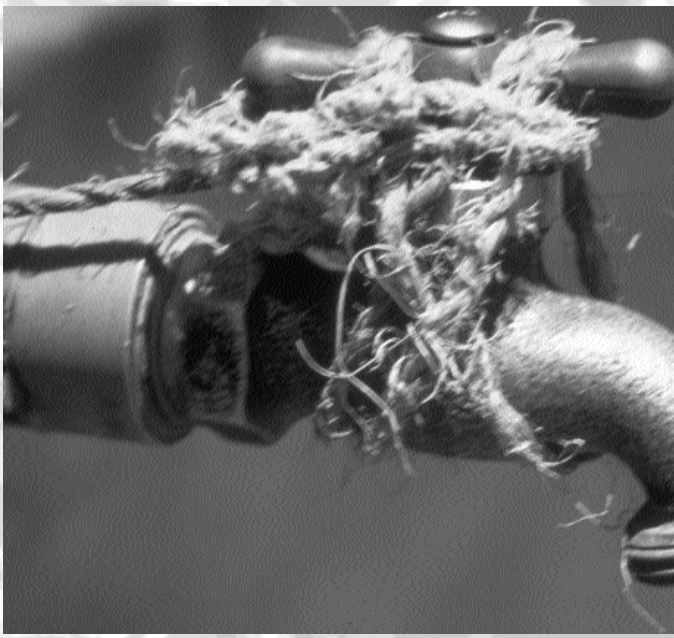


A. Impact Identification Matrix (Water Supply Systems)

Problems and damages	Heavy winds	Heavy rains	Landslides	Earthquakes	Volcanic eruptions Lava and ash	Tsunamis and floods	Manmade
1. Watersheds	Siltation; soil erosion	Uprooting of trees; soil erosion; loss of retention capacity	Uprooting of trees; loss of vegetation; loss of retention capacity	Landslides	Mud flows; fires; ash deposits; destruction of watershed; pollution of water resources; siltation	Saline intrusion and destruction of coastal zone watersheds	Deforestation; siltation; fires; pollution
2. Sources (general)	Power outages; blocked access	Power outages; blocked access	Power outages; blocked access	Power outages; blocked access	Power outages; blocked access	Power outages; blocked access	Power outages; blocked access; contamination
2.1 Springs	Physical damage from windblown debris and falling trees; blockage of screens	Physical damage from floating debris; erosion; blockage of screens	Burying of spring; physical damage to weirs, walls, pipelines	Change of aquifer; loss of source; disappearance of physical structure; cracked retaining box, wall or weir; dislocated pipe; blockage of filters by silt, debris	Change of aquifer; loss of source; physical damage by lava flow	Undermining of structure; physical damage to weirs and pipes by floating debris; blockage of filters by silt, debris, etc.	
2.2 River intakes	Physical damage from windblown debris and falling/uprooted trees; blockage of screens	Physical damage from floating debris; blockage of screens; siltation and filling of reservoir	Redirection of river bed; flow alterations; burying of intake; physical damage to walls, weirs, screens, pipes	Structural damage to weir, filter box; side- or under-cutting by water flow; dislocated or broken outlet pipe(s); valve controls dislocated or misaligned	Physical damage from lava flow and falling rocks; filling with rocks and ashes	Undermining of structure; physical damage to weirs and pipes by floating debris; side scouring of banks; siltation	
2.3 Dams and impoundments	Physical damage from windblown debris and falling/uprooted trees; blockage of screens; wave damage to embankment	Physical damage from windblown and floating debris; blockage of screens; siltation and filling of reservoir; overtopping	Loss of impoundment volume; burying of intake; physical damage to walls, weirs, screens, pipes	Structural damage to weir, filter box, side- or under-cutting by water flow; dislocated or broken outlet pipe(s); valve controls dislocated or misaligned	Physical damage by lava flow and falling rocks; filling with rocks and ashes	Undermining of structure; physical damage to weirs and pipes by floating debris; scouring of banks; overtopping by flood wave; siltation	
2.4 Groundwater well	Physical damage to above-ground structures and equipment from windblown debris and falling trees	Flooding of above-ground pumps, motors and electrical equipment	Burying of well; physical damage to pumps	Shearing of the casing; collapse of casing wall; loss of well	Physical damage by lava flow and falling rocks; collapse of cover by ash load	Flooding of above-ground pump, motors and electrical equipment	

