9 APPENDIX I

This appendix provides descriptions of the network topologies, traffic demands and control plans of all the simulation models used in the experiments, in addition to the real detector measures used in the calibration and validation processes and their characterisation.

9.1 MODEL CHARACTERISATION ITEMS

The characterisation of each model is based on the following items:

- NbSections: The total number of sections in the AIMSUN model.
- NbNodes: The total number of nodes in the AIMSUN model.
- NbCentroids: The total number of centroids or zones in the AIMSUN model.
- Kms: The total number of kilometres in the model, obtained as the sum of the length of all the sections of which the AIMSUN model is that composed.
- Kms x lane: The total number of kilometres of all lanes, obtained as the sum of the length of all lanes that compose the AIMSUN model.
- NbLinks: The total number of links of AIMSUN model. A link is generated since either one section or a polysection (a group of sections that share the same characteristics).
- InternalNodes: The total number of internal nodes. All the nodes (either junctions or joins) that have more that one entrance and/or more than one exit are considered when an internal node is generated. All nodes that represent a direct connection between two different sections are excluded.
- InternalArcs: The total number of internal arcs. An internal arc is a link between two internal nodes.
- ConnectivityIndex: The connectivity index *CI* is calculated as

$$CI = \frac{\sum_{n \in InternalNodes} \frac{ExitArcs_n}{N-1}}{N}$$

  - where N is the number of internal nodes,
    $ExitArcs_n$ is the number of exit internal arcs from node n, that is, the number of connections to other internal nodes.
- AvgDistance: The average distance in meters between all OD pairs, considering the paths calculated in free flow conditions.
- DevDistance: The distance deviation in meters between all OD pairs, considering the paths calculated in free flow conditions.
- MinDistance: The minimum distance in meters between all OD pairs, considering the paths calculated in free flow conditions.
- MaxDistance: The maximum distance in meters between all OD pairs, considering the paths calculated in free flow conditions.

- AvgTime: The average travel time in seconds between all OD pairs, considering the paths calculated during one simulation.
- DevTime: The distance travel time in seconds between all OD pairs, considering the paths calculated during one simulation.
- MinTime: The minimum travel time in seconds between all OD pairs, considering the paths calculated during one simulation.
- MaxTime: The maximum travel time in seconds between all OD pairs, considering the paths calculated during one simulation.

9.2 VITORIA MODEL

9.2.1 NETWORK TOPOLOGY

The Vitoria model is an urban network of medium size that models a part of the city of Vitoria in Spain. Figure 9-1 depicts the AIMSUN model, with 487 road sections, 179 nodes and 783 OD pairs.

