



Istanbul New Airport ESIA
Environmental Baseline and
Impact Assessment
Traffic and Transport


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7.11 Traffic and Transport

7.11.1 Introduction

This chapter assesses the potential impacts of the INA Project concerning traffic and transport, and includes:

- A review of legal requirements and international standards and guidelines;
- Brief review of the Project location in traffic and transport terms;
- High-level review of other hub airports and their travel demand characteristics;
- Outline assessment of scale and requirements for airport access;
- A qualitative assessment of the potential impacts; and
- Discussion on mitigation and residual impacts.

This assessment is primarily based on the following documents:

- The March 2014 Master Plan Traffic Analysis;
- Guidelines for Environmental Assessment of Road Traffic (Ref. 7.11.1);
- Airport Co-operative Research Programme reports (Ref. 7.11.2 and 7.11.3);
- Design Manual for Roads and Bridges (DMRB) (Ref. 7.11.4); and
- INA preliminary traffic estimates study.

7.11.2 Policy Regulatory and Administrative Framework

7.11.2.1 Turkish Legal Requirements

Public roads in Turkey are classified using a four-tier system: motorways (multi-lane access-controlled highways), state roads, provincial roads and rural roads. The General Directorate of Turkish Highways (KGM), is responsible for the regulation, planning, operation, maintenance and construction of all motorways, state and provincial roads.

KGM is the state agency in charge of the construction and maintenance of all public roadways outside of cities and towns in Turkey. KGM does not draft legislation itself but delivers against legislation of the state of Turkey. KGM was set up following the acceptance of the International Highways Act in 1949.

A key piece of legislation is the Road Transport Act 2004. The act regulates the use of roads, but not the construction or maintenance of them. The Act regulate the use of the road network for transport by motor vehicle and includes passenger transport and haulage, carriers, transport agents and brokers as well as warehouse keepers and cargo operators, persons employed in transport operations, and all types of vehicle, appliance, device, building, etc. used in road transport operations.

On this basis, the planning, operation, maintenance and construction of the INA airport access roads will fall under the jurisdiction of the General Directorate of Highways (KGM), working in support of the state of Turkey policy and regulatory framework, by acting for and on behalf of the state of Turkey, as a sub-unit to the Ministry of Transport, Maritime and Communication.

Motorways are state roads with full access control at limited intersections and toll plazas, to ensure the exclusive use of road traffic only. These roads comprise two or more lanes in each

direction, with opposing traffic separated by a median, designed and operated to provide uninterrupted flow.

State roads are highways of primary importance connecting between motorway intersections, principal seaports, main airports, main railway stations, and provincial centres.

Provincial roads are highways of secondary importance linking districts within a province to each other, the provincial centre, districts in the neighbouring provinces, state roads, other railway stations, seaports and smaller airports.

7.11.2.2 Standards and Guidelines for International Financing

Applicable IFC standards and guideline requirements for transport are provided in the following references:

- IFC General Environmental, Health and Safety General Guidelines (Ref. 7.11.5);
- IFC Environmental, Health and Safety Guidelines for Airports (Ref. 7.11.6); and
- IFC Performance Standards on Social and Environmental Sustainability (Ref. 7.11.7).

7.11.3 Assessment Methodology

7.11.3.1 Scope

INA will require landside access to enable effective interchange between surface and airport modes of travel. Landside access will be provided by motorway and metro as described in the March 2014 Master Plan. This chapter considers the traffic and transport issues identified through: a comparison of the baseline against the construction and operational phases of INA; an assessment of potential impacts prior to mitigation; the definition of mitigation measures; and an assessment of residual impacts following mitigation. The scope of this chapter is based on the following parameters, for the construction and operational phases of the Project:

- Social and environmental strategic landside access issues and risks; and
- Links to INA within an area of approximately 5 km adjoining the Project Area.

For clarity, the scope of this chapter does not include the internal airport precinct networks (parking areas, terminal forecourts, public transport hubs), any new urban areas adjacent to INA, or wider regional/national landside access networks outside the 5 km scope area.

This chapter sits alongside the Transport Assessment (to be prepared by others) and INA's preliminary traffic estimates study (Annex 7.11.C) has been taken into consideration. Therefore the scope of this chapter excludes detailed assessment of transport network performance (based on the modified transport network).

7.11.3.2 Method

In order to establish the baseline traffic data for this assessment, the following methodology was applied. The KGM has permanent traffic count sites on the state road network to enable the determination of coefficients (weekly, monthly and seasonal) required to convert annual traffic data obtained from portable and short terms counts, to Annual Average Daily Traffic (AADT) values. The traffic counts collected for the INA ESIA have been converted to AADT values by applying the relevant average monthly conversion coefficients according to the different vehicle classes/groups (i.e. car, medium goods vehicle, bus, truck and articulated truck).

The five-day traffic counts have been converted to monthly average daily traffic values through a weighted average approach, by considering the number of weekdays and weekends of the respective month according to the vehicle classes/groups. Then, AADT values are calculated by applying the relevant monthly coefficient per vehicle class/group. This method is based on the assumption that the publicly available average monthly conversion coefficients calculated using 2007 and 2008 values by KGM are valid, and on this basis the single seasonal survey is sufficiently representative for the purposes of this chapter. This is in accordance with the baseline study.

7.11.3.3 Significance Criteria

In accordance with best practice, the significance criteria, receptor groups and topics applied in this chapter are sourced from Institute of Environmental Assessment guidance: “Guidelines for Environmental Assessment of Road Traffic”) (Ref. 7.11.1).

The significance criteria adopted for potential traffic and transport impacts are based on the magnitude, extent, reversibility and sensitivity of the receptor, as set down in **Chapter 6 Impact Assessment Methodology**.

A standard approach has been adopted across the ESIA, wherever possible, to consistently define impact significance. This approach is applied to the assessment of impacts in all phases of the Project (i.e. construction and operation). The standard approach has been structured as transparently as possible using the severity criteria presented in Table 7.11.1.

Severity is dependent upon the magnitude of the impact, for example, in terms of the duration (long, medium, short term), the extent (site, local, regional, national) and reversibility (reversible, irreversible) as well as on the sensitivity of the receptor (as a resource and/or to the change or impact).

Table 7.11.1 Qualitative Severity Criteria

Severity	Description
None/Negligible	No discernible impact – Effects are non-existent or the impact is deemed to be “negligible”.
Low	Slight effects, well within acceptable thresholds Duration: short term Extent: localised to immediate area Reversibility: reversible Sensitivity of the receptor: low sensitivity/value
Moderate	Noticeable effect but still within acceptable thresholds. Duration: short term (moderate receptor sensitivity/value) or regional (low receptor sensitivity/value) Extent: local (moderate receptor sensitivity/value) or regional (low receptor sensitivity/value) Reversibility: reversible Sensitivity of the receptor: Moderate/low sensitivity/value
High	Considerable effect and/or repeated breach of acceptable thresholds. Duration: medium to long term (moderate to low value receptors), short term (high value receptors) or long term.

Severity	Description
	<p>Extent: local (high receptor sensitivity/value receptors), or irreversible (low value receptors or localised moderate/high value receptors) or regional, national or international effect.</p> <p>Reversibility: reversible (moderate/high value receptors), or irreversible (low value receptors or localised moderate/high value receptors). Limited reversibility/irreversible</p> <p>Sensitivity of the receptor: Moderate/High sensitivity/value or high sensitivity/value.</p>

The significance of the impact risk is a function of the likelihood of occurring and the severity of the impact should it occur. Table 7.11.2 below provides a description of the likelihood categories applied in this chapter.

Table 7.11.2 Likelihood Criteria

Likelihood	Description
Probable	Events that are known and expected to occur on multiple occasions during the lifetime of the Project. Probability of more than 50%.
Possible	Events known to occur periodically and expected to occur at least once during the lifetime of the Project. Probability of less than 50%.
Unlikely	Events known to occur although rarely and are unlikely to occur during the lifetime of the Project. Probability of occurrence – less than 10%.
Improbable	Events known but so rarely occur and are extremely unlikely to occur during the lifetime of the Project. Probability of occurrence – less than 1%.

The significance of the overall impact is then determined using the following matrix (Table 7.11.3).

Table 7.11.3 Significance Matrix

Likelihood of Impact	Severity of Impact			
	Negligible	Low	Moderate	High
Probable	Negligible	Low	Moderate	High
Possible	Negligible	Negligible	Low	Moderate
Unlikely	Negligible	Negligible	Negligible	Low
Improbable	Negligible	Negligible	Negligible	Negligible

While it is important to identify the initial significant impacts associated with the Project prior to implementation of mitigation, the key focus of the impact assessment is to define the significance of residual impacts and effects following application and/or consideration of mitigation measures. A residual impact is one, which continues to be present following the application of avoidance and/or mitigation measures. However, for completeness, the impact significance of potential impacts prior to avoidance and/or mitigation is discussed in Section 7.11.5. In rating the significance of residual impacts and effects, the terminology described in Table 7.11.4 has been used.

Table 7.11.4 Type of Residual Impacts and Effects

Type of Effect	Description
Adverse	negative effect to an environmental resource or receptor
Neutral	no effect to an environmental resource or receptor
Beneficial	advantageous or positive effect to an environmental resource or receptor

In response to the above significance criteria, the receptor groups relevant to the scope of this chapter are classified by sensitivity split by land use (activities around the airport and adjacent to transport links), infrastructure (the transport links) and transport users, as follows (Table 7.11.5). This table effectively hinges receptor sensitivity as land use types to transport effects, or receptor sensitivity as local community to transport effects due to infrastructure, or receptor sensitivity as transport users to transport effects.

Table 7.11.5 Receptor Groups Split by Land Use, Infrastructure and Transport Users

Sensitivity	Receptor Sensitivity as Land Use Types to Transport Effects	Receptor Sensitivity as Local Community to Infrastructure	Receptor Sensitivity as Transport Users to Transport Effects
None/ Negligible	Open Spaces	N/A	N/A
Low	Tourist sites Historic buildings Places of worship	Local distributor roads River/sea networks Informal cycle routes	General traffic occupants Fully segregated mode occupants and operators
Medium	Health facilities Parks and recreation Retail areas Residential areas Sites with narrow footways	Minor main roads Bus networks (on-road) Local segregated cycle routes	Cyclists (segregated) Road freight operators Road public transport occupants and operators
High	Education facilities Retirement homes Sites with no footways Accident black spots	Main roads and motorways Light rail, heavy rail and metro Segregated cycle highways	Pedestrians and cyclists (sharing the road) Children Elderly Those with physical or mental impairment

Institute of Environmental Assessment guidance suggests a list of topics against which the significance criteria can be applied across the relevant receptors. These are listed below in Table 7.11.6 together with a commentary on their relevance to the assessment of landside access to the Project Area (during the construction and operational phases).

