BOSNIA FORESTRY PROJECT

IMPACT OF FOREST TRUCK ROAD CONSTRUCTION
ON THE ENVIRONMENT IN REPUBLIKA SRPSKA

(EIA Study)

Banja Luka, August 2001
EXECUTIVE SUMMARY

Introduction and background

This report represents the summary on environment impact assessment of forest road construction, within Forestry project in BiH financed by World Bank. Funds for road construction should be taken from remaining funds under IDA.

Roads and locations, for which projects are elaborated, are as follows:

1. "Brankuša - section 115" in SFE "Oštrelj - Drinić" – Drinić
2. "Maksimovića potok" in SFE "Čelinac" - Čelinac
3. "Malinova" in SFE "Borja" - Teslić
4. "Livade - Bač" in SFE "Maglić" - Srbijevac
5. "Šipasno - Zlatac - Lokve" in SFE "Botin" - Nevesinje

EIA studies are elaborated for all roads. These studies are about justification of road construction from aspect of positive, but also negative applications on the environment.

Studies and executive summary have been elaborated by:
1. Mr Zoran Govedar and
2. Dipl. Ing. Ljubo Marić

The Government of Republic of Srpska, by construction of new forest roads in mentioned SFEs, intends to influence on increasing of road infrastructure and openness of the forests. In that way the costs will be reduced and working efficiency increased in the most expensive phase of forest exploitation, which is skidding of wood assortments (transportation phase). Besides that road construction would increase other operational capacities in SFEs regarding protection, regeneration and nursering of forests, as well as other common useful forest functions (tourism, recreation, hunting, collection of secondary forest products and others). In selection of SFEs and locations for road construction it was considered that SFEs, after construction, have significant benefits for local residents and workers in SFE, and inspite of that to have minor negative impacts on the environment.

Beneficial effects of the road construction on the environment, which can reflect directly or indirectly, are the following:

- Road construction will provide access – approach to forest complexes because of exploitation of forests, rehabilitation or regeneration and raising of new forests, collection of special forest products, hunting, preservation and protection of forests and game,
- Easier and more economically justified work in forest management is enabled, during carrying out of silvicultural works, and works on protection and arrangement of forests,
- Influence on increasement and preservation of vegetation and animal diversities,
- Preventive influence in cases of so called unexpected enjoyment (damages that can occur because of negative impacts of different biotic and abiotic factors),
- Facilitation of works in prevention of forest fires,
- Larger possibilities are opened for easier, more efficient and various work of workers in SFEs and local residents,
- Positive impacts of roads on values of passive utilization and non-commercial values, and others.
Possible negative effects, which are not equally emphasized in all SFEs, are the following:

- Increasing possibility for illegal fellings, illegal hunting and setting fires,
- On parts, which are gravitating on brooks, on inclined terrain and places where the route intersects water currents and similar, there is a possibility for rockfalls and appearance of erosion processes,
- In settlements, through which the roads are passing, local residents can have negative impacts because of carelessness in causing fires,
- Roads have impact on habitat fragmentation,
- Decreasement and loss of productive forest soil on the route and tree felling on the route are inevitable,
- Increased danger of so called biological invasion, especially in the area of “marginal habitats”.

However, all these potential negative impacts on the environment will not have great effect because the areas are poorly inhabited. These impacts will be reduced to a minimum with placing of warning signs and if contractors follows the guidelines of the project and EIA Studies.

**Scope of EIA Studies**

On the basis of environment impact assessment on terrain and with detailed analysis it can be concluded the environment benefits, after road construction, are multilateral (many-sided). Damages that reflect on soil, appearance of erosion and tree felling, during road construction, are minimal in relation to benefits provided by roads. EIA Studies are identifying mitigation and monitoring measures for potential impacts related to construction, maintenance and utilization of proposed roads. They also include details about carried out consultations with stakeholders, more exactly data about agreement of stakeholders regarding environment impact assessment. Besides that EIA Studies include remedies of EMP mitigation, which are related to:

- Road construction
- Utilization of roads
- Maintenance of roads
- Inspection
- Monitoring, preservation and protection of the environment

**Approach and methodology in elaboration of EIA Studies**

Terms of reference for EIA Studies describe environment impacts of road construction in SFEs, on five different locations. These impacts are analyzed from several different aspects:

a) Ecological feature of the area (broader-FEA and smaller-management units) as well as locations for construction of planned roads.

b) Impact of road on:
   - Usage of biotope
   - Habitat fragmentation
   - Terrain geomorphology
   - Habitat productivity
   - Biological invasions
   - Fito-pathological and entomological diseases
   - Biodiversity
c) Direct socio-economic impacts
   - Felling plan
   - Collection of secondary forest products

d) Indirect socio-economic impacts
   - Occurrences of forest fires
   - Values of passive utilization and non-commercial values

e) Other impacts (less or insignificantly expressed impacts)
   - Background of forest network development
   - Impact on landscape
   - Impact on aquatic habitat
   - Impact on water and air quality
   - Impact on pasture and others.

Key tasks undertaken for elaboration of Studies can be summarized as follows:

- EIA Studies are to recognize specificness of forest road construction impacts on the environment, so that construction is not only economically assessed,
- Planning and construction of roads not only to be formally – legally ecologically justified, but to point, with EIA Studies, to possible application of Studies as means for overcoming the conflict between forest ecosystems and development obligations
- Studies should provide clear connection between administrative development process in area, as well as identification of environment impact assessment
- Define more precisely different socio-economic impacts with studies
- Recognize possibilities for overcoming and decreasing negative impacts of road construction, with help of the Studies

In order to achieve goals of the Studies following activities have been carried out:

- Analysis of submitted projects with special emphasis on environment impacts of the road
- Collection of necessary literature
- Consultations with experts from different fields (forestry, planners in forestry and civil engineering, ecology and tourism, zoology, fitocenology, botanic, geology, pedology, hunting, and others)
- Visits to routes with engineers from SFEs, and finding of ground center line and chainage
- Data collecting in field about orographic factors, fitocenosis, geological base and soil, game, water currents, property, critical parts of the road and others
- Consultations with local residents, which are gravitating on the road, and after that consultations with potential contractors and SFE directors, and technical planning staff from SFEs
- Analysis and comparison of collected field data with project data, performance projects for management of forests and forest management plans
- Consultations with supervision officials, inspection services and forest rangers, about unwanted effects of road construction
- Analysis of law regulations
- Processing of collected data and writing of EIA Studies

**Summary of conclusions and recommendations**

Main conclusions and recommendations in the Studies are very similar. Drawing of conclusions and recommendations was based on comprehensive analysis.
Main conclusion is that construction of all roads is economically justified. Positive effects achieved from different aspects (efficiency in forest exploitation, protection of forests, biodiversities, dividing of habitats, protection of game and others) are far more significant,
observed on long-term basis, than negative effects caused by road construction and utilization (illegal utilization of forest reserves by felling, game hunting, fires and others).

The most significant benefit of the road construction is providing of access to inaccessible terrains, which were neglected and were not properly assessed, and their natural potential was unused. In positive sense (if used properly), roads have special significance for local residents and SFE workers, because they will facilitate their work in field.

Recommendations, regarding road construction, include decreasement to a minimum of unnecessary use of machinery and explosives in road construction. Also depositing of harmful materials, oil, fuel should be reduced to a minimum. It is necessary to avoid unnecessary felling, and especially take care about possibility of fire occurrence.

During maintenance of constructed roads it is necessary to carry out inspection and covering, especially on terrain susceptible to pluvial erosion. Also, on places with built objects (culverts) it is necessary to clean them and remove branches, stones, sand and other waste material in order to enable flow of water.

During utilization of roads works related to proper placing of signs next to the road have special significance. Those signs should warn people, which are moving next to the road, about potential danger of fires, garbage disposal, migration and game hunting, tourism and recreation possibilities of using forest ecosystems and other.

**Participation of public and private sector**

Consultations with SFEs have been carried out:

1. SFE "Oštrelj - Drinić" - Drinić
2. SFE "Čelinac" - Čelinac
3. SFE "Borja" - Teslić
4. SFE "Maglić" - Srbinje
5. SFE "Botin" - Nevesinje

Beside that following institutions were also consulted: General Directorate of PFE „Srpske Šume”, Forestry faculty from Banjaluka, as well as Road Directorate from Banja Luka, and others. Because of lack of time broader discussion was not carried out and it is planned for the following period. Mainly NGOs will be included.

**Mitigation and monitoring measures**

EIA, Mitigation plan and Monitoring plan are defining several mitigation measures, and giving recommendations for monitoring of potential negative impacts on the environment, during construction, maintenance and utilization of roads.

During elaboration of EIA Studies public consultations were carried out with stakeholders:

1. **Date:** 05.08. and 06.08. 2001  
   **Location:** SFE "Čelinac" - Čelinac  
   Consultation made with: Dipl. Ing. Vitomir Kuzmanović, director of SFE "Čelinac" - Čelinac  
   Home address:  
   Office:  
   Topic: Possibilities of construction and financing of planned road, duration of construction and interest of SFE for construction.

2. **Date:** 06.08. 2001  
   **Location:** SFE "Čelinac" - Čelinac
Consultation made with: Dipl. ing. Tomo Pejaković, manager of sector for production preparations in SFE "Čelinac" - Čelinac
Home address:
Office:
Topic: Comparative analysis of terrain conditions and project conditions. Property and legal conditions.

3. Date: 06.08.2001
Location: SFE "Čelinac" - Čelinac
Consultation made with: Dipl. ing. Tomo Pejaković, manager of sector for production preparations in SFE "Čelinac" - Čelinac
Home address:
Office:
Topic: Comparative analysis of terrain conditions and project conditions. Property and legal conditions.
ENVIRONMENT MANAGEMENT PLAN

ENVIRONMENT IMPACT OF FOREST ROAD CONSTRUCTION IN REPUBLIC OF SRPSKA

## A. MITIGATION PLAN

<table>
<thead>
<tr>
<th>Phase</th>
<th>Issue</th>
<th>Mitigating measure</th>
<th>Cost Install</th>
<th>Cost Operate</th>
<th>Institutional responsibility Install</th>
<th>Institutional responsibility Operate</th>
<th>Comments (e.g. secondary impacts)</th>
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<tbody>
<tr>
<td>Construction</td>
<td>• Material supply</td>
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<td></td>
<td>a) b) To be specified in bidding document – conditions for selection of sub-contractor for material supply</td>
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<tr>
<td></td>
<td>a) Stone quarry</td>
<td>a) use existing stone quarries; requirement for official approval or valid operating license</td>
<td>a) NA</td>
<td>a) NA</td>
<td>a) Stone quarry</td>
<td>a) Stone quarry</td>
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<td></td>
<td>dust, workers health and safety, ecosystem disturbance</td>
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<td></td>
<td>b) Soil supply</td>
<td>b) use soil and humus after construction of topping or use borrow with valid operating license</td>
<td>b) NA</td>
<td>b) NA</td>
<td>b) Contractor or SFE</td>
<td>b) Contractor or SFE</td>
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<td>Disturbances in physical and chemical features of soil, ecosystem and smaller water currents</td>
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<td>• Material transport</td>
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<td></td>
<td>a) Stone dust</td>
<td>a) wet or cover truck load</td>
<td>a) minimal</td>
<td>a) minimal</td>
<td>a) Truck operator</td>
<td>a) Truck operator</td>
<td>a) to be specified in bidding documents - Technical Specifications for realization of works</td>
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<td>Mudd and dust</td>
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<td></td>
<td>b) Soil</td>
<td>b) wet or cover truck load</td>
<td>b) minimal</td>
<td>b) minimal</td>
<td>b) Truck operator</td>
<td>b) Truck operator</td>
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<td>Mud and dust</td>
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<td></td>
<td>c) Traffic management</td>
<td>c) use alternative routes to minimize major traffic sites</td>
<td>c) NA</td>
<td>c) minimal</td>
<td>c) Transport manager; Truck operator</td>
<td>c) Transport manager; Truck operator</td>
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<td>noise, vehicle exhaust, road congestion</td>
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<td></td>
<td>• Construction site</td>
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<tr>
<td></td>
<td>a) Noise disturbance to</td>
<td>a) limit activities to daylight working hours (not between 9 p.m. and 7 a.m. or as agreed with public and authorities); equipment operating with noise mufflers</td>
<td>a) NA; minimal</td>
<td>a) NA; minimal</td>
<td>a) Construction Contractor</td>
<td>a) Construction Contractor</td>
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<tr>
<td></td>
<td>human and animal population and workers</td>
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<tr>
<td>Phase</td>
<td>Issue</td>
<td>Mitigating measure</td>
<td>Cost</td>
<td>Institutional responsibility</td>
<td>Comments (e.g. secondary impacts)</td>
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<td>b)</td>
<td>Dust</td>
<td>b) water construction site and material storage sites, and loading places</td>
<td>b) minimal</td>
<td>b) Construction Contractor</td>
<td>a)-j) to be specified in bid documents - Technical Specifications for realization of works</td>
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<td>c)</td>
<td>Traffic disruption during construction activity</td>
<td>c) Follow and redirect traffic during construction, with people in charge on the construction site</td>
<td>c) minimal</td>
<td>c) Construction Contractor</td>
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<td>d)</td>
<td>Reduced access to roadside activities</td>
<td>d) provide alternative access to roadside activities</td>
<td>d) minimal</td>
<td>d) Construction Contractor</td>
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<td>e)</td>
<td>Vibrations</td>
<td>e) limit activities to daylight working hours between 7 a.m and 9 p.m</td>
<td>e) minimal</td>
<td>e) Construction Contractor</td>
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<td>f)</td>
<td>Water and soil pollution from improper material storage, management and usage</td>
<td>f) isolate and cover working areas; in areas with watercourse use sealed formwork; isolate washdown areas; during exchange of oil and fuel take care that they are not free draining directly or indirectly into watercourse</td>
<td>f) minimal</td>
<td>f) Construction Contractor</td>
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<td>g)</td>
<td>Water and soil pollution from improper disposal of waste materials</td>
<td>g) dispose waste material at appropriate location protected from washing out, on places far from water currents, if possible at wetlands</td>
<td>g) Depends on the location</td>
<td>g) Construction Contractor</td>
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<td>h)</td>
<td>Potential contamination of soil and water from improper maintenance and fueling of equipment</td>
<td>h) proper handling of lubricants, fuel and solvents by secured storage; ensure proper loading of fuel and maintenance of equipment;</td>
<td>h) minimal</td>
<td>h) Construction contractor</td>
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<td>Phase</td>
<td>Issue</td>
<td>Mitigating measure</td>
<td>Cost</td>
<td>Institutional responsibility</td>
<td>Comments</td>
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<td></td>
<td>i) Destruction of trees, private fences, crops and fruit trees</td>
<td>i) appropriate handling with machines and damage compensation  j) provide workers with safety instructions and protective equipment; safe organization of bypassing traffic</td>
<td>i) NA  k) minimal  l) minimal</td>
<td>i) Construction Contractor and PFE “Srpske Šume”  h) Construction Contractor</td>
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<td></td>
<td>j) Workers safety</td>
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<td>i) Construction Contractor and PFE “Srpske Šume”  h) Construction Contractor</td>
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<td></td>
<td>j) Workers safety</td>
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<td></td>
<td>i) Construction Contractor and PFE “Srpske Šume”  h) Construction Contractor</td>
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<tr>
<td>Operation</td>
<td>a) Noise disturbance to human and animal population and workers</td>
<td>a) limit activities to daylight working hours between 7a.m and 9p.m; equipment operating with noise mufflers  b) Organize work of machinery, isolate equipment and oil derivatives from water currents; prevent oil and fuel spills during work of machinery; limit pouring of fuel and oil in machinery on places foreseen for those activities; maintain machinery on wet road</td>
<td>a) NA  b) Minimal  c) minimal</td>
<td>a) Maintenance Contractor  b) Maintenance Contractor  c) Maintenance Contractor</td>
<td>a)-d) to be specified in maintenance contract documents - Technical Specifications for realization of maintenance works</td>
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<td></td>
<td>b) Possible air, water and soil pollution dust, vehicle exhaust, fuel and lubricants spills</td>
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<td>a) Maintenance Contractor  b) Maintenance Contractor  c) Maintenance Contractor</td>
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<td></td>
<td>c) Vibrations</td>
<td>c) limit activities to daylight working hours between 7a.m and 9p.m</td>
<td>c) minimal  d) minimal  e) minimal</td>
<td>c) Maintenance Contractor  d) Maintenance Contractor  e) Maintenance Contractor</td>
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<tr>
<td>Phase</td>
<td>Issue</td>
<td>Mitigating measure</td>
<td>Cost</td>
<td>Institutional responsibility</td>
<td>Comments (e.g. secondary impacts)</td>
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<td></td>
<td>d) Workers safety</td>
<td>d) provide workers with safety instructions and protective equipment; provide warnings on construction site</td>
<td>d) minimal</td>
<td>d) Maintenance Contractor</td>
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<td></td>
<td></td>
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<td>d) minimal</td>
<td>d) Maintenance Contractor</td>
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<td>Phase</td>
<td>Issue</td>
<td>Mitigating measure</td>
<td>Cost</td>
<td>Institutional responsibility</td>
<td>Comments (e.g. secondary impacts)</td>
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<td>Install</td>
<td>Operate</td>
<td>Install</td>
<td>Operate</td>
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<tr>
<td>• Exploitation</td>
<td>a) <strong>Increased volume and speed of traffic; increased moving volume of cattle; dust, vehicle exhaust, fuel and lubricants spills, cattle and garbage throwing</strong></td>
<td>a) limit vehicle speed. Install warning signs for speed limit, garbage throwing and cattle</td>
<td>a) minimal</td>
<td>a) minimal</td>
<td>a) Contractor for environment protection works</td>
<td>a) Contractor for environment protection works</td>
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<td>b) <strong>Road safety</strong></td>
<td>a) <strong>Increased vehicle speed</strong></td>
<td>b) <strong>Danger of running over the game and cattle on the road</strong></td>
<td>b) Install signs for speed limit</td>
<td>b) minimal</td>
<td>b) minimal</td>
<td>a) Maintenance Contractor</td>
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<td>c) <strong>Erosion, rockfall, hazardous conditions</strong></td>
<td>e) Install appropriate nets, warning signs for rockfall, landslide, wet or slippery conditions, dangerous curve, and advertise possible impassability of roads; monitor and repair damages occurred because of harmful conditions</td>
<td>b) minimal</td>
<td>b) minimal</td>
<td>b) Maintenance Contractor</td>
<td>b) Maintenance Contractor</td>
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<td>a)-c) to be specified in maintenance contract documents-Technical Specifications for realization of maintenance works</td>
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</tbody>
</table>
## B. MONITORING PLAN

<table>
<thead>
<tr>
<th>Phase</th>
<th>What parameter is to be monitored?</th>
<th>Where is the parameter to be monitored?</th>
<th>How is the parameter to be monitored?</th>
<th>When is the parameter to be monitored? (frequency of measurement or continuous)</th>
<th>Why is the parameter to be monitored?</th>
<th>Cost</th>
<th>Institutional responsibility</th>
</tr>
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<tbody>
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<td>Install</td>
<td>Operate</td>
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<td>- Material supply</td>
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<tr>
<td>a) Stone quarry</td>
<td>a) possession of official approval or valid operating license</td>
<td>a) stone quarry</td>
<td>a) inspection</td>
<td>a) before work begins</td>
<td>a) Ensure that works in stone quarry and borrows follow requirements of the environment and health of people</td>
<td>a) NA</td>
<td>a) NA</td>
</tr>
<tr>
<td>b) Soil supply</td>
<td>b) possession of official approval or valid operating license</td>
<td>b) borrow</td>
<td>b) inspection</td>
<td>b) before works begin</td>
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<td>b) NA</td>
<td>b) NA</td>
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<td>- Material transportation</td>
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<tr>
<td>a) Stone</td>
<td>a) truck load covered or wetted</td>
<td>a) job site</td>
<td>a) supervision</td>
<td>a) unannounced inspections during work</td>
<td>safety requirements</td>
<td>a) NA</td>
<td>a) minimal</td>
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<tr>
<td>Phase</td>
<td>What parameter is to be monitored?</td>
<td>Where is the parameter to be monitored?</td>
<td>How is the parameter to be monitored?/type of monitoring equipment</td>
<td>When is the parameter to be monitored? (frequency of measurement or continuous)</td>
<td>Why is the parameter to be monitored?</td>
<td>Cost</td>
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<tr>
<td>b) soil</td>
<td>b) truck load covered or wetted</td>
<td>b) job site</td>
<td>b) supervision</td>
<td>b) unannounced inspections during work</td>
<td>b) little disruption to traffic as it is possible</td>
<td>b) NA</td>
<td>b) minimal</td>
</tr>
<tr>
<td>c) Traffic management</td>
<td>c) hours and routes selected</td>
<td>c) job site</td>
<td>c) supervision</td>
<td>c) unannounced inspections during work</td>
<td>c) little disruption to traffic as it is possible</td>
<td>c) NA</td>
<td>c) minimal</td>
</tr>
<tr>
<td>Construction site</td>
<td>a) noise levels; equipment</td>
<td>a) job site; nearest homes</td>
<td>a) sound level detector; inspection</td>
<td>a) once per week and on complain</td>
<td>a) k) assure compliance of performance with environment, health and safety requirements and enable as little disruption to traffic as it is possible</td>
<td>a) NA</td>
<td>a) NA</td>
</tr>
<tr>
<td>a) Noise disturbance to human and animal population and workers</td>
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<td></td>
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<td></td>
<td>a) Monitoring Contractor</td>
<td>a) Monitoring Contractor</td>
</tr>
<tr>
<td>b) Dust</td>
<td>b) air pollution (solid particles, suspended solids, flying heavy metal particles)</td>
<td>b) at and near job site</td>
<td>b) mobile laboratory with necessary equipment</td>
<td>b) during material delivery and construction</td>
<td>b) NA</td>
<td>b) NA</td>
<td></td>
</tr>
<tr>
<td>c) Vibrations</td>
<td>c) limited time of activities</td>
<td>c) job site</td>
<td>c) supervision</td>
<td>c) unannounced inspections during work and on complain</td>
<td>c) NA</td>
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<td>c) NA</td>
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<td></td>
<td>b) Supervision Contractor</td>
<td>c) Supervision Contractor</td>
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<tr>
<td>Phase</td>
<td>What parameter is to be monitored?</td>
<td>Where parameter to be monitored?</td>
<td>How is the parameter to be monitored?</td>
<td>When is the parameter to be monitored?</td>
<td>Why is the parameter to be monitored?</td>
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</tr>
<tr>
<td>d) Traffic disruption during construction activity</td>
<td>d) existence of traffic management plan</td>
<td>d) at and near job site</td>
<td>d) inspection; observation</td>
<td>d) before works start; once a week</td>
<td>d) NA</td>
<td>d) minimal</td>
<td>d) NA</td>
</tr>
<tr>
<td>e) Reduced access to roadside activities</td>
<td>e) provided alternative access</td>
<td>e) job site</td>
<td>e) supervision</td>
<td>e) during construction</td>
<td>e) NA</td>
<td>e) minimal</td>
<td>e) NA</td>
</tr>
<tr>
<td>f) Water and soil pollution from improper material storage, management and usage</td>
<td>f) Air, water and soil quality (suspended solids, oils, organic substances, heavy metals, pH value, water conductance)</td>
<td>f) runoff from site, material storage areas; wash down areas of equipment</td>
<td>f) gravity; observation; mobile laboratory with necessary equipment</td>
<td>f) during material delivery and construction, especially during precipitation (rain, snow, etc)</td>
<td>f) NA</td>
<td>f) NA</td>
<td>f) Monitoring Contractor</td>
</tr>
<tr>
<td>g) Water and soil pollution from improper disposal of waste materials</td>
<td>g) depository site</td>
<td>g) mobile laboratory with necessary equipment</td>
<td>g) once per week during construction and on complain</td>
<td></td>
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<tr>
<td>Phase</td>
<td>What parameter is to be monitored?</td>
<td>Where is the parameter to be monitored?</td>
<td>How is the parameter to be monitored?/type of monitoring equipment</td>
<td>When is the parameter to be monitored? (frequency of measurement or continuous)</td>
<td>Why is the parameter to be monitored?</td>
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</tr>
<tr>
<td>h) Potential contamination of soil and water from improper handling with oil derivatives</td>
<td>h) water and soil quality (suspended solids, organic compounds, heavy metals, pH value, water conductance)</td>
<td>h) job site; equipment maintenance facilities</td>
<td>h) mobile laboratory with necessary equipment; observation</td>
<td>h) once per week during construction and on complain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Destruction of crops, trees, private fences, fruit trees</td>
<td>i) land acquisition</td>
<td>i) job site</td>
<td>i) supervision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j) Workers safety</td>
<td>j) protective equipment; organization of bypassing traffic</td>
<td>j) job site</td>
<td>j) inspection</td>
<td>j) during material delivery and construction unannounced inspections during work</td>
<td></td>
<td></td>
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<td>Phase</td>
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<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>· Maintenance</td>
<td>a) Noise disturbance to human population and workers</td>
<td>a) noise levels; equipment</td>
<td>a) job site; nearest homes</td>
<td>a) sound level detector at mobile laboratory; inspection</td>
<td>a) unannounced inspections during maintenance activities and on complain</td>
<td>a) NA</td>
<td>a) NA</td>
</tr>
<tr>
<td></td>
<td>b) Possible air, water and soil pollution</td>
<td>b) air, water and soil quality (suspended solids, organic compounds, heavy metals, pH value, water conductance)</td>
<td>b) job site; wash down areas of equipment; depository site</td>
<td>b) mobile laboratory with necessary equipment</td>
<td>b) unannounced inspections during maintenance activities and on complain</td>
<td>b) NA</td>
<td>b) NA</td>
</tr>
<tr>
<td>· Dust, vehicle exhaust, fuel and lubricant spills</td>
<td>c) Vibrations</td>
<td>c) limited time of activities</td>
<td>c) job site</td>
<td>c) supervision</td>
<td>c) unannounced inspections during maintenance activities and on complain</td>
<td>c) NA</td>
<td>c) minimal</td>
</tr>
<tr>
<td>Phase</td>
<td>What parameter is to be monitored?</td>
<td>Where is the parameter to be monitored?</td>
<td>How is the parameter to be monitored? (type of monitoring equipment)</td>
<td>When is the parameter to be monitored? (frequency of measurement or continuous)</td>
<td>Why is the parameter to be monitored?</td>
<td>Cost</td>
<td>Institutional responsibility</td>
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<tr>
<td>d) Workers safety</td>
<td>d) protective equipment; organization of bypassing traffic</td>
<td>d) job site</td>
<td>d) inspection</td>
<td>d) unannounced inspections during maintenance activities and on complain</td>
<td>d) NA</td>
<td>d) minimal</td>
<td>d) Supervision Contractor</td>
</tr>
<tr>
<td>Exploitation</td>
<td>a) increased volume and speed of traffic, increased volume of cattle movement</td>
<td>Dust, vehicle exhaust, cattle, fuel and lubricant spills and garbage throwing</td>
<td>a) vehicle emission; noise levels; air, water and soil quality (suspended solids, organic compounds, heavy metals, pH value, water conductance)</td>
<td>a) road section included in project</td>
<td>a) mobile laboratory with necessary equipment</td>
<td>a) once per month and on complain</td>
<td>a) NA</td>
</tr>
<tr>
<td>Road safety</td>
<td>a) increased vehicle speed</td>
<td>a) conditions of traffic signs; vehicle speed</td>
<td>a) road section included in project</td>
<td>a) visual observation; speed detectors</td>
<td>a) during maintenance activities; unannounced</td>
<td>a) monitoring and economical traffic flow</td>
<td>a) NA</td>
</tr>
<tr>
<td>b) Danger of running over game and cattle on the road</td>
<td>b) conditions of traffic signs and warnings,</td>
<td>b) b) road section included in</td>
<td>b) visual observation</td>
<td>b) during maintenance activities;</td>
<td>a) NA</td>
<td>b) minimal</td>
<td>b) NA</td>
</tr>
<tr>
<td>c) Erosion, rockfall, hazardous conditions</td>
<td>vehicle speed and warnings to local residents</td>
<td>project unannounced</td>
<td>c) road section included in project</td>
<td>c) visual observation and speed detectors</td>
<td>c) during maintenance activities</td>
<td>c) NA</td>
<td>c) minimal</td>
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</tbody>
</table>
C. INSTITUTIONAL STRENGTHENING

1. Procurement (purchasing) of equipment

During road construction works, as well as during maintenance no special (additional) equipment will be purchased, so the monitoring contractor will not carry out such activities. Construction contract signatory, must provide evidence about possession, proper functioning of necessary equipment for works. Maintenance contract signatory also has to have evidences about necessary maintenance equipment. Beside that both Contractors must submit evidences about previous experience in such and similar works.

