Cal State San Marcos

Traffic & Transportation

BA 680 Capstone Master's Project

Mazen Aboufakhr
Brianne Daley
Dani James
Bhumika Talsania
12/4/2013

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
Air Traffic 1
Ground Transportation and Infrastructure 1
Public Transportation 1
CHAPTER 1: INTRODUCTION 2
1.1 Statement of the Problem 2
1.2 Statement of Purpose 2
1.3 Research Questions & Hypothesis 3
Air 3
Ground Transportation & Infrastructure 3
Public Transportation 4
1.4 Limitations of the Study 4
CHAPTER 2: METHODOLOGY 5
2.1 Air Traffic 5
2.2 Ground Transportation & Infrastructure 5
2.3 Public Transportation 6
CHAPTER 3: AIR TRAFFIC 7
3.1 Overview 7
3.2 San Diego – Current Operations 7
Runways 8
Arrivals 8
Departure 8
SDIA Airfield Limitations 9
3.3 San Diego – Air Traffic Statistical Analysis 9
3.4 Air Traffic Controller 10
3.5 NextGen 10
CHAPTER 4: GROUND TRANSPORTATION & INFRASTRUCTURE 12
4.1 Current Needs and Inefficiencies 12
4.2 Future Transportation Development Improvements – Coastal Region 12
4.3 Future Transportation Development Improvements – Inland Region 15
4.4 Airport Parking 18

4.5 Utilities 22
4.5.1 Sanitary Sewer Capacity 22
4.5.2 Water Sources 24
4.6 Safety Implications - General 25
4.7 Safety Implications – Campo/Boulevard 26
4.8 Safety Implications – MCAS Miramar and MCB Camp Pendleton 28
CHAPTER 5: PUBLIC TRANSPORTATION 30
5.1 Demand 30
5.1.1 Passengers 30
5.1.2 Employees 30
5.1.3 Visitors 31
5.2 Transportation Means 32
5.2.1 Private Cars 32
5.2.2 Taxicabs 33
5.2.3 Buses 34
High Frequency Local Bus 34
Rapid Bus 34
Bus Rapid Transit (BRT) 34
Courtesy Shuttles 35
5.2.4 Rail Based Modes 35
Light Rail (Trolley) 35
Intercity Rail 36
High Speed Trains 37
5.3 Access Issues and Planning 37
5.3.1 Campo/Boulevard Site 38
5.3.2 MCAS Miramar Location 39
5.3.3 MCB Camp Pendleton Site 40
CHAPTER 6: DISCUSSION 42
6.1 Air Traffic 42
6.2 Ground Transportation & Infrastructure 42
6.3 Public Transportation 43

REFERENCES 44
APPENDICES 49
Appendix A: FAA – Airspace Classification 49
Appendix B: Figure 3.2-B from SDIA Airport Master Plan 50
Appendix C: PHL Parking Layout 51
Appendix D: Urban Area Transit Strategy (RTP 2050) 52
Appendix E: Urban Area Transit Strategy (RTP 2050) 53

EXECUTIVE SUMMARY

Air Traffic

The roles of air traffic control as well as the regulations and responsibilities of air traffic are clearly defined and used to determine the competency of the current air traffic control at San Diego International Airport (SDIA). Relationships were found in both arrivals and departures with time of day and the month of the year. However, there was no correlation of arrivals and departures with day of the week. Inefficiencies in the current airport runway were found in some departing routes resulting in delays and take off performance difficulties. This can aid in the planning of new airport developments. In addition, the application of NextGen Air Transportation systems shows cost efficiencies, technological advancements, and greater safety.

Ground Transportation and Infrastructure

It was determined that the congestion that the San Diego Region currently experiences will worsen over time unless the increase in travel demand is addressed. Ground traffic around peak hours were analyzed and proposed sites showed the need to make adjustments to the surrounding areas to accommodate for a large increase in traffic. Several projects would need to be implemented to relieve high traffic sites. This includes I-5 North Coast Corridor Project, I-15 Express Lanes Project, as well as new developments for I-8. These projects include development of new access roads, freeway expansion, and on/off ramp improvements. The area needed to provide adequate parking space was also determined and each site proved to have sufficient space to accommodate the minimum acreage. Appropriate parking will assist in smooth travel within the new airport. Also, utility structures were analyzed for each site. Necessary water sources and sewage capacities were determined to support the future demand. Depending on the site location, new lines can be added to existing structures or the addition of a new plant solely for airport uses.

Public Transportation

Passenger, visitor, and employee numbers will increase the need for available public transportation, which accounts for 30% of ground travel done within the airport. Railways, taxicabs, and buses were analyzed for current demand and requirements for future demand. At the existing airport there is no access available for railways and only one bus route available to a station outside the airport. This limited access and increasing demand drives the need for more developed public transportation systems at the new site. Each site presents limiting factors in surrounding areas. These include isolation from present public transportation routes or a built out region causing problems laying new tracks. Dependent on these conditions, some sites prove more conducive to public transportation accessibility.

CHAPTER 1: INTRODUCTION

1.1 Statement of the Problem

As the United States economy recovers, a growing demand in air travel can be seen. According to the 2013 Federal Aviation Administration (FAA) Forecast, United States carrier passenger growth for the next 20 years is expected to increase on average 2.2 percent each year. As a result, the projected growth is expected to reach 1.3 billion passengers by 2031 (FAA-Forecast, 2012).

Currently, the top three travel destination states in the nation are New York, California, and Florida. According to the FAA, California is rated in the top five for international visitors, export and domestic transportation (FAA NextGen, 2013). On average, the total domestic travel to California is expected to increase by 2.3% in 2013 and 2.2% in 2014. The total international travel to California is expected to increase by 4.1% in 2013 and 4.3% in 2014 (San Diego Tourism Authority). According to the San Diego Tourism authority, the City of San Diego is ranked one of the top five travel destinations in the United States (2013 Annual report). In 2012 the San Diego International Airport (SDIA) served an approximate 17.2 million passengers (ACI, 2012).

Despite the increase in travel demand and the positive effect it has on the local economy, there is still a cause for concern at the local level. San Diego City officials are questioning the current airport's ability of sustaining the growing demand. With approximately 509 departures and arrivals daily, carrying on average 50,000 passengers, SDIA is the busiest single-runway commercial airport in the nation (San Diego Airport Authority). Even the most recent expansion of Terminal 2, with the addition of 10 gates and duel level road ways into the airport, this still may not be enough to accommodate the growing demand.

Multiple studies have shown that in the next four decades the City of San Diego is projected to grow in multiple demographic aspects. The 2050 Regional Transportation Plan (RTP) estimates that San Diego will add 1.25 million residents, resulting in the addition of 500,000 new jobs and 400,000 new homes (2050 RTP). Further studies from The Ricondo & Associates Team also show that air travel in San Diego will reach 30 million passengers a year by the year 2030. Such projections will obviously affect transportation in the entire City of San Diego; however the following section will focus solely on their implications on public transportation in and out of the new airport. This project assumes that SDIA will remain open and functioning at full capacity, considering the new airport as a compliment not a competitor.

1.2 Statement of Purpose

According to studies conducted by The Ricondo & Associates Team, in 2016 SDIA will have exceeded their capacity for operations. Building a new airport in San Diego County is therefore essential to keeping current with the growing demands of air travel. This research examines the increase in traffic and demand for transportation in and around three proposed sites for a new airport, without obsoleting SDIA. Out of the proposed sites researched by The Ricondo & Associates Team, this research will focus on MCAS Miramar, MCB Camp Pendleton and Campo/Boulevard. The purpose of this study is to determine the implications of air, ground and public transportation on each of the possible new airport sites.

1.3 Research Questions & Hypothesis

Air

Quantitative Analysis:

This study is designed to statistically analyze the peak hours of operation for air traffic at the SDIA and ground traffic on Interstate 5 (I-5). It is the hypothesis that the number of airplanes arriving and departing at SDIA is dependent on the time of the day, day of the week and month. Higher airplane traffic is expected on weekdays than weekends, as well as during the morning hours then the evening hours. It is also hypothesized that the number of cars on the I-5 around SDIA is dependent on the day of the week and time of the day. High car traffic is expected during the weekdays than weekends. The last hypothesis correlates the airplane traffic and car traffic. It is hypothesized that the number of cars on the I-5 is dependent on the number of airplane arrivals and departures.

Qualitative study:

In addition to understanding a relationship between air and ground traffic, this study also analyzes current air traffic management nationwide at SDIA. This review of air traffic management will also look at the implementation of NextGen, the next generation of air traffic control. The following research questions were formulated to better understand restrictions at SDIA and the implication of NextGen: What are the current methods of air traffic control and its management nationwide? How will NextGen affect air traffic control at SDIA? What is the impact of increased aircrafts on air traffic control personnel?

Ground Transportation & Infrastructure

Quantitative study:

This study is designed to find the peak hours of traffic congestion on the various Interstates and State Routes that people would be taking to access the new airport location. It is the hypothesis that the peak hours are largely centered on rush hour traffic associated with work schedules. High traffic is expected on weekdays during the morning and early evening hours. It is also hypothesized that without the proposed improvements to the roadways being implemented, there will be no traffic relief and delays will continue to increase.

Based on comparative analysis of other airports in the United States, the study will look at the minimum space requirements needed to accommodate parking demands. This largely centers on the projected demand for the year 2030 of 45 million travelers. In similar analyses, this study will also take into consideration the amount of utilities needed to support the new development for each site and if new gas and electric lines will need to be added. It is hypothesized that the sites developed in urbanized areas will require minimum adjustments in utilities, whereas sites developed in remote locations will require more enhancements.

Qualitative study:

It is evident that the new airport would require additional traffic lanes to be created as well as on-off ramps to accommodate airport traffic. The following two research questions were formulated to explain the implication. What is the impact to motor vehicle traffic if an additional airport is added in San Diego County? How will the current proposed changes to Interstates and State Routes change to accommodate the new airport location? Will SANDAG need to modify its current schedule?

Looking at each site independently, there are some questions that can to be answered relative to parking infrastructure. How much land is required for the parking facilities on site only? Will each site have sufficient land available to meet the minimum needs for parking? Looking at utilities for each site and taking into consideration the comparative analysis in the quantitative study the following questions have been generated. How much, if any, additional lines should be added at each site? How much energy will each site require and what are the most eco-friendly options?

Public Transportation

The Demand section will answer the question of who are the users of public transportation. The Transport Means section will address the question of what are the major public transport means at the airport, and the advantage of each. And finally, the Access Issues section will address where these means will be added, and how will they be used to collect and process passengers.

1.4 Limitations of the Study

The projected demand, including population and air travel increases, will be the main focus area of the study, however, each aspect of traffic and transportation will have its limitations. While examining the needs of air traffic control and the implementation of the NextGen system, no special circumstances pertaining to a specific proposed location will be considered in this section. For example, locations proposed near the United States and Mexico border will not be addressing the issue of International shared air space. Additionally, military sites will not address shared air space with civilian use.

Data used to determine current and forecasted improvements to roadways throughout the San Diego County region was limited to information readily available through reputable websites. This allowed for the information presented to be feasible, real time solutions. The studies for infrastructure were comparative analysis so the information is restricted to what is publically available from the airports. Limitations also can relate to the design of the new airport. For example, for parking structures, the structures could be multi-leveled or single level to the discretion of the designer.

Public transportation limitations include existing rails and the distance relative to the location of the airport. Without an existing rail system, it could prove to be very costly to build new intercity and commuter railways. Additionally, a high speed railway system has been proposed in the State of California for years; however, cost continues to be the deterrent to the implementation of the project.

CHAPTER 2: METHODOLOGY

2.1 Air Traffic

Quantitative analysis:

It was hypothesized that the number of cars on the I-5 around the airport is dependent on the number of airplanes arriving and departing at SDIA. It was also hypothesized that there is a relationship between times of the day and months when airplanes arrive and depart. In order to test the hypothesis data was collected from the FAA and SANDAG websites. The FAA data provided the actual number of airplanes arriving and departing SDIA by the hour, starting from July 1st, 2012 to June 30, 2013. The SANDAG database provided the average number of cars on I-5, between Pacific Highway (north bound) and Grape Street (south bound). The averages for the cars are broken down by the hour from July 1st, 2012 and June 30th, 2013.

Qualitative Analysis:

In order to answer the qualitative research questions, a review of research materials was conducted. Information about SDIA was collected from various government organizations including but not limited to the FAA, SANDAG and the San Diego Airport Authority. In addition, a review of scholarly articles and various feasibility studies was conducted to gather relevant data. Failed attempts were made to interview individuals working for the San Diego Regional Airport Authority.

2.2 Ground Transportation & Infrastructure

Quantitative analysis:

It was hypothesized that the peak hours are largely centered on rush hour traffic associated with work schedules. High traffic was expected on weekdays during the morning and early evening hours. It was also hypothesized that without the proposed improvements to the roadways being implemented, there will be no traffic relief and delays will continue to increase. In order to test the hypothesis, data were collected from various websites, including SANDAG, Caltrans and the Department of Transportation. SANDAG provided a regional plan for future growth and development, whereas Caltrans data included specific roadway improvements. The Department of Transportation website provided information on current and proposed projects designed to alleviate traffic congestion.

In order to determine the parking requirements for the new site, data were collected from several existing airports. These include the Reagan International Airport and the subsequent addition of the Dulles International Airport once Reagan reached capacity. The William P Hobby and the George Bush Intercontinental Airports were also taking into consideration when developing a relationship between annual enplanements and number of parking spaces. The majority of these data came from the relevant airport websites, the FAA, the Airports Council International-North America, and existing information from The Ricondo & Associates Team study. The utilities comparisons also came from airports of similar size as the proposed site such as the Logan International Airport in Boston, the Philadelphia International Airport, and the Detroit Metropolitan Wayne County Airport. The data were collected from their websites.

Qualitative Analysis:

In order to answer the qualitative research questions, a review of research materials was conducted. Information about San Diego County was collected from various government organizations including but not limited to SANDAG, Caltrans, the San Diego Airport Authority, as well as the Master Plans for the Campo/Boulevard area.

The ability to interpret the data collected and answer the research questions required additional sources. The parking design layout was gathered from San Diego County's Parking Design Manual and the parking spaces required from the website of the relevant airport. The research questions posed for the utilities required for the new site were answered using information from the airports' websites as well as the existing information gathered in report from The Ricondo & Associates Team.

2.3 Public Transportation

This research was done using quantitative and qualitative analyses to estimate projected demand for public transportation. The limitation, however, would be that future projections are based on previous historic records, which may change depending on consumer preferences and technological advances that this research may not be able to foresee. This research relied on a mix of primary and secondary data gathered from a series of interviews, as well as publications by credible authorities on the matter. The major resources of this study were the San Diego County Regional Airport Authority (SDCRAA), the San Diego Association of Government (SANDAG) as well as the Metropolitan Transit System (MTS).

CHAPTER 3: AIR TRAFFIC

3.1 Overview

Currently, the United States National Air Space (NAS) is governed by the Federal Aviation Administration (FAA). The FAA is responsible for operating and managing air traffic, setting guidelines for airport design and approval for operations. Air traffic control (ATC) and air traffic management (ATM) systems in and around the airport are also governed by the FAA. The objectives of the NAS are to accommodate the growth of aviation, replacing aging equipment and the use of satellite-based services for accuracy and increased safety and expanded airport coverage (Ashford, et al, 2008). The NAS is an integrated system, requiring 25,000 air traffic controllers, aviation safety inspectors and technicians to operate and service 19,000 airports, 600 air traffic control facilities, and over 70,000 pieces of equipment used for communication and radar surveillance (Ashford, et al, 2008). The NSA airspace is a series of rods (airways) and nodes (fixes). Nodes are a fixed geographical position determined by visual reference to the surface, radio navigational aid or celestial plotting. Rods are flight routes from one part of NAS to another. A flight route through NSA starts and ends at the airport and navigates through six different classes of airspace (Appendix A). The communication requirements with a nearby controller are dependent on the airspace classification and the flight condition (Ashford, et al, 2008).

