## **Bibliography**

- Adams, D.S. 1969. Emergency Actions and Disaster Reactions: An Analysis of the Anchorage Public Works Department in the 1964 Alaskan Earthquake. Washington, D.C.: Office of Civil Defense. Office of the Secretary of the Army.
- Agardy, F.J. 1976. The Utility as Target Jour. AWWA, 68:9:466
- Algermissen, S.T., and D. Perkins. 1976. A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States. USGS Open File Rep. 76-146.
- American Society of Civil Engineers, 1992.

  Pressure Pipeline Design for Water
  and Wastewater New York: ASCE,
- American Society of Civil Engineers/American Water Works Association, 1990.

  Water Treatment Plant Design.

  New York, McGraw-Hill.
- American Society of Civil Engineers, Technical Council on Lifeline Earthquake Engineering 1983. Advisory Notes on Lifeline Earthquake Engineering. New York: ASCE.
- ——. 1984. Guidelines for the Seismic Design of Oil and Gas Pipeline Systems. New York, ASCE
- ——. 1991 Guide to Post-Earthquake Investigation of Lifelines. Monograph No. 3. Edited by A.J Schill. New York: ASCE,
- American Water Works Association 1991. ANSI/AWWA C150/A21.50-91 American National Standard for the Thickness Design of Ductile-Iron Pipe. Denver, Colo.: AWWA.
- ——. 1986. ANSI/AWWA D110-86. AWWA Standard for Wire-Wound Circular Prestressed-Concrete Water Tanks, Denver, Colo.: AWWA.
- ———. 1987. ANSI/AWWA D103-87. AWWA Standard for Factory-Coated Bolted Steel Tanks for Water Storage. Denver, Colo.: AWWA.

- Anton, W.F. 1978. A Utility's Preparation for a Major Earthquake. Jour. AWWA, 70 6:311-314.
- Ballantyne, D.B 1993 Water System Earthquake Vulnerability Assessment and Mitigations. US Geological Survey Grant No. 1434-93-6-2328. Federal Way, Wash.: Kennedy/Jenks Consultants
- Berger, B.B., and A.H. Stevenson. 1955. Feasibility of Biological Warfare Against Public Water Supplies Jour. AWWA, 47:2 101.
- Blume, J.A. 1971 Design Control of Earthquake Effects. In *Proc AWWA Annual Conference, Fresno, Calif.* Denver, Colo.: AWWA.
- Burton, I., et al. 1965. The Shores of Megopolis: Coastal Occurrence and Human Adjustment to Flood Hazard. Office of Naval Resources, Contract NONR 4043 (00).
- The California Water Project and Earthquake Engineering 1968. Public Works, 99:11:65
- Carns, K.E., and K.B. Stinson, 1982. Hazardous Material Spills--Are You Ready? Jour. AWWA, 74:5:224.
- Chlorine Institute. 1990. Emergency Response Plans for Chlorine Facilities. Washington, D.C.: Chlorine Institute.
- 1991 Estimating the Area Affected by a Chlorine Release. Washington, D.C.. Chlorine Institute.
- Dower, J.B. 1972. Contingency Planning. Distribution WorldWide, 71:12:13.
- Earthquake Resistance of Rock Fill Dams. 1956. ASCE, 82:SM2:941.
- Eguchi, R.T., L.L. Philipson, M.R. Legg, J.H. Wiggins, and J.E. Slosson. 1981. Earthquake Vulnerability of Water Supply Systems. Lifeline Earthquake Engineering: The Current State of Knowledge 1981 pp. 277-292. New York: ASCE.
- Ellison, T. 1977. Industrial Toxicology Course Notes. The Center for Professional Advancement, N.J.
- Erickson, C.R. 1963. Water Utility Planning for Nuclear Attack. *Jour. AWWA*, 55:10:1237.