Table 7.11.6 Selection of Relevant Traffic and Transport Topics

Topic	Summary Definition	Commentary	Relevance to this Chapter
Night Time Noise	Change in existing traffic noise with the airport.	Upgraded existing main roads and new roads may increase night time noise.	Not included in this chapter - to be assessed separately.
Vibration	Change in existing traffic vibration with the airport.	Upgraded existing main roads and new roads may increase vibration.	Not included in this chapter - to be assessed separately.
Severance	An issue when neighborhoods are cut-through by new infrastructure.	Upgraded existing main roads and new roads may increase severance.	Relevant to construction and operation. Relevant to local communities generally and pedestrians/cyclists specifically.
Fear and Intimidation	An issue for pedestrians should local roads experience increases in traffic and freight movements.	No footways along upgraded main road so impact should not be felt by pedestrians.	Not relevant, as no footways adjacent to existing /new motorways.
Delay for Transport Users	An issue if there is impact on the local networks.	Driver delay possible (assessment outputs not currently available), but pedestrian delay unlikely.	Relevant to construction and operation. Relevant to road vehicle users.
Safety of Transport Users	Responds to potential changes in accident numbers.	Increase in flows, likely to increase risk of accidents occurring.	Relevant to construction and operation. Relevant to all transport users, and local community.
Amenity for Transport Users	Relates to pleasantness of the journey	Quality and smoothness of airport landside access is critical to airport operation	Relevant to operation. Relevant to all transport users generally and specifically to airport passengers.
Hazardous and Dangerous Loads	Relates to specific high- risk movements on road or rail, e.g. chemical, biological or nuclear.	No specific requirements for this type of transport identified for this Project.	Not relevant, as an airport does not require such specific high-risk movements on road or rail, e.g. chemical, biological or nuclear, during construction or operation. If ever required, this would be covered by a separate specific licence. Fuel, while considered hazardous, is within normal operating

Topic	Summary Definition	Commentary	Relevance to this Chapter
			conditions for freight carried on the highway. On this basis this topic has not been selected as relevant for this assessment. Fuel transport will be covered as part of the management plan discussed below.
Dust and Dirt	Relates to temporary quarrying and construction activity.	Upgraded existing main roads and new roads may increase dust and dirt during construction.	Not included but covered in Chapter 7.2 Air Quality.
<p>Notes:</p> <ol style="list-style-type: none"> 1. There is only a limited amount of data currently available, prior to the detailed design, so the above selected topics are assessed at a high level (where data are currently available) or qualitatively. 2. Pedestrian related topics have been discounted as not relevant for this chapter. This is due to the landside access infrastructure to the airport precinct being non-pedestrian focussed (i.e. motorway and rail/metro). Pedestrian access to the rail/metro stops, for example, is outside the scope of this chapter, but is assumed. 			

On this basis, the topics of severance, driver delay, safety of transport users and amenity for transport users have been selected as relevant for this chapter. A full definition of each selected topic and how magnitude is measured is described as follows:

Severance

Severance relates to the actual and perceived divisions that can occur within a community when it becomes separated by new transport infrastructure.

The measurement for assessing severance is difficult to predict as *“the correlation between the extent of severance and the physical barrier is not clear and there are no predictive formulae which give simple relationships between factors and levels of severance”* (Ref. 7.11.1).

However, a range of indicators has been used (based on guidance and expert judgement) to determine the significance of severance effects. The threshold for assessing severance adopted for this assessment is based on changes in peak hour traffic flows as set out in the DMRB, Volume 11, Section 3 (Ref. 7.11.4). Estimated peak hour traffic levels between the baseline and the various phases have been compared. These indicators have been used to calculate the severity of severance impact as set out in Table 7.11.7 below.

Table 7.11.7 Magnitude Classification for Pedestrian Severance

Impact Severity	Change in Traffic Flow
Negligible	< 30%
Low	30% - 60%
Moderate	60% - 90%
High	> 90%

Driver Delay

Driver delay is only likely to be significant when the traffic on the network local to the Project Area is at capacity. With the Project, the network is predicted to operate at, or close to, the capacity of the system. Assessment outputs are not currently available.

When considering driver delay the following assumptions were made:

- Where it is expected that the junction capacity results will show the junction to operate within capacity during the operational phase, the severity of the impact on driver delay has been classed as negligible;
- Where it is expected that the junction capacity results will show the junction to operate over capacity during both the baseline and the operational phase, the severity of the impact on driver delay has been classed as low; and
- Where it is expected that the junction capacity results will show the junction to operate within capacity during the baseline, but over capacity during the operational phase, the severity of impact on driver delay has been classed as moderate or high.

Owing to the lack of data currently available, professional judgement has been used to determine the scale of driver delay, based on estimated changes in baseline and estimated volume, composition of flow or speed of traffic.

Safety of Transport Users

An increase in traffic flow can lead to a higher incidence or more severe accidents, though this change is largely dependent upon the design of the infrastructure provided to handle the expected increase in flow. The construction of INA will result in an increase in traffic but in tandem, the main roads are to be upgraded to enable the flows to be handled safely. On the basis that the design of the infrastructure is fit for purpose and has been subject to safety audit procedures, the severity of impact of the Project on transport user safety has been classed as low.

Amenity for Transport Users

This topic can best be described as 'relative pleasantness of a journey'. It is affected by design, traffic flow and traffic composition. A high level qualitative view on this topic is given in this assessment in recognition of the importance of achieving the best customer experience for travellers arriving and departing from the INA via landside access modes, balanced against protecting and insuring local access.

7.11.4 Baseline Information Background and Sources of Information

7.11.4.1 Sources of Information

The baseline information for the ESIA was based on the analysis presented in Annex 7.11.A.

7.11.4.2 Findings

Currently, the baseline is characterised by the existing four-lane highway between Ihsaniye and Tayakadin, which passes through the southern section of the Project Area. This is the main road linking the area to Istanbul. The AADT values obtained on Ihsaniye to Tayakadin Highway (D-010) in 2012 are summarised by Table 7.11.8. The key values are the site closest to the airport (referred to as Segment 2).

Table 7.11.8 AADT Values on Ihsaniye to Tayakadin Highway (D-010) in 2012

Control Section Number	Segment No.	Length (km)	Type of Counting	Average Annual Daily Traffic (AADT) Values (vehicles/day)					
				Cars	Medium Goods Vehicles	Buses	Trucks	Articulated Trucks	Total
D-010	1	26	Forecast	555	30	1	166	107	859
D-010	2 (Adjacent to Project Area)	23	Automatic Vehicle Classification Counts	2,204	171	11	1,455	1,362	5,203
D-010	3	9	Forecast	32,243	1,613	194	5,303	3,495	42,848

7.11.5 Potential Impacts

7.11.5.1 Receptors

The proposed airport maximum capacity of 150 mppa will comprise six runways, with associated passenger terminals and satellites (international and domestic). From a landside access perspective, the Project can be separated between:

- Landside (within the airport precinct): forecourts, parking (staff, customers), public transport modes (train, metro, express coach, urban bus), ancillary services, emergency facilities; and
- Landside (outside the airport precinct): links to motorway and rail/metro networks.

The landside access (which includes the area within 5 km outside the airport precinct) is the focus of this assessment. Of specific note are the following strategic projects, which are understood to feed into the scoping area:

- The main four lane highway between Ihsaniye and Tayakadin which currently passes through the southern section of the Project Area is proposed to be relocated to the southern boundary of the Project Area and will serve the Project;
- The Northern Marmara Motorway connecting the 3rd Bosphorus Crossing with western Turkey and Eastern Europe is planned to run to the south of the Project Area. This is planned to be a six lane motorway; and
- A rail link/metro is proposed to connect the City of Istanbul with the INA.

The Project Area is directly surrounded by several residential zones, located between 1 and 5 km from the Project. In these residential areas (Durusu, Tayakadin and Arnavutkoy), there are dwellings, schools, mosques and health centres, which are considered sensitive in terms of traffic and transport impacts. In addition, there are local transport users who will also be sensitive receptors. Table 7.11.8 above presents how the receptors are considered sensitive to transport related impacts. This table effectively hinges receptor sensitivity as: land use types

to transport effects; receptor sensitivity as local community to transport effects due to infrastructure; or receptor sensitivity as transport users to transport effects.

Earthworks/Construction

In accordance with the scope of this chapter, construction traffic impacts relate to off-site access, not movements within the site. During construction, the following activities have the potential to generate transport and traffic impacts relating to community severance, driver delay, and transport user safety:

- Additional heavy goods vehicle (HGV) trips on the road network;
- Temporary closure of pedestrian footways; and
- Travel to/from Site by construction workers

Impacts such as noise, dust and vehicle emissions are also likely. However, these have been assessed in **Chapter 7.2 Air Quality**.

The construction traffic impact assessment is subject to future refinement of the design and construction methods. The assessment of construction impact will depend on the construction methods applied, and mix of construction transport modes available. In terms of mix of construction modes, the following has been assumed:

- Road: using the Ihsaniye to Tayakadin Highway (D-010) - construction routes to be used by construction traffic are to be confirmed;
- Rail: it is understood that the new link will not be built before the construction of Phase 1. On this basis, rail is excluded from this assessment of construction impact; and
- Shipping: it is understood that coastal shipping is not considered feasible by the Project, so this is excluded from this assessment of construction impact.

On this basis, this assessment of construction impact has focused on road based construction traffic only using HGVs.

The Project Area currently consists of forest lands and a further area has been used for open cast mining. This Project Area is proposed to be redeveloped including earthworks to provide a platform for the airport up to 92 m above sea level. This will require forest uprooting, water bodies to be filled and land to be levelled. Cut and fill will be processed and largely balanced on-site. The exception is tree roots. It is estimated that there are 60,000 tonnes of tree roots to be removed off site.

Construction is programmed to occur in four phases. With respect to construction, the volumes summarised in Table 7.11.9 have been estimated to be transported to/from the site.

