REPORT

New International Airport of Cabinda (NAIC Project) - Angola

Environmental and Social Impact Assessment - Chapter 10 - Impact Assessment, Physical Components

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10.0 PHYSICAL ENVIRONMENT – IMPACT ASSESSMENT AND MITIGATIONS

This section presents the results of the impact assessment on physical components conducted according to the Impact Assessment Methodology described in Chapter 9. For each impact factor identified, and considering all the physical components they might affect, an impact analysis will be presented, the related mitigation measures, and the residual impacts.

10.1 Impact Assessment for Construction Phase

10.1.1 Impact Assessment

As described in Chapter 09 of this ESIA (IA Methodology), the Project actions carried out during the Construction phase can be primary generators of environmental or social pressures, which are identified as impact factors.

The potential environmental impacts that may be triggered by the identified impact factors during the construction phase are described in the following table.

Table 1: Impact Assessment - Construction Phase.

Impact Factor	Impact Assessment	Components Affected
Removal/degradation of soil and vegetation	Excavation and vegetation clearance may locally modify the flow pattern and infiltration coefficient of meteoric water. These local effects may trigger or enhance sheet erosion phenomena. In addition, soil quality, structure, stability and texture can be affected by the loss of soil. The breakdown of aggregates and the removal of smaller particles or entire layers of soil or organic matter can weaken the structure of the soil and even change its texture. The soil in the Project area is of ferralsol type, which, in its natural state, is known for being stable and less susceptible to erosion than most other intensely weathered red tropical soils[1]. However, after land clearing, the natural balance between soil formation and erosion rates will be altered, possibly intensifying erosion processes. In addition, the construction of foundations and buildings involve also the compaction of the soil and changes of texture under and around these areas. Textural changes can in turn affect the water-holding capacity of the soil, making it more susceptible to extreme conditions such as drought. The Project has embedded mitigation measures to prevent soil degradation and erosion (mechanical, vegetative, and edaphic practices).	■ Soil
Change in the local morphology and topography	The construction activities of the project that can generate changes in the local morphology and topography are related to earth movements and excavation activities necessary for the execution of building foundations and subsequent filling and backfill activities; preparation of subgrades for the construction of roads, parking lots, aeronautical pavements; and earth movements for the construction of all the necessary infrastructure for the airport and campsite, among others. Changes to the visible landscape and changes in rainwater runoff patterns: the removal of large amounts of soil will change the local morphology. The impacts of this activity are associated with local changes in the pattern of water flow and infiltration on soil, which can trigger or enhance phenomena of accelerated erosion. In addition, voids left in the soil due to the removal of trees and vegetation will cause temporary changes in morphology. The area where the Project will be built is flat, therefore the risks of landslides or other earth mass movements are not significant.	■ Geomorphology and topography ■ Soil

[1] ferralsols.PDF (isric.org).

Impact Factor	Impact Assessment	Components Affected
Change in the local hydrology and surface water quality	Impacts on the hydrological regime and surface water quality could occur during the construction phase due to the discharge or introduction of pollutants into freshwaters, mainly due to the discharge of stormwater. Temporary Drainage Systems will be constructed. The stormwater collected through the system will be directed to ponds or to natural courses, depending on technical and economic feasibility. The ponds are the same ones that will be later used for Airport Operations and are located near the runway. According to the latest information provided, 6 stormwater outlets around the Project site are foreseen to discharge stormwater into natural streams, which are most likely to be temporary water streams (location of these outlets are shown in the Chapter 02 Project Description, section 2.4.1.1.6). If no effective filtration or treatment is applied before the stormwater is discharged, harmful pollutants may reach freshwaters. However, the Contractor has informed that that several Oil / Grease Interceptors will be located in the areas prone to be in contact with Oil / Grease utilization (Apron / Runway, Main Buildings, Mechanical Building, Fire Rescue Building etc.), therefore the risk of contamination of surface waters will be reduced. It is expected that, during construction, the ponds will be regularly emptied by a licensed company.	■ Hydrology and Surface Water
Change in the local hydrogeology and groundwater quality	Information from the scientific literature regarding groundwater resources is scarce. Initially, the geotechnical study performed at the Project site did not reach the aquifer. Of a total of 31 drilled boreholes, three were grooved with the aim of finding the water table: - a well with a depth of 25 meters (altimetric elevation 148.6 m); - a well with a depth of 10 meters (altimetric elevation 148 m); - a well with a depth of 10 meters (elevation 145 m). Therefore, a new survey has been conducted. The company MAFUKABINDA L.d.a. drilled a borehole on the Project area by operating direct rotation with injection of bentonite sludge and biodegradable polymers. The borehole reached a depth of 192 m and has been equipped with a submersible pump to extract the water (i.e., a Grundfos SP14-31 pump with a motor capacity of 7.5 kW, pushed to a depth of 140 meters below the local ground level). According to the hydrogeological data collected, the aquifer flows about 96 m below the local ground level; the area is underlain by alluvial sand, silt and coarse gravels Pliocene-Quaternary deposits. Above the groundwater level, the hydrogeological survey revealed the existence of clay layers, which generally act as barriers and protect the aquifer from potential infiltrating contaminants. However, no matter the type and depth of the aquifer, it should be considered that the groundwater pollution may occur indirectly, through consistent soil pollution resulting from runoff infiltration or from accidental spills onto the ground. The water well - given its crossing through low permeability clayey layers - may act as preferential contaminants flow pathway. The sampling and analysis activities on the local groundwater are currently ongoing. Reportedly, a licensed local testing laboratory is completing the analyses; the results will be issued in the following weeks (after the ESIA delivery deadline).	■ Hydrogeology and Groundwater

Impact Factor	Impact Assessment	Components Affected
Emission of greenhouse gases	Emission of GHGs will occur during several activities in the construction phase. This impact is analysed at national and global level since GHG emissions in the Project AoI during construction will not significantly impact the air quality locally but will contribute to the accumulation of GHGs emitted by Angola. Angola submitted its preliminary revised NDC in May 2021[2]. According to the GHG inventory performed by the Contractor, the entire construction phase (more than 2 years) will be responsible for the emission of around 110,000 tonnes of CO_2 equivalent (tCO_2e). For projects that are expected to or currently produce more than 25,000 tCO_2e annually, the client should quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the project. Quantification of GHG emissions should be conducted by the client annually in accordance with internationally recognized methodologies and good practice. Construction activities and their potential impacts on the atmosphere from GHG emissions are described below: - Clearing vegetation: this action will require the use of machinery, which releases CO_2 into the atmosphere. In addition, as an indirect impact, plants remove carbon dioxide from the air naturally, and trees are especially good at storing CO_2 removed from the atmosphere by photosynthesis. The removal of vegetation interrupts the natural carbon capturing process; - Earthworks, which use heavy-duty vehicles (excavators, dump trucks, vibrating roller, loaders), which are driven by diesel engines and generate large quantities of pollutants, among them is carbon dioxide (CO_2); - Transportation needed for vary activities, such as procured materials, solid waste disposal, soil disposal, etc, using vehicles that burn fossil fuels; - Use of powerhouse generator sets. In case the generators are used due to power interruptions from the public electricity distribution network, CO_2 will be released to the atmosphere due to fossil fuel burning; - Use of concrete: the impact of this activity in GHG emissions will come from the supply chain and is indirect. The construction phase will require 34.4 thousand m^3 of concrete, which will be produced at the construction site. The release of CO_2 into the atmosphere is related to cement, the main ingredient to produce concrete. The chemical manufacturing process for cement produces significant amounts of CO_2. In fact, worldwide, the manufacture of cement is responsible for around 8% of global CO_2 emissions[3].	■ Air Quality
Emission of dust and particulate matter	Dust comprises particles typically in the size range up to 75 micrometers (µm) in aerodynamic diameter. The larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited near the source of emission. Dust, therefore, is unlikely to cause long-term or widespread changes to local air quality.	■ Air Quality ■ Soil

[2] Under their revised NDC, Angola brought forward their target year for cutting emissions from 2030 in their first NDC to 2025, with the country aiming to reduce emissions up to 14% compared to business-as-usual, with a further 10% conditional on support. Source: NDC Angola.pdf (unfccc.int).

[3] Concrete is Worse for the Climate Than Flying. Why Aren't More People Talking About It? - Inside Climate News.

Impact Factor	Impact Assessment	Components Affected
	Any process that generates dust will also generate fine particulate matter (PM). Such particles can be inhaled and can result in significant health effects. Toxicity of particulate matter depends greatly on their size, less than 10 or 2.5 microns (PM_{10} or $PM_{2.5}$) considered especially dangerous since they can easily penetrate the lungs into the alveoli. Construction activities associated with the Project that have the potential to generate and/or resuspend dust are likely to include: - Excavation, levelling and loading activities; - Movement of trucks and construction vehicles on and off-site; - Materials handling, storage, stockpiling, and disposal; - Generation of construction waste; - Generator sets (in case they are used). During construction, these activities are short-term and temporary. In addition, the emission of dust and particulate matter also have the potential of degrading/polluting the soil. A major risk comes from chemicals that can more easily travel through the air as fine particles. These products are more resistant to degradation and can bioaccumulate in living organisms, such as polycyclic aromatic hydrocarbons (PAHs). In addition, when pollutants present in the air mix up with the rain and fall back on the ground (acid rain), it could also change the soil structure.	
Emission of gaseous pollutants	Several gases chemical species may lead to adverse health effects. Gaseous pollutants typically comprise sulphur dioxide (SO_2), ozone (O_3) nitrogen oxides (NO and NO_2), carbon oxides (CO and CO_2), and PAHs. Other air pollutants such as certain heavy metals and persistent organic pollutants, accumulate in the environment and can enter the food chain causing indirect exposure to them. Construction activities associated with the Project that have the potential to release gaseous pollutants are likely to include: - Vehicles use, which generate air pollutants from engine combustion, such as CO, volatile organic compounds (VOCs) and lead emissions; - Excavation, levelling and loading activities. Machinery such as the excavators and dump trucks used in the Project operate on diesel engines and release pollutants into the air. These include CO, CO_2, NOx and hydrocarbons. - Use of hazardous chemicals that may include paints, glues, oils, thinners, and plastics, which all produce noxious vapours, such as VOCs.	■ Air Quality
Emission of noise and vibrations	**<u>Emission of noise from on-site activities</u>**	■ Noise and Vibration

Impact Factor	Impact Assessment	Components Affected
	Construction activities inevitably lead to some degree of noise disturbance at locations near the construction activities. It is however a temporary source of noise. Noise levels at any one location will vary as different combinations of plant / machinery are used and throughout construction activities when the locations of activities will change. Construction activities such as vegetation clearance, earthworks, mobilization of vehicles, workers and equipment, transport of materials and waste (which will increase the amount of traffic), road works, buildings' construction and infrastructure construction are expected to generate noise and vibration. The following construction stages are anticipated to represent worst case activities generating greatest noise emissions and have been adopted for the assessment: - Stage A – Runway side – Earth works - Stage A – Runway side – Pavements and drainage - Stage B – Ground side – Road construction - Stage B – Ground side – Landscaping The above stages are considered to represent the closest possible activities to sensitive receptors involving the most intensive operations. **Changes in road traffic noise arising from construction traffic** The increase of traffic during construction with vehicles using the existing road network has the potential to increase noise levels at sensitive receptors located adjacent to roads used by construction traffic. Public information on existing road traffic flows to the Project Site is not currently available. An assessment has therefore been undertaken on a qualitative basis considering baseline information available to date and the likelihood of construction traffic resulting in significant road traffic noise increases. A quantitative assessment will be carried out once the results of the traffic count survey will be available. In line with guidance provided within the International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines, General EHS Guidelines, noise level increases below 3dB at the receptor are considered to be of negligible intensity (not significant). **Construction vibration**	

Impact Factor	Impact Assessment	Components Affected
	Construction activities also have the potential to generate notable ground borne vibration, however, vibration from construction related activity is unlikely to be significant at distances over 100m from the source[4]. As the distance from the boundary of the site and the nearest sensitive receptor is greater than 400m, significant vibration impacts are not anticipated. Assessment of construction vibration has therefore not been undertaken.	
Existence of new buildings/infrastructures	The land occupation by buildings and infrastructures mean that land is occupied, and less soil is available to interact with atmosphere (urbanization). This decrease in exposed soil affects the amount of soil moisture evaporation. Combined to the fact that buildings and roads are directly exposed to sunlight and therefore absorb heat during the day, this urbanization process could contribute to the formation of heat islands, especially during the day. In addition, the construction of permanent road infrastructures (including airport access, parking lots construction, installation of aeronautical pavements) have the potential to pollute the soil: - Roads require the introduction of a range of materials, primarily in the layer works, which may have the potential to contaminate the soil. The primary materials of concern include bitumen (asphalt) and cement. - Bitumen and cement have the potential to contaminate the soil depending on the volumes that are mobilized. - Impacts can occur not only where the roads will be built/improved, but also in the storage/preparation areas for these materials.	■ Soil
Production of solid waste	Environmental impacts caused by the production of solid waste will potentially be related to soil pollution, in the case waste management is done inappropriately. The generation of hazardous waste streams have also the potential to impact soil. Chemicals in contact with soil can result in lasting damage to the functionality of polluted soils. While these effects of pollution are reversible, depending on the type of chemical product, it can take a long time (decades or more) to adequately restore baseline conditions, and the cost of corrective action can be extremely high. Also, waste generation has the potential to result in impacts on the waste management system and practices and on the environment within the AoI. Potential impacts may arise in the situations listed below: - hazardous waste is not properly stored onsite prior to collection. Potential impacts from improper treatment, storage and disposal of hazardous wastes may include contamination of soil or groundwater (indirectly) and impacts to human health.	■ Soil ■ Solid Waste

[4] This is based on the guidance in the Design Manual for Road and Bridge LA111 *Noise and Vibration* (2020) which states that "*a study area of 100m from the closest construction activity with the potential to generate vibration is normally sufficient to encompass vibration sensitive receptors*" and that equations for predicting groundborne vibration arising from mechanised construction works in BS 5228:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites* Part 2: *Vibration* are only valid up to a maximum of 110m.

Impact Factor	Impact Assessment	Components Affected
	- waste is not properly transported. - disposal sites are not designed and operated to adequate standards. - inert wastes generate local nuisance due to dust and litter from the handling of the materials themselves. However, the Project has embedded mitigation measures in place to prevent this from happening: - According to the information received, all solid waste produced on the different work fronts and site will be sorted at source and will be collected by the Cleaning and Environment teams of the constructor consortium and sent to the Waste Management Centre (WMC), where the waste will be temporarily stored and, depending on the type of waste, it will be treated and sent to its final destination. - The Project will also implement several measures for recycling/reusing of waste, such as organic composting, residual cooking oil transformed into soap, re-use of toners and cartridges, re-use of plastic bottles, among others. A licensed local/national waste company will be in charge of collecting all the waste that will not be recycled/reused in the construction site and transport it to the area designated by the Municipal Administration of Cabinda, the Yema dumpsite, close to the city of Cabinda, about 60 km from the NAIC. However, it should be noticed that the conditions of the Yema dumpsite are not aligned to international standards[5]. According to the field photographs provided by the Contractor, the site is not properly managed, there is no fence, housekeeping is poor and the waste cells are not lined nor provided with a leachate control system. In the current conditions this dumpsite does not meet Project standards and should not be considered a waste disposal option for the Project. The Government of Cabinda has selected an area to implement a new sanitary landfill with a waste collection area and a waste treatment centre which, reportedly, will be designed to allow waste separation and segregation, recycling and recovery. This will be located at Subantando Village, about 47 km from NAIC. However, according to a recent site visit made by the Contractor, the schedule for construction is still uncertain and there is no date for the beginning of the construction. Hazardous waste: It has been reported that the hazardous waste including oil residues, generated ashes, and hazardous waste from outpatient area, will be temporarily stored in the WMC located at site and then collected by a licensed company for incineration. The company is called Angola Environmental Serviços[6]. They are licensed and have an incineration facility in the Province of Soyo, Angola.	

[5] ATERRO SANITÁRIO DE CABINDA UM ATENTADO À SAÚDE PÚBLICA – MBEMBU BUALA PRESS (avozdecabindambembubuala.com).

[6] **AES – Angola Environmental Serviços**.

