KÁROLY RÓBERT FŐISKOLA
TUDÁSSAL A JÖVŐÉRT

FELSZÍNI SZENNYEZÉS REMEDIÁCIÓ PONTOSSÁGÁNAK JAVÍTÁSA

TOWARD PRECISE SURFACE POLLUTION REMEDIATION

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Presentation outlines

Introduction: context and concepts

Part 1 – geo-processing tools development for automatic planning (parcels and navigation lines)

Conclusions 1

Part 2 - Clean-up work: practices, navigation and grading control systems

Conclusions 2

Intro: context and concepts

Context and concepts

Red mud disaster (October 4, 2010) used as case study

Context and concepts

Disaster response:

- Aerial surveys (HS, LiDAR, etc.)
- Pollution mapping (accuracy = 0,5m)

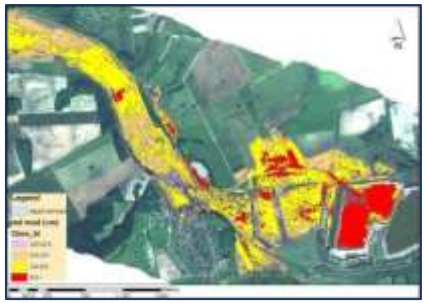
Disaster clean-up:

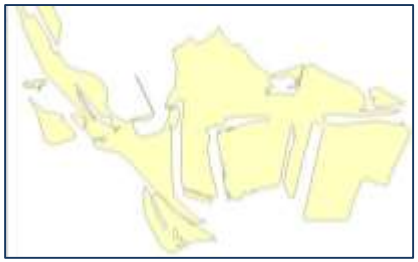
- Without digital exploitation of GI !

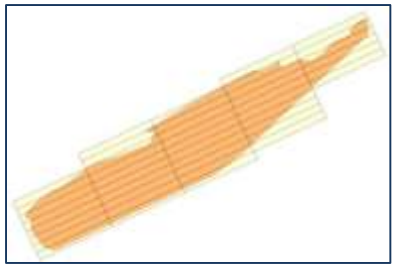
Because of the lack of geoprocessing tools & methods

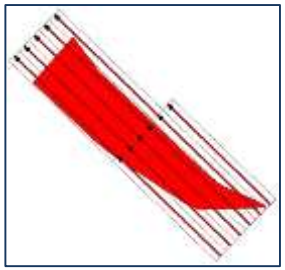
Context and concepts

Activ.:	1 Mapping — Done	2 Remediation planning method and tools — Research	3 Machine control — research
Techn.:	Remote sensing, geostatistics	GIS	Positioning /navigation (horiz.) /grading control (vert.)









Integrated approach → GI continuum (full exploitation, integrity, accuracy)

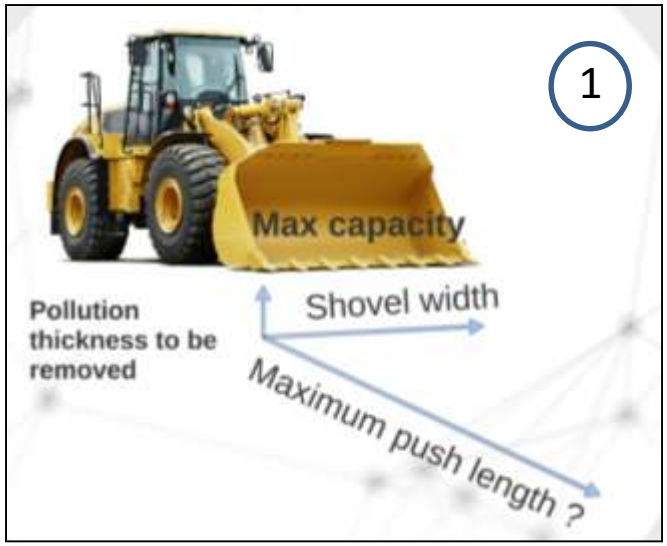
Precise remediation → More accurate removal of pollution, optimization of overlay between passages, less repass = better efficiency + faster + less costs

Part 1: geo-processing tools development for automatic planning

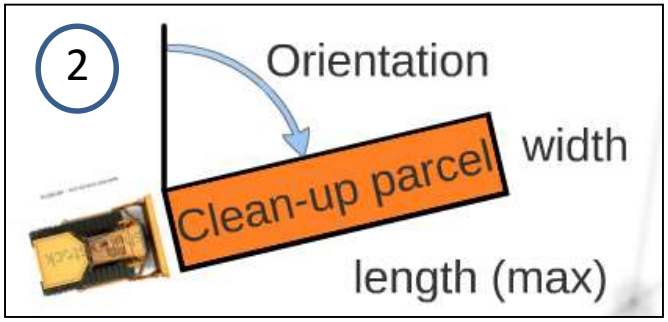
Clean-up plan algorithm development

3 input parameters:

