APPENDIX F
ENHANCING THE CIP THROUGH SUSTAINABILITY

SUSTAINABLE AIRPORT MASTER PLAN

Appendix F: Enhancing the Jetport's Capital Improvement Program through Sustainability

This appendix presents details on suggested sustainability enhancements for the Recommended Master Plan Concept, as **Table 7A** of the Portland International Jetport (PWM or the Jetport) Sustainable Airport Master Plan (SAMP) identifies. It organizes the discussion by project type, and includes case studies and other guidance documents, as available. Table F-1 of this appendix reproduces **Table 7A** of the PWM SAMP below.

Table F-1: Suggested Sustainability Enhancements and Example Recommended Master Plan Concept Applications

Suggested Sustainability Enhancements	Example Applications for the Recommended Master Plan Concept
Install Pervious and Permeable Pavements	In the construction of a public surface parking lot, incorporate permeable pavements to minimize stormwater runoff and reduce associated operations and maintenance costs.
For utilities or flat work construction, apply the Envision® sustainable infrastructure rating system	The Envision® rating system would provide projects like the ramp extension with a framework for evaluating and rating its sustainability performance over the course of its life cycle.[1]
Incorporate resiliency measures into the maintenance and design of the Jetport's existing and future critical assets	Consider incorporating resiliency measures, tailored to the unique conditions of southern Maine, into the planning and design of any terminal building expansion. This would help protect the Jetport's significant investments in its critical assets as well as minimize future operational disruptions due to the potential impacts of climate change.
In accordance with applicable regulations, accommodate water reclamation and reuse systems	New buildings such as the expanded maintenance building could include water reclamation systems such as rainwater harvesting equipment. The Jetport could use the reclaimed water for irrigation purposes, which would reduce the Jetport's overall potable water consumption and related costs.
Use highly reflective roofing and pavement materials	On acquiring the Maine Aviation Maintenance Hangar, retrofit it with highly reflective roofing materials to mitigate the urban heat island effect. Dark, non-reflective surfaces can create microclimates by increasing temperatures within built areas relative to their surroundings.
Integrate green stormwater infrastructure such as bio-swales and rain gardens into existing and future facilities	For all projects that increase the area of impervious surfaces at the Jetport such as the construction of a by-pass taxiway, consider installing green stormwater infrastructure such as bio-swales, planters, and rain gardens on Jetport property to collect and/or treat stormwater onsite, thereby limiting run-off. The Jetport should ensure that the design of such infrastructure does not attract hazardous wildlife.
Incorporate recycled materials in all pavement installations	Minimize the use of virgin materials when expanding or reconfiguring airfield pavements such as the terminal aprons and the perimeter service road by using discarded asphalt or fly-ash concrete. This would have the added benefit of reducing greenhouse gas emissions associated with the extraction, manufacturing, and distribution of raw materials.
Design for Deconstruction	For new construction such as the development of the FIS customs facilities, consider designing for deconstruction. This would provide for flexibility in future interior fit-outs, minimize waste during renovations, and allowing for disassembly at the time the facility becomes obsolete.

[1] Institute for Sustainable Infrastructure. (2016). *Envision® Sustainable Infrastructure Rating System*. Retrieved January 11, 2016, from https://www.sustainableinfrastructure.org/rating/

Pervious/Permeable Pavements

The installation of pervious or permeable pavements would assist the Jetport in managing stormwater onsite, as they allow rain and snowmelt to infiltrate the water table that lies below. This would reduce the quantity of stormwater runoff and associated pollutants, the potential for erosion, and the need for stormwater drains. An additional benefit of permeable pavements, particularly in northern communities that experience cold climates, is the lessened requirement for deicing throughout the winter season. They are also more resistant to frost than standard pavements.[2] Typical airport applications of permeable pavements include runway shoulders, service roads, and parking lots.