Impact Factor	Impact Assessment	Components Affected
Production of wastewater	Domestic wastewater (which originates predominantly from toilets, sinks, showers, washing machines, kitchens, floor cleaning in administrative areas, bedrooms, and bathrooms) and construction wastewater (site surface runoff, vehicle and equipment washing, wastewater from mortar production, washing of asphalt plant structures, etc) will be produced during the construction phase. The improper disposal of Project wastewater could adversely affect the environment, human health, and nearby vulnerable ecosystems. Wastewater can contain hazardous substances, such as oils and chemicals, which can contaminate soil, surface water sources and even groundwater. The Project has identified several mitigations to prevent environmental contamination from wastewater: an underground Wastewater Treatment Plant and the implementation of septic tanks will treat the wastewater, while sanitary drains will collect the effluents to the nearest water drains. The produced sludge will be collected by licensed operators and disposed in authorized facilities. The final destination of effluents has not been indicated, yet. The Province of Cabinda does not have a wastewater collection system. The Project is considering viable options including the use of mobile waste water treatment plants.	■ Hydrology and Surface Water ■ Soil ■ Wastewater
Energy and fuel demand	All Project activities will require some type of energy to be performed, either through the combustion of fossil fuels for the operation of vehicles and machinery (and possible use of diesel generators in the case of power outages), or through the use of electricity for the workers accommodation (air conditioners), offices (air conditioners, notebooks, monitors, printers, etc.), laundry rooms, and kitchen (air conditioners, industrial kitchen equipment, refrigerators, etc.). Impacts related to the use of fossil fuels are directly linked to air pollution by various pollutants, as explained above, in the sections of “Emission of gaseous pollutants” and “Emission of greenhouse gases”. Regarding electricity needs, the Project will be connected to the public electricity grid, supplied by the Futila Thermal Power Station, located in Malembo, adjacent to the NAIC. The plant has two turbines and dual system (diesel and gas), therefore in case of shortage of gas, the plant can also run on diesel. It is known that fuel-fired thermal power plants are not environmentally friendly with main pollutants resulting from natural gas electricity production being nitrogen oxides (NOx), which can cause respiratory problems, and also react with other substances in the air to produce particulates and ozone. Therefore, indirectly, the Project will be contributing to local air pollution due to electricity consumption. In relation to GHG emissions, according to the GHG emissions inventory prepared for the construction phase, no scope 2 emissions were considered for this phase since they will probably be minimal.	■ Air Quality

Impact Factor	Impact Assessment	Components Affected
	The Project will implement LED street lighting luminaires at the access to the airport premises (NAIC access road, Sassa-Zau road and roundabout). LED lighting have been selected for their low energy consumptions, long life and high efficacy compared to conventional street lighting fixtures.	
Water demand	The Project construction activities will use water from two sources: 1) The Cabinda Water Supply Network, whose pipes pass through the Sassa-Zau road (very close to the NAIC site), which is supplied by surface water intake from the Chiloango River. The surface water abstractions may put water systems under pressure through flow regime modification and morphological alterations. Impacts of this nature are currently considered to be low, since the Province of Cabinda is considered to have very low water scarcity risk at the present scenario[7]. 2) A water well has been constructed within the NAIC site, in the Water technical area. The existence and use of the well may have adverse effects on the groundwater. On the one hand, poorly constructed wells can result in groundwater contamination: construction problems, such as faulty casings, inadequate covers or lack of concrete footing, could allow external water and any accompanying contaminants to flow into the well. On the other hand, it is expected that water from the well will be used for construction activities (which will last 48 months). Without proper consideration of aquifer characteristics and without pre-defined groundwater management, an excessive pumping without respecting aquifer recharge rates could contribute to groundwater depletion. According to the hydrogeological study conducted on site while drilling the well's borehole, the maximum water flow limit advisable - in order to avoid the aquifer damage - is of 14 m^3/h. The groundwater, prior using it onsite, depending on its turbidity and salinity levels, might require treatment. According to the baseline data collected, both the surface water sampled from the Chiolango River and the groundwater intake from the water well present contamination. The Water Treatment Plant dimensioning and operation will take into account the surface water and groundwater chemical-physical characteristics (i.e., the physical values and the pollutants measured). Also, to mitigate potential impacts, the Project will reduce water consumption through the reuse of effluents originated from: a) the Wastewater Treatment Plant; b) the Water Treatment Station for backwashing of filters; c) the washing of concrete mixers and concrete mixer trucks; d) the water and oil separator.	■ Hydrology and Surface Water ■ Hydrogeology and Groundwater
Demand for raw materials and goods/supply chain	Many of the raw materials used for the construction activities will come from local quarries for granular materials (sand, gravel, stone powder, etc). They are outside the Project AoI, close to Kakongo.	■ Geomorphology and topography

[7] Think Hazard - Cabinda - Water scarcity.

Impact Factor	Impact Assessment	Components Affected
	In this case, a change on morphology and topography will happen indirectly, when considering the exploitation of these quarries. In addition, impacts on soil will also happen indirectly since the operation of quarries and borrow pits always generate impacts on the soil, as the soil layer will be removed.	■ Soil

10.1.2 Mitigation Measures

The mitigation measures listed below follow the mitigation hierarchy and are proposed for the construction phase; these measures will be implemented in addition to those included in the standard procedures applied by the Contractor and, eventually, by ASGC to achieve compliance with legal requirements and regulations and alignment with GIIP.

Table 2: Mitigation Measures - Construction Phase.

Mitigation hierarchy	Mitigation Measure
Impact Factor: Removal/degradation of soil and vegetation	
Avoidance	Avoid the unnecessary removal or degradation of soil and vegetation. The Contractor will forbid unnecessary soil excavations and vegetation clearance which can lead to a soil weakening and an excess of waste generation. The Contractor will plan in advance the soil and vegetation removal activities. The Contractor will ensure that: - an Erosion control and Reinstatement Management Plan will be adopted; - the Project's footprint is minimized, only the strictly necessary soil portion will be degraded and – consequently - only the strictly necessary buildings and facilities will be built, as per the design; - the amounts of excavated soils and rocks and the vegetation clearance reflect the Project's specifications (i.e., about 270k m3 of topsoil and 630k m3 of subsoil, inclusive of the areas already excavated); - an attentive planning and supervision of the activities prevents potential and unnecessary intentional or accidental deterioration of soil and vegetation; - barrier, mash or other types of soil containing measures are installed; - in case no barrier, mash or other types of soil containing measures are installed, the excavation fronts - given the lithology on site - will have a natural slope angle of 30° for preventing further soil deterioration through sliding and falls.
Avoidance	Avoid random storage of goods and materials. The Contractor will ensure that no random storing of construction materials, hazardous products (e.g., waste, chemicals, oils and lubricant bins, see Impact factors *Production of wastewater* and *Production of solid waste,* and section "*Minimize the risk of groundwater degradation*" of the impact factor *Change in the local hydrogeology and groundwater quality* for further details) and equipment will be done on the construction site. Before starting the construction activities, the Contractor will properly define the storing locations; the storages boundaries and their setup will be defined depending on the local soil and vegetation vulnerability and on the type of materials to be stored. While setting and using such areas, the Contractor will appoint an eligible specialist (e.g., an employee of the HSE team) for supervising the activities. The periodical supervision will prevent the non-compliant or random storage of products and materials on improper locations that can lead to soil and vegetation degradation.
Avoidance	Avoid using pollutant practices for removing the vegetation. The use of fire, harmful herbicides or similar substances will be strictly prohibited. For preventing the spread of pollutants, the Contractor will forbid the usage of those pesticides considered dangerous, herbicides and additives which are harmful for the human health and the environment. The Contractor will also ensure that vegetation will be removed mechanically and not with the use of fire.
Minimization	Minimize the adverse effects on the natural state of the soil. The modifications to the first layer of the soil will be minimized for preventing adverse effects on the local permeability and, consequentially, on the infiltration rates and the soil capacity of holding and distributing the water and the potential pollutants. The excessive structural change will be avoided for preventing the generation of preferential paths for the pollutants or for preventing an excessive decrease of soils permeability. During the construction activities (e.g., excavation, vehicles moving) the Contractor will ensure that practices like shrinkage and excessive soil compaction is avoided.

Mitigation hierarchy	Mitigation Measure
Minimization	Minimize the soil weathering by protecting the excavated surfaces. The Contractor will install layers (e.g., geotextiles, tarpaulins) and barriers for protecting the excavation fronts and surfaces from weathering and washing away/wash out.
Minimization	Minimize the effects of the moving vehicles. The over consolidation of soils and the vegetation disruption will be prevented - or at least limited - by keeping the moving vehicles (e.g., dumper trucks, concrete mixers, bulldozers) on predefined paths and roads to be well identified prior starting the construction activities. The onsite roads will be properly paved, highlighted, and delimited. The same rules will be applied to the area on which the construction already started.
Restoration	Topsoil and excavated material will be stockpiled and reused for backfill / rehabilitation. When planning the backfilling, the Contractor will consider that: – the excavated material should be re-used to the maximum extent practicable; – in case more material is needed for backfilling, the Contractor will purchase clean and certified material (commercial by-products will be used when natural materials are unavailable); – the excavated soil generated during the excavation activities will be removed and eventually used for backfilling or for landscaping at the end of construction; – the excavated soil not used for backfilling will be properly temporary stored and then transported by a certified company to landfills or, preferably, to recovery plants according to the Project standards, the regulatory framework and the municipality indications (see also section on waste); – any contaminated soil within the construction site area will be removed and disposed as hazardous waste. The potential contaminated soil will be properly segregated on containment systems or waterproofing sheaths and under roofed areas prior its shipping to recovery plants/landfills (see sections of the impact factor Existence of new buildings/infrastructures for further details).
Compensation	Compensate for the loss of vegetation. Where possible, the Contractor will revegetate the area for compensating the loss of vegetation and prevent further soil degradation.
Impact Factor: Change in the local morphology and topography	
Avoidance	Avoid unnecessary morphology and topography changes. The Contractor will ensure that unnecessary levelling and excavations will be avoided. The excavation rates will follow the Project design specifications, which will be designed based on the site-specific characteristics and on the natural state of the landscape. Likewise, even the creation of unnecessary high reliefs will be avoided.
Minimization	Minimize the disturbance to the existing contour. The Contractor will ensure that no excessive changes of the local morphology and topography will be generated and that – where possible - the general slope of site will be preserved. No unauthorized and uncontrolled piles and mounts of soil and rocks, debris or waste (although temporary) will be raised, and no digging of materials will be allowed. The operations will strictly follow the Project design drafted accordingly to specific technical studies. The works will consider the morphology and topography of the site and the pattern of the water flow and the infiltration rates. During the vegetation clearance, the excavation and the foundations laying, no voids will be left (i.e., sinking prevention) and no unnecessary soil over consolidation will be carried out.
Restoration	Restore the excavated areas in short times. The Contractor will ensure that the excavated areas will be restored in a short time; this will prevent generating landslides, collapses and pits and ponds due to heavy rains.

Mitigation hierarchy	Mitigation Measure
	Restoring the excavated area will also have a positive effect on the overall visual impact of the construction site.
Impact Factor: Change in the local hydrology and surface water quality	
Avoidance	Avoid improper management of stormwater. Considering that the temporary drainage system will direct the generated stormwater to surface seasonal water channels and to water ponds (to be built with the aim of reusing the rainwater), the Contractor will ensure that: – a *Soil and Drainage Management Plan* will be drafted and adopted for the whole construction time frame; – the stormwater will be properly collected through a functional surface temporary drainage system and discharged, after applying a proper filtration or treatment, to ponds (for reusing it onsite, where possible) and/or to seasonal natural water channels/streams; – the discharge into the seasonal natural water channels/streams will exclusively occur during the rainy season; – the ponds content (i.e., rainwater) will be reused (prior assessing the absence of pollutants) to the extent possible; – the ponds will be periodically emptied by vacuum trucks, operated by proper licensed companies; – the ponds emptying frequency will be defined considering the rainy season and the dry season; – the ponds bottom will be covered with a waterproofing layer for avoiding the soil absorption of the wastewater; – the ponds will be properly fenced, and their water level will be assessed continuously by appointed workers.
Avoidance	Avoid leaks and spills to surface water bodies. Even though there are no lakes, rivers, or ponds in the immediate vicinity of the Project area (the closest major river is the Chiloango, located about 5 km from the site, as already mentioned above) transportation of materials to site could be a potential source of surface water bodies pollution, especially in the wet season when seasonal water streams are generated in case of storms and heavy rains. Pollutant leaks and spills potentially generated during transportation by road will be avoided. The moving vehicles (e.g., trucks, dumper trucks, concrete mixers, bulldozers, etc.) will follow predefined paths and roads, will avoid crossing water bodies and will be regularly cleaned and repaired/maintained. For example, the Contractor will ensure that vehicles will be rinsed before leaving the construction site, goods and materials transported properly secured to avoid tripping, flipping and overflows . Vehicles will be equipped with spills prevention kits and the drivers will trained for properly behaving in case of incidents, accidental spills and leaks. A *Traffic Management Plan* will be drafted and adopted.
Avoidance	Avoid discharging liquid, semi-solid or muddy materials into surface waters. The Contractor will ensure that no intentional discharge of liquid, semi-solid or muddy materials into surface waters will be carried out. The proper supervision of materials quantities, paths and destination will help preventing such potential issue.
Avoidance	Avoid generating uncontrolled water pits and ponds. The Contractor will prevent any type of action that can lead to the generation of uncontrolled and unplanned pits and ponds, such as soil over consolidation and uncontrolled wastewater discharges. Proper runoffs and stream channeling design will prevent such risk. In case heavy rains leads to the generation of pits and ponds, the

Mitigation hierarchy	Mitigation Measure
	Contractor will promptly complete their removal by pumping the water by means of vacuum truck and disposing it of as per the Project specifications and requirements.
Minimization	Minimize surface water pollution. The potential pollution of minor surface water bodies (e.g., seasonal water channels eventually generated) will be avoided by controlling runoffs with potential adverse effects: – the storage of solid and liquid products and waste on the construction site will be properly managed (see mitigation measures related to storage and handling suggested for the Impact factors change in the local hydrogeology and groundwater quality, Production of solid waste and Production of wastewater); – the fine-grained material will be stockpiled, and placed 30 m from drains and water channels; – spreading and runoff of uncontrolled wastewater, oils, fuels or chemicals will be avoided; – the Contractor will design and install a station for managing wastewater from the construction site activities (WWTP, see the section of the Impact factor *Production of wastewater* for further details).
Restoration	Restore the natural hydrological conditions. The Contractor will design - in conformity with the topography of the site and of the local geology and hydrogeology – a proper temporary stormwater system network for managing runoffs across the construction areas.
Compensation	Revegetation / landscaping in line with design specifications. The Contractor will consider in the Project design the reduction / loss of permeable surfaces and the soil permeability and consider the installation of flowerbeds, green areas, grid paving or other types of surfaces having higher permeability (see "*Compensate for the loss of vegetation"* above in the Impact factor *Removal/degradation of soil and vegetation*).
Impact Factor: Change in the local hydrogeology and groundwater quality	
Avoidance	Wastewater discharges. The Contractor will design wastewater collection, treatment and discharging systems to avoid uncontrol discharges in the groundwater. The civil/domestic wastewater, the process water and the stormwater deriving from the construction site will be collected and discharged as per the Project specifications (see the section related to the Impact Factor *Production of wastewater*).
Avoidance	Polluted water. The Contractor will ensure a proper management of process water from the construction sites. The water deriving from both sources (i.e., the water well and the Cabinda public network, as described in the section of the Impact factor *Water demand*) will be sent to a raw water tank and then treated through a water treatment station for ensuring compliance with legal requirements and the Project standards and specifications. Water samples will be collected every three months and analyzed – according to the Project standards - throughout the 48 months of the construction phase. The parameters to be analyzes are listed in *Chapter 04 – Legal Requirements (Table 10: Groundwater Standards, Table 11: Drinking-Water Standards* and *Table 12: Surface Water Standards)*. Regarding the groundwater uptake from the water well, its sampling and analysis will be completed every three months. The parameters to be analyzed are Metals, Inorganic compounds, Aromatic compounds, PAH, Chlorinated Hydrocarbons, other contaminants like the mineral oil and the Total Hydrocarbon Content. The measured parameters should comply with the Dutch Standards. If a contamination of groundwater is suspected or confirmed, the cause will be investigated and the pollution will be managed. Specific evaluations will take place before starting the construction activities on the potential polluted areas and the local authorities will be consulted for identifying the responsible

Mitigation hierarchy	Mitigation Measure
	and the measures to be adopted (e.g., remediation) according to the Project standards and the Angolan regulatory framework. The Contractor will keep the water analysis results and register the monitoring campaigns dates on a specific log to be kept on site. Considering that the construction has started already, the log should show the results of the water testing completed prior starting the activities.
Avoidance	Avoid the environmental degradation while drilling additional the water well eventually needed. The groundwater level is deep (i.e., almost 100 m below the local ground level), however, while drilling new water wells eventually needed, potential spills and leaks of dangerous products (i.e., fuels, oils and lubricants) will be avoided. Water wells will be installed strictly following the Project specification in order to avoid the potential generation of preferential paths for pollutants. Any usage of dirty drill corers will be avoided.
Minimization	Minimize the likelihood of the water well deterioration and disruption. Given the local lithological conditions, the well can be easily clogged with sand, so a proper filtration system should be considered in addition to a secure cover resistant to weather, contaminants, insects and the infiltration of water and sand. The water well top (i.e., its casing/secure cover/protector) will be rising of at least 30 cm above the ground level and it will be well-visible for avoiding its potential disruption during the construction activities (e.g., its demolition while excavating the soil or its burial).
Minimization	Minimize the risk of groundwater degradation. There are activities and practices that can pollute the groundwater. Considering that the soil permeability on site will facilitate the absorption, the flow and circulation of water containing potential pollutants, the Contractor will ensure that: – a *Pollution Prevention Plan* and a *Waste and Hazardous Materials Management Plan* will be drafted and adopted; – groundwater sampling and testing will be completed when reaching the aquifer; – oils, fuels, liquid waste and other hazardous liquid or semi-solid materials will be properly stored in specific locations equipped with spills prevention kits and emergency eyes washing stations; – the dangerous materials will be properly labelled and arranged on containment systems or waterproofing sheaths and – where necessary - under roofed areas (i.e., protection from washout and weathering); – there will be no connection between the storage areas and the permeable surfaces, the green areas and the rainwater drainage channels; – an inventory of all potentially polluting materials chemicals will be kept at the construction site office; – the proper handling and storage of potentially pollutive chemicals and hazardous materials will reflect the indications on the corresponding Material Safety Data Sheets (MSDSs); – the work areas and the equipment, machinery and moving vehicles will be periodically washed, cleaned and maintained; – the generation of fast paths for pollutants in the deepest soil layers (e.g., unnecessary on improper boreholes drilling) will be avoided. See section *Existence of new buildings/infrastructures* for further details on the environmental protection and pollution prevention and control.
Restoration	Restore the water well area. The soil around the water well will be constantly graded and properly restored for preventing water pooling and water runoff in its vicinity.

