



**CIP Eco-innovation  
Pilot and market replication projects  
Call 2008**

**Agreement Number - ECO/08/239011/SI2.535202  
RECTYRE  
USED TYRES VALORISATION AS LIGHTWEIGHT FILLER FOR  
EMBANKMENTS**

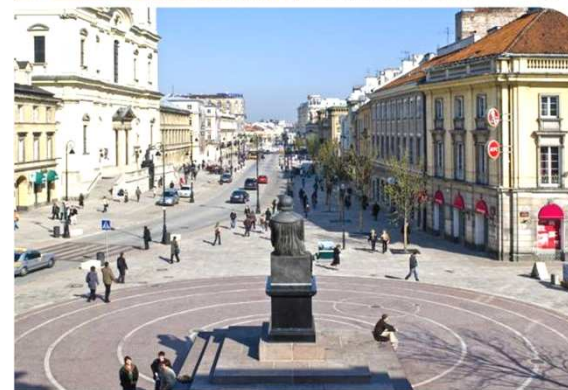
**D5.1.: Model Execution (Part A)**

**Start date of the project: 01/07/2009      Duration: 24 months**

**Lead contractor for this deliverable: MOSTOSTAL**

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Warszawa, 30.06.2011



- Work site location
- Embankment's load
- Geologic situation under the embankment
- Embankment's dimension
- Characteristics of materials built-in embankment

The main objective of the WP.5 is to build the real scale RECTYRE embankment based on the already built by ACCIONA structures as well as results of the WP4: Scenario Definition and Model Adaptation. The real scale test in the real conditions is essential to validate the results of all previous tasks and WP's. At the end of the project, with the results of the real scale test there will be a jump back to modify the model giving a final result of Applicable Optimised Model.