- Federal Emergency Management Agency Introduction to Emergency Management, Student Manual (SM 230) Washington, D.C. FEMA
- Introduction to Emergency Management Train-the Trainer (IG 230).
   Washington, D.C.: FEMA.
- Grassie, J.R. 1975 Maintaining Municipal Services During a Strike *Public Works* 106 7:50
- Harmon, JA and HF Ludwig 1964 Recovery and Restoration of Utilities After Nuclear Attack. *Jour. AWWA*, 56:12:1561
- Hartman, I. M., D. Holland, and M. Giddings 1969. Effects of Hurricane Storms on Agriculture. Water Resources Res., 5:3:555-562
- Hazardous Chemical Spill Cleanup. 1979Edited by J.S. Robinson. Park Ridge,N.J.. Noyes Data Corp.
- Indiana State Chamber of Commerce 1970.

  Management and Strikes. Indianapolis, Ind Personnel Labor Relations
  Dept.
- Isenberg, J., and C.E. Taylor 1984 Performance of Water and Sewer Lifeline in the May 2, 1983, Coalinga, California. Earthquake. Lifeline Earthquake Engineering: Performance, Design and Construction, pp. 176–189 New York ASCE.
- Jardine, J.W. 1971. Vandalism. In *Proc.* AWWA Annual Conference. Denver, Colo.: AWWA.
- Jensen, R.G. 1982 Creating the Denver Water Department's Security Program Jour. AWWA, 74:10:508.
- Kachadoorian, R. 1976. Earthquake: Correlation Between Pipeline Damage and Geologic Environment Jour. AWWA, 68:3:165.
- Kockelman, W.J. 1990. Techniques for Reducing Earthquake Hazards—An Introduction. In Proceedings of 4th Annual Workshop on Earthquake Hazards in the Puget Sound and Portland Areas, April 16-19, 1990, Scattle, Wash. Open-File Report 90-703, p. 135
- Lacy, W.J. 1963. Methods of Radioactivity Removal. Jour. AWWA, 55:10:1249
- Larkin, D.G. 1969. Readiness for Earthquake Scismicity Studies Jour. AWWA, 61:8:405

- Louis, L., and C.A. Froman Jr. 1973. Planning and Training—Key to Effective Operations. During a Strike. Jour AWWA, 65 5:326
- Manos, G.C., and R.W. Clough 1984, Dynamic Response Correlation of Cylindrical Tanks. In Lifetine Earthquake Engineering Performance, Design and Construction, pp. 190–211, New York; ASCE.
- Miles, RW 1981 Lifeline Analysis in Waste System Master Planning In Lifeline Earthquake Engineering: The Current State of Knowledge 1981 pp 257–263. New York ASCE.
- National Emergency Training Center, 1987, Earthquake Training and Education: A Collection of Issue Papers, Emmitsburg, Md.: FEMA.
- National Office of Naval Resources. 1964.

  Water Level Changes Produced on the
  Pacific Coasts of the United States
  and Canada by the Alaskan Tsunami
  of 1964. Contract NONR 4873(00).
- National Oil and Hazardous Materials Substances Pollution Contingency Plan. 1971 CEQ, USEPA, CFR Part 1510
- Nazarian, H.N. 1973 Water Well Design for Earthquake-Induced Motions Journal of the Power Division. No. 10176, November 1973. New York: ASCE.
- Neel, J.C. 1971 Plant Security—Vandalism and Riot Damage—The Utility's Point of View In *Proc. AWWA Annual* Conference, Denver, Colo.: AWWA.
- Newmark, N.M. 1967. Problems in Wave Propagation in Soil and Rock. Presented at Intern. Sym. on Wave Propagation and Dynamic Properties of Earth Materials, Albuquerque, N.M.
- Parmalee, R.A. 1973. Investigation of Soil-Structure Interaction of Buried Concrete Pipes. *Highway Res. Record*, 433.
- Petersen, K.E. 1993. Water Storage Tanks: Your Utility's Achilles' Heel? Opflow, 19:4:1.
- Rae, W.R. 1969. Civil-Disorder-Indicator Studies: Some Aspects of Riot Susceptibility. Office of Public Safety, Technical Paper RAC-TP-347.