2. Trainings and study tours

Study tours, trainings and special studies are not foreseen. Technical staff from Ministry of agriculture, forestry and water management, Ministry of urbanism, spatial arrangement and ecology, as well as staff from PFE "Srpske Sume" RS will be engaged for consulting services. This staff will consulted prior and during road construction and maintenance.

D. SCHEDULE OF ACTIVITIES

Schedule of construction and monitoring activities is hard to determine. Detailed monitoring plan and schedule of construction activities mainly depend on tender requirements (terms), and after it is carried out schedule of construction and monitoring activities can be determined more precisely. Precise beginning and date for starting and completion of construction and monitoring works are not precise even in projects. Generally, it can be concluded that these dates depend on many factors, and with great certainty it can be emphasized that these activities, considering weather conditions, can be barely finished until the end of this year.
E. INSTITUTIONAL ARRANGEMENTS

Within institutional arrangements connection and cooperation of all involved institutions during project realization is needed. Mutual responsibilities during realization must be stated precisely. Unit for Environment Protection should have special role in this. Beside local experts it should include technical staff from Ministry of agriculture, forestry and water management of RS, Ministry of civil engineering, spatial arrangement and ecology of RS and representatives of PFE "Srpske Šume" RS. Their task, during construction, is to follow the changes on the environment and to submit reports to General Directorate of PFE "Srpske Šume", more exactly to authorized Ministries in RS Government.

Inspection service for protection of the environment should submit data about conditions of the environment during construction, utilization and maintenance of roads to authorized Ministries and PFE "Srpske Šume".

Supervision contractor has to submit periodic (if possible on daily basis) reports about degree of closing down of construction works. These reports should be submitted to SFEs, in which roads are constructed, more exactly to Unit responsible for environment protection during construction and maintenance of roads.

Responsible institutions for management of constructed roads are SFEs, in which the roads are constructed, more exactly PFE "Srpske Šume", because constructed roads represent their main means for work. These SFEs, beside Supervision contractor and Inspection for environment conditions, are carrying out construction and maintenance control.

Within PFE "Srpske Šume" it is necessary to form interactive unit composed of technical staff from field Ministries of Forestry and Ecology, local experts and PFE "Srpske Šume" RS, which would be collecting periodic reports elaborated by construction contractor, Institution for maintenance, supervision contractor and environment Inspection. After that it would submit those reports to Ministry of agriculture, forestry and water management and Ministry for urbanism, spatial arrangement and ecology in RS Government.

Above mentioned obligations and activities, within institutional arrangement, should be performed according to the following model (scheme):
F. CONSULTATIONS

1. Date: 05.08. and 06.08. 2001
   Location: SFE "Čelinac" - Čelinac
   Consultations made with: Dipl. Ing. Vitomir Kuzmanović, Director of SFE "Čelinac" - Čelinac
   Topic: Possibilities of construction and financing of planned road, duration of construction and interest of the SFE

2. Date: 06.08. 2001
   Location: SFE "Čelinac" - Čelinac
   Consultation made with: Dipl. ing. Tomo Pejaković, manager of sector for production preparations in SFE "Čelinac" - Čelinac
   Topic: Comparative analysis of terrain conditions and project conditions. Property and legal conditions

3. Date: 10.08. 2001
   Location: SFE "Oštrelj - Drinci" - Drinci
   Consultations made with: Dipl. Ing. Milanko Brklić, Director of SFE "Oštrelj - Drinci" - Drinci and Dipl. Ing. Rajko Banjac, Technical director of the SFE
   Topic: Possibilities of construction and financing of planned road, duration of construction and interest of the SFE

4. Date: 15.08. 2001
   Location: SFE "Botin" - Nevesinje
   Consultations made with: Dipl. Ing. Ljubo Tešanović, Director of SFE "Botin" - Nevesinje and Dipl. Ing. Veljko Vukosav, Technical director
   Topic: Possibilities of construction and financing of planned road, duration of construction and interest of the SFE

5. Date: 21.08. 2001
   Location: SFE "Borja" - Teslić
   Consultations made with: Dipl. Ing. Milovan Božić, Director of SFE "Borja" - Teslić and Dipl. Ing. Radivojević Zoran, Manager for production preparation in SFE
   Topic: Possibilities of construction and financing of planned road, duration of construction and interest of the SFE

6. Date: 30.08. 2001
   Location: SFE "Maglić" - Srinje
   Consultations made with: Dipl. Ing. Spomenko Stojanović, Director of SFE "Maglić" - Srinje and Dipl. Ing. Vuković Milan, Manager for production preparation in SFE
   Topic: Possibilities of construction and financing of planned road, duration of construction and interest of the SFE

7. Date: 22.09. 2001
   Location: Forestry facility in Banja Luka
   Consultations made with: Dr. Čedomir Burlica, Dean of the Faculty
   Topic: Basic indexes on soil conditions, changes during construction and erosion processes on the routes

8. Date: 24.10. 2001
   Location: IRPC (planning unit) in Banja Luka, RS
   Consultations made with: Dipl. ing. Dušan Bašić, Planner
Topic: Impact of road construction on conditions and changes in forest reserves, in the areas opened with forest roads

9. Date: 24.10. 2001
Location: IRPC (planning unit) in Banja Luka, RS
Consultations made with: Dipl. ing. Travar Jovan, Planner
Topic: Impact of road construction on conditions and changes in forest fitocenosis, in the areas opened with forest roads

10. Date: 15.09. 2001
Location: General Directorate for Roads
Consultations made with: Dipl. ing. Jokanović Igor
Topic: Way of elaboration of EIA studies, mitigation and monitoring plans

Location: General Directorate of PFE “Srpske Šume” RS, in Banja Luka
Consultations made with: Dipl. ing. Jokanović Nenad, Deputy General Director
Topic: Arrangement about elaboration of EIA studies for SFEs and collection of data

12. Date: 30.08.2001 and 05.09.2001
Location: PIU Forestry RS
Consultations made with: Dipl. ing. Željko Stojanović, Director of PIU Forestry RS
Topic: Additional explanations for Executive Summary and Environment Management Plan
Ljubo Marić
Zoran Govedar

IMPACT OF FOREST TRUCK ROAD "MAKSIMOVIĆA POTOK"
CONSTRUCTION ON THE ENVIRONMENT IN MANAGEMENT UNIT
"STARČEVICA - BJELJEVINE" OF SFE "ČELINAC" - ČELINAC

( EIA Study )

Banjaluka, August 2001
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INTRODUCTION

Construction of forest roads is certainly among very important forest activities in SFE. Accessibility to forests and forestland in SFE, as well as successfulness of correct management of such forests is in direct dependence with openness of forests with forest roads.

Most of the forest roads are adapted for transportation of wood assortments with trucks and tractors. These roads are adapted for transportation to road network of public traffic. It is a fact that most of these roads, especially forest truck roads, were constructed with basic goal which is economically justified forest management, because it is well known that the phase of transportation of wood assortments is one of the most expensive phases in production process. However, ecological aspects and justification of road construction, until now, have not been taken into consideration, and considering that these are big and significant infrastructural objects in forest complexes which have influence on number of effects, more attention should be payed to environment impact of forest road construction in the future. Therefore, in number of cases until now, regarding impact on environment, construction of forest roads were not optimal.

From that comes the main activity, and that is to enlarge the analysis and recognition of specific environment impacts of forest road construction, and significance of the construction should not be only economically assessed. Procedures of planning and construction, among other things, should not be only formally – ecologically and lawfully justified, but they should really be the instrument of profession and science for overcoming the conflict between the characteristics of forest eco-systems and development obligations.

Because of that, the goal of this Study is to establish and assess the significant positive and negative effects of forest road construction on environment in the area of SFE Čelinac, in economic unit "Starčevica - Bjeljevine". Therefore, the goal is to elaborate the EIA (environment impact assessment) study for cited object that represents the generic concept, with which we indicate the administrative process in realisation of development project on site, and series of analysis procedures for identification and assessment of environment impacts.

However, in Republic of Srpska and in the areas of SFE’s, significant basis for this problem should be provided by the Environment protection law, which is currently in elaboration phase and is not adopted.

EIA study represents the system of procedures in two levels(stages), with which we, in accordance with multi discipline of public and completeness, analyze alternatives for least damages on the environment and preservation of greatest values of it.

First level (stage) represents the strategic level which means socio-economic impacts and consequences of the project on site, and as a rule they separate on regional and national level and are determined and expressed with methods based on quantitative indexes.

Second level means planning level. EIA study means that on the planning level, according to character of the investor, it should be separated if it is physical or law person with purpose of permission for work.

Previous examinations and main examinations were worked out in the study, which is in fact basically given in Terms of Reference.
1.0. BASIC CHARACTERISTICS OF THE AREA GRAVITATING ON PLANNED ROAD

1.1. Climate conditions

Climate conditions of FEA, when we observe them as macro-climate, can be classified in pre-mountain climate type up to 700m above sea level, and mountain type above 700m up to 1200m.

Climate factors have great significance for development of vegetation and animal world. Forest is the factor of stability of climate elements. This influence especially reflects on micro-climate of certain habitat or area, through decreased extreme values of climate elements, exchange of warmth and moisture in atmosphere. According to scientific knowledge, forest areas have smaller temperature swayings, and with that decreased possibility of frost occurrence and more favourable climate in total.

Forest reduces wind speed, by which it influences micro-climate conditions in the area. Raising of forests and windshied areas provides protection of agricultural land, settlements and roads. By construction of the forest road with clear cuts, large quantities of trees are removed, if width of the road is 6m and length 1000m, clear cuts include areas of 6000 m² or 200-300 m³ of timber mass. If during construction of finished road levels endangerment of forests with winds is not considered, severe damages can appear.

1.2. Geological and pedological characteristics

Geological institutes and organizations have done many scientific editions and geological maps for area of Čelinac in proportions 1:200 000 and 1:50 000, and hydrological maps in proportion 1:200 000. Mentioned maps are valuable documents because areas of forest complexes scientifically studied according to geological-hydrological composition, gravitating to municipality Čelinac are drawn in.

Latest scientific research in FEA Čelinacko were carried out in 1979 by Forestry faculty ans Forestry Institute from Sarajevo. According to scientific methodology, pedological-typological mapping of FEA has been done and the area has been classified in the area of inner Dinaric mountains, more exactly »Zone of Paleozoic shales and Mesozoic limestones«, »Central ofiolit zone« ans »internal Dinaric zone«. In the following table geological chronology in the management units is shown.

<table>
<thead>
<tr>
<th>Management unit</th>
<th>Sections</th>
<th>Home substratum</th>
<th>Type of soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Starčevica-Beljevina&quot;</td>
<td>4/2 to 11/2</td>
<td>serpentine</td>
<td>eutric brown soil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>flysch</td>
<td>distric kambisol and luvisol</td>
</tr>
<tr>
<td>&quot;Crni Vrh&quot;</td>
<td>35 to 45</td>
<td>shale</td>
<td>luvisol and pseudoglejev</td>
</tr>
<tr>
<td></td>
<td></td>
<td>silic. limestone</td>
<td>brown limestone and luvisol</td>
</tr>
<tr>
<td>&quot;Osmjača Tisovac&quot;</td>
<td>67 and 68</td>
<td>compact limestone</td>
<td>fertile soil, brown limestone and luvisol</td>
</tr>
<tr>
<td>&quot;Velika Ukrina&quot;</td>
<td>55-66, 70-77 133-141 and 183/1-235</td>
<td>diabase, amphibolite, splita, peridotites</td>
<td>eutric brown soil, ranker and distric kambisol, eutric brown soil, alkaline ranker</td>
</tr>
<tr>
<td>&quot;Jošavka&quot;</td>
<td>1-26/2</td>
<td>dolomites</td>
<td>dolomite rendzine</td>
</tr>
</tbody>
</table>

Table 1

Flysch stratum are including large complexes around area Čelinac, on these home substratums, soils with high productive possibilities were created, in most cases next to planned route of forest truck road luvisol, distric kambisol and partially pseudoglejev are exchanging mozaically. Distric kambisol which are formed on sandy soil, marl and sandy limestones in the route zone, are suitable for road construction that is undisturbing and safe for the environment.
On the places where home substratum is dilapidated, mining during construction is not required. Route planning can be done with usage of feeder. However, on places with more limestone where massive rocks break out on the surface, mining will be done and it can have negative consequences on the environment (trees, low flora, game, etc).

Forest areas included in geological surface with flysch on steep slopes and crests are susceptible to high degree of erosion and denudation processes, which represents great danger during road construction because of far-reaching negative processes on forest surfaces.

Dilapidated material, during usage of heavy machinery, is making ditches on moist soil, which is especially expressed on deep soil with unstable geological base like sandstones, marl and phyllite, which is creating conditions for hydro erosion.

Harmful consequences, during construction of forest roads, are especially expressed on geological base whose crossfall is large, so the route is constructed in cuts. It especially negatively reflects on vegetation, since the route is 6,0 m wide and it intersects soil and water currents, with consequence of drying the plant cover in the zone of the route. Crests and valleys are requiring from the contractor maximum caution during construction, in order to avoid unwanted slides and rockslides of unstable geological base.

Occurrence of slides during and after construction of forest roads are frequent on deep luvisol and kalkokambisol. Impermeable layers of clay and loam on wet terrain because of intersection and digging out of the surface soil during construction of the road, become unstable even on terrain with slope over 40%, which is often on the entire route. These terrains are exposed to potential slides of larger soil complexes. Unstable parts of soil, above the route, together with vegetation and especially trees, are falling and doing severe damage to forest road, and in most cases in lower parts of constructed road.

Part of the road that passes through surface whose home substratum mostly represents glacial deposits, phyllite and other sediment and ultra alkaline rocks, are often potential danger on truck roads. In rainy period small and large stone fractions are falling in large quantities on the road and disable the passability of the road surface and endanger the participants in the traffic.

In order of preventive protection it is necessary, on critical places, to place protective wire net, which is foreseen in the project.

1.3. Orographic factors and passability of terrain

Planned road is intersected with crests and mild hollows, which are located vertically on the road axis. With goal of technological categorization and standardization of forest areas opened with constructed road, from clear topographic map in proportion 1:10.000, presence of areas according to degree of terrain slope, coning of terrain and passability is recorded. Arial presence of terrain, according to degree of coning and slope of terrain, is done according to adopted scientific method and shown in numbers (table 2). They are relatively informing us about accessibility and passability of forest terrain and complexes, which would be opened with the road.

Mainly areas with slope of 41-50% are present, which shows us that the route will be mainly constructed in cuts (see the project of the road).

<table>
<thead>
<tr>
<th>Section</th>
<th>Area (ha)</th>
<th>1 - 20</th>
<th>21 - 40</th>
<th>41 - 50</th>
<th>51 +</th>
<th>ŽVS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1</td>
<td>63.00</td>
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<td>7.1</td>
<td>6.06</td>
<td>9.6</td>
<td>47.07</td>
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<td>-</td>
<td>1.92</td>
<td>3.9</td>
<td>43.34</td>
</tr>
<tr>
<td>11/1</td>
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<td>4.33</td>
<td>6.7</td>
<td>16.37</td>
<td>25.2</td>
<td>42.30</td>
</tr>
<tr>
<td>11/2</td>
<td>56.00</td>
<td>-</td>
<td>-</td>
<td>12.00</td>
<td>39.3</td>
<td>33.65</td>
</tr>
<tr>
<td>TOTAL:</td>
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<td>8.79</td>
<td>3.8</td>
<td>36.35</td>
<td>15.6</td>
<td>66.36</td>
</tr>
</tbody>
</table>

Note: (ŽVS) - Terrain with slope, which is not suitable for road construction.
In order to show endangerment, deformity and conditions of forest stands according to LHCD methodology, technological categorization and standardization is determined in the following table:

<table>
<thead>
<tr>
<th>Level of endangerment of habitat</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section</td>
<td>Area (ha)</td>
<td>Level of soil deformity</td>
<td>ha / %</td>
</tr>
<tr>
<td>1</td>
<td>2.</td>
<td>3.</td>
<td>4.</td>
</tr>
<tr>
<td>10/1</td>
<td>63,00</td>
<td>10,52</td>
<td>16,7</td>
</tr>
<tr>
<td>10/2</td>
<td>49,00</td>
<td>1,92</td>
<td>3,9</td>
</tr>
<tr>
<td>11/1</td>
<td>65,00</td>
<td>20,70</td>
<td>31,8</td>
</tr>
<tr>
<td>11/2</td>
<td>56,00</td>
<td>12,00</td>
<td>21,4</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>233,00</td>
<td>45,14</td>
<td>19,4</td>
</tr>
</tbody>
</table>

Note:  
I - Areas suitable for road construction  
II - Areas with acute deformity and requiring high construction costs  
III - Soil planed for forest ropeway.

Table 3

Numerical data in table 3 are informing us that forest stands are located on 187,86 ha or 80,6% of the area, with terrain slopes over 51% and with expressed occurrence of acute deformities, which requires big costs during construction of the road. But, since the course of the route is on the lower third of the slope, which includes area of 45,14 ha or 19,4 %, costs for the road are much more favourable, which is financially justifiable.

1.4. Hydrological conditions and protection of water potentials

According to carried out pedological-typological mapping and insight in topographic maps and scientific literature we realized following, regarding hydrological potential of forest complex opened with planned road.

FEA Čelinačko has involved hydrological network, whose water order equal. Main water currents of basin of river Vrbas are composed of river Vrbanja with numerous springs and brooks.

Forest complex through which planned road "Maksimovića potok" is passing, is intersected with number of small and big brooks, among the most significant are:

1. Maksimovića potok  
2. Malića potok  
3. Borski potok  
4. Sovotina potok

Mentioned brooks are gravitating towards inhabited places and supply the residents with drinking and healthy water.

Terrain relief, which is located near the planned road, is very distinct. Terrain is intersected with numerous and long crests, and depressions rich with water.

Rich vegetation, high forests of beech and oak with different evolution stages, bushes and low flora, are providing protection from erosion and denudation processes.

Infiltration of soil by water is very often on terrain near inhabited places. Unreasonable felling of low scion forests by residents and other anthropogenic factors, causes denudation and infiltration of soil with harmful consequences. In order to prevent this harmful phenomena, priority cultivation tasks are set for foresters, which include prompt prevention of illegal felling and raising of new plantation where necessary. Illegal felling is violating hydrological order, by which torrent areas are created and water is temporary withdrawing from shallow springs.

Large masses, which are moving through brooks like branches, trees and large rocks, are destroying everything in their way. It especially reflects through undermining and damage to forest roads.
With qualitative construction of the road and placing of foreseen objects, which are: culverts, drainage ditches next to the route, proper construction of shoulders and their planting with grass, erosion processes will be decreased to minimum.

Great significance of water potential in this FEA is reflected through successful supplying of residents with drinking water and supplying of vegetation and animal world in the area with drinking and healthy water.

1.5 Plant communities

On the territory of management unit "Starčevica Bjeljevina" specific and resistant forest vegetation is growing, which is characteristic for ecosystem of internal Dinaric mountains. Depending on bio-ecological requirements of trees on 150-700m above sea level, different diversible elements and vegetation stages are exchanging.

On lower, oftenly flooded terrain, next to brooks and river Vrbanja, forests of Salix alba L. And Alnus glutinosa are growing. Although natural species of these forests were cleared in past few years, still there are areas with natural forests.

Considering the productivity of these types of trees, researches have shown that they are acquiring satisfactory values already in 15th year, when their volume can be 200 m³/ha. Since these species are resistant to diseases and damage made by air and water pollution, we should try to keep these species alive (preserve).

Warmer habitats above this area are occupied with oak (Quercus petraea M. Liebl), hornbeam (Carpinus betulus L.), European ash (Fraxinus ornus L.) and Q. pubescens. Considering bio-ecological characteristics of oak, in mixed stands of this species in higher layer, there is oak and in subtenant is beech (Fagus moesiaca), hornbeam (Carpinus betulus). Colder habitats in hills are mainly are populated with pure beech stands oftenly with one species of trees, or is included in composition of some ecoecologically similar phytocenosis like maple (Acer pseudoplatanoides) and oak (Q. petraea L.). Special environment of hill area of beech is creating vegetation zone with hawthorn (Crataegus monogyna lacq.), elder(Sambucus nigra L.), sallow (Salix caprae L.).

High vegetation zone from 700 to 1,300 m mainly include beech (Fagus silavtica), fir (Abies alba Mill.), and maple (Acer pseudoplatanus L.). These are high productive stands. In this area fir has very good productivity. Research results in mixed stands have shown that they have large volume per ha (350 to 400 m³ per ha).

Species, which are giving special landscape, are white-beam tree (Sarbus aucuparia Mill.), service tree (Sarbus torminalis) and elder (Sambucus racemosa L.). Low vegetation includes bilberry (Vaccinium myrtillus L.), heather (Erica carnea L.) and (Vaccinium vitis idaea L.), and (Oxalis acetosella L.).

According to previous priority purpose, most of the forests in this management unit served for production of timber mass, more exactly priority was utilization of productive forest functions. Other functions, protective and touristic-recreative, have provided with improvement of existing economic (productive) forests.

1.6. Productivity of forests and ways of management

According to forest inventory data base has ben formed about conditions of high natural forests, which are gravitating on the planned road in management unit "Starčevica - Bjeljevina." Data clearly point to unsufficient utilization of productive potential in high natural forests. Main reason is unsufficient openness of stands with primary and secondary network of roads. Potential possibility and actual productivity of forest, which are gravitating on the road is shown in the table:
According to average values for certain stands and estimation of optimal values for volume and volume increment, we see that volume and volume increment are 85% from estimated optimal value.

By opening the stands with truck roads, prompt and systematic carrying out of raising measures in all development phases is enabled, with reduced costs.

Basic management system for forests in this FEA is based on the principle of group-selection and selection management, whose essence is combined method of natural regeneration of forests, which has great impact on preservation of natural gene fund of the forests in the area. Guarantee of success in natural regeneration of forests is in the fact that with utilization of natural potential and knowledge about environment conditions (ecological features), stand conditions with emphasis on structure, as well as knowledge about biocological features of trees, which are included in these forests, are providing satisfactory number and qualitative structure of young crop.

Usage of mentioned management systems and success of natural regeneration is depending on openness of forest complexes in the area of sections 10/1, 10/2, 11/1 and 11/2 in management unit "Starčevica Bjeljevine".

### 1.7. Conditions of game

Within the FEA "Čelinačko"–hunting area has been formed, and it is managed on the basis of hunting plans.

The most important species of game in this hunting area are:

a) Permanently protected species of game

- Weasel (Mustela pp),
- Squirrel (Sciurus vulgaris),
- Hazel hen (Tetrastes bonasia L.),
- Falcon (Falconidae),
- Hawks (Accipitriade),
- Raven (Corax corax),
- Owl (Strigidae) and others

b) Game protected with hunting closed season

- Brown bear (Ursus arctos L.),
- Roe deer (Capreolus capreolus),
- Hare (Lepus europaeus),

<table>
<thead>
<tr>
<th>Section</th>
<th>Total</th>
<th>Annual volume increment</th>
<th>Average value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>ha</td>
<td>m³</td>
<td>m³</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>-------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>10/1</td>
<td>63.00</td>
<td>14.364</td>
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<tr>
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</tr>
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<td>14.592</td>
<td>444.60</td>
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<td>11/2</td>
<td>56.00</td>
<td>12.768</td>
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<tr>
<td>TOTAL:</td>
<td>233.00</td>
<td>47.555</td>
<td>1.505.30</td>
</tr>
</tbody>
</table>

Table 4
Gray partridge (Perdix perdix),

Rock dove (Columbia livia),

Turtledove

c) Unprotected game

- Wild boar (Sus.scropha L.),
- Wolf (Canis lupus),
- Weasel (Vulpes vulpes),
- Wildcat (Felis silvestris),
- Polecat (Putoris putoris) and others.

This hunting area belongs into the category of economic sport hunting areas, so it fulfills the needs of economic hunting and hunting as sport –recreative character of members of hunting organizations.

For satisfaction of hunting area functions, from viewpoint of mobility of hunters and hunting service, existing network of forest communications is satisfactory and it is used in the periods of intensive hunting.

For construction of hunting objects (observation posts, lodging objects, places for weapon testing and others) it is necessary to construct new infrastructural objects, forest roads and hunting trails, which should enable greater mobility, and to facilitate the work first of all to game warden service, technical staff and hunters in the hunting area.

Therefore, in the existing hunting plans, it is foreseen that in the following period, new hunting paths should be built, which would increase the intensity of management and facilitate carrying out of all activities foreseen in the plan.

The road will have of greater significance because in the area of management unit “Starčevica-Bjeljevine”, after the road is constructed, game warden service will have easier access to sections, through which road is passing.

1.8. Openness of forests with forest roads

FEA “Čelinač” – Čelinač is opened with three main categories of roads:

- Public roads
- Regional rods
- Forest truck roads

Precise data about length of these roads in the SFE do not exist. However, it can be emphasized that total openness of forests and forest land in the area is in average 8 km/1000ha, which is certainly not satisfactory especially if you take into consideration that for this area optimal openness of forests is considered to be 15-20 km/1000ha. That points to the necessity for construction of new roads, especially forest truck roads that should enable the access to unopened forest complexes due to satisfaction of all positive sides of forest road construction, with all precautions and preventive measures with goal of prevention of negative consequences, which follows the construction of a road.

Approaching to the optimal openness with construction of new roads, perspectives of the area development in new conditions of the economy and development of private initiative would be greater.

Forest ecosystems of this area represent natural resources in area of Čelinač. Management with these restorable resources is based on law regulations, forest management plans, projects and hunting management plans, and with low openness like this it is significantly difficult. Because of affirmation of all positive sides provided with road construction, more successful economy and especially help to local residents, it is very important to increase openness of forests and forest land with roads.
2.0. DESCRIPTION OF THE ROUTE

2.1. Location of the road

Road "Maksimovića potok" is planned in management unit "Starčevica – Bjeljevine". Length of the route is 1,841 m. The route is set out with apex and center-line pegs, and marked with cross-section and apex numbers. The route passes through sections 10/1 and 10/2. Location of the road is given in the map.

2.2. Purpose (reasons) of road construction

Road construction should facilitate the usage of numerous resources from natural and changed forest eco-systems. Their significance is greater for local residents, who are living in economically undeveloped areas, where life and work are based on work in SFE "Čelinač - Čelinač, as the most significant economic subject of the place.

It is well known that construction of the road can have positive (useful) and negative (harmful) consequences. Special significance road construction has form the viewpoint of enabling the access to the forest complex. For the workers in SFE, especially those doing felling, construction, skidding and exporting of wood assortments in sections 10/1, 10/2, 11/1, 11/2, in management unit «Starčevica - Bjeljevine», as well as in surrounding sections of the same management unit, the work will be facilitated.

Besides that, the road should enable the easier arrival of other workers to the objects, and to local residents greater and easier activities of collection of mushrooms and medicinal herbs (special forest products), as well as easier movement of cattle from one pasture to another. Special significance road should have in facilitation of work to protection services (foresters and game wardens), which is from great importance today.

The road should also have the preventive role for prevention of forest fires expansion. Considering that the road route is passing through complex of high forests with high degree of preservation, with all the specificness of autochthonous and undisturbed vegetation in certain conditions, visitors, tourists, citizens, scientists, local residents and others will be in opportunity to get introduced with gifts of the nature in the area.

Accomplishment of more significant economic effects, especially for the SFE, will be enabled by road construction, because the costs for the most expensive phase of transportation of wood assortments will be reduced. Another reason for road construction is that pure beech and oak, as well as mixed stands of oak and beech in development phase of ripe stand are dominant in the forest complex. Because of that, in this complex, it is necessary to carry out the silviculture activities due to renovation of beech, and helping the development of beech and oak young crop. From the other aspect, by keeping too ripe and ripe beech trees, the stands in mezzoflile habitat conditions beech trees are susceptible to diseases of central rottness and decay, which significantly reduces market value of current high-quality beech trees. It is impossible to overcome this problem without constructed road.

Greater economic effects are expected after construction of the road, because local residents will use this road for providing fire-wood and collection of mushrooms, medicinal herbs and forest fruits

Construction of forest road "Maksimovića potok" has the following goals:

a) Spatial opening of stands and assuring of economic and safe collection of wood, and operations with wood  
b) Facilitation of spatial and temporal organization of regeneration and raising of stands, and protection of the stand environment  
a) Facilitation of works for local residents, easy access to forest complexes in order to utilize secondary forest products, etc.

