# Water Risk Filter

## Water Indicators

| Indicator | Value | Description | Source |
|---|---|---|---|
| Overall Basin Risk (score) | 2.69 | Overall Basin Risk (score) | |
| Overall Basin Risk (rank) | 88 | Overall Basin Risk (rank) | |
| Physical risk (score) | 3.21 | Physical risk (score) | |
| Physical risk (rank) | 27 | Physical risk (rank) | |
| Regulatory risk (score) | 1.43 | Regulatory risk (score) | |
| Regulatory risk (rank) | 173 | Regulatory risk (rank) | |
| Reputation risk (score) | 2.38 | Reputation risk (score) | |
| Reputation risk (rank) | 145 | Reputation risk (rank) | |
| 1. Quantity - Scarcity (score) | 2.96 | 1. Quantity - Scarcity (score) | |
| 1. Quantity - Scarcity (rank) | 45 | 1. Quantity - Scarcity (rank) | |
| 2. Quantity - Flooding (score) | 3.51 | 2. Quantity - Flooding (score) | |
| 2. Quantity - Flooding (rank) | 74 | 2. Quantity - Flooding (rank) | |
| 3. Quality (score) | 3.82 | 3. Quality (score) | |
| 3. Quality (rank) | 33 | 3. Quality (rank) | |
| 4. Ecosystem Service Status (score) | 2.91 | 4. Ecosystem Service Status (score) | |
| 4. Ecosystem Service Status (rank) | 59 | 4. Ecosystem Service Status (rank) | |
| 5. Enabling Environment (Policy & Laws) (score) | 1.00 | 5. Enabling Environment (Policy & Laws) (score) | |
| 5. Enabling Environment (Policy & Laws) (rank) | 179 | 5. Enabling Environment (Policy & Laws) (rank) | |
| 6. Institutions and Governance (score) | 2.00 | 6. Institutions and Governance (score) | |
| 6. Institutions and Governance (rank) | 161 | 6. Institutions and Governance (rank) | |
| 7. Management Instruments (score) | 1.41 | 7. Management Instruments (score) | |
| 7. Management Instruments (rank) | 176 | 7. Management Instruments (rank) | |
| 8 - Infrastructure & Finance (score) | 1.20 | 8 - Infrastructure & Finance (score) | |
| 8 - Infrastructure & Finance (rank) | 145 | 8 - Infrastructure & Finance (rank) | |
| 9. Cultural Diversity (score) | 1.00 | 9. Cultural importance (score) | |
| 9. Cultural Diversity (rank) | 159 | 9. Cultural importance (rank) | |
| 10. Biodiversity Importance (score) | 3.46 | 10. Biodiversity importance (score) | |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| 10. Biodiversity Importance (rank) | 101 | 10. Biodiversity importance (rank) | |
| 11. Media Scrutiny (score) | 2.55 | 11. Media Scrutiny (score) | |
| 11. Media Scrutiny (rank) | 114 | 11. Media Scrutiny (rank) | |
| 12. Conflict (score) | 2.49 | 12. Conflict (score) | |
| 12. Conflict (rank) | 103 | 12. Conflict (rank) | |
| 1.0 - Aridity (score) | 1.81 | The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment. | Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information. |
| 1.0 - Aridity (rank) | 70 | The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment. | Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information. |
| 1.1 - Water Depletion (score) | 3.57 | The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability. | Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. Elem Sci Anth, 4. |
| 1.1 - Water Depletion (rank) | 15 | The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability. | Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. Elem Sci Anth, 4. |
| 1.2 - Baseline Water Stress (score) | 4.09 | World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users. | Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). Aqueduct 3.0: Updated decision relevant global water risk indicators. Technical note. Washington, DC: World Resources Institute. |

