Roads Department of Georgia

Preparation of Feasibility Study on the Environmental Improvement Activities, Draft, Tender documentation and Environmental Management Plan (EMP) for Natakhtari-Ruisi section of the International Tbilisi-Senaki-Leselidze E-60 Highway

Environmental Improvement Activities on Natakhtari-Ruisi section of E-60 Highway

Technical Design
Volume 1
Explanatory Note

Tbilisi 2016 January

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1. Project Summary

1.1. Brief Summary of Design Works

Development of road infrastructure is one of the priorities of Georgia, as its geographical location ensures the operation of transport corridor between Europe to Asia.

Budget allocations have been made for modernization of Natakhari-Agaiani section of E60 highway, which is already completed. In 2006, the World Bank approved the first East West Highway Improvement Project (EWHIP) aimed at modernization of Agaiani-Igoeti section of the Highway. Modernization of Igoeti-Svaneti section was implemented under the second EWHIPwas also funded by the World Bank. The third EWHIP aimed to upgrade Sveneti-Ruisi section of E60 highway. The main objective of all EWHIPs was to facilitate overland transit traffic and to improve safety measures within East-West transport corridor.The main construction works included road widening from 2 to 4 lanes, construction of bridges and overpasses, etc. The fourth EWHIP-4 is currently underway.

The fourth EWHIP includes undertaking of environmental improvement activities between Natakhtari and Ruisi section along E60 highway, identification of problems for this purpose, determination of ways for the improvement and implementation of environmental improvement activities. Natakhari-Ruisi section is shown on the map below (see Figure 1.1.1.).

Figure 1.1.1Fragment of E-60 highway with indication of Natakhari-Ruisi section

This documentation represents a draft version of the detailed design, which has been developed in accordance with the requirements specification.

1.2. Initial Data of the Design

The aim of the designed works is to determine detailed technical solutions for the environmental improvement activities on 68 km long Natakhtari-Ruisi section of the international E-60 highway on the basis of feasibility study results.

Upgrading of E-60 highway has been undertaken in four interconnected sections:

#	Natakhtari-Ruisi section	Km	From Tbilisi	Builder
1	Natakhtari-Aghaiani section	16	km 27-km 43	Zimo Ltd and Caucasus Road Project Ltd
2	Agaiani- Igoeti section	12	km 43-km 55	
3	Igoeti -Svaneti section	25	km 55-km 80	Jewish company "Ashtrom internashional" Ltd.
4	Svaneti-Ruisi section	15	km 80-km 95	Azerbaijani company "AKKORD"
	Total:	**68**		

One of the most important component of EWHIPs is to create a high quality architecture of the road. Generally, construction and modernization of the road is a complex architectural and artistic task.Highways, despite their class and type, should meet not only technical, but also the basic architectural requirements:

- Road area should be defined through considering the aesthetics and engineering psychology,Spatial and landscaping design of the entire route, including the greening of the road should correspond to mountainous ensemble arrangement of Greater and Lesser Caucasus;
- Two visual aspects should be addressed: landscape perception from the road and road perception from the landscape.

Complex-valued initial data required for a detailed design of environmental improvement within Natakhtari-Ruisi section includes the following key issues identified during the audit of the section:

#	Detected problems
1	Bulks of construction materials, structures and construction waste
2	Non-functional, old bus stops (made with reinforced concrete lightweight constructions)
3	Damaged areas of landscape (pits, trenches, mounds, etc)
4	Drainage nodes to be arranged at holes of barrier walls within the dividing strip
5	Areas to be filled with soil within the dividing line
6	The culvert pipes running under the Highway to be cleaned from reinforced concrete constructions and solid household waste
7	Water diverting systems from terraces through channels should be arranged over the former earth pits
8	Recultivation works should be done in former earth pits and three-year old pine-trees and smoke trees planted
9	Water diverting to be arranged through reinforced concrete channels under the viaduct at the village of Igoeti, near the lamiskani turn.
10	Recultivation of Ltd. New –Energy's former area should be done

Thus, the present assignment included detailing of mitigation and corrective measures listed in the feasibility study, specification of the proposed works and preparation of relevant design-estimate documentation in Georgian and English languages.

1.3. Standards Used During the Design Works

- Technical Regulation - "Classification of road works for Georgian highways";
- Technical Regulation – "Rules and standards for the arrangement and operation of solid waste landfills";
- Construction norms - "Land line and land plots assignement norms for the main linear structures". Land assignment standards for highways;

2. General Description of the Area

2.1. Climate and Meteorological Conditions

Eastern Georgia is located within subtropical climate zone and is mainly influenced by the dry Caspian and Central Asian air masses from the East and the Black Sea moist air masses from the West, while it is protected from the cold North air masses by the Great Caucasus Range.

Climate of Eastern Georgia is characterized by hot summers and relatively cold winters with significantly low precipitation compared to the Western Georgia. The average air temperature within the study area in July and August is 23^0C, though, during the day it may reach 33-35^0C, while during the night hours - 20^0C. The average air temperature in winter months – December and February is 1-2^0C, while during the same period it may fall to 10^0C.