2.3. Usage of biota during the road construction

Freight vehicles traffic, which should be carried out on this forest road, after the construction is finished, would not be intensive, because of the several reasons and the following are the most important:
- Intensive felling and transportation of wood assortments, according to working cycle and 
  length of fecundation, will be carried out after 10 years as it is regulated by FMP. 
- Area, which will be opened with this road is poorly inhabited and does not connect inhabited places.

Because of that the most significant negative impacts on biota are expected exactly during road 
construction. Most significant impacts and far-reaching consequences are on forest land as integral part of biota 
and especially in the part next to the road. Within preparatory works, significant negative impacts, which are 
unavoidable, are related to felling of trees (mainly beech and oak), shrubs (*Dafne mezereum*, *Sambucus nigra*, 
*Cerasus avium*, *ilex aquifolium*, *Corilus avelana* and others) and low flora. Besides that, extraction of roots of 
mature trees is carried and habitat of pedo-fauna, which is very active here, is endangered. Holes which remain 
after extraction of roots will be filled and compacted with soil material because of stability of roadbed, which 
negatively reflects on water and air order and endangers the habitat of pedo-fauna.

Considering that there is no dense young crop on the route, damage to current young crop are not 
intensive. Surely that by road construction large quantity of this area is lost for occurrence not only of young crop 
but also other vegetation on the road. However, by opening the stand structure above the route, favourable 
conditions appear for occurrence, growth and development of heliofits next to the road (usually *Rubus*, *Sorbus*, 
*Populus tremula* occur, as well as heliofits of low flora), by which biodiversity of plant species is increasing next to 
the road.

Yet, most intensive and severe consequences are done to soil, which is permanently lost. Major part 
remains disposed in embankments, which is important but from productive viewpoint it is lost.

2.4. Geomorphologic impacts of road construction, sedimentation and 
  rockslides

Location and course of the planned route brings to a conclusion that expressive geomorphologic 
impacts, in sense of negative consequences, will be displayed in two ways and on two different parts of the 
route:

1. On the part of the route that passes through forest complex, slope is bigger and more intensive earth 
   works are expected, which would have negative impacts on habitat and negative geomorphologic 
   processes will be more expressive here.
2. On the part of the route that passes through base of the section which will be opened, negative 
   impacts will be reduced to minimum. Reason for that is slope of terrain and route, and because of 
   that intensive earth works will not be carried out, which is very important for construction of these 
   roads with special emphasis on protection of the habitat.

It is known that roads have impacts on geomorphologic processes through 5 primary mechanisms:

a) Direct impacts on structure and geometry of soil cuts, embankments, ditches and similar.
b) Changes in usual surface water currents and creation of new courses to water currents
c) Direct influence on structure and geometry of water currents
d) Speed up of erosion from the road surface
e) Causing the impact on water, especially on places where the road crosses the brooks

If possibilities of negative impacts of the road through mentioned mechanisms are reviewed, than it should 
be emphasized that on the route there is no terrain where occurrence of slides is possible. Possible more 
intensive erosions can be expected during road construction under influence of pluvial erosion. Mass of moved 
soil can be minor, because those are brown soils, which are averagely susceptible to pluvial erosion. Most of 
moved material would be undissolved dead forest cover in the zone of small ditches created by water. Cover is 
here present in thick layers, and is not completely humidified because of the stand structure. Accordingly 
possibilities of negative impacts can appear next to culverts, sediments and wood during torrents, which would 
not be expressed here. Impact of the road on this terrain, regarding movements of large soil mass, are almost 
impossible.
Clear cuts are not foreseen in this area, and depots will be constructed on flat terrain, so these dangers of pluvial erosion are reduced to minimum.

It can be concluded that road construction would not cause appearance of larger geomorphologic disturbances and erosion processes on the road or in the surroundings, because of relatively small earthworks, small cuts and embankments and favourable course of the route with small fall of finished road levels. In favour to this there is a fact there brown limestone is dominant, which are averagely susceptible to pluvial erosion, and more intensive pluvial erosion could be expected on parts where kalkokambisol is dominant. In depressions and flat terrain there are soils least susceptible to this type of erosion processes.

In order to reduce unwanted consequences of pluvial erosion processes, which are possible for this area in periods of heavy rainfalls, qualitative compaction of subgrade should be done during construction, and later continually maintain the road with special attention to most endangered parts of the road.

However, considering that there are no water currents near the road, and revitalization and renovation of low heliofit vegetation next to the road is very intensive, danger of this character will be minor.

### 2.5. Hydrological impacts of road construction

Mutual complex impact of forest roads on hydrological order and reverse represents several key things, regarding impact of forest roads on the environment. Essential problem in planning and designing, and selection of alternative solutions and decision about appropriate variant of the road, represents defining of relation between certain segments of the road on one side, and temporary and permanent reasons for failure on the other. That can reflect on the hydrology of certain slope. Often main reasons of failure during construction are caused with poor drainage of the road, especially in torrent period. Consequences, from ecological and economic viewpoint, can be disastrous.

In concrete case, danger of occurrence of torrents are reduced to minimum, for several reasons:

a) Specificness of geologica base  
b) Presence of limestone soil  
c) Non-existing waterproof layers in soil  
d) Sufficient number of pipe culverts and ditches for drainage foreseen  
e) Small slopes of terrain next to the road and near it

For preventive performance and prevention of unwanted consequences of possible smaller torrents, it is necessary to pay attention to cleaning of waste materials in collecting pit, culverts and drainage ditches, during maintenance of road. This problem is well planned within project documents, and 5 pipe culverts with diameter 1000 mm are foreseen, for transverse drainage, which is sufficient for prevention of damage on places with severe torrents.

### 2.6. Impact of the road on productivity of the habitats

Road construction directly changes features of soil resources, because roads, by passing through forest complex, are occupying productive soil and have impact on reducing of total productive potential of certain habitat.

Considering that there is no dense young crop next to the road, damage to present young crop is not significant. With road construction this area is lost for occurrence of young crop and other vegetation on the road. However, by opening of stand structure above the road, appropriate conditions appear for occurrence, growth and development of heliofits next to the road (usually species from family Rubus, Sorbus, Populus tremula appears, as well as heliofit low flora), by which biodiversity of vegetation next to the road is increased.

Yet, largest and most severe consequences are done to soil, which is permanently lost. By road construction 2 520 m³ of humus will be removed. Major part remains disposed in the embankments and that is important benefit, but from productive viewpoint it is lost.
However, road construction should not be observed from viewpoint of productivity lost, but also on long term basis through indirect impacts, significance of the road can be positive. Namely, with construction, easier and economically justified carrying out of growing activities, activities of collection of special forest products, game warden activities and other will be enabled in stands, and improvement of qualitative and quantitative structure of forests will be directly influenced. In that way, more intensively, productive potential of habitat will be used, from viewpoint of production of higher quantity of timber mass, as well as providing the continuity of management and satisfaction of common useful forest functions. Of course long term and indirect analyzing of these impacts should be kept in mind.

2.7. Impact of road construction on fragmentation of the habitats

It is unavoidably that with construction of the road habitat of naturel populations is divided in two or more parts. In the area of road construction these impacts can be viewed from two aspects:

- Classification of habitat for plant species related to biodiversity
- Classification of habitat for animal species

Existing habitat, in sections through which the route is planned, is characterized with all features of preserved habitat of domestic vegetation, of plant community of potential vegetation Querco – Fagetum illyricum, Querco carpinetum illyricum and fagetum submontanum.

When the road is constructed three habitats will be formed, from which two would have same conditions. Special micro-habitat, with all new micro ecological features, will be formed on the road, as the marginal habitat.

The most significant feature of that micro-habitat is increasing of thermophility and illumination, which will directly reflect on occurrence of heliofit species of trees, bushes and low flora next to the route. Conclusion on that can be drawn on the basis of terrain observation on certain places with damages made by wind and snow, and different breakings. Species that would probably appear are: Acer pseudoplatanus, Acer platanoides, Sorbus sp., Fraxinus excelsior, Fragaria vesca, Asarum europaeum, Rubus sp, Galium silvaticum, different fern and crop of autochthonous tree species and others. That shows the increasing of plant biodiversities next to the route, which significantly differs from biodiversities in other two macro habitats on one side, and on the other road on longer distance from the route where existing flora will remain dominant (Fagus silvatica, Quercus petraea, Carpinus betulus, Acer pseudoplatanus, Fraxinus excelsior and others).

Specificness of the occurrence of somewhat changed habitat conditions after road construction should be expected in stands, after carrying out of silvicultural and utilization works in habitats far from the road.

Those changes will be caused by felling, which will be carried out in sections, after opening of this forest complex. Main goal of these actions, besides utilization of timber volume, is to improve natural regeneration of domestic vegetation.

Negative consequences and creation of unwanted micro-habitats after road construction can be expected in forest complex, on places of irrational and irregular felling, and excessive felling on quality and volume in stands.

Consequences of these phenomena are growing of weed in habitat and loss, in productive sense, because of weed growing mainly of species Rubus and Vaccinium. That can be prevented with adequate supervision during realization of performance projects and organizing of forest ranger service.

Dividing of habitat for animals will reflect especially on game. Namely, road construction will reflect positively and negatively. Positive because with the creation of marginal habitat birds and animals, which usually inhabit the forest edge, are getting new corridor by which they can move deeper in the forest. That will increase the diversities of animal species in forest and area of habitat for these species of birds and animals.

Negative impacts would affect some species of mammals, for which is known to avoid moving on the roads. Their only habitat, by road construction (especially by usage of existing roads which are connected to planned one), will be divided with long route, which represents significant obstacle for mammals’ movement. Problems can be solved by arranging the accessory objects equally in both conditional macro-habitats.
Road impact will also have influence on terrestrial Vertabrata in the following ways:

<table>
<thead>
<tr>
<th>Type of impact</th>
<th>Assessment of impact intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Loss of habitat and fragmentation</td>
<td>Medium impacts</td>
</tr>
<tr>
<td>b) Negative impacts of road utilization, noise and running over on the road</td>
<td>Strong impact during construction and utilization of forests (felling, export and transportation), which is relatively short if you know that exploitation in these sections can be finished in 1 month/sect.</td>
</tr>
<tr>
<td>c) Excessive hunting and traping</td>
<td>Small impacts</td>
</tr>
</tbody>
</table>

Solving of these problems is possible with organization of appropriate supervision during construction by engaging only necessary machines, more intensive engagement of labour, organization and greater mobility of game warden service, and placing of warnings and appropriate signs next to the road, as well as avoiding of excessive mining on the borrows and on the route.

2.7.1. Impact of the road on biological invasions

Most oftenly, idea of biological invasion is observed through biological disturbance. By road construction, impact of anthropogenic factor during utilization and maintenance, disturbances appear that are creating marginal habitat. These marginal habitats are under more intensive human impacts (moving with vehicles, throwing garbage), and can cause appearance of outer vegetation species on habitat not typical for them. Beside human impacts different agents (water, wind, etc) can also have similar impacts, in sense of expansion and mixing of new plant species. That is why the road is oftenly considered as new corridor for expansion of outer species (Greenberg, Othors, 1977).

By construction of the road «Maksimovića potok» these impacts on biological invasion will not be intensive. The reason is, because movement of vehicles and people will not be intensive like on public roads. On unwanted effects of these impacts can be pointed during and after construction with adequate warnings next to the road. Good example of biological invasion of outer species is expansion of Robinia pseudoacacia, which represents weed on cultivable agricultural soil in lower route, on flat terrain that gravitates to inhabited part of the area.

It is also necessary, in performance projects, to point to danger of biological invasion of unwanted species because they can represent serious problem during realization of arrangement of forest, since they disrupt the structure, composition and function of forest ecosystem.

2.8. Impact of the road on diseases of trees

Existence and construction of roads, roughly observed, have no major impact on forest diseases. However, the fact is that areas opened by forest roads have larger possibility of prevention of herbal diseases appearance.

Significance of the planned road is greater if you look in context of silvicultural work. With correct carrying out of these works, occurrence of tree diseases is decreased. Carrying out of silvicultural works, quality and scope depend on openness of forest complex.
Way of natural regeneration and raising of forests represent essence of management system for forest, through which the road is planned. Considering that this complex of beech forests is in different development phases, following diseases are present: *Nectria cinnabarina*, *Melanopus squamosus*, *Orchestes fagi*, *Miciola fagi*, *Fomes sp.* and other. Entomological diseases are mostly occurring as a consequence of disturbed habitat conditions and violations in forest ecosystems. It appears mostly as a consequence of violated ecological conditions of the habitat and disturbances in forest ecosystems. Appearance of barkbeetle is expressive (*Ips.sp*), not on this location, but in other areas of RS, where openness firstly had negative impacts (because of accessibility and irrational felling), and later positive (because of easier manipulation with means and mobility of workers) effects for appearance of severe damages.

These dangers (entomological diseases), for complex, which is opened with this road, are not big, even minor. However, more severe danger are phytopatological ones and they occur on beech trees that are weak. By road construction and removal of ill trees from the stand and carrying out of sanitary felling, these dangers will be neutralized.

Road construction will enable carrying out of appropriate cultivation raising measures in middle-aged stands, which would be more stable and resistant to abiotic negative impacts after those measures. In mature stands, especially of oak, dry trees would be moved (well known drying as a consequence of common phenomenon of oak forest drying in this and broader area).

Special attention, during construction, should be payed on places where mining will be carried out. Places damaged with mining can be susceptible to phyto-phatogenic agents and disease spreading. Because of that, it is necessary to decrease the intensity of these works on lowest level.

2.9. Impact of the road on bio-diversity

Bio-diversity means diversity of life and its processes on certain area. For its proper recognition it is necessary to know relation between genetic diversity, diversity of species on one side, and impacts and functions of ecosystem on the other. Most complex ecosystem on land is forest one, which are characterized with specific diversity of species. That diversity of species enables forest ecosystems the possibility of adaptation to changes, but if it is healthy and preserved it enables functioning and life for other species, which are not typical for that habitat.

In concrete ecosystem, through which road is planned, to some species of trees, bushes, low flora and animals, attributes of main species, which are more important for normal functioning of the ecosystem then the others, can be given. It is a fact that forests of this complex, according to ecological-vegetation regional classification of BiH, are classified in the category Pre-Pannonian area and northwest Bosnian area. Potentially these are pure beech forests, pure oak forests, as well as mixed forests of beech and oak, and mixed forests of oak and hornbeam.

Regulation of composition of these forests, in order to change effective vegetation in potential, can be done faster with management measures, which are directly dependent on openness with forest roads.

Qualitative structure of these forests and their productive possibilities with carrying out of appropriate cultivation works, are also limited with openness of the area. Main species of trees, besides beech, are oak and hornbeam, and these species are defining main structural elements of this ecosystem and influence on preservation of diversity.

Help in its development, with carrying out of cultivation measures, is hindered because of small openness of the area. On the other side species of purebred deciduous tress are creating source of potential adapting, according to possible changes in the ecosystem.

Construction of the road opens the possibilities of increasement and decreasement of diversity. Unwanted consequences on diversity, which is of essential significance for long term functioning of ecosystem, is possible to decrease with preventive activities according to following:

- Strict control and supervision of realization of management plans and hunting plans
- Help in development of conifer forests
- Purebred deciduous forests should be marked for felling only from the aspect of sanitary-hygienic function of tree marking
- Prevention of distraction of young crop during felling and extraction of assortments.
3.0. DIRECT SOCIO - ECONOMIC IMPACTS

3.1. Impact of the road on felling plan

Road construction is significantly determined with need for felling and production of wood assortments in complex of sections, which belong to economic forests. Basic taxation indexes in sections and departments, which are included in opening with this road, are given in Table 4. Data have been taken from current forest management plan and given in Table 5. Considering that amplitude, according to principle of management sustainability on the level of management class, is determined on the basis of quantity of increment on one side, and on the basis of sample marking of trees for felling on the other, quantity of cut volume in sections can be estimated on the basis of increment for ten years expressed in total timber volume according to the following:

<table>
<thead>
<tr>
<th>SECTION</th>
<th>ESTIMATED FELLING VOLUME</th>
<th>m³ (1 FELLING CYCLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1</td>
<td>3 447.40</td>
<td></td>
</tr>
<tr>
<td>10/2</td>
<td>1 971.70</td>
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<td>3 556.80</td>
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<tr>
<td>11/2</td>
<td>3 064.30</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>12 040.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 5

It can be seen from the data that in sections, through which the road is passing, it is necessary to exploit large quantity of timber mass, for which it is necessary to have a firm forest road. Significance of the road for felling and transportation of wood is enormous, because access and approach to sections is provided, transportation and mobility of workers and working means, as well as control of carrying out of works is facilitated.

This road has great significance because it enables easier and more optimal construction of secondary network of tractor roads, and damages created by tractor work are reduced because transportation distance for assortment skidding is smaller.

Negative consequence of the road construction can occur because of forming of a depot on the road. Namely, it was foreseen to use turnoff, on the end of the road, as depot for wood assortments.

If there is a need for smaller depots next to the road, after completion of wood transportation from the depot to processing facilities, places of interrupted structure susceptible to weed growing can remain.

There are two ways of solving the problems:

- Placing the depots earlier, during construction, determined places where there is no young crop and where soil is covered with weed
- If there is no possibility of artificial prevention, it should be intervened with afforestation or preparation of soil for natural regeneration in order to stop growing of weed.
In order to preserve the road, big forest tractors during exploitation should move as less as possible over the road, and with that maintenance costs are reduced.

3.2. Impact of the road on collection of secondary forest products

Forest products, which are collected (mushrooms, medicinal herbs, fruits, etc), have great significance in medical and food industry. In this area following species of medicinal herbs are significant:

- Vaccinium myrtilus
- Hypericum umbelatum
- Anemone hepatica
- Fragaria vesca
- Oxalis acetosela
- Rubus sp.
- Sambucus recemos
- Sambucus nigra
- Sanicula europaea
- Tusilago farfara and others

Present mushrooms:

- Boletus edulus
- Morchella elata
- Cyromitra esculenta
- Tricholoma georgii
- Ramaria flava
- Lepiota cristata
- Lycoperdon gemhatum
- Lycoperdon pyriforme and others

All these resources are restorable. They are very significant for existence of local communities, and especially with their proper collection and construction of accessory infrastructure (places for drying) survival of residents in the area, which are poorly inhabited, are enabled and established. Collection of these special forest products is mainly done on the level of local communities and groups, and existence of roads represents critical cost factor for those which are collecting and have low incomes.

New micro habitat conditions are created by roads, which provide increase of vegetation biodiversity in which significant part have medicinal herbs and mushrooms, especially in so called marginal habitat.

Construction of the road «Maksimovića potok» would have impact on initiation and increase of interest of local residents for collecting of special forest products. In order to achieve more complete success, it is necessary to act educationally on local residents, which mainly have low living standard. Because of the fact that in many developed countries activity and standards of many people depends on medicinal herbs, lichens, moss, algae and microorganisms and forest fruits, by road construction and access to forest complex, interest of local residents will be increased, especially in undeveloped environment.

4.0. INDIRECT SOCIO – ECONOMIC IMPACTS

4.1. Impact of the road on forest fire occurrence

Increase of forest roads density increases the possibility of appearance of forest fires, but also possibility for their extinguishing and prompt interventions in case of appearance. Roads provide access, and efficiency in fighting against fires.
Special significance roads have in occurrence of so-called low fires. However, unwanted effects of the road, during occurrence of fires, are usually caused by negligence of human factor. Because of that it is necessary to pay special attention during construction of the particular road and to warn the workers on danger that can be caused by careless handling with inflammable means (oil and gasoline cans, cigarettes, lighting of fire, etc). Also after road construction, it is necessary, with appropriate warning signs, to preventively influence on people, which are moving in forest and on the forest road.

It can be emphasized that caution and preventive actions, because of possibility of occurrence of fires in forest complex which is opened with planned road, are necessary for several reasons:

- More intensive xerothermic conditions, especially in oak stands
- Composition of forest vegetation with dominance of deciduous forests (mainly oak and beech)
- Thinned structure of stands
- Facilitated possibilities for movement of residents through forest

Therefore the conclusion is that, in the zone next to the road, it is necessary to place appropriate warning signs and observation posts, and forest ranger service should be engaged in field, in order to protect against possible fires.

4.2. Impact of the road on inventory and observance

Road construction will have special significance for forest inventory works and reduction of costs for field data collecting. Quality of collected data and their quantity will be greater. It will enable collection of data, which are avoided on inaccessible terrain and also subjectivity in assessment will be avoided. In that way knowledge about conditions of forest reserves will increase, and directives of future forest management will be determined more precisely.

Possibilities of observation and informing of game warden and forest ranger services are increased with the road construction. Also access to belvederes on highest cotes of terrain opened with this road, will increase, so it can be concluded that these effects of the road are mainly positive.

4.3. Impact of the road on values of passive utilization and non-commercial values

Most often road impacts are observed through relation of road construction costs on one side, and economic value of utilized wood in forest which would be opened on the other. That comparison is relatively simple.

Optimal openness of forest complex or individual section is the one, which at particular time, is giving lowest total costs related to transportation of wood and investments in construction and maintenance of roads. For examining of optimal openness of forests with roads in above mentioned context, following data are necessary:

\[ F = \text{surface of the forest sections, which are opened (in meters)}, \]
\[ e = \text{average space between forest roads}, \]
\[ M = \text{net mass of wood for felling on that area, expressed in tons}, \]
\[ V_o = \text{costs of drive on the road depending on distance (KM/t per 1m of the road)}, \]
\[ g = \text{costs of road construction}, \]
\[ o = \text{annual costs for maintenance of road, in KM/km per year}. \]

Good indicator for examining of road construction costs is relation towards utilized timber mass. That relation, for 1 km of the road, is 527 m\(^3\) of timber mass, with average price of realization of assortments. According to current production of forests and timber mass, which is gravitating on truck road in amount of 47,555 m\(^3\) or 204,10 m\(^3\)/ha, construction of new road is certainly financially justified.

However, effects and road significance for the following, are oftenly neglected or irregularly economically (financially) evaluated:

- Access for hunting
- Observation of birds
- Experience in wilderness and other.

In concrete case these impacts of the road for mentioned values are significant. Main reason is that area of opening is really rich with wild animals and domestic birds. It is especially specific that forest vegetation is preserved and not violated, because there were no felling and work-up for a long period of time.

These so called passive values are hard and irregular for assessment and financial expressing, although there are some efforts. Regarding actively utilized values (fishing, skiing and camping), they can barely be provided by road construction and it is hard to believe that they will be present.

However, passive utilized values, which are unable by construction, more exactly objects and areas which are accepted and appreciated by local residents, and are not utilized, essentially are existential values and they cannot be financially expressed and are of great significance for local residents and entire area of gravitating villages.

On the other side, forest which are opened with road «Maksimovića potok» have great significance for future generations because they will inherit great natural resources of preserved nature. Also this inheritance cannot be expressed monetary.

5.0. OTHER DIRECT AND INDIRECT SOCIO-ECONOMIC IMPACTS

In category of other impacts we classified impacts, which in concrete conditions, have no practical need to be perceived in details, and those are:

- History of road development
- Impact of the road on landscape
- Impact of the road on aquatic habitat and fish
- Impact of the road on water and air quality
- Impact on pasture
- Impact of the road on energy and mineral resources
- Impact of the road on private property and enclave
- Impact of the road on inheritance and cultural values

Impact of the road on landscape is positive, because it enables the visitors to visit preserved forest complexes. Intensive changes on landscape, after construction, will not be expressive, because the route is in forest complex and its course can be hardly noticed from long distances.

All other impacts, whether positive or negative, which are mentioned above, are not significant in this particular case because of poor presence of impact objects; non-presence of cattle raising, mineral resources and others.
6.0. CONCLUSION

Construction of this road belongs into construction of road network of small proportions. By reviewing all positive and negative socio-economic, direct and indirect impacts, and economic justification of the road it can be concluded that positive effects of road “Maksimovića potok” construction are more significant than negative effects. Positive effects are following:

- Access is provided – to forest complex for utilization, collecting of special forest products, hunting protection of forests and game
- Easier and economically justified work is enabled on forest management by carrying out of silvicultural works and arrangement of forests (inventory)
- Influence on increasement and preservation of vegetation and animal bio-diversities
- Preventive works in cases of so called accidental enjoyment
- Prevention is facilitated in case of occurrence of forest fires.

Because of this it is considered that positive effects justify the road construction, especially from viewpoint of impacts on the environment, so it is necessary to carry out the construction on terrain.

7.0. LITERATURE

6. Forest management plan for FEA, Čelinac – IRPC Banja Luka
8. Ecological vegetation aerial classification in BiH. Forestry faculty Sarajevo
Ljubo Marić
Zoran Govedar

IMPACT OF FOREST TRUCK ROAD "BRANKUŠA" – SECTION 115
CONSTRUCTION ON THE ENVIRONMENT IN MANAGEMENT UNIT
"BOBIJA – RIBNIK" OF SFE "OŠTRELJ" - DRINIĆ

Banjaluka, August 2001
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INTRODUCTION

Construction of forest roads is certainly among very important forest activities in SFE. Accessibility to forests and forest land in SFE, as well as successfulness of correct management of such forests is in direct dependence with openness of forests with forest roads. In forest economic area (FEA) "Oštrelj - Drinić" mainly two types of forest roads are present:

1. Permanent and
2. Temporary forest roads

Most of the forest roads are adapted for transportation of wood assortments with trucks and tractors. These roads are adapted for transportation to road network of public traffic. It is a fact that most of these roads, especially forest truck roads, were constructed with basic goal which is economically justified forest management, because it is well known that the phase of transportation of wood assortments is one of the most expensive phases in production process. However, ecological aspects and justification of road construction, until now, have not been taken into consideration, and considering that these are big and significant infrastructural objects in forest complexes which have influence on number of effects, more attention should be payed to environment impact of forest road construction in the future. Therefore, in number of cases until now, regarding impact on environment, construction of forest roads were not optimal.

From that comes the main activity, and that is to enlarge the analysis and recognition of specific environment impacts of forest road construction, and significance of the construction should not be only economically assessed. Procedures of planning and construction, among other things, should not be only formally – ecologically and lawfully justified, but they should really be the instrument of profession and science for overcoming the conflict between the characteristics of forest eco-systems and development obligations.

Because of that, the goal of this Study is to establish and assess the significant positive and negative effects of forest road construction on environment and eco-system in area of SFE Drinić, economic unit "Bobija – Ribnik".

Therefore, the goal is to elaborate the EIA (environment impact assessment) study for cited object that represents the generic concept, with which we indicate the administrative process in realisation of development project on site, and series of analysis procedures for identification and assessment of environment impacts.

However, in Republic of Srpska and in the areas of SFE's, significant basis for this problem should be provided by the Environment protection law, which is currently in elaboration phase and is not adopted.

EIA study represents the system of procedures in two levels(stages), with which we, in accordance with multi discipline of public and completnes, analyze alternatives for least damages on the environment and preservation of greatest values of it.

First level (stage) represents the strategic level which means socio-economic impacts and consequences of the project on site, and as a rule they separate on regional and national level and are determined and expressed with methods based on quantitative indexes.

Second level means planning level. EIA study means that on the planning level, according to character of the investor, it should be separated if it is physical or law person with purpose of permission for work.

In accordance to previously mentioned and to the proposal (initiative) of PFE”Srpske Šume” of Republic of Srpska and the World Bank, it is necessary to elaborate the Environment Impact Assessment Study of Forest Road( "Brankuša – section 15" in economic unit "Bobija – Ribnik" in FEA "Oštrelj – Drinić" Construction in order to allow the utilization of remained IDA funds for construction of forest truck roads.
1.0. BASIC CHARACTERISTICS OF FOREST ECONOMIC AREA (FEA)

1.1. Geographic location, orographic and hydrographic characteristic of forest economic area

FEA "Oštrelj – Drinić" is located in western part of Republic of Srpska, 150 km southwest from Banjaluka. Geographic coordinates are following: IGD 16°20", SGS 44°10".

This FEA includes the area of typical young mountains of inner Dinaric mountains, with dominant mountain massif Klekovača. Highest point is Klekovača point with height of 1962m above see level, and lowest point is in Bunara with 679 m above see level.

The most significant part of the area represents the massif Klekovača, which possesses all characteristics of karst area with hollows, depressions... Expressive orography like this is the result of presence and domination of solid mesozoic limestone in the surface of this area.

Because of that in the area of permanent running water, rivers and brooks are insignificant. Only periodically when the rainfall are abundant, so called mountain brooks occur here and there. There are few smaller surface streams, which are strongest in spring, but in the summer they dry up.

