ANALYSIS OF CAR BEHAVIOR IN MATSUYAMA CITY

(USING PROBE PERSON DATA)

TEAM "G"

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The University of Tokyo, Japan
&
The University of Central Punjab, Lahore, Pakistan

GROUP INTRODUCTION

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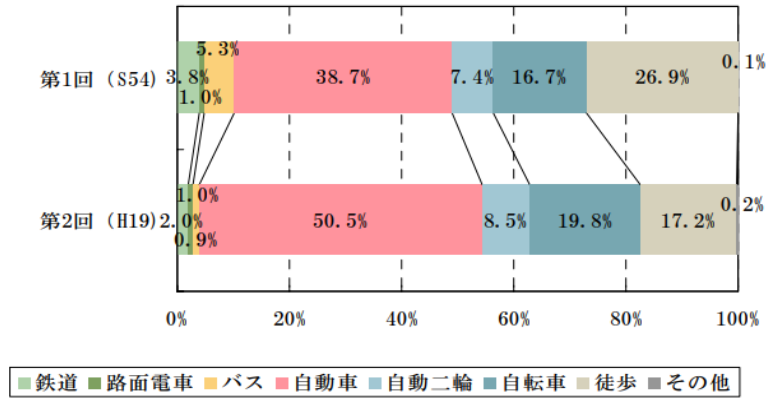
TARGET AREA

MATSUYAMA CITY

- Located in Ehime Prefecture on Shikoku Island (Western part of Japan)
- Capital and Largest City of Ehime Prefecture with Population = 516, 643 (as of January 1, 2014), Area = 429.06 m^2 and No. of Households = 229,916.

- According to the PT survey conducted in 2007, car usage is more than half showing the **Expanding Car Usage** in Matsuyama City



DATA CHARACTERISTICS & PREPARATION

Data (Given for Exercise)

- Probe Person (PP Data)
  - Location Data (Sequential GPS Log i.e. Latitude & Longitude)
  - Trip Data (OD, Duration, Mode, Purpose)
- Network Data

Combination

Path Choice Can be Assumed

Problem ⟹ Approach

How to assume the Actual Path?

Map Matching Algorithm

FOCUS

Central Area of Matsuyama City

Extraction of Data

Extracted the OD Data and Network Data for Central Area of Matsuyama City

Reason of Extraction

Data Preparation for reducing computational load on RL Model

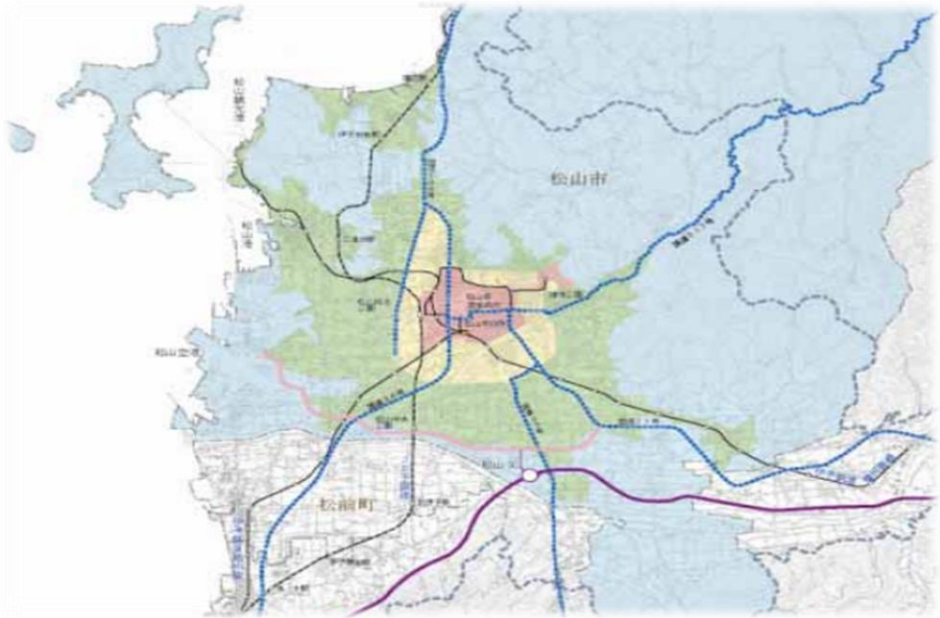
INTRODUCED POLICIES

Focus on Central Area

Attempts to make some roads Pedestrian Friendly

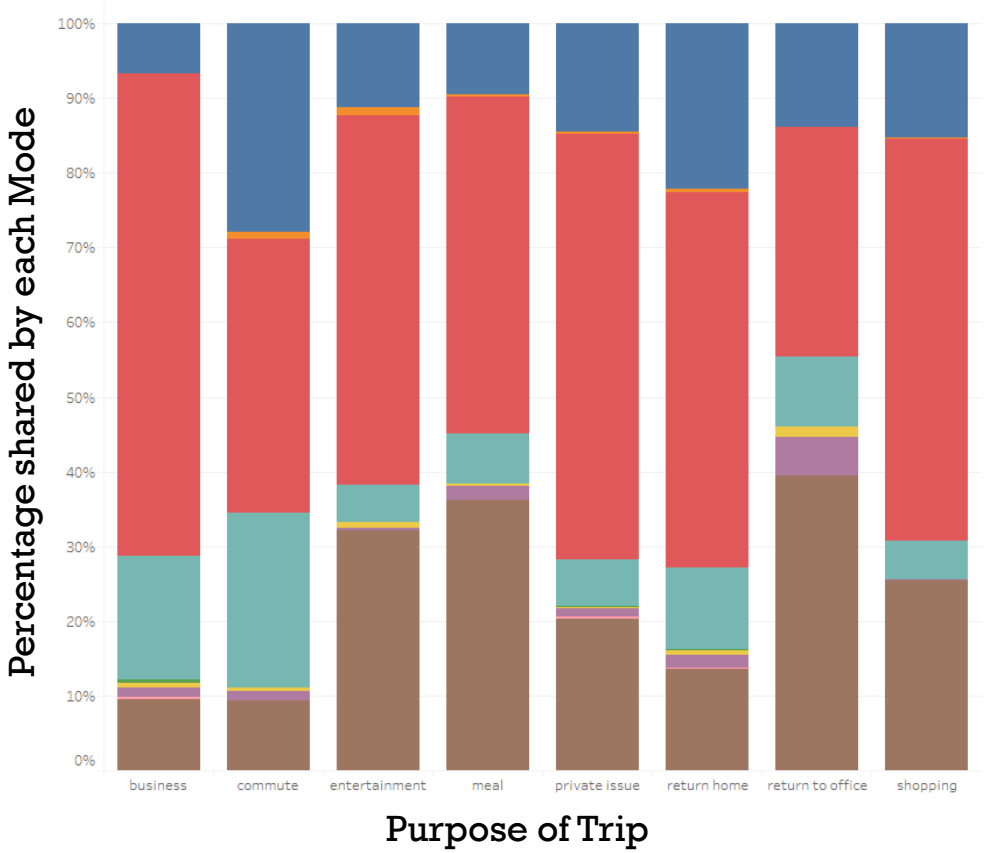
Car Flow Restraint

(In central Area)

