

## Content

<b>Content .....</b>	<b>v</b>
<b>Tables.....</b>	<b>ix</b>
<b>Figures .....</b>	<b>xi</b>
<b>1. Introduction.....</b>	<b>17</b>
1.1 Nutrient emissions to surface waters .....	17
1.2 State of the Art in modelling nutrient emissions into surface waters .....	19
1.3 Project goals.....	22
1.4 Procedure .....	24
1.5 Areas of investigation .....	29
1.5.1 Kocaeli province.....	30
1.5.2 The Porsuk basin.....	31
1.5.3 The Tahtali basin .....	32
<b>2. The GROWA Model.....</b>	<b>35</b>
2.1 Calculation of actual evapotranspiration and total runoff.....	35
2.1.1 Plane unsealed sites with deep water tables .....	35
2.1.2 High relief terrains .....	37
2.1.3 Groundwater-affected sites .....	38
2.1.4 Urban regions.....	41
2.2 Deriving the groundwater recharge.....	42
2.2.1 Determining BFI - values from measured runoff data.....	42
2.2.2 Identification of runoff-effective site conditions .....	44
2.2.3 Attribution of area-differentiated BFI values .....	46
<b>3. Data preparation and regionalization for GROWA.....</b>	<b>49</b>
3.1 Climatic data bases.....	50
3.1.1 Porsuk basin.....	50
3.1.2 Kocaeli region.....	57
3.1.3 Tahtali basin.....	62
3.2 Landcover data .....	64
3.2.1 Porsuk basin.....	64
3.2.2 Kocaeli region.....	69
3.2.3 Tahtali basin.....	71

3.3 Hydrogeological data .....	72
3.3.1 Porsuk basin.....	72
3.3.2 Kocaeli region.....	76
3.3.3 Tahtali basin.....	79
3.4 Soil Data.....	80
3.4.1 Porsuk basin.....	80
3.4.2 Kocaeli region.....	85
3.4.3 Tahtali basin.....	89
3.5 Relief data .....	90
3.5.1 Porsuk basin.....	90
3.5.2 Kocaeli region.....	92
3.5.3 Tahtali basin.....	94
3.6 Discharge data.....	95
3.6.1 Porsuk basin.....	95
3.6.2 Kocaeli region.....	96
3.6.3 Tahtali basin.....	97
<b>4. GROWA results.....</b>	<b>99</b>
4.1 Actual evapotranspiration .....	99
4.1.1 Porsuk basin.....	99
4.1.2 Kocaeli region.....	101
4.1.3 Tahtali basin.....	102
4.2 Total runoff .....	103
4.2.1 Porsuk basin.....	103
4.2.2 Kocaeli region.....	104
4.2.3 Tahtali basin.....	106
4.3 Groundwater recharge.....	107
4.3.1 Porsuk basin.....	107
4.3.2 Kocaeli region.....	108
4.3.3 Tahtali basin.....	110
4.4 Direct runoff.....	111
4.4.1 Porsuk basin.....	111
4.4.2 Kocaeli region.....	112
4.5 Predominating runoff component .....	114
4.5.1 Porsuk basin.....	114
4.5.2 Kocaeli region.....	115
4.5.3 Tahtali basin.....	116
<b>5. GROWA Validation .....</b>	<b>117</b>
5.1 Porsuk basin .....	118

5.2 Kocaeli region .....	119
<b>6. The RAUMIS model .....</b>	<b>121</b>
6.1 Basic characterisation, purpose, product coverage, temporal and spatial resolution.....	121
6.2 Methodology .....	122
6.3 Nutrient balancing.....	124
<b>7. RAUMIS results for Porsuk basin .....</b>	<b>127</b>
<b>8. Modelling nitrate concentration in leachate for Porsuk basin .....</b>	<b>129</b>
8.1 Modelling of denitrification in soils based on DENUZ model .....	129
8.2 Modelling of nitrate concentrations in the percolation water .....	132
<b>9. Determination of point sources.....</b>	<b>135</b>
9.1 Introduction.....	135
9.2 Point discharges .....	135
9.3 Streams Reaching Izmit Bay .....	138
9.4 The treatment plants around the Izmit Bay .....	139
<b>10. Nutrient model for Receiving Waters .....</b>	<b>143</b>
10.1 Mathematical Equations For The Layered Water Bodies.....	145
10.2 Data Preparation for Modelling .....	148
10.2.1 Data Collection in Izmit Bay.....	148
10.2.2 The results from Izmit Bay.....	153
10.2.3 Model results .....	158
<b>11. The Hydrodynamic and Ecological Modelling of the Izmit Bay .....</b>	<b>165</b>
11.1 The Hydrodynamic Modelling of Izmit Bay.....	165
11.2 The results of the hydrodynamic model.....	168
11.3 The Ecological Model of Izmit Bay.....	172
11.4 The results of the ecological model .....	175
<b>12. Summary.....</b>	<b>177</b>
<b>13. References.....</b>	<b>181</b>