# The contribution of forest roads to the forest fire protection

MSc  Thomas A. Psilovikos
Aristoteles Kosmas G. Doukas
Institute of Forest Engineering Sciences and Surveying
Faculty of Forestry and Natural Environment
Aristotle University of Thessaloniki
Greece
tvikos@for.auth.gr, adoucas@for.auth.gr

# INTRODUCTION

- Handling of forest fires combines both prevention and suppression. The first level of prevention is the most important, effective and less costly.
- The challenge of fire protection is the immediate detection of fire as well as the early first intervention for suppression, not later than 15 minutes from the onset of fire.
- It is found that the overall average first intervention time for fire suppression in Greece is about 33.4 minutes.
- The reduction of time needed for first intervention to less than 15-20 minutes, will result in a significant reduction of burned areas to about 70%.
- In suburban forests more than 50% of forest fire ignitions are due to intention.
- the objective of the initial response within 15-minute can only be achieved with well-distributed forest road network but not necessarily a high density one.

# Objectives of the paper

- In this work the contribution of forest roads in fire suppression is examined via the selection of two main forest roads of Thessaloniki's suburban forest.

- The research includes the capability of improving the efficiency of fire suppression involving two aspects of fire protection, the area under protection and the time of early fire suppression.

- it is examined whether the two selected main forest roads are compatible with the environment.

# Study area
# MATERIALS AND METHODS

- The suburban forest of Thessaloniki occupies a total area of 3000 ha located on the northeast side of Thessaloniki as a natural boundary of the city (Map 1).
- The failure of early fire suppression by ground (means during the summer of 1997 resulted in a disaster, with an estimated percentage of 64% of the total forest area burned.
- According to law (Presidential Decree 575, Gazette 157/9-7-1980) it has been declared as a high risk to fire zone and is by nature a suburban forest.
- Geometric characteristics of forest roads should be minimum to protect the environment but ensuring that fire extinguish vehicles will be able to move with safety and efficiency.
- A number of improvement road technical projects were conducted recently to protect forest roads from erosion and improve access.
- The research area covers the eastern part of the suburban forest of Thessaloniki, with an estimated area of 1199,5 ha, representing 40% of the total, as shown in map 2.

**Map 1: Orientation and limits of suburban forest of Thessaloniki.**

- Two main forest roads were selected with long routes throughout the research area.

A. Forest Road A1T1: Length 10.200 m. The width after the improvement projects ranging between 6.0 to 7.5 m. Slope between 3-12%.

B. Forest Road A2T2: length 12.690 m. The width after the improvement projects ranging between 5.0 and 6.0 m. Slope between 3-10%.

**In a suburban forest protected by environmental law the excessive width is not acceptable.**

- The method of calculating the road width is taking into account the width of a large fire extinguishing vehicle.

- The maximum truck width is 2.5 m plus 0.50 m clearance in both sides results in a total width of 3.50 meters.

