Chapter 5

Environmental impact assessment

5.2.4 Topography Conditions

5.2.4.1 Construction phase

(1) Study Method

In the study of the impacts fromconstruction of the runway 2 and the components of the project on the ground, the construction activities of the project were initially considered and the construction activities that could result in the changes in the topography were identified. Then, analyze and assess whether the activities would cause the changes in the topography conditions.

(2) Results of the Study

Construction of the runway 2 and project components will be conducted within the area of the international airport, U-Tapao, with activities impacting on the topography, such as land reclamation, land filling, and leveling the area to be constructed. When considering the area, it is currently found that the conditions are empty, which will causechanges in the height of the area, but will not cause the overall the topography of the U-Tapao International Airport area much different from the previous and the extent of the impact will be limited to the construction area of the project only, thus having w impact on the topography

5.2.4.2 Implementation phase

(1) Study Method

In the study of the impact of the project on the topography, the activities were considered in the project phase and identified activities that may result in the change in the characteristics of the topography. Then, the analysis and assessment of whether or not such activities would result in changes to the characteristics of the topography.

(2) Results of the Study

The activities occurring during the implementation phase will primarily relate to the boarding and downturn of aircraft and the management of U-Tapao International Airport. Most of the conditions in the area remain the same, therefore it does not affectthe topography conditions.

5.2.5 Geology and Earthquake

5.2.5.1 Construction phase

(1) Study Method

Study various construction activities of the project and identify construction activities that may be affected by geology and earthquake impacts. Evaluate the impacts that may occur in terms of disturbance to soil structure, study data statistics on earthquake occurrences, identify construction activities that may be impacted by the shaking caused by the earthquake, and assess the potential impacts.

(2) Results of the Study

Construction of the Taxiway 2 with tunnels, including elements in the project area. The result of soil survey in the project area, it was found that alluvial/Coluvial/Resi Deposits consist of loam to medium density clay or fine clay to medium hard sandy soil, coarse sandy clay medium hard to very hard and medium to very dense clay soils to coarse sand. In construction, there will be a large amount of material to be reclaimed to raise the level of office buildings and facilities above the potential flood level.

However, soil reclamation and construction of the project consist of activities such as solidification and surface crushing, and concrete and asphalt deposition. There was no work to construct foundations that had to be drilled into the lower soil structure. For building foundations or warehouses, there were stumbles that had to be hammered into the soil structure. Indesigning the building and structures, it was in compliance with the Ministry Regulations of Interior, determine load bearing resistance the durability of the building and the ground supporting the building to resist earthquake vibration in 2021 announced in the Government Gazette on March 4, 2021 The construction of the project has no impact on geology.

According to the statistics of the earthquake that affected Thailand from 2013 – 2017, it occurred (Source: Center for Earquake Measurement and Statistics, Department of Meteorology, In 2019), it was found that the project was located in Rayong province, which has no moving power through. There was no record of earthquakes in the study area. There was only the tremors felt trembling, consistent with the Thailand Earthquake Risk Areas Map of the Department of Mineral Resources, indicating that the study area in Chonburi and Rayong province, which is in an earthquake-prone area of magnitude 1 to magnitude 3-4 Mercalli, that is, it is the level that makes people living in tall buildings feel that there is an earthquake. (low risk but may cause some damage) where the impact is expected to be low.

5.2.5.2 Implementation phase

(1) Study Method

Study project implementation activities, identify activities that may be impacts to geologyand earthquakes, and assess the expected impact, as well as study soil erosion data within U-Tapao International Airport area, especially at current runway areas. Also, study statistics on earthquake occurrences and taxiway design data and assess the potential impacts of earthquake vibrations on project implementation.

(2) Results of the Study

After the operations of runways and taxiway 2 and components within U-Tapao International Airport, there are various boarding and down activities and aircraft maintenance. It is an activity that takes place on the soil layer above. There is no activity to drill into the soil layer below or acting on the soil or on the geological conditions. Therefore, there is no impact on geology in the project area.

According to the statistics of the earthquake that affected Thailand from 2013 - 2017, it was found that the project was located in Rayong province, where there are no moving power groups passing. There was no record of earthquake in the study area of the project. There were only shakes that made one feeling, consistent with the Department of Mineral Resources' Thailand Earthquake Risk Area Map, indicating that the study area is in Chonburi and Rayong Located in an earthquake-prone area of magnitude 1 to magnitude 3 - 4 Mercalli, that is, a level that makes people living in high-rise buildings feel that there is an earthquake (low risk but may cause some damage). The design of the runway construction, including the elements of U-Tapao International Airport that must support the weight of the aircraft, the shocks from the take-off and landing of the aircraft on a regular basis, as well as various activities that will occur in the project area. Therefore, it does not cause any impact on earthquakes.

5.2.6 Soil resources

5.2.6.1 Construction phase

(1) Study Method

Study the construction activities of the project and identify construction activities that may impact land resources. Assess the potential impact on erosion and soil subsidence.

(2) Results of the Study

Construction of runways and taxiway 2 including components in project areas requires soil from outside to adjust the area to a higher level than the original ground. This may change the physical and chemical characteristics of soil resources in project areas, but is limited to the construction area only.

1) Earth damage washout

Removing trees or plants covering the soil from the project area in order to prepare the area for construction of the runways taxiway and other components may cause winds and soil flushing water to break down easily. As soil in the overall project area has a proportion of sand. Due to the soil conditions with high erosion rate, in the construction phase there is activity on clearing, digging, and soil piles. There may be the impact of soil terrows down into the drainage areasin the project area, resulting in the clogging of the drainage system.

2) soil erosion

According to the results of soil penetration for the design of runways and taxiway 2, it was found thatmost areas of the construction area consist of a sand layer at a depth of 10.00 meters. at a depth of the first 2 meters , it was a dense layer of sand to medium dense. The next depth appears a layer of very loose sand. It has a thickness is about 6.00 meters and there is a very dense layer of sand under another layer of very loose sand. Groundwater is at a depth of approximately 2.00 meters from the soil surface.

In engineering, sand soil is considered to be rough ground. When soil load is received, it can cause immediate movement (medium settlement) and this movement is caused

by changes in volume by changing the space between soil grains because water and air in the space can be released. The amount of subsidence mainly depends on the amount of voids, whereas the dense sand has less space between the grains, unlike loose sand, which has more gaps between the grains. The amount of subsidence in the sandy soil will occur mainly during the construction period, not affecting the long-term use of the airport. However, in engineering, when very loose to loose sandy soil layers appear beneath the structure to be used, such soil properties should be improved to reduce the problem of subsidence in the initial stage by impacting the weight of the soil mass, it causes vibrations to cause the soil grains to move and rearrangereduction of soil pollution, resulting in the soil grain being closer together. The soil mass becomes denser, resulting in higher load-bearing strength and less subsidence.

The other subsidence in soil mass is the use of groundwater. Thiscauses the water in the space between the soil and the soil to drain. The soil mass changes in volume causing the worsening. Such subsidence occur in areas where groundwater is pumped to use in large quantities. During the construction phase, it is expected that the public water supply in the area surrounding the project, namely the Provincial Waterworks Authority, Rayong Branch, Ban Chang Branch, and Pak Nam Prasae Branch, which are the Provincial Waterworks Authority in each branch of Rayong Province. The amount of water produced exceeds the amount of water sold. Therefore, it is expected that this kind of subsidence will not occur and does not affect the construction of the project.

3) Soil solidification

Soil hardening will use different machine tools depending on the depth of soil layer to be improved on the same principle which is soil compaction. It is to improve the quality of soil to be stronger by using mechanical energy. The crushing process can be done at a shallow level of 1 - 2 meters from the ground surfaceby using a machine in a general path such as vibration rollers, water sprayers and graders. In the medium depth 2 – 10 meters from the soil surface, use the method of lifting the hammer quickly, use a weight of 7 tons or more, diameter of the hammering area 1.50 meters, distance between points 3.00 meters, use to improve the soil in areas with very loose sand layers to loose, 4 to 8 meters thick. Once crushed, the soil will be solid, with small collapse able to support the designed load. Therefore, the overall soil resource impact is low.

5.2.6.2 Implementation phase

(1) Study Method

Study project implementation activities and identify activities that may impact soil resources, as well as assess the potential impact of soil damage and damage.

(2) Results of the Study

After the operations of the runways and taxiway 2, U-Tapao International Airport will haveboarding and landing activities and aircraft maintenance. There will be no activity on the

ground floor before the ground. Therefore, activities during the course of the project will not affect land resources.

1) Earth damage washout

The project will build 1 pumping station in the reservoir 1 area to pump the excess rain water that is stored out to the outside. By installing 4 pumps of 2 cubic meters per second (use 3 pumps, reserve 1 units), with a maximum of 3 pumps at the same time. The total pumping rate is 6 cubic meters per second. Water that flows out of the pumping station will flow at high flow rate may cause soil to break down. Therefore, there must be measures to be taken to prevent and relieve the impacts during the implementation phase.

2) soil erosion

U-Tapao International Airport uses water received from water producers (Estwater Company) that does not use groundwater. Therefore, thereis no factor in contributing to soil damage in the project area.

5.2.7 Surface water hydrometallurgy

5.2.7.1 Construction phase

(1) Study Method

Study the construction activities of the project and identify construction activities that may impact surface water meteology. Assess the potential impact of flooding on the project area.

(2) Results of the Study

The construction phase consisted of: 1) land improvement/earth improvement/ground filling work, 2) work on road filling and safe area around taxiways/pavement structure construction, 3) floor structure/ pavement work, 4) excavation, installation of stilts/heads, and tunnel roofs under the runway. 5) groundwork, 6) structural work, 7) architectural work and system and 8) construction in the station/systems, architecture work inside the train station and in the center of waterway. There may be soil leaching or construction debris into nearby canals. This resulted in shallowness and poor drainage during some periods of construction. In addition, the area of U-Tapao International Airport is located on a plain. When considering the 30-year rainfall statistics (1989 - 2018) of the Sattahip Meteorological Station meteorological department Located near the U-Tapao International Airport area, the average monthly rainfall is 108.8 millimeters for the number of days with 10 average rainfall days., the average rainfall during the rainy season (May to October). The range is 156.2 - 208.8 millimeters, with October being the rainiest month being 19 days, the average rainfall of 266.5 millimeters, and December is the least rainy month at 2 days, with average rainfall 11.0 millimeters, and from the inspection of the repeated flooding areas of Rayong Province, it was found that Phala Subdistrict areas where the project is located, were notin the repetitive flood areas (details shown in**Chapter 3, Current Environment,** Section **3.7.5 drainage and flood prevention systems**) Therefore, construction of the project does not pose a risk of severe flooding. There may be some stagnant water inthe form of small puddles caused by soil adjustment, but only for a short period of time. Therefore, adjustment of soiland construction of drainage systems should be carried out during the drought to support or drain water during the rain

season. In order to reduce these impacts, there must be measures to be taken in order to prevent and alleviate the impacts during the operation phase. Therefore, the impacts are low level.

5.2.7.2 Implementation phase

(1) Study Method

Study project implementation activities and identify activities that may impact surface water meteology, as well as assess the potential impact of flooding and sludge washout on the project area.

(2) Results of the Study

After the launch of the runway and taxiway 2 of U-Tapao International Airport, there will be more take-off and landing of aircraft , as well as the use of more passenger service. This will not affect the occurrenceof flooding. Due to the topography conditions of the project area located at the sea. And from past time to present, there have been no flood reports within U-Tapao International Airport. However, in order to prevent the impacts in the event of prolonged heavy rainfall, the project has set to 2 wells, water entrapmenting water to support the water to the same as 2 ponds, total of the same as those in the same as (total volume of both ponds equal to 320,077.41cubic meters) water can be delayed for at least 1 hour prior to the discharge. In the project area, the main water drain canal and secondary lines are released into the ocean. The pumping machine with the pumping rate equal to 6 cubic meters per second, pumping water out of U-Tapao International Airport area. There is a criterion for pumping water, which is the period of rising and falling of sea water, which data from water meters in Thai territorial waters Chao Phraya River - Gulf of Thailand - Andaman Sea The Hydrographic Department, Navy, 2019, reported that the Sattahip Bay area (Chonburi) had a maximum water level of +1.1 meter at a rate of 1 meter (up to the peak between November and January) water levelis at -1.8 meters, (lowest between June and August)

For water flow study with water level and speed as an important parameter for water washout and sedimentation, it was found that in the case that there was no project and the water speed differedvery little. Therefore, the irrigation and sedimentation caused by the obstructing of water flow in the project area willnot change after the construction of the runway and the taxiway 2 were completed, which changed the land use from space to runout. And from the adequate readiness of the water drainage systemat U-Tapao International Airport which are designed to support adequate drainage, therefore the impact is low.

5.2.8 Surface water quality

5.2.8.1 Construction phase

(1) Study Method

During the construction phase, wastewater will be generated from construction activities. The use of consumer water of workers, including waste from machinery used in construction, garbage/waste, if notacquired. Such wastewater and waste may result in

contamination to surface water, which is located in the area of the U-Tapao International Airport, resulting in change in water quality of surface water source.

(2) Results of the Study

1) Elusion from the construction area

Construction activities may affect surface water quality in Khlong Bang Phai and Khlong Phla, causing cloudiness or suspended solids that may be caused by luermentation at the construction area to water source, resulting from solid values analysis of suspended in Khlong Bang Phai. During the rainy season, on July 18, 2019, and during dry season, on October 31, 2019, 3 stations, namely the area above the point of discharge, at the end of the discharge point, and the point before the discharge to sea, it was found that during the rainy season the suspended solid were 18.5, 9.2 and 19.2 milligrams per liter, respectively, and during dry season, there was a suspended solid value of 35.7, 101.0 and 43.0 milligramsper liter, respectively. It was shown that the amount of solids suspended during dry season was higher than in the rainy season and at the end of the discharge period.The amount of wastewater was higher than in the area above the initial discharge point. For Klong Phla during dry season, on 31 October 2019 at 1 station, it was found that the suspended solids were 11.0 milligrams per liter

As a result of the comparison of the solid suspension values in the Khlong Bang Phai and Khlong Phla caused by the above-outgrowing of the sedimentation point, it shows that the tendency of the sludge leaching to not affect during the rainyseason and is likely to increase during dry season. However, all of the construction activities of runways and taxiwaywayswill be conducted within the areas of Utao Pao International Airport and there is no wastewater discharge from the construction activities into natural water. Thus, the impact of sludge leaching from the construction area is low.

2) Wastewater from project activities

Wastewater was mainly caused by the use of consumer water of construction workers and construction control officers (based on the rate of wastewater generation at 80% of the amount of water used, as detailed in**Section 5.4.1 Waste Management**and Wastewater) as follows:

Phase 1: Wastewater caused by construction control officers and construction workers arriving and resting during daytime period of approximately 161.8 cubic meters per day, and wastewater that occurs at the worker shelter area of approximately 318 cubic meters per day.

Phase 2 : Wastewater caused by construction control officers and construction workers entering and resting during daytime period of approximately 49.4 cubic meters per day, and wastewater that occurs at the worker shelter area of about 97.6 cubic meters per day.

Phase 3: Wastewater caused by construction control officers and construction workers arriving and resting during daytime period of approximately 91.5 cubic meters per day, and wastewater that occurs at worker shelters of approximately 180.5 cubic meters per day.

In this regard, the project shall specify in the contract of hiring construction contractors to install a wastewater treatment system (On Site Septic Tank) for wastewater treatment caused by the project construction control office and from the construction worker

accommodation to be qualified in accordance with the Ministry of Natural Resources and Environment Notification on Determination of Control Standards Sewerage from certain types and sizes of buildings, 2005. Such wastewater treatment systems shall be able to process wastewater at no less than the amount of water at each phase. The wastewater treatment system at the worker rest area shall be able to perform the wastewater treatment during Phase 1, Phase 2 and Phase 3 no less than 318 97.6 and 180.5 cubic meters per day, respectively, and the wastewater treatment system at the construction control office must be able to process wastewater in Phase 1, Phase 2, and Phase 3, no less than 161.8, 49.4 and 91.5 cubic meters per day, respectively, before continuing to drain into the public drainage system, the impact is therefore low.

5.2.8.2 Implementation phase

(1) Study Method

During the implementation phase, when the construction of the runways increased, the use of 2 runways could support more flight volume. This would result in increased number of passengers arriving from U-Tapao International Airport. As a result, the number of arriving passengers will be able to supportapproximately 70 million passengers per year. In 1998, the increasing number of passengers will increase the amount of wastewater and waste, thus, must be evaluated and the capability of the central wastewater treatment system to support the occurrence.

(2) Results of the Study

When the project operates runways and taxiway 2, including the development area of the expansion of U-Tapao International Airport in Phase 1 (2028), Phase 2 (2038), and Phase 3 (2048), the total wastewater volume will be equal to 3,185, 5,625 and 9,212 cubic meters per day, respectively (details shown in**clause 5.4.1 Waste and wastewater management**) in which the central wastewater treatment system of U-Tapao International Airport iscurrently an activated sludge treatment system: AS can support only 75 cubic meters per day of wastewater, which cannot sterilize the wastewater that has arisen sufficiently in the future.

Based on the development of the central public utility system to support the overall development in the Eastern Aviation Promotion area, there will be construction of a central wastewater treatment system by Eastwater Company, which will be constructed of a Sequencing Batch Reactor (SBR) wastewater treatment system. There will be construction for 2 phases. Phase 1 (2020-2025) and Phase 2 (2026-2044), with each of a wastewater treatment system size 8,000 cubic meters per day, including wastewater treatment systems that can support wastewater 16,000 cubic meters per day. For wastewater, it will be treated as recycled water for approximately 5,000 cubic meters per day, and the remaining water will be reused. For example, water plants are used in green areas (cloak area) within Urtapha International Airport and other activities for non-standard sewerage. The wastewater will be rested in emergency wastewater treatment ponds and pumped back to the central wastewater treatment system again until quality is met according to the announcement of the Ministry of Natural Resources and Environment. The central wastewater

treatment system can support the amount of wastewater generated from the project development. Therefore, it will not affect the soil water quality.

In addition, aircraft maintenance activities, transportation and storage of fuel, and wastewater/waste water management at Utapao International Airport may result in contamination of wastewater from staff and from cleaning to water sources surrounding U-Tapao International Airport.

5.2.9 Underground water quality

5.2.9.1 Construction phase

(1) Study Method

During the construction phase, wastewater will be generated from the construction activities, the use of consumer water of workers, as well as waste from the various machinery used in the construction, garbage/waste, if were not collected and treated correctly according to academic principles, wastewater and those wasteage may contaminate into groundwater.

(2) Results of the Study

During the construction phase, wastewater/wasteage contamination from construction and sewage activities of consumer water of construction workers and construction control officers into the subterranean floor could affect the subterranean water quality in the project area. However, due to the amount of wastewater that will be generated, the project shall be specified in the employment agreement with the construction contractors to install the on Site Septic Tank to treat wastewater caused by the project construction control office and the housing the construction workers in accordance with the Ministry of Natural Resources and Environment on Determination of Control standard Drainage from certain types of buildings and of certain sizes 2005. The wastewater treatment system around the worker's accommodation must be able to treat the wastewater in phase 1, phase 2 and phase 3 at least 318 97.6 and 180.5 cubic meters per day , respectively, and the wastewater treatment system at the construction control office must be able to process wastewater in phase 1, phase 2, and phase 3, not less than 161.8, 49.4 and 91.5 cubic meters per day, respectively, before continuing to drain into the public drainage system. Therefore, it does not affect groundwater quality.

5.2.9.2 Implementation phase

(1) Study Method

During the period when there are more runways, it can support more travel. This will result in higher number of passengers using U-Tapao International Airport. The number of passengers expected to use the service once the construction is complete can accommodate up to 70 million visitors per year. This will result in higher volumes of wastewater that will increase. Therefore, it must be evaluated in the capacity to support the incoming wastewater and the efficiency of the central wastewater treatment system in order to prevent the release of wastewater to the external discharge, which could affect the subterranean water quality.

(2) Results of the Study

When the project was opened, the number of passengers expected in 2028, 2038 and 2048 would be 14,38 and 70 million passengers per year, respectively. However, the forecast results of the anticipated wastewater volumes inphase 1 (2028), phase 2 (2038), and phase 3 (2048) the total amount of wastewater will occur equal to 3,185, 5,625 and 9,212 cubic meters per day, respectively. This amount of wastewater generated will be delivered for treatment by a central wastewater treatment system capable of providing sufficient capacity to support the amount of wastewater generated without release into the ground, which will not affect contamination into groundwater. Therefore, it will not affect groundwater quality in any way.

5.2.10 Seawater Quality

5.2.10.1 Construction Phase

(1) Study Method

Due to the areas in the south side of U-Tapao International Airport is next to the sea, thus, during the construction phase, it may cause wastewater from both construction activities, the use of water for the consumption of workers, including wastefrom various machinery used in construction, waste, if not collected and treated correctly, according to academic principles, wastewater and those waste may be contaminated into seawater, which may affect the quality of seawater, resulting in deterioration in quality of seawater.

(2) Results of the Study

1) Elusion from the construction area

Construction activities will cause sediment from the contaminated construction area into seawater, This causes turbidity or suspended solids that may be caused by more sedimentation at the sea. From the analysis of suspended solids in the sea during the rainy season on 19 July 2019 and the dry season on 1 November 2019, consisting of 6 stations, the point affected by the project on the south side of the runway 1, 300 meter from the coast (SW1), points affected by the project on the south side of runway 2, 300 meter from the coast (SW2), the point affected by the project on the southeast side of the runway 2, 300 meter from the coast (SW3), the point that may not be directly affected by the project on southwest side of runway 1, 500 meter from the coast (SW4), the points that may not be directly affected by the project on the south side of runway 2, 500 meter from the offshore (SW5) and the point that may not be directly affected by the project on the southeast side of runway 2, 500 meter from the offshore (SW6). It was found that during the rainy season, the suspended solids were 23.4, 34.7, 13.6, 7.9, 7.0 and 9.8 milligrams per liter, respectively, and during dry season, there was a suspended solid value of 5.7, 18.4, 7.2, 10.1, 12.1 and 5.9 milligrams per liter, respectively. It shows that the amount of suspended solids in the rainy season was higher than those in dry season. Due to the leaching of sediments from surface water source into the sea suspended solids at a distance of 300-meter distance from the shore are hight, but at distance of 500-meter from the shore, there will be little

impact. The values of suspended solids during the dry season both at 300 and 500 meter from shore were similar and were slightly affected.

As a result of the comparison of seawater suspension solid values generated by sediment erosion from the shore of, 300 and 500 meter showed that the tendency of sediment erosion has no impact during dry season and is likely to increase during the rainy season. However, construction activities of runways and taxiway 2 will be conducted within the area of U-Tapao International Airport. The sediment from the construction site will flow into the surrounding drainage and flows together at the sump for sedimentation before draining into the canal and further out into the sea. Therefore, the impact is low.

2) Wastewater from construction activities

Wastewater that occurs in the construction phase is mainly caused by the use of water for consumer water of construction workers and construction control officers. (1) Wastewater that will occur in the project construction control office area, with the water usage of construction control officers and construction workers that are primarily resting in Phase 1, Phase 2 and Phase 3, with no less than 318 97.6 and 180.5 cubic meters per day, respectively. For the construction control office area in phase 1, phase 2, and phase 3, no less than 161.8, 49.4 and 91.5 cubic meters per day, respectively. (The rate of wastewater generation is calculated at 80% of the amount of water used as detailed in**clause 5.4.1 Waste and wastewater management**)

In this regard, the project shall specify in the employment contract of the construction contractor to install a wastewater treatment system (On Site Septic Tank) for wastewater treatment caused by the project construction control office and construction worker accommodation to be qualified according to the Notification of the Ministry of Natural Resources and Environment on Determination of Control Standards Drainage from certain types and size of buildings, 2005. The wastewater treatment system at the worker's accommodation must be able to process wastewater treatment in Phase 1, Phase 2 and Phase 3, with no less than 318 97.6 and 180.5 cubic meters per day, respectively, and the wastewater treatment system around the project construction control office, it must be able to process wastewater in Phase 1, Phase 2, and Phase 3, no less than 161.8, 49.4 and 91.5 cubic meters per day, respectively. There was no direct wastewater discharge into the sea, therefore the impact was low.

5.2.10.2 Implementation phase

(1) Study Method

During operations, when there is an increase in the number of 2nd runnway, it will be able to accommodate more travel. This will result in increased number of passengers coming to the U-Tapao International Airport. This will also result in increased wastewater and waste volume. If the correct treatment and collection are not performed according to academic principles, wastewater and those wastes may be contaminated into seawater, resulting in a change in better quality.

(2) Results of the Study

When the project was launched, the estimated number of passengers to visit U-Tapao International Airport in 2028, 2038 and 2048 will be 14, 38 and 70 million persons per year, respectively. However, the results of expected wastewater volumes in the Phase 1 (2028), Phase 2 (2038) and Phase 3 (2048) will total wastewater volumes of 3,185, 5,625 and 9,212 cubic meters per day, respectively. The central wastewater treatment system of U-Tapao International Airport is currently an activated sludge (AS) wastewater treatment system. It can support 75 cubic meters per day of wastewater located on the southwest side of the runway 1 about 1.2 kilometres, and there are also 4 tanks of air-filled wastewater treatment systems installed in the second terminal. Each tank has a capacity of 35 cubic meters, which can support 140 cubic meters of wastewater per day. Therefore, the current wastewater treatment system of U-Tapao International Airport cannot provide sufficient wastewater treatment in the future.

In order to support the development of the project, there will be construction of a central wastewater treatment system, which is conducted by Eastwater Company. There will be construction of a Sequencing Batch Reactor (SBR) wastewater treatment system. The construction is divided into 2 phases, i.e. Phase 1 (2020-2025) and Phase 2 (2026-2044), with each phase having a treatment system size of 8,000 cubic meters per day, including wastewater treatment systems that can support wastewater 16,000 cubic meters per day. For wastewater, it will be treated as recycled water for approximately 5,000 cubic meters per day, and the remaining water will be reused, for example, by using a tree water in a green area within the U-Tapao International Airport and other activities. For non-standard wastewater, it will be sent to rest in an emergency sewerage pond and pump back to the central wastewater treatment system again until quality is met according to the announcement of the Ministry of Natural Resources and Environment. It is found that the central wastewater treatment system will be able to support the amount of wastewater generated from the project development. Therefore, the impact is low.

In addition, aircraft maintenance activities, transportation and storage of fuel, and wastewater/waste water management at U-Tapao International Airport may result in contamination of wastewater from staff and from cleaning to water sources surrounding U-Tapao International Airport.

5.3 Biological Environment Resources

5.3.1 Terrestrial Ecology

5.3.1.1 Construction Phase

(1) Study Method

In the study, the terrestrial ecology data were usesd, including species of mammals, bird, reptile, and amphibian species, to know information about the current terrestrial ecological status of the project area and nearby areas, and compare with past study results to determine trends in terrestrial ecological change.

From the summary report of the bird hazard assessment results at U-Tapao Rayong - Pattaya International Airports Standard and Safety Department, Airports Thailand Public Company Limited during 21-22 February 2018, at 06:00 am - 21:00. Surveys were conducted in the runways, taxiways, aprons and outside the flight area. There were 43 species of birds, such as Openbill stork *Anastomus oscitansEgretta garzetta Microcarbo niger Vanellus indicus,Cypsiurus balasiensisthe Egretta gartta, theCoracias benghalensis Pycnonotus conradi Acridotheres tristis Acridotheres grandis. Passer flaveolus Anthus rufulus* , etc. The results of the assessment of the level of danger from birds can be summarized as follows:

- The three types of birds that are more likely to cause harm are large birds. The population has a high probability of collision and damage, i.e.*Anastomus oscitans*. It has a flying level at 100-200 meters, flying in a circular circle in the air and foraging in flocks.*Columba livia* is low flying level finding food on the ground, and gather in large herds, and (*Elanus caeruleus*) is high flying level.

- The bird types tend to cause moderate harm, i.e. middle-sized bird and large population. There is also a chance of crashing, but the damage is relatively low. There are 3 types of bird i.e.*Egretta garzetta.* Tricky to gather in groups or herds, and possibly many other birds, but sometimes ingest alone, *Ardeola bacchus,*and scallops*Tyto javanica*

- Bird types that are likely to cause moderate harm are medium-sized and highly populated birds. There is still a chance of crashing, but the damage is relatively low. However, it is a bird that can induce the predator to enter U-Tapao International Airport, numbering 37 species, such as*the Ardea intermedia,Microcarbo niger Vanellus indicus Geopelia striata Cypsiurus balasiensis Coracias benghalensis Passer montanus Athene brama*

From the 1st survey of wildlife resources in the project study area (during the rainy season) during 15-17 July 2019 and during 19-22 July 2019 and the 2nd (dry season or, migration season) between 15-18 November 2019 and 18-20 December 2019 by dividing the survey area into 2 areas as follows: Runway area and taxiway 2, U-Tapao International Airport And the study area of the project found 149 species of wildlife in the project area, comprising 4 species of mammals, 133 species of birds, 7 species of reptiles and 5 species of amphibians. As for plant species, it was found that the area in the project area at present was not found the area that maintains the forest condition. Most of the area is empty ground, with shrubs and cassava, in the area still remains a large tree with a diameter of 40 centimeters that is the original tree. The southern area next to the seashore, vegetation spreads far and wide along the beach, and the northern area, where the site was built before, is now a wilderness area with dense vegetation.

(2) Results of the Study

In construction of the runways and taxiway 2, construction activities that affect the changing of forest and wildlife resources such as cutting/removing/destructing plants within the project area, which will cause habitats, food sources, bird nests and animals to decrease. According to current wildlife survey, 149 species, such as a giant faced bat (*Hipposideros* sp.) *Callosciurus finlaysoniiTamiops macclelandiiMenites burdoreiPhaenicophaeus tristisGallicrex cinerea Himantopus himantopusVanellus indicusAnastomus oscitansMicrocarbo nigerPloceus philippinusColumba livia Pycnonotus conradi Acridotheres tristis Artamus fuscus Geopelia striata Elanus caeruleus Calotes versicolor Hemidactylus platyurus Leiolepis belliana Varanus salvator Microhyla mukhlesuri Fejervarya limnocharis Hoplobatrachus rugulosus Duttaphrynus melanostictus Kaloula pulchra Parinari anamensis Mangifera caloneura Pterospermum diversifolium Azadirachta indica Hibiscus tiliaceus* L.) *Hibiscus tiliaceus* L.) *Trama orientalis* (L.) Blume) *Peltoporum daisyrhachis* (Miq.) Kurz)*Leucaena leucocephala* (Lam.) de Wit) *Streplus asper* Lour.)*Acacia auriculaeformis* A.Cunn. ex Benth.) Construction site adjustment activities may result in loss of housing, hiding spots, food finders, and nesting. However, these animals have the ability to adapt. It can be moved to new habitats, hiding places, spawning nests and at new food sources, therefore the impact is low.

5.3.1.2 Implementation phase

(1) Study Method

Refer to construction phase

(2) Results of the Study

During the implementation phase of runways and taxiway 2, will increase the number of take-off and landing flights per hour. This could increase the number of accidents from aircraft colliding with birds. According to the review of statistical data on the aircraft hit the bird U-Tapao International Airport between January 2017 and July 2019, there were a number of aircraft crashes into birds. On average less than 1 time per month. The statistics of aircraft crashes into birds of 9 times in 2017, and from the data, it was found that the month with the most crashes was December, which was during that there are many migratory birds in the area of U-Tapao International Airport.

As for the assessment of the bird hazard level at U-Tapao Rayong - Pattaya International Airport Standard The Department of Standards and Airport Safety, Airports of Thailand (Public) Company Limited, 2018 found that bird types most likely to cause harm are large birds, medium birds and small birds, respectively. According to the results of the wildlife resource survey in the study area of the project - the 1st time (during the rainy season) during 15-17 July 2019, and between 19-22 July 2019 and the 2nd time (dry or migration season) between 15-18 November 2019 and 18-20 December 2019 found that most of them are small birds (body weight less than 300 grams), followed by medium-sized birds (weight between 300-1000 grams) and found large

birds (weights more than 1,000 grams) led to a low chance of serious accidents caused by birds with aircraft. Therefore, the impact was low.

5.3.2 Equatic Ecology

5.3.2.1 Surface Water Ecology

(1) Construction phase

1) Study Method

In studies, aquatic ecology data was used, including the number of types of phytoplankton zooplankton and benthic, as well as the quantity of abundance, the species found as the dominat species and index values diversity, to analyze the data condition of water sources and compare the results with historical studies to find trends in the changes in ecology.

According to the analysis results of biodiversity index values, it was found that Khlong Bang Phaiand Khlong Phla are low-to-medium quality water sources. The phytoplankton found in the dominant genus are green seaweed genus blue-green *Oscillatoria* ,green seaweed *Scenedesmus* genus diatom *Chaetoceros*, and the euglenoid genus *Euglena*, which are phytoplankton found in general water sources of medium quality and water sources containing organic matter are plentiful. The predominant genus of zooplankton is the genus Protozoa. *Centropyxis* copepods in the Nauplius stage and genus rotifers *Rotaria.* The predominant species of benthic animals are the genus freshwater gnats. *Chironomus* and genius *Bezzia* genus bivalve *Corbicula* barnacle stone *Balanus* Crustaceans of the family Penaeidae, Freshwater earthworms of the family Naididae and sea worms of the family Nereididae. Most of the aquatic plants found are water-borne plants, such as bonsai, morning glory, large-leaved sedge, watercress, staghorn cabbage, feather grass, sai grass, water hyacinth, lotus, etc., and most of the fish found are the species that can be found in general water sources, including the species found in brackish waters around the sea discharge point. The most common species are *Barbonymus gonionotus, Liza subviridis and Trichopsis viiaia.*

2) Results of the Study

In construction of runways and taxiway 2, construction activities that impact the change in surface water quality, soil washout from the area of construction and material piles into water sources, sewerage contamination from workers and from the construction into natural water sources surrounding U-Tapao International Airport and Leachate contamination into water sources surrounding U-Tapao International Airport, which will have continuous impacts on soil aquatic organisms and ecology.

2.1) Elusion from the construction area

In the construction of the project, there was construction activities that could possibly irrigate soil and construction materials such as rocks, sand from the construction area. This could impact the change of surface water quality. This caused the water to become cloudy or have a suspended solids, and may affect living in water resources. However, U-Tapao International Airport has drainage lines around the area of U-Tapao International Airport, as well as construction activities that occur in the U-Tapao International Airport. The project required to supply finished wastewater treatment systems that can treat sufficient wastewater from the activities of the construction workers of the project. There will be no discharge of wastewater from construction activities into natural water sources. The sediment from the construction area will flow into the surrounding drainage chute and flowed together at the cistern to precipitate before being discharged to public drainage systems. Therefore, the chance of contamination into external water bodies and affecting aquatic life is very low. The impact is therefore low.

2.2) Effects of salt during dry season

According to the analysis results of the biodiversity index values of the 2 water sources, namely Khlong Bang Phai, and Khlong Phla, it was found that the conditions of water science of Khlong Bang Phai at station W3: Khlong Bang Phai, sea discharge point to the sea, has salty values in the range of 4.3-18.8 parts per thousand and Khlong Phla has a salinity of 0.3 parts per thousand, which are already affected by the sea waters and the development of the project did not have construction or reconditioning of the canal. No activity would change the influence of saltwater invasion into the canals. Therefore, the both places did not have additional impacts from the project area.

2.3) Wastewater from the consumption of workers and project construction activities

The wastewater produced from the consumer of workers, which is predicted to have about 80% of wastewater generated by the volume of water used, will have the amount of wastewater generated in each construction phase as follows:

Phase 1 As the construction phase 1 has a maximum number of 2,654 workers, the accommodation of the workers is divided into 2 sites, supporting 1,327 workers of each, with the following details:

The total amount of wastewater at the worker's accommodation in phase 1 is approximately 318 cubic meters per day and the efficiency of the wastewater treatment should be at least 20 milligrams per liter of BOD. The project has determined that there will be 32 prefabricated wastewater treatment tanks of 10 cubic meters in size and must provide a sewerage pond that can accommodate wastewater for one day before discharging it into a public drainage gutter. The project has determined that the sewerage pond size is not less than 318 cubic meters.

The total amount of wastewater for worker camps in phase 1 (per site) is approximately 159 cubic meters per day and must be effective in treating wastewater with a BOD

of not more than 20 milligrams per liter of drainage. The project has specified that there are 16 prefabricated septic tanks of 10 cubic meters in size and must provide a sewerage pond that can accommodate wastewater for one day before discharging it into a public drainage gutter. The project has determined that the sewerage pond size is not less than 159 cubic meters.

Phase 2 There are 813 workers, with approximately 97.6 cubic meters per day of wastewater, and must be effective in treating water with no more than 20 milligrams per liter of drainage. The project requires 10 prefabricated wastewater treatment tanks of 10 cubic meters and must provide a sewerage pond that can accommodate wastewater for one day before discharging it into a public drainage gutter. The project specified the 97.6 cubic meters of the drainage pond.

Phase 3 has 1,504 workers. The wastewater volume will occur in approximately 180.5 cubic meters per day and must be effective in treating water for no more than 20 milligrams per liter of the drain. The project requires 19 prefabricated wastewater treatment tanks of 10 cubic meters and must provide a sewerage pond that can support wastewater for one day before discharging it into a public drainage gutter. The project specified the wastewater pond has a size of not less than 180.5 cubic meters.

In this regard, the project shall be specified in the contract for the employment of the construction contractors to provide wastewater treatment systems capable of wastewater treatment from the activities of the project construction workers as follows:

Phase 1 provide a prefabricated wastewater treatment system that can treat the wastewater from the activities of the construction workers at least 161.8 cubic meters per day. The project requires 17 prefabricated wastewater treatment tanks of 10 cubic meters and a reservoir that can hold water for 1 day before draining to natural water lines in the airport area, no less than 161.8 cubic meters.

Phase 2 provide a prefabricated wastewater treatment system that can treat the wastewater from the activities of the construction workers at least 49.4 cubic meters per day. The project requires 5 prefabricated wastewater treatment tanks of 10 cubic meters and a sewerage pond that can support wastewater for one day before draining to natural water lines in the airport area, no less than 49.4 cubic meters.

Phase 3: provide a prefabricated wastewater treatment system that can treat the wastewater from the activities of the construction workers at least 91.5 cubic meters per day. The project requires 10 prefabricated wastewater treatment tanks of 10 cubic meters and a sewerage pond that can support wastewater for one day before draining to natural water lines in the airport area, no less than 91.5 cubic meters.

(2) Implementation phase

1) Study Method

Refer to construction phase

2) Results of the Study

During the implementation phase of the project will increase the number of flights up - landing per hour, the number of passengers, service providers in the aviation industry and related businesses will increase. As a result, the amount of wastewater increases as well. In the event that wastewater is discharged into surrounding water, it may affect aquatic life that is live in water sources that support drainage from U-Tapao International Airport. The number of passengers will be expected after operating in 2028 2038 and 2048 will be 14, 38 and 70 million per year, respectively, along with development. commercial areas in U-Tapao International Airport. The estimated wastewater generated after the operation in 2028, 2038 and 2048 will be equal to 3,185, 5,625 and 9,212 cubic meters per day, respectively.

Based on the development of the central public utility system to support the overall development in the Utapao International Airport area, the central wastewater treatment system will be constructed by Eastwater Company, which will have the construction of a Sequencing Batch Reactor (SBR) wastewater treatment system. The construction will be divided into 2 phases, i.e. Phase 1 (Year 1-6) and Phase 2 (7th Year), with each of the wastewater treatment system size 8,000 cubic meters per day, including wastewater treatment systems that can support wastewater 16,000 cubic meters per day, for wastewater treatment, it is recycled approximately 5,000 cubic meters per day, which will be reused for use, such as watering trees in green areas within the U-Tapao International Airport and other activities for non-standard wastewater, will be sent to rest the emergency wastewater treatment pond and pumped back to the central wastewater treatment system until quality is achieved according to the announcement of the Ministry of Natural Resources and Environment. This central wastewater treatment system is found to be able to support the amount of wastewater generated from the project development. Therefore, the impact is low.

5.3.2.2 Marine Ecology

(1) Construction Phase

1) Study Method

In the study, the consultant used naval Ecological data, such as the number of types of plant plank, animal plankton and fauna, as well as the amount of prevalence, dominant species, and the index and diversity index.

According to the analysis results of biologically diverse index values, it was found that the dominant genus of phytoplankton is the genus Diatom *Rhizosolenia* and *Chaetoceros* and dinoflagellates genus *of Pendinium*, which is phytoplankton commonly found in seawater. The predominant genus of zooplankton are the Nauplius copepods and the genus Protozoa. *Tintinnopsis* The predominant benthic fauna is amphioxus, genus B. *ranchiostoma* Earthworms of the family Orbiniidae and Pilargidae, Amphipods, Aoridae, Sea Coins, Clypeasteridae, Balanus, Bivalves, Chamidae and Ostracod

2) Results of the Study

In construction of runways and taxiway 2, construction activities that impact changes in sea water quality, soil washout from the area of construction and material piles into water sources, sewerage contamination from workers and from construction into water sources, and leachate contamination into water sources that will continually affect marine organisms and ecology are summarized as follows:

2.1) Consumption wastewater from the construction supervision office and temporary worker accommodation (lunch break)

Prepare adequate toilets for the construction workers according to the Ministry of Interior's Notification regarding health welfare requirements for employees, announced in the Government Gazette, Special Edition, Volume 103, Part 17, 3 February 1986, Article 1(3) and 1(4) that the workplace with more than 80 workers must have at least 3 toilets, and there must be 1 additional for every 50 workers,fraction of 50 people, if more than 25 people, it is considered to be 50 people and stipulated in the contract of the contractor to provide a ready-made wastewater treatment system that can treat the wastewater from the activities of the construction workers of the project. which will have the amount of wastewater that occurs in each phase as follows

Phase 1: The maximum number of construction workers and construction control officers is 2,890, with 2,654 construction workers and 236 construction control officers. It must provide a prefabricated wastewater treatment system that can be treated from construction workers' activities, with no less than 161.8 cubic meters per day. The project has specified 17 prefabricated wastewater treatment tanks of 10 cubic meters and a sewerage pond. that can support wastewater for 1 day before draining into the natural gutter in the airport area with a size of not less than 161.8 cubic meters.

