

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.14	Overall Basin Risk (score)	
Overall Basin Risk (rank)	175	Overall Basin Risk (rank)	
Physical risk (score)	1.62	Physical risk (score)	
Physical risk (rank)	183	Physical risk (rank)	
Regulatory risk (score)	3.54	Regulatory risk (score)	
Regulatory risk (rank)	27	Regulatory risk (rank)	
Reputation risk (score)	2.32	Reputation risk (score)	
Reputation risk (rank)	156	Reputation risk (rank)	
1. Quantity - Scarcity (score)	1.65	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	147	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	2.32	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	147	2. Quantity - Flooding (rank)	
3. Quality (score)	1.03	3. Quality (score)	
3. Quality (rank)	180	3. Quality (rank)	
4. Ecosystem Service Status (score)	1.22	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	187	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	4.35	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	6	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	3.25	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	80	6. Institutions and Governance (rank)	
7. Management Instruments (score)	3.73	7. Management Instruments (score)	
7. Management Instruments (rank)	17	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	2.20	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	92	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	1.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	187	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	4.38	10. Biodiversity importance (score)	

Country Overview - Guyana

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	36	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	2.55	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	147	11. Media Scrutiny (rank)	
12. Conflict (score)	1.95	12. Conflict (score)	
12. Conflict (rank)	164	12. Conflict (rank)	
1.0 - Aridity (score)	1.00	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) geodatabase. CGIAR consortium for spatial information.
1.0 - Aridity (rank)	180	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) geodatabase. CGIAR consortium for spatial information.
1.1 - Water Depletion (score)	1.00	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. <i>Elem Sci Anth</i> , 4.
1.1 - Water Depletion (rank)	192	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. <i>Elem Sci Anth</i> , 4.
1.2 - Baseline Water Stress (score)	1.00	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). <i>Aqueduct 3.0: Updated decision relevant global water risk indicators</i> . Technical note. Washington, DC: World Resources Institute.

Country Overview - Guyana

Indicator	Value	Description	Source
1.2 - Baseline Water Stress (rank)	188	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)	1.74	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. <i>Science advances</i> , 2(2), e1500323.
1.3 - Blue Water Scarcity (rank)	135	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. <i>Science advances</i> , 2(2), e1500323.
1.4 - Projected Change in Water Discharge (by ~2050) (score)	2.30	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. <i>Proceedings of the National Academy of Sciences</i> , 111(9), 3245-3250.
1.4 - Projected Change in Water Discharge (by ~2050) (rank)	57	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. <i>Proceedings of the National Academy of Sciences</i> , 111(9), 3245-3250.

Country Overview - Guyana

Indicator	Value	Description	Source
1.5 - Drought Frequency Probability (score)	2.68	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 multiscale drought index sensitive to global warming: the standardized precipitation evapotranspiration index. <i>Journal of climate</i> , 23(7), 1696-1718.
1.5 - Drought Frequency Probability (rank)	84	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 multiscale drought index sensitive to global warming: the standardized precipitation evapotranspiration index. <i>Journal of climate</i> , 23(7), 1696-1718.
1.6 - Projected Change in Drought Occurrence (by ~2050) (score)	2.96	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)	167	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)	2.30	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)	149	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)	2.61	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)	73	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)	1.03	<p>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).</p> <p>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%).</p>	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. <i>Nature</i> , 467(7315), 555.

Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	180	<p>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).</p> <p>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%).</p>	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. <i>Nature</i> , 467(7315), 555.
4.1 - Fragmentation Status of Rivers (score)	1.00	<p>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.</p>	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. <i>Nature</i> , 569(7755), 215.
4.1 - Fragmentation Status of Rivers (rank)	191	<p>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.</p>	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. <i>Nature</i> , 569(7755), 215.
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score)	1.66	<p>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.</p> <p>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.</p>	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. <i>science</i> , 342(6160), 850-853.

Country Overview - Guyana

Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	111	<p>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.</p> <p>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.</p>	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. <i>science</i> , 342(6160), 850-853.
4.3 - Projected Impacts on Freshwater Biodiversity (score)	2.01	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. <i>Journal of Applied Ecology</i> , 50(5), 1105-1115.
4.3 - Projected Impacts on Freshwater Biodiversity (rank)	123	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. <i>Journal of Applied Ecology</i> , 50(5), 1105-1115.
5.1 - Freshwater Policy Status (SDG 6.5.1) (score)	5.00	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)	5	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)	4.00	<p>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.</p> <p>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.</p>	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Country Overview - Guyana

Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	34	<p>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.</p> <p>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.</p>	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)	4.00	<p>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.</p> <p>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.</p>	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)	39	<p>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.</p> <p>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.</p>	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)	4.00	<p>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.</p>	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.1 - Corruption Perceptions Index (rank)	91	<p>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.</p>	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.2 - Freedom in the World Index (score)	1.00	<p>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.</p>	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.

Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	181	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)	4.00	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)	40	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)	4.00	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. 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)	21	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. 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.

Country Overview - Guyana

Indicator	Value	Description	Source
7.2 - Groundwater Monitoring Data Availability and Management (score)	3.00	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 GGMM Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.2 - Groundwater Monitoring Data Availability and Management (rank)	135	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 GGMM Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.3 - Density of Runoff Monitoring Stations (score)	3.18	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 1000km ² 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)	105	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 1000km ² 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)	179	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)	3.00	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.

Country Overview - Guyana

Indicator	Value	Description	Source
8.2 - Access to Sanitation (rank)	98	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)	4.00	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)	57	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)	187	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)	3.75	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 - Guyana

Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	101	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)	5.00	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)	18	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 Tecnomia (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 & Tecnomia (TYPESA Group)
11.1 - National Media Coverage (rank)	173	This risk indicator is based on joint qualitative research by WWF and Tecnomia (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 & Tecnomia (TYPESA Group)
11.2 - Global Media Coverage (score)	2.00	This risk indicator is based on joint qualitative research by WWF and Tecnomia (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 & Tecnomia (TYPESA Group)
11.2 - Global Media Coverage (rank)	147	This risk indicator is based on joint qualitative research by WWF and Tecnomia (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 & Tecnomia (TYPESA Group)

Country Overview - Guyana

Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	2.00	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)	149	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)	1.89	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. <i>Global environmental change</i> , 52, 286-313.
12.2 - Hydro-political Risk (rank)	143	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. <i>Global environmental change</i> , 52, 286-313.
Population, total (#)	773303	Population, total	The World Bank 2018, Data , homepage accessed 20/04/2018
GDP (current US\$)	3502397094	GDP (current US\$)	The World Bank 2018, Data , homepage accessed 20/04/2018
EPI 2018 score (0-100)	47.93	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	46.19	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, <i>The Worldwide Governance Indicators: Methodology and Analytical Issues</i> (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

Country Overview - Guyana

Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	56.16	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)	41.83	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)	36.54	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)	42.31	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)	45.19	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

Country Overview - Guyana

Indicator	Value	Description	Source
WRI BWS all industries (0-5)	1.78	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)	89	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)	107	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)	104	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)	107	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 .