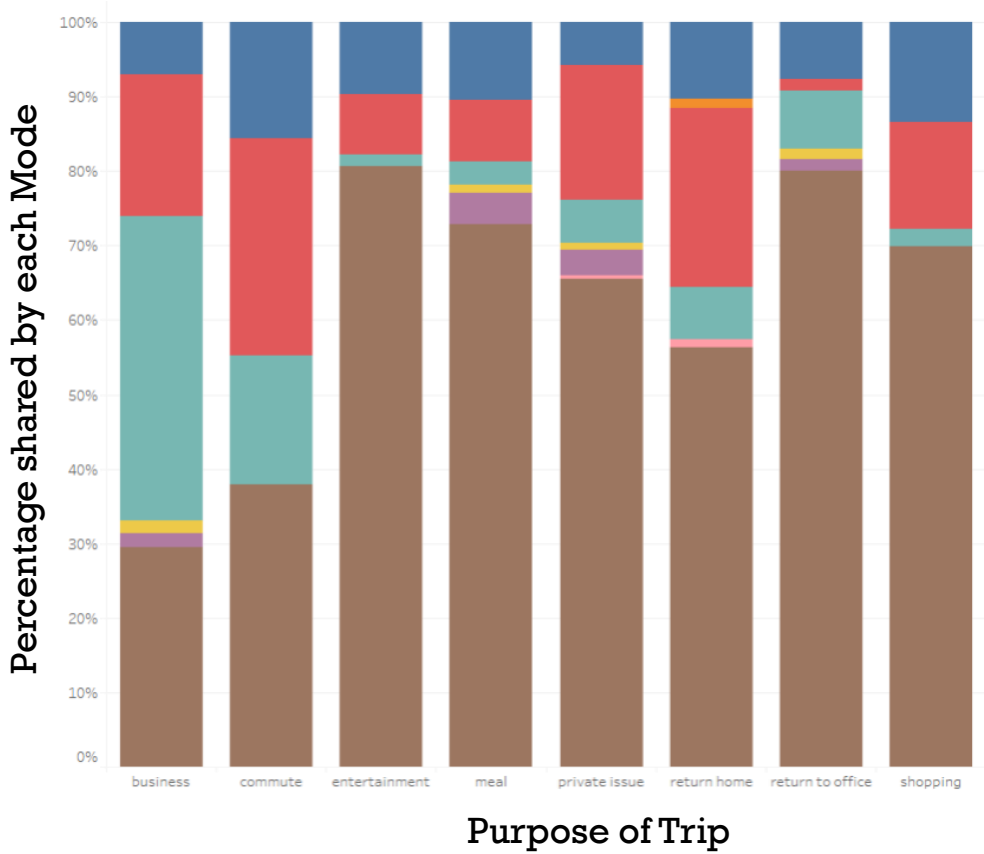


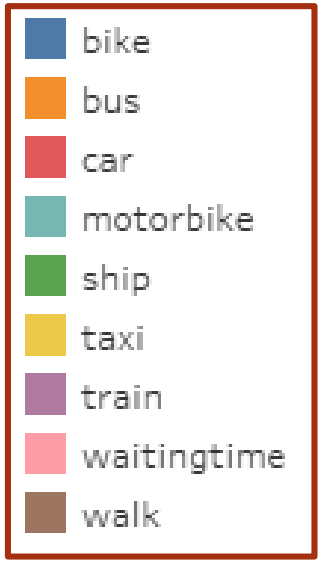
PRELIMINARY ANALYSIS

Whole City



Central Area





FORMULATION OF MODEL

Existing Route Choice Models → IIA, Path Enumeration

Sequential Route Choice Models → Spatial Cognition about downstream, Degree of Spatial Cognition

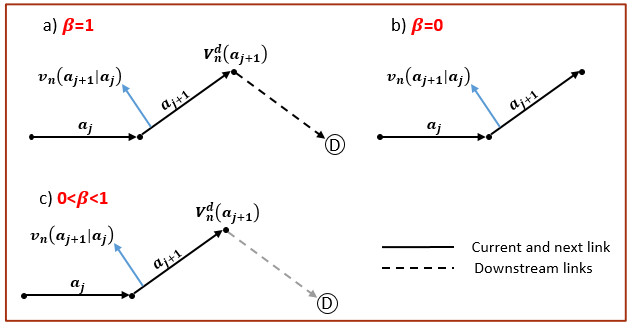
➢ β-SCALED RECURSIVE LOGIT MODEL; OYAMA AND HATO 2016

- Consider a directed connected graph; $G = (A, N)$, where $A -$ set of links, $N -$ set of nodes
- The instantaneous random utility of a link a_j condition on being in state a_{j-1} is given by, $\boldsymbol{u_n(a_j|a_{j-1}) = v_n(a_j|a_{j-1}) + \mu\varepsilon_n(a_j)}$
- The **total utility** of link a_j given the state a_{j-1} is formulated by sum of the **instantaneous utility** $\boldsymbol{u_n(a_j|a_{j-1})}$ and **maximum expected downstream utility** up to the destination link d, denoted as value function $\boldsymbol{V_n^d(a_j)}$ and defined by the Bellman equation (Bellman, 1957); $\boldsymbol{V_n^d(a_j) = \mathrm{E}\left[\max_{a_{j+1}\in A(a_j)}\{v_n(a_{j+1}|a_j) + \beta V_n^d(a_{j+1}) + \mu\varepsilon_n(a_{j+1})\}\right]} \quad \forall a_j \epsilon A$

β is time discount rate represents the spatial cognition of driver for downstream links

➢ LINK CHOICE PROBABILITY (MULTINOMIAL LOGIT MODEL)

$$P_n^d(a_{j+1}|a_j) = \frac{e^{\frac{1}{\mu}\{v_n(a_{j+1}|a_j)+\beta V_n^d(a_{j+1})\}}}{\sum_{a'_{j+1}\in A(a_j)} e^{\frac{1}{\mu}\{v_n(a'_{j+1}|a_j)+\beta V_n^d(a'_{j+1})\}}}$$



PRELIMINARY ESTIMATION RESULTS

Variables	Parameters	t-Value
Travel Time	-0.1106528	-7.2201359**
Right-Turn Dummy	-0.6584271	-6.194608**
β	0.4506658	-2.60758**
L (0)		-1268.621
LL		-1203.331
Rho-Square		0.05146568
Adjusted Rho-Square		0.04910091

INTRODUCED POLICIES

PROPOSED POLICY

Focus on Central Area of Matsuyama City

Making "Transit Mall"

(A Pedestrian Friendly area)

Car Flow Restraint

(In central Area)