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| Indicator | Value | Description | Source |
|---|---|---|---|
| 1.2 - Baseline Water Stress (rank) | 14 | World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users. | Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). Aqueduct 3.0: Updated decision relevant global water risk indicators. Technical note. Washington, DC: World Resources Institute. |
| 1.3 - Blue Water Scarcity (score) | 2.65 | The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005. | Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323. |
| 1.3 - Blue Water Scarcity (rank) | 93 | The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005. | Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323. |
| 1.4 - Projected Change in Water Discharge (by ~2050) (score) | 3.00 | This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050. | Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences, 111(9), 3245-3250. |
| 1.4 - Projected Change in Water Discharge (by ~2050) (rank) | 21 | This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050. | Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences, 111(9), 3245-3250. |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| 1.5 - Drought Frequency Probability (score) | 1.70 | This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration. | Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718. |
| 1.5 - Drought Frequency Probability (rank) | 167 | This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration. | Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718. |
| 1.6 - Projected Change in Drought Occurrence (by ~2050) (score) | 4.60 | This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios. | Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development. |
| 1.6 - Projected Change in Drought Occurrence (by ~2050) (rank) | 8 | This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios. | Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development. |
| 2.1 - Estimated Flood Occurrence (score) | 3.64 | This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source. | Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado. |
| 2.1 - Estimated Flood Occurrence (rank) | 70 | This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source. | Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado. |

| Indicator | Value | Description | Source |
|---|---|---|---|
| 2.2 - Projected Change in Flood Occurrence (by ~2050) (score) | 1.05 | This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios. | Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development. |
| 2.2 - Projected Change in Flood Occurrence (by ~2050) (rank) | 185 | This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios. | Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development. |
| 3.1 - Surface Water Contamination Index (score) | 3.82 | The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury).<br><br>The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen ( 12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%). | Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555. |

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| Indicator | Value | Description | Source |
|---|---|---|---|
| 3.1 - Surface Water Contamination Index (rank) | 33 | The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury).<br><br>The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen ( 12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%). | Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555. |
| 4.1 - Fragmentation Status of Rivers (score) | 3.05 | This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree. | Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215. |
| 4.1 - Fragmentation Status of Rivers (rank) | 57 | This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree. | Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215. |
| 4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score) | 2.20 | For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control.<br>The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018. | Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853. |

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| Indicator | Value | Description | Source |
|---|---|---|---|
| 4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank) | 83 | For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control.<br>The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018. | Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853. |
| 4.3 - Projected Impacts on Freshwater Biodiversity (score) | 4.46 | The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity. | Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. Journal of Applied Ecology, 50(5), 1105-1115. |
| 4.3 - Projected Impacts on Freshwater Biodiversity (rank) | 18 | The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity. | Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. Journal of Applied Ecology, 50(5), 1105-1115. |
| 5.1 - Freshwater Policy Status (SDG 6.5.1) (score) | 1.00 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 5.1 - Freshwater Policy Status (SDG 6.5.1) (rank) | 170 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 5.2 - Freshwater Law Status (SDG 6.5.1) (score) | 1.00 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.<br><br>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| 5.2 - Freshwater Law Status (SDG 6.5.1) (rank) | 160 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.<br><br>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (score) | 1.00 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National IWRM plans" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.<br><br>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (rank) | 177 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National IWRM plans" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.<br><br>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 6.1 - Corruption Perceptions Index (score) | 3.00 | This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector. | Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International. |
| 6.1 - Corruption Perceptions Index (rank) | 121 | This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector. | Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International. |
| 6.2 - Freedom in the World Index (score) | 1.00 | This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018. | Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House. |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| 6.2 - Freedom in the World Index (rank) | 145 | This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018. | Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House. |
| 6.3 - Business Participation in Water Management (SDG 6.5.1) (score) | 1.00 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 6.3 - Business Participation in Water Management (SDG 6.5.1) (rank) | 160 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 7.1 - Management Instruments for Water Management (SDG 6.5.1) (score) | 1.00 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category.<br><br>For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 7.1 - Management Instruments for Water Management (SDG 6.5.1) (rank) | 168 | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category.<br><br>For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| 7.2 - Groundwater Monitoring Data Availability and Management (score) | 1.00 | This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability.  The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data. | UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC). |
| 7.2 - Groundwater Monitoring Data Availability and Management (rank) | 162 | This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability.  The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data. | UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC). |
| 7.3 - Density of Runoff Monitoring Stations (score) | 3.72 | The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018). | BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG). |
| 7.3 - Density of Runoff Monitoring Stations (rank) | 69 | The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018). | BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG). |
| 8.1 - Access to Safe Drinking Water (score) | 1.00 | This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017. | WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene. |
| 8.1 - Access to Safe Drinking Water (rank) | 129 | This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017. | WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene. |
| 8.2 - Access to Sanitation (score) | 1.00 | This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017. | WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene. |

