



**New York
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Council**

The Metropolitan Planning Organization

*Transportation Models
and Data Initiative*

Technical Memorandum

Tasks 11.4

Development of Best Practice Regional Zone System

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The findings of this study are unique to the New York metropolitan region and do not have widespread applicability. However, the techniques developed in this project and documented in this report could be useful for similar travel demand modeling projects in other areas.

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Task 11.4 Development of the Best Practice Model Zones

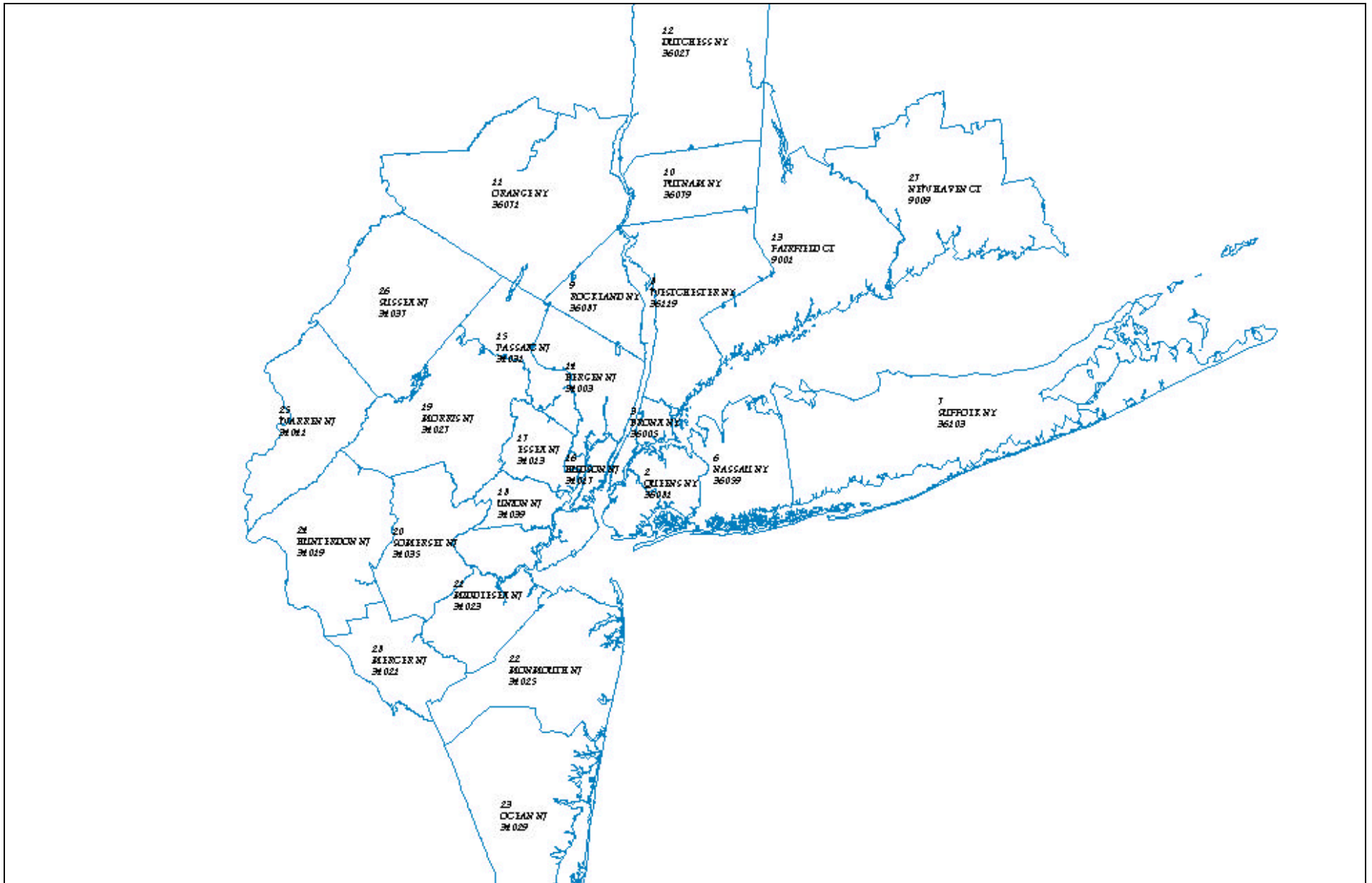
1. OVERVIEW OF THE NYMTC REGIONAL BEST PRACTICE ZONE SYSTEM

The need and basis for the BPM Transportation Analysis Zone (TAZ's) system was established in *Technical Memorandum 1.2.2 – Final Model Structure and Framework*. The requirements of the zone system to support the BPM, as well as the approach to its development were specified in that report.

The a new Phase 2 Best Practice Model (BPM) zone system has been defined for the entire 27 county – three state region to be modeled in Phase 2 of the NYMTC project as shown in **Exhibit 1**. Additionally, MCD-based zones for Mercer County, in New Jersey, while outside of the BPM area, were defined for survey reporting and analysis.