Phase 2 : The maximum number of construction workers and construction control officers is 882, with 813 construction workers and 69 construction control workers. It must provide a prefabricated wastewater treatment system that can be treated from construction workers' activities, with no less than 49.4 cubic meters per day. The project has specified 5 prefabricated wastewater treatment tanks of 10 cubic meters and a sewerage pond that can support wastewater for 1 day before draining the natural water line at the airport area with a size of not less than 49.4 cubic meters.

Phase 3: The maximum number of construction workers and construction control officers is 1,634, with 1,504 construction workers and 130 construction control officers. It must provide a prefabricated wastewater treatment system that can be treated from construction workers' activities, with no less than 91.5 cubic meters per day. The project has specified 10 prefabricated wastewater treatment tanks of 10 cubic meters and a sewerage pond that can support water for 1 day before draining the natural water lines in the airport area with a size of not less than 91.5 cubic meters.

2.2) Consumption wastewater from worker's accommodation (overnight stay)

Consumption wastewater at workers' accommodation (overnight stay) where wastewater volume is expected to occur in approximately 80 percent of the water used (Pollution Control Department, designers and manufacturers of fixed wastewater systems Handbook Volume 2, Wiang Kaew Printing, 1994) There will be wastewater volumes in each of the following phase:

Phase 1: Since construction in Phase 1 has a maximum number of 2,654 workers, the workers are divided into 2 places, supporting 1,327 workers per worker. Details are as follows:

The total amount of wastewater from the worker's accommodation (overnight stay) in phase 1 is approximately 318 cubic meters per day. The project requires 32 prefabricated wastewater treatment tanks of 10 cubic meters must provide a sewerage pond that can support wastewater for 1 day before draining into the public drain track. The project requires a wastewater pond with a size of not less than 318 cubic meters.

The total amount of wastewater from worker's accommodation (overnight stay) in phase 1 (per site) is approximately 159 cubic meters per day. The project requires 16 prefabricated wastewater treatment tanks of 10 cubic meters and must provide a sewerage pond that can support wastewater for 1 day before draining into the public drain track. The project requires a wastewater pond with a size of not less than 318 cubic meters.

Phase 2: There will be approximately 97.6 cubic meters per day of wastewater treatment. The project requires 10 prefabricated wastewater treatment tanks of 10 cubic meters and must provide a sewerage pond that can support wastewater for 1 day before draining into the public drain track. The project requires a wastewater pond with a size of not less than 97.6 cubic meters.

Stage 3: There will be approximately 180.5 cubic meters of wastewater per day. Project has defined 19 10 cubic meters of pre-fabricated wastewater treatment tanks and there must be a one-day wastewater reservoir that can support sewerage 1 day before draining into the public drain track. The project specified that the 180.5 cubic meters of sewerage.

2.3) Soil sediment from construction activities

In construction activities, sediment may be washed down from the construction area to water source, causing the water to become cloudy or suspended more solids. This can affect aquatic organisms. However, due to U-Tapao International Airport has a sewage chute around the U-Tapao International Airport area. Wastewater will flow to collect at the sewerage pond for sedimentation. This can help prevent the leaching of sediments into external water bodies before collecting them into the sewage pumping ponds and transferring them to the project's central wastewater treatment system. This will make the water quality through according to the notification of the Ministry of Natural Resources and Environment Re: Determination of Standards for Controlling Wastewater Discharge from Certain Types and Sizes of Buildings 2005 before discharging into the public drainage system and going out to sea. Therefore, the chance that the sediment will contaminate outside water bodies and have an impact on marine life is very low. The impact that occurs is therefore low.

(2) Implementation phase

1) Study Method

In the study, the consultant used naval Ecological data, such as the number of types of phytoplankton zooplankton and benthic, as well as the amount of prevalence, dominant species, and the index of diversity index was analyzed for data on sea water conditions and trends in marine ecology changes..

2) Results of the Study

2.1) Drinking water for aquatic organisms

In the implementation phase of the project, there will be an increase in the number of take-off and landing flights per hour, the number of passengers, service providers in the aviation industry and related businesses. As a result, the amount of wastewater increases as well. The wastewater will be treated as recycled water for reuse such as watering plants in green areas within U-Tapao International Airport and other activities. For non-standard wastewater will send the wastewater to stay at the emergency sewerage pond and pumped back to the central wastewater treatment system again until the quality meets the effluent standards as announced by the Ministry of Natural Resources and Environment. It is found that this central wastewater treatment system can adequately support the amount of wastewater generated from the project development. and no sewage into the sea

For rainwater drainage, it was found that there is a small amount of water and the project designed a rainwater drain system to prevent water and control water volume in the project area. The drainage system was divided into 2 parts, i.e. 1) The secondary drain system will drain water from the surface of the runway and taxiway. 2) The main drainage system transports water into the project's reservoir before discharging it into the sea. The project has designed a water retardant pond to be able to hold water for 1 hour before releasing it into the sea. With a period of the retardation allows for sedimentation which does not affect marine life and therefore the impact is low..

2.2) Sound effects on rare marine animals

The study of the resource status of rare marine animals found no habitats in the area of the study. Only sea grass sources are found in the southern part of the project, about 800 meters away from the runways and taxiway 1 and approximately 1,700 meters from runway and taxiway 2, which has not been reported to have rare marine animals in the area. The nearest rare marine animal habitat is sea turtle habitat and spawning site at Khram Yai Island, Chonburi province, approximately 13 kilometres away from the project area, which is outside the area to be affected by the level of NEF volume line ≥ 40 and NEF 30 - 40. In the case of flight expected in 1998, it is expected that the impact of the aircraft's noise will have low levels of rare ocean animals.

5.4 Value to human use

5.4.1 Waste and wastewater management

5.4.1.1 Construction Phase

(1) Study Method

1) Solid Waste

Study sources of waste and solid waste from construction activities and anticipate the amount of waste and solid waste that will be generated and consider appropriate waste management practices

2) Waste water

Study sources of wastewater from construction activities and anticipate the volume of wastewater that will be generated from construction workers and control officers, and assess the adequacy of wastewater management systems and the potential impact of wastewater discharges.

(2) Results of the Study

Due to the overall construction of the project, divided the construction period into 3 phases, i.e. Phase 1, Phase 2, and Phase 3. Each phase will take 36 months. Therefore, the project will plan management according to the construction phase, in which construction workers and construction control officers will work within U-Tapao International Airport during each period as follows:

Phase 1: There will be a maximum number of 2,890 construction workers and construction control officers, 2,654 construction workers and 236 construction control officers.

Phase 2: There will be a maximum number of 882 construction workers and construction control officers, devided into 813 construction workers and 69 construction control officers.

Phase 3: There will be a maximum number of 1,634 construction workers and construction control officers, 1,504 construction workers and 130 construction control officers.

During construction period, runways and taxiway 2, as well as project components within the U-Tapao International Airport area, there are 2 main sources of solid waste and wastewater, which are within the U-Tapao International Airport area, which are the runway construction areas and taxiway 2, the worker's lunch break canteen and the area of the project construction control office. Outside of U-Tapao International Airport is a worker accommodation area, which will be set up workers' accommodation outside the area of U-Tapao International Airport. It can separate the assessment of the amount of solid waste and the wastewater that will occur as follows.

1) Solid Waste

1.1) within the U-Tapao International Airport area.

Solid waste from sources within the U-Tapao International Airport area consists of general solid waste from construction workers' daily activities and construction control officers such as plastic bags, food scraps, foam boxes and paper, etc. and solid waste with residual materials from construction such as plaster, wood scrap, and assflult, etc., as well as hazardous waste that may be caused by construction activities such as motor oil, paint and solvent.

The estimated volume of solid waste generated is based on the number of construction workers and work control officers during each construction phase, and the rate of solid waste generated is 0.44 kilograms per person per day (the density of 118.39 kilograms per cubic meter). (Source: Thares Srisathit, 2004), which can calculate the volume of solid waste and the number of waste containers in each construction phase as follows:

Phase 1: There are a total of 1,271.6 kilograms of solid waste per day. Construction contractors must provide 27 bins for dry solid waste of 200-liters, and 27 bins for wet solid waste, 200 liters, placed at a sufficient number of points. Provide a total solid waste reservoir that can support solid waste for not less than 3 days, with a capacity of not less than 32.2 cubic meters.

Phase 2 : There are 388.1 kilograms of solid waste per day. Construction contractors must provide 9 bins for dry solid waste of 200-liters, and 9 bins for wet solid waste, 200 liters,, placed at a sufficient number of points . Provide a total solid waste reservoir that can support for solid waste for not less than 3 days, with a capacity of not less than 9.8 cubic meters.

Phase 3: There are 719.0 kilograms of solid waste generated per day. Construction contractors must provide 16 bins for dry solid waste of 200-liters, and 16 bins for wet solid waste, 200 liters, placed at a sufficient number of points. Provide a total solid waste reservoir that can support solid waste for not less than 3 days, with a capacity of not less than 18.2 cubic meters.

From the assessment of solid waste that will occur during the construction phase in the international airport area, U-Tapao found that in the phase 1 (2028), the phase 2 (2038), and the phase 3 (2048) the total amount of solid waste occurred 1,271.6, 388.1 and 719.0 kilograms per day, respectively. At present, U-Tapao International Airport has the amount of solid waste that occurred within U-Tapao International Airport in 2019 (approximately 2,000 kilograms per day, or approximately 2 tons per day). In the case of construction waste and construction hazardous waste, the construction contractor must correctly separate the containers for storing such solid waste. The construction contractor must dispose of the waste resulting from construction in a designated place every day. The responsible person for waste management at U-Tapao Airport (At present, U-Tapao Airport has collected and taken to a sorting house in Khao Tabak, KorMor 8.which is about 6 kilometres from U-Tapao International Airport)

During the construction phase, construction contractors need a system to sort and dispose of solid waste, as well as systematically manage and have strict control over the management of waste that has occurred in order to not adversely affect the aviation activities and environment. Thus, an overview of waste management and hazardous waste within the U-Tpao International Airport area is expected to have a moderate impact.

1.2) Outside the U-Tapao International Airport area

Most of the solid waste from sources outside the U-Tapao International Airport area is general solid waste from the daily activities of construction workers in the worker accommodation area. This will look the same as general solid waste from residential areas such as waste paper, rags, food packaging (plastic bags, foam boxes), food scraps and plastic scraps, etc.

The estimated amount of solid waste generated is based on the number of construction workers in each construction phase and reference the rate of solid waste generated from the accommodation workers at 0.71 kilograms per person per day (density of 153.57 kilograms

per cubic meter) (Tharet Srisathit , 2004). The amount of solid waste can be calculated from the accommodation area of workers at each construction phase as follows:

Phase 1: Since construction in the phase 1 has a maximum number of 2,654 workers, the worker accommodation is divided into 2 places, with a capacity of 1,327 workers per place as detail as follows:

The total amount of solid waste from the worker's accommodation in the phase 1 is approximately 1,884 kilograms per day. The construction contractor must provide 31 bins of 200 liter bin for dry solid waste, and 31 bins of 200 liter bin for wet solid waste placed at a sufficient number of points. Provide a total solid waste reservoir that can support solid waste for not less than 3 days, with a capacity of not less than 37 cubic meters.

The total amount of solid waste from the worker's accommodation in the phase 1 (per place) is approximately 942 kilograms per day. The construction contractor must provide 16 bins of 200-liter bin for dry solid waste and 16 bins of 200-litre bins for wet solid waste placed at a sufficient number of points. Provide a total solid waste reservoir support solid waste for not less than 3 days, with a capacity of not less than 18.4 cubic meters.

Phase 2 : The amount of solid waste generated is approximately 577 kilograms per day. The construction contractor must provide 10 bins of 200-liter bins for dry solid waste and 10 bins of 200-liter bins for wet solid, placed at a sufficient number of points. Provide a total solid waste reservoir that can support solid waste for not less than 3 days, with a capacity of not less than 11.3 cubic meters.

Phase 3: The amount of solid waste generated is approximately 1,068 kilograms per day. The construction contractor must provide 18 bins of 200-liter bins for dry solid waste and 18 bins of 200-liter bins for wet solid, placed at a sufficient number of points. Provide a total solid waste reservoir that can support solid waste for not less than 3 days, with a capacity of not less than 20.9 cubic meters.

Such solid waste, the construction contractor must provide and place adequate waste containers for the amount of solid waste generated from each phase, and coordinate with the authorized private company or liaise with the responsible local administrative agency to further process such waste for disposal. Therefore, it is expected that the amount of solid waste that occurs outside of U-Tapao International Airport during the construction phase will have a low level of impact due to the low volume. U-Tapao International Airport should have a strict inspection on the solid waste storage service confirmation document from the responsible person.

2) Waste water

Wastewater occurring during the construction phase is mainly caused by the use of water for consumer water of construction workers and construction control officers. Details are as follows:

- **Phase 1** There will be a maximum number of 2,890 construction workers and construction control officers, with 2,654 construction workers and 236 construction control officers. The phase with maximum number of construction workers will be approximately 1 month during the 19th month.
- **Phase 2** There will be a maximum number of 882 construction workers and construction control officers, devided into 813 construction workers and 69 construction control officers, The phase with maximum number of construction workers will be approximately 1 month during the 22th month.
- **Phase 3** There will be a maximum number of 1,634 construction workers and construction control officers, with a maximum of 1,504 construction workers and 130 construction control officers. The maximum number of construction workers will be around 1 month in the 19th month.

Construction workers and construction control workers will work in the U-Tapao International Airport area. All workers will travel to and from every day, not residing in U-Tapao International Airport area. Therefore, the assessment of the amount of wastewater generated is considered as 2 separate areas:

2.1) within the U-Tapao International Airport area.

Wastewater that will occur in the construction control office area of the project, which is located within the northern U-Tapao International Airport area. Most of the wastewater is caused by the daily activities of construction workers and construction control workers, such as water as sacchar from toilets. The water consumption is estimated from the water consumption rate of 70 liters per day (Kriengsak Udomsinrot, 1994) and the rate of wastewater generation at 80% of the water consumption (Source: Pollution Control Department, Manufacturer and designer of fixed wastewater systems, manual volume 2, Wiang Kaew Printing, 1994), which can calculate the amount of wastewater generated in each construction phase as follows:

Phase 1: The amount of water used by the construction control workers will be approximately 16.5 cubic meters per day and water consumption of construction workers entered the lunch break is approximately 185.8 cubic meters per day, with a water consumption rate of 70 liters per person per day (Kriengsak Udomsinrot, 1994) Total water consumption at the construction control office was 202.3 cubic meters per day, accounting for the amount of wastewater generated 161.8 cubic meters per day, in which the project must procure a finished wastewater treatment system capable of wastewater treatment from construction workers' activities of no less than 161.8 cubic meters per day. The project required 17 tanks of prefabricated septic tank of 10 cubic meters and a reservoir that can support water for 1 day before draining to natural water lines in the airport area, no less than 161.8 cubic meters.

Phase 2 : The amount of water used by the construction control workers will be approximately 4.8 cubic meters per day with water usage of construction workers entering the lunch break by approximately 56.9 cubic meters per day, with a water consumption rate of 70 liters per person per day (Kriengsak Udomsinrot, 1994) Total water consumption at the construction control

office was 61.7 cubic meters per day, accounting for the amount of wastewater generated 49.4 cubic meters per day, in which the project must procure a finished wastewater treatment system capable of wastewater treatment from construction workers' activities of no less than 49.4 cubic meters per day. The project required 5 tanks of prefabricated septic tank of 10 cubic meters and a reservoir that can support water for 1 day before draining to natural water lines in the airport area, no less than 49.4 cubic meters.

Phase 3: The amount of water used by the construction control workers will be approximately 9.1 cubic meter per day with water usage of construction workers entering the lunch break by approximately 105.3 cubic meters per day, with a water consumption rate of 70 liters per person per day (Kriengsak Udomsinrot, 1994) Total water consumption at the construction control office was 114.4 cubic meters per day, accounting for the amount of wastewater that generated 91.5 cubic meters per day, in which the project must procure a finished wastewater treatment system capable of wastewater treatment from construction workers' activities of no less than 91.5 cubic meters per day. The project required 10 tanks of prefabricated septic tank of 10 cubic meters and a reservoir that can support wastewater for 1 day before draining to natural water lines in the airport area, no less than 91.5 cubic meters

2.2) Outside the U-Tapao International Airport area

Wastewater that will occur in construction workers' accommodation outside of the international airport, U-Tapao is mainly caused by the daily activities of the construction workers, such as wastewater from washing, bathing, and showering. Water consumption is estimated from the water usage rate of 150 liters per day (water use rate of the temporary rental accommodation, Kriengsak Udomsinrot, Plumbing engineering, 1993) and the rate of wastewater generation at 80% of the water consumed (Source: Pollution Control Department, Manufacturer and designer of fixed wastewater systems, manual volume 2, Wiang Kaew Printing, 1994), which can calculate the amount of wastewater that occurs at each phase of the construction as follows:

Phase 1: Since construction in Phase 1 has a maximum number of 2,654 people, the worker accommodation is divided into 2 places, each of which can accommodate the number of workers 1,327 people each, detail as follows:

The total water consumption of the worker's accommodation in the phase 1 is approximately 398 cubic meters per day (the water usage rate of the worker in the worker's accommodation is 150 liters per day, according to the water usage rate of the temporary rental property, Kriengsak Udomsinrot, Plumbing Engineering, 1993) The amount of wastewater generated is 318 cubic meters per day. The project must provide a wastewater treatment system and must be efficient in treating wastewater with a BOD of not more than 20 milligrams per liter. The project has defined 32 prefabricated septic tanks of 10 cubic meters in size and must provide a sewerage pond that can support wastewater for one day before discharging it into a public drainage gutter. The project has determined that the sewerage pond size is not less than 318 cubic meters.

The water consumption of the worker's accommodation in phase 1 (per place) will be approximately 199 cubic meters per day (use rate of worker in the worker's

accommodation 150 liters per person per day according to the water usage rate of the temporary accommodation, Kriengsak Udomsinroj, Plumbing Engineering, 1993) The amount of wastewater generated is 159 cubic meters per day. The project must provide a wastewater treatment system and must be efficient in treating the wastewater with a BOD of not more than 20 milligrams per liter. The project has determined that there are 16 prefabricated wastewater treatment tanks 10 cubic meters, and must provide a sewerage pond that can support wastewater for one day before discharging it into the drainage trough. public The project has determined that the sewerage pond size is not less than 159 cubic meters.

Phase 2 : The water consumption will be approximately 122.0 cubic meters per day (water consumption rate of workers in the housingof 150 liters per worker per day, based on water usage rate of the temporary rental accommodation, Kriengsak Udomsinroj, Plumbing Engineering, 1993) as the amount of wastewater generated 97.6 cubic meters per day, in which the project must procure wastewater treatment systems and must be efficient in treating effluents with a BOD of not more than 20 milligrams per liter. The project has specified 10 prefabricated septic tanks of 10 cubic meters in size and must provide a sewerage pond that can support wastewater for one day before discharging it into a public drainage gutter. The project has set a pond for waste water of not less than 97.6 cubic meters.

Phase 3: The water consumption will be approximately 225.6 cubic meters per day (water usage rate of workers in worker housing 150 liters per person per day, based on water usage rate of temporary rental accommodation, Kriengsak Udomsinroj, Plumbing Engineering, 1993) as the amount of wastewater that occurs 180.5 cubic meters per day, in which the project must procure a wastewater treatment system and must be efficient in treating the wastewater with a discharged BOD of not more than 20 milligrams per liter.. The project has specified 19 prefabricated wastewater treatment tanks of 10 cubic meters and must provide a sewerage pond that can support wastewater for one day before discharging it into a public drainage gutter. The project has designated a wastewater pond with a size of not less than 180.5 cubic meters.

5.4.1.2 Implementation phase

(1) Study Method

1) Solid Waste

Study the current waste management situation and forecast the amount of solid waste covering all 3 phases of the development of U-Tapao International Airports, namely Phase 1 (2028), Phase 2 (2038), and Phase 3 (2048), to assess the capability of the solid waste disposal system to support development both inside and outside the project area, as well as to consider the plan for the development of the solid waste management system of U-Tapao International Airport in the future.

2) Waste water

Forecast the amount of wastewater that will be generated covering all the development of all U-Tapao International Airport in all three phases, namely Phase 1 (2028), Phase

2 (2038), and Phase 3 (2048), to assess the ability of wastewater treatment systems to support development both inside and outside of the project are.

(2) Results of the Study

1) Solid Waste

At present, the management of solid waste and hazardous waste in U-Tapao International Airport by U-Tapao Airport operates the collection and transportation of solid waste to a waste separation plant in Khao Tabak KorMor.8 of a private company that has received concessions from the Royal Thai Navy, to sort and dispose of it in a sanitary manner. From the study of sources of solid waste in U-Tapao International Airport, it comes from 2 parts: 1) solid waste from aircraft are sorted according to airline standards, and 2) solid waste from terminals and office buildings are sorted by employees. The amount of waste depends on the period that is normal (March-October). The amount of waste is approximately 1,000-1,200 kilograms per day or about 1.0 -1.2 tons per day and during the High Season (November-February), the amount of solid waste occurs in approximately 2,000 kilograms per day or approximately 2.0 tons per day. At present, U-Tapao International Airport collects solid waste 1-2 times a day. When considering the adequacy of containers and vehicles to collect solid waste, it can be summarized as follows.

Container: Inside the terminal, a 60-litre container can be found in various points within the terminal and office building, where staff will take care of the collection and separation before disposal to 2 containers of 6 cubic meters containers located in the terminals and office buildings. There are 3 spare containers to replace, which is enough for the current container to support solid waste.

Vehicle : The U-Tapao International Airport has 2 garbage trucks, one is a garbage truck with lifting container, and another one is a garbage truck with a 6 cubic meter hook, which is enough to support the current solid waste.

1.1) Predicting the volume of solid waste

Predicting the volume of solid waste is based on the area that developed the expansion of U-Tapao International Airport and the commercial as per the master plan (Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018) with various types of area development. The rate of solid waste generation depends on the size of the building and the usage type within each building, including the volume of solid waste generated by passengers using the service the amount of solid waste occurring in phase 1 (2028) phase 2 (2038) and phase 3 (2048) is shown in**Table 5.4 - 1** to**Table 5.4 - 3**

Table 5.4 - 1Predicted the volume of solid waste in the area of U-Tapao International Airport Phase 1

Area	Building area (square meters)	The rate of solid waste generation		the volume of solid waste	
		Quantity	Unit	kg/ Day	Tons/day

Commercial – Hotel	18,420	0.017	kg/ sq. m./ day	313	0.31
Commercial – Retail Store	5,500	0.017	kg/ sq. m./ day	94	0.09
Commercial - Office (10 square meters/person)	40,000	0.220	kg/ People/day	880	0.88
Commercial – Meeting Room	2,000	0.017	kg/ sq. m./ day	34	0.03
Terminal (14 million people)	469,000	0.440	kg/ People/day	16,877	16.88
Aviation support section	15,000	0.017	kg/ sq. m./ day	255	0.26
Warehouse/Logistics	50,250	0.017	kg/ sq. m./ day	854	0.85
Aircraft Maintenance Center	24,900	0.017	kg/ sq. m./ day	423	0.42
Other aircraft maintenance centers /Training Centre	116,670	0.017	kg/ sq. m./ day	1,983	1.98
Water refill for building group cooling system				-	-
Water refill for power plants				-	-
Total amount					**21.71**

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018

Table 5.4 – 2 Predicting the volume of solid waste in the U-Tapa International Airport area in Phase 2

Area	Building area (square meters)	The rate of solid waste generation		Solid waste volume	
		Quantity	Unit	kg/ Day	Tons/day
Commercial – Hotel	50,000	0.017	kg/ sq. m./ day	850	0.85
Commercial – Retail Store	14,930	0.017	kg/ sq. m./ day	254	0.25
Commercial - Office (10 square meters/person)	108,570	0.220	kg/ people/day	2,389	2.39
Commercial – Meeting Room	5,430	0.017	kg/ sq. m./ day	92	0.09
Terminal (38 million people)	469,000	0.440	kg/ people/day	45,808	45.81
Aviation support section	37,000	0.017	kg/ sq. m./ day	629	0.63
Warehouse/Logistics	153,100	0.017	kg/ sq. m./day	2,603	2.60
Aircraft Maintenance Center	30,850	0.017	kg/ sq. m./ day	524	0.52
Other aircraft maintenance centers /Training Centre	116,670	0.017	kg/ sq. m./ Days	1,983	1.98
Water refill for building group cooling system				-	-
Water refill for power plants				-	-
Total amount					**55.13**

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018

Table 5.4 – 3 Predicting the volume of solid waste in the U-Tapao International Airport area in Phase 3.

Area	Building area (square meters)	The rate of solid waste generation		Solid waste volume	
		Quantity	Unit	kg/ day	Tons/day
Commercial – Hotel	50,000	0.017	kg/ sq. m./ day	850	0.85
Commercial – Retail Store	27,500	0.017	kg/ sq. m./day	468	0.47
Commercial - Office (10 square meters/person)	200,000	0.220	kg/ People/day	4,400	4.40
Commercial – Meeting Room	10,000	0.017	kg/ sq. m./ day	170	0.17
Terminal (70 million people)	469,000	0.440	kg/ People/day	84,384	84.38
Aviation support section	60,000	0.017	kg/ sq. m./ day	1,020	1.02
Warehouse/Logistics	287,000	0.017	kg/ sq. m./ day	4,879	4.88
Aerospace Maintenance Center	100,000	0.017	kg/ sq. m./ day	1,700	1.70
Other aircraft maintenance centers /Training Centre	200,000	0.017	kg/ sq. m./ day	3,400	3.40

Water refill for building group cooling system				-	-
Water refill for power plants				-	-
Total amount					**101.27**

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018

The result of forecasting the amount of solid waste found that in Phase 1 (2028), Phase 2 (2038), and Phase 3 (2048) the total amount of solid waste generated 21.71, 55.13 and 101.27 tons per day, respectively, which exceeds the potential of a solid waste management system within U-Tapao International Airport, which can be supported at the present time. Due to the fact that U-Tapao International Airport currently has solid waste occurring during November - February (High Season) with a maximum of 2,000 kilograms per day or approximately 2.0 tons per day, pick up the waste up to 2 times a day with 1 container-lifting tank truck, used in combination with 2 containers located in the terminals and office building. There are also 3 spare containers, each of which are 6 cubic meters in size, and 1 tank of hooked-up trash truck to carry 6 cubic meters of solid waste to bring collected solid waste to the solid waste sorting plant of a private company, a concessionaire from the Royal Thai Navy, is responsible for separating the solid waste in Khao Tabak KorMor 8, which is about 6 kilometres away from U-Tapao International Airport. Therefore, it is expected that the current waste management system of U-Tapao International Airport will not be able to adequately support and manage the solid waste that will occur in the future.

1.2) Waste Management within U-Tapao International Airport

At present, U-Tapao International Airport does not have sufficient waste management system yet. And when the project has developed an expansion of U-Tapao International Airport and commercial according to master plan, the project has required a systematic waste management plan shown in**Figure 2.4-23 by a private** company to manage U-Tapao International Airport. The waste management arising from buildings and activities to the normal waste handling station located at U-Tapao International Airport is responsible for sorting and properly disposed according to sanitation practices. Persons authorized by government agencies or as required by law, with the project requiring the normal waste disposal station within U-Tapao International Airport, located in an easily accessible location of around 16,000 square meters, comprising of loading docks, maintenance buildings, office buildings, parking weighing and car wash areas, and facilities in the process of separating waste on road entrances and buffer areas. The system designed to support and manage solid waste within U-Tapao International Airport can be up to approximately 102 tons per day, which has the potential to handle and handle waste that has occurred in accordance with the expansion of U-Tapao and commercial International Airport in the maximum phase 3 (2048) with the volume of waste of 101.27 tons per day, therefore, the impact is moderate.

2) Waste water

Currently, wastewater that occurs within U-Tapao International Airport consists of wastewater from aircraft and wastewater from offices and terminals. The wastewater from aircraft will be collected and sent to the activated sludge (Activated Sludge; AS). It can support about 75 cubic meters of wastewater per day. Some of the wastewater from the office and terminal buildings will be sent to the same treatment system as the wastewater from aircraft, and some indoor wastewater will be transported to treatment with 4 air-filled wastewater containers installed in the terminal building. Each tank contains 35 cubic meters, which can support about 140 cubic meters of wastewater per day. After the treatment will be released into Khlong Bang Phai and continue to sea.

2.1) Predicting wastewater volume

Water supply projections were reviewed in accordance with the areas that developed the expansion of U-Tapao International Airport and the commercial as per the master plan. (Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018) the area was developed in various forms, with the estimate of the amount of wastewater that was generated, considering the use of water from the building area and the types of water used within each building, as well as the amount of water that was generated by the arriving passengers. The amount of wastewater generated is calculated as 80-90 percent of the amount of water use, except the amount of wastewater for the power plant that occurs was at 23.5 percent of the volume of water used (based on the value of the power plant design at U-Tapao International Airport), the amount of wastewater generated in phase 1 (2028), phase 2 (2038), and phase 3 (2048) is shown in**Table 5.4 - 4** to**Table 5.4 - 6**

Table 5.4 - 4 Prediction of water consumption and wastewater in the U-Tapao International Airport area in Phase 1 (2028)

Area	Building area (square meters)	Water consumption rate		Amount of water used		Waste water volume Cubic meters/ day
		Quantity of	Unit	liters/day	Cubic meters / day	
Commercial – Hotel	18,420	4	Liters/Sq.m./ Day	73,680	74	66[2/]
Commercial – Retail Store	5,500	4	Liters/Sq.m./ Day	22,000	22	20[2/]
Commercial – Office (10 square meters/person)	40,000	80	Liters/person/day	320,000	320	288[2/]
Commercial – Meeting Room	2,000	4	Liters/Sq.m./ Day	8,000	8	7[2/]
Terminal (14 million people) [1/]	182,900	25	Liters/person/day	958,904	959	767[3/]
Aviation support section	15,000	4	Liters/Sq.m./ Day	60,000	60	54[2/]
Warehouse/Logistics	50,250	4	Liters/Sq.m./ Day	201,000	201	181[2/]
Aircraft Maintenance Center	24,900	4	Liters/Sq.m./ Day	99,600	100	90[2/]
Other aircraft maintenance centers / Training Centre	16,670	4	Liters/Sq.m./ Day	466,680	467	420[2/]
Water refill for cooling system building group					900	-
Water refill for power plants					5,500	1,293[4/]
Total amount					**8,610**	**3,185**

Notes :
[1/] Predicted number of passenger in case of greater growth (Aggressive Scenario), with a maximum number of 14 million passengers per year
[2/] The amount of wastewater generated is equal to 90 percent of the amount of water used.
[3/] The amount of wastewater generated is equal to 80% of the amount of water used.
[4/] The wastewater volume that occurred was at 23.5 percent of the volume of water used. (The value of the design of the power plant at U-Tapao International Airport, B.Grim Power Public Company Limited, 2020)

Environmental impact assessment report for projects, businesses or operations that may have impacts on natural resources

Environmental quality, health, sannitation, and quality of life of people in the community severly.

Construction Project for Runway and Taxiway 2, at U-Tapao International Airport, Ban Chang District, Rayong Province

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province 2018

Table 5.4 – 5 Predicted water consumption and wastewater in U-Tapao International Airport Area in Phase 2 (2038)

Area	Building area (square meters)	Water consumption rate		Amount of water used		Waste water volume Cubic meters/ day
		Quantity	Unit	liters/day	Cubic meters / day	
Commercial – Hotel	50,000	4	Liters/Sq.m./ Day	200,000	200	180[2/]
Commercial – Retail Store	14,930	4	Liters/Sq.m./ Day	59,720	60	54[2/]
Commercial – Office (10 square meters/person)	108,570	80	Liters/person/day	868,560	869	782[2/]
Commercial – Meeting Room	5,430	4	Liters/Sq.m./ Day	21,720	22	20[2/]
Terminal (38 million) [1/]	264,100	25	Liters/person/day	2,602,740	2,603	2,082[3/]
Aviation support section	37,000	4	Liters/Sq.m./ Day	148,000	148	133[2/]
Warehouse/Logistics	153,100	4	Liters/Sq.m./ Day	612,400	612	551[2/]
Aircraft Maintenance Center	30,850	4	Liters/Sq.m./ Day	123,400	123	111[2/]
Other aircraft maintenance centers / Training Centre	116,670	4	Liters/Sq.m./ Day	466,680	467	420[2/]
Water refill for cooling systems building group					2,443	-
Water refill for power plants					5,500	1,293[4/]
Total amount					**13,046**	**5,625**

Notes :
[1/] Predicted number of passenger in case of greater growth (Aggressive Scenario) with a maximum of 38 million passengers per year
[2/] The amount of wastewater generated is equal to 90 percent of the amount of water used.
[3/] The amount of wastewater generated is equal to 80% of the amount of water used.
[4/] The wastewater volume that occurred was at 23.5 percent of the volume of water used. (The value of the design of the power plant at U-Tapao International Airport, B.Grim Power Public Company Limited, 2020)

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province 2018

Table 5.4 ‑ 6 Prediction of water consumption and wastewater in the U-Tapao International Airport area in Phase 3 (2048)

Area	Building area (square meters)	Water consumption rate		Amount of water used		Waste water volume Cubic meters/ day
		Quantity	Unit	liters/day	Cubic meters / day	
Commercial – Hotel	50,000	4	Liters/Sq.m./ Day	200,000	200	180[2/]
Commercial – Retail Store	27,500	4	Liters/Sq.m./ Day	110,000	110	99[2/]
Commercial – Office (10 square meters/person)	200,000	80	Liters/person/day	1,600,000	1,600	1,440[2/]
Commercial – Meeting Room	10,000	4	Liters/Sq.m./ Day	40,000	40	36[2/]
Terminal (70 million people) [1/]	469,000	25	Liters/person/day	4,794,521	4,795	3,836[3/]
Aviation support section	60,000	4	Liters/Sq.m./ Day	240,000	240	216[2/]
Warehouse/Logistics	287,000	4	Liters/Sq.m./ Day	1,148,000	1,148	1,033[2/]
Aircraft Maintenance Center	100,000	4	Liters/Sq.m./ Day	400,000	400	360[2/]
Other aircraft maintenance centers /Training Centre	200,000	4	Liters/Sq.m./ Day	800,000	800	720[2/]
Water refill for cooling system in a group of buildings					4,500	-
Water refill for power plants					5,500	1,293[4/]
Total amount					**19,333**	**9,212**

Notes :
[1/] Predicted number of passenger in case of accelerated growth (Aggressive Scenario), with a maximum number of 70 million passengers per year.
[2/] The amount of wastewater generated is equal to 90 percent of the amount of water used.
[3/] The amount of wastewater generated is equal to 80% of the amount of water used.
[4/] The wastewater volume that occurred was at 23.5 percent of the volume of water used. (The value of the design of the power plant at U-Tapao International Airport, B.Grim Power Public Company Limited, 2020)

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province 2018

Results of the forecast of wastewater volume found that in phase 1 (2028), phase 2 (2038), and phase 3 (2048) there was a total of 3,185, 5,625 and 9,212 cubic meters per day, respectively. The current central wastewater treatment system of U-Tapao International Airport is an activated sludge treatment system (Activated Sludge; AS). It can support 75 cubic meters of wastewater per day, located in the southwest of the runway No.1, about 1.2 kilometres, and there are also 4 air-filled wastewater treatment systems installed in the second terminal. Each tank has a size of 35 cubic meters, which can support 140 cubic meters of wastewater per day. Therefore, the current wastewater treatment system of U-Tapao International Airport cannot provide sufficient wastewater treatment in the future.

In order to support the development of the extended airport, there will be construction of a central wastewater treatment system by Eastwater, which is a Sequencing Batch Reactor (SBR), which is divided into 2 phases, i.e. Phase 1 (2020-2025), and Phase 2 (2026-2044), with each of which has a wastewater treatment system size of 8,000 cubic meters per day, combined wastewater treatment systems can support wastewater 16,000 cubic meters per day. For wastewater, it will be treated as recycled water for approximately 5,000 cubic meters per day, and the remaining water will be reused. For example, water is used in green areas within the U-Tapao International Airport, and other activities for non-standard wastewater will be taken for resting in the emergency wastewater treatment pond, then pumped back to the central wastewater treatment system until quality is met according to the announcement of the Ministry of Natural Resources and Environment. In addition, the excess sediment that occurs will be pumped to stay at the sludge dewatering pond to adjust the condition until it has about 80% or 20% humidity, looks like a cake which has a high organic composition and does not contain any harmful substances. It can be utilized as a soil conditioner for ornamental plants in the project. It is found that this central wastewater treatment system can support the amount of wastewater generated from the project development sufficiently. and the impact of wastewater is expected to be low.

5.4.2 Land use

5.4.2.1 Construction phase

(1) Study Method

Compare the land use of U-Tapao International Airport to the land use classification according to the Ministry's rules to apply the city chart including Rayong Province, 2017 (notified in the Government Gazette on 12 January 2017) and the land map and land map of Chonburi Province in 2017 (notified in the Government Gazette on 11 April 2017) and the land use chart and infrastructure development plans and utilities Eastern Special Development Zone, 2019 (announced in the Government Gazette on 20 November 2019)

(2) Results of the Study

The construction project for runways and taxiway 2, U-Tapao International Airport is located in Phala Subdistrict Ban Chang, Rayong Province and adjacent to the area of Phlu Ta Luang Subdistrict, Sattahip District, Chonburi Province which according to the ministerial rules to enforce the Comprehensive Town Planning of Rayong Province, 2017 (announced in the Government Gazette on 12 January 2017) along with the land use chart and infrastructure and utilities development plans Special Development Zone, Eastern Region, 2019 (announced in the Government Gazette on 20 November 2019) designated the project area as land type Khor Kor. -5. Promotion area: Eastern Aviation City, Special Economic Promotional Zones for special business (Brown area) with the objective to support important projects that are the basis for the development of the Eastern Special Development Zone according to the policy of the Eastern Development Zone. The construction of a runway and taxiway 2 will be built only within the area of U-Tapao International Airport. Therefore, it is in accordance with the said ministerial regulations, which during the construction phase there is no additional expropriation of the area. People living

around the current project area will not move out of the area. This will not cause any impact on changes or conflicts in the use of land in the project area.

Other study areas may be affected by construction activities, especially the transportation of construction materials and machinery into the project area which causes noise. There is a dispersion of dust and pollutants from the combustion of engine fuel, causing an impact, disrupting or hindering the ongoing land use activities of communities, homes and shops in the area of the transport route. In addition, It may also cause temporary changes in land use in the site of the worker's quarters. This may affect the amount of waste and wastewater generation. However, such changes have also had a positive impact, ie, food trading activities as well as more consumer products to support the group of workers who come to stay. This is only a temporary effect during the construction period. When the construction is completed, such change conditions will be eliminated, therefore, the impact on land use during the construction phase of the project. therefore is at a low level

5.4.2.2 Implementation phase

(1) Study Method

Study the trend of land use in U-Tapao International Airport and assessthe impact of land use in areas affected by noise projections of the volume level expected results. If the route and route 2 are open, U-Tapao International Airport

(2) Results of the Study

1) Overall impact on study area

The operations of Utao International Airport will have an impact on the use of land surrounding the project area. In other words, the use of land in the project area will change from agriculture to transportation facilities, including areas designated as East Provinces, covering 6,500 Rais, to increase the level of land use.

As a result of the development, the development will cause new communities to occur around the project area. For example, agricultural areas around U-Tapao International Airport may currently be converted to community zones. Environmental problems caused by basic infrastructure will occur. If these communities do not have adequate planning and management. However, these problems should be planned earlier by cooperation between relevant governmental agencies. Currently, there is a committee comprising related government agencies, which is appointed to develop basic infrastructure in the area. This is expected to be the minimum, with the systematic management. However, as a result of the development, the value of the land and property will change. The resulting community will have adequate infrastructure and facilities, and the price of land and property will increase. It is expected that the value of land around U-Tapao International Airport will increase rapidly. The use of land in the residential category has a low density to moderate as well as industrial areas will gradually expand more especially in the east, west and north of U-Tapao International Airport which will change in a gradual manner

2) Impact on sensitive areas along the line as loud volume

After the opening of the runway and taxiway 2 at U-Tapao International Airport, there will be an increase in the number of take-off and landing flights per hour. This results in increased internal noise impacts where land use within the area equals the volume line. Some types are not suitable according to the academic advice on noise level criteria suitable for land use around U-Tapao International Airport of the Pollution Control Department. Within the area of the NEF sound level line of 30 - 40, the average day and night noise level is between 65 - 75 dB A, and within the NEF ≥ 40 sound level line area, the average day and night noise level is greater than 75 dB A.

In this regard, there are 201 sensitive areas and communities within the study area of the runway and taxiway No. 2 construction project at U-Tapao International Airport, when compared to the noise level criteria suitable for land use around the airport (Source: Pollution Control Department, 2016) found that there were 170 places sensitive areas that were suitable according to the criteria and 31 places were not suitable according to the criteria. (details shown in**Table *5.4 – 7*** and**Figure 5.4 – 1**). Details are as follows:

- 57 Academic institutions
  - Appropriate according to criteria, 49 institutions
  - was not fit according to the criteria of 8 institutions (2 institutions in the NEF ≥ 40, area of NEF30 - 40, 6 institutions).
- Religious Place, 69 places
  - Appropriate according to criteria, 58 places
  - was not fit according to the criteria of 11 places (2 places in NEF area ≥ 40 sites 9 places in the area NEF30 - 40)
- 18 medical facilities
  - Appropriate according to criteria, 15 places
  - 3 places unsuitable (1 places in NEF area ≥ 40, area NEF30 - 40, 2 places)
- 57 communities
  - Appropriate according to criteria, 48 communities
  - Unqualified according to criteria 9 communities (1 community NEF area ≥ 40, area NEF30 - 40, 8 communities)

Sensitive areas that do not fit the noise level criteria suitable for land use around U-Tapao International Airport, will be affected by long-term aviation activities.

When considering in conjunction with the Air Navigation Safety Zone in 1995, U-Tapao International Airport (Notification of the Ministry of Transport Re: Determining the boundaries of Rayong-U-Tapao International Airport in the area of Bang Lamung District, Sattahip District, Chonburi Province and Ban Chang District, Rayong Province as a safe zone for air travel in 1995 (announced in the Government Gazette on March 8, 1995) by announcing that the vicinity of Rayong International Airport - U-Tapao in Huai Yai Subdistrict Bang Lamung District, Bang Saray Subdistrict, Phlu Ta Luang Subdistrict, Sattahip Subdistrict, Sattahip District, Chonburi Province and

Samnak Thon, Phala Subdistrict, Ban Chang Subdistrict, Ban Chang District, Rayong Province, is a safe zone for air navigation. However, when runway no. 2 is present, an air safety zone for runway no. 2 shall be declared, which shall be considered in accordance with the terms/conditions. Assemble and declare safety zones in air navigation according to the procedures of relevant agencies. This may also affect some sensitive areas in the long term as well, so the impact is at a high level.

