Annex D

Water Quality Assessment - Supporting Information

Annex D1

Water Quality Objectives

Table D1a *Water Quality Objectives for the Western Buffer WCZ*

	Water Quality Objective	Part or parts of Zone
A.	AESTHETIC APPEARANCE	
	a) There should be no objectionable odours or discolouration of the water	Whole zone
	b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	d) There should be no recognisable sewage-derived debris.	Whole zone
	e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	f) The water should not contain substances which settle to form objectionable deposits.	Whole zone
B.	BACTERIA	
	a) The level of Escherichia coli should not exceed 610 per 100 ml, calculated as the geometric mean of all samples collected in a calendar year.	Secondary contact Recreation Subzones Fish culture Subzones
	b) The level of Escherichia coli should not exceed 180 per 100 ml, calculated as the geometric mean of all samples collected from March to October inclusive in 1 calendar year. Samples should be taken at least 3 times in 1 calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
	c) The level of Escherichia coli should be less than 1 per 100 ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Water Gathering Ground Subzones
	d) The level of Escherichia coli should not exceed 1,000 per 100 ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Other inland waters
C.	COLOUR	
	a) Human activity should not cause the colour of water to exceed 30 Hazen units.	Water Gathering Ground Subzones
	b) Human activity should not cause the colour of water to exceed 50 Hazen units.	Other inland waters
D.	DISSOLVED OXYGEN	
	a) The level of dissolved oxygen should not fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters excepting Fish Culture Subzones
	b) The level of dissolved oxygen should not be less than 5 mg per litre for 90% of the sampling occasions during the year; values should be calculated as water column	Fish Culture Subzones.

Water Quality Objective	Part or parts of Zone
average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	
c) The level of dissolved oxygen should not be less than 4 mg per litre.	Water Gathering Ground Subzones and other inland waters
E. pH	
a) The pH of the water should be within the range of 6.5 - 8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters
b) Human activity should not cause the pH of the water exceed the range of 6.5 - 8.5 units.	Water Gathering Ground Subzones.
c) Human activity should not cause the pH of the water to exceed the range of 6.0 - 9.0 units.	Other inland waters.
F. TEMPERATURE Human activity should not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G. SALINITY Human activity should not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. SUSPENDED SOLIDS	
a) Human activity should neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
b) Human activity should not cause the annual median of suspended solids to exceed 20 mg per litre.	Water Gathering Ground Subzones
c) Human activity should not cause the annual median of suspended solids to exceed 25 mg per litre.	Other inland waters
I. AMMONIA The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J. NUTRIENTS	
a) Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
K. 5-DAY BIOCHEMICAL OXYGEN DEMAND	
a) The 5-day biochemical oxygen demand should not exceed 3 mg per litre.	Water Gathering Ground Subzones
b) The 5-day biochemical oxygen demand should not exceed 5 mg per litre.	Other inland waters

Water Quality Objective	Part or parts of Zone
L. CHEMICAL OXYGEN DEMAND	
a) The chemical oxygen demand should not exceed 15 mg per litre.	Water Gathering Ground Subzones
b) The chemical oxygen demand should not exceed 30 mg per litre.	Other inland waters
M. TOXIC SUBSTANCES	
a) Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole zone
b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone
N. TURBIDITY	
Waste discharges should not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Table D1b *Water Quality Objectives for the Southern WCZ*

	Water Quality Objective	Part or parts of Zone
A.	AESTHETIC APPEARANCE	
	a) There should be no objectionable odours or discolouration of the water	Whole zone
	b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	d) There should be no recognisable sewage-derived debris.	Whole zone
	e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	f) The water should not contain substances which settle to form objectionable deposits.	Whole zone
B.	BACTERIA	
	a) The level of Escherichia coli should be less than 1 per 100 ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Water Gathering Ground Subzones
	b) The level of Escherichia coli should not exceed 1,000 per 100 ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Other inland waters
	c) The level of Escherichia coli should not exceed 610 per 100 ml.	Secondary contact Recreation Subzones Fish culture Subzones
	d) The level of Escherichia coli should not exceed 180 per 100 ml.	Bathing Beach Subzones
C.	COLOUR	
	Human activity should not cause the colour of water to exceed 30 Hazen units.	Whole zone
D.	DISSOLVED OXYGEN	
	a) The level of dissolved oxygen should not fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters excepting Fish Culture Subzones
	b) The level of dissolved oxygen should not be less than 5 mg per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Fish Culture Subzones

	Water Quality Objective	Part or parts of Zone
	c) The level of dissolved oxygen should not be less than 4 mg per litre.	Inland waters
E.	pH	
	a) The pH of the water should be within the range of 6.5 - 8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters
	b) Human activity should not cause the pH of the water to exceed the range of 6.5 - 8.5 units.	Water Gathering Ground subzones
	c) Human activity should not cause the pH of the water to exceed the range of 6.0 - 9.0 units.	Other Inland Waters
	d) The pH of the water should be within the range of 6.0 - 9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH to be extended by more than 0.5 unit.	Bathing Beach Subzones
F.	TEMPERATURE	
	Human activity should not cause the natural daily temperature range to change by more than 2.0 °C.	Whole zone
G.	SALINITY	
	Human activity should not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H.	SUSPENDED SOLIDS	
	a) Human activity should neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
	b) Human activity should not cause the annual median of suspended solids to exceed 20 mg per litre.	Water gathering Ground Subzones
	c) Human activity should not cause the annual median of suspended solids to exceed 25 mg per litre.	Other Inland Waters
I.	AMMONIA	
	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J.	NUTRIENTS	
	a) Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Whole zone
	b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.1 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
K.	5-DAY BIOCHEMICAL OXYGEN DEMAND	
	a) The 5-day biochemical oxygen demand should not exceed 3 mg per litre.	Water gathering Ground Subzones
	b) The 5-day biochemical oxygen demand should not exceed 5 mg per litre.	Other inland waters
L.	CHEMICAL OXYGEN DEMAND	

	Water Quality Objective	Part or parts of Zone
	a) The chemical oxygen demand should not exceed 30 mg per litre.	Water gathering Ground Subzones
	b) The chemical oxygen demand should not exceed 30 mg per litre.	Other inland waters
M.	TOXIC SUBSTANCES	
	a) Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole zone
	b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Table D1c *Water Quality Objectives for the North Western WCZ*