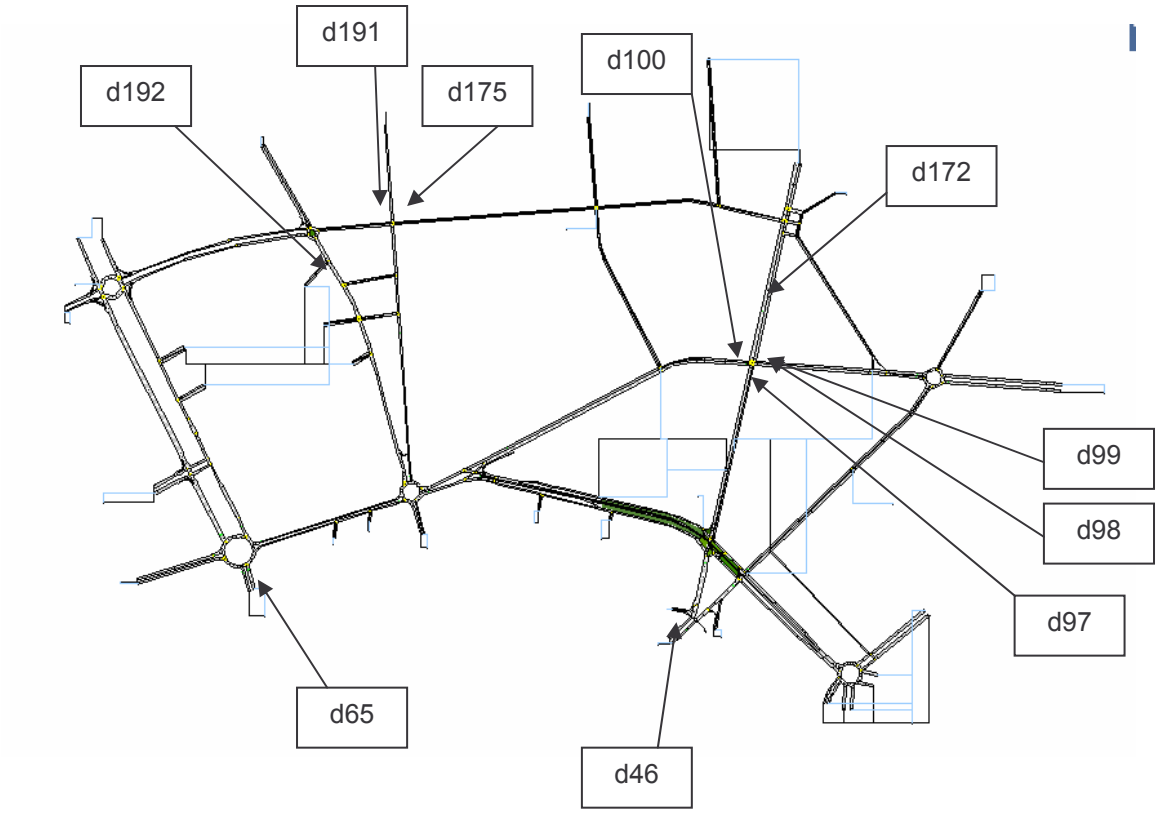


Figure 9-1. Vitoria model, with detector stations location

9.2.2 TRAFFIC DEMAND

The traffic demand of the Vitoria model is represented by an OD matrix from 18:00 to 19:00 and sliced in four time intervals of 15 minutes and the vehicles are modelled by the vehicle type “car”, with a total number of trips of 9691 vehicles

9.2.3 CONTROL PLAN

The control plan used in this model is a fixed control plan that represents the afternoon peak hour control plan. Figure 9-2 and Figure 9-3 depict an example of phase parameters and phase diagram of one intersection that belong to Vitoria model.

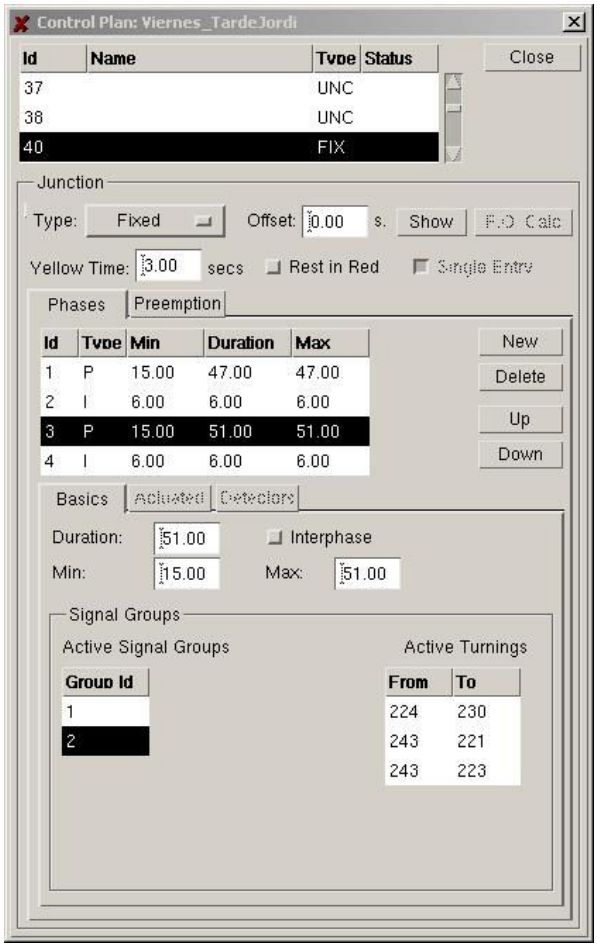


Figure 9-2. Example of the phase duration of an intersection in the Vitoria model