PRECEDING POLICY

Hanazonomachi Avenue

Reduced the No. of Car Lanes from 4 to 2

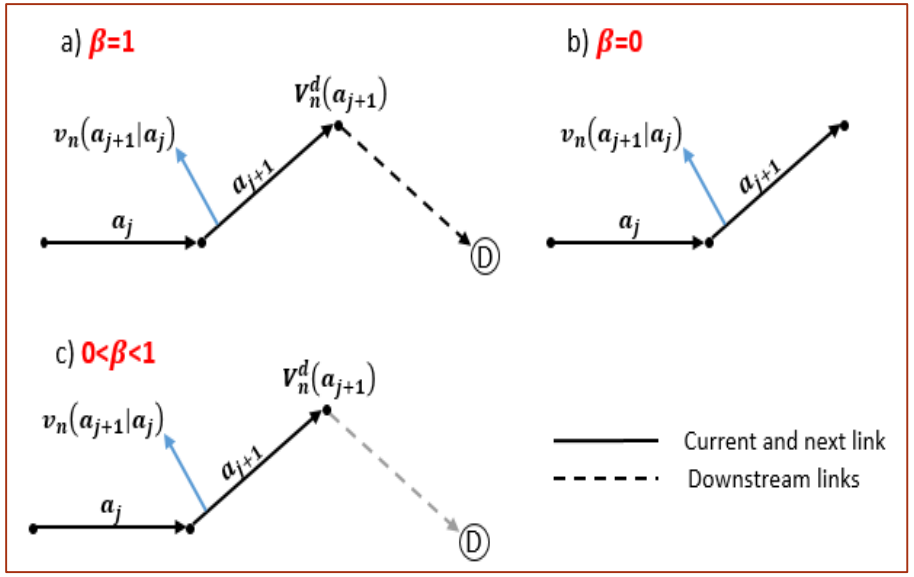
TRAFFIC ASSIGNMENT

➢ β-SCALED RECURSIVE LOGIT MODEL; OYAMA AND HATO 2016

$$u_n(a_j|a_{j-1}) = \Theta_{tt}(a_j|a_{j-1}) * (TT) + \Theta_{RT}(a_j|a_{j-1}) * (RT) + \mu\varepsilon_n(a_j)$$

$$P_n^d(a_{j+1}|a_j) = \frac{e^{\frac{1}{\mu}\{v_n(a_{j+1}|a_j)+\beta V_n^d(a_{j+1})\}}}{\sum_{a'_{j+1}\in A(a_j)} e^{\frac{1}{\mu}\{v_n(a'_{j+1}|a_j)+\beta V_n^d(a'_{j+1})\}}}$$

$$e^{V_{n,t}^d(a_j)} = \begin{cases} \frac{1}{\mu}\sum_{a_{j_+2}\in A(a_{J_+1})} e^{\{v_{n,d}(a_{j_+2}|a_{j+1})+\beta V_n^d(a_{j_+2})\}} \\ 0 \end{cases} \qquad \begin{matrix} a_{j+1} \neq d \\ a_{j+1} = d \end{matrix}$$



$$\mathbf{z} = \mathbf{M}\mathbf{z} + \mathbf{b}$$

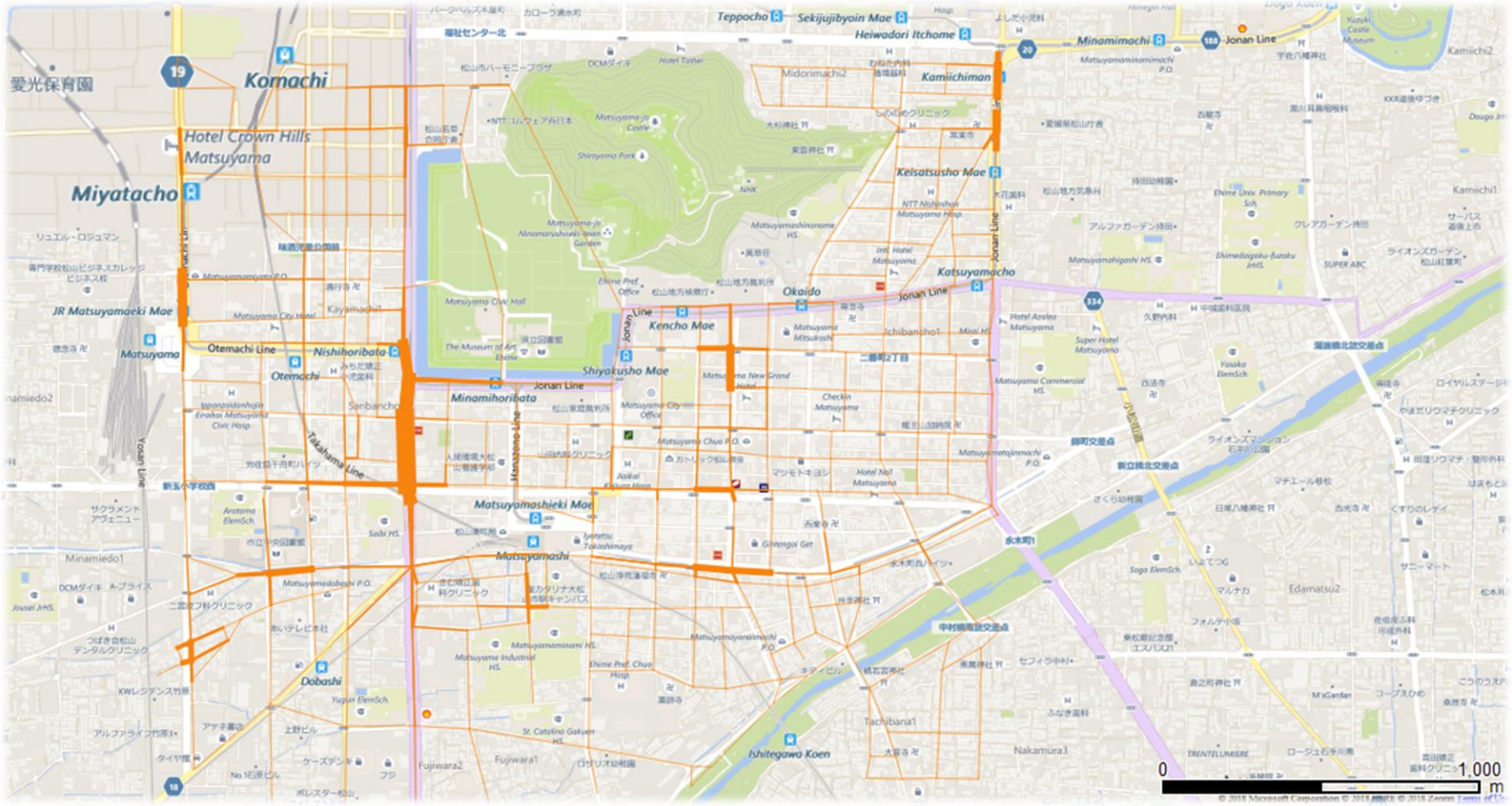
$$\mathbf{z} = (\boldsymbol{I} - \boldsymbol{M})^{-1} * \boldsymbol{b}$$

Link Flows Equation: $(\mathbf{I} - \boldsymbol{P}^{\boldsymbol{T}})\mathbf{F} = \mathbf{G}$

POLICY SIMULATION – (CASE-0)

Central Area

(**Without any change**)