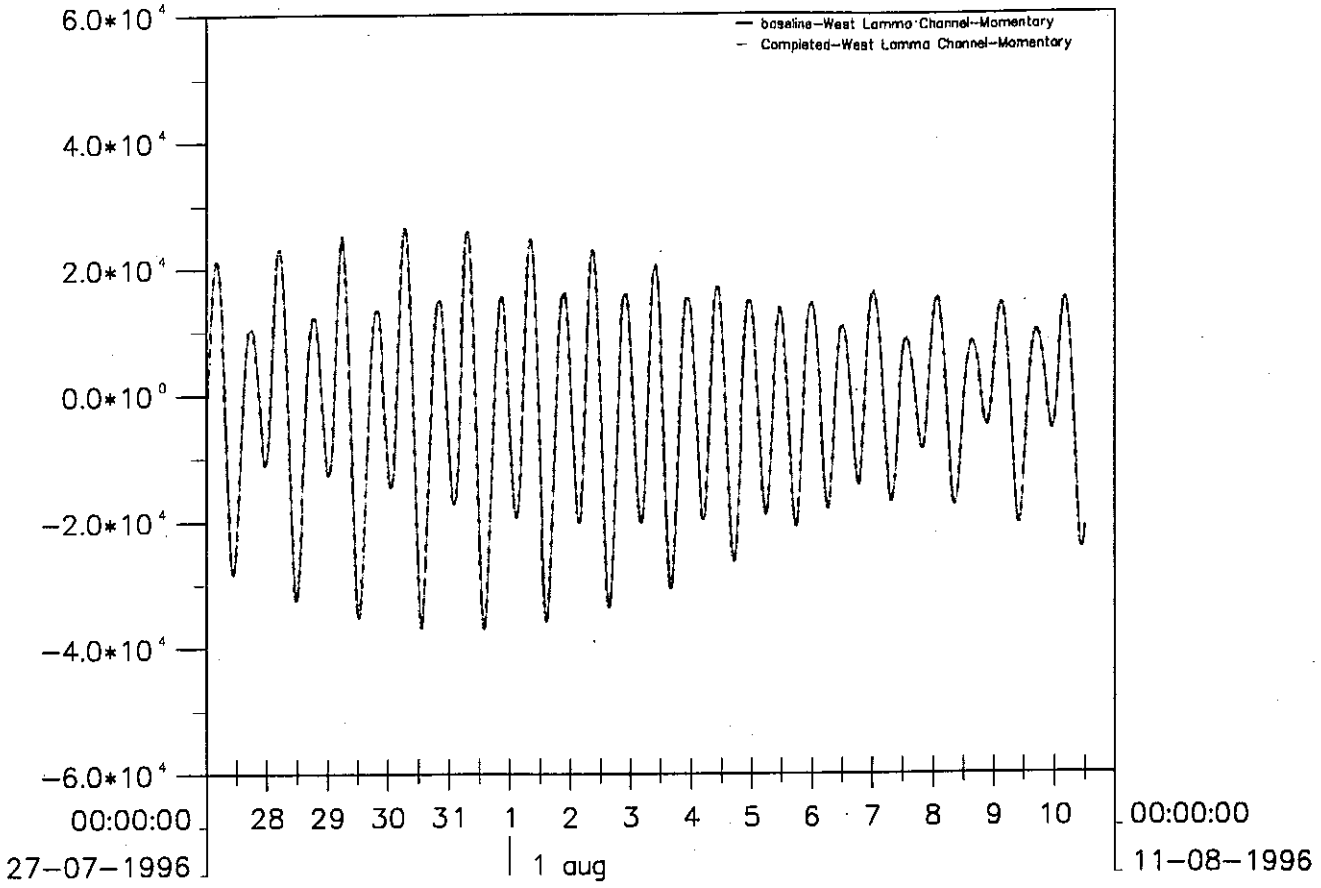
	Water Quality Objective	Part or Parts of Zone
A.	AESTHETIC APPEARANCE	
	a) Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole zone
	b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	d) There should be no recognisable sewage-derived debris.	Whole zone
	e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B.	BACTERIA	
	a) The level of Escherichia coli should not exceed 610 per 100 ml, calculated as the geometric mean of all samples collected in a calendar year.	Secondary contact Recreation Subzones
	b) The level of Escherichia coli should be less than 1 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
	c) The level of Escherichia coli should be less than 1000 per 100 ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzone and other inland waters
	d) The level of Escherichia coli should not exceed 180 per 100 ml, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C.	COLOUR	
	a) Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
	b) Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters
D.	DISSOLVED OXYGEN	
	a) Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters

Water Quality Objective	Part or Parts of Zone
b) Waste discharges shall not cause the level of dissolved oxygen to be less than 4 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water gathering Ground Subzones and other inland waters
E. pH	
a) The pH of the water should be within the range of 6.5 - 8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters excepting Bathing Beach Subzones
b) Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
c) The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
d) The pH of the water should be within the range of 6.0-9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Bathing Beach Subzones
F. TEMPERATURE Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G. SALINITY Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. SUSPENDED SOLIDS	
a) Waste discharges shall neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
b) Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
c) Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg per litre.	Other inland waters
I. AMMONIA The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J. NUTRIENTS	
a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below	Castle Peak Bay Subzone

Water Quality Objective	Part or Parts of Zone
surface, mid-depth and 1 m above seabed).	
c) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed)	Marine waters excepting Castle Peak Bay Subzone
K. 5-DAY BIOCHEMICAL OXYGEN DEMAND	
a) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
b) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 mg per litre.	Other inland waters
L. CHEMICAL OXYGEN DEMAND	
a) Waste discharges shall not cause the chemical oxygen demand to exceed 15 mg per litre	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
b) Waste discharges shall not cause the chemical oxygen demand to exceed 30 mg per litre.	Other inland waters
M. TOXINS	
Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions wit each other.	Whole zone
Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Whol zone
N. PHENOL	
Phenols shall not present in such quantities as to produce a specific odour, or in concentration greater than 0.05 mg per litre as C_6H_5OH.	Bathing Beach Subzones
O. TURBIDITY	
Waste discharges shall not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Annex D2

