TECHNICAL MEMORANDUM #3

TO: Matilda Deas, City of Canby
Sonya Kazen, ODOT Region 1

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DATE: March 31, 2010

SUBJECT: **Canby TSP – Future Forecasting** P09042-002-002

Future forecasting is an important step in the transportation planning process and provides estimates of future travel demand. This memorandum documents the forecasting methodology and results associated with the enhanced cumulative analysis tool developed in conjunction with the Canby Transportation System Plan (TSP) Update. The enhanced cumulative analysis tool provides study intersection turn movement volumes for the 2030 TSP horizon year.

Introduction

The forecasting methodology associated with the enhanced cumulative analysis tool expands upon a Cumulative Analysis approach, as defined in the Oregon Department of Transportation (ODOT) Transportation Planning Analysis Unit's (TPAU's) *Analysis Procedures Manual*.[1] In the context of the traditional 4-step travel demand model approach, the typical Cumulative Analysis is used for trip generation and trip distribution purposes only. The result is a trip table (for growth increment only) that is used as an input into traffic assignment where analysis is completed by manually assigning the new trips to a transportation network and then adding them to the existing traffic volumes to estimate future volumes.

The enhanced cumulative analysis tool uses the same trip generation and trip distribution methodology as the typical Cumulative Analysis, but it applies the methodology to all land uses within the city (i.e., both existing uses as well as any future development based on a land use inventory). The enhanced tool then uses VISUM modeling software[2] and incorporates intersection node delay to complete the equilibrium trip assignment. The result is an improved traffic volume forecasting tool that dynamically assigns both new and existing trips to the transportation network using an equilibrium assignment procedure that represents routing choice more accurately than manual assignment because it is responsive to varying levels of congestion and delay as traffic patterns change. This tool enables a more comprehensive analysis of future conditions and potential TSP alternatives.

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[1] *Analysis Procedures Manual (APM)*, Oregon Department of Transportation (ODOT) Transportation Planning Analysis Unit (TPAU), Last Updated July 2009, pgs. 61-74

[2] VISUM is a transportation travel demand modeling software developed by PTV Vision

The following sections of this memorandum detail each component of the travel forecast methodology associated with the enhanced cumulative analysis tool. These components include the roadway network, transportation analysis zones (TAZs), land use, and travel demand. The resulting 2030 future projected volumes are also provided.

Roadway Network

The roadway network included in the Canby TSP VISUM model consists of all local, collector, and arterial streets within the Canby Urban Growth Boundary (UGB). In addition, because there are TSP study intersections outside of the Canby UGB, the model includes the key roadways to the east and west of Canby that provide access to those study intersections.

An existing roadway network was built using NAVTEQ files as the initial base. Then, details were added based on an existing conditions inventory that included posted speeds, traffic control, lane geometries, and number of travel lanes. Many of the elements of the existing conditions inventory are provided in TSP Chapter 3 (Existing Conditions). The purpose of the existing conditions network was to configure the model and act as a base in the development of the future model.

The 2030 future year baseline roadway network was then developed to use for the 2030 No-Build analysis, which is provided in TSP Chapter 4 (Future Needs). The one capacity-related improvement that is planned for construction in the near future is the paving and realignment of Walnut Road on the east end of town.[3] Walnut Road currently is a narrow road connecting Southeast 1st Avenue with the Sequoia Parkway/Southeast 4th Avenue intersection. It will be widened and the southern portion will be realigned to form a new three-leg intersection with Sequoia Parkway at a location approximately 500 feet north of the Southeast 4th Avenue intersection. In addition, streets were added in the Northeast Canby Concept Plan area to provide internal circulation. The 2030 future year network will be further adjusted and used to perform analysis of the various transportation alternatives and improvements analyzed for the Canby TSP Update.

Transportation Analysis Zones

For transportation modeling purposes, the Canby UGB was divided into 72 transportation analysis zones (TAZs), which represent the sources of vehicle trip generation within the city. The Canby TSP VISUM network also includes 12 external TAZs at the key gateways into and out of the city to account for vehicle trips that enter and exit the Canby UGB, as well as four additional TAZ to represent outlying residential areas. The internal and external TAZs are shown in Figure 1. The next sections of this memorandum discuss the land uses and trip generation estimates associated with each TAZ and with the city as a whole.

[3] The City has other roadway projects that are planned for construction, but they consist of repaving or reconstructing roadways without adding additional motor vehicle travel lanes or changing intersection locations.

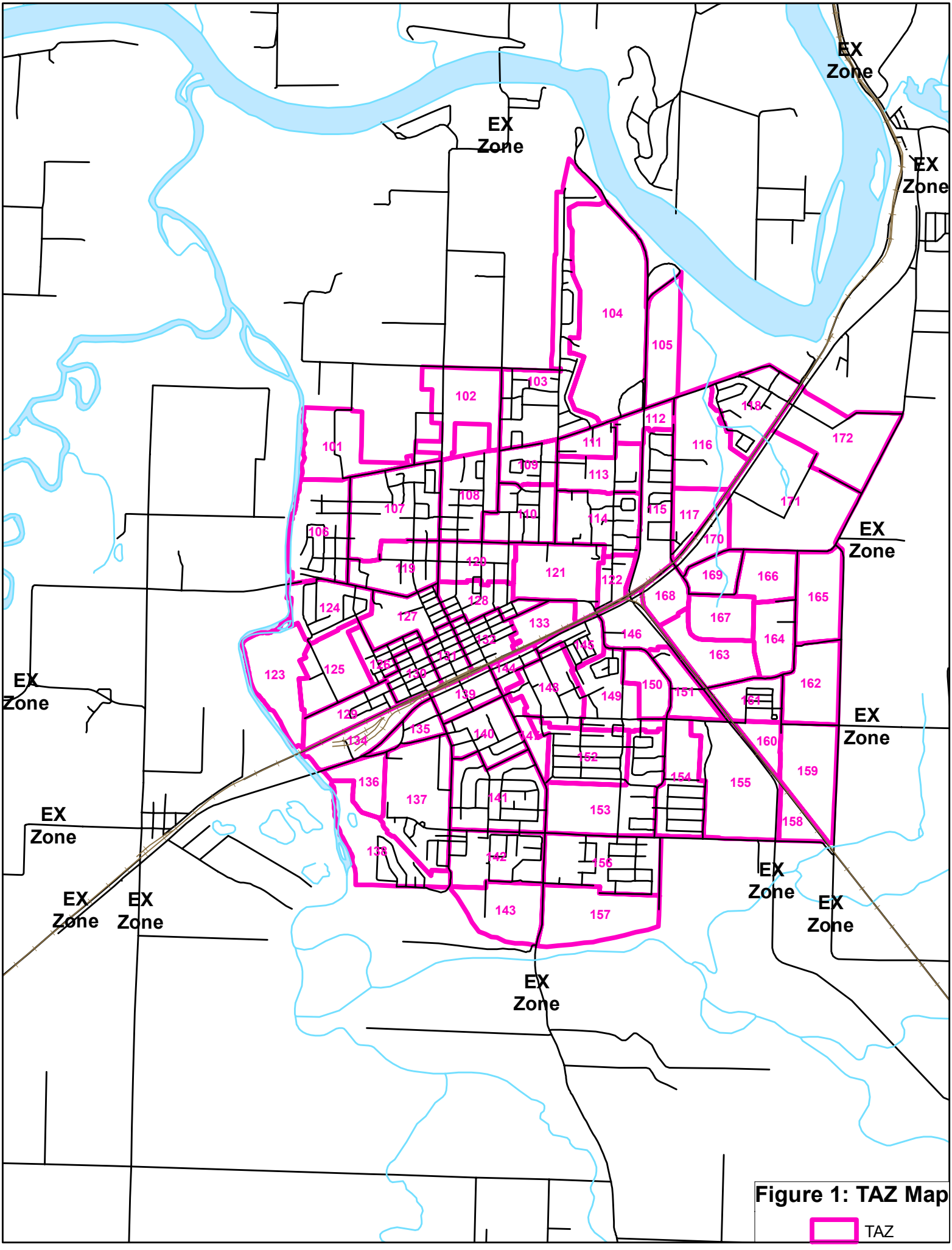
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Figure 1: TAZ Map
TAZ

Land Use

Land use is a key factor affecting the traffic demands placed on Canby's transportation system. The location, density, type, and mixture of land uses have a direct impact on traffic levels and patterns. An existing 2009 land use inventory and a future 2030 land use projection were performed for each TAZ in the Canby UGB.

The existing 2009 land use inventory approximated the number of households and the amount of retail employment, service employment, educational employment, and other employment that currently exist in each TAZ. Existing land uses within Canby were obtained from tax assessor data, census data, and zoning data and compared with existing aerial photography. The existing land uses correspond to a population of approximately 15,165 residents.

The future 2030 land use projection is an estimate of the amount of each land use that the TAZ could accommodate at expected build-out of vacant or underdeveloped lands assuming Comprehensive Plan zoning. The one exception is within the Northeast Canby Concept Plan area, which is located in northeast Canby between OR 99E, Territorial Road, Haines Road, and Southeast 1st Avenue. In this area, land uses consistent with the Northeast Canby Concept Plan[4] were assumed instead of Comprehensive Plan zoning. The projected land uses correspond to a year 2030 population projection of approximately 26,100 residents and were estimated by assuming typical development densities based on the past five years of development in Canby.

Detailed land use data by TAZ are provided as supplementary material to this memorandum, and the existing land use estimates and future projections for the entire Canby UGB are listed in Table 1.

Table 1: Canby UGB Land Use Summary

Land Use	Existing 2009 Land Use	Projected Growth from 2009 to 2030	Projected 2030 Land Use
Households			
Total Households	**6,127**	**4,403 (+72%)**	**10,530**
Employees			
Retail Employees	624	715 (+115%)	1,339
Service Employees	1,004	644 (+64%)	1,648
Educational Employees	409	257 (+63%)	666
Other Employees	1,928	3,007 (+156%)	4,935
Total Employees	**3,965**	**4,623 (+117%)**	**8,588**

[4] *Draft NE Canby Concept Plan*, Prepared by Parametrix; June 8, 2005; A review of the plan can be found in the Background Document Review Memorandum, which is included as Appendix A.

Travel Demand

Travel demand on roadways and at intersections in Canby was estimated using methodology similar to that specified by the ODOT Procedures Manual for cumulative analysis models (often referred to as Level 2 models).[5] Adjustments made to the methodology include modeling all vehicle trips (not just growth increment), adjusting the trip distribution to reduce household-to-household trips, and using VISUM modeling software to perform the trip assignment. Travel demand was performed for 30th highest hour conditions for both 2009 and 2030. The purpose of the 2009 model was to calibrate the network in preparation for developing the 2030 model network, which would then be used for the future analysis.

The travel demand analysis includes the translation of City land use information into motor vehicle trips. This was done for each of the Canby TAZs based on the existing and projected land uses described previously in the Land Use section of this memorandum. Trips traveling to and from the external TAZs were also estimated for both the 2009 and 2030 analysis years. This section of the memorandum describes the methodology used to determine the different trips types and how the trips were distributed and assigned to the roadway network. Calibration analysis is also provided.

Trip Types

Travel demand projections involve the determination of three distinct types of trips, which are categorized based on whether their origin and/or destination (i.e., the trip ends) are internal or external to the Canby UGB. The three trip types and how they apply to Canby are described in the list below.

- **External-External (E-E) Trips** do not have an origin or destination in Canby and either do not stop or only make a very minor stop while passing through the Canby UGB. These trips are typically referred to as through traffic.
- **Internal-External (I-E) Trips** originate in Canby and are traveling to a location outside of the Canby UGB and **External-Internal (E-I) Trips** originate outside of the Canby UGB and are traveling to a location within Canby.
- **Internal-Internal (I-I) Trips** travel from one location within the Canby UGB to another location within the UGB.

External Trip Ends

External trip ends are the origin and/or destination of E-E, I-E, or E-I trips and were estimated for both 2009 and 2030. The number of 2009 external trip ends was based on existing traffic volumes (i.e., 30th highest hour conditions) at key gateways to the City, which include OR 99E on the east and west, Arndt Road and Anderson Road on the west, Barlow Road, Mulino Road, and Ivy Street on the south, Township Road, Bremer Road, and New Era Road to the east, and Locust Street to the north. Growth estimates were applied to each gateway to determine 2030 external trip ends.

[5] *Analysis Procedures Manual (APM)*, Oregon Department of Transportation (ODOT) Transportation Planning Analysis Unit (TPAU), Last Updated July 2009, pgs. 61-74

External trip ends consist of through trips (i.e., E-E trips) as well as trips that enter and leave Canby (i.e., I-E and E-I trips). The proportion of each external trip type was estimated.

Future external trip end quantities were estimated based on the forecasted growth at the external gateways in Metro's 2005 and 2030 regional travel demand model. Although Canby is outside Metro's formal modeling area, the data provided in the Metro model was compared to ODOT Highway Volume Table, and determined to be reasonable for this project. The growth rates applied to entering and exiting trips at external locations range from 0.5% to 3.9% per year by direction (compounded) and are included as an attachment.