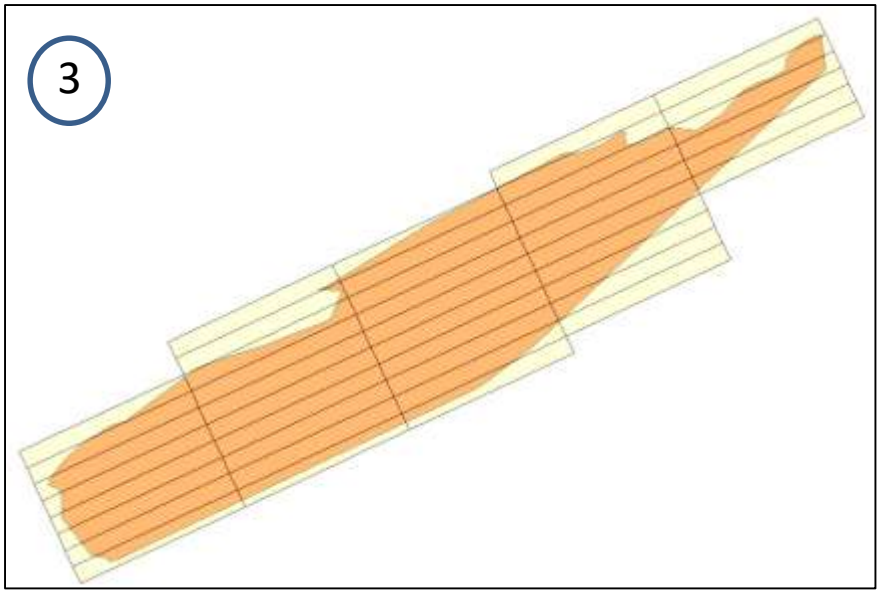
- **width**
- **max. lenght**
- **orientation**



Inherited geometric properties

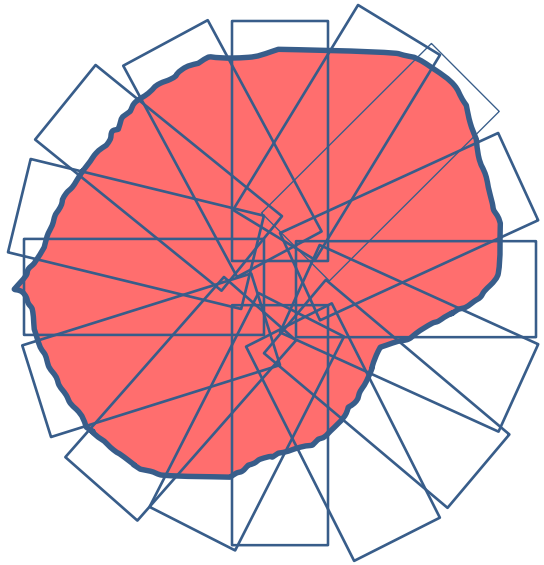


Object of Interest: clean-up parcel

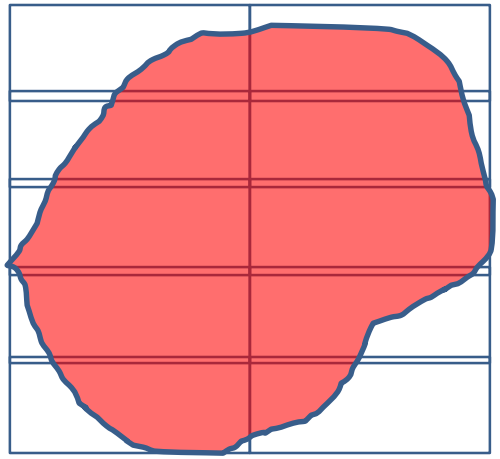


Clean-up plan

Clean-up plan algorithm development



16



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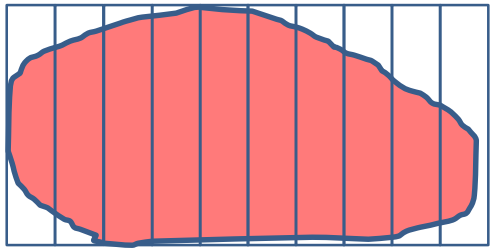