Table 7.11.9 Construction Quantities

Activity	Unit	Quantities			
		Phase 1	Phase 2	Phase 3	Phase 4
Tree Root Clearance	tonnes	60,000	-	-	-
Granular backfill	m ³	11,806,000	2,419,700	1,497,500	1,754,000
Sub-course	tonnes	22,434,400	5,187,900	4,424,500	5,563,600
Asphalt Base-course	tonnes	5,036,300	1,496,000	925,900	1,084,400
Asphalt Binder-course	tonnes	2,116,700	608,900	376,900	441,400
Asphalt Surface-course	tonnes	831,800	210,900	130,500	152,900

Activity	Unit	Quantities			
		Phase 1	Phase 2	Phase 3	Phase 4
Concrete ¹	m ³	6,467,000	20,700	373,950	551,400
Cement	tonnes	2,263,400	7,200	130,900	193,000
Aggregate	tonnes	11,317,200	36,200	654,400	965,000
<p>¹ For the purposes of this study, the total concrete requirement (including superstructures) is estimated as 1.5 x the projected airfield quantities (apron, roads, culverts, tunnel works, etc.). These may represent overestimates and are considered to be conservative figures.</p>					

On review of HGV specifications and the Turkish highway HGV loading regulations, the following pay-loads per HGV are estimated per vehicle:

- 10 tonnes of roots;
- 13.5 m³ of backfill material;
- 27 tonnes of asphalt;
- 6.1 m³ of concrete;
- 27.6 tonnes of cement; and
- 27 tonnes of aggregate.

This equates to the estimates presented in Table 7.12.10 of total 2-way HGV movements to/from the site (each load requires two vehicle movements, of which one is loaded).

Table 7.11.10 Estimate of Total 2-Way HGV Movements

Activity	Unit	Total 2-Way HGV Movements			
		Phase 1	Phase 2	Phase 3	Phase 4
Tree Roots	tonnes	12,000	-	-	-
Granular Backfill	m ³	1,749,000	358,500	221,900	259,900
Sub-course	tonnes	1,661,800	384,300	327,700	412,100
Asphalt Base-course	tonnes	373,100	110,800	68,600	80,300
Asphalt Binder-course	tonnes	148,000	42,600	26,400	30,900
Asphalt Surface-course	tonnes	61,600	15,600	9,700	11,300
Concrete	m ³	2,120,300	6,800	122,600	180,800
Cement	tonnes	158,300	500	9,200	13,500
Aggregate	tonnes	838,300	2,700	48,500	71,500

Each of the four phases of construction is estimated to last approximately 36 months. Based on a 20 day working month, this equates to 720 working days per construction phase. This gives the estimated average number of loaded trucks or truck movements to/from the site per working day and peak hour, based on a 10-hour working day presented in Table 7.11.11.

Table 7.11.11 Estimate of Average Daily and Peak Hour 2-Way HGV Movements

Activity	Average Work Day Peak Hour 2-Way HGV Movements			
	Phase 1	Phase 2	Phase 3	Phase 4
Tree Roots	5	-	-	-
Granular Backfill	245	50	30	35
Sub-course	230	55	45	55
Asphalt Base-course	50	15	10	10
Asphalt Binder-course	20	5	5	5
Asphalt Surface-course	10	<5	<5	<5
Concrete	295	<5	15	25
Cement	20	<5	<5	<5
Aggregate	115	<5	5	10

These estimated construction HGV traffic flows have been applied to the baseline to identify level of impact, relating to community severance, driver delay and transport user safety as follows.

Table 7.11.12 shows the estimated pre-construction phase peak hour flows resulting from baseline 'background' traffic on the existing highway plus traffic forecast at different future airport operational phases. Baseline and operational forecasts are introduced at this point as comparators against which to assess the impact of construction traffic.

Table 7.11.12 Total Vehicles during Normal Airport Operations (Peak Hour, 2-Way)

Assessment Period/ Year	Pre-Construction Network Baseline ¹	Operational Airport Traffic Forecast	Total
Pre-construction (2012)	750	-	750
Post Phase 1 (2018)	750	4,725	5,475
Post Phase 2 (2023)	750	4,387	5,137
Post Phase 3 (2030)	750	4,313	5,063
Post Phase 4 (2035)	750	5,135	5,885

Source: Table 7.11.14

The operational forecasts are assumed to be cumulative (i.e. the 2023 figure is the total forecast and not that the forecast for 2023 should be added to the 2018 figure). No growth in the pre-construction network baseline is assumed.

Table 7.11.13 considers data from Tables 7.11.11 and 7.11.12 and shows the anticipated changes to the estimated peak hour flows as a result of the addition of construction vehicles to baseline/previous phase flows. All flows are average weekday peak hour 2-way, split between site clearance (tree roots) and construction, based on all construction traffic being HGV movements. All traffic is assumed to use the upgraded Ihsaniye to Tayakadin Highway (D-010) as a worst case.

The % change shown in Table 7.11.13 is the impact of construction traffic compared to all existing highway traffic at each phase, e.g. phase 2 Granular Backfill traffic of 50 vehicles (see Table 7.11.11) represents a 1% increase on the 4,725 vehicles forecast (see Table 7.11.12).

Table 7.11.13 Estimated Change in 2-Way Peak-hour Traffic Flows during Construction

Activity	Phase 1 Baseline + Construction		Phase 2 Baseline + Operational Forecast + Construction		Phase 3 Baseline + Operational Forecast + Construction		Phase 4 Baseline + Operational Forecast + Construction	
	No. of Vehicles	% Change	No. of Vehicles	% Change	No. of Vehicles	% Change	No. of Vehicles	% Change
Tree Roots	755	1	-	-	-	-	-	-
Granular Backfill	995	32	4,775	1	4,420	1	4,350	1
Sub-coarse	980	31	4,780	1	4,430	1	4,370	1
Asphalt Base-course	800	7	4,740	<1	4,395	<1	4,325	<1
Asphalt Binder- course	770	3	4,730	<1	4,390	<1	4,315	<1
Asphalt Surface- course	760	1	4,725	<1	4,390	<1	4,315	<1
Concrete	1,045	39	4,725	<1	4,405	<1	4,340	1
Cement	770	3	4,725	<1	4,390	<1	4,315	<1
Aggregate	865	16	4,725	<1	4,395	<1	4,325	<1

Severance

The above estimates suggest that for Phase 1, with these construction flows, the severance effect along the Ihsaniye to Tayakadin Highway (D-010) is of low significance, based on a low severity and probable likelihood against the baseline. This is on the basis that the various estimated high construction flows will occur separately.

Should two high flow events converge at the same time (such as granular backfill and sub-coarse) then the severance effect would accumulate to one of moderate significance, based on a moderate severity and probable likelihood against the baseline.

It should be noted that the above assessment does not include plant movements. If these movements occur during the peak period, they will introduce an incremental additional severance impact. In addition, the above assessment excludes staff movements. If these

movements occur during the peak period, these construction worker movements will introduce further severance impact.

The estimated construction flows for Phases 2, 3 and 4 are very low compared to the operational airport traffic flows forecast. The severance effect of construction traffic is therefore of negligible significance, based on a probable likelihood but negligible severity of impact.

Driver Delay

As per baseline the 2012 flows, the local state road network within 5 km is considered to operate within capacity (based on a theoretical lane capacity of 1,500 vehicles per hour), in response to the modest flows of 750 vehicles in the peak hour reported (see Table 7.11.12).

With Phase 1 construction, local flows are expected to increase (see Table 7.11.13), depending on the mix and sequencing of construction flows. Impact on delay for drivers on (or seeking to cross at-grade) the Ihsaniye to Tayakadin Highway (D-010) in the peak periods during airport construction is of moderate significance. This is based on a high severity and probable likelihood against the baseline, assuming that the various estimated high construction flows will occur separately.

Should two high flow events converge at the same time (such as granular backfill and sub-coarse) then the driver delay effect would accumulate to one of high significance, based on a high severity and probable likelihood against the baseline.

It should be noted that the above assessment does not include plant movements. If these movements occur during the peak period, they will introduce an incremental additional driver delay impact. In addition, the above assessment excludes staff movements. If these movements occur during the peak period, these construction worker movements will introduce further driver delay impact.

The estimated construction flows for Phases 2, 3 and 4 are very low compared to the operational airport traffic flows forecast. The driver delay effect of construction traffic is therefore of negligible significance, based on a probable likelihood but negligible severity of impact.

Safety of Transport Users

As per Table 7.11.13, with increased traffic flow, it is expected there is an increase in numbers and potentially severity of accidents, although there is no set rate change to refer to. Therefore impact on safety for transport users on or seeking to cross at-grade the Ihsaniye to Tayakadin Highway (D-010), in the peak periods during Phase 1 construction is of high significance based on a high severity (based on accidents involving HGVs) and probable likelihood against the baseline. This is on the basis that the various estimated high construction flows will occur separately.

Should two high flow events converge at the same time (such as granular backfill and sub-coarse), then the effect on transport user safety would accumulate to one of high significance, based on a high severity (based on accidents involving HGVs), and probable likelihood (due to increased HGV flows), against the baseline.

It should be noted that the above assessment does not include plant movements. If these movements occur during the peak period, they will introduce an incremental additional transport user safety impact. In addition, the above assessment excludes staff movements. If these movements occur during the peak period, these construction worker movements will introduce further transport user safety impact.

The estimated construction flows for Phases 2, 3 and 4 are very low compared to the operational airport traffic flows forecast. The impact of construction traffic on safety of transport users is therefore of low significance, based on an unlikely likelihood but high severity.

Amenity for Transport Users

Amenity will vary depending on mode of use, trip purpose, time of travel and route taken. Based on the peak period during construction, the focus of amenity is on local trips, not connected with airport construction. It is expected that owing to the level of construction traffic flows, the impact on amenity for transport users on or seeking to cross at-grade the Ihsaniye to Tayakadin Highway (D-010) in the peak periods during airport construction is of moderate significance based on a moderate severity and probable likelihood against the baseline. This is on the basis that the various estimated high construction flows will occur separately.

Should two high flow events converge at the same time (such as granular backfill and sub-coarse), then the effect on amenity for transport users would accumulate to one of moderate significance, based on a moderate severity, and probable likelihood, against the baseline.

It should be noted that the above assessment does not include plant movements. If these movements occur during the peak period, they will introduce an incremental additional transport user amenity impact. In addition, the above assessment excludes staff movements. If these movements occur during the peak period, these construction worker movements will introduce further transport user amenity impact.

The estimated construction flows for Phases 2, 3 and 4 are very low compared to the operational airport traffic flows forecast. The impact of construction traffic on amenity for transport users is therefore of negligible significance, based on a probable likelihood but negligible severity of impact.

Airport Operations

On the basis of Table 7.11.6 above, the following topics of severance, driver delay, safety of transport users and amenity for transport users were selected as relevant to landside access airport operations.

Table 7.11.14 indicates the estimated changes in peak hour flows, between the baseline (2012) and for the various operational phases on the Ihsaniye to Tayakadin Highway (D-010). Baseline network flow is based on an estimated mode split of 40% public transport, as determined by the case study research data (see Annex 7.11.A). Post-construction forecasts are based on the INA preliminary traffic estimates study (see Annex 7.11.C). All traffic is assumed to use the upgraded Ihsaniye to Tayakadin Highway (D-010), as a worst case. In order that the pre- and post-construction figures are compared like-for-like, peak hour is taken as 17:00 – 18:00 (in line with the case study research referred to in Annex 7.11.A) even though the post-construction forecast indicates more distributed traffic flow with less well defined peaks (mainly according to forecasts of airline passenger numbers).