Internal Trip Ends

The number of internal trip ends in Canby was determined using land use trip generation methodology, which translates land use quantities (number of dwelling units or number of employees) into vehicle trip ends (number of vehicles entering or leaving a TAZ) using land use specific trip generation rates. Average PM peak hour trip generation rates are listed in Table 2 for the applicable land uses. These rates were based on national rates obtained from the Institute of Transportation Engineers (ITE) *Trip Generation, 8th Edition*[6], and were adjusted to reflect local travel patterns based on existing vehicle count data .

Table 2: PM Peak Hour Trip Generation Rates by Land Use

Land Use	Trips In	Trips Out	Total Trip Ends
Households (per dwelling unit)	0.47	0.28	0.75
Retail (per employee)	1.93	2.17	4.10
Service (per employee)	0.97	1.23	2.20
Education (per employee)	0.79	0.85	1.64
Other (per employee)	0.05	0.26	0.30

By applying these trip generation rates to the TAZ land uses, the number of trips entering and exiting each TAZ in Canby were estimated. These internal trip estimates were obtained for both the existing 2009 land uses and the projected 2030 land uses, and the detailed results are provided as supplementary material to this memorandum. For the entire City of Canby, existing land uses in 2009 are estimated to generate 10,400 internal trip ends and future land uses in 2030 are expected to generate 19,800 internal trip ends. Therefore, Canby is estimated to have traffic growth of 9,400 internal trip ends between 2009 and 2030.

Trip Distribution

Trip distribution was performed to estimate how many trips travel between each of the internal and external TAZs. The external trips passing through Canby were distributed based on the O-D survey

[6] *Trip Generation Manual*, 8th Edition, Institute of Transportation Engineers, 2009.

discussed previously in the External Trip Ends section of this memorandum. Distribution for trips traveling to and from internal zones (i.e., trips having at least one internal trip end) was based on weighting the attractiveness of each zone, as measured by the number of trip ends generated by the zone. Separate weighting percentages were used for household and non-household trip ends because otherwise household-to-household trips would be higher than expected for the PM peak hour. A detailed trip table showing the number of trips traveling between each of the internal and external zones is provided as supplementary material to this memorandum.

Trip Assignment

Trip assignment involves the determination of the specific travel routes taken by all of the trips within the transportation network. This step was performed using VISUM modeling software. Model inputs included the transportation network (i.e., road and intersection locations and characteristics, as determined from maps and field inventories) and a trip distribution table (determined using methodology described previously in this memorandum). Iterated equilibrium assignment was then performed using estimated travel times along roadways and delays at intersection movements.[7] The path choice for each trip was based on minimal travel times between locations. Model outputs include traffic volumes on roadway segments and at intersections.

Calibration

Calibration was performed on the 2009 base year model by comparing model volumes at the Canby TSP study intersections with existing 2009 traffic volumes (i.e., 30th highest hour conditions). A plot comparing the existing traffic counts and the base year model volumes for all study intersection turn movements was analyzed to evaluate the accuracy of the model and is shown in Figure 2. The slope of the fitted curve is 1.025, indicating that the model volumes are generally only 2 percent higher than the existing counts and that the trip generation is appropriate and does not require further refinement. Furthermore, the R^2 value of 0.976 indicates that the model volumes are consistent with the target volumes.

The calibration analysis for the 2009 base year model indicates that the model reasonably predicts trip patterns and volumes. Therefore, the 2030 future year model is expected to reasonably forecast future year traffic volumes for the following reasons:

- The 2030 future year model was created using the 2009 base year model as a starting point.
- Roadway network changes assumed for the future year are not expected to significantly alter travel patterns.
- Future land use projections for the year 2030 were prepared using methodology consistent with the 2009 base year land use estimates.

[7] Roadway travel times were calculated based on distance and travel speed. Intersection movement delays were calculated using Highway Capacity Manual (HCM) methodology for signalized and unsignalized intersections. Detailed lane geometry, traffic control, roadway cross-section, and roadway travel speed information is required for model accuracy.

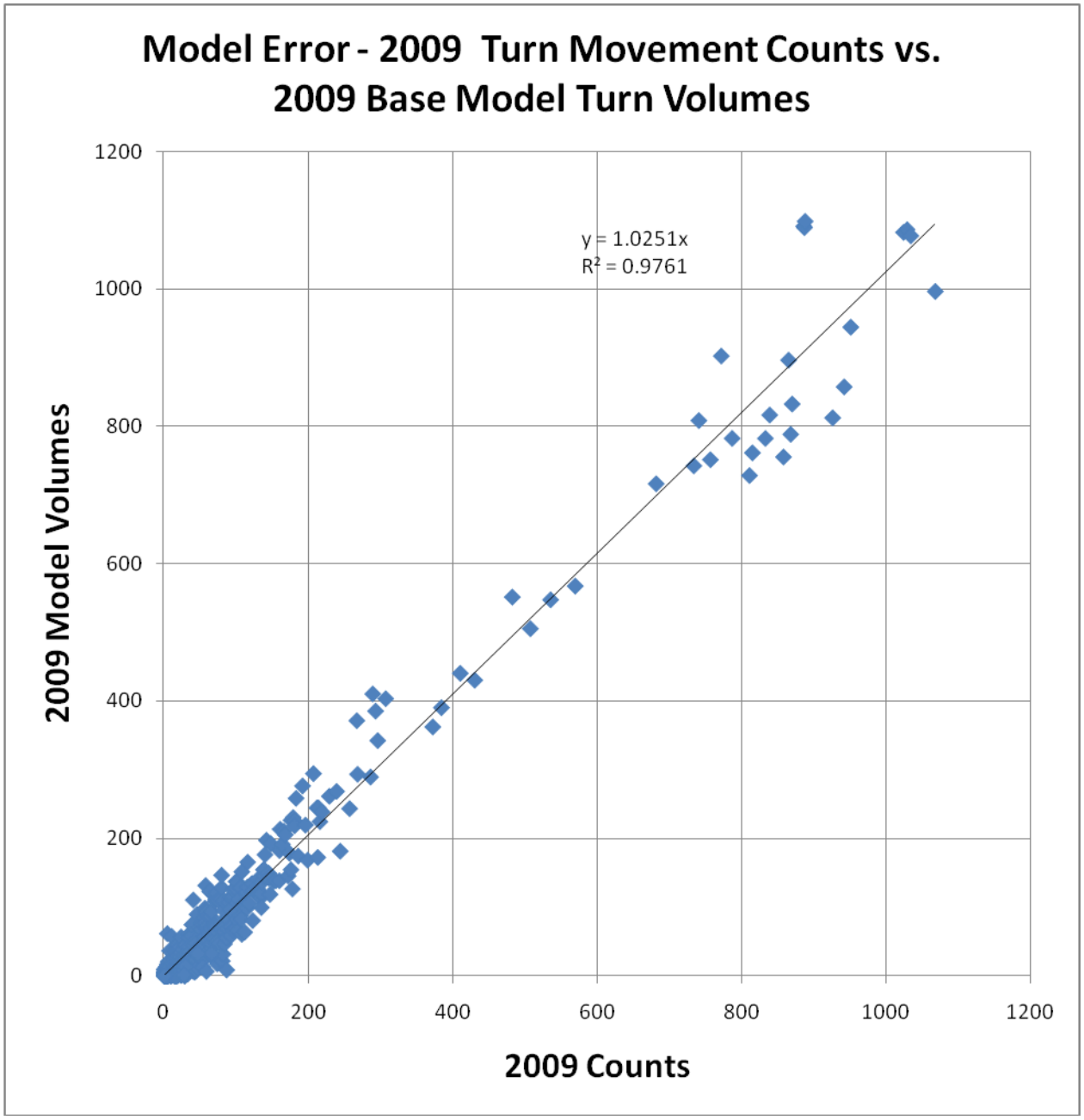
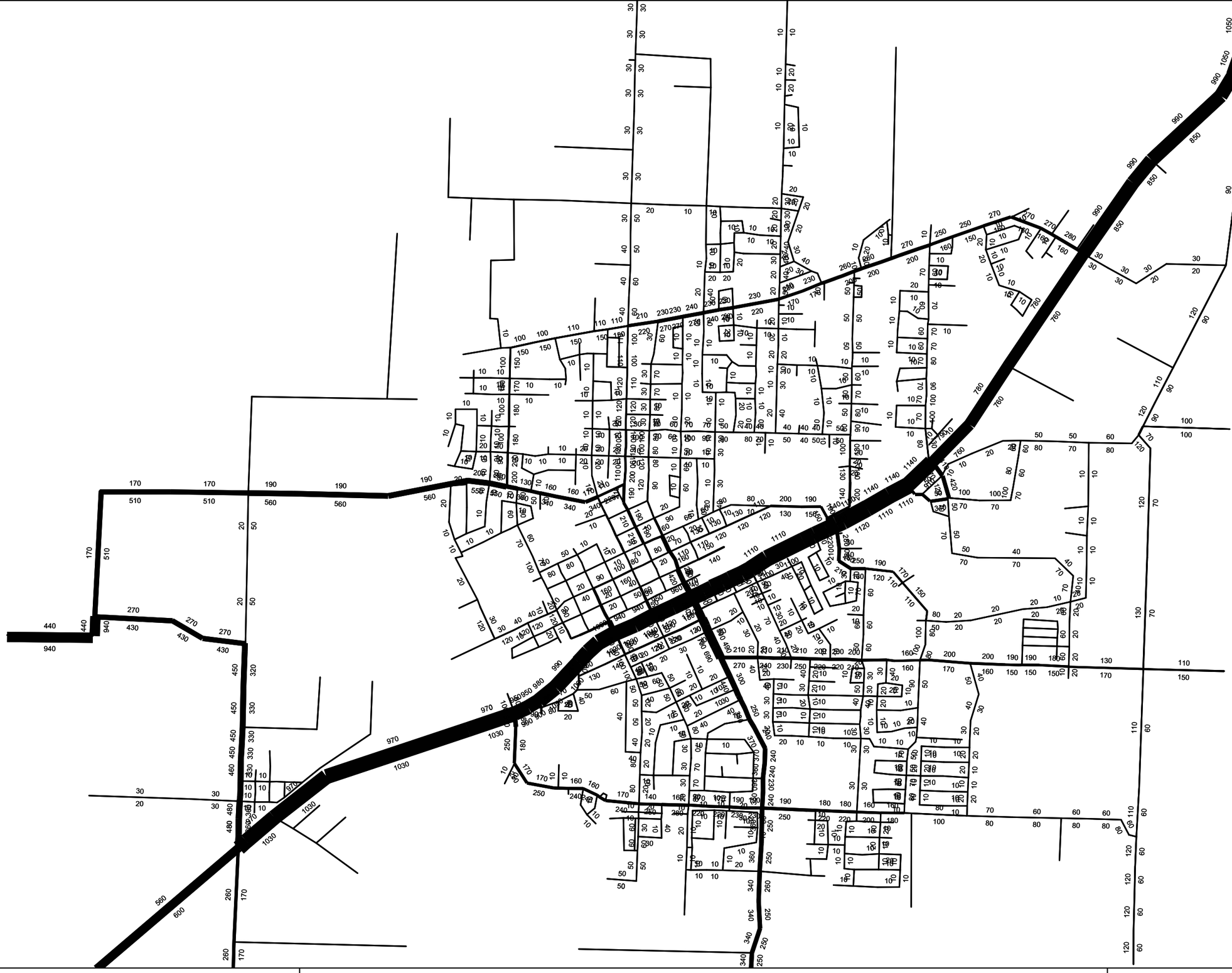


Figure 2: 2009 Model vs. 2009 30th HV Turn Movements

Model Volumes

Model output volume plots are shown in Figure 3 for the 2009 base year and in Figure 4 for the 2030 future year. Figure 5 shows the increment of traffic growth between 2009 and 2030 during the P M peak hour. Design hour volumes were extracted from the model for both the base year 2009 and forecast year 2030 scenarios. A "post processing" technique following NCHRP 255 methodology[8] was utilized to refine model travel forecasts to the volume forecasts utilized for 2030 intersection analysis. Future 2030 turn movement projections are included in Figure 6.

[8] *Highway Traffic Data for Urbanized Area Project Planning and Design - National Cooperative Highway Research Program Report 255,* Transportation Research Board, Washington D.C., 1982.