- Reese, L.C., and H. Matlock, 1968. Structural Damage From Tsunami at Hilo, Hawan Jour Hydraulic Div.—ASCE, 4:961
- Rich, L.G 1973. Environmental Systems Engineering New York: McGraw-Hill.
- Roberts, K. 1969. Planning for Operating During a Strike, Dealing With a Union Amer. Management Assn.
- Rosenthal, C.F. 1969 Phases of Civil Disturbance: Characteristics and Problems. Center for Res. in Social Systems. Washington, D.C: The American University
- Ryckman, D.W., and D.B. Miller. 1977. Case Histories of Emergency Action: Reports From Men on the Firing Line, Presented at AWWA Hazardous Materials Spills Seminar, Anaheim, Calif.
- Ryckman, D.W., and M.D. Ryckman. 1980 Organizing to Cope With Hazardous Material Spills. *Jour. AWWA*, 72 4:196.
- Ryckman, D.W., M.D. Ryckman, and D.B. Miller. 1977. Emergency Action Response for Hazardous Substances. Presented at Amer. Defense Preparedness Assn. Energy Envir Conf., Kansas City, Mo.
- Ryckman, M.D., et al. REACT's Response to Hazardous Material Spills In Proc. AWWA Conference on Control of Hazardous Material Spills, Miami, Fla. Denver, Colo.: AWWA.
- Sakurai, A., and T. Takahashi. 1969.
  Dynamic Stresses of Underground
  Pipelines During Earthquakes In
  Proc. Fourth World Conference on
  Earthquake Engineering, Santiago,
  Chile.
- Seed, H.B., and I.M. Idriss 1982. Ground
  Motions and Soil Liquefaction During
  Earthquakes Oakland, Calif.: Earthquake Engineering Research
  Institute.
- Steinbrugge, K.V. et al. 1971. San Fernando Earthquake, Feb. 9, 1971. San Francisco, Calif.: Pacific Fire Rating Bureau.

- Tagliaferri, L.E. 1972. Plant Operations During a Strike. *Personnel Admini*stration (Mar.-Apr. 1972)
- US Coast Guard. 1974. Chemical Hazards
  Response Information System (CHRIS)
  CG-446. Washington, D.C.: US Coast
  Guard.
- US Department of Commerce 1969. Earthquake Investigation in the USA. C & GS Special Pub 282
- --- . 1970 The Santa Rosa, California, Earthquakes of Oct 1, 1969. Washington, D.C.: US Department of Commerce
- US Department of Defense. 1966 Civil Defense Aspects of Waterworks Operations. Department of Defense, Office of Civil Defense, FG-F 3.6.
- US Environmental Protection Agency 1976 Quality Criteria for Water, EPA 44/9-72-023.
- US Geological Survey—Water Resources Rev. 1956.
- US Task Force on Earthquake Hazard Reduction. 1970. Report: Program Priorities Office of Science and Technology. Exec Ofce. of Pres
- Valcour, H.C 1980 Pumping Station Reliability. How and How Much *Jour*. *AWWA*, 72:4.187
- Von Hake, C.A., and W.K. Cloud. 1968.

  United States Earthquakes 1967.

  Washington, D.C.: US Department of Commerce.
- Washington State Department of Social and Health Services, Water Supply and Waste Section. 1982 Emergency Planning Instructional Guide and Workbook.
- Westgarth, W.C. 1981. Field Management of Hazardous Spills. *Jour. AWWA*, 73.7:350.
- Yokosuka, Japan, Waterworks Bureau. 1992 Providing Against Earthquakes. Video. Federal Way, Wash.: Kennedy/Jenks Consultants.
- Youd, T.L. 1978. Major Cause of Earthquake Damage Is Ground Failure. Civil Engrg., 48:4.

## Index

Note: An  $f_{\ell}$  following a page number refers to a figure.