A. Impact Identification Matrix (Water Supply Systems) (continued)

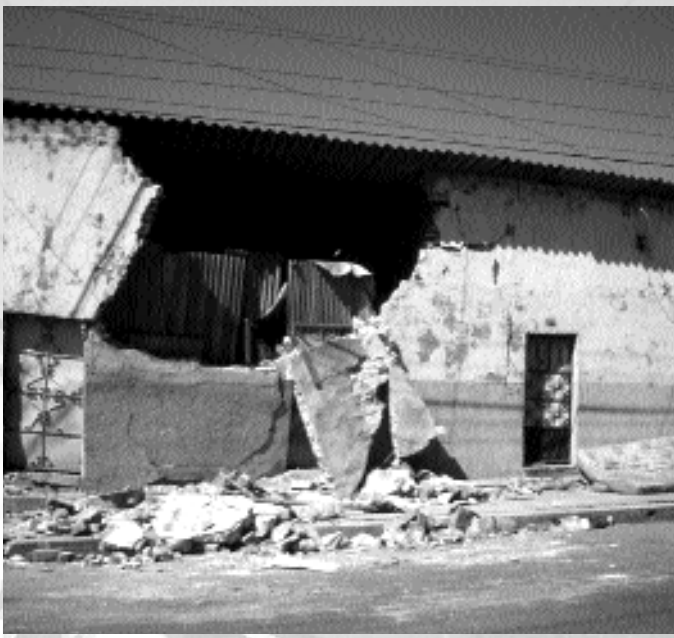
Problems and damages	Heavy winds	Heavy rains	Landslides	Earthquakes	Volcanic eruptions Lava and ash	Tsunamis and floods	Manmade
2.5 Infiltration gallery	Little impact	Little impact	Burying of gallery; physical damage	Physical damage to box/ retaining structure; dislocation of outlet pipes	Physical damage by lava flow and falling rocks	Undermining of structure; physical damage by floating debris to meshing filter and screens; side-scouring of banks; siltation	
3. Trunk (raw and treated)	Breakage of under-ground trunks by uprooting trees; breakage of exposed pipes by falling trees	Breakage and washing away of mains at river crossings and along river beds	Breaks and loss of mains; filling of mains with silt and soil	Breaks of mains	Break and loss of mains	Break and loss of mains	Puncture of mains; thieving of water; vandalism; damage during road excavations
4. Treatment plant	Collapse of structure; roof damage; blockage by debris; power outages	Under-scouring of foundations; collapse of structures; flooding of buildings; short-circuits in electrical systems; fire; power outage	Collapse and/or removal of structure; blockage by debris and mud; power outage	Structural damage; collapse of structures; short-circuiting; fires; water main breaks; water damage; power outage	Structural damage; collapse of structures; short-circuiting; fires; water main breaks; water damage; blockage by lava; power outage	Structural damage; collapse of structures; short-circuiting; fires; water main breaks; water damage; power outage.	Explosions; chlorine gas leaks; power outage
5. Pumping/booster station	Collapse of structure; roof damage; blockage by debris; power outage	Under-scouring of foundations; collapse of structures; flooding of buildings; short-circuits in electrical systems; fire; power outage	Collapse and/or removal of structure; blockage by debris and mud; power outage	Structural damage; collapse of structures; short circuiting; fires; water mains breaks; water damage; power outage	Structural damage; collapse of structures; short circuiting; fires; water mains breaks; water damage; blockage; power outage	Structural damage; collapse of structures; short circuiting; fires; water mains breaks; water damage; power outage	Power outage; explosions; chlorine gas leaks
6. Storage	Collapse of structure; roof damage; breakage of mains from debris	Under-scouring of foundations; collapse of structures; breakage of mains from debris.	Cracking; collapse and/or removal of structure	Structural damage; cracking and/or collapse of structure; breakage of mains	Structural damage; contamination of stored water	Structural damage; removal of structure; breakage of mains	Pollution
7. Distribution	Breakage of pipes by uprooting trees and falling utility poles	Breakage and washing away of pipes	Washing away of pipes	Breakage of pipes	Breakage of pipes	Pollution	Vandalism; accidental damage; pollution