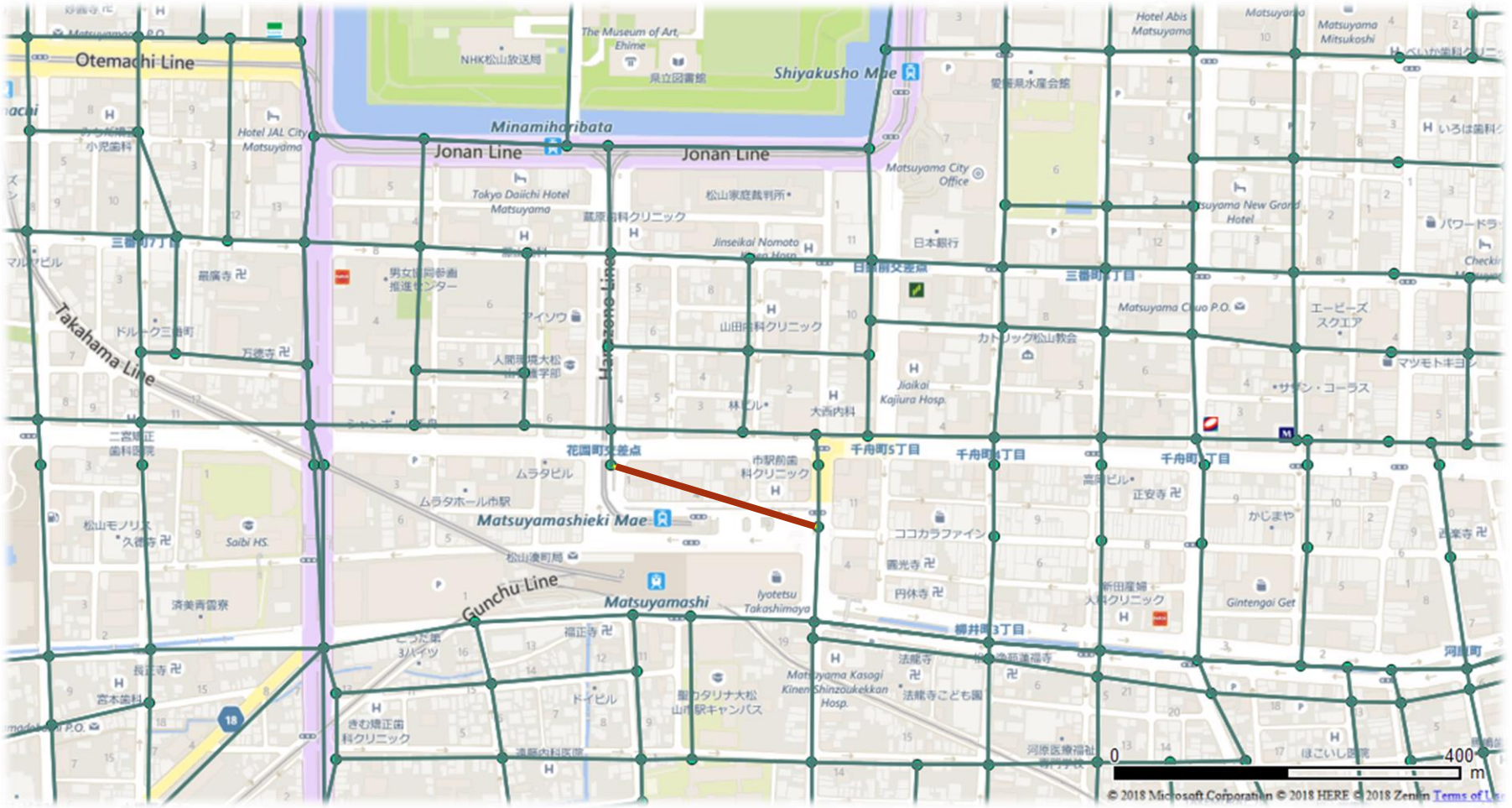


POLICY – (CASE-1)

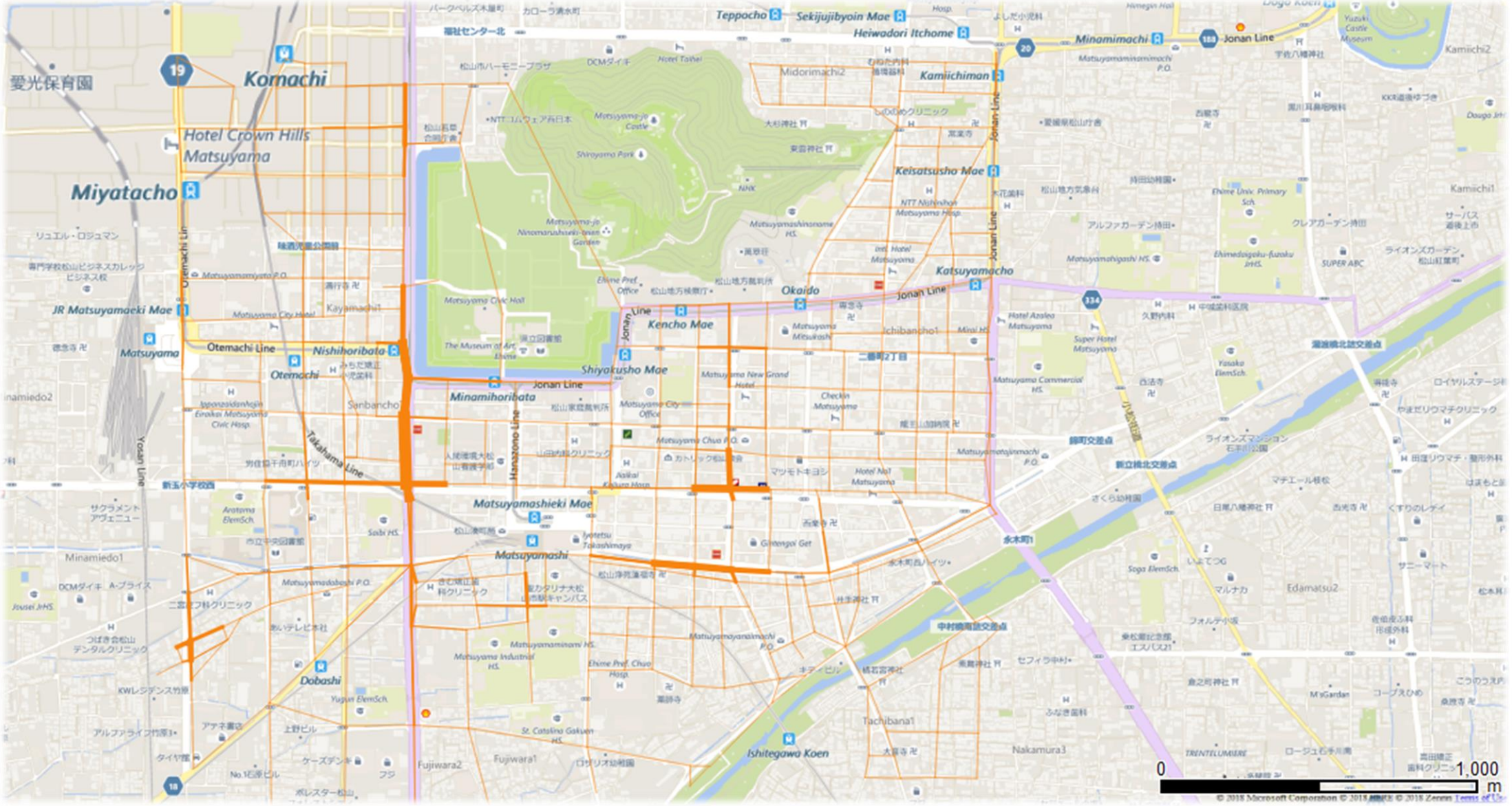
Prohibit Cars in two

(2) links

(**The road in front of Central Station**)