Access, ensuring, 45, 49, 54	Components
Accounting, disaster recovery, 77	hazard effects on, 3, 17, 19, 27
Administration, 18, 48-50	identifying, 17, 18-19, 30-31, 50, 81
Agencies, coordinating with, 48, 52, 54, 61, 68	status of, 81
	improving, 51
Agency notification, sample, 56f., 64f.	sample, 31, 33–34
Air, contamination of, 21	underground, 8
American Water Works Association	See also Equipment
(AWWA),	Component-specific plans, 77
training by, 85	Computers, 54
Appurtenances	protection for, 41–42, 46
connection with, 43, 48	Consolidations, damage from, 8-9
damage to, 22	Construction accidents, 13
Aqueducts	Contamination, 13, 14
damage to, 46	protecting against, 39–40
retrofitting, 38	sources of, 21
Automatic valves, 47	Contracts, updating, 68
Automation and Instrumentation (AWWA	Control systems, implementing, 47, 48
Manual M2), 27	Cook, John: or Hurricane Hugo, 20
AWWA. See American Water Works	Coordination
Association	importance of, 70, 81
	interagency, 38, 48, 52, 54, 61, 68
Backfill material, 47	Costs, emergency, 77
Backflow, 20, 21	Cross-connection control program, 47
Backup copies, keeping, 49	Cross-training, 38, 61, 85, 86
Batteries, 41, 46, 49	providing, 37, 38
Bear Valley Dam, retrofitting, 39	See also Training
Boil-water orders, 20, 61, 82, 83	Customer information, backup copies of, 49
Buried reservoirs	5 mars - 11 mars - 11 mars - 12 mars
probable damage to, 35	Damage
protecting, 43	assessing, 54, 80, 81
Commercial action 40	mitigation of, 37, 53, 77, 81, 83
Clasing, protecting, 40	structure, 13, 22–23, 24
Charleston Commissioners of Public Works,	Damage report form, sample, $74-76f$ .
emergency preparations by, 53–54	Dams
Check valves, 47	failure of, 9, 23, 29
Chemicals	retrofitting, 38, 39
damaged, 24	Data resources, importance of, 49, 70
protecting, 42–43, 44f., 52	Demand
Chloring Institute 42	anticipating, 30
Chlorine Institute, 43	normal/emergency condition, 30f.
Chlorine leaks, 21, 29, 54	Densification, damage from, 8–9
responding to, 68, 81, 85	Department notification, sample, 64f.
Clarifiers, damage to, 24f., 25f., 34	Design values, appropriate, 45
Cleanup operations, handling, 69	Disaster effects, summary of, 20–24, 27,
Code of Federal Regulations, 38	28f., 77
Collapsed spring-vibration isolator, 41, 42f.	Disasters
Colorado River Aqueduct, water from, 6	human-caused, 2, 3, 5, 13–14, 23
Command/haison groups, 61, 69	natural, 1, 2, 3, 5
Commercial uses, water for, 29	phases of, 80–81
Communications, 18	planning for, 2–3, 5, 37, 77
alternative, 52, 54, 82, 83	See also Emergencies
disruptions in, 24, 27, 49 improving, 21, 48–50, 83	Disaster-specific plans. See Emergency
maintaining, 70, 80	plans
mantaning, 10, 00	Diseases, waterborne, 13, 15f
	Distribution lists, updating, 77