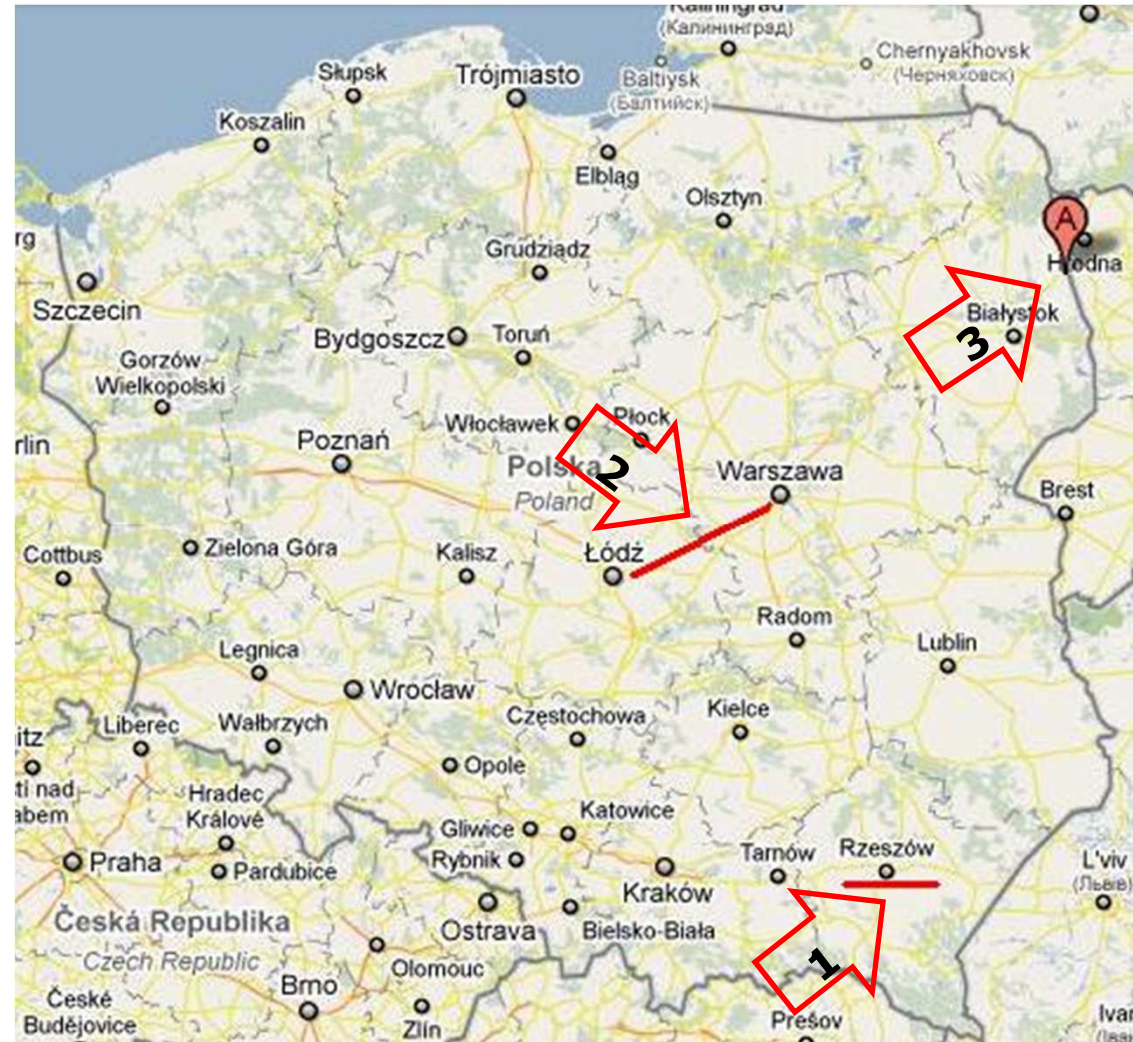


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## Potential test sites

- 1 – Ringroad of Rzeszów
- 2 – Highway (Warsaw - Łódź)
- 3 – Czuprynowo (close to the border of Belarus)



### 1.1 Ringroad of Rzeszów:

- Design-tender: Traditional Method.
- Contract based on the previously prepared specification.
- We found out that there is no chance to introduce changes to the specification.

### 1.2. Highway – Warsaw - Łódź:

- „Design and Build” contract execution model.
- Project was strongly delayed (must be delivered for EuroCup 2012) and must be delivered on time.
- Site managers were very interested but due to the problems with the building site the decision was not to go for Rectyre technology



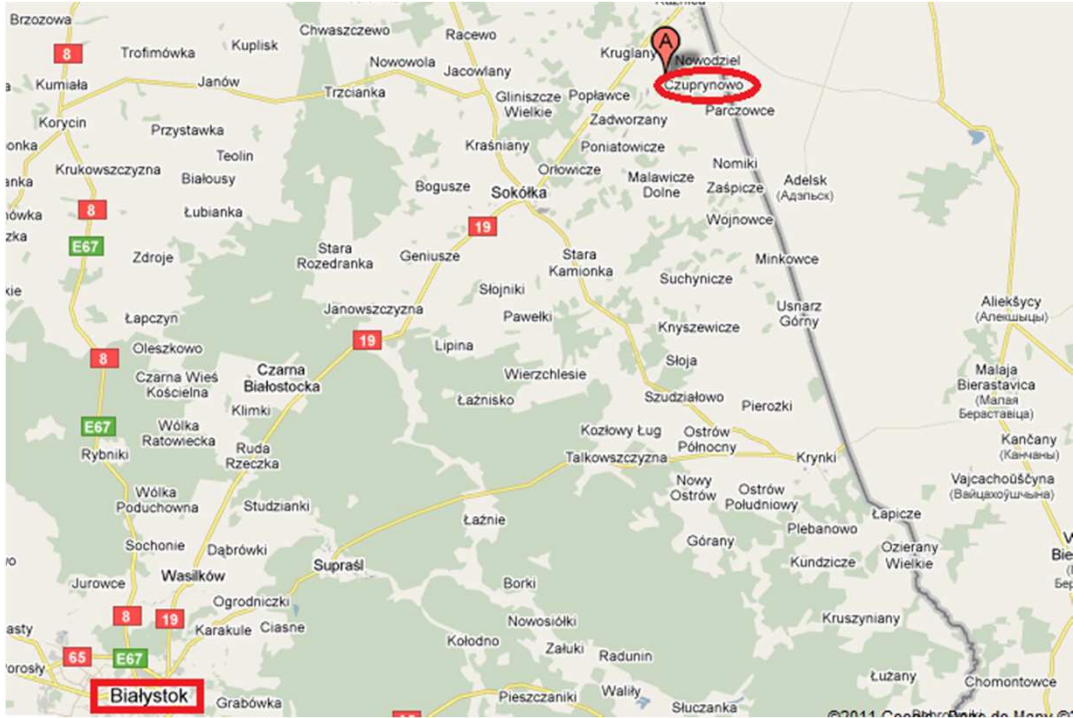
### 1.3. Czuprynowo:

- Special application (lightweight embankment construction)
- Road problem with aggragate mud and two solutions:
  - Aggragate mud removal and its substitutions with natural agregates (very expensive, large quantities of natural agregates)
  - Lightweight embankment (Rectyre solution – weight reduced by ~50%)

# 1. Selection of the test site

## 1.3. Czuprynowo:

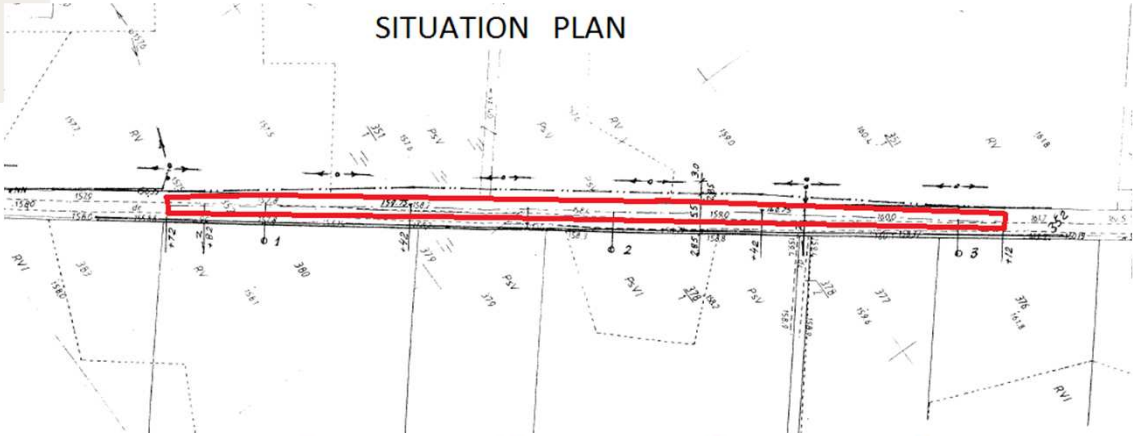
A pilot embankment is situated in Czuprynowo village, parish Kuźnica in north-eastern Poland.



# 1. Selection of the test site

## 1.3. Czuprynowo:

The planned road is a connection between Reloading Railway Station (Coal, Salt, Wood, Aggregates) and National Road no. 19.



### Embankment's load:

Due to its planned service the pilot embankment will be heavily loaded. It is designed for "KR2" road traffic category. It **was 25 computational design axes** assumed.