Country Overview - Guyana

Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	114	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)	112	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)	114	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)	125	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)	123	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)	120	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 .

Country Overview - Guyana

Indicator	Value	Description	Source
Total water footprint of national consumption (m ³ /a/cap)	1548.39	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 (%)	15.58	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)	143.00	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)	143.00	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 (%)	89.16	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)	0.00	World Development Indicators	The World Bank 2018, Data , homepage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10 ⁹ m ³ /year)	241.00	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 m ³ /year)	30.00	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 m ³ /year)	241.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

Country Overview - Guyana

Indicator	Value	Description	Source
Total renewable water resources (10 ⁹ m ³ /year)	271.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	11.07	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 (m ³ /inhab/year)	353279.00	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]	0.00	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

Guyana is an Amerindian word reputed to mean "Land of the Water". Numerous rivers flow into the Atlantic Ocean, generally in a northward direction. The Essequibo, the country's major river, runs from the Brazilian border in the south to a wide delta west of Georgetown. The rivers of eastern Guyana cut across the coastal zone, making east-west travel difficult, but they also provide limited water access to the interior. Waterfalls generally limit water transport to the lower reaches of each river.

According to Janki, M. (2007), Guyana has four main rivers – the Berbice, Corentyne, Demerara and Essequibo – and a host of smaller rivers, creeks and streams. The Essequibo River drains over half the country and is a major river by international standards.

The ground water system comprises three aquifers. The "upper" sand is the shallowest of the three aquifers and its depth varies from 30 to 60m, with thickness ranging from 15 to 120m. It is not used as a source of water because of its high iron content (>5 mg/l) and salinity (up to 1,200 mg/l). Most potable water is obtained from the two deep aquifers. The "A" sand is typically encountered between 200 and 300m below the surface with thickness ranging from 15 to 60m. Water from the "A" aquifer requires treatment for the removal of iron. The "B" sand is found at about 300 to 400m with thickness of between 350 and 800m. Water from this aquifer has very little iron, a high temperature and a trace of hydrogen sulphide which can be treated with aeration.

Average annual rainfall in Guyana is about 2,300mm. It varies from about 1,800mm in the savannahs to over 4,300mm in parts of the rainforest. In the savannahs there is one rainy season from May to August. The rest of country has two distinct rainy seasons: November to February and May to August. However the actual rainfall in any month can vary significantly (Janki, 2007).

Lakes and dams

A small amount of the copious supplies of surface water which run off is trapped by a long low earth embankment to form large shallow dams locally known as "conservancies". The conservancies are located in the "backland" or upper stream catchment areas and comprise water-retaining embankments and structures.

These reservoirs are located on the Essequibo Coast Tapakuma Conservancy (Region 2), Boerasirie (West Demerara, in Region 3), East Demerara (Region 4) and the MMA (Region 5). The Tapakuma conservancy has been designed to provide irrigation to about 120km², Boerasirie supports 360km², East Demerara 345km² and MMA 175km². Boerasirie, Demerara and Abary conservancies are entirely covered by weeds. While in most years water supply is ensured

throughout the year, if droughts occur during the secondary November-January wet season, these conservancies may have water shortages. Water shortages may also occur in the Tapakuma conservancy, which is partly supplied by pumping from the Pomeroon River.

The gross theoretical hydropower potential of Guyana is 7,607GWh/year, of which 7,000 GWh/year was estimated to be technically feasible. Despite the country's large potential, there is only one hydropower plant in operation for 500MW at Moca Moca in Region 9.

Water withdrawal

No official information has been found on water withdrawal, but World Resources have estimated values. Irrigation has a very large demand for water. The highest density of population, roughly 90 per cent, is within the coastal area and thus all residents of the coastal area depend wholly on ground water supply to meet their domestic needs. One exception is the Georgetown area, which utilizes about 30 per cent of surface water from the East-Demerara conservancy. Nationwide, water supply facilities include about 178 ground water wells and eight surface water sources. No official information has been found on water withdrawal, but World Resources have estimated values. Irrigation has a very large demand for water. The highest density of population, roughly 90 per cent, is within the coastal area and thus all residents of the coastal area depend wholly on ground water supply to meet their domestic needs. One exception is the Georgetown area, which utilizes about 30 per cent of surface water from the East-Demerara conservancy. Nationwide, water supply facilities include about 178 ground water wells and eight surface water sources.

While access to potable water through house connections and public standpipes is quite widespread, the water and sanitation sector suffers from grave deficiencies due to the low quality of these services. There are three major water treatment facilities to produce drinking water, in Georgetown, New Amsterdam and Guymine. While access to potable water through house connections and public standpipes is quite widespread, the water and sanitation sector suffers from grave deficiencies due to the low quality of these services. There are three major water treatment facilities to produce drinking water, in Georgetown, New Amsterdam and Guymine.

The amount of surface water resources in Guyana compares favourably with the level of consumption but because of the uneven distribution of rainfall over the year Guyana has some problems with droughts (and floods). In the southern part of the country, heavy rainfall during the rainy season from April to August results in widespread flooding. In February and March, however, before the rains start, some creeks can dry up. ground water is the main source of public water supply in the coastal zone. Lying beneath the coastal zone are three significant layers of sand known as the Upper Sands, A sands and B sands. The A and B sands are separated by clay. Under these sands lie the aquifers that supply water for domestic use and some water for industrial use. Along this part of the country, once a well is dug the water rises above ground level without pumping (Janki, 2007). The amount of surface water resources in Guyana compares favourably with the level of consumption but because of the uneven distribution of rainfall over the year Guyana

has some problems with droughts (and floods). In the southern part of the country, heavy rainfall during the rainy season from April to August results in widespread flooding. In February and March, however, before the rains start, some creeks can dry up. Ground water is the main source of public water supply in the coastal zone. Lying beneath the coastal zone are three significant layers of sand known as the Upper Sands, A sands and B sands. The A and B sands are separated by clay. Under these sands lie the aquifers that supply water for domestic use and some water for industrial use. Along this part of the country, once a well is dug the water rises above ground level without pumping (Janki, 2007).

Ground water is also being increasingly used in Amerindian communities in the hinterland but the extent of ground water supplies is not known and it is unclear whether this use is sustainable (Janki, 2007). Ground water is also being increasingly used in Amerindian communities in the hinterland but the extent of ground water supplies is not known and it is unclear whether this use is sustainable (Janki, 2007).

Water supply

Domestic uses

Guyana has abundant surface and ground water supplies near all populated centres. Both surface and ground water resources are relied upon for water supply requirements. Heavy amounts of precipitation provide high amounts of surface runoff and ground water recharge (USACE, 1998). Guyana has abundant surface and ground water supplies near all populated centres. Both surface and ground water resources are relied upon for water supply requirements. Heavy amounts of precipitation provide high amounts of surface runoff and ground water recharge (USACE, 1998).

