Airfield Pavement Design and Construction- Using a Sustainability Matrix: Case Studies

Presentation to CAPTG Workshop - Montreal, 2011

George Nowak P. Eng, September 15, 2011

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Outline

- Sustainability Definition - Refresher
- Key Info Sources : ORD, Greenroads™, LAWA, SAGA and ISI (new) new **LEED®** - like “Tools” for Infrastructure and “Flatwork”
- Pavement -Typical Matrix Sustainability Criteria for Design and Construction
- Case Study Matrix – New Taxiways LAX
- Case Study Matrix – New Runway YYC

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Sustainability - “Triple Bottom Line”

TBL Definition is most widely accepted approach to sustainability. (phrase coined by John Elkington, 1994)

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Reminder: Green ≠ Sustainable

- Green is only one aspect – green focuses solely on Environmental Stewardship which is very important but ….
- Sustainable projects move beyond just the "green" component and must include Economic Viability, Social Responsibility and Operational Efficiency

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Pavement Sustainability - Sources

- Best sources of Information to develop matrix assessment for sustainability
- Focus on non-Building Criteria
- State-of-the-Art

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Notable Sustainability Agencies - 1

- City of Chicago, Sustainable Airport Manual, First Issued 2003 (now updated) http://www.airportsgoinggreen.org/SAM
  - O'Hare Modernization Program
  - Planning, Design and Construction Checklists
  - Sustainable Specifications

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Notable Sustainability Agencies - 2

- Los Angeles World Airports (LAWA) Environment/Sustainability http://www.lawa.org/welcome_LAWA.aspx?id=1036
  - Detailed Guidelines – Started 2007 now in Version 5.0 Dated February, 2010
  - Planning and Design Checklist (Matrix) with Point System
  - Construction Checklist (Matrix)

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Notable Sustainability Agencies - 3

- University of Washington and CH2MHill

  http://www.greenroads.us/

  - Voluntary Rating System for Design and Construction of Roads and Bridges, Started 2007
  - Must meet 11 “Project Requirements”
  - Detailed manual and good definitions and checklists for (road) pavements
  - Can apply to get your project “certified”

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Notable Sustainability Agencies - 4

- Sustainable Aviation Guidance Alliance (SAGA). http://www.airportsustainability.org/
  - Volunteer Alliance : ACI-NA, ACC, AAAE, ATA

    Formed 2008
  - Searchable Sustainability Database – compendium of many airport checklists
  - Does Not Provide a Rating System, although looking at that step in next evolution (might be superseded by others).

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Notable Sustainability Agencies - 5

- New Group – Institute for Sustainable Infrastructure (ISI) founded by ACEC, APWA and ASCE in 2011. Want to emulate **LEED®** for non-building work.
- http://www.sustainableinfrastructure.org/
  - Draft Guidelines and Point System out for Public Comment in July, 2011
  - **envision™** roll out in early 2012

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Sustainability Criteria for Matrix Analysis and Comparison

- Many standard “checklists”, criteria and rating “metrics” are available for guidance, but there is no universally accepted “standard” like **LEED®** - at least not yet.
- You and your stakeholders/advisory panel need to establish sustainability goals for **your specific airport pavement project** - one size does not fit all.

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Typical "Airport Pavement" Sustainability Rating Criteria

Planning and Design

- Electronic Submissions
- Outreach and Stakeholder Plan
- Environmental Review Process
- Life Cycle Analysis and Inventory
- Optimal Airside Geometric Design
- Noise Control
- Climate Change Adaptation
- SWM and Erosion Control Plan
- Water Use Efficiency
- Heat Island Reduction
- Light Pollution Reduction
- Energy Alternatives/Efficiency
- Emission Impact Mitigation
- Design for Material Resources and Recycling

Construction and Operations

- Electronic Submissions (RFI, CO and Record Plans)
- Quality Control Plan
- Noise Mitigation Plan
- Waste Management Plan
- Erosion Control and Sedimentation Plan
- Recycling Plan
- Low-emissions Plan (vehicle and site transportation)
- Greenhouse Gases Emission Plan
- Employee Development Plan
- Pavement Management System
- Long Term Efficient Operations Plan

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Case Studies – Two Different Approaches to Matrix Analysis

- Los Angeles International Airport (LAX)
  New Taxiway R
- Calgary International Airport (YYC)
  New Parallel Runway

