Site Selection for Alternative SUDOKWON Landfill

In the perspective of Efficiency and Equity

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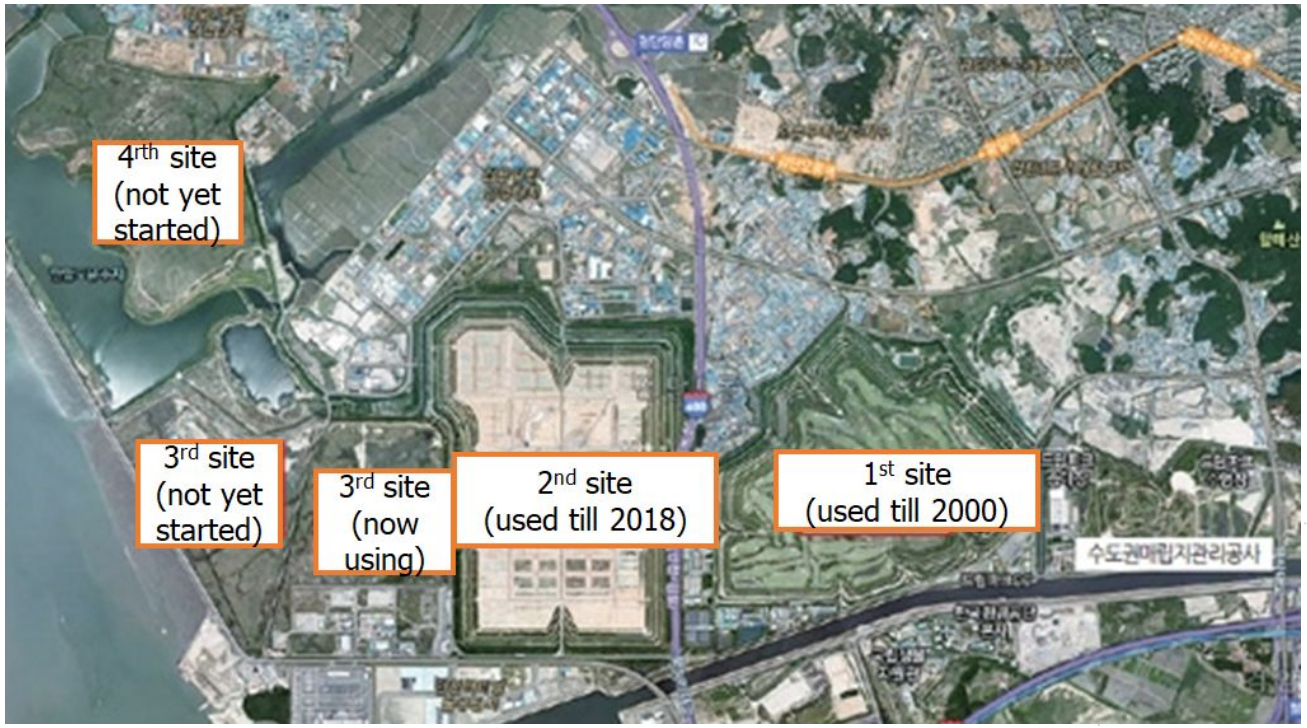
1. Introduction

Background on Sudokwon Landfill



- ✔ A mega-scale land fill site situated in Incheon
- ✔ Final destination of waste from Seoul, Incheon and Gyeonggi from 1992
- ✔ Expected to be saturated in 2025

Related bodies

- ✔ **Incheon**
  - Where the current site belongs
  - Arguing to end the current site
- ✔ **Seoul & Gyeonggi**
  - The beneficiary of this mega-scale landfill in the Incheon
  - Not show any active engagement
- ✔ **Ministry of Environment**
  - Only gave a temporary solution to prolong its operation

While Incheon calls for equity, others weight on efficiency!

1. Introduction

Objectives

- ✔ To suggest site to replace the current Sudokwon Landfill which satisfies the equity and efficiency

Questions

- ✔ Which criteria can be weighted to select an alternative landfill site?
- ✔ Where can be the best preferable place to replace Sudokwon landfill when applied the new criteria?

2. Literature Review

- **On landfill site suitability**

Han, Ji Youn (2014)	**The Systematization of Waste Landfill Site Selection Process Utilizing GIS**	**Selected the landfill site using standards criteria targeted on Cheongju area**
Yi, Sora et al. (2017)	Analysis of Landfill Resource Recovery Potentials and Strategies for Managing Future Landfills	Gave information on the current practices about landfill management
Lee, Jin Duk et al.(2000)	A Case Study on Suitability Analysis of Solid Waste Landfill Site Utilizing GIS	Suggested socio-economical, natural environmental factors and its weighting which should be considered finding Landfill suitability
Lee, Jin Duk et al.(1999)	A Case Study on Landfill Site Selection Utilizing GIS	Modeled a landfill site selection reflecting socio-economic factors and natural environmental factors.

- **On Environmental justice**

Vari Anna(1996)	**Public Perceptions about Equity & Fairness: Siting Low-level Radioactive Waste Disposal Facilities in the U.S. and Hungary**	**Highlighted technical efficiency, local consent(preference), criteria for distributive justice(contribution to the problem, ecological vulnerability, socio-economic vulnerability) in selecting a site for risky facility.**
Renn Orwin(1996)	Procedural and Substantive Fairness in Landfill Siting: A Swiss Case Study	The key point is the equal distribution of resources not status quo. The procedural equity was also stressed

3. Conceptual Framework

✔ Overall Evaluation

eco
socio

- Eco Criteria
  - Altitude
  - Slope
  - Fault
  - River
- Socio Criteria
  - Population density
  - Road
  - Land-use

✔ Zoning and site selection

Equity

- Zoned by Waste Generation per capita
- Rotate landfill zone by Waste generation

Efficiency

- Considered land price and transport distance selecting a suitable site in the designated zone.

