Based on the analysis of ten essential elements: Does Greater Zurich provide Healthy, 10-Minute Neighborhoods?

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Abstract

Since the invention of transport and land use and design control, we have become highly dependent on mobility other than walking; have lost compactness of the built environment, proximity to everyday tasks, and liveliness of the public realm. Within Greater Zurich, Switzerland's largest conurbation, we select four locations of highest intensity of land use by people (workers plus residents), workers, FTE workers in retail, and residents each, to examine ten essential spatial elements including land use and design control, and their role in providing Healthy, 10-Minute Neighborhoods. Based on geospatial data, we find that Greater Zurich has at most, one Healthy, 10-Minute Neighborhood. Therefore, we conclude that mayor transformations, both in the development and the transformation of the built environment and the public realm as well as planning, are needed.

Keywords

Planning, intensity, balance, compactness, proximity, liveliness

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Introduction

Due to the lack of intensity as well as local balance of land use, we have lost proximity to everyday tasks and got highly dependent on mobility other than walking. Land use and design control, by holding densities low and separating uses have reinforced this mobility driven urban development and transformation.

If we want Healthy, 10-Minute Neighborhoods, we need compactness and proximity of the built environment, liveliness of the public realm, and planning guiding for its provision.

To examine whether Greater Zurich has Healthy, 10-Minute Neighborhoods, we analyse ten essential elements. Five concerning compactness of the built environment, two proximity between uses, two liveliness of the public realm, and one land use and design control.

What is needed to provide Healthy, 10-Minute Neighborhoods?

For neighborhoods to be Healthy, 10-Minute Neighborhoods, within a ten minutes walk three main criteria are essential: compactness of the built environment, proximity to everyday tasks, and liveliness of the public realm. Therefore, firstly, land for human settlement, preferably near public transport of good to very good services to access destinations beyond walking distance, must be used intensively and secondly, a locally balanced relationship must be established between agglomerated workers and agglomerated residents as well as between agglomerated retail outlets and agglomerated residents. This allows restraining dependence on mobility other than walking and the provision of a built environment suitable for walking.

Cervero and Duncan (2006) show that balancing the retail to housing as well the job to housing relationships both reduce the number and distance of trips. Sadik-Kahn (2016) and Schwartz (2015) describe the mobility - proximity relationship and its effect on the built environment and public realm. Speck (2012) formulates the condition where walking is preferred over other means of transport. Fischel (2015), Elliott (2012), Talen (2012), Levine (2010), and Leinberger (2009) describe how land use and design control have affected the provision of a built environment aiming at Healthy, 10-Minute Neighborhoods.

Data

We use hectare raster, polyline and polygon data from the federal government. To illustrate the boundaries of municipalities, in Figure 1, we use Federal Statistic polygon data for swissBOUNDARIES3D for 2011. For our geospatial analysis, primarily, we use the Federal Statistic Office GEOSTAT hectare raster data of 2014 for residents and workers. Of the census data, we use information on residents and housing. Of the labor market data, we use information on workers, in particular full time equivalent FTE workers in retail according to General Classification of Economic Activities NOGA 2008 codes. Secondarily, to determine the building footprints and to estimate the number of floors as well as to estimate the number of workers and residents per 100 square meters of street area 2014, we additionally use swisstopo data on buildings and streets axis as well as for visualisation, only rail tracks and land cover (water bodies and forest) provided by GeoVITe.

Identifying the suitability of Greater Zurich's built environment for Healthy, 10-Minute Neighborhoods

To identify the suitability of Greater Zurich's built environment for Healthy, 10-Minute Neighborhoods, we select locations of which the 0.5 km radius catchment areas aggregate the highest intensity of land use. For the 0.5 km radius catchment areas of these locations, firstly, as shown in Figures 1 and 2, we generate maps to visualize the location as well as the urban structure of the built environment and public realm of the selected locations' 0.5 km radius catchment areas. Secondly, as shown in Tables 1 and 2, we analyse ten elements, which are partially based on fourteen sub-elements, to identify the suitability of the built environment and public realm for Healthy, 10-Minute Neighborhoods.