| Indicator | Value | Description | Source |
|---|---|---|---|
| 8.2 - Access to Sanitation (rank) | 148 | This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017. | WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene. |
| 8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (score) | 3.00 | This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (rank) | 101 | This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources. | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 9.1 - Cultural Diversity (score) | 1.00 | Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity. | Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International. |
| 9.1 - Cultural Diversity (rank) | 159 | Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity. | Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International. |
| 10.1 - Freshwater Endemism (score) | 4.41 | The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks. | WWF & TNC (2015). Freshwater Ecoregions of the World. |

## Country Overview - Greece

| Indicator | Value | Description | Source |
|---|---|---|---|
| 10.1 - Freshwater Endemism (rank) | 56 | The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks. | WWF & TNC (2015). Freshwater Ecoregions of the World. |
| 10.2 - Freshwater Biodiversity Richness (score) | 2.52 | The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks. | WWF & TNC (2015). Freshwater Ecoregions of the World. |
| 10.2 - Freshwater Biodiversity Richness (rank) | 133 | The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks. | WWF & TNC (2015). Freshwater Ecoregions of the World. |
| 11.1 - National Media Coverage (score) | 3.00 | This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group).  It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter). | WWF & Tecnoma (TYPSA Group) |
| 11.1 - National Media Coverage (rank) | 112 | This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group).  It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter). | WWF & Tecnoma (TYPSA Group) |
| 11.2 - Global Media Coverage (score) | 2.00 | This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group).  It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account. | WWF & Tecnoma (TYPSA Group) |
| 11.2 - Global Media Coverage (rank) | 110 | This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group).  It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account. | WWF & Tecnoma (TYPSA Group) |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| 12.1 - Conflict News Events (RepRisk) (score) | 3.00 | This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class. | RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk. |
| 12.1 - Conflict News Events (RepRisk) (rank) | 82 | This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class. | RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk. |
| 12.2 - Hydro-political Risk (score) | 1.98 | This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues. | Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. Global environmental change, 52, 286-313. |
| 12.2 - Hydro-political Risk (rank) | 136 | This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues. | Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. Global environmental change, 52, 286-313. |
| Population, total (#) | 10746740 | Population, total | The World Bank 2018, Data , hompage accessed 20/04/2018 |
| GDP (current US$) | 192690813127 | GDP (current US$) | The World Bank 2018, Data , hompage accessed 20/04/2018 |
| EPI 2018 score (0-100) | 73.60 | Environmental Performance Index | |
| WGI -Voice and Accountability (0-100) | 41.90 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132 |

# Water Risk Filter

## Country Overview - Greece

| Indicator | Value | Description | Source |
|-----------|-------|-------------|--------|
| WGI -Political stability no violence (0-100) | 68.97 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132 |
| WGI - Government Effectiveness (0-100) | 62.50 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132 |
| WGI - Regulatory Quality (0-100) | 59.13 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132 |
| WGI - Rule of Law (0-100) | 59.13 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132 |
| WGI - Control of Corruption (0-100) | 56.73 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132 |

# Water Risk Filter

| Indicator | Value | Description | Source |
|-----------|-------|-------------|--------|
| WRI BWS all industries (0-5) | 3.27 | WRI Baseline Water Stress (BWS) | Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings. |
| WRI BWS Ranking (1=very high) | 56 | WRI Baseline Water Stress (BWS) | Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings. |
| Baseline Water Stress (BWS) - 2020 BAU (1=very high) | 29 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2020 Optimistic (increasing rank describes lower risk) | 31 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2020 Pessimistic (increasing rank describes lower risk) | 29 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk) | 27 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2030 Optimistic (increasing rank describes lower risk) | 30 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2030 Pessimistic (increasing rank describes lower risk) | 30 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2040 BAU (increasing rank describes lower risk) | 28 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2040 Optimistic (increasing rank describes lower risk) | 29 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |
| Baseline Water Stress (BWS) - 2040 Pessimistic (increasing rank describes lower risk) | 28 | WRI country ranking | Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings. |