Case Studies:

- **Stewart International Airport:** In 2010, Stewart International Airport installed nearly 6 acres of permeable pavement at an expanded onsite parking lot at a cost of $9 million.[3] This parking lot expansion additionally includes bio-swales, infiltration trenches, a large void sub-base, and rain tanks. The combined system achieved 100 percent infiltration of all stormwater, and did not require any connections to the existing storm drainage system.[4]
- **San Diego International Airport:** In 2012, San Diego International Airport installed a demonstration project at the Terminal 2 parking lot to test the ability of permeable pavement to reduce stormwater runoff volume at the site. The airport designed the permeable pavement installations to accommodate the volume of runoff from its respective drainage areas in association with the 85th percentile storm event.[5]

Resources:

- Permeable Pavement Design Guidance (California Department of Transportation), http://www.uni-groupusa.org/PDF/Caltrans%20DG-Pervious-Pvm_102913.pdf
- Permeable Pavements (Permeable Pavements Task Committee, American Society of Civil Engineers)
- Guidance for Usage of Pervious Pavement at Airport (Airport Cooperative Research Program [ACRP] 02-64), http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3837 (*In Progress)*

Envision® Sustainable Infrastructure Rating System

The Envision® Sustainable Infrastructure Rating System provides a framework for evaluating and optimizing sustainability performance of non-building construction projects (i.e., roadways, bridges, pipelines, water treatment facilities, etc.). Envision takes a holistic approach to sustainability by evaluating infrastructure projects against five core areas including quality of life, natural world, leadership, resources allocation, and climate and risk. Even if the Jetport is not interested in pursuing full certification for a project, it can use the best practices and resources within the Envision® planning guide to develop projects that maximize sustainability performance. Using this rating system in conjunction with other building rating systems would ensure the integration of sustainability into all airport construction or capital improvement projects at the Jetport.

Case Studies:

- **San Diego International Airport:** The San Diego International Airport considered the Envision® rating system to examine its Green Build project, which consisted of several non-terminal infrastructure

[2] Water Environment Federation. (2012). *Porous Pavement Performance in Cold Climates*. Retrieved January 10, 2016, from http://stormwater.wef.org/2012/01/porous-pavement-performance-in-cold-climates/
[3] New York State Department of Environmental Conservation. (2016). *Stewart Airport Pervious Asphalt Pavement*. Retrieved January 10, 2016, from http://www.dec.ny.gov/lands/73105.html
[4] SAGA. (2015). *Install Permeable Pavement*. Retrieved December 28, 2015, from http://www.airportsustainability.org/practice/255
[5] San Diego County. (2014). *Demonstration Project Case Studies*. Retrieved January 10, 2016, from http://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/susmppdf/lid_san_diego_airport.pdf

improvements such as dual-level roadway for curb front traffic congestion relief, curbside check-in enhancement, aircraft parking area expansion, and taxiway improvement.[6]

Resources:

- Envision® Sustainable Infrastructure Rating System (Institute for Sustainable Infrastructure), https://www.sustainableinfrastructure.org
- Prototype Airport Sustainability Rating System—Characteristics, Viability, and Implementation Options (ACRP Report 119), http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_119.pdf

Integration of Climate Adaptation Planning

Airports around the globe are grappling with the realities of a changing climate. Extreme weather events like Hurricanes Sandy and Katrina, Tropical Storm Irene, and winter storm Nemo created awareness around the ways climate change is influencing current and future weather patterns, and how these changes can impact transportation infrastructure. This is particularly relevant to airports, as they operate critical infrastructure that supports regional economies and act as important connections that link communities to one another, an important aspect when considering the role airports play in disaster response. As 70 percent of delays at airports are the result of extreme weather events, and such events are on the rise, airports should consider the potential impacts of climate change with respect to their own environmental conditions as they make investments in the ongoing maintenance of their critical assets and through their capital improvement programs.[7]

Although the Jetport is not directly at risk from sea level rise, as demonstrated by a mapping assessment conducted by the Maine Geological Survey, Department of Conservation,[8] leadership should still consider the broader impacts of climate change in its planning and development activities. The Transportation Research Board (TRB) developed the Airport Climate Risk Operational Screening (ARCOS) tool to estimate levels of risk for airport assets and impacts to operations. Based on the ARCOS report generated for PWM, Jetport planners and operators should expect a warmer and wetter climate through 2060, and should consider how these conditions could impact its critical assets. For example, how will increased storm and heavy rain days affect the Jetport's stormwater systems? Will warmer weather impact the performance of the Jetport's tarmac pavement, and how will it require changes to the Jetport's building systems, particularly its heating, ventilation, and air conditioning (HVAC) equipment? Table B-2 summarizes climate change data that the ARCOS tool provided based on the Jetport's location and 2014 climate indicators.