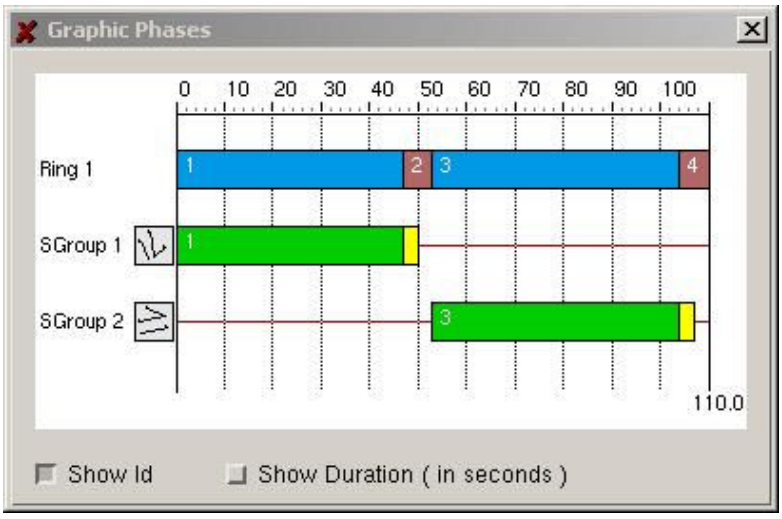


Figure 9-3. Example of a phase diagram of an intersection in the Vitoria model

9.2.4 REAL TRAFFIC DATA

The set of real traffic data available is the traffic counts at 10 detector stations (Figure 9-1 depicts the location of each detector), gathered from 4 April 1999 to 19 May 1999 with a level of 15 minutes of aggregation during the 24 hour of a day. From this data, we took only the working days and the afternoon peak hour (from 18:00 to 19:00) and calculated the average traffic count of each detector. The **Table 5.4** shows the average traffic count of each detector during the peak hour.

	Average Traffic Counts (vehs)				
Detectors	**18:00-18:15**	**18:15-18:30**	**18:30-18:45**	**18:45-19:00**	**TOTAL**
d100	166	147	153	133	599
d172	343	393	350	335	1421
d175	81	79	66	55	281
d191	70	80	49	64	263
d192	273	183	250	255	961
d46	150	145	128	121	544
d65	302	273	257	243	1075
d97	150	145	128	121	544
d98	297	175	238	70	780
d99	149	145	112	110	516

Table 9.1. Average traffic counts of a working day (Vitoria model)

9.2.5 NETWORK CHARACTERISATION

The characterisation of the Vitoria model, considering the items explained in Section 9.1, is as follows:

- NbSections: 487 sections
- NbNodes: 179 nodes
- NbCentroids: 29 centroids
- Kms: 34.52 Km
- Kms x lane: 65.89 Km
- NbLinks: 310 links
- InternalArcs: 192 arcs
- ConnectivityIndex: 0.013006
- AvgDistance: 2832.30
- DevDistance: 1105.56
- MinDistance:100.64
- MaxDistance: 6134.32
- AvgTime: 247.69.
- DevTime: 99.72.
- MinTime: 23
- MaxTime: 566

9.3 AMARA MODEL

9.3.1 NETWORK TOPOLOGY

The Amara model is an urban network of medium size that models the Amara borough of the city of San Sebastian in Spain. Figure 9-4 depicts the AIMSUN model, with 365 road sections, 100 nodes and 225 OD pairs.