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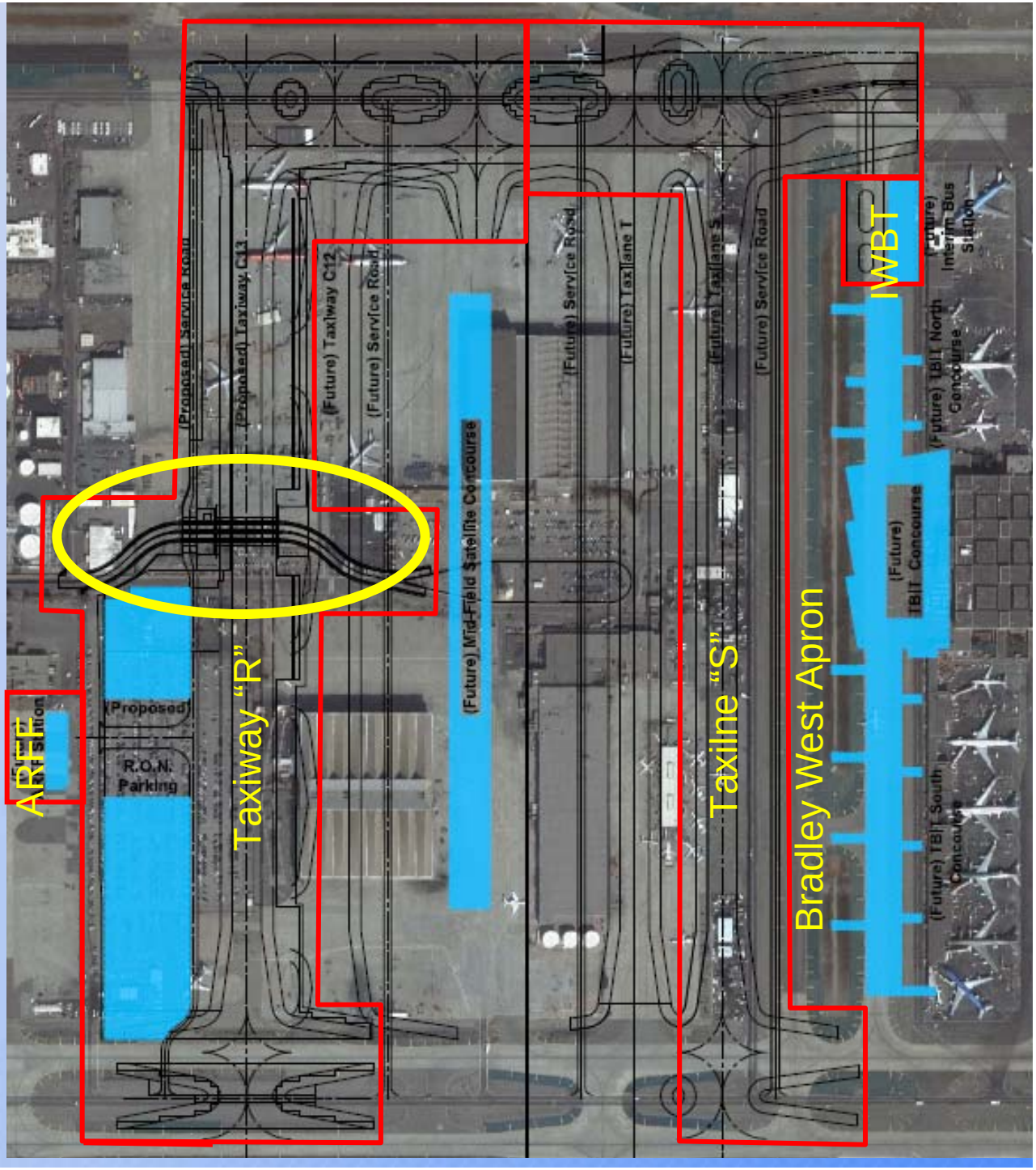
LAX Program (Civil & Building Projects)

Civil Projects:
- Taxiway R
- Taxilane S
- Bradley West Apron

Buildings:
- Aircraft Rescue and Fire Fighting (ARFF)
- Interim West Busing Terminal (IWBT)



