

Environmental Sustainability in Transportation Infrastructure



Selected Papers from the International
Symposium on Systematic Approaches
to Environmental Sustainability
in Transportation

August 2–5, 2015
Fairbanks, Alaska



Edited by
Jenny Liu, Ph.D., P.E.; Sheng Zhao, Ph.D.;
and Peng Li, Ph.D.



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ON SYSTEMATIC APPROACHES TO ENVIRONMENTAL
SUSTAINABILITY IN TRANSPORTATION

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SPONSORED BY
Center for Environmentally Sustainable Transportation in Cold Climates

The Construction Institute
of the American Society of Civil Engineers

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Frontiers of Structural and Civil Engineering, China

EDITORS
Jenny Liu, Ph.D., P.E.
Sheng Zhao, Ph.D.
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Preface

Environmental stewardship is an important factor to consider during the construction, operations, and preservations of transportation systems. This is particularly true with the more stringent environmental regulations recently developed. *Environmental Sustainability for Transportation Infrastructure* Special Technical Publication (STP) selects 22 papers that represent recent development, practices, and advances to maximize environmental sustainability of transportation infrastructure. These papers cover a wide array of topics under three groups: 1) Managing stormwater runoff through improved monitoring, advanced technology, and pervious concrete (four papers); 2) Reducing environmental impacts during construction, operations, and preservation (10 papers); and 3) Life cycle costing and assessment, energy consumption, and environmental assessment (eight papers).

Two or more reviewers along with the editors evaluated each paper published in this ASCE STP. The authors of the accepted papers have addressed all the reviewers' comments to the satisfaction of the editors. All published papers are eligible for discussion in the *Journal of Materials in Civil Engineering*, and are eligible for ASCE awards.

The papers collected in this publication were presented at the *International Symposium on Systematic Approaches to Environmental Sustainability in Transportation* held in Fairbanks, Alaska, USA from August 2 to 5, 2015. This conference was hosted by the Center for Environmentally Sustainable Transportation in Cold Climates (CESTiCC), Chinese Society of Civil Engineers, and Tongji University, China in collaboration with Environmental UTC Network, International Association of Chinese Infrastructure Professionals, the Infrastructure & Climate Network (ICNet), University of Alaska Fairbanks in USA, University of Kansas in USA, University of Tennessee in USA, and Wuhan Polytechnic University in China. The conference was co-sponsored by ASCE Construction Institute (CI), Transportation Research Board (TRB), and Frontiers of Structural and Civil Engineering in China. The Conference was chaired by Professor Jenny Liu and co-chaired by Professor Hehua Zhu.

We would like to acknowledge the assistance from Donna Dickert of ASCE, and Laura Ciampa and Paul Sgambati of ASCE CI that makes it possible for this high quality peer reviewed STP. The editors are highly indebted to the following individuals who reviewed one or more papers submitted for consideration of publication in this STP:

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Editors:

Sheng Zhao and Jenny Liu, University of Alaska Fairbanks

Peng Li, Chang'an University, China

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Green Stormwater Infrastructure Strategies for Airports: Challenges and Opportunities

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Abstract

Airports urgently need resilient and affordable solutions to address stormwater quantity and quality issues and to promote the triple bottom line of sustainability. Recent years have seen increasing use of green stormwater infrastructure (GSI) strategies at airports. GSI solutions (e.g., bioretention systems, rain gardens, vegetated filter strips, permeable asphalt or concrete pavement, drainage wells, and amended topsoil) are designed to supplement or replace conventional grey infrastructure (e.g., impermeable pavements and curbs, inlets and pipes) that inhibit water filtration or infiltration and related natural treatment and flow attenuation processes. This work aims to provide a brief overview of the GSI strategies for airports, followed by a discussion of challenges and opportunities in balancing airport priorities in environmental, economic, and social values and operational constraints. The airport challenges in implementing GSI strategies mainly include those related to wildlife attraction, climate change, anti-icing/deicing compounds, and land use limitations. This work presents a synthesis of information that can be valuable in assisting airport decision-makers and professionals responsible for managing the stormwater programs and for the planning and project development of conventional grey infrastructure and new green infrastructure related to stormwater management.

INTRODUCTION

Stormwater regulation has evolved over the past 40 years since passage of the Clean Water Act in 1972. Early legislation focused primarily on control of permitting point discharges to navigable waters through the National Pollution Discharge

Elimination System (NPDES). The limited scope of this initial rule addressed only those major manufacturing facilities with discharges that included potential for contaminated stormwater. Variations and amendments to the Clean Water Act continued until U.S. Congress and the Environmental Protection Agency (EPA) both realized the importance of addressing all stormwater discharges. The Water Quality Act of 1987 provided the framework to establish conceptual classifications of stormwater as either municipal or industrial, which allowed for more focused permitting. Today, there are three main categories of regulated stormwater discharges: municipal, industrial, and construction. Many of the day-to-day operations of airports fall under the purview of several NPDES permits. For example, transportation facilities, identified under the Standard Industrial Classification (SIC) code 45, often conduct vehicle maintenance, equipment cleaning, or aircraft deicing operations. These activities meet requirements for one or more categories defined under industrial discharges. Areas of airports that might not be subject to the industrial program may be regulated by the municipal program such as parking lots, access roads, and commercial operations. Other activities might require permits addressing construction discharge. Navigation of the rules and requirements required by airports when addressing stormwater discharge can be difficult. Although water quality across the country has improved appreciably since 1972, challenges still remain. In 2000, water-quality assessments by states indicated that 39 percent of assessed stream miles, 45 percent of assessed acres of lakes, and 51 percent of assessed estuary areas failed to meet criteria for one or more designated uses (USEPA, 2002). The top causes of impairment in assessed stream miles were siltation, nutrients, bacteria, metals (primarily mercury), and oxygen-depleting substances. Pollution from urban and agricultural land that is transported by precipitation and runoff was found to be the leading source of impairment (USEPA, 2002; Selbig et al., 2013).

Airports urgently need resilient and affordable solutions to address stormwater quantity and quality issues and to promote the triple bottom line of sustainability (as shown in Figure 1). Airports are permitted under the Industrial Permitting and must prepare a Stormwater Pollution Prevention Plan (SWPPP) that requires regular monitoring, site inspections and reporting. Additionally, airport drainage design as directed through the FAA Advisory Circular AC No: 150/5320-5D aims to safely and efficiently remove water from airport premises, to aid in safe travel on runways and other surfaces, and to discourage waterfowl and other wildlife. The quick and efficient removal of potentially polluted stormwater from airport facilities conflicts with the USEPA intent to eliminate pollutants from waterways, unless stormwater treatment and management practices are utilized. The ultimate goal is to enhance the environmental sensitivity of the built environment and improve the relationship between the airport infrastructure and its surrounding environment and local community. While green infrastructure presents great opportunities for airports in their stormwater management efforts, the implementation of green infrastructure must consider constraints related to safety and operations (e.g., standing water or risk of wildlife attraction, accessibility issues, restrictions on some facilities in specified runway zones).