The pilot has a critical position for maintaining communication. The pilot is always responsible for the flight operations and is in constant radio communication with the air traffic controller regarding instructions for take-off and arrival sequencing and safety. After the aircraft has taken off, control is passed from the control tower at the airport to the Terminal Radar Approach Control (TRACON). TRACON is a radar control facility associated with nearby airports (Ashford, et al, 2008). Terminal controllers handle air traffic within 30-50 nautical mile radius of an airport. Between TRACON, there are several Air Route Traffic Control Centers (ARTCC). An aircraft is handed off from one center to another until it reaches its destination. The Los Angeles ARTCC includes the Southern California TRACON center (Appendix B). During flight, aircrafts are tracked mainly by radar. Throughout the United States, there are thousands of radar stations or Very High Frequency Omni-directional Range finders (VOR). These radars calculate the height and speed of the aircraft so that air traffic controllers can paint a picture of the aircraft’s current general location but not pinpoint it. This results in greater separation standards for aircrafts (Ashford, et al, 2008).

Depending on the flight condition, a pilot is either operating the aircraft under Visual Flight Rule (VFR) or Instrument Flight Rule (IFR). According to VFR, a pilot will operate the aircraft if the weather conditions are clear enough for the pilot to “see and void” outside the cockpit. As a result, the pilot assumes responsibility in distancing the aircraft from other aircrafts as they are typically not assigned routes by ATC. Pilots must also adhere to visibility requirements when operating under VFR. Under IFR, a pilot is under the control of ATC at all times. There is no visibility requirement under IFR as ATC handles clearance for each part of the flight.

3.2 San Diego – Current Operations

According to the San Diego Regional Airport Authority, the airspace over San Diego has the following classifications, Class A, B, D & G (Appendix A). All flights operating under VFR enter SDIA under the control of the Los Angeles ARTCC (SD Regional Airport Authority). The control is then relayed to TRACON which provides information to the tower during the aircraft's final approach. All aircraft landing in SDIA must contact TRACON before entering Class B airspace. The air traffic control tower (ATCT) will give clearance and departing instructions to all aircraft leaving SDIA. Aircrafts approaching SDIA and operating under Instrument Flight Rule (IFR) are also controlled by the Los Angeles ARTCC. The Los Angeles ARTCC relays control to TRACON by clearing the aircraft via Standard Terminal Arrival Route (STAR). A STAR is a pre-planned arrival procedure for a pilot navigating with IFR. STARs use intersections, altitudes, and speeds to "route an aircraft into arrival flow sequence" (SDIA Master Plan, 2011). There are three STARs at SDIA.

Runways

All FAA certified runways are labeled based on the navigational compass, numbered between 01 and 36 and designed based on the opposite direction of wind flow. Therefore, planes take off in the opposite direction of the wind. For example, a runway labeled 18 is positioned at 180° (FAA AC No: 150/5325-4B). A runway can be used from both directions, weather permitting.

At SDIA, weather conditions play a significant role in the daily runways operations. Currently there are two runways at SDIA, Runway 9 and Runway 27. SDIA Runway 27 takes off heading west. Therefore, the wind is flowing in from the west at 270°. Runway 27 is used over 99.9% of the time when the cloud ceiling is greater than 700 feet and visibility is greater than two miles. SDIA operates the west flow 97% of the time, the east flow 2.5% of the time, and 0.5% of time when there is mixed air patterns. Heavy delay is expected on the east flow since air traffic controllers enforce a 5 nautical mile (NM) in-trail separation. The east flow runway or Runway 9 is used when visibility falls below the 700 feet cloud ceiling and visibility is less than 2 miles (SDIA Master Plan, 2011).

Arrivals

At SDIA, the arrival capacity is equal for both east and west flow. However, Runway 27 operates more efficiently based on the layout of the airfield. According to the San Diego Air Traffic Control Tower, a runway occupancy time of 50 seconds or less enables the air traffic controllers to decrease in-trail separates between like aircraft and allows them to maximize runway efficiency. The required in-trail separation is 2.5 nautical miles (NM). When visibility falls below the visual flight rule (VFR), 5 NM in-trail separations is enforced. This allows the aircrafts sufficient time to land, slow down and exit the runway before it's time for the next aircraft to land. At no point can there be more than one aircraft on the runway. Low runway occupancy time and decreased in-trail separation increases the aircraft arrival rate (SDIA Master Plan, 2011)

Departure

Aircrafts departing SDIA must follow designated routes in the air after taking off. There is a minimum requirement of 2.5 NM of in-trail separation between departing flights. A single runway can have multiple departing routes. These routes are equivalent to a fork in the route, as planes depart they take alternate routes. Runway 27 has three departing routes. Runway 9 is limited to one departing route due to metropolitan obstructions. Therefore, Runway 9 has a lower departure rate and capacity than Runway 27. In addition, tailwinds have a negative impact on takeoff performance. When winds are blowing eastward, approximately 30% of the flights take a voluntary delay. At SDIA, pilots will chose to delay take off because during these conditions there is low visibility which can cause a greater flight risk. This is most common during the months of May and June when fog is present (SDIA Master Plan, 2011).

SDIA Airfield Limitations

There are many limitations for SDIA to operate efficiently. First and foremost, SDIA has a single runway. According to the San Diego County Regional Airport Authority, the existing airfield taxi system has several "non-standard characteristics." Taxiway B, running parallel to Runway 27 is 362.5 ft. away from the runway. Standard separation between taxiway and runways is 400 ft. (SDIA Master Plan, 2011). Taxiway B's centerline is 110 ft. away from a service road that is south of and parallel to Taxiway B. However, the FAA recommends a 160 ft. separation. As a result, SDIA acquired a special waiver to allow Group IV (wingspan 118'-171'; tail height 45'-60') aircraft to use the taxiway. However, Group V (wingspan171' - 214'; tail height 60' – 66') is prohibited from operating on a portion of Taxiway B. In order for Group V aircrafts to depart, two risky crossings of Runway 27 are needed to join the departing queue (SDIA Master Plan, 2011). In addition to having a noncompliant taxiway, Runway 9 lacks a high speed exit taxiway. This results in increased runway occupancy time for landing aircraft because the aircraft is forced to exit the runway at a slower speed.

3.3 San Diego – Air Traffic Statistical Analysis

To analyze the peak hours of operation for air traffic at SDIA, various statistical tests were conducted. A Chi-Squared test was conducted to test the significance of the time of day, day of the week and month the flights departed and arrived. There appears to be a relationship between arrivals and time of day, $X^2(108, N = 7) = 479.64$, $p < 0.001$. There also appears to be relationships between arrival and month of the year, $X^2(198, N=12) = 1934.11$, $p < 0.00$, between departure and time of the day, $X^2(102, N=7) = 345.37$, $p < 0.001$, and between departures and month of the year, $X^2(187, N = 12) = 1327.32$, $p < 0.001$.

To further investigate the results, an analysis of variance was conducted to measure the relationship between arrivals and departures and time of the day, day of the week and month of the year, which had high air traffic. The results found no statistically significant relationships between the arrivals and month, $F(11, 223) =.02$, $p < 0.05$; between arrivals and days of the week, $F(6, 133) = .018$, $p < 0.05$, between departures and month, $F(11,200) = -17.54$, $p <0.05$, or between departure and day of the week, $F(9,126) = 0.02$, $p < 0.05$. As predicted, there is significance between time of the day and arrivals, $F(18,114) =122.17$, $p <0.05$ and between time of day and departures, $F(17,190) = 94.35$, $p <0.05$.

In order to determine which time of the day is the busiest, a Scheffe F test was conducted. Based on the Scheffe F, the top four times of day which proved to have the highest arrival traffic were between 10:00 – 10:59am, 11:00 – 11:59am, 7:00 – 7:59pm, and 8:00 – 8:59pm. The top four highest departure traffic times occurred between 6:00 – 6:59am, 11:00 – 11:59am, 1:00 – 1:59pm and 7:00 – 7:59pm.

Lastly, ground traffic on I-5 was correlated with air traffic. No significant correlation was found to exist between ground and air traffic based on the time of the day, $r(18) = 0.23$, $p < 0.05$. Nor was a significant correlation found between ground and air traffic based on the month, $r(18) = 0.46$, $p < 0.05$.

3.4 Air Traffic Controller

The nation's air traffic controller (ATC) staffing is based on the demand at the airport. The funding for the ATC comes directly from passenger fees and not from the general fund. Therefore, the staffing level has a direct correlation with the passenger growth and the runway throughput. If there is a need to increase or decrease staffing for airport operations, 90-days of airport traffic must be surveyed (Joint Planning & Development, 2006). After the 90-day traffic survey, the airport will have to work with the FAA to get approval for the increase in staff.

3.5 NextGen

The Next Generation Air Transportation System (NextGen) is a series of changes and upgrades which will enable the National Air Space to be more efficient, technologically advanced and environmental friendly. This technology will not eliminate the need for new airports and runways, but will allow them to operate more efficiently, ultimately increasing capacity and output. Current limitations on airport and runway capacity increase cost for travelers, since this limits the number of flights and competitors which serve the city (Butler, 2008). In addition, delay due to capacity constraints not only inconvenience passengers in a particular city, but other cities served by the aircraft as well. This ripple effect is more evident in a hub-based airport (Butler, 2008).

The implementation of NextGen will also have an effect on the current ATC and ATM systems. As discussed earlier, the current method for take-off and arrival requires constant radio communication between pilot and air traffic controllers. Aircrafts in flight are tracked by radar. There are four major technological changes which create the backbone of NextGen. These four changes are Required Navigation Performance, Automatic Dependent Surveillance-Broadcast, Continuous Descent Approach, and Surface Area Movement Management. The implementation of these technologies is expected to reduce noise, fuel consumption and emissions while increasing airport and runway capacity.

A. The Required Navigation Performance (RNP) allows an aircraft to fly a straight path between two points. All new Airbus and Boeing planes built since 1995 are equipped with RNP technologies. With the help of Global Positioning System (GPS) satellites, routes with exact turns and altitude change are programed directly into the aircraft. RNP allows the pilot and crew to fly a complicated approach and departure. These routes can be designed to separate arriving and departing planes and increase the rate of departures.
B. Radar surveillance is being replaced by Automatic Dependent Surveillance – Broadcast (ADS-B). Voice communication is being replaced by digital data link. Inertial navigation is being replaced by GPS (Air Traffic Control Quarterly, NextGen Takes Flight). Using GPS, ADS-B can accurately identify an aircraft's position, speed and altitude. ADS-B/In allows planes to receive signals from other planes, whereas ADS-B/Out allows planes to send signals to other planes. ADS-B/In and Out will allow the pilot to see all aircrafts nearby, as well as their direction of flight, speed and altitude. This technology is important for sequencing, allowing for better merging and reduces spacing on the aircrafts' final approach (Butler).
C. Continuous Descent Approach (CDA) allows aircrafts to descend to the airport at a low power setting (engine idle). This approach allows the aircraft to arrive into the airport at an efficient altitude, avoiding the step down approach. Streamlining of aircraft flow

results in the reduction of fuel and noise and automates the spacing between each aircraft (Butler).

D. Surface Area Movement Management (SAMM) allows pilot in the cockpit to see the traffic moving into the airport. SAMM, coupled with the central system, which provides arrival times one to two hours ahead, will assist in sequencing the aircrafts arriving in the correct order. The will result in the maximum use of gates and minimize the taxi time and separation between aircrafts during arrival (Butler).

Required Navigation Performance (RNP), Automatic Dependent Surveillance (ADS), Continuous Descent Approach (CDA), and Surface Area Movement Management (SAMM) are means and method examples of NextGen technologies. These NextGen technologies allow for the opportunity to improve the efficiency of the National Air Space. In addition to the fore mentioned benefits, this technological approach is also synergistic in that it provides for greater safety as well as potential consumer savings.

CHAPTER 4: GROUND TRANSPORTATION & INFRASTRUCTURE

4.1 Current Needs and Inefficiencies

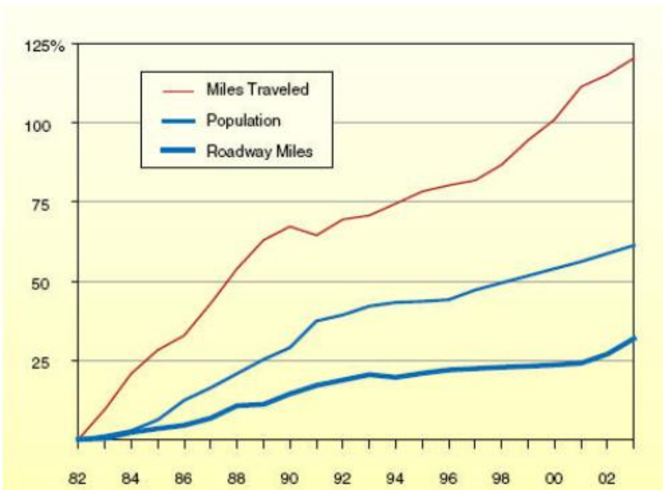
Resulting from the dramatic increase in motorized travel, coupled with an inadequate financial capacity to keep pace with the demand, many of the region's major transportation facilities are operating at or beyond their capacity. Traffic congestion in the San Diego region will most likely continue to worsen over time unless travel demand, especially during peak periods, is addressed (SANDAG, 2007). As of 2007, the population within the San Diego region was making an estimated 16.7 million trips daily by some form of motorized travel. It is estimated that by 2030 travel demand will increase to 22 million trips daily.

Similar to most major metropolitan areas around the country, the City of San Diego has seen a gradual decline in commuting by both carpool and public transit in favor of driving alone. Following the current trend, it is projected that the miles travelled in 2030 will be three times higher than they were fifty years ago in 1980 (SANDAG, 2007). As of the year 2000, over 70 percent of San Diego and Imperial County commuters drove alone to work versus less than 20 percent who carpooled (SANDAG, 2009).

As of the Census 2000, the San Diego metropolitan area was ranked 28th in average daily travel time for motorists. Currently there is a peaking of travel demand during short periods throughout the day that strain the transportation system, with excess capacity during off-peak periods. These times are generally between 7:00 and 8:00 in the morning, and then again at 5:00 in the early evening (SANDAG, 2007).

Figure 4.1 illustrates the increase in miles travelled and its relation to both the population and the total miles travelled (SANDAG, 2006). From 1982 to 2002 each of these areas has experienced dramatic increases; however population and roadway miles pale in comparison to the total increase in miles travelled over the same time period. This graphic further illustrates the need for traffic relief on the roadways throughout San Diego County.

Figure 4.1: Growth in Road Capacity Lags Travel Time



4.2 Future Transportation Development Improvements – Coastal Region

MCB Camp Pendleton is located in Northern San Diego County, east of Interstate 5 and north of State Route 76. Forty miles northwest of the San Diego Central Business District and seventeen miles southeast of the San Diego County/Orange County line, this proposed airport site will draw from the populations of North San Diego, Riverside and Orange Counties (Ricondo and Associates Team, 2006). The airport site will be located approximately three miles south of the existing military airfield, in the southern portion of MCB Camp Pendleton (Ricondo and Associates Team, 2006).

In order to accommodate the already over capacitated Interstates, there were several proposed improvements to Interstate 5 and State Routes 76 and 78 from The Ricondo & Associates Team in 2006. Specifically, additional traffic lanes should be added between State Route 76 and 78, and on State Route 76 between Interstate 5 and El Camino Real. Lastly, additional travel lanes should be added on segments of State Route 78 between Interstate 5 and Interstate 15 (Ricondo and Associates Team, 2006).

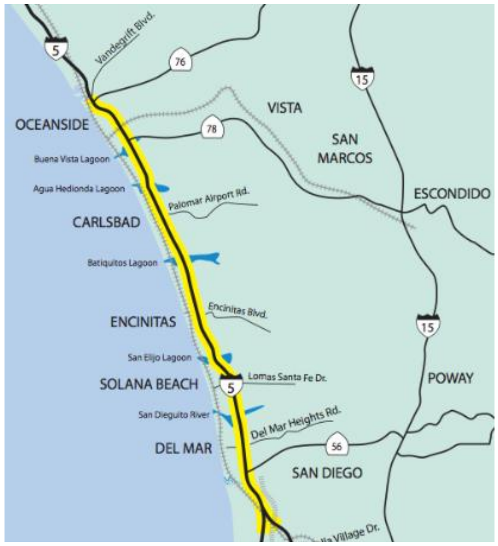
Located in central San Diego County, the proposed airport addition at MCAS Miramar would be located on the south-central portion of the air station. This site would be bordered by military training, the Miramar landfill, and the Miramar Mounds National Natural Landmark. As included in The Ricondo & Associates Team report, civilian access would occur via a new road connecting to an improved Interstate 5/Miramar Way interchange. There are also proposed relocations and/or realignments of segments of Interstate 15, State Route 163, and Kearney Villa Road north of Highway 52 (Ricondo and Associates Team, 2006).