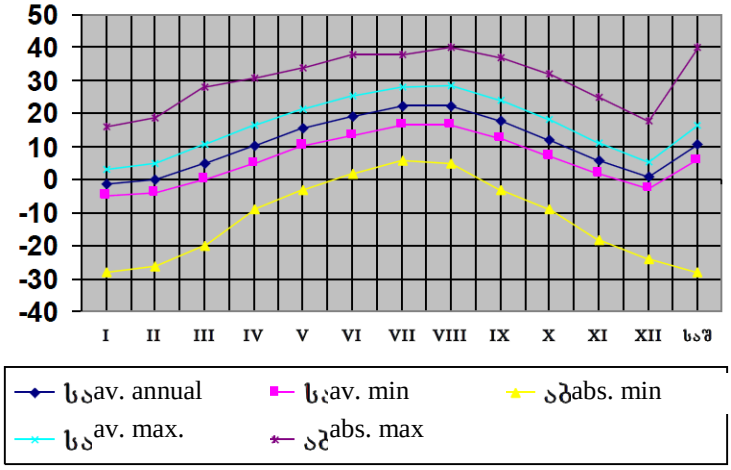
Cold winters and long hotsummers are characteristic for this area. The maximum temperature reaches +40^0C. Theminimal temperature – 16^0C is recorded in January. Annual precipitation varies within450-500 mm. The minimal level of precipitation is recorded in winter while the maximallevel in summer, which is characteristic for a dry subtropical climate. There are 40-50snowy days during a year. The thickness of the snow cover does not exceed 16 cm. Likeair temperature, the minimal temperature of soils is recorded in December-January.

Relative humidity corresponds to the level of precipitation, especially in summer, whenrelative humidity is 55-68%. Mean annual temperature of topsoil is +12-13^0C, which isthe lowest index for dry subtropical zone. The temperature of soil at a depth of 2m iscorrespondingly low. Intensity of solar radiation, long periods of sunny days and smallnumber of cloudy days dictate the temperature regime in summer.

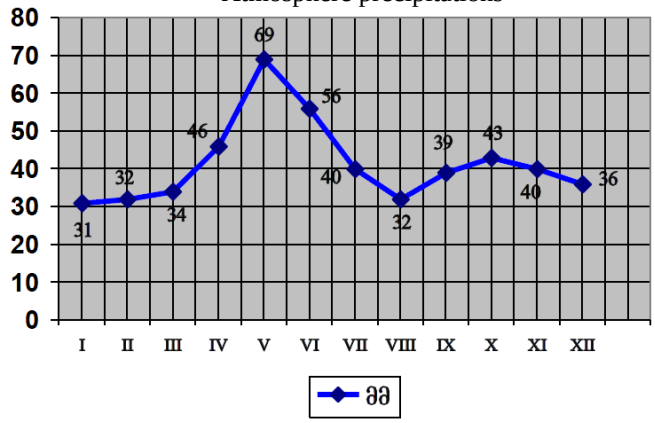
Meteorological andclimatic data are based on information provided by the Gori station of the Hydrometeorological station.

Meteorological and climatological average annual data

Air absolute annual maximum temperatures

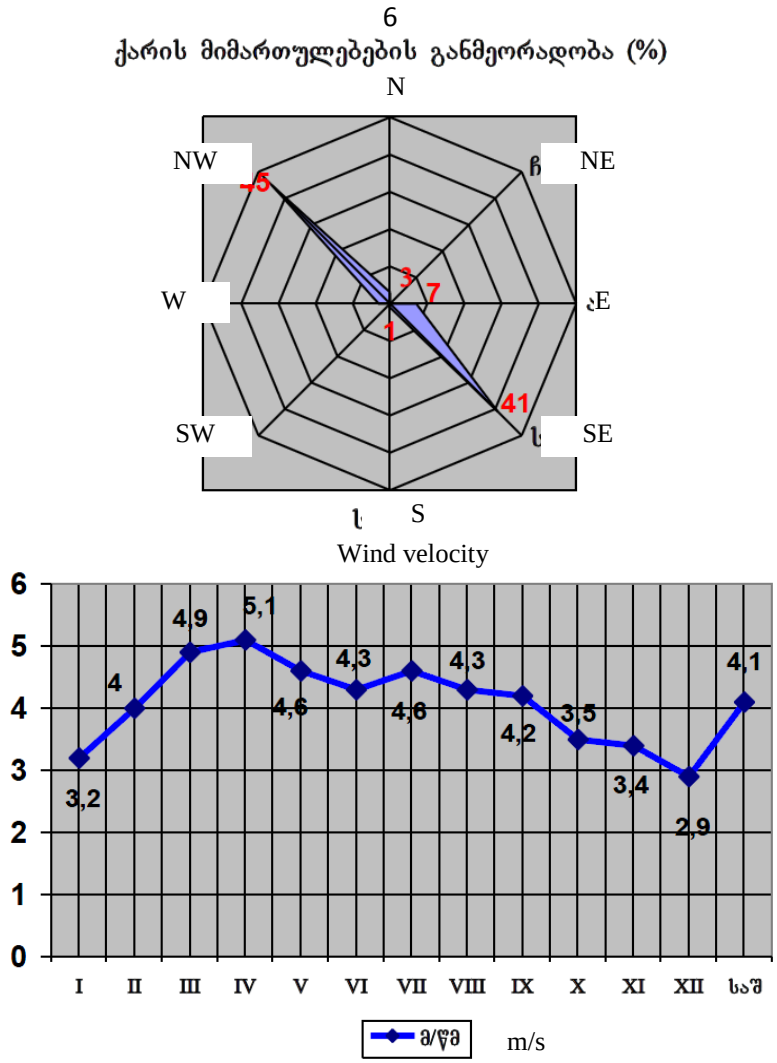


Atmosphere precipitations



mm

Repetition of wind directions (%)



2.2. The General Geomorphological and Geological Conditions within the Project Area

Geomorphological peculiarity of the area is plain-accumulative relief of Shida Kartli, which is formatted due to the erosive-accumulative processes in Mtkvari River and its left tributaries (Aragvi, Ksani and Liakhvi rivers).

Tectonically the study area is located on the Tiriponi-Mukhrani block of the Shida Kartliplunging zone of the Georgian fault and partially on the north-eastern peripheral areas ofthe central sub-zone of the Achara-Trialeti folded zone. The Sveneti-Ruisi section is builtmainly of upper palaeogene, miopliocene and quaternary sediments. The oldest sedimentsare exposed south of Urbnisi and in its south-easternmost edge. They are upperPalaeogene age and presented in the form of Khadum layer rocks (P ch). This layer isbuilt by alternation of sandstones, clays and marls. Their thickness reaches 80-100 m.