4. Data and Work flow

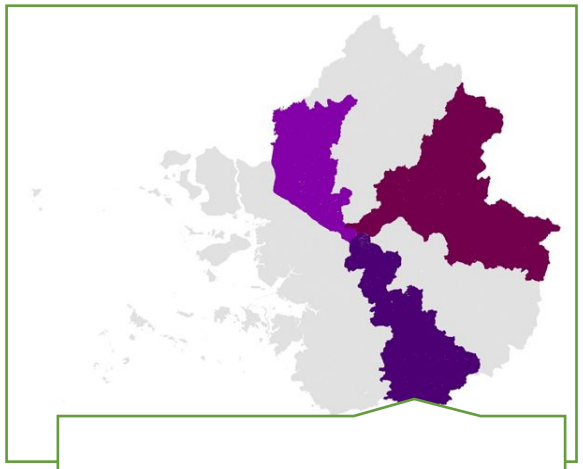
- **Data**

Classification	Variables		Input Data Type	Resource
Natural Environment Factor	Topography	Altitude	Raster	National Spatial Data Infrastructure Portal data.nsdi.go.kr
		Slope	Polygon	
		Fault	Polyline	
	Water Resources	River	Polyline	
		Reservoir	Polygon	
	Conservation Area	Water source	Polygon	
		Green-belt	Polygon	
Socio economic Factor	Population Density		Excel data	Open Data Portal data.go.kr
	Land use			
	Land price			
	Roads		Polyline	NSDIP data.nsdi.go.kr