Mitigation hierarchy	Mitigation Measure
Impact Factor: Emission of greenhouse gases	
Avoidance	Avoid materials and resources exploitations. The Project design will detail the type and amounts of materials and resources to be used. The materials will be purchased based on the Project requirements. Waste of new and unused materials or resources will be limited using cost-effective solutions. The Contractor will draft policies and guidelines inclusive of best practices for avoiding wasting materials and resources.
Avoidance	The vehicles, equipment, and the machinery, while not in use, will be properly switched off/turned off for avoiding unnecessary emissions of greenhouse gases and waste of resources (e.g., oils and fuels).
Minimization	Minimize the greenhouse gases emissions. ASGC shall report on the actual usage of fuels, electricity usage etc during the construction period as per detail provided by OEC in monthly monitoring reports. The quantification of GHG emissions will be conducted by OEC annually in accordance with internationally recognized methodologies and good practices. The Contractor will monitor/record/report relevant data to ASGC for and will decrease the overall greenhouse gases emissions throughout the construction phase by adopting specific measures such as: – adopting a *Pollution Prevention Plan* and an *Air Quality Management Plan* that will include a specific section on the GHGs; – minimizing, to the extent possible, the impact of materials and goods transportation to site by defining preferential roads (i.e., shorter paths). Considering that some construction activities related to the workers camp have already started, the Contractor should ensure that the roads have been properly defined. The materials and/or equipment used at site will travel by road, by sea and by air as they will come from quarries close to Cabinda (i.e., via national roads) and from other parts of Angola, of Africa, Europe, South America and Asia. The Contractor should try to source materials from nearby suppliers and prefer, where possible, transportation methods with minor impact on the environment; – sourcing, where practical and cost-effective, plants, machineries, vehicles, and equipment operating on carbon-neutral biofuels or renewable energies; – ensuring that the cooling systems to be installed in the administration/offices area will contain exclusively refrigerant gases with low global warning potential (GWP); the cooling system will be periodically inspected for detecting potential pollutive gas leakages; – defining strategies for decreasing waste generation through reuse and recycling limiting waste disposal to landfills (see section *Production of solid waste*); – preferring eco-friendly building materials and considering installing renewable energy on-site to be used for the construction phase and then also to be transitioned to the operational stage. It should be considered that concrete is one of the most carbon-intensive construction materials as it requires extreme heat and releases a great deal of CO_2. The Contractor should evaluate the opportunity of using low-carbon concrete over traditional materials (i.e., low embodied carbon construction materials).
Compensation	Compensate the construction phase GHG emissions. The Contractor should compensate the increase of GHG emissions generated by the construction activities by revegetating of areas within the project footprint.
Impact Factor: Emission of dust and particulate matter	

Mitigation hierarchy	Mitigation Measure
Avoidance	Avoid dust emissions deriving from the construction materials storages and from the excavated soil and rocks piles and mounts. The Contractor will draft and adopt a *Pollution Prevention Plan* and an *Air Quality Management Plan* for avoiding dust and particulate matter spreading: – the excavated material temporarily stored at the different construction areas for later use, disposal, or reuse in other areas, will be properly segregated, kept wet by spraying water to limit dust generation; – the granular material will be stored in stalls, or in controlled and treated heaps protected with tarpaulins; – covered and uncovered warehouses for storing small/medium construction materials and equipment will be installed; – the height of the mounds/piles of loose material will not exceed 2 m and the slope angle will not be more than 30° for preventing flows and sliding; – wind barriers (protective fences) will be used when necessary. The Contractor will supervise the construction site for ensuring the proper adoption of the mitigation measures and the compliance to the Dust Management Plan by carrying out periodical visual inspections. See the Impact factor *Removal/degradation of soil and vegetation* for further details.
Avoidance	Avoid dust emissions from moving vehicles. The Contractor will define rules, guidelines, and indications within the Traffic Management Plan to manage dust emissions from the construction areas. The Contractor will periodically assess the site compliance to the management plan. Actions that will be implemented on the Project area during the construction activities for avoiding the dust spreading from moving vehicles could include: – when needed under specific dust conditions and at designated areas roads will be sprayed to reduce dust generation; – the definition of pre-defined routes for vehicles across the construction areas; – adopt speed limit for heavy vehicles within construction site; – when needed and at designated areas, gravel could be disseminated for increasing the surface strength and decreasing the particulate and dust emissions; – trucks and other moving vehicles transporting loose materials will be covered up during transportation for avoiding dust and particles spreading; – fenders will be applied to the wheels of the trucks against dust emissions. – the access to the Project area will be forbidden to delivery trucks showing oils and fuel losses/dripping or clear signs of engines breakages; – trucks and other moving vehicles that will leave the project site will be washed/cleaned if necessary prior to leave the construction site. The Contractor will supervise the construction site for ensuring the proper adoption of the mitigation measures by carrying out periodical visual inspections.
Minimization	Minimize the dust emissions deriving from the construction activities. Earthworks, excavation, soil stripping and earthmoving will generate dust and particulate matter, especially during the dry seasons. The Contractor will ensure that: – water will be available on site for dust suppression; – the construction activities will not result in exceedances of relevant air quality objectives/limits;

Mitigation hierarchy	Mitigation Measure
	– dust control and mitigation measures provided in the management plans and described in the Project standards will be effectively applied; – the excavation surfaces will be stabilized, covered up and/or re-vegetated if practical; – abetment measures and control systems (e.g., welding tents and barriers or mobile aspirators equipped with filters) will be adopted, when needed. Operations such as welding, cutting, grinding and sandblasting (representing major sources of airborne particles) will be carried out by using proper equipment and techniques compliant to the environmental and safety measures, especially when harmful construction materials containing silica (e.g., concrete or abrasives) are processed; – where possible, hazardous and pollutant operations such as cutting will be avoided by preferring prefabricated materials; – mobile plants for crushing, screening and grading the materials should be authorized by the appropriate local Authority and should be sited as far away from possible from sensitive receptors. The Contractor will carry out periodical site inspection for assessing the proper management of dust control measures and will also carry out seasonal (wet season vs dry season) monitoring campaigns to measure dust, particles and gaseous emissions. A qualified specialist/technician or a contracted company will be engaged by the Contractor for measuring the air pollutants according to the Project standards (see *Chapter 04 – Legal Requirements, Table 6, Table 7* and *Table 8*). The pollutants to be measured are SO_2, NO_2, PM10, PM2.5, Ozone, CO and Heavy Metals. Also, NO_x, SO_2 and Particulate Matter (PM) will be measured from the stationary sources (i.e., diesel generators).
Minimization	Minimize dust emissions from trucks loading and unloading operations. The Contractor will ensure that the trucks loading and unloading operations will be carried out properly and that dust and particulate emissions will be controlled. Under high wind conditions, water spraying could be used to reduce dust generation.
Restoration	Restore highly degraded soil and excavated areas. Where and to the extent possible, the Contractor will restore the roads and the construction area surfaces to their earlier conditions for preventing the continuous issuing of dust and particulate matter in time.
Impact Factor: Emission of gaseous pollutants	
Avoidance	Avoid leaving vehicles, equipment and machinery turned on while not in use. The combustion of fossil fuel from construction machinery will generate Carbon monoxide, Carbon dioxide, Sulphur compounds, Nitrogen oxides and Hydrocarbons. Also, the diesel fueled equipment and machinery such as the heavy-duty vehicles (e.g., dump trucks, cement mixer, transport trucks, excavators, cranes and bulldozers) and the stationary engines (e.g., generators, pumps, compressors, mobile cement mixer trailer) will generate exhaust emissions (i.e., Carbon, Polycyclic Aromatic Hydrocarbons PAH, and metals). The Contractor will ensure that engines, vehicles, equipment and machinery are turned off while not in use. The onsite gaseous pollutants will be quarterly measured as described in the section above *"Minimize the dust emissions deriving from the construction activities".*
Avoidance	Avoid using machinery, equipment and vehicles that don't undergo periodical control and maintenance. For preventing the increase of the emissions and enhance the Project environmental impact, according to the Project standards the Contractor will carry out: – regular periodical maintenance on equipment and machinery;

Mitigation hierarchy	Mitigation Measure
	– periodical maintenance and control on the emission control systems (e.g., aspiration and filtration systems) serving the machinery, equipment and vehicles; – periodical verifications on the fuel and oil types used and on their consumption; – periodical control on the speed of moving trucks; – periodical verification of the weight of the truckloads. The Contractor will ensure that an eligible specialist or a specialized subcontractor will be appointed for carry out the periodical maintenance and control activities; such activities will be tracked by registering them on a dedicated log to be kept on site.
Avoidance	Avoid using non-compliant chemicals. The Contractor will ensure that the materials and chemicals used onsite (i.e., paints, glues, oils, thinners, and plastics) will all be sourced and purchased according to the Project standards. The use of non-compliant or unlabeled chemicals will not be allowed. The chemicals bins and trays will be properly labelled. The materials and chemicals' labels will show the product name and the hazard pictograms (e.g., Hazardous to the environment or Acute toxicity symbols). Each product will be equipped with its updated MSDS showing the productor name, the chemical formula/the components, the hazard pictograms, the warnings and the danger indications and the safety advice on the proper personal or collective protection equipment to be used for the handling.
Avoidance	Avoid improper management of chemicals. The Contractor will ensure that the materials and chemicals used onsite will be properly stored in dedicated locations which will be locked-up and well-ventilated. The bulks, cans, bins and trays will be closed/sealed for avoiding pollutants runoffs.
Minimization	Minimize emission of gaseous pollutants by preferring low sulphur fuels. Where possible, the Contractor will purchase low sulphur fuels for feeding vehicles and engines.
Compensation	Compensate the emission of gaseous pollutants. Considering that the vegetation plays an important positive role in atmospheric purification and air pollutants reduction and that the phytoremediation has many potential advantages for contrasting the air pollution, the Contractor should plant native species and revegetate, where possible, the Project area (see also section "*Compensate for the loss of vegetation*" of the Impact factor *Removal/degradation of soil and vegetation*).
Impact Factor: Existence of new buildings/infrastructures	
Avoidance	Avoid leaks and spills of oils, fuels, liquid waste and other hazardous products and materials. The soil of the Project area mainly consists of deeply weathered topsoil (i.e., ferrasols) covered by vegetation and sands having medium permeability that can facilitate rapid absorption, flow and circulation of water and/or other substances used on site. The Contractor will ensure that: – solid waste will be properly stored in specific, dedicated locations on concrete paved flooring or on waterproofing sheaths and – where necessary – under roofed areas (i.e., protection from weathering) as described in the dedicated section of the Impact factor *Production of solid waste*; – chemicals (hazardous products such as toxic products, oils, lubricants and chemicals) and the liquid special waste will be segregated and stored - in dedicated locations - on stable secondary containment systems (which will be periodically checked for ensuring their integrity and tightness) or on waterproofing sheaths as described above in the section "*Minimize the risk of*

Mitigation hierarchy	Mitigation Measure
	groundwater degradation" of the impact factor *Change in the local hydrogeology and groundwater quality*; – storage areas will be kept clean and inspected regularly; – dangerous goods (e.g., oils, toxic chemicals, liquid waste) will be placed in proper areas with fire protection and spills prevention kits and emergency eyes washing stations; – explosives' storage areas will be labeled with the "ATEX" label; – chemicals' storages will be well ventilated and locked up so that exclusively authorized and properly trained employees will be able to access; – the chemicals will be kept in their original containers (no decanting or mixing will be allowed), will be equipped with updated MSDS and will be labeled and placed with their labels well visible; – chemicals' containers (e.g., bulks, bins and trays) will be closed with caps and sealed for avoiding the issue of pollutants such as noxious vapors/VOCs; – an inventory of all chemicals will be kept at the construction site office and the handling and storage of chemicals will reflect the indications on the corresponding MSDSs and will be allowed only to properly trained employees (see also "*Minimize the risk of groundwater degradation*" of the impact factor *Change in the local hydrogeology and groundwater quality*); – dangerous goods, materials and products handling will be carried out exclusively when personal and collective protective equipment are available; – excavated soil generated during the excavation activities will be properly temporary stored (i.e., stockpiled on geotextiles and protected from weathering, as described above in the Impact factors *Removal/degradation of soil and vegetation* and *Change in the local morphology and topography*) and then used for backfilling or for landscaping after the end of construction; – soil waste not used for backfilling will be temporary stored on dedicated areas and then sent to recovery plant or to landfills as per the Project standards, the regulatory framework and the municipality indications; – any contaminated soil found within the construction area will be removed and disposed as hazardous special waste. The contaminated soil will be properly segregated on containment systems or waterproofing sheaths and under roofed areas. If a contamination of land is suspected or confirmed, the cause will be identified (for both onsite and offsite contaminations and for both current or historical contaminations) and the polluted land will be delimited, secured and properly managed. In this case, a specific environmental site characterizations will take place before starting the construction activities and the local authorities will be consulted for identifying the responsible and the measures to be adopted (e.g., remediation) according to the Project specifications and the Angolan regulatory framework; – work areas and the equipment, machinery and moving vehicles will be kept clean and properly maintained; – the generation of fast paths for pollutants in the deepest soil layers (e.g., unnecessary boreholes drilling) will be avoided. A proper *Emergency Preparedness and Response Management Plan* will be drafted and reviewed/updated once a year. The Contractor will complete site inspections for verifying the site conditions.
Avoidance	Avoid discharging liquid, semi-solid or muddy materials into soil. The liquid, semi-solid or muddy materials will be properly managed (e.g., treated on site) and disposed of according to the Project standards (see the section related to the Impact Factor *Production of wastewater*). All hoses and washers will be properly positioned before fuels and other liquids are supplied/distributed. The locations where liquid, semi-

Mitigation hierarchy	Mitigation Measure
	solid or muddy materials are handled (e.g., oils storage, fuel pumps, sludge collection tanks) will be equipped with spills prevention kits.
Avoidance	Avoid that polluted surface runoffs reach the soil. The runoffs generated on the construction site, considering the local lithology, will be high in turbidity and sediment laden. Such runoffs will be collected and properly managed (e.g., filtered and discharged/disposed) according to the Project standards (see the section related to the Impact Factor *Production of wastewater*). The work areas and the equipment, the machinery and the moving vehicles will be periodically washed, cleaned and maintained for avoiding the increase of pollutants and sediments within the runoffs.
Avoidance	Avoid using locations not included within the Project area boundaries for storing materials and equipment. The Contractor will ensure that no materials, waste and chemicals storages will be carried out outside of the Project area boundaries. All the activities and operations will be limited to the Project area. The Contractor will appoint eligible technicians or specialists who will periodically visit the site surroundings at the site boundaries and will ensure that the Project area perimeter is free, cleaned and in its natural pre-construction state.
Minimization	Minimize the potential pollution of soil. The Contractor will ensure that workers will properly manage hazardous materials, waste and chemicals loading, unloading and transportation. Specific areas will be allocated and properly equipped (e.g., waterproofed flooring) for managing hazardous products. The activities will be supervised and controlled by appointed EHS specialists. For example, the Contractor will ensure that: – solid and liquid wastes will be managed as described in the dedicated sections of the Impact factors below *Production of solid waste* and *Production of wastewater;* – asphalt and cement preparation/production areas will be well prepared, equipped and controlled (because of the potentially high pollutants that will be handled); – no intentional or accidental burning of products and substances will be allowed; – the products and chemicals mixing and preparation will be made on proper areas equipped with spills and leaks protection systems. Workers will be instructed on techniques for soil contamination prevention and soil management and reinstatement. The training will include practical drills to teach workers how intervening (especially in case of emergency chemicals or oils spills and leaks). Training records will be kept and made available for review. Further preventive actions and mitigation measures are described in the section above "*Avoid leaks and spills of oils, fuels, liquid waste and other hazardous materials*".
Restoration	Restore immediately areas where spills and leaks occur. In case of leaks and spills, the Contractor will appoint properly trained workers for removing the contaminated soil and replacing it with uncontaminated fill sand or other similar soil so that the level of contamination at the site will be immediately decreased and the human exposure to contamination will be avoided. The excavated contaminated soil will be then properly stored on site and transported to a landfill or other facility for the appropriate treatment/reuse/recycle/disposal based on the waste characteristics of the soil and based on the applicable legislation.
Restoration	Restore the areas where temporary deposits have been dismantled. As storage and temporary deposits areas will be decommissioned, these will be restored, cleaned and destinated to other purposes or vegetated.
Impact Factor: Production of solid waste	

Mitigation hierarchy	Mitigation Measure
Avoidance	Avoid unnecessary waste generation. The Contractor will ensure that any type of unnecessary waste generation will be avoided during the construction phase. A specific *Waste and Hazardous Materials Management Plan* will be drafted and adopted. Where possible, the waste will always be reduced, reused and recycled. An appointed eligible specialist, a contracted company or employees from the HSE team will work based on the *Waste and Hazardous Materials Management Plan* and develop systems and strategies for improving waste reduction, recycling and reuse (e.g., as by-products). For example: – organic waste will be composted and the final composted product will be used to recover areas degraded by construction; – residual cooking oil will be transformed into vegetable soap suitable for human consumption; – plastic bottles will be reused in the seedling nursery and in decorative adornments, the metal scrap will be collected by local steel mills; – toners and ink cartridges will be reused; – industrial oils will be sent to be used in outsourced brick manufacturing units in the region. The recycling procedures will be completed both onsite and offsite at dedicated plants. The Contractor will prefer waste recycle or recovery plants - if available - to landfills. Waste which cannot be recycled, will be transported to the closest proper and suitable treatment or disposal site (compliant to the Project standards, the legal requirements and the international best practices). The waste management will be completed according to specific documents (e.g., Waste Management Plan or Solid Waste Inventory and Management) to be drafted and adopted on site and to the Project standards and the legal requirements. Moreover, according to national legal requirements, the *Waste and Hazardous Materials Management Plan* will be certified by the National Waste Agency. Also, the construction waste will be managed and disposed in accordance with the Executive Decree nº 17/13, of January 22.
Avoidance	Avoid onsite improper waste management. The Contractor will ensure that: – all the solid waste generated on site will be properly managed, tracked and periodically registered on specific documents (i.e., *Waste and Hazardous Materials Management Plan*); – Project area will be equipped with proper temporary waste storage/accumulation areas; – temporary waste storage/accumulation areas will be roofed, concrete-paved or waterproofed or equipped with containment trays to prevent spills and leakages and avoid the exposure to weathering; – waste will be stored segregated per categories, it will not be mixed and it will be labelled for its identification and classification; – drains of the waste storage/accumulation areas will collect the water runoffs and convey them into the wastewater treatment plant WWTP, see section "*Avoid discharging polluted wastewater*" of the Impact factor *Production of wastewater*; – no waste mixing, no storing on the bare land and no burning will be allowed; – materials that can be recycled (such as packaging paper, plastic and glass bottles) will be sent to licensed recycling facilities, as far as practicable; – waste from the equipment maintenance (e.g., filters, oily rugs and metal parts containing hydrocarbons, oils and lubricants) will be properly stored on a leak-proof floor covered with a shelter and then sent to recovery/disposal;

