



LITTLE HOOVER COMMISSION
Hearing on California Climate Change Adaptation Strategies
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Testimony by
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Thank you for this opportunity to testify before this Commission. Your focus on climate change adaptation strategies is important to help local, regional and state agencies in developing thoughtful and reasonable guidelines to address sea level rise.

In my testimony today, I will present challenges from sea level rise that SFO is facing due to climate change and projects and initiatives we are undertaking or planning to do in order to address these challenges. I will be addressing Commission's questions and goals as well as making recommendations we feel could be helpful to the state and that will be constructive for important infrastructure assets such as SFO to adapt to sea level rise.

OVERVIEW OF GOVERNING STRUCTURE/LEGAL FRAMEWORK

San Francisco is a city and county chartered under the California State Constitution, and is governed by an 11 member Board of Supervisors and the Mayor, serving as the chief executive officer. San Francisco International airport (SFO) is owned and operated by the City & County of San Francisco ("City"), acting through the San Francisco Airport Commission ("Airport Commission") pursuant to the City's Charter. Under the Charter, the Airport Commission is responsible for the "construction, management, supervision, maintenance, extension, operation, use and control of all property, including the real, personal and financial assets under its jurisdiction."

The primary federal agency with jurisdiction over the Airport is the Federal Aviation Administration ("FAA"). The FAA's key role is to promote safety and the safe use of airspace. As such, the FAA has primary responsibility for airspace and the safe operation of the national aviation system. The FAA operates the Air Traffic Control System to coordinate all domestic air traffic and international air traffic entering U.S. airspace, certifies airline companies and the aircraft they fly, certifies commercial and general aviation pilots, develops the National Plan of Integrated Airport Systems, administers the Airport and Airway Trust Fund, and establishes Federal Noise Standards.

SFO also is subject to state regulations administered primarily by the Department of Transportation, Division of Aeronautics, pursuant to the California State Aeronautics Act (California Public Utilities Code Section 21001 *et seq.*). This state law, which establishes permitting and safety inspection functions, as well as noise regulations, addresses issues not within the sole purview of the FAA. The stated purpose of the Act is "to further and protect the public interest in aeronautics and aeronautical progress" through a number of means, which include, among others, protecting persons residing near airports from

unreasonable aircraft noise. The Act establishes requirements for Airport Land Use Commissions and preparation of Airport Land Use Compatibility Plans.

AIRPORT SETTING/ORIGIN OF LOCATION

In the mid 1920's San Francisco's civic leaders were resolved to build public support in order to allocate capital and develop an "Air Port" to serve San Francisco. However, the geography of the City's famous hills and watery surroundings at the tip of a peninsula, along with its marine-influenced weather, placed serious restrictions on available land of suitable size and favorable conditions within city limits. There was a realization, that for the setting of a municipal airport setting, San Francisco would have to look beyond its boundaries. In November 1926 the voters approved "Measure 30—Air Port" at the polls, which called for a charter amendment allowing the city to purchase or lease an airport site outside city limits. Section 1238, Code of Civil Procedure, State of California, also outlined the authority under which the City and County could acquire land for airport use outside its jurisdiction.¹

After much debate over numerous proposed locations, a preferred location known as the San Bruno Airport Site was selected. The object of focus was a modest 150-acre parcel of pastureland among the vast tracts owned by the Mills Estate, Inc. Its waterfront location along the bay met the criteria for both landplane and seaplane operations, as was desired. (Amphibious and flying boat type aircraft were more heavily relied upon in that era.) The Airport began as Mills Field in 1927, on land leased and then later purchased by the City and County of San Francisco. In the 1940s, the State conveyed two parcels subject to the public trust to the City for Airport use. What followed at Mills Field were decades of expansion at the airport that tracked developments in aircraft technology and customer demand for travel and cargo shipment. That expansion took the form of bay fill to lengthen runways for new and larger aircraft as well as the development of new and larger terminals to process the increasing number of passengers. This on-going process has culminated in the San Francisco International Airport we see today.

It is important to note the fill history and stratigraphy in the development of the Airport. The earliest developments of the airport were built onto low-lying pastures and farm fields that had been closed-off from the bay by dikes before the turn of the 20th century. Construction of the first airfield involved the import and placement of fill inboard of the levee in 1927. Subsequent expansion of the airport involved successive episodes of fill placement within the bay with the last episode of filling in 1972. In general, the airport fills were constructed by placing dry materials onto the marsh floor and into the shallow bay waters. The soils and rock underlying the airport may be grouped into several principal strata, which include in descending sequence with depth: fill, young San Francisco Bay Mud, upper layered sediments, old San Francisco Bay Clay (also known as old bay mud), upper alluvial sediments, lower alluvial sediments, and bedrock of the Franciscan Formation. Fill is the surface unit and consists primarily of silty and clayey sands and silts and clays, sometimes containing small amounts of building debris.

Since 1927 SFO has grown to be roughly 2300 acres in land area and is relatively level and free of obstructions to comply with FAA regulations. Grade elevations on runways ranges from lowest at 6 feet

¹ Department of Public Works, Bureau of Engineering, M. M. O'Shaughnessy, City Engineer, Mills Field Municipal Airport of San Francisco, Miscellaneous Data. January 1928. SFO Museum 2000.018.080 a c

NAVD88 on the 10s ends to highest at 12.5 feet NAVD88 on the 28s. Grade elevations at 19s and 1s are at 9 feet and 10 feet respectively. Low laying areas between runways can be as low as 3 feet. Terminal buildings are typically surrounded by aprons of elevations around 11 feet.

SFO is geographically located midway on the Pacific coast along the San Francisco Bay approximately 13 mile south of the San Francisco downtown within San Mateo county. It is surrounded by the cities of South San Francisco, San Bruno, Millbrae, and Burlingame and Highway 101 on the north, south and the west. The east is bounded by San Francisco Bay with a shoreline of approximately eight miles long.