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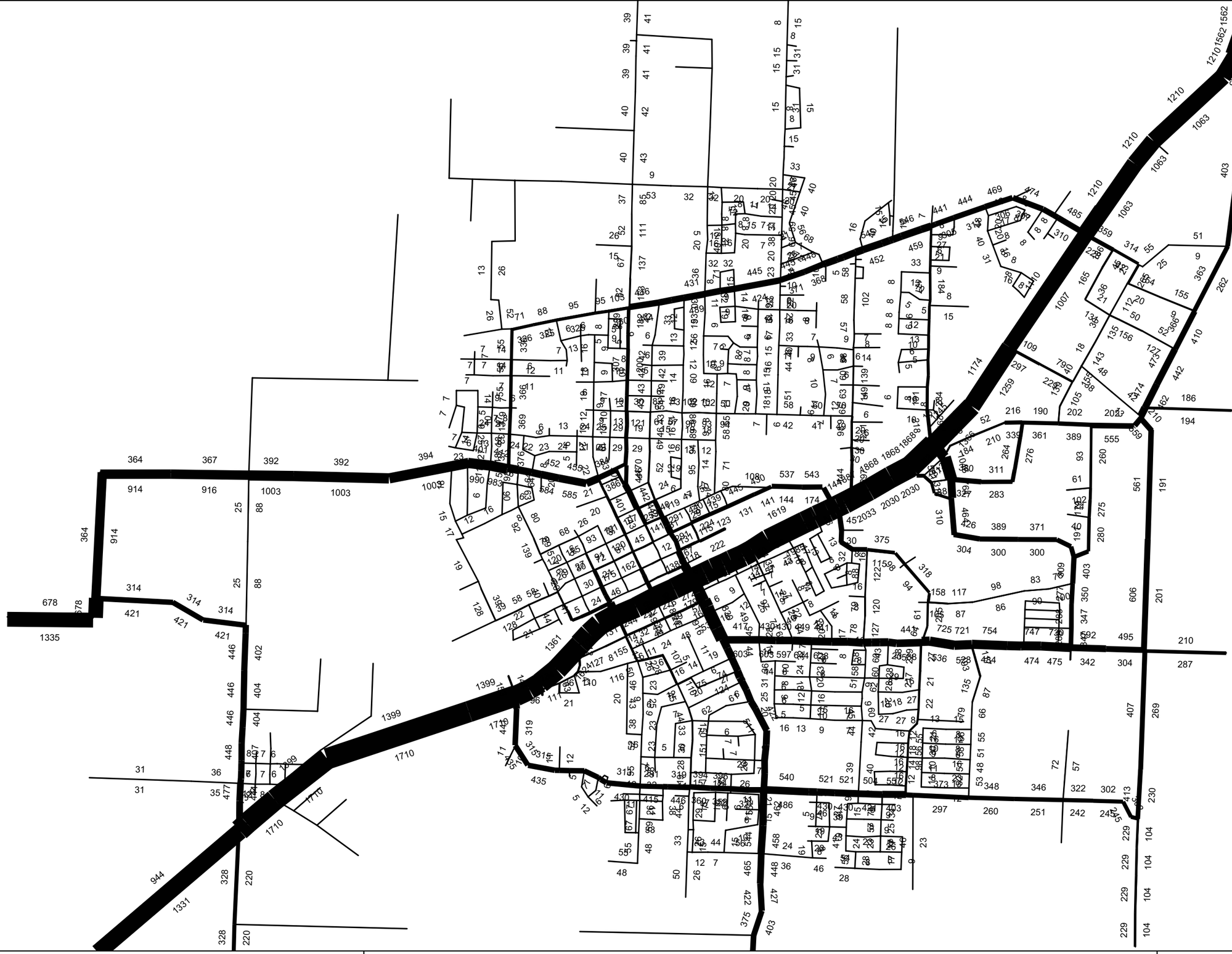

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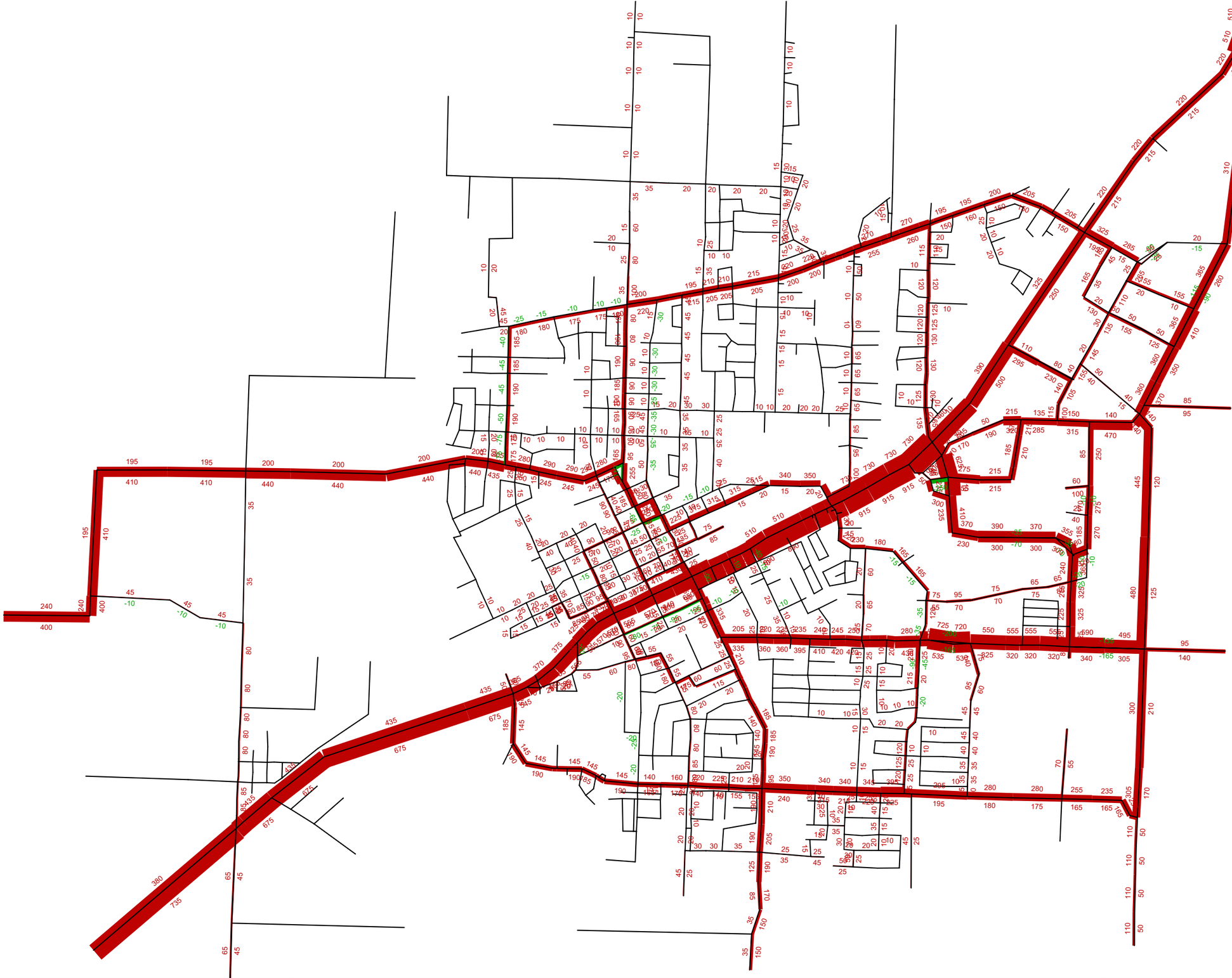

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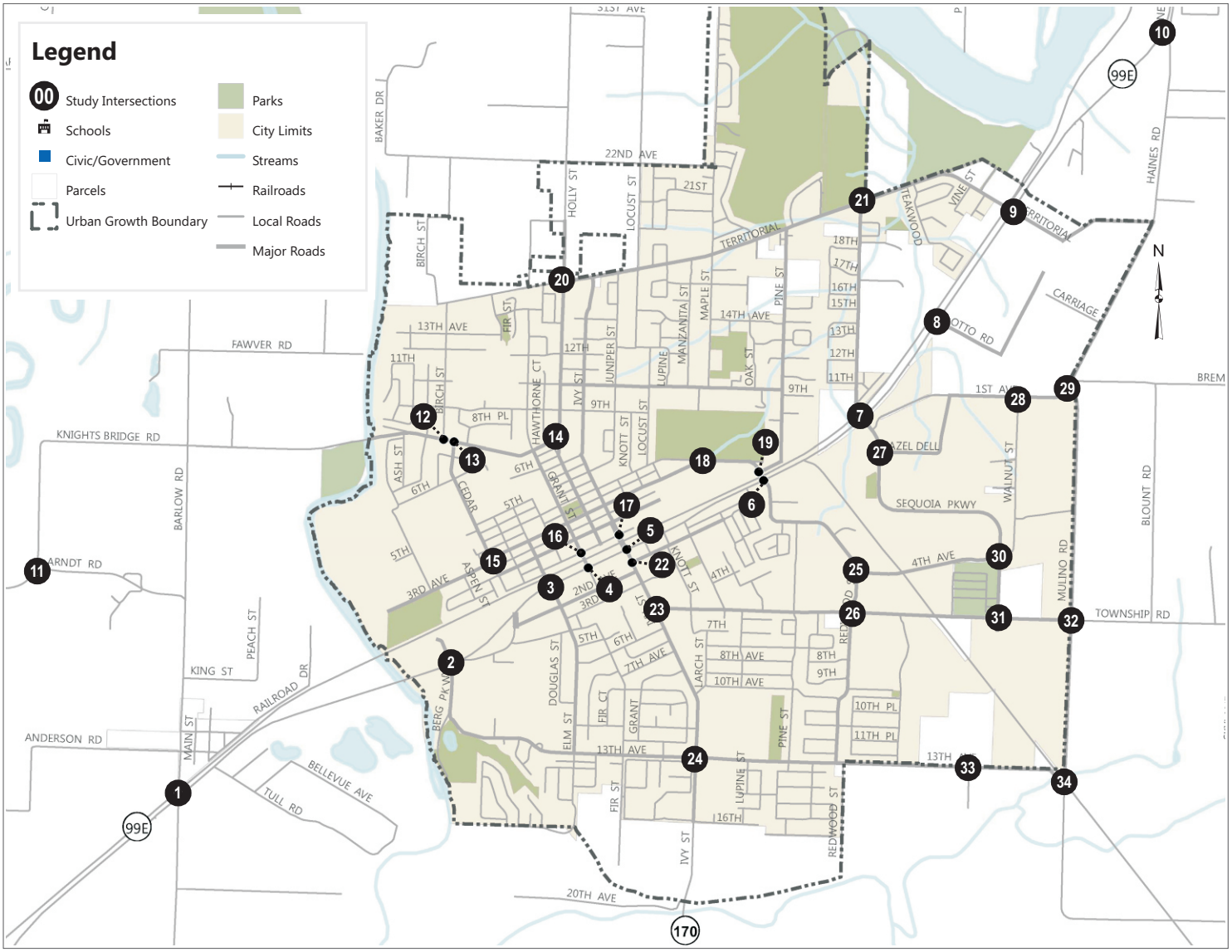
	PM 1-hr Difference Volumes	1:20248



Intersection Detail Legend

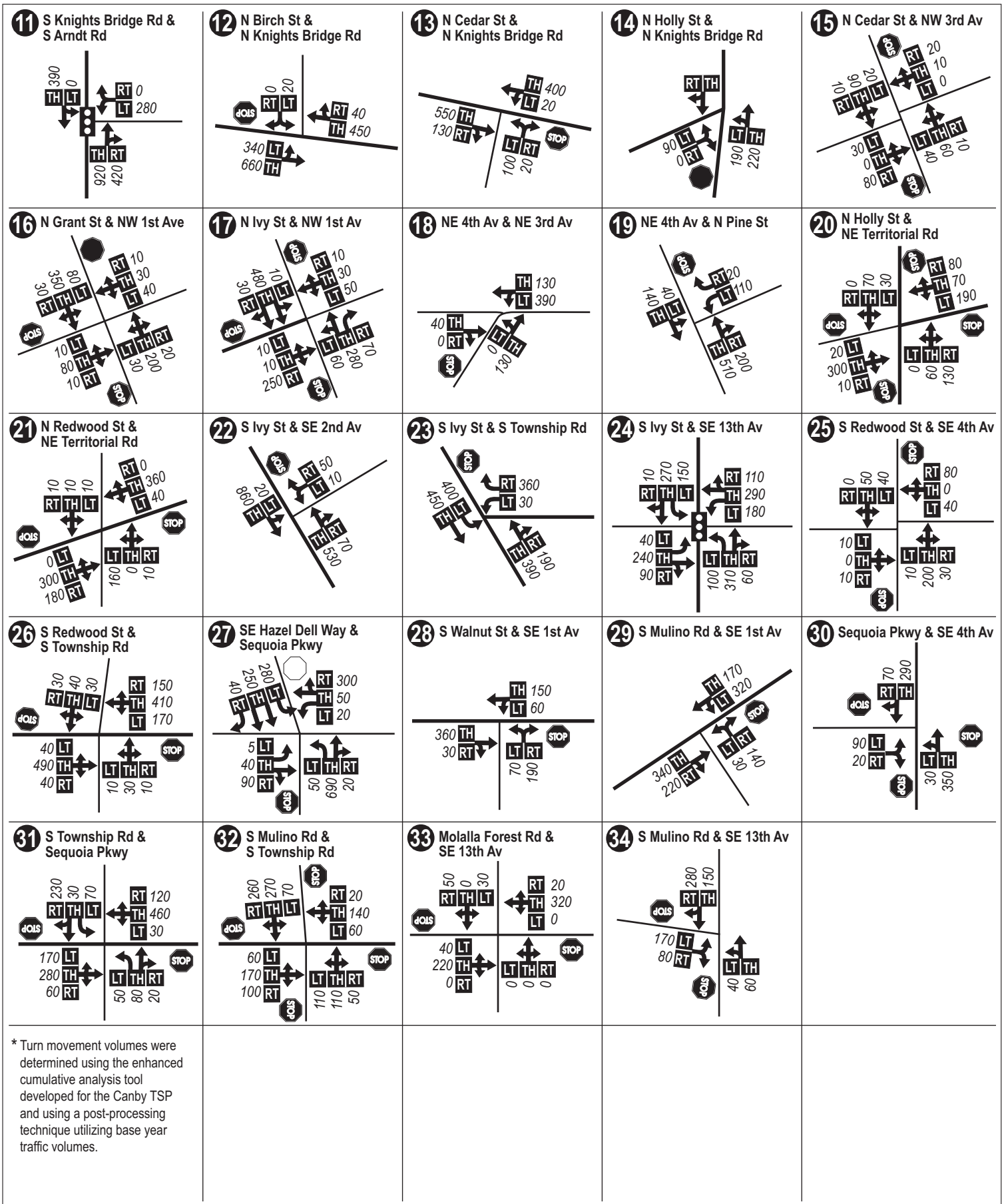
- *00* - 30th Highest Hour Traffic Volume*
- LT TH RT (Left•Thru•Right) - Volume Turn Movement
- ← - Lane Configuration
- Traffic Signal
- STOP - Stop Sign