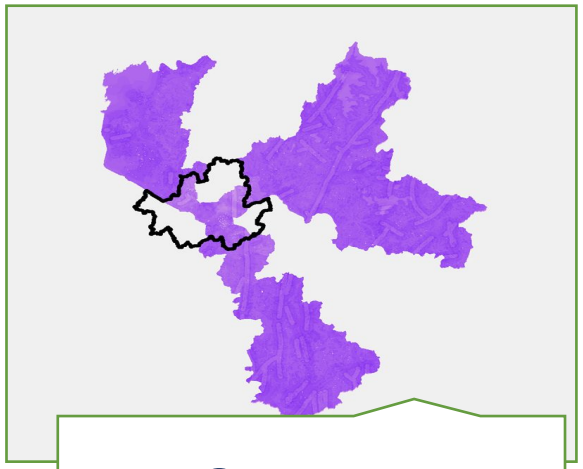
4. Data and Work flow

- **Work flow**

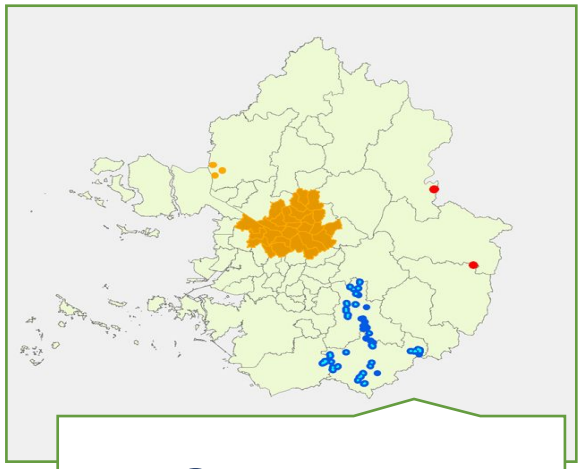
Exclusion



Zoning



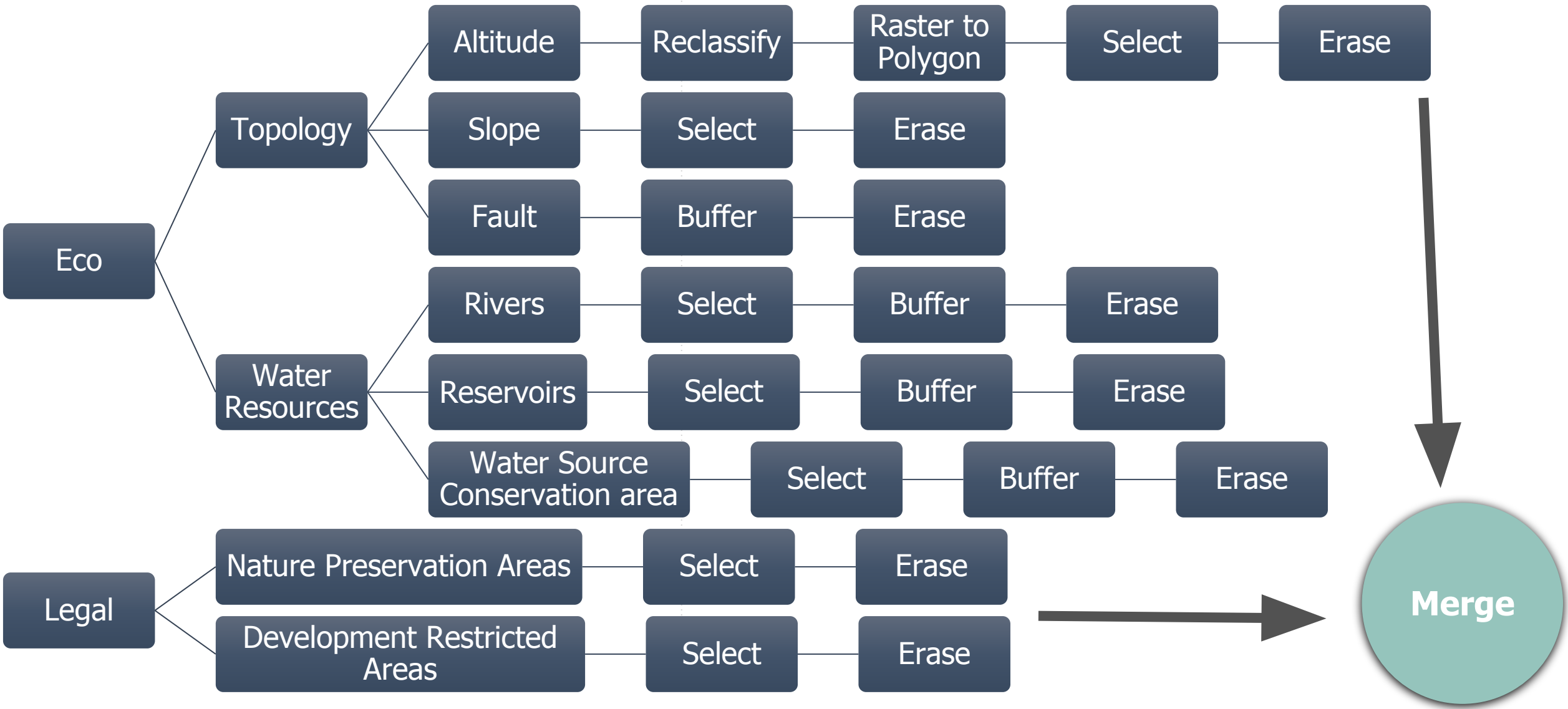
Scoring



Selection

5. Analysis with ArcGIS

- **Exclusion Flow**



5. Analysis with ArcGIS

- **Exclusion Standard**

	Criteria	Standard
Exclusion Factors	Fault	Within 600m
	Altitude	Over 600m
	Slope	Over 30%
	River	Within 300m
	Reservoir	Within 300m
	Conservation Area	Natural source/Green-belt/ Water source