Most of the domestic water supply comes from ground water resources, while most of the water supply for agriculture (sugarcane and rice) and industry comes from surface water (USACE, 1998). Most of the domestic water supply comes from ground water resources, while most of the water supply for agriculture (sugarcane and rice) and industry comes from surface water (USACE, 1998).

Sewage systems in the urban areas are inadequate to nonexistent with minimal purification of water via filtration and chlorination, which occurs only in Georgetown when supplies are available and operational. The rest of the country uses septic tanks. Water distribution systems within Georgetown are poorly maintained and unreliable, forcing most residents to use individual cisterns. Canals throughout Georgetown are sources of water, but they also serve as sewers and are usually laden with agricultural and biological contamination and solid wastes (USACE, 1998). Sewage systems in the urban areas are inadequate to nonexistent with minimal purification of water via filtration and chlorination, which occurs only in Georgetown when supplies are available and operational. The rest of the country uses septic tanks. Water distribution systems within Georgetown are poorly maintained and unreliable, forcing most residents to use individual cisterns. Canals throughout Georgetown are sources of water, but they also serve as sewers and are usually laden with agricultural and biological contamination and solid wastes (USACE, 1998).

About 90 per cent of the domestic water supply comes from ground water sources, and the

remaining 10 per cent from surface water. The Georgetown Sewerage and Water Commission (GSWC) provides the water supply for the capital of Georgetown. This agency is responsible for the supply, treatment, and distribution of domestic and industrial water service within the city (USACE, 1998). About 90 per cent of the domestic water supply comes from ground water sources, and the remaining 10 per cent from surface water. The Georgetown Sewerage and Water Commission (GSWC) provides the water supply for the capital of Georgetown. This agency is responsible for the supply, treatment, and distribution of domestic and industrial water service within the city (USACE, 1998).

Individual landowners use rooftop catchment systems with cisterns as a secondary water supply source. Georgetown has a demand of 20 million gallons per day with about 8 million being furnished from surface water and 12 million from ground water. Surface water is supplied by the East Demerara River Water Conservancy. Domestic water supply has third priority for use of the surface water supplied by the conservancy, so in periods of short supply, irrigation and transportation demands must be met first, and any excess water can then be used for domestic supply. This has led the GSWC to look to ground water for all future needs and as a replacement for surface water supplies (USACE, 1998). Individual landowners use rooftop catchment systems with cisterns as a secondary water supply source. Georgetown has a demand of 20 million gallons per day with about 8 million being furnished from surface water and 12 million from ground water. Surface water is supplied by the East Demerara River Water Conservancy. Domestic water supply has third priority for use of the surface water supplied by the conservancy, so in periods of short supply, irrigation and transportation demands must be met first, and any excess water can then be used for domestic supply. This has led the GSWC to look to ground water for all future needs and as a replacement for surface water supplies (USACE, 1998).

Industrial Uses and Needs

Industrial water supply comes from both surface and ground water. Approximately 40 per cent of the ground water supply is for industrial uses and needs. In the future, more of the water supply for industry will come from ground water due to the declining supply of surface water. The predominant industrial use of water is the mining industry. Gold mining involves hydraulic dredging of the rivers, and uses river water to wash the dredged material to extract the gold (USACE, 1998). Industrial water supply comes from both surface and ground water. Approximately 40 per cent of the ground water supply is for industrial uses and needs. In the future, more of the water supply for industry will come from ground water due to the declining supply of surface water. The predominant industrial use of water is the mining industry. Gold mining involves hydraulic dredging of the rivers, and uses river water to wash the dredged material to extract the gold (USACE, 1998).

Agricultural Uses and Needs

The main agricultural crops are sugarcane and rice, which require intensive irrigation. Along the coast, several conservancies supply water to agricultural lands using reservoirs, canals, and irrigation ditches. Each major township along the coast has one conservancy with its own unique entity and governing body. The East Demerara River Water Conservancy supplies the agricultural

water needs for the Georgetown area. It is south of the city, and water is gravity-fed to the surrounding agricultural fields (USACE, 1998). The main agricultural crops are sugarcane and rice, which require intensive irrigation. Along the coast, several conservancies supply water to agricultural lands using reservoirs, canals, and irrigation ditches. Each major township along the coast has one conservancy with its own unique entity and governing body. The East Demerara River Water Conservancy supplies the agricultural water needs for the Georgetown area. It is south of the city, and water is gravity-fed to the surrounding agricultural fields (USACE, 1998).

These drainage and irrigation systems, once adequate, have deteriorated because of lack of maintenance and can no longer sufficiently provide crop irrigation. The lack of storage capacity has hindered agricultural production, reduced the flood control capacity of the impoundments, and restricted the use of the impounded water for domestic consumption (USACE, 1998). These drainage and irrigation systems, once adequate, have deteriorated because of lack of maintenance and can no longer sufficiently provide crop irrigation. The lack of storage capacity has hindered agricultural production, reduced the flood control capacity of the impoundments, and restricted the use of the impounded water for domestic consumption (USACE, 1998).

Hydropower

There is no hydropower presently available, but significant potential exists. Development is limited because most of the sites are difficult to reach, and reliable estimates are lacking on the potential of many streams. Currently, several projects are in the planning, design, and construction phase under agreements with outside power companies. Completion of some of these projects could make the country self-sufficient in providing abundant low-cost power for development of industry, agriculture, and domestic needs (USACE, 1998). There is no hydropower presently available, but significant potential exists. Development is limited because most of the sites are difficult to reach, and reliable estimates are lacking on the potential of many streams. Currently, several projects are in the planning, design, and construction phase under agreements with outside power companies. Completion of some of these projects could make the country self-sufficient in providing abundant low-cost power for development of industry, agriculture, and domestic needs (USACE, 1998).

Waterway Transportation

Inland waterways are used for transportation by the logging industry. The Amerindians, the native Indian population, also use the rivers for local transportation. Approximately 6,000km of navigable waterways exist. The Berbice, Demerara, and Essequibo Rivers are navigable by oceangoing vessels for 150km, 100km, and 80km respectively. Ports are in the towns of Bartica, Georgetown, Linden, New Amsterdam, and Parika (USACE, 1998). Inland waterways are used for transportation by the logging industry. The Amerindians, the native Indian population, also use the rivers for local transportation. Approximately 6,000km of navigable waterways exist. The Berbice, Demerara, and Essequibo Rivers are navigable by oceangoing vessels for 150km, 100km, and 80km respectively. Ports are in the towns of Bartica, Georgetown, Linden, New Amsterdam, and Parika (USACE, 1998). The quality of surface water is a growing concern, with biological and chemical contamination most prevalent along the coast. Sewage systems within Georgetown are inadequate with disposal

into the Atlantic Ocean. Periods during the wet and dry seasons are more susceptible for inducing contamination; open-ditch sewers and septic tanks may flood during the wet seasons, and during dry seasons, there may be insufficient flow to flush and dilute the contaminants (USACE, 1998). The quality of surface water is a growing concern, with biological and chemical contamination most prevalent along the coast. Sewage systems within Georgetown are inadequate with disposal into the Atlantic Ocean. Periods during the wet and dry seasons are more susceptible for inducing contamination; open-ditch sewers and septic tanks may flood during the wet seasons, and during dry seasons, there may be insufficient flow to flush and dilute the contaminants (USACE, 1998).