- The adoption of a maximum width of 3.50 m is the best compromise on the condition that widening will be applied not only along turns but also at the straight parts of the roads (figure 1) at a spacing of 250m along their route as well as reversing positions every 500m.
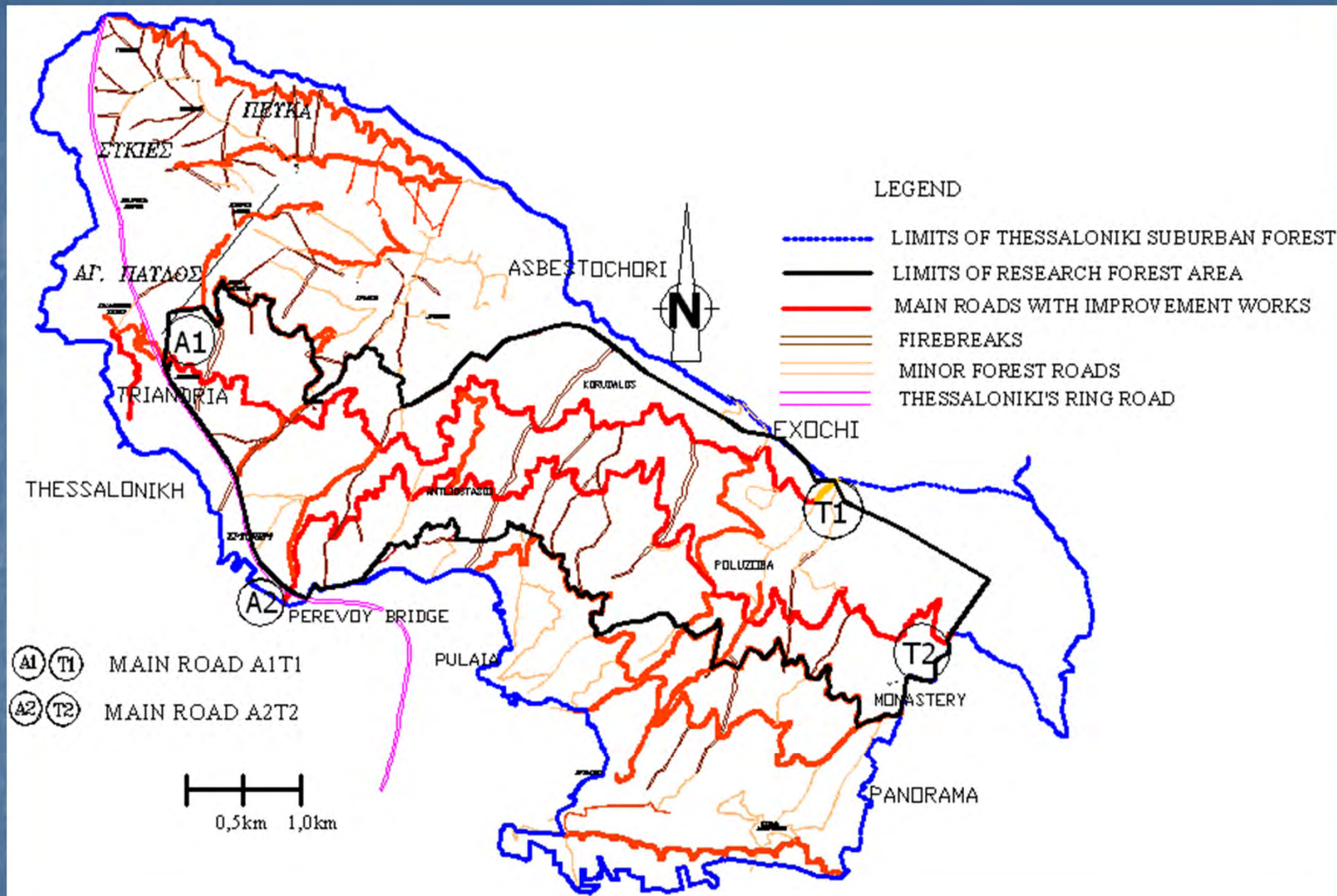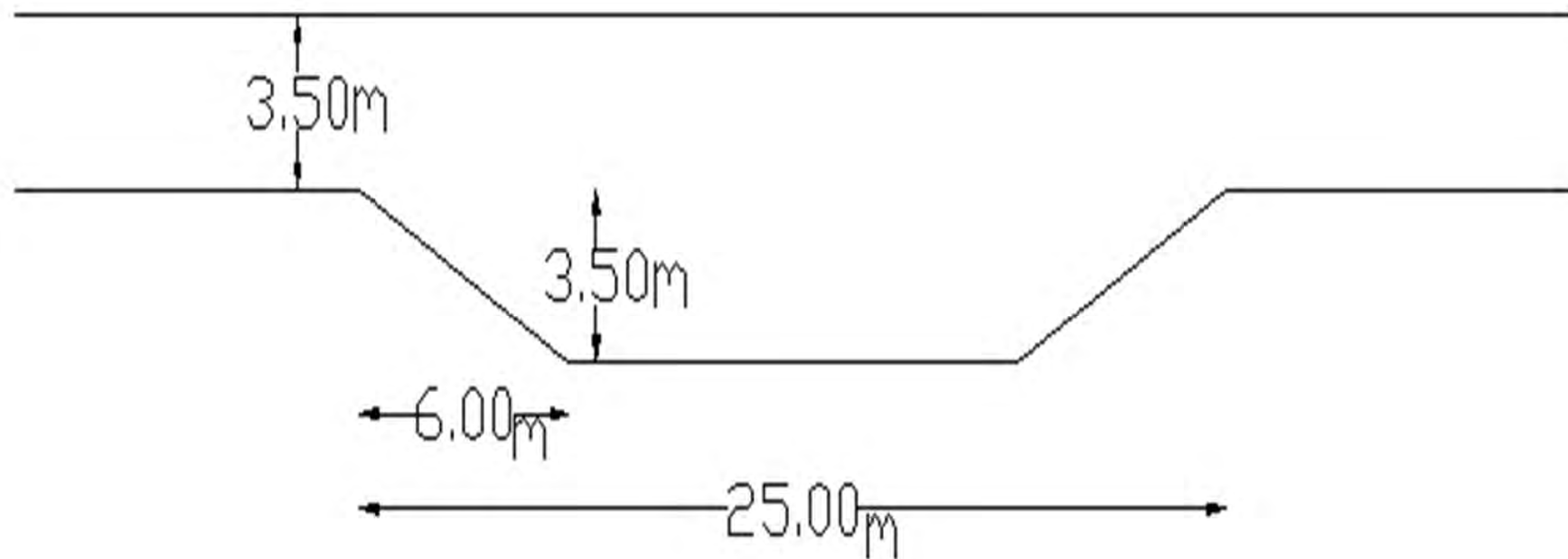
**Map 2: Limits of research area of suburban forest of Thessaloniki.**