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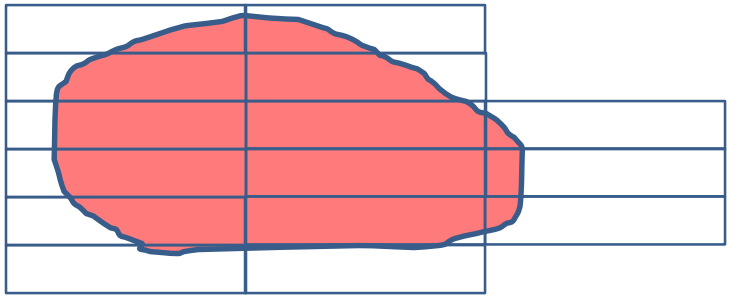
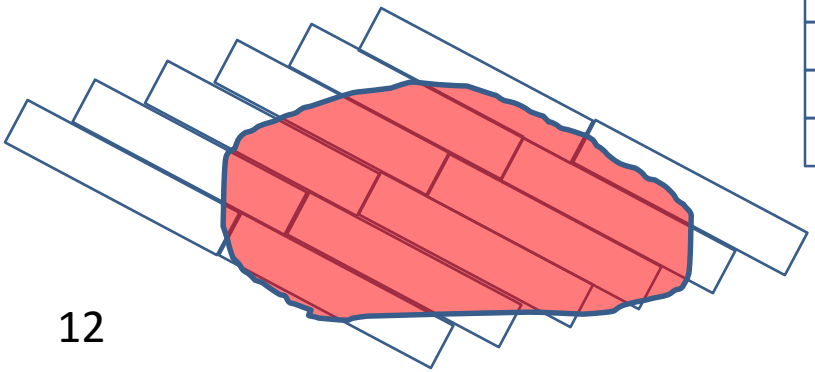
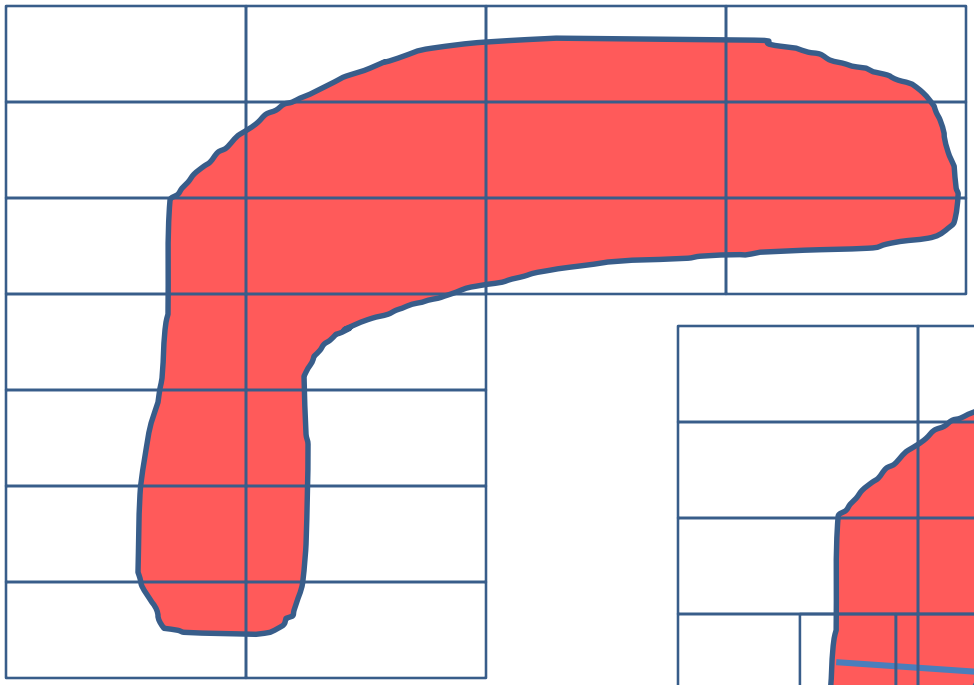