Hydrodynamic Modelling Results



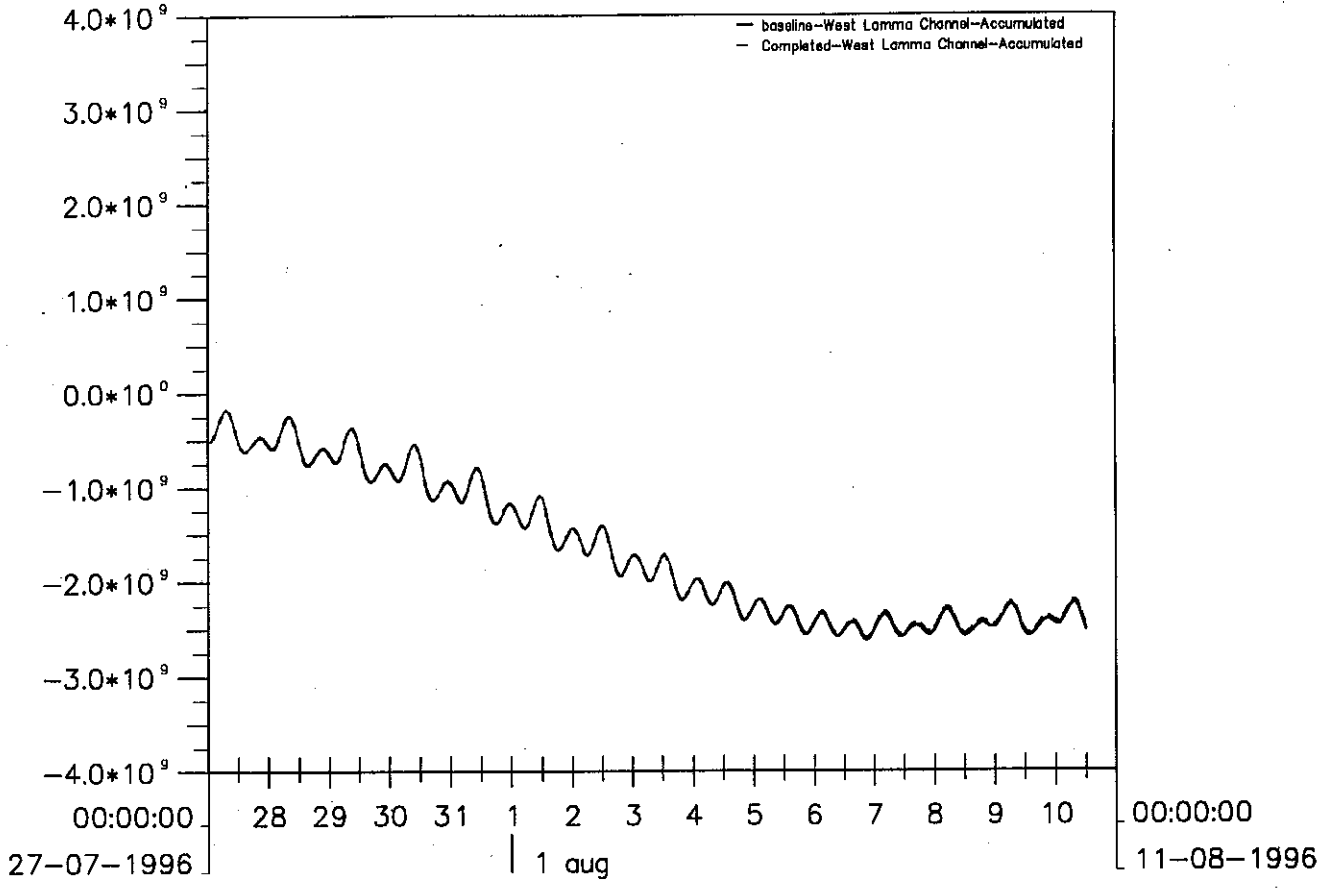


Figure D2a Momentary and Accumulated Discharges through West Lamma Channel - Wet Season

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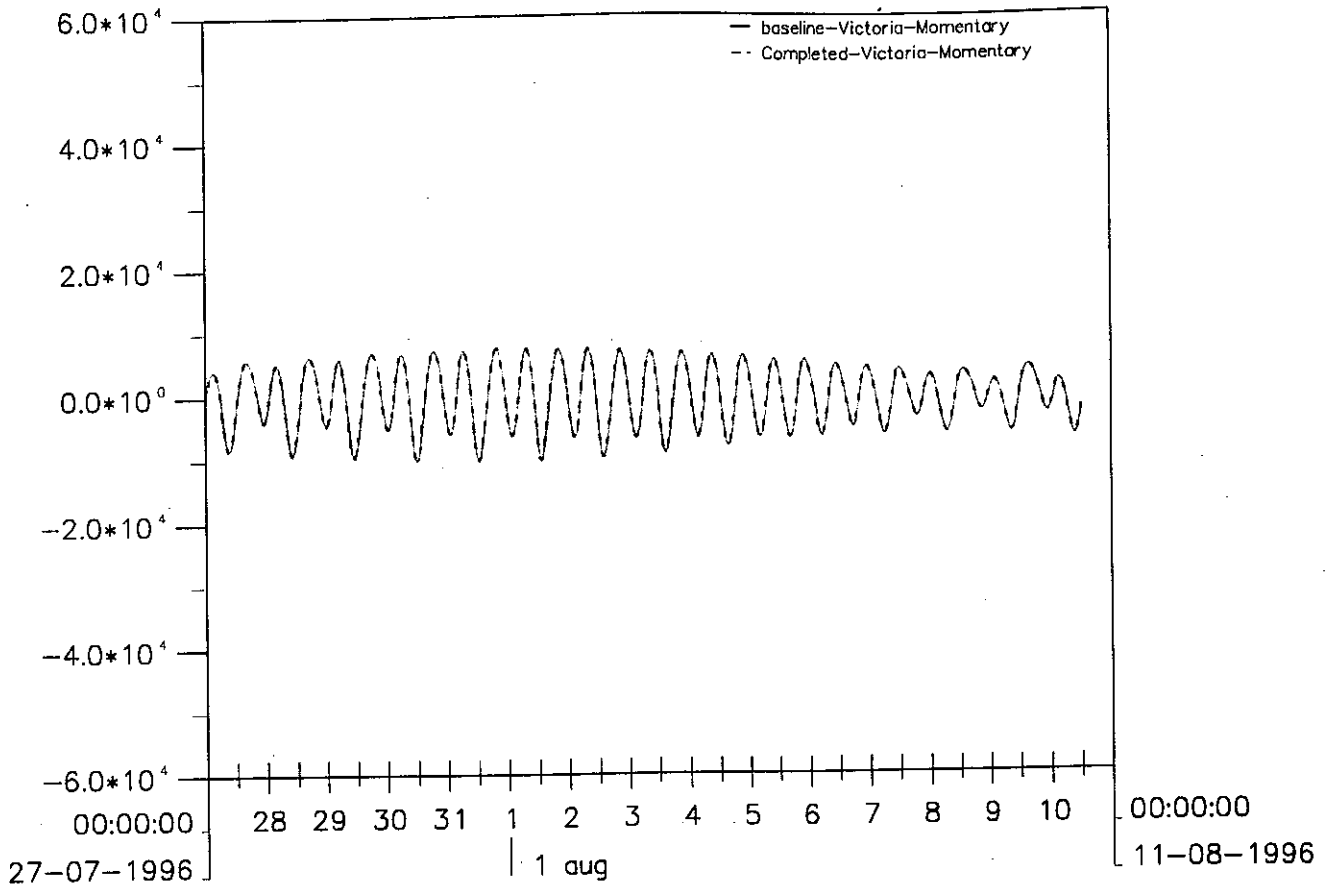