In a suburban forest protected by environmental law the excessive width is not acceptable.

Figure 1: Proposed Widening along a straight part of a main road to accomodate two-way passing of fire trucks

3,50m

3,50m

6,00m

25,00m

# Percentage of forest protection area

- Capacity of fire trucks to pump water at a range of 500m.

- "practical protection zone" corresponds to a fire suppression bandwidth (buffer zone) with a capacity radius of 150m uphill and 300m downhill even on a steep terrain.

- "theoretical protection zone" corresponds to a fire suppression capacity of 300m uphill and 500m downhill, not on steep terrain.

- By adopting the practical protection zone the research area is covered by 95.2% (Map 3).

- By adopting the theoretical protection zone, the total research area is covered (Map 4).
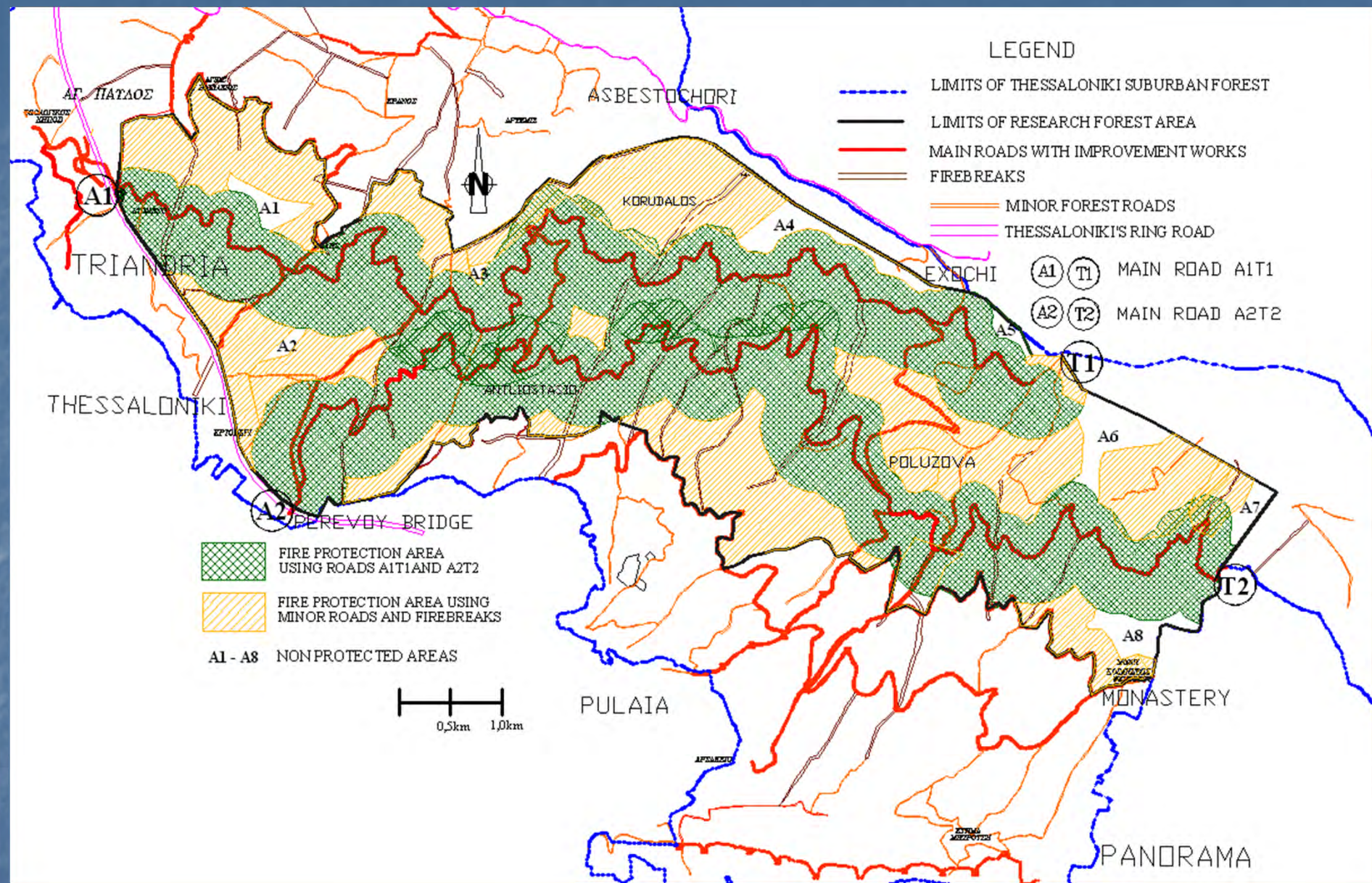
**Map 3: Area of fire protection using a range of 150-300m from forest roads within the research area.**
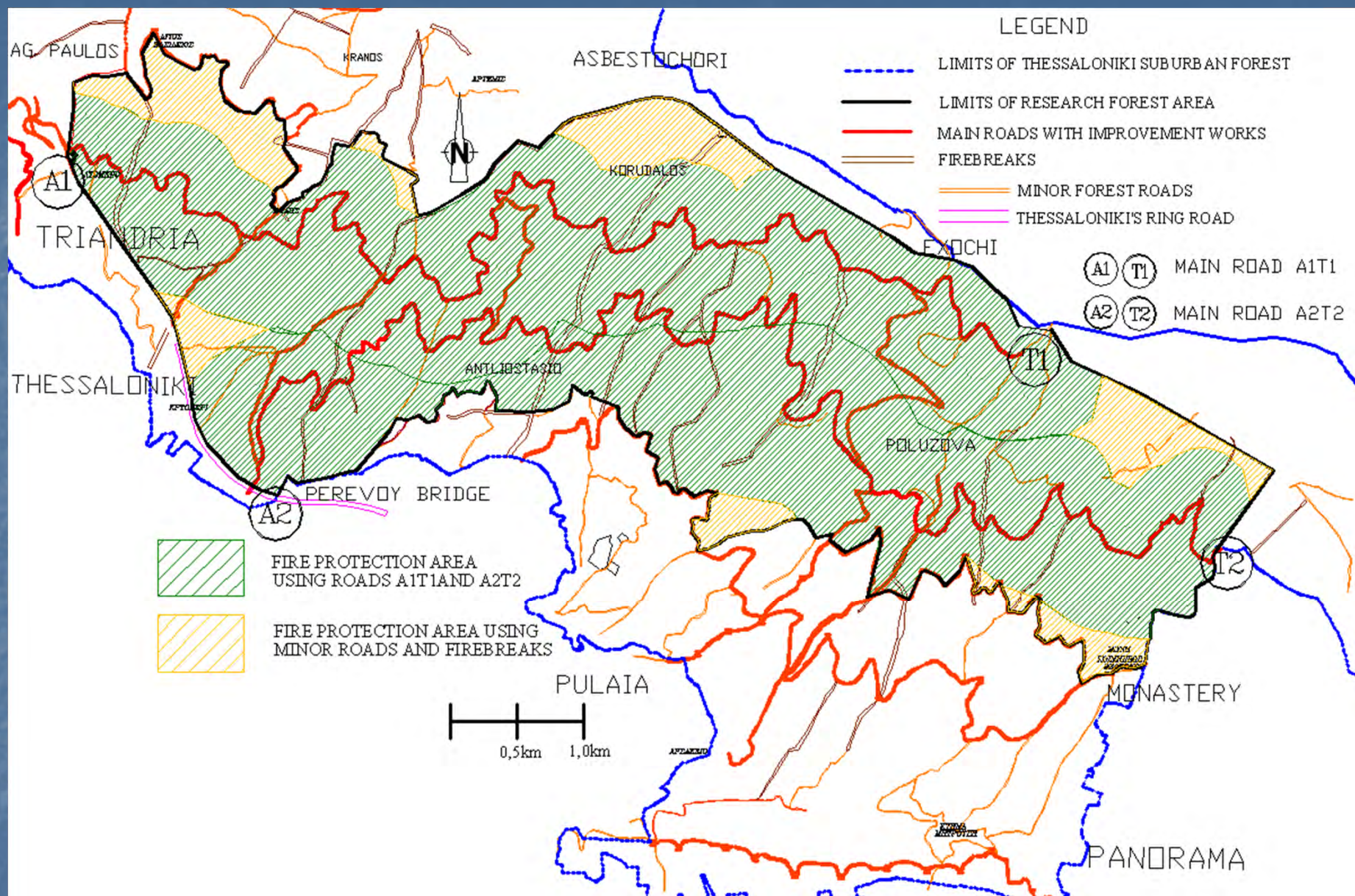
**Map 4: Area of fire protection using a hose range of 300-500m from forest roads within the research area.**