Mitigation hierarchy	Mitigation Measure
	– waste oils will be collected in specific containers; the different kinds of oils will not be mixed for storage; – an appointed eligible technician/specialist or contracted company will carry out regular site inspections for verifying the spills and leaks containment systems (i.e., containment trays and leak-proof floor) conditions and integrity; – workers at site will be trained on good practices and arrangements for collection, safe handling and effective and correct disposal of both hazardous and non-hazardous waste. The training will include indications and best-practices for enhancing the waste reduction, reuse and recycling; – medical waste generated from the site infirmary will not be mixed to the general waste but it will be properly segregated and it will be managed by a company licensed for managing medical waste.
Avoidance	Avoid offsite improper waste management. The Contractor will ensure that: – waste will be reduced, reused and recycled, where possible; – a licensed local/national waste management contracted company will be in charge of collecting the waste that will not be recycled/reused at the construction site and will transport it to proper landfills, recycling centres or recovery plants; – no improper dumpsites will be used (e.g., dumpsites like Yema one having serious management problems such as no planned deposition, no fencing, no paved areas and no lined cells or leachate control system); – materials which are easier to recycle, and reuse will be sourced and purchased, where possible; – single use items will be avoided. An eligible technician/specialist from a contracted company or the HSE team will be appointed to identify opportunities to maximize the recycling and reuse of materials (i.e., implement innovative techniques for waste recycling and minimization). For managing the waste which will not be reused or recycled, the Contractor will plan alternative solutions, such as: – install a mobile incinerator on site (to be properly designed and authorized as per the Project standards and Angolan legislation); – practice onsite biological, chemical or physical treatment for decreasing the percentage/amount of unrecyclable and non-reusable waste; – appoint an eligible technician/specialist from a contracted company or the HSE team who will research proper landfills – compliant to the Project standards, the legal requirements and the international best practices – within Angola or in bordering countries to use for disposing of the unrecyclable/non-reusable waste; – install a waste compactor on site for allowing longer and more efficient waste storage and for decreasing the number of the potential shipment trips to landfills. Moreover, ASGC will contact the proper entities and authorities within the Government of Cabinda for speeding up the construction of the new Subantando landfill (currently this landfill has only been planned and a site has been selected as eligible).
Avoidance	Avoid unauthorized companies for managing waste. The Contractor will ensure that only properly licensed and authorized companies and plants will manage the solid waste and that the waste management operations will be traceable and registered: – waste will be transported by licensed companies to licensed materials recovery plants (e.g., licensed waste recovery plant operating soil-washing or bio-treatment) or to waste disposal plants (e.g., licensed landfills or incinerators);

Mitigation hierarchy	Mitigation Measure
	– recovery and recycle will be preferred if technically feasible and if facilities are available; – waste generated and shipped will be registered on specific logs/registers; – waste shipped will travel with a proper transportation document indicating details such as the type, the amount and the hazardousness of the waste; – waste-related documents, tracked in register, will be kept on site; – an appointed eligible technician/specialist from the HSE team or an external contracted company will periodically check the waste managers authorizations (license of drivers, compliance of trucks and authorizations of plants and landfills); – during the waste managers selection phase, the Contractor should visit the waste treatment/recycling/disposal selected facilities and landfills to ensure that proper disposal practices are implemented and that they operate in compliance with the Project standards, the legal requirements, the international best practices and the local environmental standards.
Avoidance	Avoid burning waste. The toxic chemicals released during burning include nitrogen oxides, sulfur dioxide, VOCs and polycyclic organic matter. Burning plastic and treated wood also releases heavy metals and toxic chemicals, such as dioxin. The Contractor will ensure that no intentional or accidental waste burning will occur on site. The Contractor will take immediate actions – according to the legal framework - in case a waste arson starts. In case an incinerator will be needed, this will be properly designed, authorized, installed and operated.
Avoidance	Avoid waste spreading all over the construction site. The Contractor will install trash bins all over construction site for avoiding waste spreading, burning and burial. The domestic solid waste from the accommodation camp and the rest areas will be properly collected, segregated, and managed as per the Project standards. The site HSE team will raise the workers' awareness on the proper general waste disposal.
Restoration	Restore areas where temporary deposits have been dismantled. As temporary waste storage/accumulation areas will be dismantled/decommissioned, these will be restored, cleaned and destinated to other purposes or revegetated.
Compensation	Compensate the excessive production on waste by recycling and reusing as byproducts. The Contractor will maximize, as far as practicable in terms of material properties (i.e., technical, and economic feasibility), the re-use of waste soils and aggregates arising from excavations and materials processing like cutting.
Impact Factor: Production of wastewater	
Avoidance	Avoid exceeding the estimated generation of wastewater. The Contractor will ensure that: – a *Wastewater Management Plan* will be drafted and adopted on site; – the construction site maximum monthly production of wastewater will not exceed 60,000 liters/day. The maximum amount will be ensured by measuring the discharges daily. An hydrometer and a flow meter (or a flow sensor) will be installed on the wastewater discharge outputs for measuring the amount of liquid waste and the flow rates; – the daily data will be collected and reviewed weekly for preventing negative effects on the local groundwater;

Mitigation hierarchy	Mitigation Measure
	– the monitoring campaigns will follow the indications reported in the section below.
Avoidance	Avoid discharging polluted wastewater. The Contractor will ensure that: – the WWTP will receive the civil/domestic sewage water from the accommodations, bathrooms, offices, gym and canteen; – when possible, the treated wastewater will be recycled and reused onsite; – when possible, the treated wastewater will be reinjected in the water well (see section "*Compensate the water usage*" of the impact factor *Water demand* for further details); – treated effluents from the WWTP not reusable on site will be collected by local specialized and certified companies and sent to licensed sanitary landfills or discharged to a nearby surface water body (e.g., Chiloango River) after carrying out specific analyses and obtaining a specific authorization; – the WWTP will be properly operated and sampling of treated water will be carried out to ensure the plants are working according to vendor specifications. Results of testing will be kept at site in case of inspections and audits – oil-containing effluents from food preparation, vehicles workshop and the equipment washing and cleaning areas will be sent to special degreasers (water and oil separation systems) for recovering oil and grease from the wastewater. – monitoring campaigns will be completed as per the Project standards (see *Chapter 04 – Legal Requirements, Table 13*) by appointed eligible specialists from the Contractor's HSE team or by a contracted company; – – the results of the monitoring campaigns and data will be reviewed monthly; – in case of exceedances, the Contractor will immediately carry out an inspection on the equipment (plants, sensors and flow meters) and will appoint a subcontractor to carry out the repair and maintenance eventually needed. – the sludge generated from the WWTP will be collected by local companies specialized and certified for the activity and it will then be sent to licensed sanitary landfills; – the stormwater will be managed as shown in the section "*Avoid improper management of stormwater*" of the Impact factor *Change in the local hydrology and surface water quality.*
Minimization	Avoid the uncontrolled discharge of civil/domestic wastewater. Since there is no wastewater collection system in the Cabinda province, the Contractor will provide the construction site with chemical toilets and with a temporary sewage system served by storage/septic tanks. The Contractor will ensure that: – civil/domestic wastewater disposal will be completed as described above in the section "*Avoid discharging polluted wastewater*"; – the civil/domestic wastewater yard collection system and the septic tanks will be constantly properly functioning and in good conditions; – the sewage storage tanks/septic tanks content will be collected by local companies specialized and certified for the activity and it will then be sent to licensed sanitary landfills; – periodical maintenance and control activities will be carried out for preventing malfunctioning of drains, pipelines, manholes, septic tanks, spills and leaks;

Mitigation hierarchy	Mitigation Measure
	– periodical maintenance and control activities will be carried out for ensuring the storage tanks tightness and proper placement, under the tanks, of secondary containment systems; – every maintenance or control activity will be registered on a dedicated log.
Minimization	Minimize the risk of environmental pollution deriving from the equipment and machinery cleaning and washing. For minimizing the risk that the equipment and machinery cleaning and washing will generate environmental pollution, the Contractor will ensure that: – the areas/stations for washing the vehicles, the equipment, the machinery and the chemicals bins and trays will be equipped with leak-proof floor and proper wastewater collection system; – the wastewater generated will be treated as mentioned in the section above "*Avoid discharging polluted wastewater*" through a degreaser and the resulting oils and lubricants will be properly managed as special waste.
Impact Factor: Energy and fuel demand	
Avoidance	Avoid energy sources exploitation for preventing energy shortages in the site vicinity. For preventing unnecessary energy wastes and consequent shortages in the site vicinity, the Contractor will ensure that: – the primary source of electricity will be the Futila power station; – the construction site will not exceed the usage of 750 kVA for the administrative activities and of 1250 kVA for the construction operations; – the energy use will be bonded to the effective issuing of the authorization for setting up the power transformer station (to be issued by the National Electricity Distribution Company of Angola); – a *Resource Efficiency Management Plan* (including indications on both water and energy sources) will be drafted, according to the Project standards, and will describe the measures to adopt for optimizing the energy efficiency and enhancing sustainable construction management practices; – a dedicated technician/team will be appointed for regularly measuring, monitoring and registering the construction site energy uses (associated with plants, facilities, offices, construction vehicles and equipment, offices, food preparation, etc.); – precise performance targets (e.g., energy consumption) will be defined and periodically reviewed; – the effective energy consumption will be regularly compared to the performance targets so that the actions to be taken for reducing the consumptions can be properly identified.
Minimization	Minimize the energy use. Currently, the Contractor is considering the option of using the solar energy for lighting the internal circulation routes and the access roads to the construction site. Additionally, all lamps purchased for buildings (accommodation, offices, laundry, kitchen, etc.) will be LED. Other than using renewable energy sources and installing LED lamps, for minimizing the energy use the Contractor will: – train the construction site workers on energy saving actions and encourage them to participate in eco-friendly practices onsite (e.g., switching off plants and equipment when not in use); – constantly monitor energy consumptions; – carry out periodical maintenance to equipment and machineries;

Mitigation hierarchy	Mitigation Measure
	– prefer machinery powered by grid electricity to diesel-fueled portable generators; – ensure that the construction activities will take advantage of natural light, where possible; – install energy efficient devices in the construction site temporary buildings.
Minimization	Minimize the potential machinery and equipment breakdowns. Part of the potential energy waste that will be generated on the construction site will be deriving from equipment and machinery malfunctioning. For preventing such events, the Contractor will ensure that: – equipment and machinery will always be in good running conditions; – equipment and machinery maintenance will be properly carried out by an eligible company; – repairing and maintenance operations will be registered on a dedicated log to be kept in the construction site offices; – old and inefficient equipment will be replaced with higher efficiency models; – the 8 diesel fuelled portable generators will be periodically checked and placed on leak-proof near spills prevention kits for cleaning potential spills and leaks deriving from the equipment and machinery fuel injection/recharge.
Impact Factor: Water demand	
Avoidance	Avoid the exploitation of the water sources. The potential excessive exploitation of the water sources (i.e., one water well and the Cabinda public mains which are supplied by surface water intake from the Chiloango River) could negatively impact the environment and the Project area surroundings (i.e., the community and the industrial and commercial receptors). The Contractor will ensure that: – a *Resource Efficiency Management Plan* (including indications on both water and energy sources) will be drafted, according to the Project standards, and will describe the measures to adopt for optimizing the water efficiency and enhancing sustainable construction management practices; – the maximum amount of water used during the 48 months of construction phase will not exceed the total amount of 8,738 m^3 expected; – water intake from both the water well and from the mains - that will be sent to a raw water tank – will be measured with proper sensors and equipment (e.g., flow meters); – water intake will be sent to a water treatment station for ensuring that complies to the Project standards and the Angolan law; – treated water will be stored in PVC above ground storage tanks; – the water will be pumped from the tanks through a pressurization system into the underground network of HDPE pipes, to their destinations, without losses or wastes; – periodical maintenance and control of the systems and structures will be completed by a licensed eligible company for ensuring the tanks and pipes tightness and the lack of water losses and wastage; – specific training will be completed for raising awareness of the employees on the proper water usage and consumption.
Avoidance	Avoid using freshwater for cleaning and washing of equipment or dust prevention measures.

Mitigation hierarchy	Mitigation Measure
	Where possible, closed-cycle systems for avoiding water wastage will be installed. The Contractor will adopt proper measures for to decreasing the water consumption during the construction activities: – clean treated effluents from the water treatment plant, the backwashing of the water treatment plant filters and the degreaser water will be reused – for various purposes - in accordance with the Project specification and the Angolan legislation; – recycled water will be mainly destined to degraded areas in the process of recovery, to the soil wetting process and other non-noble purposes and to construction activities such as earthmoving, wetting aggregates, washing vehicles and concrete mixers, washing industrial plants, workshops and loading areas, wetting to control atmospheric emissions, irrigating vegetation, among others; – prior using and spreading the recycled water, its quality will be assessed according to the Project specifications.
Minimization	Minimize the use of water. The Contractor will appoint an eligible specialist, an employee part of the HSE team or a contracted company who will periodically identify, regularly measure, monitor and register the water flows on site. The specialist will also define and regularly review performance targets which will be adjusted to account for the type of construction activity. The existing water flow data will be regularly compared with the performance targets for identifying potential actions to be taken for reducing water wastage.
Restoration	Restore the area once the water well is dismantled. The water well, once not anymore in use and if its usage is not needed in the future, will be dismantled for avoiding safety and environmental-related issues (e.g., open borehole behaving as a fast path for pollutants spreading). The Contractor will ensure that the well dismantling will be carried out by removing the structure and then filling the borehole with proper, ad hoc, soil of good quality selected according to the local lithology.
Impact Factor: Demand for raw materials and goods/supply chain	
Avoidance	Avoid purchasing materials and products from unverified suppliers. During the supply chain screening and selection process, the Contractor will draft a detailed Supply Chain Management Plan that will identify the suppliers and will assess - where relevant - their potential adverse impact on the environment (e.g., the negative impact related to the goods or material source and provision, as materials sourced from protected natural habitats or as the use of highly pollutants transportation methods or processing techniques). The Contractor will – throughout the whole construction phase - assess the existence, the adequacy and the effectiveness of the supplier's environmental management systems and processes and will consider the leverage and control of project supply chains to address the environmental risks by setting out specific steps and measures to evaluate and address the risks identified.
Avoidance	Avoid suppliers of goods and materials having high environmental impacts. The Contractor will choose properly the suppliers considering their environmental impact. Suppliers of re-used, recycled, refilled, recharged, or reconditioned materials should be preferred. The Contractor will avoid purchasing raw materials which are not certified to environmental standards; it will choose materials – where possible - of responsibly sourced, from less distant destinations and having lower effects on climate change.
Minimization	Minimize the environmental-related reputational risk on the supply chain selection. The Contractor will purchase goods and materials exclusively from verified companies and suppliers (e.g., verified, legal and traceable quarries) which are authorized according to the environmental local legislation.

Mitigation hierarchy	Mitigation Measure
Impact Factor: Emission of noise and vibrations	
Avoidance	Avoid emissions of noise and vibration during the night, evening, at weekend and on bank holidays. Normal construction activities should be avoided at night, evenings, during weekends and on bank holidays, except for emergency work.
Avoidance	Avoid emissions of noise from unnecessary idling / revving of engines. Revving engines should not take place unnecessarily. Equipment / engines should be switched off when not in use.
Minimization	Minimize as far as practicably possible, noise emissions generated from construction operations. The Contractor will draft and adopt a Noise Management Plan which outlines how the construction phase will be managed to minimize the effects of noise and vibration on the surrounding environment. The Noise Management Plan will include the following general good practice measures: – keep internal haul roads well maintained; – use rubber linings for dumpers to reduce noise impact; – minimize drop height of materials; – start-up plant and vehicles sequentially rather than all together; – use of reversing alarms that do not have a tonal component (i.e. broadband), if applicable. In this type of alarm, the sound energy would be spread homogenously across the frequency spectrum minimising the possibility of acoustic feature in the reversing alarm; – sources of significant noise should be enclosed, as far as reasonably possible; – loading and unloading should be done away from noise-sensitive areas, where possible; – locate any stationary plant (i.e. pumps, compressor, concrete mixing, etc) away from noise-sensitive receptors, where possible; – ensure regular and effective maintenance for the plant and any sound-reducing equipment; – electrically powered plant is to be preferred to mechanically powered alternatives; – program deliveries to avoid sensitive periods (i.e. avoid deliveries outside of core hours); – As part of the grievance mechanism, establish and maintain an effective liaison with the local community throughout the construction period. Such measures could include provision of information on the on-going activities and provision of contact telephone numbers for the site for use during operational hours, as well as identifying a person with appropriate authority to resolve any identified noise problems; – appropriate training of construction site workers in noise minimization; – construction vehicles to use agreed routes only. Associated roads to be well maintained and free of irregularities.

10.1.3 Impact Value and Residual Impact Value Calculation

This section describes the Impact Values and the Residual Impact Values (after the implementation of the mitigation measures) assessed for each impact factor on each physical component.

The description of how the calculations have been completed is reported in the Chapter 09 of this ESIA.

10.1.3.1 Air Quality

All the four impact factors that can affect air quality are listed in Table 3.

The impact values calculated range from **very high** to **low**. With the application of the mitigation measures, the Project's residual impact on the air quality component for the construction phase, has been assessed to be **negligible** for the e*nergy and fuel demand* impact factor, **low** for the *emission of dust and particulate matter* and *emission of gaseous pollutants* impact factors and **medium** for the *emission of greenhouse gases* impact factor. According to the baseline study performed, the sensitivity of the air quality component is **medium-high**.

The residual impact value for *energy and fuel demand* resulted negligible because of the planned installation of a power transformer station and of LED lamps, of the potential installation of solar panels for feeding the lighting system, and thanks to the expected mitigations with medium to high effectiveness. The residual impact values of the remaining impact factors are not negligible instead, but range from medium to low, even though proper mitigation measures have been identified and are expected to be implemented. This depends on various reasons, such as the site climatic and lithological conditions and the type of activities that will take place (i.e., earthmoving of loose sand by using heavy vehicles emitting exhaust gases throughout the 48 months of construction). The values also depend on the duration (medium-long) and the frequency (from highly frequent to continuous) of the considered factors. Specifically, for the *emission of greenhouse gases* factor, the resulting residual impact value is mainly due (as well as the frequency) to its global geographic extent and its irreversibility. It should be considered that the Project area, prior starting the construction activities, mainly consisted of an empty greenfield. The deterioration of the site air quality - deriving from an overall increase of greenhouse gases, dust and particulate matter and gaseous pollutants - will be tangible, despite the mitigation.