Except for brackish or saline ground water near the Atlantic coast, ground water is suitable for most uses. Biological and chemical contamination of ground water is more common near populated areas and in the shallow aquifers (USACE, 1998). Except for brackish or saline ground water near the Atlantic coast, ground water is suitable for most uses. Biological and chemical contamination of ground water is more common near populated areas and in the shallow aquifers (USACE, 1998).

Mining is an important industry in Guyana, but it is also a major source of surface and ground water contamination and degradation of rivers and streams. Dredging and other types of mining operations cause hydrocarbons to be released and increase sediment loading in rivers and streams. Improper disposal of sawmill wastes is another major concern, which raises biochemical oxygen demand levels (USACE, 1998). Mining is an important industry in Guyana, but it is also a major source of surface and ground water contamination and degradation of rivers and streams. Dredging and other types of mining operations cause hydrocarbons to be released and increase sediment loading in rivers and streams. Improper disposal of sawmill wastes is another major concern, which raises biochemical oxygen demand levels (USACE, 1998).

1. Surface Water Quality

1. Surface Water Quality
In Georgetown and in populated areas of the coastal lowlands, surface water contamination occurs from inadequate waste disposal and from chemicals used in the production of rice and sugarcane. Contamination of surface water, if not monitored properly, could develop into a major health hazard. Chemical contamination of surface water occurs primarily near manufacturing areas, especially along major rivers within mining districts. Commonly mined minerals are bauxite, gold, diamonds, and manganese. The contaminant of concern in bauxite production is caustic soda (sodium hydroxide). Contaminants of concern in gold production are cyanide, sulfuric acid, hydrochloric acid, and mercury. Mercury is used in extracting gold in small mining operations, with arsenic generated as a by-product. The Essequibo, the Mazaruni, the Cuyuni, the Barima, and the Barama rivers and associated tributaries are probably polluted by these chemicals. Documented cases of mercury spills into interior streams from gold-mining operations have led to strict environmental protection practices. Cyanide is used in the processing of gold from hard rock. Cyanide contamination from gold production operations has occurred more than once in the Omai and Essequibo rivers. The Demerara River, the Upper Berbice, the Upper Canje, and associated tributaries may be chemically polluted from caustic soda (sodium hydroxide) used in the production of bauxite. The presence of chemicals to control aquatic weeds in the canals is also

a serious problem in the coastal lowlands (USACE, 1998). In Georgetown and in populated areas of the coastal lowlands, surface water contamination occurs from inadequate waste disposal and from chemicals used in the production of rice and sugarcane. Contamination of surface water, if not monitored properly, could develop into a major health hazard. Chemical contamination of surface water occurs primarily near manufacturing areas, especially along major rivers within mining districts. Commonly mined minerals are bauxite, gold, diamonds, and manganese. The contaminant of concern in bauxite production is caustic soda (sodium hydroxide). Contaminants of concern in gold production are cyanide, sulfuric acid, hydrochloric acid, and mercury. Mercury is used in extracting gold in small mining operations, with arsenic generated as a by-product. The Essequibo, the Mazaruni, the Cuyuni, the Barima, and the Barama rivers and associated tributaries are probably polluted by these chemicals. Documented cases of mercury spills into interior streams from gold-mining operations have led to strict environmental protection practices. Cyanide is used in the processing of gold from hard rock. Cyanide contamination from gold production operations has occurred more than once in the Omai and Essequibo rivers. The Demerara River, the Upper Berbice, the Upper Canje, and associated tributaries may be chemically polluted from caustic soda (sodium hydroxide) used in the production of bauxite. The presence of chemicals to control aquatic weeds in the canals is also a serious problem in the coastal lowlands (USACE, 1998).

2. Ground Water Quality

Biological contamination of shallow aquifers by pathogens due to improper disposal of animal and human wastes is a common problem. Chemical contamination is primarily related to the use of fertilizers in the sugarcane and rice fields of the coastal lowlands. The Upper Sands aquifer, which is not normally used for water supply, is highly susceptible to biological and chemical contamination, particularly in the Georgetown area, and the water is generally brackish to saline. Overuse of aquifers in coastal areas may result in saltwater intrusion. During the dry seasons in the interior, shallow wells may temporarily go dry until sufficient aquifer recharge occurs (USACE, 1998). Biological contamination of shallow aquifers by pathogens due to improper disposal of animal and human wastes is a common problem. Chemical contamination is primarily related to the use of fertilizers in the sugarcane and rice fields of the coastal lowlands. The Upper Sands aquifer, which is not normally used for water supply, is highly susceptible to biological and chemical contamination, particularly in the Georgetown area, and the water is generally brackish to saline. Overuse of aquifers in coastal areas may result in saltwater intrusion. During the dry seasons in the interior, shallow wells may temporarily go dry until sufficient aquifer recharge occurs (USACE, 1998).

According to Janki (2007), in all areas of Guyana where mining takes place, pollution is a threat to water supplies whether these are surface waters or ground waters. Pollutants include cyanide and mercury. In August 1995 the breach of a tailings pond at the Omai gold mine resulted in a massive spill of tailings containing cyanide into the Omai river and down to the Essequibo, Guyana's largest river. Amerindians in the vicinity complained that their sources of water were polluted and they developed skin diseases. A national emergency was declared, an inquiry was held and there have

been attempts at litigation, so far without success. According to Janki (2007), in all areas of Guyana where mining takes place, pollution is a threat to water supplies whether these are surface waters or ground waters. Pollutants include cyanide and mercury. In August 1995 the breach of a tailings pond at the Omai gold mine resulted in a massive spill of tailings containing cyanide into the Omai river and down to the Essequibo, Guyana's largest river. Amerindians in the vicinity complained that their sources of water were polluted and they developed skin diseases. A national emergency was declared, an inquiry was held and there have been attempts at litigation, so far without success.

Mercury is used in small-scale mining by individuals, known locally as porkknockers, who travel through the interior searching for gold. Their use of mercury is difficult to regulate and monitor and there is still a lack of awareness of the dangers which mercury poses to health (Janki, 2007). Mercury is used in small-scale mining by individuals, known locally as porkknockers, who travel through the interior searching for gold. Their use of mercury is difficult to regulate and monitor and there is still a lack of awareness of the dangers which mercury poses to health (Janki, 2007).

Water supplies are also affected by missile dredging in which high powered hoses are used to break away river banks. These collapse into the rivers and result in high levels of turbidity. Trees and other vegetation destroyed in the process further clog the rivers (Janki, 2007). Water supplies are also affected by missile dredging in which high powered hoses are used to break away river banks. These collapse into the rivers and result in high levels of turbidity. Trees and other vegetation destroyed in the process further clog the rivers (Janki, 2007).