# RESULTS

# Action of the fire trucks on forest roads within a 15 minutes time interval

- Time taken from existing fire extinguish vehicles standby positions to reach any position along the routes of the selected main roads A1T1 and A2T2 with operation speed of 30km/h.

- Road A1T1: The fire extinguishing vehicles are able to reach any point along the route within 15min. The first 7500m are covered by the standby position at the starting point A1 and the last 2.700m of the route are serviced via the standby position on Polyzova hill near road A2T2.

- Road A2T2: The standby position of fire extinguish vehicles is at the starting point A2 during the hot season only. From this location vehicles reach the first 7.500m of the road route within 15min. The rest 5.190m of road are reached by the standby position on Polyzova hill.

- Disadvantage: the lack of an independency for road A1T1 from Polyzova hill. This results in an operational failure in case of simultaneous fire evolutions in both roads.

# Proposals of measures to be taken

- introduction of a new standby location along the route of A1T1 at a mileage of 6300m away from the starting point A1 near an accessible firebreak connecting the two roads A1T1 and A2T2 (Map 5).

- there is no need for any additional measures on forest road A2T2 but the standby location at A2 needs to be permanent throughout the year.

- the theoretical replacement of the two existing main forest roads with one main road, coded as A0T0 having the same direction from south to north-east. This enhances the effort to optimize the relationship between the conflicting interests of environmental protection and fire suppression operations. The standby locations for fire brigade services are shown in map 6.