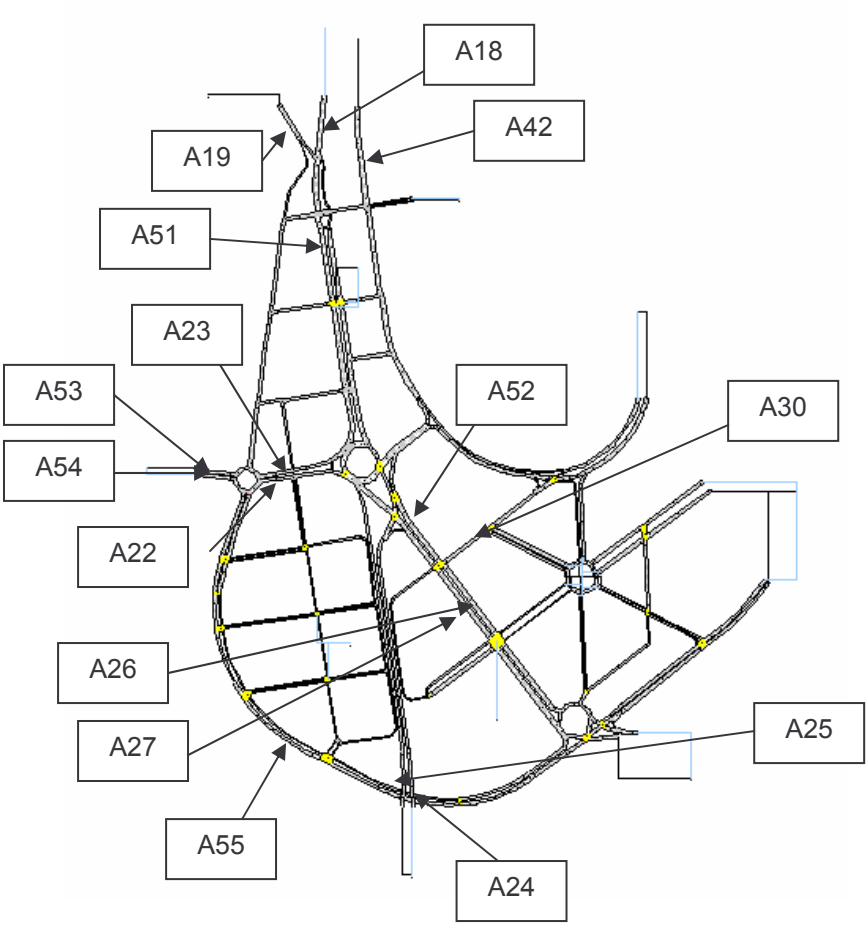
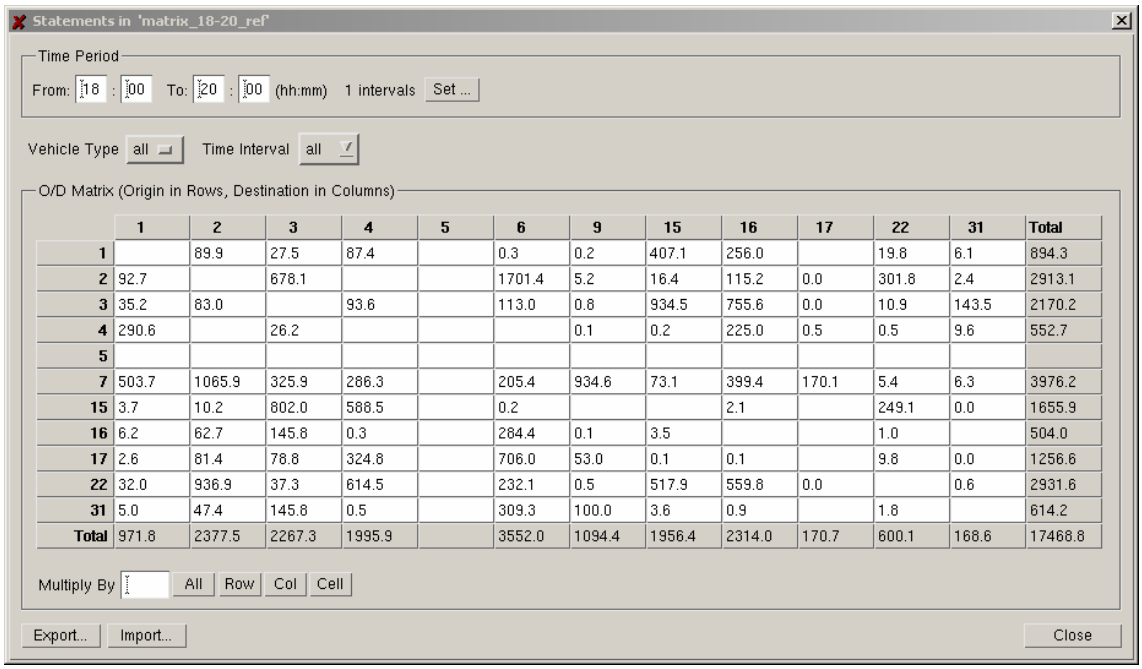