LAX Taxiway R Bridge

Los Angeles International Airport

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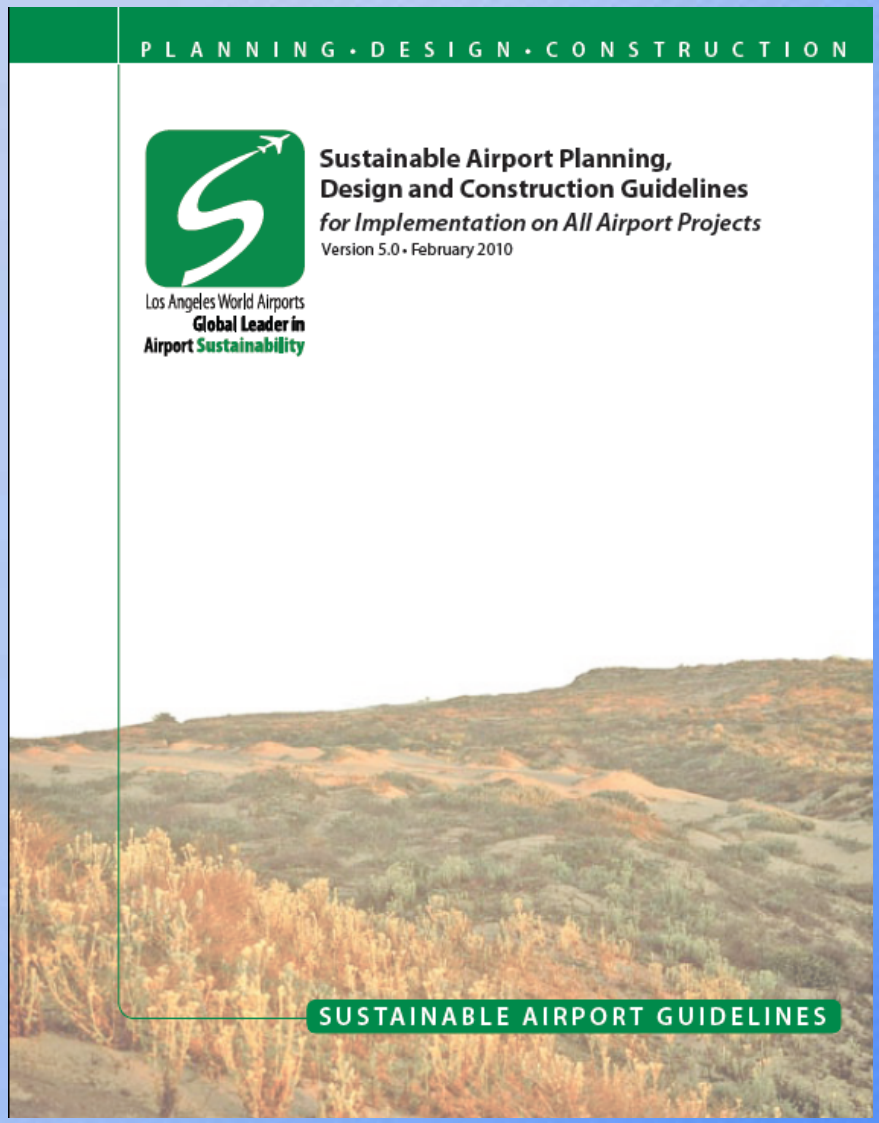
LAWA's Sustainability Program

- LSAG: LAWA's Sustainable Airport Planning, Design and Construction Guidelines (LSAG)
- LSAG outlines sustainability expectations and implementation process
- LSAG creates a channel for stakeholders & engages the design and construction community



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PD1-PI-6 Project Implementation: Engage Stakeholders

INTENT

Engage stakeholders during the planning and design phase so that an open exchange of information, ideas, opportunities and constraints can be identified and considered prior to implementation. Use the knowledge of LAWA construction and maintenance staff, tenant, airline, FAA, USEPA and state representatives to assist in project planning.

ACTIONS & TARGETS

To achieve points, comply with the following:

- Ensure identified stakeholders are active in the initial and regular Project Sustainability Meetings throughout the course of the project; AND
- Make stakeholders aware of available training and materials on sustainability; AND
- Review expectations for the level of sustainability performance for the project during planning, design and construction.

TECHNICAL APPROACHES

- Establish a regular meeting schedule.
- Enable members to utilize conference calls, web-meetings or other electronic meeting tools when unable to attend in person.
- Facilitate meetings in order to ensure agenda items are thoroughly addressed in an efficient manner.
- Utilize visual aids where appropriate to facilitate discussion.
- Utilize project planning and tracking tools to organize documentation and coordinate communication.

POINT ALLOCATION

2 Potential Planning & Design Points

- See Actions & Targets for further breakdown of points.