Table 3: Residual impact assessment matrix for Air Quality during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Emission of greenhouse gases	Duration:	Medium-long	Medium-high	Reversibility:	Irreversible	**Very High**	Medium-high	**Medium**
	Frequency:	Continuous						
	Geo. Extent:	Global						
	Intensity:	Negligible						
Emission of dust and particulate matter	Duration:	Medium-long	Medium-high	Reversibility:	Short-mid-term	**Medium**	Medium	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Local						
	Intensity:	Medium						
Emission of gaseous pollutants	Duration:	Medium-long	Medium-high	Reversibility:	Short-mid-term	**Medium**	Medium	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Local						
	Intensity:	Medium						
Energy and fuel demand	Duration:	Medium-long	Medium-high	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.1.3.2 Soil

All the seven impact factors that can affect soil are listed in Table 4.

The impact values calculated varies from one impact to another. The impact has been assessed as **low** for the factors *emission of dust and particulate matter* and p*roduction of wastewater*, as **medium** for r*emoval/degradation of soil and vegetation, change in the local morphology and topography* and *demand for raw materials and goods/supply chain* and as **high** for *existence of new buildings/infrastructures* and *Production of solid waste.* According to the baseline study performed, the sensitivity of the soil component is **medium**.

Considering the application of the mitigations, the Project's overall residual impact on the soil component in the construction phase is of negative direction.

The resulting residual impact is medium for the factor *existence of new buildings/infrastructures* and ranges from negligible to low for the remaining factors, as shown in the matrix below. The medium residual impact mainly derives from the irreversible changes that the construction will cause on site and from the expected medium effectiveness of the mitigation measures planned. Considering the proper application of the mitigation measures on the other factors, the lowest residual impacts resulted for *emission of dust and particulate matter* and *production of wastewater*. For example, if the wastewater will be properly collected in tanks and systems which will be periodically checked for ensuring their tightness, there will be no considerable residual impact. Moreover, the low residual impact value of the factor *production of solid waste* is due to the effectiveness of the planned mitigation measures on site (e.g., soil will be protected by storing the waste on waterproofed flooring and under roofed areas). For the calculation of the residual impact of the factor *demand for raw materials and goods/supply chain,* for example, has been considered the high vulnerability of the soil while handling and storing the hazardous products and sourcing and transporting the construction materials (i.e., irreversible effects on the local quarries for purchasing the construction materials). The *removal/degradation of soil and vegetation* and the *change in the local morphology and topography* residual impacts values depend on the pre-construction state of the area (e.g., no reliefs nor valuable vegetative cover or geomorphologies). Also, the construction will be carried out to preserve the natural state of the soil by avoiding excessive and unnecessary soil structural degradation. As shown in the following table, the resulting residual impact values for this component – besides site specific conditions above mentioned – also depend on the duration (medium-long), the reversibility (from long term to irreversible for 5 factors over 7) and the averagely high frequency of the impact factors considered.

Table 4: Residual impact assessment matrix for Soil during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Removal/degradation of soil and vegetation	Duration:	Medium-long	Medium	Reversibility:	Irreversible	**Medium**	Medium-high	**Low**
	Frequency:	Moderately frequent						
	Geo. Extent:	Project footprint						
	Intensity:	Low						
Change in the local morphology and topography	Duration:	Medium-long	Medium	Reversibility:	Irreversible	**Medium**	Medium-high	**Low**
	Frequency:	Moderately frequent						
	Geo. Extent:	Project footprint						
	Intensity:	Low						
Emission of dust and particulate matter	Duration:	Medium-long	Medium	Reversibility:	Short-term	**Low**	High	**Negligible**
	Frequency:	Highly frequent						
	Geo. Extent:	Local						
	Intensity:	Medium						
Existence of new buildings/infrastructures, visual impact	Duration:	Medium-long	Medium	Reversibility:	Irreversible	**High**	Medium	**Medium**
	Frequency:	Continuous						
	Geo. Extent:	Project footprint						
	Intensity:	Medium						
Production of solid waste	Duration:	Medium-long	Medium	Reversibility:	Long term	**High**	High	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						
Production of wastewater	Duration:	Medium-long	Medium	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Low						
Demand for raw materials and goods/supply chain	Duration:	Medium-long	Medium	Reversibility:	Short-mid-term	**Medium**	Low	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Global						
	Intensity:	Low						

10.1.3.3 Geomorphology and Topography

The impact factors that can affect the geomorphology and topography are listed in Table 5.

The impact values calculated is **low** for the factor *change in the local morphology and topography* and **medium** for *demand for raw materials and goods/supply chain*. According to the baseline study performed, the sensitivity of the geomorphology and topography component is **low**. Considering the application of the mitigation measures, the Project's overall residual impact on geomorphology and topography component in the construction phase is of negative direction.

The residual impact has been assessed to be negligible for the factor *change in the local morphology and topography* and low for the factor *demand for raw materials and goods/supply chain.* The negligible residual impact depends on the Project design; the construction is not expecting to change the natural site topography and morphology (e.g., no generation of anthropic mounds/burials). The non-negligible (low) residual impact of the second factor, instead, is due to the irreversible effect that the construction will have on the quarries and on the temporary generation on site of piles and mounds for storing the material. The resulting residual impact values also depend on the duration (medium-long) and the reversibility (irreversible) of the considered factors and on the global geographic extent of the *demand for raw materials and goods/supply chain* factor.

Table 5: Residual impact assessment matrix for Geomorphology and Topography during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Change in the local morphology and topography	Duration:	Medium-long	Low	Reversibility:	Irreversible	**Low**	Medium	**Negligible**
	Frequency:	Moderately frequent						
	Geo. Extent:	Local						
	Intensity:	Medium						
Demand for raw materials and goods/supply chain	Duration:	Medium-long	Low	Reversibility:	Irreversible	**Medium**	Medium	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Global						
	Intensity:	Medium						

10.1.3.4 Hydrology and Surface Water

The impact factors affecting the component hydrology and surface water are listed in Table 6.

The impact values calculated are **low** for all the impact factors. According to the baseline study performed, the sensitivity of the hydrology and surface water component is considered **medium-high**. Considering the application of the mitigation measures, the Project's overall residual impact on this component in the construction phase is of negative direction.

It should be considered that there are no lakes, rivers or natural ponds in the immediate vicinity of the Project area (the closest major river is the Chiloango, located about 5 km from the site and the other existing channels are all seasonal). The potential sources of pollution of the surface water bodies will be deriving from the discharge of stormwater and the goods and materials transportation. The mitigation measures proposed are expected to have medium to high effectiveness, so the residual impact has been assessed to be negligible.

Table 6: Residual impact assessment matrix for Hydrology and Surface Water during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Change in the local hydrology and surface water quality	Duration:	Medium-long	Medium-high	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Negligible						
Production of wastewater	Duration:	Medium-long	Medium-high	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Negligible						
Water demand	Duration:	Medium-long	Medium-high	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Low						

10.1.3.5 Hydrogeology and Groundwater

The impact factors that can affect the hydrogeology and groundwater component are listed in Table 7.

As shown in the table below, the impact values calculated range from **medium** to **low**. According to the baseline study performed, the sensitivity of the hydrogeology and groundwater component is **medium**. Considering the application of the mitigation measures, the Project's overall residual impact on this component in the construction phase is of negative direction.

The residual impact has been assessed to be negligible for the factor *change in the local hydrogeology and groundwater quality* and low for the factor *water demand*. The construction could potentially affect the soil structure by interfering with its hydrogeological characteristics (permeability, infiltration rates, surface runoff, etc.), however, the mitigation measures will minimize such effects. Referring to the residual impact value of the *water demand*, it should be considered that the current knowledge regarding the groundwater resources in the Project AoI is limited; despite the proper application and expected positive effectiveness of the mitigations proposed, a significant demand of water is expected for the 48 months of construction. The resulting residual impact values also depend on the duration (medium long) and the frequency (continuous) of the factors for this component.

Table 7: Residual impact assessment matrix for Hydrogeology and Groundwater during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Change in the local hydrogeology and groundwater quality	Duration:	Medium-long	Medium	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Local						
	Intensity:	Negligible						
Water demand	Duration:	Medium-long	Medium	Reversibility:	Short-mid-term	**Medium**	Medium	**Low**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Low						

10.1.3.6 Noise and Vibrations

The relevant construction phase noise impact factors are listed in Table 8.

Considering the Project location and the absence of receptors in the proximity of the construction areas, the impact value calculated for noise from on-site construction activities is **low**, and for construction road traffic noise is **medium**. With the application of site-specific mitigations, the Project's residual noise impact for the construction phase has been assessed to be low impacts generated by both on-site activities and construction traffic. According to the baseline study, the sensitivity of local noise sensitive receptors is medium-high.

The residual impact value from noise associated to on-site construction activities is predicted to be low because of the distance from sensitive receptors (over 400 meters). The residual impact value from noise generated by construction traffic on the existing road network is predicted to be low because it is expected that the number of construction vehicle movements will be relatively low compared to existing traffic using the road network. Construction traffic is expected to use the road EN220 which, based on baseline noise measurement data, appears to be already a well trafficked road generating relatively high baseline road traffic noise. Furthermore, construction traffic is not expected to pass noise sensitive receptors before entering the site. The best practice operational and physical mitigations to be implemented to minimise potential noise impacts also contribute to the low residual impact value for both on-site construction generated noise and construction generated road traffic noise.

Table 8: Residual impact assessment matrix for Noise during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Emission of noise and vibrations	Duration:	Medium-long	Medium-high	Reversibility:	Short-mid-term	**Low**	Low	**Low**
	Frequency:	Moderately frequen						
	Geo. Extent:	Local						
	Intensity:	Negligible						
Increase of traffic	Duration:	Medium-long	Medium-high	Reversibility:	Short-mid-term	**Medium**	Low	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Local						
	Intensity:	Negligible						

10.1.3.7 Solid Waste

The only impact factor affecting the solid waste is the p*roduction of solid waste*, as shown in Table 9.

According to the baseline study performed, the sensitivity of the solid waste component is **medium-high**. The impact value calculated is **very high** for the impact factor. This is mainly due to the lack of data available to date on the final destination of those wastes that will not be recycled/reused at the construction site. Initially, the area designated by the Municipal Administration of Cabinda was the Yema dumpsite, that is non-compliant to the Project standards and GIIP (e.g., Yema has no fencing, no paved areas and no leachate control system).

The Project's overall residual impact on this component in the construction phase is of negative direction. In fact, the residual impact has been assessed as medium. This mainly depends on the proper application of the mitigation measures, for example, the waste reduction, recycling and re-use, the selection of properly equipped landfills only, the onsite installation of a mobile incinerator and the research of a landfill nearby.

Table 9: Residual impact assessment matrix for Solid Waste during construction.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Production of solid waste	Duration:	Medium-long	Medium-high	Reversibility:	Long term	**Very High**	Medium-high	**Medium**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Very high						

10.1.3.8 Wastewater

The only impact factor affecting the wastewater component is the *production of wastewater*, as shown in Table 10.

The impact value calculated is **high** for the impact factor. According to the baseline study performed, the sensitivity of the wastewater component is **medium-high**. Considering the application of the site-specific

mitigations, the Project's overall residual impact on this component in the construction phase is of negative direction.

Specifically, the residual impact has been assessed as low. This is mainly due to the proper application and expected positive effectiveness of both the mitigation measures identified (e.g., WWTP) and proposed (e.g., installation of hydrometers, sensors and flowmeters for the consumptions continuous monitoring and quality and quantity periodical measurements). The non-negligible (i.e., low) residual impact mainly depends on the duration (medium-long term), the frequency (highly frequent) and the reversibility (mid-term) of the impact factor.

Table 10: Residual impact assessment matrix for Wastewater during construction.

mpact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Production of wastewater	Duration:	Medium-long	Medium-high	Reversibility:	Mid term	**High**	Medium-high	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.2 Impact Assessment for Operation Phase

10.2.1 Impact Assessment

As described in Chapter 9 of this ESIA (IA Methodology), the Project actions carried out during the operational phase can generate environmental and/or social pressures, which are identified as impact factors.

The potential environmental impacts that may be triggered by the identified impact factors during the operation phase are described in the following table.

Table 11: Impact Assessment – Operation Phase.

Impact Factor	Impact Assessment	Components Affected
Change in the local hydrology and surface water quality	Impacts on the hydrological regime and surface water quality could occur during the operational phase due to the discharge or introduction of pollutants into freshwaters, mainly due to the discharge of Project stormwater, including the reject water from reverse osmosis (RO) process (brackish water) from the Water Treatment Station, which may be discharged into the wastewater network. It has been informed that, depending on the salinity levels, the reject water will be disposed of by pumping into the external wastewater network. In case this is not possible, evaporation ponds could be used as a method for the disposal of reject water. It is therefore expected that this will require the construction of lined open basins, which are normally used for projects in similar environmental contexts, however they could cause impacts to the surroundings, such as: - the evaporation ponds, when not well maintained, can leak contaminated contents into the environment and may pollute soil and water sources, and directly affecting human and animal health; - during the rainy season they can accumulate more water than what can evaporate, which can cause effluent spillage and negative impacts to the surrounding environment. The location of these ponds (in case they are used) has not been clarified at this stage, but it could be expected they will be situated outside Project limits due to their possibly large dimensions. To collect the stormwater produced during Project operations, the airport will have a stormwater drainage system covering both landside and airside parts. In the airside, open channels will collect the stormwater, while in the landside, a normal and conventional system with gullies, pipe and grated channels will be adopted. Both networks from airside and landside will convey the stormwater to main collectors. According to the maps provided, the drainage system will have direct connection with natural streams in at least five locations around the Project, including in the airport access road. Part of the stormwater is also planned to be drained into the stormwater collector and after that, discharged into flood attenuation ponds (situated within Project limits), which are also connected to a natural water stream. The ponds will be emptied within 48 hours to prevent attracting birds. In addition, these ponds will be provided with physical barriers such as bird balls, wire grids, floating covers, vegetation barriers (i.e., bottom liners) or netting to prevent access to animals and birds, in line with the guidelines of the FAA Advisory Circular No. 150/5200-33C on “Hazardous Wildlife Attractants on or near Airports”. Contaminated stormwater will be collected through oil interceptors. The clean stormwater will be then discharged into external stormwater channels.	■ Hydrology and Surface Water ■ Soil

Impact Factor	Impact Assessment	Components Affected
Change in the local hydrogeology and groundwater quality	Impacts on the hydrogeological regime and groundwater quality could occur during the operational phase due to the discharge or introduction of pollutants into the aquifer. Besides the flood attenuation ponds technique above-mentioned, it has been informed that deep well injection into the aquifer could be also used as a method for the disposal of water from the Water Treatment Station. The injection of brine into aquifers could cause detrimental effects on the surrounding environment. The local groundwater sampling and analysis activities have been made available. Concentration of phosphates and elements in high concentration like Manganese, Nickel and Bario is noted. Although Manganese and Barium likely come from natural origin, nickel might be a signal of industrial contamination or other metal structures. Consequently some possible impacts are listed below: - The salinity of the groundwater (in case observed) could be associated to the proximity with coastal/saline waters. The injection of brines into coastal aquifers can exacerbate seawater intrusion, resulting in a reduction in available water in terms of both quantity and quality. - Water injected underground may seep into other aquifers that are used for water supply. - Water injected underground may seep into streams if their bottoms fall below the water table elevation.	■ Hydrogeology and Groundwater
Emission of greenhouse gases	Ground-based airport GHG emissions are caused by gasoline and diesel fuel for airport vehicles and ground support equipment (GSE), fossil fuel for electricity and heating, jet fuel for auxiliary power units (APUs) that power aircraft at airport gates, and other sources. Greenhouse gases emitted at airports include CO_2 (carbon dioxide), CH_4 (methane), NO_x (nitrogen oxides), SO_2 (sulphur dioxide), and fluorinated gases. However, the largest share of GHG emissions is associated to the aircraft operations and passengers transiting to and from the airport. The impact of GHG on the environment is directly linked to climate change, which is of global concern.	■ Air Quality
	Non-volatile particulate matter (nvPM), including ultrafine particulates (UFP) are found to be large sources of air pollutants in airports. Literature also shows elevated levels of particulate matter under 2.5 microns (PM2.5) in airports and surroundings[8]. In addition to emissions from turbine engine aircraft, other sources, including piston engine aircraft, ground support equipment, and vehicle traffic all contribute to pollution levels in the vicinity of commercial airports. Turbine engine aircraft, in particular, emit large amounts of UFP.	■ Air Quality ■ Soil

[8] A Systematic Review of The Impact of Commercial Aircraft Activity on Air Quality Near Airports - PMC (nih.gov).

Impact Factor	Impact Assessment	Components Affected
Emission of dust and particulate matter	Examples of environmental and social impacts from dust and particulate matter are as follows: - Health effects concerning especially outdoor personnel. Although few studies address health effects of PM from aircraft turbine engines, substantial information regarding the respiratory toxicology of combustion PM can be obtained from studies on road traffic[9] (particle pollution can increase the risk of heart disease, lung cancer and asthma attacks and can interfere with the growth and work of the lungs). - PM deposited directly to the soil can influence nutrient cycling, especially that of nitrogen. - Impaired visibility. - In case of heavy particulate pollution, forests and wildlife ecosystems can be impacted.	
Emission of gaseous pollutants	According to ICAO[10], the main components of airport air pollutants are Carbon monoxide (CO), Oxides of nitrogen (NOx), Volatile organic compounds (VOC), Hydrocarbons (HC), Sulphur oxides (SOx), Ozone (O_3), Lead (Pb), and Hazardous air pollutants (HAPs). The largest source of these pollutants is emissions form aircraft engine. Emissions from fuel combustion can also come from motor vehicles used on the airport and ground transport surrounding the airport. It is expected that the considerable traffic increase for passenger transiting to and from the airport will also contribute to the emission of gaseous pollutants. Environmental and social impacts from air pollution can be significant. Examples are as follows: - Acid rain: rainwater becomes much more acidic when it is mixed with certain air pollutants such as sulphur dioxide and nitrogen dioxide. Acid rain can be harmful to natural ecosystems, in particular its impact on soil properties and nutrients. - Eutrophication: an important impact of air pollution on ecosystems and biodiversity is eutrophication caused by airborne nitrogen deposition to ecosystems. - Short-term and long-term effects on people's health.	■ Air Quality ■ Soil
Emission of noise and vibrations	For the noise impact assessment during operations, there are still some data missing from the airport designer on characteristics of the noise sources inside the airfield. Once these data are available, a noise model will be prepared, as an independent document to determine the impacts. Therefore, the noise assessment for operation is not described in this report. The proposed noise assessment and modelling approach is however described as follows. <u>Operational Aircraft Noise</u>	■ Noise and Vibrations

[9] Non-volatile particle emissions from aircraft turbine engines at ground-idle induce oxidative stress in bronchial cells | Communications Biology (nature.com).