The basic characteristics of the Phase 2 BPM zone system are:

- While aggregate representations of locations of individual households, employers and other activities, the zones should be small enough to provide for good estimates of highway and transit travel times and costs for individual trips used to estimate the models, but
- The total number of zones used for regional modeling, however, should not be excessive. Computational resources needed in application of the model (disk storage and processing time), for the many large matrices used in the model, increases exponentially with the number of zones. A budget of no more than 3,500 was established for zones in the base case regional model. A reserve of 500 “floating” zones is planned to allow subdivision of base case zones to detail a subregion for corridor, MIS, or sub-area studies.
- Correspond as much as possible to the “holes” in the BPM highway network, where the lowest level of roadway are typically minor arterials for the “loading” of vehicular traffic so that established criteria for highway assignment will be met – good volumes on major arterials and higher level roadways.
- In contrast to the Phase 1 IAM model that used separate zone structures for the highway and transit steps, a single integrated zone system, for both highway and transit is needed for the BPM.
- The zone system should be based on Census geography, no smaller than tracts, unless there are compelling reasons to use block-group boundaries (only in parts of Manhattan). In addition to ensuring data availability, a tract-based system will be most compatible with other planning zone systems in use in the region. There are more than 5,000 tracts in the tri-state region represented in the BPM.



2. BPM ZONE DEVELOPMENT PROCESS

As shown in the Exhibit a target number of zones was established for each county, allocating the total regional budget of 3,500 zones, initially according to consideration of a uniform range of tracts per zones – Manhattan (.93), other New York City (1.2), and suburban New York (1.4). This yielded a target number of zones that could be added to the number Phase 1 zones in each county, nearly doubling the average number of zones in the New York counties for the BPM.

The project team developed the new BPM zone system based on the principles described above, using these initial “budgets, and the Stage 1 BPM highway network. Conflated to underlying streets (LION in New York City, TIGER elsewhere), the NYMTC regional highway network database contains virtually all roads that are minor arterials or higher.

Based on an initial “budget” of 3,500 BPM TAZ’s, “targets” were established for the optimal number of zones in each county, with reasonably uniform ratios of Census tracts to zones consideration of creating zones that were in most cases, smaller, but not larger than Phase 1 (IAM) zones. The initial county target number of zones that were used to begin the agency review and project team editing process described below, are shown in **Exhibit 2**.

In each county, detailed plots of this network, color coded by Functional Class were created, with Census tracts and the Phase 1 zone boundaries displayed. Transit rail lines and stations were also shown. The 1990 Census estimates of households and job (workplaces) were posted in each tract.

Using the information on the plots, a decision was made by the project team staff on a case-by-case basis whether each Phase 1 zone should be split into smaller zones to better “fit” the highway network and transit service catchment. Mostly, new zones were formed by the splitting of old zones along census tract boundaries that coincided with minor arterials (or in some cases major collectors), improving the congruence of the zones with the transportation networks. In a few instances, the boundary of a Phase 1 zone was moved for similar reasons, or old zones were combined. In Manhattan, census tracts were subdivided along block groups for select zones in Midtown (very high employment per zone), and in the Upper West Side, to better separate subway service areas.

The BPM zone system for New Jersey, was developed after consultation with New Jersey Transit and North Jersey Transportation Planning Authority staff planners to insure consistency with transportation analysis zones used in the northern New Jersey portion of the NYTMC models area. The project team implemented the approach recommended by NJ Transit, which is comprised of Minor Civil Division (MCD) zones in all counties other than the most urban – Essex and Hudson, for which both single tracts define BPM zones. The relatively large number of MCD’s in Bergen County was deemed sufficient to comprise the BPM zones for that county.

The result of this process is a new zone system that has been defined for the entire 27 county NYMTC Modeled Area. Additionally, MCD-based zones for Mercer County, in New Jersey, while outside of the BPM area, were defined for survey reporting and analysis. The final zone system is summarized at a county level in **Exhibit 3**.

Detail maps of the zones, keyed to counties and subregions , can be found in **Appendix A**.