15



12

Clean-up plan algorithm development



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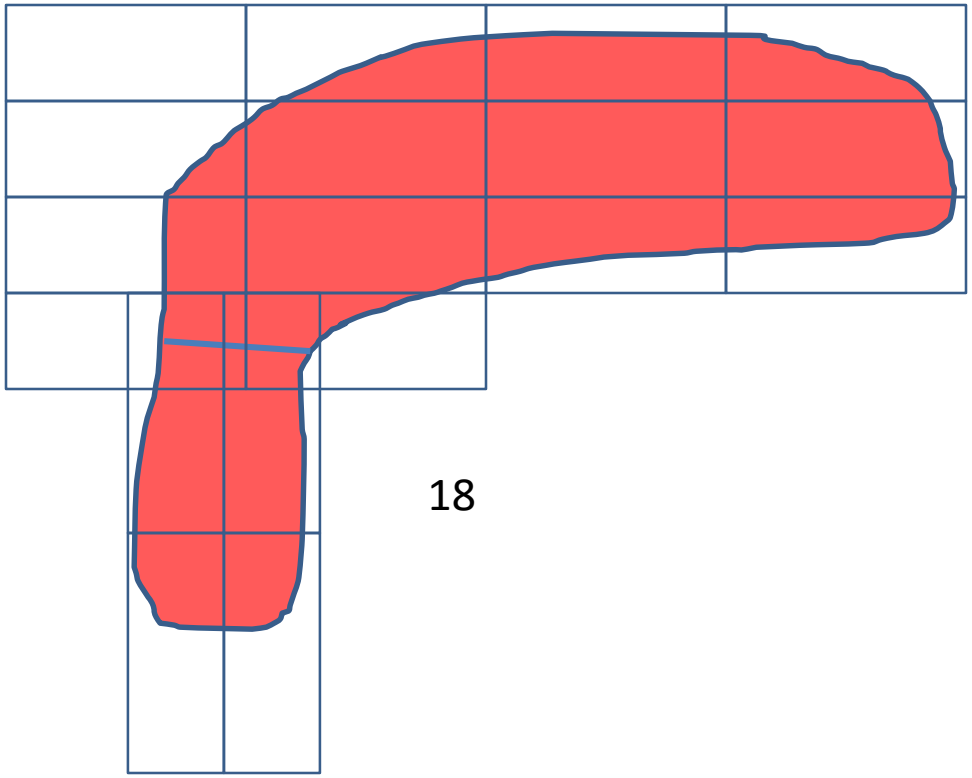
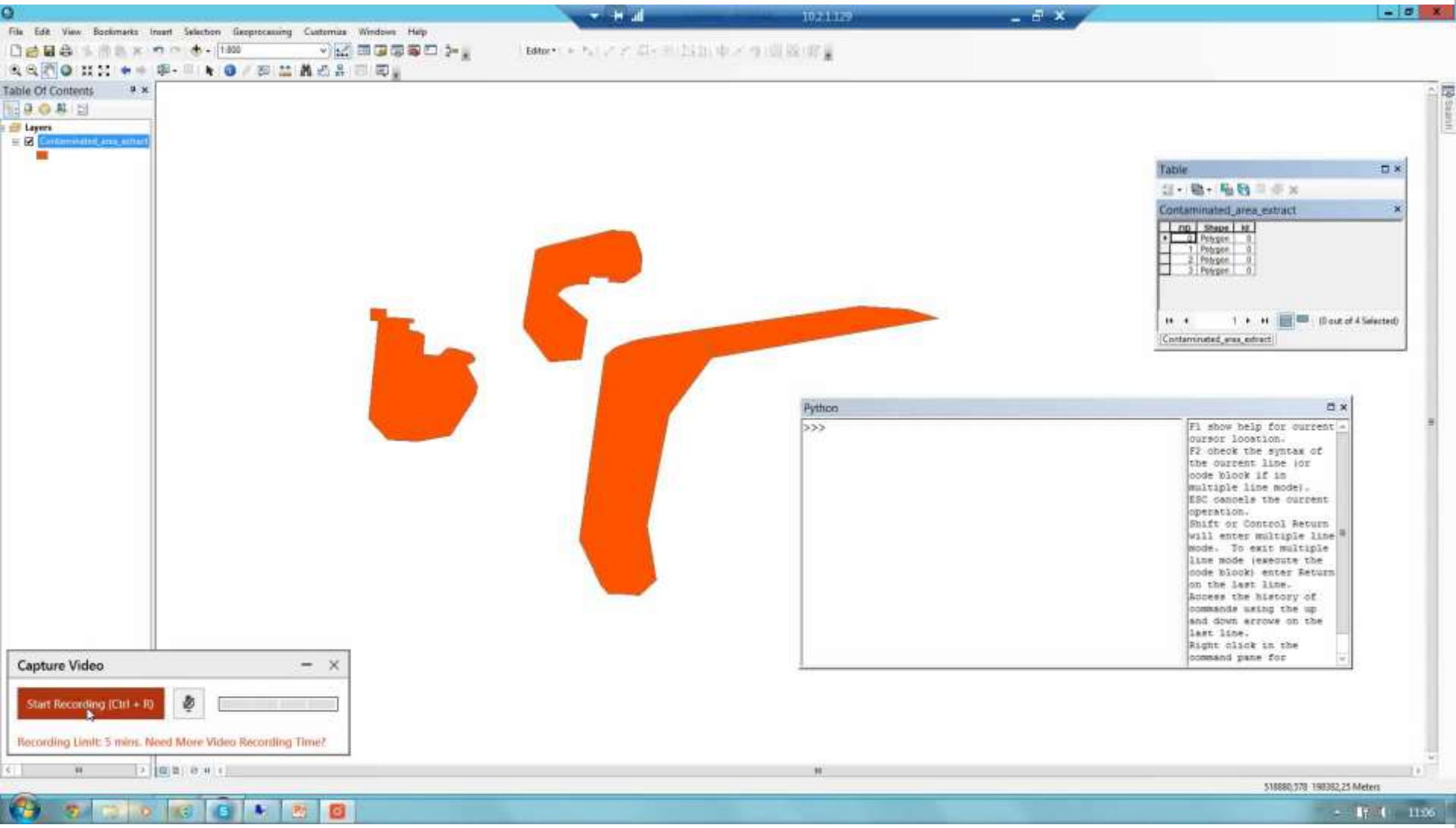