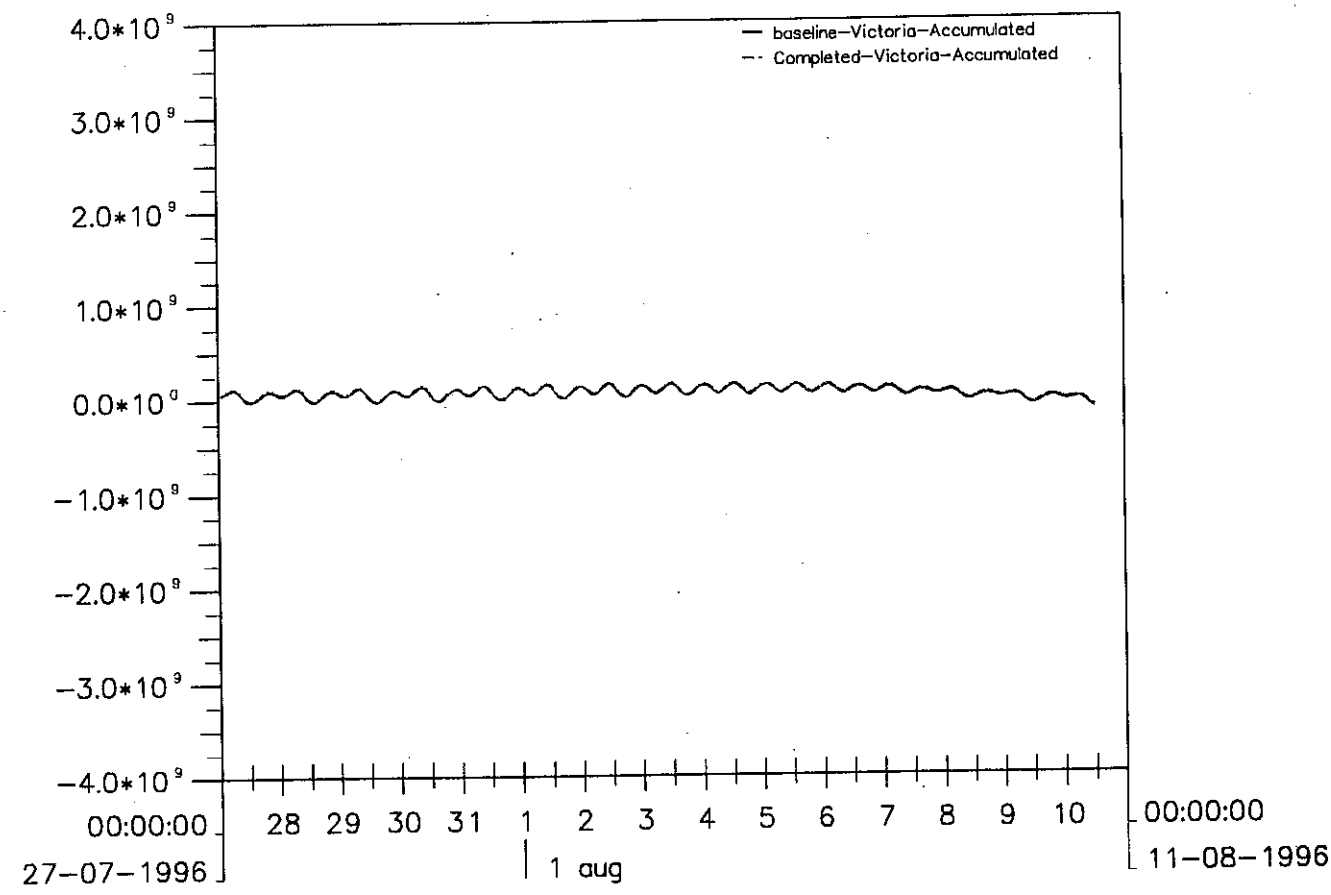

Figure D2b Momentary and Accumulated Discharges through Victoria Harbour - Wet Season

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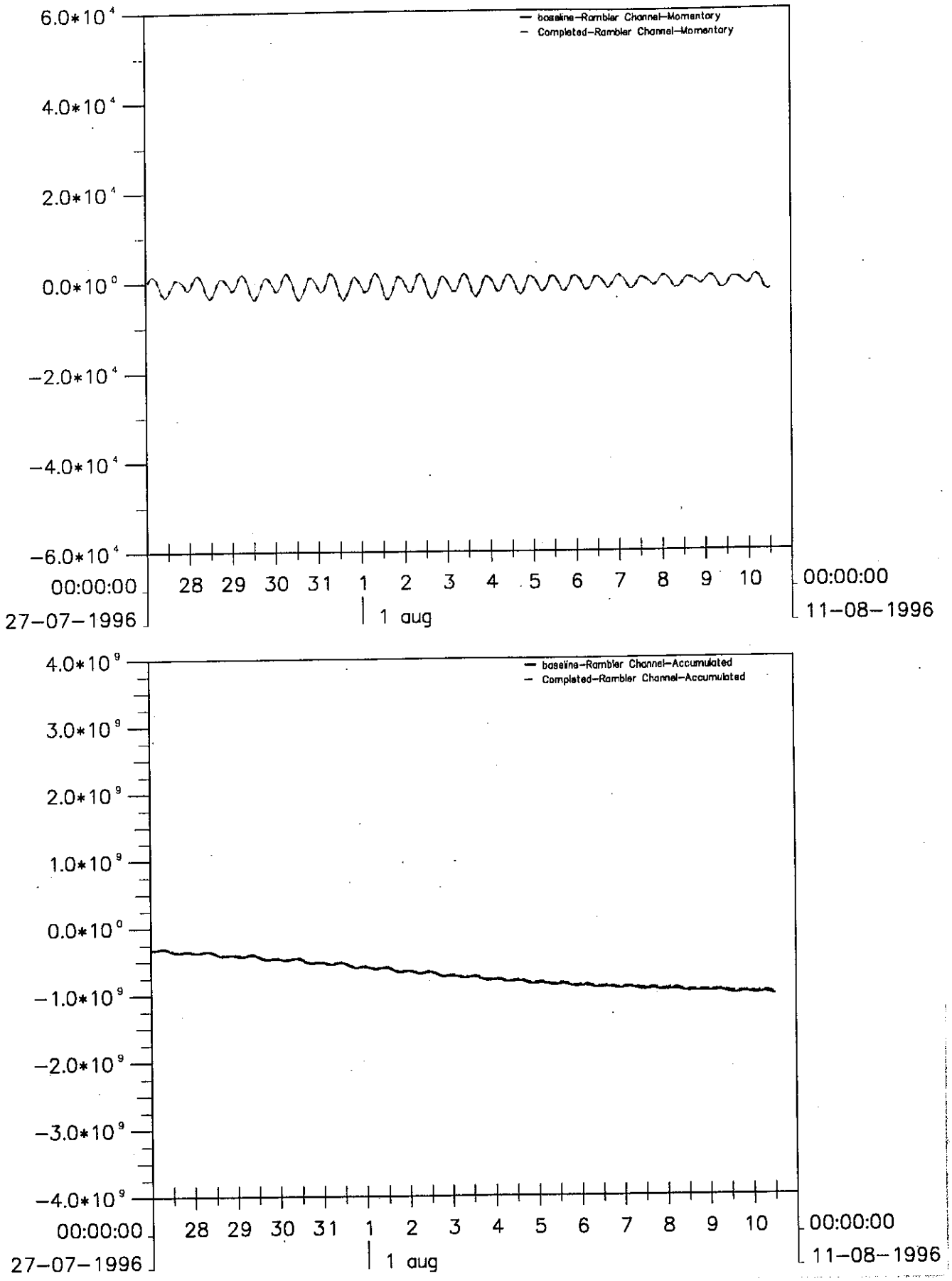

Figure D2c Momentary and Accumulated Discharges through Rambler Channel - Wet Season