POLICY SIMULATION – (CASE-1)

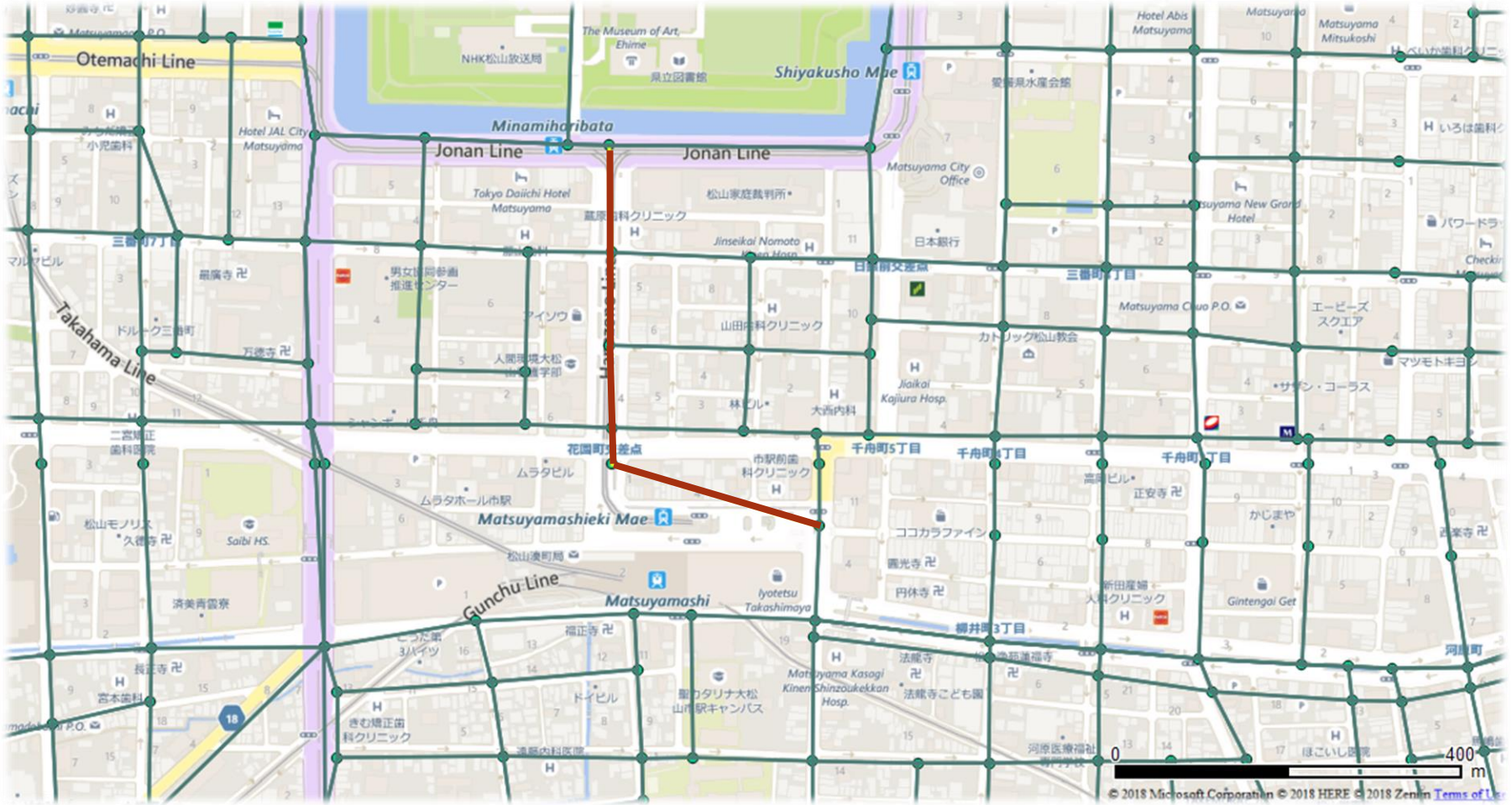


POLICY – (CASE-2)