Exhibit 2: Development of Best Practice Zone System- Initial Budget Targets

ID-County	Tracts per BPM(1)		Initial BPM Added		Adjust-ments	Revised BPM Tracts		Final BPZ: 7/4/99
	TAZ	IAM TAZ's	TAZ Budget	to IAM TAZ's		TAZ Budget	per BPM(2) TAZ	
1-New York	0.93	198	320	122		320	0.93	318
2-Queens	1.20	219	561	342	-48	513	1.31	434
3-Bronx,NJ	1.20	131	296	165	-28	268	1.32	273
4-Kings	1.20	242	658	416	-54	604	1.31	513
5-Richmond	1.20	41	84	43	-8	76	1.32	84
6-Nassau	1.21	174	223	49	-16	207	1.31	238
7-Suffolk	1.21	140	257	117	-30	227	1.37	236
8-Westchester	1.39	109	159	50		159	1.39	169
9-Rockland	1.39	31	30	-1	1	31	1.35	38
10-Putnam	1.39	7	14	7		14	1.39	14
11-Orange	1.39	67	48	-19	19	67	1.00	66
12-Dutchess	1.39	68	49	-19	19	68	1.00	66
13.1-Fairfield, CT	1.33	213	161	-52		161	1.33	213
13.2-New Haven, CT	1.33		139	139		139	1.33	184
14-Bergen,NJ	3.00	154	70	-84	84	154	1.36	70
15-Passaic,NJ	3.00	16	31	15		31	3.00	16
16-Hudson,NJ	3.00	123	54	-69	69	123	1.31	158
17-Essex,NJ	3.00	41	75	34		75	3.00	218
18-Union,NJ	3.00	21	35	14		35	3.00	21
19-Morris,NJ	3.00	35	30	-5	5	35	2.54	39
20-Somerset,NJ	3.00	19	20	1		20	3.00	21
21-Middlesex,NJ	3.00	27	59	32		59	3.00	25
22-Monmouth	3.00	24	49	25		49	3.00	53
23-Ocean,NJ	3.00	5	29	24		29	3.00	33
24-Hunterdon	3.00	1	7	6		7	3.00	26
25-Mercer,NJ	3.00	8	21	13	-13	8	7.90	
26-Warren,NJ	3.00	1	8	7		8	3.00	23
27-Sussex,NJ	3.00	1	14	13		14	3.00	24
Total: Region		2116	3500	1384	0	3,500		2741

New York portion of the region with nearly 2,500 BPM-TAZ's defined, averaging about 1,750 households, and 2,300 jobs (census workplace-based) per zone. As shown in the table, about one-third of the BP zones are in Connecticut (213) or New Jersey (476).

Exhibit 3: Summary of Final Best Practice Zone System

Census FIPS	ID-County	IAM TAZ's	Best Practice Model Zones								
		# of Zones	# of BPZ(3) TAZ's (7/4/99)	Tracts per BPM TAZ	House-holds: 1990	HHS per BPM(3) TAZ	Index	Employ-ment: 1990	Jobs per BPM(3) TAZ	Index	
36061	1-New York	198	318	0.93	716,811	2,233	1.13	2,064,349	6,431	2.65	
36081	2-Queens	219	434	1.56	718,377	1,663	0.84	584,435	1,353	0.60	
36005	3-Bronx,NJ	131	273	1.30	423,191	1,550	0.78	293,330	1,074	0.47	
36047	4-Kings	242	513	1.54	827,679	1,613	0.81	643,075	1,254	0.55	
36085	5-Richmond	41	84	1.20	130,216	1,550	0.78	100,937	1,202	0.53	
36059	6-Nassau	174	238	1.13	431,148	1,812	0.91	572,670	2,406	1.06	
36103	7-Suffolk	140	236	1.33	424,623	1,815	0.91	526,315	2,249	0.99	
36119	8-Westchester	109	169	1.31	319,657	1,903	0.96	411,336	2,448	1.08	
36087	9-Rockland	31	38	1.11	84,891	2,234	1.13	100,009	2,632	1.16	
36079	10-Putnam	7	14	1.36	27,983	1,999	1.01	19,432	1,388	0.61	
36071	11-Orange	67	66	0.99	101,730	1,496	0.75	113,964	1,676	0.74	
36027	12-Dutchess	68	66	1.03	89,627	1,358	0.68	119,956	1,818	0.80	
9001	13-Fairfield, CT	213	213	1.00	305,167	1,433	0.72	431,242	2,025	0.89	
9009	27-New Haven, CT		184	1.00	304,169	1,644	0.83	-	-	0.00	
34003	14-Bergen,NJ	154	70	3.00	308,795	4,411	2.22	422,861	6,041	2.67	
34031	15-Passaic,NJ	16	16	5.81	155,450	9,716	4.90	188,012	11,751	5.19	
34017	16-Hudson,NJ	123	158	1.00	208,574	1,295	0.65	190,022	1,180	0.52	
34013	17-Essex,NJ	41	218	1.00	277,667	1,234	0.62	371,726	1,652	0.73	
34039	18-Union,NJ	21	21	4.95	179,966	8,570	4.32	234,276	11,156	4.92	
34027	19-Morris,NJ	35	39	2.28	148,627	3,811	1.92	245,876	6,305	2.78	
34035	20-Somerset,NJ	19	21	2.81	88,819	4,229	2.13	133,249	6,345	2.80	
34023	21-Middlesex,NJ	27	25	7.08	238,974	9,559	4.82	341,206	13,648	6.02	
34025	22-Monmouth	24	53	2.77	197,325	3,723	1.88	228,332	4,308	1.90	
34029	23-Ocean,NJ	5	33	2.64	168,312	5,100	2.57	118,423	3,589	1.58	
34019	24-Hunterdon	1	26	0.85	38,152	1,467	0.74	40,017	1,539	0.68	
34041	25-Warren,NJ	1	23	1.04	33,876	1,473	0.74	24,376	1,060	0.47	
34037	26-Sussex,NJ	1	24	1.71	44,492	1,854	0.93	33,648	1,402	0.62	
36	New York / 12 Cos.	1427	2,449	1.31	4,295,933	1,754	0.88	5,549,808	2,266	0.93	
34	Connecticut / 2 Cos.	213	397	1.00	609,336	1,531	0.77	431,242	1,084	0.45	
09	New Jersey / 13 Cos.	476	727	2.04	2,205,806	2,993	1.51	2,727,668	3,701	1.52	
	Total NYTMC Modeled Area - 27 Counties	2116	3,573	1.43	7,111,075	1,984	1.00	8,708,718	2,430	1.00	