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
1	Early childhood nursery RTN. 6, Royal Thai Naval Air Division	Academic institution	Appropriate			
2	Wat Phla School	Academic institution	Appropriate			
3	Municipal Child Development Center, Phala Subdistrict	Academic institution	Appropriate			
4	Ban Khlong Sai School	Academic institution	Appropriate			
5	Rayong Bilingual School	Academic institution	Appropriate			
6	Suan Rayong International School	Academic institution	Appropriate			
7	Ban Chang 1 Municipal School (Khiri Phawanaram Temple)	Academic institution	Appropriate			
8	Wat Khiri Phawanaram School	Academic institution	Appropriate			
9	Ban Khlong Bang Phai School	Academic institution	Appropriate			
10	Phatthanavej Suksa School	Academic institution		Inappropriate		
11	Phatthanavej Technological College	Academic institution		Inappropriate		
12	Saeng Song La Child Development Center 3	Academic institution				Inappropriate
13	Wat Sa Kaeo School	Academic institution				Inappropriate
14	Wat Somboonaram School (Viatri Relic)	Academic institution		Inappropriate		

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
15	Municipal Child Development Center, Samnak Thon Subdistrict, in Wat Somboonaram School	Academic institution		Inappropriate		
16	Academic School	Academic institution	Appropriate			
17	Office of the Non-Formal and Informal Education Ban Chang District	Academic institution	Appropriate			
18	Wat Suwan Rangsan Community School	Academic institution	Appropriate			
19	Ban Yai Ra Child Development Center	Academic institution	Appropriate			
20	Wat Samnak Kathon School	Academic institution		Inappropriate		
21	Ban Samnak Thon Child Development Center	Academic institution		Inappropriate		
22	Burapathit Child Development Center Ban Samnak Thon SAO	Academic institution	Appropriate			
23	Wat Chak Mak School	Academic institution	Appropriate			
24	St Andrews International School Green Valley, Rayong	Academic institution	Appropriate			
25	Municipality Child Development Center, Ban Chang (Phayun Center)	Academic institution	Appropriate			
26	Ban Phayun School	Academic institution	Appropriate			
27	Rakpasa School	Academic institution	Appropriate			
28	Wat Ban Chang School (Boonrawd Prachanukul)	Academic institution	Appropriate			
29	Municipality Child Development Center, Ban Chang Subdistrict 3 (Ban Prachum Mit-Lor Kwian)	Academic institution	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
30	Ban Chang Municipality School (Ban Prachum Mit-Lor Kwian)	Academic institution	Appropriate			
31	Prachum Mitbamrung Temple	Academic institution	Appropriate			
32	Udom Wittayanukul School	Academic institution	Appropriate			
33	Municipality Child Development Center, Ban Chang (Noen Kraprok Temple)	Academic institution	Appropriate			
34	Wat Noen Kraprok School	Academic institution	Appropriate			
35	Patana Elementary School	Academic institution	Appropriate			
36	Aksorn Business Administration Technology College	Academic institution	Appropriate			
37	Banchang Kanchanakun Wittaya School	Academic institution	Appropriate			
38	Ban Khao Huai Mahad School	Academic institution	Appropriate			
39	Ban Phudon Child Development Center- Huai Mahad	Academic institution	Appropriate			
40	Ban Map Fakthong School	Academic institution	Appropriate			
41	Phurhu School YorSorSor. 80	Academic institution	Appropriate			
42	Ban Khao Chi Chan School	Academic institution	Appropriate			
43	Ban Khlod Child Development Center	Academic institution	Appropriate			
44	Ban Khlod School	Academic institution	Appropriate			
45	Plutaluang Wittaya School	Academic institution	Appropriate			
46	Athit Than Kindergarten school	Academic institution	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
47	Child Development Center, Subdistrict Administrative Organization Plutaluang 2, Ban Khao Baisri	Academic institution	Appropriate			
48	Ban Khao Baisri School	Academic institution	Appropriate			
49	Chaleo-Pavana Memorial School (Chonburi Special Education)	Academic institution	Appropriate			
50	Ban KorMor 5 School	Academic institution	Appropriate			
51	Sattahip School, Royal Thai Fleet	Academic institution	Appropriate			
52	Early childhood nursery, RTN. 8	Academic institution	Appropriate			
53	Chuk Samet School	Academic institution	Appropriate			
54	Chuk Samet Child Development Center	Academic institution	Appropriate			
55	Ban Chong Samaesarn Child Development Center	Academic institution	Appropriate			
56	Non-National Education Center, Samaesarn Subdistrict	Academic institution	Appropriate			
57	Ban Chong Samaesarn Community School	Academic institution	Appropriate			
58	Wat Phala Vipassana Center	Religious Place	Appropriate			
59	Phala Temple	Religious Place	Appropriate			
60	Li Hu Ong Eh Shrine	Religious Place	Appropriate			
61	Khlong Sai Temple	Religious Place	Appropriate			
62	Khiri Phawanaram Temple	Religious Place	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
63	Christ Church, Ban Chang	Religious Place	Appropriate			
64	Ban Chang Church	Religious Place	Appropriate			
65	Ban Khlong Bang Phai Temple	Religious Place	Appropriate			
66	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak	Religious Place		Inappropriate		
67	Naval Aviation Museum, Royal Thai Naval Air Division	Religious Place		Inappropriate		
68	The royal monument of King Taksin the Great (Air Defense Regiment 1)	Religious Place		Inappropriate		
69	Somdej Phra Pathom (Air Defense Regiment 1)	Religious Place		Inappropriate		
70	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	Religious Place		Inappropriate		
71	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	Religious Place				Inappropriate
72	The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	Religious Place		Inappropriate		
73	The Phra Siam Thevathirat Shrine (Bans, Cannons Fighting Aircraft)	Religious Place		Inappropriate		
74	Sa Kaeo Temple	Religious Place				Inappropriate
75	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	Religious Place	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
76	Somboonaram Temple	Religious Place		Inappropriate		
77	Abundant Grace Church, Ban Chang	Religious Place	Appropriate			
78	Samnak Kathon Temple	Religious Place		Inappropriate		
79	Suwan Rangsan Temple	Religious Place	Appropriate			
80	Nong Bot Temple	Religious Place	Appropriate			
81	Luang Tia Chak Mak Shrine	Religious Place	Appropriate			
82	Chak Mak Temple	Religious Place	Appropriate			
83	Luang Tia Ban Phayun Shrine	Religious Place	Appropriate			
84	Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	Religious Place	Appropriate			
85	Chonthara Ram Temple (Phayun)	Religious Place	Appropriate			
86	Mosque Dawah Tul Islam	Religious Place	Appropriate			
87	Chinese shrine in the Buddhathammasongkroh Foundation	Religious Place	Appropriate			
88	Luang Tia Shrine, Ban Chang	Religious Place	Appropriate			
89	Lao Yi Guan Yu Shrine, Ban Chang	Religious Place	Appropriate			
90	Ban Chang Temple	Religious Place	Appropriate			
91	Prachum Mitbamrung Temple	Religious Place	Appropriate			
92	Luang Tia Shrine, Noen Kraprok, No. 1	Religious Place	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
93	Luang Tia Shrine, Noen Kraprok, No. 2	Religious Place	Appropriate			
94	Noen Kraprok Temple	Religious Place	Appropriate			
95	Phudon Nim Sano Temple	Religious Place	Appropriate			
96	The Christ Church Ban Chang	Religious Place	Appropriate			
97	Anek Kuson Sala (Viharn Sien)	Religious Place	Appropriate			
98	Yannasangwararam Temple	Religious Place	Appropriate			
99	Sirisirirak House of Priest	Religious Place	Appropriate			
100	Anan Buraparam Meditation Center	Religious Place	Appropriate			
101	Map Fakthong Temple	Religious Place	Appropriate			
102	Khao Chi Chan Buddha Mountain	Religious Place	Appropriate			
103	Khao Chi Chan Temple	Religious Place	Appropriate			
104	Rat Samakkhi Temple	Religious Place	Appropriate			
105	Kuan Im Shrine	Religious Place	Appropriate			
106	The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	Religious Place	Appropriate			
107	Judprakai Thamma Mediation Center	Religious Place	Appropriate			
108	Mediation Practice Center, Kor Mor.8	Religious Place	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
109	Rang Si Sunthon Temple (Kor Mor. 5)	Religious Place	Appropriate			
110	Bodhipiya House of Priest (Dhammayut) Phothi Samphan Branch	Religious Place	Appropriate			
111	Sattahip Meditation Center (Khao Bandai Kaeo)	Religious Place	Appropriate			
112	Thung Prong Temple	Religious Place	Appropriate			
113	Khao Phlu Ta Luang Meditation Center	Religious Place	Appropriate			
114	The Shrine of Sadet Tia Krom Luang Chumphon Khet Udomsak	Religious Place	Appropriate			
115	Khao Bai Sri Temple, Santitham	Religious Place	Appropriate			
116	Welu Amphawan Vipassana Center	Religious Place	Appropriate			
117	The Royal Monument of His Majesty King Rama III	Religious Place	Appropriate			
118	The Royal Monument of His Majesty King Rama VI	Religious Place	Appropriate			
119	Phatthanakan Samaesarn Church	Religious Place	Appropriate			
120	The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	Religious Place	Appropriate			
121	Chong Samaesarn Temple	Religious Place	Appropriate			
122	Viharn Luang Por Dam	Religious Place	Appropriate			
123	Somdej Phrachao Taksin Maharat Shrine (Cham San)	Religious Place	Appropriate			
124	Thai Island and Sea Natural History Museum	Religious Place	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
125	Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)	Religious Place	Appropriate			
126	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	Religious Place	Appropriate			
127	Eastern - Nong Muang Community Health Service Center	Medical facilities	Appropriate			
128	Phala Subdistrict Health Promoting Hospital	Medical facilities	Appropriate			
129	Ban Chang Hospital	Medical facilities	Appropriate			
130	Subdistrict Health Promoting Hospital Ban Khlong Bang Phai	Medical facilities		Inappropriate		
131	Subdistrict Health Promoting Hospital Ban Sakaeo	Medical facilities				Inappropriate
132	Ban Khao Krog District Health Promotion Hospital	Medical facilities		Inappropriate		
133	Subdistrict Health Promoting Hospital Ban Yai Ra	Medical facilities	Appropriate			
134	Subdistrict Health Promoting Hospital Samnak Thon	Medical facilities	Appropriate			
135	Subdistrict Health Promoting Hospital Ban Chak Mak	Medical facilities	Appropriate			
136	Subdistrict Health Promoting Hospital, Ban Phayun	Medical facilities	Appropriate			
137	Public Health Service Center 2, Ban Chang Municipality (Tassanee Center)	Medical facilities	Appropriate			
138	Community Health Service, Phudon- Huay Mahad	Medical facilities	Appropriate			
139	Wat Yannasangwararam Hospital	Medical facilities	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
140	Somdet Phra Sangharaj Nyanasamvara Geriatric Hospital, Chonburi Province	Medical facilities	Appropriate			
141	Subdistrict Health Promoting Hospital, Ban Khong Wan Phen	Medical facilities	Appropriate			
142	Queen Sirikit Hospital Naval Medical Department	Medical facilities	Appropriate			
143	Sattahip Hospital KorMor. 10	Medical facilities	Appropriate			
144	Subdistrict Health Promoting Hospital Ban Chong Samaesarn	Medical facilities	Appropriate			
Phala Subdistrict Municipality (Phala Subdistrict, Ban Chang District, Rayong Province)						
145	Village No. 1 Ban Sakulthong	Community	Appropriate			
146	Village No. 2, Ban Kilo 16	Community	Appropriate			
147	Village No. 4, Ban Thung Prong	Community	Appropriate			
148	Village No. 5, Phala Subdistrict	Community	Appropriate			
149	Village No. 6, Ban Takad	Community	Appropriate			
150	Village No. 7, Ban Khlong Sai	Community	Appropriate			
Samnak Thon Subdistrict Municipality(Samnak Thon Subdistrict, Ban Chang District, Rayong Province)						
151	Village No. 1, Ban Samnak Thon	Community		Inappropriate		
152	Village No. 2, Ban Chak Mak	Community		Inappropriate		
153	Village No. 3, Ban Sakaeo	Community				Inappropriate
154	Sakaeo Community 1	Community	Appropriate			
155	Sakaeo Community 2	Community	Appropriate			
156	Village No. 4, Ban Khlong Bang Phai	Community		Inappropriate		
157	Village No. 5, Ban Yai Ra	Community	Appropriate			
158	Village No. 6, Ban Khao Khrok	Community		Inappropriate		
159	Village No. 7, Ban Nong Takhian	Community		Inappropriate		
160	Village No. 8, Ban Choeng Khao	Community		Inappropriate		
Ban Chang Municipality (Ban Chang Subdistrict, Ban Chang District, Rayong Province)						
161	Eastern- Nong Muang Community	Community	Appropriate			
162	Wat Khiri Phawanaram Community	Community	Appropriate			
163	Ban Chang-Phla Community	Community	Appropriate			

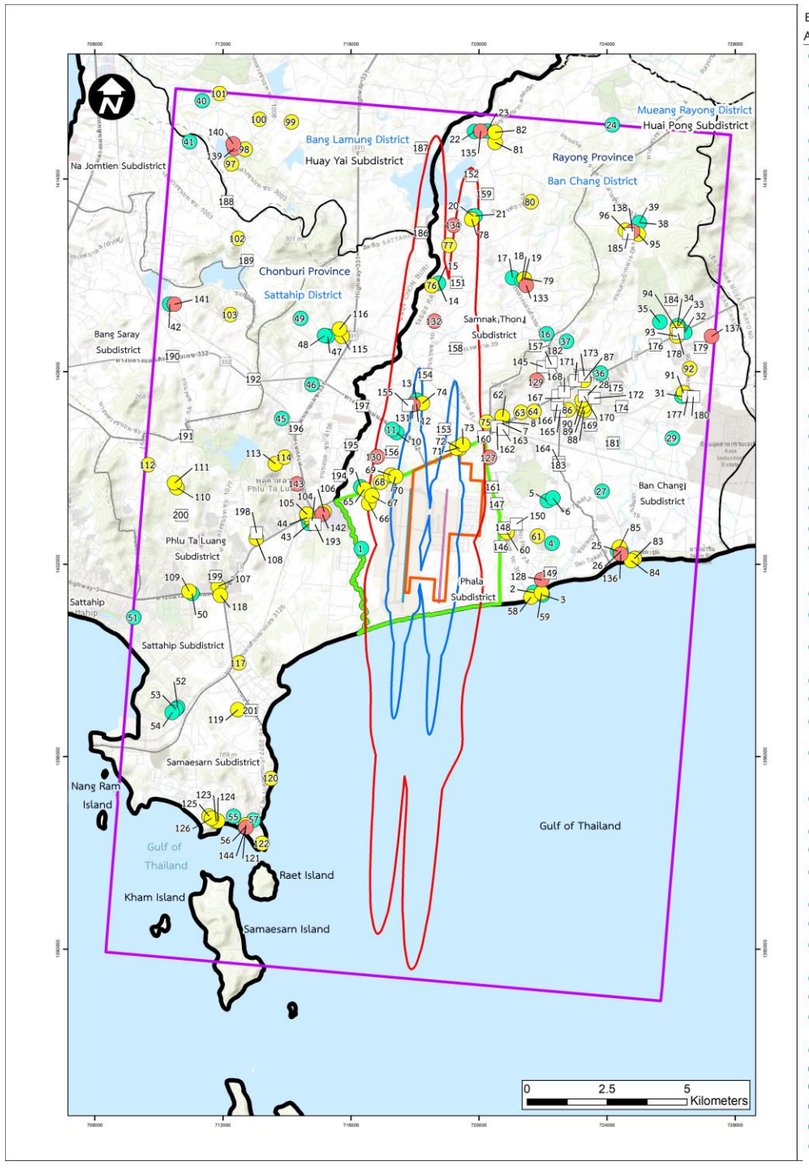
Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
164	Ruamsompong Community	Community	Appropriate			
165	Ming Monkol Community	Community	Appropriate			
166	Jor. Khu Community	Community	Appropriate			
167	Wirat Pattana Shopping Center Community	Community	Appropriate			
168	Thep Ginda Community	Community	Appropriate			
169	Suan Sukkaphap Community	Community	Appropriate			
170	Wat Ban Chang community	Community	Appropriate			
171	Dongdang Community	Community	Appropriate			
172	Night Market Community	Community	Appropriate			
173	Ruammit Community	Community	Appropriate			
174	Ban Chang - Noen Kraprok Community	Community	Appropriate			
175	Dao Phithak Community	Community	Appropriate			
176	Tai Wah Community	Community	Appropriate			
177	Ban Noen Kraprok East Community Prachum Mitr	Community	Appropriate			
178	Ban Noen Kraprok Community	Community	Appropriate			
179	Nong Yai Community	Community	Appropriate			
Ban Chang Subdistrict Municipality (Ban Chang Subdistrict, Ban Chang District, Rayong Province)						
180	Village No. 1, Ban Phaen Din Thai	Community	Appropriate			
181	Village No. 2, Ban Prachum Mitr	Community	Appropriate			
182	Village No. 3, Ban Noen Samre	Community	Appropriate			
183	Village No. 4, Ban Phayun	Community	Appropriate			
184	Village No. 6, Ban Noen Kraprok	Community	Appropriate			
185	Village No. 7, Ban Khao Phudon Huay Mahad	Community	Appropriate			
Huai Yai Subdistrict Municipality (Huai Yai Subdistrict, Bang La Mung District, Chonburi Province)						
186	Village No. 11, Ban Map Fakthong	Community		Inappropriate		
187	Village No. 13, Ban Nong Phak Kut	Community	Appropriate			
Khao Chi Chan Subdistrict Municipality (Na Jomtien Subdistrict, Sattahip District, Chonburi Province)						
188	Village No. 6, Khao Chi Chan Subdistrict Municipality	Community	Appropriate			
189	Village No. 7, Khao Chi Chan Subdistrict Municipality	Community	Appropriate			

Table 5.4 – 7 Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Sensitive area	Land use category	Average Day - Night Noise (Decibel A)			
			Less than 65	65-70	70-75	More than 75
Kled Kaew Subdistrict Municipality(Bang Saray Subdistrict, Sattahip District, Chonburi Province)						
190	Village No. 6 (Ban Kho Krating Community)	Community	Appropriate			
191	Village No. 7 (Ban Nong Hin Community)	Community	Appropriate			
192	Village No. 11 (Ban Khong Wanphen Community)	Community	Appropriate			
Phlu Ta Luang Subdistrict, Sattahip District, Chonburi Province						
193	Village No. 1, Ban Phlu Ta Luang	Community	Appropriate			
194	Village No. 2, Ban Khlod	Community	Appropriate			
195	Village No. 3, Ban Khlong Phai	Community	Appropriate			
196	Village No. 4, Ban Khlong Phlu Ta Luang	Community	Appropriate			
197	Village No. 5, Ban Khao Baisri	Community		Inappropriate		
198	Village No. 6, Ban Khao Tabak	Community	Appropriate			
199	Village No. 7, Ban Nong Ya Noi	Community	Appropriate			
200	Village No. 8, Ban Nong Ya Noi	Community	Appropriate			
Samaesarn Subdistrict, Satathip District, Chonburi Province						
201	Ban Nong Krachong community	Community	Appropriate			

Note : Comparative criteria, refer to academic advice on noise level criteria appropriate to land use around the airport, Pollution Control Department 2016



Explanation of symbols

Academic institution

1. Early childhood nursery RTN 6, Royal Thai Naval Air Division
2. Wat Phla School
3. Municipal Child Development Center, Phala Subdistrict
4. Ban Khlong Sai School
5. Rayong Bilingual School
6. Suan Rayong International School
7. Ban Chang Municipality School 1 (Khiri Phawanaram Temple)
8. Wat Khiri Phawanaram School
9. Ban Khlong Bang Phai School
10. Phatthanavej Suksa School
11. Phatthanavej Technological College
12. Saeng Song La Child Development Center 3
13. Wat Sa Kaeo School
14. Wat Somburanaram School (Temradanusorn)
15. Municipal Child Development Center, Samnak Thon Nai Subdistrict, Wat Somburanaram School
16. Sajja Suksa School
17. Office of the Non-Formal and Informal Education, Ban Chang District
18. Wat Suwan Rangsan Community School
19. Ban Yai Ra Child Development Center
20. Wat Samnak Kathon School
21. Ban Samnak Thon Child Development Center
22. Burapathit Child Development Center, Sub-District Administrative Organization, Samnak Thon
23. Wat Chak Mak School
24. St Andrews International School Green Valley, Rayong
25. Municipal Child Development Center, Ban Chang Subdistrict (Pyun Center)
26. Ban Pyun School
27. Rakpasa School
28. Wat Ban Chang School (Boonrawd Prachanukul)
29. Municipality Child Development Center, Ban Chang Subdistrict 3 (Ban Prachum Mit-Lor Kwian)
30. Ban Chang Municipality School (Ban Prachum Mit-Lor Kwian)
31. Wat Prachum Mit Bamrung School
32. Udom Wittayanukul School
33. Municipality Child Development Center, Ban Chang (Noen Kraprok Temple)
34. Wat Noen Kraprok School
35. Patana Elementary School
36. Aksorn Business Administration Technology College
37. Banchang Kanchanakun Wittaya School
38. Ban Khao Huai Mahad School
39. Ban Phudon Child Development Center- Huai Mahad
40. Ban Map Fakthong School
41. Phurhu School YorSorSor. 80
42. Ban Khao Chi Chan School
43. Ban Khlod Child Development Center
44. Ban Khlod School
45. Plutaluang Wittaya School
46. Athit Than Kindergarten School
47. Child Development Center, Subdistrict Administrative Organization Plutaluang 2, Ban Khao Baisri
48. Ban Khao Baisri School
49. Chaleo-Pavana Memorial School (Chonburi Special Education)
50. Ban KorMor 5 School
51. Sattahip School, Royal Thai Fleet
52. Early childhood nursery RTN. 8
53. Chuk Samet School
54. Chuk Samet Child Development Center
55. Ban Chong Samaesarn Child Development Center
56. Non-National Education Center, Samaesarn Subdistrict
57. Ban Chong Samaesarn Community School

Religious Place

58. Wat Phla Vipassana Center
59. Phla Temple
60. Li Suo Ong Yee Shrine
61. Khlong Sai Temple
62. Khiri Phawanaram Temple
63. Christ Church Ban Chang
64. Ban Chang Church
65. Ban Khlong Bang Phai Temple
66. The Monument of Admiral Phra Chao Boromwongsether Krom Luang Chumphon Khet Udomsak
67. Naval Aviation Museum, Royal Thai Naval Air Division
68. King Taksin the Great Monument (Air Defense Regiment 1)
69. Somdej Phra Pathom (Air Defense Regiment 1)
70. The Monument of Admiral Phra Chao Boromwongsether Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)
71. The Monument of Admiral Phra Chao Boromwongsether ther Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)
72. The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)
73. The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)
74. Sa Kaeo Temple
75. King Taksin the Great Shrine
76. Somburanaram Temple
77. Abundant Grace Church, Ban Chang
78. Samnak Kathon Temple
79. Suwan RangsanTemple
80. Nong Bot Temple
81. Luang Tia Chak Mak Shrine
82. Chak Mak Temple
83. Luang Tia Ban Phayun Shrine
84. Somdej Phra Chao Taksin Maharat Shrine (Ban Chang)
85. Chonthara Ram Temple (Phayun)
86. Mosque Dawah Tul Islam
87. Chinese shrine in the Buddhathammasongkroh Foundation
88. Luang Tia Ban Chang Shrine
89. Lao Guan Yu Shrine, Ban Chang
90. Ban Chang Temple
91. Prachum Mitbamrung Temple
92. Luang Tai Shrine, Noen Kraprok, No. 1
93. Luang Tia Noen Kraprok Shrine, No. 2
94. Noen Kraprok Temple
95. Phudon Nim Sano Temple
96. The Christ Church Ban Chang
97. Anek Kuson Sala (Viharn Sien)
98. Yansangwararam Temple
99. Siri Sirirak House of Priest
100. Anan Buraparam Dharma Practice Center
101. Map Fak Thong Temple
102. Khao Chi Chan Buddha Mountain
103. Khao Chi Chan Temple
104. Rat Samakkhi Temple
105. Kuan Im Shrine
106. Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani
107. Judprakai Thamma Mediation Center
108. Kor Mor 8 Mediation Center
109. Rang SI Sunthon Temple (Kor Mor. 5)
110. Potipiya Pharaphiya Sangam (Pholut) Section
111. Sattahip Meditation Center (Khao Bandai Kaeo)
112. Thung Prong Temple
113. Khao Phlu Ta Luang Mediation Center
114. The Shrine of Sadet Tia Krom Luang Chumphon Khet Udomsak
115. Khao Bai Sri Temple, Santitham
116. Welu Amphawan Vipassana Meditation Center
117. The royal monument of King Rama III
118. The royal monument of King Rama VI
119. Phatthanakan Samaesarn Church
120. The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)
121. Chong Samaesan Temple
122. Viharn Luang Por Dam
123. Somdej Phra Chao Taksin Maharat Shrine (Cham San)
124. Thai Island and Sea Natural History Museum
125. Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)
126. The Royal Monument of King Taksin the Great (Special Naval Warfare Command)

Medical facilities

127. Community Health Service Center, Eastern - Nong Muang
128. Phala Subdistrict Health Promotion Hospital
129. Ban Chang Hospital
130. Subdistrict Health Promotion Hospital, Ban Khlong Bang Phai
131. Subdistrict Health Promotion Hospital, Ban Sa Kaeo
132. Subdistrict Health Promotion Hospital, Ban Khao Khrok
133. Subdistrict Health Promotion Hospital, Ban Yai Ra
134. Subdistrict Health Promotion Hospital, Samnak Thon
135. Subdistrict Health Promotion Hospital, Ban Chak Mak
136. Subdistrict Health Promotion Hospital, Ban Phayun
137. Public Health Service Center 2, Ban Chang Municipality (Tassanee Center)
138. Community Health Service, Phudon-Huay Mahad
139. Wat Yansangwararam Hospital
140. Somdet Phra Sangharaj Nyanasamvara Geriatric Hospital, Chonburi Province
141. Subdistrict Health Promotion Hospital, Ban Khong Wan Phen
142. Queen Sirikit Hospital, Naval Medical Department
143. Sattahip Hospital km.10
144. Subdistrict Health Promotion Hospital, Ban Chong Samaesan

Community

145. Village No. 1 Ban Sakul Thong
146. Village No. 2, Ban Kilo 16
147. Village No. 4, Ban Thung Prong
148. Village No. 5, Phala Subdistrict
149. Village No. 6 Ban Takad
150. Village No. 7, Ban Khlong Sai
151. Village No. 1, Ban Samnak Thon
152. Village No. 2, Ban Chak Mak
153. Village No. 3, Ban Sa Kaeo
154. Sa Kaeo Community 1
155. Sa Kaeo Community 2
156. Village No. 4, Ban Khlong Bang Phai
157. Village No. 5, Ban Yai Ra
158. Village No. 6, Ban Khao Khrok
159. Village No. 7, Ban Nong Takhlan
160. Village No. 8, Ban Choeng Khao
161. Eastern-Nong Muang Community
162. Wat Khiri Phawanaram Community
163. Ban Chang-Phla Community
164. Ruamsompong Community
165. Ming Monkol Community
166. Jor. Khu Community
167. Wirat Pattana Shopping Center Community
168. Thep Ginda Community
169. Suan Sukkaphap Community
170. Wat Ban Chang Community
171. Dongdang Community
172. Night Market Community
173. Ruammit Community
174. Ban Chang - Noen Kraprok Community
175. Dao Phithak Community
176. Tai Wa Community
177. Ban Noen Kraprok East Community, Prachum Mitr
178. Ban Noen Kraprok Community
179. Nong Yai Community
180. Village No. 1 Ban Phaen Din Thai
181. Village No. 2 Ban Prachum Mitr
182. Village No. 3 Ban Noen Samre
183. Village No. 4 Ban Phayun
184. Village No. 6 Ban Noen Kraprok
185. Village No. 7 Ban Khao Phudon Huai Mahad
186. Village No. 11 Ban Map Fak Thong
187. Village No. 13 Ban Nong Phak Kut
188. Village No. 6 Khao Chi Chan Subdistrict Municipality
189. Village No. 7 Khao Chi Chan Subdistrict Municipality
190. Village No. 6 (Ban Kho Krating Community)
191. Village No. 7 (Ban Nong Hin Community)
192. Village No. 11 (Ban Khong Wanphen Community)
193. Village No. 1 Ban Plu Ta Luang
194. Village No. 2 Ban Klod
195. Village No. 3 Ban Khlong Phai
196. Village No. 4 Ban Khlong Plu Ta Lung
197. Village No. 5 Ban Khao Bai Sri
198. Village No. 6 Ban Khao Tabak
199. Village No. 7 Ban Nong Ya Noi
200. Village No. 8 Ban Nong Ya
201. Ban Nong Krachong Community

Province
District
Subdistrict
Runway No. 1 (current)
Runway No. 2
Airport Extension Area (Project Area)
U-Tapao International Airport area
Project Study Area

Lines as NEF sound level

In the case of the flight situation in 2019 and the flight forecasts of 2028, 2038 and 2048 (maximum 1,364 flights per day) plus any route closure (791 flights per day), July 2021

NEF 40 (area 14.30 square kilometers)
NEF 30 (area 48.25 square kilometers)

Figure 5.4 – 1 The map shows a line equal to the, volume level, the implementation phase in the map shows the location of sensitive areas and communities in the Project Study Area .

5.4.3 Transportation

5.4.3.1 Construction phase

(1) Study Method

During the construction phase of the project, traffic volume around the project and U-Tapao International Airport road was predicted to assess the impact on traffic agility from increasing number of vehicles in construction activities. Details of study guidelines are as follows:

- Various activities during the construction phase are to transport tools, machinery, equipment, and workers used in the project into the construction area by using trucks or trailers, which are expected to increase traffic volume in the current area, and to predict traffic volume increase due to the implementation of the project. The proportion of traffic volume to support the highway will be determined in the form of V/C Ratio to assess the project impact on transportation conditions in the area using**equation 7.**

$$\text{V/C Ratio} = \frac{\text{Traffic Volume (PCU/hr.)}}{\text{Road Capacity (PCU/hr.) x No. of Lane}} \quad \textbf{(Equation 7)}$$

- Each vehicle type requires a weighted value from the Passenger Car Unit (PCU) value as Passenger Car Equivalents (PCE) as detailed in**Table 5.4 - 8** Type
- Mid-block traffic condition analysis and service level analysis use Highway Capacity Manual 2010 principles to determine the level of service (LOS) of the road and to check for traffic level appropriate to the expected traffic volume provided that the service level of the route is within the specified criteria.

Table 5.4 - 8 Typeof Vehicle with Personal Passenger Vehicle Equivalent Unit (PCU)

Vehicle Type	PCE Factor
Motorcycle	0.333
Cars can not be more than 7 people.	1.00
Cars exceeding 7 people	1.00
Small-sized buses	1.50
Mid-sized buses	1.50
Large bus service	2.10
Small 4 wheel drive truck	1.00
6 wheeler medium duty truck	2.10
Heavy duty 10 wheeler truck	2.50
Trailer Truck	2.50
Semi-trailer truck	2.50

Source: The analysis report calculates the traffic congestion index and traffic density, Office of Safety Administration, Department of Highway, 2018

For the ability to support a car of the road or the road capacity will use the requirements of the Engineering Division, Department of Highways, details are shown as Table 5.4 - 9 [/ g1]

Table 5.4 - 9 Road Capacity

Road type	Road Capacity (C)
Freeway	2,200 PCU/Lane/hr.
Multiple Lane Highway	2,000 PCU/Lane/hr.
2 Lanes Highway, 2 Direction	2,000 PCU/hr.
3 Lanes Highway, 2 Direction	4,000 PCU/hr

Source: Division of Engineering, Department of Highway

Traffic condition analysis to evaluate the flexibility of traffic on the study area's transportation routes, including the assessment of the impacts of transportation. It analyses the mobility conditions, efficiency of traffic flow, using the level of service of the transport network (Level of Service : LOS) is an indicator based on traffic engineering theory, assessment of service level, and the ability to support traffic volume of the road network is divided into 6 levels from level A to level F. It is a qualitative and effective system assessment (Qualitative Measure), which is ordered from the best to the worst conditions, shown in**Table 5.4** - 10

Table 5.4 – 10 Classification of service levels of the road network

Level of service provided	Description	V/C Ratio	Traffic conditions
A.	Free flow can be selected from any level of speed. and there will be overtaking, which is the driver and the passenger will travel easily and quickly without the impacts of other cars.	0.00 < A ≤ 0.60	Very agile
B	Fixed flow, but the car operator can see other cars clearly and can choose the speed of the car that they want, but may not have flexibility. In overtaking cars in the same route	0.60 < B ≤ 0.70	It is flexible.
C	Fixed flow, but the driver will be affected by other cars When choosing speed and overtaking, care must be exercised. On the road, while the convenience and flow will be reduced.	0.70 < C ≤ 0.80	the movement is fair.
D	High density flow and starting to be unstable, fast and agile In overtaking is limited, convenience and flow will be reduced. And a slight increase in traffic will cause traffic problems. On a certain level	0.80 < D ≤ 0.90	Very stuck
E	The level of flow that is nearby or in critical condition means the speed of all cars. It will decrease, but it will continue to be fast, overtaking. Difficulty and assistance increase travel convenience However, the ease of flow will be reduced, causing the driver to not be able to drive at his/her own pace. Therefore, this level of mobility will not be stable due to traffic. that are denser or confused by drivers in traffic routes. This will cause bottlenecks.	0.90 < E ≤ 1.00	Stalling Severely
F	This level is the condition that occurs when the group traffic (Platoon) It exceeds the amount that can flow because it exceeds the traffic channel capacity. The cars are arranged in a row and move intermittently similar to the shock waves, which will cause a significant disruption in traffic almost stops.	F > 1.00	Rarely able to move

Source: The analysis report calculates the traffic congestion index and traffic density, Office of Safety Administration, Department of Highway, 2018

(2) Results of the Study

Based on the assessment of the number of workers from the construction activities in 3 phases of the consultant design of the construction project, the runway and taxiway 2 , U-Tapao International Airport, Ban Chang District, Rayong Province, 2021, shown as**Table 5.4-11**The project summarizes the assumptions used to analyze the traffic volume during the construction phase. By considering the Worst Case as follows:

The construction of the 3 phases of the project takes the same construction period of 3 years or 36 months. Consultants have used data on workers and supervisors in the month with the highest volume of each year for evaluation. By transporting workers will use 6-wheeled vehicles with a capacity of 20 people and a supervisor who drives a private car 1 person per vehicle. Both parts will enter the project during the rush morning and leaving the project during the rush evening. Construction materials transport vehicles consist of soil, rock, sand, asphaltic concrete. will be transported by a 10-wheel truck, which is legally stipulated for the maximum net weight of the load. (including vehicle weight) not more than 25 tons, with a weight rating of approximately 16 tons per vehicle, while cement and rebar will be transported by a 3-axle, 18-wheel trailer truck (Trailer), which is required by law. Max net payload (including vehicle weight) not more than 47 tons, with a load weight of approximately 30 tons per vehicle. The analysis of traffic volume from material transport trucks will assess the average construction period of 3 years or 36 months in each phase by transporting workers. And all construction materials will use Highway No. 3 or Sukhumvit Road.

Table 5.4 – 11 Basic information for traffic volume analysis during the construction phase

Construction phase information	Phase 1 2021-2023	Phase 2 2030-2032	Phase 3 2040-2042
Work on runway, taxiway, tunnels	12,352,860		
- Soil (tons)	4,476,840		
- Rock (ton)	2,315,700		
- Sand (tons)	705,100		
- Cement (ton)	238,800		
- Steel rod (ton)	547,296		
- Asphaltic concrete (tons)	**20,636,596**		
Total (tons)			
Additional work			
- Soil (tons)	4,972,500	1,989,164	2,739,539
- Rock (ton)	455,079	182,047	250,720
- Sand (tons)	910,158	364,093	501,440
- Cement (ton)	223,548	89,426	123,161
- Steel rod (ton)	41,782	16,714	23,019
Total (tons)	**6,603,066**	**2,641,445**	**3,637,879**
Total (tons)	**27,239,662**	**2,641,445**	**3,637,879**
The highest workers (people)	2021 was equal to 2,244. 2022 is equal to 2,687. 2023 is equal to 2,677.	2030 is equal to 360. 2031 is equal to 813. 2032 is equal to 769.	2040 is equal to 1,312. 2041 is equal to 1,504. 2042 is equal to 1,408.
The highest supervisors (people)	2021 was equal to 169. 2022 is equal to 203 2023 is equal to 206	2030 is equal to 31 2031 is equal to 69. 2032 is equal to 65.	2040 is equal to 114. 2041 is equal to 130. 2042 is equals to 122.

Predicted transportation activities for tools, materials, construction equipment, ground transportation, rock, sand, cement and steel bar and construction staff (workers and supervisors) with reference weight According to the announcement of the director of special highways, director of national highways and the director of the concession highway on the prohibition of vehicles with a weight, payload or axle weight exceeds the limit or where the vehicle may cause damage to the highway, running on the highway National Highways and Concession Highways, No. 8, 2015 and requiring the use in the 10-day transportation to be conducted by 10 hours, 09.00-16.00 hours (7 hours) and 18 hours at night 18.00-21.00 (3 hours) by avoiding impacts on traffic volume during rush hours.

The total number of trucks for transporting workers is considered by considering the maximum number of workers and the highest number of supervisors in each year of the construction phase. The number of workers are required to enter the area at the same time. The transportation of workers will use medium-sized buses (6-wheeled buses), carrying 30 people per vehicle, and must be transported within 1 hour, 2 round-trip pick-up trips, and the supervisors are required to drive 1 personal car per vehicle.

1. Construction Phase 1, in the year of 2021-2023 (3 years or 36 months)

Construction in phase 1 will consist of 2 parts, namely part 1, construction of route 2 with tunnels under the runway and parallel taxiway. The main material quantities required are soil, rock, sand, cement, steel, and concrete asphalt, which have a total weight of about 20,636,596 tons. Part 2 is work additional part. There are 5 types of construction materials, namely soil, rock, sand, cement and steel bar, with a total weight of about 6,603,066 tons. Therefore, the total quantity of construction materials that must be transported in the construction phase 1 is approximately 27,239,662 tons

- Soil, rock, and sand and asphaltic concrete are carried by 10-wheel truck, rated with a load of approximately 16 ton per van per one-way, with the total volume of all 4 types of material having a total volume of 26,030,433 tons. Average annual adjustment analysis (3 years) per day (1 year equals to 365 days) and per hour (1 day of delivery for 10 hours). The total of 2 round trips will be approximately 298 cars per hour.

- Cement and steel bar are transported by a 3-lane trailer, 18-wheel truck (Trailer), rated with a load of approximately 30 tons per truck per way, with the total volume of both types of material 1,209,230 tons, analyzed with an average per year (3 years), average per day (1 year equals to 365 days) and per hour (1 day of delivery for 10 hours). The total cost of 2 round trips will be approximately 8 vehicles per hour.

When considering the volume of transportation by the truck in the construction of the project as a PCU, the quantity of transportation of construction materials 298 + 8 = 306 units per hour = 306 x 2.5 = **765 PCU/hour**

- In 2021, the maximum number of workers is 2,244. 6 medium-sized wheels are required. The traffic volume is approximately 150 vehicles per hour (round-trip). The maximum number of 169 supervisors, use 169 vehicles per hour. Consider the PCU to be equal to (150 x 1.5)

+ (169 x 1.0) = 394 PCU/hour. When the amount of transportation is used for construction materials, it will be equal to **1,159 PCU/hour.**

- In 2022, the maximum number of workers is 2,687. 6 medium-sized wheels are required, with a traffic volume of approximately 180 vehicles per hour (from round-trip). The maximum number of supervisors is 203 persons, use vehicles per hour. Considering in the form of a PCU will be equal to (180 x 1.5) + (203 x 1.0) = 473 PCU/hour. When the volume of the construction material transport truck is equal to **1,238 PCU/hour.**

- In 2066, the maximum number of workers is 2,677. 6 medium-sized wheels are required. The traffic volume is approximately 180 vehicles per hour (from round-trip round-trip). The maximum number of personnel is 206 vehicles per hour. Considering the PCU will be equal to (180 x 1.5) + (206 x 1.0) = 476 PCU/hour. When the amount of transportation is used for construction materials, it will be equals to **1,241 PCU/hour.**

2. Construction phase 2, 2030-2032 (3 years or 36 months)

- Soil, rock and sand are transported with 10 wheels, rated with a load of about 16 tons per truck, and for each way.The total volume of all 3 materials has a total volume of 2,535,304 tons. The average annual adjustment is made (3 years) per day, (1 year is 365 days) and per hour (1 day of transportation for 10 hours). The total cost is 2 round trips, with an average of 30 vehicles per hour.

- Cement and steel lines are transported by a 3-lane trailer, 18-wheel truck (Trailer), rated with a load of approximately 30 tons per truck per way. The total volume of both materials is 106,140 tons, compared with average per year (3 years), averaged over each day (1 year, 365 days), and hourly (1 day, 10 hours of transportation), with a total of 2 round trips, with an approximate 2 units per hour.

When considering the volume of transportation by the truck in the construction of the project as a PMU, the amount of transportation of construction materials is 30 + 2 = 32 units per hour = 32 x 2.5 = 80 PCU/hour.