B. Mitigation Identification Matrix (Water Supply Systems)

Problems and damages	Heavy winds	Heavy rains	Landslides	Earthquakes	Volcanic eruptions Lava and ash	Tsunamis and floods	Manmade
1. Watersheds	Prevent deforestation; carry out reforestation	Prevent deforestation; carry out reforestation; contour plowing	Prevent deforestation; carry out reforestation	Prevent deforestation; carry out reforestation	Careful selection of resource watershed	Careful selection of resource watershed regarding flood zones	Prevent deforestation; carry out reforestation; install measures to control fires and pollution
2. Sources (general)	Standby generator; provide all-weather access roads (including for heavy equipment)	Standby generator; provide all-weather access roads, (including for heavy equipment)	Careful siting; prevention of deforestation; standby generator; all-weather access roads (including for heavy equipment)	Careful siting; standby generators	Careful siting	Careful siting; provide all-weather access roads (including for heavy equipment)	Careful siting; increased security
2.1 Springs	Keep site clear of loose debris; cover collection box and channels with protective slabs	Deeper foundations		Construct earthquake proof structures; use flexible joints	Decentralize sources	Deeper foundations	
2.2 River intakes	Install stop-logs upstream; install intake and sediment tank several feet upstream of weir and beside the main channel	Sheet piling under foundation; provide stop-logs; rock-fill river banks; construct rubble masonry wall		Construct earthquake proof structures;use sheet piling; extend wing walls; use flexible joints	Decentralize sources	Sheet piling under foundation; provide stop-logs; rock-fill river banks; construct rubble masonry wall	
2.3 Dams and impoundments	Remove trees from embankment; construct wave-protected embankments	Install stop-log (boom); install sirjet cleaner behind screens; provide parapet wall	Careful siting; prevention of deforestation	Construct earthquake proof structures; use sheet piling; extend wing walls; use flexible joints; develop sloping banks below and above water line; provide parapet wall	Decentralize sources	Construct grout curtain; earth-fill corners; provide stop-logs; rock-fill river banks; construct rubble masonry wall	
2.4 Groundwater well		Raise the pump house; install exterior flood wall or dike		Increase strength of casing by adding liner, if possible	Decentralize sources; know location of alternative well sites	Raise the pump house; install exterior flood wall or dike	

B. Mitigation Identification Matrix (Water Supply Systems) (continued)

Problems and damages	Heavy winds	Heavy rains	Landslides	Earthquakes	Volcanic eruptions Lava and ash	Tsunamis and floods	Manmade
2.5 Infiltration gallery		Install wood shoring or Gabion baskets along the bank, creating a sedimentation area		Construct earthquake proof structures; use flexible pipe joints	Decentralize sources	Construct deeper foundations and wider dams	
3. Trunk (raw and treated)	Lay mains away from trees and utility poles	Bury mains; reduce number of river crossings; affix main at downstream side of bridges; encourage vegetation for slope stabilization	Select main route away from landslide-prone areas; select pipe material suitable for soil conditions; promote vegetation for slope stabilization	Use flexible joints and appropriate pipe material.	Use flexible joints and appropriate pipe material	Use flexible joints and appropriate pipe material	Bury mains; indicate location of mains
4. Treatment plant	Design and construct to withstand high wind speeds; install standby generators	Ensure adequate drainage; install standby generators	Select site away from slide-prone areas	Design and construct to withstand earthquakes. Install standby generators; careful siting; use flexible joints and wall crossings	Careful siting; use flexible pipe joints at wall crossings; install standby generators	Careful siting of plant; adequate drainage; install standby generators	Careful siting; implement adequate safety procedures; install standby generators; increase security and security training of staff
5. Pumping/booster station	Design and construct to withstand high wind speeds; install standby generators	Ensure adequate drainage; install standby generators or use gravity systems	Select site away from slide-prone areas; follow topography	Design and construct to withstand earthquakes; install standby generators; careful siting; use flexible joints and wall crossings	Careful siting; use flexible pipe joints and wall crossings; install standby generators	Careful siting of station; install standby generators	Careful siting; implement adequate safety procedures; install standby generators; increase security
6. Storage reservoirs	Ensure reservoirs are filled during storms and close valves (to be installed if necessary)	Ensure adequate drainage	Select site away from slide-prone areas	Design and construct to withstand earthquakes; careful siting; use flexible joints and wall crossings	Careful siting; use flexible pipe joints and wall crossings; design and construct to carry ash loads	Careful siting of reservoir	Careful siting; increase security; implement adequate safety procedures
7. Distribution	Lay pipes away from trees and utility poles	Bury lines	Careful routing of pipes	Select adequate pipe material; use flexible joints and wall crossings	Select adequate pipe material; use flexible joints and wall crossings	Bury pipes and lay pipes away from trees and utility poles	Bury pipes; indicate location; proper mapping



