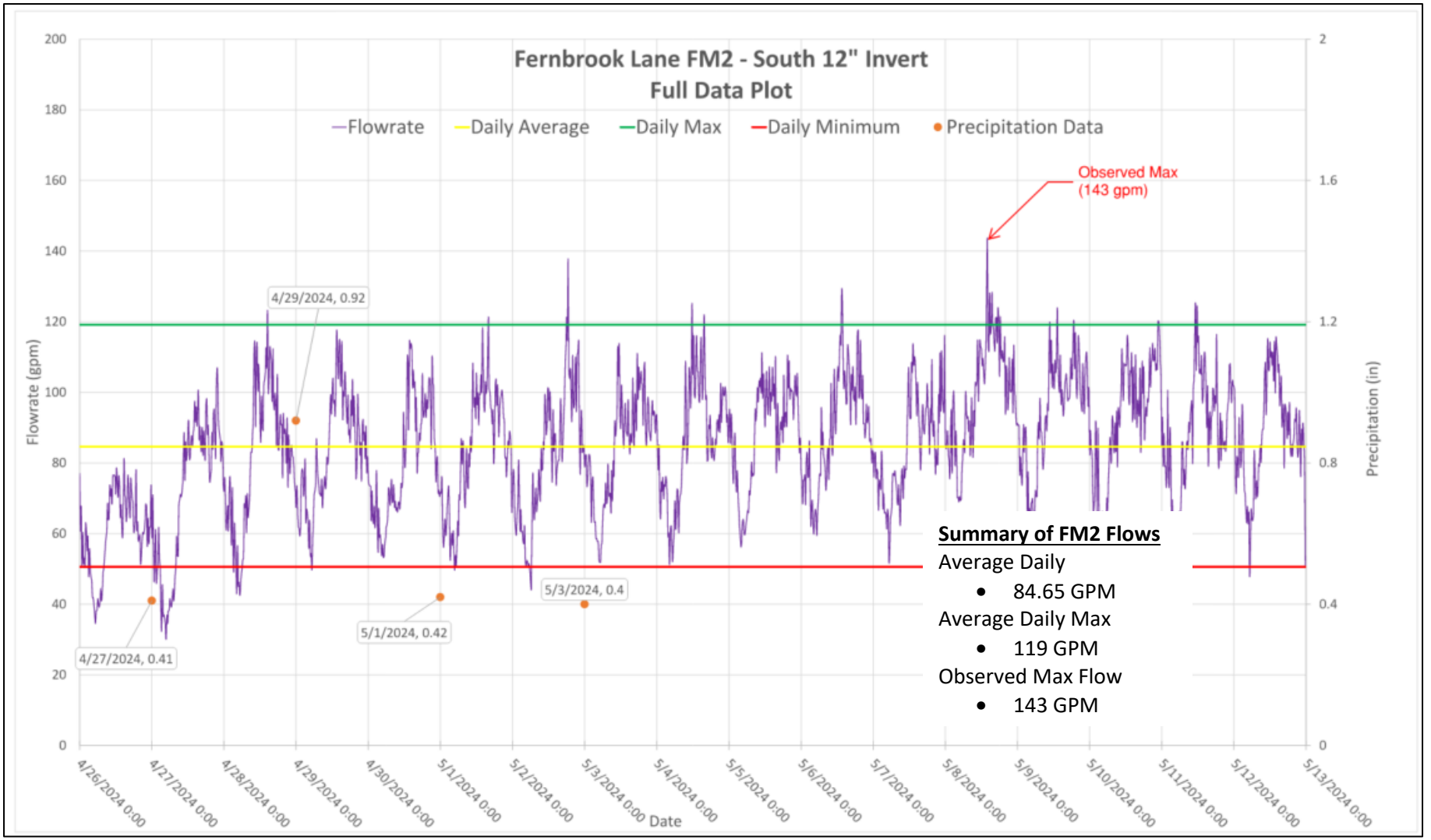
Two sanitary flow meters were installed from April 26th, 2024, to May 12th, 2024. Flow data was measured on 15-minute intervals for 17 days to capture the flow in the sanitary sewer. During the study period, there were four rain events greater than 0.4", therefore, the analysis accounts for potential, typical inflow and infiltration (I&I) to the system.