BENEFITS

- Informs important stakeholders of projects and gains their support to enable project success.
- Gains knowledge from stakeholders to identify opportunities and constraints in planning and design.
- Minimizes Stop Work incidences, Change Orders, redesign needs and other potential design and construction obstacles and setbacks that could potentially increase project costs through the proactive consideration during the planning and design phases.
- Facilitates the permitting processes, including the NEPA and CEQA processes.

DOCUMENTATION

- Attendance list including name, company, department, role on the project and contact information. This may be the same list from PD1-PI-1, Sustainability Planning and Progress Meetings.
- Document the absence of pertinent stakeholders and provide evidence that a separate meeting was held for those stakeholders and/or that meeting notes were distributed with opportunity for input from these members later.

Typical Guideline

- 93 PD
- 48 CN

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Sustainable Checklists - Planning and Design (PD)

8 Checklists -
Max. Points: 190

SUSTAINABLE PLANNING AND DESIGN CHECKLIST

Project Name: _____ Date: _____

☐ Draft Date: _____ ☐ Final (Please sign last page)

Yes	Maybe	No	Possible Points	Number	Performance Standard Title	Notes	Status	Verified (initials)
Project Implementation								
			1	PD1-PI-1	Sustainability Planning and Progress Meetings			
			1	PD1-PI-2	Recycled & Bleach Free Paper			
			1	PD1-PI-3	Double-Sided Printing			
			1	PD1-PI-4	Electronic Submissions			
			1	PD1-PI-5	Electronic Meetings			
			2	PD1-PI-6	Engage Stakeholders			
			7		TOTAL			
General Planning								
			2	PD2-GP-1	Minimize Impervious Area - 25%			
			1	PD2-GP-1	Minimize Impervious Area - 50%			
			2	PD2-GP-2	Avoid Development of Inappropriate Sites			
			3	PD2-GP-3	Contaminated Sites Re-Development			
			3	PD2-GP-4	Community Education			
			2	PD2-GP-5	Site Protection & Restoration			

SUSTAINABLE PLANNING AND DESIGN CHECKLIST

Project Name: _____ Date: _____

☐ Draft Date: _____ ☐ Final (Please sign last page)

Yes	Maybe	No	Possible Points	Number	Performance Standard Title	Notes	Status	Verified (initials)
Social Responsibility - Planning & Design								
			1	PD17-SR-1	Environmental Justice			
			3	PD17-SR-2	Community Partnerships			
			1	PD17-SR-3	Codes of Conduct			
			1	PD17-SR-4	Employee Development			
			1	PD17-SR-5	Sustainable Labor Practice Indicators			
			1	PD17-SR-6	Philanthropy & Social Investments			
			1	PD17-SR-7	Access to Quality Health Care			
			9		TOTAL			
Additional Planning & Design Elements								
			1	PD18-AE-1	LEED Accredited Professional - Planning & Design			
			1	PD18-AE-2	Innovation in Planning & Design			
			1	PD18-AE-2	Innovation in Planning & Design			
			1	PD18-AE-2	Innovation in Planning & Design			
			1	PD18-AE-2	Innovation in Planning & Design			
			5		TOTAL			
			190		GRAND TOTAL			

Goals not captured in existing Performance Standards

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Sustainable Checklists – Construction (CN)

4 Checklists -
Max. Points: 61

SUSTAINABLE CONSTRUCTION CHECKLIST

Project Name: _____ Date: _____

☐ Draft Date: _____ ☐ Final (Please sign last page)

Yes	Maybe	No	Possible Points	Number	Performance Standard Title	Notes	Status	Verified (initials)
Project Logistics								
			1	CN1-PL-1	Develop & Implement Sustainable Construction Training			
			1	CN1-PL-2	Implement a Sustainability Inspection Program			
			1	CN1-PL-3	Construction Scheduling & Sequencing			
			1	CN1-PL-4	Paperless Submittals & Change Orders			
			4		**TOTAL**			
Contractor Sustainability Requirements								
			1	CN2-CS-1	Contractor Sustainability Experience/Performance Requirement			
			1	CN2-CS-2	Designation and Actions of Contractor Sustainability Liasison			
			1	CN2-CS-3	Electronic As-Built Drawing Submittals			
			2	CN2-CS-4	Contractor Public Involvement			
			5		**TOTAL**			

SUSTAINABLE CONSTRUCTION CHECKLIST

Project Name: _____ Date: _____

☐ Draft Date: _____ ☐ Final (Please sign last page)