SANDAG and Caltrans have partnered to develop a Transportation Demand Management (TDM) Plan to improve traffic congestion along the Interstate 5 North Coast Corridor, which stretches approximately from La Jolla Village Drive in San Diego to Harbor Drive in Oceanside (TransNet, 2013). For the proposed site at MCB Camp Pendleton this would aid in supporting the increase in traffic with the addition of an airport (SANDAG, 2013). The Interstate 5 North Coast Corridor is the lifeline connecting San Diego to Los Angeles County, Orange County, and Baja California. Currently, there is an average of more than 200,000 vehicles travelling throughout day-to-day traffic, and this number is expected to increase to more than 300,000 by 2030. Important to commuters, commercial and recreational travel, without capacity improvements Interstate 5 will suffer from bottleneck delays throughout the day, not just during the morning (7:00 to 8:00 a.m.) and early evening (5:00 p.m.) rush hours that were previously mentioned (SANDAG, 2013).

With a cost estimated to be $3.5 billion, in 2011 dollars, and the projected completion date in 30 years (2043), the 27-mile project would add two Express Lanes for both northbound and southbound traffic, operational improvements (auxiliary lanes and local freeway interchange modifications), as well as environmental enhancements that will aim to preserve, protect, and restore hundreds of acres of critical coastline habitat (SANDAG, 2013).

The Interstate 5 Express Lanes project will allow for a more dependable, congestion-free travel alternative throughout the North Coast Corridor and is slated to contain more than 22 noise-mitigating walls along the route. The operational improvements are set to include the Interstate 5/Genesee Avenue Interchange Project, Interstate 5/56 Interchange Project and the Interstate 805 HOV/Carroll Canyon Road Extension Project. Figure 4.2 illustrates the location of the Interstate 5 North Coast Corridor Project along Interstate 5.

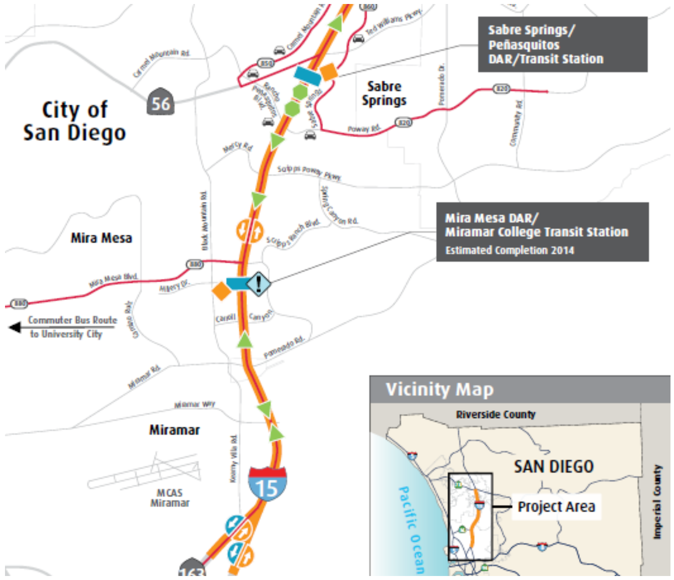
Figure 4.2: Illustration of Interstate 5 North Coast Corridor Project



The Interstate 5/Genesee Avenue Interchange will include the replacement of the existing overcrossing, the widening of freeway access ramps and the addition of auxiliary lanes as well as a Class 1 bicycle and pedestrian facility. The Interstate 5/56 Interchange is proposed to improve traffic operations between Del Mar Heights Road and Carmel Valley Road, and State Route 56 between Interstate 5 and Carmel Country Road (TransNet, 2013). The Interstate 805 HOV/Carroll Canyon Road Extension includes the extension of Carroll Canyon Road under Interstate 805, construction of two miles of HOV lanes in each direction, and a northerly Direct Access Ramp from the Carroll Canyon Road HOV lanes (TransNet, 2013).

Aside from the Interstate 5 North Coast Corridor Project, there have also been improvements made inland with the Interstate 15 Express Lanes Project. Stretching from State Route 163 north to State Route 78, the four lane, 20 mile express lane median was designed to meet the various needs of local travelers, commuters, as well as commerce located within the San Diego region. With four distinct segments (North, Middle, South, and Bus Transit) that have been opening in segments since 2008, the total project cost is over $1.2 billion (TransNet, January 2013). Figure 4.3 illustrates the portion of the project that will benefit the MCAS Miramar location.

Figure 4.3: I-15 Express Lanes Project Map



There are northbound and southbound immediate access points from Miramar Way. Although this will aid in freeway congestion, the proposed improvements from the Ricondo & Associates Team via the new road connecting to an improved Interstate 5/Miramar Way interchange will also need to be completed. In addition, a new Bus Rapid Transit (BRT) System is expected to start in 2014 and will provide high frequency transit services along the Express lanes route. These buses are designed to run more often and provide a convenient service that is similar to that of a light rail system, and will encourage a lessened use of personal vehicles (TransNet, January 2013).

Currently, Interstate 15 is experiencing traffic volumes fluctuating from 197,000 to 312,000 vehicles daily. By 2020, it is expected that daily traffic volumes will exceed 380,000 vehicles. Prior to the Express Lanes project, average traffic delays added anywhere from 30 to 45 minutes to an individual’s commute. Without the completion of this project, it is estimated that these delays would increase anywhere from 80 to 90 minutes (TransNet, January 2013).

4.3 Future Transportation Development Improvements – Inland Region

The Campo/Boulevard site is located south of Interstate 8, 69 miles east of the San Diego Central Business District. Largely vacated with scattered rural, residential developments, space would not appear to be a constraint for this site (Team, 2006). With a current population of over 5,800, the expected population in 2030 is expected to increase by over 34% to 8,800 (San Diego Planning Commission, 2011). Despite this increase in population over the next 17 years, it still appears that there would be sufficient space for an airport site. Taking into consideration Imperial County as a whole, it is estimated that the population will see a 270 percent increase from 2000 to 250 to almost 388,000 people (SANDAG, 2009).

With the wish to preserve the rural atmosphere, it has been determined that “all development proposals shall demonstrate a diligent effort to retain significant existing natural features characteristic of the community’s landscape.” In addition to this it is noted that any new developments must provide a buffer to residential areas from incompatible activities that create heavy traffic, noise, and lighting (San Diego Planning Commission, 2011). This constraint will force the design of the airport, as well as any additions to the Interstate and surface streets to reduce the visual impacts it creates as well as its placement. Due to the need to buffer traffic, noise and lighting it is suggested that an airport in the Campo/Boulevard area be placed well away from residentially populated areas.

The Mountain Empire Subregional Plan also stipulates that development must ensure the careful management of environmental resources in the area. Therefore a complete Environmental Impact Review (EIR) will need to be completed around the desired location. In addition to the specific requirements set forth in the Mountain Empire Subregional Plan, according to the National Environmental Policy Act of 1969 and the Airport and Airway Development Act of 1970, "due consideration must be given to effects on the quality of the environment and the surrounding communities in regard to airport expansion, use and development" (NASA, n.d.). Therefore, for any of the proposed airport locations, prior to building a new facility or expanding an existing one, an impact study or feasibility study must be completed.

Interstate 8 is used primarily by Imperial County agricultural producers to ship products into the San Diego area. This has been particularly true since the parallel railway was disrupted in 1976 and again in 1983. Interstate 8 therefore provides access to suppliers of the agricultural support industries, as well as connects distribution centers and consumers between the San Diego region and the Calexico/Mexicali region and beyond (Department of Transportation, n.d.).

Currently, Interstate 8 is a four lane freeway (2 lanes each direction) which accommodates the majority of the east to west Southern California traffic. The Campo/Boulevard area is accessed by State Route 94. There are currently two on-off ramps that serve Campo/Boulevard, Crestwood Road and Ribbonwood Road (San Diego Planning Commission, 2013). With an approximate addition of 20 million passengers by 2030 to the new airport site, if full capacity is achieved, additional on-off ramps will be necessary to account for the increased traffic on the roadways. An exit dedicated to airport traffic would be ideal to lessen the use of surface streets used by residents. For example, SDIA has multiple entrance and exit points to help alleviate bottlenecks on and off the freeway.

From looking at multiple documents, there is no clear indication that the Campo/Boulevard area is experiencing bottlenecks due to excess traffic. In general, 89 percent of Imperial County commuters are experiencing a travel time to work of less than 40 minutes (SANDAG, 2009). Traffic volumes on State Route 94 currently range from 1,300 daily vehicles in the east portion of the county to 87,000 daily vehicles to the west near San Diego County. In contrast, Interstate 8 daily traffic volumes range from 12,000 daily vehicles to nearly 90,000 as you approach El Cajon (SANDAG, 2009). Although it will take time for traffic congestion to develop in the Campo/Boulevard area, there are currently congestion issues along Interstate 8 as motorists move closer to the San Diego area. Therefore, in relation to the Camp/Boulevard area, the 2nd Avenue exit in El Cajon will serve as a relatively close, populated exit off the freeway for gathering traffic statistics.

From Figures 4.4 and 4.5, it can be seen that there is a distinct rush hour of traffic in the morning hours when traveling westbound and in the evening when traveling eastbound when comparing 2010, 2011 and 2012 data (Department of Transportation, n.d.). These rush hour peaks remain consistent today.

Figure 4.4: I-8 Average Westbound Weekly Hourly Delay (I-5 to 2nd Street)

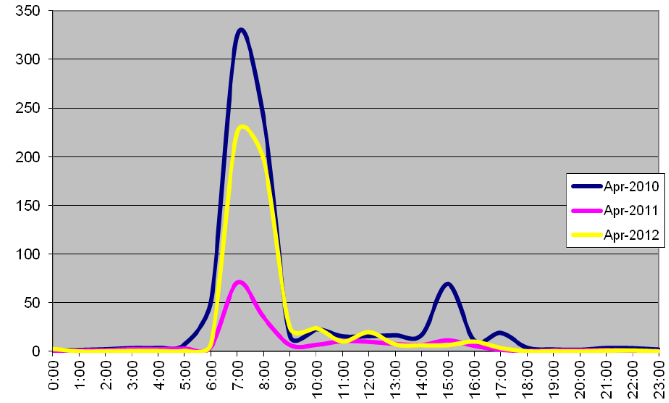
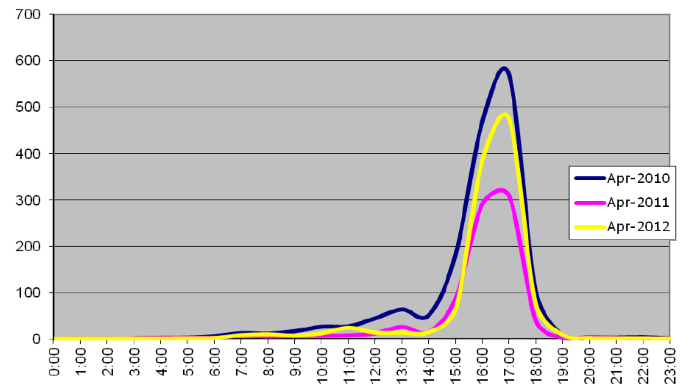


Figure 4.5: I-8 Average Eastbound Weekly Hourly Delay (I-5 to 2nd Street)



Aside from the limited access, this section of Interstate 8 is routinely closed due to high winds. Although this will generally only affect campers and large trailers, the weather conditions may hinder airport operations with regards to cargo transport if large trailers are not able to enter the area. These high winds might also contribute to a more turbulent atmosphere for the planes to take-off and land into. Because of this, the layout of the airport will be critical for passenger safety. Mountain winds are usually stronger than valley winds, especially during the winter months (NASA, n.d.).

As mentioned within the Ricondo & Associates Team study, there are several off-airport improvements that will need to be made in order for an airport to be feasible in the Campo/Boulevard area. The three biggest improvements being additional lanes along sections of Interstate 8, the optional development of a high speed transit system, and the extension of utility corridors to handle the influx of people. From research conducted, if a high speed transit system were to be developed it would connect major cities along the coast (SANDAG, n.d.). Because it would not include stops in Imperial County, a high speed transit system would not be a feasible transportation option for the Campo/Boulevard area.

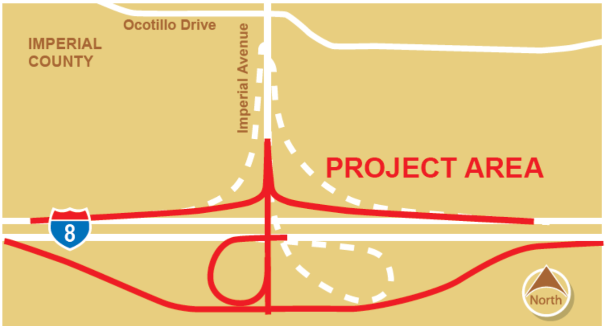
There are several projects that are aimed at reducing current and future congestion on Interstate 8 in Imperial County. Although none of the current projects are specific to the Campo/Boulevard area, as traffic increases these improvements would be expected to help alleviate congestion throughout the Interstate 8 route, close to the City of San Diego. Estimated to be complete in the summer of 2014 and cost roughly $33.1 million, Caltrans is working to lessen the current congestion at the Interstate 8 Dogwood Road Interchange. The Interstate 8

Dogwood Road interchange has experienced rapid commercial and residential development. Construction will widen the ramps from one to two lanes and will add four lanes to the bridge overcrossing, including two designated turn lanes. Traffic studies have shown that by widening the ramps on and off the freeway, as well as adding signals to and widening the bridge, traffic congestion should be alleviated. Figure 4.6 illustrates the location of the improvement (Department of Transportation, 2013).

Figure 4.6: Interstate 8 Dogwood Road Interchange Project

With an estimated completion of 2018 (and also when funding is established) and a cost of $42 million, Caltrans is also proposing to reconstruct the interchange at Interstate 8 and Imperial Avenue. With approximately 16,000 to 27,000 vehicles accessing this roadway, similar to other sections of highway, Imperial Avenue experiences congestion during the morning and early evening rush hours. This project is proposing to install two ramps that will provide direct access to the southern sections of Imperial Avenue from Interstate 8. With traffic on this portion of Interstate 8 projected to nearly double by 2025, it is vital that improvements occur prior to in order to keep pace with anticipated demand. Figure 4.7 illustrates the location of the improvement (Department of Transportation, Interstate 8 Imperial Avenue Interchange, 2013).

Figure 4.7: Interstate 8 Imperial Avenue Interchange



4.4 Airport Parking

Airport infrastructure requires specific planning. The proposed development should serve the needs of the community while maintaining certain flexibility during a changing environment. The level of development will depend on the needs of the community it is serving as well as the projected demand for the airport. Well managed infrastructure development ensures the protection and safety of the travelers as well as taking into account the effects on surrounding areas. Additionally, the scale of the project needs to be taken into account together with size and building requirements.

Infrastructure covers a wide variety of airport structures including terminal facilities, access roads, and parking facilities. This section will be primarily focused on parking. Many factors need to be taken into account when developing parking areas and structures. When considering building the parking facilities, the right quality and mix of space is an important issue to address (FAA 2012, September 4). An airport needs to have short term and long term parking available to the passengers. Even more important to consider is the land available for development, and should be involved in the airport layout plan. The amount of land available for future expansion is a key element when deciding on the most efficient site for the new airport (FAA n.d. *Airport Planning & Capacity*).

Each site has its own advantages and disadvantages. However, each site will have to have the capability to meet the future demand of the greater San Diego area. Since each proposed site will range in their size and complexity it would be best to compare the locations to existing airports with similar layouts (FAA n.d. *Commercial Service Airports*).

Taking into account the parking structures available on site only, it can be seen that the San Diego Airport is already falling short for their current demand for enplanements. This is not taking into account the people leaving the airport as they no longer will require a parking spot. In keeping with the Ricondo & Associates Team of a "Planning Activity Level" for future expansion of 45 million passengers per year we can determine the minimum area needed for each site to provide sufficient parking. Since the current San Diego Airport will not be obsolete we can assume that it will still work at their capacity of 15 million passengers per year. This leaves the new site to accommodate the remaining 30 million. Table 4.1 shows San Diego International Airport parking spaces and annual enplanements in comparison with other similar airports that have added a supplemental airport (ACI-NA, 2013, August 28).