3. ZONE TYPES

The Best Practice Model Zones (BPZ') are classified in two manners:

- Based on their underlying Census Geography – Tracts or MCD's
- Relative to the geographic units by which the NYTMC Project small area socioeconomic, demographic and land used data has been developed (in Track 8)

Census Geography Basis

For New York counties, all BPZ's are based on Census tracts – either single tracts or combined tracts. The exception is Manhattan (New York County), where some BPZ's as described previously have been formed by splitting of tracts – in Lower Manhattan and on the Upper Westside. Most BPZ's in Manhattan are single tracts, with only a few where two tracts have been combined.

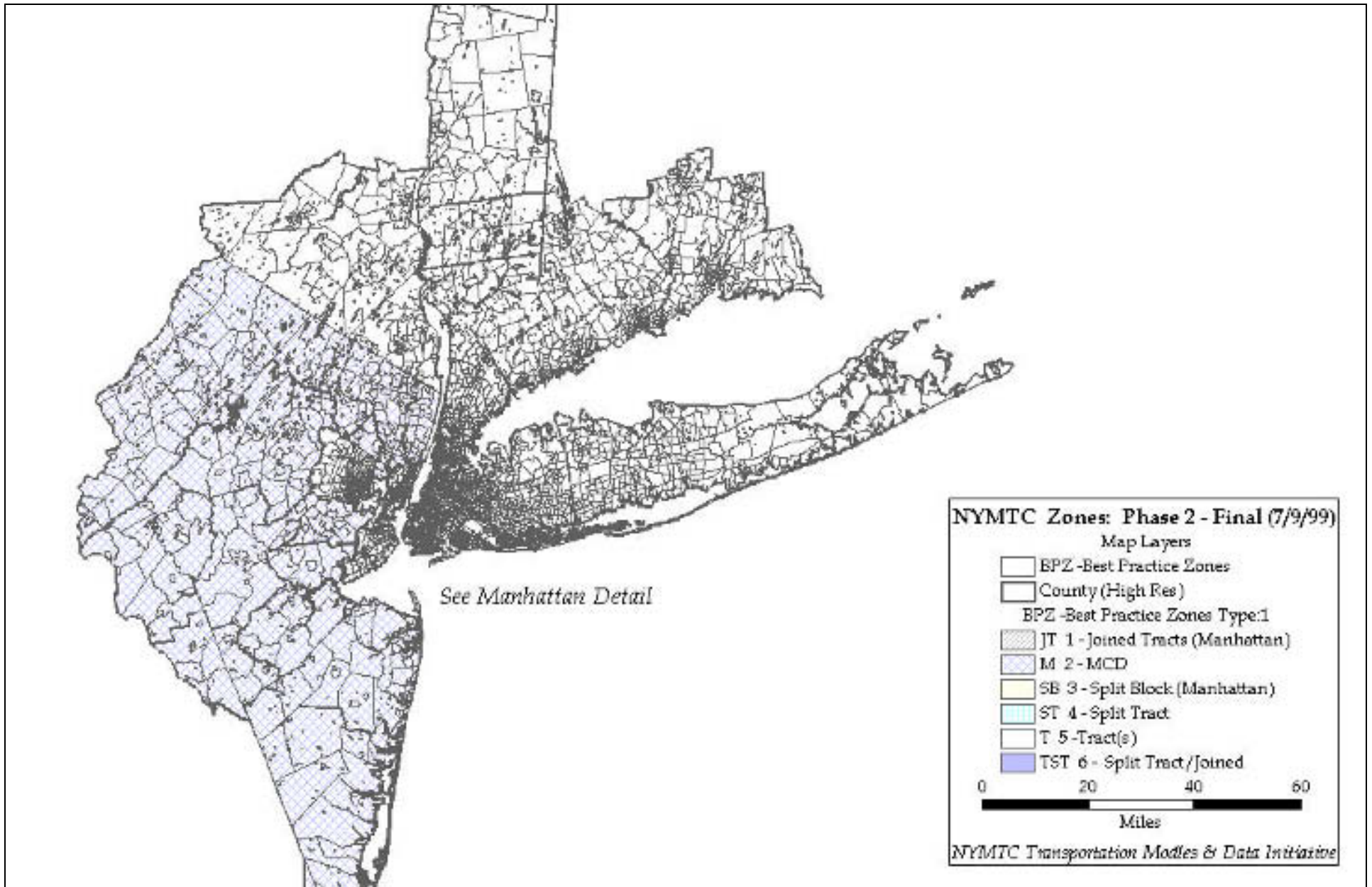
Similarly, the BPZ's for the two Connecticut counties (Fairfield and New Haven) in the NYMTC model area, are also tract-based