Flow meters were installed to measure sanitary sewer flows at two locations within the sewershed:

1. **3131 Fernbrook Lane FM 1** - MH 2 from City of Plymouth's Fox Meadows First Edition Plans (City Asbuilt I-59) – 9" VCP West influent sewer CIPP Lined (Assumed 8.5" diameter)

2. **Fernbrook Lane FM2** - MH N216 from City of Plymouth Northwest Trunk Sewer Plans (City Asbuilt B21) – 12" RCP South influent sewer.





Existing Model Development & Calibration

An existing condition model was created based upon existing land use designations which were then calibrated to match the average daily and maximum measured flows.

The land use-based existing flow contributions were derived using the parcel land-use information, parcel area, and Table 9-4 Future Land Use Sanitary Loading Rates from the city's comprehensive sewer plan. Within the model these flows were then applied to the existing sanitary sewer pipe network which was created to replicate the existing pipe network as defined by city provided GIS information and record drawings. The representative flow contributions from the adjacent upstream parcels were added to their respective manhole and imputed into the modeled system. The model was then calibrated to match the results from the two locations of the 2-week flow monitoring study.

Figure 1 of the appendix displays the parcels within the study area, along with their respective land-use descriptions, and future sanitary loading rate.

Proposed Model Results & Development Flows

From the existing conditions model, a proposed conditions model was created to assess the suitability of the proposed pipe capacities within the proposed redevelopment and the impacts on the existing pipe capacities downstream of the proposed redevelopment.

To create the proposed condition calibrated models, the existing condition models were updated by matching the proposed gravity sewer as specified in the plans for the development improvements. The development plans propose the construction of a 12" pvc gravity sewer, connecting to the existing manhole 02941, constructed through the middle of the site and connecting to existing manhole 02943.

During our input of proposed sanitary sewer elevations and grades, we noted some apparent discrepancies within sanitary sewer pipes as proposed. The existing manhole and the uppermost proposed manhole in the developers plans (C6.02) have the same invert elevation (946.50). On an elevation basis, this therefore proposes a pipe slope of 0.00%, not the 0.22% called out on the plans. For modeling purposes, the fall across each proposed manhole in the model was adjusted from 0.1 feet to 0.05 feet in an attempt match the assumed the intent of the developers plans. This adjustment maintains the existing structure invert and the identified grade along the entire proposed sanitary run. This adjustment is not intended as a recommendation for the engineer who may establish their own resolution to the discrepancy, but is merely an effort to develop a functional sanitary sewer model. It is recommended the Engineer of Record for the plans consult 10 States Standards for Wastewater Facilities for information regarding inverts across sanitary sewer manholes.

Within the proposed condition model for the planned area of redevelopment, the flows derived from the existing land use were subtracted and the proposed flow contributions from the redevelopment were added. Proposed flow contributions were calculated by using the Proforma Unit Totals table provided on the redevelopment plan cover sheet (T 1.0), assumed tenant occupancy for each unit type, and typical assumed water usage rates per capita. The daily sewer contributions from each building are summarized in Table 1 & 2 below. A local peaking factor was applied to the base flow rate to determine a peak flow rate shown in Tables 3 & 4. The base and peak flow values from the proposed development were determined using best practices and information from the 10 States Standards for Wastewater Facilities.