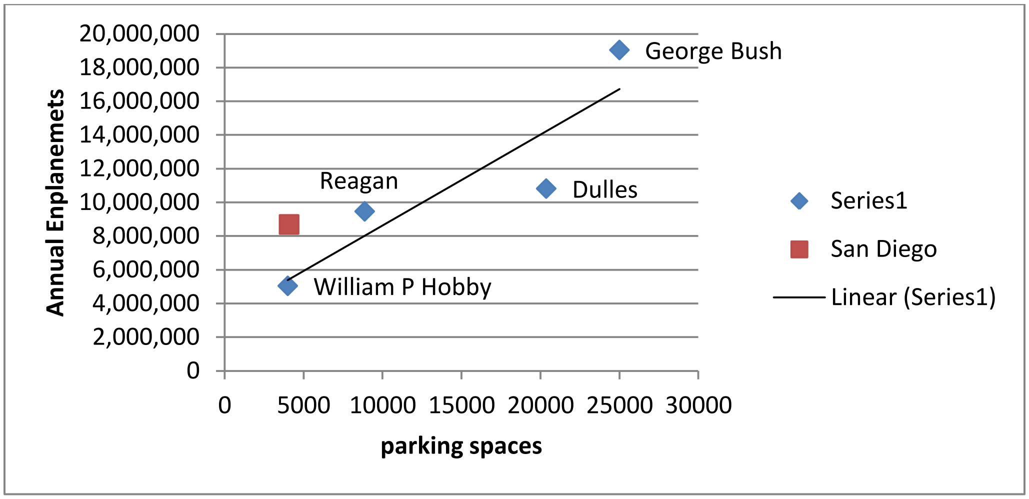
Table 4.1: Airport Parking Space and Annual Enplanements

	Parking Structures	**Total Parking Spots**	**Enplanements (2012)**
Reagan International Airport	3	8,872	9,462,231
Dulles International Airport	3	20,365	10,816,216
William P Hobby Airport	3	4,000	5,043,737
George Bush Intercontinental Airport	4	25,000	19,039,000
San Diego International Airport	3	4,085	8,686,621

In this table, a comparison can be made of the total parking spots of the San Diego International Airport with other cities that added an additional airport. The Reagan International airport had started to reach its capacity only a few short years after its opening (Metropolitan Washington Airports Authority n.d. *Reagan*). The Dulles International Airport site had been quickly decided on; it was developed as a 10,000 acre site with three runways. Since its opening the demand continually increased each year and now they offer over 20,000 parking spots (Metropolitan Washington Airports Authority n.d. *Dulles*). The William P Hobby Airport opened in 1927 as a private airport. International flights started landing and the airport quickly reached its capacity. The George Bush Intercontinental Airport was opened in 1969. This airport was proposed due to limitations on expansion at the Hobby Airport. Both the Reagan and the

William P Hobby Airports had similar limitations to the San Diego International Airport. The Dulles and the George Bush Airports opened to give relief to the existing airports but with larger parking capabilities of over 20,000 parking spots.

Figure 4.8: Number of Parking Spaces to Annual Enplanements



The total enplanements for the Reagan International Airport are similar to that of the San Diego Airport however, it can be seen that the total number of spots available is over double (ACI-NA, 2013, August 28). Since the projected future amount far exceeds the capabilities of SDIA the new site should be able to accommodate parking structures for a potential of 30 million travelers. Staying in comparison with these airports, the subsequent airport in San Diego should have quite a few more parking spaces than the current airport; possibly around 20,000 spaces. To further expand on this number of spaces the new proposed site can be compared to an existing airport of similar demand such as the Philadelphia Airport.

The Philadelphia Airport (PHL), according to the Airports Council International-North America, had 30.25 million travelers in the year 2012, similar to the projected 30 million passengers that the new site would need to account for. Including long term and short-term parking, PHL offers over 19,000 spaces and several parking structures, comparable to the Dulles International Airport with 20,365 and the George Bush Intercontinental Airport with about 25,000 (Philadelphia International Airport n.d.). The location of the new site should closely resemble Philadelphia's parking abilities which can be seen in Appendix C. Since the projected number of travelers for SDAI coincides with PHL's annual passengers, Philadelphia's layout can be used to model the layout of the new airport (Philadelphia International Airport n.d.). Although Philadelphia is one of the better options to model, San Diego ordinances should be followed.

Section 6792 of the Zoning Ordinance states that each parking spot should be a minimum of nine feet wide and eighteen feet long not including handicap accessible spots. This is enough for a standard full size vehicle. Additionally, one way aisles of the parking structure need to be a minimum of 12 feet and a two way aisle a minimum of 24 feet. Table 4.2 exhibits the minimum requirements for parking design from the San Diego County Parking Design Manual (San Diego County 2012, June.).

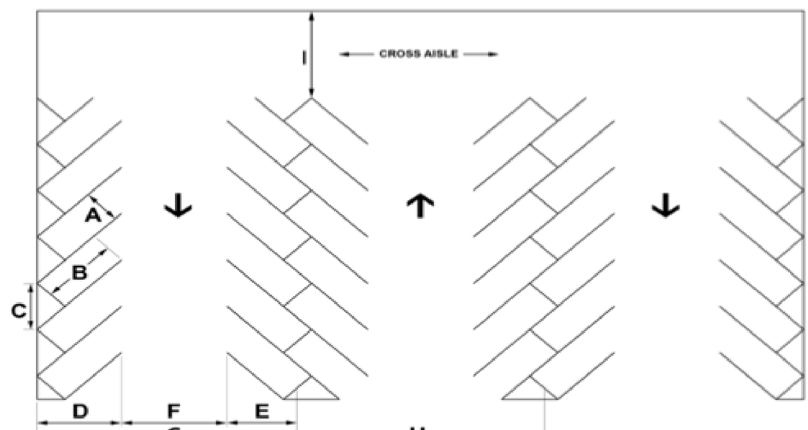
Table 4.2: Minimum Design Measurements

Figure 3 Label	Design Component		Parking Angle 0° (Parallel)	30°	45°	60°	90°
A	Stall Width		9'(8')[1]	9'	9'	9'	9'
B	Stall Length		22'	18'	18'	18'	18'
C	Stall Width Parallel to Aisle		N/A	18'-0"	12'-9"	10'-5"	9'-0"
D	Stall Depth to Curb or Wall		N/A	16'-10"	19'-1"	20'-1"	18'-0"
E	Stall Depth to Interlock		N/A	12'-11"	15'-11"	17'-10"	18'-0"
F	Aisle Width[2]	One-Way	13'	14'	16'	19'	N/A
		Two-Way	24'	22'	24'	24'	26'
G	Module Width Wall/Curb to Interlock	One-Way Aisle	N/A	43'-9"	51'-0"	46'-11"	N/A
		Two-Way Aisle	N/A	51'-9"	59'-0"	61'-11"	62'-0"
H	Module Width Interlock to Interlock	One-Way Aisle	N/A	39'-10"	47'-10"	54'-8"	N/A
		Two-Way Aisle	N/A	47'-10"	55'-10"	59'-8"	62'-0"
not shown in Figure 3	Module Width Wall/Curb to Wall/Curb	One-Way Aisle	31'-0"	47'-8"	54'-2"	59'-2"	N/A
		Two-Way Aisle	42'-0"	55'-8"	62'-2"	64'-2"	62'-0"
I	Cross Aisle Width[2]	One-Way	15'	15'	15'	15'	15'
		Two-Way	22'	22'	22'	22'	22'

[1] 8' width applies to on-street parking stalls
[2] The Director may require greater aisle width due to emergency San Diego County Fire Authority equipment access needs. Aisles less than 24' shall not be designated as Fire Access.
N/A – Not Applicable

Figure 4.9 corresponds to the design measurements laid out in the above table.

Figure 4.9: Drawing for Table 4.2



Just taking into account the space needed for the parking spots alone, the new site should have a minimum of 162 square feet per space. To accommodate the projected 30 million passengers, and using Philadelphia's parking space as a model, the new site should allow at least 3,078,000 square feet or about 70 acres. In table 4.3 are the calculations used determining these minimum requirements (San Diego County 2012, June.).

Table 4.3: Minimum Parking Requirement

Width of one Space	9'
Length of one Space	18'
Total Sq. Ft per Space	9x18 = 162 sq. ft.

PHL Spaces x Total Sq. Ft per Space	19,000 x 162
3,078,000 square feet	~70 acres

Note: this is not taking into account the space for the aisles, whether the aisles are one or two way, or loading areas.

With a minimum space needed for parking determined, there are a few other considerations that need to be addressed on a per site basis. All of the sites meet the minimum area needed to build the parking structures but the type of structure must also be dealt with. The type of structure used at each site should minimally impact the area so several structures can be considered. The design and aesthetics of the parking area should coincide with the surrounding area as well. The future demand and the minimum space have been determined, what is left for each site is the structure design, safety of design, and layout of the parking lot (Parking Structure Technical Report n.d.).

At the Campo/Boulevard site the land requirements are sufficient enough to accommodate the minimum parking requirements. The proposed ground transportation and parking area should serve well enough, however environmental factors should be taken into consideration. If the area has a certain height limit, a multi-level parking garage may not be feasible. In this case, there needs to be enough land area to expand outwards instead of upwards. Since the area surrounding the site is fairly undeveloped this may not be an issue for future expansion.

Similar to the Campo/Boulevard site, MCB Camp Pendleton has an area surrounding the proposed site that would allow for future expansion. With the total area of the site encompassing 2,700 acres and undeveloped surroundings, this would also be a feasible area for a larger airport that can accommodate the minimum amount of parking spaces.

Unlike Campo/Boulevard or MCB Camp Pendleton, the MCAS Miramar site is surrounded by developed land. If chosen, this site can accommodate the minimum requirements but future developments should be considered. The total area of the site encompasses 23,000 acres which far exceeds the minimum requirements for parking. However, developers need to consider the joint use for military as well as once the area is fully developed there will be little to no room left for future expansions.

4.5 Utilities

Utilities are an important aspect of airport planning. Not only is it needed to make the airport operational but also environmental contracts need to be in place for waste and storm water runoff. Sanitary sewer capacity, natural gas, main water, electrical systems, and storm water detention are all part of the utilities that should be taken into consideration when developing a new airport. The focus of this section will be on sewer capacity and water supply and each presents its own unique situation so, using comparative analysis of airports that currently serve around 30 million travelers, the types of systems and minimum requirements of these systems can be determined.

4.5.1 Sanitary Sewer Capacity

First, looking at the Detroit Metropolitan Wayne County Airport's (DTW) sanitary sewer capacity the airport's total design capacity can be determined. DTW serves an annual 32.2 million travelers so would be a good airport to look at minimum requirements for the new development. Table 4.4 shows the different sub systems, the size and location of their sewers but more importantly shows capacity design of each sub system. Taken form DTW's master plan the total design capacity is roughly 29 million gallons per day (Wayne County Airport Authority. n.d.).

Table 4.4 Sanitary Sewer Capacity

Sub System	Size	Location	Design Capacity
#1	24"	McNamara	4,134,000 gal/day
#1 Outlet	42"	McNamara	12,504,000 gal/day
#2	15"	North Terminal	1,616,000 gal/day
#3	21"	North Terminal	3,237,000 gal/day
#4	15"	North Terminal	1,616,000 gal/day
#5	10"	North Terminal	749,000 gal/day
#4/#5 Outlet	24"	North Terminal	4,134,000 gal/day
#6	12"	North Terminal	1,079,000 gal/day
Total			29,069,000 gal/day

In addition to DTW, the Minneapolis St. Paul International Airport (MSP), which serves an annual of 33.2 travelers, can be used in a comparative analysis. However, contrary to the Detroit Airport, MSP operates its own plant that has a design capacity of 250 million gallons per day. This plant is called the Metropolitan Council Environmental Services (MCES)-Metropolitan Wastewater Treatment Plant. This plant serves over 65 communities including the MSP Airport and a total population of about 1.8 million per day (Metropolitan Airports Commission. n.d.).

These two options should be considered when designing the new airport for San Diego. As each site being considered has various conditions surrounding it no one option may be best for all sites. As stated by the Ricondo & Associates Team, the Campo/Boulevard site is in a rather undeveloped area. In this case the plant may be the best option. Even though there are current waste systems in place they are for the purpose of serving relatively small communities as opposed to an airport that is expected to serve an estimated 30 million people a year.

On the other hand, both MCB Camp Pendleton and the MCAS Miramar sites have developed cities surrounding the proposed locations that have the ability to add additional sub systems to, similar to Detroit Metropolitan Wayne County Airport's sub systems. Adding these sub systems would be far less costly than building a new plant.

Currently the Carlsbad Sanitary District serves a population of about 104,652, estimated by the California Department of Finance in 2009, and the City of Carlsbad wastewater service area covers about 30.5 square miles or an estimated 78% of the total city area. The proposed site of the new airport would be adjacent to the system so additional sub systems would need to be developed to accommodate the needs of the airport (City of Carlsbad).

Similar to the MCB Camp Pendleton site, MCAS Miramar has the City of Miramar to add sub systems to. According to the city's sewer standards, Table 4.5 shows the city is currently running at the following capacity (City of Miramar):

Table 4.5: Miramar Peak Sewer Amounts

Population in Thousands Flow Range, MGD*-ADF**	Hourly Peak Factor
0.000 to 0.100	4

0.100 to 0.250	3.5
0.250 to 1.000	3
1.000 to 4.000	2.5

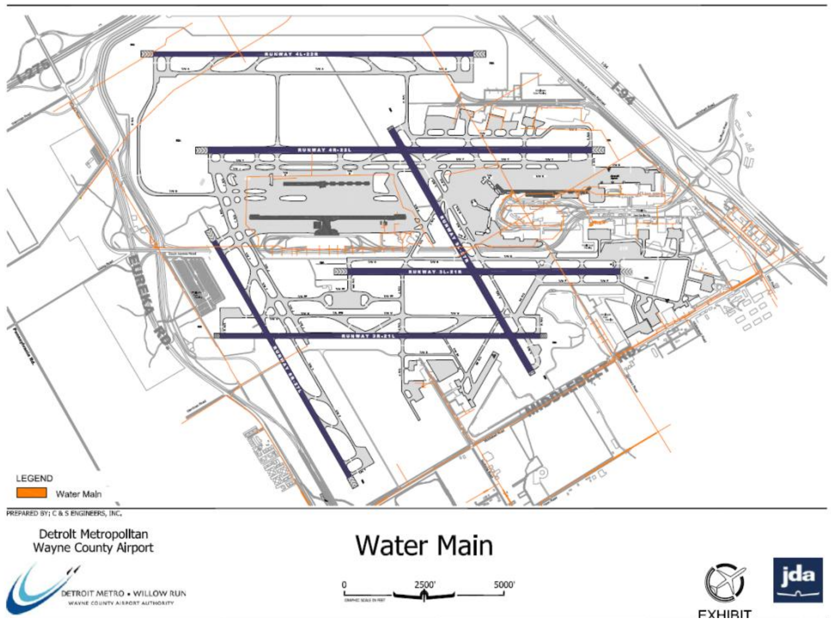
* MGD: millions gallons per day
**ADF: average daily flow

The Miramar Treatment Plant currently serves 140 million gallons of water per day but in the winter of 2008 the City of San Diego proposed to increase the plant's capacity to 215 million gallons a day. This will rival the Metropolitan Wastewater Treatment Plant in Minneapolis and assist in the building requirements if the Miramar site is chosen (Water and Wastewater Departments. n.d.).

4.5.2 Water Sources

Water sources are another important aspect of utilities. Water uses can range from passenger amenities in the terminals to irrigation. Again, looking at the DTW's main water source we can start to get a breakdown of what may be needed for the new site. DTW has three main water systems to support their facility. Figure 4.10 includes the system layout in orange. These systems support the terminals as well as the hangars and irrigation systems. Runoff is also managed by this layout (Wayne County Airport Authority. n.d.).

Figure 4.10: DTW Main Water Supply



In addition to having an effective water system in place the water sources need to be sufficient enough to provide for all of the airports' needs. The MSP Airport's water sources brought in around 916,000 gallons per day in 2009 (Metropolitan Airports Commission. n.d.).

Significant construction would be required to support the water systems at the Campo/Boulevard site. This can lead to contamination of the water supply from the surface water resources particularly in the Jewel Valley Creek. Groundwater and surface water will need to be utilized to support the needs of an airport of the size that is proposed.