*See note on Figure 4-2b

CITY OF CANBY
Transportation System Plan

FIGURE 6a

FUTURE 2030 BASELINE VOLUMES (SHEET 1 OF 2)



* Turn movement volumes were determined using the enhanced cumulative analysis tool developed for the Canby TSP and using a post-processing technique utilizing base year traffic volumes.

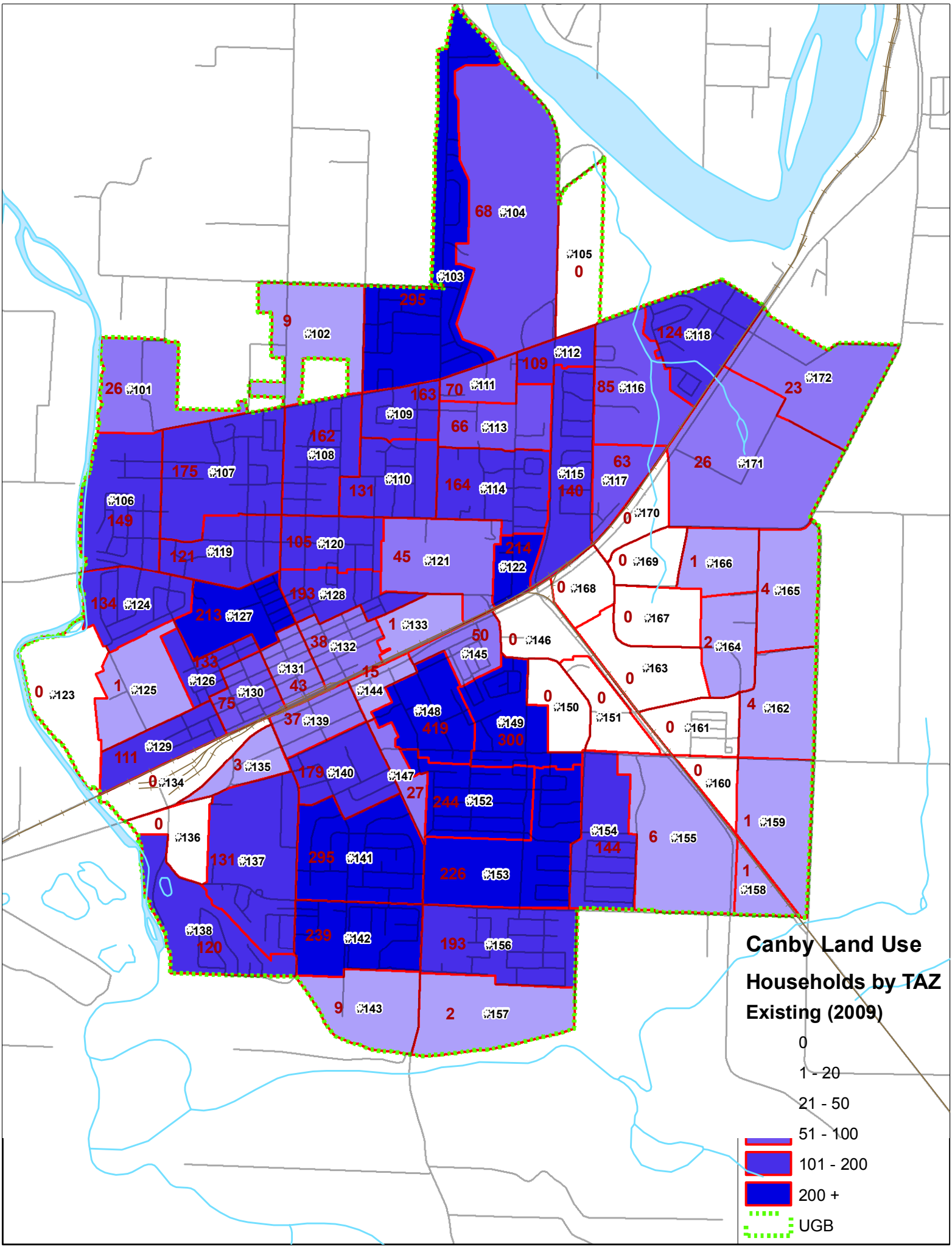
Intersection Detail Legend

- *00* - 30th Highest Hour Traffic Volume*
- LT TH RT (Left•Thru•Right) - Volume Turn Movement
- ← - Lane Configuration
- Traffic Signal
- STOP - Stop Sign

CITY OF CANBY
Transportation System Plan

FIGURE 6b

FUTURE 2030 BASELINE VOLUMES (SHEET 2 OF 2)