Yes	Maybe	No	Possible Points	Number	Performance Standard Title	Notes	Status	Verified (initials)
Construction Roadways								
			1	CN15-CR-1	Construction Traffic Control			
			1	CN15-CR-2	Prevent & Repair Roadway Damage During Construction			
			2		**TOTAL**			
Social Responsibility - Construction								
			1	CN16-SR-1	Environmental Accountability			
			1	CN16-SR-2	Codes of Conduct			
			2	CN16-SR-3	Sustainable Employee Development			
			1	CN16-SR-3	Sustainable Employee Development			
			2	CN16-SR-4	Sustainable Workplace			
			1	CN16-SR-4	Sustainable Workplace			
			2	CN16-SR-5	Company Philanthropy & Social Investments			
			1	CN16-SR-6	Promote Use of Local Contractors & Suplliers			
			11		**TOTAL**			
Additional Construction Elements								
			1	PD18-AE-1	LEED Accredited Professional - Construction			
			1	PD18-AE-2	Innovation in Planning & Design			
			1	PD18-AE-2	Innovation in Planning & Design			
			1	PD18-AE-2	Innovation in Planning & Design			
			4		**TOTAL**			
			61		**GRAND TOTAL**			

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LAWA Sustainable Certification Levels (Civil Projects Greater than 1,000 SF)

Planning & Design			
Sustainable Level	Points	Target	Estimate
Sustainable	Min. 70	70	48 + 35
Business Class	Min. 80		
First Class	Min. 100		
Construction			
Sustainable Level	Points	Target	Estimate
Sustainable	Min. 25	25	28
Business Class	Min. 30		
First Class	Min. 35		

If a building project > 1,000 SF,
LEED certification (min. Sliver) replaces PD checklist

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LAX Sustainable PD Points Breakdown (1 of 2)

Checklist Summary	Yes	Maybe
Project Implementation	6	0
General Planning	5	3
Airside Planning	5	6
Landside Planning	0	2
Climate Change Adaptation Planning	0	0
Storm Water Mgmt/Erosion Control	0	4
Landscape Design	0	3
Water Efficiency & Conservation	1	0
Heat Island Reduction	2	0
Interior & Exterior Lighting Quality	0	4
Noise Pollution	0	0

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LAX Sustainable PD Points Breakdown (2 of 2)

Checklist Summary (Continue)	Yes	Maybe
Energy Efficiency and Conservation	3	5
Emission Impacts Evaluation and Mitigation	1	0
Materials and Resources	12	5
Indoor Environmental Quality	0	0
Post Construction Maintenance, Monitoring and Reporting	0	3
Social Responsibility	9	0
Additional Design Elements	4	0
Total Targeted Points	48	35

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Highlights of Sustainability Implementation in LAX

- Reuse 90+% demolition waste. Crushed existing pavement for re-use.
  - allow up to 100% recycled aggregates in mix design of Econocrete base
  - 6” Processed Miscellaneous Base Course
- Setup onsite concrete batch plant to reduce construction traffic for concrete delivery.
- Provide efficient construction access routes to reduce roadway congestion.