Defining and selecting locations of highest intensity of land use

We use Greater Zurich, as defined in an earlier study (Wälty 2018), to select locations of highest intensity of land use. We use the concept of focal statistics to measure intensity and balance of land use within a 0.5 km radius catchment area, which correspond to a travel time of about 10 minutes on foot. To avoid omitting data, we buffer the Greater Zurich boundary by 0.5 km.

For the analysis of ten essential elements, we select four locations of the highest intensity for people (workers plus residents), workers, FTE workers in retail and residents each. Since two locations of the highest intensity for workers, one location for FTE workers in retail and one location for residents are identical to the location for people we'll have twelve locations for comparison. As seen in Figure 1, locations for people, we labeled 1 to 4, for workers, we labeled 1, 3, 5, 6, for FTE workers in retail, we labeled 2, 7, 8, 9 and for residents, which we labeled 4, 10, 11, 12. Of the twelve locations, six are within the city of Zurich with location 1 at Kreis1, location 2 at Kreise 1 and 4, location 4 at Kreise 3 and 4, location 5 at Kreise 5 and 10), location 10 at Kries 6, location 12 at Kreis 9. Locations 3, 7, and 11 are located within the city of Luzern, location 8 within the city of Winterthur, location 6 within the city of Zug and location 12 within the municipality of Wallisellen and Kreis 12 within the city of Zurich.

Analysing the urban structure

To analyse the urban structure of the twelve selected locations 0.5 km radius catchment areas, we display buildings, street axes, rail tracks and land cover such as water bodies at locations 1, 2, 3, 5, 7 and forests at location 9.

Measuring the compactness of the built environment

To measure the compactness of the built environment for the year 2014, as shown in Table 1 lines 1 to 5 and Table 2 lines 1 to 8 and line 12 to 14, firstly, we measure workers and residents per hectare of total land within the 0.5 km radius catchment area. Secondly, we estimate the gross floor to area ratio (FAR) (includes total land within the 0.5 km radius catchment area). Therefore, we multiply workers per hectare total land with 30 square meters and residents with 40 square meters, which we use as an approximation, divided by 10000 square meters for transformation. Thirdly, we estimate the building footprints in hectares and the share of built land from polygon data. Finally, to estimate the average number of floors, we multiply the estimated gross FAR with the total land of 78 hectares of the 0.5 km radius catchment area divided by the building footprint.

Measuring the proximity between workers to residents as well as FTE workers in retail to residents

As shown in Table 1 lines 6 and 7, to measure the proximity between workers and residents as well as FTE workers in retail to residents for the year 2014, we calculate the hypothetical share of local FTE workers in relation to residents as well as the share of FTE workers in retail to residents as local customers to retail outlets. As shown in Table 2 lines 3 to 5, these two measurements are based on the measures of two ratios. Firstly the ratio of FTE workers to residents and secondly, the ratio of FTE workers in retail to residents both as an indicator of balance of land use. The measurements of hypothetical balance of 49% to 54% for the FTE workers to residents and 3.1% to 3.4% for the FTE workers in retail and residents relationships estimated for Greater Zurich, we use from our earlier study (Wälty 2018).

Measuring the liveliness of the public realm

To measure the liveliness of the public realm for the year 2014, as shown in Table 2 lines 2, 5, 9, and 10, we calculate workers and residents per 100 square metres of street area. We do this by dividing the number workers and the number of residents by the street area in square meters, and by 100 to use measure per one hundred instead of one square meter.

Including the role of land use and design control

As an indicator for compactness, proximity and in consequence liveliness of the public realm for the year 2014, we measure, as shown in Table 1 line 10, the share of dwelling units built before 1946, when land use and design control have been introduced yet.

At most, Greater Zurich provides one Healthy, 10-Minute Neighborhood

Table 2 line 5 shows that only location 4 aggregates more than 15’000 residents within its catchment area of a radius of 0.5 km. Furthermore, Table 1 lines 6 to 9 show that 85.9% of the residents working are hypothetical local workers and 93.7% of the residents are local customers. In consequence, 4.2 workers and 5.1 residents per 100 square meters street space provide liveliness on the street.