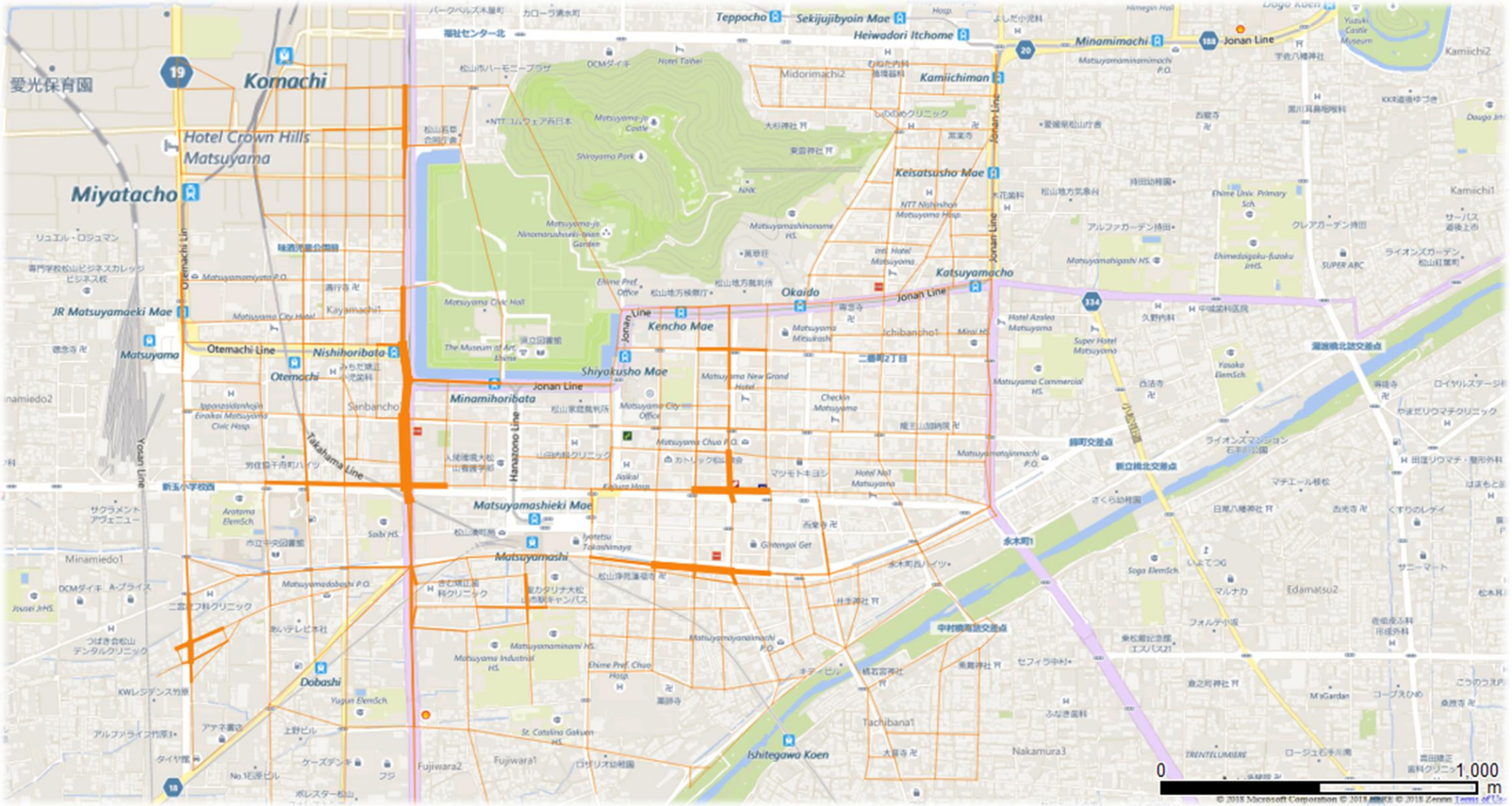
Prohibit Cars in ten

(10) links

(**Case-1 + Hanazonomachi Avenue**)

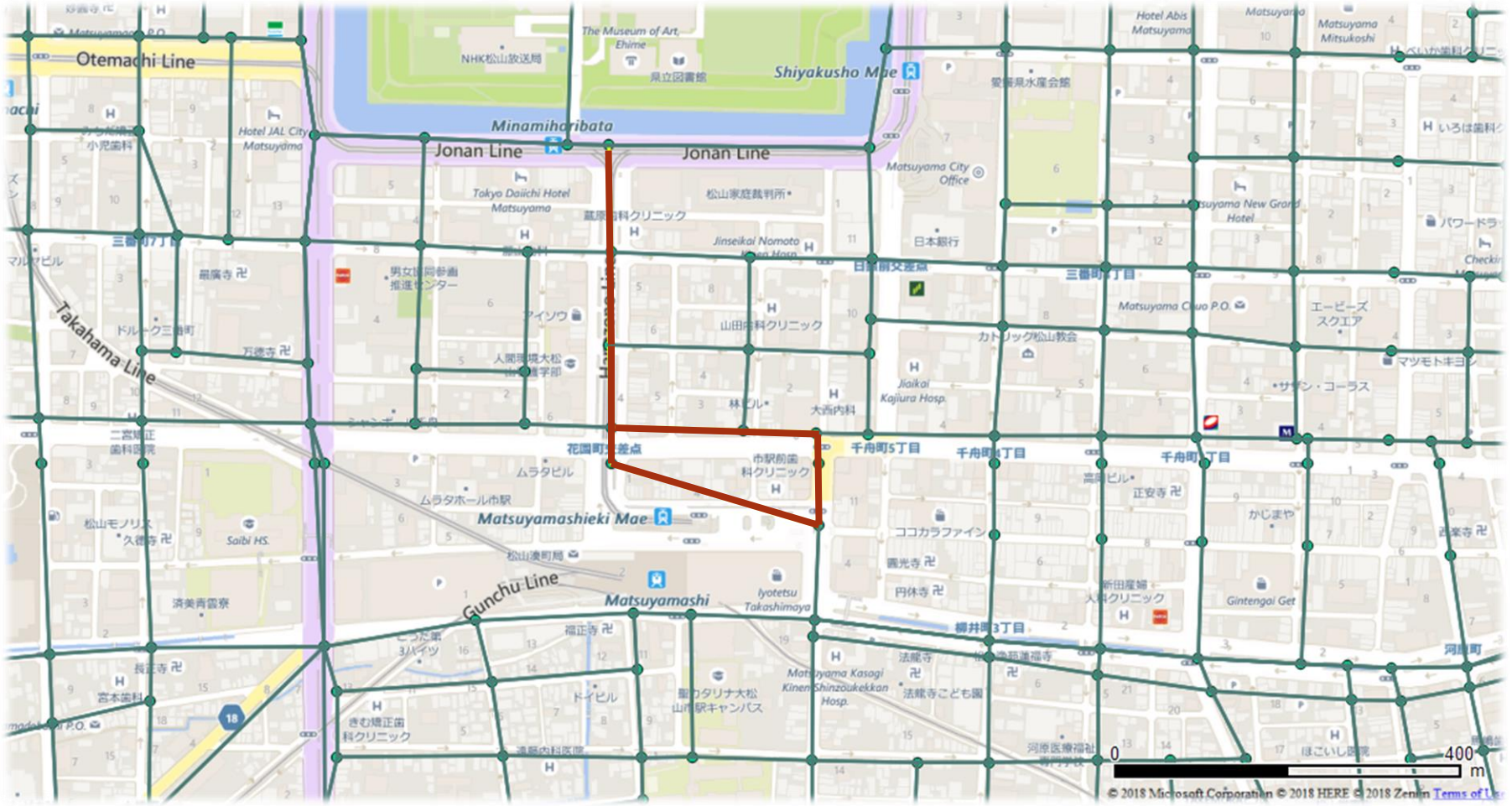


POLICY SIMULATION – (CASE-2)