| Indicator | Value | Description | Source |
|---|---|---|---|
| Total water footprint of national consumption (m3/a/cap) | 2338.09 | WFN Water Footprint Data | Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf |
| Ratio external / total water footprint (%) | 46.47 | WFN Water Footprint Data | Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf |
| Area equipped for full control irrigation: total (1000 ha) | 1517.00 | Aquastat - Irrigation | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Area equipped for irrigation: total (1000 ha) | 1517.00 | Aquastat - Irrigation | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| % of the area equipped for irrigation actually irrigated (%) | 76.80 | Aquastat - Irrigation | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Electricity production from hydroelectric sources (% of total) | 11.56 | World Development Indicators | The World Bank 2018, Data , hompage accessed 20/04/2018 |
| Total internal renewable water resources (IRWR) (10^9 m3/year) | 58.00 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Total internal renewable water resources (IRWR) (10^9 m3/year) | 10.40 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Water resources: total external renewable (10^9 m3/year) | 58.00 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |

# Water Risk Filter

| Indicator | Value | Description | Source |
|---|---|---|---|
| Total renewable water resources (10^9 m3/year) | 68.40 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Dependency ratio (%) | 15.20 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Total renewable water resources per capita (m3/inhab/year) | 6244.00 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| World happiness [0-8] | 5.36 | WorldHappinessReport.org | World Happiness Report, homepage accessed 20/04/2018 |

# Country Aspects

## 1. PHYSICAL ASPECTS

### 1.1. WATER RESOURCES

#### 1.1.1. WATER RESOURCES

Greece has a Mediterranean climate with mild and rainy winters, relatively warm and dry summers and many hours of sunshine almost all year. The coldest months are January and February, with mean minimum temperatures ranging between 5-10°C near the coasts and 0-5°C in mainland areas, and lower values (below freezing) in the northern part of the country. The warm season lasts from April until September. The warmest period is in July and August, with mean maximum temperatures in the range 29-35 C. Precipitation is concentrated in the cold period, with almost no precipitation in the warmest months. The amount of rainfall is approximately halved in the eastern part compared to the western part of the country [HNMS, 2009].

Greece has a long-term average annual precipitation of 652mm/year. The long-term average of annual renewable water resources is 74,250 million m³/year of which 78 per cent are considered internal water resources (57,915 million m³) and around 22 per cent are considered external water resources (16,335 million m³). As at 2009 the total dam (reservoir) capacity was 11,770 million m³.

Climate change is said to directly affect weather conditions. Since the end of the 1990s, the temperature in Greece has been increasing, especially during the summer. There is a trend of decreasing precipitation, mainly between 1980 and 2000, with a trend of increasing precipitation over the following years. Extreme weather conditions, including flooding, drought, heat-waves and storms, also occur [NCESD, 2009]. The impacts of climate change may be environmental, economic and social (e.g. biodiversity loss, increased insurance in flood-risk zones, changing holiday patterns).

However, in Greece, freshwater issues are related to quantity rather than quality. Greece has an uneven spatial mean annual and seasonal rainfall distribution, resulting in rather small catchment areas, small lakes and relatively small rivers, distributed throughout the country. In addition, the catchments in Greece are marked by high spatial differences in morphologic, climatic, hydrographical, petro-graphic and vegetative features. The hydro-geological conditions differ significantly with geographical latitude and longitude. The main aquifers have been formed either from depositions in layers of sand, gravel and shingle or from chalky rocks that become karst due to the flow of water through cracks that were shaped by tectonic movements. It should be emphasised that groundwater that flows in aquifers of the first category can be utilised more easily and therefore has already been exploited intensively. On the other hand, karst groundwater was not abstracted until 1968 and there is still the possibility of further utilisation. The over-abstraction/exploitation of groundwater resources has in many instances led to the decline of the water table as well as to the deterioration of water quality, primarily through saltwater intrusion in coastal areas.