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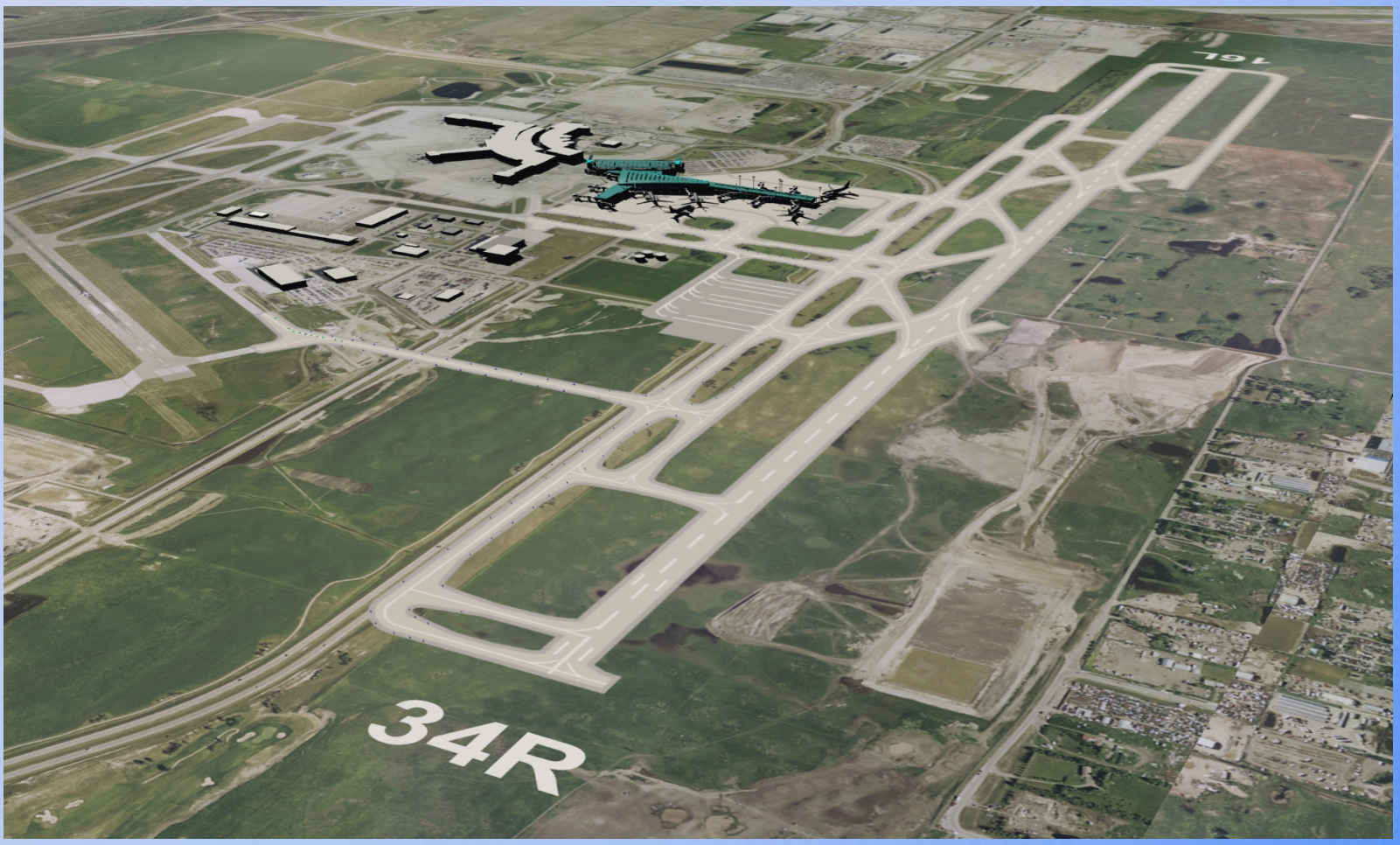
Highlights of Sustainability Implementation in LAX

- Use energy efficient airfield lighting (LED)
- Use regional materials (stimulate local economy; reduce fuel/ cost)
- Use reclaimed greywater for dust suppressant (to conserve potable water)
- Reduce heat island effects
  - Short term: white concrete curing compound
  - Long term: white concrete
- Low-emitting materials (dowel coating, lubricant, curing compounds)

YYC New Parallel Runway (RDP)



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RDP Key Scoping Elements

- $620 million project (excluding AT tunnel)
- 4,267 m (14,000ft) CAT III ICAO Code F runway and taxiways
- 7.5 million m^3 earthworks
- 500,000 m^3 gravels
- 260,000 m^3 concrete (LCC done)
- 5000+ runway, taxiway and approach lights
- In service date May, 2014

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RDP Status - September, 2011

- CM Appointed including own-forces work for pavement structure execution
- All designs completed (except ALCMS, FEC which are performance/design-build)
- All contracts awarded
- Earthworks 40%+ complete
- PCC initial paving this year
- Nav Canada ATCT under construction

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RDP Sustainability Framework

- YYC committed to a self-directed full EA that shadowed the federal CEAA Process
- YYC also defined keys elements of sustainability in 2009 Accountability Report
- Sustainability Workshop held in January 2010 to use YYC Accountability measures and SAGA guidelines to define key sustainability measures for design and construction
- http://www.yyc.com (Comprehensive Study)

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Sustainability Workshop Criteria

Developed Sustainability and Mitigation or Mitigation-by-Design measures

Design/Const - 193

Monitoring - 22

- Soils (22) (4)
- Groundwater (3) (3)
- Vegetation (19) (1)
- Dust Management (10)
- Stormwater Management (20)
- Water Conservation (6)
- Surface Water and Aquatic Resources (2)
- Lighting and Light Pollution Reduction (9)
- Building Design (5)
- Noise Pollution Reduction (1) (1)
- Fuel Reduction (5)
- Paving (7)
- Waste Minimization (12)
- Socio-economic (8) (3)
- Miscellaneous (17)
- Transportation (8) (1)
- Climate and Greenhouse Gases (11) (1)
- Air Quality (16) (1)
- Noise (2) (2)
- Wildlife, Land, Health Monitor (6)