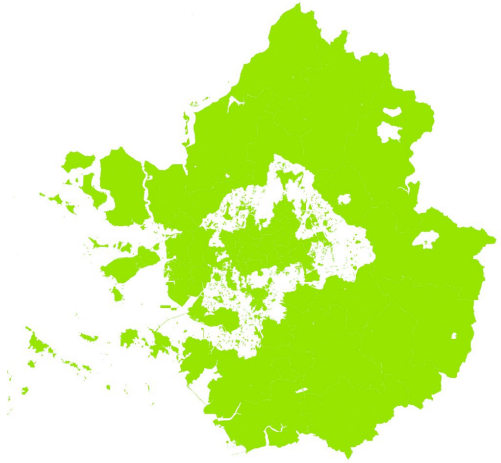
5. Analysis with ArcGIS

- **Exclusion Factors**

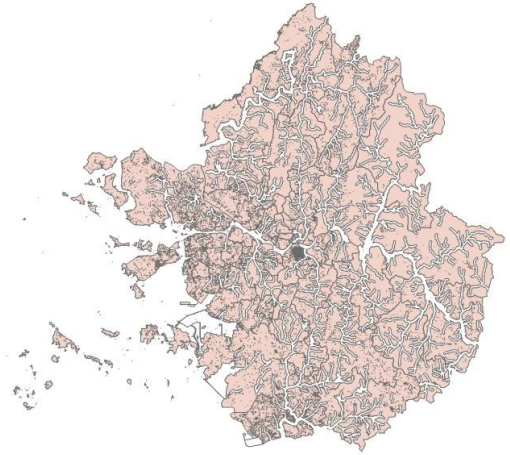
Altitude

Fault

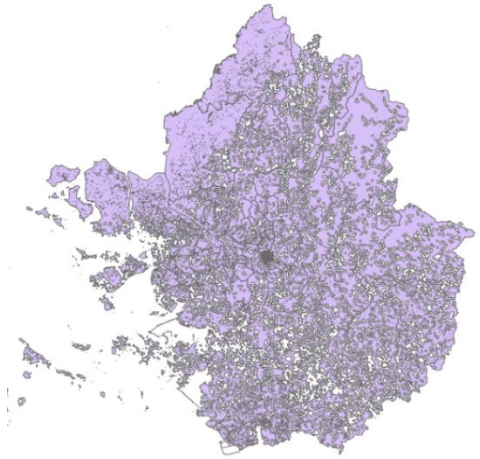
Slope



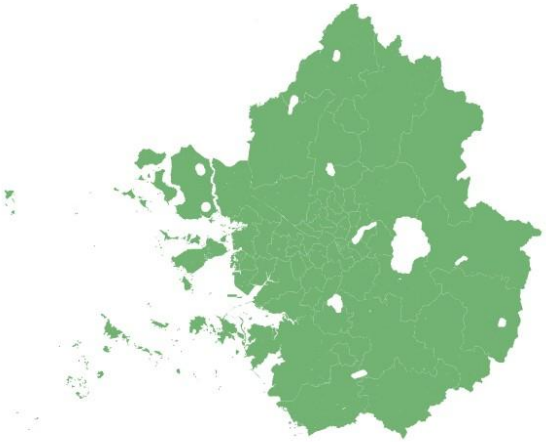
Conservation Area



River



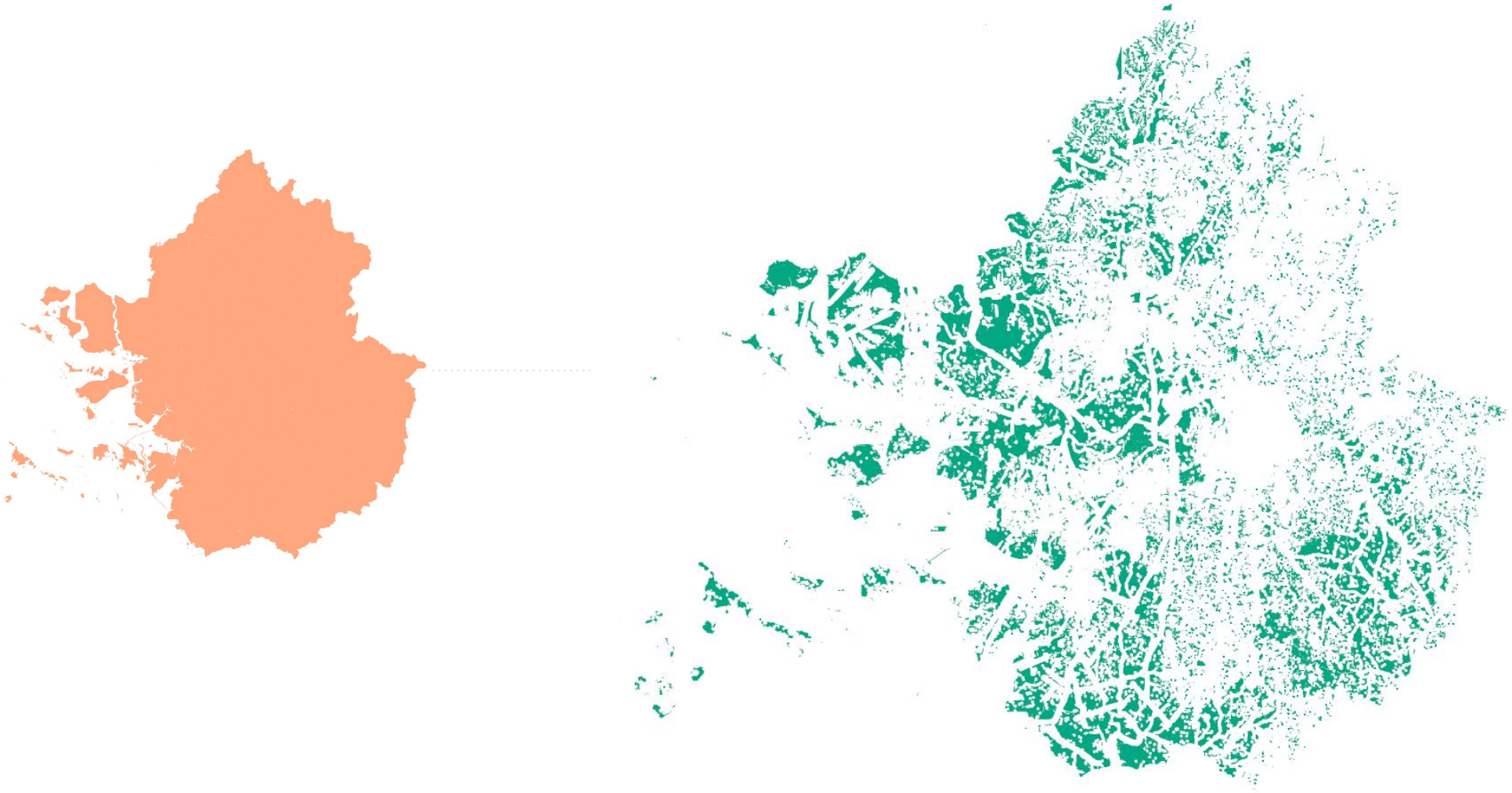
Reservoir



Water Source Conservation Area

5. Analysis with ArcGIS

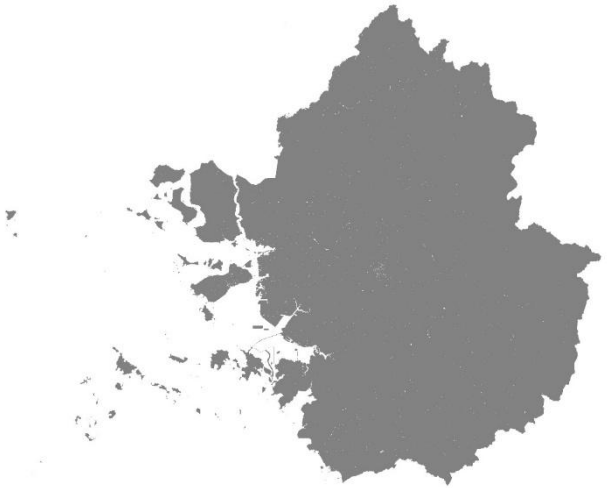
- **Exclusion(all combined)**



5. Analysis with ArcGIS

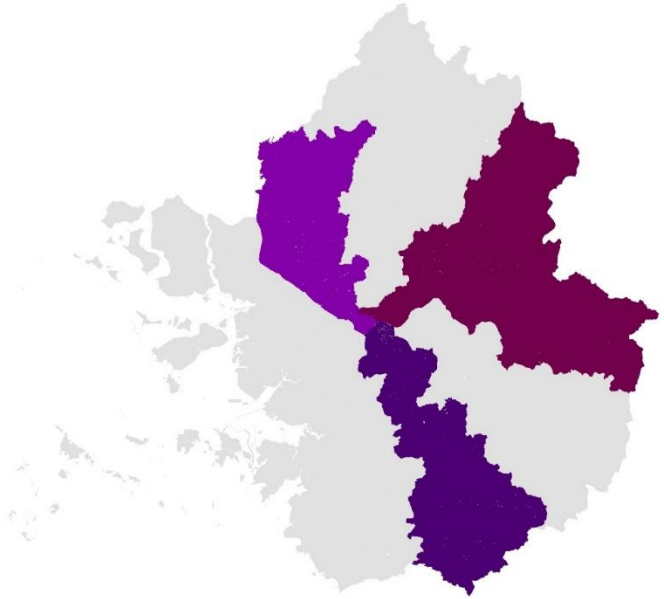
- **Zoning**

Sudokwon Map → **Assign values** (Spatial join) → **7 zones** (Dissolve/ Clip)



1. Dividing Sudokwon area to several zones
   - ✔ Referring for Seoul bus line system
2. Ranking zones by waste generation per person

Rank	Area	Amount Kg/1person/1day
1	Seongdong, Gwangjin, Guri, Yangpyeong, Gapyeong	1.404kg
2	Seocho, Gangnam, Seongnam, Yongin, Anseong	1.245kg
3	Mapo, Paju, Seodaemun,Goyang,	1.203kg