There are 14 river basin districts in Greece. In the north there are the Thrace, the Eastern, Central and Western Macedonia, and the Epirus. In the central part of the country there are the Western and Eastern Sterea Ellada and the Attica. Finally, in the south there are the Northern, Eastern and Western Peloponnese, the Aegean islands and Crete. The majority of the River Basin Districts (RBD) - in which Greece is divided for an effective management of the water resources - use the largest percentages of their abstracted water for agriculture. In 2007, only in the Attica RBD did the water supply take the largest percentage of abstracted water, since the metropolitan area of Athens is the country's largest urban centre, representing almost half of the country's population.

### 1.1.2. WATER USE

Water withdrawal in the country by the year 2007 was estimated to be 9,471 million m³. Of this, 61 per cent (5,820 million of m³) was from surface water, and 39 per cent was from groundwater abstraction (3,650 million m³). A very small portion of the water resources (10 million m³) were produced by desalination processes.

This water abstraction can be itemized by user sector. By the year 2007, it was estimated that the water dedicated to agriculture reached 8,458 million m³. These resources were used in 128,000km² from the total area equipped for irrigation of 150,000km², which itself represents a significant percentage ( 47.9 per cent) of the area dedicated to cultivation. Water abstraction for urban purposes was estimated to be 846 million m³; and for industrial uses, 167 million m³.

The growing demand for drinking water supply and irrigation has resulted in an intense and frequently unreasonable exploitation of water resources. The metropolitan areas of Athens, Thessaloniki and Patra, which account for most of the population and economic activities, are geographically distant from important water resources. On the other hand, peak demands from agriculture, the greatest water consumer, occur mainly in the summer period. During the same period, drinking water consumption is significantly increased due to tourist activity, especially in the islands where there are no water bodies of significant size. Consequently, available water quantities are presently declining and large areas have or soon will become deficient in water. Water demands in many cases are met by transporting water over long distances, resulting in increased capital, operational and maintenance costs.

### 1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

Until the middle of the last century, surface freshwater in Greece mainly followed the slow rhythm of natural changes, with little or no influence from human activities. However from the 1960s, a number of water bodies situated either in the vicinity of urban areas or in regions with increased agricultural and industrial activity, showed signs of pollution. The phenomena associated with

pollution have gradually grown and have recently started to influence smaller and previously unaffected water bodies.

Urbanization has been a strong driver of land use change over the post-war period in Greece. Eight million people live in urban areas. Urbanization exacerbates some local environmental problems, such as air and noise pollution, traffic congestion and urban waste disposal. Inappropriate waste disposal and management practices may lead to the degradation of surface and ground waters, air pollution and forest fires. In addition, agricultural production has been intensified in productive areas and, in combination with bad land management, can be a threat for the soil. The implementation of the revised Common Agriculture Policy (CAP) by the year 2011 and the introduction of good agricultural practices, are expected to improve the soil condition in Greece (EEA, 2009).

The catchments in Greece are marked by high spatial differences in morphologic, climatic, hydrographic, petrographic and vegetative features and variability in pollution impact . As a result, river and stream habitat, hydrochemical regime and biocommunity structure, vary considerably along their courses. In addition, research on ecological quality assessment is limited and geographically restricted, and classification systems are absent. Hence, the assessment of the ecological quality of Greek rivers is a complex task and needs a special approach, since an optimal 'ecological quality assessment' can only be achieved through regional adaptations.

The nitrate concentrations in groundwater bodies generally reflect the relative importance and intensity of agricultural activities above them. Mean nitrate concentrations in groundwaters are above the background levels (10mg/l NO3), but well below the parametric value of 50mg/l NO3 [Drinking Water Directive]. Between 2000 and 2007, the annual average nitrate concentrations in Greek rivers decreased by approximately -43.5 per cent (from 2.67 to 1.51mg N/l), reflecting the effect of measures to reduce agricultural inputs of nitrate. Nitrate levels in lakes are generally much lower than in rivers and vary between 0.27mg N/l and 0.44 mgN/l over the period 2000 to 2007. The number of monitoring stations in lakes increased from 13 stations in 2000 to 26 stations in 2007. Phosphorus concentrations in Greek rivers and lakes have generally low levels over the period 2000 to 2007.