As the gold reserves in the rivers become exhausted miners have been moving into the smaller creeks with the same adverse impacts. Dredges used on land also contribute to the turbidity and pollution of waterways (Janki, 2007). As the gold reserves in the rivers become exhausted miners have been moving into the smaller creeks with the same adverse impacts. Dredges used on land also contribute to the turbidity and pollution of waterways (Janki, 2007).

The activities which pollute the waterways and threaten customary use are already illegal. The problem is one of enforcement and Amerindian communities have so far not used the legal system to stop these activities (Janki, 2007). The activities which pollute the waterways and threaten customary use are already illegal. The problem is one of enforcement and Amerindian communities have so far not used the legal system to stop these activities (Janki, 2007).

The protection of shallow aquifers around villages is also becoming an issue. There is a potential risk from domestic effluent to nearby wells but there is still insufficient monitoring and insufficient data available on this (Janki, 2007). The protection of shallow aquifers around villages is also becoming an issue. There is a potential risk from domestic effluent to nearby wells but there is still insufficient monitoring and insufficient data available on this (Janki, 2007).

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

The present administrative organization of Guyana's water resources has been in place for over a century. There are some 15 agencies administering the legislation relating to water and their functions often overlap either directly or indirectly. The functions of the more important of these agencies are as follows:

-Drinking water supply and sanitation:

-The Guyana Water Authority (GUYWA), under the policy direction of the Ministry of Public Works, Communications and Regional Development, provides water supply services for the whole country with the exception of Georgetown, New Amsterdam and Linden, where the systems are run by municipalities. Since 1984, responsibility for provision of water services has lain with the Regional Democratic Councils. The Ministry of Health monitors water quality and has responsibility for sewerage and sanitation activities. The municipalities are responsible for the construction, operation and maintenance of urban drainage systems.

-Irrigation and drainage:

-Overall responsibility for drainage and irrigation in Guyana is vested in the National Drainage and Irrigation Board (NDIB). The NDIB is mandated to provide drainage and irrigation services in Declared Drainage and Irrigation Areas (DDIAs). All DDIAs are administered by the Regional Democratic Boards, except the Mahaica-Mahaicony-Abary system that is managed by an independent water authority. Regional Democratic Boards are responsible for maintenance of the conservancies, water allocation from the conservancies, operation of the reservoirs, and maintenance of the dams and head regulators. The Regional Democratic Boards do not themselves collect the water users' share of costs, this is the responsibility of the local authorities. Local authorities are required by the Drainage and Irrigation Act to assess the level of the drainage and irrigation rates on DDIAs and levy charges on landowners.

-Other water uses:

-The Ministry of Public Works, Communications and Regional Development has responsibility for establishing water sector policy.

-The Hydrometeorology Department of the Ministry of Agriculture has responsibility for the monitoring and assessment of surface and ground water resources and for providing basic meteorological information.

-The Guyana Electricity Corporation (GEC) is responsible for the generation, transmission and distribution of electricity.

-Development of natural resources - including mining, energy, fossil fuel development and forestry - is the responsibility of the Guyana Natural Resources Agency.

According to USACE (1998) the Guyana Water Authority (GUYWA) has responsibility for domestic water supply for the rest of the country. Since almost all the population lives along the coast in numerous autonomous villages and communities, the water supply is furnished by a series of

wells drilled along the coast.

GSWC is responsible for the drilling and maintenance of wells in Georgetown. Outside the Georgetown city limits, all water well drilling must be authorized by GUYWA, which provides most of the well drilling in the country. Drillers must be registered with GUYWA, and nongovernment contractors must obtain drilling permits from GUYWA before drilling a well (USACE, 1998).

GUYWA also maintains data on most of the wells and available documents indicate that 603 drilled wells currently exist in the country. Another government agency, the Hydro-Meteorological Service, keeps historical reports on water wells and ground water data (USACE, 1998).

2.2. WATER MANAGEMENT

The challenges the government faces in its task to support the development of agriculture are enormous. The sector's potential relies heavily on extensive rehabilitation of the country's deteriorated infrastructure and on technological improvements. This task will require not only extensive public sector efforts, but increased involvement and participation of the private sector in areas such as maintenance of drainage and irrigation systems.

The principal options Guyana plans to pursue for further development of the agricultural sector and achievement of improved water management are likely to include:

(i) increase in productivity through better seeds and agricultural practices;

(ii) development and rehabilitation of the irrigation and sea defence infrastructure: evidence from pilot projects on the coast shows farmers are willing to pay rent or user fees to get better operation and maintenance services for the drainage and irrigation systems which serve them;

(iii) promotion of privatisation through a programme of complementarity between the government and the private sector;

(iv) improved land tenure;

(v) crop diversification: new trends in the expansion of non-traditional crops are expected to enhance the food security and nutritional needs of the country.

In terms of external trade, the 1990s have seen an improvement of competitiveness: non-traditional exports such as fruit and vegetables are being exported in increasing quantities to the neighbouring countries. Close to 500,000 metric tons of rice are exported to nearby Caribbean countries annually and increased demand is expected for the medium term since the commodity is a staple of the diet. However, Guyana's food exports depend precariously on rice and depend heavily on the policies of the European Union in terms of rice imports.

Drought

Seasonal variations in rainfall can lead to drought during the dry season. Particularly dry years occur approximately every five to seven years at roughly the same frequency as the El Nino effect (and probably linked to it). There are some suggestions that drought is increasing and that the uncontrolled burning of savannahs which destroys trees and other vegetation is leading to a drier environment. However there is insufficient scientific data on these issues (Janki, 2007).

In 1998 the government of Guyana began a programme to construct new wells and improve existing wells by making them deeper in order to protect customary access to water. There is

incomplete data on ground water in the hinterland and as yet it is not clear whether current levels of use are sustainable (Janki, 2007).

Mining-related water issues

There has been a tendency to ignore the involvement of Amerindian communities in mining but this is a serious issue which has to be addressed. For many Amerindian men, working on a dredge is one of the few opportunities available for employment and they have very little choice but to take part in an activity which may bring in cash in the short term but undermines the community in the long term. There have also been reports of one Amerindian leader owning and operating a dredge in the upper Mazaruni region (Janki, 2007). There has been a tendency to ignore the involvement of Amerindian communities in mining but this is a serious issue which has to be addressed. For many Amerindian men, working on a dredge is one of the few opportunities available for employment and they have very little choice but to take part in an activity which may bring in cash in the short term but undermines the community in the long term. There have also been reports of one Amerindian leader owning and operating a dredge in the upper Mazaruni region (Janki, 2007).

At the next level up, some villages have sought to increase community income by allowing mining within the village territory. However the agreements are generally made without legal advice and are to the detriment of the community (Janki, 2007). At the next level up, some villages have sought to increase community income by allowing mining within the village territory. However the agreements are generally made without legal advice and are to the detriment of the community (Janki, 2007).