Distribution Network Analysis (AWWA Manual M32), 31	Facility vulnerability analysis form, sample, 71–73f.
Distribution system, 18	Fault rupture, damage from, 7
contamination of, 21	Field investigation groups, 61, 69
failure of, 29	Fire departments, 86
protecting, 46- 48, 53	hazardous materials and, 70
Forthaudre	Fires
Earthquakes damage from, 7–9, 21, 22, 23, 24, 24f.,	damage from, 11-12, 13, 23, 38
27, 38, 46	preparing for, 39, 46, 68, 79
planning for, 3, 5–6, 39, 40–11, 46, 49,	probability/magnitude of, 15f.
53, 68, 79	water for, 29, 30
probable effects from, 6, 15f., 31, 34-35	First aid, courses in, 85
water demand following, 30	Flexibility, providing for, 39, 47
See also Ground shaking	Flocculator clarifiers, damage to, 24f., 25f., 34
Earthquake source regions, 7f.	Flooding
East Bay Municipal Utility District	damage from, 10, 11, 12f., 22, 23, 24, 27
(EBMUD), 39, 46	38, 82
Education. See Training	preparing for, 5, <b>53</b> , <b>68</b>
Electric cabinets, 41	probability/magnitude of, 15f.
Electric power, 18, 24	responding to, 81, 83
alternative, 41, 49, 52	road damage from, 27f.
interruption in, 46, 54	Foundation designs
protecting, 39, 40, 41–42, 80 Elizabethtown Water Company	evaluating, 45
(Elizabethtown, N.J.), emergency	problems with, 8
response by, 82	Congretors 00
Emergencies, 54	Generators, 80
major/minor, 2	ernergency, 41, 42f., 46 Geographic information quaterns (CIS)
preparing for, 1, 79, 80–81	Geographic information systems (GIS) files, 19
responding to, 53	Ground shaking, 24
See also Disasters	damage from, 7, 34
Emergency communication report,	See also Earthquakes
sample, 59 <i>f</i> .	Groundwater
Emergency messages log, 54	contamination of, 13, 21
sample, 61f.	protecting, 38, 39-40
Emergency notifications, 82, 83	
sample, 57–58 <i>f</i> .	Hazardous materials
Emergency Planning and Community	damage from, 13, 21
Right-to-Know Act (1986), 70	reporting, 4, 70
Emergency plans, 20, 37, 86	storing/using, 39, 70
activating, 53–54, 68–70, 82 backup copies of, 49	Hazardous-materials spills, 3, 29 emergency-response plans for, 39, 68–70
costs and scheduling for, 49-50	probability/magnitude of, 15f.
developing, 2–3, 4, 5, 51, 54, 68, 77, 79,	Hazards, 5
81, 85, 87	estimating, 3, 14, 17, 39
elements of, 1, 2, 3, 51–52, 52–54, 61,	Hazard summaries, 17, 52, 68, 77, 81
68-70, 77, 81	listing, 14
types of, 80	sa <b>mple,</b> 15–16 <i>f.</i>
Emergency shelters, water for, 29	Hospitals, water for, 29
Emergency valves, 46	Human-caused disasters, 2, 3
Employees. See Personnel	damage from, 13-14, 23
Equipment	preparing for, 5
damage to, 23–24	Hurricanes
emergency, 82	damage from, 9–10, 10f., 19–20, 21, 22,
maintaining, 42–43, 44f., 70 sample, 33	23, 24, 26f., 27, 38, 49f.
shared use of, 85	preparing for, 3, 5, 53–54, 68 probability/magnitude of, 15f.
Sec also Components	responding to, 53, 80–81
Existing resources, considering, 51	Hydrants, 19
Expansion joints, 47	damage to, 20, 24
- w '	Hygiene, water for, 29
	Hypochlorinator, 11