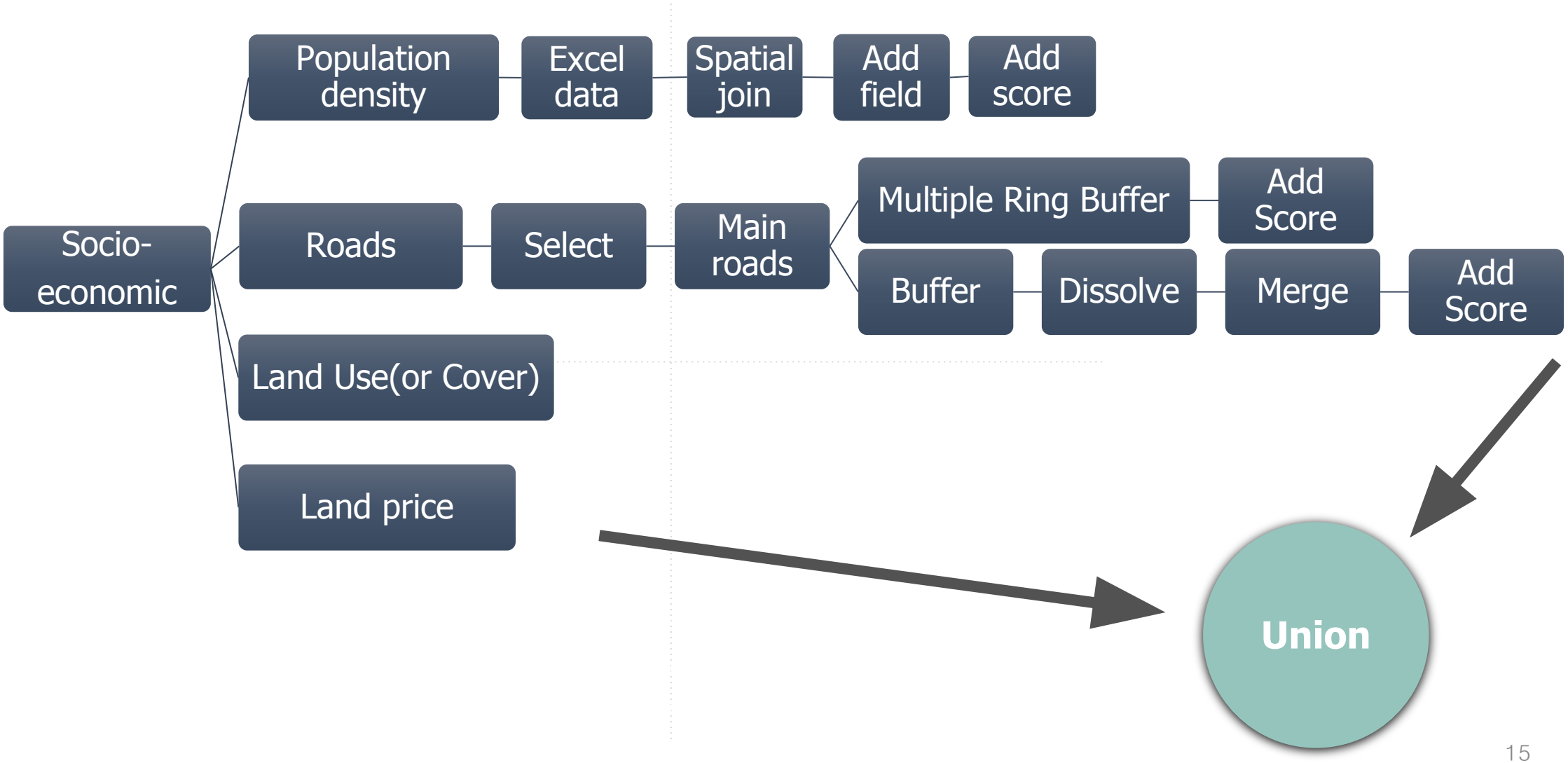


5. Analysis with ArcGIS

- **Scoring flow**

5. Analysis with ArcGIS

- **Scoring flow**



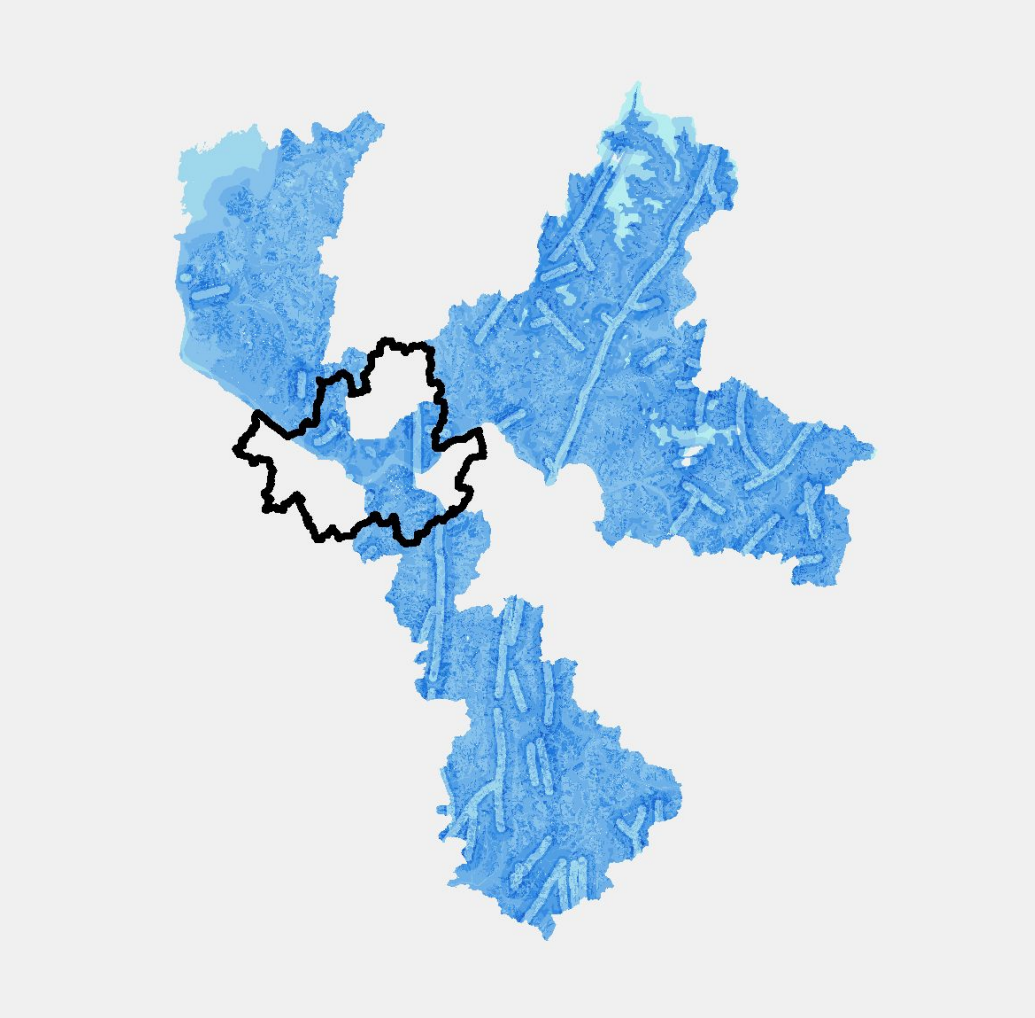
5. Analysis with ArcGIS

- **Scoring Board**

	Criteria	1st(3 points)	2nd(2 points)	3rd(1 points)
Eco	Fault	2000m -	1000 - 2000m	600 - 1000m
	Altitude	- 200m	200 – 400m	400 - 600m
	Slope	0 – 7%	7 - 15%	15 - 30%
	River	- 500m	500 – 1000m	1000 – 1500m
	Reservoir	- 500m	500 – 1000m	1000 – 1500m
Socio	Population Density	–16,400 cap/km^2	16,400 – 13,200 cap/km^2	20,000 –16,400 cap/km^2