Table 7.11.14 Estimated Change in Traffic Flow Following Each Construction Phase

Assessment Period / Year	Operational Airport Traffic Forecast	Total (Baseline + Airport)	Total
Baseline Network Flow (2012)	-	750	-
Phase 1 (2018)	4,725	5,475	630%

Assessment Period / Year	Operational Airport Traffic Forecast	Total (Baseline + Airport)	Total
Phase 2 (2023)	4,387	5,137	-6%
Phase 3 (2030)	4,313	5,063	-1%
Phase 4 (2035)	5,135	5,885	16%

Severance

The above estimates suggest that for operational Phase 1, the severance effect along the Ihsaniye to Tayakadin Highway (D-010) is of high significance, based on a high severity and probable likelihood, against the baseline.

The flows forecast for operational Phases 2 and 3 decrease slightly against the operational forecast flows for the preceding phase in each case. The changes are, however, within normal fluctuations in peak hour traffic flows (Ref. 7.11.8) and so the impacts of Phases 2 and 3 are of negligible significance. As such no requirement for additional mitigation is anticipated, based on the assumption that Phase 1 mitigation measures remain in place.

The forecast following Phase 4 is for traffic flow to increase once again. The severance effect along the Ihsaniye to Tayakadin Highway (D-010) is of moderate significance. This is based on a 16% increase representing moderate severity (noticeable effects but still within acceptable thresholds) and probable likelihood, compared to the prior operational Phase 3.

Driver Delay

As per baseline 2012 flows, the local state road network within 5 km is considered to operate within capacity (based on a theoretical lane capacity of 1,500 vehicles per hour), in response to the modest flows of 750 vehicles in the peak hour reported (see Table 7.11.14).

As a result of Phase 1, local flows are expected to increase (see Table 7.11.14). Therefore impact on driver delay for drivers on or seeking to cross at-grade the Ihsaniye to Tayakadin Highway (D-010) in the peak periods during airport operation is of high significance, based on a high severity and probable likelihood against the baseline.

Following Phases 2 and 3, operational flows are forecast to decrease slightly against the operational forecast flows for Phase 1. The changes are, however, within normal fluctuations in peak hour traffic flows (Ref. 7.11.8) and so the impacts of Phases 2 and 3 are of negligible significance. As such no requirement for additional mitigation is anticipated, based on the assumption that Phase 1 mitigation measures remain in place.

Phase 4 is forecast to see an increase in flows from those forecast for Phases 2 and 3. On this basis the impact on driver delay in peak periods will be of moderate significance. This is based on a 16% increase representing moderate severity (noticeable effects but still within acceptable thresholds) and probable likelihood.

Safety of Transport Users

In response to Phase 1, local flows are expected to increase (see Table 7.11.14), so accidents are expected to rise, although there is no set rate change to refer to. Therefore impact on transport user safety, for transport users on or seeking to cross at-grade the Ihsaniye to Tayakadin Highway (D-010), in the peak periods during Phase 1 airport operations is of moderate significance, based on a moderate severity (balance between change in number of

accidents and the potential severity of any accidents), and probable likelihood, against the baseline.

Following Phases 2 and 3, operational flows are forecast to decrease slightly against the operational forecast flows for Phase 1. The changes are, however, within normal fluctuations in peak hour traffic flows (Ref. 7.11.8) and so the impacts of Phases 2 and 3 are of negligible significance. As such no requirement for additional mitigation is anticipated, based on the assumption that Phase 1 mitigation measures remain in place.

Phase 4 is forecast to see an increase in flows from those forecast for Phases 2 and 3. On this basis, the impact on transport user safety in peak periods will be of moderate significance. This is based on a 16% increase representing moderate severity (noticeable effects but still within acceptable thresholds) and probable likelihood.

Amenity for Transport Users

Amenity will vary depending on mode of use, trip purpose, time of travel and route taken. Against a background of expected increases in traffic on local roads, trips can be split between airport and non-airport (local) trips:

- Airport trip amenity is delivered by the new/upgraded infrastructure to enable reliable, smooth, legible access to and from the airport by road, bus or rail; or
- Non-Airport (local) trip amenity is delivered by connectivity, ease of passage, respect of existing routes and segregation from airport flows where possible, for local access trips by road, bus, rail, cycle or on-foot.

On this basis, it is considered that the Phase 1 impact on amenity for transport users on or seeking to cross at-grade the Ihsaniye to Tayakadin Highway (D-010) in the peak periods during airport operation is of moderate significance, based on a moderate severity and probable likelihood against the baseline.

Following Phases 2 and 3, operational flows are forecast to decrease slightly against the operational forecast flows for Phase 1. The changes are, however, within normal fluctuations in peak hour traffic flows (Ref. 7.11.8) and so the impacts of Phases 2 and 3 are of negligible significance. As such no requirement for additional mitigation is anticipated, based on the assumption that Phase 1 mitigation measures remain in place.

Phase 4 is forecast to see an increase in flows from those forecast for Phases 2 and 3. On this basis the impact on transport user amenity in peak periods will be of moderate significance. This is based on a 16% increase representing moderate severity (noticeable effects but still within acceptable thresholds) and probable likelihood.

7.11.6 Mitigation and Residual Impacts

The following section describes the actions and strategies designed to avoid, minimise or mitigate the potential adverse impacts of the Project, or to enhance potential Project benefits.

7.11.6.1 Earthworks/Construction

As described above, construction activities will generate traffic and transport impacts relating, in varying degrees, to severance, delay, safety and amenity effects.

In response to the identified impact of the estimated number of daily peak hour HGV 2-way moves (Table 7.11.13), the Project will incorporate the following construction impact mitigation measures:

- Re-use cut on-site as fill or bunds rather than remove off-site, where possible;
- Treat contaminated soils for re-use on-site where possible;
- Enable concrete fabrication on-site where possible;
- Use high efficiency HGVs and consolidate loads to reduce empty trailer movements;
- Reduce construction worker travel impact by managing non-car access options, e.g. worker shuttles;
- Introduce worker shift start/finish times so that they fall outside the network peak times, to reduce impact during the peak periods;
- A detailed Construction Logistic Plan is to be completed detailing the specific number and routing of vehicles to and from the Project Area by mode. Depending on the detail of the Construction Logistics Plan, construction traffic and transport impact will probably remain moderate, and of moderate significance, albeit temporary in nature, across the topics of severance, driver delay, safety of transport users and amenity for transport users; and
- The traffic and transport impacts of construction are to be controlled through the framework ESMP and Traffic and Transport Management Plan, which will be developed for the Project.

However, in response to the construction programme resulting in the scale of the estimated HGV movements (especially during Phase 1 construction) combined with the lack of choice in construction transport mode, it is expected that the introduction of the above mitigation measures would not significantly reduce the level of impact identified in the construction assessment in relation to severance, delay, safety or amenity effects especially during Phase 1 construction. This is due to the scale of HGV flows especially during Phase 1, which is unlikely to reduce enough with the mitigation measures, to mitigate the identified impacts still further. This is mainly in response to there being only one mode choice for construction; HGV. On this basis the above mitigation measures are only expected to achieve a minor reduction in level of impact.

Therefore residual construction traffic effects are identified as **Negligible to Low** (Adverse) in respect of severance; **Negligible to Moderate** (Adverse) in respect of driver delay; **Low to Moderate** (Adverse) in respect of safety for transport users; and **Negligible to Low** (Adverse) in respect of amenity for transport users.

7.11.6.2 Airport Operations

Measures to be implemented during the operational phase to prevent, minimise, and control transport and traffic impacts due to INA landside access across all operational phases will include:

- Development of landside access strategy, parking business plan and airport sustainable access strategy for the Project, based on agreed objectives and requirements, founded on currently available data, evidence and transparent option assessments;
- Provide a high quality mix of landside access modes to include high quality road, bus, coach and rail access from Istanbul urban and national networks;
- Design landside access to/from the INA to ensure against compromise in terms of safety, reliability, resilience, and legibility; and

- Ensure landside access design protects and enhances local access for local trips by all modes through appropriate segregation, severance minimisation and delay impact management.

How these overarching airport operations mitigation measures will apply to the specific impact topics of severance, driver delay, safety and amenity is described below.

Severance

The identified impact on severance is mitigated through the following planning and design principles:

- Future land use planning which removes the demand for connections across the main roads accessing the INA; and
- Where such demand cannot be avoided (e.g. existing), the main road airport access design will ensure local connectivity for all travel modes on routes seeking to cross the airport access roads with suitably scaled and quality of crossing facility (bridges or underpasses).

With the correct application of these principles through balanced design, residual severance impact is expected to be reduced to low significance, based on a low severity and probable likelihood against the operational assessment. The remaining residual severance impact is unavoidable due to the introduction of the new transport links into the existing landscape, and the influence this will have on future land use planning decisions. The residual severance impact is identified as adverse and of **Negligible to Low** significance.

Driver Delay

The identified impact on driver delay during airport operations is mitigated through infrastructure upgrades in terms of intersection layouts and link geometries, to deal with the changes in flows, speed, mix of traffic to meet the expected levels of service.

Therefore, through balanced design, driver delay impact is expected to be reduced to moderate significance, based on a moderate severity and probable likelihood against the operational assessment, owing to the inherent change in delay to journeys that will arise owing to new road layouts/intersections and the expected increase in flows on local roads due to the airport. The residual driver delay impact is identified as adverse and of **Negligible to Moderate** significance.

Transport User Safety

The impact on transport user safety of increased traffic flows is balanced by new and upgraded infrastructure to carry the increased flows safely, efficiently and in accordance with airport access expectations.

A key part of the new and upgraded infrastructure is the segregation of local traffic and vulnerable road users away from the high airport flows, to mitigate safety impact.

The identified impact on transport user safety is mitigated through the design of walk and cycle routes to avoid conflict with traffic flows, and the design on intersections to provide a safer intuitive and legible driving environment. As a result transport user impact is expected to remain at moderate significance, based on a moderate severity (balance between change in number of accidents and the potential severity of any accidents), and probable likelihood, against the operational assessment, owing to the increase in flows and speed of traffic on the

local roads, and introduction of more conflict points at intersections. The residual transport user safety impact is identified as adverse and of **Negligible to Low** significance.

Amenity

The identified impact on traveller amenity through the operational assessment is considered to be of moderate significance. However, through quality of design of the intersections, crossing points, signage and traffic controls, and creative and artistic enrichment (e.g. art installations), to announce INA and to produce a pleasant travelling environment for airport and non-airport travellers, it is expected that amenity impact is mitigated to achieve a beneficial residual amenity impact of **Moderate** significance.