1.2. Climatic conditions

For recognition and analysis of climatic conditions of the area we have used the Thornthweite climate analysis method. Results on the basis of average indexes about quantity (level) of percipitations and temperature for observance period from 1963 to 1991, that we have taken from meteorological (weather forecast) station Drinić, located on 730m above sea level, are shown in table 1 and graph 1.

According to data from the table 1 and graph 1 it can be noticed that the area of Drinić is rich with percipitations, especially in autumn and winter. However very large quantity of percipitations is in vegetative period and is around 47% from total percipitations, which is very convenient for growth of vegetation in the area.

Negative impacts of outstanding percipitations during the winter months (December, January and February) which amounts around 30%, are very significant for forestry works, because these are mostly snow that hinders the works of the SFE since the access, to forest complexes and sections in which particular works are foreseen, is hindered. Because of that, construction of forest roads and greater openness of forest complexes is necessary, in order to facilitate the works during winter and hindered passing.
## HYDRIC BALANCE ACCORDING TO THORNTHWEITE

### METEOROLOGICAL STATION: Drnić

<table>
<thead>
<tr>
<th></th>
<th>ToC</th>
<th>i</th>
<th>(PE)</th>
<th>PE</th>
<th>P</th>
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<td>0</td>
<td>750</td>
</tr>
<tr>
<td>V.P.</td>
<td>13.6</td>
<td></td>
<td>513</td>
<td>641</td>
<td></td>
<td></td>
<td>513</td>
<td>0</td>
<td>128</td>
</tr>
</tbody>
</table>

**In. Hum. = 125.32**

**In. Arid. = 0**

**Kl. Ind. = 125.32**

### CLIMATE TYPE: INTENSIFIED HUMID (B3)

**Table 1**
Area of Drinić, according to the classification of the climate by Milosavjević, M.(1973), can be characterized to have mountain climate.

It is known that abundant rainfall can cause severe damage, because so called pluvial erosion, which is particularly important for forest roads. Pluvial erosion appears as a result of great kinetic energy of rain drops. We expressed the possibility of appearance of pluvial erosion with Furnije coefficient by formula:

\[ C = \frac{p^2}{P} \]

\( C \) – Furnije coefficient  
\( p \) – Average quantity of precipitations in the rainest month (mm)  
\( P \) – Average annual quantity of precipitations (mm)

According to value of this coefficient, which is 13.91 for October and 19.69 for December, it can be concluded that the area is from average and up to very endangered with pluvial erosion. On lower heights of the area precipitations are mostly rain, and on higher are snow. It means that
area of Bunara (lowest point), where it is necessary to construct the planned road, is more endangered with pluvial erosion, especially in autumn and it should be considered. However, certain reducing of pluvial erosion danger in the area is possible, because the geological surface is composed of limestone which is exceptionally water permeable and so-called depth or karst erosion, which somewhat lessens the negative consequences of pluvial erosion, is expressive.

1.3. Geological – pedological characteristics

Dominant geological surface in the area is consisted of crypto-crystal limestone. Those are mainly marine sediments from Mesozoic. They are mostly of layer structure and rarely are massive and intensively cracked. They are characterized with uneven and intensive karstification, and great water permeability, by which danger from pluvial erosion is decreased. One smaller group of rocks is composed of crypto-crystal dolomites, which mainly represent marine sediments from Mesozoic. They are mostly massive and cracked, and classified locally. By their decaying they create sand, which is susceptible to erosion. These dolomite rocks are located in southeast parts of FEA.

Depending on the intensity of impacts of pedo-genetic factors, first of all geological surface and climatic influences, in most of the FEA, humus-cumulative soil with A-C profile type is formed. Those are mainly limestone fertile soil and limestone-dolomite fertile soil, and brown limestone soil.

All these soils are very rich with pedo-fauna, which is micro-fauna, mezzo-fauna and macro-fauna (Anelidae, Enchytraeidae, Isopodae, ants and others). Their work is very intensive, especially because the great resources of humus and undissolved dead forest cover.

1.4. Plant communities

SFE "Drinic" from Drinić is located on 13 288ha of forestland. From that amount on 12 703ha are high forests with natural regeneration, raisings 87ha, bare land 406ha and non-productive surfaces 92ha.

Biggest areas in the FEA are covered with fir, spruce and beech, which are mainly classified in high forests of fir, spruce and beech on limestone dolomite soil with. Average total volume of this management class is around 392m³/ha, from which 254 m³/ha or 64.8% are conifers and 138 m³/ha or 35% are deciduous forests.

Regarding the size of intensity next community is beech and fir (Abieti-fagetum) whose stands bvelong to management class of high forests of beech and fir on limestone dolomite soil with variable depth, with total volume around 406 m³/ha, from which 252 m³/ha or 62.06% are conifers and 154 m³/ha or 37.94% are deciduous forests.

Particular significance, especially from the aspect of the terms of reference (since the planned route is passing through sectons which are classified in this type of forests (management class) represent communities of high forests of second class beech in mixed zone of beech, fir and spruce on limestone dolomite soil with variable depth. Total average volume of these forests on FEA level is 309 m³/ha, from which 289 m³/ha or 93.52% are deciduous forests (mainly beech and thoroughbred deciduous forests) and 20 m³/ha or 6.48% are conifers.

Forests of white pine in succession towards mixed forests of beech, fir and spruce on dolomite soil have average total volume of 358 m³/ha, from which 336 m³ or 93.58% are conifers and 22 m³/ha or 6.15% are deciduous forests.

Exceptional value in the FEA managed by this SFE has the virgin forest Lom, which represents the rarity not only in RS but also in Europe. It is distinguished in the category of forests
with special purpose. It includes 5 sections (297.75 ha). Basic characteristic is that stands in the virgin forest are left to spontaneous growth and are isolated from any influence, first of all from anthropogenic factors. Consequently, they are not classified in so called economic forests but in forests that serve for needs of scientific research in forestry, biology, ecology, zoology and other, as well as for needs of tourism and recreational function of forests. The stands mainly belong to communities of mixed forests of beech, fir and spruce on limestone soil. Average total volume in virgin forest is 729 m\(^3\)/ha, from which 510 m\(^3\)/ha or 70% are conifers and 219 m\(^3\)/ha or 30% are deciduous forests.

Uniqueness of this FEA also represents the seed stand of white pine in section 109 (so called "Ravna Glavica") located on the area of 15.70 ha. This stand is belongs in the high – quality class of seed objects in RS, and is distinguished and registered during the activities of distinguishing and registration of seed stands on State level. Significance of this object is great, because with seed collection from this stand preservation of qualitative gene fond is provided throughout new generations of nursery material from the nursery production.

1.5. Basic taxation indexes, structure of stands and way of management

Situation of wood supplies in the period of arrangement in FEA"Drinčko" is 5 671 800 m\(^3\) on the entire FEA. From the total volume 3 197 400 m\(^3\) or 56% are conifers and 2 474 400 m\(^3\) or 44% are deciduous forests. Average total volume of conifers on the level of entire FEA is 251 m\(^3\)/ha and 195 m\(^3\)/ha of deciduous forests. It is important to emphasize that share of conifers with breast-height diameter above 30cm, in total volume on the FEA level, is 80%.

In the period of arrangement, the situation of current volume growth increase of high forest class, on the FEA level is 9.19 m\(^3\)/ha or around 116 740 m\(^3\) in average.

According to indexes of forest management plans and analyses of structural development of stands in the area, it can be concluded that stands of different age with approximate characteristic structure for selection forests are dominant. That can be especially applied for mixed stands of beech, fir and spruce. Smaller complexes of second-class pure beech forests have the uniqueness of same age stands. This structural development of forests is a result mainly of management ways, environment conditions and bio-ecological features of native species.

Annual cut (etat) in this FEA, according to data of current FMP, is 146 283 m\(^3\), from which 69 169 m\(^3\) are conifers and 77 114 m\(^3\) are deciduous forests.

Application of selection management system of natural renovation depends a lot on openness of forest complexes by roads. Namely, for successful realization of the project and adequate spatial arrangement of the section, with goal of successful natural renovation, protection of second growth, reduction of damage on second growth and mature trees, especially during the application of logging tractors in the process of pulling and skidding of wood assortments to timber yard, appropriate network of forest truck roads is necessary.

1.6. Conditions of game

Within the FEA "Oštrelj" – Drinić – after the war (1995), hunting area "Drinić – Potoci" has been formed, and it is managed on the basis of hunting plans with validity from 01.04.1999 to 01.04.2009.

The most important species of game in this hunting area are:

a) Permanently protected species of game

- Lynx (lunx lunx),
b) Game protected with hunting closed season

- Brown bear (Ursus arctos L.),
- Roe deer (Capreolus capreolus),
- Hare (Lepus europaeus),
- Big grouse male (Tetrao urogalus L.),
- Hazel grouse male (Tetrastes bonasia L.),
- Gray partridge (Perdix perdix),
- Rock dove (Columbia livia),
- Turtledove

c) Unprotected game

- Wild boar (Sus scropha L.),
- Wolf (Canis lupus),
- Weasel (Vulpes vulpes),
- Wildcat (Felis silvestris),
- Badger (Meles meles),
- Polecat (Putoris putoris),
- pine marten (Martes Martes),
- Stone marten (Martes Fiona)

The most important species of this hunting area, which represent the main grown game, are native species of this climate:

- Roe deer (Capreolus capreolus),
- Bear (Ursus arctos),
- Big grouse (Tetrao urogalus L.),
- Hazel hen (Tetrastes bonasia)

This hunting area belongs into the category of economic sport hunting areas, so it fulfills the needs of economic hunting and hunting as sport—recreative character of members of hunting organizations.

For fulfillment of hunting area functions, from aspects of mobility of hunters and hunting service in the area, existing network of forest communications is satisfactory and they are used in the period of intensive hunting. However, for construction of hunting objects (observation posts, lodging objects, places for weapon testing and others) it is necessary to construct new infrastructural objects, forest roads and hunting trails, which should enable greater mobility, and to facilitate the work first of all to game warden service, technical staff and hunters in the hunting area.
Advantage of the construction of the road “Brankuša – section 115” in management unit “Bobija – Ribnik” is related to hunting areas, because the road is attached to the existing road that passes through sections 122, 123 and 126 in management unit “Bobija – Ribnik” and new road is passing through sections 115, 116 and 121 of the same management unit. Taking in consideration that these sections are not included in area for intensive game management, this road will not be an obstacle for migration of mammals, which escape from anthropogenic influenced roads and are passing by them. The road will have of greater significance because it will enable an easier access to the area of intensive management for hunters, employees and others, and will not directly endanger and disturb the natural totality of the area for intensive management. The access will be easier from the direction of Bravska from the road Ključ – Drinić. Starting point of the area boundary is from altitude 1191 over the boundaries of the sections 131/2 and 138 in management unit “Bobija – Ribnik” up to altitude 1229, and then boundaries of sections 99 and 96 up to 101 etc.

1.7. Openness of forests with forest roads

FEA “Oštrelj” – Drinić is opened with three main categories of roads:

- Public roads
- Regional roads
- Forest truck roads

Precise data about length of these roads in the SFE do not exist. However, it can be emphasized that total openness of forests and forest land in the area is in average 9.2 km/1000ha, which is certainly not satisfactory especially if you take into consideration that for this area optimal openness of forests is considered to be 20km/1000ha. That points to the necessity for construction of new roads, especially forest truck roads that should enable the access to unopened forest complexes due to satisfaction of all positive sides of forest road construction, with all precautions and preventive measures with goal of prevention of negative consequences, which follows the construction of a road.

Approaching to the optimal openness with construction of new roads, perspectives of the area development in new conditions of the economy and development of private initiative would be greater.

In favor of that fact it should be emphasized that economic conditions in the area, after the war in BiH was finished, were very difficult. But thanks to efforts of the SFE, as the most developed economic subject, the area has developed into firm community, which has the tendency of further successful development.

2.0. DESCRIPTION OF THE ROUTE

2.1. Location of the road

Road “Brankuša – section 115” is planned in management unit Bobija – Ribnik. Actual length of the route is 3202m. The route is set out with apex and center-line pegs, and marked with cross-section and apex numbers. The route passes through sections 120, 121, 116 and ends in section 115.

Starting point of the route is attached to the existing forest road from Bravska to Brankuša in section 120.
Planned road extends between 800 and 900m above see level. The route extends in east-west direction, beginning from centerline chainage on 900m above see level in forest Malić (Brankuša in section 120), and ends on chainage (cross section) no. 247 on 807.07m above see level in section 115, near the boundary of FEA “Ključ” and border of FBiH. The road, with its main center line, is located south from Bravsko field, on average distance of about 2km from FBiH border.

2.2. **Purpose (reasons) of road construction**

Road construction should facilitate the usage of numerous resources form natural and changed forest eco-systems. Forest as a property with public interest, besides production function, has other useful functions, which are necessary for people. Possibilities of utilization of common useful functions of forests are significantly decreased if there are no constructed forest roads in forest complexes. Their significance is greater for local residents (returnees to Drinići), who are living in economically undeveloped areas, where life and work are based on work in SFE “Oštrelj” – Drinići, as the most significant economic subject of the place.

It is well known that construction of the road can have positive (useful) and negative (harmful) consequences. Special significance road construction has form the viewpoint of enabling the access to the forest complex. For the workers in SFE, especially those doing felling, construction, skidding and exporting of wood assortments in sections 115, 116, 120 and 121, in management unit «Bobija – Ribnik», as well as in surrounding sections of the same management unit, the work will be facilitated.

Besides that, the road should enable the easier arrival of other workers to the objects, and to local residents greater and easier activities of collection of mushrooms and medicinal herbs (special forest products), as well as easier movement of cattle from one pasture to another. Special significance road should have in facilitation of work to protection services (foresters and game wardens), which is from great importance today.

The road should also have the preventive role for prevention of forest fires expansion. Considering that the road route is passing through complex of high forests with high degree of preservation, with all the specificity of autochthonous and undisturbed vegetation in certain conditions, visitors, tourists, citizens, scientists, local residents and others will be in opportunity to get introduced with gifts of the nature in the area. The road will enable development of hunting tourism and economy of the area, because it passes through the parts with protected and undisturbed forest complexes. It should be emphasized that tree felling in this complex has not been done in the last 20 years.

Accomplishment of more significant economic effects, especially for the SFE, will be enabled by road construction, because the costs for the most expensive phase of transportation of wood assortments will be reduced. Another reason for road construction is that pure beech stand in the forest complex, in development phase of mature stands, are dominant. Considering the total structure of the stands, expressive mezzofility of habitat of the natural site and biocological features of beech and fir, renewing of beech is hindered and of fir is overaged. Because of that, in this complex, it is necessary to carry out the silviculture activities due to renovation of beech, and helping the development of fir and spruce progeny. From the other aspect, by keeping too ripe and ripe beech trees, the stands are acquiring the features of virgin forest, and on limestone surface in mezzofile conditions of the natural site the beech trees are susceptible to diseases of central rottness and decay, which significantly reduces market value of current high-quality beech trees. It is impossible to overcome this problem without constructed road.
Greater economic effects are expected after construction of the road, because even local residents (returnees) will use this road for providing fire-wood and collection of mushrooms, medicinal herbs and forest fruits.

2.3. Project and road size

Main project for construction of the road «Brankuša – section 115», 3.180km long, is elaborated by RO «Šipad – IRC» OOUR «Silva», in Sarajevo - 1984. Within the technical report, it is emphasized that the route is elaborated according to valid guidelines for forest road planning. It is especially significant that the terrain configuration enabled for the horizontal extension of the route to be on satisfactory level, which is exceptional in limestone terrain. The favourable horizontal extension of the route, with small gradients, enables the minimum earth works, decreased excavations and embankments, decreased cuts, which positively influences on preservation of the environment. Width of the road surface should be 3.0m and of the shoulders 2x0.5m. Inclination of the cut slopes (mitre bank) are varying from 1:1 to 3:1, and inclination of embankment slopes (mitre bank) are 1:1.3. Passing places are foreseen on 400m. With goal of decreasing the possible damage on the plant cover next to the road, passing places should be placed on shorter distance cca 300m.

Considering that it is water permeable home substratum no water flowing trails, from the slopes and next to the route, are noticed, but it is planned in the project to place the pipe culverts with 60cm diameter in the side ditches in order to reduce the danger of heavy rainfalls, and to use natural drainage. It is necessary, especially in the period of heavy precipitation and snow melting (table 1), to clean the pipe culverts from the deposits of dead forest cover in order to make culverts functional. Side drainage is foreseen with trapeze ditches 15cm deep and 30cm wide in the base.

Road structure will be constructed with 20cm of macadam in rolled state. Main material will be used from the quarry in Bunara, near the route. Main construction works on the route are:

- Excavation 8141.7 m³ and
- Embankment 3186.5 m³

2.4. Usage of biota during the road construction

Freight vehicles traffic, which should be carried out on this forest road, after the construction is finished, would not be intensive, because of the several reasons and the following are the most important:

- Intensive felling and transportation of wood assortments, according to working cycle and length of fecundation, will be carried out after 10 years as it is regulated by FMP
- Area, which will be opened with this road is poorly inhabited, does not connect inhabited places, and near (section 115) it is the boundary of FEA «Ključko».

Because of that the most significant negative impacts on biota are expected exactly during road construction. Most significant impacts and far-reaching consequences are on forest land as integral part of biota and especially in the part next to the road. Within preparatory works, significant negative impacts, which are unavoidable, are related to felling of trees (mainly beech), shrubs (Daphne mezereum, Sambucus nigra, Cerasus avium, Illex aquifolium, Corilus avelana and others) and low flora. Besides that, extraction of roots of mature trees is carried and habitat of pedo-fauna, which is very active here, is endangered. Holes which remain after extraction of roots will be filled and compacted with soil material because of stability of roadbed, which negatively reflects on water and air order and endangers the habitat of pedo-fauna.
2.5. Geomorphologic impacts of road construction, sedimentation and Rockslides

Impact of road construction on geomorphologic features of terrain can be perceived through chronic and long term changes and consequences. Location and course of the planned road is leading to a conclusion that significant geomorphologic impacts, regarding negative consequences, will be reduced to a lowest intensity. Reason for that is, that considering the slope of terrain and route, intensive earth works will not be carried out, which is very important regarding preservation of habitat. It is known that roads have impacts on geomorphologic processes through 5 primary mechanisms:

a) Direct impacts on structure and geometry of soil cuts, embankments, ditches and similar.
b) Changes in usual surface water currents and creation of new road on water currents
c) Direct influence on structure and geometry of water currents
d) Speed up of erosion from the road surface
e) Causing the impact on water, especially on places where the road crosses the brooks

If possibilities of negative impacts of the road through mentioned mechanisms are reviewed, than it should be emphasized that on the route there is no terrain where occurrence of slides is possible. Possible more intensive erosions can be expected during road construction under influence of pluvial erosion. Mass of moved soil can be minor, because those are shallow or medium deep limestone soil (kalkomelanosol and kalkokambisol). Limestone fertile soil, brown soil will be mostly seized. Most of moved material will represent undissolved dead forest cover, which is here represented in thick layers and is not completely with humus because of total structure of stands. According to that, possibilities of negative impacts can occur on culverts with 60cm diameter through which water flows, sediment and wood in the period of torrents, which will not be expressed here.

Near the planned route there are no permanent water currents, so the surface erosion from the roads, cuts and ditches will not cause increasement of presence and source of sediments in water currents.

It can be concluded that road construction, will not cause occurrence of significant geomorphologic disturbances and erosion processes on the road and surroundings, because of relatively small earth works, small cuts and embankments and favourable course of the road with relatively small side fall of finished road levels. Fact that brown limestone soils are dominant, which are averagely susceptible to pluvial erosion, goes in favour to this, and more intensive pluvial erosion can be expected on soils where kalkomelanosol is dominant. In depressions and flat terrain there is soil less susceptible to this type of erosion processes.

2.6. Hydrological impacts of road construction

In concrete case, danger of occurrence of torrents are reduced to minimum, for several reasons:

a) Specificness of geologica base
b) Presence of limestone soil
c) Non-existing waterproof layers in soil
d) Sufficient number of pipe culverts foreseen (5 pieces with total length of 33m), collecting pits and places for natural drainage
e) Non-existing permanent water currents next to the route and in surroundings
f) Small slopes of terrain next to the road and near it
For preventive performance and prevention of unwanted consequences of possible smaller torrents, it is necessary to pay attention to cleaning of waste materials in collecting pit, culverts and drainage ditches, during maintenance of road.

2.7. **Impact of the road on productivity of the habitats**

By construction of the road, conditions of soil resource is changed, because by passing through forest complex roads occupy productive soil and have influence on total production potential of certain habitat.

Considering that there is no dense young crop next to the road, damage to present young crop is not significant. With road construction this area (1.3ha) is lost for occurrence of young crop and other vegetation on the road. However, by opening of stand structure above the road, appropriate conditions appear for occurrence, growth and development of heliophits next to the road (usually species from family Rubus, Sorbus, Populus tremula appears, as well as heliophit low flora), by which biodiversity of vegetation next to the road is increased.

Yet, largest and most severe consequences are done to soil, which is permanently lost. Major part remains disposed in the embankments and that is important benefit, but from productive viewpoint it is lost. Total quantity of soil mass, which will be violated is around 1000m³.

However, road construction should not be observed from viewpoint of productivity lost, but also on long term basis through indirect impacts, significance of the road can be positive. Namely, with construction, easier and economically justified carrying out of growing activities, activities of collection of special forest products, game warden activities and other will be enabled in stands, and improvement of quality and quantitative structure of forests will be directly influenced. In that way, more intensively, productive potential of habitat will be used, from viewpoint of production of higher quantity of timber mass, as well as providing the continuity of management and satisfaction of common useful forest functions. Of course long term and indirect analyzing of these impacts should be kept in mind.

2.8. **Impact of road construction on fragmentation of the habitats**

It is unavoidably that with construction of the road habitat of natural populations is divided in two or more parts. In the area of road construction these impacts can be viewed from two aspects:

- Classification of habitat for plant species related to biodiversity
- Classification of habitat for animal species

In both cases populations can be classified in smaller sub-populations and habitats split, which can negatively reflect on genetic variability.

Existing habitat, in sections through which the route is planned, is characterized with all features of preserved habitat of domestic vegetation, of plant community of potential vegetation Abieto – fagetum illyricum. When the road is constructed three habitats will be formed, from which two would have same conditions. Special micro habitat, with all new micro ecological features, will be formed on the road, as the marginal habitat. The most significant feature of that micro habitat is increasing of thermophility and illumination, which will directly reflect on occurrence of heliophit species of trees, bushes and low flora next to the route. Species that would probably occur are: Acer pseudoplatanus, Acer platanoides, Picea abies, Sorbus sp., Fraxinus excelsior, Fragaria vesca, Asarum europaeum, Rubus sp, Galium silvaticum, different fern and young crop of domestic species of trees and other. That shows the increasesment of plant biodiversities next to the route, which significantly differs from biodiversities in other two macro habitats on one side, and on the other road on longer distance from the route where existing flora will remain dominant (Fagus silvatica, Abies alba, Acer pseudoplatanus, Fraxinus excelsior and other).
Specificness of the occurrence of somewhat changed habitat conditions after road construction should be expected in stands, after carrying out of silvicultural and utilization works in habitats far from the road. Those changes will be caused by felling, which will be carried out in sections, after opening of this forest complex. Main goal of these actions, besides utilization of timber volume, is to improve natural regeneration of domestic vegetation.

Dividing of habitat for animals will especially effect on game. Namely, road construction will have positive and negative effects. Positive because with the creation of marginal habitat birds and animals, which usually inhabit the forest edge, are getting new corridor by which they can move deeper in the forest. That will increase the diversities of animal species in forest and area of habitat for these species of birds and animals.

Negative impacts will especially reflect on certain species of mammals, for which is known that they avoid movement over the roads. Their only existing habitat for now, by road construction (especially utilization of existing one, which will be connected to the planned one), will be divided with 8km long route, which represents significant obstacle for movement of mammals. Problem can be solved with accessory objects for food supply, which will be placed equally in both macro habitats.

Road impact will also have influence on terrestrial Vertebrata in the following ways:

<table>
<thead>
<tr>
<th>Type of impact</th>
<th>Assessment of impact intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Loss of habitat and fragmentation</td>
<td>Small impacts</td>
</tr>
<tr>
<td>b) Negative impacts of road utilization, noise and running over on the road</td>
<td>Strong impact during construction and utilization of forests (felling, export and transportation)</td>
</tr>
<tr>
<td>c) Excessive hunting and trapping</td>
<td>Medium impacts</td>
</tr>
</tbody>
</table>

Solving of these problems is possible with organization of appropriate supervision during construction by engaging only necessary machines, more intensive engagement of labour, organization and greater mobility of game warden service, and placing of warnings and appropriate signs next to the road.

2.8.1. Impact of the road on biological invasions

Most oftenly, idea of biological invasion is observed through biological disturbance. By road construction, by impact of anthropogenic factor because of utilization and works on maintenance (cleaning of ditches, culverts, road leveling, etc), disturbances occur, which are creating and maintaining the marginal habitat.

By road «Brankuša-section 115» construction these impacts on biological invasion will not be intensive. The reason is, because movement of vehicles and people will not be intensive like on public roads. On unwanted effects of these impacts can be pointed during and after construction with adequate warnings next to the road. Good example of biological invasion of outer species is expansion of Robinia pseudoacacia, which represents weed on cultivable agricultural soil.

It is also necessary, in performance projects, to point to danger of biological invasion of unwanted species because they can represent serious problem during realization of arrangement of forest, since they disrupt the structure, composition and function of forest ecosystem.
2.9. **Impact of the road on diseases of trees**

Existence and construction of roads, superficially observed, do not have major impacts on forest diseases. However, it is a fact that areas opened with forest roads have greater possibility of prevention of occurrence of plant diseases. This significance is greater if you consider it in context of silvicultural works.

Way of natural regeneration and raising of forests represent essence of prescribed system of forest management through which road construction is planned. Considering that this complex of beech forests is in development phase of ripe and over ripe trees for felling of ill beech trees and purebred deciduous trees are evident and present, and mostly rotteness and other diseases: Nectria cinnabarina, Melanopus squamosus, Orchstes fagi, Miciola fagi, Rhitisma acerinum, Fomes sp., and others. Occurrence of entomological diseases is possible because of unstability of ecosystem and physiological weakening of plants, which is especially expressed in last 5 years. It occurs mostly as a consequence of violated ecological conditions of the habitat and disturbances in forest ecosystems. Impact and occurrence of barkbeetle is intensive (Ips sp.). Danger of this type (entomological diseases) for forest complex, which is openened with this road, is not significant. However, greater dangers have phyto-pathological character on beech trees, which are physiologically weak because of over ripe. By road construction and removing of ill trees from the stands and carrying out of cultivation-sanitary felling, these dangers will be neutralized.

2.10. **Impact of the road on bio-diversity**

Bio-diversity means diversity of life and its processes on certain area. In concrete ecosystem, through which road is planned, to some species of trees, bushes, low flora and animals, attributes of main species, which are more important for normal functioning of the ecosystem then the others, can be given. It is a fact that forests of this complex are classified in the category of secondary beech forests, which according to ecological-vegetation arial classification in BiH, belong to potentially mixed forests of beech and fir.

Regulation of composition of these forests, in order to change effective vegetation in potential, can be done faster with management measures, which are directly dependent on openness with forest roads. Fir (Abies alba), as the domestic specie of this area, is less present in composition of these forests, considering the scope of presence it should have according to potential of this habitat. This specie of tree, besides beech, represents main specie of trees, which is defining main structural elements of this ecosystem and influences the sustainability of diversity. Help in its development, with carrying out of cultivation measures, is hindered because of small openness of the area. On the other side species of purebred deciduous trees are creating source of potential adapting, according to possible changes in the ecosystem.

Construction of the road opens the possibilities of increasement and decreasement of diversity. Unwanted consequences on diversity, which is of essential significance for long term functioning of ecosystem, is possible to decrease with preventive activities according to following:

- Strict control and supervision of realization of management plans and hunting plans
- Help in development of conifer forests
- Purebred deciduous forests should be marked for felling only from the aspect of sanitary-hygienic function of tree marking
- Prevention of distruction of young crop during felling and extraction of assortments.
3.0. DIRECT SOCIO-ECONOMIC IMPACTS

3.1. Impact of the road on felling plan

Road construction is significantly determined with need for felling and production of wood assortments in complex of sections, which belong to economic forests.