The urban structure is mostly not suitable for Healthy, 10-Minute Neighborhoods

Only the selected locations 1 to 4 have a continuous urban block structure. Locations 6 and 9, due to a bigger share of land used for water bodies or forest, but also due to larger street width, have the biggest share of land not used for buildings. Aside from above-average street width, they have a similar building typology mix (from superblock to single-family dwelling) as locations 5 and 8. Finally, locations 7 and 10 to 12 show a combination of block, line and point structure, with locations 7 and 11 showing the biggest variance in building typologies.

In summary, it can be said that the urban structure of locations 1 to 4 with their continuous and compact block structure is suitable for Healthyn 10-Minute Neighborhoods, while the urban

structure of locations 5 to 12 is not compact enough and therefore unsuitable for Healthy, 10-Minute Neighborhoods.

The compactness of the built environment is mostly not sufficient for Healthy, 10-Minute Neighborhoods

As shown in Table 1, while locations 1 and 2 show the highest number of workers per hectare total land, location 4 has the highest number of residents per hectare total land. Although location 10 has the second highest number of resident per hectare total land, in contrast to location 4 its number of workers per hectare is far lower. This number nonetheless is about twice as high as the number of workers per hectare total land of the locations 1 and 2 and the same as for location 3. While location 1 and 2 have an estimated gross FAR of two and over, locations 3 and 4 have an estimate gross FAR slightly below 1.5. The reason for location 3 to have a slightly lower estimated gross FAR than location 2 maybe due to the lower share of built land and a lower estimated average number of floors. Interestingly, while location 6 and 9 have the lowest shares of built land, location 6 due to the second highest average number of floors has the same estimate gross FAR as locations 7, 8 and 11 of slightly over and around 1. Meanwhile, the estimated gross FAR of locations 10 and 12 are below 1 and location 9, due to the lowest estimated average number of floors, is slightly over 0.5, which reflects in the lowest number of people (workers plus residents) per hectare total land.

In summary, compactness of locations 1 to 4 appears to be sufficient for Healthy, 10-Minute Neighborhoods. While the compactness of locations 5, 6, 8, and 9, as shown in Table 2 lines 9, primarily suffers from large street width, the compactness of locations 7 and 10 to 12, as can be seen in Figure 2, primarily suffer from a large share of small-scale single-family dwelling buildings.

The proximity between uses is mostly not sufficient for Healthy, 10-Minute Neighborhoods

Location 4 in particular, but also location 11, is hypothetically only marginally dependent on FTE workers from outside the 0.5 km radius catchment area. In contrast, locations 1 to 3 and 5 to 9 are highly dependent on FTE workers who commute from outside the 0.5 km radius catchment areas and locations 10 and 12 on residents who commute to work outside the 0.5 km radius catchment areas. Furthermore, location 4 in particular, but also location 11, are only marginally dependent on customers who live outside the catchment areas. In contrast, locations 1 to 3 and 5 to 9 are highly dependent on customers who live outside the 0.5 km radius catchment areas, and locations 10 and 12 are dependent on residents travelling outside the 0.5 km radius catchment areas.

In summary, locations with the highest and the lowest intensity in workers (locations 1, 3, 5, 6, 10, 11 12) and FTE workers in retail (locations 2, 7, 8, 9) are highly dependent on mobility. Whereas location 4, with a high intensity of residents and almost balanced FTE workers to residents as well FTE workers in retail to residents ratios, is least dependent on mobility and is the only Healthy, 10-Minute Neighborhood in terms of proximity.

The liveliness of the public realm is mostly not sufficient for Healthy, 10-Minute Neighborhoods

While location 1 and 2 have nearly three times as many workers on the street as location 4, the latter has about three times as many residents on the street as the other two. Location 11 has approximately the same number of workers on the streets as location 4, but slightly fewer residents. Although locations 10 and 12 have almost as many residents on the street as location 4, they have only about half of the number of workers on the street.

In summary, the more workers and residents and the smaller width of the street, the more lively of the public realm becomes. Moreover, the imbalance in land use is also reflected in imbalance in liveliness on the street.