These sediments are covered with the 50-80 m thick stack of Sakaraulo age comprised ofsandstone, gravelite and noncarbonated clay sub-layers. Then comes the 100-130 m thickstack of Kotsakhuri age (N1 kc) comprised of jarosite containing non-carbonate clays andgreywacke sandstones. These sediments are covered with 50-100 m thick stack ofChocrack layer (N1 c) built of alternated sub-layers of conglomerates, sandstones, marland sandy clays. A 55-70 m thick stack of Karagan layer (N1 kr) built of limestone, marl,sandstone and conglomerates comes next. A 50-60 m thick stack of Conck age (N1 kn) isfound upper. It is built mainly of sandstone, caly, marl and sandstone-marl layers.

Sarmatian rocks are relatively more widespread. They are comprised of lower, middleand upper sarmatian layers. Lower Sarmatian (N1 s1) sediments are 400-500 m thick and are presented in the form of alternating clays and sandy clays where the inclusions of conglomerate sub-layers and lenses are often found. Middle Sarmatian (N1 s2) sediments are less thick (250-300 m). They are presented in the form of a stack built of alternatingconglomerates, sandstones, clay sandstones and marls. Upper Sarmatian stack ispresented in the form of Natskhor rocks (N1 nc). The Natskhor rocks are arranged inlower and upper sub-layers due to their

lithological diversity. The Upper sub-layer rocks(N1 nc2) are presented mainly by conglomerates with participation of clay sandstone andclay strata. Their thickness varies within 300-400 m. The lower sub-layer is comprisedmainly of clay and clay-sandstone strata. Their total thickness varies within 400-500 m.

These sediments are overlaid by the Dusheti rocks of meotic-pont age. According to thelevel of refinement and conglomeration they are divided into four sub-layers: The lower(N_{1-2} ds_1) and upper (N_{1-2} ds_1). Dusheti sub-layers, which in turn are divided into twoparts: the lower and upper strata of the lower part of the Dusheti layer and the lower andupper strata of the upper part of the Dusheti layer. The lowest sub-layer (N_{1-2} ds_1) is 250-350 m thick. It is built of fine gravel, well-ordered and consolidated conglomerates inwhich clay and sandstone sub-layers are found. The second lower sub-layer (N_{1-2} ds_1) is
300-390 m thick. It is built of well-ordered consolidated medium gravel conglomerates inwhich clay and loam sub-layers are found. The thickness of the third part, i.e. the lowersub-layer of the Dusheti upper layer (N_{1-2} ds_1)varies between 350-450 m. It is comprisedmanly of weakly consolidated coarse gravel conglomerates. Sandstone and clay sublayersare found rarely. The thickness of the top sub-layer (N_{1-2} ds_1)reaches 400-500.This is built of unconsolidated coarse gravel conglomerates. The clay and loam lenses arerare.

Among quaternary sediments (Q_{II-IV}), the most widespread are terraced alluvial-proluvialand proluvial-deluvial rocks. Their total thickness reaches 200-250 m. They are presentedin the form of either unconsolidated or weakly consolidated conglomerates built ofpebble and gravel of various sizes and alternating sandstone and sand. Clay sub-layers arerarely found in these sediments.

2.3. Characterization of Soils

According to the existing classification of Georgian soils mainly three types of soils:brown, brown-carbonate and alluvial-carbonate are widespread within the study area.The most widespread are brown soils. They cover about 50-55% of the area. Browncarbonatesoils (35-40%) are less widespread. Alluvial-proluvial soils occupy minorareas, especially along the gorges of the rivers Mejuda and Pshana in the form of anarrow strip.

3. Major Design Solutions

As noted above, landscape harmonization principle should be protected during the implementation of works required for environmental improvement - to minimize changes in views adjacent to the highway through implementingmeasures such as grading of the road corridor and recovery of view near the initial contour.

Design solutions should be implemented by the contractor for environmental improvement within thoses areas that are affected by the construction of the proposed highway. As specified by the client, the primary importance should be given to the issues of property adjacent to the highway- improvement of privatelyowned land plots is not included in the project.

The project considers only issues related to the improvement and recovery of state and municipal owned land plots. Besides,as specified by the client, the project includes technical improvement of road embankment, carriageway, dividing line, bridges, tunnels, overpasses, transportation system, culverts, retaining walls , pedestrian trails along the road, also, right of way and other road structures within its area on the Natakhtari-Ruisi section of the International Tbilisi-Senaki-Leselidze E-60 Highway.

Reuse of waste soil within the corridor of right of way, which is represented in the form of dump, depends on its suitability for usage. Soil can be properly used according to the following directions:

- dividing centre line filling
- recultivation of former bases territories
- recultivation of the former quarries
- stabilization of slopes N1 and N2 at54-55 km and 80-81 km

3.1. Areas Selected for Environmental Improvement of the Road

The following basic areas are considered by the project:

- Right of way – initial areas for implementing environmental improvement activities depends on specific location, as determined by the results of the audit and agreed with the client;
- Areas for temporary buildings – not functioning construction camps, inert material quarries with expired licenses and storage areas for any materials - will be fully restored to pre-construction conditions (technical and biological recultivation), after the dismantling of temporary structures.

3.2. Areas outside the Corridor of Right of Way

Areas located outside the corridor of right of way include:

- Inert materials quarries (currently inactive) required for the construction of roads;
- Territories of the former bases of construction companies.

3.3. Methods for Environmental Improvement

Some complaints were submitted by local population to the Roads Department of Georgia in 2012 indicating that during the construction of Igoeti-Svaneti section (2009) the land plots in their ownership were covered with construction waste, making them unusable for agricultural purposes thereby. In their complaints the local population also requested that the irrigation channel in the village of Gamdlistkaro should have to be restored.