[10] AIR QUALITY MANAGEMENT AT AIRPORTS.pdf (icao.int).

Impact Factor	Impact Assessment	Components Affected
	An assessment of aircraft noise from use of the new runway will be undertaken. Aircraft noise will be modelled using the Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT). This model will be prepared using proposed operational information (flight numbers, aircraft types, etc.) and airport geometry details (runway layout, route structure etc) to be provided by the future operator. The aircraft noise model will be used to generate noise contours for up to two scenarios (e.g., opening year and future year or 10 years after opening). Noise contours representing average daytime aircraft movements will be produced. Noise contours will also be prepared representing average night-time movements where relevant. Single Event Level (SEL) and / or L_{AFmax} contours will be produced for a small selection of aircraft types that will use the proposed development. The potential impact of aircraft noise will be assessed against appropriate guidelines based on Good International Industry Practice (GIIP) and other relevant guidance such as the World Health Organisation (WHO) Environmental Noise Guidelines (2018) and the following International Finance Corporation Performance (IFC) guidelines: - International Finance Corporation Performance (IFC) Standards, Environmental, Health and Safety (EHS) Guidelines. General EHS Guidelines: Environmental. Noise Management. 1.7 Noise. 2007; - International Finance Corporation Performance (IFC) Standards, Environmental, Health and Safety (EHS) Guidelines. Airports. Environmental, Health, and Safety Guidelines for Airports. 2007. <u>Ground Noise</u> Due to the current stage of the proposed development, it is unlikely that sufficient detail will be available to undertake noise modelling of ground noise sources associated with the airport operations (e.g., taxiing aircraft, use of Ground Power Units and Auxiliary Power Units, engine ground running, support vehicles etc). Assessment of potential noise impacts from these sources will therefore be provided on a qualitative basis considering potential noise sources and distance from sensitive receptors. Assessment will be undertaken considering the noise level guidelines on environmental noise set out by the IFC EHS on noise management. <u>Surface Access Noise</u> An assessment of changes in road traffic noise associated with the proposed development will be undertaken based on available information on existing and future road traffic vehicle flows on the existing road network local to the proposed development. As some data on traffic baseline are still to be collected, the assessment is postponed. Assessment will consider the IFC guidelines and GIIP guidance including, but not limited to the following:	

Impact Factor	Impact Assessment	Components Affected
	- Highways England, Design Manual for Roads and Bridges, Sustainability & Environment Appraisal, LA 111 Noise and Vibration, Revision 2, May 2020; - Calculation of Road Traffic Noise (CRTN). Department of Transport and Welsh Office. 1988. Operational vibration Operational activities also have the potential to generate notable levels of vibration. Given that the distance between the boundary of the site and the nearest sensitive receptor is greater than 400m, significant vibration impacts are not anticipated. Assessment of operational vibration is therefore not proposed to be undertaken.	
Production of solid waste	Both non-hazardous and hazardous waste will be produced during operations. Environmental impacts caused by the production of solid waste will potentially be related to soil and air pollution, in the case waste management is done inappropriately. Chemicals in contact with soil can result in lasting damage to the functionality of polluted soils. While these effects of pollution are reversible, depending on the type of chemical product, it can take a long time (decades or more) to adequately restore baseline conditions, and the cost of corrective action can be extremely high. Contaminated soils can leach toxic chemicals into nearby ground or surface waters, where these materials can be taken up by plants and animals, contaminate a human drinking water supply, or volatilize and contaminate the indoor air in overlying buildings. It is expected that the following waste streams are generated during the airport operations: - Municipal solid waste from terminal and office-based locations, such as product packaging, cardboard, plastics, glass, plastic and aluminium bottles, paper items, food waste, etc. Deplane aircraft waste is also included in this category, which is waste originating from aircraft flights (bottles and cans, newspaper and mixed paper, plastic cups and service ware, food waste, food soiled paper, paper towels, etc). - Hazardous waste, such as waste oils, oil contaminated filters and rags, batteries, tyres, chemical waste, waste electrical equipment (e-waste), metallic waste, solvents, and anything used for the repair and maintenance of aircraft. The presence of such waste in soil causes severe toxicity and imbalances in the soil ecosystem as a whole. In addition, the improper disposal of hazardous waste can release toxic gases and chemicals into the air, leading to air pollution. - Medical waste. Although expected to be negligible in volume, the type of medical waste generated during the airport operations has not been informed (e.g., syringes, gauze and bandages, soiled gloves, lancets, soiled personal protective equipment, etc.). Medical waste is a special pollutant with infectious and toxic characteristics generated during medical diagnosis and treatment. Compared to general solid waste, medical waste poses a greater risk of environmental pollution, which often carries viruses, germs and chemical pollutants. When improperly disposed of, pathogens, heavy metals and organic pollutants can cause serious soil pollution and reach surface water and groundwater through runoff and infiltration. In	■ Air Quality ■ Soil ■ Solid Waste

Impact Factor	Impact Assessment	Components Affected
	addition, in case storage outdoor, medical waste can release harmful gases such as methane and sulphide that pollute the atmosphere. - Green waste from landscape maintenance activities. According to the information received, a Solid Waste Collection Area is planned for the airport, where waste will be segregated and sorted in specific containers (organics / mixed dry recyclables / residuals). The storage area will have chemical resistant walls and floors, connections to the wastewater network, and air conditioning. To date, information related to measures such as waste reuse and recycling has not been provided. However, it is expected that a licensed waste company will be responsible for collecting all waste that will not be recycled/reused at the airport and transporting it to a suitable designated area. Currently, no information has been provided on the final destination of waste during operations.	
Production of wastewater	The wastewater generated onsite will be collected and treated through the WWTP. The wastewater produced during operations is expected to be mostly from two types: 1. Civil/domestic wastewater from airport buildings, airport kitchen and from airplane toilets (lavatory waste). Lavatory waste itself contains different and dangerous chemicals and pathogens that can compromise the safety of the environment and human health. After the sewage is collected through a drain line, a disinfectant solution is injected for rinsing the waste tank, also generating wastewater. 2. Wastewater deriving from the equipment and machinery repairing, washing and cleaning, from airplane hangars or other maintenance facilities which may contain oil or heavy metals. The improper disposal of operations wastewater could adversely affect the environment, human health, and nearby vulnerable ecosystems since it contains hazardous substances, such as oils and chemicals, which can contaminate soil, surface water sources and even groundwater. NAIC will have a WWTP to receive and treat domestic wastewater. According to the information received, the design of the WWTP will consider municipal wastewater characteristics in nature. It has been informed that the generated effluent will be used for irrigation and that the sludge will be stored and aerated prior to disposal by tanker truck on a weekly basis. The WWTP will have two treatment trains, each with a design capacity of 90 m^3/day on average. One train will be installed for Phase 1 and an additional train will be added for the Ultimate Phase. No information was provided in addition to other possible destinations for the effluent besides irrigation. As already above-mentioned in this report, the Province of Cabinda has no wastewater collection system in place and wastewater produced by human activity can become a source of pollutants in rivers, leading to poor water quality and ecological degradation. Common impacts are due to the presence of phosphorus and nitrogen, elevated temperatures below effluent outfalls, dissolved oxygen levels, high nutrient levels which may increase algal biomass and water turbidity, among others.	■ Hydrology and Surface Water ■ Wastewater

Impact Factor	Impact Assessment	Components Affected
	It is currently unclear how the wastewater from airplane hangars or other maintenance facilities will be handled, but according to information received it is expected that it will be pre-treated at source before discharging in the wastewater network. The type of technology used for the pre-treatment is unknown until the present moment. The expected wastewater flows from the entire site including domestic and maintenance facilities is 96656 m^3/month.	
Energy and fuel demand	Airports are facilities similar to small or medium-sized cities and therefore large consumers of energy. Regarding electricity consumption, major sources include: 1) At airport terminal - cooling (air conditioning), building lighting, ventilation, and a large number of miscellaneous sources, including check-in desks, escalators, conveyor belts, lifts, computers, cooking equipment, among others; 2) At airport airside - runway lighting, auxiliary power units (APUs), hangars, ground vehicles, etc.. An electrical switch & transformer station will provide electricity for the airport. It has been informed that the station will be sufficiently sized to cater for the anticipated demand for the Project first phase, and space will be reserved in the airport layout plan to accommodate future expansion of this facility. Electricity will be primarily supplied by the existing public network from the Futila Thermal Power Station located around 1.5 km from the Project site. Fuel fired thermal power plants are known to be not an environmentally friendly way of generating electricity and the main pollutants resulting from natural gas electricity generation are nitrogen oxides (NOx). Not only does NOx cause respiratory problems, but it also reacts with other substances in the air to produce particulate matter and ozone[11]. Therefore, indirectly, the Project will be contributing to local air pollution due to electricity consumption. In addition, a 100% standby power is provided via 4 x 2500 kVA prime rated diesel generators. In case used, generators produce emissions that can locally harm the environment, specifically air pollution. These emissions include NOx, PM, and CO, which can contribute to smog and poor air quality. Regarding fuel demand, it is expected that the airport ground support vehicles such as refuelers, buses, tugs, container loaders, lavatory service vehicles, etc, will be fuel driven. Impacts related to the use of fossil fuels and to their purchasing and transportation are directly linked to air pollution by various pollutants, as explained above, in the sections of “Emission of gaseous pollutants”, “Emission of greenhouse gases”, and “Emission of dust and particulate matter”.	■ Air Quality

[11] No, Natural Gas Power Plants Are Not Clean - Union of Concerned Scientists (ucsusa.org).

Impact Factor	Impact Assessment	Components Affected
Water demand	Airports are facilities with large water consumption. The NAIC will use water from two sources: 1) The Cabinda Water Supply Network, whose pipes pass through the Sassa-Zau road (very close to the NAIC site), which is supplied by surface water intake pumping station from the Chiloango River. The surface water abstractions may put water systems under pressure through flow regime modification and morphological alterations. Impacts of this nature are currently considered to be low, since the Province of Cabinda is considered to have very low water scarcity risk at the present scenario[12]. However, in the long term, the risk of water scarcity may increase, when considering the large amounts of water needed by the airport (130 m^3/day during the first phase and 300 m^3/day during the ultimate phase) and the availability of water in the region (considering possible changes in the climate and industrial expansion in the region). 2) A water well that has been constructed within the NAIC site, in the water technical area. The use of the drinking-water could have the greatest potential to affect groundwater during the Project lifetime. In case the water well is not well-maintained, external water and contaminants could flow into the well. An excessive pumping without respecting aquifer recharge rates could contribute to groundwater depletion. According to the hydrogeological study conducted on site while drilling the well's borehole, the maximum water flow limit advisable - in order to avoid the aquifer damage - is of 14 m^3/h. To date, it is not known which measures to reduce water consumption during the NAIC operational phase will be adopted and considered.	■ Hydrology and Surface Water ■ Groundwater

[12] Think Hazard - Cabinda - Water scarcity.

10.2.2 Mitigation Measures

The mitigation measures listed below reflect the mitigation hierarchy and are proposed for the operation phase. These measures will be implemented in addition to the Project mitigation measures which are a standard procedure applied by the airport operator to achieve compliance with legal requirements and regulations and alignment with good industry practice.

The appropriate Management Plans to be applied during the NAIC's operational phase must be prepared in a timely manner before the start of operations. The overarching document “Environmental & Social Management System” shall also be prepared.

Based on the impact assessment, the Management Plans to be prepared are included in the following table. However, the MPs mentioned may benot exhaustive and depending on future needs, they can be modified to better adapt to the Project needs, as well as others can also be included.

Table 12: Mitigation Measures - Operation Phase.

Mitigation hierarchy	Mitigation Measure
Impact Factor: Change in the local hydrology and surface water quality	
Avoidance	Avoid improper management of stormwater. SGA will be responsible to prepare the *Wastewater and Drainage Management Plan* to manage the related stormwater aspects in advance to start operation. SGA will also be responsible to prepare the *Soil and Erosion Control Management Plan* to manage the related soil aspects in advance to start operation. The airport operator will ensure that: – in the airside, the open channels that will collect the stormwater will be maintained in good conditions; – in the landside, the collection system with gullies, pipes and grated channels will be properly functioning and kept in good conditions; – the drainage system connections with natural streams will be properly functioning and kept clean and in good conditions; – the stormwater drains will be kept free from waste, debris and other type to avoid clogging; – the stormwater collected within the process areas (e.g., workshops, fueling stations, washing and cleaning areas, waste and chemicals storages) and runway will be treated/filtered before their discharge to avoid that potential pollutants such as hydrocarbons, rubber and/or heavy metals enter the environment. A suitable separator sump fitted to all water drainage can be used for this purpose; – the large stormwater collector will be constantly inspected and maintained in good conditions; – the flood attenuation ponds will have proper tightness for preventing uncontrolled leaks and their connections with the natural water stream will be constantly properly functioning and in good conditions; – the ponds will be properly fenced and periodically controlled to prevent access to animals and birds (physical barriers such as bird balls, wire grids, floating covers, vegetation barriers like bottom liners or netting) as per FAA guidelines “Hazardous Wildlife Attractants on or near Airports AC No. 150/5200-33C”; – the ponds maximum level will be monitored (e.g., by installing float switch for level control) for preventing spillages;

Mitigation hierarchy	Mitigation Measure
	– the ponds will be emptied by using the outlet pipes with vacuum trucks, operated by proper licensed companies, every 48 hours from heavy rain events to prevent attracting birds; – periodical tests of the bottoms of the ponds will be completed; – the stormwater will be reused (prior assessing the absence of pollutants) to the extent possible; – the non-reusable stormwater will be collected and sent to licensed sanitary landfills; – proper appointed eligible specialists or a contracted company will be in charge of maintenance and control activities.
Avoidance	Avoid exposing to pollutants the surface water bodies. SGA will be responsible to prepare the *Water Management Plan* to manage the related surface water aspects in advance to start operation. Even though there are no permanent lakes or rivers in the immediate vicinity of the airport, the improper management of wastewater, solid and liquid waste, and hazardous products managed and generated on site will be a potential source of surface water bodies pollution. The airport operator will ensure that: – wastewater (i.e., civil/domestic wastewater, process water and stormwater), waste and hazardous products and materials will be properly managed, as described in the section above "*Avoid improper management of stormwater*" and in the dedicated sections of the Impact factors *Production of solid waste, Production of wastewater* and *Change in the local hydrogeology and groundwater quality*); – no accidental or intentional discharges, spills and leaks of materials will be allowed into surface water bodies nor into dry channels (i.e., seasonal water streams); – the transportation (i.e., delivery trucks) of hazardous and pollutant products will be made safely and according to precise standards and indications, there will be a proper supervision and control of the quantities of transported/delivered materials (e.g., fuels and additives), of the paths to be followed and of the transportation means and methods; – no moving vehicles will be allowed to cross the permanent rivers nor the seasonal water channels while reaching or leaving the airport; – a proper management plan (i.e., *Emergency Preparedness and Response Plan* for properly behaving in case of accidental spills and leaks) will be drafted as per ICAO standards and adopted. Any storage area of polluted wastewater, hazardous products and pollutant materials will be equipped with spills prevention kits; – operations like refuel and maintenance of aircrafts and airport vehicles will be only completed at specific dedicated zones/areas; – the areas where hazardous or pollutant products are stored or handled will be equipped with a dedicated stormwater/clean water collection system, secondary containment systems, waterproofed flooring or impermeable paving and roofing for avoiding washouts and runoffs.
Avoidance	Avoid generating uncontrolled water pits and ponds. The airport operator will prevent any type of action that can lead to the generation of pits and ponds such as soil over consolidation (e.g., off-road materials storages and vehicles driving), laying of impermeable surfaces and uncontrolled wastewater discharges. In case heavy rains leads to the generation of pits and ponds, the airport operator will promptly complete their removal by pumping the water by means of vacuum trucks and will dispose it of as per the legal requirements.