Land use and design control do not sufficiently support the provision of Healthy, 10-Minute Neighborhoods

More than three quarters of the housing stock at locations 1 to 4, 7 and 8, 10 and 11 were built before 1946 and the introduction of land use and design control. Of these, locations 1, 2, and 4 have the highest estimated gross FAR, location 10 one of the lowest. Furthermore, locations 1 and 2 are heavily dependent on workers living outside the 0.5 km radius catchment areas, while location 4 is slightly dependent on workers and customers living outside the 0.5 km radius catchment area. In addition, location 10 is the only location that is dependent on residents who go beyond the 0.5 km catchment area. By contrast, less than one third of the housing stock at locations 5, 6, 9, and 12 were built before 1946 and the introduction of land use and design control. In fact, locations 9 and 12 have the lowest estimated gross FAR.

In summary, it can be said that on the one hand if a location was built compactly prior to the introduction of land use and design control, as locations 1 to 3 show, it was most likely to fail in terms of proximity. On the other hand, if as for locations 5, 6, 9, 12, the majority of housing units were built after the introduction of land use and design control compactness and proximity are not enough. Only location 4 is sufficiently intensive and locally balanced enough to become a role model for Healthy, 10-Minute Neighborhoods.

Mayor transformations are needed

If we look at these twelve locations with the highest intensity of land use for people, workers, FTE workers in retail or residents, it seems that locations 1 to 4 are sufficiently compact for Healthy, 10-Minute Neighborhoods. However, only location 4 is not particularly dependent on mobility due to its relatively well-balanced distribution of land use, which is reflected in an above-average and balanced liveliness on the street. Compactly built prior to the introduction of land use and design control, location 4 is the only location that has remained sufficiently balanced. It is therefore clear that location 4 is the only Healthy, 10-Minute Neighborhood and that it could be a role model in terms of compactness, proximity, and liveliness on the streets.

Since land use and design control has not succeeded in guiding for compact and locally balanced land use and thus liveliness in public realm, it becomes clear that major transformations are necessary in order to promote Healthy, 10-Minute Neighborhoods both in the development and transformation of the built environment and public realm and in planning.

Acknowledgements

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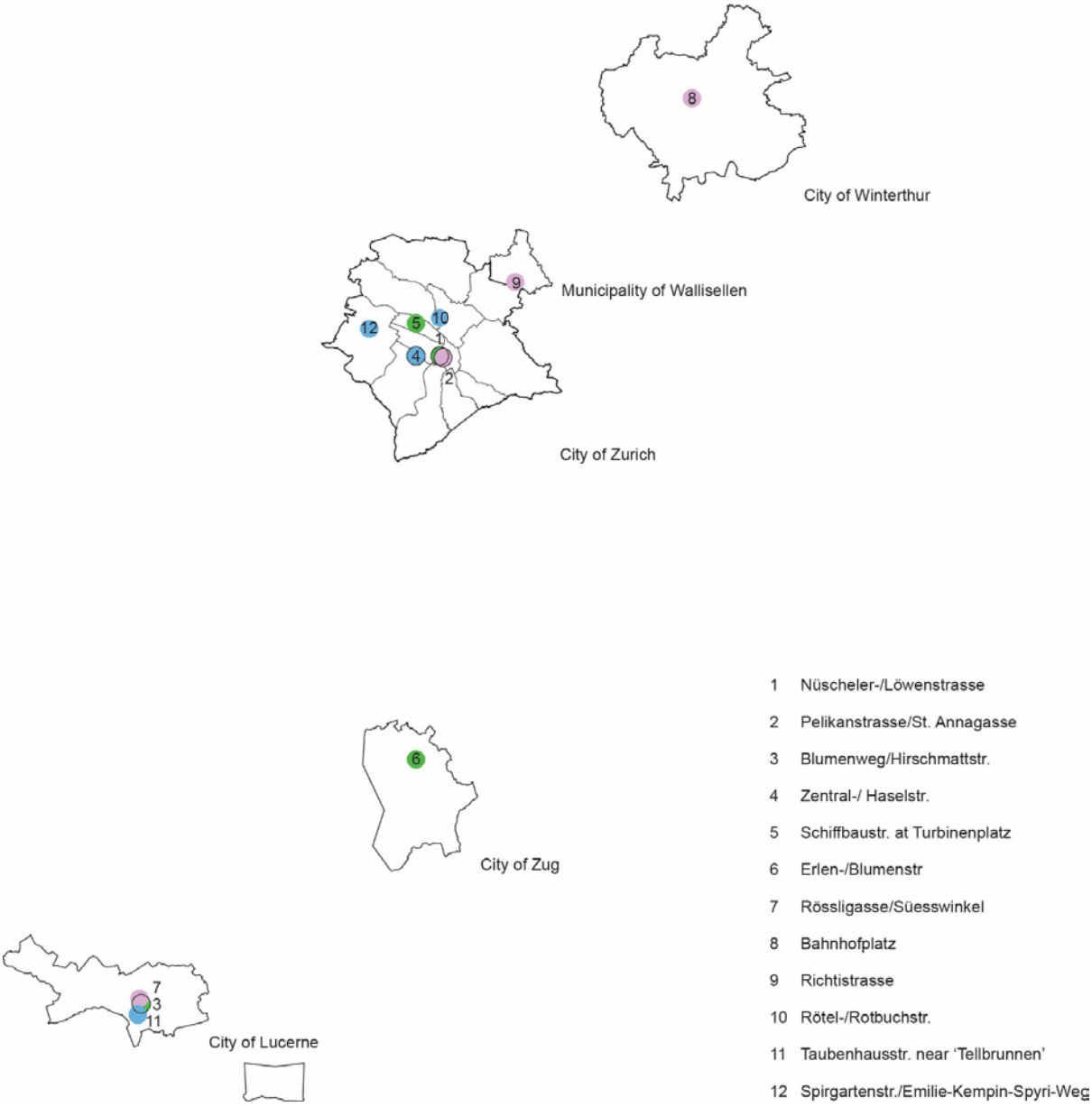