According to written requests, the project envisages removal of construction waste from the above plots and restoration of the irrigation channel – arrangement of new pipeline (plastic pipe, d=300mm).

#	Identified Problems	Ways of environmental improvement
1	Bulks of construction materials, structures and construction waste	Cleaned up the area. Loading of construction waste on dump trucks (if necessary, through crane) and transportation of construction waste to the landfill.
2	Inactive light structures and fundamental buildings (above ground and underground)	Dismantling of buildings. If necessary, implementation of earth works in order to remove the foundation. Transportation of construction waste to the landfill. Cleaning up and leveling of the area. Biological recultivation of the leveled surface(arrangement of topsoil with 15 cm thickness and planting of herbaceous species).
3	Damaged areas of landscape (pits, trenches, mounds, etc.)	Leveling of the area. Arrangement of topsoil with 15 cm thickness and biological recultivation.
4	Abandoned inert materials quarries	Arrangement of water drainage grooves. Area planning, techical and biological recultivationand planting of endemic species.
5	Areas to be filled with soil within the dividing line	Filling up dividing line with soil
6	Contamination of culverts	Cleaning up and recovering of culverts and water drainage systems. Removal of waste.
7	Damaged irrigation channel in the village Gamdlistskaro	Full rehabilitation of the irrigation channel

3.3.1. Construction waste fit for reuse

Construction waste fit for reuse will be transported and stockpiled to a specially allocated base officially belonging to the Road Department of Georgia, located in the suburbs of Gori, on the left bank of Liakhvi river, at a distance of 200m from the Highway. The construction waste will be registered by the Road Department of Georgia. The area of the base and its location meet the basic environmental standards.

3.4. Management of Construction Equipment and Transport Operation and Traffic during the Project Implementation Period

Construction vehicles and mechanisms (bulldozer, crane, grader, tamping machine, excavator, etc.) will be intensively used during implementation of works required for environmental improvement on Natakhtari-Ruisi section of the International Tbilisi-Senaki-Leselidze E-60 Highway. Negative impacts of construction vehicles and mechanisms on population, as well as on trucks and cars moving on the highway should be reduced to a minimum.

Key problems related to the movement and operation of construction vehicles and mechanisms within the framework of the project are:

- Municipalities and residents within the project area should be provided with sufficient information on the regime, shedule and volume of operation and movement of construction vehicles and mechanisms (Operation schedule of vehicles and construction machinery defined by the Georgia Department of

Transportation);

- The number of project-related construction equipments and vehicles, traffic frequency and operation time should be limited. Thus, negative impact on population and nearby environment will be reduced to a minimum, where it is possible;
- Establish and ensure the systematic control of the risk factors related to the movement of construction vehicles and operation of construction machinary, ensure high quality technical maintenance of vehicles and construction machinery.Maximum permissible levels of the relevant standards should be protected, including noise limit;
- Prior to any construction works within the project area, the contractor should develop specific Management Plan for traffic and operation of construction vehicles (including the contractor's parking lot) in accordance with the requiremenets of the project and agree with the Georgia Department of Transportation.
- When filling the Highway's middle dividing line with earth, Contractor should use dump trucks that are able to unload the body from left and right sides (this is a necessary condition)
- Filling works for the middle dividing line of the Highway shoud be agreed with the Road Patrol Police Department, should be carried out under their supervision and in accordance with the submitted project.

3.5. Subsoil Recovery - Technical Recultivation

Generally, subsoil recovery (technical recultivation) precedes the restoration of topsoil.In consideration of this,subsoil will be deployed in the affected areas in such a way that:

- 95% -105% of filling should be achieved with respect to nearby pristine area;
- A final level of compaction should be at or 0.15 m below the surface level of the surrounding area.

3.6. Topsoil Recovery - Biological Recultivation

Topsoil will be reinstated separately from subsoil, as mixing of materials should to be excluded. Contractor will use only that particular layer, which is classified as fertile soil / humus.

The depth of topsoil restoration is 0.15 m.

The contractor should plantopsoil restoration activities in such a way that works should start in the most remote part of the bulk-piles and progressively come closer to it in order to protect the newly recovered soil from damage due to the movement of construction machinery.

On agricultural lands, where topsoil is restored, the surface will be prepared for sowing. The contractor will also irrigate recovered area in order to reduce dust formation.

The contractor will implement biological remediation works in the corresponding periods of plant growth. Seedlings will be planted during the period, when a sufficient amount of sediments will contribute to their establishment and growth.Schedule for planting herbaceous species is defined with proper season and following issues are considered: Individual plant properties, favorable weather and season for each section of the road.

Woody species selected for planting on Natakhtari-Ruisi section of E 60 highway, on hilly terraces on 55km and 58 km

Plant species, varietal characteristics of which are consistent with the conditions of the environment where it will constantly have to exist should be used for planting existing terraces. In this case, the seedlings are relatively easy to adapt to a new environment and are more resistant to the negative impact; especially in case of transplanting a young seedlings from a healthy environment to the environment saturated with vehicle emissions, which may cause weakening of their resilience, in most cases the plant may slow the growth or in some cases, it will dry up.

Considering all the above mentioned, plant will have to survive and get used to the constant environment. For this purpose, agroterms should be considered while planting in lawns; transplantation-cultivation process must be conducted in late fall (November 01–30) or in early spring (March 01-31); besides, seed coma should be used in order to make it easier for plants to adapt to new habitats. Young seedlings are very sensitive to temperature and air saturated with the gas released during the movement of the vehicle. In addition, soil factor is very important during planting. We consider that it is necessary to plant seedlings in individual trenches with a mixture of humus and land.Elements necessary for plant growth and development are not fully represented in rocky soil, which often lead to drying up of plants.