	Main roads	- 500m	500 – 1000m	1000 – 1500m
	Land Use	paddy field, orchard, pasture, forestry,	park, gymnastic site, recreation area	residential,commercial, industrial facilities
	Land price	–1,400,000 W/m2	1,400,000–3,000,000 W/m^2	3,000,000–11,000,000 W/m^2

5. Analysis with ArcGIS

- **Scoring(Eco)**



- **Considering factor**

  Fault + Altitude + Slope

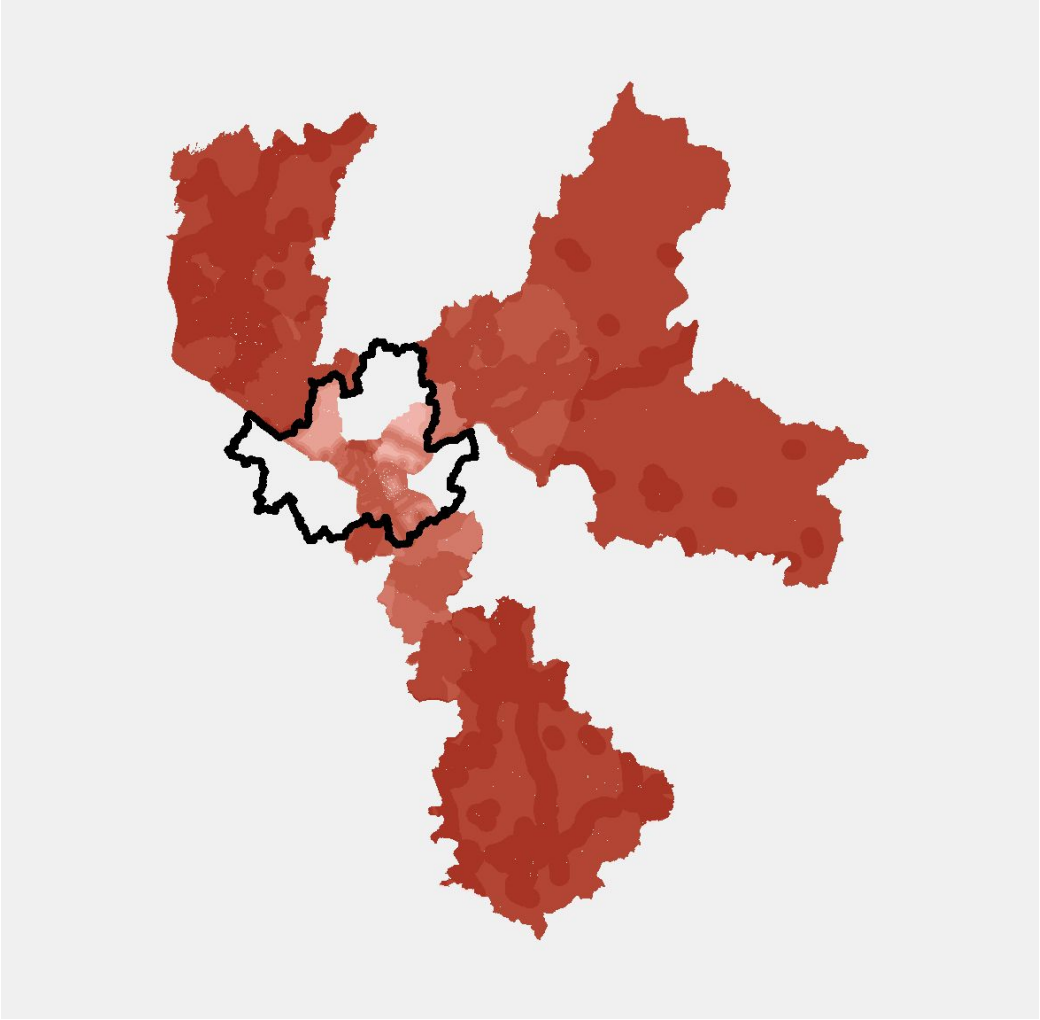
  + River + Reservior

- **Layer**

  Dark blue = highscore(0~12)