7.11.7 Summary of Impacts

A summary of the potential impacts and mitigation measures is given in Table 7.11.15 below.

Table 7.11.15 Summary of Residual Impacts

Topic	(Receptor/ Beneficiary)	Phase	Impact Categorisation	Potential Significance Prior to Mitigation	Design, Enhancement or Mitigation Measures	Management Plan	Residual Significance
Severance	Local community	All Phases of Construction	Type: Negative Duration: Temporary Extent: Local (boundaries of main road/rail links) Reversibility: Reversible (subject to temporary works and Traffic and Transport Management Plan) Sensitivity: Moderate/High	Likelihood: Probable Severity: Negligible to Low Significance: Negligible to Low	Project to: <ul style="list-style-type: none"> • Re-use cut on-site as fill or bunds; • Treat soils for re-use on-site; • Concrete fabrication on-site; • Use high efficiency HGVs; • Consolidate loads; • Use worker shuttles; and • Introduce off-set shift patterns. 	Traffic and Transport Management Plan	Negligible to Low (Adverse)
Severance	Local community	All Phases of Operation	Type: Negative Duration:	Likelihood: Probable Severity:	<ul style="list-style-type: none"> • Future land use planning to avoid demand for connections across the main 	Landside Access Design Process	Negligible to Low (Adverse)

Topic	(Receptor/ Beneficiary)	Phase	Impact Categorisation	Potential Significance Prior to Mitigation	Design, Enhancement or Mitigation Measures	Management Plan	Residual Significance
			Full time Extent: Local (boundaries of main road/rail links) Reversibility: Reversible (subject to design) Sensitivity: Moderate/High	Negligible to High Significance: Negligible to High	roads accessing the airport, where possible; and <ul style="list-style-type: none"> Where such crossing demand cannot be avoided (e.g. existing), the Project is to include main road airport access design which ensures local connectivity for all modes on appropriate desire lines across the main road provided with suitably scaled and quality of crossing facility (bridges or under-passes). 		
Driver delay	Local community	All Phases of Construction	Type: Negative Duration: Temporary Extent: Local (at intersections on main road links) Reversibility: Reversible (subject to temporary works and ESMP) Sensitivity:	Likelihood: Probable Severity: Negligible to High Significance: Negligible to High	Project to: <ul style="list-style-type: none"> Re-use cut on-site as fill or bunds; Treat soils for re-use on-site; Concrete fabrication on-site; Use high efficiency HGVs; Consolidate loads; Use worker shuttles; and Introduce off-set shift patterns. 	Traffic and Transport Management Plan	Negligible to Moderate (Adverse)

Topic	(Receptor/ Beneficiary)	Phase	Impact Categorisation	Potential Significance Prior to Mitigation	Design, Enhancement or Mitigation Measures	Management Plan	Residual Significance
			Moderate				
Driver Delay	Local community and Airport Users	All Phases of Operation	Type: Negative Duration: Full time Extent: Local (at intersections on main road links) Reversibility: Reversible (subject to design) Sensitivity: Moderate	Likelihood: Probable Severity: Negligible to High Significance: Negligible to High	Project design to: <ul style="list-style-type: none"> include new/ upgraded intersection layouts and link geometries, to deal with the changes in flows, speed, and mix of traffic; and deal with increased expectation for excellent levels of service, comparable to the scale, role and significance of the airport. 	Landside Access Design Process	Negligible to Moderate (Adverse)
Safety of transport users	Local community	All Phases of Construction	Type: Negative Duration: Full time Extent: Local (at intersections and links) Reversibility:	Likelihood: Unlikely to Probable Severity: High Significance: Low to High	Project to: <ul style="list-style-type: none"> Re-use cut on-site as fill or bunds; Treat soils for re-use on-site; Concrete fabrication on-site; Use high efficiency HGVs; Consolidate loads; Use worker shuttles; and Introduce off-set shift patterns. 	Traffic and Transport Management Plan	Low to Moderate (Adverse)

Topic	(Receptor/ Beneficiary)	Phase	Impact Categorisation	Potential Significance Prior to Mitigation	Design, Enhancement or Mitigation Measures	Management Plan	Residual Significance
			Reversible (subject to temporary works and ESMP) Sensitivity: High				
Safety of transport users	Local community and airport users	All Phases of Operation	Type: Negative Duration: Full time Extent: Local (at intersections and links) Reversibility: Reversible (subject to design) Sensitivity: High	Likelihood: Probable Severity: Negligible to Moderate Significance: Negligible to Moderate	Project design to include: <ul style="list-style-type: none"> • new/upgraded infrastructure to segregate local traffic and vulnerable road users away from the high airport flows where possible; and • walk and cycle routes to avoid conflict with traffic flows to manage safety impact for transport users. 	Landside Access Design Process	Negligible to Low (Adverse)
Amenity for transport users	Local community	All Phases of Construction	Type: Negative Duration: Temporary Extent:	Likelihood: Probable Severity: Negligible to Moderate	Project to: <ul style="list-style-type: none"> • Re-use cut on-site as fill or bunds; • Treat soils for re-use on-site; • Concrete fabrication on-site; 	Traffic and Transport Management Plan	Negligible to Low (Adverse)

Topic	(Receptor/ Beneficiary)	Phase	Impact Categorisation	Potential Significance Prior to Mitigation	Design, Enhancement or Mitigation Measures	Management Plan	Residual Significance
			Local (at intersections and links) Reversibility: Reversible (subject to temporary works and ESMP) Sensitivity: Low	Significance: Negligible to Moderate	<ul style="list-style-type: none"> • Use high efficiency HGVs; • Consolidate loads; • Use worker shuttles; and • Introduce off-set shift patterns. 		
Amenity for transport users	Local community and airport users	All Phases of Operation	Type: Negative Duration: Full time Extent: Local (at intersections and links) Reversibility: Reversible (subject to design) Sensitivity: Low	Likelihood: Probable Severity: Negligible to Moderate Significance: Negligible to Moderate	<ul style="list-style-type: none"> • Airport trip amenity is delivered by new/upgraded infrastructure to enable reliable, smooth, legible access to and from the airport by road, bus or rail. • Non-Airport (local) trip amenity is delivered by connectivity, ease of passage, respect of existing routes and segregation from airport flows where possible, for local access trips by road, bus, rail, cycle or on foot. 	Landside Access Design Process	Moderate (Beneficial)

7.11.8 Conclusions

As indicated above, following mitigation, it is considered that some residual impact will remain, split between construction and operations.

Construction (all phases):

- Adverse severance residual impact of **Negligible to Low** significance;
- Adverse driver delay impact of **Negligible to Moderate** significance;
- Adverse safety impact of **Low to Moderate** significance; and
- Adverse amenity impact of **Negligible to Low** significance.

All impacts associated with the operational phase of Phases 2 and 3 are considered to be **Negligible** (Adverse). Operational Phases 1 and 4 would have the following residual impacts:

- Adverse severance impact of **Negligible to Low** significance;
- Adverse driver delay impact of **Negligible to Moderate** significance;
- Adverse safety residual impact of **Negligible to Low** significance; and
- Beneficial amenity residual impact of **Moderate** significance.

References

Ref. 7.11.1	Institute of Environmental Assessment. Guidelines for Environmental Assessment of Road Traffic. 1993
Ref. 7.11.2	Airport Cooperative Research Program. Ground Access to Major Airports by Public Transportation. Report 4, 2008
Ref. 7.11.3	Airport Cooperative Research Program. Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies. Report 24, 2009
Ref. 7.11.4	UK Highways Agency. Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, 2009
Ref. 7.11.5	IFC General Environmental, Health and Safety General Guidelines, 2007
Ref. 7.11.6	IFC Environmental, Health and Safety Guidelines for Airports, 2007
Ref. 7.11.7	IFC Performance Standards on Social and Environmental Sustainability, 2006
Ref. 7.11.8	UK Highways Agency. Design Manual for Roads and Bridges (DMRB), Volume 5, Section 1, 1997

Annex 7.11.A: Baseline Traffic Survey Methodology

Traffic Survey Methodology

Introduction

The INA Site is located 35 km north-east of the existing Ataturk Airport and 40 km north-east from the centre of the city of Istanbul. It is reported in the ESIA that the Northern Marmara Motorway (including 3rd Bosphorus Bridge) Phase 1 and Phase 2 (Izzettin-Odayeri) Projects, which are in construction, passes adjacent to the Project Area. In the planning of this Motorway, the location of the INA and its connection roads were also considered.

The Hasdal-Kemberburgaz State Road passes from the south of the Project Area, Istanbul Ring Highway passes to the south-east of the Project Area, the Ihsaniye to Tayakadin Highway (D-010) passes through the Project Area (12 km section in the Project Area) and Orcunlu-Oklalali Road and Catalca – Istanbul Highway lie to the west of the Project Area.

The closest main roads to the Project Area are Ihsaniye to Tayakadin Highway (D-010) and Hasdal-Kemberburgaz State Road. The Ihsaniye to Tayakadin Highway is scheduled to be relocated to the south of the Project Area prior to airport construction activities progressing.

The existing roads in the vicinity of the Project Area together with available traffic volume counts are shown on the map given in Figure 7.11.A.1.

Objectives

In the scope of the ESIA for INA, traffic surveys were conducted complementary to the traffic data for the vicinity of Project Area obtained from General Directorate of Highways. The main objective of these surveys was to obtain current traffic data that show what the current vehicle movements are in the Project area and the potential impact area (area of influence). This served as a basis for determination of the impacts of the Project and led to the development of mitigation where necessary.

Available Traffic Data

Highway transportation surveys are performed to establish a basis for transportation planning process and to contribute to make highway's design, construction, maintenance and management facilities in a rationalised and scientific way. Transportation surveys accomplished according to Annual Transportation Survey Program are carried out by Traffic Safety Departments of Regional Divisions of General Directorate of Highways in order to determine traffic characteristics of highways by using modern counting devices and technique. After the evaluation of traffic survey data, the publication called Traffic and Transportation Surveys is published every year¹.

¹ Traffic and Transportation Information for 2012 (Annual Average Daily Traffic Values and Transportation Information According to Traffic Segments of Motorways and State Roads), Traffic Safety Department, Transportation Surveys Office, June 2013.