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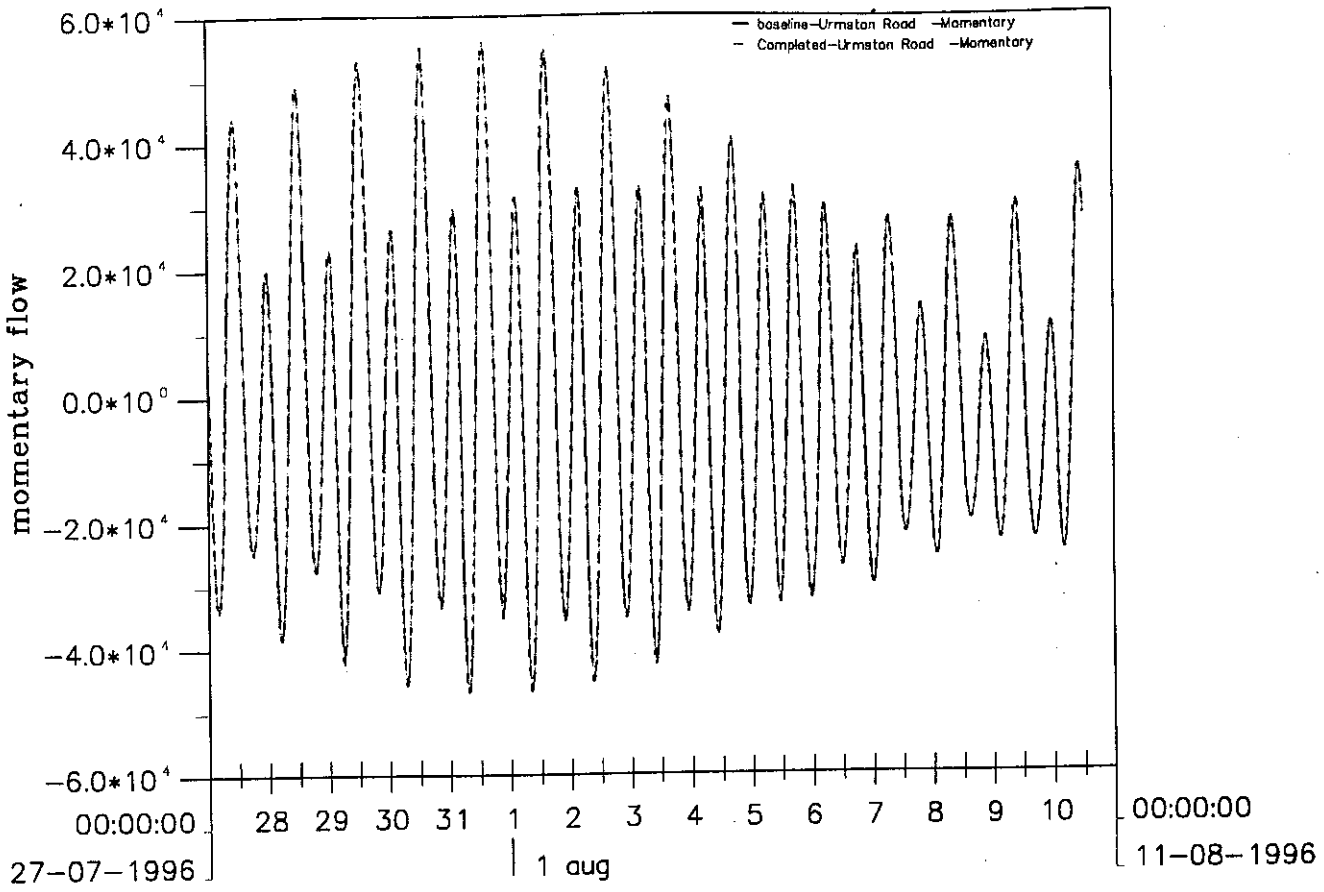

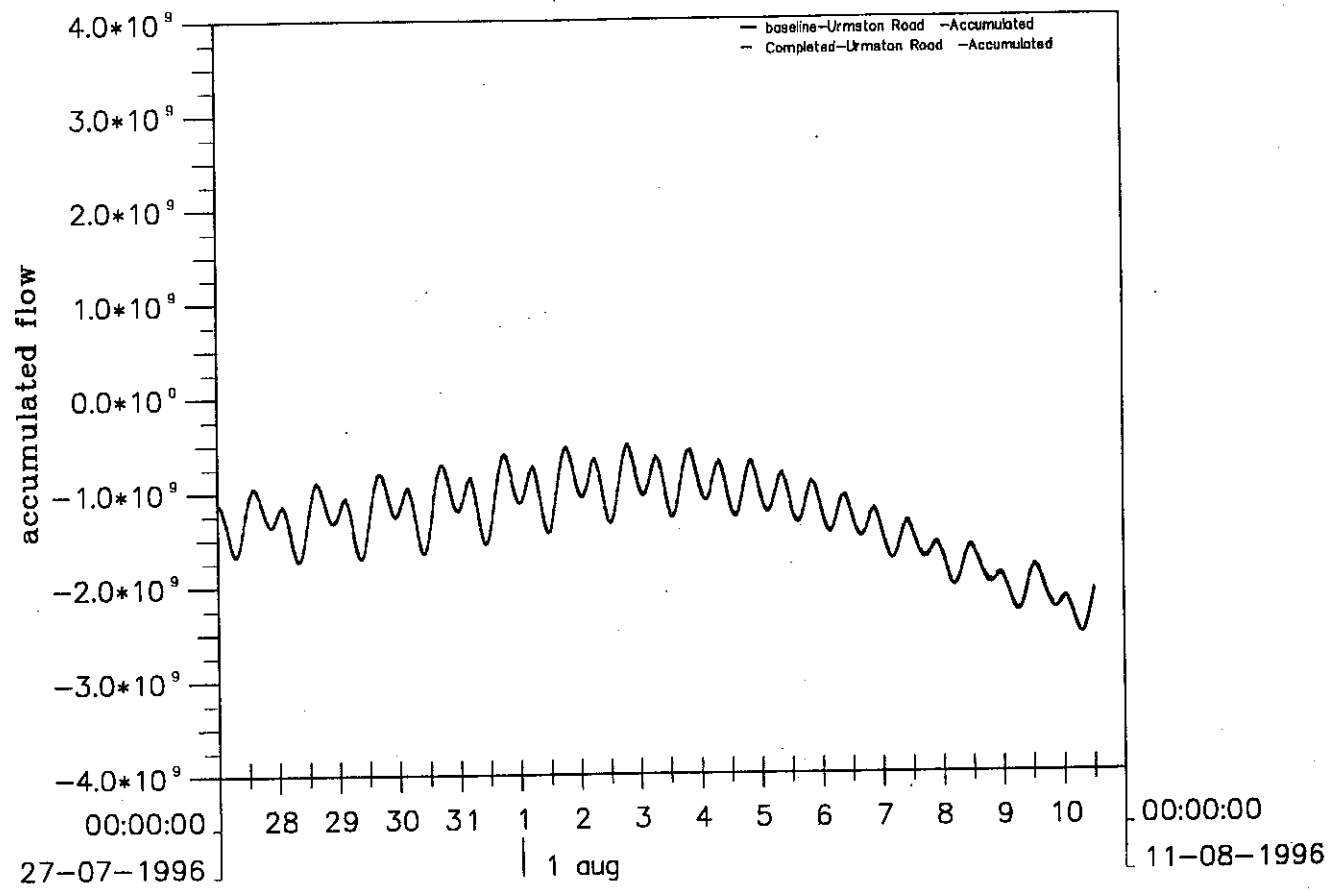

Figure D2d Momentary and Accumulated Discharges through Urmston Road - Wet Season