SFO'S ROLE AS A TRANSPORTATION PROVIDER WITHIN CALIFORNIA, THE NATION AND THE WORLD

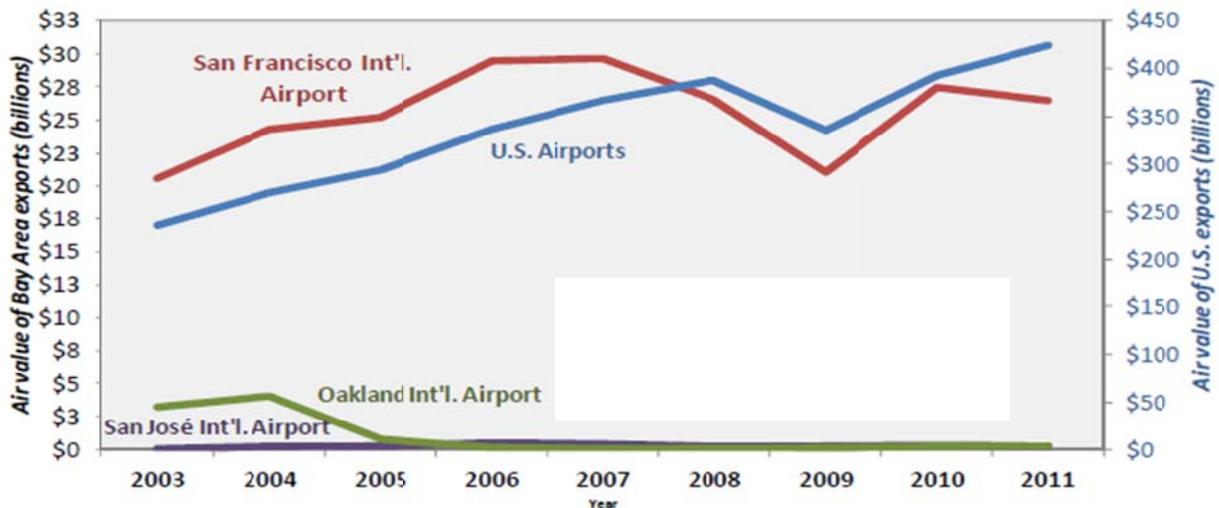
SFO is the largest airport in the Bay Area, the seventh (7th) largest in the United States, twenty second (22nd) in the world in terms of air passenger traffic, and has the seventeenth (17th) highest cargo tonnage in North America. There are 12 domestic passenger air carriers, 26 international passenger air carriers, 11 cargo air carriers, 10 regional commuter/seasonal charter air carriers for a total of 59 airlines operating from SFO. SFO is a key entry and departure point for millions of travelers. In 2013, more than 420,000 aircraft operations were conducted at the airport, serving a record high for SFO of more than 44.7 million incoming and outgoing passengers, and moving 370,000 metric tons of cargo. Annually, SFO serves about 35 million total domestic passengers, capturing 66% of domestic Bay Area market share. Meanwhile, SFO had an international Bay Area market share of 97% with roughly 10 million international passengers served annually.

In 2012, SFO directly accounted for \$5.4 billion in business activity supporting the 33,580 jobs (Table 1) at the airport. Off-site business activities that depend directly on local air service for staff movements, cargo deliveries, or customer visits (visitor spending) together raise the direct airport economic contribution to the Bay Area to \$31.2 billion in business sales with 153,000 jobs. There are also spin-off activities in the region (indirect and induced multiplier effects) associated with suppliers of goods and services to the directly affected businesses, and the re-spending of additional worker income on consumer goods and services. Adding in these effects raises the total economic footprint of SFO in the Bay Area to almost \$55.8 billion in business sales, including \$19.6 billion in total payroll, and more than 288,000 jobs in the region.

The economic activities generated by SFO also return significant tax revenues to the State of California, the nine Bay Area counties, and to the nation in terms of federal aviation taxes. The state and local tax revenues linked to operations at SFO totaled \$2.5 billion in 2012 (Figure 1),, including \$1.3 billion from direct activities and \$1.1 billion from purchases of supplier goods and services (tax impacts from indirect effects) and subsequent spending of worker income in the Bay Area (tax impacts from induced effects). Approximately \$1.6 billion (\$1.1 billion from direct activities) (Figure 2) stem from on-airport commerce and visitor spending, while more than \$900 million are attributable to air-reliant shippers that use SFO for air freight (\$300 million from direct economic activity). In addition, aviation operations at SFO generated \$604 million dollars in federal taxes including \$104 million from taxes on international and domestic passengers and \$499 million in U.S. Customs revenue from domestic air freight shipments. These tax revenues are remitted to the U.S. Department of the Treasury and do not directly benefit the Bay Area or the State of California.

Given its proximity to Asian markets, SFO has historically played an important role in international trade. Over the past decade, the airport experienced a trend in export activity similar to that of airports across the country (Figure 3). From 2003 to 2011, the total air value of exports passing through SFO grew at an average annual rate of 8.9 percent, from \$20.6 billion to \$29.7 billion. Despite being one of three commercial service airports within the region, SFO now accounts for virtually all export value that flies out of the Bay Area (Figure 3).