18

Modification of parcel desing algorithm, tests and results



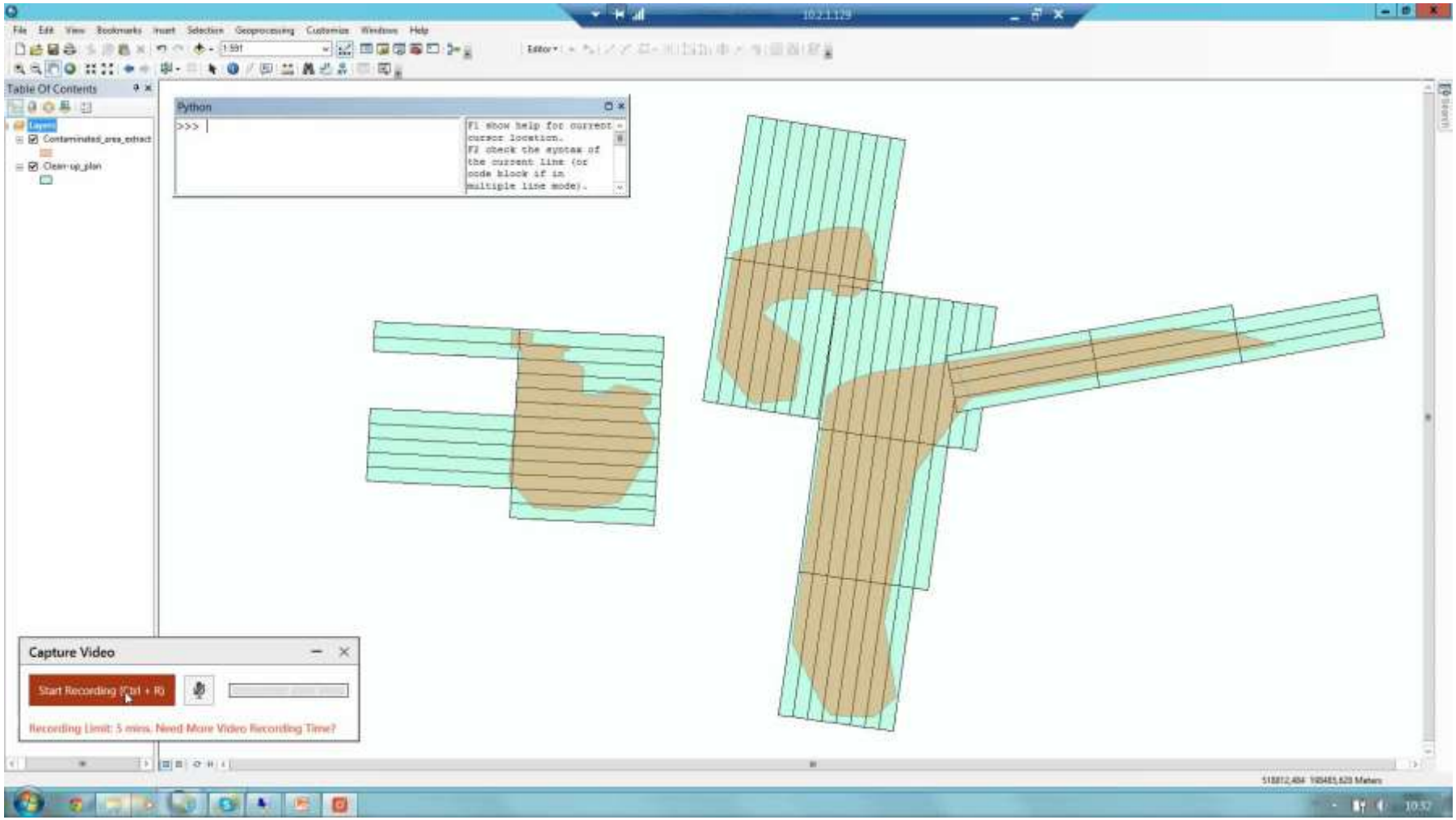
Modification of parcel desing algorithm, tests and results

Version 1.0 Version 2.0

Sum max: 63842 parcels Sum min: 57896 Sum: 55066

- 9 % -5 %

Navigation line algorithm results



Conclusions – Part 1

Automatic navigation data generation is done. Two steps: clean-up plan & navigation lines.

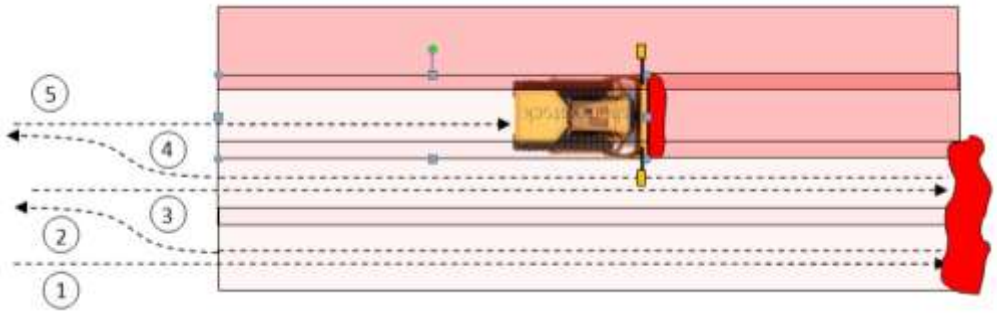
Orientation is a parameter to consider to optimize the planning.