Injuries, reducing of, 81, 83 Instrumentation, protecting, 41 Instrumentation and Computer Integration of Water Utility Operations (AWWARF and JWWA), 27	Notifications, 61, 82, 83 sample, 55f, 56f., 57-58f., 64f., 67f. Nuclear accidents damage from, 14 probability/magnitude of, 16f.
Insurance companies, working with, 81 Intake structures, protecting, 39 Internal soil piping, damage from, 23	Olive View Hospital, broken pipeline at. 23f.
Isolation valves, 40, 45, 47	OP/NET control system, 46 OSHA See US Occupational Safety
Joints bell-and-spigot type, 48	and Health Agency Overtopping, damage from, 23
expansion, 47 restrained, 48 vulnerability of, 22	Performance goals, establishing, 17, 27, 29-30
, affectionity (1, 22	Personnel
Kauai Electric, hurricane response by,	replacement, 38
80, 81 Kinard, Steve: on Hurricane Hugo, 19–20	responsibilities of, 54, 61, 82 shortages of, 20–21
Laboratories	training for, 37-38, 54, 69, 83, 85-87
	Phenol spills. 20, 69
arrangements with, 70, 85	Pile supports, 47
protecting, 43, 44f. Landslides	Pipes, 19, 33
	buried, 43
damage from, 9, 38	ceiling-supported, 43
maps for, 9	connecting, 40
Leadership, emergency, 69 Lifelines, 2, 27, 54	damage to, 7, 20, 21, 22, 23f., 24, 34, 43
communication with, 49	earthquake-induced forces on, 8f.
interrelationship of, 17, 52	flexibility of, 45
Lightning strikes, protection against, 41, 42	modern, 47, 48
Liquefaction, 21, 47	protecting, 42–43, 46–48, 47f.
damage from, 7–8, 23, 34	redundant, 83
stabilization against, 40	repairing, 48
Los Angeles Department of Water	routing, 47
and Power, 6	stockpiling. 48
and rower, o	Planning for Emergencies (video), 79
McBryde Sugar Company, hurricane	Plans. See Emergency plans
response by, 80–81	Potable water
Manson, Iowa tornado in, 11	availability of, 29
Mass media, communication with, 49	cross-tie sources of, 79
Material safety data sheet (MSDS), 70	emergency, 2, 84f.
Miami-Dade Water and Sewer Authority,	Power lines, broken, 24, 26f.
20-21	Preparedness plans. See Emergency plans
Mitigation, 38-40, 52, 68, 77	Pressure change, 20, 21
costs and benefits of, 3-4, 50, 83	monitoring, 54
employee input for, 38	Pressure relief valves, 19
procedures for, 37, 47	Pressure zones, 19
Motors	Prevention programs, goals of, 52 Priorities
damage to, 21	
protecting, 41	accomplishing, 80 establishing, 61, 83
MSDS. See Material safety data sheet	Priority-service form, sample, 65f., 66f.
National Oceanic and Atmospheric	Process basins, protecting, 44
Administration (NOAA), 80	Process Safety of Highly Hazardous
National Response Center, hazardous	Materials, 38 Public health, water for 29
materials and, 70	Public health, water for, 29
National Weather Service, warnings	Public notifications, 61
from, 53	sample, 55f., 67f. Pumps
Natural disasters, 1, 2	damage to, 21, 22
occurrence/severity of, 3	protecting, 40
preparing for, 5 NOAA. See National Oceanic and	stocking, 80
Atmospheric Administration	submersible, 40
>1	•