MCB Camp Pendleton would also require additional construction including earthwork which could also lead to contamination of the surrounding waters. However, since this area is developed it already has storm water treatment facilities that are not expected to be impacted. Additional lines will have to be added to the Carlsbad Municipal Water District which currently serves about 85% of the community (Carlsbad Municipal Water District).

MCAS Miramar would involve additional development which could lead to contamination of surrounding canyons. Development to the Miramar Water Treatment Plant may also be an option for this site. This plant is currently serving 500,000 people drinking water from its main source, the Miramar Reservoir. Its current capacity is 144 million gallons of treated water a day. This would need to be increased in comparison to the 916,000 gallons that supplies the MSP Airport (Water. n.d.).

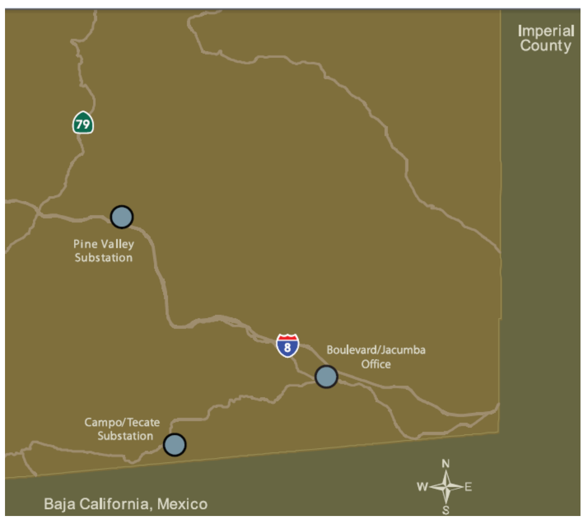
For all sites, additional building would be required for sewer treatment and water supply. The extent of this building will depend on the sites and the current capacities of each site. It is important to meet the demands presented by the Ricondo & Associates Team and to incorporate the costs of the development. The Campo/Boulevard site would require the most building. Both the MCB Camp Pendleton and MCAS Miramar sites have facilities that can be expanded on but the extent of the expansion will vary for each site.

4.6 Safety Implications - General

Public Safety as a whole will likely see an increase in the number of responses due to an influx of people on the roads leading into and out of any of the proposed airport sites. The increase in population, through both residents and travelers will place an increased demand for law enforcement agencies as well as fire departments throughout the area as well as along the International Border. In order to ensure the safest possible environment, each of the locations will need to determine the current and future needs of their public safety agencies. This section will focus more on the needs of fire and police departments, as standards for the airport itself will be set by the Federal Aviation Administration (FAA), Peace Officer Standards Training (POST), and National Fire Protection Association (NFPA) for each branch of public safety.

The Campo/Boulevard area as well as MCB Camp Pendleton will largely be serviced by the San Diego County Sheriff's office as well as the military police, whereas MCAS Miramar will be serviced by the City of San Diego Police Department as well as the military police. In addition to local support there would likely be personnel dedicated to the airport site, as there is at the SDIA. Figure 4.11 indicates the current locations of the San Diego County Sheriff as they relate to the Campo/Boulevard location (San Diego County Sheriff's Department, 2012). Fire services will be provided by the Boulevard Fire & Rescue Department and Campo Fire and Rescue for the Campo/Boulevard areas, the Camp Pendleton and City of Oceanside Fire Department's for the MCB Camp Pendleton site, and the MCAS Miramar and City of San Diego Fire Department's for the MCAS Miramar site.

Figure 4.11: San Diego County Sheriff Substation Locations



4.7 Safety Implications – Campo/Boulevard

With regards to the Campo/Boulevard site, and the closeness of the international border and its uncontrolled nature, there have been numerous documented incidents of drug and human trafficking (San Diego Planning Commission, 2013). This safety concern is unique to the area and will have to be examined with the possible development of an airport site. In turn, this will also create a greater demand on law enforcement as well as border protection. In 2004, an estimated 10 million passenger vehicles entered into Imperial County through the United States/Mexico border (SANDAG, 2009).

The Campo/Boulevard areas are currently served by San Diego County Sheriff officers as well as United States Border Patrol officers. The San Diego County Sheriff Campo Substation was established in 1987 and serves an unincorporated area of nearly 300 square miles with a population of approximately 2,000 persons. The area includes the San Diego backcountry communities of Campo, Potrero, Tecate and Dulzura (San Diego County Sheriff's Department-Campo, 2013). The San Diego County Sheriff Boulevard Substation is a satellite office of the Pine Valley Substation. The office serves an area encompassing over 200 square miles which includes the communities of Boulevard and Jacumba, with a population of over 2,000 (San Diego County Sheriff's Department-Boulevard, 2013).

In 2012, the San Diego County Sheriff personnel division reviewed over 4,200 applicants and hired 365 new personnel to assist in border protection (San Diego County Sheriff's Department, 2012). It is likely that the addition of an airport, and in turn a dramatic increase in people entering the area will require the addition of more border protection officers. In accordance, additional Sheriff Officers will likely be needed at each of these substations.

In addition to law enforcement, fire protection activities will also likely experience an increase in dispatched responses. The Boulevard Fire & Rescue Department is currently made up of 15 volunteer firefighters responding out of a single fire station (Boulevard Fire and Rescue Department, 2013). This indicates a clear set of improvements needed for their fire service. The resources needed to respond to an all-risk environment will dramatically increase, and in most cases the capabilities of a volunteer fire department will not suffice. Not only will the equipment needs increase, but the skill level and training necessary to respond to a greater variety of incidents will also increase.

Campo Fire & Rescue is a not for profit corporation who serves the Campo Community. With one fire station and a crew of volunteer firefighters, the depth of this department is similar to that of the Boulevard Fire & Rescue Department (Campo Fire and Rescue, n.d.). Limited funds and equipment will hinder the response capabilities of Campo Fire & Rescue personnel to a full scale incident at an airport. This further demonstrates the need for additional funds to be provided to these fire departments, as well as a full-time crew to be stationed at the airport who are trained for an airport response.

To gain perspective, the San Diego Fire-Rescue Department maintains crash and rescue equipment at two of its fire stations that are dedicated to the airport. In addition to the equipment maintained by the fire department, the San Diego Regional Airport Authority maintains four rescue apparatus (Rescue 1, 2, 3, and 5) at the San Diego International Airport. Rescue 1 has the capacity to carry 1,000 gallons of water, 130 gallons of foam (light water) and 500 pounds of Halon 1211, a chemical designed to smother fire. Rescue 2 and 3 each have the capacity to carry 3,200 gallons of water and 410 gallons of foam. Lastly, Rescue 5 can carry 3,200 gallons of water and 410 gallons of foam. These four apparatus are always staged and do not leave the airport grounds (San Diego Fire and Rescue Department, 2012). Figure 4.12 illustrates what the Rescue Apparatus look like.

Figure 4.12: Rescue Apparatus

The addition of an airport in the area will mandate the addition of an ARFF unit on site as well as additional law enforcement personnel. As part of the Federal Aviation Administration's (FAA) Part 139 Airport Certification, an airport must agree to certain operational and safety standards based upon its size and the type of flights that will be made available. Including such things as firefighting and rescue equipment, approximately 35 FAA Airport Certification Safety Inspectors typically conduct yearly inspections, but can also make unannounced visits (FAA, 2013).

One of the requirements with regards to aircraft rescue and firefighting inspection is to conduct a timed-response drill, review aircraft rescue and firefighting personnel training records, including annual live-fire drill and documentation of basic emergency medical care training, and lastly to check equipment and protective clothing for operation, condition, and availability (FAA, 2013). In addition, per Part 139.315, the holder of a Class I, II, III, or IV airport will comply with the following four stipulations: (1) pre-arranged firefighting and emergency medical response procedures, including agreements with responding services, (2) means for alerting firefighting and emergency medical response personnel, (3) type of rescue and firefighting equipment to be provided, and (4) training of responding firefighting and emergency medical personnel on airport familiarization and communications (FAA, 2004).

4.8 Safety Implications – MCAS Miramar and MCB Camp Pendleton

In contrast to the Campo/Boulevard area, MCAS Miramar and MCB Camp Pendleton have more resources when it comes to law enforcement and fire protection. Both military bases have their own law enforcement and fire departments, and they would also be able to utilize the services of neighboring jurisdictions. MCAS Miramar would be able to resource the City of San Diego Police and Fire Departments in the event of an emergency incident. MCB Camp Pendleton would be able to utilize both the Sheriff's Department as well as local jurisdictions; the City of Oceanside would be the nearest agency. For fire protection services the closest agencies they would be able to utilize would be North County Fire Protection as well as the City of Oceanside.

MCAS Miramar employs their own, full service, all-risk fire department which covers approximately 23,015 acres and employs sixty-nine personnel in two fire stations. With crews covering the military base 365 days a year, 24-hours a day, there is a consistent fire department presence in the area (Miramar, n.d.). Although they are farther along than the volunteer fire departments of Campo and Boulevard with regards to equipment and resources, formal and structured training events are often varying and centered around wildland fire suppression rather than structure fires, disaster preparedness, and rescue operations. In addition, training with neighboring jurisdictions is often nonexistent (Miramar Fire Department, 2007). A civilian airport site here would mean additional training as well as equipment to be able to effectively respond to an emergency incident.

With eleven fire stations and over 120 active firefighters, the Camp Pendleton Fire Department is charged with protecting the more than 125,000 acres that make up the marine base (Pendleton, n.d.). With training more centered around the ability of an all-risk response, as well as periodic training evolutions with neighboring jurisdictions (Carlsbad, Oceanside, Vista, North County, Encinitas, and Rancho Santa Fe Fire Departments), the Camp Pendleton Fire Department appears to be better equipped for an emergency response.

CHAPTER 5: PUBLIC TRANSPORTATION

5.1 Demand

Although they represent the largest demand for public transportation in an airport, air travelers are not the only users of such a service. Airport employees, senders, greeters and airport visitors (cargo, shipping and servicing personnel) also represent a very large portion of the demand for public transportation in any given airport. For simplicity however, the total number of senders and greeters in addition to the number of vendors will be lumped together into one category called “Visitors.” According to Norman Ashford and his co-authors of the book “Airport Engineering and Design” traffic in United States airports consists of an average of 55% air passengers, 10% airport employees, and close to 35% are what are called “visitors” (Ashford, Mumayiz & Wright, 2011). In order to have a comprehensive understanding of the total demand for public transportation, the demand formula must contain all of the categories mentioned above:

Total Demand = Total Passengers + Total Employees + Total Visitors

5.1.1 Passengers

According to the San Diego County Regional Airport Authority, the San Diego Airport served 17,250,265 passengers in year 2012 (san.org, 2013). This number is expected to reach 30 million passengers by 2030, using a 3.5% growth rate. Furthermore, the Regional Transportation Plan prepared by the San Diego Association of Governments (SANDAG) also expects that total demand for flights in and out of San Diego to also cater to anywhere between 45 million to 50 million passengers by the year 2050. Building a new airport with a capacity of 45 million passengers a year, will be a very costly and time consuming project. Therefore, it would be safe to assume that building a smaller airport with a capacity of 35 million passengers a year will be a more cost and time efficient process. This process will allow the current SDIA to remain functional at a capacity of 15 million passengers a year. Combined, both airports will have the capacity of 50 million passengers a year, which will meet all demand projections all the way to year 2050.

On average 75% of total passengers use private vehicles to access the airport, while the rest use public transport means to get to the airport (Airport Transit Plan, 2008). According to a study done the HNTB Corporation, 10 to 15% out of the 75% above mentioned use rental cars, while the rest get dropped off/picked up by family or friends. Therefore, it would be projected that by the year 2030, an average between 3 to 4 million passengers per year will need to rent a car. Another 10% to 12% of passengers use taxi cabs, leading to a potential demand of 3 to 3.2 million taxi rides per year; also assuming a total demand of 30 million passengers per year. The rest are spread out between buses, shuttles, and rail based modes which will account to an average of 15% of total passengers (Airport Transit Plan, 2008).

5.1.2 Employees

It is very important to estimate the number of employees that will be working at the new airports because, according to the “Airport Transit Plan for SDIA” prepared by HNTB, employees represent two thirds of the total usage of public transit (bus and light rail) leading to the airport here in San Diego.

Norman Ashford and his co-authors estimate that on average, United States airports employ anywhere between 900 to 1,200 employees for every one million passengers at the airport (Ashford, Mumayiz & Wright, 2011). Currently, San Diego International Airport employs 4,900 employees, given that it serviced 17,250,265 passengers in 2012 (san.org, 2013). That is a ratio of 280 employees for every 1 million passengers. Los Angeles International Airport (LAX) on the other hand, serviced close to 61 million passengers in 2012 and employed 59,000 employees representing a ratio of 968 employees for every 1 million passengers (lawa.org, 2013). JFK employed 995 employees per 1 million passengers, employing 35,000 individuals and servicing close to 49.2 million passengers (panynj.gov, 2013). It becomes apparent that the San Diego International Airport is an outlier that falls far below national averages in airport employment. The main reason for the shortfall would be associated with the limited capacity the current airport functions under. It falls on a smaller lot of land then any major airports in the United States, and also does not service any international flights at the moment except for Mexico, London, Canada and Japan. Such limitations result in the absence of a duty free zone and all the potential employees that such a zone may attract. It also results in not needing as many TSA agents, security officers, law enforcement agents, transportation personnel, and administrative personnel in the airport.

It would then be expected that at the new airport, the employees to passenger's ratio should increase dramatically as the need for the above mentioned services will also increase. Given that San Diego is smaller than Los Angeles and New York in population, it would then be fair to estimate that the new airport will fall on the lower end of the averages employing close to 900 employees for every 1 million passengers. With a suggested capacity of 35 million passengers a year this will result in a total of 31,500 employees at the new site. According to Andy Boyd at the Metropolitan Transit System (MTS), route 992 currently services close to 1,000 passengers a day to and from the airport. And the HNTB has already identified that two thirds of the users are airport employees, which is close to 640 passengers per day. This is an average of 13% of all employees at the airport. Assuming, that a similar percentage of employees will still use public transport at the new airport, this number will now be close to 4,725 individuals, almost quadrupling the current demand for public transport.

5.1.3 Visitors

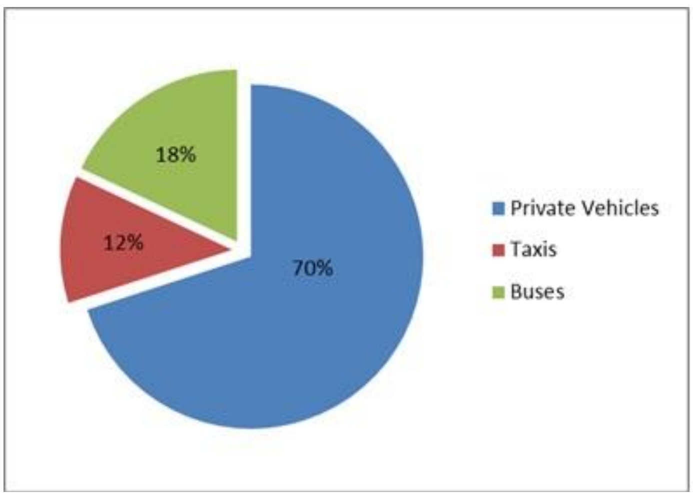
Other than the air travelers and the airport employees, airports are visited by senders, greeters, business partners, maintenance crews, shipping and cargo personnel and a plethora of other individuals who come to the airport without the intentions of flying. For reasons of simplicity, these individuals will all be lumped into one category called "Visitors". It is actually estimated that 35% to 40% of all airport ground traffic is caused by visitors not by air passengers (Ashford, Mumayiz & Wright, 2011). According to the San Diego County Regional Airport Authority (SDCRAA), in a study done in July 2004, 70% of all traffic in all the terminals and parking lots of the airport was caused by private vehicles, and the other 30% was caused by all other means of public transportation (Airport Transit Plan, 2008). According to another study done by SDCRAA in 2004, an average of 5,350 vehicles drove through non passenger related drives, streets, entrances and parking lots. That is an annual average of 1,952,750 private vehicles that did not carry any passengers. This represent close to 12% of total passengers in 2014 which was 16,377,304, which falls below the national average (san.org, 2013). The new airport will have far more facilities and capacities what would push this average back up to a little over 12%, expecting to normalize at 35% of all traffic in the airport.