- In 2030, the maximum number of 360 workers required 6 medium-sized wheels is approximately 24 vehicles per hour (total to round-trip). The maximum 31 operators use 31 cars per hour. Consider this in the form of PCU to be equal to (24 x 1.5) + (31 x 1.0) = 67 PCU/hour. When the amount of transportation is used for construction materials, it will be equal to **147 PCU/hour.**

- In 2031, the maximum number of workers is 813. 6 medium-sized wheels are required. The traffic volume is approximately 54 vehicles per hour (from round-trip round-trip). Max 69 operators use 69 cars per hour. Consider this in the form of a PCU to be equal to (54 x 1.5) + (69 x 1.0) = 150 PCU/hour. When the amount of transportation materials for construction materials is combined, it will be equals **to 230 PCU/hour.**

- In 2032, the maximum number of workers is 769. 6 medium-sized wheels are required. The traffic volume is approximately 52 vehicles per hour (from round-trip). The maximum

number 65 operators use 65 vehicles per hour. Consider this in the form of PCU to be equal to (52 x 1.5) + (65 x 1.0) = 143 PCU/hour. When the amount of transport vehicles, the construction materials will be taken up to **223 PCU/hour.**

3. Construction phase 3, 2040-2042 (3 years or 36 months)

- Soil, rock, and sand are transported with 10 wheels, rated with a load of approximately 16 tons per truck per way, with total of 3 types of material being 3,491,699 tons. Average annual adjustment analysis (3 years) per day (1 year equals 365 days) and per hour (1 day of transport for 10 hours) taking total of 2 round trips and returning will be approximately 40 vehicles per hour.

- Cement and steel lines are transported by a 3-shaft trailer, 18-wheel truck (Trailer), rated with a load of approximately 30 tons per truck per way. The total volume of both materials are 146,180 tons, compared with averaged values per year (3 years), averaged by 365 days, and per hour (1 day of transport for 10 hours), with a total of 2 round trips, with approximately 2 units per hour.

When considering the volume of transportation by the truck in the construction of the project as a PMU, the quantity of transportation of construction materials is 40 + 2 = 42 vehicles per hour = 42 x 2.5 = **105 PCU/hour.**

- In 2040, the maximum number of workers is 1,312. 6 medium-sized wheels are required. The traffic volume is approximately 88 vehicles per hour (from round-trip round-trip). The maximum number of 114 operators are responsible for 114 cars per hour. Consider the PCU to be equal to (88 x 1.5) + (114 x 1.0) = 246 PCU/hour. When the total volume of the construction material transport truck is equal to **351 PCU/hour.**

- In 2041, the maximum number of workers is 1,504. 6 medium-sized wheels are required, with a traffic volume of approximately 100 vehicles per hour (from round-trip). 130 operators use 130 cars per hour. Consider that the PCU will be equal to (100 x 1.5) + (130 x 1.0) = 280 PCU/hour. When the amount of transportation materials for construction materials is combined, it will be equal to **385 PCU/hour.**

- In 2042, the maximum number of workers is 1,408. A 6-wheeler mid-sized bus is required. The traffic volume is approximately 94 vehicles per hour (from round-trip). The maximum number of personnel is 122 using 122 cars per hour. Considering in the form of a PCU will be equal to (94 x 1.5) + (122 x 1.0) = 263 PCU/hour. When the total volume of construction material transport is equal to **368 PCU/hour.**

The assessment of traffic impacts divided into 3 phases during the construction phase 2 and phase 3 will be conducted to assess traffic arising from the development of Phase 1 and Phase 2 developments respectively. In this regard, when the construction phase 1 is completed, the project is operational in 2024 and will be able to carry up to 14 million passengers per year until 2028. In the year 2029 will be designed, and construction phase 2 starting in the year 2030-2032, during which the airport will still have a volume of 14 million passengers per year, and when the

construction of the 2nd phase is completed, it will open for service in 2033. It will be able to accommodate up to 38 million passengers per year until the year 2038, then in the year 2039 will be designed, and construction phase 3 starting from 2040-2042, during which the airport will still have a volume of 38 million passengers per year, and when the construction of the 3rd phase is completed, it will open for service in 2043 will be able to accommodate up to 70 million passengers per year until 2048 onwards. The results of the construction period assessment are shown as **Table 5.4-*12***

Table 5.4 – 12 Evaluation results of traffic conditions during the construction of the project, Phase 1 – Phase 3

Year:	Highway 3 (Sukhumvit Road)					
	In case there is no project			If there is a project		
	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS
Phase 1 r 2021-2023						
2021	3,248	0.27	A.	4,407	0.37	A.
2565	3,458	0.29	A.	4,696	0.39	A.
2566	3,651	0.30	A.	4,892	0.41	A.
Phase 2 2030-2032						
2030	4,930	0.41	A.	6,421	0.54	A.
2574	5,109	0.43	A.	6,890	0.57	A.
2575	5,281	0.44	A.	7,262	0.61	B
Phase 3 2040-2042						
2040	6,628	0.55	A.	10,550	0.88	D
2584	6,788	0.57	A.	11,030	0.92	E
2585	6,948	0.58	A.	11,457	0.95	E

It can be seen that the forecast of traffic volume in the project area during the construction period of 3 years during the 1st phase of 2021-2023 and the construction of the 2nd phase during the year 2030- 2032, it was found that Highway No. 3 or Sukhumvit Road had a slight increase in traffic from transporting construction materials and construction workers. It didn't affect much. The service level remains in the A-B level with high flexibility, but the construction in the 3rd phase of the year 2040 - 2042 will have an impact. There is still impact on the traffic from passengers during the past operation period. As a result, the service level compared to the absence of the project was greatly reduced, from Level A to Level D and Level E respectively. Therefore, during the construction phase 3, the project will already accommodate 38 million passengers per year. It will affect the changing traffic conditions to a high level.

5.4.3.2 Implementation phase

(1) Study Method

Predict traffic volume and V/C Ratio that arises from the journey of passengers using U-Tapao International Airport to analyze traffic conditions on roads around U-Tapao International Airport, as well as compile current and future information on transportation network development, in accordance with the infrastructure development action plan, in the special development areas of the East, in order to comply with the development plan of the U-Tapao International Airport, with details of the study guidelines shown in the construction phase.

(2) Results of the Study

Main road network surrounding the project area consists of the 7th Highway (Bangkok-Ban Chang Line, Pattaya-Mabtapoot Period), 3rd Highway, 331 Highway, 332 Highway, and 3126 Highway with details and concepts of traffic connections between the project area and the road transportation network, divided into 2 directions as follows:

1) Linking the travel to the project from the north, this part of the journey is traveling from the Pattaya, Chonburi area or from other regions. The concept of developing an interconnection network to support traffic in this section will be planned to link in and out of the project using Highway No. 3 (Sukhumvit Road) and Intercity Highway No. 7 mainly. Once the airport opens, passengers will be able to travel using the elevated gates to the new terminal. (Terminal 3) directly, thereby avoiding traffic congestion during local traffic with the traffic of passengers at the airport. In addition, the local traffic of people in the area can also be connected to the project by using Highway 332 connecting to Sukhumvit Road and entering the airport by using the elevated road leading to the airport. At the front of the 3rd terminal details are shown as **Figure 2.4-5**.

2) The connection to the project from the south, traveling from the south is Sattahip area and Chuk Samet Pier. There is a plan to link to the project via Highway No. 3126. Currently there is a main road to support access to the current terminal, but in the future, when the third terminal is opened, travel into The project via Highway No. 3 (Sukhumvit Road) will use the elevated road directly to the passenger terminal.

According to the concept of connecting highway network in-out of the airport both in the north and in the south as detailed above. The consultant can forecast the traffic volume from both passenger and cargo volume from the project and assess the impact of traffic conditions on various road networks in the future. Intercity Expressway No. 7 (Motorway) which will be constructed as a 4-lane elevated highway crossing Highway No. 3 (Sukhumvit Road) connecting directly to the northern side of the project which will be opened for service in 2025. It will help alleviate traffic in and out of the airport from Highway 3126, with service level F or very congestion in 2045 onwards. then is shown as **Table 5.4 - 13**

- In the case of projects on all routes when the development is in phase 3 (2048), the main road network, such as Highway 3 (Sukhumvit Road), Highway 331, Airport route entrance to and exit, and Highway 7 will be very busy with service level F. Therefore, it is necessary to extend all main road traffic channels, with a minimum of 6 trafficways in the development phase 2 (2038), and 10 traffic channels in the development phase 3 (2048).

- Airport roads can support the volume of traffic in and out of the airport until 2045, which will be fully capable of supporting cars. The traffic lane should be expanded to 6 lanes.

Highway 3126 is the route to the southern airport, which is currently under construction to improve the size of 6 traffic lanes along the route as it leads to Chuk Samet Pier. It can accommodate travel links between the port and the airport, while the Intercity Expressway No. 7 which is an elevated tollway connecting to and from the airport in the north should be expanded to 6 Lanes before 2047

Table 5.4 - 13Analysis results of traffic conditions on each road network compared to the development of the project in the implementation phase

Year:	Highway No. 3						Highway 331						Highway 332						Highway 3216						Airport entrance and exit road						Inter-City Highway No. 7		
	In case there is no project			If there is a project			In case there is no project			If there is a project			In case there is no project			If there is a project			In case there is no project			If there is a project			In case there is no project			If there is a project			If there is a project		
	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS	Average traffic volume (PCU/hour)	V/C Ratio	LOS
2024	3,833	0.32	A.	4,011	0.33	A.	2,510	0.31	A.	2,627	0.33	A.	2,096	0.26	A.	2,188	0.27	A.	2,302	0.19	A.	2,414	0.20	A.	934	0.12	A.	1,434	0.18	A.	-	-	-
2568	4,006	0.33	A.	4,376	0.36	A.	2,630	0.33	A.	2,873	0.36	A.	2,190	0.27	A.	2,384	0.30	A.	2,380	0.20	A.	2,613	0.22	A.	997	0.12	A.	1,018	0.13	A.	1,018	0.12	A.
2569	4,211	0.35	A.	4,769	0.40	A.	2,737	0.34	A.	3,103	0.39	A.	2,279	0.28	A.	2,570	0.32	A.	2,471	0.21	A.	2,822	0.24	A.	1,073	0.13	A.	1,320	0.16	A.	1,320	0.15	A.
2570	4,390	0.37	A.	5,133	0.43	A.	2,837	0.35	A.	3,324	0.42	A.	2,365	0.30	A.	2,752	0.34	A.	2,555	0.21	A.	3,021	0.25	A.	1,158	0.14	A.	1,621	0.20	A.	1,621	0.18	A.
2571	4,569	0.38	A.	5,498	0.46	A.	2,942	0.37	A.	3,552	0.44	A.	2,452	0.31	A.	2,937	0.37	A.	2,633	0.22	A.	3,216	0.27	A.	1,237	0.15	A.	1,922	0.24	A.	1,922	0.22	A.
2572	4,749	0.40	A.	5,887	0.49	A.	3,051	0.38	A.	3,798	0.47	A.	2,541	0.32	A.	3,135	0.39	A.	2,718	0.23	A.	3,433	0.29	A.	1,310	0.16	A.	2,252	0.28	A.	2,252	0.26	A.
2573	4,930	0.41	A.	6,421	0.54	A.	3,152	0.39	A.	4,034	0.50	A.	2,626	0.33	A.	3,328	0.42	A.	2,801	0.23	A.	3,646	0.30	A.	1,392	0.17	A.	2,582	0.32	A.	2,582	0.29	A.
2574	5,109	0.43	A.	6,890	0.57	A.	3,255	0.41	A.	4,273	0.53	A.	2,713	0.34	A.	3,522	0.44	A.	2,882	0.24	A.	3,856	0.32	A.	1,470	0.18	A.	2,911	0.36	A.	2,911	0.33	A.
2575	5,281	0.44	A.	7,262	0.61	B	3,359	0.42	A.	4,513	0.56	A.	2,799	0.35	A.	3,717	0.46	A.	2,963	0.25	A.	4,068	0.34	A.	1,547	0.19	A.	3,241	0.41	A.	3,241	0.37	A.
2576	5,456	0.45	A.	7,421	0.62	B	3,462	0.43	A.	4,752	0.59	A.	2,885	0.36	A.	3,911	0.49	A.	3,046	0.25	A.	4,281	0.36	A.	1,626	0.20	A.	3,571	0.45	A.	3,571	0.41	A.
2577	5,629	0.47	A.	7,801	0.65	B	3,563	0.45	A.	4,988	0.62	B	2,970	0.37	A.	4,104	0.51	A.	3,127	0.26	A.	4,491	0.37	A.	1,705	0.21	A.	3,900	0.49	A.	3,900	0.44	A.
2578	5,800	0.48	A.	8,179	0.68	B	3,665	0.46	A.	5,227	0.65	B	3,056	0.38	A.	4,298	0.54	A.	3,207	0.27	A.	4,702	0.39	A.	1,783	0.22	A.	4,230	0.53	A.	4,230	0.48	A.
2579	5,968	0.50	A.	8,554	0.71	C	3,766	0.47	A.	5,464	0.68	B	3,141	0.39	A.	4,491	0.56	A.	3,288	0.27	A.	4,913	0.41	A.	1,861	0.23	A.	4,560	0.57	A.	4,560	0.52	A.
2580	6,135	0.51	A.	8,928	0.74	C	3,867	0.48	A.	5,700	0.71	C	3,226	0.40	A.	4,683	0.59	A.	3,368	0.28	A.	5,123	0.43	A.	1,940	0.24	A.	4,889	0.61	B	4,889	0.56	A.
2581	6,302	0.53	A.	9,302	0.78	C	3,967	0.50	A.	5,936	0.74	C	3,310	0.41	A.	4,876	0.61	B	3,448	0.29	A.	5,333	0.44	A.	2,018	0.25	A.	5,219	0.65	B	5,219	0.59	A.
2582	6,465	0.54	A.	9,751	0.81	D	4,067	0.51	A.	6,223	0.78	C	3,394	0.42	A.	5,109	0.64	B	3,528	0.29	A.	5,592	0.47	A.	2,096	0.26	A.	5,659	0.71	C	5,659	0.64	B
2583	6,628	0.55	A.	10,550	0.88	D	4,166	0.52	A.	6,510	0.81	D	3,478	0.43	A.	5,341	0.67	B	3,608	0.30	A.	5,851	0.49	A.	2,174	0.27	A.	6,098	0.76	C	6,098	0.69	B
2584	6,788	0.57	A.	11,030	0.92	E	4,265	0.53	A.	6,796	0.85	D	3,561	0.45	A.	5,574	0.70	B	3,687	0.31	A.	6,109	0.51	A.	2,253	0.28	A.	6,538	0.82	D	6,538	0.74	C
2585	6,948	0.58	A.	11,457	0.95	E	4,363	0.55	A.	7,081	0.89	D	3,644	0.46	A.	5,806	0.73	C	3,766	0.31	A.	6,367	0.53	A.	2,331	0.29	A.	6,977	0.87	D	6,977	0.79	C
2586	7,105	0.59	A.	11,532	0.96	E	4,461	0.56	A.	7,366	0.92	E	3,727	0.47	A.	6,037	0.75	C	3,844	0.32	A.	6,625	0.55	A.	2,409	0.30	A.	7,417	0.93	E	7,417	0.84	D
2587	7,261	0.61	B	11,973	1.00	F	4,558	0.57	A.	7,651	0.96	E	3,809	0.48	A.	6,269	0.78	C	3,922	0.33	A.	6,883	0.57	A.	2,488	0.31	A.	7,856	0.98	E	7,856	0.89	D
2588	7,415	0.62	B	12,413	1.03	F	4,655	0.58	A.	7,935	0.99	E	3,891	0.49	A.	6,500	0.81	D	4,000	0.33	A.	7,140	0.60	A.	2,566	0.32	A.	8,296	1.04	F	8,296	0.94	E
2589	7,568	0.63	B	12,851	1.07	F	4,752	0.59	A.	8,219	1.03	F	3,973	0.50	A.	6,730	0.84	D	4,078	0.34	A.	7,397	0.62	B	2,644	0.33	A.	8,735	1.09	F	8,735	0.99	E
2590	7,719	0.64	B	13,287	1.11	F	4,848	0.61	B	8,502	1.06	F	4,055	0.51	A.	6,961	0.87	D	4,156	0.35	A.	7,654	0.64	B	2,723	0.34	A.	9,175	1.15	F	9,175	1.04	F
2591	7,868	0.66	B	13,721	1.14	F	4,943	0.62	B	8,785	1.10	F	4,136	0.52	A.	7,191	0.90	D	4,233	0.35	A.	7,910	0.66	B	2,801	0.35	A.	9,614	1.20	F	9,614	1.09	F

5.4.4 Utilities and Facilities

5.4.4.1 Construction Phase

(1) Study Method

Predict the demand of water consumptionof construction workers and construction control officers on the construction of the 2nd runway and taxiway, including the components of the project. Assess the adequacy of water sources and water reserve systems. Assess the impacts of the project's water consumption on the current water users around U-Tapao International Airport, as well as consider the electrical system management for construction activities.

(2) Results of the Study

Due to the overall construction of the project, it divided the construction phase into 3 phases, i.e. Phase 1, Phase 2, and Phase 3. Each construction phase will take 36 months. Therefore, the project has been adjusted to manage the construction following the construction phase. It will have construction workers and construction control officers working within U-Tapao International Airport. The number of construction workers and construction control officers in each phase are as follows:

Phase 1: There will be a maximum number of 2,890 construction workers and construction control officers, devided into2,654 construction workers and 236 construction control officers .

Phase 2: There will be a maximum number of 882 construction workers and construction control officers, devided into 813 construction workers and 69 construction control officers.

Phase 3: There will be a maximum number of 1,634 construction workers and construction control officers, devided into 1,504 construction workers and 130 construction control officers

1) Water consumption

1.1) Within the area of U-Tapao International Airport

The project must prepare sufficient water for the consumption of the construction control officers and construction workers who come to work. The water consumption in each construction phase is as follows:

Phase 1: The amount of water used by the construction control officerswill be approximately 16.5 cubic meters per day and the amount of water used by the construction workers, entering the lunch break will be approximately 185.8 cubic meters per day, with a water consumption rate of 70 liters per person per day (Kriangsak Udomsinroj, 1994). The total water consumption at the constructionsupervision office will be 202.3 cubic meters per day. The project must provide a reserve water storage tank that can be used for 3 days, with a volume of no less than 606.9 cubic meters in the event that the water does not flow. Also, it is required 61 tanks of

10-cubic meter-water tank in the area of the construction supervision office, which reserve sufficient amount of water.

Phase 2 : The amount of water used by the construction control officerswill be approximately 4.8 cubic meters per day and the amount of water used by the construction workers entering the lunch break will be approximately 56.9 cubic meters per day, with a water consumption rate of 70 liters per person per day (Kriangsak Udomsinroj, 1994). The total water consumption at the construction supervision office will be 61.7 cubic meters per day.The project must provide a reserve water storage tank that can be used for 3 days,with a volume of no less than 185.2 cubic meters in the event that the water does not flow. Also, it is required 19 tanks of 10-cubic meterwater tank in the area of the construction supervision office, which reserve sufficient amount of water.

Phase 3: The amount of water used by the construction control officers will be approximately 9.1 cubic meter per day and the amount of water used by the construction workers entering the lunch break will be approximately 105.3 cubic meters per day, with a water consumption rate of 70 liters per person per day (Kraingsak Udomsinroj, 1994). The total water consumption at the construction supervision office will be 114.4 cubic meters per day.The project must provide a reserve water storage tank that can be used storefor 3 days, with a volume of no less than 343.2 cubic meters in the event that the water does not flow. Also, it is required 35 tanks of 10-cubic meter water tankin the area of the construction supervision office, which reserve sufficient amount of water.

During the construction phase, it is able to purchase water from the Provincial Waterworks Authority near the project site, which are the Provincial Waterworks Authority Rayong branch, Ban Chang branch, and Pak Nam Prasae branch.The nearest water supply to the project site is the Provincial Public Waterworks Authority, Ban Chang branch.. Considering the statistics of water users, production and distrubution volume of the Provincial Waterworks Authority of each branch in Rayong province, the amount of water produced is more than the amount of water distributed. It is sufficient for distribution to the project site during the construction phase.

1.2) Outside the area of the U-Tapao International Airport

The project must provide water reservoirs or water tanks and faucets sufficient for use, and provide enough water for the consumption of workers staying in the area of the workers' housing. The estimates of water consumption of each construction phase are as follows:

Phase 1: Since the construction phase 1 has a maximum number of 2,654 workers, the accommodation of workers is divided into 2 areas, with a capacity of 1,327 workers per area as following details :

The total water consumption for workers' accommodation in the phase 1 will be approximately 398 cubic meters per day (water consumption rate of workers in the workers' accommodation is 150 liters per person per day, according to the water consumption rate of the temporary rental accommodation, Kriangsak Udomsinroj, Public Water Engineering, 1993). The project will provide a reserve water storage tank that can be used for 3 days, with a volume of no less than 1,194 cubic meters in the event that the water does not flow. Also, it is required 120 tanks of 10-cubic meter water tank in the area of the construction supervision office, which reserve sufficient amount of water.

The water consumption of workers in the phase 1 (per area) will be approximately 199 cubic meters per day (water comsumption rate of workers in the workers' accommidation is 150 liters per person per day, according to the water consumption rate of the temporary rental accommodation,Kriangsak Udomsinroj, Water Supply Engineering, 1993). The project will provide a reserve water storage tank that can be used for 3 days , with a volume of no less than 597 cubic meters.in the event that the water does not flow. Also, it is required 60 tanks of 10-cubic meter water tank in the area of the construction supervision office, which reserve sufficient amount of water

Phase 2 : The water consumption will be approximately 122.0 cubic meters per day (water consumption rate of workers in the workers' accommodation is 150 liters per person per day, according to the water consumption rate of the temporary rental accommodation, Kriangsak Udomsinroj,, Water Supply Engineering, 1993). The project will provide a reserve water storage tank that can be used for 3 days with a volume of no less than 366.0 cubic meters in the event that the water does not flow.Also, it is required 37 tanks of 10- cubic meter water tank in the area of the construction supervision office, which reserve sufficient amount of water.

Phase 3: The water consumption will be approximately 225.6 cubic meters per day (water consumption rate of workers in the workers' accommodation is 150 liters per person per day, according to the water consumption rate of the temporary rental accommodation, Kraingsak Udomsinroj, Water Supply Engineering, 1993). The project will provide a reserve water storage tank that can be used for 3 days, with a volume of no less than 667.8 cubic meters in the event that the waterdoes not flow. Also, it is required 68 tanks of 10-cubic meter water tank in the area of the construction supervision office, which reserve sufficient amount of water.

During the construction phase, it is able to purchase water from the Provincial Waterworks Authority near the project site, which are the Provicial Waterworks Authority Rayong branch, Ban Chang branch, and Pak Nam Prasae branch. The nearst water supply to the project site is the Provincial Waterworks Authority, Ban Chang branch. Considering the statistics of water users, production, and distribution volume of the Provincial Waterworks Authority of each

branch in Rayong province, the amount of water produced is more than the amount of water distributed. It is sufficient for the distribution and consumption of construction workers.

2) Electrical consumption

The project will receive electricity from the electrical system of B.Grimm Power Pubic Company Limited. According to the plan, the construction of the electrical system will be completed in the middle of 2022 to distribute electricity to the entire construction phase of the project. However,, if the development of the airport (expansion) starts before the completion of electrical system project, the construction contractor can request electricity services from the Electricity Authority, the Royal Thai Navy Welfare Concession , which is the agency responsible for the current U-Tapao airport area. There is a sufficient potential to support the increasing demand from construction workers and construction activities, which can provide sufficient electricity. Also, for the construction of the project will be occurred in a short period of time, therefore, it will not cause any impacts.

3) Communication system

The communication system in the U-Tapao International Airport area during the construction of the 2nd runway and taxiwayis very important. At present, U-Tapao International Airport uses the Analogue PABX system with Core Switch located at Terminal 1, which is responsible for the U-Tapao International Airport's telephone line assembly. It is comprised of a central number (9 digits) and an internal number (5 digits). Suchsystem will be provided for relevant agencies within the area of U-Tapao International Airport, and it has a concession company provided services for the internet network In this regard, the development of this project will not affect the use of telephone calls at U-Tapao International Airport and nearby communities. Therefore, it is expected that [4]this will not affect the telecommunication network.

5.4.4.2 Operation phase

(1) Study Method

Predict the demand of water consumption when the 2nd runway and taxiway are open in the future. Assess the adequacy of water sources, water reserve systems, and service development plans of relevant agencies. AAssess the impact of the project's water consumption on the current water users around the project site, as well as consider the electrical system management for use within the area of U-Tapao International Airport.

(2) Results of the Study

1) Water consumption

When the project is opened for running the runway and taxiway 2 of U-Tapao International Airport, it will increase the number of service users or passengers and it will result in increasing demand for water consumption. The predicted water consumption is based on the area developed for the expansion of U-Tapao International Airport and commercial expansion in the master plan. (Master Planning Project, Feasibility Study Project, U-Tapao International Airport

Development Project and Surrounding Areas Rayong Province, 2018). The water consumption rate depends on the number of people in each building and the use within each building. It was found that in the phase 1 (2028), phase 2 (2038), and phase 3 (2048), the total demand for water consumption will be 8,610 and 13,046 and 19,333 cubic meters per day, respectively. Details are shown in**Table 5.4 - 14**to **Table 5.4 - 16**

Table 5.4 - 14 Prediction of water consumption in U-Tapao International Airport area in Phase 1 (2028)

Area	Building area (square meters)	Water consumption rate		Amount of water used	
		Amount	Unit	liters/day	Cubic meters/ day
Commercial – Hotel	18,420	4	Liters/square meters/day	73,680	74
Commercial – Retail Store	5,500	4	Liters/square meters/day	22,000	22
Commercial – Office (10 square meters/person)	40,000	80	Liters/person/day	320,000	320
Commercial – Meeting Room	2,000	4	Liters/square meters/day	8,000	8
Terminal (14 million people) [1/]	182,900	25	Liters/person/day	958,904	959
Aviation support section	15,000	4	Liters/square meters/day	60,000	60
Warehouse/Logistics	50,250	4	Liters/square meters/day	201,000	201
Aircraft Maintenance Center	24,900	4	Liters/square meters/day	99,600	100
Other Aircraft Maintenance Center/ Training Service Center	116,670	4	Liters/square meters/day	466,680	467
Water refill for cooling systems building group					900
Water refill for power plants					5,500
Total amount					**8,610**

[1/] Prediction of the number of passengers in case of greater growth than base case (Aggressive Scenario), with a maximum number of 14 million passengers per year

Notes :

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018

Table 5.4 - 15 Prediction of water consumption in U-Tapao International Airport area in Phase 2 (2038)

Area	Building area (square meters)	Water consumption rate		Amount of water used	
		Amount	Unit	liters/day	Cubic meters/ day
Commercial – Hotel	50,000	4	Liters/square meters/day	200,000	200
Commercial – Retail Store	14,930	4	Liters/square meters/day	59,720	60
Commercial – Office (10 square meters/person)	108,570	80	Liters/person/day	868,560	869
Commercial – Meeting Room	5,430	4	Liters/square meters/day	21,720	22

Terminal (38 million people) [1/]	264,100	25	Liters/person/day	2,602,740	2,603
Aviation support section	37,000	4	Liters/square meters/day	148,000	148
Warehouse/Logistics	153,100	4	Liters/square meters/day	612,400	612
Aircraft Maintenance Center	30,850	4	Liters/square meters/day	123,400	123
Other Aircraft Maintenance Center/ Training Service Center	116,670	4	Liters/square meters/day	466,680	467
Water refill for cooling systems building group					2,443
Water refill for power plants					5,500
Total amount					**13,046**

[1/] Prediction of the number of passengers in case of greater growth than base case (Aggressive Scenario) with a maximum of 38 million passengers per year

Notes :

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018

Table 5.4 - 16Prediction of water consumption in U-Tapao International Airport area in Phase 3 (2048)

Area	Building area (square meters)	Water consumption rate		Amount of water used	
		Amount	Unit	liters/day	Cubic meters/ days
Commercial – Hotel	50,000	4	Liters/square meters/day	200,000	200
Commercial – Retail Store	27,500	4	Liters/square meters/day	110,000	110
Commercial – Office (10 square meters/person)	200,000	80	Liters/person/day	1,600,000	1,600
Commercial – Meeting Room	10,000	4	Liters/square meters/day	40,000	40
Terminal (70 million people) [1/]	469,000	25	Liters/person/day	4,794,521	4,795
Aviation support section	60,000	4	Liters/square meters/day	240,000	240
Warehouse/Logistics	287,000	4	Liters/square meters/day	1,148,000	1,148
Aircraft Maintenance Center	100,000	4	Liters/square meters/day	400,000	400
Other Aircraft Maintenance Center/ Training Service Center	200,000	4	Liters/square meters/day	800,000	800
Water refill for cooling systems building group					4,500
Water refill for power plants					5,500
Total amount					**19,333**

[1/] Prediction of the number of passengers in case of greater growth than base case (Aggressive Scenario), with a maximum number of 70 million passengers per year.

Notes :

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018

However, in the operation phase, U-Tapao International Airportwill receive public water from Eastwater Company's water production system, which has designed a water production system with the highest capacity of 20,000 cubic meters per day. Itsconstruction will be divided into 2 phases, which are Phase 1 (2020-2025) and Phase 2 (2026-2044). Each phase will have a water production system capacity of 10,000 cubic meters per day and have water reserve tank capacity of 30,000 cubic meters. From the potential of the water production system, the water can be supplied to U-Tapao International Airport to accommodate up to 70 million passengers. This will not affect the water comsumption of those living around U-Tapao International Airport.

2) Electrical consumption

During the operation phase, the project will receive the electricity from B.Grimm Power Public Company Limited, which produces and distributes electricity to the private co-investors to set up the system for distribution of electricity to the project areas. From the prediction of the total demand of electricity 98.58 MW, with theelectricity capacity produced up to 160 MW, the amount of electricity produced will be distibutedto U-Tapao International Airport areas, while the remaining amount of electricity will be distributed to the Electricity Authority, the Royal Thai Navy Welfare Concession to further strengthen the electricity system within the project areas. It has prediction of the demand for electricity consumption in each phase. It was found that in Phase 1 (in 2028), Phase 2 (in 2038) and Phase 3 (in 2048), the demand for electricity will be 66.12, 27.17, and 22.69 MVA, respectively. Details are shown in**Table 5.4 – *17* Prediction**. The overall demand of U-Tapao International Airport in 2048, the total demand for electricity will be 115.98 MVA or 98.58 MW and the remaining electricity will be distributed to Electricity Authority, the Royal Thai Navy Welfare Concession with 36.3 MW. Details are shown in**Table 2.5-1**

Table 5.4 – 17Prediction of the electricity demand in eachphase

Area	Electricity Demand (MVA)		
	Phase 1	Phase 2	Phase 3
Commercial – Hotel	3.78	0.00	0.00
Commercial – Retail Store	2.66	0.00	0.00
Commercial - Office (10 square meters/person)	6.72	6.72	0.00
Commercial – Meeting Room	0.97	0.00	0.00
Terminal 70 million peopleper year	13.06	5.80	14.63
Aviation support section	5.05	0.00	0.00
Warehouse/Logistics	2.89	2.89	3.86
Aircraft Maintenance Center	10.08	0.00	0.00

Other Aircraft Maintenance Center / Training ServiceCenter	0.00	10.08	0.00
Water refill for cooling systems in building group	10.92	1.68	4.20
Water refill for power plants	10.00	0.00	0.00
Total	**66.12**	**27.17**	**22.69**
Total cumulative volume	**66.12**	**93.29**	**115.98*** **

Note : *** means that Power Factor 0.85 equals 98.58 MW.

Source: Master Planning Project, Feasibility Study Project, U-Tapao International Airport Development Project and Surrounding Areas Rayong Province, 2018.

Therefore, the amount of electricity supply is sufficient to meet the demand. So, it will not affect the surrounding areas.

3) Communication system

U-Tapao International Airport has designed the equipment that will connect to the main network, such as loT equipment, VoIP Phone, WiFi, etc., that can connect and respond to operations quickly and efficiently. U-TapaoInternational Airport's data center will be connected to 2 or more internet service providers (ISP) for connectivity at any time. Therefore, the project will not affect telecommunication systems within U-Tapao International Airport and its surrounding areas.

5.4.5 Drainage system and flood prevention

5.4.5.1 Construction phase

(1) Study Method

Study the nature of activities during the construction of the 2nd runway and taxiway, and predict the possible impacts of drainage systems within U-Tapao International Airport area.

(2) Results of the Study

The construction of the runway and taxiway 2 along with the components of the project within the area of U-Tapao International Airport it has construction activities, namely: 1) area improvement work/ soil quality improvement work/soil filling work 2) filling work on road and safety areas around taxiway , 3) work on the road layer structure/surface work, 4) work on digging, installation/extraction of pile head, and underpass tunnels, etc.5) foundation work 6) structural work 7) architectural work and system work, and 8) construction work inside the station/system work and architectural work within the train station etc. These activities may have soil leaching into a drainage canal in U-Tapao International Airport. Then it may cause canal shallow and cause poor drainage during some phases of construction. Also, the project site located next to the sea and it may have a low negative impact. This will only have a negative impact on the drainage system within U-Tapao International Airport area. Thus, the project should have measures to prevent those scrap from falling into the drainage system to minimize the impact.

5.4.5.2 Operation phase

(1) Study Method

Due to the change in land use, from the land which has not been developed to become a runway made by asphalitic concrete as the runway surface material and portland concrete cement as the taxiway surface material, this has changed the hydrological conditions , surface water, and drainage.

(2) Results of the Study

The project has designed and constructed sub-drainage systems for the runway and taxiway 2 and other areas sufficiently. The drainage system within the project area is not affected. Since U-Tapao International Airport is located above a moderate sea level, it is considered that the location is not in the recurring flooding area. Therefore, the impact caused by flooding would come from the amount of rainfall falls to the project area, which deems as the only one factor. Considering the usable areas of U-Tapao International Airport, it can be divided according to the nature of the areas into 2 parts: the ground part, and Asphaltic concrete part as a runway surface material and Portland concrete cement part as a taxiway surface material. For the gound part, some amount of rainfall will seep into the soil. The residual rainwater is considered to be run-off. For the concrete and asphaltic part, the amount of rainfall is considered almost all run-off because the amount of rainwater seeps into the soil very little. In this regard, the study of drainage capacity can be analyzed as follows: ,

1) Flow rate analysis

The analysis of the flow rate of the project area isbased on the conditionsof the water catchment area. After development, the project structure will have a concrete area and an asphalt area equal to 7,531,370.73 square meters. The grass ground is equal to 3,578,943.56 square meters, shown in **Figure 5.4-2**. To assess the amount of rainfall forthe project, the coefficient of runoff (C) for concrete and asphalt is 0.90 and the coefficient of grass is 0.40. Then, the result of calculation of average coefficient, the C is 0.74.

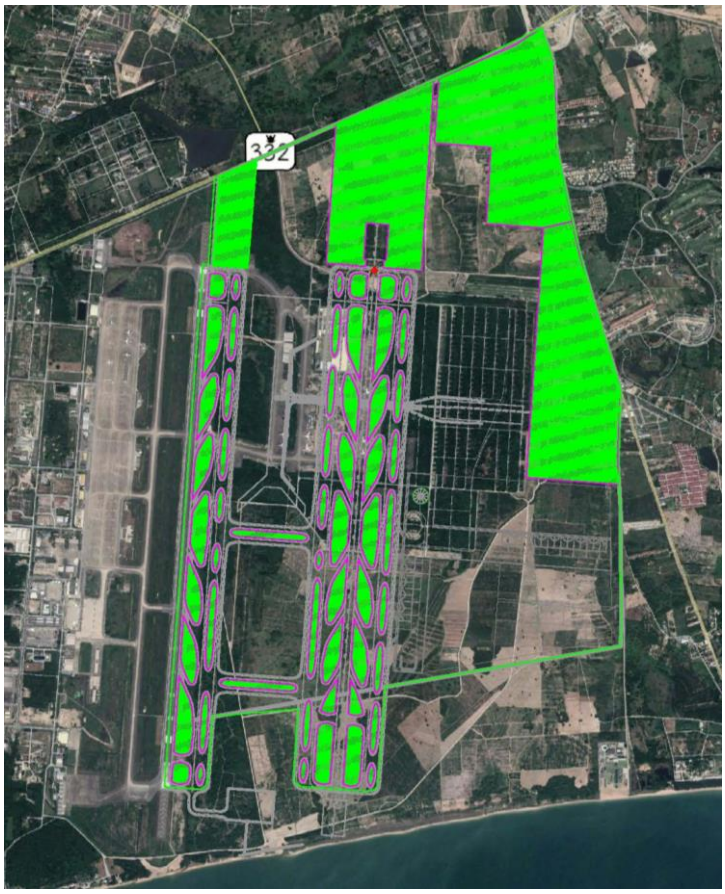


Figure 5.4 – 2 Area assessed as the grass ground of the project after development

Based on the characteristics of the topography and the patterns of the runway and taxiway 2, as well as other components in the study area of the project, to find the maximum flow rate of the water, it considers the amount of excess rain water that falls in the water catchment area (The amount of rain water left from evaporation, soil absorption, and storage in the basins).

Assuming that rainfall is evenly strong and spread throughout the water catchment l area during the period of raining, the amount of water required to drain from the area (flood or run-off) can be calculated using the Rational Method as per **equation no. 1.**

$$Q = 0.278\ CIA \qquad \textbf{(Equation 1)}$$

Q = Maximum water flow rate, at the point of consideration is measured as cubic meters per second.

C = Coefficient of Runoff is based on the forms of the rainwater catchmentarea.

I = Rainfall Intensity, in millimeters per hour

A = Rainwater catchment area, in square kilometers. It can be found by the separation of the rainwater catchment area

on the high-floor map or by the map showing the water way structure.

The coefficient of runoff (C) is the value that shows how much rainfall will turn into runoff compared to the amount of rainfall. This depends on the formsof the water catchment area shown in**Table 5.4-18 The** coefficient

Table 5.4 - 18The coefficientof runoff of various areas

Area conditions	Coefficient of Runoff (C)
Park / Lawn	0.10 - 0.25
Playground	0.20 - 0.40
Railway Station, juncture	0.20 - 0.40
Wasteland/empty land	0.10 - 0.30
Lawn	0.05 - 0.10
Smooth sandy soil, 2 percent	0.10 - 0.15
Sandy soil, average 2-7 percent.	0.15 - 0.20
Steep sandy soil, 7 percent	0.13 - 0.17
Smooth, firm soil, 2 percent	0.18 - 0.22
Firm soil, average 2-7 percent	0.25 - 0.35
Steep, firm soil, 7 percent	0.70 - 0.95
Roads	0.80 - 0.95
Asphalt	0.70 - 0.95
Concrete	0.80 - 0.95
Bricks	0.70 - 0.85
Driving and walking	0.75 - 0.85
Roofing	0.75 - 0.95

Source: Design of project drainage system, 2020

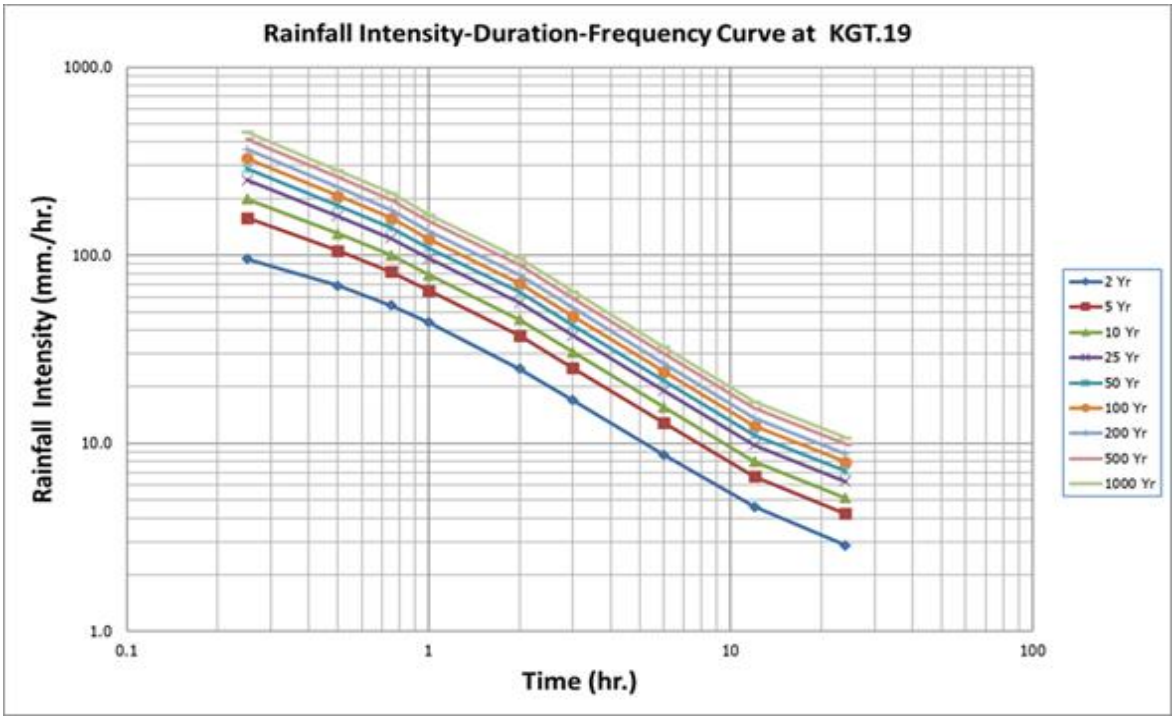
2) Rainfall Amount Analysis

The analysis of the drainage system within the U-Tapao International Airport, it has to find the relationship between Rainfall Intensity-Duration-Frequency Curve(IDF Curve) and Depth-Duration-Frequency Curve (DDF Curve). It used the short rain fall data from the Irrigation Department, station code 09171 located at Khao Nang Nom, Phanasnikom District, Chonburi Province, to use as a representative station in designing the drainage system within the area of U-Tapao International Airport. Details are shown in**Table 5.4 -** 19 graphs showing relationship between Intensity-Duration-Frequency as shown in**Figure 5.4-3** and **Figure 5.4-4**.