Average current increment on the level of management classes, for all sections and departments (except section 120 of department b) is 7.60 m³/ha, while for section 120/b is 10.43 m³/ha. Considering that amplitude, according to principles of continuity (sustainability) of management on the level of management class, is determined on one side according to quantity of increment, and on the other according to sample (test, experimental) marking of trees for felling, felling volume in section can be estimated on the basis of increment for period of ten years, expressed in total timber volume according to following:

<table>
<thead>
<tr>
<th>SECTION</th>
<th>ESTIMATED FELLING VOLUME m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>3669</td>
</tr>
<tr>
<td>116</td>
<td>3998</td>
</tr>
<tr>
<td>120</td>
<td>5876</td>
</tr>
<tr>
<td>121/1</td>
<td>3592</td>
</tr>
<tr>
<td>121/2</td>
<td>3506</td>
</tr>
<tr>
<td>TOTAL</td>
<td>20 631</td>
</tr>
</tbody>
</table>

It can be seen from the data that in sections, through which the road is passing, it is necessary to exploit large quantity of timber mass, for which it is necessary to have firm forest road. Significance of the road for felling and transportation of wood is enormous, because access and approach to sections is provided, transportation and mobility of workers and working means, as well as control of carrying out of works is facilitated. This road has great significance because it enables easier and more optimal construction of secondary network of tractor roads, and damage occurring during works with tractors are decreased, because transportation distance of skidding of assortments is smaller.

Negative consequence of the road construction can occur because of forming of depot on the road. After transportation of wood from depot to processing facilities is finished, usually places of interrupted structure remain, which are susceptible to weed.

There are two ways of solving the problems:

- Placing the depots on earlier, during construction, determined places where there is no young crop and where soil is covered with weed
- If there is no possibility of artificial prevention, it should be intervened with afforestation or preparation of soil for natural regeneration in order to stop growing of weed.
In order to preserve the road, big forest tractors during exploitation should move as less as possible over the road, and with that maintenance costs are reduced.

3.2. Impact of the road on collection of secondary forest products

Forest products, which are collected (mushrooms, medicinal herbs, fruits, etc), have great significance in medical and food industry. In this area following species of medicinal herbs are significant:

- Vaccinium myrtilus
- Hipericum umbelatum
- Anemone hepatica
- Fragaria vesca
- Oxalis acetosela
- Rubus sp.
- Sambucus recemosa
- Sambucus nigra
- Sanicula europaea
- Tusilago farfara
- Allinum ursinum and other

Present mushrooms:

- Morchella elata
- Cyromitria esculenta
- Tricholoma georgi
- Ramaria flava
- Lepiota cristata
- Lycoperdon gemhatum
- Lycoperdon pyriforme

All these resources are restorable. They are very significant for preservation of local communities, especially with their correct collection and construction of accessory infrastructure (shed), return of people on these areas is enabled and affirmed. Usually collecting is done on the level of local communities and groups, and existence of roads represents critical cost factor for collectors with usually low income.

New micro habitat conditions are created by roads, which provide increase of vegetation biodiversity in which significant part have medicinal herbs and mushrooms, especially in so called marginal habitat.

Construction of the road «Brankuša-section 115» would have impact on initiation and increase of interest of local residents for collecting of special forest products. In order to achieve more complete success, it is necessary to act educationally on local residents (returnees), which mainly have low living standard.
4.0. INDIRECT SOCIO-ECONOMIC IMPACTS

4.1. Impact of the road on forest fire occurrence

Special significance roads have in occurrence of so called low fires. However, unwanted effects of the road, during occurrence of fires, are usually caused by negligence of human factor. Because of that it is necessary to pay special attention during construction of the particular road and to warn the workers on danger that can be caused by careless handling with inflammable means (oil and gasoline cans, cigarettes, lighting of fire, etc). Also after road construction, it is necessary, with appropriate warning signs, to preventively influence on people, which are moving in forest and on the forest road.

However, it can be emphasized that possibility of forest fire occurrence of great proportions, in forest complex opened with the planned road, is far more smaller for few reasons:

- Mezzofilc habitat conditions
- Composition of forest vegetation with dominance of deciduous forests (mainly beech)
- Relatively small movements of residents through forests, because of small inhabitence of areas Bravska polja and Bunare
- Small presence of conifer species especially susceptible to fires
- Relatively high quantity of precipitation (table 1) in periods of the year when forest are occurring

According to that, the conclusion is that there will be no significant danger of fires and the road only can have greater significance in increasement of possibilities of preventive acting and prevention of possible fires.

4.2. Impact of the road on inventory and observance

Road construction will have special significance for forest inventory works, reduction of costs for field data collecting. Quality of collected data and their quantity will be greater. It will enable collection of data, which are avoided on inaccessible terrain and also subjectivity in assessment will be avoided.

Possibilities of observation and informing of game warden and forest ranger services are increased with the road construction. This is especially significant if you look in context of facilitated possibilities for construction of observation posts, whose construction is determined by road construction. Also access to belvederes on highest cotes of terrain opened with this road, will increase, so it can be concluded that these effects of the road are mainly positive.

4.3. Impact of the road on values of passive utilization and non-commercial values

Most often road impacts are observed through relation of road construction costs on one side, and economic value of utilized wood in forest which would be opened on the other. That comparison is relatively simple. However, effects and road significance for the following, are oftenly neglected or irregularly economically (financially) evaluated:

- Access for hunting
- Observation of birds
- Experience in wilderness

In concrete case these impacts of the road for mentioned values are significant. Main reason is that area of opening is really rich with wild animals and domestic birds. It is especially specific that forest vegetation is preserved and not violated, because there were no felling and work-up for a long period of time, so the forests have some characteristics of virgin forest type beech stands.

These so called passive values are difficult and irregular to assess, and financially express, although there are attempts. Within active utilized values (recreative fishing, skiing and camping), by road construction, they can be poorly provided and it is difficult to believe that they will be present.

However, passive utilized values, which are unable by construction, more exactly objects and areas which are accepted and appreciated by local residents, and are not utilized, essentially are existential values and they cannot be financially expressed and are of great significance for local residents and entire area of Drinić.

5.0. OTHER DIRECT AND INDIRECT SOCIO-ECONOMIC IMPACTS

In category of other impacts we classified impacts, which in concrete conditions, have no practical need to be perceived in details, and those are:

- History of road development
- Impact of the road on landscape
- Impact of the road on aquatic habitat and fish
- Impact of the road on water and air quality
- Impact on pasture
- Impact of the road on energy and mineral resources
- Impact of the road on private property and enclave
- Impact of the road on inheritance and cultural values

Impact of the road on landscape is positive, because it enables the visitors to visit preserved forest complexes. Intensive changes on landscape, after construction, will not be expressive, because the route is in forest complex and its course can be hardly noticed from long distances, for example from road Ključ-Drinić.

Also all other impacts of the road, whether positive or negative, which are mentioned above, are not significant in concrete case because of main reason of weak presence of impact objects; unpresent developed cattle raising, permanent water currents and fish, mineral resources and theirs.
6.0. CONCLUSION

Construction of this road belongs into construction of road network of small proportions. By reviewing all positive and negative socio-economic, direct and indirect impacts, and economic justification of the road it can be concluded that positive effects of road "Brankuša – section 115" construction are more significant than negative effects. Positive effects are following:

- Access is provided – to forest complex for utilization, collecting of special forest products, hunting protection of forests and game
- Easier and economically justified work is enabled on forest management by carrying out of silvicultural works and arrangement of forests (inventory)
- Influence on increasement and preservation of vegetation and animal biodiversities
- Preventive works in cases of so called accidental enjoyment
- Solved property relations
- More significant economic effects for local residents, because more possibilities are opened for activities provided by forest as a natural resource and other.

Because of this it is considered that positive effects justify the road construction, especially from viewpoint of impacts on the environment, so it is necessary to carry out the construction on terrain.

7.0. LITERATURE

6. Forest management plan for FEA „Oštrelj - Drinić“ – IRPC Banja Luka
IMPACT OF FOREST TRUCK ROAD
"ŠIPAŠNO – ZLATAČ - LOKVE" CONSTRUCTION
ON THE ENVIRONMENT IN SFE "BOTIN" – NEVESINJE

Banja Luka, August 2001
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INTRODUCTION

Openness of forests in Republic of Srpska, before the war, has been very low (about 7 km/1000 ha), and up to last ten years, because of the war and very difficult financial conditions after the war, new roads were not constructed, so the current openness remained as it was ten years ago. Previously constructed roads, because they were not maintained during and after the war, are exposed to further collapse, and one part became hardly passable or impassable for heavy trucks with big loads.

Insufficient openness not only influences the forest exploitation economy but also negatively reflects on the environment. Namely, because of the insufficient openness of forest areas annual cut cannot be equally realized on the entire area, but very often, during the silvicultural rotation, the same area is entered several times or --------- are carried out on the open area. That negatively reflects on the sustainability of forest management and endangers particular forest ecosystems. In the unopened area prompt carrying out of protection measures against fires, herbal diseases and natural catastrophes are disabled.

PFE of Republic of Srpska “Srpske Šume” proposed that, among others, construction of forest truck road “Šipašno – Zlatac - Lokve”, 5 758m long, in the area of SFE “Botin” – Nevesinje should also be included.

Data for Study elaboration were acquired by visiting the route, and during that we have used the project. After that we have collected data from the SFE, from forest management plan, as well as from forest cadastre for FEA “Nevesinje”.

Goal of the Study is to point to all relevant facts, which could have negative impact on the environment during construction and utilization of the road, as well as to suggest the measures for possible elimination of negative effects.

It is necessary to emphasize that these studies are the first of this kind, which are elaborated for forest truck roads, and that authors had problems with lack of necessary data, as well as lack of any research in this field (branch) in the previous period in the area.

Second problem was lack of law scale of norms for the field of forest road construction, especially regarding protection of the environment.
1.0. CONDITIONS OF FORESTS AND FOREST LAND IN SFE “BTIN” - NEVESINJE

SFE “Botin” – Nevesinje works within PFE “Srpske Šume” and manages FEA “Nevesinjsko”. This area includes forests and forest land in the area of municipality Nevesinje (97.2 %), and smaller part of the area belongs to municipality of Srpski Mostar (2.8 %).

1.1. Basic survey indexes

According to tables review given in the Study it can be seen that FEA “Nevesinjsko” includes forests and forest land in the area of 57 372 ha. That includes:

- High forests with natural regeneration 8 645 ha
- High degraded forests 328 ha
- High forest unsuitable for management 1 604 ha
- Forest raisings 2 042 ha
- Scion forests 16 455 ha
- Areas for afforestation 16 579 ha
- Areas not suitable for afforestation 11 819 ha

TOTAL 57 372 ha

Timber volume for all forests in the arrangement period (overall mass) is:

- Conifer forests 18 m³/ha or totaly 538 300 m³
- Deciduous forests 91 m³/ha or totaly 2 636 500 m³

Total: 109 m³/ha or totaly 3 174 800 m³

Annual volume growth increase for all forests is:

- Conifer forests 0.60 m³/ha or totaly 17 800 m³
- Deciduous forests 3.20 m³/ha or totaly 92 200 m³

Total: 3.80 m³/ha or totaly 110 000 m³

Annual cut plan (etat) for all forests (overall timber mass) is:

- Conifer forests 0.40 m³/ha or totaly 12 953 m³
- Deciduous forests 2.20 m³/ha or totaly 62 371 m³

Total: 2.60 m³/ha or totaly 75 324 m³

Wood reserves in high forests with natural regeneration are in average 245 m³/ha and are relatively low and below normal. That was kept in mind during determination of annual cut volume, so it was foreseen to cut less in regard to growth increase (with conifers 33% and with deciduous forests 32% less than growth increase.).

That means that with decreased cuts and increased silvicultural works, in FEA, it is planned to significantly decrease further degradation and improve the conditions of forest ecosystems.

1.2. Openness of the FEA

In the FEA there are 108 km of constructed forest truck roads, from which 65 km through high forests, 17.0 km through scion forests and 26 km through bare land. Beside that, according to to data from forests cadastre, there are 80 km of asphalt roads and 100 km of public macadam roads in the area. Openness of high forest is 7.2 km/1000 ha, and low forests is 6.5 km/1000 ha. Data have been taken from forests cadastre with situation on 31.12.2000. This openness is very low and does not guaranty successful management neither from economic or ecological viewpoint.
2.0. IMPACT OF OPENING OF FORESTS, WITH FOREST TRUCK ROADS, ON THE ENVIRONMENT

Construction of forest truck roads can have positive and negative impacts on the environment.

Positive impacts are reflected through the following:

- Utilization of forests can be done equally in the entire area and there is no need for ------ on particular areas, by which degradation of ecosystems is avoided,
- Protection measures against fires, diseases and natural catastrophes can be promptly and efficiently carried out,
- Sustainability of management is not endangered,
- Access and realization of all silvicultural works are enabled,
- Access to rural areas and better utilization of agricultural land are enabled,
- Better and more efficient utilization of all natural resources in the area is enabled,
- Access to many landscapes is enabled, in order to use them for recreative, health and sport purposes,
- If there are any historical, natural, archeological or other objects it enables the access to them, as well as other various scientific, educational, research and other activities.

Opening of forests also has some unwanted consequences, from viewpoint of protection of forests, soil and water, biodiversities of vegetable and animal world, and others.

During the forest truck road construction and its utilization, greater or smaller damages are done to the environment. Unprompted and incomplete maintenance of constructed roads can also cause greater or smaller damages in economic and ecological sense. Intensive damages are especially done on soil, springs and water currents. The consequence of that is endangerment of the environment.

2.1. Impact of the road construction on soil

Road construction can have negative impacts on geo-morphological processes, as well as on the environment, in several ways:

- Productive soil is permanently lost by construction of the road and objects on the road,
- Road construction often brings to increased and speed up soil erosion, and in that way it degrades the soil with deposits and makes great damage to agricultural soil, water currents, reservoirs, inhabited places and others,
- On places where the soil is formed on the impermeable surface, and is on the slope, because of the cutting the road through, land slides can appear especially where underground waters appear,
- Also, large slides appear during rockslides on road cuts and embankments in heavy rain weather,
- Large quantity of water pours on the road, and the damage made by water on the road and on soil under the road or on water currents etc., depends on the quality of constructed drains and road permeability.

Unfortunately, nowadays we have no concrete data about damages on soil made by forest truck road construction, and no research has been done regarding that. Also we do not have data about damage on roads done by bad weather, although we know that they are severe.

2.2. Impact of the road on geomorphologic processes

Impacts of the road on geomorphologic processes reflects through the following:

- Speeds up the erosion from the road surface,
- Directly influences on to the structure and shape of the furrows,
- Changes the direction of surface flow of water, and changes or lengthens the erosion furrows on previously untouched part of the area,
- Causes the mutual influence on water, sediments and timber waste, on the place where the road crosses the brook.
2.3. Impact of the road construction on hydrological processes

Interaction between forest roads and water represents the essence of several key things, which includes the impact of roads on the environment.

Rocks have three primary impacts on hydrological processes:

- They directly hold (keep) raindrops on the road surface and road cuts, and divert water bellow the surface, which pours down the slope,
- They concentrate the flow across the surface or in the near by canals and ditches and
- They change the water current from the natural direction, by which the water would flow if there was no road.

Construction of forest truck roads can have negative impacts on springs and water quality. Namely, the roads enable the increased movement and possibility of usage of different chemicals for protection of forests and fertilization, in forests. During the road construction heavy machines are used, which spill oil and petroleum, and later the rain rinse it out to the springs and water currents next to the road. Other materials and waste, that can be found on the road and around it, can be added to that.

2.4. Impact of the road construction on biodiversity

Many species, which are forming the biodiversity in certain habitat, have very significant role for ecosystem and its stability. For stability of an ecosystem, in order to function, it is necessary to be healthy, in order to enable all species to live and preserve in most optimal conditions.

In the previous chapter we have seen that forest roads with construction and maintenance can endanger and divide certain habitat. Since there are big disturbances on soil, water and air, there are also changes in micro climate in the habitat. All those factors can endanger the species that, in the habitat, have optimal conditions for growth and can cause the occurrence of unwanted outer species, and violation and endangerment of the ecosystem.

2.5. Impact of the road construction on air

During the construction and utilization of forest roads air becomes polluted, which can affect the narrower part next to the road. Since the roads are mostly not asphalted, but macadam roads, negative impacts can be reflected in production of dust, noise and exhaust gases, as well as mining in the construction phase on the route and in quarries, where the construction material is used from.

2.6. Impact of the road construction on habitat

Construction and presence of the roads in the productive habitat can have impacts on the productivity. Construction of the road leads to creation of new marginal habitat in the forest.

The roads are creating a corridor for birds and animals from the forest edge, so that they can go deeper into the part of the forest, which were previously closed with continuous forest cover. Diversity can expand on that location with species inhabiting the edge of the forest. Road construction and maintenance inside the forest represent disturbances, which create new marginal habitat. Roads can be first entrance places for outer species in new area and it can serve as a corridor further expansion of outer plants. Setting of new species can endanger the existing biological ecosystems and their structure.

2.7. Socio-economic impacts of the road construction

These impacts can be direct and indirect. Direct socio-economic impacts include employment of the population on felling and production of wood assortments, export of wood assortments, employment on growing and protection of forests, collection of secondary forest products (medicinal herbs, aromatic herbs, different forest seeds and fruits, mushrooms, snails and other). These are restorable natural resources. This can be significant source of income for local residents. Construction of roads has direct influence on reduction of export costs for these assortments and enables faster movement.
Indirect socio-economic factors include the role of roads in prevention of forest fires. Constructed roads enable faster approach (access) and prompt intervention in case of forest fires. Roads also act as the obstacle to fire expansion and as the line for free and successful intervention of firemen.

Among benefits of the roads we can include researches, inventory and observation in forest. Roads also provide access to private property and in that way provide better economic utilization of those areas. Roads also have many non-commercial values, which cannot be measured. Those are access to landscapes, access to hunting, observation of vegetation and animal world, visits and observation of different architectural, cultural and historical values.

3.0. CHARACTERISTICS OF THE PROJECT AND CONSTRUCTION PROCESS

3.1. General characteristics of the project

Investor: SFE “Botin” – Nevesinje
Planner: “Silva” – Institute for research and planning, Sarajevo
Project name: Programmed forest truck road “Šipašno – Zlatac – Lokve” – first part
Road length: 5 758 m

GENERAL DATA ABOUT THE ROAD:
- Width of the road surface 3.0 m
- Width of shoulders 2 x 0.5 m
- Maximum gradient 8.0 %
- Maximum radius of horizontal curves 20 m
- Number of sections: 5

FORESEEN WORKS
- Cutting of shrubs 1 200 pieces
- Extraction of stumps 575 pieces
- Stripping of topsoil 3 250 m³
- Excavation of soil in III/IV class of material 21 531 m³
- Excavation of soil in V/VI class of material 9 227 m³
- Excavation of benching and ditches 3 797 m³
- Excavation of embankment in III/IV class of material 7 334 m³
- Excavation of embankment in V/VI class of material 3 143 m³
- Construction of embankment facing with crushed stone 25 cm thick, 1 489 m³
- Construction of shoulders 1 439 m³
- Construction of metalling 19 635 m²

FORESEEN OBJECTS AND ROAD FURNITURE
- Revetments of culverts and bridges 200 m³
- Placing the prefabricated pipe culverts with diameter 50 cm, 65 pieces
- Placing the prefabricated pipe culverts with diameter 60 cm, 42 pieces
- Placing the spur stones 198 pieces
- Placing the traffic signs 35 pieces
- Placing the kilometer columns 11 pieces

3.2. Purpose of the road construction

Main purpose of construction of this road is opening of management unit “Bjelasica Ded”, section which belongs to SFE “Botin” – Nevesinje, due to utilization of existing timber mass and other forest products. Residents of local villages will use the road for better access to mountain pastures.

The road will enable easier carrying out of silvicultural works and protection of forests especially against fires, which are very certain taking in consideration ecological conditions.
3.3. Usage of soil

Access to the first part of the route is from village road, which is partly asphalted on the town exit. This road starts from village Šipašno (150m above school) and goes over sections 136 (bare land and scion forests), section 137 (bare land and scion forests), section 131 (bare land and forest of beech and fir), section 130 (bare land and forest of beech and fir) and comes to the boundary of sections 129/130.

Entire length of the road goes over state owned land and there are no problems regarding property.

3.4. Review (summary) of alternatives

Entire terrain of this management unit is stony with karst depressions, so the planner has taken care of in order to come to high forests of beech and fir with lowest construction costs, guided by allowed gradient.

He especially tried to surmount karst depressions, steep slopes and hollows, with shortest distance and lower construction costs.

From ecological viewpoint, considering rough karst terrain, disregarding the alternative variants, they are similar if we analyze them from aspect of hindering of road construction.

4.0. CHARACTERISTICS OF THE EXISTING SITUATION OF MANAGEMENT UNIT “BJELASICA – DED” AND THE ENVIRONMENT

Forest truck road “Šipašno – Zlatac – Lokve” section I should open management unit “Bjelasica – Ded”, part that belongs to SFE “Botin” – Nevesinje. This part should open following sections: 125, 128 to 143.

4.1. Climatic conditions

Average annual temperature is 8.9 C. Average temperature for vegetative period is 14.5 C. Total quantity of precipitation, in average per year is 1771 mm, from which in vegetative period is 621 or 35%.

Vegetative period lasts 173 days. In this area climate is temperate - continental and Mediterranean. Because of that influence of continental climate is stronger in northern expositions of higher terrain, and Mediterranean on southern expositions and in areas closer to Adriatic Sea.

4.2. Location and relief of terrain

Area of management unit “Bjelasica – Ded” is located 30 km east from Nevesinje, between fields Gatčko and Nevesinjsko. Hight above see level is between 1200 and 1867m (peak of Velika Bjelasica).

This area, in orographic sense, represents clear mountain area. It is a karst area where karst cracks are distinct. On lower terrain there is a small number of depressions, and larger number on higher terrain.

4.3. Geological and pedological characteristics

Dominant geological base in the area, through which the planned route is passing, is made of solid limestone. Solid limestone is characterized with small insoluble remainders, high karstification, with all kart elements, depressions, stones, slopes, large rocks and holes.

In this area, depending from relief and influence of erosion of soils mostly on solid limestone, following are formed: limestone stones or litosol, organic-mineral fertile soil (kalkomelanosol), brown soil (kalkokambisol), as well as luvisol. More shallow soil are disposed on slopes, while on flat surfaces and depressions deeper soil is formed. Those are mostly mosaically formed soils, on which their mechanical, chemical conditions and productive possibilities depend. Most un-productive ones are litosol and kalkomelanocol while, kalkokambisol and luvisol because of their depth and better water order have increased productive value. Shalloow and poor soils are rich with humus and have neutral reactions, while deeper soils are more sour and poor with humus. First and second ones are poorly supplied with nitrogen and phosphorus, while medially with potassium.
4.4. Vegetation characteristics and biodiversity

Planned route passes through karst areas. On the starting point of the route there are scion and degraded forests of beech and complexes of mixed forests of beech and fir (Abieti – Fagetum illyrum, Horv.), and several sub-associations appear there. Main species in these forests are: Beech, fir, maple, elm, European ash and others. Most frequent shrubs are: Rhamnus fallax, Sambucus nigra, Lonicera xylosteum, and lower flora: Elymus europaeus, Asperula odorata, Asarum europaeum, Nephrodium filix mas, Euphorbia amygdaloides, Melica nutans, Peris quadrifolia, Galeobdolon luteum and others.

According to acquired data, following game can be found on this and broader area:

a) Basic game
Roedeer (Capreolus capreolus), bear (Ursus arctus), hare (Lepus europaeus), gray partridge (Perdix perdix).

b) Permanently protected game
Squirrel (Sciurus vulgaris), weasel (Mustela sp), otter (Lutra lutra), hawk (Accipitridae), falcon (Falconidae), raven (Corvus corax) and owls (Strigidae).

c) Game protected with closed season
Mallard (Anas sp.) and hazel hen (Tetrastes bonasia).

4.5. Hydrological characteristics

Mountains in this area including Bjelasica, because of intensive presence of limestone, are mostly waterless. However, in fields of Nevesinjsko and Gatačko

4.6. Air pollution

There are no data about air pollution on mountain Bjelasica and broader area. Only possible polluter could be steam power plant Gacko, which is located east of this area, but there are also no data about that.

4.7. Conditions of forests gravitating on the road

Following sections of the management unit "Bjelasica – Ded" are gravitating on the road "Šipanov – Zlatak – Lokve": 125, 128 to 143.

- High forests with natural regeneration 438.7 ha or 22.3 %
- Scion forests 143.3 ha or 7.3 %
- Surfaces incapable for afforestation 1,388.8 ha or 70.4 %

TOTAL 1,970.8 ha or 100%

Timber volume for all forests in arrangement period (overall mass) is:

- conifers 93 m³/ha or totaly 54,144 m³
- deciduous 147.6 m³/ha or totaly 85,853 m³

Total: 240.6 m³/ha or totaly 139,977 m³

Annual growth increase volume for all forests is:
- conifers 2.18 m³/ha or totaly 1 268 m³
- deciduous 2.60 m³/ha or totaly 1 517 m³
Total: 4.78 m³/ha or totaly 2 785 m³

Annual cut plan (etat) for all forests is (overall timber mass):

- conifers 1.71 m³/ha or totaly 996 m³
- deciduous 2.87 m³/ha or totaly 1 674 m³
Total: 4.58 m³/ha or totaly 2 670 m³

Total timber reserves per ha is satisfactory taking the terrain conditions into consideration (large part of the area is karst, which has low productive possibilities. With terrain inspection it can be concluded that the timber mass is too old and the it has poor quality, especially beech. Low reserves of timber mass of scion forests are the result of very bad terrain conditions and anthropogenic influence, because below these forests there are villages whose residents are using these forests for pasture and providing the wood.

Bare land is not suitable for afforestation, since it is distinctive karts created by erosion and man. Growth increase is low because of terrain conditions. Planned cut volume is somewhat lower than growth increase. This is the result of stand conditions, because the stands of beech are to old and have poor quality, and were still not utilized.

4.8. Openness of the management unit

Management unit “Bjelasica – Ded”- part that belongs to Nevesinje, has not been open with truck roads, so this is the first road to be constructed in this area.

5.0. SIGNIFICANCE OF THE PROJECT EFFECTS FOR THE ENVIRONMENT

Planned road in the area of “Bjelasica – Ded” has a great significance for forest management in the area. Positive effects are expected in ecological and economic sense, taking into consideration that no silvicultural and protection measures could not been carried out because of unopenness, and the area and forests were left to spontaneous development for a long period of time.

5.1. Positive effects

The most important effect of the road construction is reflected through the fact that the area gravitating to the road will open and enable carrying out of exploitation works, silvicultural and protection works in the area.

Construction of the road opens the possibility of employment of local residents on construction and maintenance of roads, silvicultural works, protection and exploitation of forests, and utilization of secondary forest products and other. Residents would be able to use the road for better access to mountain pastures. Mountain landscapes would be more accessible to visitors.

By opening this area, the exploitation surface will increase, so the pressure on the opened part of the area will decrease, and with that more equal management of forests and other resources in broader area will be enabled.

5.2. Negative effects

Considering that this is the karst area, significant negative impacts on the environment are not expected during construction. The soil in lower part of the route is almost completely un-productive. In the entire area there are no permanent springs except few periodical ones, and there are no water currents. Occurrence of slides is not expected during and after construction. Only negative possibility is change of water flows in big cuts and side cuts in the period of heavy rainfalls, and occurrence of erosion, which would contribute the rinsing out of small quantities of poor soil. Considering the great permeability of karst terrain great negative consequences are also not expected.
During construction and utilization soil can be partly polluted with oil and petroleum spilling. During construction and later utilization noise can appear because of machine works and mining, which can have negative impacts on game. Construction of the road in the area of high forests can increase the intensity of light next to the route, as well as the expansion of heliofits and some outer species. It changes the ecosystem in narrower area. Often occurrence of strong and hurricane winds in the area can cause damages on trees next to the road, as well as during exploitation of forests if felling is intense. Road will enable more intensive movement of people and that means increased danger of fires, which would have far more intensive negative consequences. Poor vegetation would be destroyed and also possibility of its regeneration. With opening of the area there is a possibility of illegal hunting, illegal felling and utilization of other resources. There is not going to be any significant air pollution except exhaust gases in the construction phase and utilization of the road, because of mining and dust on the road. There are no recreative, health or sports objects, cultural and historical heritage in the area, so in that sense road construction will not have any major impacts.