It is clear that communities are in an increasingly difficult position in trying to protect their sources of water but needing to obtain income in order to take part in the increasing cash economy (Janki, 2007). It is clear that communities are in an increasingly difficult position in trying to protect their sources of water but needing to obtain income in order to take part in the increasing cash economy (Janki, 2007).

Complaints have been made to the Guyana Geology and Mines Commission, the Minister responsible for mining and the Environmental Protection Agency, all of whom have carried out some investigations and taken some limited action. The Guyana Geology and Mines Commission had asked some communities to provide them with information about their villages and water use but this does not appear to have been done. The Prime Minister has visited Amerindian communities affected by mining and taken some steps to resolve the issue. Members of the Guyana Gold and Diamond Mining Association have also had meetings with Amerindian communities (Janki, 2007). Complaints have been made to the Guyana Geology and Mines Commission, the Minister responsible for mining and the Environmental Protection Agency, all of whom have carried out some investigations and taken some limited action. The Guyana Geology and Mines Commission had asked some communities to provide them with information about their villages and water use but this does not appear to have been done. The Prime Minister has visited Amerindian communities affected by mining and taken some steps to resolve the issue. Members of the Guyana Gold and Diamond Mining Association have also had meetings with

Amerindian communities (Janki, 2007).

Water rights in Guyana are generally regarded as the property of the State (as successor to the Crown) which then authorises use. Section 36 of the Constitution provides that the State will protect and make rational use of its water resources, the clear assumption being that all water belongs to the State. The State Lands Act (Cap 62:01) also assumes that the State is the owner of all water. In keeping with this the Hydro-electric Power Act (Cap 56:03) provides that, "Subject to any rights lawfully held, the property in and the sole right to the use of all State water powers are hereby declared to be vested in and shall remain the property of the State." (Janki, 2007). Water rights in Guyana are generally regarded as the property of the State (as successor to the Crown) which then authorises use. Section 36 of the Constitution provides that the State will protect and make rational use of its water resources, the clear assumption being that all water belongs to the State. The State Lands Act (Cap 62:01) also assumes that the State is the owner of all water. In keeping with this the Hydro-electric Power Act (Cap 56:03) provides that, "Subject to any rights lawfully held, the property in and the sole right to the use of all State water powers are hereby declared to be vested in and shall remain the property of the State." (Janki, 2007).

In 2002, as part of a major reform of the water sector in Guyana, the government brought in new legislation – the Water and Sewerage Act 2002 (the Act) – "to provide for the ownership, management, control, protection and conservation of water resources, the provision of safe water..." This Act is the key piece of legislation and must be looked at in some detail to understand how water is now dealt with. All water rights are now governed by this Act which establishes a new regime for water use and management in Guyana (Janki, 2007). In 2002, as part of a major reform of the water sector in Guyana, the government brought in new legislation – the Water and Sewerage Act 2002 (the Act) – "to provide for the ownership, management, control, protection and conservation of water resources, the provision of safe water..." This Act is the key piece of legislation and must be looked at in some detail to understand how water is now dealt with. All water rights are now governed by this Act which establishes a new regime for water use and management in Guyana (Janki, 2007).

Under Section 18 of the Act "the ownership of all water resources and the rights to use, abstract, manage and control the flow of water are vested in the State." The Act creates rights in water through a licensing scheme. It also recognises existing rights and attempts to incorporate these into the new regime. Ground water and surface water are dealt with in slightly different ways (Janki, 2007). Under Section 18 of the Act "the ownership of all water resources and the rights to use, abstract, manage and control the flow of water are vested in the State." The Act creates rights in water through a licensing scheme. It also recognises existing rights and attempts to incorporate these into the new regime. Ground water and surface water are dealt with in slightly different ways (Janki, 2007).

Groundwater

In the case of groundwater, any person who is operating a borehole must within three months of the commencement of the Act notify the Hydro-meteorological Department (Hydromet) of the location of the borehole. A borehole is defined as "any well, excavation or any artificially

constructed or improved underground cavity” for the purpose of collecting or storing water from an aquifer. The operator must inform Hydromet of the use for which water is abstracted, the rate and volume of abstraction and the authority by which such borehole is operated (Janki, 2007). In the case of ground water, any person who is operating a borehole must within three months of the commencement of the Act notify the Hydro-meteorological Department (Hydromet) of the location of the borehole. A borehole is defined as “any well, excavation or any artificially constructed or improved underground cavity” for the purpose of collecting or storing water from an aquifer. The operator must inform Hydromet of the use for which water is abstracted, the rate and volume of abstraction and the authority by which such borehole is operated (Janki, 2007).

It is illegal to operate a borehole without a licence or other lawful authority. The operator is required to apply for a licence or risk a fine of 10,000 – 40,000 Guyana dollars (approximately US\$50 to \$200) (Janki, 2007). It is illegal to operate a borehole without a licence or other lawful authority. The operator is required to apply for a licence or risk a fine of 10,000 – 40,000 Guyana dollars (approximately US\$50 to \$200) (Janki, 2007).

The application for the licence must be made to Hydromet and there are restrictions on who may hold a licence. An individual applicant must be a citizen of Guyana. Corporate bodies have to be registered cooperative societies, public corporations (i.e. government corporations) or local government organs such as Amerindian councils. A private company controlled by citizens of Guyana can also hold a licence but any other company must first obtain the permission of the Minister (Janki, 2007). The application for the licence must be made to Hydromet and there are restrictions on who may hold a licence. An individual applicant must be a citizen of Guyana. Corporate bodies have to be registered cooperative societies, public corporations (i.e. government corporations) or local government organs such as Amerindian councils. A private company controlled by citizens of Guyana can also hold a licence but any other company must first obtain the permission of the Minister (Janki, 2007).

The licence grants rights to abstract and use water. Those rights are subject to restrictions whose purpose is to ensure that water is used in a sustainable way. The licence holder has a statutory duty, “not to exercise his rights in such a way as to jeopardise or threaten the water supply for existing or potential water users...”. The Act imposes on Hydromet a duty to specify in the licence the maximum and minimum quantities of water which may be abstracted on a daily and an annual basis. This provision is particularly important in those areas where unrestricted use may result in future shortages. If there is likely to be insufficient water in the water resource, the Act allows Hydromet to amend the licence in order to accommodate existing or authorised water uses. However other licences for that area must be amended in an equitable manner. Hydromet can also amend the licence to protect the quality of the water resource. Any abstraction which exceeds the levels set in the licence is unlawful. If a licence holder abstracts more than he is entitled to, then Hydromet may suspend or cancel the licence (Janki, 2007). The licence grants rights to abstract and use water. Those rights are subject to restrictions whose purpose is to ensure that water is used in a sustainable way. The licence holder has a statutory duty, “not to exercise his rights in such a way as to jeopardise or threaten the water supply for existing or potential water

users...”. The Act imposes on Hydromet a duty to specify in the licence the maximum and minimum quantities of water which may be abstracted on a daily and an annual basis. This provision is particularly important in those areas where unrestricted use may result in future shortages. If there is likely to be insufficient water in the water resource, the Act allows Hydromet to amend the licence in order to accommodate existing or authorised water uses. However other licences for that area must be amended in an equitable manner. Hydromet can also amend the licence to protect the quality of the water resource. Any abstraction which exceeds the levels set in the licence is unlawful. If a licence holder abstracts more than he is entitled to, then Hydromet may suspend or cancel the licence (Janki, 2007).