Manual preparation of dataset is necessary

4 km^2 = 3h40 hours processing (only considering planning) with 55 000+ parcels

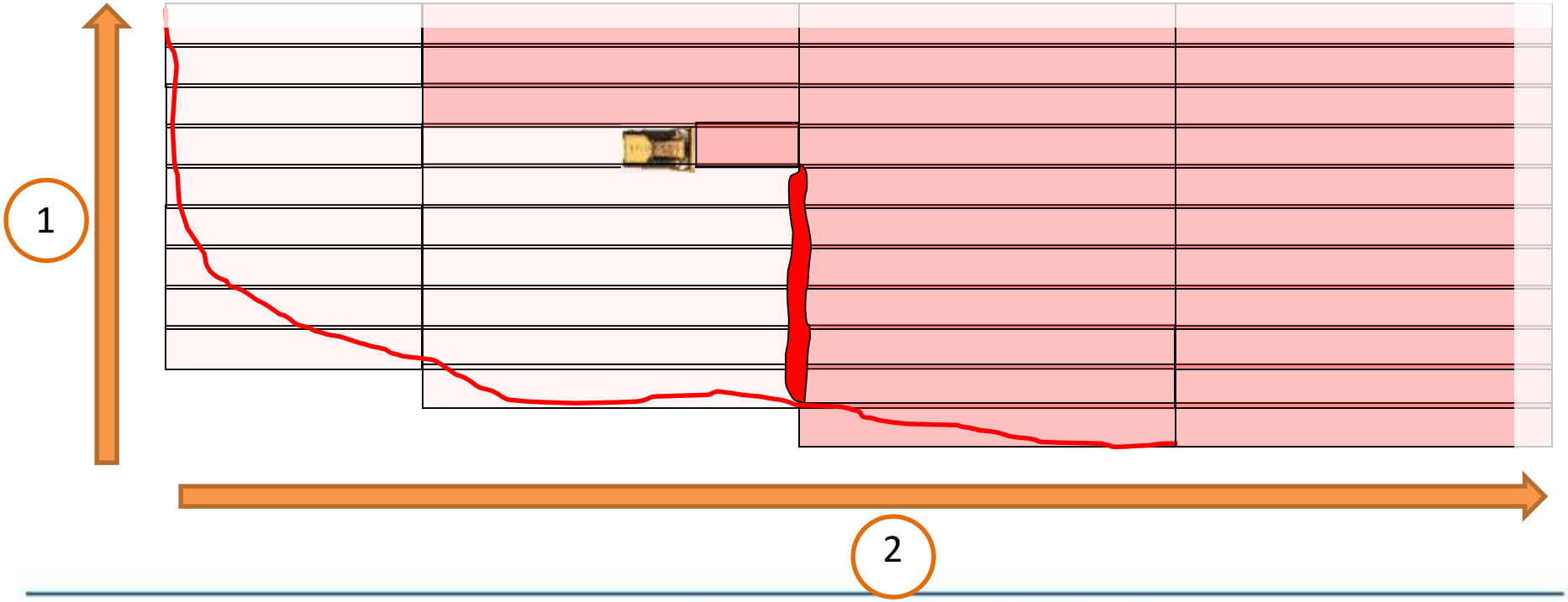
Part 2: Field practices, navigation and grading control