Figure 9-4. The Amara model, with detector stations location

9.3.2 TRAFFIC DEMAND

The traffic demand of the Amara model is represented by an OD matrix from 18:00 to 20:00 and the vehicles are modelled by the vehicle type “car”, with a total number of trips of 17469 vehicles. Figure 9-5 depicts the afternoon peak hour OD matrix defined in the AIMSUN model.



	1	2	3	4	5	6	9	15	16	17	22	31	Total
1		89.9	27.5	87.4		0.3	0.2	407.1	256.0		19.8	6.1	894.3
2	92.7		678.1			1701.4	5.2	16.4	115.2	0.0	301.8	2.4	2913.1
3	35.2	83.0		93.6		113.0	0.8	934.5	755.6	0.0	10.9	143.5	2170.2
4	290.6		26.2				0.1	0.2	225.0	0.5	0.5	9.6	552.7
5													
7	503.7	1065.9	325.9	286.3		205.4	934.6	73.1	399.4	170.1	5.4	6.3	3976.2
15	3.7	10.2	802.0	588.5		0.2			2.1		249.1	0.0	1655.9
16	6.2	62.7	145.8	0.3		284.4	0.1	3.5			1.0		504.0
17	2.6	81.4	78.8	324.8		706.0	53.0	0.1	0.1		9.8	0.0	1256.6
22	32.0	936.9	37.3	614.5		232.1	0.5	517.9	559.8	0.0		0.6	2931.6
31	5.0	47.4	145.8	0.5		309.3	100.0	3.6	0.9		1.8		614.2
Total	971.8	2377.5	2267.3	1995.9		3552.0	1094.4	1956.4	2314.0	170.7	600.1	168.6	17468.8

Figure 9-5. Afternoon peak hours OD matrix of the Amara Model

9.3.3 CONTROL PLAN

The control plan used in this model is a fixed control plan that represents the afternoon peak hour control plan.

9.3.4 REAL TRAFFIC DATA

The set of real traffic data available is the traffic counts at 15 detector stations, gathered from 4 April 1999 to 19 May 1999 with a level of 1 hour of aggregation during the 24 hour of a day. From this data, we took only the working days and the afternoon peak hours (from 18:00 to 20:00) and calculated the average traffic count of each detector. Table 9.2 shows the average traffic count of each detector during the peak hours.

	Average Traffic Counts (vehs)		
Detectors	**18:00-19:00**	**19:00-20:00**	**TOTAL**
A18	1994	2018	3962
A19	531	518	1049
A22	871	782	1653
A23	482	524	1006
A24	1551	1362	2913
A25	1136	1241	2377
A26	897	938	1836
A27	1098	1099	2197
A30	948	958	1906

A42	1838	1731	3569
A51	1469	1556	3025
A52	1446	1443	2889
A53	433	547	979
A54	429	467	896
A55	341	421	602

Table 9.2. Average traffic counts of a working day (Amara model)

9.3.5 NETWORK CHARACTERISATION

The characterisation of the Amara model, considering the items explained in Section 9.1, is as follows:

- NbSections: 365 sections
- NbNodes: 99 nodes
- NbCentroids: 13 centroids
- Kms: 15.77 Km
- Kms x lane: 28.40 Km
- NbLinks: 187 links
- InternalArcs: 152 arcs
- ConnectivityIndex: 0.023457
- AvgDistance: 1496.14
- DevDistance: 559.39
- MinDistance:150.49
- MaxDistance: 3400.54
- AvgTime: 176.10
- DevTime: 77.14
- MinTime: 11
- MaxTime: 364

9.4 BRUNNSVIKEN MODEL

9.4.1 NETWORK TOPOLOGY

The Brunnsviken model is a non-urban network of medium size that models a part of the city of Stockholm in Sweden. Figure 9-6 depicts the AIMSUN model, with 494 road sections, 199 nodes and 576 OD pairs.

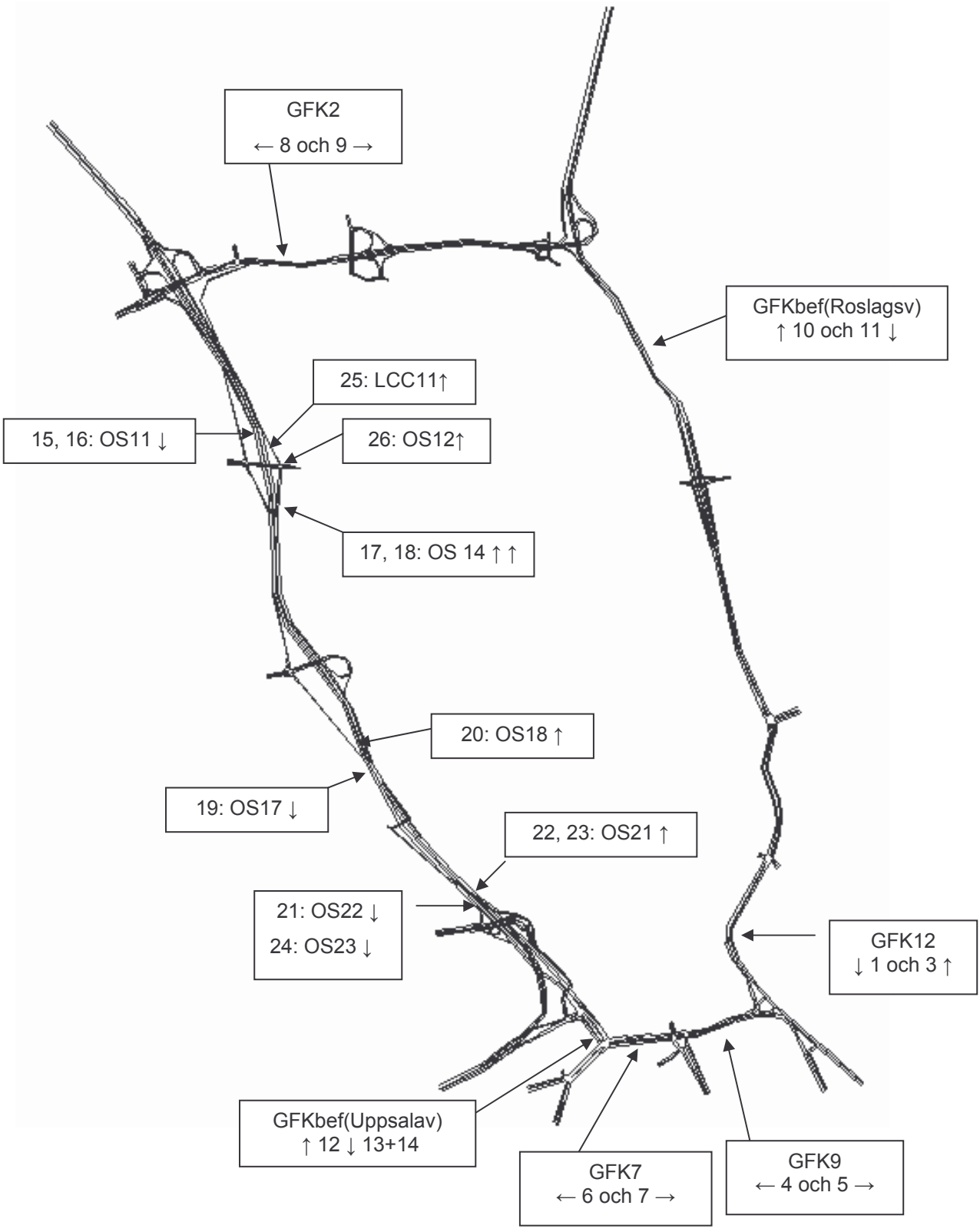


Figure 9-6. Brunnsviken model, with detector stations location

9.4.2 TRAFFIC DEMAND

The traffic demand of the Brunnsviken model is represented by an OD matrix from 07:00 to 08:30, sliced by three time intervals of 30 minutes each, and the vehicles are modelled by the vehicle type “car”, with a total number of trips of 32,931 vehicles.

9.4.3 REAL TRAFFIC DATA

The set of real traffic data available is the traffic counts at 23 detector stations, gathered on 3 May 2001 and 4 May 2001 with a level of 30 minutes of aggregation during the 24 hour of a day. From this data, we took only the morning peak hour (from 07:00 to 08:30) and calculated the average traffic count of each detector. Table 9.3 shows the average traffic count of each detector during the peak hour.

	Average Traffic Counts (vehs)			
Detectors	7:00-7:30	7:30-8:00	8:00-8:30	TOTAL
GFK12 (mot Roslagstull)	905.5	817.5	788.5	2511.5