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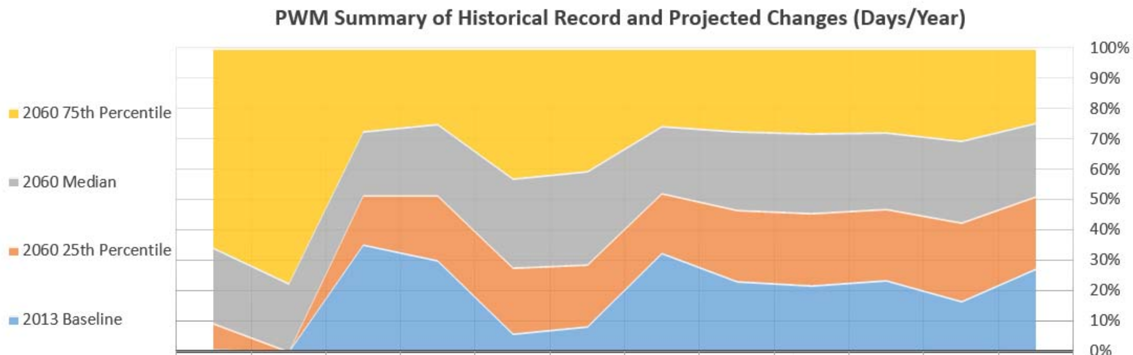
[6] SAGA. (2015). *Use the Envision™ rating system to assess the sustainability performance of airport infrastructure projects and development programs*. Retrieved January 12, 2016 from http://www.airportsustainability.org/practice/23

[7] ACRP. (2012). *ACRP Synthesis 33: Airport Climate Adaptation and Resilience*. Retrieved January 10, 2016, from http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_033.pdf

[8] Maine Department of Conservation. (2011). *Preparing Portland for the Potential Impacts of Sea Level Rise*. Retrieved January 10, 2016, from http://www.portlandmaine.gov/DocumentCenter/View/6323

Table B-2: Summary of Historical and Projected Climate Changes for PWM



	Hot Days	Very Hot Days	Freezing Days	Frost Days	Hot Nights	Humid Days	Snow Days	Storm Days	Heavy Rain (One Day)	Dry Days	Cooling Days	Heating Days
2060 75th Percentile	21.3	2.4	31.7	100.3	63.6	61.1	7.2	41.6	15.7	16.8	96.8	233.6
2060 Median	8.1	0.7	24.7	94.4	43.8	45.9	6.3	39.3	14.6	15.1	86	232.4
2060 25th Percentile	2.8	0	18.6	86.2	32.4	30.9	5.6	35.6	13.3	14.2	83.7	228.6
2013 Baseline	0.3	0	41.2	120.7	9	12.5	9.2	35.2	12.3	14.3	52.8	261.6

Source: Airport Climate Risk Operational Screening (Version 4.0.5715.27958). (2014). Climate Change Data for PWM Jetport.

Case Studies:

- **Boston Logan International Airport:** At Boston Logan International Airport, the Massachusetts Port Authority (Massport) established a comprehensive resiliency program that anticipates and prepares for future climate events through strategic convening, research and planning, resilient design, education and training, and operational preparedness. As part of this program, Massport developed the Disaster and Infrastructure Resiliency Planning Study (DIRP), which assessed the risks associated with extreme weather events at Logan Airport and Massport's maritime facilities. It also created a Floodproofing Design Guide that provides planning and design considerations for improving the resiliency of Massport's critical facilities with respect to flooding events. More information on Massport's resiliency program is at https://www.massport.com/business-with-massport/resiliency/.

Resources:

- Airport Climate Adaptation and Resilience (ACRP Synthesis 33), http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_033.pdf
- Climate Change Adaptation Planning: Risk Assessment for Airports (ACRP Report 147), http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_147.pdf

Water Reclamation and Reuse Systems

The Jetport can incorporate water reclamation and reuse systems into buildings and/or operations to reduce overall water consumption and reliance on potable freshwater systems. Water treatment plants treat potable water to meet stringent drinking water quality standards, which makes it a valuable, but limited commodity. Non-potable water, such as reclaimed water or stormwater, is a more cost-effective option that the Jetport can use for general purposes. The Jetport can install rainwater harvesting equipment, stormwater filtration devices, or more advance wastewater treatment systems to process reclaimed water for uses such as landscape irrigation, air conditioning, construction activities, and aircraft or car washing services. Capitalizing on rainwater and modifying water practices at the Jetport is an economical and environmentally sound option for long-term sustainability planning.