Figure 3: Air Value of U.S. and Bay Area Exports, 2003-2011



Source: US Census Bureau Foreign Trade Division, provided by WISERTrade

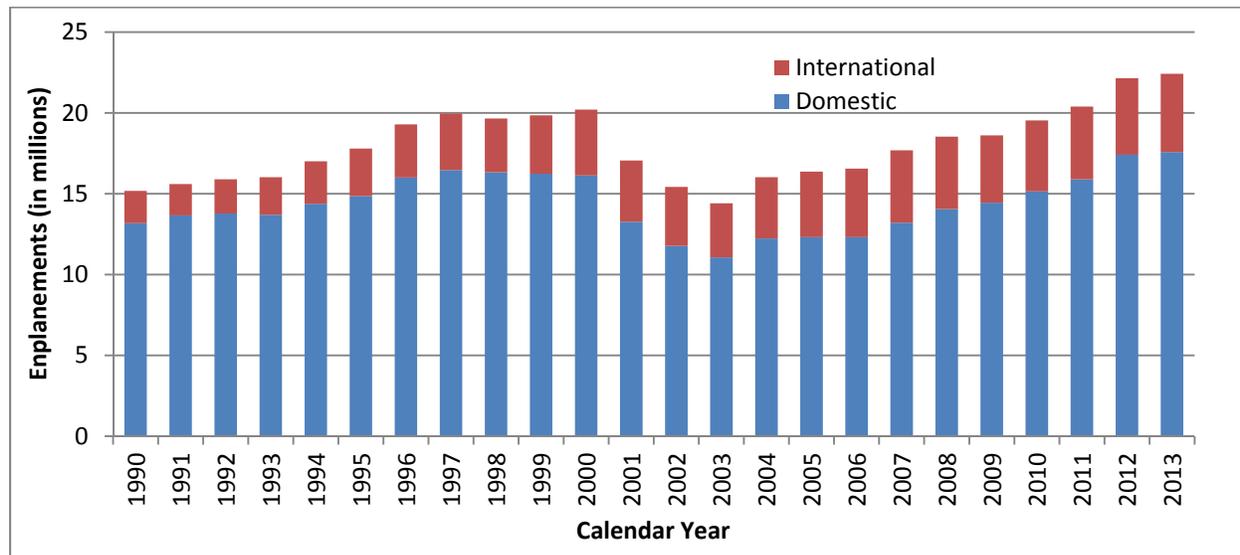
In 2011, the airport was the third busiest in the nation in terms of trans-pacific trade SFO accounted for 12.5 percent of the total value of U.S.-Asian exports by air in 2011. The airport has held its place among the most active in the country in terms of trade with Asia for at least the past decade.

POTENTIAL GROWTH AND EXPANSION PLANS FOR THE FUTURE

SFO is one of 29 U.S. airports which enplane one percent of total U.S. enplanements and is consequently designated as a “Large Hub Primary Commercial Service Airport” by the FAA. Described as the “gateway to the Pacific,” SFO serves as a major port of entry to the United States for passengers coming from Asia. Traffic at SFO consists of about 78% origin/destination traffic, or traffic that begins or ends a trip in the San Francisco Bay Area and 22% connecting traffic, or traffic that connects through SFO but does not begin or end a trip in the San Francisco Bay Area. This is an important statistic as it indicates that, unlike primarily connecting traffic airports where the majority of economic activities are concentrated at the airports themselves, the vast majority of traffic that flows through SFO supports the local economies and local economic growth in tourism and business. This illustrates SFO’s critical importance to the San Francisco Bay Area and the region.

The chart (Figure 4) below shows a record of historical enplanements or aircraft passenger boardings at SFO over the past two decades. Despite ups and downs through time, traffic at the Airport continues to grow.

Figure 4: SFO Annual Enplanements, 1990 – 2013



Source: SFO Year End Traffic Reports

The intrinsic links between the level of aviation activity and economic growth are well documented. Simply put, growth in population, employment, income, and tourism activity typically lead to increased demand for air travel both for business and leisure purposes. An individual's demand for air travel is often referred to as "underlying demand" in that it cannot be realized without the presence of air service at a price that results in the decision to fly.

Recent forecasts anticipate continued growth at the Airport. In response to steady growth in air traffic over the past decade and anticipated future growth, SFO has identified a series of projects to redevelop and enhance existing airport facilities as well as to develop new facilities. This \$4.1 billion 10-year capital plan includes major terminal renovations in each of the Airport's three domestic terminals, additional parking and cargo development, a new airport hotel, an air extension of the airport's air train system and new air train stations, and other airport facilities and infrastructure. This continued investment in SFO recognizes the Airport's continued national and international importance as a transportation facility and the City and County of San Francisco's commitment to the long term operation and viability of the Airport.

THE CITY AND SFO RESPOND TO CLIMATE CHANGE – SUSTAINABILITY

The City and the Airport are taking a two pronged approach to climate change, one approach is mitigation, and the other is adaptation. To touch briefly on mitigation, the people and policymakers of San Francisco believe in the imperative of reducing carbon emissions to the air from our daily personal activities, as well as from private business and governmental agencies. In 2008 the San Francisco Board of Supervisors enacted, and the Mayor signed, Ordinance No. 81-08 requiring all City Departments to reduce their greenhouse gas (GHG) emissions below 1990 emission levels as follows: 25% by 2017, 40% by 2025 and 80% by 2050. The Airport Commission and Airport management have been firmly committed to achieving these goals. In FY 2012 SFO reduced the GHG emissions from Commission-controlled operations by 34% below the 1990 emission levels, exceeding the 2017 reduction goal by 9%.

SFO achieved this milestone by conserving energy, constructing Green Buildings, recycling over 77% of our solid waste, improving the fuel efficiency of our vehicle fleet and shuttle buses and constructing the AirTrain system to eliminate the need for rental car shuttle buses. In addition, we provided partial funding to bring BART to SFO enabling over two million passengers per year to forego the use of their vehicles for travel to and from the Airport. The Airport has also planted over 2,000 trees around the Airport which sequester carbon dioxide from the air and enhance our passengers' experience significantly. While mitigation will not alter the need for climate adaptation, we believe that it is still an important component in the overall response to climate change.