- The total length of A0T0 road within the study area is 8742m, far less than the two existing roads A1T1 and A2T2.
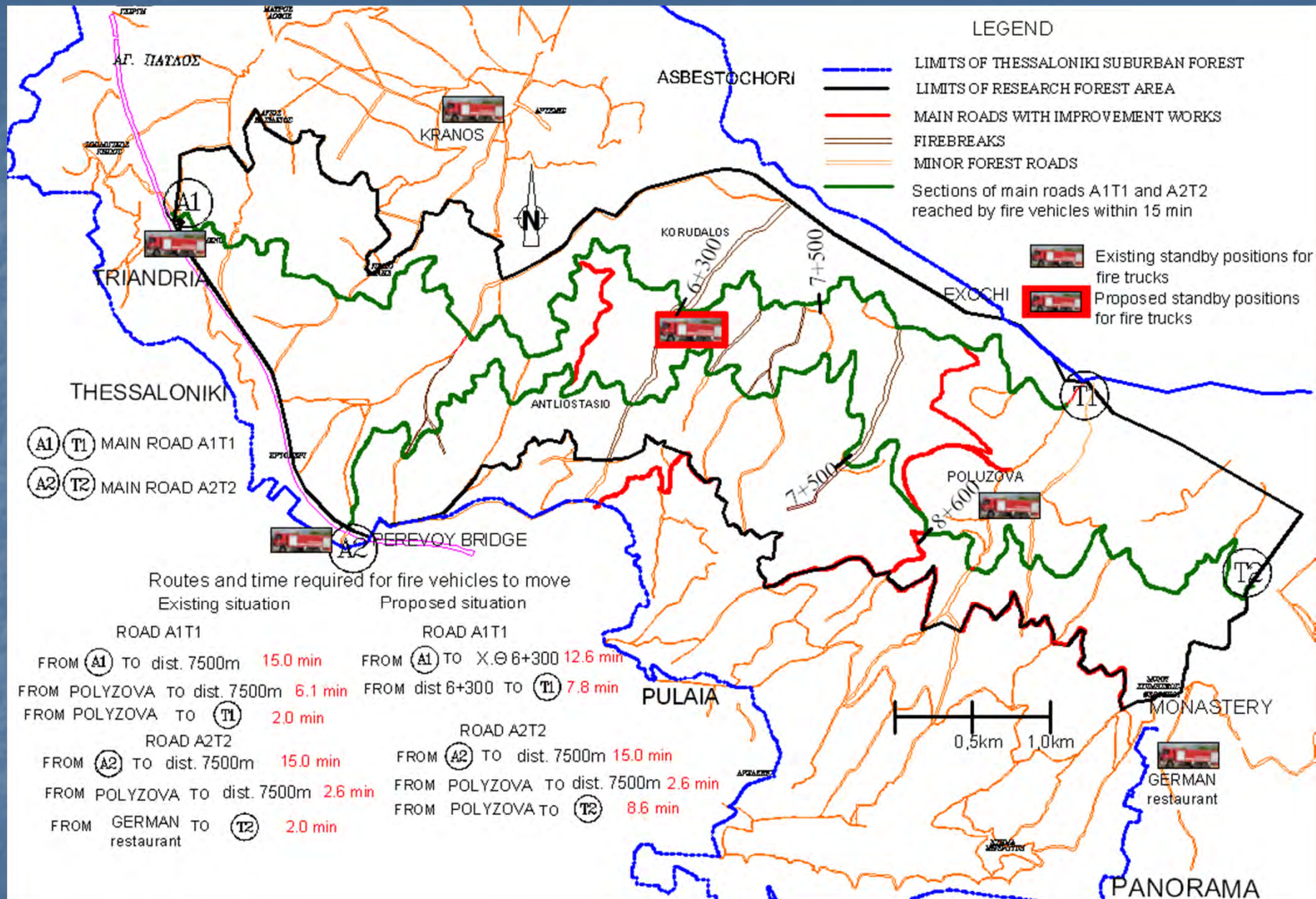
**Map 5: Routes and time needed for the extinguish vehicles to reach a fire source for the existing situation and the proposed solution**
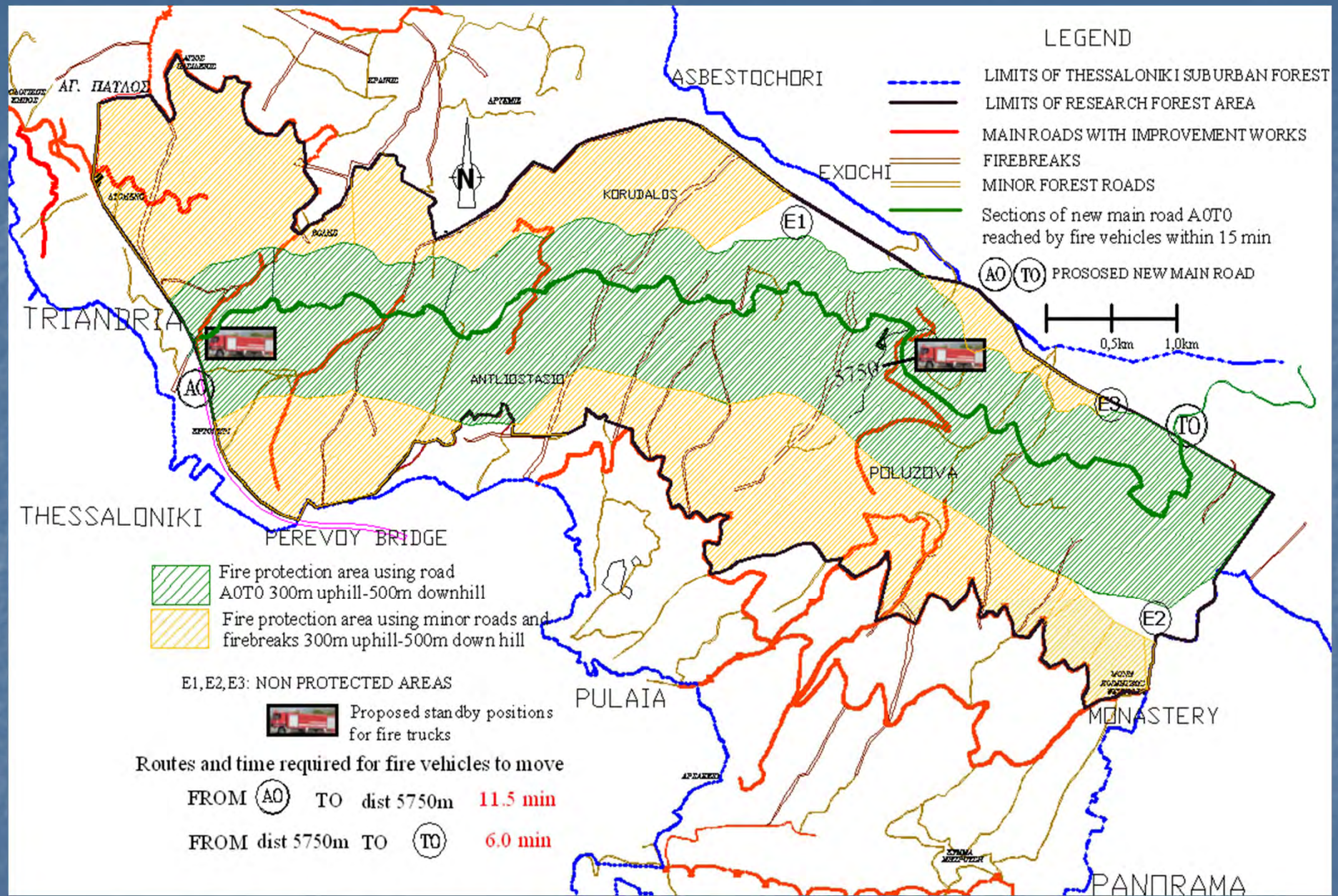
**Map 6: Area of fire protection and time needed for fire extinguish vehicles to reach a fire source using the proposed road A0T0.**