5. Analysis with ArcGIS

- **Scoring(socio)**



- **Considering factor**

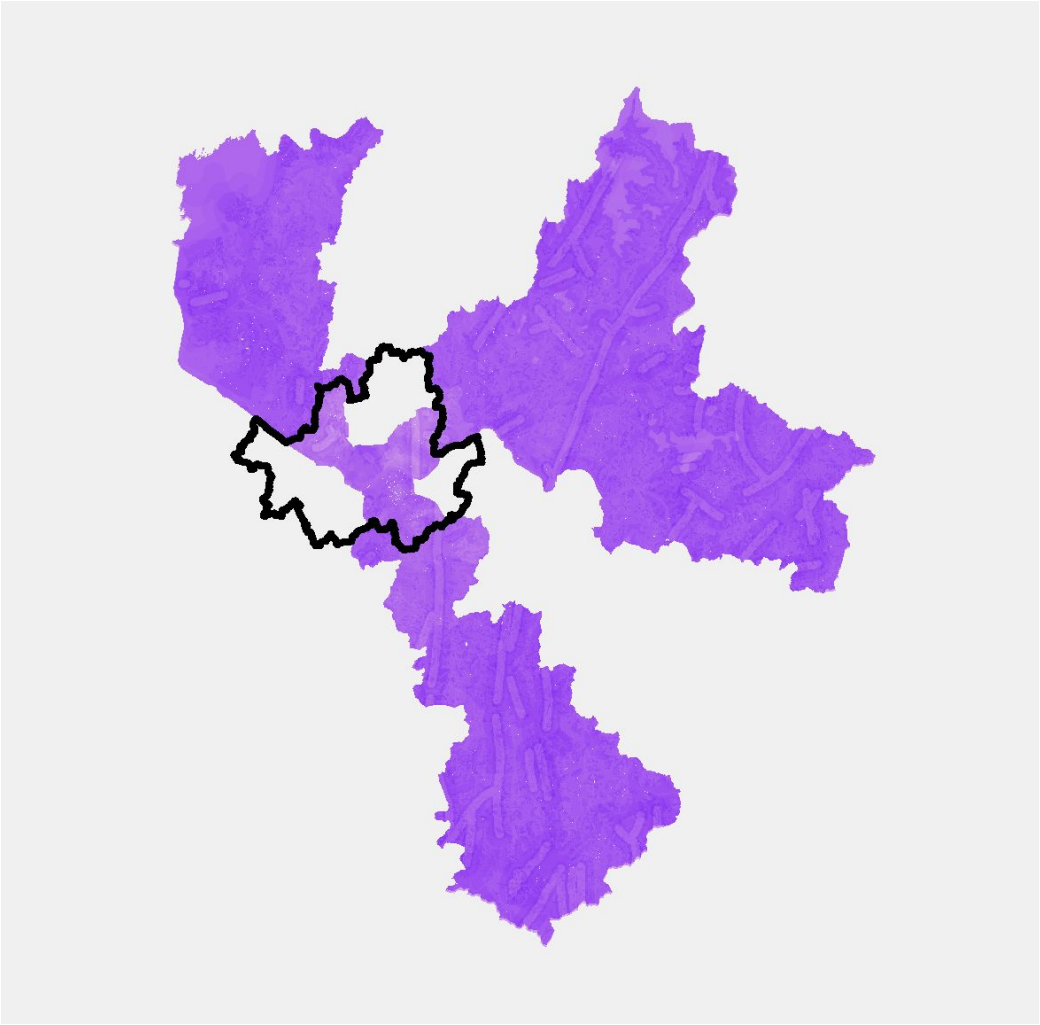
  Population density + Main road + Land use + Land price

- **Layer**

  Dark red = highscore(0~12)

5. Analysis with ArcGIS

- **Scoring(All combined)**



- **Considering factor**

  total score =

  Eco factor + socio factor

- **Layer**

  Dark violet

=highscore(0~24)