Vegetation development on the right slopes of the highway is ver importatnt. In addition to decorative function, it has the function of protecting soil. They reinforce and protect the sharply inclined slopes from erosion and collapse. Such trees and bushes should be resistent to frost, drought and other adverse events. At the same time, they should less depended on soil.For the development of slopes and terraces, plant species have been selected according to their ability to adapt to the distribution of a given area.

From topographical point of view, slope exposition is directed to the south, where light intensity and temperature is high, the soil is drier and less powerful, the risk of soil removal is likely to be high.Therefore, species that will be planted on terraces will prevent or hinder such processes.

Considering the above mentioned circumstances, the following species have been selected: **Pine** (black pine - *Pinus nigra),* **Ash tree** (Raywood - *Fraxinus oxycarpa*, Green ash - *Fraxinus lanceolata*) and **Smoke bush***Cotinus coggygria.*

Black pine/*Pinus nigra* –is a high (up to 25-35) tree. It has strong adaptability to the soil. Grows in dry, saline and clay soils; it has well developed lateral roots; Its root system is very plastic. Black pine is widely distributed in western Georgia. Due to its high adaptability to the environment, it is also widely distributed in Eastern Georgia. It is tested, easily adapts to translocation and new habitat.
As project area is characterized by a harsh winter, planting of Black pine was considered to be more appropriate.

Smoke Bush/*Cotinus coggygria* –it is a 2-4 m high shrub. It is spread on the lower zones of plains and mountain slopes throughout the Caucasus. It has (had) great economic importance, on the one hand, in the production of leather as its all vegetative body contains tanning and coloring substance and on the other hand, in decorative gardening, as a beautiful plant. It is a drought tolerant plant. It is less demanding on soil resources. Therefore, it is good for strengthening dry and fallow slopes.

Pine tree that will be selected for planting is recommended to be 3 years old and 1 m tall. Distance between the trees planted on terraces should not exceed 3 m; in such cases, the plant is protected from impact and soil disturbances. For the aesthetic purposes, Smoke trees may be planted between the pine trees. In addition, it is desirable to fill trenches with humus. While planting, plant root system should be firm and with large coma, so it does not collapse and the roots are not exposed. Then, seedling will be placed in a preliminary prepared hole.
Once seedlings have been planted, they should be watered on a one-off basis.

After all, permanent monitoring group should be established in order to protect newly planted species from damage. This group will be responsible for maintenance and looking after the plantations during not less than 2 years. During the drought and hot summer days, planted areas should be watered.

It is advisable to plant isolated smoke bushes between the trees, as it will enrich the soil with humus during leaf fall, make the area more beautiful and, moreover, the soil will be protected against erosion and fracturing. The distance for planting smoke saplings is 1,5 meters.

Vegetation of terraces adjacent to the Highway should be carried out through succession of pine and smoke trees. Smoke saplings should be planted at each layer due to its properties, at a distance of 1,5m.

12 terraces found at 55km of western direction should be vegetated in the following way:

- The first terrace from downwards should be vegetated by pine and smoke saplings planted in one row, the distance between pines should be one meter and smoke sapling planted between them.
- Smoke saplings should be planted at the second and third terraces, in one row with a distance of 1,5m.
- The fourth terrace should be vegetated by pine and smoke saplings planted in one row, the distance between pines should be 3 meters and one smoke sapling planted between them.

- The fifth terrace will not be vegetated as it will be used for watering-cart to access the area.
- The sixth terrace will be vegetated similar to fourth terrace, by planting pine trees and smoke bushes between them.
- The seventh, eighth and nineth terraces will be vegetated only by smoke saplings, planted in onw row with a distance of 1,5 meters.
- The tenth and eleventh terraces will be vegetated by pine and smoke saplings planted in one row, the distance between pine trees should be 3 meters and one smoke sapling planted between them.
- The twelveth terrace will not be vegetated like the fifth terrace as it will be used for operations.

As it was mentioned, saplings should be planted late in autumn, before frosts, pits for saplings should be digged deep to the depth of 0,5m and 20cm deep humus layer spread over the pit bottom and sapling planted with its own ball (by no means with exposed roots and root collar shoul not be covered with soil. Once saplings have been planted, humus should be spread over the whole area).

Saplings need no watering during the winter period, natural precipitation of winter period will be sufficient for their growth. Saplings will be adapted to the environment in spring. In hot summer period, during draughts it will be necessary to water the vegetations.

Strict adherence to each item of the abovementioned instructions and recommendations will ensure positive results.

At 58km of western direction a non-operating inert materials quarry is found that will be vegetated by three-year old pine saplings. Saplings will be palnted in late autumn to principle as for 55th km, but pine saplings will be planted in an alternate pattern as per the scheme provided on 21st Drawing of album of drawings.

Works to be carried out

- Seedlings should be planted in late autumn of 2015 (end of October- beginning of November, before frosts)
- Pits of 0,40x0,40 x0,50Hm should be digged out and 20cm thick fertile soil, i.e. humus should be spread over the pit bottom.
- Black pine should be planted by root ball, planting of bare-root seedlings is inadmissible (as the likelihood that it will not sprout up is high).
- A seedling should be placed in the hole to a depth of root collar and backfilled soil tamped firmly.
- Pits on the slopes should be arranged in rows as per the scheme provided in the project.
- A bell should be arragned around the planted seedling so that moisture is maximally accumulated in the pits during precipitations.
- Once seedlings have been planted they should be watered on a one-off basis.
- Further maintenance should be carried out from May 2016 to August including (maintenance implies weeding, irrigation and other measures considered necessary by Contractor).
- Inventory of seedlings should be made in early autumn of 2016 (September) to identify faded plants.
- Faded plants should be replaced by new ones in late autumn (end of October – beginning of November, prior to frosts).
- Planting should be completed in a short period of time (all seedlings should be planted within a one month period).
- Seedlings should be planted immediately (the day they have been transported to the site from the nursery) to avoid drying of roots, otherwise temporary planting of seedlings will be required.
- Protection of plantations from sheep and goats as well as cattle is a vital condition for plants to sprout. To this end, the areas to be vegetated will be fenced with barbed wire along the whole perimeters.
- A contractor company that wins the tender should ensure that minimum 80% of seedlings sprout and grow during the two-year maintenance period.
- In Septemebr of 2017 the Contractor company will delegate responsibility for maintenance of the young plants to the Road Department of Georgia.
- A two-year period of maintenance of the above seedlings will be completed in September of 2017.
- It is advisable that these activities are carried out in subsequent years as required, observing the above instructions.