The City has also created a working committee called **SF Adapt** lead by the Department of the Environment to understand and set policy regarding sea level rise in which SFO is an active participant. As part of SF Adapt, a climate adaptation subcommittee has been formed with members from city departments including SFO, Department of Public Works (DPW), Public Utilities Commission (PUC), Municipal Transportation Agency (MTA), and Port of San Francisco, and various other City agencies. Members from public sectors and private firms include climate scientists, engineers, legislative liaisons, planners and capital analysts. Work tasks for the subcommittee include looking into the state of science, current permitting and regulatory guidelines from Coastal Commission, BCDC and RWQCB, projects underway in the city and in the region as well as adaptation strategies undertaken nationwide. The committee will develop a procedure to identify hazards and risks caused by sea level rise, a process to assess vulnerability and adaptation, a set of elements of the sea level rise assessment and adaptation including vulnerability assessment, asset valuation, adaptive capacity and risk tolerance, and adaptation strategies. The product resulting from this committee's tasks is expected to provide general guidelines to be used in the City's capital planning. The committee will also make recommendations to the mayor on next steps to adapt to climate change and sea level rise.

THREATS TO SFO AS A RESULT OF SEA-LEVEL RISE IN THE SAN FRANCISCO BAY

Flood protection and sea-level rise adaptation have become a major focus for the City and the Airport. With the City's recent participation in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP), FEMA has been updating their Flood Insurance Rate Map (FIRM) for San Francisco to identify Special Flood Hazard Areas (SFHA) for the 1%-annual chance floods. The published draft FIRM shows SFO to be much more vulnerable to potential flooding. FEMA's current coastal study finds the still water elevation of a 1-percent-annual chance flood or base flood elevation (BFE) to be 10.5' NAVD88 and its draft FIRM map includes substantially all of SFO in SFHA Zone AE (EL11). The mandate to comply with FEMA's NFIP and our increasing understanding of the sea level rise phenomenon has driven the Airport to look very closely at this issue and incorporate future adaptation into our current planning.

The Presidio gauge, in service since June 1854, located near Crissy Field in the Presidio of San Francisco, is the oldest continually operating tidal gauge in the Western Hemisphere. Using data recorded at the Presidio, Sausalito and Fort Point, NOAA determined the sea level rise relative to land over the intervening 140 years to be at least 0.7 feet.² So we already have direct evidence within the bay of sea

² ref: NOAA Technical Report NOS CO-OPS 035, Historical Golden Gate Tidal Series, Oct 2002
<http://tidesandcurrents.noaa.gov/publications/techrpt35.pdf>

level rise. SFO, located about 13 miles southeast of Presidio typically experiences water levels 1.4 feet higher than high tides at Presidio due to in-bay ramp effects.

Using the ranges of sea level rise presented in the June 2012 National Research Council (NRC) report on *Sea-Level Rise for the Coasts of California, Oregon, and Washington*, Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT) estimates 0.39 to 2.0 ft (5 to 24 inches) of sea level rise by 2050 and 1.38 to 5.48 ft (17 to 66 inches) by 2100³. BCDC estimates 10-17 inches with an average of 14 inches of sea level rise by 2050 and a high end scenario of 43 to 69 inches with an average of 55 inches of sea-level rise by 2100. SFO must comply with these guidelines when applying for construction permits

SFO RESPONDS TO CLIMATE CHANGE – ADAPTING TO SEA LEVEL RISE

Existing Seawalls:

Having developed on the bay, the Airport has always been aware of the need for shoreline protection. SFO has built approximately 30,000 feet of shoreline protection measures, consisting of rock and soil berms, concrete seawalls, and vinyl sheet piles constructed between 1983 and 2006. These structures were built for erosion control and protection against tidal flooding. Existing gaps of various lengths between seawall sections would allow inundation of the airfield and the terminal areas during extreme flood events such as the 100-year floods.

Adaptation Feasibility Study:

In January 2013, the Airport commissioned a two year shoreline protection feasibility study responding to the threat of sea level rise. This study, conducted by Moffatt & Nichol and AGS, Joint Venture, will analyze the Airport's vulnerability to flooding from 100 year floods (1-percent-annual chance floods or base floods) and sea level rise, determine the deficiencies of the Airport's existing seawall systems, and develop shoreline protection system recommendations. To do that, the study utilizes latest LiDAR (Light Detection and Ranging) data from USGS (U.S. Geological Survey), selects sea level rise scenarios that are suitable for the region and that meets or exceeds guidelines set forth by BCDC and other state and federal agencies, performs bay water modeling to determine base flood elevation and identify deficiencies in the Airport's seawall systems based on existing conditions, conducts geotechnical assessments including soil stability analyses, and examines the interior drainage system by performing additional hydraulic analyses as needed to ensure that ponding in the airfield, if any, could be eliminated. Based on sound coastal, geotechnical and structural engineering, the study will develop alternative flood protections system improvements to address the identified deficiencies and analyze alternatives using multi-objective criteria, and make recommendation to the Airport on near term, medium term, and long term sea level rise protection projects and/or a program to be incorporated into the Airport's capital planning. The recommendations will help guide Airport Senior Management and policy makers on the best approach to defend the Airport from sea level rise.

It is anticipated that this study will be completed in January 2015 and may result in near term and longer term actions that can be implemented sequentially in an adaptive manner in response to rising sea

³ (http://scc.ca.gov/files/2013/04/2013_SLR_Guidance_Update_FINAL.pdf). BCDC's Staff Report, living with a Rising Bay (<http://www.bcdc.ca.gov/BPA/LivingWithRisingBay.pdf>)

levels. For example, near term actions may likely include filling all remaining gaps within SFO's existing seawall along the San Francisco Bay shoreline. Medium term actions may include closing potential water infiltration paths on the north, west, and south sides of the airport, thereby largely isolating the Airport from flooding that could occur in adjacent areas around SFO. A longer term action may consist of establishing additional sea wall protection outboard of existing sea walls to dampen wave energy, or increasing the strength and height of existing seawalls.