6. Results

- **Site Selection**

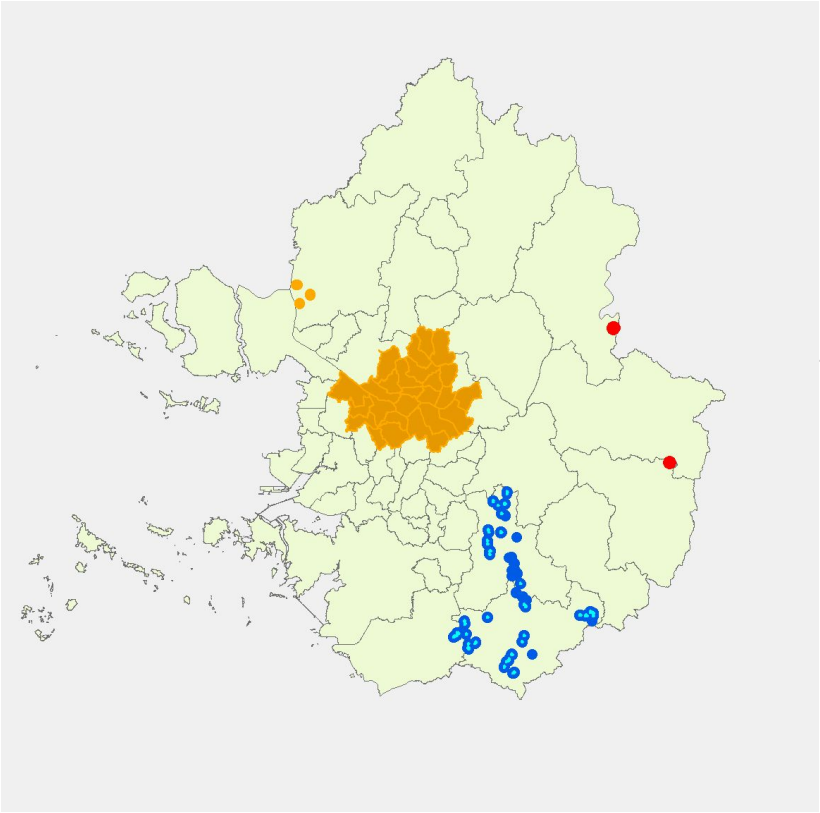
Union
- Eco map
- Socio map

→ Erase
- Exclusion areas

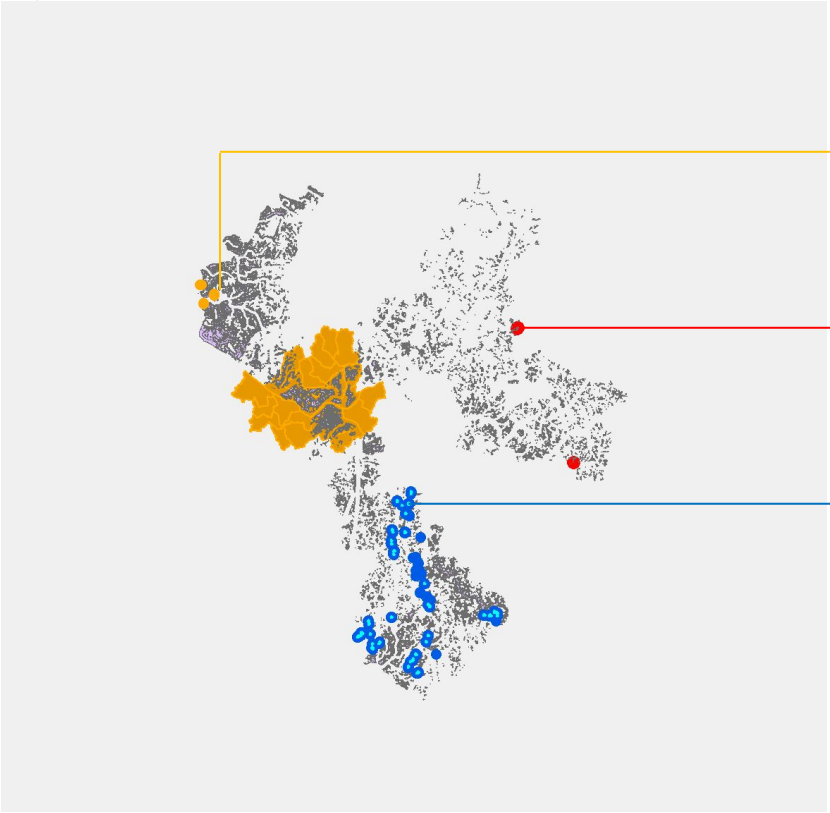
→ Select by attribute

→ Site selection

Site location in SUDOKWON



Site location in AREA2, 4, 7



AREA7
Tanhyeon-myeon, Paju

AREA2
Sulmak-myeon,
Gapyeong-gun

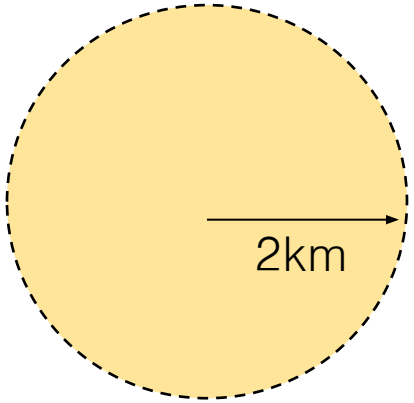
AREA4
Chou In-gu, Yongin

6. Results

- **Explanation on the site**

AREA7

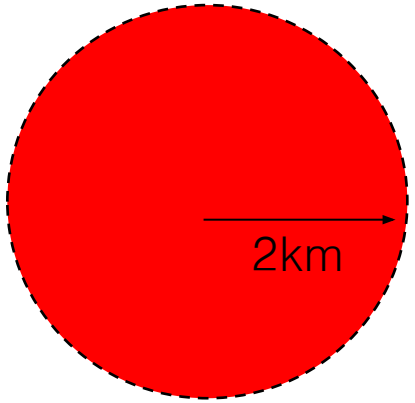
Tanhyeon-myeon, Paju



Paddy field & Forestry	Value
Land price	117,513 Won/m^2
Land purchase cost	480,628,000,000 Won
Paddy+forestry Rate	52.40% (6.6km^2/4πkm^2)
Distance to Gwanghwamun	50km(road) 34km(straight)

AREA2

Sulmak-myeon, Gapyeong-gun



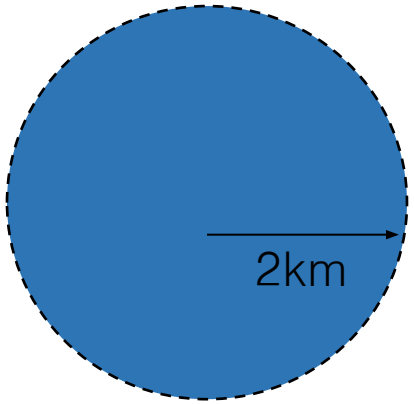
Paddy field & Forestry	Value
Land price	40,472 Won/m^2
Land purchase cost	165,530,000,000 Won
Paddy+forestry Rate	89.52% (11.24km^2/4πkm^2)
Distance to Gwanghwamun	60km(road) 49km(straight)

6. Results

- **Explanation on the site**

AREA4

Chou In-gu, Yongin



Paddy field & Forestry	Value
Land price	85,567 Won/m^2
Land purchase cost	349,969,000,000 Won
Paddy+forestry Rate	78.44% (9.85km^2/4πkm^2)
Distance to Gwanghwamun	51km (road) 42km(straight)

[Comparison] of Socio factor

Comparison	Gapyeong	Paju	Yong-in
Land price	40,472Won/m^2	117,513Won/m^2	85,567Won/m^2
Land cost	165billion won	480billion won	350billion won
Rate	89.52%	52.40%	78.44%
Dist. to Seoul	49km(straight)	34km(straight)	42km(straight)
Pop. density	100(person/km^2)	700(person/km^2)	1400(person/km^2)

7. Implications

- **Policy implication**

1. No capable land for landfill to achieve “Polluter pays principle”

   In fact, Jung-gu, a center of Seoul, has a highest level of the waste generation among the sudokwon, but the area are filled with other facilities.

2. Replace the land-fill method to the alternatives with eco-friendly ways

   Instead of mega scale of land-fill, we have to set up small-scale land-fills by reducing waste generation and increasing preprocessing facility like a MBT(Mechanical Biological Treatment).

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