

Contents

Foreword	v
1. Introduction	1
1.1 Introduction	2
1.2 Alluvial Fan Hazards	3
1.3 Playa Lakes	11
1.4 Conclusion	13
References	14
2. Geologic and Hydraulic Concepts of Arid Environments	19
2.1 Introduction	19
2.1.1 Desert landscape formation	20
2.2 Geologic Theories of Formative Processes	21
2.2.1 Catastrophism	21
2.2.2 Gradualism (Uniformitarianism)	21
2.2.3 Integration	22
2.3 Flow Processes	22
2.3.1 Fluvial	22
2.3.2 Hyperconcentrated flows	23
2.4 Soils	26
2.4.1 Soil formation in arid environments	27
2.4.2 Desert pavement	28
2.4.3 Indurated soil layers	30
2.4.4 Vegetation and biologic role in soil development	30

2.5	Runoff, Infiltration Potential, and Transmission Losses . . .	32
2.5.1	Runoff and infiltration potential	32
2.5.2	Channel transmission losses	32
	References	33
3.	Traditional Approaches to Flood Hazard Identification and Mitigation on Alluvial Fans	37
3.1	Introduction	38
3.2	Background	39
3.3	Technical Issues Regarding the Assumptions	41
3.4	Implementation of the Assumptions	47
3.4.1	Understanding the traditional approach	48
3.4.2	Implementation for hazard identification	50
3.5	An Approach to Hazard Mitigation	53
3.6	Conclusion	54
	References	55
4.	New Approaches for Alluvial Fan Flood Hazard	59
4.1	Predicting Alluvial Fan Flooding — Background	59
4.2	FEMA's Three Phase Approach to Alluvial Fan Flood Mapping	62
4.2.1	Identification of fan geomorphology	64
4.2.2	Active versus inactive fan areas	65
4.2.3	100-year flood hazard modeling and mapping	65
4.3	Alluvial Fan Flood Modeling	65
4.3.1	Developing an alluvial fan flood model	66
4.3.2	2-D unsteady alluvial fan model limitations	68
4.3.3	Alluvial fan sediment issues	69
4.4	Important Criteria for Flood Hazard Delineation	75
4.5	Hazard Mapping as a Planning Tool	77
4.6	Flood Damage Mapping	82
4.7	Alluvial Fan Mitigation Measures	82
	References	84
5.	Flood Hazard Mapping Versus Flood Risk Analysis	89
5.1	Risk and Uncertainty of Alluvial Fan Flooding	89
5.1.1	Concepts of flood hazard and flood risk: Hazard \neq risk	90

5.2	Stochastic versus Deterministic Flood Hazard Assessment	92
5.3	Stochastic Methods for Fan Flood Hazards	93
5.3.1	Monte Carlo simulations	94
5.3.2	Probability distributions representing physical fan parameters	95
5.3.3	Random walk algorithm to determine flow paths	97
5.3.4	Alluvial fan flood probability — creating the linkage between the stochastic model and the deterministic model	98
5.3.5	Evolution of the alluvial fan — modeling future conditions	99
5.4	Integrating Alluvial Fan Flood Hazard Mapping and Damage Assessment	100
	References	105
6.	Playa Lake Hazards and Resources	109
6.1	Introduction	109
6.1.1	Historic role of playas in military and civilian use	110
6.2	Inundation of Playas	112
6.2.1	Predicting the depth of inundation on playa lakes	112
6.2.2	Predicting the duration of inundation on playa lakes	114
6.3	Geologic Hazards on Playa Lakebeds	122
6.3.1	Evolution of desiccation cracks on playas	123
6.4	Playas as a Water Resource: Studies in Jordan	124
6.4.1	Azraq basin	125
6.4.2	Playas in the Northeastern Badia	127
6.5	Conclusions	128
	References	129
7.	Needs and Benefits of Co-Operation	133
7.1	Introduction	133
7.2	Identifying the Alluvial Fan Hydrologic Apex	134
7.3	Watershed Delineation	135
7.4	History	136

7.5	Surficial Geology	136
7.6	Paleohydrology	138
7.7	Aggradation and Scour	138
7.8	Climate Change	139
7.9	Planning	139
7.10	Summary	140
	References	141
8.	Meeting the Challenge	143
Case Study #1: Two-Dimensional Hydraulic Modeling for Alluvial Fan Floodplain Hazard Identification		145
8.1	Introduction	145
	8.1.1 Local regulatory framework	147
	8.1.2 Project setting	148
	8.1.3 Hydraulic model development	149
8.2	Hydraulic Model Data and Assumptions	152
	8.2.1 Topography and grid development	152
	8.2.2 Discharge	153
	8.2.3 Precipitation	154
	8.2.4 Infiltration	154
	8.2.5 Manning’s n-values	155
	8.2.6 Boundary conditions	156
	8.2.7 Flow obstruction	157
	8.2.8 Froude number	157
	8.2.9 Computational time step and grid element size	158
8.3	Hydraulic Model Results	159
8.4	Summary and Conclusions	161
	References	162
Case Study #2: Numerical Modeling of the 2005 La Conchita Landslide, Ventura County, California		164
8.5	Introduction	164
8.6	Background, Geology, and Kinematics	166
	8.6.1 Introduction	166
	8.6.2 Historical setting	168

8.6.3	Geologic conditions	169
8.6.4	Vegetation and soils	169
8.6.5	Sedimentology	172
8.6.6	Physical dimensions	173
8.6.7	Velocity	175
8.7	Previous Studies of Debris Flow Behavior	176
8.8	FLO-2D Numerical Modeling	178
8.8.1	Introduction	178
8.8.2	FLO-2D modeling of debris flows	178
8.8.3	Input parameters	180
8.8.4	Model results	185
8.9	Summary	189
	References	189

Case Study #3: Tiger Wash, Western Maricopa County,
 Arizona, USA 192

8.10	Site Description	192
8.10.1	Watershed	192
8.10.2	Geologic setting	194
8.10.3	Surficial geology	195
8.10.4	Channel morphology	198
8.10.5	Outfall	199
8.11	Flood History	200
8.11.1	Gauge record	200
8.11.2	Peak discharge estimates	200
8.11.3	September 26, 1997 flood	201
8.12	Previous Studies	203
8.13	Discussion	204
8.13.1	What is an alluvial fan?	204
8.13.2	What are the key elements of alluvial fan flooding?	207
8.13.3	Alluvial fan boundary delineation	209
8.13.4	Predicting avulsions	210
8.13.5	Importance of infiltration and attenuation	212
8.13.6	Flood hazard delineation	213
8.14	Summary	214
	References	214

9.	Future Directions	217
9.1	Introduction	217
9.2	What We Know — What We Don't Know	218
9.2.1	Education	218
9.2.2	Precipitation and flow data issues	219
9.2.3	Geology and geomorphology	220
9.2.4	Monitoring and modeling	221
9.3	Conclusion	223
	References	223