GFK12 (mot Roslagsv)	410.0	532.5	537.0	1479.5
GFK9 (mot Sveaplan)	1105.0	1135.0	1148.5	3388.5
GFK9 (mot Roslagstull)	707.0	754.0	725.5	2186.5
GFK7 (mot Norrtull)	1235.0	1340.0	1423.5	3998.5
GFK7 (mot Sveaplan)	905.5	928.0	907.5	2741.0
GFK2 (mot Järva krog)	1497.0	1275.0	1262.5	4034.5
GFK2 (mot Roslagsv)	1234.0	1381.0	1296.0	3911.0
GFKbef. (Roslagsv N)	567.0	747.0	898.5	2212.5
GFK bef. (Roslagsv S)	1880.5	1869.0	1527.5	5277.0
GFK bef. (Uppsalav N)	1285.5	1510.5	1625.0	4421.0
GFKbef. (Uppsalav S1+S2)	1216.0	1234.0	1231.5	3681.5
MCS OS11A+B	2961.0	2783.2	2660.1	8404.3
MCS OS14A	1662.9	1991.9	2070.5	5725.4
MCS OS14B	477.1	598.3	550.8	1626.3
MCS OS17	2676.6	2595.9	2467.0	7739.4
MCS OS18	1942.9	2267.2	2320.1	6530.1
MCS OS22	1618.3	1511.3	1402.5	4532.1
MCS OS21E4	1436.7	1554.2	1531.7	4522.5
MCS OS21E450	753.3	991.7	1090.0	2835.0
MCS OS23	896.7	920.8	837.5	2655.0
MCS LCC11	681.3	729.2	688.8	2099.2
MCS OS12	1859.6	1861.4	1945.1	5666.1

Table 9.3. Average traffic counts of a working day (Brunnsviken model)

9.4.4 NETWORK CHARACTERISATION

The characterisation of the Brunnsviken model, considering the items explained in Section 9.1, is as follows:

- NbSections: 494 sections
- NbNodes: 199 nodes
- NbCentroids: 24 centroids
- Kms: 46.26 Km
- Kms x lane: 94.27 Km
- NbLinks: 333 links
- InternalArcs: 199 arcs
- ConnectivityIndex: 0.013705
- AvgDistance: 5422.97
- DevDistance: 2790.64
- MinDistance:92.07
- MaxDistance: 15,132.99
- AvgTime: 333.63
- DevTime: 189.02
- MinTime: 9
- MaxTime: 1526