Annex 2

Forms for damage assessment(*)

Summary

DATE: ____ __ ____ __
dd mm yy

J-1

Water Supply Damage Assessment Form

Name of Surveyor _____ Function/Title _____

Component	Name and Exact Location	Damage Description	Present Capacity %	Needs: Manpower/ Equipment	Estimated Repair (days)	Action Time	Condition of Access Routes
Source							
Collection							
Transmission							
Treatment Plant							
Storage Tanks							
Distribution							

(*) Adapted from *Guidelines for Assisting Caribbean Goverments in the Event of a Disaster*. PAHO/WHO, CPC Barbados, 1999.

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ dd _____ mm _____ yy

J-2

Name of Surveyor _____ Function/Title _____

Name of Lab Technician _____

Sample Point	Nº	Date	Time	pH	Res. Cl_2	Turb.	F. Col.	Color	Odor

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ dd _____ mm _____ yy

J-3	Water Source*

Name of Surveyor _____ Function/Title _____

Name of Water Source _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Type of water source:

Spring ☐ River Intake ☐ Well ☐ Dam ☐ Infiltration Gallery ☐

Other (indicate): _____

Is the source operating normally? (circle one) **YES** **NO**

Flow before disaster _____ l/s Flow after disaster _____ l/s

Describe turbidity/appearance of water:

Describe any blockage of roads	**Describe needs to provide access**

Describe damage to source	**Describe needs to repair damage**

* If water is treated at source, use form for Treatment Plant (J-6)
If water is pumped from source, use form for Pumping Station (J-7)

Damage and Needs Assessment Forms (WATER SUPPLY) Date: ____ ____ ____ dd mm yy

J-4	Storage Tanks

Name of Surveyor _____ Function/Title _____

Name of Water Source _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Type of tank

Steel ☐ Rubber ☐ Concrete ☐ Fiberglass ☐ Underground ☐ Above ground ☐ Elevated ☐

Shape of tank

Square ☐ Round ☐ Conical ☐ Rectangular ☐ Other ☐ Describe _____

Size of tank _____ m^3

At _____ hours (indicate time) the tank is:

Full ☐ 3/4 Full ☐ 1/2 Full ☐ 1/4 Full ☐ Empty ☐

Tank outlet valve present?

No ☐ Yes ☐ Open ☐ Closed ☐

Is tank and/or contents secured against unauthorized users? (check one) YES ☐ NO ☐

Describe any visual indications of damage:	Describe needs pertaining to damage:

Any Other Comments:

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ dd _____ mm _____ yy

J-5	Transmission Lines

Name of Surveyor _____ Function/Title _____

From: _____ To: _____ Diagram No.: _____

Length (m): _____ Diameter: (mm): _____ Type: _____ Nominal Pressure: _____

No. of stream crossings: _____ No. of crossings damaged: _____

Access:

Track ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Describe damage to lines:

Location	Damages	Access	Urgent Action

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ dd _____ mm _____ yy

J-6	Treatment Plant

Name of Surveyor _____ Function/Title _____

Name of Treatment Plant _____

Name of Plant Supervisor _____ Tel: _____

Name of Plant Operator _____ Tel: _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Main Treatment Process

Coagulation/Flocculation		Roughing filter	
Rapid sand filter		Disinfection	
Slow sand filter		Reservoirs	

Other, please indicate: _____

Is Treatment Plant operating normally? (check one) YES ☐ NO ☐

Capacity before disaster: _____ l/s Capacity after disaster: _____ l/s

Flow at entrance to plant before disaster: _____ l/s Flow at entrance to plant after disaster: _____ l/s

Describe turbidity/appearance of:

Incoming water	Treated water

Power Supply

	Yes		No		Yes		No
Mains		(kVA)		Standby		(kVA)	

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ – _____ – _____
dd mm yy

J-6	Treatment Plant (continued)

Describe damages to power supply:

Mains	
Transformer	
Standby	
Controls	

Describe needs pertaining to damages to power supply:

Describe general condition of treatment plant:

Describe any structural damage:	Describe needs pertaining to structural damage:

Describe condition of laboratory:

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ dd _____ mm _____ yy

J-6	Treatment Plant (continued)

Describe any damages to equipment (air valves, piping, pressure tanks, dosing equipment, flow and level recorders, pressure gauges, washouts, etc.)