Regional Collaboration:

If you look at the flood maps of SFO from BCDC or FEMA, you can see that sea level rise and flooding in the vicinity of SFO doesn't just affect the Airport. All of the neighboring cities are affected as well as Highway 101 and possibly BART and Caltrain. It is conceivable that the Airport could put in place protections on our bay front perimeter and still suffer flooding coming from our north or south boundaries through the property of neighboring jurisdictions. There must be cooperation between regional and sub-regional entities and a cohesive plan which spans jurisdictional boundaries to protect everyone against sea level rise. So climate change adaptation must be viewed as a regional issue and a frame work should be established to address it.

As part of a regional effort, SFO has reached out to stakeholders and neighboring communities to begin a dialog on adaptation strategies. SFO jointly applied with San Mateo County for a climate ready grant from the State Coastal Conservancy and won the grant to extend the current feasibility study to include San Bruno and Colma Creeks which empty into the bay immediately north of the Airport. The extended study will perform sea level rise vulnerability assessment on the creeks to follow the guidelines set forth in the California Climate Adaptation Planning Guide, consider a range of sea level rise scenarios for the years 2050 and 2100, and build upon the lessons learned from BCDC's Adapting to Rising Tides (ART) project. An Interagency Working Group will be formed to guide and develop sea level rise adaptation and mitigation strategies for the project area. These strategies may include: improvements to the San Bruno Creek and Colma Creek; tidal land restoration; habitat enhancement; the development of parks, recreation areas and trails; and levee construction. The strategies will include protection of endangered species and invasive spartina management.

The Airport has also begun discussions with the Army Corps of Engineers (Corps) to determine whether they can assist the Airport to achieve protection against flooding and sea level rise. The Corps has two potential programs that might be available to the Airport. The first is under their Continuing Authorization Program (CAP), which has a maximum allowable federal budget of \$7M with local cost sharing requirement of 35% in construction phase. CAP projects are usually short term one time projects. If accepted as a project by the Corps, authority to proceed and fund the project lies with the Corps local district office. The second type of program through the Corps called a General Investigation (GI). Programs of this type are usually much larger, more complex, and costlier. For a project or a program to be included in a GI, the Corps must get congressional authority to study the problem and a second authority to fund and construct the required physical facilities included in the program. The GI process is quite involved, very costly, and takes a much longer time. It also requires some level of political support to move through the congressional approval process.

In addition the Airport understands that to address sea level rise, we would have to work closely with State agencies which have oversight and jurisdiction over the bay.

LONG TERM VIABILITY

As previously noted, SFO is a critical piece of national and international transportation infrastructure. SFO has made and continues to make major investments in maintaining and enhancing the Airport infrastructure. In addition, given the complexity associated with establishing new airports that would not only need infrastructure to be developed on the ground but also three dimensional routes and clearances within the airspace around the airport and tie-ins with the national airspace system, it is unlikely that a new airport could be developed to replace SFO while still locating it within a reasonable ground transportation distance from major population centers within the San Francisco Bay Area. Given the comparative ease with which the Airport's existing flood protection structures can be extended and enhanced to provide for the long term viability of SFO, the Airport is anticipating a strategy of adaptive planning to maintain the long term viability of the Airport as opposed to a strategy of managed retreat that could require eventual closing of the Airport at some point in the future.

GOVERNMENT-BASED CHALLENGES AND ROADBLOCKS TO FORTIFYING SFO AGAINST PROJECTED IMPACTS OF CLIMATE CHANGE

Statutory:

With the publication of BCD's Bay Area Sea Level Rise Map in 2008, SFO has been identified to highlight the imminent dangers of climate change and rising tides on San Francisco Bay. Yet, even with this focus on the danger to SFO in the emerging public dialogue, the implications for SFO and other regional economic assets on the bay shoreline has not been fully vetted.

As Airport staff has come to understand the issue of global warming and climate change, we have seen that much of the statutory focus has been to reduce greenhouse gas emissions. For example:

AB 32, California's Global Warming Solutions Act of 2006, gives the California Air Resources Board authority over sources of greenhouse gas emissions, including cars and light trucks. According to the California Air Resources Board, transportation accounts for 40 percent of greenhouse gas emissions, with cars and light trucks accounting for almost three-quarters of those emissions. [*Institute for Local Government* - <http://www.ca-ilg.org/post/basics-sb-375>]

SB 375 directs the Air Resources Board to set regional targets for the reduction of greenhouse gas emissions. Working in tangent with AB32, SB375 establishes a collaborative process between regional and state agencies to set regional GHG reduction targets, and provides CEQA incentives for development projects that are consistent with a regional plan that meets those targets. [*Institute for Local Government* - <http://www.ca-ilg.org/post/basics-sb-375>]

At the local level, the City of San Francisco has been a leader in promoting environmental programs and sustainability initiatives that are promulgated through Chapter 7, of the San Francisco Administrative Code with the focus on the development of Climate Action Plans to reduce carbon emissions to 1990 Levels.

With regard to Sea Level Rise, the San Francisco Bay Conservation and Development Commission (BCDC) updated the *San Francisco Bay Plan* in October 2011 to deal with the anticipated impacts of climate change in San Francisco Bay. Since updating the Bay Plan, BCDC has been pursuing a regional strategy of:

- *Protecting critical developed areas along the shoreline from flooding;*
- *Enhancing the natural resources of the Bay by preserving existing habitat and identifying areas where tidal wetlands can migrate landward; and*
- *Improving the ability of communities to adapt to sea level rise in ways that advance economic prosperity, social equity and environmental protection.*

[Zachary Wasserman, BCDC Chair – Testimony before the Little Hoover Commission, October 24, 2013]

Through the Bay Plan update process, there has been much discussion on the opportunities for natural adaptation measures such as wetland restoration in the north and south Bay regions, but there has been little action on the part of statutory legislation and regulatory mandates to address how priority uses, as these important economic assets are identified in BCDC’s Bay Plan, such as SFO will be protected.