Surface waterSurface water

In the case of surface water the Act merely provides that, “No person shall divert or abstract surface water in an amount which exceeds that prescribed by regulations unless such diversion or abstraction is authorised by a valid licence or by law.” No regulations have yet been promulgated and no licences have been issued for abstraction of surface water (Janki, 2007). In the case of surface water the Act merely provides that, “No person shall divert or abstract surface water in an amount which exceeds that prescribed by regulations unless such diversion or abstraction is authorised by a valid licence or by law.” No regulations have yet been promulgated and no licences have been issued for abstraction of surface water (Janki, 2007).

Administrative ArrangementsAdministrative Arrangements

The administrative arrangements for water resources and water rights in Guyana are divided among different agencies. This has led to a lack of clarity and potential for institutional conflict and concurrent jurisdiction (Janki, 2007). The administrative arrangements for water resources and water rights in Guyana are divided among different agencies. This has led to a lack of clarity and potential for institutional conflict and concurrent jurisdiction (Janki, 2007).

The Minister of Housing and Water is the minister with primary responsibility for water under the Act. He has a duty to develop a national water policy for the use of water resources. However the Minister of Agriculture has the power to make drought orders which may restrict the use of water, including customary use and use under a licence. The Minister of Housing and Water is the minister with primary responsibility for water under the Act. He has a duty to develop a national water policy for the use of water resources. However the Minister of Agriculture has the power to make drought orders which may restrict the use of water, including customary use and use under a licence.

There is a risk that drought orders could be inconsistent with the national water policy (Janki, 2007). There is a risk that drought orders could be inconsistent with the national water policy (Janki, 2007).

The Act also establishes a National Water Council whose role is to advise the Minister on the development of a national water policy which will contain the strategies, objectives, plans, guidelines and procedures to ensure the equitable allocation of water in Guyana (Janki, 2007). The Act also establishes a National Water Council whose role is to advise the Minister on the development of a national water policy which will contain the strategies, objectives, plans,

guidelines and procedures to ensure the equitable allocation of water in Guyana (Janki, 2007). The Minister of Housing and Water is responsible for appointing a public supplier who has the duty to provide potable water for domestic purposes and a satisfactory supply of water for industrial and commercial purposes. The Act requires there to be a public supplier for every region in Guyana. The current public supplier is Guyana Water Inc., (GWI) a company which is wholly owned by the government of Guyana but managed by a British water company. GWI operates under a licence for 25 years and its obligations include providing potable water to Amerindian communities. Its role with regard to customary rights is examined below (Janki, 2007). The Minister of Housing and Water is responsible for appointing a public supplier who has the duty to provide potable water for domestic purposes and a satisfactory supply of water for industrial and commercial purposes. The Act requires there to be a public supplier for every region in Guyana. The current public supplier is Guyana Water Inc., (GWI) a company which is wholly owned by the government of Guyana but managed by a British water company. GWI operates under a licence for 25 years and its obligations include providing potable water to Amerindian communities. Its role with regard to customary rights is examined below (Janki, 2007). The Hydromet department is responsible for operating the licensing system for ground water and, when it comes into operation, the system for licensing surface water. Hydromet is responsible for verifying existing lawful uses and bringing those uses within the regulatory framework established by the Act. Hydromet is also responsible for establishing and maintaining systems to monitor water quality and use. Hydromet reports to the Minister of Agriculture not the Minister of Housing and Water (Janki, 2007). The Hydromet department is responsible for operating the licensing system for ground water and, when it comes into operation, the system for licensing surface water. Hydromet is responsible for verifying existing lawful uses and bringing those uses within the regulatory framework established by the Act. Hydromet is also responsible for establishing and maintaining systems to monitor water quality and use. Hydromet reports to the Minister of Agriculture not the Minister of Housing and Water (Janki, 2007). Under Section 21 of the Amerindian Act, Amerindian Village Councils have the power to make rules for the provision, maintenance and regulation of water supplies and the prohibition of the poisoning of the waters of any river and stream. These regulations bind the Amerindian community but no one else (Janki, 2007). Under Section 21 of the Amerindian Act, Amerindian Village Councils have the power to make rules for the provision, maintenance and regulation of water supplies and the prohibition of the poisoning of the waters of any river and stream. These regulations bind the Amerindian community but no one else (Janki, 2007).

<h2>2.3.WATER POLICY AND LEGAL FRAMEWORK2.3.WATER POLICY AND LEGAL FRAMEWORK

3. GEOPOLITICAL ASPECTS

Guyana is located in the northern part of South America, with a 430km Atlantic coastline, and bounded by Venezuela in the northwest, Brazil in the west and south, and Suriname in the east. Guyana, with 214,970km², is a sparsely populated country endowed with ample natural resources

for agriculture. It is also one of the few countries in the world where population pressure on natural resources is virtually non-existent.

Guyana is one of eight countries sharing the Amazon Basin. Its main river, the Essequibo, is one of the principal rivers of South America with a mean flow of 2,100m³/s. In fact, the Essequibo is the largest river flowing into the Amazon between the Orinoco and Amazon rivers. Much of Guyana's Kinterland area is drained directly or by major tributaries of the Essequibo and fresh surface water is generally in plentiful supply for most of the year (MACRG, 2006).

The Amazon River Basin occupies the entire central and eastern area of South America, lying to the east of the Andes mountain range and extending from the Guyana Plateau in the north to the Brazilian Plateau in the south. The Basin covers more than 6,100,000km², or 44 per cent of the land area of the South American continent, extending into Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela. The Basin has widely varying climatic and topographic characteristics, with elevations ranging from sea level at the river's mouth, to an altitude of 6,500 m in the Andes (OAS, 2005).

The Amazon River, which runs for approximately 7,100km from its source in Peru to the Atlantic coast of Brazil, is the world's longest, widest, and deepest river. Its discharge of approximately 210,000 m³/s exceeds the combined discharge of the world's nine next largest rivers. The Amazon River system is divided into 10 sub-basins, the largest of which in area are the Negro, Xingú, Madeira, Tapajós, and Juruá sub-basins. In terms of discharge, from a hydrological standpoint, an estimated 65 per cent of the Basin's total flow into the Atlantic Ocean comes from the Solimoes and Madeira river sub-basins, originating in the Andes and comprising about 60 per cent of the Basin's land area (OAS, 2005).

Most of the Basin is covered by tropical rainforest, accounting for more than 56 per cent of all broad leaf forests in the world. Its ecosystems are characterized by great biodiversity, with more than 30,000 plant species, nearly 2,000 fish species, 60 reptile species, 35 mammal families, and approximately 1,800 bird species (OAS, 2005).