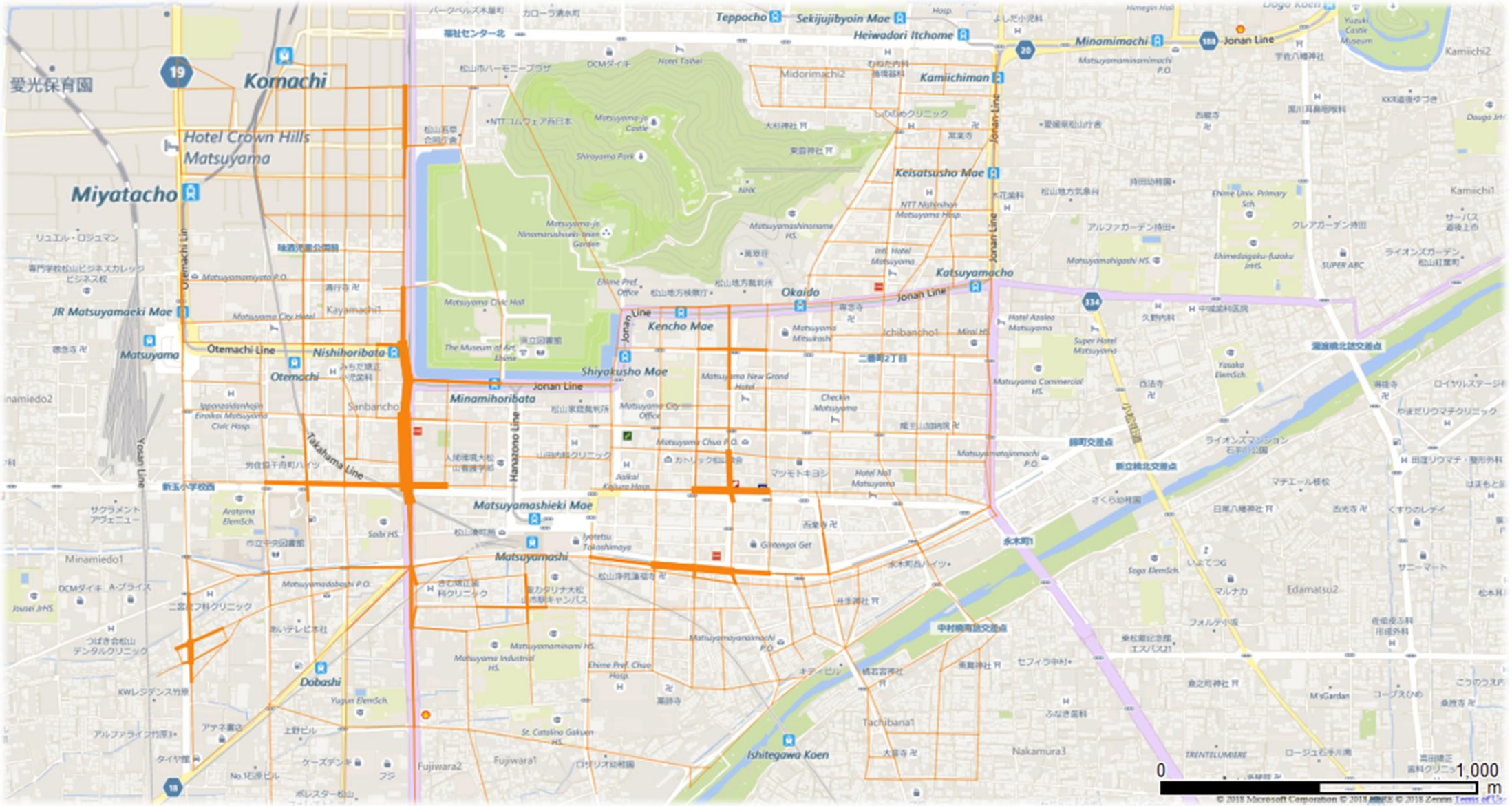


POLICY – (CASE-3)

Prohibit Cars in sixteen (16) links (**Case-1,2 + Making a Small Traffic Cell**)



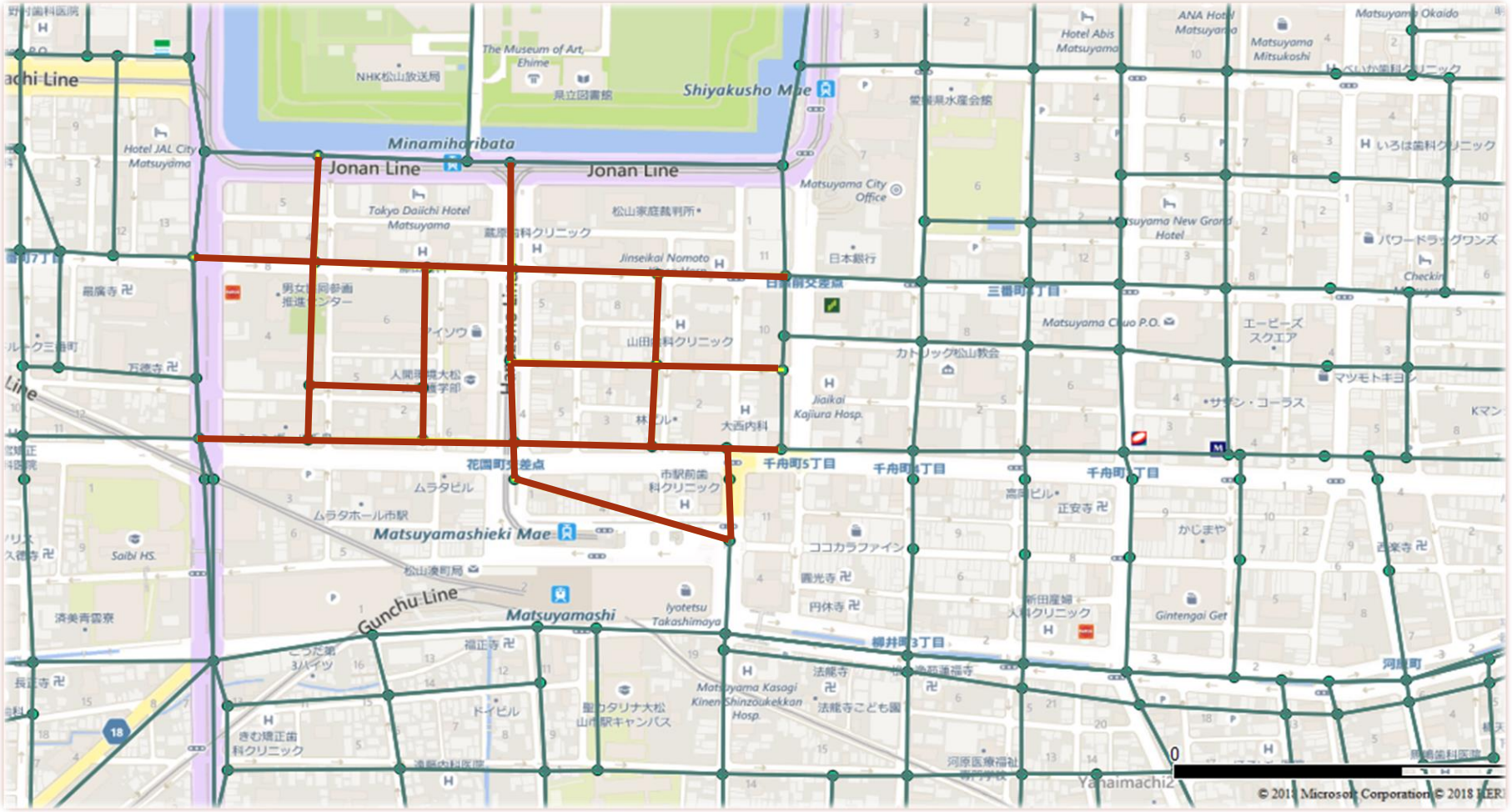
POLICY SIMULATION – (CASE-3)