See the attached plan-schedule for planting and maintenance of seedlings.

Plan-schedule for planting and maintenance of seedlings required for vegetating the terraces

№	Description of works	Years and months																									
		2015				2016												2017									
		IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X
	Planting activities																										
1	Digging out pits of 0,40x0,40x 0,50 m Spreading 20cm thick humus layer																										
2	Temporary planting of young plants																										
3	Planting, watering of seedlings and arrangement of bells																										
4	Inventory of sprouted seedlings																										
5	Replacing dried out seedlings with new ones																										
	Maintenance activities																										
1	Weeding around the seedlings																										
2	Watering of seedlings																										

Humus - Dark-colored soil organic matter, which is formed from cellular structure characteristic of plants and micro-organisms or animals and it is accumulated in the upper soil horizon. It is the basis of soil fertility.

On the terraces and slopes of the closed quarry at 55km, at the height of about 10-15 cm the humus layer is eroding. The mentioned activity will support intensive formation of grass cover resulting in soil stabilization and slowing of erosive processes on the slopes (1m^3 of humus should be spread over about 6-7 m^2 of land area).

Topsoil from the mounds NN 8, 15 and 16 will be transported to the closed quarry located at 58km, where 13530 m^3 of topsoil will be spread over the terraces with an area of 16746 m^2. The thickness of the applied topsoil should be 80cm.

3.7. Fencing of areas to be vegetated

To protect the vegetated terraces of N 1 and N 2 quarries located at 55th and 58th km, barbed wire should be stretched between wooden posts along the above areas. It will ensure that the seedlings are fully protected against impact from cattle.

3.8. Waste Management

Waste inventory was conducted during the audit process and was reflected in elaborated recommendations for waste disposal/usage. The following categories of waste according to their types have been recorded:

- Solid household waste;
- Inert construction waste;
- Non-hazardous construction waste.

3.8.1. Disposal at an Organized Landfill

Above mentioned wate should be disposed at an organized landfill, as composting of all types of solid domestic waste is not possible, while incineration will lead to the formation of waste that should be disposed at organized landfill in accordance with the environmental standards of Georgia. Below is given the list of licensed landfills, where construction waste, solid domestic waste and unused soil may be temporarily / permanently disposed:

- Solid waste landfill in Kaspi - 55 km from Tbilisi;
- Solid waste landfill in Gori- 83 km from Tbilisi (7 km from turning point towards Gori);
- Construction waste disposal area in Otarsheni village - 83 km from Tbilisi;
- Solid waste landfill in Kareli -101 km from Tbilisi.

3.9. Stabilization of slopes N1 and N2 at54-55 km and 80-81 km

3.9.1. Project objective

The proposed project reviews the reclamation measures for the eroded slopes (located at the right side of the road) at the E60 Highway Natakhtari section, on the 54th and 81stkm from Tbilisi.

3.9.2. Brief description of the area

As mentioned above, the slope to be reclaimed is located at the Ruisi-Natakhtari section of E60 Highway. The slope #1 is located between 54th and 55th km of the Highway, on the right side of the road, while the slope #2 is found between 80th and 81st km of the Highway, on the right side of the road as well.

Slope #1. Its length is 283,5m. The reclamation flatness area of the slope equals 6297m^2 . The upper arch of the slope, the so-called eyebrow is 291 linear m. Average slope inclination equals 1:1,5 - 1:2.

Slope #2. Its length is 458 m. The reclamation flatness area of the slope equals 5778,5m^2 . The upper arch of the slope, the so-called eyebrow is 489 linear m. Average slope inclination equals 1:1,5.

3.9.3. Slope reclamation activities to be carried out

First, a drainage channel should be arranged at the ridge, i.e. eyebrow of slope #1 and #2. 291 linear m for slope #1 and 498 linear m for slope #2. The only and major function of the diversion channel will be to divert water streaming from upper parts of the slope during excessive atmospheric precipitations, channel it in an organized way and protect the slope from being washed off.

Parameters for the designed drainage channel are the following: depth – 0,60m, while its neck width - 0,80m. The channel will be arranged manually, a 3cm wide sand cushion will be arranged and 5mm thick concrete canvas laid.
Once the channel has been covered with a concrete canvas, a concrete canvas should be watered on a one-off basis. After 24 hours following watering the concrete canvas achieves hardness grade 350, and its hardness increases and reaches grade 450 in subsequent 28 days.

At the next stage the works are carried out directly on the slope, micro-terraces are arranged on the slope. Micro-terracing implies arrangement of 0,5m wide terrace manually at every 1,5m, along the full length. Later, 0,1m thick humus should be spread over the terraced slope and compacted manually using a compactor. Micro-terracing tends to increase slope stability and preserve more moisture on the slope that is so vital for grass vegetation.

The humus used for slope reclamation is rich with seeds of endemic grass plant species. The plants will have no difficulty to spring up and grow as these areas are their natural habitat.

With every subsequent spring the slopes will become greener and greener naturally; sprung plants will develop a system of roots ensuring slope stabilization and control of erosive processes, thereby.