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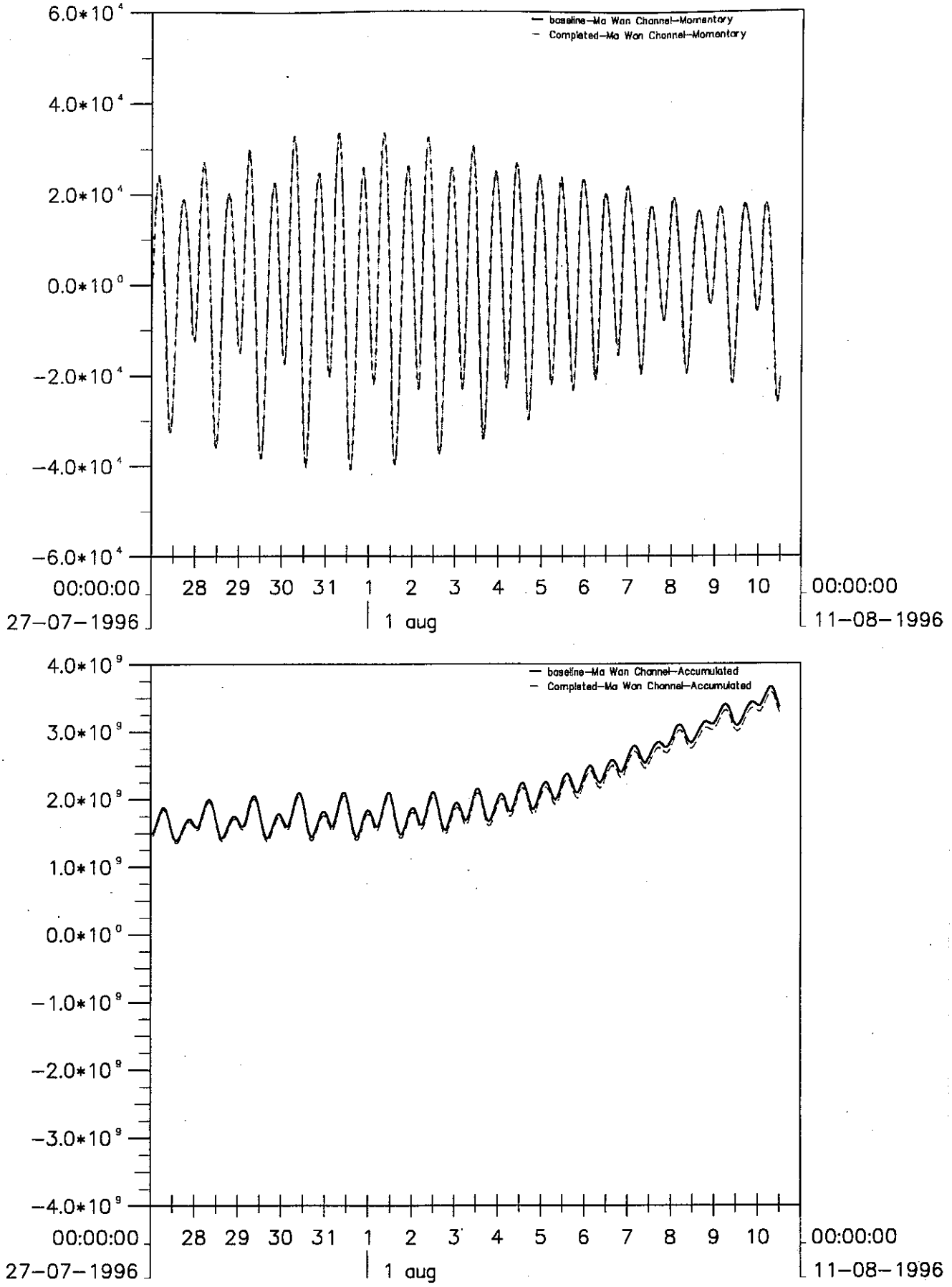

Figure D2e Momentary and Accumulated Discharges through Ma Wan Channel - Wet Season

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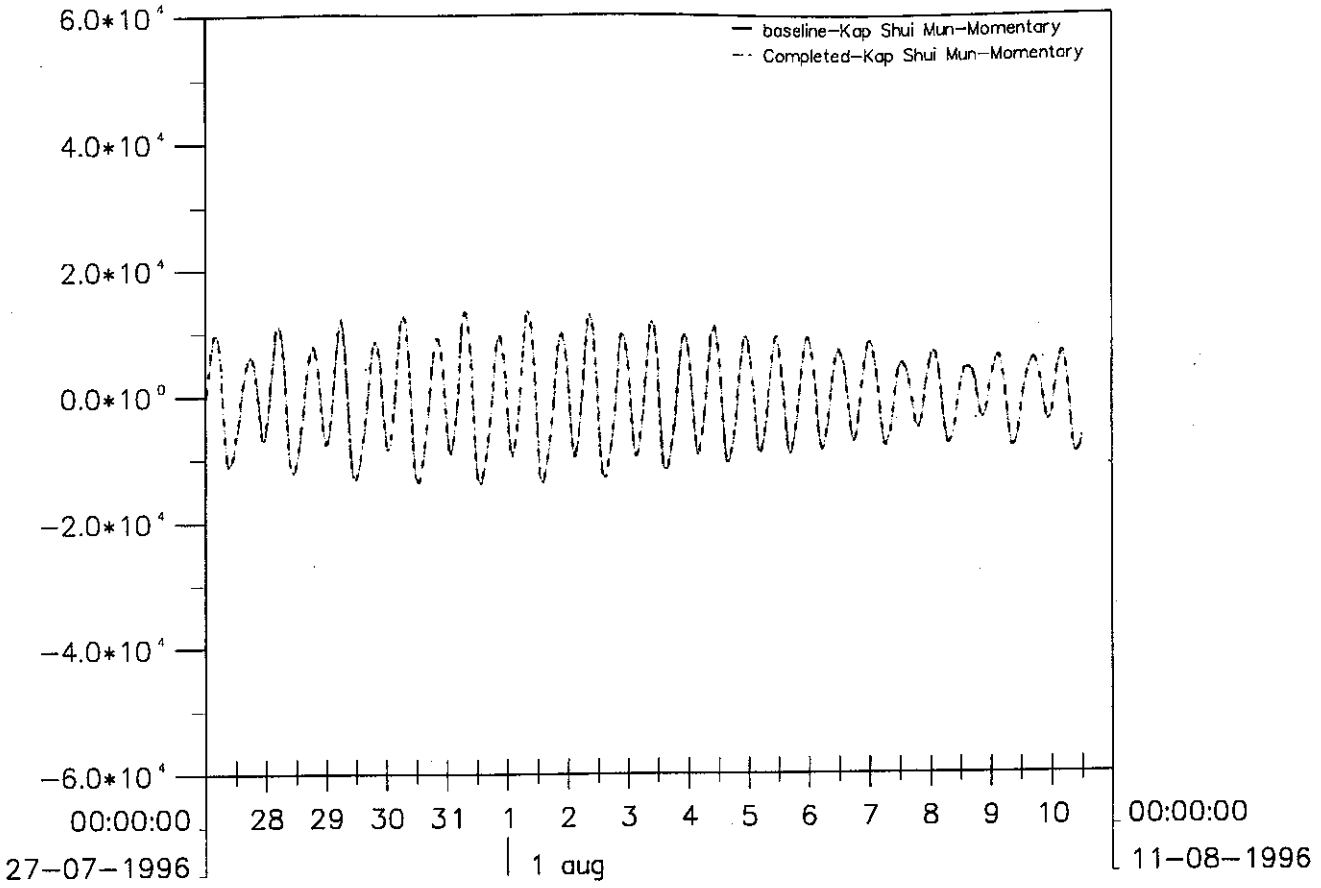