Methods

Traffic counts are performed by the General Directorate of Highways as permanent, portable and special counts. Permanent counts are realised continuously in the year. The aim of these counts is to determine the coefficients (weekly, monthly, seasonal) used to convert annual programs traffic data obtained from portable and short term counts to AADT values. Portable counts are short term counts and are performed in every season, seven days and 24 hours according to annual programs. Using coefficients obtained from permanent continuous counts, traffic values from portable counts are converted to AADT. Special counts are generally performed by devices for 48 hours and manual counts for 8 hours in accordance to special demands excluding annual programs. Counts are generally performed on the state roads, provincial roads and free motorway sections. Counts are realised each year on the State roads and in a long term period as 3-5 years and/or in accordance with special demands on the provincial roads.

Two different automatic counting devices are used in determining ADDT values on state roads. Each device has a different accuracy level because these devices have different working principles. In general, the accuracy rate is approximately $\pm 95\%$ on traffic counts and $\pm 90\%$ on classification counts. Traffic data are presented according to control sections number on the State roads for all road segments. Vehicles are aggregated in five different categories, defined as the following;

1. Car (Passenger car, pick-up, jeep, vehicles with maximum 3.5 tonnes loaded weight and vehicles with 8-14 person passenger capacity (minibus, etc.);
2. Medium Goods Vehicle (vehicles with 14-25 person passenger capacity and trucks with 3.5 -10 tonnes loaded weight);
3. Bus (Vehicles with more than 25 person passenger capacity);
4. Truck; and
5. Articulated truck.

On some sections of state roads where traffic counts could not be realised, previous years (2011) traffic values are forecasted to obtain current year (2012) traffic in order to give an opinion about the traffic volumes to users. Also on sections nearby the counting stations, considering the route traffic conditions and if there is not a big effect that changes the traffic, the existing counting results are assumed as alignment traffic.

Traffic Volume Counts in the vicinity of the Project Area in 2012

The results of traffic volume counts conducted in the vicinity of the Project Area in 2012 are shown on the map given in Figure 7.11.A.1. As shown on the map, there is only one post where a traffic count was performed on the Ihsaniye to Tayakadin Highway (D-010) that passes through the Project Area. This post is classified as a "Portable Vehicle Count and Classification Post". Automatic vehicle classification counts were performed at this post. This means that vehicle classification counts were realised in every season for at least 7 days and 24 hours by classification devices which are pneumatic tubes. The error rate for this type of count is approximately $\pm 5\%$ on traffic counts, $\pm 10\%$ on classification counts. The length of this segment (D-010 - Segment 2) is 23 km and almost covers the whole section passing through the Project Area.

There are also two other locations on this road in the vicinity of the Project Area where traffic forecasts are available. The length of these segments (D-010 - Segment 1 and D-010 - Segment 3) are 26 km and 9 km respectively.

As discussed in the previous section, AADT values at these locations have been provided in five categories as car, medium goods vehicles, bus, truck and articulated truck. The AADT values obtained on Ihsaniye to Tayakadin Highway (D-010) in 2012 are summarised in Table 7.11.A.1.

Table 7.11.A.1 AADT Values on Ihsaniye to Tayakadin Highway (D-010) in 2012

Control Section Number	Segment No.	Length (km)	Type of Counting	Average Annual Daily Traffic (AADT) Values (vehicle/day)					
				Car	Medium Goods Vehicles	Bus	Truck	Articulated Truck	Total
D-010	1	26	Forecast	555	30	1	166	107	859
D-010	2	23	Automatic Vehicle Classification Counts	2,204	171	11	1,455	1,362	5,203
D-010	3	9	Forecast	32,243	1,613	194	5,303	3,495	42,848

Complementary Traffic Survey (Count) Methodology

Traffic Volume Count Method

There are two methods available for conducting traffic volume counts^{2,3}; manual and automatic. Manual counts are typically used to gather data for determination of vehicle classification, turning movements, direction of travel, pedestrian movements, or vehicle occupancy. Automatic counts are typically used to gather data for determination of vehicle hourly patterns, daily or seasonal variations and growth trends, or annual traffic estimates. As described in previous sections, the General Directorate of Highways uses automatic count methods. However, considering the objective and scope of the survey and the traffic volume data needed for analysing the available data and assessing the potential impacts, it is considered that a manual count method would be sufficient enough for the purpose of this study. Therefore, a manual count method would be used within the scope of the ESIA studies for the INA Project.

² Traffic Volume Counts

³ Traffic Flow Properties and Traffic Parameters of State Roads (Seasonal Factors, K Factor, Directional Distribution), General Directorate of Highways, December 2009

Traffic Count Locations

The map showing the roads within the Project Area is given in Figure A2. As shown from this map, there are many haul roads within the Project Area used and/or were used by the mining /quarry activities within and by the Project Area. There is also one road connecting Ihsaniye to Tayakadin Highway to Akpınar Village. After the commissioning of construction activities for the INA Project, entrance to the Project Area will be completely banned. This will result in use of other roads for the access to the quarry activities outside the Project Area and a new road requirement for the access to Akpınar Village. In order to have a better understanding regarding the current vehicle movements within the Project Area, there is a need for a complementary traffic survey (count) on these roads which will enable comparisons with available traffic data on Ihsaniye to Tayakadin Highway and analysing the relevance of the available data with the Project Area. By this way probable impact could be assessed and potential mitigation approaches could be developed. The proposed traffic count (survey) locations are also shown on the map given in Figure 7.11.A.2.

Recording Method

There are three manual count recording methods used; tally sheets, mechanical counting boards and electronic counting boards. Recording data onto tally sheets is the simplest means of conducting manual counts. Therefore, manual traffic count using the tally sheet method would be used.

Traffic Count Period

Traffic flow (volume) changes hourly, daily, monthly and seasonally. Therefore, these variations should be taken into account during traffic surveys. In order to have representative data and enable comparison with the available traffic data (AADT values obtained from General Directorate of Highways) traffic counts would be conducted both at the weekend and weekdays covering the whole day (24-hour). It should be noted that AADT counts represent the average 24-hour traffic volume at a given location averaged over a full 365-day year.

Traffic volumes during a week vary both in vehicle numbers and vehicle class (car, bus, etc.). Total traffic volume generally starts to increase on Monday and reaches its peak on Friday, then decrease at weekend. Traffic distribution of previous years' counts shows that traffic volumes and vehicle classification show similar trends on Tuesday, Wednesday and Thursday. Generally, passenger movements concentrate at weekends while heavy truck movements (cargo, etc.) concentrate at weekdays. Car movements are generally higher on Friday, Saturday and Sunday compared to other days. Considering the general trends in traffic volumes and classification, traffic counts on the selected locations would be conducted for five days; on Friday, Saturday, Sunday, Monday and Tuesday or Thursday. Tuesday or Thursday values obtained would represent three weekdays (Tuesday, Wednesday and Thursday).

It should be noted that traffic counts would not be conducted during special events (such as national and religious holidays) and compromising weather conditions (such as heavy snow).

Traffic volumes generally decrease at nighttime and increase in the daytime. The 03:00-05:00 time interval usually represents the minimum traffic flow while 17:00-18:00 is the maximum (rush hour). The number of counts in a day (24-hour) are as given in Table 7.11.A.2 considering the hourly traffic variations. Count interval are 15 minutes. Therefore, a total of 14 15-minute counts are performed to obtain representative traffic values covering one day (24-hour).

Table 7.11.A.2 Traffic Count Periods

Time Interval	Traffic Count Period and Time
00:00-01:00	15-minute count at around 01:30
01:00-02:00	
02:00-03:00	
03:00-04:00	15-minute count at around 04:00
04:00-05:00	
05:00-06:00	15-minute count at around 05:30
06:00-07:00	15-minute count at around 06:30
07:00-08:00	15-minute count at around 07:30
08:00-09:00	15-minute count at around 08:30
09:00-10:00	15-minute count at around 10:00
10:00-11:00	
11:00-12:00	15-minute count at around 12:30
12:00-13:00	
13:00-14:00	
14:00-15:00	15-minute count at around 15:30
15:00-16:00	
16:00-17:00	
17:00-18:00	15-minute count at around 17:30
18:00-19:00	15-minute count at around 18:30
19:00-20:00	15-minute count at around 19:30
20:00-21:00	15-minute count at around 20:30
21:00-22:00	15-minute count at around 22:30
22:00-23:00	
23:00-24:00	

Traffic Count Calculations

The General Directorate of Highways performs permanent counts to determine the coefficients (weekly, monthly, seasonal) used to convert annual programs traffic data obtained from portable and short terms counts to AADT values. Therefore, traffic counts to be performed within the scope of the ESIA the Project were be converted to AADT values by using the

average monthly conversion coefficients according to vehicle classes/groups (car, medium goods vehicle, bus, truck and articulated truck) given in Table 7.11.A.3.

First of all, traffic counts to be conducted for five days were converted to monthly average daily traffic values by considering the number of weekdays and weekends of respective month (month in which traffic counts conducted) according to vehicle classes/groups. Weighted average method would be used for this purpose. Then, AADT values were calculated by using the following formula according to vehicle classes/groups:

$$\text{Annual Average Daily Traffic} = \text{Monthly Average Daily Traffic} / \text{Monthly Coefficient}$$

The basic assumptions made for the conversion of traffic count values to AADT values were:

- Publicly available average monthly conversion coefficients calculated using 2007 and 2008 values by General Directorate of Highways are still valid.
- One seasonal survey data will be sufficient for the purpose of impact assessment studies where obtained values will be accepted as annual values with an acceptable error rate.