Table 5.4 - 19Relationship between rainfall Intensity (millimeters per hour) - Duration - Frequency of the Irrigation Department (station code 09171)

Duration	Period of occurrence: Tr, years								
	2	5	10	25	50	100	200	500	1,000
0.25 minutes	95.8	157.8	198.8	250.7	289.1	327.3	365.4	415.5	453.6
0.50 minutes	68.9	105.9	130.4	161.4	184.3	207.1	229.8	259.8	282.4
0.75 minutes	54.3	81.9	100.3	123.5	140.7	157.7	197.1	197.1	214.1
1 hour	44.0	64.9	78.7	96.1	109.1	121.9	151.6	151.6	164.4
2 hours	25.0	37.4	45.6	55.9	63.6	71.2	88.8	88.8	96.4
3 hours	17.0	25.2	30.6	37.4	42.5	47.6	59.2	59.2	64.2
6 hours	8.7	12.9	15.6	19.1	21.6	24.2	30.1	30.1	32.6
12 hours	4.6	6.7	8.0	9.8	11.1	12.4	15.3	15.3	16.6
24 hours	2.9	4.2	5.1	6.3	7.1	8.0	9.9	9.9	10.7

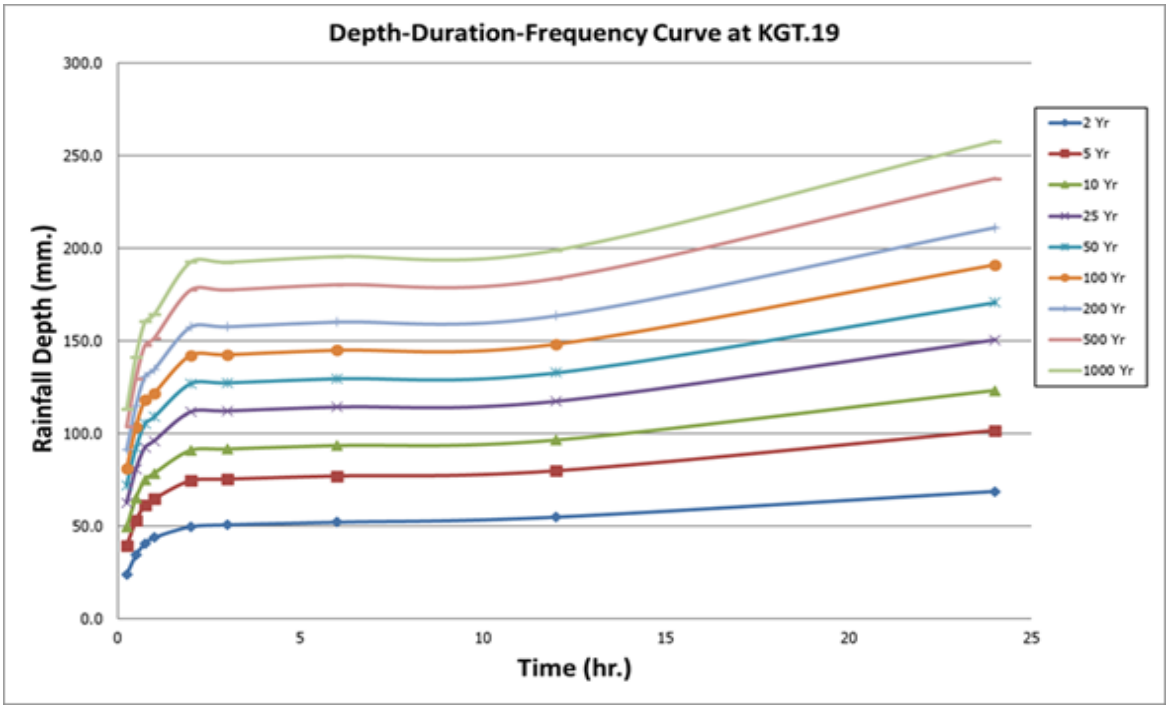
Source: Data from finding the relationship between Rainfall Intensity (millimeters per hour) – Duration – Frequency of Air Monitoring Station, Bang Na, Bangkok, Thai Meteorogical Department between 1990- 2012



Note : The calculation of the project water flow rate for gutter (permanent) uses a return period of 10 years, and gutter (temporary) uses a return period of 5 years .

Source: Design of the project drainage system , 2020 by referring to information from the Irrigation Department, Ministry of Agriculture and Cooperatives, 2015

Figure 5.4 - 3 Rainfall Intensity - Duration – Frequency Curve (IDF Curve)



Note : The calculation of the project water flow rate for gutter (permanent) uses a return period of 10 years and gutter (temporary) uses a return period of 5 years .

Source: Design of the project drainage system , 2020 by referring to information from the Irrigation Department, Ministry of Agriculture and Cooperatives, 2015

Figure 5.4 – 4 Depth - Duration – Frequency Curve (DDF Curve)

In order to find the rainfall intensity (I) from the graph, the following parameters need to be known:

1. Return Period of rainfall used for design

2. The duration of the rain used in calculation is equal to the time period when excess rainwater falls in the water catchment area concurrently at the designed drain point(tTime of the Concentration), which can be calculated from**equation 2.**

$$Tc = \frac{(0.87L^3)^{0.385}}{H}$$ **(Equation No. 2)**

T_c = Time of Concentration, in hours

L = The distance from the farthest point to the drain outlet point, in kilometers

H = The difference of heightfrom the farthest point to the drain outlet point, in meters.

For the rainfall intensity (I), it can be found from the IDF (Intensity-Duration-Frequency Curve) graph. Itis made from the highest rainfall amount at various time points. The calculation of the project water flow rate, for a permanent gutter, it uses a return period of 10 years and a temporary gutter uses a return period of 5 years. In this regard, the project has

designed a rainwaterdrainage system to prevent water and control the amount of water around the runway and taxiway 2, which is divided into 2 parts namely:

1) Secondary Canal drainage system will drain water that flows on the ground of runway and taxiway as well as other areas conveyed into the open gutter system. It is divided according to the structure of drainage system as follows:.

- BOX CURVERT : LINE 1S-S/1, 1S-S/2, 4S-S/1, 4S-S/2, 7S-S/1 and 7S-S/2
- TRAPEZOIDAL DITCH: LINE 2S-S/1, 2S-S/2, 5S-S/1, 5S-S/2 8S-S

2) The water from the secondary canal drainage system will be conveyed to the primary canal drainage system in a form of U-DITCH.

- U-DITCH : LINE 3S-P/1, 3S-P/2, 6S-P, 8S-S/1 and 9S-P

Each size of drain gutter can support a maximum volume of water approximately 120.21 cubic meters per second to transport water into two reservoirs. The reservoir No.1 has a maximum storage volume of 124,820 cubic meters, and the reservoir No.2 has a maximum storage volume of 195,257.41 cubic meters. The sum of the storage volume of reservoir No. 1 and No.2 is at 320,077.41 cubic meters. This is sufficient for the excess water that occurs at the project, which is equal to 251,691.20 cubic meters.

In addition, the project will build a pump station at the reservoir No. 1 to pump out excess rain water that has been stored outside by installing 4 pumps of 2 cubic meters per second (use 3 pumps, reserve 1 spare pump). It will be used simultaneously with a maximum of 3 pumps, with a total pumping rate of 6 cubic meters per second. It will have the staff to control the water pumping 24 hours a day and maintain the machine to be ready at all times. The criteria of pumping out water from the area of the U-Tapao International Airport is the time period of up-down of the seaMoreover, it has to coordinate with the Meteorogical Department to check the rainfall data and forecast the estimated amount of rain water. After consideration, the drainage and flooding prevention system of the project can support the amount of rainfall without causing flooding in the areas of project and it will not affect the surrounding areas of the project. The project has designed the reservoir No.1 and No.2 to be a sedimentation tank and a reservoir itself. After the rain has stopped and the water quality has been checked, the water quality is within the standard. Then the water can be pumped out. Therefore, the impact of this event is low .

5.5 Value to Quality of Life

5.5.1 Economy and society

The assessment of economic and social impacts has been conducted as follows:

5.5.1.1 Source of Data

Conduct the study and collect economic and social data by considering both the secondary data, which can be obtained from the collection of data from relevant documents and reports of various agencies, and the primary data from the field visits to survey social and economic

data as well as the public hearing around U-Tapao International Airport. The survey questionnaire can be summarized as follows:

1) Secondary data

Conduct data collection from documents, study reports and data statistics from relevant agencies, including ministries, bureaus, departments, in provincial level, district level, and subdistrict level. For example, survey result or observation report, annual report, study report, annual report of social and environmental responsibility, information on the economic and social conditions of the people in the study area, scope of government in the study area, details of population, number of households, population and size of households, proportions of people accordingto age, occupations, Gross Provincial Product, per capita income, household incomes and expenses, average amount of debt per household, and public utilities data which may be related to the construction and operation of the project in the future etc.

In this regard, such information has been used to support the assessment of the economic and social impacts that may arise from the development of the project. This will make it aware of limitations prior to the development of the project as well as the determination of preventive measures and corrective actions and appropriate monitoring measures of the economic and social impacts.

2)Primary data

Conduct the questionnaire survey of economic and social data by interviewing target groups in the study area, divided into 3 groups.It is consisted of households group (NEF ≥ 40 area, NEF 30 – 40 area, and NEF < 30 to the study area range), community leaders group and sensitive area group. This includes collecting the public economic and social concerns from public participationactivities in the form of formal meetings , public hearing meetings, small group meetings, and in-depth interviews. It considers the community lifestyle and the previous impacts of the construction of U-Tapao International Airport to predict the impacts of construction and operation of the 2nd runway which may cause social impacts on the community in the study area.

5.5.1.2 Determination of the scope of the assessment, and the assessment of significance level of the social environmental impact

Determining the scope of assessment and the significance level of the social environmental impact in order to assess the possible impact on social conidtions(quality of life), both positive and negative impacts from activities in the construction phase and operation phase of U-Tapao International Airport, it has considered the possibility of impacts, duration, scope of the affected areas , as well as the severity of possible impacts. , This enables to determine the preventive measures and corrective actions of environmental impacts and the social environmental monitoring measures.From the operations, they are in accordance with the community environment. The assessment of quality of life impact has been conducted in accordance with ONEP's social impact assessment and public participation guidelines. Details are as follows:

1) Summary of Project Data

In the primary social survey process, it was conducted by the Project Review, the processing of data from the secondary sources from central government agencies, regional government agencies, and local administrative agencies. For example, the National Statistics Office, Department of Provincial Administration, Office of the National Economic and Social Development Council, District Office, and Local Administrative Organization in the study area. This is to classify stakeholders from the project and provide an overview of the community expected to be impacted by the project. The following information was compiled and summarized as preliminary information and used in the project proposal and presentation document for public participation activities in order to inform stakeholders during the public hearing and used to support the social environmental impact assessment.

- Information related to the reasons of the project, including necessity and objectives, type and size, and expected results.
- Information related to project operation, including location map, components, activities, and operationplan
- Information related to the responsible agencies, including project owner agencies and other related agencies.

Stakeholders from the project can be classified into 2 areas as follows:

- **The main affected area** is the area affected by severe level of noise from aircraft, It is not suitable for residence, and should not have activities that are sensitive to the effects of noise, as it may cause health effects of the people living in long-term. This study is called an NEF ≥ 40 area.

- **The secondary affected** area is thesecondary affected area from the project activities. The study is divided into 2 groups:(1) NEF 30 - 40 area, which is minor to moderate levels of the impact of the aircraft noise and should not have activities that are sensitive to the impact of the noise and other activities such as transportation, etc. And (2) NEF < 30 area to the study area range, which are not affected by the aircraft noise.

2) Observation of social environmental impacts

The project has considered the relationship and consistency between project conditions and community demographic, economic and social data, community characteristics, relevant cultural values, nature and aesthetics. It has used the questionnaires in the Social Environmental Impact Assessment Guideline (ONEP, 1996). The restuls of observations of the social environmental impact details are shown in**Table 5.5 - 1** Observation results

Table 5.5 - 1 Observation results on social environmental impacts

Questionnaires Guideline	Observation results
1. Has the project ever been associated with the community or had any thoughts of running a project in this community before?	- The Project Owner (Royal Thai Navy : RTN) has a long history of area involvement. It had begun with the initiative of His Majesty King Vajiravudh in 1914 and on September 1922, His Royal Highness Prince Admiral Chumphon Khet Udomsak, while holding the position as the Chief of Naval Staff , wrote a letter to His Majesty King Vajiravudh, in order to request a reserved land of

Table 5.5 – 1 Observation results on social environmental impacts

Questionnaires Guideline	Observation results
	Sattahip subdistrict to be a Naval Base.The Navy used such land as the Naval base. It was formerly known as the Sattahip Public Works Division, and has been renamed several times. Until on 19 September 1974, it was renamed the Naval Base - U-Tapao Airport is an airport under the supervision of the Royal Thai Navy, which initiated the project in 1961. The Supreme Command Headquarters has approved the construction of a new airport of the Royal Thai Navy in the village of U-Tapao, Rayong Province - In 1962, Field Marshal Thanom Kittikachorn, the Command-in-Chief at that time was given an order to the Royal Thai Navy to use this airport in government work and to maintain the airport by using the name "U-Tapao Airport". - After the renovation of U-Tapao Airport by the Department of Commercial Aviation, the Cabinet considered that it should be better used more at U-Tapao Airport. Therefore, it had been developed to become an international airport, which was called "Rayong-U-Tapao International Airport" under the affiliation of the Royal Thai Navy. It has been developed to be a commercial airport with the Department of Commercial Aviation, Ministry of Transport. - However, the project owner had conducted a project in the form of using the land as a naval base and an airport for security for a long time. For the community aspect, there were some issues with living in the land related to the project for a long time. It has affected public concerns that they may have to be relocated if the project owner needs the space. The project owner has acknowledged the issues and obstacles from the public participation and has worked to resolve those problems by working with relevant agencies to take further action.
2. Does the project have objectives that meet the needs or expectations of the community?	- The development project of U-Tapao Airport and the Eastern aviation city is considered as one of the main infrastructure projects of the Eastern Economic Corridor EEC). The EEC aims to raise the level of U-Tapao International Airport to be the “ 3rd Major Commercial International Airport”. It strategically set three important missions: becoming “ the 3rd Bangkok Airport”, connecting Don Mueang Airport and Suvarnabhumi Airport withthe high-speed train, becoming “the I Tourism, and Logistics & Aviation Industry Center” of the EEC, and becoming “the Important Port City”, connecting Bangkok to the east by water, land, and airways. - On 3 June 2015, the memorandum of understanding was signed to develop U-TapaoInternational Airport to be the third commercial airport. The project aims to meet the needs or expectations of the community in many issues such as employment, income generation, career opportunities, etc. In this regard, based on the public survey of 868 samples on the project in 2020 – 2021,it was found that a household samples agreed with the project development of 90.4% (785 samples) overall.
3. Will the project help solve important community problems?	- The project has opportunities and possibilities to be a part of the support to help solve important issues of the community in terms of revenue generation, career development, and indirect results, when the overall economic

Table 5.5 – 1 Observation results on social environmental impacts

Questionnaires Guideline	Observation results
	development is driven by the overall national income.
4. Will the project threaten the basic needs of people in the community or exarcerbatethe important community problems?	- The project does not contribute to any threats of the basic needs of people in the community or exacerbate important community problems because the project is developing the overall economy driven by the overall national income.
5. Will the project cause severe impacts on minorities or underprivileged persons?	- The operation of the project will not affect any minorities or underprivileged persons.
6. Will the project impact the important value of the community?	- Overall, the project has no impact on the important value of the community.
7. How much or less has the community been informed and contacted with the external communities?	- It has close communication between communities and the current communication way has a great progress.It is able to communicate through many channels both from outside and within the community. However, the project owner has made a priority in making understanding of the project to be accurate and to get the public involved in giving feedback on the project. And it is able to communicate in two ways with social science method, such as group dicussions, individual interviews, including at the community leader level, and especially those who have the possibility to be negatively affected from the project, such as the noise impact. There are totally 28 group discussions. o
8. Has the community ever had experiences with development projects similar to this project? Is it a positive or negative experience?	- The community has experiences in studying environmental impacts assessment in other projects to express concerns about the projects such as the construction projects of special highways, and high-speed rail projects, etc.
9. Has the community ever had experiences with the project's organization? Is it a positive or negative experience ?	- The community as a whole has positive and negative experiences with the project owners of the above-mentioned projects.
10. Other observations	- The relationship between the project owners and the community in the past did not have much communication or activities together (details from the public hearing meeting). - Stakeholders see the benefits of developing projects (details on economic surveys, social surveys, issues, opinions of the overall project) if they wish the project owner to consider the group affected by the noise to be fair. The project owner has acknowledged the detailed impacts of the matter from hearing the opinions and concerns from the public and will consider further measures to reduce the impacts.

3) Preliminary impact prediction

From considering the activities of the upcoming proect in the construction phase and operation phase, the social experts has predicted the expected impact on the group/community and prepared a table of expected social impacts as per the details shown in **Table 5.5 - 2** Prediction of

Table 5.5 – 2 Prediction of Impact and Preventive and Corrective Measures on Social Impact

Activity/period	Impacts	Impact recipients	Nature of impacts	Level/size of impacts	Measures to reduce impacts
Construction phase					
	Dust, roads	Road users, residents along transport routes	The negative impact is the inconvenience of traveling along the transport route. The impact is limited to the project area and nearby areas only.	Limited impact, low severity, temporary impact	Specify and follow measures to prevent and resolve environmental impacts on public utilities, transportation, and air quality.
	Noise from transportation of materials in construction, and construction activities and adjustment of areas.	The residents in the vicinity of U-Tapao International Airport and live along the transport route.	The negative impactson the inconveniences and disturbances are limited to the project area and nearby U-Tapao International Airport and the residents living along the transport routes during the construction phase.	Limited impact, low severity, temporary impact	Specify and follow measures to prevent and resolve environmental impacts on noise, transportation, occupational health and safety.
	Vibration from transportation of construction materials	Residents living along transport routes	The negative impact on the inconvenience and disturbance are limited to the project area and nearby areas of U-Tapao International Airport and the residents living along the transport routes during the construction phase.	Limited impact, low severity, temporary impact	Specify and follow measures to prevent and resolve environmental impacts on vibration, transportation, occupational health and safety.
Operation phase					
	Dust, driving routes, and road user traffic	Road users and local people	The negative impact on the inconvenience of traveling along the transport routes is limited to the project area and nearby areas only.	Limited impact, low severity, temporary impact	Specify and follow measures to prevent and resolve environmental impacts on public utilities, transportation, and air quality.

Table 5.5 ‑ 2 Prediction of Impact and Preventive and Corrective Measures on Social Impact

Activity/period	Impacts	Impact recipients	Nature of impacts	Level/size of impacts	Measures to reduce impacts
	Noise impact	Those who live in the area that is the route of take-off and landing of U-Tapao International Airport are classified as:	The negative impact is that it is not suitable for living because it causes health effects of the people who live in such noise lines.	Limited impact, in high severity level, and continuous impact	Specify and follow measures to prevent and resolve environmental impacts on transportation, occupational health and safety. The project shall negotiate the purchase of land and buildings in accordance with the rules and procedures.
	Noise Impact	1. NEF ≥ 40 group 2. NEF 30 – 40 group	The negative impact is an habitable area, but housing should be improved to reduce the noise caused by aircraft.	Limited impact, in high severity level, and continuous impact	Specify measures for the project to support building improvement in order to reduce the impact of noise according to the rules and procedures.
	Economic and social aspects	Residents in the vicinity of U-Tapao International Airport.	The positive impact is the increasing capacity of passenger transport resulting in continuous business expansion , promotion of tourism, as well as service businesses that will occur, such as foreign investment, car rental services, and travel services e.g. accommodation and restaurants.	Broad impact, in moderate - high level, and continuous impact	Specify and follow measures to prevent and resolve environmental impacts on the economic and social aspects

4) Assessment of economic and social impacts

Based on the findings and recommendations obtained from public participation activities with the groups/communities that may be affected, and taken into account with basic community information, the assessment of positive and negative environmental impacts can be performed both in the construction phase and in the operation phase. The summary of the nature of the impact and the level of impact can be seen in**Table 5.5 -** 3

5) Guidelines and Procedures

For reducing public anxiety to the impact of noise in the operation phase, which is an important issue and the people in the community are interested, the project has guidelines for conducting surveys and compensation for those affected. The project hires the consultants to monitor the compliance with the environmental preventive and corrective measures and the environmental impact monitoring measures as specified in the Environmental Health Impact Assessment report. The project has prepared a map along the level of NEF noise level by using a mathematical model to compare with the comparative NEF noise level map where compensation was performed. If it is found that there is an increase in noise impact area, a survey will be conducted and a database of those affected by noise will be performed, and the compensation will be taken promptly. .

Guidelines and methods for studying the noise impact compensation of housing survey, the study process is as follows:

(1) Create a map showing the noise- impacted areas and placed on the aerial photographic map.. In case of the construction of the 2nd runway, the survey area is divided into 2 areas, which are the NEF ≥ 40 area and the NEF 30 40 area,. It also counts the number of houses and buildings from the image shown.

(2) After receiving the map data showing the number of houses or buildings already, the map is then used to determine the next field survey plan.

(3) The field survey process by the survey team will coordinate with the community leaders to publicize the people in the area to be aware of the survey in order to prepare information and documents showing land ownership s and building years before the survey team will conduct field survey with the home owner or residents. It includes using GPS tools to record the location of each house and building in UTM format and using digital camera for recording photos, characteristics of the houses, buildings and nearby buildings, as well as observing the surrounding environment around buildings whether it is exact or similar according to the aerial photographs.

(4) Prepare a database showing the location and details of the building. Then, copy the recorded information in the form of a table to facilitate the processing of all information received in compensation payments, and deliver land ownership documents, building structures, and building evidences and information provided by the building owner to check the completeness of the documents before proceeding further.

(5) Prepare a summary report of the results of house, and building field survey by separating the number of houses, and buildings according to the characteristics of the building. Therefore, such information can be used to estimate the compensation payment budget.

Table 5.5 – 3 Results of Social Environmental Impact Assessment

Activity/ Duration	Social environmental impact issues	Impact analysis	Summary of nature/level of impact
Construction phase			
Positive impact	Economic aspect	The construction activities may help to spread income since there will have approximately 330 workers/day during construction phase (varies according to construction activities) and it will take a 36-month construction period. Thus, it will create employment.	Low, temporary, and limited positive impact.
	Public utility and facilities	The development of public utilities, public facilities, and other infrastructure has increased to support the services to the U-Tapao International airport, and surrounding areas by related agencies, such as State Railway of Thailand (SRT), Provincial Electricity Authority (PEA), Provincial Waterworks Authority (PWA), etc.	Moderate, temporary, and limited positive impact
Negative impact	Mental and anxiety aspects of the local people	According to the public survey of the project in 2020, it was found that 76.1% of households in the NEF ≥ 40 area were worried about the development of the project and 14.4% of households in the NEF 30 – 40 area were worried about the development of the project. The issues of concern were about lifestyle, safety in life and property, and the adequacy of the public utility.	High, temporary, limited negative impact
	Transportation aspect	The number of trips used to transport soil is 920 times/day, resulting in increasing traffic volume affecting traffic conditions in the surrounding road network and the entrance – exit of U-Tapao International Airport. Due to the current traffic conditions,it is considered to be quite heavy, particularly at the Kasem Phon intersections and Pattanawet School where traffic is already congested during peak hours. Thus, it causessome changes in traffic conditions, but not suddenly.	Moderate, temporary, and limited negative impact
	Dust and noise from transportation of construction materials	The main sources of dust and noise in construction phase are the vehicles used to transport construction materials and machinery used in construction. Since there is a materials transportation for land adjustment, which is a task that uses many machinery. The construction activities which will be noisy and have the greatest impact on the public is the land adjustment. This is because it is an activity where multiple machines may be used simultaneously: tractors, trucks, and graders.	Moderate, temporary, and limited negative impact
Operation phase			
Positive impact	Economic aspect	The development of U-Tapao Airport is the development of aviation competitiveness for Thailand, which will have widely national and local economic impacts, which are: 1. the foreign investment that will enhancethe role of Thailand's air freight sector by attracting investments in airfreight services such as electronics, pharmaceutical industry and e-commerce business. This model is used in cities around the world such as Amsterdam Schiphol airport city in the Netherlands, Zhengzhou airport economy zone in China.	Broad, moderate to high, and continuous positive impact

Table 5.5 – 3 Results of Social Environmental Impact Assessment

Activity/ Duration	Social environmental impact issues	Impact analysis	Summary of nature/level of impact
		2. The expansion of related businesses such as warehouses, flight-related services and tourism, such as rental businesses, hotel accommodation, food service businesses, restaurants, etc. 3. The increase in employment due to the expansion of the related businesses, the urban expansion,and transportation. This impacts on investment and financial circulation in the area, residential construction, transportation, logistics, etc.	
Negative impact	Noise aspect of the aircraft	The community in the sensitive areas that are along the take-off and landing routes of aircrafts will be affected by the aircraft noise. From the study, it can be devided into: 1. NEF ≥ 40 group will have negative impact. It is not suitable for living as it causes health effects. 2. NEF 30 – 40 group will have the negative impact. It is an habitable area but it should have improvements in housing to reduce the noise caused by aircraft.	High level of severe negative impact. Continuous impact.
	Mental and anxiety aspects of the local people	The anxiety of the groups of people affected by the project can be classified as follows: 1. The anxiety of the people affected by take-off and landing of aircraft, especially communities, households and sensitive areas that are expected to be affected.It can be classified as follows: 1.1 The communities, households, and sensitive areas in NEF ≥ 40 group are not suitable for living since it causes health effects. From the participation activities in public hearing, a survey of people inthe NEF ≥ 40 group of 86 households found that 74 participants (86.0) have concerns about the development of the project by 76.7%. However, this group has opinions about compensation for land and buildings devided into 2 groups as follows: 1.1.1 Move out of the area and receive compensation 1.1.2 No need to move out of the area, receive/ do not receive compensation, and have terms and conditions. . 1.2 The NEF 30 – 40 group is a habitable area but it should have improvements in housing to reduce the noise caused by aircraft.. From the participation activities in the public hearing, a survey in NEF 30 – 40 group of 354 households found that 289 participants (81%.6) have concern about the development of the project by 14.4%. The issues of concern are about lifestyle, safety in life and property, and the adequacy of basic public utilities. However, this group has the opinions on building improvements as follows: 1.2.1 Want to improve buildings and structures, and still residing. 1.2.2 Do not want to improve buildings and structures, do not want to reside and have terms and conditions, such as wanting to receive compensation and move out, etc.	Low level of severe negative impact. Temporary and limited impact.

Table 5.5 – 3 Results of Social Environmental Impact Assessment

Activity/ Duration	Social environmental impact issues	Impact analysis	Summary of nature/level of impact
		However, in regards to the anxiety in the project development, the consultant has already determinedmeasures to reduce the impact. 2. Concerns about compliance with the environmental monitoring measures	
	Transportation, driving routes, traffic inconvenience to road users.	When both runways are open for use at the same time, the traffic volume will increase considerably. During the average hours, traffic congestion occurs. Especially during peak hours, it has mostof traffic congestion, and traffic volume exceeding the lane capacity. However, for the entrance – exit of U-Tapao International Airport, traffic conditions are still good. Thus, it has low level of severe negative impact. It is continuous, local and limited impact.	Low level of severe negative impact. Continuous, local, and limited impact.

5.5.1.3 Analysis of the establishment of fund for the impact from U-Tapao International Airport

The establishment of the fund to look after the impacts of the airport. There is no foreign law or Thai law. Only foundations or independent non-profit organizations are established overseas. In Thailand, there is no fund that matches this objective. For this reason, the results of the analysis of advantages, disadvantages, and limitations can be summarized as follows:

1. In case that the establishment of the fund is the same as the Community Development Fund in the area around the power plant, the fund is charged to the airline operators from fees or fines.

The Community Development Fund in the area around the power plant was established by the Energy Industry Act B.E.2550 (2007) and it has government officials as Fund Management Committee. . Even though it can be charged from private operators, the establishment of the fund to develop communities from aircraft expansion does not have any laws to support like the two funds above.

If a new bill will be created to support the establishment of such fund, it is difficult because the new bill has complicated processes and takes a long time. Also, the reasons for raising the bill must cover all the issues for drafting. Waiting for a new bill to be incorporated into a law may take too long, and it cannot be used in a timely manner as intended.

2. In case of the establishment of an independent non-profit organization in order to create a community development project based on the development of the airport area, like England and Singapore instead of establishingg a fund, it is practically possible. Sincethe establishment of an independent non-profit organization, it can be done and it does not take a long time. However, bringing money into the organization must be clearly identified its sources. It may have the following sources:

- Money obtained from airline offenses, such as fines for noise or others.
- Share of profit gained from business operations
- Money derived from the fees collected from the flights
- Money received from donation

It has to define clearly the scope of action to develop communities by presenting as projects each year. It must clearly specify which areas to support, for example:

- Sports promotion activities or learning promotions, such as sports training during the semester breaks for children and young people in the area affected by the airport expansion
- Career promotion activities in the community to encourage the creation of career in the community.
- Educational support activities for children and young people in the area affected by the airport expansion
- Environmental protection activities in the community

In this regard, the scope of activities should be a way of improving quality of life. This excludes medical treatment and the physical impact of the airport development. In this matter, it should be separated as a remedy during and after airport construction in order to avoid overlapping between them.

Management of the Fund for the Impacts from U-Tapao International Airport

Based on the consideration of the management of the fund to develop and maintain communities from the development of the airport in foreign countries and similar Thai funds, the project then proposed the concept of management of the fund to manage the impacts from U-Tapao International Airport in order tobuild cooperation between the communities around the airport,government agencies, agencies that manage U-Tapao International Airport, and service providers at U-Tapao **International Airport.** In this regard, the development of the U-Tapao International Airport may have impacts on natural resources, environmental quality, health, sanitation, and quality of life of people in the community, which need to compensate those affected persons. Apart from the direct compensation for damages, there is also a concept of compensation in the form of development after direct compensation. The compensation will be devided into two cases as follows:

1. Compensation for those affected persons, before, during, and after the airport construction, which damage caused by the actions of the construction operators. It divides the level of remedies with those affected by the damages. Remedies may be of the form of medical assistance or compensation, as appropriate to the damages incurred.This is different from the 3rd party insurance measures specified in the economic and social measures in the EHIA report.

2. Compensation in the form of community development. This promotes the quality of life of the people living in areas around U-Tapao International Airport in several aspects such as education, training and career promotion and sports.

In this regard, the compensation must be appropriately laid out and not contrary to the law, in which Thailand does not have a direct law on such matters.

1) Fund management structure for the impacts from U-Tapao International Airport

The fund management for U-Tapao International Airport impact will be operated in the form of the Emergency Damage Security and Public Life Quality Improvement Foundation (The Foundation). The foundation's establishment and operation will be in accordance with the Civil and Commercial Code. The Foundation Committee will be responsible for the fund management of the U-TapaoInternational Airport's impact in accordance with the objectives of Foundation with 2 funds, namely:

- Emergency Damage Security Fund for quick remedy of emergency damage from the project development of U-Tapao International Airport
- Public Life Quality Improvement Fund is to improve the quality of life of people in the communities, to conserve nature and environment, as well as to operate or collaborate with charityorganizations and public benefit organizations in enhancing the sustainable development of communities.

Definitions

- Foundation means assets that the project has been allocated specifically for the purpose as a guarantee for damage quickly in case of an emergency and to improve the quality of life for the people or surrounding communities without seeking any profit, and it is registered under Civil and Commercial laws.

- Fund means the assets of the Foundation that the project has collected for both objectives above.

In addition, the Foundation, which has the assets collected for both objectives in the form of the above two funds, will be managed by the Foundation Committee. The composition of the Foundation Committee consists of representatives from various related organizations, including representatives from the project. The appointment of representatives from the head of the local administrative organization and the selection of representatives from those afftected in the noise lane including those who are outside the noise lane but are in the Project Study Area for 30 people It will be carried out by the method of the representative selection from the affected persons which will be determined by the rules/regulations of the Foundation.

The fund management structure responsible for the impacts of U-Tapao International Airport in the form of Emergency Damage Security and Public Life Quality Improvement Foundation as shown in **Figure 5.5 – 1**

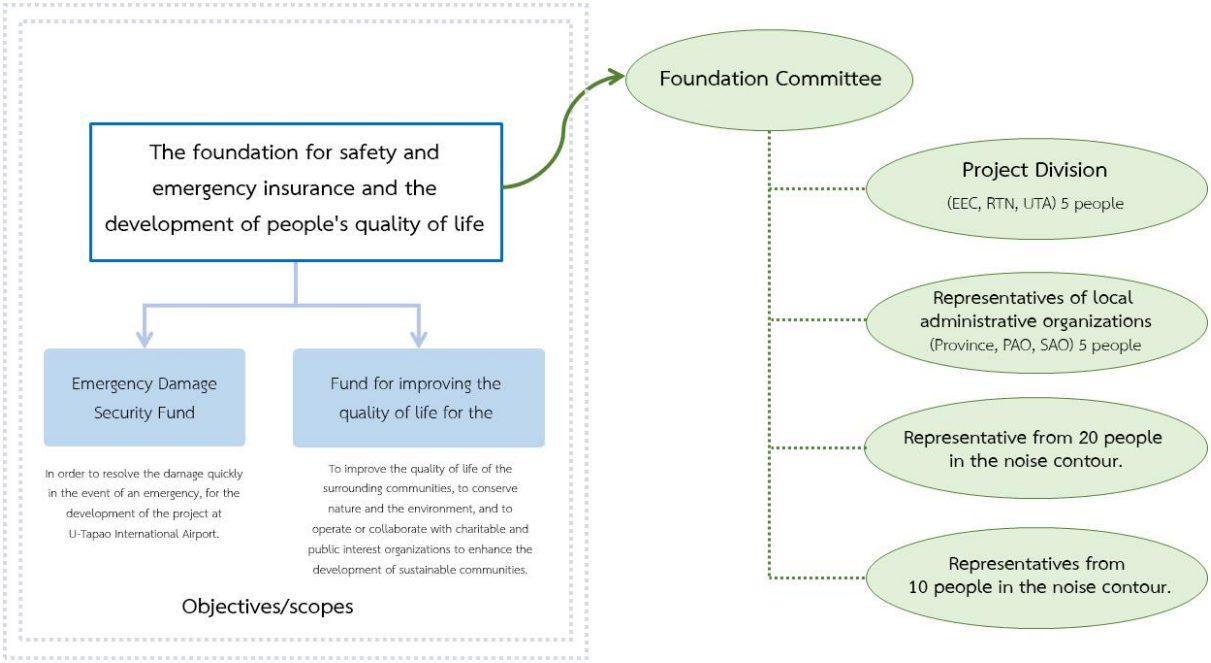


Figure 5.5 – 1 (Draft) Structure of Foundation Committee for the remedy of affected persons and people's life quality improvement of U-Tapao International Airport and Eastern Aviation City development project.

In this regard, the Eastern Economic Corridor Office of Thailand (EECO) will establish the Damage Security and Public Life Quality Improvement Foundation (the Foundation) under Civil and Commercial law to manage the impacts from U-Tapao International Airport. It will be filed for

establishment within 3 months after approval of the project by the Cabinet as well as prepare the Articles of Association of the Foundation The main provisions of the Foundation are as follows:

- Name of Foundation, name of symbol, and location of office
- Objectives as specified in the EHIA report
- Capital, property, and acquisition of assets. In submitting the registration of Foundation by ECCO, there will be an initial fund of the Foundation no less than 500,000 baht because during the application period, the Foundation has not yet received the money into the fund. For the acquisition of capital asset, it shall be in accordance withrules, conditions, and methods of acquiring money for contractors and airport operators as the Committee will issue the regulations of the Foundation, which must be consistent with the EHIA report.
- The Articles of Association of the Foundation specifying the committee members's conditions include the number, qualifications, appointment of the committee, removal of office of the committee, and meetings of the committee. In this regard, the number of committees and the acquisition of committee of each sector shall be in accordance with the principles set out in the EHIA report. The committee representing the affected persons 3]which will be from the selection, shall be specified in the rules, conditions and procedures in the Articles of Association of the foundation. It specifies that the provincial governor of the affected area shall be the chairman of the committee. It requires that the selection of committees who are representatives from the affected persons must be completed within 1 year after the Foundation's establishment date. If there is a reason why the selection of the committees cannot be completed within 1 year and the chairman of committee has exercised a good faith discretion and see that it is a reasonable cause and necessary to extend the selection period of such people's representavie committee. The chairma must notify the Foundation Committee to request an extension of the selection period. The request of the extension of the selection period shall be no more than 1 year.
- The authority of the Foundation Committee shall have the main authority to consider the appropriateness of the remedies to the affected persons, fund management and fund disbursements to be effective in accordance with the objectives of the foundation, and shall be in accordance with the EHIA report.
- The meeting of Foundation Committee which is scheduled to have an ordinary meeting at least 2 times a year, and must have Committee members attend at least a half of the total number of committee members. In the case that it is necessary, the Foundation Committee may hold extraordinary general meetings at the discretion of the Chairman of the Foundation or when 2 or more committee membersexpress the intention to the Chairman of the Foundation.

- Amendments to the Articles of Association of the Foundation, it specifies that there must be at least three-fourths of the total number of committee members attending the meeting, and the approval to amend or add the articles of association must consist of votes of no less than two-thirds of the number of the committee members attending the meeting.
- and others as required by the Civil and Commercial Code.

In this regard, within the authority under the Articles of Association of the Foundation, the Committee shall establish the rules related to the consideration of damages caused by the affected persons, and the rules concerning compensation for damages to the affected persons in order to provide compensation for immediate damages (Rapid Response Fund), and the rules regarding compensation or community development for the improvement of the quality of life of the people, fund disbursement regulations, and other regulations to operate appropriate remedy for the affected persons.

After the establishment and operation of the Foundation for 1 year, the Foundation Committee shall review and revise the management structure, benefit area allocations, and fund budget allocations, etc. as specified in the Articles of Association and the regulations of the Foundation to cover the impacts of the project in order to have complete operations as specified in the EHIA report.

2) Operations of the Foundation

The Foundation will operate under the main objectives of: to manage the fund for emergency damages security and to manage the fund for people's life quality improvement . The issues of impact management include:

1. Community, residents, community property and private property of the people.
2. Quality of life for people in the community.
3. Community and public economies
4. The community environment includes noise, soil conditions, air conditions, water consumption.
5. Historical environment
6. Conditions for land use

The Foundation Committee shall clearly and transparently specify criteria for reducing the impacts, expenses rules, and promotional measures arising from the aforementioned factors, as well as the monitoring measures that arise from the management of the measures.

3) Assets acquisition ofthe Foundation for us operations

The project proposed the drafting of the possibility of acquiring assets of the foundation, which is funds. And spending money from both funds: Emergency Damage Security

Fund and Public Life Quality Improvement Fund during the construction phase and the operation phase. The sources of income of the Foundation are as follows:

1. Money received from contractors, airport operators
2. Donations
3. Government contributions
4. Others obtained without commercial or business use

4) Drafting rules on acquiring and using money from fund for emergency damage security and fund for public life quality improvement of U-Tapao International Airport

The Foundation Committee shall establish rules on acquiring and using money from fund for emergency damage security and fund for public life quality improvement of U-Tapao International Airport. In this regard, the project has proposed to draft the rules on acquiring and using money from fund for emergency damage security and fund for public life quality improvement of U-Tapao International Airport as follows:

Table 5.5 - 4 Details of the draft of emergency damage security fund and the public life quality improvement fund

(Draft) Emergency Damage Security Fund	
Fund Name	Emergency Damage Security Fund
Objectives	In order to provide the compensation for urgent damages relief, in the event of an emergency, the affected person shall submit the issue to the Foundation Committee and the Foundation Committee shall hold a extraordinary general meeting prior to the normal period in order to quickly consider the remedies for damages according to the rules, conditions, and methods prescribed by the Fund Committee.
Fund acquisition	1) Construction phase: Construction contractor or operator is a contributor to the fund according to the conditions and criteria as determined by the Foundation Committee, with a contribution rangeof 0.2 percet of the project value. 2) Operation phase : When airport operations are opened, airport administrators are the leader of the annual fund contributions of 5 million Baht/year. The airport administrators may allocate money from income from the airport use of passesgers and the use of the area for which the airport administrators are using, according to the conditions and criteria prescribed by the Foundation Committee.
Fund expenditure	**1) In the event of damage during the construction** phase, the Foundation Committee shall pay the fund reserves during the construction phase to remedy the incident or affected persons first. After that, it shall take legal action to find the responsible person to reimburse the fund for the fund already paid. **2) In the event of damage after the construction is complete**, the Foundation Committee shall pay the fund reserves during the operation phase to remedy the incident or affected persons first. After that, it will take legal action to find the responsible person to reimburse the fund that has already been paid. Inthis regard, the use of fund will be paid according to the regulations on asset spending of the Foundation. In this regard, the use of fund shall be in accordance with the regulations on asset spending of the Foundation.

Table 5.5 – 4 Details of the draft of emergency damage security fund and the public life quality improvement fund

(Draft) Fund for Public Life Quality Improvement	
Fund Name	Fund for Public Life Quality Improvement
Objectives	To improve the quality of life of the communities surrounding the airport, protect nature and environment, provide initial mitigation and damage from the effects of the project, including supporting expenses or compensation for fund management operations of the Foundation Committee, and other working groups as deemed appropriate by the Foundation Committee.
Fund acquisition	1) Construction phase: Construction contractor or operator is a contributor to the fund according to the conditions and criteria prescribed by the Foundation Committee, with the contribution range of 0.45 percent of the project value. 2) Operation phase : When airport operations are opened, airport administrators are the leader of the annual fund contributions of no less than 15 million Baht/year. The airport administrators may allocate money from the income from the airport use of passengers or airlines, or the use of the area for which the airport administrators are using, according to the conditions and criteria prescribed by the Foundation Committee. In this regard, according to Air Navigation Act 1954 Section 60/37' it stated that the fee for departing passengers is to be collected for the purpose of airport safety and maintenance, procurement and improvement of airport facilities for passengers, as well as for protecting the environment and reducing pollution caused by airport use.
Fund expenditure	**Construction and operation phase** 1) 50% of the fund's contributions are allocated to the communities in the NFF >=30 area for improving the quality of life. 2) 40% of the fund contributions are allocated to the communities in the project radius of 10 kilometers that are not in the NEF >=30 area. 3) 10% of fund contributions are allocated as fund management fees and community reserves, depending on the consideration of the Foundation Committee. In this regard, the use of fund shall be in accordance with the regulations on asset spending of the Foundation.

However, the Foundation Committee may consider appointing one or two sub-committees to be responsible for and follow the rules regarding the acquisition and spending of emergency damage security fund and public life quality improvement fund of U-Tapao International Airport. The said sub-committees must be appointed to have the composition of sub-committees representing the affected people to be sub-committees in more than half of the total number of sub-committees.

5) Term of fund forimpacts from U-Tapao International Airport

throughout the operation of the commercial airport.

5.5.2 Relocation and replacement of assets

5.5.2.1 Construction phase

(1) Study Method

In the study of the impacts from the construction of the Runway and Taxiway No.2 and the components of U-Tapao International Airport on the relocation and replacement of assets. It starts considering the construction activities of the project and identify construction activities that may result in relocation,. then analyze and assess whether such activities will cause impact or not.