In Greece, existing policies are effective in reducing loading discharges of nutrients and organics. Much progress was made during the period 1980 to 2008 in equipping Greece with sewerage and wastewater treatment systems, thus satisfying the objectives of the EU Urban Waste Water Directive 91/271/EC (UWWD).

Water quality and safe sanitation are considered to be of a high priority and measures have been taken. There is a particular challenge in fully covering the water supply needs of the small islands and remote mountainous villages. In order to comply with the UWWD, by the end of 2008, 91 per cent of the population is expected to have wastewater treatment plants meeting the requirements of the directive, and 88 per cent of this population will be served by sewerage systems.

There are 290 treatment plants in Greece, with 242 municipal wastewater treatment plants falling under the UWWD, and smaller plants making up the remainder. The authorities responsible for the operation of most treatment plants are the Municipal Services for Water Supply, but in cases of the Psytalia (Athens) and Thessaloniki treatment plants, the responsible authorities are EYDAP and DEYATH respectively.

## 2. GOVERNANCE ASPECTS

### 2.1. WATER INSTITUTIONS

In Greece, there are two levels of government: the state; and local self-government. The Ministry for the Environment, Energy and Climate Change is responsible for the development and implementation of environmental policy at the national and regional level. Water is included within these competencies.

The 13 regions of Greece represent the second level of local self-government and are responsible for the administration of local matters at regional level. The responsibilities of the regions include planning and programming, economic development, social development, culture and quality of life. There are 325 municipalities which constitute the first level of local self-government and are responsible for the administration of local matters.

### 2.2. WATER MANAGEMENT

A National Strategy for Water Resources (NSWR) has been developed in Greece, aiming at the sustainable use of water resources, the efficient protection of water ecosystems and the attainment of high quality standards for all surface water and groundwater bodies by the year 2015.

The basic areas covered by the NSWR are:

•An integrated approach for water management: the development of management plans on a river basin level, including transboundary watercourses, based on water quality and quantity considerations, and the interaction between surface water and groundwater.

•Decentralisation of water management authorities: with the establishment of the Regional Water Directorates, a transposition of competencies on water resources management has been transferred to regional level.

•Upgrading and expansion of infrastructure, including the promotion of specific measures and actions for meeting the demand for water supply through the expansion of existing networks as well as through the decrease of losses; and the construction of new and the upgrading of existing wastewater treatment plants with emphasis on recycling.

•Incorporation of socio-economic considerations in water management. This includes measures to reinforce public participation in water management efforts as well as the adaptation of pricing policies to include 'the social cost' in water services provision.

In accordance with the principles stated by the EU Water Framework Directive 2000/60/EC (WFD), the National Water Strategy should be coordinated through the general planning process (the development of the River Basin Management Plan) that is currently being carried out for all 14 RBDs.

In addition, there are other developments related to water under the General Framework for

Spatial Planning and Sustainable Development in Greece, which was approved by the parliament in 2008. This was followed by the approval and issue of the following thematic frameworks at national level:

•The Special Framework for Renewable Sources of Energy, which aims at the creation of an effective mechanism for the spatial planning of installations of renewable sources of energy;

•The Special Framework for Industry, which aims at the transformation of the territorial structure of industry to the direction of sustainable development; and

•The Special Framework for Tourism, which formulates a realistic action plan for the next 15 years for the territorial structure, development and organization of tourism in Greece.

The national spatial planning is expected to contribute to territorial development, within the framework of sustainability, based on a synthetic and balanced review of the parameters that promote the protection and improvement of the natural and cultural environment and strengthen social and economic cohesion and competitiveness.

## 2.3. WATER POLICY AND LEGAL FRAMEWORK

The main Directives and related legislation at the European level, relating to water resources management are:

•Directive 80/68/EEC of 17 December, 1979 on the protection of groundwater against pollution caused by certain dangerous substances;

•Directive 82/176/EEC of 22 March, 1982 on limit values and quality objectives for mercury discharges by the chlor-alkali electrolysis industry; covers inland surface water, territorial waters and internal coastal waters;

•Directive 83/513/EEC of 26 September, 1983 on limit values and quality objectives for cadmium discharges; sets limit values and quality objectives for cadmium discharges in the aquatic environment;