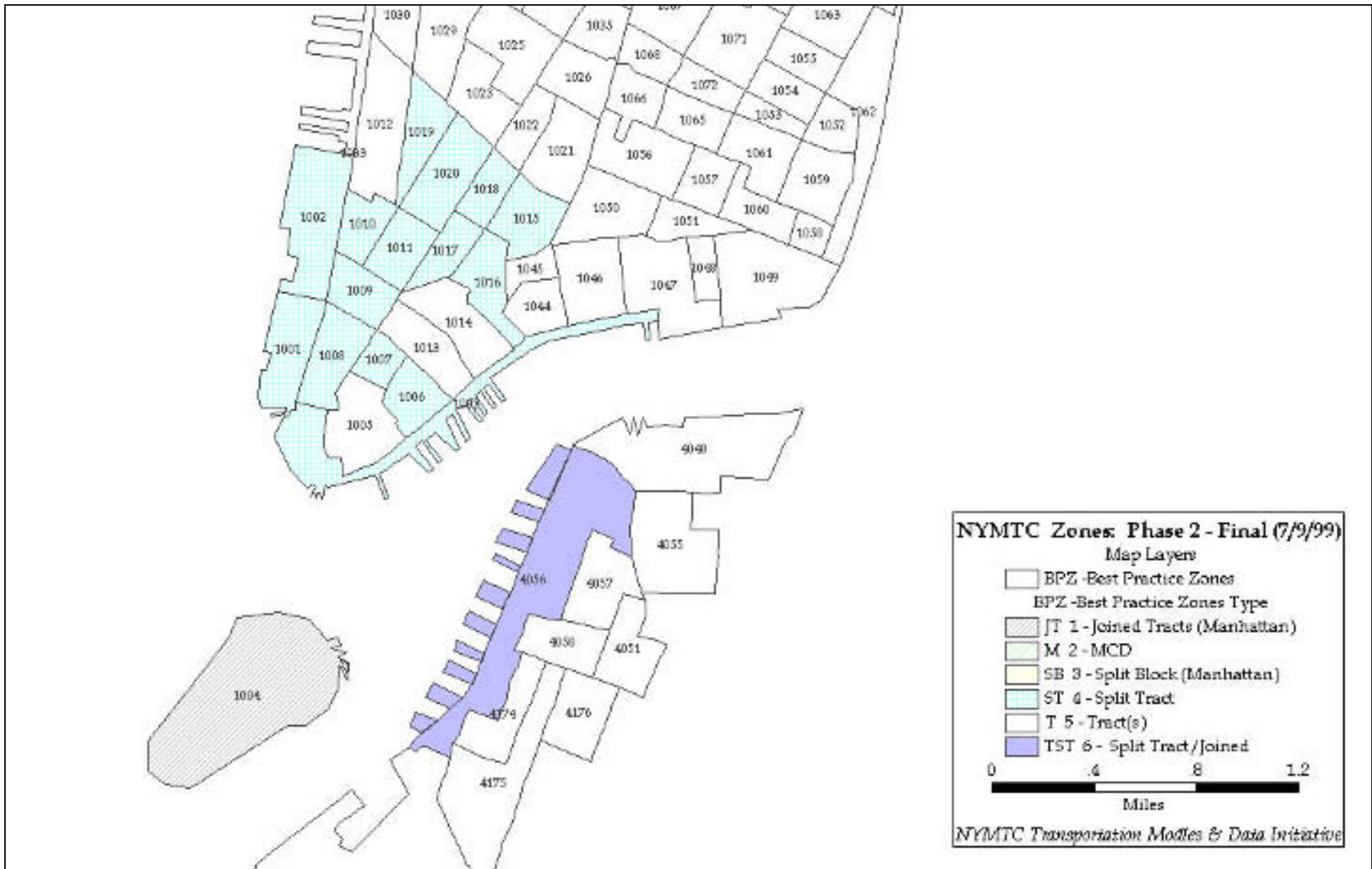
Label	Description
Tract	Tract-Based (1 or more)
SplitTract	Zone based on a tract split along Block-groups boundaries
SpltBlock	Zone based on a tract split along Block boundaries
JoinedTract	Joined Tract (Manhattan)
MCD-T	Minor Civil Division - One per zone; Congruent with Tract(s)
MCD-NT	Minor Civil Division - One per zone; Not Congruent with Tract(s)
JT-ST	Joined Tract (Kings) with portion of Split Tract (1 case)

The BPM zone system for New Jersey is comprised of Minor Civil Division (MCD) zones in all counties other than the most urban – Essex and Hudson, for which both single tracts define BPM zones.

Exhibits 4-1, 4-2 and 4-3 provide maps that show the BPM zones based on their underlying Census geography.

Exhibit 5 is a table that summarizes the BPM geography type by county.