Canby Land Use
Households by TAZ
Existing (2009)
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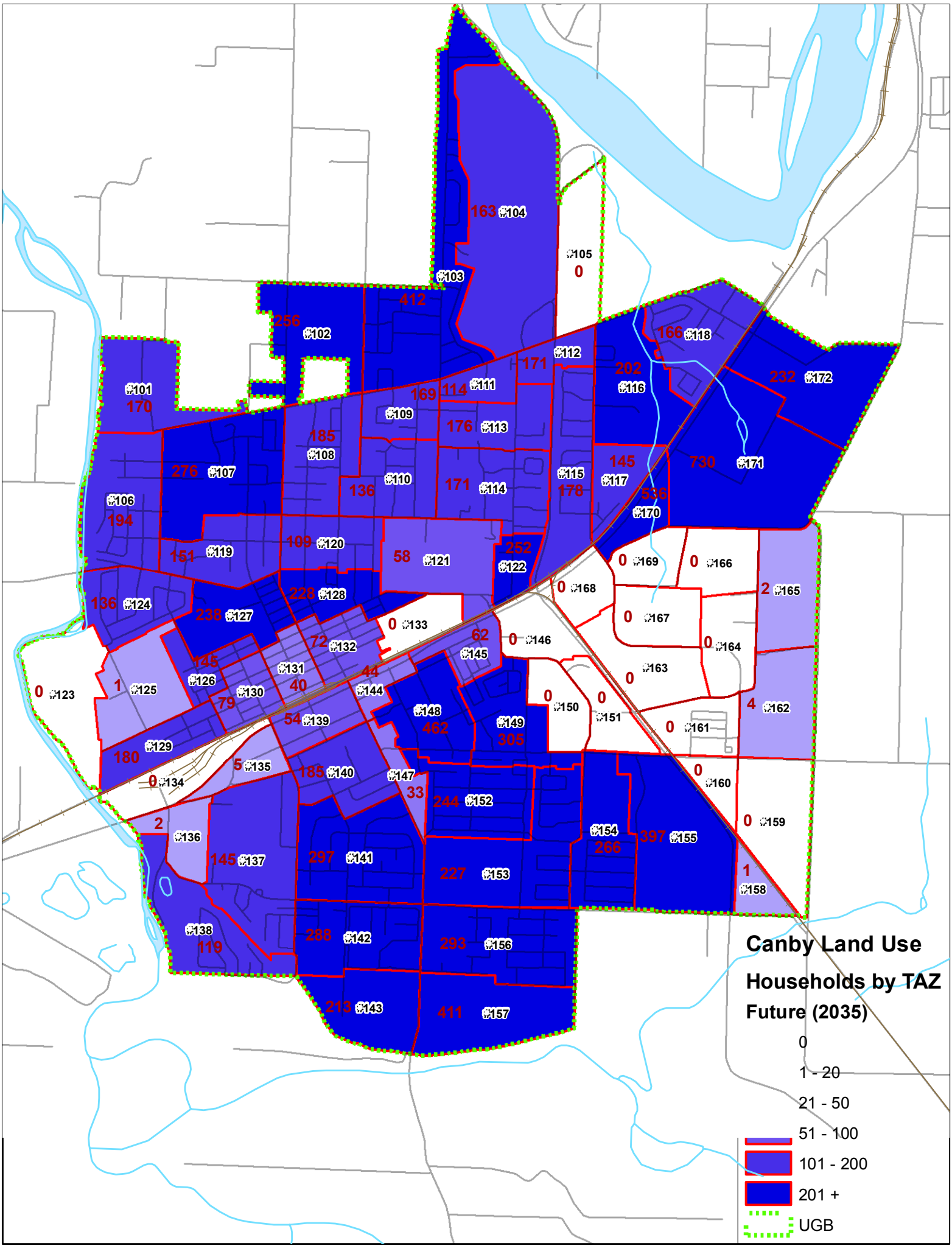
Canby Land Use
Households by TAZ
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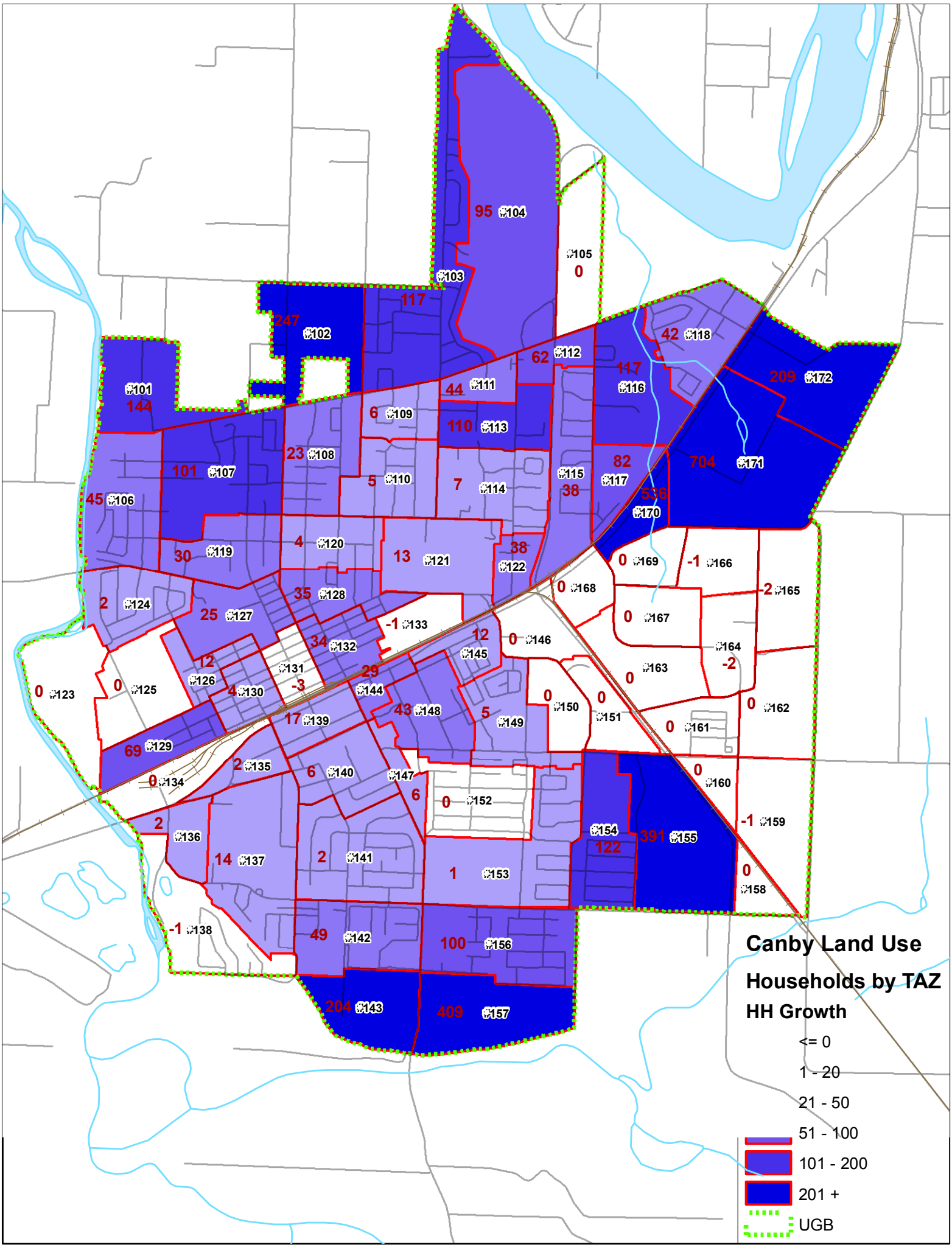
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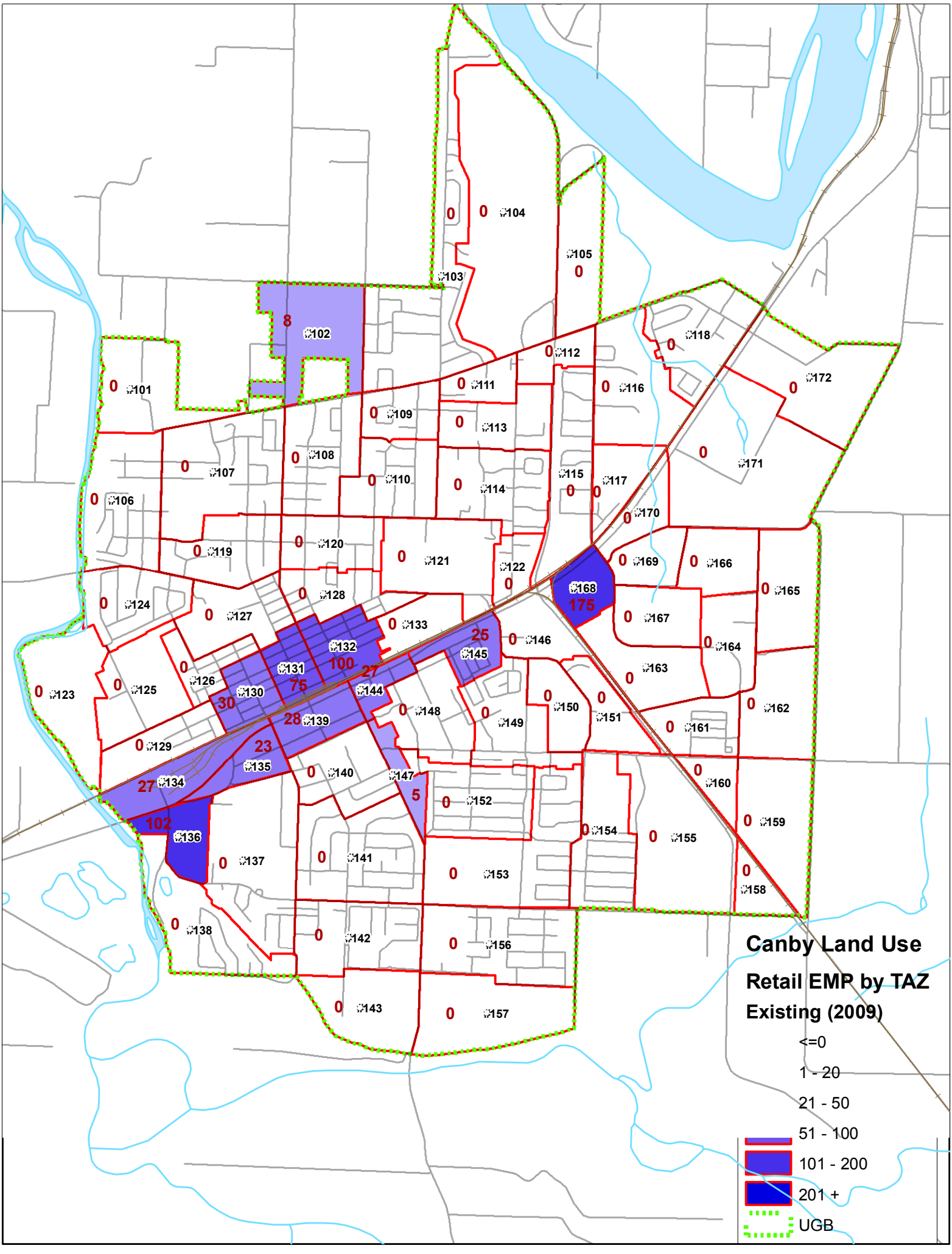
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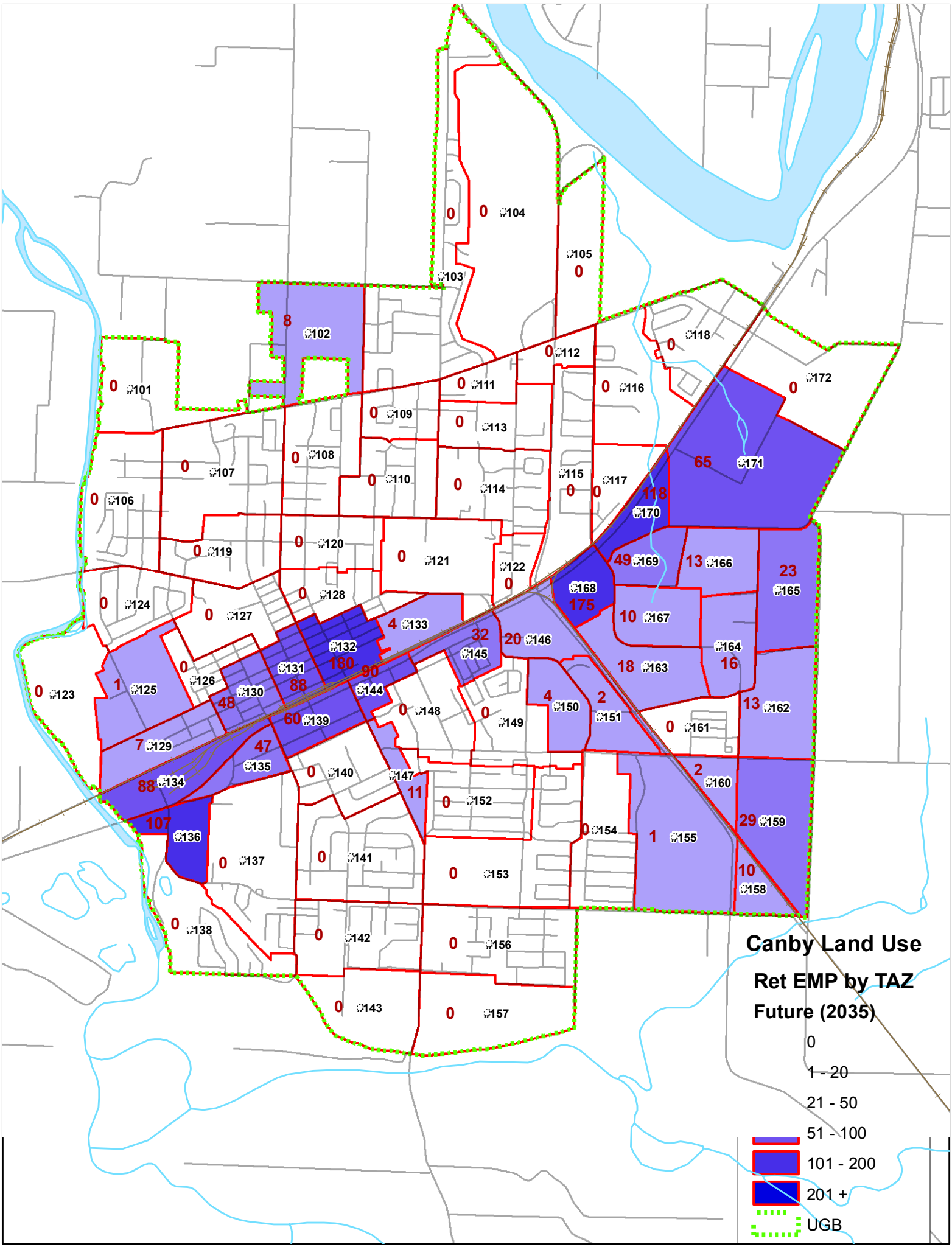