•Directive 84/156/EEC of 8 March, 1984 on limit values and quality objectives for mercury discharges by sectors other than the chlor-alkali electrolysis industry; sets limit values and quality objectives for mercury discharges in sectors other than the chlor-alkali electrolysis industry;

•Directive 84/491/EEC of 9 October, 1984 on limit values and quality objectives for discharges of hexachlorocyclohexane;

•Directive 91/271/EEC of 21 May, 1991 concerning urban waste water treatment;

•Directive 91/676/EEC of 12 December, 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (known as the Nitrates Directive);

•Directive 98/83/EC of 3 November, 1998 on the quality of water;

•Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy;

•Regulation (EC) No 648/2004 of the European Parliament and of the Council of 31 March, 2004 on detergents;

•Decision 2006/507/EC of 14 October, 2004 concerning the conclusion, on behalf of the European Community, of the Stockholm Convention on Persistent Organic Pollutants (POPs);

•Directive 2006/7/EC of the European Parliament and of the Council of 15 February, 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC (with effect from 31 December, 2014);

•Directive 2006/44/EC of 6 September, 2006 on the quality of fresh waters needing protection or improvement in order to support fish life (this Directive will be repealed by the Framework Directive on water as of the end of 2013);

•Directive 2006/11/EC of the European Parliament and of the Council of 15 February, 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community the European Union (this Directive will be repealed by the Framework Directive on water as of the end of 2013);

•Proposal for a European Parliament and Council Directive of 22 September, 2006 setting out a framework for soil protection and amending Council Directive 2004/35/EC [COM (2006) 231 final – not published in the Official Journal];

•Directive 2006/118/EC of the European Parliament and of the Council of 12 December, 2006 on the protection of groundwater against pollution and deterioration;

•Directive 2007/2/EC of the European Parliament and of the Council of 14 March, 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE);

•Commission Communication of 18 July, 2007: "Addressing the challenge of water scarcity and droughts in the European Union" [COM (2007) 414 final – not published in the Official Journal];

•Directive 2007/60/EC of the European Parliament and of the Council of 23 October, 2007 on the assessment and management of flood risks; aims to manage and reduce the risk of floods, particularly along rivers and in coastal areas;

•Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control (the IPPC Directive);

•Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

As a member state of the European Union, Greece has to implement this legislation within its own legal framework, defining specific laws for the implementation of the different directives and the common legislative principles. This is a responsibility of the Ministry for the Environment and further information on this local legislation can be found on its web page.

## 3. GEOPOLITICAL ASPECTS

Greece is situated in the southernmost extension of the Balkan peninsula. The surface area of Greece is 130,100km2 of which 20 per cent is distributed on its 3,000 islands. Two thirds of the Greek territory is hilly or mountainous with steep slopes. More than 40 per cent of the land is over 500 metres in altitude (peaks >2,000m). Greece has the longest coastline in Europe (14,000km), of which 5 per cent belongs to areas of unique ecological value. The coastline is equally distributed between the mainland and the 3,000 islands. Over 70 per cent of the coastline is rocky [EEA, 2009]. The national population is around 11 million with a density of 84 inhabitants/km2. About one third of the Greek population is concentrated along the coastline.

After exploding in the 1970s, the rate of urban growth has slowed significantly in recent years. Today, Greece is relatively urbanised with about 50 per cent of the urban population living in the country's two main metropolitan areas, Athens (with around 3.8 million inhabitants) and Thessaloniki (with around 1 million). Also, around 80 per cent of the urban population lives in the other 11 largest cities, while 20 per cent live in the 72 cities with a population of between 1,000 and 50,000 inhabitants [Economou et al, 2007].

Following the restoration of democracy in 1974, the most important political development that affected all aspects of the Greek society was Greece's entry into the European Union in 1981. This led to continuous economic growth and the improvement of living standards. A significant reduction in poverty and inequality was seen in the period 1974 to 1982, while at the end of the 1990s increasing tendencies appear again.

