

Contents

List of Figures	xii
List of Tables	xiv
Contributor Biographies	xv
Preface	xvi
Acknowledgments	xvii
1. Introduction	1
1.1 Why Is This Book Needed?	1
1.1.1 Pedestrian Safety and the Pedestrian Environment	2
1.1.2 New Technologies	3
1.1.3 Attention from a Broad Range of Stakeholders	4
1.2 Development of This Book	5
1.3 Scope and Structure of This Book	5
2. Lighting 101: Technical Fundamentals	8
2.1 Purpose and Scope of This Chapter	8
2.2 Basic Lighting Concepts and Terms	8
2.2.1 Vision and Lighting	9
2.2.2 Measuring Light Levels and Visibility	10
2.2.3 Luminaires and Other Equipment	12
2.2.4 Light Level Recommended Values	15
2.2.5 Color Rendition	20
2.2.6 Street Environment and Street Trees	21
2.2.7 Vehicle Headlights	21
2.3 Key Reference Documents	22
2.3.1 IES RP-8-18. Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting	22
2.3.2 Transportation Association of Canada Guide for the Design of Roadway Lighting	23
2.3.3 AASHTO Lighting Design Guide	23
2.3.4 FHWA Roadway Lighting Handbook	24
2.3.5 CIE Guidelines and Standards	24
2.3.6 FHWA Midblock Crosswalk Lighting Informational Report	24
2.3.7 IES LP-2-20. Lighting Practice: Designing Quality Lighting for People in Outdoor Environments	24

2.3.8	National Academies' Solid-State Roadway Lighting Design Guide	25
2.4	Legal Responsibility	25
3.	Benefits of Improving Lighting	29
3.1	Purpose and Scope of This Chapter	29
3.2	Duration of Darkness	29
3.3	Traffic Safety	30
3.3.1	Fatalities and Injuries after Dark	30
3.3.2	Reduced Fatalities and Injuries through Enhanced Lighting	31
3.3.3	How Lighting Improvements Complement Other Traffic Safety Measures	34
3.4	Security, Comfort, and Falls Prevention	35
3.4.1	Decreased Actual and Perceived Crime Rates	36
3.4.2	Is Crime Just Being Relocated?	36
3.4.3	Visibility of Tripping and Slipping Hazards	37
3.4.4	Determinants of Reassurance	37
3.5	Sense of Place	38
3.5.1	Historic Identity	38
3.5.2	Place Relationship to Technology	39
3.5.3	Place Relationship to the Natural Environment	40
3.6	Aesthetics and Information	40
3.6.1	Public Art	41
3.6.2	Information	41
3.6.3	Fairs and Festivals	41
3.7	Increased Economic Activity	43
4.	Costs and Potential Adverse Impacts of Lighting	48
4.1	Purpose and Scope of This Chapter	48
4.2	Financial Costs	48
4.2.1	Capital Costs	49
4.2.2	Operations and Maintenance Costs	51
4.2.3	Life Cycle Costs	52
4.3	Energy Use and Greenhouse Gas Impacts	52
4.4	Light Pollution	53
4.4.1	Light Trespass	53
4.4.2	Glare	53
4.4.3	Skyglow	54
4.5	Human Health Impacts of Lighting	55
4.5.1	Melatonin Suppression	56
4.5.2	AMA Recommendation and Visibility Research	56
4.5.3	Other Human Health Impacts	57
4.6	Flora and Fauna Impacts of Light	58
4.7	Fixed Object Hazards	59
4.8	Aesthetics of Poles and Wires	60
4.9	Regulatory Tools for Controlling the Adverse Impacts of Lighting Projects	60