While everyone recognizes that sea level rise is a regional issue, and there has been focus on mitigation of greenhouse gas emissions and nature based adaptation, there is currently little guidance for the armoring of important fixed assets on the bay against sea level rise. There are currently no opportunities, incentives, or directives for entities such as the Airport to work collaboratively in the sub-region with others to ensure that the efforts of one are consistent with the adaptive efforts of their adjoining neighbors. Also important to the understanding of sea level rise as a regional issue, is to recognize that adaptation and mitigation should be applied within a site specific context. So where wetland restoration opportunities may be preferred in the north and south Bay, for SFO, there are fewer opportunities for natural adaptive measures and hard armoring of the shoreline and minor Bay fill may be necessary.

Regulatory:

There are many permitting agencies with overlapping policies and regulations for protection of water quality, air quality, endangered and threatened species, and conservation of natural habitats. However, there is no consistent approach or guidelines on the local, state, or federal level specifically addressing sea level rise. Permittees such as SFO are often left to address each agency policy and criteria without consistent guidance between the local, state and federal agencies.

For activities at the Airport, SFO deals with a full range of state and federal permitting agencies that include:

- Bay Conservation and Development Commission
- US Army Corps of Engineers
- San Francisco Bay Regional Water Quality Control Board
- Federal Aviation Administration
- US Fish and Wildlife Service
- California Department of Fish and Wildlife
- National Marine Fisheries Service
- Bay Area Air Quality Management District
- Federal Emergency Management Administration

Many Federal agencies do not have policies to address climate change or sea level rise and the multiple agency permits and authorizations that SFO will need to address sea level rise, will require federal and

state agency permits to address inconsistent requirements related to species and habitat protection versus maintenance, repair, upgrade or new construction of shoreline protection projects.

There is a gap between the statutory requirements that mandate local communities to address climate change, and the regulatory standards that must be met to address sea level rise. This lack of coordination between federal and state regulatory requirements results in inefficiencies that are counterproductive towards a concerted effort to consider serious capital investments for large scale construction projects to address sea level rise.

From SFO's perspective, and as we have quickly learned of the issues related to global warming and climate change, the focus of statutory and regulatory actions when they have been taken, has been directed towards sea level rise and the impacts on shoreline development. However, as we have learned, the effects of climate change will manifest itself in two ways, sea level rise and extreme weather events. Extreme weather events or the anticipated increase in storm events will also result in increased flooding. While sea level rise has captured the imagination of many, the effects of flooding in the next century resulting from inundated creeks and storm drainage channels, has not received the attention that it should.

For SFO, there is no ability to implement natural conservation measures or shoreline retreat. The airport is located between the Bay shoreline and Highway 101 and the BART and Caltrain rights of way. Therefore, SFO must look comprehensively at everything from mitigation, adaptation, and resiliency, to ensure operational capability in normal rising tide levels throughout this century, and perhaps most importantly, during extreme storm events that are also expected to increase in frequency due to climate change. For this reason, SFO must consider redundant systems that may include armoring our shoreline with seawalls and earthen berms, as well as constructing storm surge barriers and other in Bay measures.

Sea level rise and climate adaption projects pose an interesting dilemma for SFO, in that, the project scope and planning horizon for addressing climate adaptation goes well beyond what typically is done at the Airport through our five and ten year capital improvement program process. To develop redundant systems for our shoreline, as the Airport has done for our other infrastructure systems such as water and power, to ensure operational readiness in emergency situations, will likely require improvements along the shoreline band and in the Bay. These on-airport improvements and those linkages to off-airport shoreline measures may require SFO to obtain off-site mitigation. It has been SFO's experience for prior wetland fill projects, that there are few off-airport mitigation sites that meet permit requirements for creation versus restoration of wetlands. We believe this will remain an issue for the future as conversion of former salt ponds is restored to their former state. These restoration projects in the South Bay and North Bay will require substantial funding to proceed. Therefore, it would be beneficial for the region to allow permit applicants such as SFO, to mitigate for our shoreline projects that require wetland fill by utilizing both wetland creation and restoration projects to meet our permit obligations, particularly if these fill projects will address sea level rise or flood conditions attributable to climate change.

WHAT IS AT STAKE IF SFO AND OTHER CALIFORNIA AIRPORT BECOME INOPERABLE FOR SHORT OR EXTENDED PERIOD OF TIME DUE TO CLIMATE CHANGE IMPACTS?

Air travel indirectly stimulates both the global and national economy by facilitating trade and transporting passengers. Airports play a huge role in supporting the 10 million jobs and the \$1.3 trillion

that civil aviation contributes annually to our nation.⁴ California has two of the nation's top ten passenger airports – Los Angeles International and San Francisco International Airport. Conversely, many small California airports provide service to larger in-state airports, which illustrates the fact California commercial aviation is a system that ensures access to long-distance air travel. The economic impact of California commercial aviation is larger than that of any other single state, with California estimated to contribute 13.4% of national aviation economic output⁵.

If SFO becomes inoperable for a short or extended period of time, economic activities in and around the Bay Area would be curtailed with the effect rippling through the state and national economies. In aggregate⁶, over 288,000 jobs, \$20 billion in payroll dollars, and \$56 billion in business revenue could potentially be lost from the Bay Area's economy. This could affect the state and national levels in the form of curtailed business revenue generated through the multiplier effect, and decreased state and federal tax receipts.

The Bay Area is a national center for business innovation and technology. This core strength of the Bay Area economy has specialized air service needs that are served by SFO. The high-tech and pharmaceutical manufacturing, knowledge based service sectors, hospitality, and agricultural industries rely on air services. SFO contributes to the economic development in the Bay Area by enabling these firms to sell products across the U.S. and the world, and thereby maximize shares of national and international trade. Without the services offered at SFO (and if the similar scale of air services are not assumed by another regional airport), companies in the Bay Area that produce and ship products would find markets limited and market shares curtailed. In turn, economic activity in the Bay Area that is associated with production of goods shipped through SFO would be reduced. As a point of reference, the economic value of domestic and international exports originating in the Bay Area via SFO generated over 103,000 jobs, \$9.8 billion in labor income, and \$24.5 billion in business revenue.