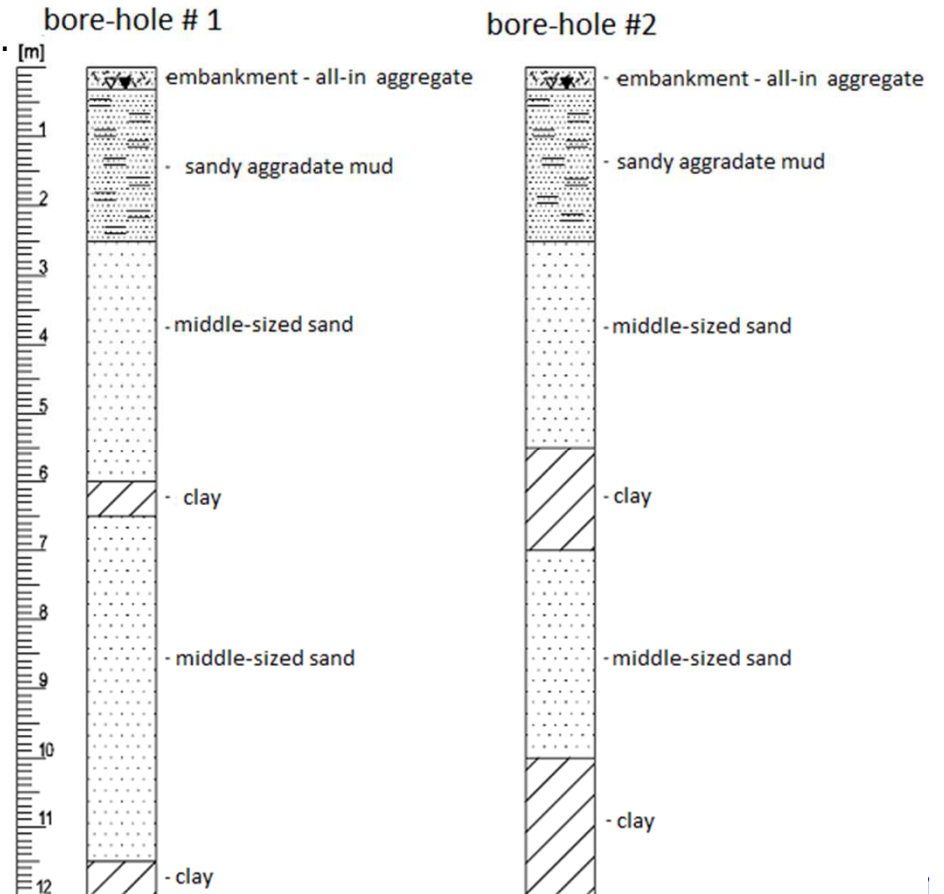
Road traffic category	Number of computational design axes (100 kN) on computational lane [L]	Number of computational design axes (100 kN) in assumed period (20 years)
<b>KR2</b>	<b>13 ÷ 70</b>	<b>90000 ÷ 510000</b>



It was carried out two 12 metre-deep bore-holes on the area of designed embankment.



**Frost penetration in Poland** – Czuprynowo is situated in IV zone. It means that depth of frost penetration is about 1,4m.