Mitigation hierarchy	Mitigation Measure
Minimization	Minimize the effects of the extreme events. The airport operator will ensure that the *Emergency Preparedness and Response Plan* will include indications for acting during extreme weather conditions such as storms and surface water flooding. The stormwater network will be inspected and kept in good conditions (e.g., clean and free from clogging materials) and workers will be properly trained on the behaviours necessary during the extreme rain events.
Restoration	Restore the deteriorated areas. For preventing adverse runoffs full of pollutants (mostly during the rainy season) periodical inspections and maintenance activities will be completed and, when necessary, the airport operator will also renew the green areas, the surfaces, the structures, the buildings and the equipment showing signs of deterioration.
Impact Factor: Change in the local hydrogeology and groundwater quality	
Avoidance	Avoid improper wastewater discharges. Considering the existing lithology, improper wastewater discharges on the soil can contaminate the groundwater. The airport operator will properly manage and periodically inspect the wastewater collection, treatment and discharging systems and no uncontrol discharge will be allowed (see the Impact factor *Change in the local hydrology and surface water quality* above and the Impact factor *Production of wastewater* for further details).
Minimization	Minimize the likelihood of the water well deterioration and disruption. Given the local lithological conditions, the water well can be easily clogged with sand, so the filtration system will be periodically checked and eventually replaced. Also, the airport operator will ensure that the well casing/secure cover will be resistant to the weather and to the infiltration of insects, oils and fuels, water and sand. The water well top (i.e., its casing/secure cover) will be always rising of at least 30 cm above the ground level and it will be well-visible for avoiding its potential disruption during the vehicles moving and crossing.
Minimization	Minimize the risk of groundwater degradation. SGA will be responsible to prepare the *Water Management Plan* to manage the related groundwater aspects in advance to start operation. Even though the groundwater level is deep, there are various types of pollutants that can generate its contamination (e.g., highly movable and long-lasting pollutants). The airport operator will focus on the monitoring and control of the major pollutants that will expose the airport groundwater (and soil) to pollution: – ethylene or propylene glycols; – urea, acetates, aprons, and taxiways; – oils, lubricants and fuels, from spills during refueling and leaks from pipes or tanks; – fire suppressant chemicals and foams dispersed in firefighting frills; – hydrocarbons from paved surfaces and engine leaks; – herbicides and pesticides. Considering that the medium soil permeability on site will facilitate the absorption, the flow and circulation of water containing potential pollutants, the airport operator will ensure that: – discharges, spread or spills will be avoided on the airport area, in or nearby stormwater drains or on the green/vegetated areas; – groundwater sampling and testing will be periodically carried out (i.e., groundwater monitoring campaigns) and will follow a specific monitoring plan which will include the frequency of sampling, sampling locations, and a

Mitigation hierarchy	Mitigation Measure
	list of parameters to be sampled (according to the Project standards and the Angolan legislation); – oils, fuels, liquid waste and other hazardous liquid or semi-solid materials will be properly stored in specific dedicated locations. Such locations will be equipped with spills prevention kits; – the underground fuel tanks will be subjected to periodical maintenance and inspections (e.g., tightness tests) and equipped with continuous monitoring devices for immediately assessing potential decreases of fuel due to losses (i.e., tanks breakage or damages); – hazardous materials will be properly labelled and arranged on containment systems or waterproofing sheaths and – where necessary - under roofed areas (i.e., protection from washout and weathering); – there will be no connection between the storage areas and the permeable surfaces, the green areas and the rainwater drainage channels; – an inventory of all potentially polluting materials and chemicals will be kept and updated by the appointed eligible specialist/contracted company; – handling and storage of chemicals and hazardous materials will follow the indications on the corresponding Material Safety Data Sheets (MSDSs); – maintenance yards and the equipment, machinery and moving vehicles will be periodically washed, cleaned and maintained; – considering that airport rescue and firefighting equipment often uses fire suppressant foams containing per- and polyfluoroalkyl substances (PFAS), the use of environmental-friendly products will be preferred; – If a contamination of groundwater is suspected or confirmed, the cause will be investigated, and the eventual pollution will be managed. Specific evaluations will eventually take place and the local authorities will be consulted for identifying the responsible and the measures to be adopted (e.g., remediation) according to the Project standards and the Angolan regulatory framework. Also, the maximum water flow of the water intake from the well - in order to avoid the aquifer damage – will not exceed 14 m^3/h.
Minimization	Minimize adverse effects on the groundwater from wastewater reintroduction. In case the option to reintroduce wastewater into the water well is adopted, the airport operator will evaluate the risks of brine injection into aquifers. Groundwater studies will be completed prior starting the injection/reintroduction. In case the injection will be carried out, the airport operator will ensure that: – all the operations will be properly authorized and completed as per the Project specification and the legal requirements; – the seawater intrusion will not be exacerbated by the potential injection of brines into the aquifer for preventing adverse effects such as reduction of available water (in terms of both quantity and quality); – the water injected underground will not seep into other aquifers that are used for water supply; – the water injected underground will not seep into streams having bottoms falling below the water table elevation; – the water injected underground will be of proper and compliant quality and quantity (i.e., measurable and controllable by installing proper equipment).
Compensation	Compensate the existence of impermeable surfaces and areas.

Mitigation hierarchy	Mitigation Measure
	To allow natural recharge of the local aquifer, the airport operator will ensure that green areas (i.e., permeable surfaces) will be properly maintained and periodically renewed and that, when possible, new areas will be vegetated in the airport lifetime.
Impact Factor: Emission of greenhouse gases	
Avoidance	Avoid materials and resources exploitations. The airport operator will appoint dedicated technicians/teams for regularly monitoring and registering the materials and resources consumptions. The appointed specialist/contracted company will collect data on the type and amounts of materials and resources consumed, will set precise performance targets, and will periodically review the data for preventing any unnecessary excess. The airport operator will prepare a Climate Adaptation Plan which will include all measures to mitigate the effects of physical climate change risks (see *Chapter 15 – Climate Change Risk Assessment_Physical Risks*) as well as policies and guidelines including best practices for avoiding wasting materials and resources. The plan will include short term actions with respect to of the type of materials and resources purchased (e.g., food, toilet paper, cleaning detergents, chemicals and additives, fuels, lamps, etc.), mid-term and long-term actions to be defined at national/international level in conjunction with the strategies and programs for the aviation sector in Angola.
Avoidance	Avoid leaving the vehicles, equipment and machinery turned on while not in use. The vehicles, equipment and the machinery, while not in use, will be properly switched off/turned off for avoiding unnecessary emissions of pollutants such as CO_2 (carbon dioxide), CH4 (methane), Nox (nitrogen oxides), SO_2 (sulfur dioxide), and fluorinated gases.
Minimization	Minimize GHG emissions. SGA will be responsible to prepare the *Air Quality Management Plan* to manage the related GHS emission aspects in advance to start operation. The airport operator will adopt measures to reduce GHG emissions throughout the lifetime of the airport: – increasing, over time, the investments on renewable energies sources; – monitoring the efficiency of the cooling, ventilation and heating systems; – expanding the airport recycling programs; – minimizing, to the extent possible, the materials and goods transportation impact by defining preferential roads (i.e., shorter paths) to be followed for delivering the goods; – sourcing and purchasing goods and materials that can travel by road instead of by sea and by air (i.e., source nearby suppliers of materials and prefer, where possible, the transportation methods having minor impact on the environment and avoid high-impact transportation methods); – offering low GHG emission transfer services – self-made or organized with the municipal public transport entities – to reduce the use of private cars to reach / leave the airport (see the section "*Minimize the cars-related gaseous pollutants emissions"* of the Impact factor *Emission of gaseous pollutants*); – sourcing, where possible, plants, machineries, and equipment operating on carbon-neutral biofuels or renewable energies and low or zero-emission vehicles and GSE (e.g., sustainable aviation fuels, fuel-efficient aircrafts, electrical fleet of forklifts and cranes); – ensuring that the cooling systems will contain exclusively refrigerant gases with low global warning potential (GWP);

Mitigation hierarchy	Mitigation Measure
	– defining strategies for decreasing the waste generation and enhancing waste reuse and recycling and, consequently, decrease the waste disposing off to landfills; – preferring eco-friendly resources and materials (e.g., recycled paper and plastic, local food "Zero-km", low consumption hand-dryers and low consumption plumbing sewer for toilets); – affixing "good practices" indications/flyers for saving water and paper in the airport public toilets; – carry out awareness training to the personnel on resources consumption and waste reduction.
Minimization	Minimize fuel consumption. The airport operator will optimize aircrafts routes by improving flights management, maintenance, and booking systems and by adopting a route plan optimizing software. The airport operator will periodically monitor the consumptions of resources such as gasoline and diesel fuel for airport vehicles and GSE, fossil fuel for electricity and heating and jet fuel for auxiliary power units that power aircraft at airport gates. For example, the airport operator can digitalize the fueling operations for find ways for decreasing the consumptions.
Compensation	Compensate GHG emissions. The airport operator should compensate the increase of GHG emissions generated from the air traffic by identifying locations within the airport area (or in its surroundings If feasible) for planting vegetation (i.e., forests carbon sinks) or by funding local groups and associations operating in the environmental protection and conservation field.
Impact Factor: Emission of dust and particulate matter	
Avoidance	Avoid dust and particulate matter emissions from equipment and machinery. SGA will be responsible to prepare the *Air Quality Management Plan* to manage the related dust and particulate matter emission aspects in advance to start operation. The airport operator will ensure that: – moving vehicles will be periodically checked and maintained (e.g., brakes, tires, filters and engines, etc.); – roads will be periodically maintained and cleaned to reduce dust from asphalt and soil; – all moving vehicles moving within the airport will follow pre-defined routes and paths which will be all paved and maintained; – a speed limit for the support fleet and heavy vehicles will be maintained within the airport; – machinery, equipment and vehicles will be periodically washed/cleaned (as necessary and likely more frequent during the dry season). – the organic ultrafine particles formed in aircraft and diesel engines due to incomplete combustion will be reduced by installing proper filters and completing the periodical maintenance and control; – low sulphur content jet fuels will be purchased; – diesel engines used for handling and loading will be replaced, where possible, with electrical engines. The airport operator will continuously supervise the area for ensuring the proper adoption of the mitigation measures by carrying out periodical visual inspections.

Mitigation hierarchy	Mitigation Measure
Avoidance	Avoid dust emissions during takeoff and landing. The airport operator will ensure that the airstrip and taxiways will be free of sand and soil to reduce dust formation. The airport operator will define rules, guidelines and indications within an air Traffic Management Plan and will ensure the operations compliance to this management plan. f actions that will be implemented include: – proper maintenance of takeoff/landing areas ; – water spraying of takeoff/landing unpaved areas when necessary. The airport operator will continuously supervise the area for ensuring the proper adoption of the mitigation measures by carrying out periodical visual inspections.
Avoidance	Avoid leaving vehicles, equipment and machinery turned on while not in use. See the mitigation measures listed for the Impact factor above *Emission of greenhouse gases* in the section "*Avoid leaving the vehicles, equipment and machinery turned on while not in use*".
Avoidance	Avoid using machinery, equipment and vehicles that do not undergo periodical control and maintenance. For preventing the increase of the emissions and enhance the airport operation environmental impact, according to the Project standards, the airport operator will ensure that regular periodical maintenance on equipment, plants and machinery will be completed. Also, periodical verifications on the fuel and oil types used, and on their consumption, will be made. The airport operator will ensure that periodical maintenance and control activities will be completed and registered on dedicated logs and forms. All interventions will be registered on a dedicated log to be kept on site.
Minimization	Minimize dust and particulate matter emissions. The airport operator, for minimizing the emission of dust and particulate matter, will: – ensure that the take-off times will be as short as possible (the aircraft engines will be turned off when possible); – ensure that proper filters will be installed on equipment and machineries; – ensure that engines are turned off during idle periods; – provide a binding limit value for emissions and particles of engines and set a limit value to comply with; – carry out periodical air quality monitoring campaigns; – appoint a team to control air emissions and to ensure that specific and measurable targets are identifies (i.e., investigate specific actions to limit the particles emissions and reducing the employees exposure).
Impact Factor: Emission of gaseous pollutants	
Avoidance	Avoid gaseous pollutants emissions. SGA will be responsible to prepare the *Air Quality Management Plan* to manage the related gaseous pollutants aspects in advance to start operation. See the mitigation measures listed for the Impact factor above *Emission of dust and particulate matter* in the sections "*Avoid dust and particulate matter emissions from equipment and machinery*" and "*Minimize dust and particulate matter emissions*".
Avoidance	Avoid leaving the vehicles, equipment and machinery turned on while not in use. See the mitigation measures listed for the Impact factor above *Emission of greenhouse gases* in the section "*Avoid leaving the vehicles, equipment and machinery turned on while not in use*".

Mitigation hierarchy	Mitigation Measure
Avoidance	Avoid using machinery, equipment and vehicles that don't undergo periodical control and maintenance. See the mitigation measures listed for the Impact factor above *Emission of dust and particulate matter* in the section "*Avoid using machinery, equipment and vehicles that don't undergo periodical control and maintenance*".
Avoidance	Avoid using non-compliant chemicals. The airport operator will ensure that the materials and chemicals used onsite (i.e., paints, glues, oils, lubricants, detergents) will all be sourced and purchased according to the Project standards. The usage of non-compliant or unlabeled chemicals will not be allowed. The chemicals bins and trays will be properly labelled. The materials and chemicals' labels will show the product name and the hazard pictograms (e.g., Hazardous to the environment or Acute toxicity symbols). Each product will be equipped with its updated MSDS showing the productor name, the chemical formula/the components, the hazard pictograms, the warnings and the danger indications and the safety advice on the proper personal or collective protection equipment to be used for the handling.
Avoidance	Avoid generating hazardous products and chemicals gaseous emissions. The airport operator will ensure that hazardous products and chemicals used onsite (e.g., additives, lubricants, cleaning detergents) will be properly stored in dedicated locations – locked and well-ventilated – and segregated per type of content/pollutants/hazard. The bulks, cans, bins and trays will be closed/sealed for avoiding pollutant gases runoffs.
Minimization	Minimize the cars-related gaseous pollutants emissions. The airport operator will offer sustainable transfer services or will collaborate with the municipality's public transport entities for avoiding the passengers transiting to and from the airport by private cars.
Compensation	Compensate the emission of gaseous pollutants. Considering that the vegetation plays an important positive role in atmospheric purification and air pollutants reduction and that the phytoremediation has many potential advantages for contrasting the air pollution, the airport operator will plant native species and revegetate, where possible, in the airport area and its surroundings.
Impact Factor: Production of solid waste	
Avoidance	Avoid onsite improper waste management. SGA will be responsible to prepare the *Waste and Hazardous Materials Management Plan* to manage the related solid waste, hazardous waste and hazardous materials aspects in advance to start operation. To avoid improper waste management the airport operator will ensure that: – waste management will follow specific guidelines and standards to comply with; – proper temporary waste storage/accumulation areas will be installed; – temporary waste storage/accumulation areas will be properly ventilated, roofed and equipped with chemicals resistant waterproof paving or containment trays to prevent spills and leakages; – temporary waste storage/accumulation areas will be often checked and cleaned for preventing the problematic odors generation; – waste will be stored segregated per categories, labelled by indicating the type of waste, the date of collection and its hazardous nature;

Mitigation hierarchy	Mitigation Measure
	– drains of the waste storage/accumulation areas will collect the water runoffs and convey them into the WWTP; – no waste mixing, no storing on the bare land and no intentional or accidental waste burning will be allowed; – materials that can be recycled such as packaging paper, plastic and glass bottles will be sent to licensed recycling facilities, as far as practicable; – waste from equipment maintenance (e.g., chemicals trays, filters, oily rugs and metal parts containing hydrocarbons, oils and lubricants residues) will be properly stored on a leak-proof flooring, covered with a shelter and then sent to recovery/disposal; – waste oils will be collected in specific containers and recycled through authorized vendors, if possible; – a specialist will carry out regular site inspections and for verifying the spills and leaks containment systems conditions and integrity, the storage area adequate conditions and the proper waste labeling and segregation; – the airport personnel will be trained for collection, safe handling and correct disposal of both hazardous and non-hazardous waste. The training will include indications and best-practices for enhancing the waste reduction, reuse and recycling; – trash bins will be installed across the airport area. The bins will be emptied every day or more than once a day (if necessary); – the general/domestic solid waste generated (flights/aircrafts general waste, food preparation, shops, restaurant, toilets, trash bins, etc.) will be properly collected, segregated, and managed as per the Project standards; – medical waste generated from the infirmary will not be mixed with general waste properly segregated and managed by a licensed company.
Avoidance	Avoid offsite improper waste management. The airport operator will ensure that: – waste will be reduced (see *minimize the waste generation* section below), reused and recycled, where possible; – a licensed local/national waste management company will be in charge of collecting non recycled/reused waste for disposal to licensed disposal facilities or recycling centres compliant with project's standards; – no improper dumpsites will be used (e.g., dumpsites like Yema are currently considered not aligned with Project standards and GIIP); – materials easy to recycle and reused will be sourced and purchased, where possible; – single use items will be avoided. An eligible technician/specialist from a contracted company or the HSE team will be appointed for researching new practices for maximizing the recycling and reuse of materials (i.e., implement innovative techniques for waste recycling and minimization). For the management of waste which will not be reused or recycled, the airport operator will plan alternative solutions, such as: – practice onsite biological, chemical or physical treatment for decreasing the percentage/amount of unrecyclable and non-reusable waste; – appoint an eligible technician/specialist from a contracted company or the HSE team who will research proper landfills – compliant to the Project standards, the legal requirements and the international best practices –

Mitigation hierarchy	Mitigation Measure
	within Angola or in bordering countries to use for disposing of the unrecyclable/non-reusable waste; – install a waste compactor on site to reduce waste volume and the number of shipment trips to landfills/final disposal facilities. The Ministry of Transport will liaise with the Government of Cabinda and with the other Ministries responsible for waste management to seek solution at Cabinda for the correct disposal of solid waste and speed up the process for creating the new landfill system. Also, the Ministry of Transport will evaluate the voluntary adherence to the *Airport Sustainability Planning*, launched by ICAO and define a set of initiatives to improve the sustainable performance and reduce the carbon emissions. One major point for the initiative is the management of solid waste and the implementation of recycle.
Avoidance	Avoid unauthorized companies for managing waste. The airport operator will ensure that only properly licensed and authorized companies will manage waste collection and disposal: – waste management operations shall be all traceable and registered; – waste will be transported only by licensed companies to licensed materials recovery plants (e.g., licensed waste recovery plant operating soil-washing or bio-treatment) or to waste disposal plants (e.g., licensed landfills); – recovery will be always preferred when technically feasible and if recovery facilities are available; – the waste generated and shipped will be registered on specific logs/registers and waste-related documents will be kept on site; – an appointed eligible specialist/contracted company will periodically check the waste managers authorizations (license of drivers, trucks and plants); – the airport operator should periodically visit the waste recycling/disposal selected facilities to ensure that proper disposal practices are implemented and that they operate in compliance with the local environmental standards.
Minimization	Minimize the waste generation. The airport operator will attempt to minimize the waste throughout the airport buildings, on the flights and during ground operations. The appointed eligible specialist/contracted company will draft a Waste Management and Reduction Plan and a waste minimization strategy to set waste & recycling targets which will be periodically monitored and re-assessed. Specific waste reduction policies (e.g., plastic bag charges, plastic bottle deposits and discounts for using reusable cups) will be introduced. The appointed eligible specialist/contracted company will also be in charge of raising awareness of the airport personnel (the flights crews, the security workers, the tenants of airport shops, etc.) on the waste reduction and recycle policies and best practices. The airport operator will ensure that materials and goods less wasteful will be sourced and purchased. Also, the periodical maintenance and control of equipment, plants and machinery will lengthen their life by keeping them efficient.
Restoration	Restore the areas where temporary waste deposits have been dismantled. Temporary waste storage/accumulation areas will be dismantled/decommissioned at the end of their operation and the areas will be cleaned and destinated to other purposes or revegetated.
Compensation	Compensate the excessive production of waste by recycling and reusing as byproducts. The airport operator will maximize, as far as practicable in terms of material properties (i.e., technical, and economic feasibility), the re-use of waste. For example, food waste should be turned into organic fertilizers by composting it. Also, exhausted/used