Case Studies:

- **Chandler Municipal Airport:** In 2015, the Arizona Water Association named the Chandler Airport's Water Reclamation Facility expansion project as the Water Reuse Project of the Year. Completed in fall of 2014, it included new reservoir, aeration basins, clarifiers, and the expansion of filtration and flocculation facilities. This project increased the airport's capacity from 10 million gallons per day (MGD) to 15 MGD.[9]
- **Frankfurt Airport:** Since 2001, the Frankfurt Airport has maintained its potable water volume at the same level, despite increasing passenger numbers. This is due, in part, to airport-operated rainwater treatment plants that supply non-potable water, or service water, to Terminals 1 and 2. The airport maintains separate stormwater and sewage water treatment systems, which reduces the volume of water that it needs to treat at the facility.[10]

Resources:

- A Handbook for Addressing Water Resource Issues Affecting Airport Development Planning (ACRP Report 53), http://www.trb.org/main/blurbs/165998.aspx
- Sustainable Airport Environments: A Review of Water Conservation Practices in Airports (Resources, Conversation & Recycling), http://www.repositorio.ufop.br/bitstream/123456789/5568/1/ARTIGO_SustainableAirportEnvironments.pdf
- Water Conservation and Efficiency at Vancouver International Airport (University of British Columbia), https://open.library.ubc.ca/cIRcle/collections/undergraduateresearch/34125/items/1.0075688
- Rainwater Use in Airports: A Case Study in Brazil (Resources, Conversation & Recycling), http://www.dec.ufv.br/modules/mastop_publish/files/PublicacoesdoPrograma/LUCIA_Resources,%20Conservation%20and%20Recycling_2012_2.pdf

Reflective Roofing and Pavement Materials

Developed areas with large amounts of heat-retaining concrete and dark surfaces absorb a high percentage of solar radiation, which contributes to increased temperatures across surrounding areas, otherwise known as the *heat island effect*.[11] This not only increases the amount of energy used for cooling buildings, but it also impacts the surrounding vegetation, wildlife, and community at large. To mitigate the heat island effect, the Jetport can use roofing or pavement materials that are highly reflective and do not retain heat. Best practices indicate that pavement materials should have a solar reflectance index (SRI) of at least 29 or higher (standard black surface is "0" and a standard white surface is "100").[12] Accordingly, the Jetport can paint rooftop surfaces lighter colors to reflect solar radiation or install rooftop vegetation to help keep buildings cool and manage stormwater runoff. Reflective and vegetated roofs have been shown to reduce energy demand for building cooling by up to 50 percent.[13]

[9] McCarthy Building Companies. (2015). *Chandler Airport Water Reclamation Facility Expansion Project 2015 Water Reuse Project of the Year by Arizona Water Association.* Retrieved January 12, 2016 from http://www.mccarthy.com/news/2015/05/20/chandler-airport-water-reclamation-facility/
[10] Frankfurt Airport Environmental Statement. (2014). *Environmental Statement 2014 Including the Environmental Program until 2017.* Retrieved January 12, 2016 from http://www.fraport.com/content/fraport/en/misc/binaer/sustainability1/stakeholder-dialog/environmental_statements/environmental-statement/jcr:content.file/environmental-statement-2014.pdf
[11] US EPA. (2016). *Heat Island Effect*. Retrieved January 13, 2016, from: http://www.epa.gov/heat-islands
[12] Institute for Sustainable Infrastructure. (2016). Envision® Sustainable Infrastructure Rating System Planning Guide Credit Climate and Risk 2.5. Retrieved January 13, 2016, from: https://www.sustainableinfrastructure.org
[13] Natural Resources Defense Council. (2012). *Looking Up: How Green Roofs and Cool Roofs Can Reduce Energy Use, Address Climate Change, and Protect Water Resources in Southern California*. Retrieved from https://www.nrdc.org/sites/default/files/GreenRoofsReport.pdf

Case studies:

- **Chicago O'Hare International Airport:** In 2009, O'Hare International Airport incorporated reflective concrete pavers and a 9,000 square foot green roof at the airport's North Air Traffic Control Tower as part of the a sustainable, whole-building approach.[14]
- **Denver International Airport:** A fabric roof encloses the Jeppesen Terminal at the Denver International Airport, which includes steel masts and cables that support a tensile membrane material covered by a lightweight fiberglass exterior that reflects 76 percent of solar radiation. This level of reflectivity and type of roofing material reduces heat retention, while providing sufficient daylighting in the terminal.[15]

Resources:

- Guidelines for Selecting Cool Roofs (United States Department of Energy), https://heatisland.lbl.gov/sites/all/files/coolroofguide_0.pdf
- Towards Sustainable Pavement Systems: A Reference Document (United States Department of Transportation, Federal Highway Administration [FHWA]), http://www.fhwa.dot.gov/pavement/sustainability/hif15002/hif15002.pdf
- Reducing Urban Heat Islands: Compendium of Strategies – Cool Pavements (United States Environmental Protection Agency [US EPA]), http://www.epa.gov/sites/production/files/2014-06/documents/coolpavescompendium.pdf

Green Stormwater Infrastructure

Impervious surfaces decrease the rate at which the ground can absorb and filter water. They also accelerate stormwater runoff, which can lead to soil erosion and is a major source of water pollution. The Jetport can complement its construction projects with green infrastructure design strategies to help manage stormwater, improve regional water quality, and save on energy costs by reducing the volume of water diverted to water treatment plants. Examples of such strategies include bioswales, green roofs, permeable pavements, planter boxes, rain gardens, and rainwater harvesting. In developing these strategies, the Jetport should avoid vegetation that attracts unwanted wildlife.

Case Studies:

- **Paris-Orly Airport:** In spring 2014, the Paris-Orly Airport established a 70,000 square foot filter marsh to supplement their stormwater treatment processes. This includes a two-step process. First, the airport pre-treats stormwater and water contaminated by de-icing pollutants in a buffer tank, and second, the airport transfers the water to the marsh for filtering. The marsh consists of filtering materials such as reeds in sand and aggregate. To monitor water quality at the marsh, the airport installed sensors.[16]
- **Chattanooga Airport:** Through collaborative efforts with the City of Chattanooga, the Chattanooga Airport engaged in a water quality demonstration project that converted impervious surfaces (two buildings and parking lots) into bio retention areas for stormwater management. The implementation of this project reduced local flooding issues, diverted stormwater away from wastewater treatment facilities, improved soil conditions, and restored ecological habitats.[17]

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[14] Aviation Pros. (2009). *A Model for Sustainability*. Retrieved January 12, 2016, from http://www.aviationpros.com/article/10372998/a-model-for-sustainability

[15] Roof Consultants Institute. (2006). *A Fabric Roof for Denver's New Airport Terminal.* Retrieved January 12, 2016, from http://www.rci-online.org/interface/2006-cts-barden.pdf

[16] Paris-Orly Airport. (2014). *Paris-Orly Airport begins using its "filter marsh" An innovative process for the treatment of stormwater run-off*. Retrieved on January 13, 2016, from: https://www.aeroportsdeparis.fr/docs/default-source/groupe-fichiers/presse/cp_avril-juin-2014/2014_04_08-presse-paris_orly_airport_begins_using_filter_marsh.pdf?

[17] Chattanooga Airport. (2016). *Water Quality Demonstration Project* Retrieved on January 13, 2016, from: http://www.chattairport.com/www/docs/155.2060/chattanooga-airport-water-quality-demonstration-.html

Resources:

- Green Infrastructure Directory (New England Environmental Finance Center), http://digitalcommons.usm.maine.edu/cgi/viewcontent.cgi?article=1005&context=sustainable_communities
- Green Infrastructure (US EPA), http://www.epa.gov/green-infrastructure

Recycled Pavements

Appropriate reuse of pavement can significantly reduce material costs and greenhouse gas emissions associated with the production and transport of virgin materials while diverting reusable materials from landfills. The Jetport can mill pavement materials from previous service roads, or other obsolete concrete or asphalt uses, to offset project costs for pavement expansions or installations for new runways, parking lots, parking garages, building structures, and access roads. Recycling solutions include incorporating reclaimed asphalt pavement (RAP) mixtures and/or recycled concrete aggregate (RCA) through efficient on-site processes such as warm-mix asphalt, cold-in-place recycling (CIR), or hot-in-place recycling (HIR). In addition, the subbase granular materials can be recycled as parts of a new subbase for planned pavement construction projects to further reduce material costs.