6.0. ENVIRONMENT PROTECTION MEASURES (ACTIVITIES)

Taking in consideration all above mentioned impacts of construction of forest truck road “Šipašno – Zlatac – Lokve” on the environment, it is necessary to undertake certain protection measures in order to, if not avoid, than reduce to acceptable the negative consequences. Protection measures should include not only road construction but also everything that precedes it and comes after it (utilization of the road). Taking the previous remarks into consideration, as well as acquired data, protection measures can be systematized in several groups:

- Protection measures in preparatory phase of construction
- Protection measures during road construction
- Protection measures during utilization of the road

6.1. Protection measures in preparatory phase of construction

In order to achieve better effects on protection of the environment during road construction, more exactly opening of forest complexes, it is necessary that from the beginning and selection of the most appropriate variant of the road, the most appropriate variant is determined during construction, from the aspect of negative and positive effects on the environment. After that the best variant would be selected, which would have lowest negative impacts on the environment. The following should be undertaken:

- All proposed measures have to be applied during construction and utilization of the road
- Since this is the project elaborated before the war it is necessary to renovate the route

6.2. Protection measures during road construction

During construction it is necessary to:

- Remove all stumps, trees, humus in order to avoid their covering on the road
- During excavation of soil form side cuts and cuts, use the part of material for embankments and slopes, and surplus should be deposited on certain places and protect it from moving in the brook during heavy rainfalls
- All operations with petroleum and oil exchange, during construction, should be done on places specified for that with maximum protection measures
- Oil and petroleum packages need to be collected and taken to controlled deposits. That applies for old tires and broken parts of the machines and other waste on the site
- During mining, take care of reducing the damage on trees and soil to minimum
Machines should be parked on particular places determined for that, with maximum protection measures against pollution of soil with oil, petroleum and products.

Since borrow for material were not defined in the project, the investor needs, before the works start, to determine the places and way of arrangement after the works are completed.

During embankment construction, bearing capacity of the ground should be priory defined. Material which is built in the embankment need to have appropriate geo-mechanical quality. Compaction should be done in 20 to 30 cm layers, and crossfall for subgrade must be foreseen, so the water does not retain.

If it is estimated during construction, that additional culvert should be built in the investor would give order through the supervisor to do so.

6.3. Protection measures during utilization of the road

Considering the consequences on the environment and damages that can appear during the utilization of the road, it is necessary to:

- To equip the constructed road with vertical and horizontal signs, which should include all kind of necessary information and prohibitory signs
- Regarding protection of game it is necessary to set the appropriate warning signs for caution
- It is necessary to place signs which forbid setting of fires, with additional information
- On noticeable places, information boards which forbid depositing of garbage, should be placed
- Carry out regular maintenance, especially of culverts and drainage ditches, in order to prevent blockage and damages to road, soil and water currents
- In case of rockslide in cuts, side cuts and embankments, it is necessary to intervene promptly in order to decrease the possibility of severe
- SFE should introduce monitoring of all kind of damages on the road, and ecological and economic consequences caused by construction

7.0. CONCLUSION

Openness of FEA “Nevesinjsko” with roads is very low and for high forests is 7.2 km / 1000 ha, and in low forests is 6.5km/1000ha, including public roads. Low openness has negative impacts on sustainable management, and also on business economy and environment.

Road “Šipašno – Zlatac – Likve” is the first road that opens the area of management unit “Bjelasica – Ded”, and that makes it more significant. The construction will contribute to more sustainable management and better business economy.

Taking into consideration the terrain conditions, significant negative impacts on the environment are not expected. Negative impacts can be expected in smaller scope on soil and biodiversity. Those are minor impacts in regard to benefits obtained with construction in ecological and economic sense.
8.0. Literature

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9. Road project „Šipašno – Zlatac - Lokve“. Planning agency Banjaluka, 1986
10. Legend for pedological and typological maps for FEA “Nevesinjsko – Gatačko” – Planning agency Banjaluka, 1984
11. Forest management plan for karst area of Nevesinje. Planning agency Banjaluka
IMPACT OF FOREST TRUCK ROAD "LIVADE - BAČ" CONSTRUCTION
ON THE ENVIRONMENT IN SFE "MAGLIĆ" – SRBINJE

Banja Luka, August 2001
INTRODUCTION

Openness of forests in Republic of Srpska, before the war, has been very low (about 7 km/1000 ha), and up to last ten years, because of the war and very difficult financial conditions after the war new roads were not constructed, so the current openness remained as it was ten years ago. Previously constructed roads, because they were not maintained during and after the war, are exposed to further collapse, and one part became hardly passable or impassable for heavy trucks with big loads.

Insufficient openness not only influences the forest exploitation economy but also negatively reflects on the environment. Namely, because of the insufficient openness of forest areas annual cut cannot be equally realized on the entire area, but very often, during the silvicultural rotation, the same area is entered several times or over exaggerated felling is carried out on the open area. That negatively reflects on the sustainability of forest management and endangers particular forest ecosystems. In the unopened area prompt carrying out of protection measures against fires, herbal diseases and natural catastrophes are disabled.

PFE of Republic of Srpska “Srpske Šume” proposed that, among others, construction of forest truck road “Livade - Bać” section II, 6 315 m long, in the area of SFE “Maglić” - Srbinje should also be included. “Silva” - Institute for research and planning in forestry, Sarajevo elaborated a project for this road in 1988.

Data for Study elaboration were acquired by visiting the route, and during that we have used the project. After that we have collected data from the SFE, from forest management plan, as well as from forest cadastre for FEA “Tesličko”.

Goal of the Study is to point to all relevant facts, which could have negative impact on the environment during construction and utilization of the road, as well as to suggest the measures for possible elimination of negative effects.

It is necessary to emphasize that these studies are the first of this kind, which are elaborated for forest truck roads, and that authors had problems with lack of necessary data, as well as lack of any research in this field (branch) in the previous period in the area. Second problem was lack of law scale of norms for the field of forest road construction, especially regarding protection of the environment.
1.0. CONDITIONS OF FORESTS AND FOREST LAND IN SFE "BORJA" - TESLIĆ

SFE "Maglić" – Srbinje works within PFE “Srpske Šume” and manages FEA “Srbinjsko”. This area includes forests and forestland in the area of municipality Srbinje (97.8 %), and smaller part of the area belongs to municipality Čajniče (2.2 %).

Forest management plan for this area was valid from 01.01.1990 to 31.12.1999. Now new management plan is in the elaboration phase.

1.1. Basic survey indexes

According to tables review given in the Study it can be seen that FEA “Srbinjsko” includes forests and forestland in the area of 55 200 ha. That includes:

- High forests with natural regeneration 21 565 ha
- High degraded forests 7 210 ha
- High forests not suitable for management 2 333 ha
- Forest raisings 3 654 ha
- Scion forests for management 10 738 ha
- Scion forests not suitable for management 2 702 ha
- Areas for afforestation 2 304 ha
- Areas not suitable for afforestation 4 694 ha

**TOTAL 55 200 ha**

Timber volume for all forests in the arrangement period (overall mass) is:

- conifer 96 m$^3$/ha or totaly 4 315 500 m$^3$ 38%
- deciduous 156 m$^3$/ha or totaly 7 045 000 m$^3$ 62%

**Total: 252 m$^3$/ha or totaly 11 360 500 m$^3$ 100%**

Annual volume growth increase for all forests is:

- conifer 3.2 m$^3$/ha or totaly 138 500 m$^3$ 43%
- deciduous 4.2 m$^3$/ha or totaly 180 900 m$^3$ 57%

**Total: 7.4 m$^3$/ha or totaly 319 400 m$^3$ 100%**

Annual cut plan (etat) for all forests (overall timber mass) is:

- conifer 2.3 m$^3$/ha or totaly 93 560 m$^3$ 45%
- deciduous 2.8 m$^3$/ha or totaly 113 710 m$^3$ 55%

**Total: 5.1 m$^3$/ha or totaly 207 270 m$^3$ 100%**

Annual cut volume is determined realistically considering ecological factors and growth increase. So the annual cut volume in high forests with natural regeneration is 83% from growth increase (for conifer 72% and for deciduous 103%), and in high degraded forests under 50% of growth increase. In scion forests for management only 26%, etc.

That means that with decreased cuts and increased silvicultural works, in FEA, it is planned to significantly decrease further degradation in all categories and improve the conditions of forest ecosystems.

1.2. Openness of the FEA

In the FEA there are 312.3 km of constructed forest truck roads, as well as 35.5 km of asphalt roads and 19 km of public macadam roads, which directly open high and scion forests.
Openness of high forest is 8.9 km/1000 ha, and of scion forests is 4.3 km/1000 ha. That is somewhat better than with other SFE's, but far under optimal openness. Because of that, costs for exploitation of forest are high, which significantly decreases business economy.

2.0. IMPACT OF OPENNING OF FORESTS, WITH FOREST TRUCK ROADS, ON THE ENVIRONMENT

Construction of forest truck roads can have positive and negative impacts on the environment.

Positive impacts are reflected through the following:

- Utilization of forests can be done equally in the entire area and there is no need for over exaggerated felling on particular areas, by which degradation of ecosystems is avoided,
- Protection measures against fires, diseases and natural catastrophes can be promptly and efficiently carried out,
- Sustainability of management is not endangered,
- Access and realization of all silvicultural works are enabled,
- Access to rural areas and better utilization of agricultural land are enabled,
- Better and more efficient utilization of all natural resources in the area is enabled,
- Access to many landscapes is enabled, in order to use them for recreative, health and sport purposes,
- If there are any historical, natural, archeological or other objects it enables the access to them, as well as other various scientific, educational, research and other activities.

Opening of forests also has some unwanted consequences, from viewpoint of protection of forests, soil and water, biodiversities of vegetative and animal world, and others.

During the forest truck road construction and its utilization, greater or smaller damages are done to the environment. Unprompted and incomplete maintenance of constructed roads can also cause greater or smaller damages in economic and ecological sense. Intensive damages are especially done on soil, springs and water currents. The consequence of that is endangerment of the environment.

2.1. Impact of the road construction on soil

Road construction can have negative impacts on geo-morphological processes, as well as on the environment, in several ways:

- Productive soil is permanently lost by construction of the road and objects on the road,
- Road construction often brings to increased and speed up soil erosion, and in that way it degrades the soil with deposits and makes great damage to agricultural soil, water currents, reservoirs, inhabited places and others,
- On places where the soil is formed on the impermeable surface, and is on the slope, because of the cutting the road through, land slides can appear especially where underground waters appear,
- Also, large slides appear during rockslides on road cuts and embankments in heavy rainfalls,
- Large quantity of water pours on the road, and the damage made by water on the road and on soil under the road or on water currents etc., depends on the quality of constructed drains and road permeability.

Unfortunately, nowadays we have no concrete data about damages on soil made by forest truck road construction, and no research has been done regarding that. Also we do not have data about damage on roads done by bad weather, although we know that they are severe.

2.2. Impact of the road on geomorphologic processes

Impacts of the road on geomorphologic processes reflects through the following:

- Speeds up the erosion from the road surface,
- Directly influences on to the structure and shape of the furrows,
Changes the direction of surface flow of water, and changes or lengthens the erosion furrows on previously untouched part of the area,
- Causes the mutual influence on water, sediments and timber waste, on the place where the road crosses the brook.

**2.3. Impact of the road construction on hydrological processes**

Interaction between forest roads and water represents the essence of several key things, which includes the impact of roads on the environment.

Roads have three primary impacts on hydrological processes:
- They directly hold (keep) raindrops on the road surface and road cuts, and divert water below the surface, which pours down the slope,
- They concentrate the flow across the surface or in the near by canals and ditches and
- They change the water current from the natural direction, by which the water would flow if there were no road.

Construction of forest truck roads can have negative impacts on springs and water quality. Namely, the roads enable the increased movement and possibility of usage of different chemicals for protection of forests and fertilization, in forests.

During the road construction heavy machines are used, which spill oil and petroleum, and later the rain rinse it out to the springs and water currents next to the road. Other materials and waste, that can be found on the road and around it, can be added to that.

**2.4. Impact of the road construction on biodiversity**

Many species, which are forming the biodiversity in certain habitat, have very significant role for ecosystem and its stability. For stability of an ecosystem, in order to function, it is necessary to be healthy, in order to enable all species to live and preserve in most optimal conditions.

In the previous chapter we have seen that forest roads with construction and maintenance can endanger and divide certain habitat. Since there are big disturbances on soil, water and air, there are also changes in micro climate in the habitat.

All those factors can endanger the species that, in the habitat, have optimal conditions for growth and can cause the occurrence of unwanted outer species, and violation and endangerment of the ecosystem.

**2.5. Impact of the road construction on air**

During the construction and utilization of forest roads air becomes polluted, which can affect the narrower part next to the road. Since the roads are mostly not asphalted, but macadam roads, negative impacts can be reflected in production of dust, noise and exhaust gases, as well as mining in the construction phase on the route and in quarries, where the construction material is used from.

**2.6. Impact of the road construction on habitat**

Construction and presence of the roads in the productive habitat can have impacts on the productivity. Construction of the road leads to creation of new marginal habitat in the forest.

The roads are creating a corridor for birds and animals from the forest edge, so that they can go deeper into the part of the forest, which were previously closed with continuous forest cover. Diversity can expand on that location with species inhabiting the edge of the forest. Road construction and maintenance inside the forest represent disturbances, which create new marginal habitat. Roads can be first entrance places for outer species in new area and it can serve as a corridor further expansion of outer plants. Settling of new species can endanger the existing biological ecosystems and their structure.
2.7. Socio-economic impacts of the road construction

These impacts can be direct and indirect. Direct socio-economic impacts include employment of the population on felling and production of wood assortments, export of wood assortments, employment on growing and protection of forests, collection of secondary forest products (medicinal herbs, aromatic herbs, different forest seeds and fruits, mushrooms, snails and other). These are restorable natural resources. This can be significant source of income for local residents. Construction of roads has direct influence on reduction of export costs for these assortments and enables faster movement.

Indirect socio-economic factors include the role of roads in prevention of forest fires. Constructed roads enable faster approach (access) and prompt intervention in case of forest fires. Roads also act as the obstacle to fire expansion and as the line for free and successful intervention of firemen.

Among benefits of the roads we can include researches, inventory and observation in forest. Roads also provide access to private property and in that way provide better economic utilization of those areas.

Roads also have many non-commercial values, which cannot be measured. Those are access to landscapes, access to hunting, observation of vegetation and animal world, visits and observation of different architectural, cultural and historical values.

3.0. CHARACTERISTICS OF THE PROJECT AND CONSTRUCTION PROCESS

3.1. General characteristics of the project

Investor: SFE “Maglić” – Srinje
Planner: “Silva” Institute for research and planning in forestry – Sarajevo
Year of project elaboration: 1988
Project name: Main project for forest truck road “Livade - Bač” – section II
Road length: 6 315 m

GENERAL DATA ABOUT THE ROAD:
- Width of the road surface 3.0 m
- Width of shoulders 2 x 0.5 m
- Foreseen passing places 16 X 60 m² = 960 m²
- Number of sections 398
- Number of curves 114
- Minimum radius of horizontal curves 20 m
- Minimum radius of serpentines 10m
- Maximum gradient 8.0 %
- Maximum crosfall 4.0 %
- Side drainage: Trapeze ditches

FORESEEN WORKS
- Cutting of shrubs 3 000 m²
- Extraction of stumps 946 pieces
- Stripping of topsoil 7 506 m³
- Excavation of soil in III/IV class of material 93 500 m³
- Excavation of soil in V/VI class of material 22 009 m³
- Excavation of benching and ditches 2 681 m³
- Construction of embankment 10 156 m³
- Construction of shoulders 2 652 m³
- Construction of metalling 30 cm thick, 22 551 m²

FORESEEN OBJECTS AND ROAD FURNITURE
- Excavation of foundation in III/IV class of material 145.8 m³
- Excavation of foundation in V/VI class of material 16.2 m³
Putting the culverts in concrete 106 m³
Installation of culverts with diameter 50 cm, 12 pieces – 95 m
Installation of culverts with diameter 80 cm, 1 pieces – 10 m
Installation of culverts with diameter 100 cm, 3 pieces – 21 m
Installation of culverts with diameter 120 cm, 1 pieces – 6 m
Placing the kilometer columns 12 pieces
Placing the spur stones 72 pieces
Placing the traffic signs 7 pieces

3.2. Purpose of the road construction

Main purpose for road "Livade – Bać"-section II construction is opening of basin of “Prevrački potok” to which sections 6 to 10 are gravitating, in management unit “Slatina”. Opening of this basin would enable exploitation of forests in gravitating sections and protection of foreseen forests in these sections, according to forest management plan. Also utilization of other resources from the area is enabled.

3.3. Usage of soil

The route is planned to go over state owned land, only small part of it goes over private property. For part that goes over private property, property status has been solved earlier.

Part of the route has been done, with the fact that it deviates from the project in the starting point of the route. One large slope occurred there, and technical solution must be found for that in order to be repaired, or the route should deviate and would be constructed below the slope. Height level would be attained with serpentine so that the route can fit into already cut through route in the extension. Since the project has been elaborated earlier, marks of the route have been destroyed, so it should be renovated before the works start.

3.4. Review (summary) of alternatives

For opening of management units “Jošanica” and “Slatina” firm “Silva” from Sarajevo has elaborated the Study for opening of this area in 1988. According to decision from the Study, this road has been planned in basin of “Prevrački potok”.

4.0. CHARACTERISTICS OF THE EXISTING SITUATION OF BASIN "MALA INOVA" AND THE ENVIRONMENT

Road “Livade - Bać” – section II opens the area of basin “Prevrački potok”, that is sections 6 to 10 in management unit “Slatina”, more exactly left side of this basin. Right side of the basin is inhabited and mainly private property with small areas of state owned forests are on the right side. There are already built village roads on the right side of the basin.

4.1. Climatic conditions

In broader area of Srbinje we can see two climate zones or types of climate:

- Valley climate
- Mountain climate

Valley climate includes riverbeds of Drina with tributaries Sutjeska, Čehotina, Bistrica and Kolomska. Mountain type includes higher areas up to 1 500m above sea level. Basin of “Prevrački potok”, which empties into Čehotina on the entrance into Srbinje, belongs to valley climate type and data from meteorological station in Srbinje are the most authoritative for it. The station is located on 395m above sea level and on latitude of 43° 30’.

Average annual temperature is 10.8 C and annual quantity of precipitation is 975 mm.
Vegetation period lasts for 191 days, and average relative air humidity (moisture) is 83%. This area is under influence of moderate – continental climate, with the fact that in the valleys there is rarely influence of Mediterranean climate.

4.2. Location and relief of terrain

Starting point of the area of this basin is in Srbinje, more exactly from the place where “Prevrački potok” empties into Čehotina and goes in northeast direction. Prevrački potok is created from Duboki potok (deep brook) and Kaldmnski potok, and on his way there are few permanent and periodical little brooks from left and right side. There are steep slopes on the right and left side, which are intersected with mentioned brooks. Height is from 400m to 1110 m above sea level.

4.3. Geological and pedological characteristics

According to pedological map for management unit Slatina, on the entire area of the basin, there is sour brown soil (district kambisol) on alternating series of shale and sandy soil. It is the most spread type of soil in entire FEA “Srbinjsko” and it is located on different silicate substratum.

In the area of basin “Prevrački potok”, varieties on softer surface have more appropriate characteristics. In horizon “A” there is mainly sandy loam, and in horizon “B” mainly loam and sandy-clay loam. Those are soar soils rich with humus, and degree of saturation with bases is low. Presence of physiologically active phosphorus is medium, and of potassium and nitrogen is good.

From productive - ecological aspect, these soils belong to productive and soils suitable for forest growing. With appropriate silvicultural and protection measures these degraded forests can be converted in productive forest ecosystems.

4.4. Vegetation characteristics and biodiversity

In this basin, more exactly in sections from 6 to 10 of management unit “Slatina”, according to typological map, high-degraded hill forests are mostly present on deep soar brown soil.

The trees include beech, hornbeam, oak, aspen and birch. Low flora includes: Lactuca muralis, Lamium luteum, Festuca Montana, Lusula nemorosa, Oxalis acetosella, Anemone nemorosa, Geranium robertianum, Veronica latifolia, Pteridium aquilinum, Vaccinium myrtillus, Nephrodium fillix mass, Sambucus racemosa, Daphne mezereum.

Since those are productive habitats, these forests should be converted into more valuable types by including conifers, and on mezophilic habitats retain beech and purebred deciduous forests.

Other types of vegetation in this area are scion beech forests on deep soar soils and scion oak forests on deep soar soils. In scion oak forests there are oak, hornbeam, beech, cerris, maple and birch. There are shrubs: Vaccinium myrtillus, Calluna vulgaris, Lusula nemorosa, Veronica chamaedris, Galium cruciatum, Potentilla erecta, Dorocinium herbaeum, Pteridium aquilinum, Melanopirum pratense, Hieracium murorum, Ligustrum vulgare, Corilus avellanm, Crataegus monogyyna and other.

These forests also should be converted into higher growing type, with the fact that beech, oak and hornbeam and other deciduous trees with successful development would be retained. On more kseroterm soils white pine should be included.

Data about vegetative communities are entered according to typological map for this area and map legend for FEA “Gornje – Drinsko”.

According to acquired data, following game can be found on this and broader area:

a) Basic game

Roedeer (Capreolus capreolus), bear (Ursus arctus), hare (Lepus europaeus), gray partridge (Perdix perdix).

b) Permanently protected game
Squirrel (Sciurus vulgaris), weasel (Mustela sp), otter (Lutra lutra), hawk (Accipitridae), falcon (Falconaceae), raven (Corvus corax) and owls (Strigidae).

c) Game protected with closed season

Mallard (Anas sp.) and hazel hen (Tetrastes bonasia).

d) Unprotected

Wild boar (Sus scropha), wolf (Canis lupus), fox (Vulpes vulpes), wildcat (Felis silvestris), pine marten (Martes martes), stone marten (Martes fiona), badger (Meles meles) and polecat (Putarius putarius).

4.5. Hydrological characteristics

This basin, in hydrological sense, can be treated as rich, as well as broader area. Prevrački potok gives the area basic feature. From the left and right side several brooks empty into Prevrački potok. Some of those brooks are permanent (Duboki and kalandrikski, and Trnovacki and Osojski), while others are periodical, they appear during heavy precipitation especially in winter and spring. Right side of the brook is more inhabited, and there you can find settlements: Zlatari, Gornji Prevrac i Donji Prevrac.

Left side is not inhabited and is covered with forest vegetation. Planned road passes from the starting point to the end of the basin and goes from the southeast side of the brook, one with forests. The route is mostly above the brook, so it's construction should not endanger the brook. On smaller steep part there is a possibility of partial covering of brook during the road's cutting through, as well as on the beginning of the route where the road is foreseen to go next to the brook.

Brooks that empty from the left side intersect the road, so the longitudinal and transverse drainage have to be carried out according to the project, and appropriate culverts placed. Because of hydrological, pedological and geological features of this basin there is a possibility of erosion and slopes, and it should be taken into consideration during construction. There is a special problem with steep terrain, where the geological base is made of horizontal layers of shale.

4.6. Air pollution

There are no data, on local or broader level, about ait pollution in the basin.

4.7. Conditions of forests in the area of basin "Prevrački potok"

Basin of "Prevrački potok" includes sections from 6 – 10 in management unit "Slatina". Structure of the areas:

<table>
<thead>
<tr>
<th>Type of Land Use</th>
<th>Area (ha)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>High degraded forests</td>
<td>264.5</td>
<td>72%</td>
</tr>
<tr>
<td>Scion forests</td>
<td>91.4</td>
<td>24.9%</td>
</tr>
<tr>
<td>Bare land and shrubbery for afforestation</td>
<td>7.8</td>
<td>2.1%</td>
</tr>
<tr>
<td>Unproductive areas</td>
<td>3.6</td>
<td>1%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>367.3</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Timber volume for all forests in arrangement period (overall mass) is:

<table>
<thead>
<tr>
<th>Type of Land Use</th>
<th>Volume (m³/ha)</th>
<th>Total Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High degraded forests</td>
<td>259.3</td>
<td>68 589  m³  · 82%</td>
</tr>
<tr>
<td>Scon forests</td>
<td>162/ha</td>
<td>14 809  m³  · 18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>234.3 ha</strong></td>
<td><strong>83 398  m³  · 100%</strong></td>
</tr>
</tbody>
</table>
Average annual growth increase volume for all forests is:

- High degraded forests deciduous 7.2 m$^3$/ha or totaly 1 896 m$^3$ - 79%
- Scon forests deciduous 5.4 m$^3$/ha or totaly 497 m$^3$ - 21%
Total: deciduous 6.7 m$^3$/ha or totaly 2 393 m$^3$ - 100%

Annual cut plan (etat) for all forests is (overall timber mass):

- High degraded forests deciduous 3.4 m$^3$/ha or totaly 914 m$^3$ - 88%
- Scon forests deciduous 1.4 m$^3$/ha or totaly 127 m$^3$ - 12%
Total: deciduous 2.9 m$^3$/ha or totaly 1 041 m$^3$ - 100%

According to previous tables it can be seen that, in this basin, there are only high degraded forests and scion forests, and exclusively deciduous ones.

Although these are high degraded forests and scion forests, according to conditions of timber reserves and growth increase, it can be concluded that they belong to more qualitative forest in this classes of forests. Average reserves of 259.3 m$^3$/ha in high and 162 m$^3$ in scion forests, as well as growth increase of 7.7 m$^3$/ha for high and 5.4 m$^3$/ha for scion forests, shows that those are productive soil. That imposes a need of urgent conversion of these forests, with different land-reclamation and silvicultural activities, into more productive forests. This fact, besides utilization of timber mass, favours the opening of this basin.

Annual cut volume for high degraded forests is 47% and for scion forests 26% from annual growth increase, and according to that significant improvement of existing conditions is expected.

4.8. Openness of the basin

Area foreseen for utilization and silvicultural works, sections from 6 to 10, were not open until now. There are built village roads in the basin, but because of terrain relief and long distance they cannot be used for skidding of wood assortments from mentioned sections.

5.0. SIGNIFICANCE OF THE PROJECT EFFECTS FOR THE ENVIRONMENT

Planned road in the basin of Mala Inova has a great significance for forest management in the area. Beside positive effects in ecological and economic sense, if full attention is not payed during construction and utilization of the road, as well as during the exploitation of forests in the area, there could be negative consequences especially ecological ones.

5.1. Positive effects

The most important effect of the road construction is reflected through the fact that the basin will open and enable carrying out of exploitation works, silvicultural and protection works in the area. Considering the conditions of forests in which they are now, emergency interventions are requested in order to stop further degradation and to improve the conditions. It is foreseen with forest management plan that existing conditions of forests, with land-reclamation and silvicultural activities, should be converted into more productive and ecologically more stable forest ecosystems.

There is a possibility of employment of local residents on construction and maintenance of roads, silvicultural works, protection and exploitation of forests, and utilization of secondary forest products and other. Also there is a possibility of utilization of this exciting landscape for recreation.
By opening of broader area, pressure on the forests that are already open will be decreased. That opens the possibility for equal management of forests and other resources.

5.2. Negative effects

Major undesirable consequences are expected on soil and hydrological conditions in the area, especially during the road construction and exploitation of forests.

By constructing the road there is increased possibility of slides and erosion appearance, especially on steep terrains, cuts, side cuts and embankments. It is necessary to mention that danger of slides is big because of features of geological surface and soil, as well as terrain relief.

Former water currents are intersected and new ones are formed. Water can be polluted with oil spilling form machines on the site, as well as by throwing the different garbage on the site and next to the route.

On smaller surface on the road, vegetation communities can change because the intensity of light is increased with road construction and with that expansion of heliofits, as well as some outer species. The road significantly endangers the game, because of noise created by vehicles. Machines for constructions and mining also create noise. There are also many cases of game being hit with vehicles on roads with intensive traffic.

Increased noise is expected during construction of the road and exploitation of forests. There is not going to be any direct significant air pollution except exhaust gases in the construction phase and utilization of the road, because of mining and dust on the road. Road will enable more intensive movement of people and vehicles, and that means increased danger for fires, illegal hunting, illegal felling, illegal utilization of medicinal herbs, mushrooms, forest fruits, snails and others.

There are no recreative, health or sports objects, cultural and historical heritage in the area, so in that sense road construction will not have any major impacts.

6.0. ENVIRONMENT PROTECTION MEASURES (ACTIVITIES)

Taking in consideration all above mentioned impacts of construction of forest truck road “Livade - Bač” on the environment, it is necessary to undertake certain protection measures in order to, if not avoid, than reduce to acceptable the negative consequences. Protection measures should include not only road construction but also everything that precedes it and comes after it (utilization of the road).