Part 1 – mouvements & progressions & coordination

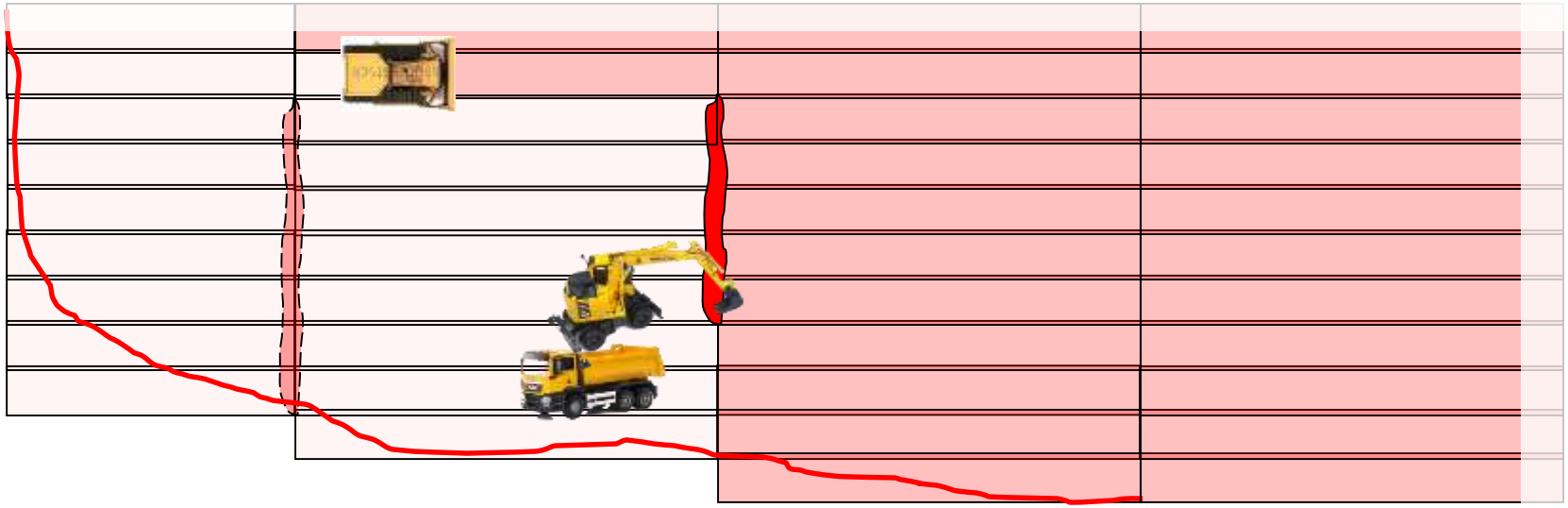


Avoiding cross-contamination

Rule: machine moves only on clean surfaces



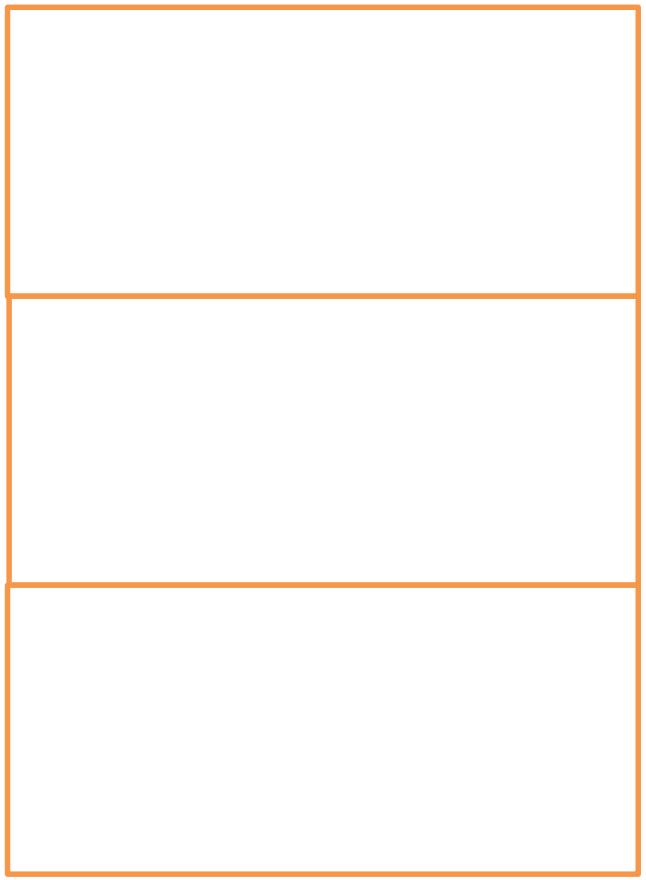
Field practices - coordination



Field practices – overlay between passages

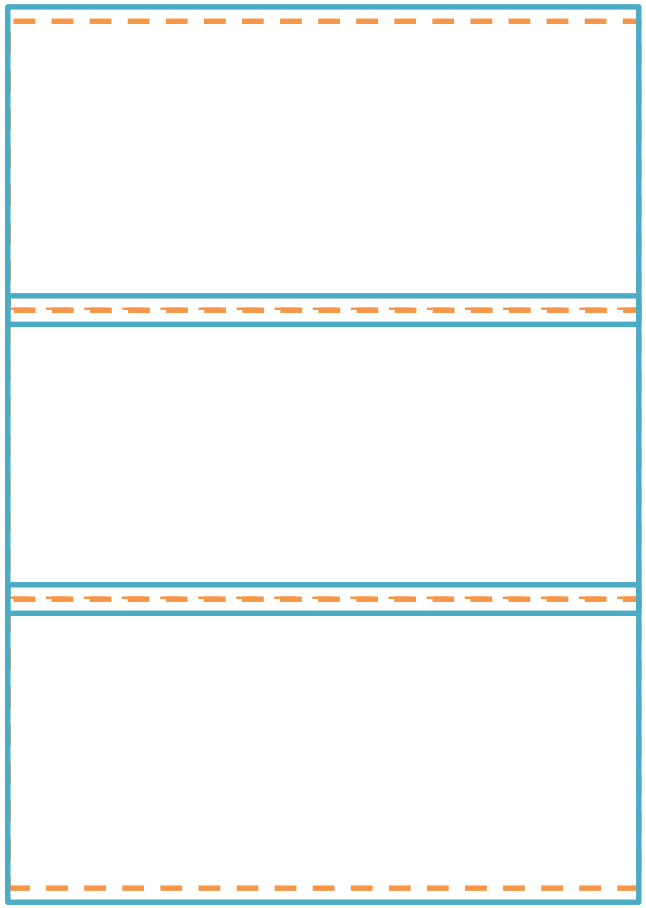
Planning: width of blade width – targeted overlay