(2) Results of the Study

The construction of the runway and taxiway No.2of U-Tapao International Airport is a part of the development of the Eastern Aviation Promotion area, which is in the infrastructure development plan under the responsibility of the Eastern Economic Corridor Office of Thailand (EECO) In this regard, construction of projects is within the area of U-Tapao International Airport. The activities occurring during the construction phase include ground conditioning adjustment, ground reclamation and crushing for construction of runway and taxiway, and transportation of equipment and equipment used for construction. These activities are conducted within the area of U-Tapao International Airport. The project does not move buildings and structures of people living around U-Tapao International Airport. Therefore, during the construction phase, it is expected to have low impact.

5.5.2.2 Operation phase

(1) Study Method

Conduct a study on community sites and nearby areas of the project, especially sites or communities that are under the impacts caused by aircraft. Housing and residential facilities require survey and compensation for assets that may be affected by assessment using the AEDT model (Aviation Environmental Design Tool) and an aerial photography map (Scale 1 : 4,000 or higher resolution) which covers an area of approximately 471.36 square kilometres. It is measured from the boundary area of the airport, in north and south of 10 kilometers, east and west of 6 kilometres, covering the area of air travel safety, and areas that may be affected by the noise from aircraft. It is to determine by means of geo-information technology to assess the areas affected by the runways and taxiways No.1 and No.2. Then it has to survey the communities/buildings that are expected to be affected. The study process on the survey of houses, and residential buildings has the objective to know the number of houses and residential buildings around U-Tapao International Airport along the noise exposure lines when the operation of the runway and taxiway no.2 are open. It is calculated by mathematical model of the project. The survey areas are devided into 2 areas, which are: the area along the noise exposure forecast level equal to or greater than 40 (NEF ≥ 40), and the area along the noise exposure forecast level equal to 30 to 40 (NEF 30 – 40) by using the satellite photographs or aerial photographs of the present year to be the image references in such survey. The details of study process are shown as **Figure 5.5 - 2**

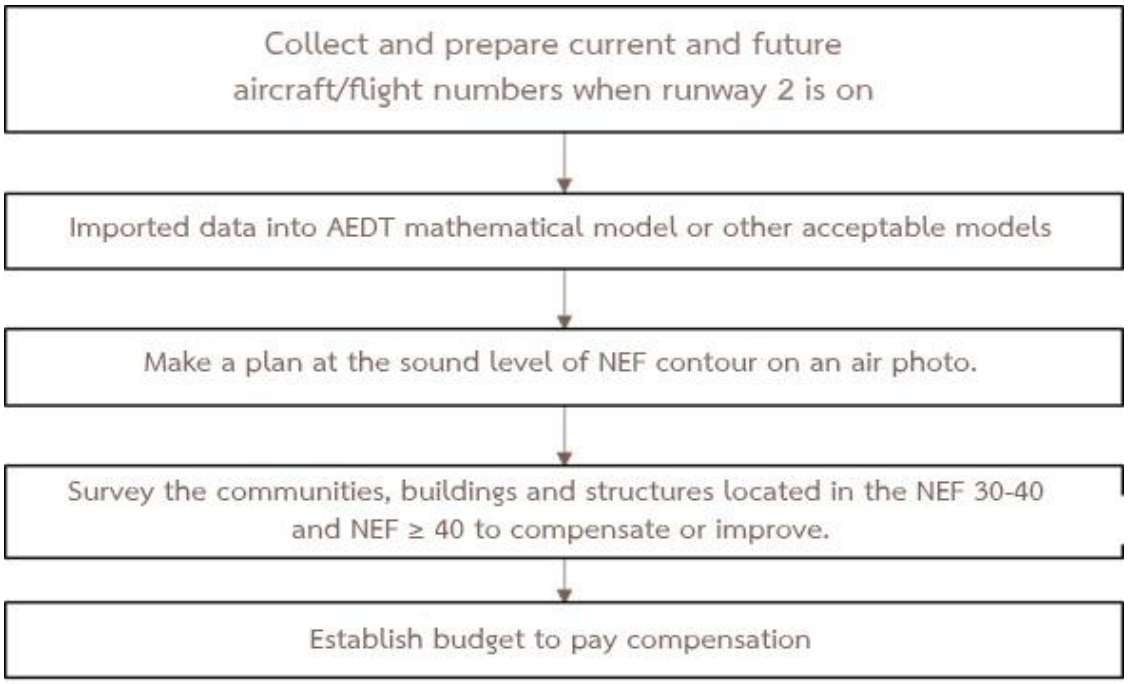


Figure 5.5 - 2 The study process of relocation and replacement of assets from the impact of aircaft noise

(2) Results of the Study

1) Noise impact

After the opening of the runway and taxiway no.2, U-Tapao International Airport , it will cause noise effects due to the increasing number of users and tourists. This increases the number of flights taking off and landing that could impact the employees and the people who live around U-Tapao International Airport. The noise caused by the aircraft may exceed the control standards as announced by the Minister published in the Thai Government Gazetteprescribing standards to control pollution from the sources.

According to the assessment of the mathematical model, and making a line equal to noise exposure level and summary of area, number of buildings . by counting from aerial photograps in 2019, it found that there were 2,559 buildings and structures affected. There were 93 buildings in line with noise exposure level of NEF ≥ 40, and there were 2,466 buidings in line with noise exposure level of NEF 30 – 40.(as**Figure 5.5-3**).

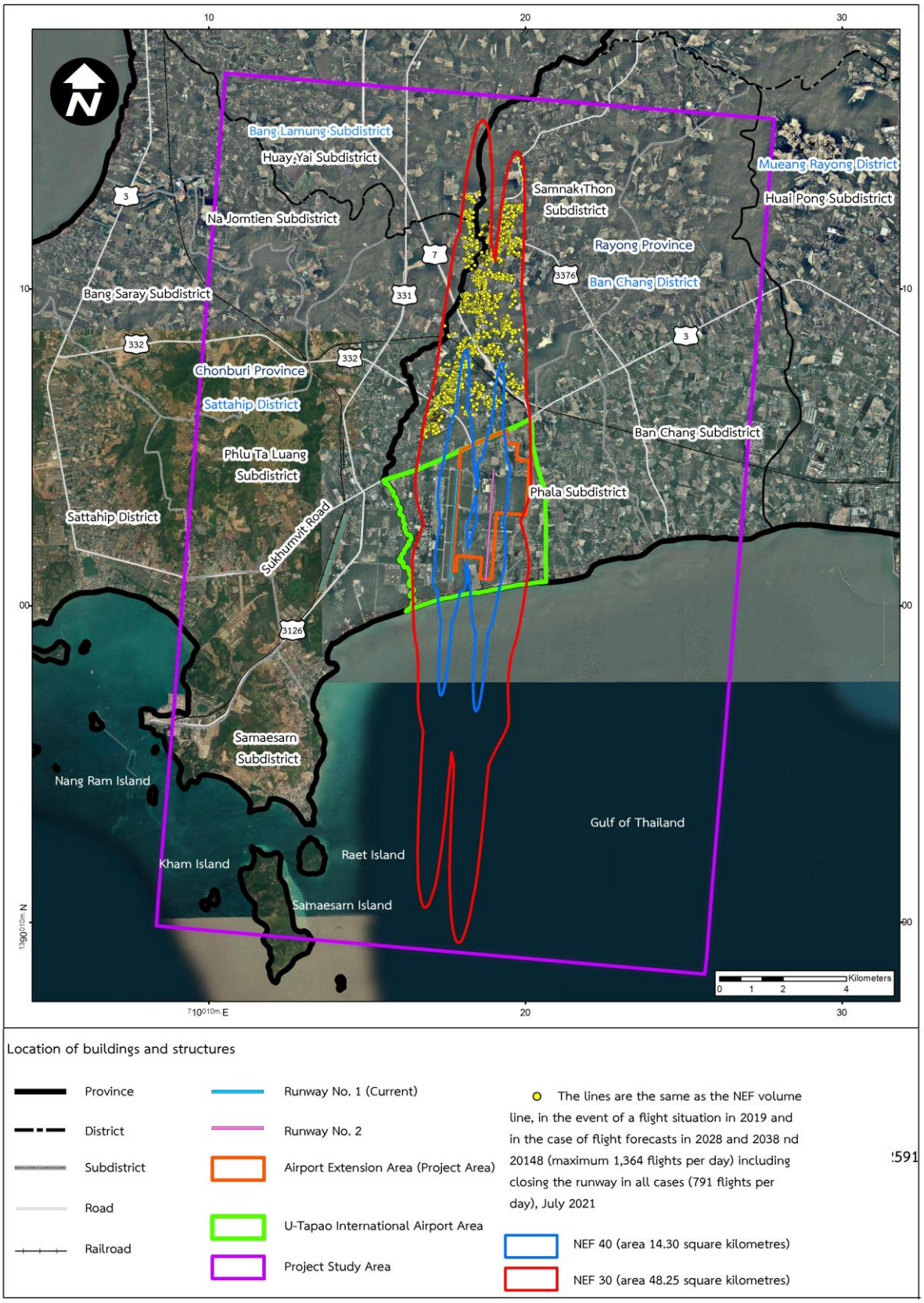


Figure 5.5 - 3 The area map forecast impacted by aircraft noise in 2048.

It is found that in Samnak Thon Subdistrict, Ban Chang District, Rayong Province there are the largest number of buildings and structures, with 2,4501 buildings (95%), followed by Pluta Luang Subdistrict, Sattahip District, Chonburi Province, with 68 buildings (3%) and Huai Yai Subdistrict, Bang Lamung District, Chonburi Province, with the least number of buildings as 40 buildings (2%) as shown in**Table 5.5 - 5**

Table 5.5 - 5 Number of buildings and structures separated by the administrative scope

Province	District	Subdistrict	Number of buildings and structuresin line with noise exposure level (buildings)		
			NEF ≥ 40	NEF 30 - 40	Total
Rayong	Ban Chang	Samnak Thon	93	2,358	2,451
Chonburi	Sattahip	Pluta Luang	-	68	68
	Bang Lamung	Huai Yai	-	40	40
Total			**93**	**2,466**	**2,559**

As a result of the impact of the noise caused by the aircraft in the operations of U-Tapao International Airport, the noise causes impact on the people living in the line of noise exposure. The project must compensate to those affected for noise impact to show the social responsibility and help and alleviate public trouble in the areas affected by noise in humanitarian way. The compensation is divided into 2 characteristics of the areas, as follows:

1.1) Severely affected area (NEF ≥ 40)

The main affected area is the area affected by the severe aircraft noise. It is not suitable for living and should not have activities that are sensitive to noise impacts. This may cause long-term public health effects. In this study, this is called an NEF ≥ 40 area. The project must negotiate to buy land and buildings or support the building improvement budget in order to reduce the impact of noise to those in the said area.

1.2) Moderately affected area (NEF 30 - 40)

The secondary affected area is the secondary affected from the main affected area. The study is divided into 2 groups, which are NEF 30 - 40 area., It is impacted by mild to moderate aircraft noise, and should not have activities that are sensitive to noise impacts. The project must have corrective measures to support the budget for improvement of the building in order to reduce the impact of noise for those in the said area. And the area of NEF < 30 to the area study scope, which is considered to be not impacted by the aircraft noise. However, there may be other impacts, such as traffic, social change etc.

Therefore, if the compensation will be paid to those affected by noise from the operations of the U-Tapao International Airport, the project must propose to the Cabinet for

1. Approve principle of compensation that will be paid to those affected by noise from the operations of U-Tapao International Airport.

2. Approve criteria, methods, conditions for evaluation of compensation to those affected.

3. Approve the announcement of noise line for the use of runway.

4. Approve day, month, year of the construction of the building that is entitled to receive compensation.

In this regard, once the Cabinet has passed its resolution to approve the implementation, the further guidelines of the work must be divided into 2 parts:

1. The engineer department assesses the building price.

- The detailed survey of the buildings located within the noise line will be required to be entitled for how much compensation, and what type of building is it?
- Assess the cost of compensation based on the prescribed procedures.
- Create a map showing the location of the buildings.
- Prepare a detailed assessment of compensation for each building.

2. The legal department collects land and building ownership documents such as

- Copy of house registration of the affected house
- Building construction , modification or demolition permit (if any)
- Home ID number request
- House number control account
- Change of house number permit(if any)
- Land title deeds of the affected house
- Land lease agreement (in case of land rental for building construction)
- National ID card who is entitled to receive compensation
- A Sale and purchse agreement, an agreement for a registration with the official, or A contract for sale, a contract for a registered employee, or a court order authorizing the juristic act on behalf of a minor in the event that the person entitled to compensation is a minor.
- Other documents as necessary, depending on the case.

The compensation payment must be recorded and the said record should be verified by the Office of the Attorney General for the accuracy. The compensation payment shall be paid to the owner of the building, house, and structure to improve their building, house, and structure by themselves.

2) Impact on air quality

After the openingof the runway and taxiway no.2 of U-Tapao International Airport,it may affect the lifestyles of people living around U-Tapao International Airport, caused by air emissions, dust or smell ca since the increase of daily take-off and landing of aircraft.This impacts on people living around U-Tapao International Airport exposing pollution which causes mental effects, anxious about exposure to pollution, and eventually causes health effects.

3) Impact on quality of life

After the opening of the runway and taxiway no.2, U-Tapao International Airport, it may affect the lifestyle of people living around U-Tapao International Airport since the increasing noise of daily take-off and landing of aircraft. This impacts on living and sleeping, resulting in reduced physical and mental well-being.

5.5.3 Attractions and scenery

5.5.3.1 Construction phase

(1) Study Method

1) Travel aspect

From the review of tourist attraction data in the study area according to the 4-year local development plan and the tourist attraction database system from the Department of Tourism, it was found that there are various types of tourist attractionslocated throughout the area generallyin the study area of the project. They are natural tourist attractions and man-made tourist attractions. F The major tourist attractions resources in Rayong provinces, such as Napha Thanaphirom beach, Phala beach, Phayun beach, Ban Phayun Small Boat Fishing, Nam Rin beach, Huai Mahad mountain. Also, in Chonburi province, such as Anek Kusala Sala (Viharn Sien), Nong Nooch Tropical Garden, Upside Down House, Pattaya, Buddha Image of Khao Chi Chan, Silverlake Vineyard, Ramayana Water Park, Siri Charoenwat Forest Park , Bunpachon Siam Garden, Tien Talay beach, Sea Turtle Conservation Center, Sattahip Naval Base, Nang Rong beach, Nam Sai beach, Thai Island and Sea Natural History Museum, Percula Farm, Chong Samae Sarn Village, Raet Island, Tien Talay beach, Look Lom beach, Pla Muek Island, Samae Sarn Island, and Kham Island. (Details are shown as **Chapter 3, current environment**, Title **3.8.5 Attractions and scenery**)

The assessment of the impacts on the ease of accessibility to tourist attractions. The accessibility is one of the important features of tourist attractions . If any tourist attractions are easily visited, such tourist attractions will be able to attract more tourists' attention. For the construction project of the runway and taxiway no.2 ofU-Tapao International Airport, it is expected to have an impact on the convenience of not only those tourist attractions that appear in the vicinity of the study area but also other tourist attractions in nearby provinces that need to use roads near U-Tapao International Airport to be a route through those attractions.

2) Scenery aspect

In the study of the impacts of construction on the runway and taxiway no.2 on the scenery, it first considered the construction activities of the project and identified the construction activities that may result in the change of scenery. Then, it must analyze and assess whether the activities will cause the change in scenery.

(2) Results of the Study

1) Tourism impacts

During the construction of the runway and taxiway no.2 of U-Tapao International Airport, the 1st runway and the terminal building still operates as usual.. It is expected that this will

not result in a decrease in number of users or tourists because the project is being constructed within U-Tapao International Airport. however, the users and tourists come to use the service and travelling may get convenience.. It is because that during the construction phase, there is transportation and movement of construction materials, equipment, tools, and labor from the outside area into the construction area. This causes the increase of traffic on various routes, especially highway no. 3, 331, 332 and 3126. This causes traffic congestion and slowdown, particularly during public holidays or festival holidays. This will decrease the convenience to access tourist attractions compared to the situation before the construction of this project. Therefore, the impact is low.

Currently, the Project Study Area is in the Eastern Economic Corridor (EEC). It has a transportation network development plan to support the increasing traffic volume, consisting of 1) the road transportnetwork, such as Highway No. 3126 project, the entrance to U-Tapao International Airport – Chuk Samet Pier (Plan Period: 2018 – 2020) , Highway No. 332 , Highway No. 3 Intersection (J Intersection) Highway No.3 Intersection (U-Tapao Intersection) (Plan Period : 2019 – 2021) and Bangkok-Chonburi-Pattaya-Map Ta Put Motorway (Plan Period: 2016 - 2020) , 2) Rail Transport networks, such as U-Tapao rai;way station (Plan Period: 2018-2020) and Bangkok – Rayong high speed rail project (seamless connection of 3 airports) (Plan period : 2018 – 2023). (Details as shown in **4.3 Transportation**)

2) Scenery impact

During the construction of the runway and taxiway no.2, transportation of machinery/equipment and building materials, piles of soil, piles of stones in the construction area, and the dispersion of dust, the area is affected by the construction activities, resulting in unattractive and unpleasant images. The trees and plants in the area are cut/moved out.However, it only affects the construction site and its impacts only occur during the construction phase. This may affect the feeling of the critical viewers as follows:

1. Users or passengers in the U-Tapao International Airport waiting for boarding are a large group of viewers. They can see construction activities of the runway and taxiway no.2 for a long time as they have to wait for boarding.

2. Staff include the airline staff, the staff of U-Tapao International Airport working at U-Tapao International Airport. It is a group that can see the construction activities of the runway and taxiway no.2 more closely than the others. . However, they have their duties that require more attentionSo, it leads them to not focusing much on the construction activities of the runway and taxiway no.2, or seeing them for a short period of time.

3. People living around U-Tapao International Airport, and those who drive to deliver passengers, are a large group of viewers. They can see the construction activities of the runway and taxiway no.2 from cars, motorcycles, and roads around U-Tapao International Airport.

However,, the impact will not cause danger due to the nature of the project. This is a horizontal construction without a high vertical structure. Therefore, the impact of this event is low.

Terminal 2 and concourses for boarding passengers

Airside area at runway no.1 (current)

Navy aircraft hangar, on the west side of the runway no.1

Air navigation aids at the end of the runway no.1 (36L)

Behind Terminal 2 for boarding and landing passengers.

Area on the east side of the runway no.1 for construction of the runway no.2

Figure 5.5 – 4 Current scenery of U-Tapao International Airport

5.5.3.2 Operation phase

(1) Study Method

1) Tourism aspect

From the review of the tourist attraction data in the study area according to the 4-year local development plan and the tourist attraction database system from the Department of Tourism, it was found that in Rayong and Chonburi, there are many natural and man-made tourist attractions, resulting in a large number of local and international tourists. To assess the impact, it

will assess the ease of accessibility to toursit attractions. The ease of accessibility is one the important factors of the tourism.

2) Scenery aspect

Study the project data and the current environment of the topography, land use and scenery in the study area, which resulted from the change of view and scenery, and assess the environmental impact on the scenery in order to propose preventive and corrective measures on the environmental impacts of the scenery.

(2) Results of the Study

1) Tourism impact

When the project is open for use of the runway and taxiway no.2, U-Tapao International Airport, it will not cause any problems with access to any tourist attractions in the study area and other nearby areas. As the project is an air transport service, the travel wil become more convenient. This will result in more visitors and tourists in the area. Also, in the future, the road and rail transport networks will be developed to connect to U-Tapao International Airport, which makes it convenient and quick access to the tourist attractions. . Therefore, it is expected that there will be a positive impact on tourism as a whole in the province and the region. Thus, the result of the project development is considered to be a high positive impact. (Positive effect)

2) Scenery impact

After the opening of the runway and taxiway no.2 of U-Tapao International Airport located within the area of U-Tapao International Airport. The conditions of the area are of beautiful nature.Due tothe topography, on the mountainous north side, it is a forested area. On the south side, it is the sea. On the east side, it is motorway. And on the west side, it is Khlong Bang Phai,national highway and naval base. With the structure of the runway and taxiway no.2 are on the ground level. Therefore, it will not affect the scenery to those who use the service at U-Tapao Internaional Airport, and the people living near the project area. Also, there are an improvement in landscape within and around U-Tapao International Airport. Thus, it does not cause the scenery impact.

However, the development of the project will cause changes in land use in the areas that have potential to develop for tourism and services. This may have a negative indirect impact if there is no proper supervision. For example, there might be unattractive scenery problems from buildings, billboards, waste, and wastewater, which will obstruct the beautiful scenery of natural tourist sites, etc.The overall impacts of scenery are expected to be low.

5.5.4 Archaeological and historical sources

5.5.4.1 Construction phase

(1) Study Method

Consider examining the current environment and the importance of historical and archaeological places, including local religious sites, located in the study area of the project. It is to

assess the possible environmental impacts from the construction of the runway and taxiway no.2 of U-TapaoInternational Airport to propose the preventive and corrective measures and the monitoring measures on environmental impacts of archaeological and historical sites.

(2) Results of the Study

The results of the study of historical and archaeological data. According to the study report on archaeological studies of both Thai and foreign scholars, according to the geo-informatics system database on the survey project of cultural heritage sites of Fine Arts Department, and the field survey in the study area, no archaeological sites were found except the historical and archaeological sites (monument type, museum) and religious sites in a total of 69 sites which of them is designated by Fine Arts Department as a registered archaeological site and pending-registered archaeological site. The construction activities may cause impacts on air quality, noise, and vibration to the said 69 sites of the historical and archaeological sites as well as religious sites. The construction activities include the construction of the runway no.2, parallel driveway, underpass tunnel, parking lots and pits, terminal 3, warehouse, air traffic control tower, ground transportation center, parking building, fire-fighting building, roads, office buildings/shops, aviation support area, and high-speed train station (underground). Details of such activities are shown in **chapter 2 title 2.4 Project components within the project area**

According to the assessment of the impacts of air quality, noise and vibration in the construction phase, it may cause impact on historical and archaeological sites, including religious sites around the project area, totaling 69 sites. They have a distancefrom the edge of the construction area to the boundary/fence, in the range of 40 - 13,170 meters. The following conclusions can be made:

1) Impact on air quality

The assessment of air quality from the construction activities of the 2nd runway, parallel driveway, underpass tunnel, terminal 3, air traffic control tower, roads, office buildings/shops, aviation support area, and high-speed train station (underground), it has the pollution emission sources. Pollution emission sources include open ground, and emission from engine of construction machinery and equipment. The assessment results conclude that all points are within the general atmospheric air quality standard. The impact of air pollution caused by the project's construction activitieees that may affect historical and religious sites is expe cted to be low. The details are shown in **Table 5.5-6**

Table 5.5 – 6 Results of assessment of atmospheric air quality on historical and religious sites (construction phase)

Unit: micrograms per cubic meter

Historical sites, archaeological sites, and religious sites	Distance from the project area (meters)	Results of measurement at current conditions 4/				Results of assessment from the model				Results of measurement at the current conditions combined with the assessment from the model			
		TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr	TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr	TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr
1. Wat Phala Vipassana Center	2,470	142.000	64.000	2,240.000	79.800	27.064	5.980	49.355	57.064	169.064	69.980	2,289.355	136.864
2. Phala Temple	2,510	142.000	64.000	2,240.000	79.800	29.825	6.052	32.942	38.748	171.825	70.052	2,272.942	118.548
3. Li Hu Ong Eh Shrine	840	142.000	64.000	2,240.000	79.800	38.655	9.587	28.925	33.503	180.655	73.587	2,268.925	113.303
4. Khlong Sai Temple	1,640	142.000	64.000	2,240.000	79.800	35.571	7.651	19.441	22.739	177.571	71.651	2,259.441	102.539
5. Khiri Phawanaram Temple	1,630	142.000	64.000	2,240.000	79.800	7.047	1.350	5.044	5.614	149.047	65.350	2,245.044	85.414
6. Christ Church, Ban Chang	2,200	142.000	64.000	2,240.000	79.800	6.490	1.250	5.883	6.682	148.490	65.250	2,245.883	86.482
7. Ban Chang Church	2,540	142.000	64.000	2,240.000	79.800	8.163	1.573	7.654	8.805	150.163	65.573	2,247.654	88.605
8. Ban Khlong Bang Phai Temple	1,460	142.000	64.000	2,240.000	79.800	61.697	12.477	38.085	43.914	203.697	76.477	2,278.085	123.714
9. The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak	1,330	142.000	64.000	2,240.000	79.800	56.245	12.870	38.404	41.454	198.245	76.870	2,278.404	121.254
10. Naval Aviation Museum, Royal Thai Naval Air Division	1,240	142.000	64.000	2,240.000	79.800	59.111	11.664	41.855	46.164	201.111	75.664	2,281.855	125.964
11. The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	1,010	142.000	64.000	2,240.000	79.800	93.802	20.742	46.426	52.579	235.802	84.742	2,286.426	132.379
12. Somdej Phra Pathom (Air Defense Regiment 1)	660	142.000	64.000	2,240.000	79.800	86.972	19.886	52.168	58.524	228.972	83.886	2,292.168	138.324
13. The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	550	142.000	64.000	2,240.000	79.800	92.894	21.377	56.861	64.338	234.894	85.377	2,296.861	144.138
14. The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	90	142.000	64.000	2,240.000	79.800	60.792	16.295	37.925	42.925	202.792	80.295	2,277.925	122.725
15. The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	40	142.000	64.000	2,240.000	79.800	58.308	14.374	34.165	38.592	200.308	78.374	2,274.165	118.392
16. The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	180	142.000	64.000	2,240.000	79.800	50.975	12.450	28.980	32.752	192.975	76.450	2,268.980	112.552
17. Sa Kaeo Temple	1,720	142.000	64.000	2,240.000	79.800	79.164	18.858	125.685	146.193	221.164	82.858	2,365.685	225.993
18. Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	1,200	142.000	64.000	2,240.000	79.800	6.723	1.453	4.828	5.448	148.723	65.453	2,244.828	85.248
19. Somburanaram Temple	5,070	142.000	64.000	2,240.000	79.800	27.755	6.481	21.743	24.741	169.755	70.481	2,261.743	104.541
20. Abundant Grace Church, Ban Chang	6,380	142.000	64.000	2,240.000	79.800	21.206	5.029	15.727	17.743	163.206	69.029	2,255.727	97.543
21. Samnak Kathon Temple	7,140	142.000	64.000	2,240.000	79.800	13.106	3.026	11.608	14.015	155.106	67.026	2,251.608	93.815
22. Suwan Rangsan Temple	5,560	142.000	64.000	2,240.000	79.800	11.750	2.541	10.215	11.659	153.750	66.541	2,250.215	91.459
23. Nong Bot Temple	7,810	142.000	64.000	2,240.000	79.800	9.726	2.243	7.111	8.285	151.726	66.243	2,247.111	88.085
24. Luang Tia Chak Mak Shrine	9,630	142.000	64.000	2,240.000	79.800	10.069	2.240	8.502	10.470	152.069	66.240	2,248.502	90.270
25. Chak Mak Temple	9,700	142.000	64.000	2,240.000	79.800	10.232	2.282	8.375	10.325	152.232	66.282	2,248.375	90.125
26. Luang Tia Ban Phayun Shrine	4,870	142.000	64.000	2,240.000	79.800	17.847	3.640	11.393	13.554	159.847	67.640	2,251.393	93.354
27. Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	4,790	142.000	64.000	2,240.000	79.800	17.077	3.521	12.220	14.189	159.077	67.521	2,252.220	93.989
28. Chonthara Ram Temple (Phayun)	4,280	142.000	64.000	2,240.000	79.800	23.444	4.719	13.094	15.612	165.444	68.719	2,253.094	95.412
29. Mosque Dawah Tul Islam	3,450	142.000	64.000	2,240.000	79.800	13.824	2.669	14.586	16.015	155.824	66.669	2,254.586	95.815

Table 5.5 ‑ 6 Results of assessment of atmospheric air quality on historical and religious sites (construction phase)

Unit: micrograms per cubic meter

Historical sites, archaeological sites, and religious sites	Distance from the project area (meters)	Results of measurement at current conditions 4/				Results of assessment from the model				Results of measurement at the current conditions combined with the assessment from the model			
		TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr	TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr	TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr
30. Chinese shrine in the Buddhathammasongkroh Foundation	4,340	142.000	64.000	2,240.000	79.800	16.150	3.446	27.135	30.575	158.150	67.446	2,267.135	110.375
31. Luang Tia Shrine, Ban Chang	3,820	142.000	64.000	2,240.000	79.800	10.520	2.315	20.294	22.903	152.520	66.315	2,260.294	102.703
32. Lao Yi Guan Yu Shrine, Ban Chang	3,920	142.000	64.000	2,240.000	79.800	12.832	3.017	24.122	27.193	154.832	67.017	2,264.122	106.993
33. Ban Chang Temple	3,900	142.000	64.000	2,240.000	79.800	16.144	3.892	28.160	30.831	158.144	67.892	2,268.160	110.631
34. Prachummit Bamrung Temple	6,710	142.000	64.000	2,240.000	79.800	7.586	1.506	9.016	10.388	149.586	65.506	2,249.016	90.188
35. Shrine of Luang Tia, Noen Kraprok, No. 1	7,340	142.000	64.000	2,240.000	79.800	6.771	1.379	10.054	11.906	148.771	65.379	2,250.054	91.706
36. Shrine of Luang Tia, Noen Kraprok, No.2	7,540	142.000	64.000	2,240.000	79.800	5.033	1.048	7.842	9.018	147.033	65.048	2,247.842	88.818
37. Noen Kraprok Temple	7,630	142.000	64.000	2,240.000	79.800	4.038	0.867	6.270	7.168	146.038	64.867	2,246.270	86.968
38. Phudon Nim Sano Temple	8,670	142.000	64.000	2,240.000	79.800	2.195	0.431	2.429	2.779	144.195	64.431	2,242.429	82.579
39. The Christ Church Ban Chang	8,560	142.000	64.000	2,240.000	79.800	2.621	0.515	2.341	2.668	144.621	64.515	2,242.341	82.468
40. Anek Kuson Sala (Viharn Sien)	11,040	142.000	64.000	2,240.000	79.800	11.081	2.467	11.311	12.978	153.081	66.467	2,251.311	92.778
41. Yannasangwararam Temple	11,080	142.000	64.000	2,240.000	79.800	10.471	2.396	10.812	12.443	152.471	66.396	2,250.812	92.243
42. Sirisirirak House of Priest	11,440	142.000	64.000	2,240.000	79.800	6.512	1.548	9.034	10.564	148.512	65.548	2,249.034	90.364
43. Anan Buraparam Meditation Center	11,950	142.000	64.000	2,240.000	79.800	7.164	1.640	12.022	13.796	149.164	65.640	2,252.022	93.596
44. Map Fakthong Temple	13,170	142.000	64.000	2,240.000	79.800	9.743	2.180	9.096	10.465	151.743	66.180	2,249.096	90.265
45. Khao Chi Chan Buddha Mountain	9,080	142.000	64.000	2,240.000	79.800	3.582	0.800	5.985	6.930	145.582	64.800	2,245.985	86.730
46. Khao Chi Chan Temple	7,420	142.000	64.000	2,240.000	79.800	3.026	0.683	7.202	8.379	145.026	64.683	2,247.202	88.179
47. Rat Samakkhi Temple	2,990	142.000	64.000	2,240.000	79.800	31.965	7.226	21.033	24.188	173.965	71.226	2,261.033	103.988
48. Kuan Im Shrine	3,220	142.000	64.000	2,240.000	79.800	27.379	6.428	21.903	25.407	169.379	70.428	2,261.903	105.207
49. The Royal Monument of His Royal Highness Prince Mahitala Dhibesra Adulyadej Vikrom, the Prince Father and Her Royal Highness Princess Srinagarindra, the Princess Mother	2,690	142.000	64.000	2,240.000	79.800	33.891	7.924	23.695	27.417	175.891	71.924	2,263.695	107.217
50. Judprakai Thamma Mediation Center	5,810	142.000	64.000	2,240.000	79.800	18.568	3.836	12.748	14.804	160.568	67.836	2,252.748	94.604
51. Mediation Practice Center, Kor Mor.8	4,650	142.000	64.000	2,240.000	79.800	21.189	4.773	15.150	17.742	163.189	68.773	2,255.150	97.542
52. Rang Si Sunthon Temple (Kor Mor. 5)	6,670	142.000	64.000	2,240.000	79.800	17.400	3.645	11.379	13.157	159.400	67.645	2,251.379	92.957
53. Bodhipiya House of Priest (Dhammayut), Phothi Samphan Branch	7,340	142.000	64.000	2,240.000	79.800	2.850	0.648	3.990	4.739	144.850	64.648	2,243.990	84.539
54. Sattahip Meditation Center (Khao Bandai Kaeo)	7,400	142.000	64.000	2,240.000	79.800	3.654	0.860	5.459	6.389	145.654	64.860	2,245.459	86.189
55. Thung Prong Temple	8,200	142.000	64.000	2,240.000	79.800	2.848	0.605	4.808	5.752	144.848	64.605	2,244.808	85.552
56. Khao Phlu Ta Luang Meditation Center	4,220	142.000	64.000	2,240.000	79.800	1.627	0.350	2.634	3.149	143.627	64.350	2,242.634	82.949
57. The Shrine of Sadet Tia Krom Luang Chumphon Khet Udomsak	4,030	142.000	64.000	2,240.000	79.800	25.663	5.980	18.558	21.716	167.663	69.980	2,258.558	101.516
58. Khao Bai Sri Temple, Santitham	4,690	142.000	64.000	2,240.000	79.800	20.663	4.789	18.935	21.647	162.663	68.789	2,258.935	101.447
59. Welu Amphawan Vipassana Center	4,960	142.000	64.000	2,240.000	79.800	18.103	4.219	17.364	19.840	160.103	68.219	2,257.364	99.640
60. The Royal Monument of His Majesty King Rama III	5,590	142.000	64.000	2,240.000	79.800	12.039	2.349	10.897	12.584	154.039	66.349	2,250.897	92.384
61. The Royal Monument of His Majesty King Rama VI	5,680	142.000	64.000	2,240.000	79.800	16.066	3.361	11.916	13.783	158.066	67.361	2,251.916	93.583
62. Phatthanakan Samaesarn Church	6,340	142.000	64.000	2,240.000	79.800	15.163	3.373	11.404	13.060	157.163	67.373	2,251.404	92.860

Table 5.5 – 6 Results of assessment of atmospheric air quality on historical and religious sites (construction phase)

Unit: micrograms per cubic meter

Historical sites, archaeological sites, and religious sites	Distance from the project area (meters)	Results of measurement at current conditions [4/]				Results of assessment from the model				Results of measurement at the current conditions combined with the assessment from the model			
		TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr	TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr	TSP 24 hours	PM_{10} 24 hours	CO 1 hr	NO_2 1 hr
63. The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	7,130	142.000	64.000	2,240.000	79.800	10.668	2.089	12.502	14.324	152.668	66.089	2,252.502	94.124
64. Chong Samaesarn Temple	8,660	142.000	64.000	2,240.000	79.800	9.741	1.877	9.216	10.545	151.741	65.877	2,249.216	90.345
65. Viharn Luang Por Dam	8,950	142.000	64.000	2,240.000	79.800	9.376	1.916	8.313	9.475	151.376	65.916	2,248.313	89.275
66. Somdej Phrachao Taksin Maharat Shrine (Cham San)	9,230	142.000	64.000	2,240.000	79.800	11.158	2.126	7.732	8.946	153.158	66.126	2,247.732	88.746
67. Thai Island and Sea Natural History Museum	9,160	142.000	64.000	2,240.000	79.800	10.708	2.043	7.390	8.578	152.708	66.043	2,247.390	88.378
68. Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)	9,260	142.000	64.000	2,240.000	79.800	10.439	2.047	7.718	8.990	152.439	66.047	2,247.718	88.790
69. The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	9,280	142.000	64.000	2,240.000	79.800	11.142	2.118	7.732	8.968	153.142	66.118	2,247.732	88.768
Standards		**330**[1/]	**120**[1/]	**34,200**[2/]	**320**[3/]	**330**[1/]	**120**[1/]	**34,200**[2/]	**320**[3/]	**330**[1/]	**120**[1/]	**34,200**[2/]	**320**[3/]

Note : [1/] Standards as per the National Environment Board Announcement No. 24 (2004) regarding the establishment of general atmospheric air quality standards

[2/] The standard according to the National Environment Board Notification No. 10 (1995), regarding the establishment of general atmospheric air quality standards.

[3/] The standard according to the announcement of the National Environmental Committee No. 33 (2009), regarding the standard of nitrogen dioxide gas in general atmospheres.

[4/] The results of monitoring the quality of air in general atmospheres were highest between 18-24 July 2019 and 3-10 November 2019. In order to evaluate the impact of air quality for sensitive areas and communities that are not representative of atmospheric air quality measurement points in general, use the highest level of measurement results to represent the results in the current conditions.

Total particulate matter, average 24 hours, was highest at Patanawet Suksa School, measured 142 micrograms per cubic meter, Wat Khiri Phawanaram School, measured 71 micrograms per cubic meter, Wat Phla School, measured 89 micrograms per cubic meter, Ban Khlong Bang Phai School, measured 74 micrograms per cubic meter, and Wat Sakaeo School, measured 89 micrograms per cubic meter.

Dusts of up to 10 micron, average 24 hours, was highest at Phatthanavej Suksa School, measured 64 micrograms per cubic meter, Wat Khiri Phawanaram School, measured 42 micrograms per cubic meter, Wat Phla School, measured 53 micrograms per cubic meter, Ban Khlong Bang Phai School 53 micrograms per cubic meter, and Wat Sakaeo School

53 micrograms per cubic meter.

Carbon monoxide, average 1 hour, the highest at Patanawet Suksa School area at 2,244.581 microgram per cubic meter. Wat Khiri Phawanaram School, measured 1,740.695 micrograms per cubic meter. Wat Phla School, measured 1,763.599 micrograms per cubic meter. Ban Khlong Bang Phai School, measured 1,465.849 micrograms per cubic meter

Wat Sakaeo School, measured 1,465.849 micrograms per cubic meter.

Nitrogen dioxide gas, average 1 hour, the highest in the area of Pattanawet Suksa School, measured 24.270 micrograms per cubic meter. Wat Khiri Phawanaram School, measured 25.022 micrograms per cubic meter. Wat Phla School, measured 17.685 micrograms per cubic meter. Ban Khlong Bang Phai School, measured 79.71 micrograms per cubic meter. Wat Sakaeo School measured 18.061 micrograms per cubic meter.

[5/] Representative of sensitive areas to measure air quality in general

2) Noise impact

The results of noise assessment from construction activities, area improvement / soil quality improvement / soil filling work, embankment filling and safety areas around taxiways / pavement structure construction, road layer structure / pavement work, excavation work Supporting/extracting pile heads, and roof tunnels under runways, foundation work, structural work, architectural work, and surrounding systems and construction work within stations/systems and architectural work inside the train stations that could affect historical and ancient landmarks, including 69 places of worship located around the project area. It was found that the 24-hour average noise level was in the range of 65.0 - 85.6 decibels, most of which were within the general sound level standards according to the National Environment Board Notification No. 15 (1997) which sets the average 24-hour noise level not exceeding 70 decibela, except for 3 monuments and places of worship , which are located in the range of 40, 90 and 180 meters from the project area. The value exceeds the standard shown in **Table 5.5 - 7 Predict**including:

1) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion) Fighting Aircraft

2) The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)

3) The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)

However, these three landmarks are places for religious purposes during various occasions of military officials and no one else lives regularly. Therefore, the potential impact will be short-term impact on the people who came to worship. It is only an impact during the construction period. It is estimated that the impact on noise is low.

For the assessment of the noise level from the construction materials transport of the project to the historical site and 26 religious places located along the 500-meter transportation route, shown in**Table 5.5 - 8**. It was found that the average 24-hour noise level at the location of the recipient in the transportation route (Highway No. TorLor. 3 TorLor.332 TorLor. 3126 and TorLor. 3376) at a distance of 32 - 411 meters, with a value in the range of 37.3 - 53.9 dBA having a baseline sound level (the current level of volume) in the range of 65.0 decibela. When assessing the volume from transportation of construction materials, it is in the range of 65.0 - 65.3 decibela, with a value in the general standard at the volume level according to the announcement of the National Environment Board, No. 15 (1997), with a 24 hour average sound level of the project not exceeding 70 decibels. It is expected that the noise impact from the construction material transportation of the project is low.

3) The effect of vibration

From the assessment of the impacts of vibration, it was found that the historical and archaeological landmarks and archeology as well as religious places surrounding the project area totaling 69 sites at distances of 40 - 13,170 meters, the maximum particulate speed caused by the use of a Bore Piling Machine device, is in the range of 0.0000 - 0.0610 inches per second (0.0003-1.5501 millimeters/second) and the level of impact on the people in the area is incapable

of feeling. When considering the impact on the building structure, it was found that there was no impact/damage on all types of structures. Therefore, the impact is low. Details are shown in**Table 5.5 - 9Level**

Fromthe assessment of impacts on air, noise, and vibration in construction phase, which is expected to impact historical and archaeological sites, including surrounding sites, project areas, and located along the transportation route of construction materials, it was found that the impacts of the construction material are low. The project has specified preventive measures to implement and solve the impacts on the environment, air quality, noise and vibration. It requires that measures be taken to prevent and correct the impacts of air quality, noise, vibration in the construction phase of the project strictly.

4) Destruction of archaeological places

Surveys on environmental impact to historical and archaeological places, including local religious sites of this project, must be aware that this is only ground level study, but there are soil adjustment, excavation, digging, and digging for the foundation of the buildings,which may cause damage to archaeological evidence that may exist underground in the construction area. Therefore, the project has put measures and implemented those impacts in the construction area. If there is any archaeological evidence, while digging, the archaeological excavations should bestopped in the area and save the image as evidence and coordinate with the Fine Arts Office No. 5, Prachinburi, which is responsible for maintaining ancient sites and archeological sites in Rayong province, to consider inspecting the area for study and retrieving important evidence (if any) before further construction

Table 5.5 – 7 Predicta 24-hour average noise level in the historical and archaeological sites, as well as on campuses in the study area, from construction activities (construction phase).