3.10. Information regarding stockpiles deposited in private properties

Topsoil stockpiles removed during the road construction are found here and there on the right and left side of the road along the Natakhtari-Ruisi section of the Highway. Stockpiles are deposited mainly on private properties. The album of drawings provides information on those land owners where topsoil is stockpiled.

On 28th May of 2015 communication was established with private owners of land plots. Cooperative relations were established with the private owners. Agreements signed with identified land owners regarding topsoil removal from their plots is attached to the project (See Annex 4.7).

As for the areas of closed inert material quarries found at 54th and 58th km, they area not anybody's property. This project envisages organized diverting of atmospheric precipitations from the quarries' territories by culverts and vegetation of terraces by pine and smoke tree seedlings. Once the works envisaged by the project are carried out, we will receive aesthetically spectacular, stable slopes and terraces.

4. Annexes

4.1. Volumes of soil required for filling the empty spaces between the curbs of the dividing line on various areas of Natakhtari-Rusisi section of E-60 Highway

Section №	Distance from Tbilisi*, km	Average width of the section, m	Average depth of the section, m	length of the section, m	Needed volume of soil within the section, m^3
1	42.34	4.60	0.90	3346	13852
2	58.91	5.40	0.65	4020	14110
3	63.52	8.00	1.10	1040	9152
4	64.72	5.90	0.75	1448	6407
5	66.57	5.30	1.00	1416	7505
6	68.37	7.50	0.85	2470	15746
7	71.53	2.40	0.70	1230	2066
8	73.80	2.20	0.70	908	1398
9	77.53	2.30	0.70	323	520
ჯამი				**16201**	**70756**

*** - Distance from Tbilisi to the start of the dividing line section**

4.2. Volumes of construction waste and secondary structure in the vicinity of the road and their final disposal area

Stationing in km is shown in column 2 – from Tbilisi to Leselidze and from Leselidze to Tbilisi

№	Construction waste disposal areas, km	Volumes of construction waste, m^3	Final disposal area of construction waste, distance to, km	Notes
1	2	3	4	5
1	42	3,00	Solid waste landfill in Kaspi, 16 km	Fragments of parapet
2	54	2,00	Solid waste landfill in Kaspi, 6 km	Hardened concrete solution
3	57	22,40	Solid waste landfill in Kaspi, 7 km	Dismantling and disposal of the abandoned building
4	62	32,75	Road department base at Gori, 12 km	Rectangular wells
5	78	20,00	Solid domestic waste landfill in Gori, 11 km	Big size debris of concrete blocks
6	474	3,75	Road department base at Gori, 11 km	Road parapets, 5 pcs.
7	475	3,75	Road department base at Gori, 12 km	Road parapets, 5 pcs.
8	477	3,75	Road department base at Gori, 16 km	Road parapets, 5 pcs.
9	479	4,50	Road department base at Gori, 17 km	concrete slab, 4 pcs. of parapets
10	478	3,75	Road department base at Gori, 16 km	Road parapets, 5 pcs.
11	479	3,10	Road department base at Gori, 21 km	Road parapets, 4 pcs.
12	481	4,00	Solid waste landfill in Kaspi, 19 km	Construction waste
13	483	6,00	Solid waste landfill in Kaspi, 17 km	Dismantling and disposal of bus stop
14	486	10,00	Solid waste landfill in Kaspi, 15 km	Dismantling and disposal of bus stop
15	487	11,00	Solid waste landfill in Kaspi, 14 km	Dismantling and disposal of bus stop
16	489	9,00	Solid waste landfill in Kaspi, 11 km	Dismantling and disposal of bus stop
17	491	4,00	Solid waste landfill in Kaspi, 9 km	Dismantling and disposal of bus stop
18	491	3,00	Road department base at Gori, 9 km	Parapets, 2 pcs.
19	494	1,50	Road department base at Gori, 8 km	Parapets, 3 pcs.
20	495	3,20	Road department base at Gori, 7 km	R/concrete drainage gutters, 12 pcs.
21	495	12,80	Road department base at Gori, 7 km	Prestressed beams, L=8m, 2 pcs.
22	495	17,25	Road department base at Gori, 7 km	Parapets, 23 pcs.
23	495	18,00	Solid waste landfill in Kaspi, 7 km	Small sized concrete parapets, 30 pcs.

№	Construction waste disposal areas, km	Volumes of construction waste, m^3	Final disposal area of construction waste, distance to, km	Notes
1	2	3	4	5
24	495	15,00	Solid waste landfill in Kaspi, 7 km	Remains of r/concrete columns
25	495	12,00	Solid waste landfill in Kaspi, 7 km	Construction waste
26	497	440,00	Solid waste landfill in Kaspi, 6 km	Wall block remains close to the base of "New Energy" at Igoeti

4.3. Arrangement of drainage holes in median strip

Drainage holes with certain intervals are arranged in reinforced concrete parapets of dividing line of atakhtari-Ruisi section of E60 Highway (there are two types of holes - rectangular 30 x 5 and ϕ10 circular).

Some sections of the dividing line, where drainage holes have been observed, can be of two types: section that should be filled with soil and section that is already filled with soil. These two sections differ from each other by the list of required works, which is described in details in Table below.