Table 1: Summary of assumed development service daily flow for Building 1

BUILDING 1

UNIT TYPE	QUANTITIY	TENANTS	GALLONS/DAY/TENANT	GALLONS PER DAY
1 BED	84	1	90	7560
1 BED + DEN	10	1.5	90	1350
1+ BED	5	1.5	90	675
1- BED	14	1	90	1260
2 BED	29	2	90	5220
2 BED + DEN	5	2	90	900
3 BED	10	3	90	2700
ALCOVE	15	1	90	1350
STUDIO	4	1	90	360
	176		**Total Gallons per day**	**21,375**

Table 2: Summary of assumed development service daily flow for Building 2

BUILDING 2

UNIT TYPE	QUANTITIY	TENANTS	GALLONS/DAY/TENANT	GALLONS PER DAY
1 BED	89	1	90	8010
1 BED + DEN	10	1.5	90	1350
1- BED	14	1	90	1260
2 BED	24	2	90	4320
2 BED + DEN	5	2	90	900
3 BED	10	3	90	2700
ALCOVE	15	1	90	1350
STUDIO	10	1	90	900
	177		**Total Gallons per day**	**20,790**

Table 3: Building 1 – Assumed Peak Flow

Building 1

Daily Flow	21,375	gallons/day
Base Flow	14.85	gpm
Peaking Factor	4	
Peak Flow	**59.40**	**gpm**

Table 4: Building 2– Assumed Peak Flow

Building 2

Daily Flow	20,790	gallons/day
Base Flow	14.44	gpm
Peaking Factor	4	
Peak Flow	**57.76**	**gpm**

The proposed flow rates above were accounted for within the proposed condition model at their respective receiving sanitary manholes that the building services are shown connected to within the proposed development plans. The Building 1 service discharges into proposed manhole #2 and Building 2 service discharges into manhole #3. The results from the models are shown in the table below. For the comparison purposes, the model results shown are at FM 2 site.

Table 5: Calibrated Model Capacity Analysis

12" RCP Pipe Capacity – At FM 2 (MH029510-MH02961)			
	Modeled Flow Results (gpm)	**Model Pipe Capacity (gpm)**	**Percent of Pipe Capacity Used**
Existing Conditions Maximum Model	143.1	604.1	23.7%
Proposed Conditions Model	195.1	604.1	32.2%
Proposed Conditions Maximum Model	250.0	604.1	41.4%

Conclusion

Based on the calibrated sanitary sewer model, the existing sewer downstream of the proposed develop has adequate capacity to accommodate the peak flows generated by the two apartment buildings. The existing sewer was modeled to be using 23.7% of its total capacity during the maximum observed flow of the monitoring study. The proposed and peak proposed conditions showed the downstream pipe uses 32.2% and 41.4%.

We recommend the proposed sanitary sewer between SMH 5 and the upstream existing manhole be revisited within the development plans. Our analysis can be updated to reflect any changes made, though at this time, we do not anticipate results indicating further sanitary sewer replacement being necessary given the pipe capacity observations summarized in Table 5.

We appreciate the opportunity to analyze your sanitary sewer system capacity regarding proposed future redevelopment. We are available to meet and discuss these findings and recommendations in more detail as requested.

Sincerely,

Bolton & Menk, Inc.