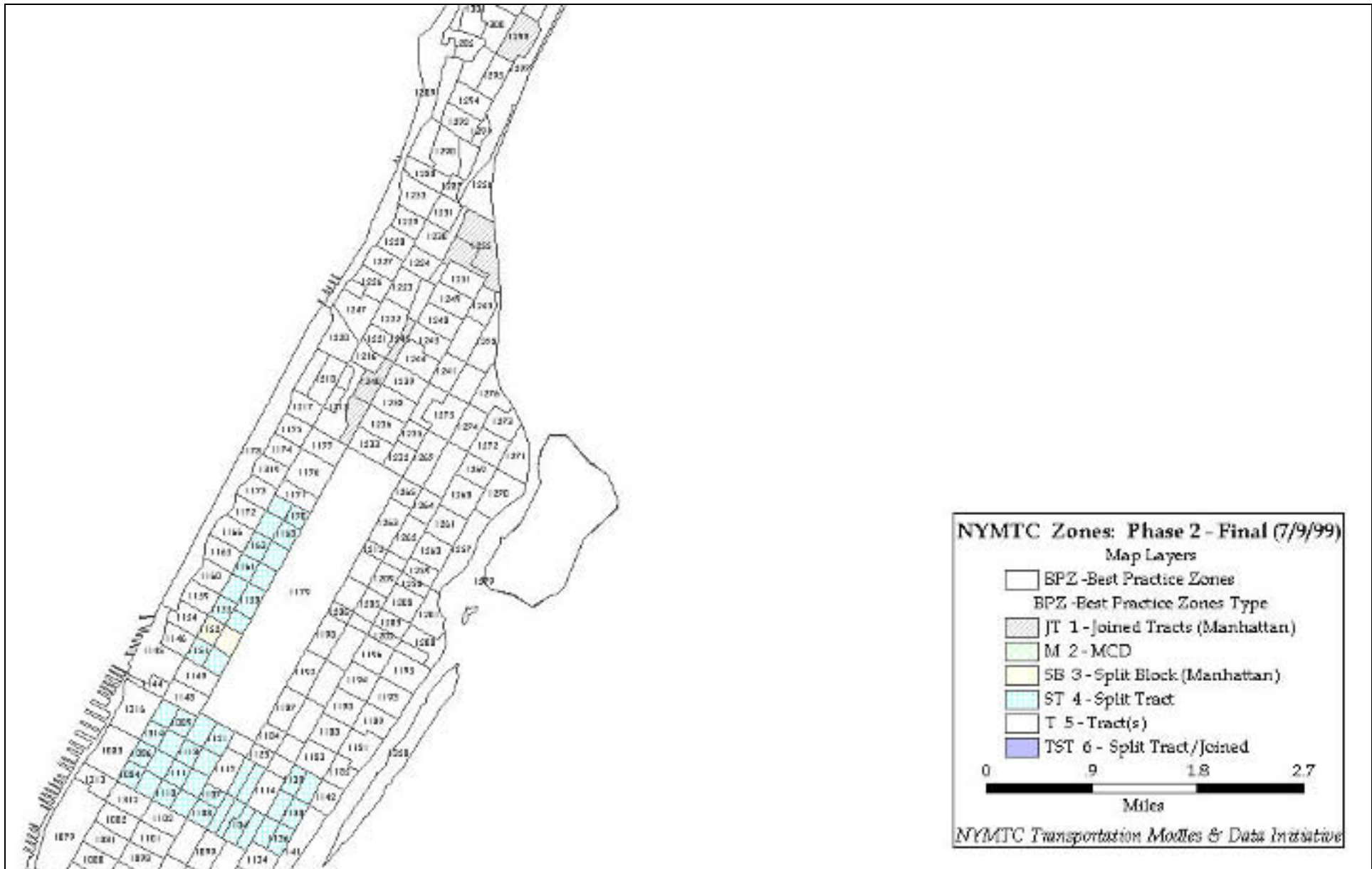


Exhibit 5: BPM Zone Types - Relationship to Census Geography

NYMTC County ID	County Name	1) Joined Tracts - Manhattan	2) Minor Civil Division (MCD)	3) Split Block Group - Man-hattan	4) Split Tract - Man-hattan	5) Tract - Single or Grouped	6) Split Tract - Kings	Grand Total
1	1-New York	7		2	59	250		318
2	2-Queens					434		434
3	3-Bronx,NJ					273		273
4	4-Kings					512	1	513
5	5-Richmond					84		84
6	6-Nassau					238		238
7	7-Suffolk					236		236
8	8-Westchester					169		169
9	9-Rockland					38		38
10	10-Putnam					14		14
11	11-Orange					66		66
12	12-Dutchess					66		66
13	13-Fairfield, CT					213		213
14	14-Bergen,NJ		70					70
15	15-Passaic,NJ		16					16
16	16-Hudson,NJ					158		158
17	17-Essex,NJ					218		218
18	18-Union,NJ		21					21
19	19-Morris,NJ		39					39
20	20-Somerset,NJ		21					21
21	21-Middlesex,NJ		25					25
22	22-Monmouth		53					53
23	23-Ocean,NJ		33					33
24	24-Hunterdon		26					26
25	25-Warren,NJ		23					23
26	26-Sussex,NJ		24					24
27	27-New Haven, CT					184		184
28	28-Mercer,NJ *		13					13
Total Regional Area (with Mercer)		7	364	2	59	3153	1	3586
NYMTC Modeled Area - BPM		7	351	2	59	3153	1	3573

*** NOTE:**

Mercer County has been zoned for analysis and reporting purposes of the Household Interview Survey only. It will be treated as an external area for the NYMTC Best Practice 27 County Modeled Area.