Taking the previous remarks into consideration, as well as acquired data, protection measures can be systematized in several groups:

- Protection measures in preparatory phase of construction
- Protection measures during road construction
- Protection measures during utilization of the road

6.1. Protection measures in preparatory phase of construction

In order to achieve better effects on protection of the environment during road construction, more exactly opening of forest complexes, it is necessary that from the beginning and selection of the most appropriate variant of the road, the most appropriate variant is determined during construction, from the aspect of negative and positive effects on the environment. After that the best variant would be selected, which would have lowest negative impacts on the environment. The following should be undertaken:

- All proposed measures have to be built in the project, or kept in mind while signing the contract with contractor
- Since this is the project elaborated before the war it is necessary to renovate the route
- Property relations need to be solved, if there are any
- Agree with contractor the rehabilitation of slides, which are not included in the project
6.2. Protection measures during road construction

During construction it is necessary to:

- Remove all stumps, trees, humus in order to avoid their covering on the road or in the brook, and to use humus for covering the slopes
- During excavation of soil from side cuts and cuts, use the part of material for embankments and slopes, and surplus should be deposited on certain places and protect it from moving in the brook during heavy rainfalls
- All operations with petroleum and oil exchange, during construction, should be done on places specified for that with maximum protection measures
- Oil and petroleum packages need to be collected and taken to controlled deposits. That applies for old tires and broken parts of the machines and other waste on the site
- During mining, take care of reducing the damage on trees and soil to minimum
- Machines should be parked on particular places determined for that, with maximum protection measures against pollution of soil with oil, petroleum and products
- Since borrow for material were not defined in the project, the investor needs, before the works start, to determine the places and way of arrangement after the works are completed
- During embankment construction, bearing capacity of the ground should be priory defined. Material, which is built in the embankment need to have appropriate geo-mechanical quality. Compaction should be done in 20 to 30 cm layers, and crossfall for subgrade must be foreseen, so the water does not retain
- Check if the planned profiles of culverts will satisfy the needs or they should be replaced with bigger
- Special attention should be paid to transverse and longitudinal drainage of water. If it is not qualitatively solved, there can be severe ecological and economical damages.
- If it were estimated during construction, that additional culvert should be built in the investor would give order through the supervisor to do so.

6.3. Protection measures during utilization of the road

Considering the consequences on the environment and damages that can appear during the utilization of the road, it is necessary to:

- To equip the constructed road with vertical and horizontal signs, which should include all kind of necessary information and prohibitory signs
- Regarding protection of game it is necessary to set the appropriate warning signs for caution
- It is necessary to place signs which forbid setting of fires, with additional information
- On noticeable places, information boards which forbid depositing of garbage, should be placed
- Carry out regular maintenance, especially of culverts and drainage ditches, in order to prevent blockage and damages to road, soil and water currents
- In case of rockslide in cuts, side cuts and embankments, it is necessary to intervene promptly in order to decrease the possibility of severe
- SFE should introduce monitoring of all kind of damages on the road, and ecological and economic consequences caused by construction
- Considering that this is terrain disposed to erosion and slides, before carrying out of exploitation works in sections gravitating to the road, tractor and other roads have to be planned within the project. These facts have to be taken into consideration, in order to reduce damages during skidding of wood assortments in the future.
7.0. CONCLUSION

Involvement of qualitative high forests in FEA "Srbinjsko" is 39%. Reserves of timber mass and growth increase are also satisfactory, and involvement of conifers is 38%. Other categories of forests have reserves and growth increase, which are on the average level for these categories of forests.

Openness of these forests is low and is 8.9km/1000ha in high forests, and in low forests is 4.3km/1000ha. This openness is not sufficient and does not provide business economy, as well as carrying out of necessary silvicultural and protection measures, which can have consequences in endangerment and further degradation of forest ecosystems in the area. Because of sustainability and more economic management, and carrying out of silvicultural and protection measures, as well as better utilization of productive abilities of soil in the area, construction of forest roads and opening of areas is a priority task.

By constructing the road "Livade – Bač" section II, 6 315m long, sections from 6 to 10 in management unit "Slatina" will open. It would enable utilization of forests, carrying of silvicultural and protection works, as well as utilization of other resources. Converting these forests into higher growing classes will be facilitated, which is planned within forest management plan. That means that further degradation will be prevented with those measures, and that conditions in productive and ecological sense would be improved.

With prompt interventions and skilled carrying out of works, damages can be significantly reduced if they occur during construction and utilization of the road, in economic and ecological sense.

8.0. Literature

1. Begović, B. (1986): Exploitation of forests and development of wood processing in industry in the area of Usorsko – Teslić region during the Austrian administration in BiH. Sarajevo
3. Ecological – vegetational classification of Bosnia and Herzegovine. Forestry faculty, Sarajevo
8. Forest management plan for FEA „Srbinjsko“ – IRPC Banja Luka
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IMPACT OF FOREST TRUCK ROAD "MALA INOVA" CONSTRUCTION
ON THE ENVIRONMENT IN SFE "BORJA" – TESLIĆ

(EIA Study)

Banja Luka, August 2001
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7.0. CONCLUSION

8.0. LITERATURE
INTRODUCTION

Openness of forests in Republic of Srpska, before the war, has been very low (about 7 km/1000 ha), and up to last ten years, because of the war and very difficult financial conditions after the war new roads were not constructed, so the current openness remained as it was ten years ago. Previously constructed roads, because they were not maintained during and after the war, are exposed to further collapse, and one part became hardly passable or impassable for heavy trucks with big loads.

Insufficient openness not only influences the forest exploitation economy but negatively reflects on the environment. Namely, because of the insufficient openness of forest areas annual cut cannot be equally realized on the entire area, but very often, during the silvicultural rotation, the same area is entered several times or excessive felling are carried out on the open area. That negatively reflects on the sustainability of forest management and endangers particular forest ecosystems. In the unopened area prompt carrying out of protection measures against fires, herbal diseases and natural catastrophes are disabled.

PFE of Republic of Srpska "Srpske Šume" proposed that, among others, construction of forest truck road "Mala Inova", 5 298.94 m long, in the area of SFE "Borja" – Teslić should also be included. Šipad IRC OOUR – Planing agency, Banja Luka, elaborated a project for this road in 1986.

Data for Study elaboration were acquired by visiting the route, and during that we have used the project. After that we have collected data from the SFE, from forest management plan, as well as from forest cadastre for FEA "Tesličko".

Goal of the Study is to point to all relevant facts, which could have negative impact on the environment during construction and utilization of the road, as well as to suggest the measures for possible elimination of negative effects.

It is necessary to emphasize that these studies are the first of this kind, which are elaborated for forest truck roads, and that authors had problems with lack of necessary data, as well as lack of any research in this field (branch) in the previous period in the area. Second problem was lack of law scale of norms for the field of forest road construction, especially regarding protection of the environment.
1.0. CONDITIONS OF FORESTS AND FOREST LAND IN SFE "BORJA" - TESLIĆ

SFE "Borja" - Teslić works within PFE "Srpske Šume" and manages FEA "Tesličko". This area includes forests and forestland in the area of municipality Teslić (96 %), and smaller part of the area belongs to municipalities Doboj (2.5 %), Kotor Varoš (1.1 %) and Čelinaç (0.4 %). FEA "Tesličko" includes seven management units and their parts:

1. M.U. «Donja Velika Usora»
2. M.U. «Gornja Velika Usora»
3. M.U. «Mala Usora»
4. M.U. «Mala Ukrina»
5. M.U. «Velika Ukrina»
7. M.U. «Lješnica – part»

1.1. Basic taxation indexes

Conditions of areas of forests and forestland, wood reserves, increment and etat (cut volume) are shown in tables 1, 2, 3, and 4. Data have been taken from existing FMP, for period from 01.01.1995 to 31.12.2004.

Presence of tree species per mass is:

- Beech 54%
- Oak 19%
- Purebred and other deciduous forests 4%
- Fir 13%
- Spruce 3%
- White pine 3%
- Black pine 4%
Table 1: Review of area by forest category and management units

<table>
<thead>
<tr>
<th>Forest category</th>
<th>Management Unit</th>
<th>FEA &quot;Teslic&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Donja velika</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gornja velika</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mala Usora</td>
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<tr>
<td></td>
<td>Mala Ukrina</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Velika Ukrina</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tesanjka -a part-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ljesnica -a part-</td>
<td></td>
</tr>
<tr>
<td>High forests of beech</td>
<td>3477.27</td>
<td>2721.34</td>
</tr>
<tr>
<td>High forests of fir and spruce and mixed</td>
<td>3342.03</td>
<td>7818.53</td>
</tr>
<tr>
<td>beech and spruce forests</td>
<td>143.20</td>
<td>434.24</td>
</tr>
<tr>
<td>High forests of black and white pine</td>
<td>389.52</td>
<td>938.18</td>
</tr>
<tr>
<td>High forests of oak</td>
<td>7352.02</td>
<td>11912.29</td>
</tr>
<tr>
<td>Total of high forests with natural</td>
<td>97.49</td>
<td>-</td>
</tr>
<tr>
<td>regeneration</td>
<td>51.42</td>
<td>554.09</td>
</tr>
<tr>
<td>Degraded high forests of beech</td>
<td>148.91</td>
<td>554.09</td>
</tr>
<tr>
<td>Degraded high forests of oak</td>
<td>19.62</td>
<td>65.54</td>
</tr>
<tr>
<td>Total of degraded high forests</td>
<td>1814.08</td>
<td>587.62</td>
</tr>
<tr>
<td>Raisings of spruce and fir</td>
<td>88</td>
<td>6.46</td>
</tr>
<tr>
<td>Raisings of black and white pine</td>
<td>1580.55</td>
<td>259.97</td>
</tr>
<tr>
<td>Raisings of other coniferous</td>
<td>654.87</td>
<td>120.55</td>
</tr>
<tr>
<td>Total of forest raisings</td>
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<td>380.52</td>
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<tr>
<td>Scion forests of beech</td>
<td>3204.09</td>
<td>1128.06</td>
</tr>
<tr>
<td>Total of scion forests</td>
<td>220.21</td>
<td>336.99</td>
</tr>
<tr>
<td>Area suitable for afforestation and</td>
<td>22.63</td>
<td>340.65</td>
</tr>
<tr>
<td>management</td>
<td>12100.89</td>
<td>14184.16</td>
</tr>
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</table>
### Table 2: Timber volume of all forests with estimated timber reserves in FEA

<table>
<thead>
<tr>
<th>Forest category</th>
<th>Area (ha)</th>
<th>Type of forest</th>
<th>Average per ha</th>
<th>On entire area</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forests with natural regeneration</td>
<td>33666.21</td>
<td>Coniferous</td>
<td>52</td>
<td>1719072</td>
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<td></td>
<td></td>
<td>Deciduous</td>
<td>181</td>
<td>6133544</td>
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<td></td>
<td></td>
<td>Total</td>
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<td>7852616</td>
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<tr>
<td>Degraded high forests</td>
<td>996.29</td>
<td>Coniferous</td>
<td>19</td>
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<tr>
<td></td>
<td></td>
<td>Deciduous</td>
<td>127</td>
<td>126845</td>
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<tr>
<td></td>
<td></td>
<td>Total</td>
<td>146</td>
<td>147459</td>
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<tr>
<td>Forest raisings</td>
<td>3852.27</td>
<td>Coniferous</td>
<td>108</td>
<td>420444</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deciduous</td>
<td>24</td>
<td>90683</td>
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<tr>
<td></td>
<td></td>
<td>Total</td>
<td>132</td>
<td>511127</td>
</tr>
<tr>
<td>Scion forests</td>
<td>5480.98</td>
<td>Coniferous</td>
<td>*</td>
<td>8622</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deciduous</td>
<td>133</td>
<td>733148</td>
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<tr>
<td></td>
<td></td>
<td>Total</td>
<td>133</td>
<td>741770</td>
</tr>
<tr>
<td>Forests unsuitable for management</td>
<td>300.78</td>
<td>Coniferous</td>
<td>8</td>
<td>2752</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deciduous</td>
<td>194</td>
<td>58548</td>
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<td></td>
<td>Total</td>
<td>202</td>
<td>61300</td>
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<tr>
<td>All forests in FEA</td>
<td>44296.53</td>
<td>Coniferous</td>
<td>48</td>
<td>2171504</td>
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<tr>
<td></td>
<td></td>
<td>Deciduous</td>
<td>161</td>
<td>7142768</td>
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<tr>
<td></td>
<td></td>
<td>Total</td>
<td>209</td>
<td>9314272</td>
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</table>
Table 3: Annual volume increment

<table>
<thead>
<tr>
<th>Forest category</th>
<th>Area (ha)</th>
<th>Type of forest</th>
<th>Average per ha</th>
<th>On entire area</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forests with natural regeneration</td>
<td>33666.21</td>
<td>Coniferous</td>
<td>1.80</td>
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<td></td>
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<td>4.84</td>
<td>160455</td>
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<td>Total</td>
<td>6.64</td>
<td>220314</td>
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<td>Degraded high forests</td>
<td>996.29</td>
<td>Coniferous</td>
<td>0.70</td>
<td>675</td>
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<td></td>
<td></td>
<td>Deciduous</td>
<td>3.40</td>
<td>3321</td>
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<td></td>
<td>Total</td>
<td>4.10</td>
<td>3996</td>
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<td>Forest raisings</td>
<td>3852.27</td>
<td>Coniferous</td>
<td>6.74</td>
<td>25596</td>
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<td>Scion forests</td>
<td>5480.98</td>
<td>Coniferous</td>
<td>0.07</td>
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<td></td>
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<td>5.16</td>
<td>28257</td>
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<td>Total</td>
<td>5.23</td>
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<td>Forests unsuitable for management</td>
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<td></td>
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<td>Deciduous</td>
<td>5.20</td>
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<td></td>
<td>Total</td>
<td>5.45</td>
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<tr>
<td>All forests in FEA</td>
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<td></td>
<td></td>
<td>Deciduous</td>
<td>4.43</td>
<td>196132</td>
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<tr>
<td></td>
<td></td>
<td>Total</td>
<td>6.38</td>
<td>282696</td>
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</table>
Table 4: Cutting volume plan by wider categories of forests

<table>
<thead>
<tr>
<th>Type of forest</th>
<th>Total timber mass</th>
<th>Amount of cutting (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>In 10 years</td>
</tr>
<tr>
<td></td>
<td>On entire area</td>
<td>Per 1 ha</td>
</tr>
<tr>
<td>A) High forests with natural regeneration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferous</td>
<td>221970</td>
<td>6.6</td>
</tr>
<tr>
<td>Deciduous</td>
<td>1225800</td>
<td>36.4</td>
</tr>
<tr>
<td>Total</td>
<td>1447770</td>
<td>43.0</td>
</tr>
<tr>
<td>B) Degraded high forests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferous</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Deciduous</td>
<td>96100</td>
<td>161.6</td>
</tr>
<tr>
<td>Total</td>
<td>96100</td>
<td>161.6</td>
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<tr>
<td>C) Forest raisings</td>
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<td>Coniferous</td>
<td>87630</td>
<td>22.7</td>
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<td>Deciduous</td>
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<tr>
<td>Total</td>
<td>155570</td>
<td>40.3</td>
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<tr>
<td>D) Scion forests</td>
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</tr>
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<td>Coniferous</td>
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<td>-</td>
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<td>Deciduous</td>
<td>247000</td>
<td>44.1</td>
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<td>Total</td>
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<td>44.1</td>
</tr>
<tr>
<td>Total of all forests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferous</td>
<td>309600</td>
<td>7.0</td>
</tr>
<tr>
<td>Deciduous</td>
<td>1636840</td>
<td>37.1</td>
</tr>
<tr>
<td>Total</td>
<td>1946440</td>
<td>44.1</td>
</tr>
</tbody>
</table>
From the tables, following can be concluded:

- Conifers participate with 23%, and deciduous with 77%, which means that conifers are not enough present. According to data from «Ecological-vegetational classification in BiH», elaborated by Forestry faculty from Sarajevo, «Tesličko» area belongs to north Bosnian area within Pre Panonian area, and southern part to area of Zavidovičko – Tesličko within internal Dinaric mountains. Potential vegetation on lower northern part should contain forests of sessile – flowered oak and hornbeam (Querco – Carpinetum illyricum), sporadic inundated forests of English oak (Genisto elatae – Carpinetum roboris), forests of sessile – flowered oak, beech forests (Fagetum montanum), as well as forests of willow and fir (Abieti – Fagetum silicicolum) inside which are interleaved forests of pine and oak. Lowest areas belong to beech and oak.

- Reserves of timber mass per 1ha are significantly lower (somewhere up to 50%) in regard to normal forests, which is the result of long duration exploitation. Exploitation of forests in this area begun in 1869, when the Austria-Hungary established the factory for wood destilation in Teslic and later sawmill for conifers.

- Average annual increment is also below optimal considering conditions in the area. Reason for this is probably low reserves and their structure.

- During elaboration of new management plan, having in mind conditions of forests, SFE determined etat significantly lower than increment in order to improve conditions of reserves in the following period. Increment of conifers for entire FEA is 86 696 m³ or 1.95 m³/ha, and for deciduous 196 132 m³ or 4.43 m³/ha, or totaly 182 696 m³ or 6.38 m³/ha.

- Annual felling volume for conifers is 30 960 m³ or 0.7 m³/ha, and for deciduous 163 644 m³ or 4.4 m³/ha. It means that planned annual felling of conifers is 35.8% in regard to increment, and of deciduous is 83.4%, or totaly 68.8%. From above mentioned it can be seen that in the following period not only overall conditions will improve, but also involvement of conifers in regard to deciduous.

- In the previous period significant areas were afforested. According to the plan there are 6 126.83 ha of afforested areas, from which there are raisings of fir and spruce on 113.24 ha or 1.9%, raisings of black and white pine on 5 789.49 or 94.6% and other conifers on 215.10 ha or 3.5%. In mentioned raisings there are raisings with assessed timber mass (3 852.27 ha with total mass of 511 127 m³) while remaining part of raisings is significantly younger (2 274.56).

- Since 96% is afforested with pine, there are big problems related to raising measures (thinning) and lack of market for pine assortments, especially for pitprops and pulpwood.

1.2. Openness of the FEA

In the FEA there are 338.3 km of constructed forest truck roads, from which 319.1 km through high forests, 14.0 km through scion forests and 5.2 km through bare land. Beside that, according to to data from forests cadastre, there are 65 km of asphalt roads and 72 km of public macadam roads in the area. Openness of high forest is 7.8 km/1000 ha, and low forests is 2.5 km/1000 ha. Data have been taken form forests cadastre with situation on 31.12.2000. This openness is very low and does not guaranty successful management neither from economic or ecological viewpoint.

Beside the fact that openness is low it is not equally disposed in the area. That is the reason why more frequent fellings and excessive utilization of forests occur in the opened part of the area. On the other side, in the unopened part forests are ruined and there is no possibility of carrying out of silvicultural works.

Excessive felling in the opened part and impossibility of interventions in unopened part of the area directly endangers stability of forest ecosystems and biodiversity.
2.0. IMPACT OF OPENNING OF FORESTS, WITH FOREST TRUCK ROADS, ON THE ENVIRONMENT

Contemporary forest management requires, from economical and ecological viewpoint, optimal openness of forest areas with forest truck roads.

Optimal openness means the openness that will provide the most economical utilization of forests in the area, and not to endanger productive capability of soil and forests, and environment and biodiversity of vegetation and animal world, on that occasion.

Optimal openness depends on terrain conditions, stand conditions and technology of forest utilization. Openness of high forests in RS is around 7.7 km/1000 ha, in average for all categories of forests. That is very low openness in regard to developed countries with developed forestry, where openness in high forests is 20 to 40 km/100 ha. In our country the most qualitative forests are opened, in economic and ecological sense. Often there are excessive felling and endangerment of stability of those forest ecosystems.

For proper forest management and continuous supplying of market with wood assortments, it is necessary that entire area is equally opened, and that means road construction also in rough terrain. During opening of certain areas it is necessary to realize all possible variants, taking into consideration impacts of certain variants on the environment, besides economical justification.

Construction of forest truck roads can have positive and negative impacts on the environment.

Positive impacts are reflected through the following:

- Utilization of forests can be done equally in the entire area and there is no need for over exaggerated felling on particular areas, by which degradation of ecosystems is avoided,
- Protection measures against fires, diseases and natural catastrophes can be promptly and efficiently carried out,
- Sustainability of management is not endangered,
- Access and realization of all silvicultural works are enabled,
- Access to rural areas and better utilization of agricultural land are enabled,
- Better and more efficient utilization of all natural resources in the area is enabled,
- Access to many landscapes is enabled, in order to use them for recreative, health and sport purposes,
- If there are any historical, natural, archeological or other objects it enables the access to them, as well as other various scientific, educational, research and other activities.

Opening of forests also has some unwanted consequences, from viewpoint of protection of forests, soil and water, biodiversities of vegetative and animal world, and others.

During the forest truck road construction and its utilization, greater or smaller damages are done to the environment. Unprompted and incomplete maintenance of constructed roads can also cause greater or smaller damages in economic and ecological sense. Intensive damages are especially done on soil, springs and water currents. The consequence of that is endangerment of the environment.

2.1. Impact of the road construction on soil

Impact of road construction on soil depends on location, terrain configuration, geological and pedological base, etc. Relation between roads and land surface is complicated. Roads constructed on slopes can cause massive movement of mass (landslides or erosion). Roads constructed in foot can often be the obstacle to moved mass, and if they intersect water currents they can also have influence on stopping of material and even change of water currents.

Road construction can have negative impacts on geo-morphological processes, as well as on the environment, in several ways:

- Productive soil is permanently lost by construction of the road and objects on the road,
Road construction often brings to increased and speed up soil erosion, and in that way it degrades the soil with deposits and makes great damage to agricultural soil, water currents, reservoirs, inhabited places and others,
- On places where the soil is formed on the impermeable surface, and is on the slope, because of the cutting the road through, land slides can appear especially where underground waters appear,
- Also, large slides appear during rockslides on road cuts and embankments in heavy rainfalls,
- Large quantity of water pours on the road, and the damage made by water on the road and on soil under the road or on water currents etc., depends on the quality of constructed drains and road permeability.

Unfortunately, nowadays we have no concrete data about damages on soil made by forest truck road construction, and no research has been done regarding that. Also we do not have data about damage on roads done by bad weather, although we know that they are severe.

2.2. Impact of the road on geomorphologic processes

Impacts of the road on geomorphologic processes reflects through the following:
- Speeds up the erosion from the road surface,
- Directly influences on to the structure and shape of the furrows,
- Changes the direction of surface flow of water, and changes or lengthens the erosion furrows on previously untouched part of the area,
- Causes the mutual influence on water, sediments and timber waste, on the place where the road crosses the brook.

On steep terrain, forestland susceptible to slides, most significant influence of roads on scope of erosion depends on increasement of moved mass after road construction. Scope of erosion, created by road construction, is varying with climatic, geological features, age of the road, way of construction and intensity of rain and torrent.

Slides, created by road construction, are occurring because of movement of soil mass, irregularly placed structure of embankments and brook crossings, unsuitable dimensions of culverts, sediments, wood waste during torrents, bad compaction of road, bad drainage, as well as removal of water currents according to unstable soil.

It often happens, that during road construction through forest, stumps and other assortments are removed which cause slides and movement of mass when they decay.

2.3. Impact of the road construction on hydrological processes

Interaction between forest roads and water represents the essence of several key things, which includes the impact of roads on the environment.

Roads have three primary impacts on hydrological processes:
- They directly hold (keep) raindrops on the road surface and road cuts, and divert water bellow the surface, which pours down the slope,
- They concentrate the flow across the surface or in the near by canals and ditches and
- They change the water current from the natural direction, by which the water would flow if there were no road.

Problems of drainage and transportation of water and materials, especially during torrents, are main reasons why roads are failure with main structural, ecological and economic consequences. Impacts of roads on maximum flow of water in brooks depend on size of basin.
Construction of forest truck roads can have negative impacts on springs and water quality. Namely, the roads enable the increased movement and possibility of usage of different chemicals for protection of forests and fertilization in forests.

During the road construction heavy machines are used, which spill oil and petroleum, and later the rain rinse it out to the springs and water currents next to the road. Other materials and waste, that can be found on the road and around it, can be added to that.

Garbage deposits are frequently formed next to roads, and especially in the forests. They come from households of near settlements or sites in the forest. Those are so called wild deposits, since garbage is deposited next to the roads without control. Deposits contain different kinds of garbage: metal, plastic, paper and other kinds of garbage from industry and households. They often contain toxic and harmful substances. All that pollutes brooks and water currents next to the road.

2.4. Impact of the road construction on biodiversity

Many species, which are forming the biodiversity in certain habitat, have very significant role for ecosystem and its stability. For stability of an ecosystem, in order to function, it is necessary to be healthy, in order to enable all species to live and preserve in most optimal conditions.

In the previous chapter we have seen that forest roads with construction and maintenance can endanger and divide certain habitat. Since there are big disturbances on soil, water and air, there are also changes in micro climate in the habitat. All those factors can endanger the species that, in the habitat, have optimal conditions for growth and can cause the occurence of unwanted outer species, and violation and endangerment of the ecosystem.

Some species can have more significant role than the others, for normal functioning of ecosystem. On the other side species that do not have significant role in ecosystem, are creating reservation of potential adaptations towards changes. Since one ecosystem cannot predict changes, diversity specie serevs as a defense against those changes.

Biodiversity is significant for long – term functioning of ecosystem, and human activities , which have impact on decreasement of biodiversity, can endanger it. On that basis, hypothesis is made, that review and measurement of biodiversity is providing the best integral assessment of road impact on ecosystem.

2.5. Impact of the road construction on air

During the construction and utilization of forest roads air becomes polluted, which can affect the narrower part next to the road. Since the roads are mostly not asphalted, but macadam roads, negative impacts can be reflected in production of dust, noise and exhaust gases, as well as mining in the construction phase on the route and in quarries, where the construction material is used from.

By road construction quantity of hard particles in the air is increased and visibility is decreased, and besides that they represent health problem.

According to certain research, dust raised from silicate geological base represents danger for people exposed to it, more exactly near it.

2.6. Impact of the road construction on habitat

Construction and presence of the roads in the productive habitat can have impacts on the productivity. Construction of the road leads to creation of new marginal habitat in the forest. Roads are creating a corridor for birds and animals from the forest edge, so that they can go deeper into the part of the forest, which were previously closed with continuous forest cover. Diversity can expand on that location with species inhabiting the edge of the forest.

Roads can have impact on terrestrial Vertabarta in a way of dividing their habitat, and especially vehicle traffic has influence because it is a threat of running over them. Because of that Vertabarta are avoiding roads. With better access to forest complexes, easier hunting and catching of game in traps is enabled, which is a negative consequence of road construction. By intersecting and covering of brooks, forming of different obstacles it can be negatively influenced on moving and breeding of fish, and to endanger habitat in water.
Road construction and maintenance inside the forest represent disturbances, which create new marginal habitat. Roads can be first entrance places for outer species in new area and it can serve as a corridor further expansion of outer plants. Settling of new species can endanger the existing biological ecosystems and their structure.

2.7. Socio-economic impacts of the road construction

These impacts can be direct and indirect. Direct socio-economic impacts include employment of the population on felling and production of wood assortments, export of wood assortments, employment on growing and protection of forests, collection of secondary forest products (medicinal herbs, aromatic herbs, different forest seeds and fruits, mushrooms, snails and other). These are restorable natural resources. This can be significant source of income for local residents. Construction of roads has direct influence on reduction of export costs for these assortments and enables faster movement.

Roads also serve for easier movement of cattle in the areas where pasture is allowed. Forest roads can also serve for drawing of energy and mineral resources in areas where they are present.

This can negatively reflect on the environment (loss of habitat, increasement of noise and creation of particles, which are entering water currents and air).

Roads enable utilization of forests in recreative and health purposes. All these require new approach in road construction, from the aspect of optimizing of multipurpose utilization of roads.

Indirect socio-economic factors include the role of roads in prevention of forest fires. Constructed roads enable faster approach (access) and prompt intervention in case of forest fires. Roads also act as the obstacle to fire expansion and as the line for free and successful intervention of firemen.

Among benefits of the roads we can include researches, inventory and observation in forest. Roads also provide access to private property and in that way provide better economic utilization of those areas.

Roads also have many non-commercial values, which cannot be measured. Those are access to landscapes, access to hunting, observation of vegetation and animal world, visits and observation of different architectural, cultural and historical values.