RECOMMENDATIONS

Legislative:

1. Recognize and allow alternate shoreline protection methods such as construction of seawalls for airports and ports when natural protection methods are not feasible. Natural shoreline protection generally involves restoration and creation of wetlands along the waterfront to promote wild life including birds. However, bird strikes pose serious safety hazards to airplanes especially in the vicinity of airports. Therefore, allowing alternate solution to qualifying agencies will be critical when adapting to sea level rise.
2. Consider legislative relief for wetland fill mitigation obligations when projects are intended for climate change adaptation, through streamlining and linking mitigation funding for regional economic assets on the shoreline to wetland restoration projects in the south and north bays

⁴ "NextGen and Airports: Enhanced Safety and Fewer Delays", Michael Huerta, New Orleans, Louisiana, October 22, 2012.

⁵ Derived from data presented in The Economic Impact of Commercial Aviation in 2010, prepared by CDM Smith for the Airports Council International – North America; February 2012.

⁶ Includes direct, indirect, and induced economic impacts.

that would not only benefit marsh land habitat and species, but improve regional adaptation to climate change and sea level rise.

3. Consider bringing together the disparate regional and sub-regional stakeholders. SFO advocates expanding the stakeholder participation model developed by BCDC for the Adapting to Rising Tides Pilot Study of the East Bay shoreline from Emeryville to Newark. The ARTs approach would serve to improve the coordination and collaboration necessary to address climate change and sea level rise at the sub-regional and local levels.
4. Recognize the need for a regional plan by enforcing or mandating regional coordination and collaboration when adapting to sea level rise. SFO could not function without the critical transportation systems such as the Bayshore Freeway, Caltrans, BART and Caltrain, etc. that connect the airport to San Francisco Bay Area communities, and key infrastructure that include power, water, wastewater and aviation fuels systems that keep the airport operational.
5. Seek uniform guidance between federal, state and local governments to ensure consistency, minimize or eliminate conflicting standards and regulations.
6. State of California to advocate at the federal level for mandating that key infrastructures, ports and airports develop and implement sea level rise protection plans.
7. Mandate that cities and counties include climate change adaptation plans in their respective general plans, local coastal plans and similar programs.
8. Recognize that bay fill in some site-specific circumstances might be necessary to reduce sea level rise hazards.

Funding:

1. Consider providing funding for local and regional climate change adaptation strategy programs to develop guidelines and procedures in addressing sea level rise due to climate change.
2. Consider providing funding for vulnerability and risks assessment projects that address sea level rise at local, regional and state-wide levels.
3. Consider providing funding for adaptive capacity assessment projects (feasibility studies) addressing sea level rise.
4. Consider providing funding for climate change adaptation implementation projects (construction).

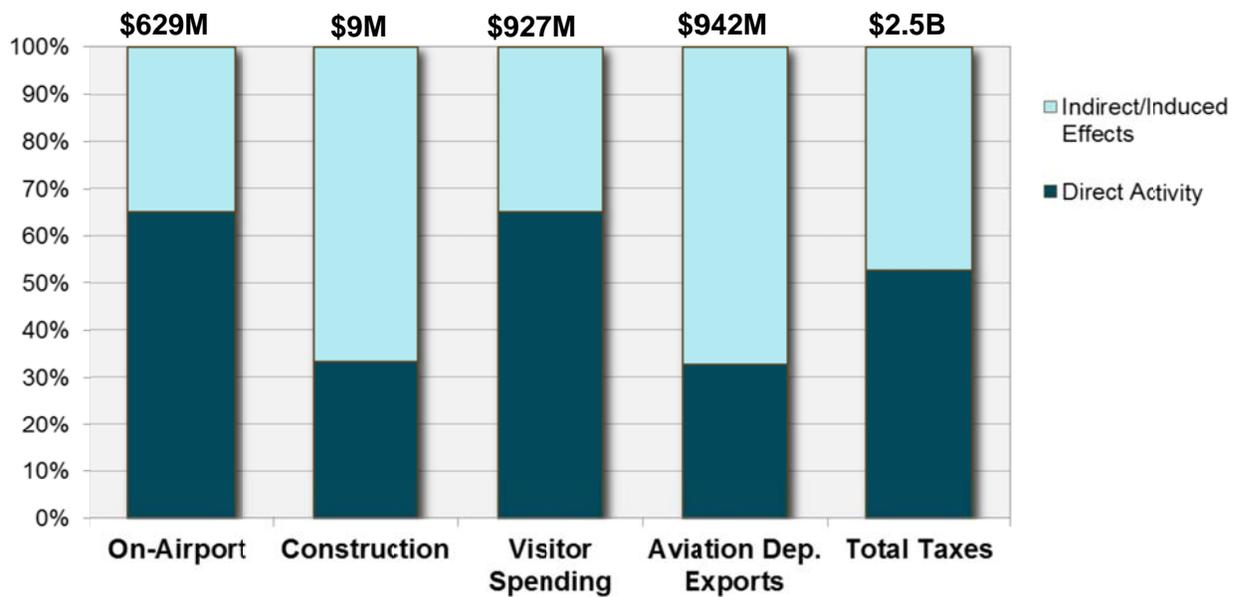
Appendix: Figures, Table, Map

Table 1: Many Roles of SFO Create an Economic Engine for the Bay Area and its Counties

Impacts	Airport Generated	Visitor Spending	Aviation Dependent Exports	Total Impact
Jobs				
Direct	33,580	82,790	36,430	152,800
Indirect & Induced	26,417	42,404	66,714	135,535
Total Jobs	59,997	125,193	103,144	288,334
Business Revenue (\$millions)				
Direct	\$5,462	\$9,126	\$16,636	\$31,223
Indirect & Induced	\$4,397	\$7,155	\$13,008	\$24,561
Total Business Revenue	\$9,859	\$16,280	\$29,644	\$55,783
Payroll/Personal Income (\$millions)				
Direct	\$2,092	\$3,035	\$4,786	\$9,913
Indirect & Induced	\$1,755	\$2,934	\$5,033	\$9,722
Total Payroll/Personal Income	\$3,847	\$5,970	\$9,819	\$19,635
Weighted Average Income/Employee	\$64,111	\$47,684	\$95,194	\$68,098