Figure 1 shows the location and 0.5 km catchment areas of the twelve selected areas of highest intensity of land use for people (workers plus residents) 1, 2, 3, 4, workers 1, 3, 5, 6, FTE workers in retail 2, 7, 8, 9, and residents 4, 10, 11, 12.

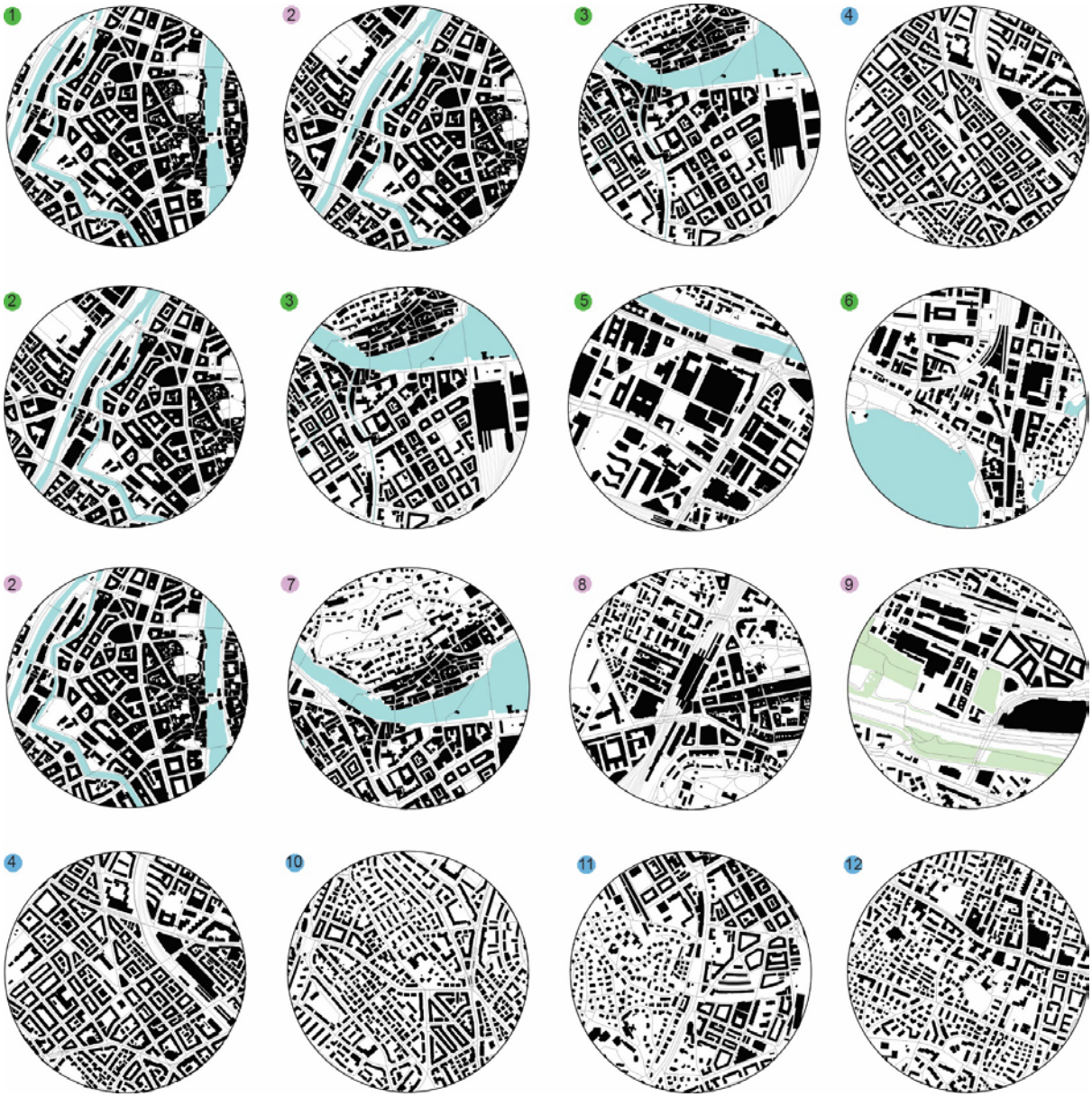

Figure 2 the first row shows 0.5 km catchment areas of highest intensity of land used for people (workers plus residents), the second row for workers, the third row for FTE workers in retail and the fourth row residents.

	People	1	2	3	4
	Compactness				
1	Workers per hectare total land	646	590	345	174
2	Residents per hectare total land	61	69	70	212
3	Estimated gross FAR*	2.2	2.0	1.3	1.4
4	Built land [%]	41	42	35	38
5	Estimated average number of floors	5.3	4.8	3.8	3.6
	Proximity				
6	Hypothetical local workers [%]	6.0	7.4	14.7	85.9
7	Local customers [%]	2.7	2.7	7.3	93.7
	Liveliness				
8	Workers per 100 m2 street area	15.1	14.1	10.2	4.2
9	Residents per 100 m2 street area	1.4	1.6	2.1	5.1
	Land use and design control				
10	Dwelling units built before 1946 [%]	77	87	64	77

	Workers	1	3	5	6