Relation to Socioeconomic and Land Use Data Geographic Format

Small area socioeconomic, demographic and land use data developed in Track has been estimated or forecast based on either Census Tracts or MCD's. As a result, in order to transfer these data items to the BPM zonal files, a custom program has been developed that applies the appropriate aggregation or allocation method based on the "data type" for each zone.

Type 1: Tract-based

- ◆ All New York counties , except for some zones in Manhattan (see Type 3)
- ◆ Hudson County, NJ
- ◆ Newark, Essex County, NJ

Method of data transfer:

- Direct equivalency or aggregation from tract data:

Type 2: MCD-based

- ◆ All counties in New Jersey, except for Hudson, and City of Newark, Essex.

Method of data transfer:

Direct equivalency (one-to-one) MCD data

Type 3: Block-Group based: Allocated from Tract Data

- ◆ About 20 zones in Manhattan

Method of data transfer:

Allocate each tract value to constituent BPZ's based on appropriate CTPP: Tract-to-Block Group allocation factor for each data item; either

- Workplace-related, or
- Residence-based

Type 4: Tract-based: Data allocated from MCD

- ◆ Essex County - remainder (not City of Newark)
- ◆ Connecticut: Fairfield and New Haven

Method of data transfer:

Allocate each MCD value to constituent BPZ's based on appropriate CTPP: MCD-to-Tract allocation factor for each data item; either

- Workplace-related, or
- Residence-based

4. ZONE SYSTEM DATA

Geographic Information System (GIS) Formats

The Best Practice Zone system has been developed and used in TransCAD, as are the networks and model application procedures for the NYMTC Best Practice Model. The BP zones are maintained as a polygon GIS layer in TransCAD.

For the BPM transit and highway networks, the underlying GIS base for the zone system is TIGER for all parts of the regional area, except for New York City, where the NYCDCP's LION base map has been used for the foundation line layer. In all New York City boroughs but Manhattan, the TIGER and LION geography was found to be sufficiently similar for the displaying of zonal boundaries, that a decision was made to use TIGER as the as the "building" blocks for the BP zones except for Manhattan (an Island), where LION tract polygons were used.

BPM Zone Database Formats

The data structure and contents of the three principal files used to develop and maintain the BPM zone system are documented in **Exhibit 5-2, 5-2, and 5-3**.

The principal file described in **Exhibit 5-1**, is a database that is comprised of records each corresponding to a BP zone. This DBF (or Excel) file is the same as the "Dataview" database found in the TransCAD BP Zone geographic file.

Exhibit 5-2 shows the structure and contents of the Combined Geography file, where each record is the lowest-level Census geographic unit that defines a BP zone – either Tract or MCD. This file is directly used in the allocation of Track 8 socioeconomic and land use data to created zonal data files for use in the BPM.

While many BP zones in New Jersey are MCD based, the file shown in **Exhibit 5-3** is a tract level file, for which the BP Zone associated with that tract is identified. This file is useful when incorporating tract data into a BP zonal database.

Exhibit 6-1: Database Dictionary: BPM Zone Records

File	in TC file	BPZ90709
Record units		BPM Zones
Number of cases		3586 (including Mercer County)

Field		Description
ID	Yes	TransCAD ID
AREA	Yes	area in square miles (TransCAD)
DATA	Yes	TransCAD Data Field
TAZ_ID	Yes	Best Practice Model Zone ID (Final -07/09/99) - Network Centroid ID
BPZ3_ID	Yes	Best Practice Model Zone ID (Final - 07/09/99) - Standard ID / County-based.
REGION	Yes	1) NYC / NYSDOT Region 11 2) Nassau-Suffolk / NYSDOT Region 10 3) Mid-Hudson NY / NYSDOT Region 8 4) Fairfield-New Haven, CT 5) New Jersey
CountyCode	Yes	NYMTC Project: Standard County ID
TYPE	Yes	T) Tract-based (1 or more) ST) Split Tract (along BlockGroup bndry) / Manhattan only, JT) Joined Tracts / Manhattan only SB) Split BlockGroup - Manhattan only M) MCD Based (NJ other than Hudson and Essex county) one-to one. M2) MCD Based - one-to-one / not congruent w/ tracts. [see Zone Type sheet] JT-ST) Joined Tract (Kings) with portion of Split Tract (1 case)
TRACT1	Yes	Tract (FIPS name)
TRACT2	Yes	Tract (FIPS name) - other tract if Joined Tract type BPZ; listed for Manhattan only
MCD	Yes	Minor Civil Division FIPS id (if MCD-based type BPZ)
BG1	Yes	BlockGroup FIPS id - 1st member (for Split Tract type BPZ)
BG2	Yes	BlockGroup FIPS id - 2nd member
BG3	Yes	BlockGroup FIPS id - 2rd member
BG4	Yes	BlockGroup FIPS id - 4th member
WPFAC	Yes	WorkPlace Factor (share of jobs from CTPP); use to allocate workplace tract data
RSEAC	Yes	Residential Factor (share of population from CTPP); use to allocate household tract data
ATYPE_1	Yes	AreaType (Preliminary - Stage 1 A) 1) CBD 2) Core Commercial 3) Core Residential 4) Urban Commercial 5) Urban Residential 6) Suburban Commercial 7) Suburban Residential 8) Rural 9) Other (not defined yet) (11) New Jersey CBD (not used) 12) New Jersey Urban 13) New Jersey Suburban 14) New Jersey Rural