By the time the new airport is built and fully functional, it would be expected to service 35,000,000 air passengers, 31,500 employees, and close to 15,000,000 visitors for total demand for transportation close to 50,000,000 users per year. It becomes apparent that such a massive operation would need to be organized in the most efficient way possible to keep it running. Public transportation and mass transportation of users would be one of the most effective ways of reducing traffic from the roads, while also bringing down the stress level of airport users. Public transportation, however, is something that San Diegans do not heavily rely on yet. In order to make it more appealing to passengers and users, public transportation must be organized, accessible, convenient and very well maintained or else it will not serve the purpose it was built for.

5.2 Transportation Means

Access modes in and out of the airport could be split into two main models: Road Based Models and Rail Based Models. Road Based Models consist of means that use regular roads as their access ways such as private cars, rental cars, taxis, buses and shuttles. The Rail Based Model consists of means that need an existent railway in place for it to be operational, and such means could be like the light rail service, intercity rail, commuter rail, and also high speed rail which is not yet existent in California. Currently at SDIA there is no rail based transportation, and is only being served by the Bus Line Route 992. Figure 5.1 illustrates the current transportation distributions at SDIA (Airport Master Plan, 2008).

Figure: 5.1 Current Transportation Distributions at SDIA



5.2.1 Private Cars

Either by being dropped off at the airport or driving down to the airports, using private cars remains the prevalent mode of airport access in the Unites States and the rest of the developed countries. Such modes of transportation represent 70% of all passengers being dropped off or picked up at the San Diego International Airport (Airport Master Plan, 2008). Most people prefer this mode of transportation because of the flexibility and convenience it offers, especially for large families with children and luggage. These transportation modes are also common in counties where the cities are distanced from each other. Specifically in areas where the airport is a greater travel distance from most of the passengers that use it. This is the disadvantage that the new airport is going to face, regardless of the location where it will be built.

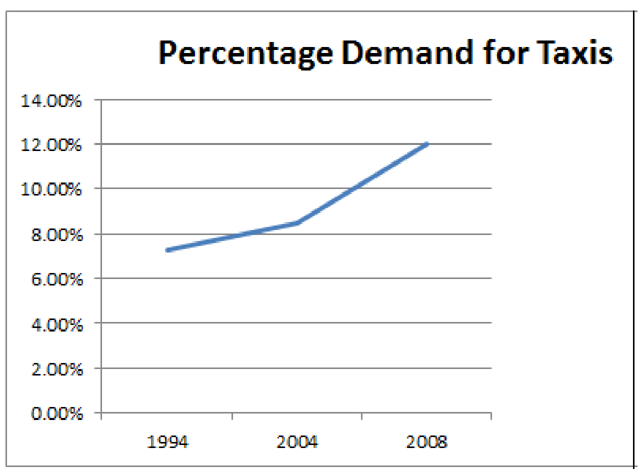
According to a quarterly customer satisfaction survey conducted by SDIA, 58% of all passengers travelled to the airport in private vehicles (Airport Transit Plan, 2008). At the new airport, where capacity will be at 35 million passengers per year, the number will become close to 20,300,000 private vehicles a year. The same survey also found that close to 15% of all passengers used rental cars to get to or from the airport. At the new airport this will translate into 5,250,000 rental cars per year. Combined, the new airport should have the capacity to accommodate 25,550,000 private cars a year to circulate through it.

The down side for private cars however is mainly the traffic that they cause. Private cars have lower capacity for transportation compared to other means of public transportation, causing the freeways and the streets leading in and of the airport to get congested. Such congestions typically end up forcing individuals to leave their houses earlier than their scheduled flights or risk arriving late.

5.2.2 Taxicabs

A 1994 study done by the airport authority showed that demand for taxis was 7.3% of overall transportation. In 2004 demand increased to 8.5% (Airport Transit Plan, 2008). The most recent survey conducted by San Diego County Regional Airport Authority, in collaboration with the HNTB, reported that taxi cab rides have increased to 12% of overall passenger count (Airport Master Plan, 2008). Figure 5.2 below depicts the increasing trend in taxi cab use at the airport.

Figure 5.2: Percentage demand for Taxis through the years



The increasing trend in demand for taxis could be linked to the increasing demand for travel in San Diego, in general, or to business related traffic. In fact, studies have shown that the demand for taxis is the highest where business travel is prevalent and where there is a small distance between the airport and the center of city (Ashford, Mumayiz & Wright, 2011).

Taxis are used because of their convenience and speed of transaction. Actually, when using a taxi, passengers do not have to worry about parking their vehicles. In addition, taxis have their own designated lanes resulting in a speedy and convenient experience for travelers. However, taxis could get pricey for individual travelers and still remain subject to traffic congestions coming into and traveling out of the airport.

5.2.3 Buses

Bus transportation is currently the second most common use of transportation, after private cars. Bus transport in San Diego currently represents 18% of overall transportation at the airport (Airport Master Plan, 2008). However, there are different kinds of bus services at the San Diego Airport, and not all of them are equal in market share. The below presentation will go over the different types of buses, and their share of market.

High Frequency Local Bus

This type of bus facilitates short distanced trips that are usually five to ten miles long, not to exceed 25 miles because of their average speeds of 12 miles per hour (Chapter6, RTP 2050). In San Diego this bus is known as the Red Bus and is operated by the MTS with a capacity to serve 40 to 50 riders at a time. High Frequency Local Buses, seen in Figure 5.3, circulate with an average frequency intervals of ten minutes each, and have the benefit of integrating well with street traffic and using transit lanes when available (Chapter6, RTP 2050).

Figure 5.3: MTS High Frequency Local Bus

Rapid Bus

With a capacity of 40 seated individuals and 20 standing, and an average speed of 25 miles per hour, the rapid bus provides higher speed alternatives to passengers with further destinations then the city where they are located (Chapter6, RTP 2050). The average trip that this bus travels is 15 miles with a maximum capacity of 30 miles per trip and a frequency of one bus every 15 minutes (Chapter6, RTP 2050). This bus also shares similar advantages with the local bus as far as integrating well with street and freeway traffic while always reserving the right to use the transit lanes when available. When integrating rapid buses to a city plan or airport plan however, it is always recommended that it have its own access lanes and stations for maximum efficiency. The typical station spacing for Rapid buses are typically distanced at one mile, to one and a half miles each.

Bus Rapid Transit (BRT)

BRT systems, as seen in Figure 5.4, are the most complex of the bus transit systems. They are designed for high capacity (60 to 80 passengers) and longer distanced trips averaging around 30 miles (Chapter6, RTP 2050). The BRT system does not integrate well with street traffic, and requires a complex network of designated lanes for it. BRT systems require special access ways on the side streets of the airport as well as the High Occupancy Vehicles (HOV) lanes on the freeway for its multi-city trips. The typical speed for such buses could reach 60 miles per hour, and they typically share the same stations as the rapid buses, as they do not require their own (Chapter6, RTP 2050).

Figure 5.4: MTS Bus Rapid Transit

Courtesy Shuttles

Courtesy shuttles are typically present at airports of tourist destinations, and are usually offered by hotels, resorts, and business centers located very close to the airport. In addition to hotels and resorts, rental car companies and extended stay parking lots tend to offer such services for their customers. In San Diego, courtesy shuttles represent close to 12% of all public transport at the airport. 10% out of the 12% comes from car rental shuttles, while the other 2% comes from hotels and resorts located in San Diego (Airport Master Plan, 2008). Courtesy shuttles use the same kind of buses as the High Frequency Local Buses, with similar capacities (Chapter6, RTP 2050).

5.2.4 Rail Based Modes

Light Rail (Trolley)

The Light Rail System used in San Diego would be equivalent to the MTS Trolley, as seen in Figure 5.5, or to the Sprinter between Oceanside and Escondido. The benefits of such a system are that it is relatively cheap to build and maintain, and has very easy access points throughout the city. Light Rail Systems work best in small cities where the destinations are relatively close to each other. The disadvantages of the trolley are that it is inconvenient for travelers with luggage, or large families. Because they are designed for shorter distances, light rail services are at a disadvantage in distanced cities like San Diego County, because they also do not have the capacity to travel long distances.

Figure 5.5: MTS Trolley

Such systems are typically electric or diesel powered, and travels at speeds not exceeding 50 miles per hour (Chapter 6, RTP 2050). Their relative small size allows them to integrate very well with city traffic and surroundings, and their lines are no longer than 25 miles each. Typically light rail systems are equipped with three cars each, and a capacity of 60 seated passengers and 40 standing passengers per car (Chapter 6, RTP 2050).

Intercity Rail

Intercity rail does not share the same railing system as light rail, and most of the time requires its own railing network. Intercity rail is typically used for longer distance trips with longer station spacing. In Southern California the intercity rail is represented by the Amtrak and the Pacific Surf Liner trains, shown in Figure 5.6. The intercity rail system at the new airport will allow international travelers to travel beyond the local city, linking San Diego to Irvine, Los Angeles, and Santa Barbara, and extend all the way north to San Francisco. Building such a complex system however is no easy task and typically happens by adding railing to an already existent infrastructure of rails. These systems run on diesel powered engines with average speeds of 80 miles per hour, sometimes reaching 100 mile per hour. This system would be very comfortable to use for travelers, because of the spaced out cars, and plenty of room for luggage and comfort (Chapter 6, RTP 2050).

Figure 5.6: Amtrak Train, an Example of the Intercity Rail

Currently the Trolley and the Amtrak share the same station in San Diego, the Santa Fe Station. The Santa Fe Station is linked to the airport by route 992, which is a bus route that transports passengers to and from the station.

High Speed Trains

High speed trains are not yet existent in California, however they could be compared Frances' TGV or to the AVE of Spain. They are designed for very high speed, long distance intercity trips with very long station spacing. They also would need their own railing system, as they cannot use the same ones as the intercity systems. This project has been brought up in the state of California multiple times, and is currently on the list of projects on the RTP 2050. Figure 5.7 illustrates the proposed design of the California High Speed Rail.

This system has been presented as a link between Sacramento and San Diego and eventually to the rest of California's major cities. It is expected that such trains will have the capacity to carry approximately 1,300 passengers per train, and will have the ability to travel at 200 miles per hour (Chapter 6, RTP 2050).

Figure 5.7: Potential Design of California High Speed Rail

The disadvantage of a system like this is that it will cost billions of dollars to build; currently estimated at $4.3 billion in the RTP 2050 just for the completion of the first phase. Funding for such a project will need to come from the county, city, state and federal level in addition to any grants that it may receive from donors.

5.3 Access Issues and Planning

In 2008 only 1.2% of San Diego's airline passengers used the bus to travel to and from the airport, while the national average is right around 6% (Airport Transit Plan, 2008). More recently this number has become slightly higher. According to Andy Boyd from the MTS the bus serves close to a 1,000 passenger per day to and from the airport, which represents an annual average of 365,000 passengers. Unfortunately, and according to a study done by the HNTB, two thirds of who used the buses leading in and out of the airport were airport employees, while only one third of those were airline passengers (Airport Transit Plan, 2008). Realistically, an average of 330 passengers used the bus to travel per day, or 120,450 passengers per year. That represents 0.7% of total passengers in 2012. There could be a variety of reasons why San Diego passenger's use of public transport means is so low, however, the most obvious reasons are:

1) There is no railway at the airport, and passengers have to take route 992 to downtown San Diego first before diverting into rail based transit.
2) Availability of only one bus route at the moment, route 992 which transports individuals into the offsite bus station which then redistributes passengers.
3) Limited access of buses to the rest of the county, which is something that is currently being worked on according to the 2050 RTP prepared by SANDAG.

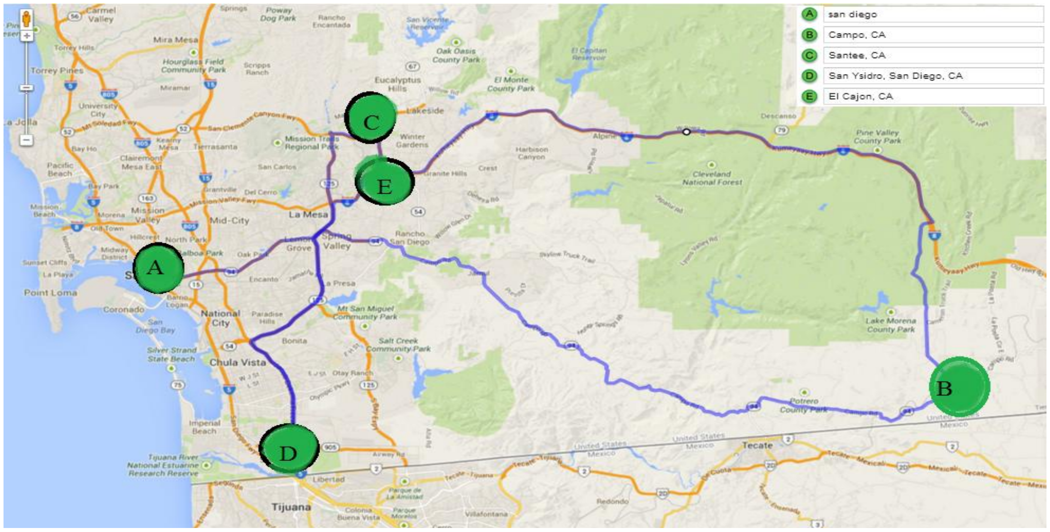
The lack of railway stations at the airport is a direct result of the space limitations that have already been mentioned in this research. SDIA is currently at capacity in terms of space and acreage, and it has no room for any further expansion. This issue should definitely be addressed and actually resolved at the new location, as railway stations must be existent at the airport, and not offsite, for easier access and use. The location of the new airport will be a determining factor of the feasibility, the cost and the possible revenues from such a project.

SANDAG has already established the RTP 2050 laying out all future projects the association is planning to implement in the County of San Diego. The project has already identified major employment areas and the respective travel corridors needed for them. As seen in Appendix E, SANDAG has already identified San Marcos/Vista, University City, Sorrento Mesa, Kearny Mesa, and Otay Mesa/Otay Ranch as major employment areas from now through the year 2050. The above mentioned business centers will naturally create high activity areas around them. The RTP 2050 identified these cities as Oceanside, San Marcos, Escondido and the San Diego city limits. SANDAG is well on its way to implement some of the projects already proposed, and has shown a very strong commitment for future projects as well. Therefore, it would make most sense to take their projects into consideration when looking for an ideal location for a new airport.

5.3.1 Campo/Boulevard Site

When it comes to the availability of space, the suggested Campo/Boulevard site would be the best answer since space is nearly unlimited in that part of town. However, with the availability of space come many challenges in accessibility and existing infrastructure. Figure 5.8 shows the relative distance between Campo (Site B) and the closest Trolley Station to it.

Figure 5.8: Relative distance between Campo/Boulevard and the closes Trolley Stations



In fact, Campo is 55 miles away from downtown San Diego (Site A), 48 miles away from Santee, Site C, 45miles away from El Cajon, Site E, and 46 miles away from San Ysidro, Site D (Google Maps, 2013). Therefore, on average, the MTS would be looking at adding at least 50 miles of new lines that do not currently exist in order to link the Campo/Boulevard site to the rest of the county. According to Brent Boyd at the MTS the last project they accomplished was adding 11 miles of lines to the mid-cost trolley extension and that cost them $1.8 billion to accomplish. Mr. Boyd also highlighted the fact that this expansion happened without any elevation, should there be elevated land like there would be in Campo/Boulevard, Mr. Boyd said that the cost would have increased exponentially.

Furthermore, the Amtrak station is at the Santa Fe Station in downtown San Diego, and has no other presence in either, San Ysidro, El Cajon or Santee. If the Amtrak wants to add their lines to the new airport they would be looking at adding at least 60 miles of line, and as already mentioned adding new railway for intercity rail like Amtrak or the Coaster is far more costly then adding for the trolley lanes.

When it comes to the possibility of adding high speed rail as well, which the RTP mentioned that it is going to do, the Campo/Boulevard site becomes further away from reality. According to the RTP, the HSR will start in downtown San Diego and will go straight north towards the Riverside/Ontario area to head back into Los Angeles and up the coast (Appendix D). There were no mentions of any plans to expand a better transportation network in the Campo/Boulevard area by the RTP 2050. This strengthens the belief that adding the airport in the Campo/Boulevard area will be the highest cost and inefficient when taking public transportation into consideration.