Table 7.11.A.3 Average Monthly Conversion Coefficients According to Vehicle Classes/Groups

MONTHS	CAR			MEDIUM GOODS VEHICLE			BUS			TRUCK			ARTICULATED TRUCK		
	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.
December	0.77	1.00	0.41	0.88	1.14	0.48	0.93	1.60	0.38	0.95	1.49	0.51	0.98	1.52	0.56
January	0.70	0.98	0.42	0.74	1.03	0.36	0.85	1.05	0.57	0.80	1.04	0.44	0.76	1.02	0.40
February	0.71	0.99	0.46	0.77	1.00	0.42	0.85	1.08	0.47	0.85	1.08	0.35	0.82	1.09	0.35
March	0.81	0.98	0.62	0.88	1.16	0.48	0.86	1.17	0.62	0.93	1.16	0.49	0.91	1.13	0.54
April	0.91	1.06	0.73	0.98	1.30	0.56	0.92	1.29	0.62	0.99	1.29	0.79	0.97	1.26	0.66
May	0.99	1.13	0.83	1.08	1.43	0.83	1.01	1.89	0.67	1.05	1.34	0.80	1.02	1.28	0.81
June	1.16	1.41	0.77	1.12	1.55	0.31	1.08	1.46	0.38	1.10	1.40	0.21	1.06	1.31	0.23
July	1.47	2.14	1.03	1.17	1.65	0.89	1.22	2.29	0.93	1.09	1.60	0.85	1.09	1.61	0.95
August	1.60	2.47	1.03	1.18	1.64	0.89	1.24	1.76	0.70	1.09	1.39	0.78	1.12	2.29	0.90
September	1.05	1.36	0.83	1.12	1.99	0.89	1.10	1.45	0.82	1.08	1.47	0.80	1.11	1.43	0.93
October	0.97	1.19	0.73	1.09	1.73	0.89	1.02	1.46	0.70	1.06	1.49	0.55	1.09	1.47	0.77
November	0.86	1.10	0.45	0.98	1.46	0.57	0.94	1.41	0.35	1.01	1.40	0.60	1.07	1.65	0.61

Figure 7.11.A.1 Traffic Volume Counts in the vicinity of Project Area in 2012

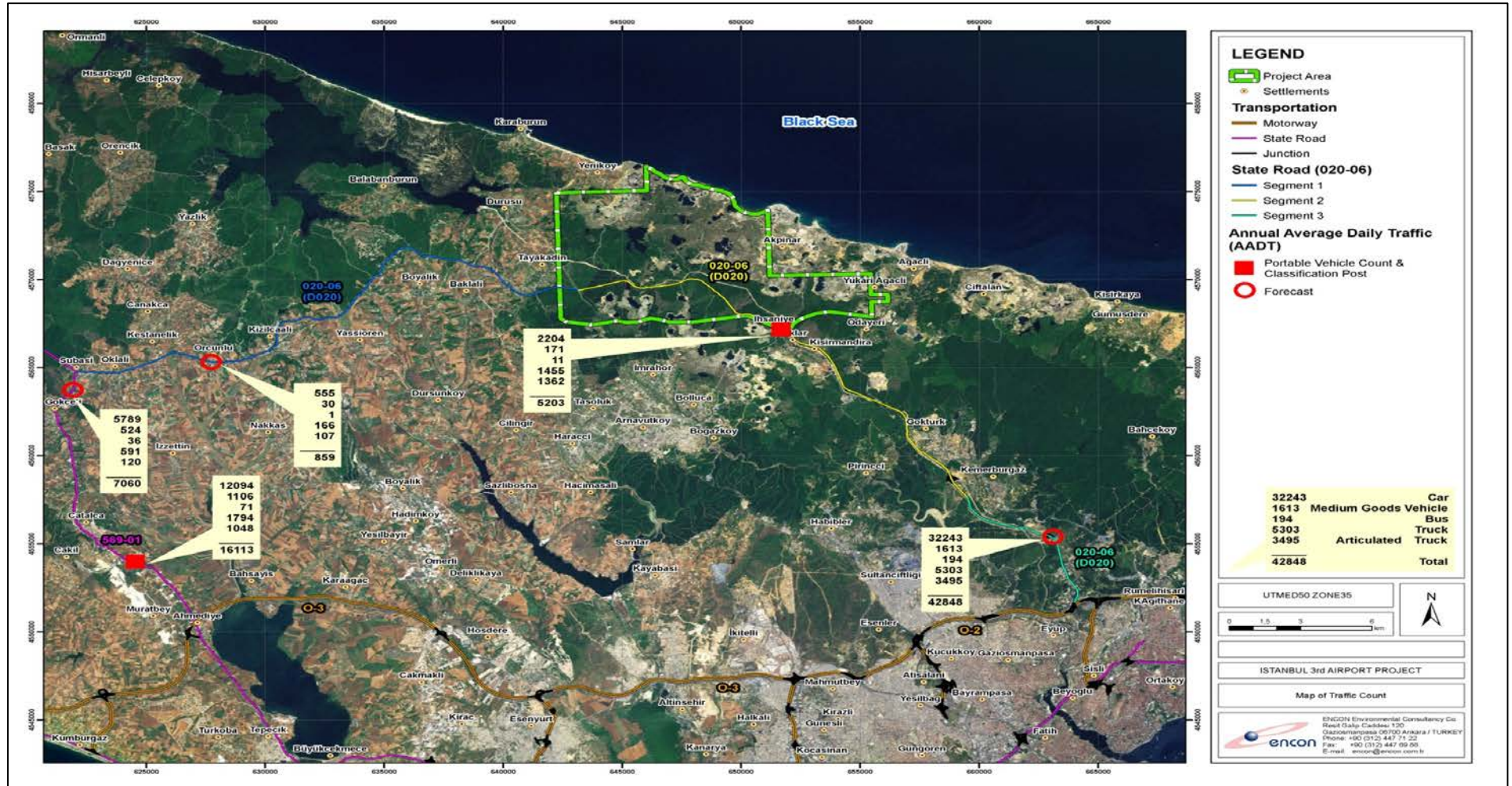


Figure 7.11.A.2 Roads within Project Area



Annex 7.11.B: Airport Landside Access Assessment

Review of Other Hub Airports – Landside Access Mode Share

Introduction

Landside access is a key component of the airport customer experience, and will be critical to airport product positioning, business performance, scheme planning approval and environmental performance.

This review of landside access is based on the following references:

- The March 2014 Master Plan document including Appendix B - Traffic Analysis; and
- Airport Co-operative Research Programme reports (Ref.. 7.11.B.1 and 7.11.B.2);

Research carried out by the Airport Cooperative Research Programme (Ref. 7.11.B.1) suggests that landside access performance varies significantly alongside airport location, size and context. It is important to note that airport passengers do not behave in the same way as urban commuters or leisure users. This is due to the fact that an airport is an interchange so therefore the trip to the airport is to enable interchange as part of a full trip. This means there is greater uncertainty for the passenger (it is unlikely to be a daily trip) leading to a need for greater trip reliability to counter perceived/actual unfamiliarity with the trip and a resultant higher emotional, stress and anxiety response, should reliability be compromised for the passenger making the trip to the airport. On this basis merely extending the urban transit multi-stop system to the airport is unlikely to meet the requirements for many airport passengers looking for speed and directness.

Airport employees are, however, more like urban commuters in behaviour as the airport trip becomes daily and familiar. However, airports tend to not be directly accessible from a wide range of residential areas, so the airport needs to focus on achieving good integration with urban transit systems to enable an attractive and efficient commute to be possible for staff to and from home. On this basis extending the urban multi-stop system is likely to meet the need of more employees looking for connectivity and choice of route to the airport.

In essence, one landside access option does not fit all requirements and a multi-modal offer is required flexing according to convenience, reliability, price, speed and directness. This reflects the multiple segments within the airport landside access market. The airport landside access strategy should therefore be based on the understanding of these segments and not beholden to any particular mode or technology. On review of hub airports across the Europe and Asia, it is apparent that in general:

- Size of airport does not determine public transport mode share;
- The longer the trip to the airport, the less attractive is taxi or car drop-off;
- Directness is less important than transfers; fewer transfers gives higher public transport mode share; and
- Speed does not determine public transport mode share.

There is no one single factor that determines the public transport mode share. It is the combination of factors together. Taking a sample of airports with a mix of speed, directness, distance and connectivity, the following public transport mode shares (Ref. 7.11.B.1) were recorded in 2008 (see Table 7.11.B.1).

Table 7.11.B.1 Public Transport Mode Share by Airport

Airport	Rail %	Bus %	Total %
Oslo	39	25	64
Hong Kong	28	35	63
Narita	37	22	59
Shanghai	8	43	51
Zurich	42	6	48
Vienna	30	11	41
Stansted	30	10	40
Paris CDG	27	13	40
Amsterdam	35	3	38
Copenhagen	33	5	38
Munich	28	9	37
Heathrow	23	14	37
Stockholm	18	17	35
Frankfurt	27	7	34
Gatwick	24	7	31
Geneva	21	7	28
Brussels	17	9	26
Paris Orly	15	11	26
Dusseldorf	18	4	22

Available European and Asian airport data suggest a wide variation in public transport mode share in the range of approximately 20 to 60%. However, what is noticeable is that with the inclusion of rail (be it high speed or urban metro), the mode share increases substantially. INA will have a metro link to Istanbul city centre as part of the wider urban rail network.

The potential mode split for INA is still to be determined and assessed. However, for the purposes of this assessment, a first principles approach has been taken based on a sub-group extracted from the above table, based on the larger airports which are located relatively distant from the associated city, served by rail and motorway (see Table 7.11.B2).

Table 7.11.B.2 Public Transport Mode Share by Airport Sub Group

Airport	Rail %	Bus %	Total %
Gatwick	24	7	31
Hong Kong	28	35	63
Paris CDG	27	13	40
Amsterdam	35	3	38
Frankfurt	27	7	34
Heathrow	23	14	37
Shanghai	8	43	51
Average	24	17	42

Based on Table 7.11.B.2, the average public transport mode share is approx. 40%. This information will inform the assessment of transport and traffic impacts reported in this chapter. The range of mode share is indicative of the underlying mix of factors (size, location, context, access options) that come together and drive the mode share per airport.

It should be noted that landside access is only relevant to passengers arriving or departing the terminal and airport precinct, and not for passengers passing through transit/transfer processing. The proportion of transit and transfer passengers as part of the total passenger flow will be an input to the landside access demand forecasts.

In addition, the development of the airport as a standalone facility or (as per the 2014 Master Plan) an airport city, means there will be a mixture of airport access and airport city access demands, both likely to be served by the same infrastructure. The definition of the airport city is not currently available, which means no account can be taken for the airport city access demands as part of this assessment of landside access infrastructure requirements, on the approaches to the airport precinct.

Airport Access Scale and Requirements

Based on the 2014 Master Plan documents together with the above airport mode split review the scale of landside access requirement for the new airport has been estimated by way of various mode share scenarios.

Landside Assessment Methodology

In summary, the landside access assessment methodology of this chapter is:

- Estimation of landside access trip generation, based on forecasted peak day/hour passenger levels (from the 2014 Master Plan) converted to landside vehicle trips;
- Assessment of baseline landside traffic to establish (with a high share by car – assumed to 90%) maximum infrastructure before other modes are factored in; and
- Consider response to potential modal share which will likely shift demand to other transport modes so that traffic, parking and highway construction impacts are minimised (based on the above airport mode split review), to establish a more likely scale of requirement and therefore effect.

Assessment Inputs

Currently available baseline highway traffic volume data (2012 AADT) have been used to establish the current traffic patterns and capacity limitations, building on the condition and extent of existing highways bordering and traversing the site, as well as planned improvements and expansions to the highway network.

Landside airport operations generally involve the movement of passengers and freight, as well as operational staff and other ancillary services. Freight operations typically occur during time periods that do not conflict with peak vehicular traffic, and in line with other airports, freight flow volumes for INA are generally expected to be significantly lower than passenger flows. Furthermore, support staff and ancillary services traffic volumes assume similar characteristics. Therefore, it is appropriate to focus traffic impact estimates on the passenger traffic arriving to and departing the airport. The currently available primary input data for the assessment are therefore passenger daily and hourly volumes, minus transfers, based on materials provided in the 2014 Master Plan, Appendix B – Traffic (see Table 7.11.B.3).