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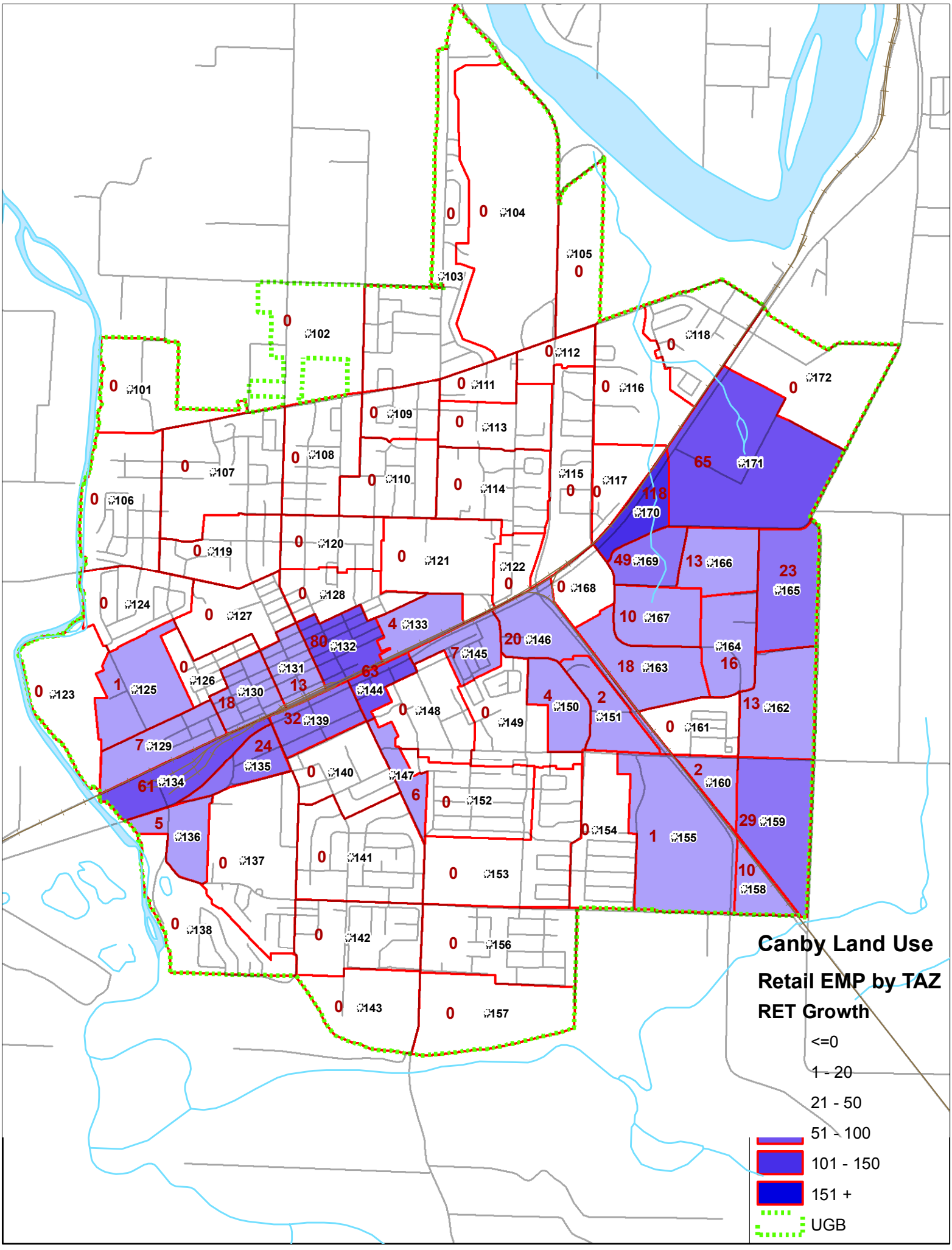
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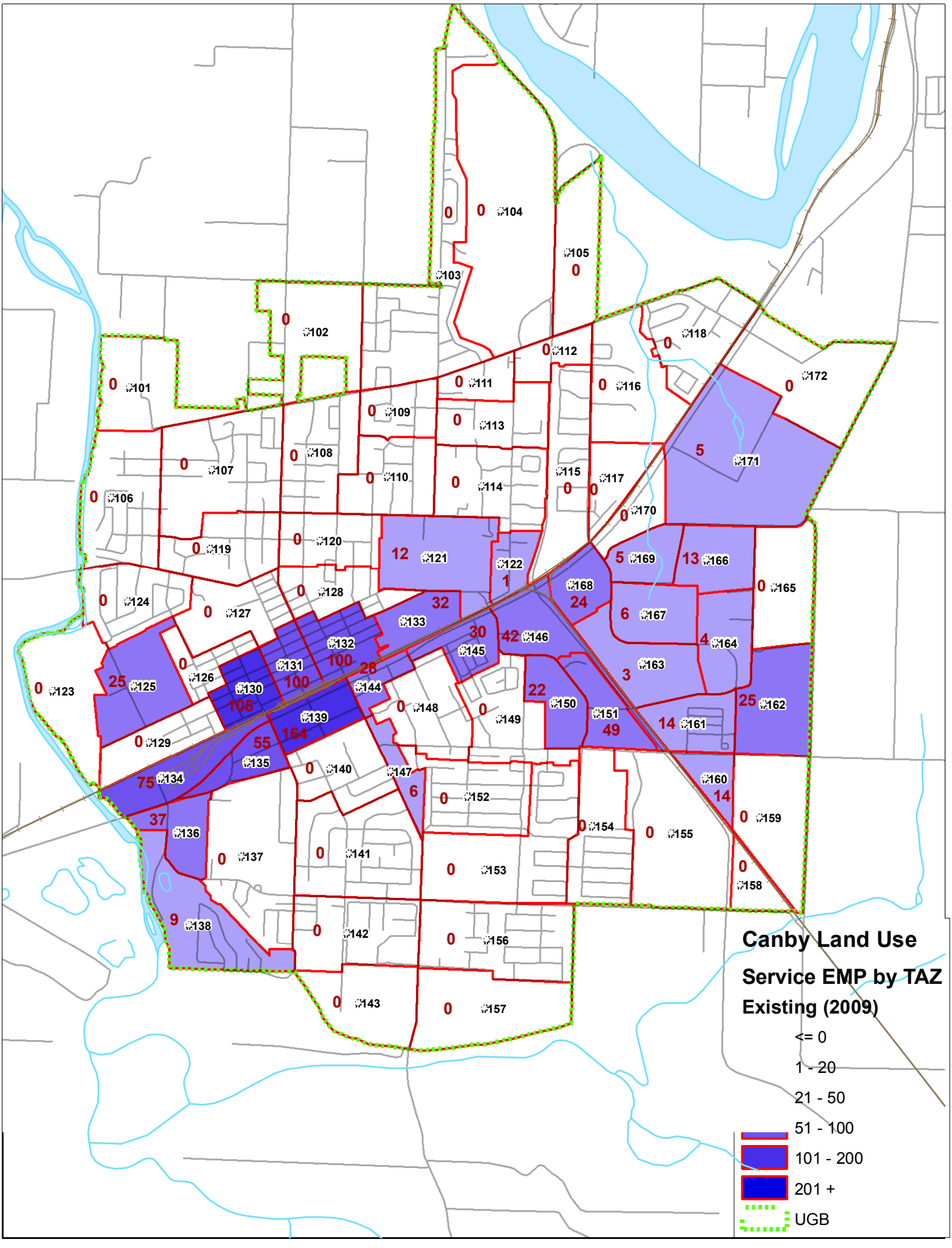
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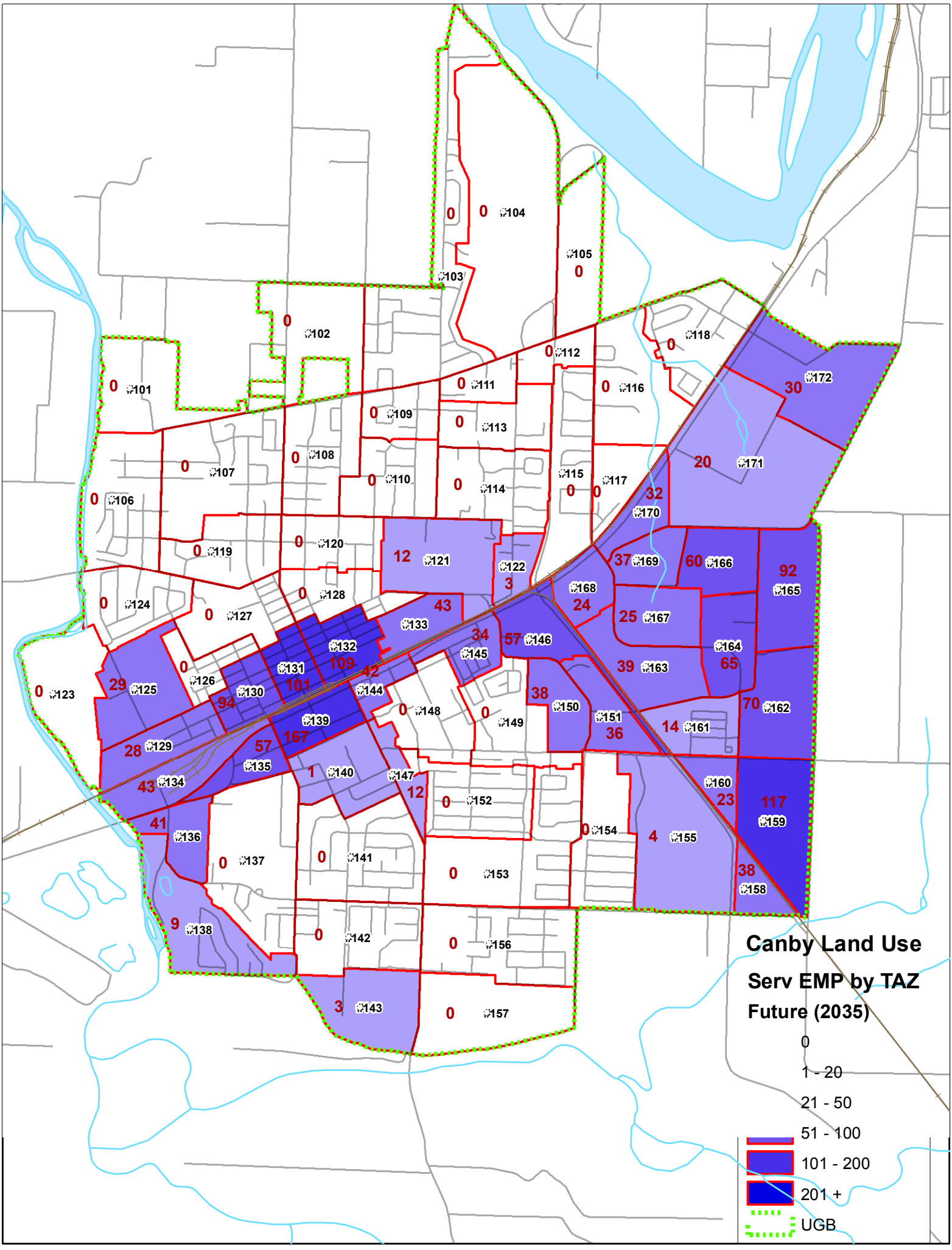
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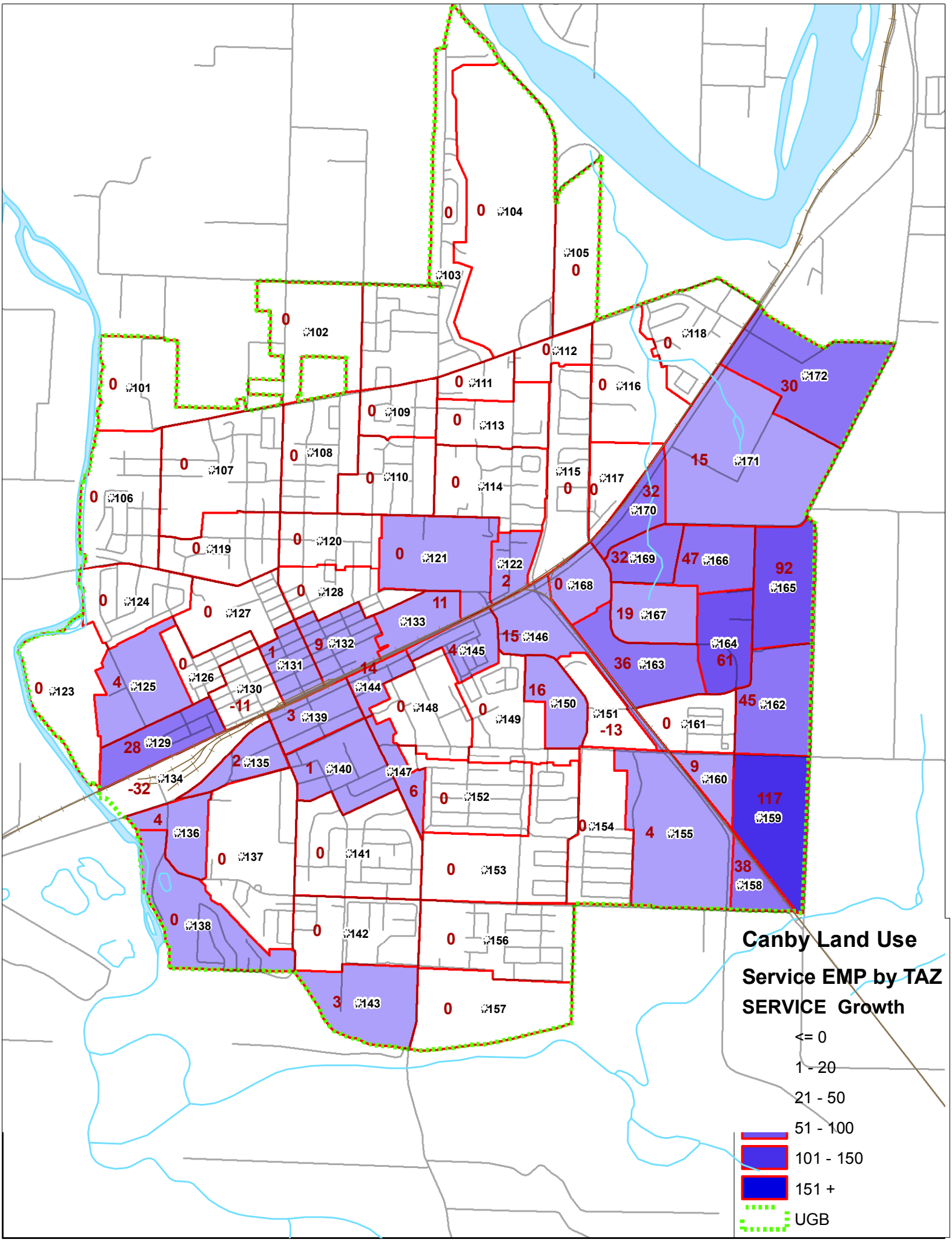
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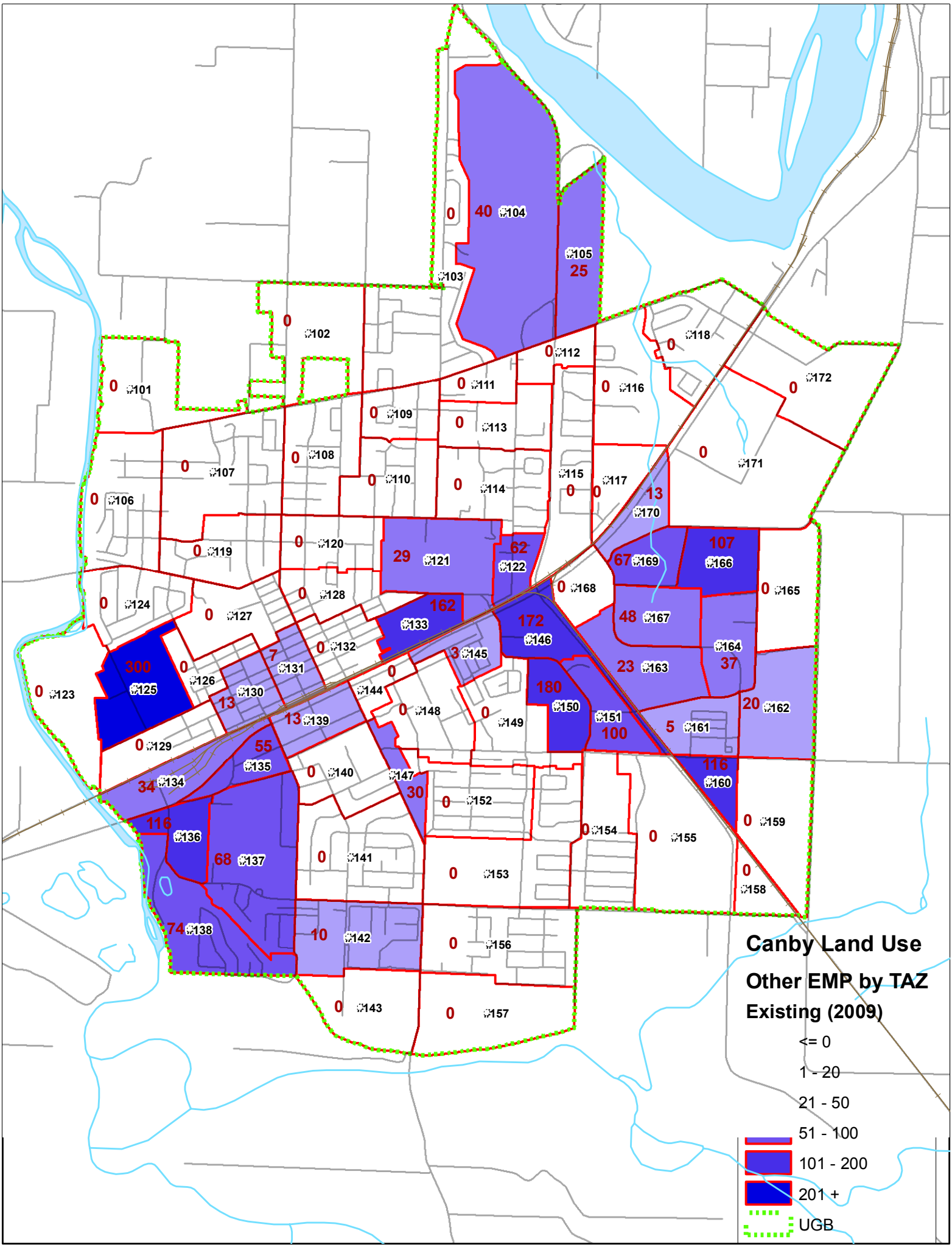