# CONCLUSIONS

- Thessaloniki's suburban forest is under environmental protection but at the same time is characterized as a high risk to fires. Thus the width of 3.5 m corresponding to main roads is adequate for fire suppression, provided the existence of special widening every 250 m and of reversing positions every 500 m, avoiding the excessive environmental damage.

- The fire protection area under the practical protection zone is 95.2% and under the theoretical protection zone is 100%The "practical protection zone" should be applied to a very steep terrain or in case of smaller fire extinguishing vehicles The proposed forest Road A0T0 as shown on Map 5 replacing the existing main roads A1T1 and A2T2 offers an fire protection coverage of  97.1%.

- the proposed replacement of the two main roads A1T1 and A2T2 with a new main road A0T0 with similar route as shown in map No 6 is justified. The benefits are less construction and maintenance costs but mainly an optimum solution between the conflicting interests of environmental protection and fire operational management.

- the existing fire service management provides full coverage on the two main roads A1T1 and A2T2 within 15 minutes from the detection of a fire source but not in the case of simultaneous fire incidents on both roads. The suggestion for an additional standby position, located at a distance of 6300 m from the origin point A1, resolves the problem of independency. In a theoretical basis the proposed main forest road A0T0 complies with the criterion of fast suppression within 15 minutes for first intervention at any point along its route as shown on Map No 5.

THANK YOU FOR THE ATTENTION