Equipment damaged	Needs

Indicate what chemicals are available and/or needed

Chemicals or reagents	Quantity Available	Quantity Needed

Any Other Comments:

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: ____ dd __ ____ mm __ ____ yy

J-7	**Pumping and Booster Station**

Name of Surveyor: _____ Function/Title _____

Name of Water Source: _____ Area: _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Pumps	Type of pump(s)				Pump specifications				
	Submersible	Ram Pump	Multi-stage	Other	Volts	Amps	Cycles (Hz)	Speed (RPM)	Brand Name
1									
2									
3									
4									
5									

Power Supply

	Yes	(kVA)	No
Mains			

	Yes	(kVA)	No
Standby			

Describe Damages to Power Supply

Mains	
Standby	
Transformer	
Controls	

Describe any structural damage:

Describe needs pertaining to structural damage:

Describe any damages to equipment (pumps, valves, air valves, washouts, surge tanks, piping, flow recorders, pressure gauges, etc.)

Damage and Needs Assessment Forms (WATER SUPPLY)

DATE: _____ _____ _____
dd mm yy

J-7	Pumping and Booster Station (continued)

Equipment damaged	Needs

Any Other Comments:

Summary

DATE: ____ __ ____ __ ____
dd mm yy

J-8	Water Supply Compilation Sheet

Name of Surveyor _____ Function/Title _____

Community	% of Capacity Remaining	Urgent Needs < 1 week	Medium-Term Needs > 1 week

Damage and Needs Assessment Forms (SEWERAGE)

DATE: ____ – ____ – ____
dd mm yy

J-9	**Distribution System**

Name of Surveyor: _____ Function/Title: _____

Name of Water Source: _____ Area: _____ Population served: _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Location	Pipe		Nature of Damage	Access
	Size	Type		

DATE: _____ _____ _____
dd mm yy

J-10	Sewage Treatment Plant

Name of Surveryor _____ Function/Title _____

Name of Treatment Plant _____

Name of Plant Supervisor _____ Tel: _____

Name of Plant Operator _____ Tel: _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Main Treatment Process

Ponds		Oxidation ditch	
Trickling filters		Extended aeration	
Activated sludge		Anaerobic digestion	

Other, please indicate: _____

Is Treatment Plant operating normally? (check one) YES ☐ NO ☐

Capacity before disaster: _____ l/s Capacity after disaster: _____ l/s

Flow at entrance to plant before disaster: _____ l/s Flow at entrance to plant after disaster: _____ l/s

Describe turbidity/appearance of:

Incoming residual water	Treated residual water

Power Supply

	Yes	(kVA)	No
Mains			

	Yes	(kVA)	No
Standby			

Damage and Needs Assessment Forms (SEWERAGE)

DATE: _____ – _____ – _____
dd mm yy

J-10	Sewage Treatment Plant (continued)

Describe damages to power supply:

Mains	
Standby	
Transformer	
Controls	

Describe needs pertaining to damages to power supply:

Describe general condition of treatment plant:

Describe any structural damage:

Describe needs pertaining to structural damage:

Describe condition of laboratory:

DATE: _____ _____ _____
dd mm yy

J-10	Sewage Treatment Plant (continued)

Describe any damages to equipment (blowers, pumps, valves, piping, pressure tanks, dosing equipment, flow recorders, skimmers, grit removers, laboratory, etc.)

Equipment damaged	Needs

Indicate what chemicals are available and/or needed

Chemical or reagent	Quantity Available	Quantity Needed

Any Other Comments:

Damage and Needs Assessment Forms (SEWERAGE)

DATE: _____ dd _____ mm _____ yy

J-11	Sewer Systems

Name of Surveyor: _____ Function/Title: _____

Location: _____

Access:

Truck ☐ 4WD-Jeep ☐ Car ☐ Foot ☐ Boat ☐ Air ☐ No Access ☐

Location	Pipe		Nature of Damage	Access
	Size	Type		

Damage and Needs Assessment Forms (SEWERAGE)

DATE: ____ __ ____ __ ____
dd mm yy

J-12	**Sewerage Compilation Sheet**

Name of Surveyor _____ Function/Title _____

Community	% of Capacity Remaining	Urgent Needs < 1 week	Medium-Term Needs > 1 week