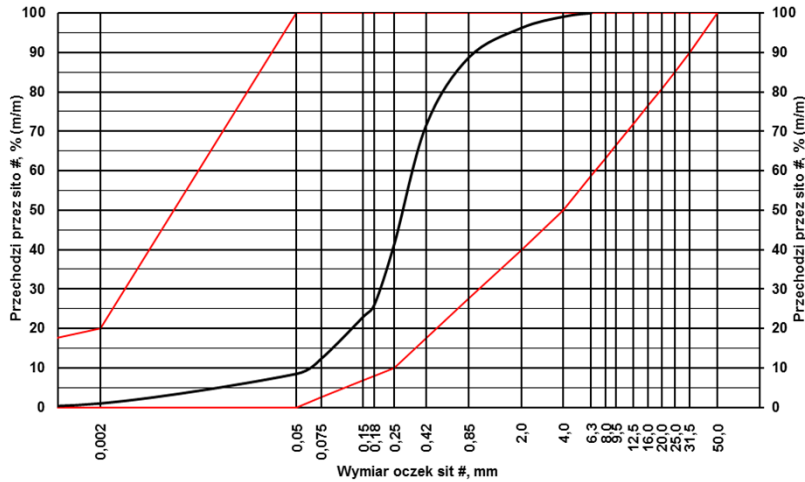


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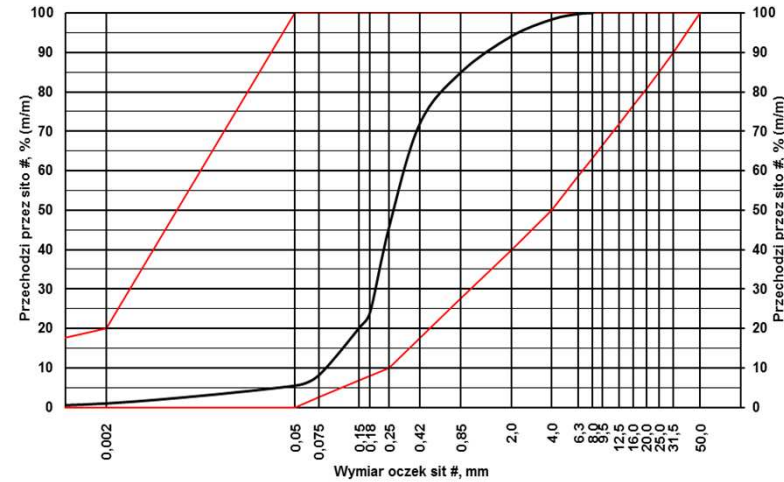


# Geologic situation under the embankment

Soil #1 – Middle-sized sand(bore-hole #1)



Soil #2 – Middle sized sand (bore-hole #2)



Sand ratio (WP):

	Probe #1	Probe #2
Probe weight [g]	120	120
h <sub>1</sub> [mm]	259	258
h <sub>2</sub> [mm]	77	77
100(h <sub>2</sub> /h <sub>1</sub> )	29,7	29,8
SE	30	

$$C_U = \frac{d_{60}}{d_{10}} = \frac{0,34}{0,065} = 5,24$$

Sand ratio (WP):

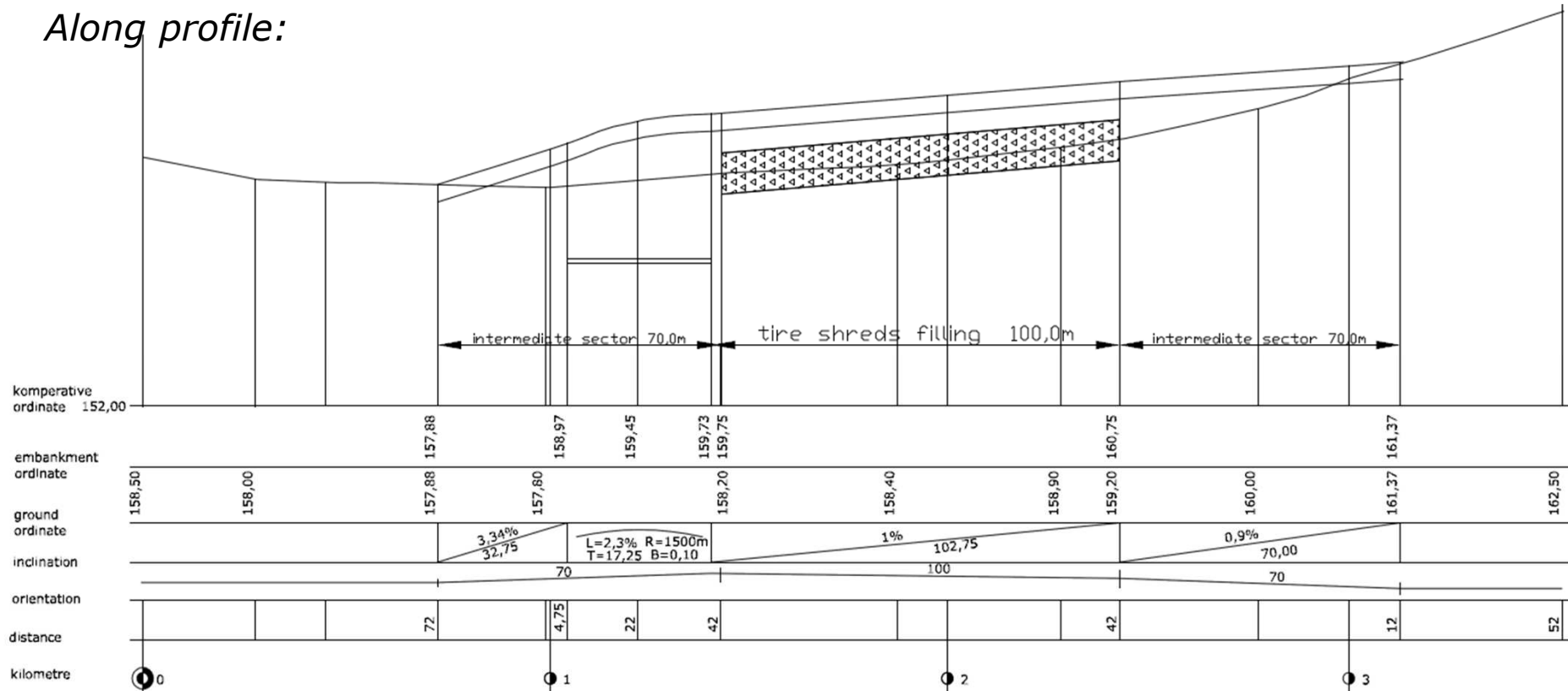
	Probe #1	Probe #2
Probe weight [g]	120	120
h <sub>1</sub> [mm]	167	165
h <sub>2</sub> [mm]	78	78
100(h <sub>2</sub> /h <sub>1</sub> )	46,7	47,3
SE	47	