Table 7.11.B.3 Estimated Peak Hour Passengers

	2019	2027	2034	2042
Arrivals - Peak Hour	10,441	14,089	16,835	19,962
Departures - Peak Hour	10,920	14,736	17,608	20,879
Total Passengers - Peak Hour	21,361	28,825	34,443	40,841

High Level Transport Assessment Process

For simplicity, one passenger per vehicle is assumed. This assumption ensures that vehicle occupancy rates and passenger grouping rates are balanced against the redundant vehicle trips generated by large airports.

Total vehicle trips in the baseline assumption are adjusted to reflect a minimum modal split of 90% car use and 10% other. Vehicle trips counts are then converted to required additional lanes for purposes of comparison to other transport modes. The existing traffic conditions are simply overlaid with future traffic demand to determine outline estimates of changes in traffic demand as a result of the Project.

With the knowledge that INA is intended to support multiple modes of transportation, including private cars, taxis, metro/rail and buses, it is appropriate to reduce the initial baseline car trip assumptions by applying several shifts in the modal split to demonstrate how these modes can reduce traffic impacts as well as driver delays due to construction. Moreover, the analysis indicates how these reductions can similarly reduce parking demand and therefore reduce project costs, or at least shift costs from infrastructure of one kind (e.g. parking decks) to another (e.g. public transport).

High Level Transport Assessment Outputs

The existing highway infrastructure to the north and west of Istanbul is proposed to be improved to facilitate traffic traveling to and from INA. While there are several smaller highways that provide access to the area, and some traffic is likely to choose to use these routes out of proximity or convenience, it is assumed that the majority of traffic will travel using

the main roads (both new and upgraded) between Istanbul and the Northern Marmara Motorway, which run along the Southern section of the Project Area.

Currently available traffic volume data from 2012 indicate AADT of 5,203 total vehicles. Using a basic assumption of 15% AADT traffic during the peak hour, it is expected that peak hour traffic volumes will be approximately 750 vehicles per hour (vph). For a four lane highway, these volumes are very low, and demonstrate that sufficient capacity exists to support future traffic generated by the proposed development. However, the currently provided data indicates that traffic volumes along the same highway and closer to the Istanbul city centre are in the range of AADT 42,848, which would approximately equate to 6,300 vph during the peak hour.

Even if this amount is assumed to be an overestimation, current demand likely far exceeds capacity during peak periods, and therefore, while traffic conditions further north are capable of accepting additional new volumes, the primary route to and from Istanbul city centre will not support any additional traffic without major highway expansions.

Vehicle trips generated by the proposed development are conservatively estimated to equate to one per passenger during the peak hour of flight activity, minus transfer flight passengers. Based on currently available data in the 2014 Master Plan, Appendix B – Traffic, approximately 40% of all trips at INA will be transfer trips, while in later years this value increases to 50%. For the purposes of this analysis, a constant 50% transfer trips are assumed and applied to the total passenger trips to identify the total number of trips either originating or ending at INA. Table 7.11.B.4 shows this adjustment made for the various study years.

Table 7.11.B.4 Peak Hour Passengers Forecast Adjusted for Transfers

	2019	2027	2034	2042
Arrivals - Peak Hour	5,221	7,045	8,418	9,981
Departures - Peak Hour	5,460	7,368	8,804	10,440
Total Passengers - Peak Hour	10,681	14,413	17,222	20,421

To convert the peak hour passenger trips from the March 2014 Master Plan, Appendix B – Traffic to vehicle trips, an initial modal split assumption of 90% car and 10% other was applied. Table 7.11.B.5 presents the estimated number of peak hour vehicle trips at a 90% car modal split, and across a range of mode split levels, including a modal split of 60% which represents the case study data reported above.

Table 7.11.B.5 Vehicle Trips as a Function of Reduced Modal Split

	2019	2027	2034	2042
Modal Split 90% - Vehicle Trips	4,698	6,340	7,576	8,983
Modal Split 70% - Vehicle Trips	3,654	4,931	5,892	6,987
Modal Split 60% - Vehicle Trips	3,132	4,227	5,051	5,989
Modal Split 50% - Vehicle Trips	2,610	3,522	4,209	4,991

Table 7.11.B.6 below shows how converting vehicle trips to lanes required, by a factor of 1,500 vehicles per lane, for all routes within 5 km of the project area, for the years 2019, 2027, 2034, and 2042 respectively.

Table 7.11.B.6 Additional Highway Lanes Required as a Function of Mode Split

	2019	2027	2034	2042
Additional Lanes Required - 90%	3	4	5	6
Additional Lanes Required - 70%	2	3	4	5
Additional Lanes Required - 60%	2	3	3	4
Additional Lanes Required - 50%	2	2	3	3

Based on this exercise, the additional lanes required to support a high car share modal split would range from three to six lanes. The above exercise clearly demonstrates that assuming or proposing to design for a high car modal split is not viable, and will not fit the intent of the current airport master plan. Furthermore, as mentioned above, this estimate does not consider the additional layer of traffic volumes associated with the airport city which will very likely contribute higher trip generation during the same peak periods. Therefore it is impractical to assume that a highway network would be built to support this level of high car mode profile. The case study data fully reinforces this message through the conclusions relating to a need for a mix of travel options to enable a large hub airport to operate effectively with room for growth, contingency, resilience and market segmentation/ development. The 2014 Master Plan reflects this through the inclusion of extensive metro/rail and bus facilities, which in turn support the expected higher level of public transport mode share.

The above estimation (based on 40% public transport mode share (as per Table B2 above)) indicates that the envisaged road infrastructure is of the right scale to provide an appropriate level of access, and is consistent with the established mode split benchmark for hub airports.

However, the public transport solution needs greater definition. The required shift in trips to public transport options to realise reasonable traffic conditions needs more detailed project solutions and concept design development, to ensure that all trips can be accounted for and not defaulted to additional vehicle trips on the adjacent highway system.

The shift in trips to other modes, such as public transport, should be balanced against the ridership and station capacity of alternative systems to avoid overcrowding or other undesirable consequences of an undersized system that may lead to deteriorating attractiveness the system, and consequently an un-anticipated shift towards higher car mode share.

The latter years of the analysis suggest a required shift of approximately 3,000 to 4,000 trips to public transport during the peak hour. Passenger capacities vary across various public transport systems at various speeds. To facilitate connectivity to the airport and acceptable frequencies, it is assumed that a dedicated lane/rail system with high speeds will be employed, such as the metro system connection indicated in the 2014 Master Plan. The required volumes of passengers for the above modal split assumptions are well within the capacity of multiple public transport systems, including metro, light rail, commuter and intercity heavy rail.

Summary of Airport Access Scale and Requirements

In summary, the assessment of airport access scale and requirements indicates that:

- Based on case study research, an airport of this size and location should expect to achieve 40% public transport and 60% car access;

- This mode split benchmark is supported and correlates with the March 2014 Master Plan in terms of traffic lanes and parking provision; and
- Applying this mode share to the estimated peak hour landside access travel demands, indicates a requirement for main road links comprising four traffic lanes. This is consistent with the airport March 2014 Master Plan.

References

Ref. 7.11.B.1	Airport Cooperative Research Program. Ground Access to Major Airports by Public Transportation. Report 4, 2008
Ref. 7.11.B.2	Airport Cooperative Research Program. Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies. Report 24, 2009

Annex 7.11.C: INA Preliminary Traffic Estimates Study

Table 7.11.C.1 Hourly Vehicle Numbers Forecast During Operational Phases

Vehicle Numbers	2018											
	04:00-06:00	06:00-08:00	08:00-10:00	10:00-12:00	12:00-14:00	14:00-16:00	16:00-18:00	18:00-20:00	20:00-22:00	22:00-24:00	00:00-02:00	02:00-04:00
To Airport												
Taxi	364	1062	1154	941	1032	862	771	923	1032	1081	729	152
Private/Rental Car	1081	3153	3423	2793	3063	2558	2288	2739	3063	3207	2162	450
Public Bus	35	103	112	91	100	84	75	89	100	105	71	15
Metro												
Rapid Metro												
High Speed Rail												
Truck/Van	291	73	58	44	29	29	219	248	291	102	44	29
Employee Bus	0	622	311	0	311	622	622	156	156	311	0	0

Vehicle Numbers	2023											
	04:00-06:00	06:00-08:00	08:00-10:00	10:00-12:00	12:00-14:00	14:00-16:00	16:00-18:00	18:00-20:00	20:00-22:00	22:00-24:00	00:00-02:00	02:00-04:00
To Airport												
Taxi	392	1144	1242	1014	1112	929	831	994	1112	1164	785	163
Private/Rental Car	913	2664	2892	2359	2588	2162	1933	2314	2588	2710	1827	381
Public Bus	33	95	103	84	92	77	69	83	92	97	65	14
Metro												
Rapid Metro												
High Speed Rail												

Truck/Van	338	84	68	51	34	34	253	287	338	118	51	34
Employee Bus	0	551	275	0	275	551	551	138	138	275	0	0

Vehicle Numbers	2030											
	To Airport	04:00-06:00	06:00-08:00	08:00-10:00	10:00-12:00	12:00-14:00	14:00-16:00	16:00-18:00	18:00-20:00	20:00-22:00	22:00-24:00	00:00-02:00
Taxi	303	885	961	784	860	718	642	769	860	900	607	126
Private/Rental Car	889	2591	2814	2295	2517	2103	1881	2251	2517	2636	1777	370
Public Bus	54	157	171	139	153	128	114	137	153	160	108	22
Metro												
Rapid Metro												
High Speed Rail												
Truck/Van	389	97	78	58	39	39	292	331	389	136	58	39
Employee Bus	0	634	317	0	317	634	634	159	159	317	0	0

Vehicle Numbers	2035											
	To Airport	04:00-06:00	06:00-08:00	08:00-10:00	10:00-12:00	12:00-14:00	14:00-16:00	16:00-18:00	18:00-20:00	20:00-22:00	22:00-24:00	00:00-02:00
Taxi	514	1499	1628	1328	1456	1217	1088	1302	1456	1525	1028	214
Private/Rental Car	1011	2948	3201	2611	2864	2392	2140	2561	2864	2999	2022	421
Public Bus	49	143	155	126	139	116	104	124	139	145	98	20

Metro												
Rapid Metro												
High Speed Rail												
Truck/Van	443	111	89	66	44	44	332	376	443	155	66	44
Employee Bus	0	721	361	0	361	721	721	180	180	361	0	0