	Compactness				
1	Workers per hectare total land	646	345	314	275
2	Residents per hectare total land	61	70	44	41
3	Estimated gros FAR*	2.2	1.3	1.1	1.0
4	Built land [%]	41	36	36	24
5	Estimated average number of floors	5.3	3.7	3.1	4.1
	Proximity				
6	Hypothetical local workers [%]	6.0	14.7	8.4	11.7
7	Local customers [%]	2.7	7.3	19.3	10.1
	Liveliness				
8	Workers per 100 m2 street area	15.1	10.2	5.3	5.8
9	Residents per 100 m2 street area	0.6	1.1	0.4	0.6
	Land use and design control				
10	Dwelling units built before 1946 [%]	77	64	32	23

	Retail	2	7	8	9
	Compactness				
1	Workers per hectare total land	590	276	246	142
2	Residents per hectare total land	69	52	63	38
3	Estimated gros FAR*	2.0	1.0	1.0	0.6
4	Built land [%]	42	30	34	25
5	Estimated average number of floors	4.8	3.4	2.9	2.3
	Proximity				
6	Hypothetical local workers [%]	7.4	13.2	17.8	15.8
7	Local customers [%]	2.7	5.1	9.4	7.0
	Liveliness				
8	Workers per 100 m2 street area	14.1	7.4	5.4	2.4
9	Residents per 100 m2 street area	1.6	1.4	1.4	0.6
	Land use and design control				
10	Dwelling units built before 1946 [%]	87	61	57	9