**Exhibit 6-2: BPM Zone Types - Database Dictionary: Census Units
Either Tracts of Minor Civil Divisions (MCD's)**

File		COM90709
Record units		Mixed: Lowest level required to define BPZ3B: MCD's, Tracts, or Blockgroups
Number of cases		4391
Field		Description
NYM_CO		NMTC Project: Standard County ID
CountyName		Character name of county
FIPS_CO		Standard Census code: 5 digits - 1-2 state, 3-5 county id
BPZ		Best Practice Model Zone ID (Final - 6/21/99)
Update		Update Codes: from 9/98 Draft to 6/21/99 Final (see <i>UpdateNotes</i> sheet)
FIPS		Standard Census code: 5 digits - 1-2 state, 3-5 county id, other Tract, BlockGroup or MCD
TYPE		Units of Geogrphahy (see <i>Zone Type</i> sheet)
FIPS_BG1		BlockGroup FIPS id - 1st member (for Split Tract type BPZ)
FIPS_BG2		BlockGroup FIPS id - 2nd member
FIPS_BG3		BlockGroup FIPS id - 2nd member
FIPS_BG4		BlockGroup FIPS id - 4th member
JoinTract		Flag field: 1 = member of BPZ that is a joined tract (Manhattan only)
SplitTR		Flag field: >1 = member of BPZ that is a split tract (Manhattan only)
SplitBG		Flag field: >1 = member of BPZ that is a split tract (Manhattan only)
WPFAC		WorkPlace Factor (share of jobs from CTPP); use to allocate workplace tract data
RSFAC		Residential Factor (share of population from CTPP); use to allocate household tract data

**Exhibit 6-3: BPM Zone Types - Database Dictionary:
Census Tracts - Level**

File	in TC file	NYMTRC6e
Record units		Tracts
Number of cases		5109
Field		Description
ID	Yes	TransCAD ID
AREA	Yes	area in square miles (TransCAD)
DATA	Yes	TransCAD Data Field
UPDATE		Update Codes: from 9/98 Draft to 7/09/99 Final (see UpdateNotes sheet)
NAME	Yes	FIPS number (character format)
BPZ	Yes	Best Practice Model Zone ID (Final - 7/09/99) - for tract-based BPZ's (blank if other)
BPZOTHER	Yes	ID for BPZ type split tracts - 2nd zone ID (listed for Manhattan only)
BPZTAG	Yes	Best Practice Model Zone ID (Final - 7/09/99) - tract "tagged" by TransCAD; with some corrective edits
POPULATION	Yes	Census 1990 total population of tract
NYM_CO	Yes	NMTC Project: Standard County ID
CountyName	Yes	Character name of county
FIPS_CO	Yes	Standard Census code: 5 digits - 1-2 state, 3-5 county id
FIPS	Yes	Standard Census code: 5 digits - 1-2 state, 3-5 county id, other Tract, BlockGroup or MCD
TYPE	Yes	Units of Geogrpahy (see <i>Zone Type</i> sheet)
JoinTract	Yes	Flag field: 1 = member of BPZ that is a joined tract (Manhattan only)
SplitTR	Yes	Flag field: >1 = member of BPZ that is a split tract (Manhattan only)
SplitBG	Yes	Flag field: >1 = member of BPZ that is a split tract (Manhattan only)
POPDEN	Yes	Population Density (1990) [see sheet "AreaType"]
EMPDEN	Yes	Employment Density (1990) [see sheet "AreaType"]
ATYPE	Yes	AreaType (Preliminary - Stage 1 A) [see sheet "AreaType"]
IAM_TAG	Yes	Interim Analysis Method (IAM) Zone ID - Tagged by TransCAD (at Tract Level)

Relation to Other Zone Systems

An updated version of the master zone equivalency file developed in Phase 1 of the NYTMC models project has been developed (ZREG1i2a).

This is a comprehensive regional master file formatted at the smallest level of geography common to prevalent zone systems used in the region. This can be useful in the transferring of zonal data from one analysis or coding system to another, such as the MTA LRF project network zones and planning districts, and ARC zones and districts, and NJ Transit and NJTPA zones.

Appendix:

NYMTC Models Region

Best Practice Model Zone System - by County and Subarea