5.3.2 MCAS Miramar Location

The MCAS Miramar location is quite central in relation to rest of the county especially relative to Campo/Boulevard and MCB Camp Pendleton. The airport would have to be located on the eastern side of the freeway, where space is plentiful. The closest trolley station to Miramar would be in either Mission Valley or Downtown San Diego, which is an average of 15 miles to either city. If the MTS looks at establishing lines at this location, they would face an extensive need for infrastructure in that side of Miramar since it has been a military zone for a period of time, and also due to the elevation.

Both Amtrak and the Coaster Rail Systems would also face challenges in adding rail in Miramar. At the moment both companies run their lines along the coast, and Miramar is at least 8 miles (Straight line assumption) deeper to the east then where their lines currently run. In addition to the distance, the companies will also face the challenges of elevation since the Torrey Pines hills, as well as the Sorrento Valley hills would be a hurdle to overcome. It is doubtful that the companies will be able to simply establish a straight shot line from Miramar to Torrey Pines like it was assumed above, because there are two freeways that would also prevent them from doing so, I-5 and I-805. Therefore, it would likely be far more challenging to add lines, and if they do chose to move forward with it, it will be far longer than just eight miles. The only rail based project that the RTP 2050 currently is considering close to that area is the extension of the Trolley Route 510 to Mira Mesa via Sorrento Valley.

The RTP 2050 did mention that the high speed rail system may pass from Miramar, on its way up to the Ontario/Riverside area (Appendix D). If the HSR does end up getting the adequate funding, then the MCAS Miramar location would definitely be ideal for the trajectory of such a train. The new airport would then have a HSR station, and will allow travelers from downtown San Diego as well as Ontario and Riverside to enjoy the new airport.

As far as Road Based Modes, Miramar is again in a central location with existent freeways surrounding it. It is conveniently located off of the I-15, and is surrounded by the freeway 52 to its south and Freeway 56 to its north, both within a five mile distance. Access of cars and buses should not be an issue to this location either. The only projects suggested by the RTP 2050 that would benefit the MCAS Miramar location were to simply better the HOV lanes already mentioned on the I-15 North/South. Developments like this have already begun on this freeway. Such improvements are noticeable especially with the addition of two new lanes of HOV/Carpool from Miramar to Escondido. This addition was an answer to an existing inefficiency when the carpool lanes were the same for northbound and southbound lanes, opening them according to rush hour traffic. In addition to side streets, the plan included "15 new Bus Rapid Transit (BRT) routes, six new Rapid Bus Routes and three shuttles and local bus routes" (Chapter 6, RTP 2050) that will better connect North County with South County, as well as some of the East Counties with the Coasts. According to chapter 6 of the Regional Transportation Plan, titled "Systems Development: Offering More Travel Choices" some of the suggest improvements include new BRT routes linking:

- Oceanside to Sorrento Mesa
- Escondido to Mira Mesa and Sorrento Mesa
- Escondido to UCSD
- Escondido to Kearny Mesa

5.3.3 MCB Camp Pendleton Site

Although MCB Camp Pendleton is 40 miles away from downtown San Diego, this location has many attractive features. The 40 mile distance to downtown San Diego no longer becomes as great of an issue, especially if the current SDIA remains in business. This location would not only attract passengers from San Diego, but also from San Clemente, Mission Viejo, Irvine and possibly Newport Beach. The biggest advantage to the suggested location is that it is right at the coast, where most of the railway already exists, potentially saving billions of dollars in new infrastructure.

As far as light rail goes, the MCB Camp Pendleton location would rely more on the Sprinter that currently links Oceanside to Escondido, then the Trolley. The Oceanside Transit Station where the sprinter starts is within a two mile distance of MCB Camp Pendleton and currently services a straight line from Oceanside to Escondido. Amtrak, also shares the same station with the Sprinter, making it fairly easy for passengers to take intercity rail going either down to San Diego or up to Orange County and Irvine.

As previously mentioned, the RTP 2050 plans on extending the HSR system towards Riverside/Ontario more than Oceanside and MCB Camp Pendleton. Therefore, one of the disadvantages of this location would be that it may not be able to take advantage of the high speed rail project that may occur in the future.

The RTP 2050 will bring a wide range of improvements to that area's Rail Based modes. This will make MCB Camp Pendleton quite an attractive location as a suggested airport. Some of the planned improvements are:

- Double tracking and increasing frequency of the Coaster from Oceanside to Downtown San Diego/PETCO Park, thus increasing connectivity with downtown San Diego.

- Double tracking to increase the frequency of the Sprinter from Oceanside to Escondido, which will also increase the connectivity of Oceanside to the eastern cities.

As far as road based transportation modes, SANDAG has projected that by year 2035 there will be significant improvements to freeways I-5, I-15 and I-805 which all run north to south, linking downtown San Diego to Escondido and Oceanside. Improvements will come in form of lane expansions and the additional HOV lanes for easier vehicle and bus travel. Most of the new street lines that the RTP will implement benefit the suggested MCB Camp Pendleton location, and the two most important additions would be:

- Downtown Escondido : Connecting the Escondido Transit Station to downtown Escondido, by adding an East/West street to Fig Street
- Downtown Oceanside: Connecting the Oceanside Transit Center to Coast Highway Sprinter Station.

The RTP also suggests introducing new rapid bus routes to further improve ground transportation into Oceanside. Route 473 will connect Oceanside to UTC via highway 101, and Route 474 which will also link Oceanside to Vista via Mission Avenue and Santa Fe corridor.

CHAPTER 6: DISCUSSION

6.1 Air Traffic

According to the statistical analysis, no correlation was found between the air traffic at SDIA and ground traffic from I-5. Therefore, ground traffic is independent of air traffic. Based on the results of the X^2 testing, there was a relationship between arrivals and time of day and there was a relationship between departures and time of the day. Even though no statistically significant relationship was found between ground and air traffic, this study was able to determine the peak hours of operations for arrivals and departures at SDIA. Knowing the peak hours will assist in airport planning for high traffic time period. SDIA can plan to have sufficient gates, terminals and personnel available during this time. Peak air traffic flow can be routed to the new airport to nearby airports such as Palomar McClellan Airport or Brown Airport.

A review of other studies and literature found the implementation of NextGen technology will assist for airports similar to SDIA to increase their capacity without having to build a new runway or airport. Limitations at SDIA prevent any further expansion to the runway, therefore limiting number and size of planes arriving and departing. The four main technologies encompassing NextGen; RNP, ADS-B, CDA and SAMM will provide more precision control on arrivals. This collection or processes and technologies will help increase capacity while reducing in-trail separation between airplanes.

6.2 Ground Transportation & Infrastructure

There are numerous improvements that are either proposed or seeing fruition throughout the existing roadways in San Diego County, in order to accommodate the continuing increase of traffic. Peak rush hour times during 7:00 and 8:00 in the morning and 5:00 in the early evening are causing the greatest bottlenecks for the system. Current enhancements are aiding the system, however, traffic delays should be continuously studied in order to remain as far ahead of the demand as possible. The Campo/Boulevard area would see the greatest influx of traffic as it currently services agricultural transports. The addition of an airport here would require an expansion of the current infrastructure. Both the MCB Camp Pendleton and MCAS Miramar locations are already surrounded by expansive roadways, however they also have experienced a continued increase in traffic congestion.

SDIA parking structures are falling short to the amount of annual enplanements. The George Bush Intercontinental Airport as well as the Reagan International Airport built the William P Hobby International Airport and the Dulles International Airport, respectively. Both added an average of 22,500 parking spots to accommodate growing demand. Using Philadelphia International Airport and San Diego County Parking Design Manual the minimum amount of space per spot was determined. It is recommended that the new site has at least 70 acres available for parking spaces only.

One of two approaches can be taken for the sanitary sewer system for the new site: to expand on existing sanitary plants and adding new sub systems to the existing system or to build a plant for the sole purpose to support the airport. It is feasible to build a plant for the Campo/Boulevard site however it will be costly. A less costly option would be to expand the plants in the city of Carlsbad and Miramar. Similar to the sewer systems, the water systems will also need to be developed. Minneapolis St Paul International Airport consumes about 916,000 gallons of water per day. The new site should have a plant that can accommodate roughly this amount of turnover with as little construction or contamination brought to the surrounding environments.

6.3 Public Transportation

With the projected increase in demand for public transportation, the new airport must be well equipped to not only accommodate this demand but also attract more of it. Therefore, it is important to have a harmonized public transportation system in place to meet future demand and meet the expectations of travelers. In order to do so, the new airport must be easily accessible and be better connected to the surrounding cities and counties. This can be accomplished by having a trifecta of private vehicles, public vehicles, and a rail system in place that will allow the future traveler to have the option of choosing.

Some of the suggested locations had these options more readily available then others. With regards to space, the Campo/Boulevard site appears to be a more feasible location. The MCAS Miramar location was definitely the best answer to centrality and easy access from all sides of the county. Both of these locations lack of railway infrastructure, making them a costly expansion site for the new airport. Even though it was not quite central for the county, the MCB Camp Pendleton location proved to be best equipped in existent infrastructure. Freeway I-5 to its west, SR-76 to the east, and SR-78 to its south, in addition to a complex mix of light rail and intercity rail station, make MCB Camp Pendleton an easier project. With the existence of SDIA, most San Diegans looking for local travel could revert back to it as their local hub, and for international travelers around the county, driving up to MCB Camp Pendleton remains 80 miles shorter of a trip then travelling up to LAX.

REFERENCES

Airport Council International-North America (2013, August 28). *Airport Traffic Reports | Airports Council International - North America*. Retrieved September 28, 2013, from http://www.aci-na.org/content/airport-traffic-reports

Ashford, N., Mumayiz, S. A., & Wright, P. H. (2011). *Airport engineering: Planning, design, and development of 21st century airports*.

Boulevard Fire and Rescue Department (2013). *Boulevard Fire and Rescue Department*. Retrieved October 2013, from FireDepartment.net: http://firedepartment.net/directory/california/san-diego-county/boulevard/boulevard-fire-and-rescue-department

Boyd Brent. Personal Communication, October 22, 2013.

Butler, Viggo 2008. "Increasing Airport Capacity Without Increasing Airport Size". The Reason Foundation 1 (2008).

Campo Fire and Rescue Department (n.d.). *Campo Fire & Rescue-Station 46*. Retrieved November 2013, from Campo Fire & Rescue: http://www.campofire.org/

Carlsbad Municipal Water District. (n.d.). *City of Carlsbad* -. Retrieved September 28, 2013, from http://www.carlsbadca.gov/SERVICES/DEPARTMENTS/WATER/Pages/default.aspx

City of Carlsbad. (n.d.). *2012 SEWER MASTER PLAN*. Retrieved October 12, 2013, from http://www.carlsbadca.gov/services/utilities/Documents/SewerMasterPlanReport.pdf

City Of Miramar. (n.d.). *ENGINEERING STANDARDS for PUBLIC WORKS & UTILITIES SYSTEMS*. Retrieved October 12, 2013, from http://www.ci.miramar.fl.us/engineering/docs/PW_UTIL-Standards.pdf

Department of Transportation (2013, March). *Interstate 8 Dogwood Road Interchange*. Retrieved November 2013, from Department of Transportation: http://www.dot.ca.gov/dist11/facts/8_Dogwood.pdf

Department of Transportation (2013, March). *Interstate 8 Imperial Avenue Interchange*. Retrieved November 2013, from Department of Transportation: http://www.dot.ca.gov/dist11/facts/8_Imperial.pdf

Department of Transportation (n.d.). *Interstate-8 San Diego County Transportation Concept Summary*. Retrieved November 2013, from Department of Transportation: http://www.dot.ca.gov/dist11/departments/planning/pdfs/tcs/2012_I_8_TCS_SanDiego.pdf

Department of Transportation: Federal Aviation Association - Air Traffic Organization policy, order #JO 7232.5G

Federal Aviation Administration, FAA (2004, June). *eCFR? Code of Federal Regulations*. Retrieved November 2013, from Federal Aviation Administration: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=1f5b6490ae325153efd0fb2ade517c46&rgn=div8&view=text&node=14:3.0.1.1.14.4.3.8&idno=14

Federal Aviation Administration, FAA (2013, November). *Part 139 Airport Certification-What is Part 139?* Retrieved November 2013, from Federal Aviation Administration: http://www.faa.gov/airports/airport_safety/part139_cert/?p1=what

Federal Aviation Administration (June 2013) NextGen Implementation Plan. Retrieved September 10, 2013, from https://www.faa.gov/nextgen/implementation/media/NextGen_Implementation_Plan_2013.pdf

Federal Aviation Administration (2013) NextGen. Retrieved October 5, 2013, from http://www.faa.gov/nextgen

Federal Aviation Administration (2005) Advisory Circulatory No: 150/5325-4B. Retrieved October 5, 2013, from http://www.faa.gov/documentLibrary/media/advisory_circular/150-5325-4B/150_5325_4b.pdf

Federal Aviation Administration (n.d.). *Airport Planning & Capacity - Airports*. Retrieved October 12, 2013, from http://www.faa.gov/airports/planning_capacity/

Federal Aviation Administration (2012, September 4). *Airport Planning*. Retrieved October 12, 2013, from http://www.faa.gov/airports/central/aip/sponsor_guide/media/0500.pdf

Federal Aviation Administration (n.d.). *Commercial Service Airports, based on Calendar Year 2012 Enplanements*. Retrieved October 12, 2013, from http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/CY12CommercialServiceEnplanements.pdf

Federal Aviation Administration (2013) FAA Aerospace Forecast Fiscal Year 2013-2033. Retrieve October 5, 2013, from http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/aerospace_forecasts/2013-2033/media/2013_Forecast.pdf

HNTB Corporation, Lea Elliott. (2008). *Airport Transit Plan, San Diego International Airport*. Prepared for Airport Transit / Roadway committee. San Diego, CA.

Jacobs Consultancy. (2009). *Destination Lindbergh Technical Report, San Diego International Airport.* Prepared for San Diego County Regional Airport Authority. San Diego, CA.

Joint Planning and Development Office. (2006, May 13). Weather Concept of Operations. Next Generation Air Transportation System. Retrieved November 7, 2013, from http://www.jpdo.gov/library/Weather_ConOps.pdf

Los Angeles World Airports. (2013). *Airport Information.* Extracted from: http://www.lawa.org/welcome_lax.aspx?id=798

Marine Corps Air Station Miramar (n.d.). *Miramar Fire Department Operations*. Retrieved November 2013, from Marine Corps Air Station Miramar: http://www.miramar.usmc.mil/docs/FireDepartmentOPSV2.pdf

Metropolitan Airports Commission. (n.d.). *MSP Long Term Comprehensive Plan Update*. Retrieved September 20, 2013, from http://www.mspairport.com/docs/about-msp/long-term-comprehensive-plan/2010/03-Chapter-1-Inventory.aspx

Metropolitan Washington Airports Authority (n.d.). *Parking*. Retrieved October 15, 2013, from http://www.metwashairports.com/dulles/184.htm

Metropolitan Washington Airports Authority (n.d.). *Parking*. Retrieved October 15, 2013, from http://www.metwashairports.com/reagan/227.htm

National Aeronautics and Space Administration, NASA (n.d.). *Influences on Airport Layout*. Retrieved November 2013, from http://virtualskies.arc.nasa.gov/airport_design/6.html

North County Transit District (NCTD). (2013). *Schedules and Maps.* Extracted from: http://www.gonctd.com/sprinter

Parking Structure Technical Report. (n.d.). *MTC Smart Growth Technical Assistance*. Retrieved September 18, 2013, from http://www.mtc.ca.gov/planning/smart_growth/parking/6-12/MTC_Parking_Structure.pdf

Philadelphia International Airport (n.d.). *Parking Garages*. Retrieved September 28, 2013, from http://www.phl.org/passengerinfo/directionsparking/Pages/parkingGarages.aspx

Ricondo and Associates Team. (2006). *Airport Site Selection program, Decision Document*. San Diego, CA

San Diego Association of Governments, SANDAG. (2011). *2050 Regional Transportation Plan*. < http://www.sandag.org/uploads/2050RTP/F2050rtp_all.pdf>

San Diego Association of Governments, SANDAG. (2009, February). *2050 Regional Transportation Plan, Technical Appendix 19: San Diego-Imperial County Interstate 8 Corridor Study.* Retrieved November 2013, from http://www.sandag.org/uploads/2050RTP/F2050RTPTA19.pdf

San Diego Association of Governments, SANDAG. (2006, March). *SANDAG: An Assessment of Its Role in the San Diego Region*. Retrieved November 2013, from Legislative Analyst's Office: http://www.lao.ca.gov/2006/sandag/sandag_033006.htm

San Diego Association of Governments, SANDAG. (2007, November). *SANDAG: PROJECTS: San Diego's Regional Planning Agency*. Retrieved October 2013, from SANDAG: http://www.sandag.org/index.asp?projectid=292&fuseaction=projects.detail

San Diego Association of Governments, SANDAG. (2013, September). *I-5 North Coast Fact Sheet*. Retrieved October 2013, from SANDAG: http://www.sandag.org/uploads/publicationid/publicationid_720_1069.pdf

San Diego Association of Governments, SANDAG. (n.d.). *SANDAG: PROJECTS: San Diego's Regional Planning Agency*. Retrieved November 2013, from http://www.sandag.org/index.asp?projectid=26&fuseaction=projects.detail

San Diego County Sheriff’s Department (2012). *San Diego County Sheriff's Department 2012 Annual Report*. Retrieved November 2013, from San Diego County Sheriff Department: http://www.sdsheriff.net/documents/2012-annualreport.pdf

San Diego County Sheriff’s Department (2013). *San Diego County Sheriff's Department-Boulevard*. Retrieved November 2013, from San Diego County Sheriff's Department: http://www.sdsheriff.net/patrolstations/boulevard.html

San Diego County Sheriff’s Department (2013). *San Diego County Sheriff's Department-Campo*. Retrieved November 2013, from San Diego County Sheriff's Department: http://www.sdsheriff.net/patrolstations/campo.html

San Diego County Regional Airport Authority. (2012). Airport *Fast Facts*. Retrieved from: http://www.san.org/sdia/at_the_airport/education/airport_statistics.aspx

San Diego County Regional Airport Authority, (2008). *San Diego International Airport, Airport Master Plan.* San Diego, CA.