$$C_U = \frac{d_{60}}{d_{10}} = \frac{0,32}{0,085} = 3,76$$



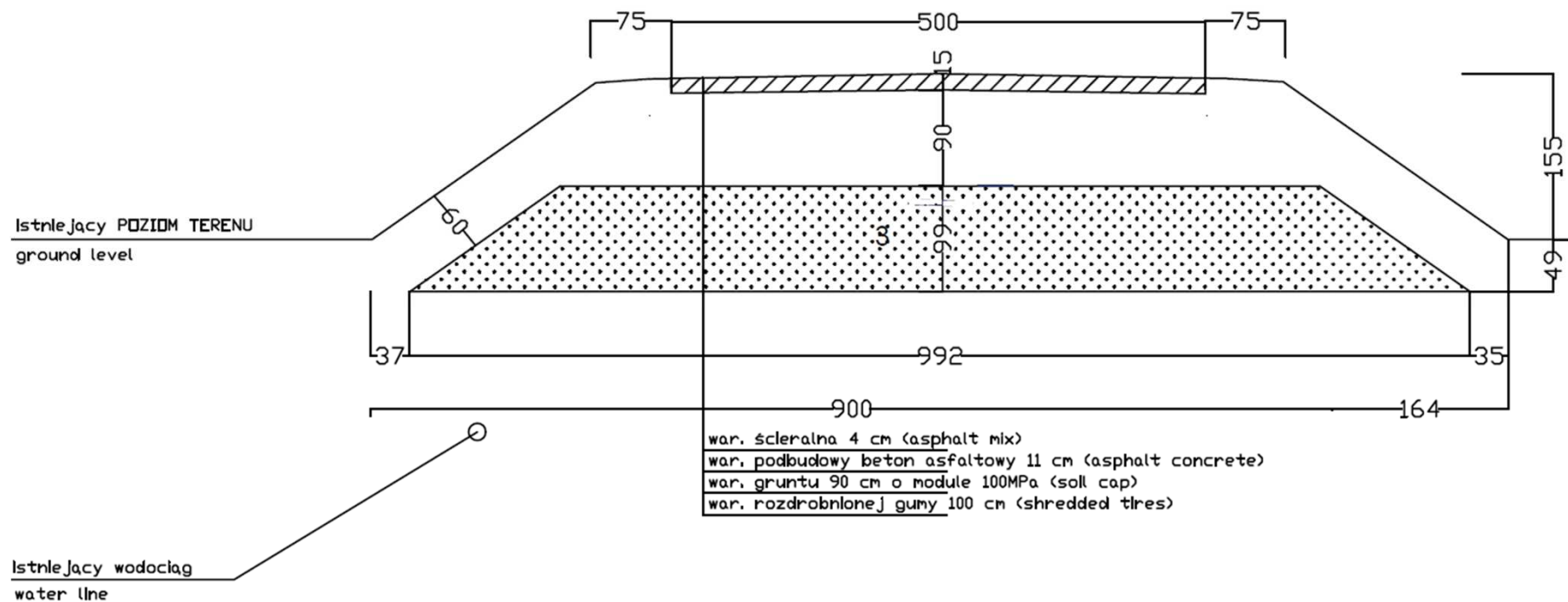
The embankment is about 240m long.