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RDP Matrices and Procedures

- Design and Construction Sustainability Matrices
- Design Matrix was completed and revisited 3 times during design phase to see how points target was being achieved and to push for greater progress through the sustainability monitor on the program management team – more proactive
- Same approach will occur in construction

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RDP Design Matrix - Summary

- Administrative Procedures
  (4 tasks – 15 points)
- Soils
  (6 tasks – 20 points)
- Groundwater
  (2 tasks – 3 points)
- Energy and Atmosphere
  (7 tasks – 17 points)
- Water Efficiency
  (8 tasks – 30 points)
- Noise Pollution Reduction
  (2 tasks – 5 points)
- Materials and Resources
  (11 tasks – 35 points)
- Socio-Economic
  (5 tasks – 10 points)
- Miscellaneous
  (5 tasks – 15 points)

150 Maximum Points

50 Tasks

Design Revisited

Total Points

Revised: 25-Mar-11
Milestone: 100% Design

Mar-11 Points Obtained	Feb-11 Points Obtained	Oct-10 Points Obtained	Possible Points		Category	Responsibility
1.0 ADMINISTRATIVE PROCEDURES						
1.5	1.5	0.5	2	1.1	Green Meetings - Guide meeting hosts, planners and attendees toward more eco-friendly meetings and incorporate environmental considerations into planning and conducting meetings.	All
2.5	2	1	3	1.2	Document Reduction and Recycling Initiative (DRRI) - Reduce the volume of paper used and facilitate the recycling of documents.	All
3	3	0.5	5	1.3	Establish and Adopt a Project Sustainability Policy - Provide opportunity for exceptional performance above the requirements set forth above and/or innovative performance in sustainability not covered in the work plan.	EM
3	3	2.5	5	1.4	Adopt Best Management Practices based on Environmental Assessment and Eco Plan	All
2.0 SOILS						
1.5	1	1	3	2.1	Minimize the duration in which erodible topsoil/subsoils (i.e., medium-textured, silty soils) are exposed and stabilize soil stockpiles exposed for extended periods (> 6 months).	PMT/CM
2.5	2	1	3	2.2	Those areas in the PRP footprint where contingency soils handling measures may be required are clearly marked in advance of construction.	PMT/CM
4	4	4	5	2.3	Consider using a balanced earthwork management plan and keep as much excavated earth on-site as possible to reduce off-site disposal/storage.	PMT/CM
2	2	2	2	2.4	Reduce transport of soils to off site locations and make soils available for reuse on other non-airport projects.	PMT/YYC
4	4	3	5	2.5	Plan to conserve top soil; identify and segregate saline soils.	PMT/CM
2	2	1	2	2.6	Plan to minimize the amount of soil that is disposed of in landfills.	PMT/CM

Revised: 25-Mar-11
Milestone: 100% Design

Mar-11 Points Obtained	Feb-11 Points Obtained	Oct-10 Points Obtained	Possible Points		Category	Responsibility
2	2	1	2	8.1	Delineate the construction site perimeter for safety and security reasons and to prevent disturbance outside the construction area.	PMT
1	1	0	2	8.2	Provide for on-site security, emergency health care and fire services during the construction phase.	PMT/CM
0.5	0.5	0.5	1	8.3	Facilitate possible future transit connections.	PMT/YYC
2	2	1	3	8.4	Provide safe bicycle lanes and paths for access to and from YYC.	PMT/YYC
1	0.5	0	2	8.5	Design aircraft viewing areas and/or construction equipment viewing areas.	YYC
9.0 MISCELLANEOUS						
1	1	1	2	9.1	Limit number of concrete washout areas in the design.	PMT
2	2	2	2	9.2	Locate haul roads so that they can be reused as service roads where possible.	PMT
5	5	4	5	9.3	Design duct-bank systems to reduce future excavation and cabling and use of resources.	PC
1	1	1	3	9.4	Consider trucking schedules to reduce idling time.	PMT
0	0	0	3	9.5	Extend current wildlife deterrent systems to the parallel runway.	PMT

Total Points obtained	Total Points obtained	Total Points obtained	Total Possible Points
112.5	108.5	85.5	150

Meets sustainability goals
Work well developed and underway to achieve sustainability goals
Work initiated and underway, but not complete
Work non initiated and/or not developed

RDP Design Matrix

50 Criteria

150 Points

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RDP Construction Matrix - Summary