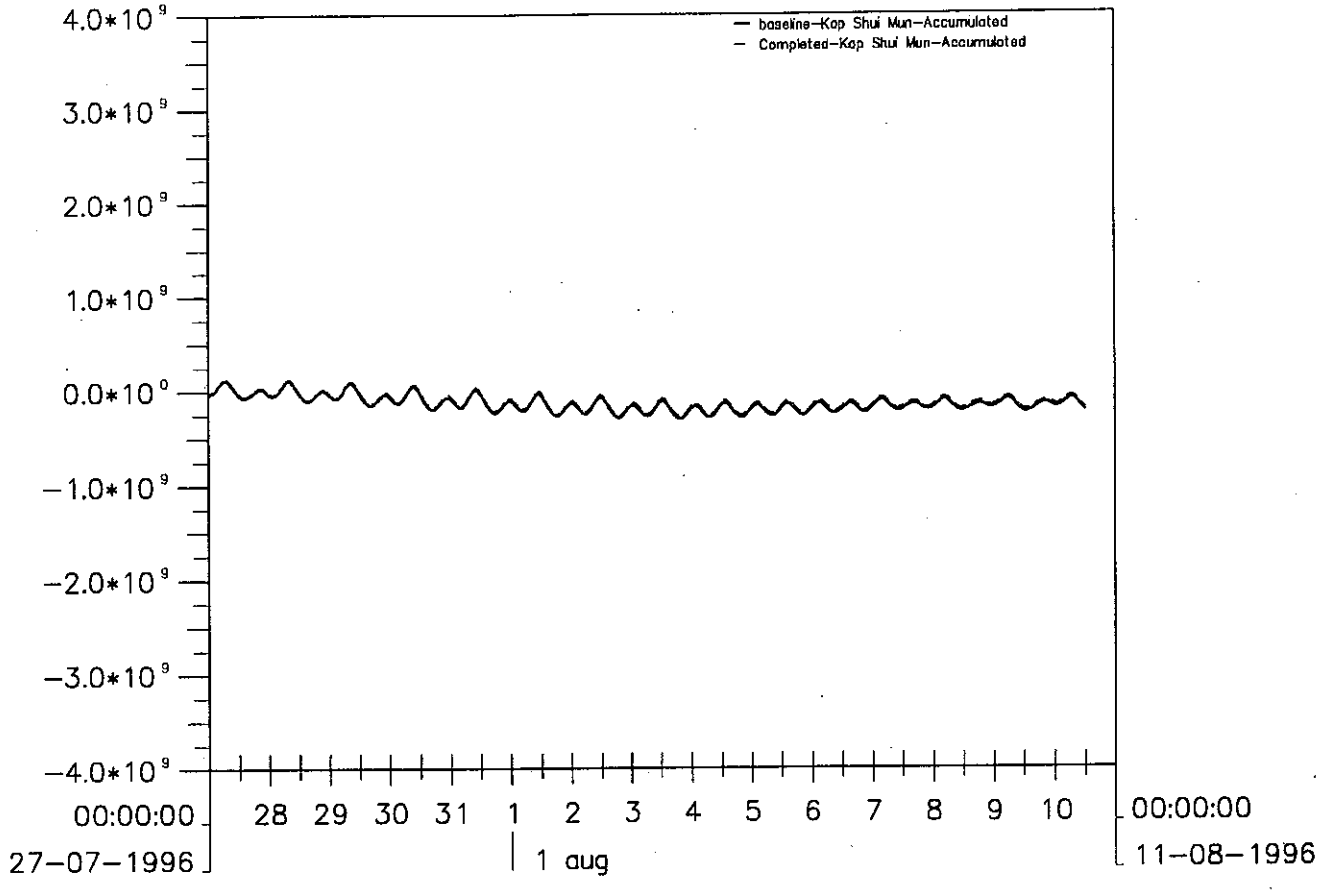

Figure D2f Momentary and Accumulated Discharges through Kap Shui Mun - Wet Season

Environmental Resources Management

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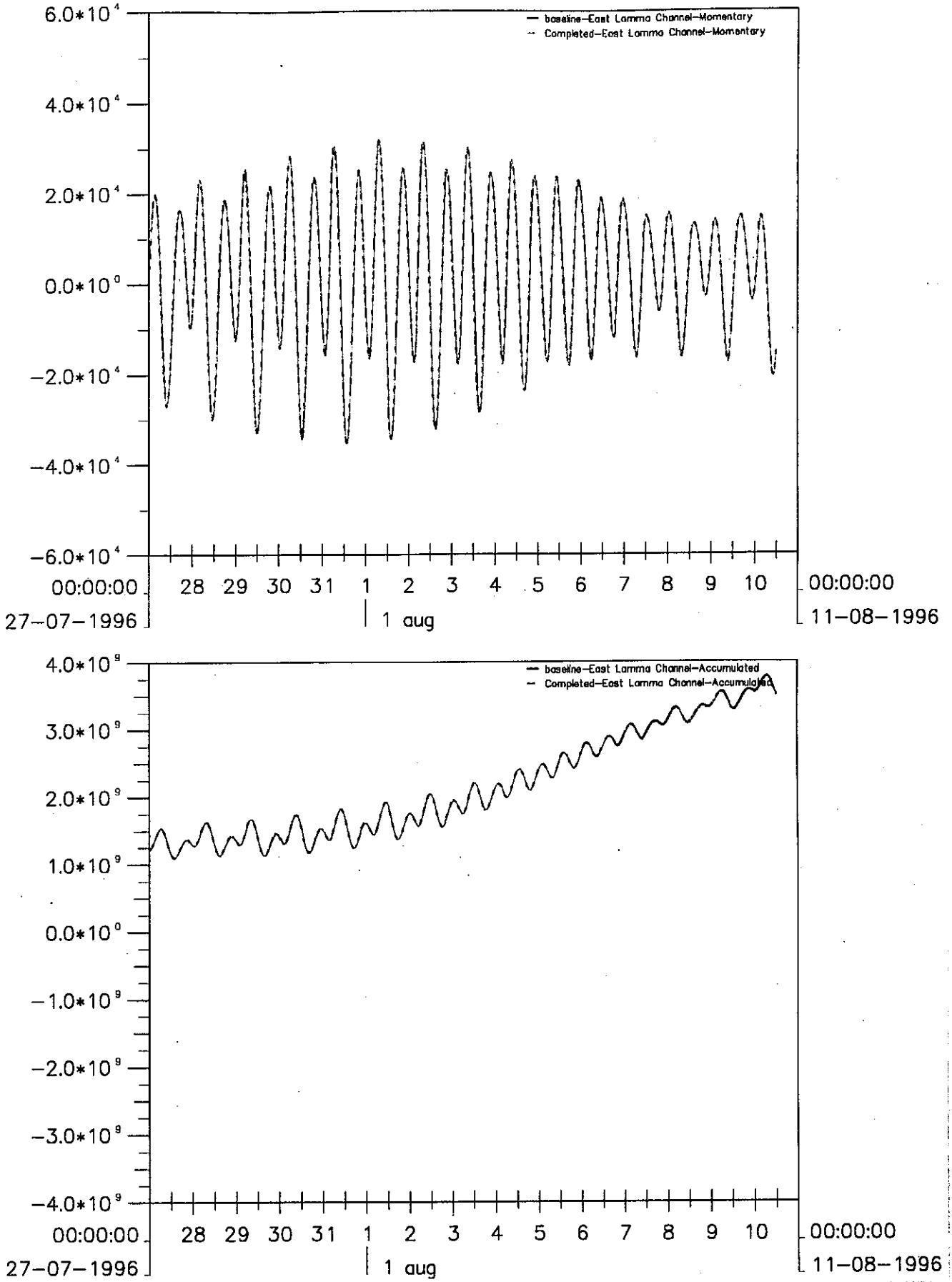

Figure D2g Momentary and Accumulated Discharges through East Lamma Channel - Wet Season