Sequence	Historic landmarks and archaeology and places of worship	Distance from edge of construction area (meters) scope/fence	24 hours noise level from construction activities (decibela)								Noise level in current condition[1/]	Total sound level (including sound in current state) (decibel A)							
			Land adjustment /improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/ Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations		Land adjustment/improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations
1.	Wat Phla Vipassana Center	2,470	47.7	40.7	46.8	49.8	43.1	46.9	38.7	43.5	65.0	65.1	65.0	65.1	65.1	65.0	65.1	65.0	65.0
2.	Phala Temple	2,510	47.5	40.5	46.6	49.6	42.9	46.7	38.5	43.3	65.0	65.1	65.0	65.1	65.1	65.0	65.1	65.0	65.0
3.	Li Hu Ong Eh Shrine	840	57.0	50.0	56.1	59.1	52.4	56.2	48.0	52.8	65.0	65.6	65.1	65.5	66.0	65.2	65.5	65.1	65.3
4.	Khlong Sai Temple	1,640	51.2	44.2	50.3	53.3	46.6	50.4	42.2	47.0	65.0	65.2	65.0	65.1	65.3	65.1	65.1	65.0	65.1
5.	Khiri Phawanaram Temple	1,630	51.3	44.3	50.4	53.4	46.7	50.5	42.3	47.1	65.0	65.2	65.0	65.1	65.3	65.1	65.2	65.0	65.1
6.	Christ Church, Ban Chang	2,200	48.7	41.7	47.8	50.8	44.1	47.9	39.7	44.5	65.0	65.1	65.0	65.1	65.2	65.0	65.1	65.0	65.0
7.	Ban Chang Church	2,540	47.4	40.4	46.5	49.5	42.8	46.6	38.4	43.2	65.0	65.1	65.0	65.1	65.1	65.0	65.1	65.0	65.0
8.	Ban Khlong Bang Phai Temple	1,460	52.2	45.2	51.3	54.3	47.6	51.4	43.2	48.0	65.0	65.2	65.0	65.2	65.4	65.1	65.2	65.0	65.1
9.	The Monument of Phra Chao Boromwongthee Krom Luang Chumphon Khet Udomsak	1,330	53.0	46.0	52.1	55.1	48.4	52.2	44.0	48.8	65.0	65.3	65.1	65.2	65.4	65.1	65.2	65.0	65.1
10.	Naval Aviation Museum, Royal Thai Naval Air Division	1,240	53.7	46.7	52.8	55.8	49.1	52.9	44.7	49.5	65.0	65.3	65.1	65.3	65.5	65.1	65.3	65.0	65.1
11.	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	1,010	55.4	48.4	54.5	57.5	50.8	54.6	46.4	51.2	65.0	65.5	65.1	65.4	65.7	65.2	65.4	65.1	65.2
12.	Somdej Phra Pathom (Air Defense Regiment 1)	660	59.1	52.1	58.2	61.2	54.5	58.3	50.1	54.9	65.0	66.0	65.2	65.8	66.5	65.4	65.8	65.1	65.4
13.	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	550	60.7	53.7	59.8	62.8	56.1	59.9	51.7	56.5	65.0	66.4	65.3	66.1	67.1	65.5	66.2	65.2	65.6
14.	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	90	76.4	69.4	75.5	78.5	71.8	75.6	67.4	72.2	65.0	76.7	70.8	75.9	78.7	72.7	76.0	69.4	73.0
15.	The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	40	83.5	76.5	82.6	85.6	78.9	82.7	74.5	79.3	65.0	83.5	76.8	82.7	85.6	79.1	82.8	74.9	79.4
16.	The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	180	70.4	63.4	69.5	72.5	65.8	69.6	61.4	66.2	65.0	71.5	67.3	70.8	73.2	68.4	70.9	66.6	68.7
17.	Sa Kaeo Temple	1,720	50.8	43.8	49.9	52.9	46.2	50.0	41.8	46.6	65.0	65.2	65.0	65.1	65.3	65.1	65.1	65.0	65.1

Table 5.5 – 7 Predicta 24-hour average noise level in the historical and archaeological sites, as well as on campuses in the study area, from construction activities (construction phase).

Sequence	Historic landmarks and archaeology and places of worship	Distance from edge of construction area (meters) scope/fence	24 hours noise level from construction activities (decibela)								Noise level in current condition[1/]	Total sound level (including sound in current state) (decibel A)							
			Land adjustment /improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/ Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations		Land adjustment/improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations
18.	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	1,200	53.9	46.9	53.0	56.0	49.3	53.1	44.9	49.7	65.0	65.3	65.1	65.3	65.5	65.1	65.3	65.0	65.1
19.	Somboonaram Temple	5,070	41.4	34.4	40.5	43.5	36.8	40.6	32.4	37.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
20.	Abundant Grace Church, Ban Chang	6,380	39.4	32.4	38.5	41.5	34.8	38.6	30.4	35.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
21.	Samnak Kathon Temple	7,140	38.4	31.4	37.5	40.5	33.8	37.6	29.4	34.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
22.	Suwan Rangsan Temple	5,560	40.6	33.6	39.7	42.7	36.0	39.8	31.6	36.4	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
23.	Nong Bot Temple	7,810	37.7	30.7	36.8	39.8	33.1	36.9	28.7	33.5	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
24.	Luang Tia Chak Mak Shrine	9,630	35.8	28.8	34.9	37.9	31.2	35.0	26.8	31.6	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
25.	Chak Mak Temple	9,700	35.8	28.8	34.9	37.9	31.2	35.0	26.8	31.6	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
26.	Luang Tia Ban Phayun Shrine	4,870	41.8	34.8	40.9	43.9	37.2	41.0	32.8	37.6	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
27.	Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	4,790	41.9	34.9	41.0	44.0	37.3	41.1	32.9	37.7	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
28.	Chonlatharam Temple (Phayun)	4,280	42.9	35.9	42.0	45.0	38.3	42.1	33.9	38.7	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
29.	Dahwatl islam mosque	3,450	44.8	37.8	43.9	46.9	40.2	44.0	35.8	40.6	65.0	65.0	65.0	65.0	65.1	65.0	65.0	65.0	65.0
30.	Chinese shrine in the Buddhathammasongkroh Foundation	4,340	42.8	35.8	41.9	44.9	38.2	42.0	33.8	38.6	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
31.	Luang Tia Shrine, Ban Chang	3,820	43.9	36.9	43.0	46.0	39.3	43.1	34.9	39.7	65.0	65.0	65.0	65.0	65.1	65.0	65.0	65.0	65.0
32.	Lao Yi Guan Yu Shrine, Ban Chang	3,920	43.7	36.7	42.8	45.8	39.1	42.9	34.7	39.5	65.0	65.0	65.0	65.0	65.1	65.0	65.0	65.0	65.0
33.	Ban Chang Temple	3,900	43.7	36.7	42.8	45.8	39.1	42.9	34.7	39.5	65.0	65.0	65.0	65.0	65.1	65.0	65.0	65.0	65.0
34.	Prachum Mitbamrung Temple	6,710	39.0	32.0	38.1	41.1	34.4	38.2	30.0	34.8	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
35.	Luang Tia Shrine Noen Kraprok, No. 1	7,340	38.2	31.2	37.3	40.3	33.6	37.4	29.2	34.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
36.	Luang Tia Shrine Noen Kraprok No. 2	7,540	38.0	31.0	37.1	40.1	33.4	37.2	29.0	33.8	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
37.	Noen Kraprok Temple	7,630	37.9	30.9	37.0	40.0	33.3	37.1	28.9	33.7	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
38.	Phudon Nim Sano Temple	8,670	36.8	29.8	35.9	38.9	32.2	36.0	27.8	32.6	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
39.	The Christ Church Ban Chang	8,560	36.9	29.9	36.0	39.0	32.3	36.1	27.9	32.7	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
40.	Anek Kuson Sala (Viharn Sien)	11,040	34.7	27.7	33.8	36.8	30.1	33.9	25.7	30.5	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0

Table 5.5 – 7 Predicta 24-hour average noise level in the historical and archaeological sites, as well as on campuses in the study area, from construction activities (construction phase).

Sequence	Historic landmarks and archaeology and places of worship	Distance from edge of construction area (meters) scope/fence	24 hours noise level from construction activities (decibela)								Noise level in current condition[1/]	Total sound level (including sound in current state) (decibel A)							
			Land adjustment /improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/ Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations		Land adjustment/improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations
41.	Yannasangwararam Temple	11,080	34.6	27.6	33.7	36.7	30.0	33.8	25.6	30.4	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
42.	Sirisirirak House of Priest	11,440	34.4	27.4	33.5	36.5	29.8	33.6	25.4	30.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
43.	Anan Buraparam Meditation Center	11,950	34.0	27.0	33.1	36.1	29.4	33.2	25.0	29.8	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
44.	Map Fakthong Temple	13,170	33.1	26.1	32.2	35.2	28.5	32.3	24.1	28.9	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
45.	Khao Chi Chan Buddha Mountain	9,080	36.4	29.4	35.5	38.5	31.8	35.6	27.4	32.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
46.	Khao Chi Chan Temple	7,420	38.1	31.1	37.2	40.2	33.5	37.3	29.1	33.9	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
47.	Rat Samakkhi Temple	2,990	46.0	39.0	45.1	48.1	41.4	45.2	37.0	41.8	65.0	65.1	65.0	65.0	65.1	65.0	65.0	65.0	65.0
48.	Kuan Im Shrine	3,220	45.4	38.4	44.5	47.5	40.8	44.6	36.4	41.2	65.0	65.0	65.0	65.0	65.1	65.0	65.0	65.0	65.0
49.	The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Phra Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	2,690	46.9	39.9	46.0	49.0	42.3	46.1	37.9	42.7	65.0	65.1	65.0	65.1	65.1	65.0	65.1	65.0	65.0
50.	Judprakai Thamma Mediation Center	5,810	40.2	33.2	39.3	42.3	35.6	39.4	31.2	36.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
51.	Mediation Practice Center, Kor Mor.8	4,650	42.2	35.2	41.3	44.3	37.6	41.4	33.2	38.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
52.	Rang Si Sunthon Temple (Kor Mor. 5)	6,670	39.0	32.0	38.1	41.1	34.4	38.2	30.0	34.8	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
53.	Bodhipiya House of Priest (Dhammayut) Phothi Samphan Branch	7,340	38.2	31.2	37.3	40.3	33.6	37.4	29.2	34.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
54.	Sattahip Meditation Center (Khao Bandai Kaeo)	7,400	38.1	31.1	37.2	40.2	33.5	37.3	29.1	33.9	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
55.	Thung Prong Temple	8,200	37.2	30.2	36.3	39.3	32.6	36.4	28.2	33.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
56.	Khao Phlu Ta Luang Meditation Center	4,220	43.0	36.0	42.1	45.1	38.4	42.2	34.0	38.8	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
57.	Krom Luang Chumphon Shrine Khet Udomsak	4,030	43.4	36.4	42.5	45.5	38.8	42.6	34.4	39.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
58.	Khao Bai Sri Temple, Santitham	4,690	42.1	35.1	41.2	44.2	37.5	41.3	33.1	37.9	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
59.	Welu Amphawan Vipassana Center	4,960	41.6	34.6	40.7	43.7	37.0	40.8	32.6	37.4	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0

Table 5.5 – 7 Predicta 24-hour average noise level in the historical and archaeological sites, as well as on campuses in the study area, from construction activities (construction phase).

Sequence	Historic landmarks and archaeology and places of worship	Distance from edge of construction area (meters) scope/fence	24 hours noise level from construction activities (decibela)								Noise level in current condition[1/]	Total sound level (including sound in current state) (decibel A)							
			Land adjustment /improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/ Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations		Land adjustment/improvement/Groundwork	Freestanding work and safety area surrounding driveway/building work of surface structure	Floor Structure/Surfing	Excavation work, installation of propulsion/pression of needle column heads and tunnel roof under the runway	Work, foundation	Structure work	Architecture and system work	Construction work inside stations/systems and architectural works inside stations
60.	The Royal Monument of His Majesty King Rama III	5,590	40.6	33.6	39.7	42.7	36.0	39.8	31.6	36.4	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
61.	The Royal Monument of His Majesty King Rama VI	5,680	40.4	33.4	39.5	42.5	35.8	39.6	31.4	36.2	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
62.	Phatthanakan Samaesarn Church	6,340	39.5	32.5	38.6	41.6	34.9	38.7	30.5	35.3	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
63.	The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	7,130	38.5	31.5	37.6	40.6	33.9	37.7	29.5	34.3	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
64.	Chong Samaesarn Temple	8,660	36.8	29.8	35.9	38.9	32.2	36.0	27.8	32.6	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
65.	Viharn Luang Por Dam	8,950	36.5	29.5	35.6	38.6	31.9	35.7	27.5	32.3	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
66.	Somdej Phrachao Taksin Maharat Shrine (Cham San)	9,230	36.2	29.2	35.3	38.3	31.6	35.4	27.2	32.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
67.	Thai Island and Sea Natural History Museum	9,160	36.3	29.3	35.4	38.4	31.7	35.5	27.3	32.1	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
68.	Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)	9,260	36.2	29.2	35.3	38.3	31.6	35.4	27.2	32.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
69.	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	9,280	36.2	29.2	35.3	38.3	31.6	35.4	27.2	32.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0

Note : [1/] Noise level in current condition: Choose the average 24-hour volume value that has the highest value of 65 dBA. It represents the level in the current condition of sensitive areas from the sound level measurement at Wat Phla School, the 1st time, rainy season, measured on 18 - 25 July 2019 and the 2nd, dry season, measured on 3 - 10 November 2019

Table 5.5 – 8 The results of the forecasting of noise levels from transportation of construction materials around historical and archaeological sites, including places of worship within a 500-meter distance from the transportation route (construction phase)

Sequence	Historic landmarks and archaeology and places of worship	Type of sensitive area/community	Distance from the center of the transportation route to the nearby building (meters)	Noise level in current condition[2/] (Decibel A)	24 hours noise level from transportation of construction materials at the receiver location[4/] (Decibel A) on the transport route (Road No.)				The total volume from the transportation of construction materials and the original volume in the current condition[5/] (Decibel A) in the transport route (Road number)			
					TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376	TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376
5	Khiri Phawanaram Temple	Community temple	52	65.0	53.8	-	-	-	65.3	-	-	-
6	Christ Church, Ban Chang	Church	66	65.0	52.3	-	-	-	65.2	-	-	-
7	Ban Chang Church	Church	85	65.0	50.6	-	-	-	65.2	-	-	-
8	Ban Khlong Bang Phai Temple	Community temple	57	65.0	53.2	-	-	-	65.3	-	-	-
9	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak	Memorial Hall	399	65.0	40.5	-	-	-	65.0	-	-	-
10	Naval Aviation Museum, Royal Thai Naval Air Division	History Museum	194	65.0	45.2	-	-	-	65.0	-	-	-
11	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	Memorial Hall	71	65.0	51.8	-	-	-	65.2	-	-	-

Table 5.5 – 8 The results of the forecasting of noise levels from transportation of construction materials around historical and archaeological sites, including places of worship within a 500-meter distance from the transportation route (construction phase)

Sequence	Historic landmarks and archaeology and places of worship	Type of sensitive area/community	Distance from the center of the transportation route to the nearby building (meters)	Noise level in current condition[2/] (Decibel A)	24 hours noise level from transportation of construction materials at the receiver location[4/] (Decibel A) on the transport route (Road No.)				The total volume from the transportation of construction materials and the original volume in the current condition[5/] (Decibel A) in the transport route (Road number)			
					TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376	TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376
12	Somdej Phra Pathom (Air Defense Regiment 1)	Places for religious ceremonies and worshiping Buddha images	142	65.0	47.2	-	-	-	65.1	-	-	-
13	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	Memorial Hall	42	65.0	55.1	-	-	-	65.4	-	-	-
14	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	Memorial Hall	80	65.0	51.0	-	-	-	65.2	-	-	-

Table 5.5 – 8 The results of the forecasting of noise levels from transportation of construction materials around historical and archaeological sites, including places of worship within a 500-meter distance from the transportation route (construction phase)

Sequence	Historic landmarks and archaeology and places of worship	Type of sensitive area/community	Distance from the center of the transportation route to the nearby building (meters)	Noise level in current condition[2/] (Decibel A)	24 hours noise level from transportation of construction materials at the receiver location[4/] (Decibel A) on the transport route (Road No.)				The total volume from the transportation of construction materials and the original volume in the current condition[5/] (Decibel A) in the transport route (Road number)			
					TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376	TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376
15	The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	Places for religious ceremonies and worshiping Buddha images	36	65.0	56.2	-	-	-	65.5	-	-	-
16	The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	Thepharak Shrine	106	65.0	49.1	-	-	-	65.1	-	-	-
18	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	The place of worship for King Taksin the Great	351	65.0	41.3	-	-	-	65.0	-	-	-
20	Abundant Grace Church, Ban Chang	Church	114	65.0	-	-	-	48.7	-	-	-	65.1
21	Samnak Kathon Temple	Community temple	83	65.0	-	-	-	50.7	-	-	-	65.2
22	Suwan Rangsan Temple	Community temple	307	65.0	-	-	-	42.2	-	-	-	65.0

Table 5.5 – 8 The results of the forecasting of noise levels from transportation of construction materials around historical and archaeological sites, including places of worship within a 500-meter distance from the transportation route (construction phase)

Sequence	Historic landmarks and archaeology and places of worship	Type of sensitive area/community	Distance from the center of the transportation route to the nearby building (meters)	Noise level in current condition[2/] (Decibel A)	24 hours noise level from transportation of construction materials at the receiver location[4/] (Decibel A) on the transport route (Road No.)				The total volume from the transportation of construction materials and the original volume in the current condition[5/] (Decibel A) in the transport route (Road number)			
					TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376	TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376
24	Luang Tia Chak Mak Shrine	Chinese shrine	172	65.0	-	-	-	46.0	-	-	-	65.1
25	Chak Mak Temple	Community temple	263	65.0	-	-	-	43.2	-	-	-	65.0
30	Chinese shrine in the Buddhathammasongkroh Foundation	Chinese shrine	61	65.0	52.8	-	-	-	65.3	-	-	-
33	Ban Chang Temple	Community temple	411	65.0	40.3	-	-	-	65.0	-	-	-
36	Luang Tia Noen Kraprok Shrine No. 2	Chinese shrine	32	65.0	56.9	-	-	-	65.6	-	-	-
37	Noen Kraprok Temple	Community temple	92	65.0	50.1	-	-	-	65.1	-	-	-
47	Rat Samakkhi Temple	Community temple	61	65.0	-	52.8	-	-	-	65.3	-	-
48	Kuan Im Shrine	Chinese shrine	218	65.0	44.5	-	-	-	65.0	-	-	-

Table 5.5 – 8 The results of the forecasting of noise levels from transportation of construction materials around historical and archaeological sites, including places of worship within a 500-meter distance from the transportation route (construction phase)

Sequence	Historic landmarks and archaeology and places of worship	Type of sensitive area/community	Distance from the center of the transportation route to the nearby building (meters)	Noise level in current condition[2/] (Decibel A)	24 hours noise level from transportation of construction materials at the receiver location[4/] (Decibel A) on the transport route (Road No.)				The total volume from the transportation of construction materials and the original volume in the current condition[5/] (Decibel A) in the transport route (Road number)			
					TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376	TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376
49	The Monument of Somdej Phra Mahitalathibet [1]Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	The monument memorial hall	165	65.0	46.2	-	-	-	65.1	-	-	-
60	The Royal Monument of His Majesty King Rama III	The Memorial Hall of Resemblances in the Great Buddha and Researsals	102	65.0	-	49.4	-	-	-	65.1	-	-
Average 24 Hours Noise Standard[1/]				70								

Table 5.5 – 8 The results of the forecasting of noise levels from transportation of construction materials around historical and archaeological sites, including places of worship within a 500-meter distance from the transportation route (construction phase)

Sequence	Historic landmarks and archaeology and places of worship	Type of sensitive area/community	Distance from the center of the transportation route to the nearby building (meters)	Noise level in current condition[2/] (Decibel A)	24 hours noise level from transportation of construction materials at the receiver location[4/] (Decibel A) on the transport route (Road No.)				The total volume from the transportation of construction materials and the original volume in the current condition[5/] (Decibel A) in the transport route (Road number)			
					TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376	TorLor. 3	TorLor. 3126	TorLor. 332	TorLor. 3376

Note : [1/]General Noise Standards according to the National Environment Board's Notification No. 15 (2540)

[2/ Volume] data 1st time of the rainy season, measured on 18-25 July 2019 and 2nd time measured on 3-10 November 2019). An average of 24 hours is used. The highest value (65 dBA) represents the level of the sensitive area and community in the current state.

[3/] Points in which the level of the sensitive area and community are measured in the current state (same period as [2/])

[4/] Calculate the volume from various phase of construction activities using the Leq(hi) = (L0)Ei+10log10(NiD0/SiT)+10log10(D0/D)1/α - 25+ΔS equation and L_{AeqT} = Lp+ 10 log (t/T) equation.

[5/] Calculated using the total Lp equation = 10 log □ $10^{Lpi/10}$

Table 5.5 – 9Levelof vibration from construction activities, areas of historical and archaeological landmarks, as well as religious facilities in the study area

Sequence No.	Historic landmarks and archaeology, and religious places	Distance from edge of construction area (scope/fence) (meters)	Maximum particulate speed generated by the use of Pile Driver		Effects on humans[2/]	Impact on building structure[3/]
			(inches/second)[1/]	(millimeters/second)		
1	Wat Phala Vipassana Center	2,470	0.0001	0.0032	1	A.
2	Phala Temple	2,510	0.0001	0.0031	1	A.
3	Li Hu Ong Eh Shrine	840	0.0006	0.0161	1	A.
4	Khlong Sai Temple	1,640	0.0002	0.0059	1	A.
5	Khiri Phawanaram Temple	1,630	0.0002	0.0060	1	A.
6	Christ Church, Ban Chang	2,200	0.0001	0.0038	1	A.
7	Ban Chang Church	2,540	0.0001	0.0031	1	A.
8	Ban Khlong Bang Phai Temple	1,460	0.0003	0.0070	1	A.
9	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak	1,330	0.0003	0.0081	1	A.
10	Naval Aviation Musseum, Royal Thai Naval Air Division	1,240	0.0004	0.0090	1	A.
11	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	1,010	0.0005	0.0122	1	A.
12	Somdej Phra Pathom (Air Defense Regiment 1)	660	0.0009	0.0231	1	A.
13	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	550	0.0012	0.0304	1	A.
14	Monument to Admiral Phrachao Boromwongse Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	90	0.0181	0.4593	2	B
15	The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	40	0.0610	1.5501	2	B
16	The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	180	0.0064	0.1624	2	B

Table 5.5 – 9Levelof vibration from construction activities, areas of historical and archaeological landmarks, as well as religious facilities in the study area

Sequence No.	Historic landmarks and archaeology, and religious places	Distance from edge of construction area (scope/fence) (meters)	Maximum particulate speed generated by the use of Pile Driver		Effects on humans[2/]	Impact on building structure[3/]
			(inches/second)[1/]	(millimeters/second)		
17	Sa Kaeo Temple	1,720	0.0002	0.0055	1	A.
18	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	1,200	0.0004	0.0094	1	A.
19	Somboonaram Temple	5,070	0.0000	0.0011	1	A.
20	Abundant Grace Church, Ban Chang	6,380	0.0000	0.0008	1	A.
21	Samnak Kathon Temple	7,140	0.0000	0.0007	1	A.
22	Suwan Rangsan Temple	5,560	0.0000	0.0009	1	A.
23	Nong Bot Temple	7,810	0.0000	0.0006	1	A.
24	Luang Tia Chak Mak Shrine	9,630	0.0000	0.0004	1	A.
25	Chak Mak Temple	9,700	0.0000	0.0004	1	A.
26	Shrine of Luang Tia, Ban Phayun	4,870	0.0000	0.0012	1	A.
27	Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	4,790	0.0000	0.0012	1	A.
28	Chonthara Ram Temple (Phayun)	4,280	0.0001	0.0014	1	A.
29	Mosque Dawah Tul Islam	3,450	0.0001	0.0019	1	A.
30	Chinese shrine in the Buddhathammasongkroh Foundation	4,340	0.0001	0.0014	1	A.
31	Shrine of Luang Tia, Ban Chang	3,820	0.0001	0.0017	1	A.
32	Lao Yi Guan Yu Shrine, Ban Chang	3,920	0.0001	0.0016	1	A.
33	Ban Chang Temple	3,900	0.0001	0.0016	1	A.
34	Prachum Mitbamrung Temple	6,710	0.0000	0.0007	1	A.
35	Shrine of Luang Tia, Noen Kraprok, No. 1	7,340	0.0000	0.0006	1	A.
36	Shrine of Luang Tia, Noen Kraprok, No. 2	7,540	0.0000	0.0006	1	A.
37	Noen Kraprok Temple	7,630	0.0000	0.0006	1	A.

Table 5.5 – 9Levelof vibration from construction activities, areas of historical and archaeological landmarks, as well as religious facilities in the study area

Sequence No.	Historic landmarks and archaeology, and religious places	Distance from edge of construction area (scope/fence) (meters)	Maximum particulate speed generated by the use of Pile Driver		Effects on humans[2/]	Impact on building structure[3/]
			(inches/second)[1/]	(millimeters/second)		
38	Phudon Nim Sano Temple	8,670	0.0000	0.0005	1	A.
39	The Christ Church Ban Chang	8,560	0.0000	0.0005	1	A.
40	Anek Kuson Sala (Viharn Sien)	11,040	0.0000	0.0003	1	A.
41	Yannasangwararam Temple	11,080	0.0000	0.0003	1	A.
42	Sirisirirak House of Priest	11,440	0.0000	0.0003	1	A.
43	Anan Buraparam Meditation Center	11,950	0.0000	0.0003	1	A.
44	Map Fakthong Temple	13,170	0.0000	0.0003	1	A.
45	Khao Chi Chan Buddha Mountain	9,080	0.0000	0.0005	1	A.
46	Khao Chi Chan Temple	7,420	0.0000	0.0006	1	A.
47	Rat Samakkhi Temple	2,990	0.0001	0.0024	1	A.
48	Kuan Im Shrine	3,220	0.0001	0.0021	1	A.
49	The Monument of Somdej Phra Mahitalathibet [1]Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	2,690	0.0001	0.0028	1	A.
50	Judprakai Thamma Mediation Center	5,810	0.0000	0.0009	1	A.
51	Mediation Practice Center, Kor Mor.8	4,650	0.0000	0.0012	1	A.
52	Rang Si Sunthon Temple (Kor Mor. 5)	6,670	0.0000	0.0007	1	A.
53	Bodhipiya House of Priest (Dhammayut), Phothi Samphan Branch	7,340	0.0000	0.0006	1	A.
54	Sattahip Meditation Center (Khao Bandai Kaeo)	7,400	0.0000	0.0006	1	A.
55	Thung Prong Temple	8,200	0.0000	0.0005	1	A.
56	Khao Phlu Ta Luang Meditation Center	4,220	0.0001	0.0014	1	A.

Table 5.5 – 9Levelof vibration from construction activities, areas of historical and archaeological landmarks, as well as religious facilities in the study area

Sequence No.	Historic landmarks and archaeology, and religious places	Distance from edge of construction area (scope/fence) (meters)	Maximum particulate speed generated by the use of Pile Driver		Effects on humans[2/]	Impact on building structure[3/]
			(inches/second)[1/]	(millimeters/second)		
57	Sadet Tia Shrine Krom Luang Chumphon Khet Udomsak	4,030	0.0001	0.0015	1	A.
58	Khao Bai Sri Santitham Temple	4,690	0.0000	0.0012	1	A.
59	Welu Amphawan Vipassana Center	4,960	0.0000	0.0011	1	A.
60	The Royal Monument of His Majesty King Rama III	5,590	0.0000	0.0009	1	A.
61	The Royal Monument of His Majesty King Rama VI	5,680	0.0000	0.0009	1	A.
62	Phatthanakan Samaesarn Church	6,340	0.0000	0.0008	1	A.
63	The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	7,130	0.0000	0.0007	1	A.
64	Chong Samaesarn Temple	8,660	0.0000	0.0005	1	A.
65	Viharn Luang Por Dam	8,950	0.0000	0.0005	1	A.
66	Somdej Phrachao Taksin Maharat Shrine (Cham San)	9,230	0.0000	0.0004	1	A.
67	Thai Island and Sea Natural History Museum	9,160	0.0000	0.0004	1	A.
68	Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)	9,260	0.0000	0.0004	1	A.
69	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	9,280	0.0000	0.0004	1	A.

Table 5.5 – 9Levelof vibration from construction activities, areas of historical and archaeological landmarks, as well as religious facilities in the study area

Sequence No.	Historic landmarks and archaeology, and religious places	Distance from edge of construction area (scope/fence) (meters)	Maximum particulate speed generated by the use of Pile Driver		Effects on humans[2/]	Impact on building structure[3/]
			(inches/second)[1/]	(millimeters/second)		

Note: 1/ Calculated by using the PPVequip equation = PPVref x $(25/D)^{1.5}$

Effects on human and the impact on the building structure, based on criteria based on Whiffin, A.C., and Leonard, D.R., A Survey of Traffic Induced Vibration, Eng., 1971. and determine the level of impact as follows:

2/ effects on humans (1 = unable to feel, 2 = Possible level of awareness, 3 = feeling the vibration, 4 = Continuous vibration will cause annoyance, 5 = the tremor disturbed the people living in the building, 6 = people will feel unsatisfied if there is constant vibration)

3/ Impacton the building structure (A, B = It does not affect all types of structure, C = damage or damage to ancient site, D = No risk of damage to general buildings or architectural structures, E = There is damage to the general residential architectural structure with the walls and ceiling as a plaster, F = damage to the architectural structure and slightly damage to the structure)

5.5.4.2 Implementation phase

(1) Study Method

Assess the impact of project implementation activities, when the runways and taxiway 2 are activated, which may impact historical and archaeological sites, as well as places of worship in the study area, to recommend preventive measures and to resolve impacts and environmental impact monitoring measures that may have on these landmarks.

(2) Results of the Study

For information on the volume of air traffic, the direction and proportion of flight route use used to import the AEDT model to estimate the emission rate of air pollution, use the same data set as the data for the model to support the assessment of sound impacts. The results of the assessment of air pollution emission rates for all 11 projects (details are shown in **section 5.2.3 Air quality**) can be summarized as follows.:

1) Impact on air quality

1.1) General Atmospheric Quality

Based on the expected dispersion of air pollutants in the air condition in general, it consists of carbon monoxide (CO), nitrogen dioxide ($NO_{2)}$, sulfur dioxide (SO_2),dust of less than 10 microns (PM_{10}), and dust of less than 2.5 micron ($PM_{2.5}$) Using the AERMOD model, it was found that the average maximum concentration (Cmax) of carbon monoxide gas (CO) was averaged 1 hour maximum, and 8 hours maximum. (NO_2) 1 year average sulfur dioxide (SO_2), average 24 hours, maximum and 1 year average, including particulate matter up to 10 µm (PM_{10}) and 2.5 µm ($PM_{2.5}$) 24 hours average, maximum and 1 year average, in all cases, the value does not exceed the general atmospheric air quality standard.

The project considered particulate matter no more than 10 micron (PM_{10}) that may affect historical and archaeological landmarks, including religious sites in the study area. Considering the 11 PM_{10} concentration in the historical and archaeological areas including 69 places, it was found that the PM_{10} concentration values were in all the standard. Details are shown in **Table 5.5 – 10Predicted**

1.2) Volatile organic substances

Volatile Organic Compound Assessment Results Compare with the surveillance cost by referring to the announcement Pollution Control Department on Surveillance values were established for volatile organic compounds in the atmosphere generally at 24 h of acroline not exceeding 0.55 mcg/m3 in Thailand found that benzene and 1,3 butadiene mean 24 hours, the value does not exceed the monitoring value, while the 24-hour average achlorine value exceeds the surveillance value, the highest concentration position. (C_{max}) outside the airport was 3.261 µg/m3, higher than the surveillance value of 0.55 µg/m3. There are memorials and religious places in the study area of the project that will be received in excess of the surveillance value, with is in the range of 0.572-2.241 micrograms per cubic meter, 4 places, namely:

1) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)
2) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)
3) The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)
4) The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)

These 4 places, even those that are responsible for religious rituals at various occasions of the military officials and do not have regular residents. They may affect the health of people who practice at various occasions, even short-term impacts. The project has established preventive and corrective measures and monitoring measures for the environmental impact of air quality during the implementation phase, as well as preventive and preventive measures for the monitoring of occupational health and safety during the project implementation phase.

Table 5.5 – 10Predictedresults of the dissemination of particulate matter no more than 10 micron in the atmosphere,areas of historical and archaeological landmarks, and religious places in the study area (implementation phase)

Historic landmarks, archaeological places, and religious places		The concentration value of particulate matter up to 10 micron (microgram per cubic meter)																				
		Average 24 hours											Average 1 year									
		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
Maximum concentration value (Cmax)		0.27858	2.61136	3.98690	6.33753	9.73596	**11.01529**	7.93866	3.25194	2.26251	7.97626	5.74644	0.02913	0.20203	0.39819	0.63479	**0.97479**	0.82663	0.83011	0.24404	0.23658	0.59857	0.60088
Location of maximum concentration value		718692.23	719692.23	719692.23	719692.23	719692.23	719692.23	718692.23	719692.23	718692.23	719692.23	718692.23	718692.23	719692.23	718692.23	718692.23	718692.23	719692.23	718692.23	719692.23	718692.23	719692.23	718692.23
		1406801.29	1405801.29	1405801.29	1405801.29	1405801.29	1405801.29	1406801.29	1405801.29	1406801.29	1405801.29	1406801.29	1404801.29	1405801.29	1404801.29	1404801.29	1404801.29	1405801.29	1404801.29	1405801.29	1404801.29	1405801.29	1404801.29
		Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	Outside of the project area	In the project area	Outside of the project area	In the project area	In the project area	In the project area	Outside of the project area	In the project area	Outside of the project area	In the project area	Outside of the project area	In the project area
1	Wat Phala Vipassana Center	0.01295	0.10317	0.25748	0.41009	0.62982	0.34417	0.36904	0.10160	0.10518	0.24921	0.26713	0.00137	0.01188	0.02872	0.04573	0.07024	0.04046	0.03912	0.01195	0.01115	0.02930	0.02832
2	Phala Temple	0.01261	0.10420	0.25639	0.40834	0.62714	0.35096	0.35940	0.10361	0.10243	0.25413	0.26016	0.00130	0.01152	0.02764	0.04401	0.06760	0.03944	0.03716	0.01164	0.01059	0.02856	0.02690
3	Li Hu Ong Eh Shrine	0.01791	0.15969	0.38182	0.60805	0.93387	0.54793	0.51045	0.16176	0.14548	0.39676	0.36949	0.00194	0.02246	0.04916	0.07826	0.12021	0.08119	0.05529	0.02397	0.01576	0.05879	0.04002
4	Khlong Sai Temple	0.01738	0.14618	0.35725	0.56896	0.87383	0.49454	0.49537	0.14600	0.14118	0.35810	0.35857	0.00139	0.01355	0.03139	0.04998	0.07676	0.04741	0.03964	0.01400	0.01130	0.03433	0.02870
5	Khiri Phawanaram Temple	0.00801	0.10894	0.22748	0.36209	0.55616	0.40386	0.22825	0.11923	0.06505	0.29244	0.16522	0.00086	0.01418	0.02816	0.04482	0.06884	0.05388	0.02446	0.01591	0.00697	0.03901	0.01771
6	Christ Church, Ban Chang	0.00616	0.10476	0.20100	0.31984	0.49128	0.40449	0.17564	0.11941	0.05006	0.29289	0.12714	0.00084	0.01677	0.03197	0.05087	0.07814	0.06497	0.02403	0.01918	0.00685	0.04705	0.01739
7	Ban Chang Church	0.00645	0.11096	0.19388	0.30838	0.47370	0.44575	0.18388	0.13159	0.05241	0.32277	0.13310	0.00090	0.02511	0.04500	0.07159	0.10996	0.09986	0.02558	0.02948	0.00729	0.07231	0.01852
8	Ban Khlong Bang Phai Temple	0.02783	0.19081	0.50660	0.80703	1.23941	0.60883	0.79308	0.17974	0.22603	0.44086	0.57407	0.00250	0.01201	0.03774	0.06015	0.09238	0.03298	0.07122	0.00974	0.02030	0.02388	0.05155
9	The Monument of Admiral Phra Chao Boromwongsether Krom Luang Chumphon Khet Udomsak	0.03040	0.19472	0.50332	0.80175	1.23131	0.63375	0.86632	0.18710	0.24690	0.45890	0.62709	0.00293	0.01394	0.04401	0.07015	0.10772	0.03811	0.08338	0.01125	0.02376	0.02760	0.06036
10	Naval Aviation Museum Royal Thai Naval Air Division	0.02515	0.19516	0.49215	0.78389	1.20390	0.64642	0.71660	0.19084	0.20423	0.46808	0.51871	0.00304	0.01393	0.04488	0.07153	0.10985	0.03728	0.08658	0.01101	0.02468	0.02699	0.06267
11	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	0.02985	0.17145	0.40022	0.63730	0.97881	0.59713	0.85066	0.17629	0.24244	0.43239	0.61576	0.00389	0.01597	0.05467	0.08715	0.13383	0.03979	0.11098	0.01175	0.03163	0.02882	0.08033
12	Somdej Phra Pathom (Air Defense Regiment 1)	0.05903	0.12983	0.64540	1.02965	1.58099	0.48911	1.68203	0.14440	0.47938	0.35417	1.21755	0.00572	0.02071	0.07614	0.12140	0.18642	0.04682	0.16300	0.01382	0.04645	0.03390	0.11799
13	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	0.07974	0.16739	0.87805	1.40077	2.15083	0.48174	2.27217	0.14222	0.64757	0.34883	1.64472	0.00732	0.02453	0.09448	0.15064	0.23132	0.05155	0.20865	0.01522	0.05946	0.03733	0.15103
14	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	0.06405	0.41888	0.98094	1.56206	2.39909	1.69379	1.82518	0.50004	0.52017	1.22649	1.32117	0.01171	0.09691	0.23830	0.37953	0.58289	0.32654	0.33371	0.09640	0.09511	0.23645	0.24156
15	The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	0.05171	0.41480	0.91393	1.45505	2.23481	1.58944	1.47356	0.46923	0.41996	1.15092	1.06664	0.01006	0.09859	0.22793	0.36294	0.55743	0.34537	0.28681	0.10196	0.08174	0.25008	0.20761

Table 5.5 – 10Predictedresults of the dissemination of particulate matter no more than 10 micron in the atmosphere,areas of historical and archaeological landmarks, and religious places in the study area (implementation phase)