Along profile:



Embankment's top is 6,5m wide, bottom is 10,60m wide, inclination is about 1:1,5

*Transverse profile:*



Keeping in mind ACCIONA's example, it has developed a new design embankment model in which natural soil has been substituted by scrap tyres to fill embankments for road and railway construction. Embankment is raised on natural ground (muds). It is built of 3 kinds of materials: natural aggregate (all-ups), tyre shreds and geotextiles. Selection was done neatly having regard to high level of groundwater and ground conditions.

- **Soil**

Soil layers of the embankment were performed using all-ups extracted from nearby deposit. It was brought to the building site by dump truck and formed by excavator and loaders.

$C=0$  (uncohesive soil)

$\Phi_U=36^\circ$

$\rho=1,70 \text{ [t}\cdot\text{m}^{-3}\text{]}$

After compaction:

$I_D=0,98 \rightarrow \Phi_U=42,2^\circ; \rho=1,85 \text{ [t}\cdot\text{m}^{-3}\text{]}$



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- **Tire shreds**

The tires were brought to the construction site, shredded in pieces ranging from 20 to 40 cm. The supplier of tire shreds was J&B Recycling. This company has offered the best price of tire shreds in aid of its quality.

Weightiness ( $1,0-1,3 \text{ g/cm}^3$ ),

Volume weightiness:

slack condition ( $0,3-0,5 \text{ g/cm}^3$ ),  
condensed ( $0,5-0,8 \text{ g/cm}^3$ ),



# Characteristics of materials built-in embankment

Granularity:

Sieve mesh measurement [ mm ]	Tire shreds			
	Sample I	Sample II	Sample III	Sample IV
	Sieve, %			
400	43,40	34,36	36,28	37,50
300	10,06	21,79	27,45	30,26
200	19,92	17,88	18,95	21,05
45	25,79	25,0	16,99	10,86
4	0,83	0,97	0,33	0,33

Sieve mesh measurement [ mm ]	Tire shreds			
	Sample I	Sample II	Sample III	Sample IV
	Sieve, weight [kg]			
400	20,7	24,6	11,1	11,4
300	4,8	15,6	8,4	9,2
200	9,5	12,8	5,8	6,4
45	12,3	17,9	5,2	3,3
4	0,4	0,7	0,1	0,1
<b>Total weight</b>	<b>47,7</b>	<b>71,6</b>	<b>30,6</b>	<b>30,4</b>



- **Geomembrane**

No #	Feature	FolGam H
1	Thickness [mm]	1
2	Weightiness [g/m <sup>2</sup> ]	1700
3	Broadness x lenght [m]	2m x lenght till 30m
4	Colour	black
5	Max tensile stress [Mpa]	≥ 15
	-along	≥ 15
6	Extension at bust-up [%]	≥ 200
	-along	≥ 200
7	Rent resistance [N/mm]	≥ 200
	-along	≥ 170
8	Moisture capacity [%]	≤ 0,5
9	Water infiltration at pressure 0,4 [Mpa]	waterproof
10	Penetration resistance (CBR) [kN]	1,7



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- **Geofabric**

No #	Feature	StradomGeo 19
1	Thickness [mm]	1
2	Weightiness [g/m <sup>2</sup> ]	100
3	Broadness [m]	till 5,25m
4	Colour	black
5	Max tensile stress [Mpa]	≥ 19
	along	≥ 19
	-across	
6	Extension at bust-up [%]	≥ 12
	-along	≥ 10
7	Water infiltration at pressure 0,4 [Mpa]	29 (±4) [mm/s]
8	Penetration resistance [kN]	3,22



**Thank you very much**

<http://www.rectyre.solintel.eu>

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