- Administrative Procedures
  (5 tasks – 19 points)
- Soils
  (6 tasks – 24 points)
- Groundwater
  (2 tasks – 3 points)
- Energy and Atmosphere
  (5 tasks – 17 points)
- Water Efficiency
  (6 tasks – 20 points)
- Vegetation
  (5 tasks – 13 points)
- Materials and Resources
  (8 tasks – 27 points)
- Wildlife
  (4 tasks – 11 points)
- Miscellaneous
  (6 tasks – 16 points)

150 Maximum Points

47 Tasks

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Construction Revisited

Total Points

Revised: 7-Jul-11
Milestone: 6 months

Points Obtained	Jan-12	Jul-11	Jan-11 Points Obtained	Possible Points		Category	Responsibility
1.0 ADMINISTRATIVE PROCEDURES							
		0.5	0	2	1.1	Green Meetings - Guide meeting hosts, planners and attendees toward more eco-friendly meetings and incorporate environmental considerations into planning and conducting meetings.	All
		1	0	2	1.2	Document Reduction and Recycling Initiative (DRRI) - Reduce the volume of paper used and facilitate the recycling of documents.	All
		0	0	5	1.3	Follow the project Sustainability Policy.	All
		1	0	5	1.4	Implement Best Management Practices	All
		2	1	5	1.5	An Environmental Inspector advises the contractor during construction	All
2.0 SOILS							
		1	0.5	5	2.1	Implement effective erosion control and sediment interception measures.	CM
		1	0	2	2.2	Locate construction lay-down areas and stockpiles on areas that are paved as part of the construction and the stockpiles are separated by a minimum of 3.0 m to avoid potential mixing.	PMT/CM
						...ils and restricting	PMT/CM

Revised: 7-Jul-11
Milestone: 6 months

Points Obtained	Jan-12	Jul-11	Jan-11 Points Obtained	Possible Points		Category	Responsibility
		0	0	1	8.4	Ongoing landscaping and conservation initiatives by the Authority incorporate vegetation species that provide for the future habitat for "At Risk" species or migratory birds.	CM
9.0 MISCELLANEOUS							
		0.5	0	2	9.1	Limit number of concrete washout areas and implement BMP for concrete redi-mix plant sites	CM
		1	0	3	9.2	PRP-specific Emergency Response measures are implemented as part of the ECO Plan.	PC/CM
		1	0	4	9.3	All construction equipment and vehicles used on this project are pre-cleaned using steam or other BMPs prior to deployment on-site.	CM
		1	0	4	9.4	All heavy equipment is regularly inspected for fuel leaks, hydraulic leaks, and other sources of potential soil contaminants. Where possible, biodegradable hydraulic fluids are used.	CM
		1	0	2	9.5	Fuel storage has secondary containment.	CM
		0.5	0	1		Prior to entering within 100 m of a wetland, all equipment and machinery scheduled to work in and/or along the wetland are inspected and found to be clean and free of leaks.	CM

Total Points obtained	Total Points obtained	Total Points obtained	Total Points obtained	Total Possible Points
0	0	58	12.5	150

Meets sustainability goals
Work well developed and underway to achieve sustainability goals
Work initiated and underway, but not complete
Work non initiated and/or not developed

RDP Constn. Matrix

47 Criteria

150 Points

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RDP Initial Construction 2011

New Runway
North End
August 2011

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RDP Initial Construction 2011

New Concrete Batch Plant for PCC Pavement

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RDP Initial Construction 2011

“Miner” used for Rippable Rock 300,000 m^3

7.5 Million m^3 Earthworks – Nothing Leaves Airport Site

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Conclusions -1

- Excellent web sources for airport sustainability guidelines with step-by-step procedures and checklists/matrices.
- Still up to airport to determine what criteria are important for specific project, local site conditions and local stakeholders.
- Developing matrices with important tasks and appropriate weightings excellent way to monitor sustainability progress during design and construction.

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Conclusions - 2

- Pavements are not buildings – no universal equivalent to LEED® rating system at present time. Maybe in next 3-5 years, but will be likely be infrastructure based and not pavement specific.
- One size does not fit all – make sure your matrix fits with your airport's overall sustainability plan. Its **your** sustainability plan and **TBL** rating system.

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Acknowledgements

- Katie Chou Ph.D. P.E. Project Engineer Hatch Mott MacDonald, LAX Office

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- Tom Jacklin, P. Eng. Senior Environmental Engineer, AECOM, Calgary

  (Calgary RDP Case Study)

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HMM . . .
Thank You... Questions?