Mitigation hierarchy	Mitigation Measure
	oil can be re-refined into lubricants, processed into fuel oils, and used as raw materials for the refining and petrochemical industries.
Impact Factor: Production of wastewater	
Avoidance	Avoid generating excess of wastewater. SGA will be responsible to prepare the *Wastewater and Drainage Management Plan* to manage the related wastewater aspects in advance to start operation. The expected wastewater flows from the entire site including domestic and maintenance facilities will be of 96,656 m^3/month. The airport operator will be measuring wastewater discharges. A flow meter (or a flow sensor) will be installed on the wastewater discharge outputs for measuring the amount of liquid waste and the flow rates. The wastewater amounts and data measured will be registered on dedicated logs and forms. If the data will show inconsistencies the airport operator will carry out an inspection on the equipment (e.g., plants, sensors and flow meters check-ups) and will appoint a technician or a company to carry out the required repairs. Also, the quality of the wastewater discharge will be periodically checked (i.e., periodical wastewater monitoring campaigns) for avoiding negative effects on the quality and quantity of the local surface water and groundwater. The airport operator will ensure that the WWTP will collect and treat the civil/domestic wastewater (to be collected, treated and discharged to the sewage system installed onsite), the stormwater (to be collected through a drainage system) and the process wastewater deriving from the equipment and machinery repairing, washing and cleaning. The discharges (both to the surface water and to the groundwater) will be authorized and completed according to the Project standards, the legal requirements, and the environmental standards.
Avoidance	Avoid discharging polluted wastewater. The stormwater and the flood attenuation ponds will be managed as indicated in the section "*Avoid improper management of stormwater*" of the Impact factor *Change in the local hydrology and surface water quality.* The domestic wastewater from airport buildings, airport kitchen and from airplane toilets and the "process" wastewater from the airplane hangars or other maintenance facilities (e.g., equipment and machinery washing station and workshop) - which may contain high amounts of oils or heavy metals – will be properly managed. The airport operator will ensure that the collection and treating systems will be constantly checked and maintained (i.e., functioning and in good conditions) and that the effluents will meet the Project standards and the legal requirements (i.e., qualitative and quantitative). Specifically, the airport operator will ensure that: – the wastewater collection and treatment systems will be properly operated in line with the vendor specifications; – the WWTP will be able to treat the volume received (90 m^3/day, on average); – wastewater from airplane hangars or other maintenance facilities will be pre-treated at source before discharge; – the WWTP will be equipped with flowmeters and sensors for monitoring the flow and intervening immediately in case of losses and malfunctioning; – eligible appointed specialists, technicians and contracted companies - properly trained - will carry out qualitative and quantitative analyses and maintenance and control operations and will periodically review the data for assessing the rates; – the reverse osmosis water will be properly collected and disposed of by pumping it to the external wastewater network (depending on its salinity); – oily effluents (e.g., from workshop and food preparation area) will be equipped with special degreasers for collecting oil and grease from the wastewater before discharge;

Mitigation hierarchy	Mitigation Measure
	– where possible, prior treatment and control, the effluents will be always re-used onsite; – the odor control unit of the WWTP building will be properly working in continuous.
Avoidance	Avoid the uncontrolled discharge of civil wastewater. Since there is no wastewater collection system in the Cabinda province, the airport operator will ensure that: – periodical maintenance and control activities will be carried at drains, pipelines, manholes, septic tanks, spills and leaks; – inspections will be properly registered on a site log; – sewage sludge will be properly managed by licensed waste management companies for disposal to licensed sanitary landfills (prior to municipal authorization) compliant to the Project standards. For further details on the proper management of the wastewater made by external contracted companies, see the section "Avoid unauthorized companies *for managing waste*" of the Impact factor *Production of solid waste.*
Minimization	Minimize the risk of environmental pollution deriving from the equipment and machinery cleaning and washing. For minimizing the risk that equipment and machineries cleaning and washing will generate environmental pollution, the airport operator will ensure that the washing stations will be roofed, equipped with leak-proof flooring and with a proper wastewater collection system. The wastewater generated will be treated trough a degreaser and the resulting oils and lubricants will be properly segregated and managed as special waste (as already indicated in the section above *Avoid discharging polluted wastewater*).
Compensation	Compensate the excessive production on wastewater by recycling and reusing it. The airport operator will maximize, as far as practicable from a technical and economic perspective, the re-use of wastewater. For example, the condensate water from the air conditioning system should be reused (after assessing its quality) for irrigation or for equipment and machinery washing. More details are reported in the section "*Minimize the water exploitation*" of the Impact factor *Water demand*.
Impact Factor: Energy and fuel demand	
Avoidance	Avoid energy sources exploitation for preventing energy shortages in the site vicinity. SGA will be responsible to prepare the *Resource Efficiency Management Plan* to manage the related energy aspects in advance to start operation. For preventing unnecessary energy wastes and consequent shortages in the site vicinity, the airport operator will ensure that: – energy will be supplied exclusively by the existing public network; – the airport source from Futila power station will not exceed 5.49 MVA; – the standby generator system serving as a 100% back-up electrical system that will operate automatically (i.e., the Switching Stain via 4 x 2500 kVA prime rated diesel generators) will be periodically checked and maintained; – grid electricity will be preferred to the use of diesel fueled generators; – a dedicated eligible specialist/contracted company will be appointed for regularly measuring, monitoring and registering the airport energy uses; – precise performance targets, based on the effective and ideal energy consumption, will be defined and periodically reviewed;

Mitigation hierarchy	Mitigation Measure
	– the effective energy consumption will be regularly compared to the performance targets so that the actions to be taken for reducing the consumptions can be properly identified.
Minimization	Minimize the energy consumption. The energy consumption will be minimized by adopting proper energy saving measures such as: – installing energy efficient LED lamps and local switches or occupancy sensors at the airport building (toilets, restaurants, shops, etc.); – installing low-consumption lighting contactors in the lighting panels at the larger areas (waiting areas, gates, etc.); – equipping the baggage handling system with low friction belts; – training the airport personnel for raising their awareness on energy saving actions and encourage them to participate in eco-friendly practices onsite (e.g., switching off lights, plants and equipment when not necessary); – benefit, when possible, of natural light; – avoiding excessive cooling or heating; – installing energy efficient screens and devices (e.g., energy efficient LED screens at the departure gates); – assessing the benefit and incentivized the using electric luggage trucks and electric buses inside the airport.
Minimization	Minimize the energy losses caused by machinery and equipment breakdowns. Part of the potential energy waste will derive from equipment and machinery malfunctioning. For preventing such events, airport operator will ensure that: – the equipment and machineries (including small devices serving the food preparation area, the toilets and the shops) will always be kept in good conditions with regular inspections and maintenance carried out by a qualifiedcompany; – old and inefficient equipment and devices will be replaced with higher efficiency models; – diesel fuelled standby generators serving as back-up electrical system will be periodically checked and placed on leak-proof containment systems, near spills prevention kits for cleaning potential spills and leaks deriving from the equipment and machinery fuel injection/recharge.
Compensation	Compensate for the energy use. Whether any excess of energy will be generated from the future potential installation of solar panels and/or the other renewable sources of electricity, such excess of energy should be introduced into the electricity grid and made available to the surrounding communities.
Impact Factor: Water demand	
Avoidance	Avoid the exploitation of the water sources. SGA will be responsible to prepare the *Resource Efficiency Management Plan* to manage the related water demand aspects in advance to start operation. A water quality monitoring program should be established (indications from ICAO Water management at Airports, part of the Eco airport toolkit) will be considered. The airport operator will ensure that:

Mitigation hierarchy	Mitigation Measure
	– water intakes will be measured by a continuous monitoring system equipped with proper sensors (e.g., hydrometers/flow meters); – the maximum water flow of the water intake from the well - in order to avoid the aquifer damage – will not exceed 14 m3/h; – water intake will be sent to a water treatment station to ensure compliance with Project standards and the Angolan law; – treated water will be stored in PVC above ground storage tanks; – periodical maintenance and control of the systems and structures will be completed by a qualified company to identify potential leaks and ensure tanks and pipes' tightness; – specific training will be completed for raising awareness of the airport personnel on the proper water usage and consumption.
Avoidance	Avoid using freshwater when not necessary. Where possible, closed-cycle systems for avoiding water wastage will be installed. The airport operator will adopt proper measures for decreasing the water consumption and, where possible, will ensure that the effluents generated on site will be reused and recycled in accordance with the Project specification and the Angolan legislation. The recycled water will mainly consist of the clean/treated effluents from the water treatment plant, the backwashing of the water treatment plant filters, the degreasers, the HVAC (heating, ventilation, and air conditioning) condensate water. Prior to use the recycled water, its quality will be assessed according to the Project specifications.
Minimization	Minimize the water exploitation. The airport operator will appoint a qualified specialist/contracted company to periodically inspect, identify, regularly measure, monitor and register the water flows on site. Review performance targets will be defined to account for the type of activities. Existing water flow data will be regularly compared with the performance targets for identifying potential actions to be taken for reducing water wastage. The data will be registered on a dedicated log. The airport operator will ensure that, proper measure for saving water will be adopted, for example: – aircrafts dry wash will be conducted, when possible; – recycled water - in accordance with the Project specification and the Angolan legislation - will be used onsite for various purposes (supplying cooling towers, feeding the power washers used on curb fronts and arrival/departure roadways, washing down the airfield or service vehicles, irrigation, washing and cleaning the equipment and machinery, feeding the firefighting system etc.); – low-flow fixtures and other water saving plumbing fixtures (e.g., faucets and toilets) will be installed to achieve water savings by having a lower flow rate of water or a smaller quantity per flush; – native plants and species requiring little or no irrigation will be planted and the irrigation system will be automated.

10.2.3 Impact Value and Residual Impact Value Calculation

This section describes the impact value and the residual impact values (after the implementation of mitigation measures) found for each impact factor on each physical component. The description of how calculations have been performed can be found in Chapter 9 of this ESIA.

10.2.3.1 Air Quality

All five impact factors that can affect air quality during the operation are listed in Table 13.

The impact values calculated range from **very high** to **low**. With the application of the mitigations, the Project's residual impact on air quality component for the operation phase, is of negative direction but it varies considerably from one impact factor to another. According to the baseline study performed, the sensitivity of the air quality component is **medium-high**.

The residual impact value of *greenhouse gases emission* resulted as medium because of the long duration, the continuous frequency, the global extent and the irreversibility of the factor; the mitigation measures are expected to have medium-high effectiveness in this case. The residual impact resulted for this factor is also due to the type of Project, the high GHG emissions are intrinsic characteristics of airports. The impact factors related to the emissions (i.e., *emission of dust and particulate matter* and *emission of gaseous pollutants*) and *production of solid waste*, also show medium residual impact values. In these cases, the mitigation measures proposed are expected to have medium to medium-high effectiveness (e.g., management of engines idling and proper and frequent maintenance and control activities, and waste recycling). The low residual impact value of the factor *energy and fuel demand* derives mainly from the short-term reversibility and the medium to high effectiveness of the mitigation measures proposed (e.g., energy savings, use of renewable sources like solar panels and fuel wasting avoidance). The residual impact values have been calculated based on the currently available information. Future further studies may affect the results.

Table 13: Residual impact assessment matrix for Air Quality during operation.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Emission of greenhouse gases	Duration:	Long	Medium-high	Reversibility:	Irreversible	**Very High**	Medium-high	**Medium**
	Frequency:	Continuous						
	Geo. Extent:	Global						
	Intensity:	Low						
Emission of dust and particulate matter	Duration:	Long	Medium-high	Reversibility:	Mid term	**High**	Medium-high	**Medium**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Medium						
Emission of gaseous pollutants	Duration:	Long	Medium-high	Reversibility:	Mid term	**High**	Medium-high	**Medium**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Medium						
Production of solid waste	Duration:	Long	Medium-high	Reversibility:	Mid term	**High**	Medium	**Medium**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						
Energy and fuel demand	Duration:	Long	Medium-high	Reversibility:	Short-term	**Low**	Medium-high	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.2.3.2 Soil

All the four impact factors that can affect soil during the operation are listed in Table 14.

The impact values calculated range from **high** to **low**. With the application of the mitigations, the Project's residual impact on the soil component for the operation phase is of negative direction and ranges from **low** to **negligible**. According to the baseline study performed, the sensitivity of the soil component is **medium**.

The residual impact values resulted are due to the expected effectiveness (from medium high to high) of the mitigation measures. For example, the *production of solid waste* has a high impact value but intervening properly

(e.g., by recycling, assessing the eligibility of the landfills, properly managing the waste onsite) the impact value decreases to low. The emissions-related residual impacts are negligible, this is mainly due to the insignificant effects that such factors are expected to have on the soil component following the application of the mitigation measures proposed.

Table 14: Residual impact assessment matrix for Soil during operation.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Change in the local hydrology and surface water quality	Duration:	Long	Medium	Reversibility:	Short-mid-term	**Medium**	Medium-high	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Low						
Emission of dust and particulate matter	Duration:	Long	Medium	Reversibility:	Short-term	**Low**	High	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Low						
Emission of gaseous pollutants	Duration:	Long	Medium	Reversibility:	Short-term	**Low**	High	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Low						
Production of solid waste	Duration:	Long	Medium	Reversibility:	Long term	**High**	Medium-high	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.2.3.3 Hydrology and Surface Water

The impact factors that can affect hydrology and surface water during the operation are listed in Table 15.

The impact values calculated are all **medium**. With the application of the mitigations, the Project's residual impact on the hydrology and surface water component for the operation phase, is of negative direction and ranges from **low** to **negligible**. According to the baseline study performed, the sensitivity of the hydrology and surface water component is **medium-high**.

The resulting residual impact values are low for the factor water demand and negligible for the two remaining factors. The results derive from the expected medium high to high effectiveness of the mitigation measures proposed (e.g., proper collection and treatment of the wastewater and proper management of stormwater).

Table 15: Residual impact assessment matrix for Hydrology and Surface Water during operation.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Change in the local hydrology and surface water quality	Duration:	Long	Medium-high	Reversibility:	Short-mid-term	**Medium**	High	**Negligible**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Low						
Production of wastewater	Duration:	Long	Medium-high	Reversibility:	Short-mid-term	**Medium**	High	**Negligible**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						
Water demand	Duration:	Long	Medium-high	Reversibility:	Short-mid-term	**Medium**	Medium-high	**Low**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.2.3.4 Hydrogeology and Groundwater

The impact factors that can affect hydrology and surface water during the operation are listed in Table 16.

The impact values calculated are both **medium**. With the application of the mitigation measures, the Project's residual impact on the hydrology and surface water component for the operation phase, is of negative direction and ranges from **low** to **negligible**. According to the baseline study performed, the sensitivity of the hydrology and surface water component is **medium-high**.

The residual impact values are due to the expected medium high to high effectiveness of the mitigation measures proposed (as per the previous sections). For example, withdrawing large amounts of groundwater from the well might impact the local hydrogeology in many ways; however, by properly building, managing and maintaining the water well (e.g., avoid polluting, clogging and overusing the well) the impact value decreases consistently.

Table 16: Residual impact assessment matrix for Hydrogeology and Groundwater during operation.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Change in the local hydrogeology and groundwater quality	Duration:	Long	Medium	Reversibility:	Short-mid-term	**Medium**	High	**Negligible**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Negligible						
Water demand	Duration:	Long	Medium	Reversibility:	Short-mid-term	**Medium**	Medium	**Low**
	Frequency:	Continuous						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.2.3.5 Solid Waste

The only impact factor that can affect solid waste during the operation is the *production of solid waste*, as shown in Table 17.

The impact value calculated is **very high**. With the application of the mitigation measures, the Project's residual impact on the solid waste component for the operation phase, is **low**. According to the baseline study performed, the sensitivity of the solid waste component is **medium-high**.

For example, the mitigations proposed that are expected to have medium-high effectiveness on the component are: minimize the waste generated on site, avoid conferring the waste to improper dumping sites and, most of all, engage with local authorities for speeding up investments and projects for building new landfills and/or waste disposal facilities. By applying such measures, the impact value decreases heavily.

Table 17: Residual impact assessment matrix for Solid Waste during operation.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Production of solid waste	Duration:	Long	Medium-high	Reversibility:	Long term	**Very High**	Medium-high	**Medium**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						

10.2.3.6 Wastewater

The only impact factor that can affect wastewater during the operation is the *production of wastewater*, as shown in Table 18.

The impact value calculated is **medium**. With the application of the mitigations, the Project's residual impact on the wastewater component for the operation phase, is **low**. According to the baseline study performed, the sensitivity of the wastewater component is **medium-high**.

The low residual impact is due to the expected medium high effectiveness of the mitigation measures proposed; for example, by reusing as much as possible the treated effluents in closed-cycle systems, the wastewater to

be conferred to disposal will strongly decrease. Also, the proper maintenance and control activities on the equipment for the wastewater collection and treatment, prevents negative effects such as mechanical components failures (i.e., systems and parts breakdowns) that leads to uncontrolled waste liquid losses.

Table 18: Residual impact assessment matrix for Wastewater during operation.

Impact Factor	Impact Factor Features		Component Sensitivity	Impact Features		Impact Value	Mitigation effectiveness	Residual impact value
Production of wastewater	Duration:	Long	Medium-high	Reversibility:	Short-mid-term	**Medium**	Medium-high	**Low**
	Frequency:	Highly frequent						
	Geo. Extent:	Regional						
	Intensity:	Medium						

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