Mark Onken, PE
Project Engineer

CC: Mike Waltman, PE, Principal Engineer

Jason Clemens, PE, Project Engineer

3131 Fernbook Lane Sanitary Sewer Evaluation

City of Plymouth

Figure 1 - Existing Land-Use

May 2024

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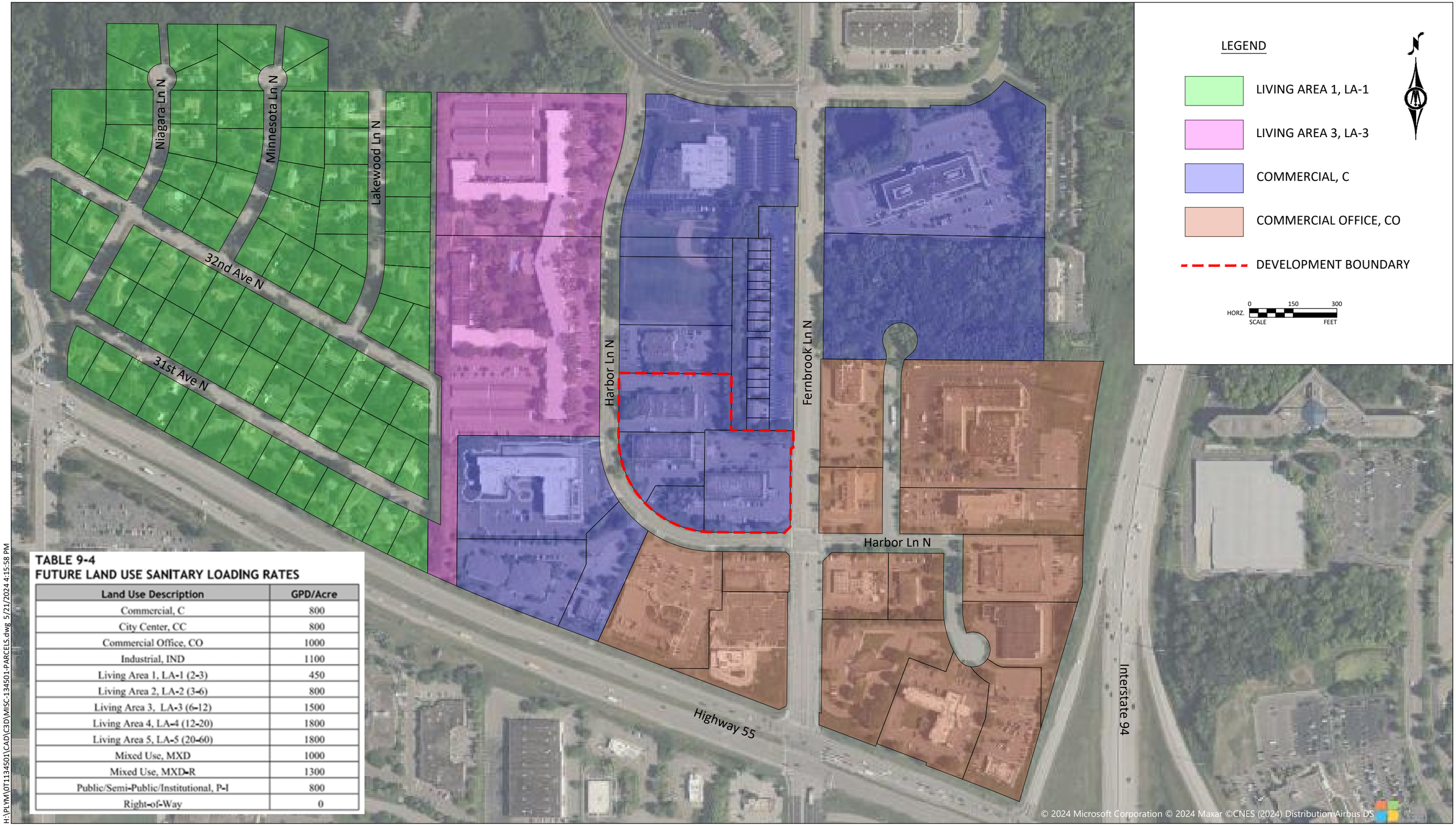

TABLE 9-4
FUTURE LAND USE SANITARY LOADING RATES

Land Use Description	GPD/Acre
Commercial, C	800
City Center, CC	800
Commercial Office, CO	1000
Industrial, IND	1100
Living Area 1, LA-1 (2-3)	450
Living Area 2, LA-2 (3-6)	800
Living Area 3, LA-3 (6-12)	1500
Living Area 4, LA-4 (12-20)	1800
Living Area 5, LA-5 (20-60)	1800
Mixed Use, MXD	1000
Mixed Use, MXD-R	1300
Public/Semi-Public/Institutional, P-I	800
Right-of-Way	0

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