Pump stations, 31	Standpipes, 31
probable damage to, 35	damage to, 23, 35
protecting, 40, 46	protecting, 45
Quake Grip-type restraints, 41	State Department of Environmental
quake onpreshe reserantes, 41	Protection (New Jersey), emergency
Radio, communication with, 49, 52, 80	response by, 82
Raritan-Millstone Filter Plant	State emergency-response commission,
(Elizabethtown, N.J.), 82	hazardous materials and, 70
REACT (spill-response group), 69	Storm surges, 20
Recovery, steps for, 79, 81, 83, 85	damage from, 10, 11
Redundancy, providing for, 44, 47, 83	probability/magnitude of, 15f
Relief, funding for, 77	Strikes, damage from, 14
Remote terminal unit (RTU), 46	Structure damage, 13, 22–23, 24
Repair clamps, stocking, 48, 80	Supervisory control and data acquisition
Repairs, 20, 48	(SCADA) system, 54
performing, 83	Supplies
Reservoirs, 18	damage to, 23–24
buried, 35, 43	maintaining, 37, 38, 70, 82
protecting, 39	Support call-up form and list, sample,
Retrolits, 37, 38, 39, 40-45, 43f., 49, 50	62–63f.
Rinconada Water Treatment Plant, 24f.	Surface water
Riots, damage from, 14	contamination of, 13, 14, 21
Risk management, goals of, 3, 52	protecting, 38–39
RTU. See Remote terminal unit	System maps and records, 19, 49
Safe Drinking Water Act (SDWA) (1974),	Tanks
on emergency circumstances, 2	buried, 35, 43
Safety, concern for, 29, 37, 38, 81	chlorine, 24, 34, 37, 43, 43f.
SARA Title III. See Emergency Planning	concrete, 23, 24, 45
and Community Right-to-Know Act	damage to, 6f., 7, 9f., 21, 23, 24, 25f., 34
SCADA system. See Supervisory control	elevated, 23, 45
and data acquisition system	horizontal, 45
SDWA. See Safe Drinking Water Act	monitoring, 54
Security, 41, 45, 49	process, 24, 44
Seiche, damage from, 9	protecting, 45, 45f.
Seismic Risk Committee (ASCE-TCLEE),	retrofitting, 37, 43, 43f., 44, 45
vulnerability analysis by, 31, 33–34	standards for, 45
Service	steel, $6f., 45$
acceptable levels of, 27, 29-30	storage, 7, 9f., 21, 23, 45, 45f.
priorities for, 29	Tank trucks, 30, 84f.
restoring, 2, 53	Telemetry, 27, 41, 54
Settling basins, alternative, 39	protecting, 49
Severe weather	Tornados
damage from, 12	damage from, 10, 11, 19, 22, 24
probability/magnitude of, 15f.	probability/magnitude of, 15f.
warnings for, 53	tracking, 10
Sewer lines	Total system, 17
broken, 22	Training, 4, 54, 69, 83, 85-86, 87
restoring, 53	importance of, 37–38
Shallow cover, 47	See also Cross-training
Sloshing	Transformers
damage from, 24, 24f., 34, 35	damaged, 26f.
measures against, 45	protecting, 41
Slotted casings, 40	Transmission system, 18
Soils, stabilizing, 24, 47	protecting, 38
So the People May Know (AWWA), 61	Transportation system, 18
Source water, 18	damage to, 21, 49
protecting, 38–39	failures in, 13, 23, 27
Sprinkler systems, 20, 29	maintaining, 70
Standard for Welded Steel Tanks for Water	protecting, 48–50
Storage, 34	water systems and, 52

Treatment facilities, 18, 31 portable, 84f. probable damage to, 34 retrofitting, 37, 40-45 Treatment response groups, 61, 69	Vulnerability analysis, 3–4, 19, 27, 52, 68, 81 facility, 77 steps for, 17, 31, 37
Truck crane, damage to, 49f. Tsunami. damage from. 9	Water and Sewerage Committee (ASCE-TCLEE), vulnerability analysis by, 31, 33-34
US Army Corps of Engineers, warnings from, 53 US Geological Survey earthquake data from, 6	Water hammer, damage from, 22 Water requirements, estimating, 29–30 Watersheds contamination of, 21
warnings from, 53 US Occupational Safety and Health Agency (OSHA), hazardous materials list by, 13 Use-reduction orders, 83	monitoring, 38–39 Water supplies degraded quality of, 1, 19, 21 emergency, 39, 83
Valves automatic, 47 check, 47 connection with, 48 damage to, 24 emergency, 46 protecting, 46–48 isolation, 40, 45, 47 location of, 19 pressure-relief, 19 Vandalism damage from, 14 preventing, 41	Water system emergency, notification form for, 55f., 56f.  Water systems air contamination and, 21 damage to, 6 goals of, 29 protecting, 2, 40–41 responsibility for, 2 restoring, 53, 80, 82–83 sample schematic of, 32f. strength/weaknesses of, 17 Water towers, damaged, 1f., 29, 81 Water Treatment Plant Design, 40 Wells, 18
probability/magnitude of, 16f. Velcro restraints, 41 Vibration-isolated bases, 41 Volcanic eruptions, damage from, 12, 38	wells, 18 damage to, 21, 22, 22f, 34 protecting, 38, 39-40 Well screens, 40 Work-order numbering system, emergency, 77