The Amazon Cooperation Treaty Organisation (ACTO) was established in 1978 by the governments of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela. Its goal was to plan for the sustainable development of the region's resources and people, and in 2004 a strategic plan for the years 2004-2012 was published. The plan defines a number of areas or themes for development; including the sustainable management of the region's water and soil resources (MACRG, 2006).

The project, 'Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin', was prepared by the countries that are signatories to ACTO. The goal of this project was to strengthen the institutional framework for planning and executing, in a coordinated and coherent manner, activities for the protection and sustainable management of the land and water resources of the Amazon River Basin. The proposed project endeavoured to realize a shared vision for sustainable development in the region, based upon the protection and integrated management of transboundary water resources and its adaptation to climate changes. This will clearly be a long-term effort (MACRG, 2006).

The development of an institutional structure for the coordinated management of the Amazon region is recent and still fragile. The challenge, in terms of its hemispheric scale and the number of countries sharing responsibility, is great. All eight are developing countries, and their economic and technical capacities have evolved in very different ways, both in terms of scale as well as related institutional and legal frameworks (MACRG, 2006).

Accordingly, the project is proposed to be divided into three four-year phases: the first for planning and development of institutional capacity; the second for implementation of jointly identified strategic activities; and the third for strengthening sustainable and integrated water resources management in the Basin, recognizing the likely impacts forecasted to arise as a consequence of ongoing changes to the global circulation and climatic regimes (MACRG, 2006).

In Guyana, the Hydrometeorological Service of the Ministry of Agriculture has been given the mandate of coordinating efforts aimed at sustainably managing Guyana's water and soil resources in response to changes in global climatic conditions. However, Guyana's soil and water resources are affected by a number of other interest groups and activities, whose views must be taken into consideration when defining the country's vision (MACRG, 2006).

The Consensual Vision for the Basin will be defined based on the analysis of the current situation, as well as on the prognostics of future scenarios. It is hoped that these efforts would partially assist in the identification of issues of transboundary interest in the Transboundary Diagnostic Analysis (DAT) of the Basin as a whole (MACRG, 2006).

4. RELIGIOUS AND CULTURAL ASPECTS

Traditional water entitlements

Traditional water entitlements in Guyana means use by Amerindian communities. It includes use that is recognised as custom in the strict common law sense as well as use that is traditional or historical (Janki, 2007).

There are two main sources of water for Amerindian communities: (i) ground water in those villages which have wells; and (ii) surface water from rivers, creeks and ponds (small lakes).

Most of the Amerindian communities depend on nearby creeks and rivers or dig shallow wells close to their homes for their water supply. Use is domestic and agricultural. Any industrial type use is sporadic and is limited to small-scale mining. Safe sources of drinking water are preserved by ensuring that only certain springs and creeks are used for drinking and other uses such as washing or bathing are prohibited near those water sources (Janki, 2007).

Most communities do not collect and store rain water. Buildings are traditionally constructed with roofs made from leaves which makes them unsuitable for collecting water. Those communities which collect rain water have to ensure that collection facilities are sealed to prevent the spread of mosquito larvae and the risk of diseases such as malaria. Black plastic tanks which are the preferred option have to be brought in from Georgetown and the cost of purchasing and transporting them is prohibitive for many communities (Janki, 2007).

However some villages have been able to obtain these, usually with assistance from the government of Guyana. Traditional water entitlement is taken to mean access to sufficient water.

Drawing on the definition used in Water and the Web of Life, "access" includes affordability and "sufficient" includes both quantity and quality. In Guyana, Amerindian communities have traditionally taken water at will, without restriction and without making any payment. The Guyana Water Authority (now replaced by Guyana Water Inc.) has assisted some villages to construct limited systems to make water available to communal buildings such as schools, community centres and health centres which are usually located in the centre of the village. Under these systems water is available free of charge (Janki, 2007).

The Global Water Supply and Sanitation Assessment 2000 Report sets rural water coverage in Guyana at 91 per cent. This figure which includes hinterland use under rural use is incorrect. The draft Hinterland Strategy shows that only 106 out of 148 settlements are covered by some form of improved water supply. These include 52 hand driven pumps, 8 engine driven pumps, 19 windmill driven pumps, 5 solar pumps and 3 electric sub-pumps. However even this analysis may be optimistic. Since Amerindians live at some distance from one another, an improved water point is unlikely to reach more than a few people and actual coverage from an improved supply may be very low. This means that traditional access to water remains a critical issue (Janki, 2007).

Rules of water allocation

There are no formal rules of water allocation within Amerindian communities. The likely reason is the abundance of water relative to the size of the population. Historically there has been sufficient water for each person or family within the community to abstract whatever is needed for their use. Communities have been established close to safe and reliable sources of water such as creeks and smaller rivers. With the exception of a few villages (e.g. Santa Rosa, Aishalton) the villages have relatively low populations (under 1,200) with all members of the community knowing one another. The pressure on water resources is reduced by the fact that families tend to live at some distance from one another and to locate their farms away from the village. As a result they may be using different sources of water. If there is a shortage then use has traditionally been reduced by consensus (Janki, 2007). There are no formal rules of water allocation within Amerindian communities. The likely reason is the abundance of water relative to the size of the population. Historically there has been sufficient water for each person or family within the community to abstract whatever is needed for their use. Communities have been established close to safe and reliable sources of water such as creeks and smaller rivers. With the exception of a few villages (e.g. Santa Rosa, Aishalton) the villages have relatively low populations (under 1,200) with all members of the community knowing one another. The pressure on water resources is reduced by the fact that families tend to live at some distance from one another and to locate their farms away from the village. As a result they may be using different sources of water. If there is a shortage then use has traditionally been reduced by consensus (Janki, 2007).

5. SOURCES

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

US Army Corps of Engineers (USACE). 1998. Mobile District & Topographic Engineering enter .

Water Resources Assessment of Guyana.

Janki, M. 2007. Customary Water Laws and Practices: Guyana. FAO-IUCN (The World Conservation Union). Available at www.fao.org/Legal/advserv/FAOIUCNcs/Guyana.pdf [accessed 26 February 2012]

Ministry of Agriculture of the Cooperative Republic of Guyana (MACRG). Integrated and Sustainable Management of Transboundary Water Resources in The Amazon River Basin, GEF Amazonas Project - ACTO/GEF/UNEP/OAS. Final Report National Vision Document. Hydrometeorological Service, November 2006. Available at: iwlearn.net/iw-projects/2364/reports/amazon-basin-vision/RelatorioVisaoGuiana30108.pdf [accessed 26 February 2012]

Organization of American States (OAS). 2005. Office for Sustainable Development & Environment. Amazon River Basin: Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin. Water Project Series, Number 8 - October 2005. Available at http://www.oas.org/dsd/events/english/documents/osde_8amazon.pdf [accessed 26 February 2012]