Table 4.3.1.Arrangement of drainage holes in median strip

№	Stationing in km from Tbilisi to Leselidze and from Leselidze to Tbilisi	Beginning of the section of drainage holes with UTM coordinates	End of the section of drainage holes with UTM coordinates	Length of the section of drainage holes, m	Number of holes in unfilled median strips	Number of holes in filled median strips	Notes
1	2	3	4	5	6	7	8
1	54-55	X-452601 Y-4648185	X-452382 Y-4648351	275.4	-	15	
2	56-57	X-451679 Y-4649188	X-451391 Y-4649476	414.6	-	16	
3	58-59	X-449400 Y-4649969	X-449188 Y-4650028	219.8	-	12	
4	59-60	X-448353 Y-4650242	X-448181 Y-4650284	177.3	10	-	
5	65-66	X-442949 Y-4652188	X-442638 Y-4652266	320.4	17	-	
6	67-68	X-440673 Y-4652581	X-440555 Y-4652601	118.9	7	-	
7	68-69	X-440368 Y-4652628	X-440149 Y-4652649	219.8	12	-	
8	68-69	X-439770 Y-4652657	X-439591 Y-4652658	179.3	11	-	
9	69-70	X-438719 Y-4652741	X-438507 Y-4652762	213.1	12	-	
10	70-71	X-438148 Y-4652701	X-436296 Y-4652747	1861.5	93	-	
11	72-73	X-436296 Y-4652747	X-432880 Y-4653093	3456.5	-	173	

№	Stationing in km from Tbilisi to Leselidze and from Leselidze to Tbilisi	Beginning of the section of drainage holes with UTM coordinates	End of the section of drainage holes with UTM coordinates	Length of the section of drainage holes, m	Number of holes in unfilled median strips	Number of holes in filled median strips	Notes
1	2	3	4	5	6	7	8
12	79-80	X-429527Y-4652243	X-429143Y-4652052	429.0	-	22	
13	473-474	X-430182 Y-4652401	X-430491 Y-4652557	345.7	-	17	
14	475-476	X-432323 Y-4653028	X-432380 Y-4653026	55.5	-	3	
15	479-480	X-435491 Y-4652739	X-436238 Y-4652722	747.6	-	38	
16	483-486	X-439335 Y-4652632	X-441793 Y-4652355	2483.6	124	-	
17	486-487	X-442311 Y-4652294	X-442879 Y-4652194	578.8	29	-	
18	487-488	X-443273 Y-4652010	X-444588 Y-4651370	1462.3	73	-	
19	491-493	X-447438 Y-4650428	X-448868 Y-4650086	1471	74	-	
			Total	**15030.1**	**462.0**	**296.0**	

4.4. Disposal Areas for soil stockpiles and their volumes

Stockpile №	Stationing in km from Tbilisi to Leselidze and from Leselidze to Tbilisi	Disposal area, m^2	Fertile soil disposal area in UTMcoordinates	Volume of soil, m^3
1	2	3	4	5
1	61-62	3444	X – 446898.208 Y – 4650590.388	6000
2	61-62	2783	X – 446552.551 Y – 4650662.596	5500
3	61-62	2147	X – 446021.624 Y – 4650819.757	8400
4	62-63	522	X – 445349.571 Y – 4651085.768	630
5	63-64	11002	X – 444754.376 Y – 4651332.861	37580
6	63-64	2846	X – 444655.661 Y – 4651417.641	9960
7	64-65	9611	X – 443404.739 Y – 4651966.980	25000
8	65-66	4834	X – 442398.041 Y – 4652333.419	10630
15	68-69	1361	X – 440108.836 Y – 4652655.768	1700
16	68-69	1378	X – 440090.556 Y – 4652697.499	1200
9	70-71	8338	X – 437495.037 Y – 4652730.602	41700
10	73-74	4509	X – 434806.331 Y – 4652976.286	5400
11	75-76	7277	X – 433735.170 Y – 4653044.594	3700
12	77-78	2774		
14	77-78	3023	X – 431204.722 Y – 4652958.128	3700
17	484-485	6349	X – 441086.870 Y – 4652125.729	6300
13	493-494	2473	X – 448966.715 Y – 4649908.418	6200
ჯამი:		75188		173900

4.5. Arrangement of Former Base Areas

4.5.1. Arrangement of the Former Base Area of New Energy Ltd

The former base area of New Energy Ltd is located near Igoeti Village, along the old road, the area of which is 0.75 ha (see picture – contour of the area with UTM coordinates).

Approximately 1 m high humus small stockpiles are disposed in the A part of the area, while in the B part – construction waste stockpiles, reinforced concrete structures of various sizes (with approximately dimension of 440 m^3), which can be reused for various purposes. Therefore, these structures should be transported to the solid waste landfill in Kaspi. After the removal of reinforced concrete structures, technical recultivation will be required. B part of the area will be leveled by bulldozer, after which fertile soil taken from the A part will be powdered throughout the area and thus, biological recultivation will be carried out. Additional humus will not be required.

The Former Base Area of New Energy Ltd with UTM coordinates

4.5.2. The Former Second Base Area of New Energy Ltd

The former second base area of New Energy Ltd is located near Igoeti village, on the left side of 56km west of E60 highway

The Former Second Base Area of New Energy Ltd

The former base area is located between the highway and old road and covers 0.5 ha area. Various reinforced concrete structures are found there, such as reinforced concrete prefabricated drainage channels – 19 m long, reinforced concrete parapets – 22 units and two 8 m long reinforced concrete prestressed beams.

Damaged reinforced concrete constructions should be removed to Kaspi solid waste landfill, while good constructions that can be reused later should be transported to the Road Department base near Gori.

About 14 m^3 construction waste remained on the territory should be loaded on dump trucks and disposed at Kaspi solid waste ladfill. After the area is cleaned up, 500 m^3 fertile soil will be transported from the nearest dumping site, it will be spread over the area by bulldozer with 10 cm thickness and thus, biological remediation will be completed.

4.6. Works to be carried out at culverts

The necks of the culverts (arranged under the Highway) should be cleaned from reinforced concrete fragments and solid household waste. See the photos:

477-thkm

481-st km

The above waste will be loaded onto the dump tuck by excavator and removed to the nearest landfill in Kaspi or Gori. The overall volume of wate equals 8 m^3.

4.7. Statements and agreements of private land owners