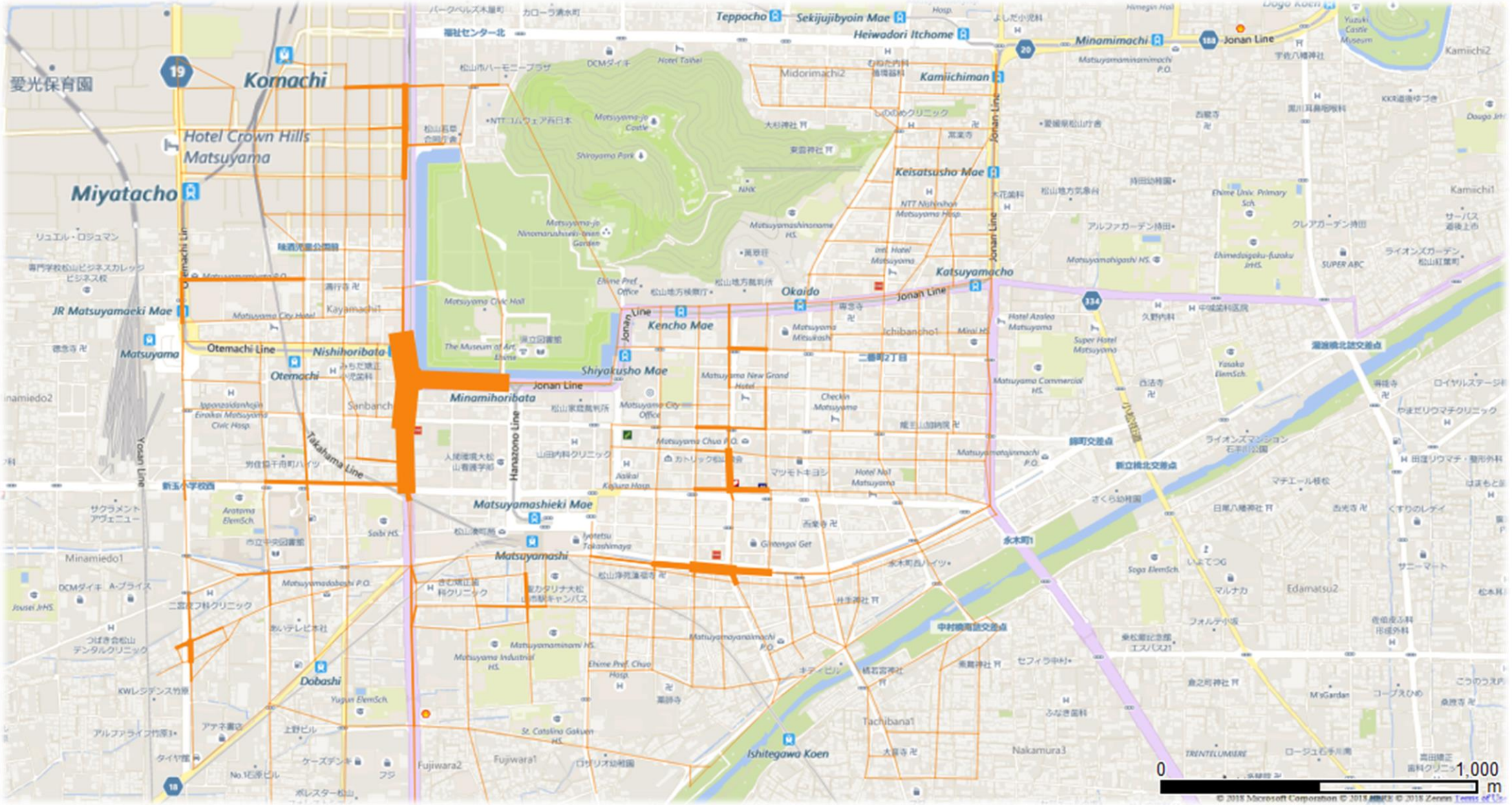
POLICY – (CASE-4)

Prohibit Cars in sixty (60) links

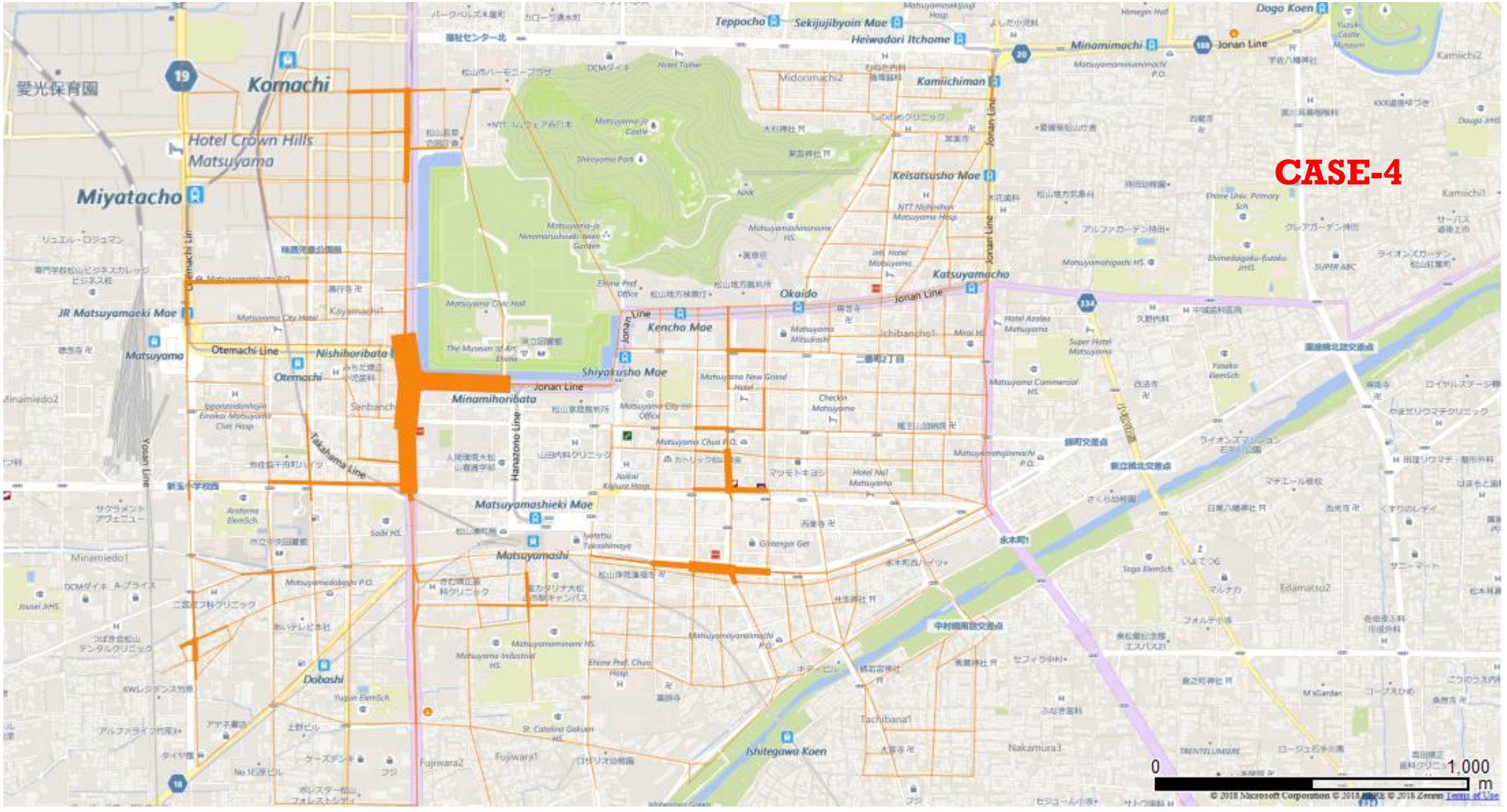
(Making a Large Traffic Cell)



POLICY SIMULATION – (CASE-4)



VISUALIZATION OF FLOW CHANGE




THANK
YOU