	Residents	4	10	11	12
	Compactness				
1	Workers per hectare total land	174	70	160	63
2	Residents per hectare total land	212	147	138	136
3	Estimated gros FAR*	1.4	0.8	1.0	0.7
4	Built land [%]	41	29	27	28
5	Estimated average number of floors	3.4	2.8	3.8	2.6
	Proximity				
6	Hypothetical local workers [%]	85.9	166.2	61.1	159.0
7	Local customers [%]	93.7	270.3	83.1	82.7
	Liveliness				
8	Workers per 100 m2 street area	4.2	2.0	4.1	2.0
9	Residents per 100 m2 street area	5.1	4.2	3.6	4.2
	Land use and design control				
10	Dwelling units built before 1946 [%]	77	79	55	29

Table 1 shows the ten essential elements needed for Healthy, 10-Minute Neighborhoods.

	People	1	2	3	4
1	People [nr]	55187	51392	32394	30079
2	Workers [nr]	50422	46013	26919	13580
3	FTE workers [nr]	41143	37375	19246	9895
4	FTE workers in retail [nr]	5715	6437	2422	572
5	Residents [nr]	4765	5379	5475	16499
6	Building footprint [ha]	32	33	27	30
7	FTE workers to residents ratio*	863	695	352	60
8	FTE workers in retail to residents ratio**	119.9	119.7	44.2	3.5
9	Street width [m]	14.7	13.9	13.7	16.0
10	Street length [m]	22728	23581	19332	20106
11	Street area [ha]	33	33	26	32

	Workers	1	3	5	6
1	People [nr]	55187	32394	27908	24635
2	Workers [nr]	50422	26919	24469	21414
3	FTE workers [nr]	41143	19246	21065	14190
4	FTE workers in retail [nr]	5715	2422	578	1033
5	Residents [nr]	4765	5475	3439	3221
8	Building footprint [ha]	32	28	28	19
6	FTE workers to residents ratio*	863	352	613	441
7	FTE workers in retail to residents ratio**	119.9	44.2	16.8	32.1
9	Street width [m]	14.7	13.7	25.7	23.5
10	Street length [m]	22728	19332	17933	15694
11	Street area [ha]	33	26	46	37

	Retail	2	7	8	9
1	People [nr]	51392	25590	24084	14025
2	Workers [nr]	46013	21500	19158	11070
3	FTE workers [nr]	37375	15943	14251	9662
4	FTE workers in retail [nr]	6437	2623	1709	1368
5	Residents [nr]	5379	4090	4926	2955
6	Building footprint [ha]	33	24	26	20
7	FTE workers to residents ratio*	695	390	289	327
8	FTE workers in retail to residents ratio**	119.7	64.1	34.7	46.3
9	Street width [m]	13.9	13.2	19.1	22.5
10	Street length [m]	23581	21916	18599	20835
11	Street area [ha]	33	29	36	47

	Residents	4	10	11	12
1	People [nr]	30079	16961	23246	15507
2	Workers [nr]	13580	5484	12459	4918
3	FTE workers [nr]	9895	3557	9088	3430
4	FTE workers in retail [nr]	572	138	422	416
5	Residents [nr]	16499	11477	10787	10589
6	Building footprint [ha]	32	22	21	22
7	FTE workers to residents ratio*	60	31	84	32
8	FTE workers in retail to residents ratio**	3.5	1.2	3.9	3.9
9	Street width [m]	16.0	15.9	15.8	14.4
10	Street length [m]	20106	17210	19037	17354
11	Street area [ha]	32	27	30	25

12	Total land [ha]	78
13	surface per worker [m2]	30
14	surface per resident [m2]	40

* hypothetically balanced at 51.5% with a variance from 49% to 54%
** hypothetically balanced at 3.25 with a vraiance from 3.1% to 3.4%

Table 2 shows the fourteen sub-elements partially needed for the calculation of the essential elements shown in Table 1.