Case Studies:

- **Nashville International Airport:** Nashville International Airport saved millions of dollars on a pavement reconstruction project by reusing 35-year-old pavement. The airport's existing runway pavement was deteriorating due to an alkali-silica reaction, which causes the aggregate gel to expand within the concrete and cause pavement cracking. The airport was able to mill this existing pavement and transform it from rubble into usable aggregate. This eliminated the need for trucking materials, which reduced fuel costs and associated greenhouse gas emissions. BNA estimated that recycling the aggregate reduced project costs by approximately $2 million in aggregate costs alone.[18]
- **Boston Logan International Airport:** Massport used recycled asphalt pavement during a runway-resurfacing project at Boston Logan International Airport. It used an on-site, warm-mix asphalt process that incorporated 18 percent recycled materials. This helped the organization avoid transportation costs and emissions from the production and distribution of virgin materials, which led to an estimated reduction of 4,500 tons in carbon dioxide emissions (about 20 percent lower compared to the conventional hot-mix method) and saved approximately 450,000 gallons of diesel fuel.[19]
- **Waukesha County Airport:** The Waukesha County Airport in Wisconsin used fly ash concrete to rebuild an auxiliary runway and roadways. The airport purchased fly ash from a nearby coal fired power plant, which saved the airport an estimated 25 percent in material costs, while diverting fly ash from nearby landfills.[20]

Resources:

- What's Next in Airport Pavements? (Airport Consultants Council), https://www.acconline.org/documents/SpecialFeature.pdf
- Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice (FHWA), http://www.fhwa.dot.gov/publications/research/infrastructure/pavements/11021/11021.pdf
- Asphalt Pavement Recycling with Reclaimed Asphalt Pavement (FHWA), http://www.fhwa.dot.gov/pavement/recycling/rap/index.cfm
- Fly Ash Facts for Highway Engineers (FHWA), http://www.fhwa.dot.gov/pavement/recycling/fach02.cfm

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[18] Infrastructure Quarterly – Volume 2 Issue 3. (2010). *Reclaiming Water and Revenue.* Retrieved January 13, 2016, from https://garverusa.com/iq/201023/27/recycled-runway/
[19] Massport. (2013). *Boston Logan Airport Completes $100 Million in Runway Safety Projects*. Retrieved January 13, 2016, from http://www.massport.com/news-room/news/boston-logan-airport-completes-$100-million-in-runway-safety-projects/
[20] Aggregate Research Institute. (2006). *Recycling Coal for a Runway.* Retrieved January 13, 2016, from http://www.aggregateresearch.com/articles/9337/Recycling-coal-for-a-runway.aspx

- Pavement Life-Cycle Cost Analysis Software (FHWA), http://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm

Designing for Deconstruction

Designing for Deconstruction (DfD) prioritizes the reuse or repurposing of materials and buildings prior to or in lieu of demolition. The DfD approach considers the life-cycle elements of structures and materials to enhance flexibility and increase the possibility of alternative future uses. The value of materials recovered and landfill tipping fees are key factors in developing standards for DfD. Deconstruction takes longer then demolishing a building, which should be a consideration in developing related construction contracts. At a minimum, the Jetport can advertise the demolition of a building so that contractors can have an opportunity to remove and reuse valuable materials.

Case Studies:

- **San Francisco International Airport:** The San Francisco International Airport established Sustainable Planning, Design, and Construction Guidelines to improve sustainability performance in project development. Part of the sustainability assessment protocol is to "document the impact of building deconstruction procedures for the alternative conceptual models." The airport provides a checklist of requirements to ensure that contractors are designing with highly durable materials, products, and equipment that can be deconstructed, repurposed, reused, or recycled.[21]
- **London Gatwick Airport:** The London Gatwick Airport developed a design scheme that includes initiatives to manage and mitigate waste during construction and operation. Included in this scheme is guidance on DfD and an associated checklist.[22]

Resources:

- Design for Deconstruction Manual (US EPA), http://www3.epa.gov/region9/greenbuilding/pdfs/DesignForDeconstrManual.pdf
- Design for Disassembly: A Guide to Closed-Loop Design and Building (King County, Washington), http://your.kingcounty.gov/solidwaste/greenbuilding/documents/Design_for_Disassembly-guide.pdf

[21] San Francisco International Airport. (2015). *Sustainable Planning, Design and Construction Guidelines - Delivering Healthy, High Performing, and Resilient Facilities – Version 4.* Retrieved on January 13, 2016, from: http://media.flysfo.com/media/sfo/community-environment/sfo-dc-sustainability-guidelines-sm.pdf

[22] London Gatwick Airport. *A Second Runway for Gatwick, Appendix A31 Waste*. Retrieved on January 18, 2016, from https://www.gatwickairport.com/globalassets/publicationfiles/business_and_community/all_public_publications/second_runway/airports_commission/gatwick_appendix_a31_waste.pdf