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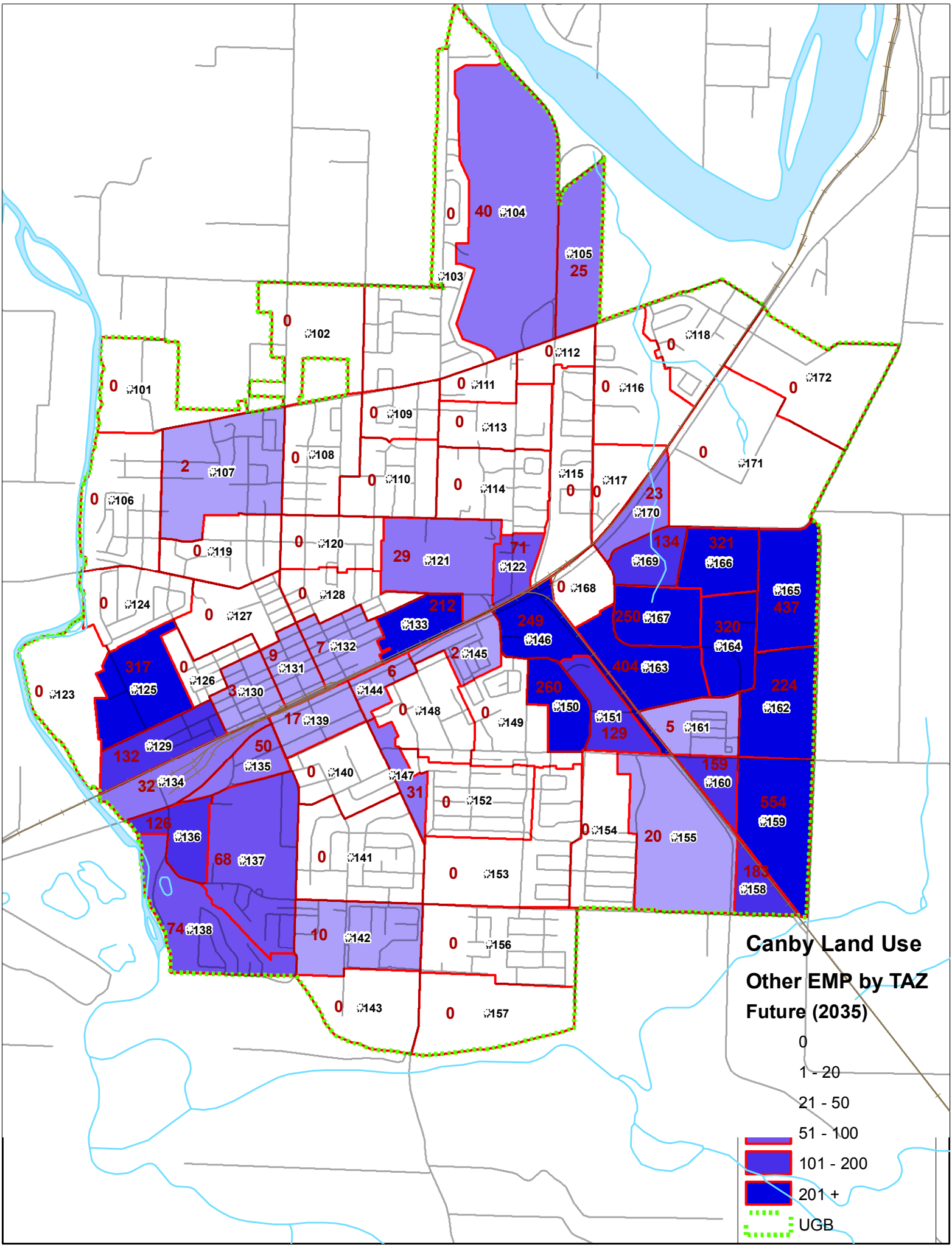
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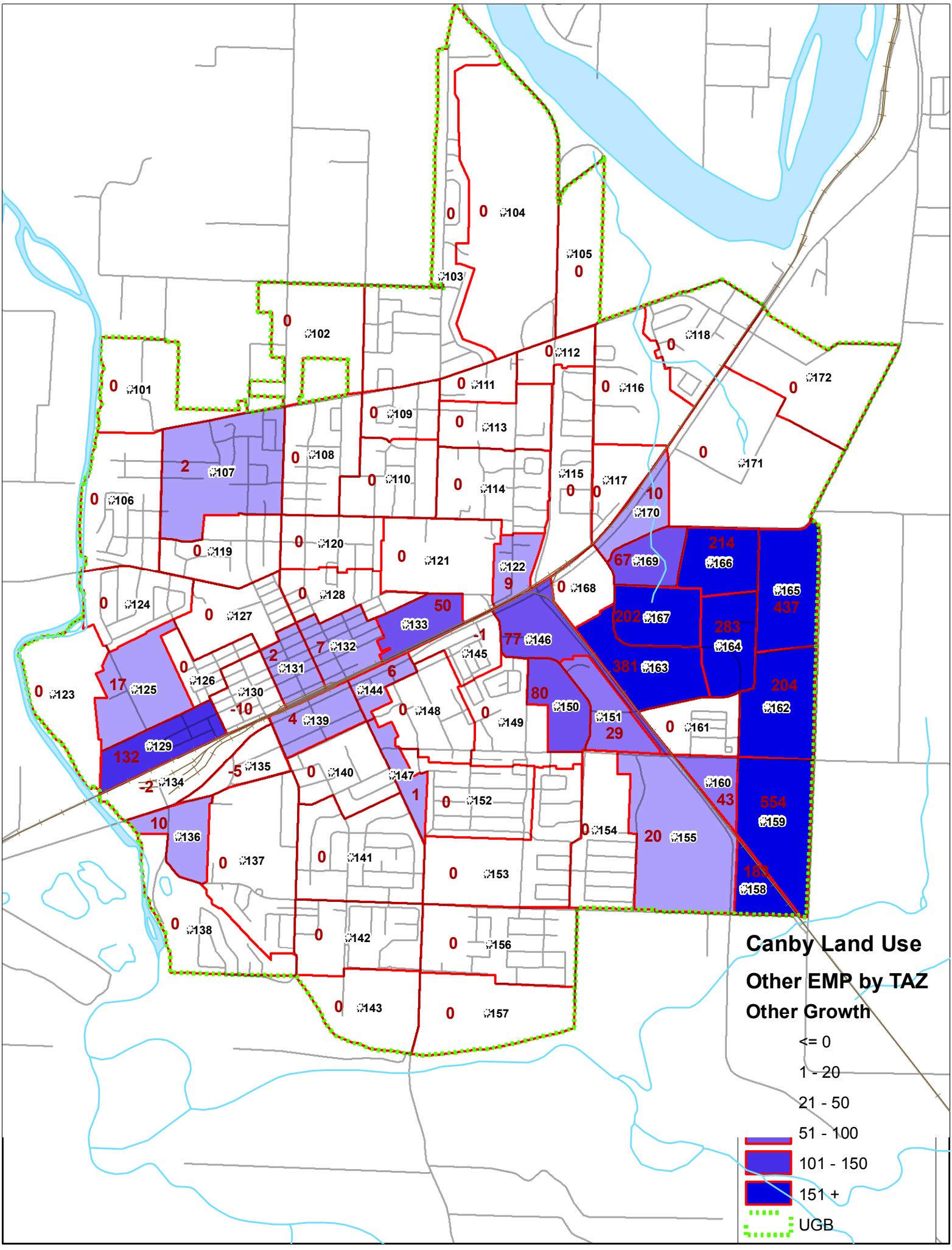
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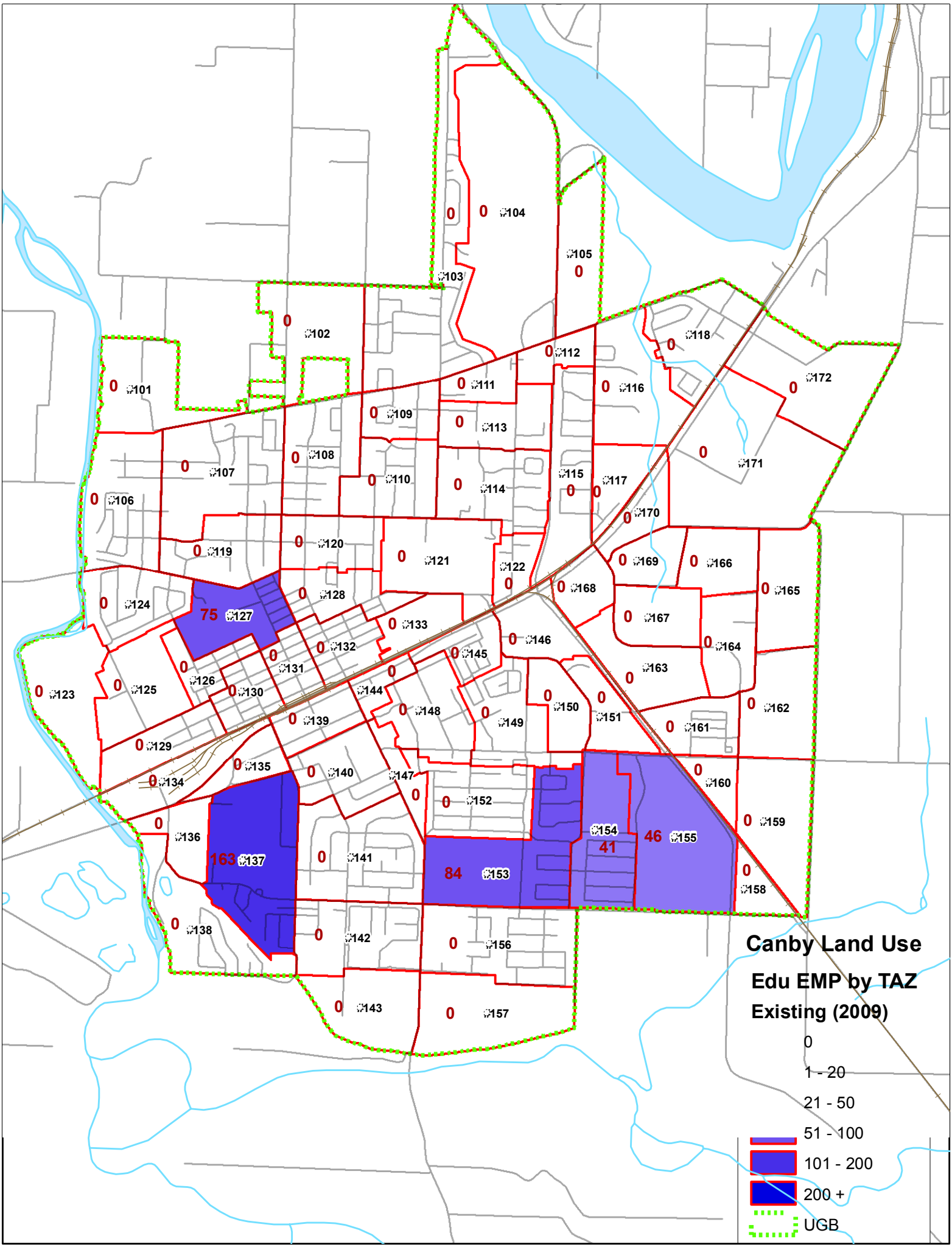
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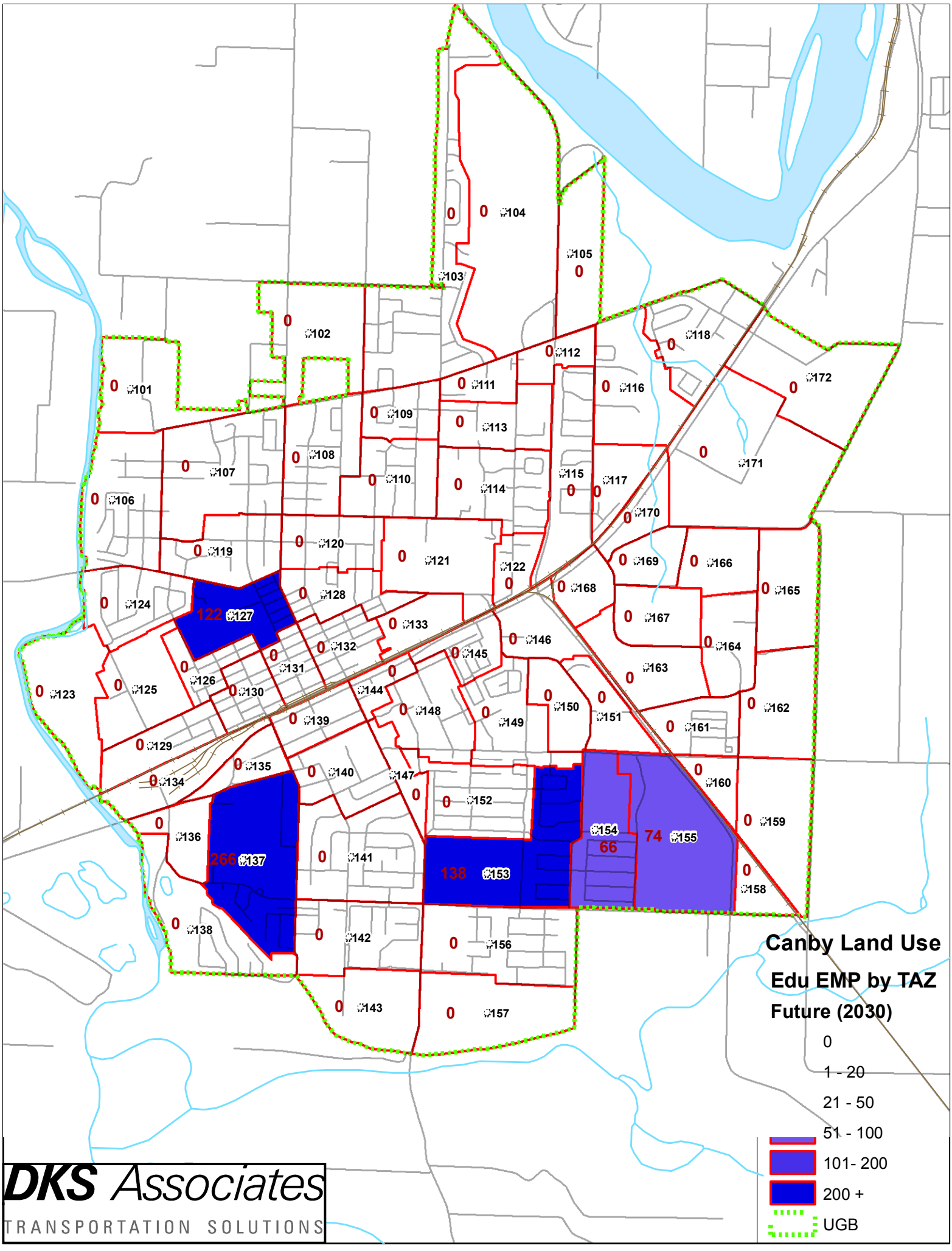
Canby Land Use
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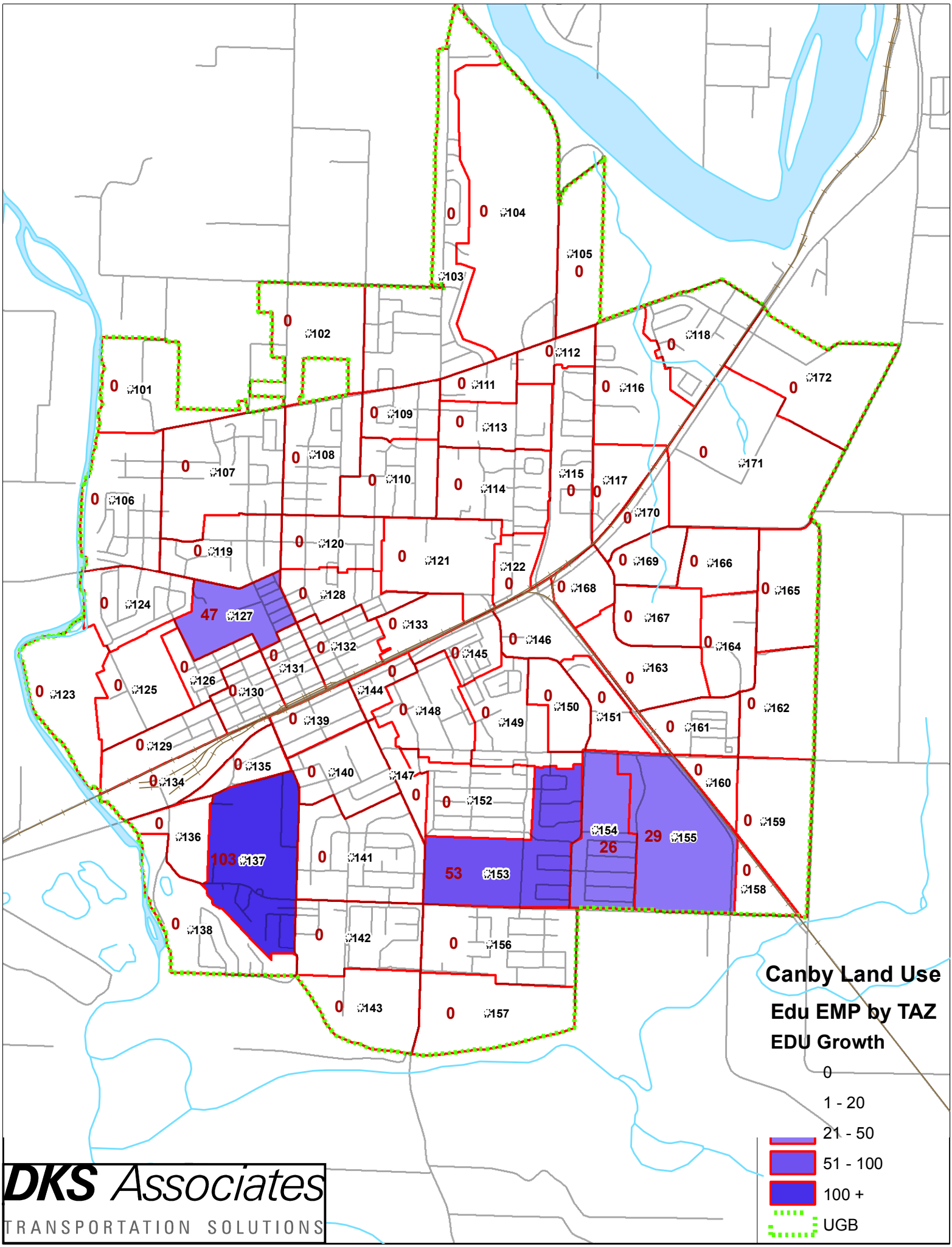
TRANSPORTATION SOLUTIONS