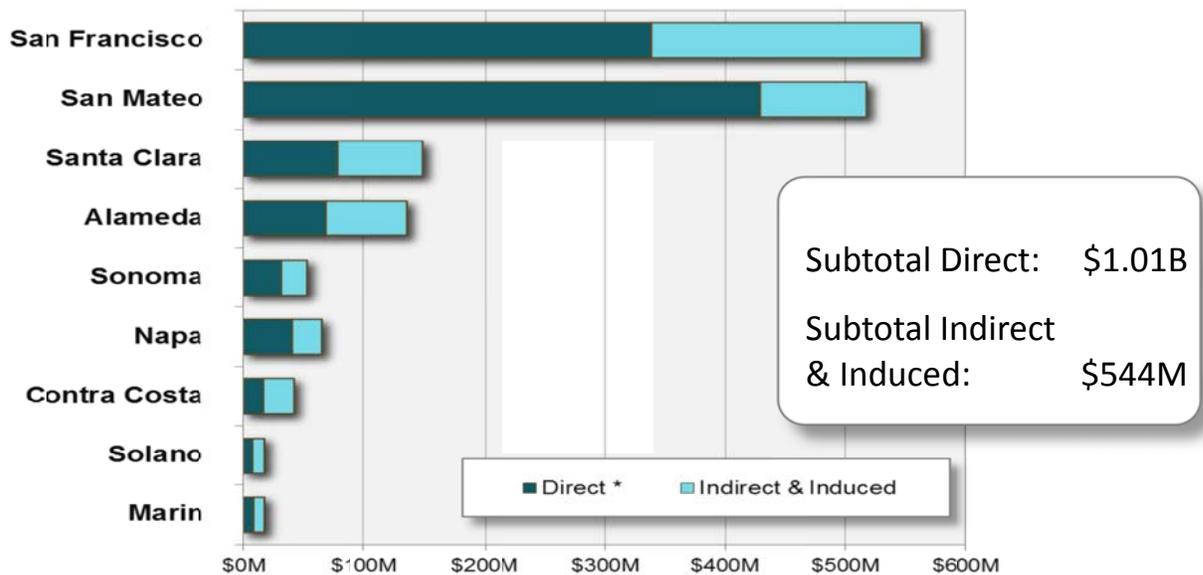
Source: 2013 Economic Impact study of San Francisco International Airport

Figure 1: 2012 SFO State & Local Tax Revenues



Source: 2013 Economic Impact study of San Francisco International Airport

Figure 2: State & Local Taxes Generated On-Airport and from Visitor Spending

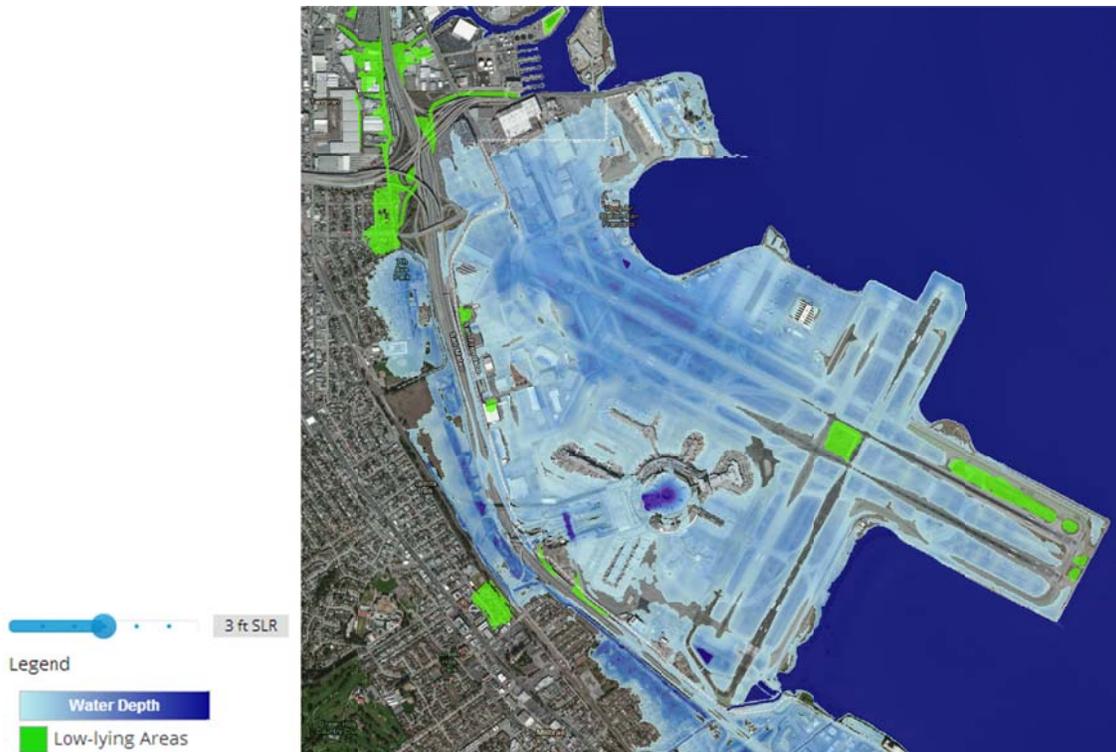


Source: 2013 Economic Impact study of San Francisco International Airport

Figure 5: FEMA's Draft FIRM (May 2013)



Figure 6: Sea Level Rise Impact at SFO



Source: NOAA <http://csc.noaa.gov/fig/viewer/>