3.0. CHARACTERISTICS OF THE PROJECT AND CONSTRUCTION PROCESS

3.1. General characteristics of the project

Investor: SFE "Borja" – Teslić
Planner: ŠIPAD – IRC – OOUR Planning agency Banja Luka (current name “Srpske Šume” – Research – development and planning center, Banja Luka)
Project name: Forest truck road “Mala Inova” – main project
Road lenght: 5 298.94 m

GENERAL DATA ABOUT THE ROAD:
- Width of the road surface 3.0 m
- Width of shoulders 2 x 0.5 m
- Foreseen pasing places 13 with P = 60 m²
- Turnoff: 1 with P = 420 m²
- Number of sections: 313
- Number of curves 91
- Maximum radius of horizontal curves 20 m
- Maximum gradient 8.0 %
- Maximum crosfall 4.0 %
- Side drainage: Trapeze ditches
- Transverse drainage: Culverts and bridges
FORESEEN WORKS

- Tree felling 1 800 pieces
- Excavation of soil in III/IV class of material 2 334.39 m³
- Excavation of soil in V/VI class of material 14 006.39 m³
- Excavation in V/VI class of material 7 003.19 m³
- Construction of embankment 6 331.55 m³
- Excavation of ditches 869 m³
- Construction of shoulders 5 299 m³
- Rolling of subgrade 23 664 m²
- Construction of blanket course 18 365 m²
- Construction of road surface 18 365 m²
- Construction of cohesive layer 18 365 m²

FORESEEN OBJECTS AND ROAD FURNITURE

- Construction of prefabricated concrete pipe culverts with diameter 300 mm, 18 pieces – 100 m
- Construction of prefabricated concrete pipe culverts with diameter 500 mm, 5 pieces – 27 m
- Construction of prefabricated concrete pipe culverts with diameter 1000 mm, 2 pieces – 11.5 m
- Construction of prefabricated concrete pipe culverts with diameter 2x1000 mm, 1 piece – 12 m
- Construction of bridges I = 8 m, 1 piece
- Construction of bridges I = 6 m, 1 piece
- Placing the spur stones 120 pieces
- Placing the traffic signs 8 pieces

3.2. Purpose of the road construction

One of the main reasons for road construction is opening of forest area of brook basin Mala Inova in management unit “Mala Usora”. Main purpose of opening of the area is exploitation the forests in the area, as well as prompt carrying out of interventions of growing and protection of forests.

Project has special significance for realization of “Program for reconstruction of forests in management unit Mala Usora”.

3.3. Usage of soil

First part of the route passes through inhabited settlement Buletići (villages Trivunovići, Vukovići, Mićići and Radonjići) and is 2.8 km long, and goes over existing village road. Road, through inhabited place, is going over old route of narrow forest railway and is very narrow, so it has to be significantly widen over private property and fences have to be moved. Because of that the investor first has to solve property conditions (relations). On the remained part, planned road goes through the state forest and there are no property problems, because those forests are managed by the SFE (the investor). That part also goes over the role of the old forest railway with smaller deviations and widenings.

Before the works start it is necessary to renovate and set out the route because previous marks are destroyed. It is necessary to solve property problems on the part that passes through settlement (cca 2.8km), because the existing village road has to be widened. During solving of property relations, existing fences, walls and possible smaller objects has to be moved where required by future road.

Since the are two roads on the starting point, 6 m and 8 m long, contractor has to provide alternative access to villages and property during construction. On the part that goes through forest the investor is obligated to mark, cut and remove trees and bushes from the route, and contractor has to extract roots and stumps in order not to cover them in road base.

Contractor will use following machines for construction: bulldozers, trenchers, loaders, graders, vibrating rollers and tipper trucks. Stripping of top soil is not foreseen with project, but if there is a need for that it should be removed on a pile and later use for soiling of the slope. Material for topping will be used from excavation.
3.4. **Review (summary) of alternatives**

According to the Technical report it can be seen that the planner examined (discussed) two alternatives:

1. The first idea was to open the basin of brook "Mala Inova" form the road "Berča – Vranpoije". This variant requires surmounting of the section between Male and Velike Inove, which passes through serpentine crest. This variant would require bigger and heavier earthworks and would be economically less justified. Also during the route building, severe damages would be done to soil and forest, and because of that from the ecological viewpoint this solution less favorable.

2. Second alternative, according to which the project is elaborated, is more favorable from the economic aspect, because the earthworks are smaller, and the route goes over former narrow forest railway constructed during the Austrian rule and is not functioning until 1900. According to this variant, the road is planned mostly to go next to the brook Mala Inova with minor deviations and crossings of the brook on few places.

All other alternatives, which would possibly go over basin slope or crest, would be more difficult for carrying out and would require longer road and higher investments.

4.0. **CHARACTERISTICS OF THE EXISTING SITUATION OF BASIN "MALA INOVA" AND THE ENVIRONMENT**

Road "Mala Inova" passes through the lowest points of the basin of brook Mala Inova and all masses, from the right and left side of the basin, are gravitating to it. Road opens the sections from 61 to 56 of the management unit "Mala Usora". Basin area is 539,05 ha.

4.1. **Climatic conditions**

Data about climatic factors were taken from meteorological station Teslić, which is located on 225m above sea level.

a) **Average air temperature per month**

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<th></th>
<th>I</th>
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<th>III</th>
<th>IV</th>
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<th>VII</th>
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<th>XI</th>
<th>XII</th>
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<tr>
<td></td>
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<td>12.7</td>
<td>11.5</td>
<td>5.8</td>
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b) **Quantity of precipitation**

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<tr>
<td></td>
<td>39</td>
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<td>69</td>
<td>53</td>
<td>119</td>
<td>74</td>
<td>951</td>
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c) **Number of snowy days monthly and annually**

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<th>XII</th>
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<td>5</td>
<td>2</td>
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<td>6</td>
<td>31</td>
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</table>
Average month temperatures point that only in December temperature falls under 0°C, and in other months that temperatures are within average for those months. Most abundant precipitations are in April, July and December, and most of snowy days are in December. Average month temperature for vegetation period is 15.9°C. Average annual air humidity is 82%, and in vegetation period is 79%, while average sum of precipitations in vegetation period is 525 mm. Index of drought, according to De Marton, averagely for vegetation period is 23.1. Vegetation period lasts for 191 days.

According to above data it can be concluded that climate has more expressed moderate-continental character (55% of precipitations is related to vegetation period) and that it is very suitable for growth of forest vegetation.

4.2. Location and relief of terrain

Basin of the brook Mala Inova is located southwestern from Teslic, on the slopes of mountain Borja between 325m and 1008 m (peak Tajan) above sea level. Starting point of the road is on 325 m above sea level and ends on 560 m.

First part of the road comes from asphalted road and goes partly over private property over village road. In upper part the terrain is covered with forests, steep and intersected with small brooks. Brook Mala Inova, which is the main feature of the basin, flows eastwards and changes direction to northeast until mouth of Velika Inova. Practically Road will be constructed next to entire flow of Mala Inova.

4.3. Geological and pedological characteristics

Area of basin Mala Inova, regarding geological characteristics, is the part of large ultramafit massif Borja, a mountain mainly composed of peridotites. These peridotites are one of the magmatic associations, which is pressed inside volcanogenic-sediment formation. According to petrographic composition they belong to lerconit, with the fact that they are more or less serpentined.

Important feature of peridotites is that they are massive, but are easily crushed into scree material with different size. Presence of large stones is significant. Peridotites are impermeable rocks, which is important for appearance of erosions. Increased erosion in area of basin Mala Inova is permanent factor, which should be taken care about. Peridotites are characterized with relief of «great energy». It is about steep slopes intersected with numerous crests and hollows. Main crests are 4 to 6 km long in basin of Mala Inova.

It is important to emphasize specific mineral composition of peridotites through broad ratio between Mg and Ca, lack of P and K and richness of oligo elements. This is significant for appearance of specific flora, so called serpentinofits in area of basin Mala Inova.

Disposition of soil on peridotites in Mala Inova firstly depends on relief and on erosion processes, which have influence on dynamics of these soils.

In this area, there is a series of soils where eutric ranker and kambisol prevail. Luvisol and pseudoglejev are found out but their presence is not significant, and they are not registered in the maps.

It should be mentioned that significant areas of sirozem (litosol), created as a consequence of erosion on peridotitic terrains. Eutric ranker are significantly present, which is understandable since those are steep slopes and crests (parts of sections 51,52,53, 55 and 56). Eutric kambisol have the similar presence and they are on less steeper slopes (upper part of Mala Inova, sections 52,53,54). Complex soils of topogenic row made of eutric ranker and eutric kambisol have the same significance and spatial presence. Involvement of these components in the combination is related to relief. On steep parts involvement of ranker is more intensive, and on less steeper involvement of kambisol is more intensive. More or less, deeper or shallow soils are important from the production viewpoint.

It is important to emphasize that rankers and kambisols are particularly skeleton soils; they are permeable, warm and dry soils, which effects on appearance of vegetation and flora, which are adapted to these conditions.

From viewpoint of productivity of timber mass sirozems and rankers belong to soil with low productivity, while kambisols are medium productive. River drift rankers and skeleton rankers a bit can be productive soils, and shallow and skeleton kambisols have low productivity. If it is about trees, oak has low productivity even on kambisols, and black pine on rankers has good productivity.
4.4. Vegetation characteristics and biodiversity

Mountain Borja, according to ecological vegetative area classification, belongs to the area of inner Dinaric mountains and to area of Zavidović and Teslić. In this "Peridotitic" terrain, impacts of orographic-edaphic conditions, determine the disposition of vegetation. Slope increases or decreases flow of energy to a certain place. Change in certain vegetation units follows the changes in slope and exposition, while the impact of height in the area of Mala Inova does not have significant impact. South steeper slopes of the sections 55 and 56, northern very steep slopes and valleys in Male Inove are ecological conditions suitable for communities of black pine (*Pinetum nigrae silvestris, Pavl. 1951*).

Mesofile forests of beech and fir with beech (*Abieti - Fagetum serp. picetosum a.r.*) are located on colder sites, and they are northern exposition and hollows in northern exposition. Deeper soils are mainly represented there deep eutric kambisol.

In high layers, they are spread form 450 up to 1000 m above sea level (from riverbed of Mala Inova up to peak M. Tajan 1008 m).

Scion forests of (*Potentillo – Quercetum petraeae Pavl. 1951*), are located on north. Northwest and northeast slopes, next to main crest from M. Tajana to Rudina (677 m above sea level), and which are very steep. Over narrow crest they descend almost to the riverbed of Mala Inova. On this area, shallow soil prevails ranker and shallow kambisol. In ecological sense, these forests are located between forests of black pine and beech-fir-spruce forests.

Observing from the production viewpoint, forests of beech and fir with spruce have average or bad productivity, but forests of black pine and *Quercus petraeae* mainly have bad productivity, which in the area of basin Mala Inova have protective character.

Floristic composition and structure of mentioned communities is related with degree of preservation, firstly from the conditions of the composition. In stands that greater openness of shrubs is better developed, regarding number of species and their number and coverness.

Forests of black pine and sessile-flowered oak are mainly opened and therefore bright and floristically richer. In tree layer there are black pine and sessile-flowered oak of poor quality, *Betula verucosa, Populus tremula, Sorbus torminalis and Sorbus aucuparia*.

In layer of shrubs there are: *Frangula alnus, Prunus mahaleb, Rosa glutinosa, Rosa spinosima, Rosa pendulina, Rubus ideaus, Rubus tommetosus, Rubus rusticanus, Rubus hirtus, Spirea ulmifolia, Spirea media, Sorbus torminalis, Sorbus aucuparia, Pyrus piraster, Rhamnus chatarica, Fraxinus ornus* and others.

In layer of low vegetation there are: *Brachypodium pinatum, Calamagrostris varia, Pteridium aquilinum, Potentilla alba, Peucedanum camfolia, Serratula tinctoria, Erica carnea, Betonica officinalis, Fragaria vesca, Mellitis melioskophyllum, Daphne blagayana, Vaccinium myrtillus, Lilium matragon, Shyphutum tuberosum, Solidago virgaurea, Aremonia agrimonoides, Campanula persicifolia, Stachis recta, Dictamnus albus, Euphorbia glabriflora, Euphorbia polychroma, Melica nutans, Festuca heterophylla, Thymus serpyllum, Galium cruciata, Polygonatum odoratum, Epimedium alpinum, Asplenium adiantum nigrum, Dorychium herbaceum, Lasertpilum sp. And others.*

In mezophilic forests of beech and fir with spruce, in tree layer except edificators there are also: *Acer pseudoplatanus, Sorbus aucaparia, Betula verucosa, Acer platanoides, Salix caprea, Populus tremula, Ostrya carpinifolia, Tilia parvifolia and others.*

In the shrubberies layer there are: *Rubus idaeaus, Rubus hirtus, Daphne moesereum, Sambucus racemosa, Sambucus nigra, Hedera helix, Spirea ulmifolia, Rosa pendulina, Rosa spinosima, Frangula alnus, Daphne blagayana and others.*

In the layer of low vegetation there are: *Festuca drymea, Vaccinium myrtillus, Pteridium aqulinaum, Lusula silvatica, Shyphutum tuberosum, Hieracium murorum, Vida silvestris, Asarum europaeum, Nephrodium filix mas, Erica carnea, Asperula odorata, Glechoma hirsute, Athyrium filix femina, Carex digitata, Ruscus hypoglousum, Sanicula europaea, Euphorbia amygdaloïdes, Polyctistium lobatum, Asplenum trichomanes, Senecio nemorensis, Calamagrostris varia, Thymus sp., Atropa belladonna, Polygonatum verticillatum and others.*

According to acquired data, following game can be found on this and broader area:

a) Basic game
Roedeer (Capreolus capreolus), bear (Ursus arctus), hare (Lepus europaeus), gray partridge (Perdix perdix) and pheasant (Phasanis colchicus).

b) Permanently protected game
Squirrel (Sciurus vulgaris), weasel (Mustela sp), otter (Lutra lutra), hawk (Accipitridae), falcon (Falconaceae), raven (Corvus corax) and owls (Strigidae).

c) Game protected with closed season
Mallard (Anas sp.) and hazel hen (Tetrastes bonasia).

d) Unprotected
Wild boar (Sus scropha), wolf (Canis lupus), fox (Vulpes vulpes), wildcat (Felis silvestris), pine marten (Martes martes), stone marten (Martes fiona), badger (Meles meles) and polecat (Putarius putarius).

4.5. Hydrological characteristics
This relatively small basin that gravitates to planned road, in hydrological sense, can be considered rich, as well as broader area of management unit to which it belongs. Main characteristic, in hydrological sense, is given by brook Mala Inova, which from its source to the mouth in Velika Inova, flows mainly through the basin. Brook Mala Inova is created from several springs and small brooks that are mainly on the right slope and their current is relatively short. According to available data these are permanent springs with small capacity and always have water in them. Entire surroundings are rich with water currents and most of them are moving from southwest towards southeast. This movement is caused with geologic base and orography of terrain, because the area is characterized with presence of numerous crests and steep slopes.

4.6. Air pollution
Air pollution can be caused by several sources, which can be present on local, regional and broader area. Polluters can be different objects, which emission particles in different state of aggregation.

Data about air pollution in area of Teslić are very modest. Ristić T. in his work "Consequences of destruction of forest vegetation during wart in municipality Teslić – eco-climatic factors" states that excessive felling of trees in the area during war decreased role of forests as a natural filter for all kinds of aerosols and air regenerators. In 1987 Forestry faculty from Sarajevo, according to conclusions of federal Committee for Agriculture in Beigrade and Geneve Convention about excessive air pollution (1979), joined the realization of Convention, and on the basis of conclusions program known as IPC-forests has been elaborated. With that program control of forests health conditions has been introduced in Europe, and former Yugoslavia joined the realization of that program. Bio – indication places were placed in BiH, and there were 4 of them in Teslić. Unfortunately war interrupted the supervision of health conditions in forests, air pollution and similar, in BiH, and also in area of Teslić so we were not able to use data from previous registrations.
4.7. Conditions of forests in the area of basin "Mala Inova"

Basin of "Mala Inova" includes sections 51 – 56 of the management unit "Mala Usora".

a) Structure of areas

Table 5

<table>
<thead>
<tr>
<th>Forest category</th>
<th>ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forests with natural regeneration</td>
<td>433.1</td>
<td>80.3</td>
</tr>
<tr>
<td>Forest raisings</td>
<td>4.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Scion forests</td>
<td>69.3</td>
<td>12.8</td>
</tr>
<tr>
<td>Surfaces for afforestation</td>
<td>32.6</td>
<td>6.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>539.1</td>
<td>100</td>
</tr>
</tbody>
</table>

b) Timber volume for all forests in arrangement period (overall mass)

Table 6

<table>
<thead>
<tr>
<th>Forest category</th>
<th>Type</th>
<th>Volume m³/ha</th>
<th>On entire area (m³)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forests with natural regeneration</td>
<td>Coniferous</td>
<td>120</td>
<td>52040</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>64</td>
<td>27796</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>184</td>
<td>79836</td>
<td>100</td>
</tr>
<tr>
<td>Sprout forests</td>
<td>Coniferous</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>66</td>
<td>1147</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>66</td>
<td>1147</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>Coniferous</td>
<td>103</td>
<td>52040</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>58</td>
<td>28943</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>161</td>
<td>80983</td>
<td>100</td>
</tr>
</tbody>
</table>

c) Annual average increment (overall mass)

Table 7

<table>
<thead>
<tr>
<th>Forest category</th>
<th>Type</th>
<th>Volume m³/ha</th>
<th>On entire area (m³)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forests with natural regeneration</td>
<td>Coniferous</td>
<td>3.54</td>
<td>1535</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>2.40</td>
<td>1038</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5.96</td>
<td>2573</td>
<td>100</td>
</tr>
<tr>
<td>Sprout forests</td>
<td>Coniferous</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>3.64</td>
<td>252</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.64</td>
<td>252</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>Coniferous</td>
<td>3.05</td>
<td>1535</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>2.56</td>
<td>1790</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5.61</td>
<td>2850</td>
<td>100</td>
</tr>
</tbody>
</table>
d) Annual felling volume (etat)

Table 8

<table>
<thead>
<tr>
<th>Forest category</th>
<th>Type</th>
<th>Volume m³/ha</th>
<th>On entire area</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forests with natural regeneration</td>
<td>Coniferous</td>
<td>0.86</td>
<td>371</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>1.18</td>
<td>513</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2.04</td>
<td>884</td>
<td>100</td>
</tr>
<tr>
<td>Sprout forests</td>
<td>Coniferous</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>1.60</td>
<td>112</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.60</td>
<td>112</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>Coniferous</td>
<td>0.74</td>
<td>371</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Deciduous</td>
<td>1.24</td>
<td>625</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.98</td>
<td>996</td>
<td>100</td>
</tr>
</tbody>
</table>

Mass reserves per ha are far below normal, so these forests should be classified in the category of degraded forests. Foreseen scope of cutting, in regard to growth increase, is significantly lower and is 24% with conifers and 48% with deciduous forests. Considering this condition of forests in basin of Mala Inova and broader area of management unit Mala Usora, SFE elaborated a program of forest reconstruction in management unit Mala Usora, by which all sections of basin Mala Inova are included. The programme foresees:

- clear cuts 58.10 ha
- thinning 209.30 ha
- group cutting 189.10 ha
- afforestation of bare land 54.10 ha
- filling of raisings 8.10 ha

So total area for carrying out of works is 518.70 ha. 10 690 m³ of forests would be cut (2 261 m³ of conifers and 8 429 m³ of deciduous forests). Ares with clear and group felling (247.40 ha) would be afforested. This reconstruction program has been elaborated before elaboration of management plan, so there are some differences in areas and volumes.

Successful realization of the program is directly dependent on openness of the area with forest roads, and that is the main reason why SFE decided to construct a road in basin of Mala Inova.

4.8. Openness of the basin

Areas of this basin were opened in the time of Austrian rule in BiH with narrow forest railway, highline cables and slides. Forest truck roads were not constructed in the basin. There is only adapted route of former forest railway, which is used by residents of the village near the route, but it is necessary for truck traffic. That is a part of the route that should be reconstructed within this project.

5.0. SIGNIFICANCE OF THE PROJECT EFFECTS FOR THE ENVIRONMENT

Planned road in the basin of Mala Inova has a great significance for forest management in the area. Beside positive effects in ecological and economic sense, if full attention is not payed during construction and utilization of the road, as well as during the exploitation of forests in the area, there could be negative consequences especially ecological ones.

Effects of the road will depend on skill, quality and responsibility during construction in the area. If works are carried out successfully and qualitatively positive effects of the construction will be more significant, while negative one, if not avoided, than reduced to a minimum.
5.1. Positive effects

Elaboration of this study is already a positive effect, because the goal of the Study is to warn the contractors on great economic and ecological damages that can occur if construction works, utilization of the road, exploitation works, cultivation and protection works, are not carried out properly.

The Study would have more significant effect if it were elaborated before main project and if some proposed measures could be put into the project.

The most important effect of the road construction is reflected through the fact that the basin will open and enable carrying out of exploitation works, silvicultural and protection works in the area. Considering the conditions of forests in which they are now, emergency interventions are requested in order to stop further degradation and to improve the conditions. All works that are foreseen in the reconstruction program for forests in management unit “Mala Usora” sections 51 to 58, 61 to 65, 75, 76, 78 to 82, can be carried out more efficiently and cheaper.

Effect of the road is reflected through the possibility of emergency intervention in case of fires, tree diseases and other damages.

Small villages, which are gravitating on this road, would get better and more qualitative access to their homes and property, as well as connection with Teslić. There is a possibility of employment of local residents on construction and maintenance of roads, silvicultural works, protection and exploitation of forests, and utilization of secondary forest products and other. Also there is a possibility of utilization of this exciting landscape for recreation.

By opening of broader area, pressure on the forests that are already open will be decreased. That opens the possibility for equal management of forests and other resources.

5.2. Negative effects

Major undesirable consequences are expected on soil and hydrological conditions in the area, especially during the road construction and exploitation of forests. Since the route mostly goes over the former forest railway, earthworks are reduced to lowest extent as well as damages on soil and brook Mala Inova and its tributaries.

During construction there can be some covering of brooks and sedimentation of small particles and creation of mud, so water habitat can be endangered. Also, culvert with insufficient diameter on water crossings can hold the material and in that way endanger not only water currents but also the road, because during heavy rainfalls severe damages can be done to the road.

By constructing the road there is a possibility of slides and erosion appearance, especially on steep terrain, cuts, side cuts and embankments. Former water currents are crossed and new ones are formed. Water can be polluted with oil spilling form machines on the site, as well as by throwing the different garbage on the site and next to the route.

On smaller surface on the road, vegetation communities can change because the intensity of light is increased with road construction and with that expansion of heliofits, as well as some outer species. The road significantly endangers the game, because of noise created by vehicles. Machines for constructions and mining also create noise. There are also many cases of game being hit with vehicles on roads with intensive traffic.

Increased noise is expected during construction of the road and exploitation of forests. There is not going to be any direct significant air pollution except exhaust gases in the construction phase and utilization of the road, because of mining and dust on the road. Road will enable more intensive movement of people and vehicles, and that means increased danger for fires, illegal hunting, illegal felling, illegal utilization of medicinal herbs, mushrooms, forest fruits, snails and others.

There are no recreative, health or sports objects, cultural and historical heritage in the area, so in that sense road construction will not have any major impacts.
6.0. ENVIRONMENT PROTECTION MEASURES (ACTIVITIES)

Taking into consideration all above-mentioned impacts of construction of forest truck road Mala Inova on the environment, it is necessary to undertake certain protection measures in order to, if not avoid, then reduce to acceptable the negative consequences. Protection measures should include not only road construction but everything that precedes it and comes after it (utilization of the road).

Taking the previous remarks into consideration, as well as acquired data, protection measures can be systematized in several groups:

- Protection measures in preparatory phase of construction
- Protection measures during road construction
- Protection measures during utilization of the road

6.1. Protection measures in preparatory phase of construction

In order to achieve better effects on protection of the environment during road construction, more exactly opening of forest complexes, it is necessary that from the beginning and selection of the most appropriate variant of the road, the most appropriate variant is determined during construction, from the aspect of negative and positive effects on the environment. After that the best variant would be selected, which would have lowest negative impacts on the environment. The following should be undertaken:

- All proposed measures have to be built in the project
- Since this is the project elaborated before the war it is necessary to renovate the route
- Property relations need to be solved, on the part passing through the inhabited settlement and private property
- Before construction of bridges starts, alternative accesses to settlements should be found
- After property relations are solved, fences and objects on the route should be removed

6.2. Protection measures during road construction

During construction it is necessary to:

- Remove all stumps, trees, humus in order to avoid their covering on the road or in the brook, and to use humus for covering the slopes
- During excavation of soil from side cuts and cuts, use the part of material for embankments and slopes, and surplus should be deposited on certain places and protect it from moving in the brook during heavy rainfalls
- All operations with petroleum and oil exchange, during construction, should be done on places specified for that with maximum protection measures
- Oil and petroleum packages need to be collected and taken to controlled deposits. That applies for old tires and broken parts of the machines and other waste on the site
- During mining, take care of reducing the damage on trees and soil to minimum
- Machines should be parked on particular places determined for that, with maximum protection measures against pollution of soil with oil, petroleum and products
- Since borrows for material were not defined in the project, the investor needs, before the works start, to determine the places and way of arrangement after the works are completed
- During embankment construction, bearing capacity of the ground should be predefined. Material which is built in the embankment need to have appropriate geo-mechanical quality. Compaction should be done in 20 to 30 cm layers, and crossfall for subgrade must be foreseen, so the water does not retain
- On some places, within the project, only cross-sections with 30 cm diameter are foreseen, which would cause fast blockage and severe damages, which means that during heavy rainfalls part of the road could be destroyed. On the part of the road that is passing through the forest, culverts should have diameter 50 cm
- If it is estimated during construction, that additional culvert should be built in the investor would give order through the supervisor to do so.
6.3. Protection measures during utilization of the road

Considering the consequences on the environment and damages that can appear during the utilization of the road, it is necessary to:

- To equip the constructed road with vertical and horizontal signs, which should include all kind of necessary information and prohibitory signs
- Regarding protection of game it is necessary to set the appropriate warning signs for caution
- It is necessary to place signs which forbid setting of fires, with additional information
- On noticeable places, information boards which forbid depositing of garbage, should be placed
- Carry out regular maintenance, especially of culverts and drainage ditches, in order to prevent blockage and damages to road, soil and water currents
- In case of rockslide in cuts, side cuts and embankments, it is necessary to intervene promptly in order to decrease the possibility of severe
- SFE should introduce monitoring of all kind of damages on the road, and ecological and economic consequences caused by construction

Since the soil is disposed to erosion, it is necessary to plan and build skidding tracks and roads in order to avoid damages to soil, road and water currents, by which damages can be reduced to lowest extent.

7.0. CONCLUSION

Openness of FEA “Tesličko” with roads is very low and for high forests is 7.8 km / 1000 ha. Structures of forests and wood reserves (total reserves for entire area in average is 209 m³/ha, which is far below normal) are also negative. According to data Begović, B. (1986), hundred years ago only in the area of Male and Velike Usore, and brook Lukavac there were about 23 000 ha of virgin forests. Exaggerated exploitation of forests especially in the first half of IX century brought to degradation of forest ecosystems in broader area of Teslič. In the basin of Mala Inova, where the the construction of road is proposed in length of 5.3 km, conditions are worse than in the entire area in average, since the average reserve is 161 m³/ha.

Main goal of the construction of road Mala Inova is enabling the re-construction of degraded forests. With that purpose program for forest reconstruction in management unit Mala Usora is elaborated for sections 51 to 58, 61 to 61 to 65, 75,76, 78 to 82 i 86 to 88.

It means that the construction of this road has great ecological significance, since the main goal is to stop further degradation of forests in the area and gradual improvement of conditions. However, the construction itself can have negative ecological consequences.

Those are minor negative consequences in regard to benefits (advantages) that are gained with road construction, in ecological and economic sense. Those consequences can be significantly decreased with application of mentioned measures. Negative impacts are expected in small scope on water currents, soil and biodiversity.
8.0. Literature

1. Begović, B. (1986): Exploitation of forests and development of wood processing in industry in the area of Usorsko – Teslić region during the Austrian administration in BiH. Sarajevo
3. Ecological – vegetational classification of Bosnia and Herzegovine. Forestry faculty, Sarajevo
12. Road project „Mala Inova”. Planning agency 1986
13. Program for forest reconstruction in management unit „Mala Usora” for sections 51 – 58, 61- 65, 75, 76, 78 – 82, 86 – 88. Planning agency Banja Luka