Since the early 1990s, Greece has evolved from a migrant-exporting to a migrant-receiving country. Greece is the migrant's gateway to Europe. The number of migrants and ethnic returnees in Greece is estimated to be more than a million, which is equivalent to 9 per cent of the population and 12 per cent of the labour force of the country [ELIAMEP, 2009]. As with all European states, Greece has adopted the European Pact on Immigration and Asylum (2008), seeking a fair, balanced and effective policy to deal with all aspects of immigration at the same time. The country needs migrants in certain sectors and regions in order to deal with economic and demographic needs. However, a number of measures must be adopted within EU to fight illegal immigration, targeting especially traffickers and smugglers.

## 4. SOURCES

FAO. 1997. Aquastat. Available at: http://www.fao.org/nr/water/aquastat/main/index.stm, [accessed 26 February 2012]

Charalambis, D., Maratou-Alipranti, L. and A. Hadjiyanni, A. (eds). 2004. Recent Social Trends in Greece, 1960–2000. McGill-Queen's University Press, ISBN 0 7735 2202 6.

EC. 2008. Environment Policy Review 2007. Luxembourg: Office for Official Publications of the European Communities. ISBN 978-92-79-09384-5 (printed version), ISBN 978-92-79-09564-1 (web version) Available at: http://ec.europa.eu/environment/pdf/illust_epr.pdf [accessed 26 February 2012]

Economou, D., Petrakos, G. and Y. Psycharis. 2007. National Urban Policy in Greece, in Van den Berg, L., et al. (eds), National Policy Responses to Urban Challenges in Europe. Ashgate publishing, UK, ISBN 075464846X.

EEA - European Environmental Agency. 2009. Soil Country analysis. Country Report: Greece. To be published.

EEA. 2011. The European Environment – State and Outlook 2010. Available at: http://www.eea.europa.eu/soer/ [accessed 26 February 2012]

ELIAMEP – Hellenic Foundation for European and Foreign Policy, 2009. Available at: http://www.eliamep.gr/en/migration/publications-migration/migration-policy-in-greece/ [accessed 26 February 2012]

GNTO, 2009 - Greek National Tourism Organisation. http://www.gnto.gr [accessed 26 February 2012]

HNMS, 2009 - Hellenic National Meteorological Service. Climatology: the Climate of Greece. http://www.hnms.gr/hnms/english/climatology/climatology_html [accessed 26 February 2012]

Ministry of Environment (MINENV). 2002. National Strategy for Sustainable Development 2002. Available at: http://www.minenv.gr/4/41/000/nssd-english-final.pdf [accessed 26 February 2012]

MINENV. 2009. Climate Change: GHG Emissions projections – policies and measures, May 2009. Available at: http://cdr.eionet.europa.eu/gr/eu/ghgmm/envsg1jtq/20090515_Resubmission_of_GHG_Projections_and_PAMS_May_2009.pdf [accessed 26 February 2012]

Ministry of Economy and Finance (MNEC). 2009. Economic data and reports: Factsheets. Available at: http://www.mnec.gr/en/press_office/fact_sheets/ [accessed 26 February 2012]

MNEC. 2008a. The Greek Economy at a glance. Available at: www.mnec.gr/export/sites/mnec/en/economics/greek_economy_prospects/FactSheet_GreekEconomy_October_08.pdf [accessed 26 February 2012]

MNEC, 2008b. The Greek Economy: Dynamic progress – Great potential. Available at: www.mnec.gr/export/sites/mnec/en/economics/greek_economy_prospects/GreekEconomy_May08_general.ppt [accessed 26 February 2012]

National Centre for Environment and Sustainable Development. 2009. Greece: State of the Environment Report 2008, edited by C. Dimitroulopoulou (in Greek), to be published.

National Statistical Service of Greece (NSSG). 2007. Concise Statistical Yearbook, 2007. Available at: www.statistics.gr/Documents/yearbook.pdf

NSSG. 2008. Greece in figures, 2008. Available at: www.statistics.gr/eng_tables/hellas_in_numbers_EN.pdf

The European Pact on Immigration and Asylum. 2008. Available at: immigration.gouv.fr/IMG/pdf/Plaquette_EN.pdf [accessed 26 February 2012]

Tsakloglou and Mitrakos. 2006. In Petmesidou, M and Mossialos, E (eds.) Social Policy Development in Greece. Ashgate, UK. ISBN 0 7546 4370 0.