Example: 3 - 0,2 = 2,8 m



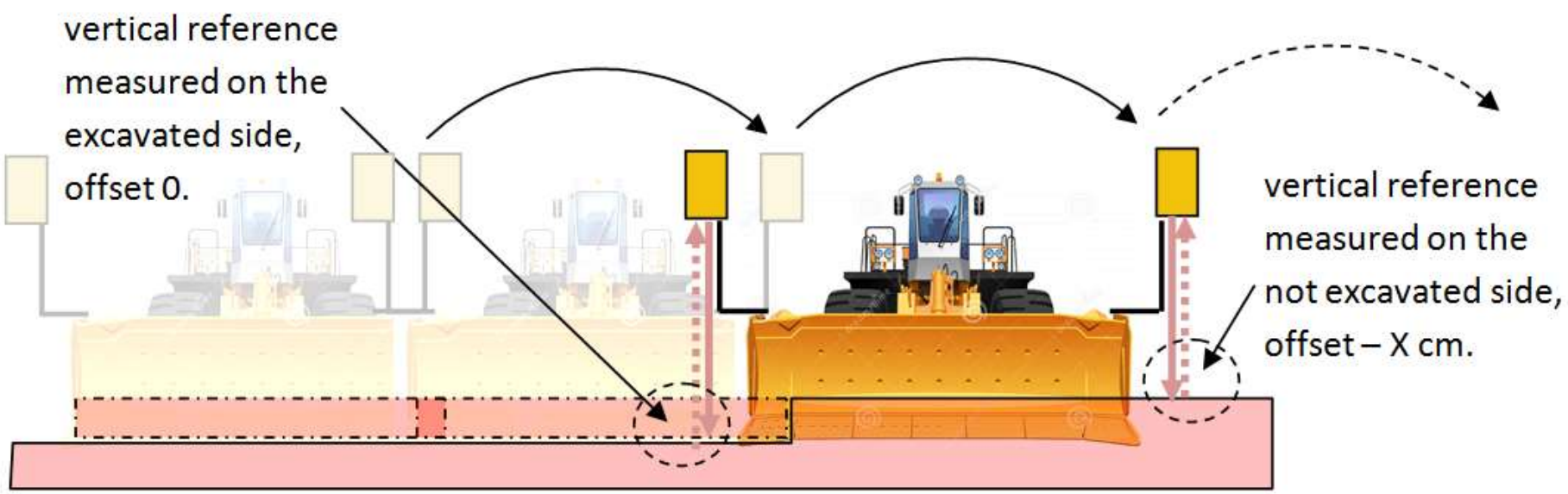
Blade of the bull width = 3 m

10 cm extra on each side = 20 cm final overlay



Field practices – grading control system + navigation system

Field practices – detail of sonic sensors use

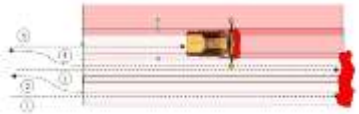


Field practices – grading control proposal

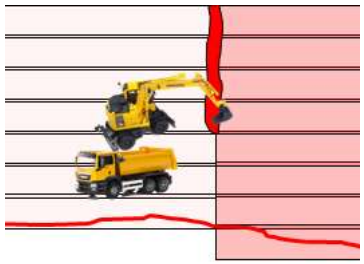
Field practices – grading control (vertical)

Fine terrain	Coarse terrain	Chaotic terrain
Parcel planning	Parcel planning	1/ Excavation (assisted???) 2/ Parcel planning
		
2D grading system with sonic sensor	3D grading system with double GPS	1/ 3D grading system with 1 GPS antenna, and one bucket sensors
Parcels, navigation lines	Parcels, navigation lines, TIN terrain model	+ TIN terrain model

Field practices – grading control (vertical)



€ 1 m^3



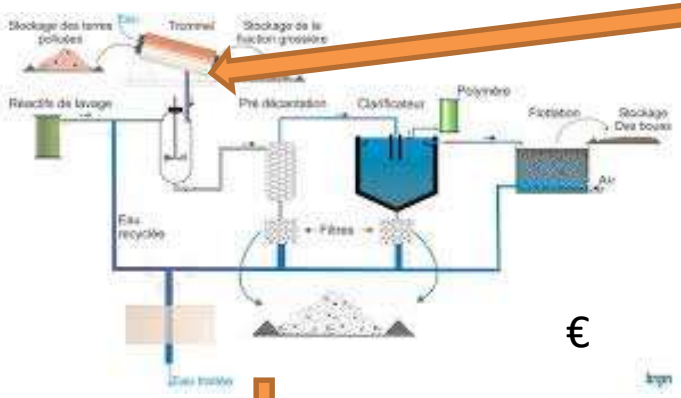
€

1,3- 1,5 m^3

€

Option A

Option B



€

€

€

€

€

Option A: €€€€

Option B: €€€€€€

Field practices – Conclusion

Navigation guidance:

- **Just the necessary overlay in achieved**
- **Work is achieved faster with guidance**
- **Achieve more precise work (horizontal) with guidance**
- **Tracability with the possibility to record the trajectory and fieldwork footprint**

Grading control:

- **Achieve more precise control on the thickness**
  - **Less soil to be removed, transported and treated (or stored)**
  - **Less contamination left in the field (= less repass)**

Pollution clean-up efficient + timely better = reduced costs.

Possible additional fields of application

Foreseen/possible fields of application:

- **Clean-up of surface contamination around leaking pipelines**
- **Automatise clean-up in case of major nuclear disaster**
- **Support in the harvest of polymetallic nodules in the seabed (algorithm)**
- **More generally, assistance with the optimization of the spatial planning of spatial any process done in (algorithm)**

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