Historic landmarks, archaeological places, and religious places		The concentration value of particulate matter up to 10 micron (microgram per cubic meter)																				
		Average 24 hours											Average 1 year									
		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
16	The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	0.05129	0.70167	1.29187	2.05533	3.15709	2.75892	1.46162	0.81449	0.41656	1.99776	1.05800	0.00919	0.11331	0.24334	0.38738	0.59499	0.41393	0.26190	0.12220	0.07464	0.29973	0.18958
17	Sa Kaeo Temple	0.06192	0.39686	0.74000	1.17738	1.80851	1.55192	1.76445	0.45816	0.50287	1.12376	1.27721	0.01085	0.04264	0.14954	0.23838	0.36607	0.10297	0.30930	0.03040	0.08815	0.07456	0.22389
18	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	0.00983	0.10785	0.22050	0.35111	0.53926	0.44883	0.28024	0.13250	0.07987	0.32500	0.20285	0.00101	0.01637	0.03267	0.05200	0.07987	0.06207	0.02881	0.01832	0.00821	0.04494	0.02085
19	Somboonaram Temple	0.04718	0.31801	0.56750	0.90471	1.38928	1.28016	1.34453	0.37793	0.38319	0.92697	0.97325	0.00590	0.03428	0.09808	0.15628	0.24000	0.10297	0.16815	0.03040	0.04792	0.07456	0.12172
20	Abundant Grace Church, Ban Chang.	0.02369	0.25009	0.40590	0.64541	0.99147	1.03298	0.67504	0.30496	0.19239	0.74799	0.48863	0.00391	0.03322	0.08086	0.12878	0.19778	0.11270	0.11137	0.03327	0.03174	0.08161	0.08062
21	Samnak Kathon Temple	0.01163	0.25788	0.40849	0.64945	0.99768	1.07436	0.33142	0.31717	0.09445	0.77795	0.23990	0.00177	0.03297	0.06374	0.10144	0.15581	0.12686	0.05055	0.03745	0.01441	0.09186	0.03659
22	Suwan Rangsan Temple	0.00860	0.17549	0.27622	0.43914	0.67461	0.73272	0.24511	0.21632	0.06985	0.53057	0.17742	0.00125	0.02459	0.04700	0.07479	0.11488	0.09510	0.03574	0.02807	0.01019	0.06886	0.02587
23	Nong Bot Temple	0.00787	0.07938	0.18166	0.28925	0.44425	0.27979	0.22413	0.08260	0.06388	0.20260	0.16224	0.00084	0.01174	0.02431	0.03869	0.05943	0.04369	0.02387	0.01290	0.00680	0.03164	0.01728
24	Luang Tia Chak Mak Shrine	0.00717	0.11732	0.20763	0.33036	0.50744	0.47751	0.20440	0.14097	0.05825	0.34577	0.14796	0.00114	0.02016	0.03937	0.06265	0.09623	0.07719	0.03235	0.02279	0.00922	0.05590	0.02341
25	Chak Mak Temple	0.00756	0.12593	0.23231	0.36960	0.56772	0.51057	0.21535	0.15073	0.06137	0.36971	0.15588	0.00117	0.02098	0.04088	0.06506	0.09993	0.08046	0.03330	0.02375	0.00949	0.05826	0.02410
26	Luang Tia Ban Phayun Shrine	0.00889	0.07964	0.19006	0.30267	0.46486	0.27357	0.25329	0.08076	0.07219	0.19810	0.18334	0.00094	0.00805	0.01954	0.03113	0.04780	0.02735	0.02681	0.00807	0.00764	0.01980	0.01941
27	Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	0.00889	0.08000	0.19059	0.30352	0.46616	0.27514	0.25322	0.08123	0.07217	0.19923	0.18329	0.00094	0.00811	0.01962	0.03124	0.04799	0.02762	0.02675	0.00815	0.00762	0.02000	0.01937
28	Chonthara Ram Temple (Phayun)	0.01052	0.09392	0.22443	0.35741	0.54893	0.32239	0.29974	0.09518	0.08543	0.23344	0.21697	0.00105	0.00859	0.02121	0.03378	0.05188	0.02884	0.02992	0.00852	0.00853	0.02089	0.02166
29	Mosque Dawah Tul Islam	0.01483	0.28754	0.55094	0.87668	1.34660	1.11098	0.42265	0.32798	0.12045	0.80447	0.30594	0.00196	0.03164	0.06319	0.10056	0.15446	0.11992	0.05581	0.03540	0.01591	0.08684	0.04040
30	Chinese shrine in the Buddhathammasongkroh Foundation	0.03210	0.24056	0.61528	0.98005	1.50516	0.78888	0.91477	0.23289	0.26071	0.57123	0.66216	0.00271	0.02632	0.06104	0.09719	0.14927	0.09203	0.07725	0.02717	0.02202	0.06664	0.05592
31	Luang Tia Shrine, Ban Chang	0.01781	0.20200	0.41382	0.65865	1.01166	0.75609	0.50746	0.22321	0.14463	0.54749	0.36733	0.00196	0.02436	0.05217	0.08305	0.12756	0.08912	0.05578	0.02631	0.01590	0.06453	0.04037
32	Lao Yi Guan Yu Shrine, Ban Chang	0.02148	0.19650	0.45301	0.72134	1.10788	0.68954	0.61214	0.20357	0.17446	0.49930	0.44310	0.00238	0.02367	0.05446	0.08671	0.13318	0.08314	0.06791	0.02455	0.01935	0.06021	0.04916
33	Ban Chang Temple	0.02752	0.20470	0.52518	0.83654	1.28475	0.66980	0.78429	0.19774	0.22352	0.48501	0.56771	0.00285	0.02395	0.05853	0.09321	0.14316	0.08101	0.08117	0.02392	0.02313	0.05866	0.05875
34	Prachum Mitbamrung Temple	0.02149	0.11922	0.34864	0.55555	0.85317	0.35118	0.61226	0.10367	0.17449	0.25429	0.44319	0.00103	0.01060	0.02409	0.03835	0.05890	0.03752	0.02930	0.01108	0.00835	0.02717	0.02121
35	Luang Tia Shrine Noen Kraprok No. 1	0.01174	0.15054	0.31957	0.50871	0.78134	0.55331	0.33443	0.16335	0.09531	0.40065	0.24208	0.00077	0.01272	0.02528	0.04024	0.06180	0.04833	0.02199	0.01427	0.00627	0.03500	0.01592
36	Luang Tia Shrine Noen Kraprok No. 2	0.00534	0.18320	0.27995	0.44501	0.68364	0.77254	0.15218	0.22807	0.04337	0.55940	0.11016	0.00048	0.01567	0.02744	0.04364	0.06704	0.06292	0.01361	0.01858	0.00388	0.04556	0.00985
37	Noen Kraprok Temple	0.00398	0.05584	0.10667	0.16973	0.26071	0.21604	0.11353	0.06378	0.03236	0.15644	0.08218	0.00032	0.00707	0.01320	0.02100	0.03225	0.02764	0.00911	0.00816	0.00260	0.02001	0.00660
38	Phudon Nim Sano Temple	0.00239	0.03619	0.07345	0.11690	0.17955	0.13607	0.06814	0.04017	0.01942	0.09853	0.04932	0.00023	0.00312	0.00656	0.01044	0.01603	0.01155	0.00667	0.00341	0.00190	0.00836	0.00483
39	The Christ Church Ban Chang	0.00315	0.03728	0.08102	0.12898	0.19811	0.13533	0.08964	0.03995	0.02555	0.09799	0.06488	0.00025	0.00319	0.00681	0.01083	0.01664	0.01168	0.00723	0.00345	0.00206	0.00845	0.00523
40	Anek Kuson Sala (Viharn Sien)	0.01115	0.09927	0.22158	0.35280	0.54186	0.35498	0.31760	0.10480	0.09051	0.25704	0.22989	0.00073	0.00436	0.01233	0.01964	0.03017	0.01323	0.02085	0.00391	0.00594	0.00958	0.01510
41	Yannasangwararam Temple	0.01175	0.07972	0.20118	0.32043	0.49212	0.28043	0.33482	0.08279	0.09542	0.20306	0.24236	0.00085	0.00492	0.01408	0.02244	0.03446	0.01477	0.02416	0.00436	0.00688	0.01070	0.01748

Table 5.5 – 10Predictedresults of the dissemination of particulate matter no more than 10 micron in the atmosphere,areas of historical and archaeological landmarks, and religious places in the study area (implementation phase)

Historic landmarks, archaeological places, and religious places		The concentration value of particulate matter up to 10 micron (microgram per cubic meter)																				
		Average 24 hours											Average 1 year									
		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
42	Sirisirirak House of Priest	0.00836	0.10076	0.18994	0.30223	0.46423	0.39217	0.23835	0.11578	0.06793	0.28398	0.17253	0.00054	0.00624	0.01367	0.02177	0.03344	0.02253	0.01544	0.00665	0.00440	0.01631	0.01118
43	Anan Buraparam Meditation Center	0.01561	0.08966	0.20556	0.32773	0.50326	0.32237	0.44487	0.09517	0.12679	0.23343	0.32202	0.00073	0.00605	0.01484	0.02363	0.03629	0.02043	0.02068	0.00603	0.00589	0.01479	0.01497
44	Map Fakthong Temple	0.00969	0.07150	0.18404	0.29315	0.45022	0.25189	0.27609	0.07436	0.07869	0.18239	0.19985	0.00063	0.00422	0.01135	0.01808	0.02776	0.01334	0.01805	0.00394	0.00514	0.00966	0.01307
45	Khao Chi Chan Buddha Mountain	0.00211	0.02418	0.05310	0.08454	0.12984	0.08728	0.06013	0.02577	0.01714	0.06320	0.04353	0.00015	0.00144	0.00340	0.00541	0.00830	0.00500	0.00441	0.00148	0.00126	0.00362	0.00320
46	Khao Chi Chan Temple	0.00224	0.04685	0.07818	0.12432	0.19098	0.19553	0.06373	0.05772	0.01816	0.14158	0.04613	0.00017	0.00335	0.00643	0.01023	0.01572	0.01292	0.00498	0.00381	0.00142	0.00936	0.00361
47	Rat Samakkhi Temple	0.02319	0.14446	0.40017	0.63756	0.97913	0.44582	0.66086	0.13162	0.18834	0.32283	0.47836	0.00146	0.00899	0.02503	0.03988	0.06124	0.02763	0.04158	0.00816	0.01185	0.02001	0.03010
48	Kuan Im Shrine	0.02359	0.14693	0.40699	0.64843	0.99582	0.45345	0.67209	0.13387	0.19155	0.32835	0.48650	0.00137	0.00847	0.02356	0.03754	0.05766	0.02605	0.03911	0.00769	0.01115	0.01886	0.02831
49	The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	0.02593	0.16355	0.45046	0.71767	1.10217	0.50706	0.73881	0.14969	0.21056	0.36716	0.53479	0.00155	0.00944	0.02646	0.04216	0.06475	0.02886	0.04431	0.00852	0.01263	0.02089	0.03208
50	Judprakai Thamma Mediation Center	0.00951	0.06926	0.17922	0.28549	0.43845	0.22526	0.27090	0.06650	0.07720	0.16312	0.19609	0.00113	0.00781	0.02064	0.03288	0.05049	0.02500	0.03211	0.00738	0.00915	0.01810	0.02325
51	Mediation Practice Center, Kor Mor.8	0.01566	0.10168	0.27645	0.44042	0.67637	0.31854	0.44619	0.09404	0.12716	0.23066	0.32297	0.00117	0.00794	0.02119	0.03376	0.05185	0.02524	0.03341	0.00745	0.00952	0.01827	0.02418
52	Rang Si Sunthon Temple (Kor Mor. 5)	0.00811	0.06033	0.15478	0.24654	0.37864	0.19739	0.23115	0.05828	0.06588	0.14294	0.16732	0.00110	0.00753	0.02002	0.03189	0.04898	0.02401	0.03139	0.00709	0.00895	0.01739	0.02272
53	Bodhipiya House of Priest (Dhammayut), Phothi Samphan Branch	0.00294	0.03304	0.07302	0.11625	0.17855	0.11882	0.08387	0.03508	0.02390	0.08604	0.06071	0.00012	0.00139	0.00303	0.00482	0.00740	0.00504	0.00336	0.00149	0.00096	0.00365	0.00244
54	Sattahip Meditation Center (Khao Bandai Kaeo)	0.00346	0.03635	0.08206	0.13066	0.20067	0.13543	0.09856	0.03998	0.02809	0.09806	0.07134	0.00014	0.00188	0.00397	0.00632	0.00970	0.00691	0.00412	0.00204	0.00117	0.00500	0.00298
55	Thung Prong Temple	0.00274	0.03226	0.06605	0.10516	0.16151	0.12299	0.07800	0.03631	0.02223	0.08906	0.05646	0.00012	0.00146	0.00312	0.00497	0.00763	0.00534	0.00332	0.00158	0.00095	0.00387	0.00241
56	Khao Phlu Ta Luang Meditation Center	0.00147	0.01876	0.03757	0.05979	0.09184	0.07102	0.04180	0.02097	0.01191	0.05143	0.03025	0.00007	0.00079	0.00174	0.00277	0.00425	0.00284	0.00198	0.00084	0.00056	0.00206	0.00143
57	Sadet Tia Shrine Krom Luang Chumphon Khet Udomsak	0.02804	0.10072	0.30262	0.48278	0.74129	0.35244	0.79914	0.10405	0.22775	0.25521	0.57846	0.00267	0.00983	0.03581	0.05709	0.08766	0.02252	0.07616	0.00665	0.02170	0.01631	0.05513
58	Khao Bai Sri Temple, Santitham	0.03270	0.13444	0.42921	0.68433	1.05086	0.41537	0.93179	0.12263	0.26556	0.30077	0.67448	0.00269	0.01167	0.03870	0.06168	0.09472	0.03020	0.07655	0.00892	0.02182	0.02187	0.05541
59	Welu Amphawan Vipassana Center	0.02320	0.13121	0.34843	0.55533	0.85280	0.44077	0.66118	0.13012	0.18844	0.31916	0.47860	0.00207	0.01129	0.03326	0.05300	0.08139	0.03302	0.05888	0.00975	0.01678	0.02391	0.04262
60	The Royal Monument of His Majesty King Rama III	0.01124	0.08930	0.22308	0.35531	0.54569	0.29771	0.32022	0.08789	0.09126	0.21557	0.23179	0.00087	0.00681	0.01708	0.02721	0.04179	0.02262	0.02469	0.00668	0.00704	0.01638	0.01788
61	The Royal Monument of His Majesty King Rama VI	0.01070	0.06651	0.17621	0.28078	0.43120	0.21769	0.30490	0.06427	0.08690	0.15763	0.22070	0.00112	0.00787	0.02072	0.03301	0.05069	0.02529	0.03206	0.00747	0.00914	0.01831	0.02321
62	Phatthanakan Samaesarn Church	0.00985	0.07053	0.16436	0.26173	0.40198	0.24590	0.28059	0.07260	0.07997	0.17806	0.20310	0.00091	0.00674	0.01732	0.02758	0.04236	0.02206	0.02588	0.00651	0.00738	0.01597	0.01874
63	The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	0.00909	0.06739	0.15856	0.25249	0.38779	0.23360	0.25910	0.06896	0.07384	0.16915	0.18755	0.00056	0.00515	0.01221	0.01944	0.02986	0.01775	0.01610	0.00524	0.00459	0.01285	0.01165

Table 5.5 – 10Predictedresults of the dissemination of particulate matter no more than 10 micron in the atmosphere,areas of historical and archaeological landmarks, and religious places in the study area (implementation phase)

Historic landmarks, archaeological places, and religious places		The concentration value of particulate matter up to 10 micron (microgram per cubic meter)																				
		Average 24 hours											Average 1 year									
		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
64	Chong Samaesarn Temple	0.00769	0.05395	0.11975	0.19072	0.29292	0.21670	0.21920	0.06398	0.06247	0.15692	0.15867	0.00042	0.00441	0.00995	0.01585	0.02434	0.01567	0.01195	0.00463	0.00341	0.01135	0.00865
65	Viharn Luang Por Dam	0.00581	0.05388	0.12265	0.19529	0.29995	0.19048	0.16548	0.05623	0.04716	0.13793	0.11978	0.00033	0.00344	0.00782	0.01246	0.01913	0.01217	0.00954	0.00359	0.00272	0.00881	0.00690
66	Somdej Phrachao Taksin Maharat Shrine (Cham San)	0.00781	0.07023	0.16742	0.26661	0.40947	0.24142	0.22267	0.07127	0.06346	0.17482	0.16118	0.00059	0.00548	0.01290	0.02055	0.03156	0.01899	0.01679	0.00560	0.00479	0.01375	0.01215
67	Thai Island and Sea Natural History Museum	0.00725	0.06864	0.16058	0.25571	0.39273	0.23872	0.20657	0.07048	0.05887	0.17286	0.14953	0.00056	0.00535	0.01244	0.01982	0.03043	0.01870	0.01582	0.00552	0.00451	0.01354	0.01145
68	Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command))	0.00846	0.06546	0.16527	0.26324	0.40428	0.21663	0.24108	0.06395	0.06871	0.15687	0.17450	0.00060	0.00565	0.01327	0.02113	0.03245	0.01961	0.01718	0.00579	0.00490	0.01420	0.01244
69	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	0.00855	0.06854	0.17063	0.27177	0.41739	0.22905	0.24363	0.06762	0.06943	0.16585	0.17635	0.00061	0.00565	0.01335	0.02125	0.03264	0.01954	0.01746	0.00577	0.00498	0.01415	0.01264
Standards*		120*											50*									

Notes: Case 1: Assumptions for the aviation situation in 2019 (1 runway) Case 2 : Assumptions for the highest flight forecast in 2028 (2 routes) Case 3: Assumptions for the highest flight forecast in 2038 (2 routes) Case 4: Assumptions for the highest flight forecast in 2048 (2 routes) Case 5: Assumptions for the bad case (Peak Hour) Maximum flight forecast Case 6 : The assumption is to close the runway either way, closing the 1st runway (in the year of 2048)4]in case 7 : The assumption is to close the runway either way. Closing the second runway (in the year of 2048) Case 8 : The assumption of closing the runway 1 (in the year of 2028) Case 9 : The assumption of closing the runway 2 (in the year of 2028) Case 10 : The assumption of closing the runway 1 (in the year of 2038) Case 11 : The assumption of closing the runway 2 (in the year of 2038)

* Dust standard no more than 10 micron over 24 hours and 1 year refers to the announcement of the National Environment Board No. 24 (2004) regarding the establishment of general air quality standards.

2) Sound aspect

During the implementation phase, the main activities of the project are aviation of various aircraft, which is based on the assessment of the impact of the noise from take-off and drop-off of the aircraft that may have on historical and archaeological sites, including 69 religious places located in the study area. It was found that in the level line of NEF ≥ 40, or areas with an average day and night volume of more than 75 decibels, there are 2 monuments and religious places lacated as follows;

1) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)
2) Sa Kaeo Temple

In the area along the lines of NEF 30 – 40 noise levels, or in areas with an average day and night volume of 65 – 75 decibela, there were 9 memorials, museum and religious places as followa:

1) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak
2) Naval Aviation Musseum, Royal Thai Naval Air Division
3) King Taksin the Great Momument Maharaj Reign (Air Defense Regiment 1)
4 Somdej Phra Pathom (Air Defense Regiment 1)
5) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)
6) The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)
7) The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)
8) Somboonaram Temple
9) Samnak Kathon Temple

There are 2 locations located on the noise level line NEF ≥ 40, or in areas with an average day to night volume of more than 75 decibela. The location is located in the NEF range 30 – 40 areas, or in areas with an average day and night noise level in range of 65 – 75 decibels. There are 9 locations in total of 11 places are not suitable according to the appropriate land use criteria. This is the area that is expected to be impacted by sound from aviation in the severe to medium because it will cause health and safety impacts, including those who are in the long-term living-term residents, including the religious practice of 11 religious places. The project has established preventive and corrective measures and noise impact monitoring measures in the implementation phase, including preventive and corrective measures and environmental impact monitoring measures on occupational health and safety in the implementation phase of the project.

In areas outside the boundary line, the volume level NEF < 30 or areas with an average day and night volume less than 65 decibela, there are 58 historical and archaeological landmarks, including religious places, which are expected not to be affected by aircraft noise. This is appropriate for land use according to academic advice regarding the level of appropriate land use around the airport of the Pollution Control Department, details are shown in **Table 5.5 - 11**and Figure 5.5 **- 5**

Table 5.5 – 11Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Historic landmarks, archaeological sites, and religious places	Average sound level suitable for land use around U-Tapao International Airport				
		Land use category	Average day and night volume (dB)			
			Less than 65	65-70	70-75	More than 75
1	Wat Phla Vipassana Center	Mediation Practice Center	Appropriate			
2	Phala Temple	Community temple	Appropriate			
3	Li Hu Ong Eh Shrine	Chinese shrine	Appropriate			
4	Khlong Sai Temple	Community temple	Appropriate			
5	Khiri Phawanaram Temple	Community temple	Appropriate			
6	Christ Church, Ban Chang	Church	Appropriate			
7	Ban Chang Church	Church	Appropriate			
8	Ban Khlong Bang Phai Temple	Community temple	Appropriate			
9	The Monument to Admiral Phrachao Boromwongtheo Krom Luang Chumphon Khet Udomsak	Memorial Hall		Not appropriate		
10	Naval Aviation Musseum, Royal Thai Naval Air Division	Museum		Inappropriate		
11	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	Memorial Hall		Inappropriate		
12	Somdej Phra Pathom (Air Defense Regiment 1)	Places for religious ceremonies and worshiping Buddha images		Inappropriate		
13	The Monument to Admiral Phrachao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	Memorial Hall		Inappropriate		
14	The Monument to Admiral Phonboomwongva, the Royal Chumphon Department, Udomsak District (Air Defense Artillery Battalion)	Memorial Hall				Inappropriate
15	The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	Places for religious ceremonies and worshiping Buddha images		Inappropriate		
16	The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	Thepharak Shrine		Inappropriate		

Table 5.5 – 11Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Historic landmarks, archaeological sites, and religious places	Average sound level suitable for land use around U-Tapao International Airport				
		Land use category	Average day and night volume (dB)			
			Less than 65	65-70	70-75	More than 75
17	Sa Kaeo Temple	Community temple				Inappropriate
18	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	Place of Worship	Appropriate			
19	Somboonaram Temple	Community temple		Inappropriate		
21	Samnak Kathon Temple	Community temple		Inappropriate		
20	Abundant Grace Church, Ban Chang	Church	Appropriate			
22	Suwan Rangsan Temple	Community temple	Appropriate			
23	Nong Bot Temple	Community temple	Appropriate			
24	Luang Tia Chak Mak Shrine	Chinese shrine	Appropriate			
25	Chak Mak Temple	Community temple	Appropriate			
26	Shrine of Luang Tia, Ban Phayun	Chinese shrine	Appropriate			
27	Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	Place of Worship	Appropriate			
28	Chonlatharam Temple (Phayun)	Community temple	Appropriate			
29	Dahwatl islam mosque	Mosque	Appropriate			
30	Chinese shrine in the Buddhathammasongkroh Foundation	Chinese shrine	Appropriate			
31	Luang Tia Ban Chang Shrine	Chinese shrine	Appropriate			
32	Lao Yi Guan Yu Shrine, Ban Chang	Chinese shrine	Appropriate			
33	Ban Chang Temple	Community temple	Appropriate			
34	Prachum Mitbamrung Temple	Community temple	Appropriate			
35	Shrine of Luang Tia, Noen Kraprok, No. 1	Chinese shrine	Appropriate			
36	Shrine of Luang Tia, Noen Kraprok, No. 2	Chinese shrine	Appropriate			
37	Noen Kraprok Temple	Community temple	Appropriate			
38	Phudon Nim Sano Temple	Community temple	Appropriate			
39	The Christ Church Ban Chang	Church	Appropriate			
40	Anek Kuson Sala (Viharn Sien)	Museums, cultural exhibitions and venues	Appropriate			

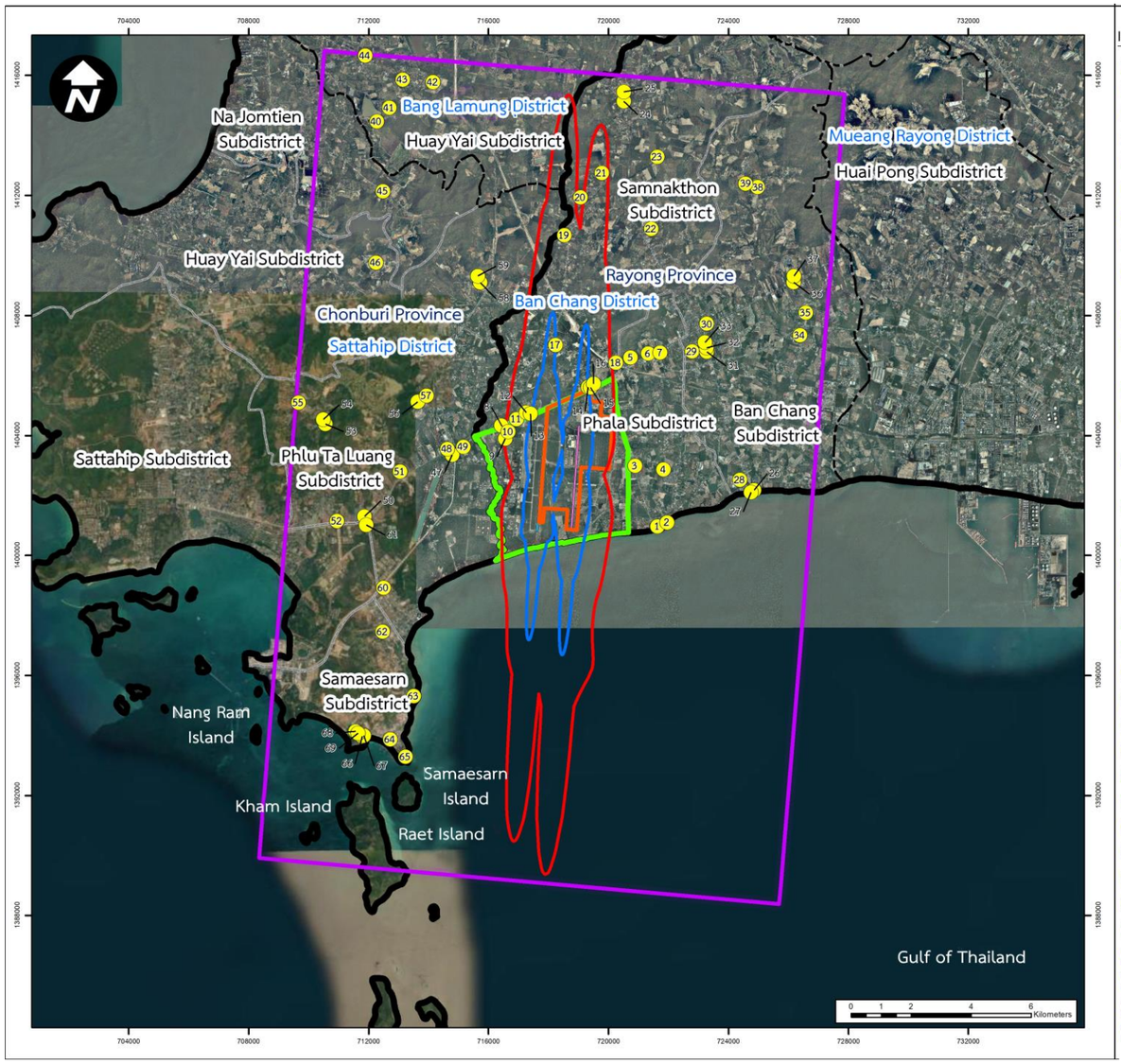
Table 5.5 – 11Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Historic landmarks, archaeological sites, and religious places	Average sound level suitable for land use around U-Tapao International Airport				
		Land use category	Average day and night volume (dB)			
			Less than 65	65-70	70-75	More than 75
41	Yannasangwararam Temple	The First Class Monastery, Woramahawihan	Appropriate			
42	Sirisirirak House of Priest	House of Priest	Appropriate			
43	Anan Buraparam Meditation Center	Mediation Center	Appropriate			
44	Map Fakthong Temple	Community temple	Appropriate			
45	Khao Chi Chan Buddha Mountain	The statue of Buddha carved on the cliff of Khao Chi Chan	Appropriate			
46	Khao Chi Chan Temple	Community temple	Appropriate			
47	Rat Samakkhi Temple	Community temple	Appropriate			
48	Kuan Im Shrine	Chinese shrine	Appropriate			
49	The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	The Great Monument / Memorial Hall	Appropriate			
50	Judprakai Thamma Mediation Center	Mediation Practice Center	Appropriate			
51	Mediation Practice Center, Kor Mor.8	Mediation Practice Center	Appropriate			
52	Rang Si Sunthon Temple (Kor Mor. 5)	Community temple	Appropriate			
53	Bodhipiya House of Priest (Dhammayut), Phothi Samphan Branch	House of priest	Appropriate			
54	Sattahip Meditation Center (Khao Bandai Kaeo)	Mediation Practice Center	Appropriate			
55	Thung Prong Temple	Community temple	Appropriate			
56	Khao Phlu Ta Luang Meditation Center	Mediation Practice Center	Appropriate			
57	Somdet Tia Krom Luang Chumphon Khet Udomsak Shrine	Place of Worship	Appropriate			
58	Khao Bai Sri Santitham Temple	Community temple	Appropriate			
59	Welu Amphawan Vipassana Center	Mediation Practice Center	Appropriate			
60	The royal monument of King Rama III	Memorial Hall	Appropriate			
61	The royal monument of King Rama VI	Memorial Hall	Appropriate			

Table 5.5 – 11Compare the use of land around U-Tapao International Airport with the appropriate noise level criteria.

Sequence	Historic landmarks, archaeological sites, and religious places	Average sound level suitable for land use around U-Tapao International Airport				
		Land use category	Average day and night volume (dB)			
			Less than 65	65-70	70-75	More than 75
62	Phatthanakan Samaesarn Church	Church	Appropriate			
63	The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	Place of Worship	Appropriate			
64	Chong Samaesarn Temple	Community temple	Appropriate			
65	Viharn Luang Por Dam	Important Buddha images of fishermen in the eastern region	Appropriate			
66	Somdej Phrachao Taksin the Great Shrine (Samaesarn)	Place of Worship	Appropriate			
67	Thai Island and Sea Natural History Museum	Natural Science Museum	Appropriate			
68	Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)	Religious Places	Appropriate			
69	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	Memorial Hall	Appropriate			

Note: Comparative criteria, Refererring to Academic Advice on Noise Level Criteria Suitable for Land Use Around Airport, the Department of Pollution Control, Ministry of Natural Resources and the Environment, 2016



Important places in history and archeology

1. Wat Phla Vipassana Center
2. Phla Temple
3. Li Suo Ong Yee Shrine
4. Khlong Sai Temple
5. Khiri Phawanaram Temple
6. Christ Church Ban Chang
7. Ban Chang Church
8. Ban Khlong Bang Phai Temple
9. The Monument of Admiral Phra Chao Boromwongsether Krom Luang Chumphon Khet Udomsak
10. Naval Aviation Museum, Royal Thai Naval Air Division
11. The Royal Monument of King Taksin the Great (Air Defense Regiment 1)
12. Somdej Phra Pathom (Air Defense Regiment 1)
13. The Monument of Admiral Phra Chao Boromwongsether Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)
14. The Monument of Admiral Phrachao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)
15. The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)
16. The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)
17. Sa Kaeo Temple
18. Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)
19. Somburanaram Temple
20. Abundant Grace Church, Ban Chang
21. Samnak Kathon Temple
22. Suwan Rangsan Temple
23. Nong Bot Temple
24. Luang Tia Chak Mak Shrine
25. Chak Mak Temple
26. Luang Tia Ban Phayun Shrine
27. Somdej Phra Chao Taksin Maharat Shrine (Ban Chang)
28. Chonthara Ram Temple (Phayun)
29. Mosque Dawah Tul Islam
30. Chinese shrine in the Buddhathammasongkroh Foundation
31. Luang Tia Ban Chang Shrine
32. Lao Guan Yu Shrine, Ban Chang
33. Ban Chang Temple
34. Prachum Mitbamrung Temple
35. Luang Tai Shrine, Noen Kraprok, No. 1
36. Luang Dian Shrine, Noen Kraprok No. 2
37. Noen Kraprok Temple
38. Phudon Nim Sano Temple
39. The Christ Church Ban Chang
40. Anek Kuson Sala (Viharn Sien)
41. Yansangwararam Temple
42. Siri Sirirak House of Priest
43. Anan Burapharam Dharma Practice Center
44. Map Fak Thong Temple
45. Khao Chi Chan Buddha Mountain
46. Khao Chi Chan Temple
47. Rat Samakkhi Temple
48. Kuan Im Shrine
49. The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani
50. Judprakai Thamma Mediation Center
51. Kor Mor. 8 Mediation Center
52. Rang Si Sunthon Temple (Kor Mor. 5)
53. Bodhipiya Priest's Camp Site (Thammayut) Bodhi Samphan Branch
54. Sattahip Meditation Center (Khao Bandai Kaeo)
55. Thung Prong Temple
56. Khao Phlu Ta Luang Mediation Center
57. The Shrine of Sadet Tia Krom Luang Chumphon Khet Udomsak
58. Khao Bai Sri Temple, Santitham
59. Welu Amphawan Vipassana Meditation Center
60. The Royal Monument of His Majesty King Rama III
61. The Royal Monument of His Majesty King Rama VI
62. Phatthanakan Samaesarn Church
63. The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)
64. Chong Samaesan Temple
65. Viharn Luang Por Dam
66. Somdej Phra Chao Taksin Maharat Shrine (Cham San)
67. Thai Island and Sea Natural History Museum
68. Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)
69. The Royal Monument of King Taksin the Great (Naval Special Warfare Command)

Province
District
Subdistrict
Runway No. 1 (current)
Runway No. 2
Airport Extension Area (Project Area)
U-Tapao International Airport area
Project Study Area

Lines as NEF sound level
In the case of the flight situation in 2019 and the flight forecasts of 2028, 2038 and 2048 (maximum 1,364 flights per day) plus any route closure (791 flights per day), July 2021

NEF 40 (area 14.30 square kilometres)
NEF 30 (area 48.25 square kilometres)

Figure 5.5 – 5 maps showing historical and archaeological landmarks, as well as various religious places that are surveyed in the Project Study Area , compared to the sound level (NEF) in the implement phase.

3) Vibration side

The main activities in the implementation phase of U-Tapao Airport are the increased take-off and landing of aircraft , causing more vibration in the air caused by the compressed air (Wake Vortex) respectively. It may affect various facilities located in the area under the flight route. The impact of this is caused by damage to the building roof or structure, such as tiles moving and falling tiles, as well as damage to the ceiling. (Refer to the information on the nature of the impact from the statistics of complaints and the payment of roof repair fees from air pressure (Wake Vortex) of Suvarnabhumi Airport (2016 - 2019). For U-Tapao International Airport, there has been no complaint and payment for roof repairs due to the impact of aircraft compression (Wake Vortex) from the past to the present. Therefore, the project has assessed the impact of aircraft's wing tip winds (Wake Vortex) that may have on 69 historical and archaeological places, including religious places located in the project study area by using the data layer in the geographic information system to analyze to find areas at risk from aviation activities (Aviation Risk) by using the Overlay Technique and using the relevant information of the field. U-Tapao international flights are as follows:

- Information on the airport area of U-Tapao International Airport (Airport Area)
- Air safety zone information 1995 (Air Safety Zone)
- Information on flight route distribution,both in and out, the height is approximately 3,000 feet.
- Slope information in the up-and-down path; draft flight route
- Noise level information (NEF)
- Information on sensitive areas, archaeological and religious places

According to the assessment, there was a risk area of being affected by the wake vortex near the area away from the runway head at a distance of 1 -10 kilometres, with a height of approximately 1 – 2,100 feet (MSL.) in the summer and the distance from the runway head at a distance of 1-11 kilometers, the height is approximately 1 – 2,700 feet (MSL.) in the winter, and from inspection of the area along the flight route of U-Tapao International Airport, it was found that there are 11 important places in historical and archaeological sites, including religious sites that may have been affected by wing tip wind (Wake Vortex), details are shown in **Figure 5.5 - 6** (Refer to concepts of analytical methods from the study project, land use to reduce the impact of sound from Suvarnabhumi Airport, Environmental Research and Training Center DepartmentEnvironmental Quality Promotion, in 2013) namely:

1) The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion) fights aircraft.
2) The Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)
3) The Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)
4) Wat Kaew Temple (the reign of King Rama 9)
5) Somboonaram Temple (The reign of King Rama 5)
6) Abundant Grace Church, Ban Chang

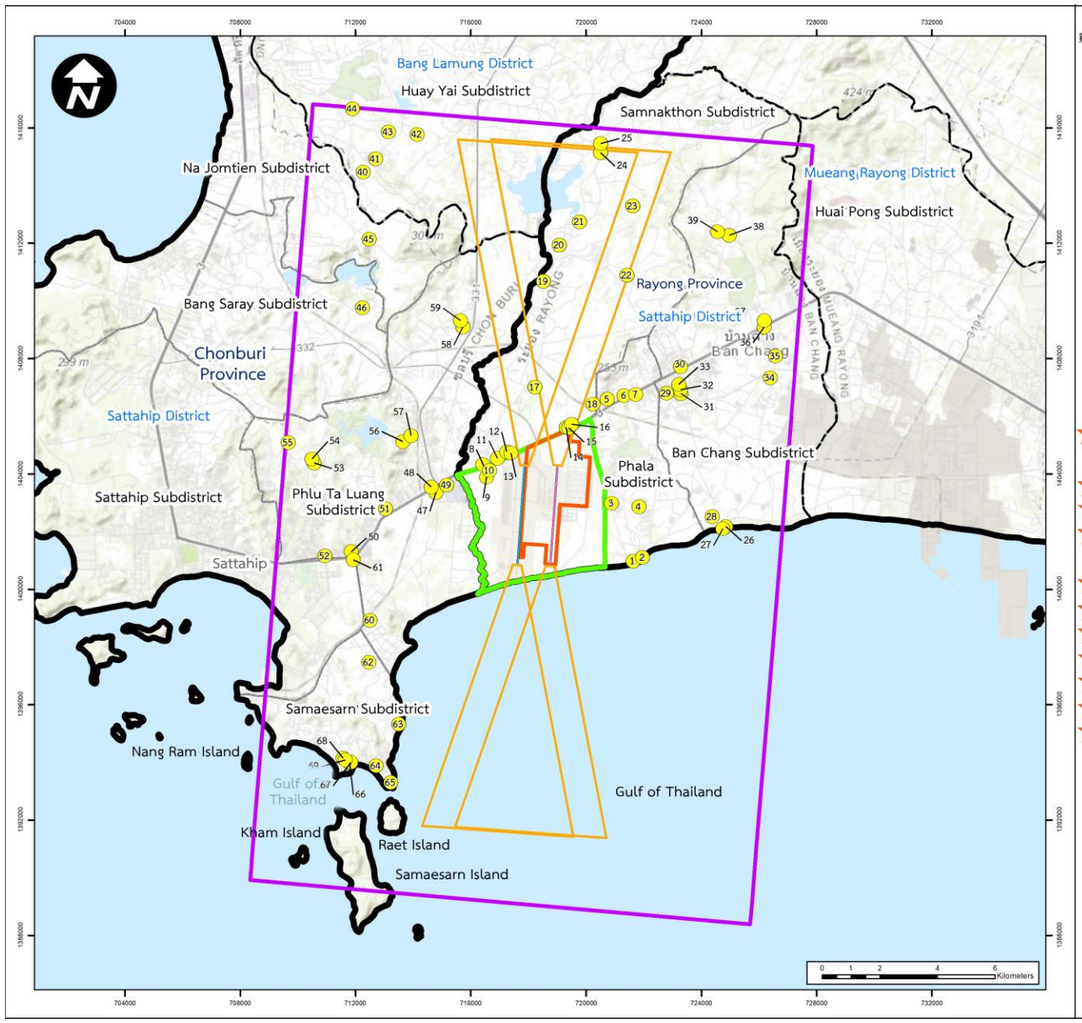
7) Samnak Kathon Temple (the reign of King Rama 9)
8) Suwan Rangsan Temple (the reign of King Rama 9)
9) Nong Bot Temple (the reign of King Rama 9)
10) Luang Tia Chak Mak Shrine
11) Chak Mak Temple (During the Reign 6)

Among the 11 important places mentioned above, there might be affected by vibration caused by the wind at the wingtips that damage the roofs of buildings inside the religious place.

Furthermore, it is noted that among the 11 important places, it is not an archaeological site registered or archaeological site pending registration,, but 2 old temples,which inside the temple there is an old ordination hall and an old wooden monastery may be considered ancient places, namely:

1) Somboonaram Temple: This is an old temple set during the reign of King Rama V. There is an old ordination halls which has been restored.
2) Chak Mak Temple : The old temple in the reign of King Rama VII, there is ordination hall, although it has been restored, but now the roof is partially damaged and an old wooden monk's house in the middle of the pond. It is in a very dilapidated condition. (Currently not being used)

Therefore, it is expected that all 11 locations may be affected from moderate to high level. The project has implemented preventive and corrective measures, including environmental impact monitoring measures to reduce these impacts in the project as detailed in**Chapter 7 Environmental and Health Action Plan, Measures to prevent and correct environmental and health impacts, and Measures to monitor environmental and Health impacts, and the schedule of measures SorPhorRor.1 of the project.**



สถานที่สำคัญทางด้านประวัติศาสตร์และโบราณคดี ระยะห่างจากเขตสนามบินอู่ตะเภาไปยังอาคารที่ใกล้ (กิโลเมตร)

1	Wat Phla Vipassana Center	0.96
2	Phla Temple	1.19
3	Li Suo Ong Yee Shrine	0.24
4	Khlong Sai Temple	1.04
5	Khiri Phawanaram Temple	0.87
6	The Church of The Christ Church Ban Chang	1.42
7	Ban Chang Church	1.80
8	Ban Khlong Bang Phai Temple	0.08
9	The monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak, is at the airport.	
10	The Naval Aviation Museum, Royal Thai Naval Air Division is at the airport.	
11	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	0.09
12	Somdej Phra Pathom (Air Defense Regiment 1)	0.17
13	The Monument of Admiral Phra Chao Boromwongsether Krom Luang Chumphon Khet Udomsak (Air Defense Regiment 1)	0.07
★14	The Monument of Admiral Phra Chao Boromwongtheo Krom Luang Chumphon Khet Udomsak (Air Defense Artillery Battalion)	0.10
★15	Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	0.05
★16	Phra Siam Thevathirat Shrine (Air Defense Artillery Battalion)	0.12
★17	Sa Kaeo Temple	1.77
18	Somdej Phra Chao Taksin Maharat Shrine (Foothills of Krok Tabaek Mountain)	0.53
★19	Somburanaram Temple	4.96
★20	Abundant Grace Church, Ban Chang	6.12
★21	Samnak Kathon Temple	6.79
★22	Suwan Rangsan Temple	5.01
★23	Nong Bot Temple	7.52
★24	Luang Tia Chak Mak Shrine	9.23
★25	Chak Mak Temple,	9.30
26	Luang Tia Ban Phayun Shrine	4.20
27	Somdej Phrachao Taksin Maharat Shrine (Ban Chang)	4.11
28	Chonthara Ram Temple (Phayun)	3.65
29	Mosque Dawah Tul Islam	2.79
30	Chinese shrine in the Buddhathammasongkroh Foundation	3.60
31	Luang Tia Ban Chang Shrine	3.25
32	Lao Guan Yu Shrine, Ban Chang	3.27
33	Ban Chang Temple	3.24
34	Prachum Mitbamrung Temple	6.31
35	Luang Tai Shrine, Noen Kraprok, No. 1	6.81
36	Luang Thia Shrine, Noen Kraprok No. 2	6.85
37	Noen Kraprok Temple	6.91
38	Phudon Nim Sano Temple	7.97
39	The Christ Church Ban Chang	7.85
40	Anek Kuson Sala (Viharn Sien)	10.92
41	Yansangwararam Temple	11.00
42	Siri Sirirak House of Priest	11.45
43	Anan Buraparam Dharma Practice Center	11.96
44	Map Fak Thong Temple	13.18
45	Khao Chi Chan Buddha Mountain	8.72
46	Khao Chi Chan Temple	6.63
47	Rat Samakkhi Temple	0.94
48	Kuan Im Shrine	0.99
49	Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinagarindra Boromrajajonani	0.48
50	Judprakai Thamma Mediation Center	4.15
51	Kor Mo 8 Mediation Center	2.72
52	Rang Si Sunthon Temple (Kor Mor. 5)	5.04
53	Bodhipiya Priest's Camp Site (Thammayut) Bodhi Samphan Branch	4.97
54	Sattahip Meditation Center (Khao Bandai Kaeo)	5.05
55	Thung Phrong Temple	5.92
56	Khao Phlu Ta Luang Mediation Center	2.21
57	The Shrine of Sadet Tia Krom Luang Chumphon Khet Udomsak	2.09
58	Khao Bai Sri Temple, Santitham	4.75
59	Welu Amphawan Vipassana Meditation Center	4.97
60	The Royal Monument of His Majesty King Rama III,	3.84
61	The Royal Monument of His Majesty King Rama VI of the King	4.12
62	Phatthanakan Samaesarn Church	4.44
63	The Shrine of Admiral Phra Chao Boromwongtheo Krom Luang Chumpon Khet Udomsak (Samaesarn)	5.38
64	Chong Samaesan Temple	6.80
65	Viharn Luang Por Dam	7.16
66	Somdej Phra Chao Taksin Maharat Shrine (Cham Sang)	7.35
67	Thai Island and Sea Natural History Museum	7.29
68	Phra Phuttha Singhanat Navy Hall (Naval Special Warfare Command)	7.47
69	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	7.47

- Province
- District
- Subdistrict
- Runway No. 1 (Current)
- Runway No. 2
- Airport Extension Area (Project Area)
- U-Tapao International Airport area
- Project Study Area
- Wake Vortex
- ★ An important historical and archaeological landmarks in the wake vortex area

Figure 5.5 - 6 Maps showing historical and archaeological landmarks, as well as religious places in the study area of the project compared to wake vortex area.

Contents