San Diego County Regional Airport Authority (March 2011) Regional Aviation Strategic Plan. Retrieved October 25, 2013, from http://san.org/sdcraa/airport_initiatives/master_plan/master_plan.aspx

San Diego County (2012, June). *Parking Design Manual*. Retrieved October 16, 2013, from http://www.sdcounty.ca.gov/pds/advance/POD_11-005_Draft_Parking_Design_Manual.pdf

San Diego Fire and Rescue Department (2012). *Apparatus Aircraft Crash Truck*. Retrieved November 2013, from http://www.sandiego.gov/fire/about/apparatus/crashrescue.shtml

San Diego International Airport (2008, May) Airport Master Plan Section 7.1 Retrieved September 10, 2013, from http://san.org/sdcraa/airport_initiatives/master_plan/master_plan.aspx

San Diego International Airport (2008, May) Airport Master Plan Section 3.2 Retrieved September 10, 2013, from http://san.org/sdcraa/airport_initiatives/master_plan/master_plan.aspx

San Diego Metropolitan Transit System. (2013). *Trolley Map*. Extracted from: http://www.sdmts.com/Trolley/documents/TrolleyMap.pdf

San Diego Planning Commission (2011, August). Retrieved September 2013, from Mountain Empire Subregional Plan: http://www.sdcounty.ca.gov/pds/docs/CP/MTN_Empire_CP.pdf

San Diego Planning Commission (2013, May). *Boulevard Subregional Planning Area*. Retrieved September 2013, from http://www.sdcounty.ca.gov/pds/docs/CP/Boulevard_CP.pdf

San Diego Tourism Authority. (July 2013). Tourism Economic Quarterly Travel. Retrieved October 5, 2013, from http://www.tourismeconomics.com/

The Port Authority of New York and New Jersey. (2013). *Facts and information.* Extracted from: http://www.panynj.gov/airports/jfk-facts-info.html

TransNet. (2013, January). *Interstate 15 Express Lanes: Project Fact Sheet*. Retrieved November 2013, from Keep San Diego Moving, TransNet: http://www.keepsandiegomoving.com/Libraries/Lossan-doc/CW_T_I15_TO1A1_AllSeg_FS_10_24_13.sflb.ashx

TransNet. (2013, July). *NCC Highway Improvements Introduction*. Retrieved October 2013, from Keep San Diego Moving: http://www.keepsandiegomoving.com/I-5-Corridor/Hwy-Impr-Intro.aspx

Water. (n.d.). *Treatment Plants*. Retrieved September 28, 2013, from http://www.sandiego.gov/water/quality/watersources/treatmentprocess/treatmentplants.shtml

Water and Wastewater Departments. (n.d.). *City of San Diego*. Retrieved October 14, 2013, from http://www.sandiego.gov/water/pdf/press/waterlinewinter08.pdf

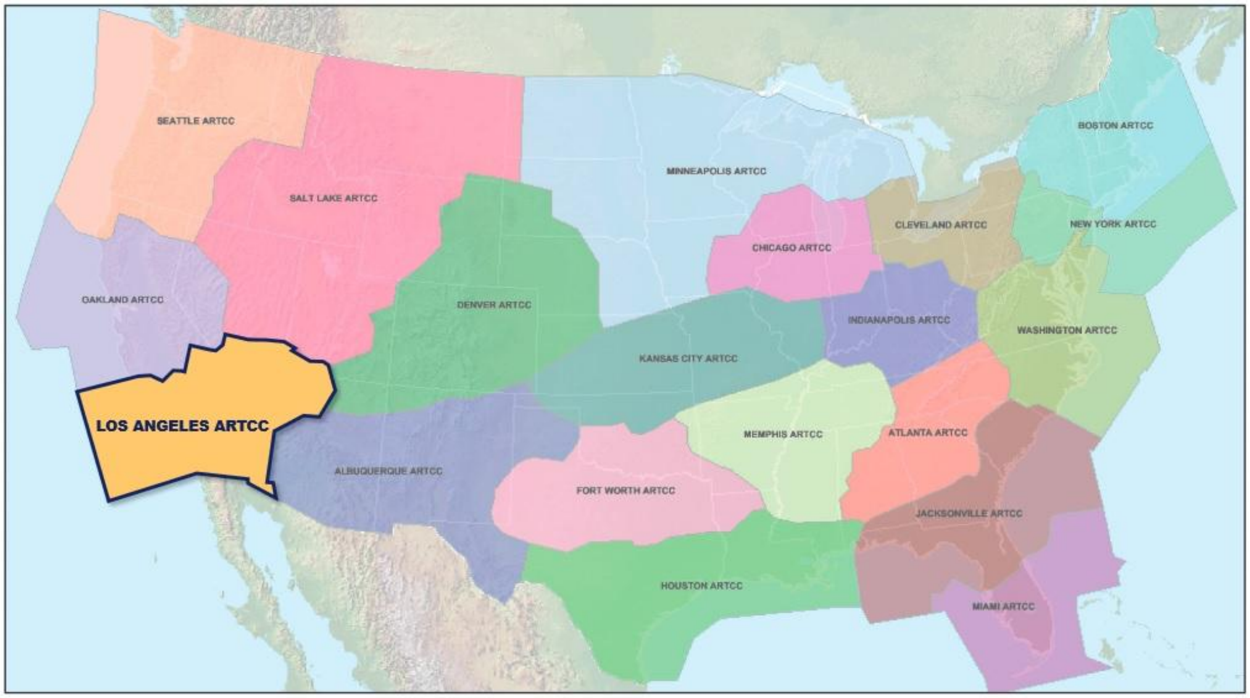
Wayne County Airport Authority. (n.d.). *DTW Master Plan*. Retrieved September 20, 2013, from http://wcaa.us/Portals/WCAACorp/WCAA%20Documents/PDFs/DTW-MasterPlan/02%20-%20Inventory%20of%20Existing%2

APPENDICES

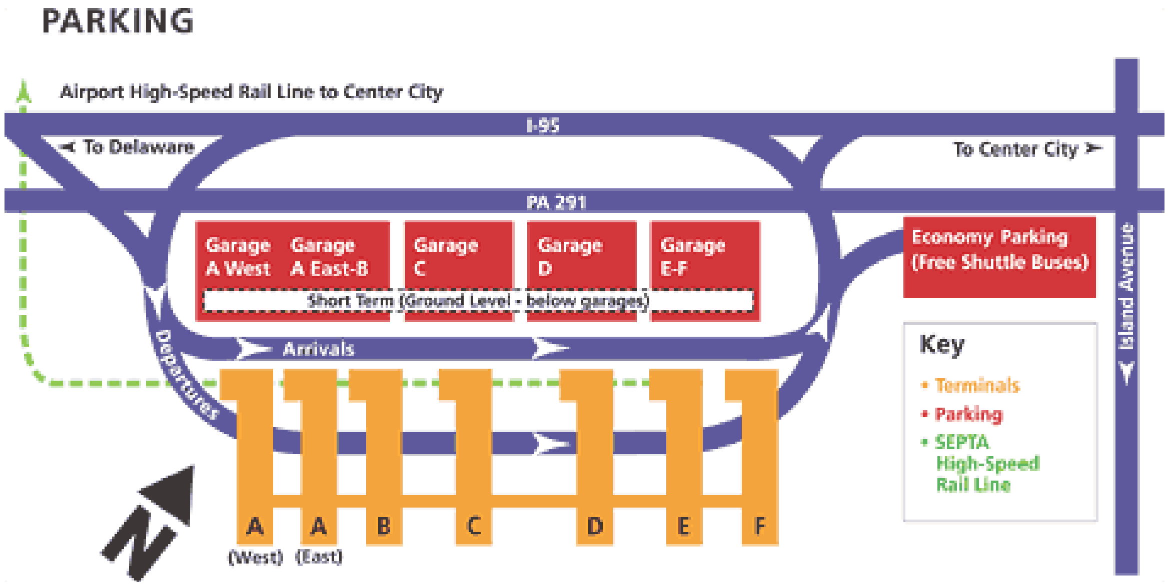
Appendix A: FAA – Airspace Classification

Class A Airspace	Class A airspace is also known as en-route airspace, which includes all airspace between 18,000 feet MSL and 60,000 feet MSL. Class A airspace also includes the airspace overlying the waters within 12 NM of the contiguous United States and Alaska. All persons operating aircraft in Class A airspace must operate under Instrument Flight Rules (IFR).
Class B Airspace	Figure 3.2-7illustrates the extent of San Diego Class B airspace. Nationally, Class B airspace is established at 29 high-density airports as a means of regulating air traffic activity in these areas. It is established on the basis of a combination of enplaned passengers and volume of operations. Class B airspace is designed to regulate the flow of air traffic above, around, and below the arrival and departure airspace required for high-performance and passenger-carrying aircraft at major airports. Class B airspace is the most restrictive controlled airspace routinely encountered by pilots operating under VFR in a controlled environment. Aircraft must have special radio and navigation equipment, and pilots must obtain clearance to fly through Class B airspace. To operate within Class B airspace, pilots at minimum must have a private certificate or a student must meet FAR Part 61.95 requirements that regulate special ground and flight training for Class B airspace. Helicopters do not need special navigation equipment or a transponder if they operate at or below 1,000 feet and have made prior arrangements in the form of an LOA with the FAA for Class B operation.
Class C Airspace	Class C airspace is centered on airports with air traffic control towers other than the busiest 29 airports in the United States. Class C airspace is not present in the San Diego area.
Class D Airspace	The airspace under the jurisdiction of a local ATCT is called Class D airspace, which includes airspace within a horizontal radius of 5 NM of an airport, extending from the surface (ground level) up to a designated vertical limit above airport elevation. The purpose of Class D airspace is to provide ATCT-controlled airspace for aircraft in and around the immediate vicinity of an airport. Aircraft operating within this area are required to maintain radio communications with the ATCT. NAS North Island, Montgomery Field, Gillespie Field, Naval Outlying Field (NOLF) Imperial Beach, Marine Corps Air Station (MCAS) Miramar, and Brown Field all operate in Class D airspace.
Class E Airspace	Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace. Class E airspace is not present in the San Diego area.
Class G Airspace	Class G airspace is uncontrolled airspace not designated as Classes A, B, C, D, or E. Class G airspace is present in the San Diego area.

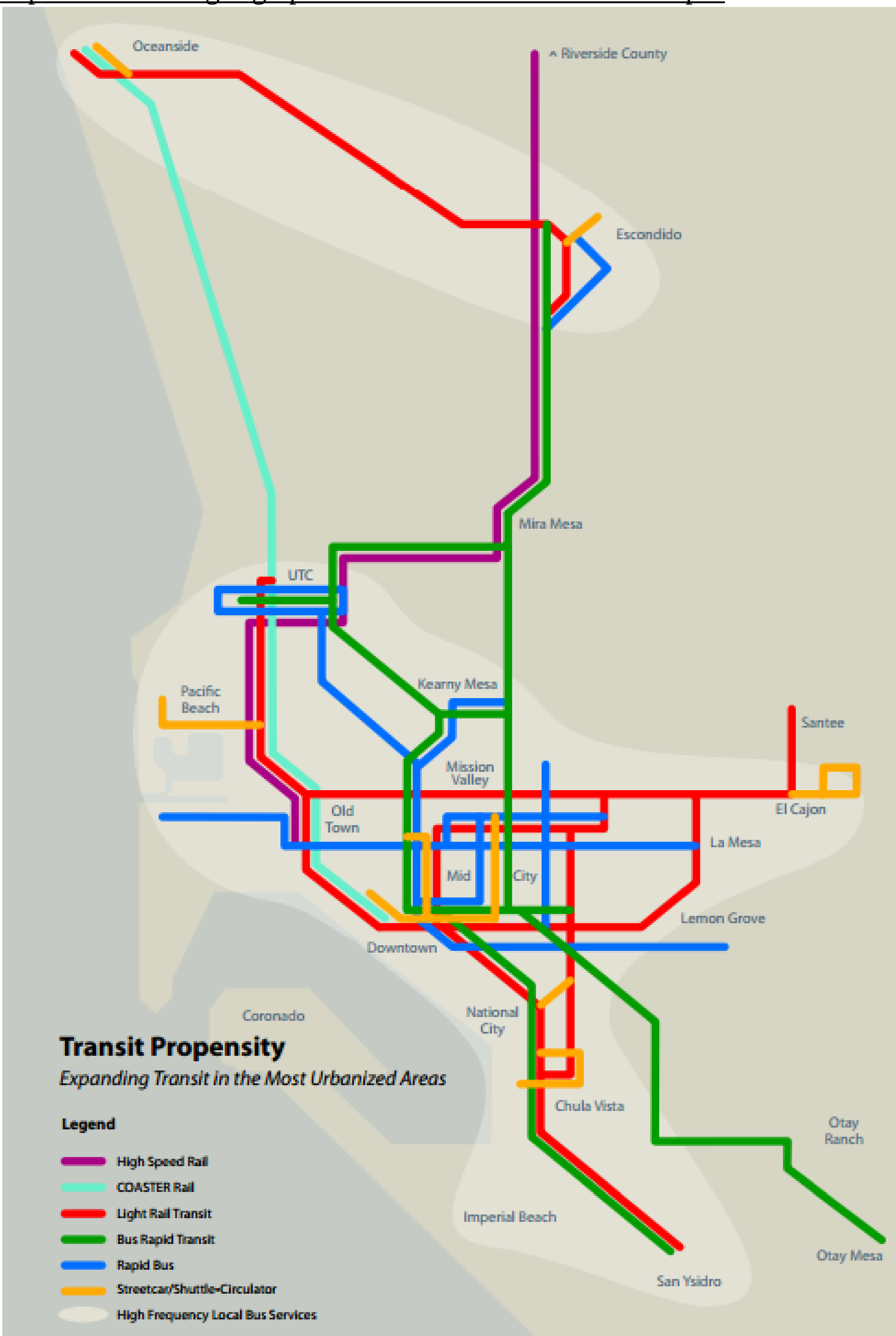
Appendix B: Figure 3.2-B from SDIA Airport Master Plan.



Appendix C: PHL Parking Layout



Appendix D: Urban Area Transit Strategy (RTP 2050)
http://www.sandag.org/uploads/2050RTP/F2050RTPTA7.pdf



Appendix E: Urban Area Transit Strategy (RTP 2050)
http://www.sandag.org/uploads/2050RTP/F2050RTPTA7.pdf