Canby Land Use
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TRANSPORTATION SOLUTIONS

Vacant Land Use Assumptions

Sisters Example - Units per Acre

Zone	HH	RET	SERV	OTH
C	0	6	1	2
CH	0	6	3	1
LI	0	2	2	5
LM	0	0	0	0
PF	0	0	0	0
R	5	0	0	0
R-MFSD	15	1.5	0.5	1
UAR	10	1.5	0.5	1

Canby Assumptions Units per Acre

Zone	HH	RET	SERV	OTH
AG	0.2	0	0	0.2
DC	5	11	3	1
FL	0	0	0	0
HC	5	11	3	1
HDR	15	0	0	0
HI	0	0.5	1	10.5
LDR	5.5	0	0	0
LI	0	0.5	2	9.5
MC	0	5	2	1
MDR	6	0	0	0
P	0	0	0	0
PR	0	0	0	0
RC	6	0.5	4	0.5

TAZ	HH_EX	RET_EX	SERV_EX	OTH_EX	EDU_EX	HH_Fut	RET_Fut	SERV_Fut	OTH_Fut	EDU_Fut
101	26	0	0	0	0	170	0	0	0	0
102	9	8	0	0	0	256	8	0	0	0
103	295	0	0	0	0	412	0	0	0	0
104	68	0	0	40	0	163	0	0	40	0
105	0	0	0	25	0	0	0	0	25	0
106	149	0	0	0	0	194	0	0	0	0
107	175	0	0	0	0	276	0	0	2	0
108	162	0	0	0	0	185	0	0	0	0
109	163	0	0	0	0	169	0	0	0	0
110	131	0	0	0	0	136	0	0	0	0
111	70	0	0	0	0	114	0	0	0	0
112	109	0	0	0	0	171	0	0	0	0
113	66	0	0	0	0	176	0	0	0	0
114	164	0	0	0	0	171	0	0	0	0
115	140	0	0	0	0	178	0	0	0	0
116	85	0	0	0	0	202	0	0	0	0
117	63	0	0	0	0	145	0	0	0	0
118	124	0	0	0	0	166	0	0	0	0
119	121	0	0	0	0	151	0	0	0	0
120	105	0	0	0	0	109	0	0	0	0
121	45	0	12	29	0	58	0	12	29	0
122	214	0	1	62	0	252	0	3	71	0
123	0	0	0	0	0	0	0	0	0	0
124	134	0	0	0	0	136	0	0	0	0
125	1	0	25	300	0	1	1	29	317	0
126	133	0	0	0	0	145	0	0	0	0
127	213	0	0	0	75	238	0	0	0	122
128	193	0	0	0	0	228	0	0	0	0
129	111	0	0	0	0	180	7	28	132	0
130	75	30	105	13	0	79	48	94	3	0
131	43	75	100	7	0	40	88	101	9	0
132	38	100	100	0	0	72	180	109	7	0
133	1	0	32	162	0	0	4	43	212	0
134	0	27	75	34	0	0	88	43	32	0
135	3	23	55	55	0	5	47	57	50	0
136	0	102	37	116	0	2	107	41	126	0
137	131	0	0	68	163	145	0	0	68	266
138	120	0	9	74	0	119	0	9	74	0
139	37	28	164	13	0	54	60	167	17	0
140	179	0	0	0	0	185	0	1	0	0
141	295	0	0	0	0	297	0	0	0	0
142	239	0	0	10	0	288	0	0	10	0
143	9	0	0	0	0	213	0	3	0	0
144	15	27	28	0	0	44	90	42	6	0
145	50	25	30	3	0	62	32	34	2	0
146	0	0	42	172	0	0	20	57	249	0
147	27	5	6	30	0	33	11	12	31	0
148	419	0	0	0	0	462	0	0	0	0
149	300	0	0	0	0	305	0	0	0	0
150	0	0	22	180	0	0	4	38	260	0
151	0	0	49	100	0	0	2	36	129	0
152	244	0	0	0	0	244	0	0	0	0
153	226	0	0	0	85	227	0	0	0	138
154	144	0	0	0	41	266	0	0	0	66
155	6	0	0	0	46	397	1	4	20	74
156	193	0	0	0	0	293	0	0	0	0
157	2	0	0	0	0	411	0	0	0	0
158	1	0	0	0	0	1	10	38	183	0
159	1	0	0	0	0	0	29	117	554	0
160	0	0	14	116	0	0	2	23	159	0
161	0	0	14	5	0	0	0	14	5	0
162	4	0	25	20	0	4	13	70	224	0
163	0	0	3	23	0	0	18	39	404	0
164	2	0	4	37	0	0	16	65	320	0
165	4	0	0	0	0	2	23	92	437	0
166	1	0	13	107	0	0	13	60	321	0
167	0	0	6	48	0	0	10	25	250	0
168	0	175	24	0	0	0	175	24	0	0
169	0	0	5	67	0	0	49	37	134	0
170	0	0	0	13	0	536	118	32	23	0
171	26	0	5	0	0	730	65	20	0	0
172	23	0	0	0	0	232	0	30	0	0
TOTAL	**6,127**	**624**	**1,004**	**1,928**	**409**	**10,530**	**1,339**	**1,648**	**4,935**	**666**

Metro Model Volume Projections
PM Peak 2 Hour Model Volumes

	Metro Model (2 hr)			Existing	Projected
Road	**2005**	**2030**	**Annual Growth (compounded)**	**2009**	**2030**
99E West	1965	3736	3.3%	1158	2274
99E East	3284	4745	1.9%	1904	2802
Township	233	522	4.1%	261	496
Mulino	153	189	1.1%	174	330
Ivy	704	810	0.7%	593	778
Barlow	257	320	1.1%	436	549
Arndt	1977	2845	1.8%	1375	2015
Combined Twsp/Mul	386	711	3.1%	-	-