Environmental Resources Management

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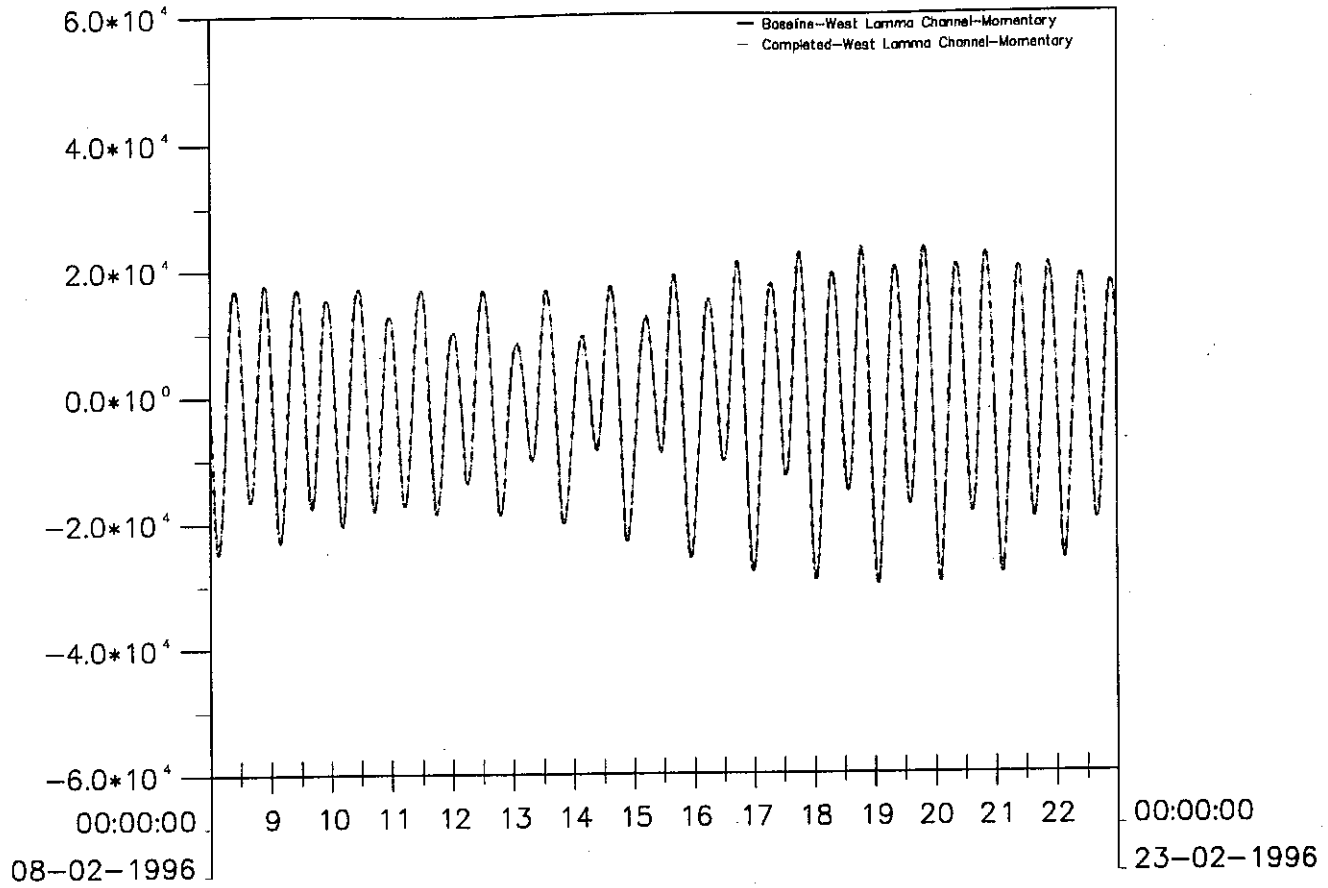

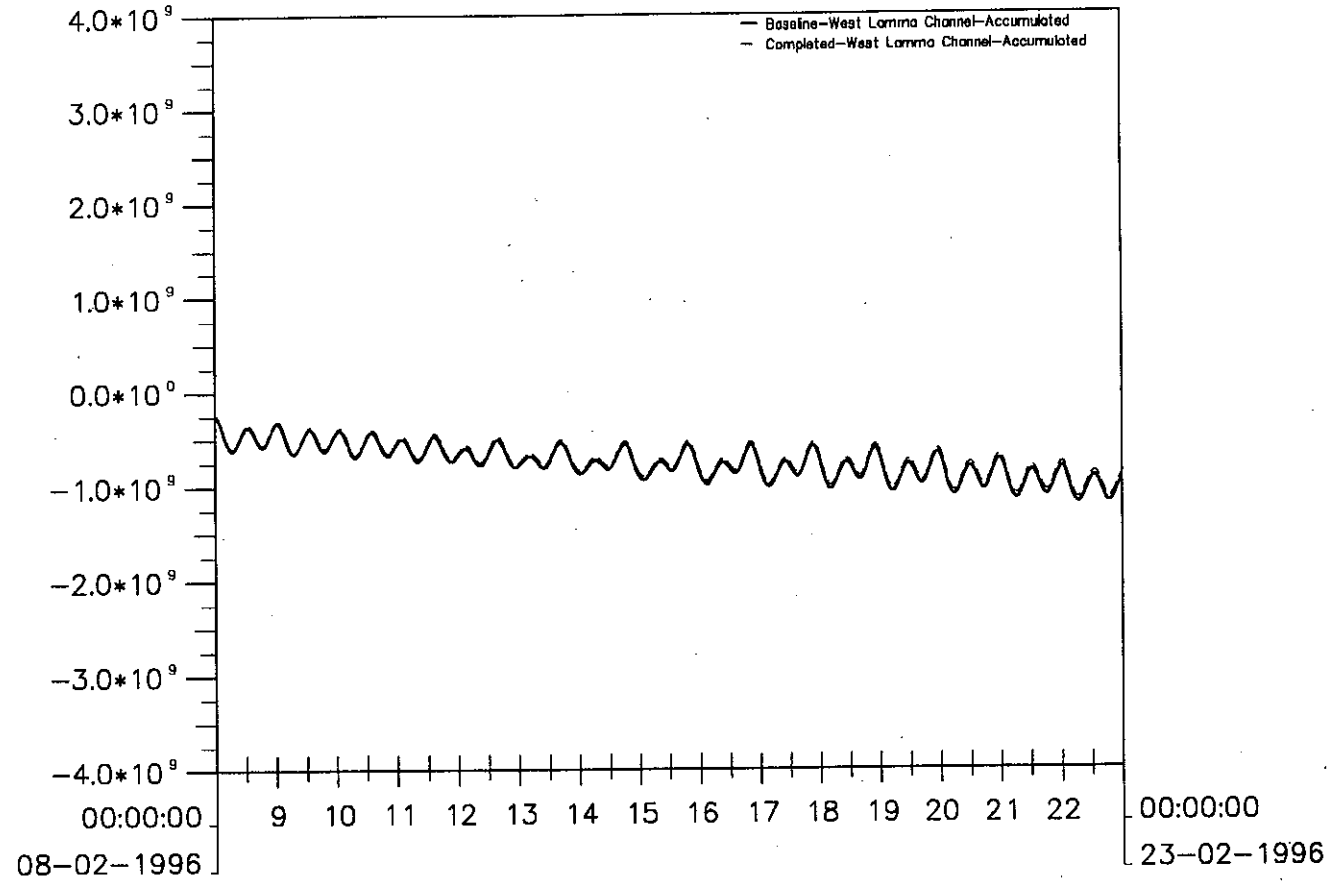

Figure D2h Momentary and Accumulated Discharges through West Lamma Channel - Dry Season

Environmental Resources Management

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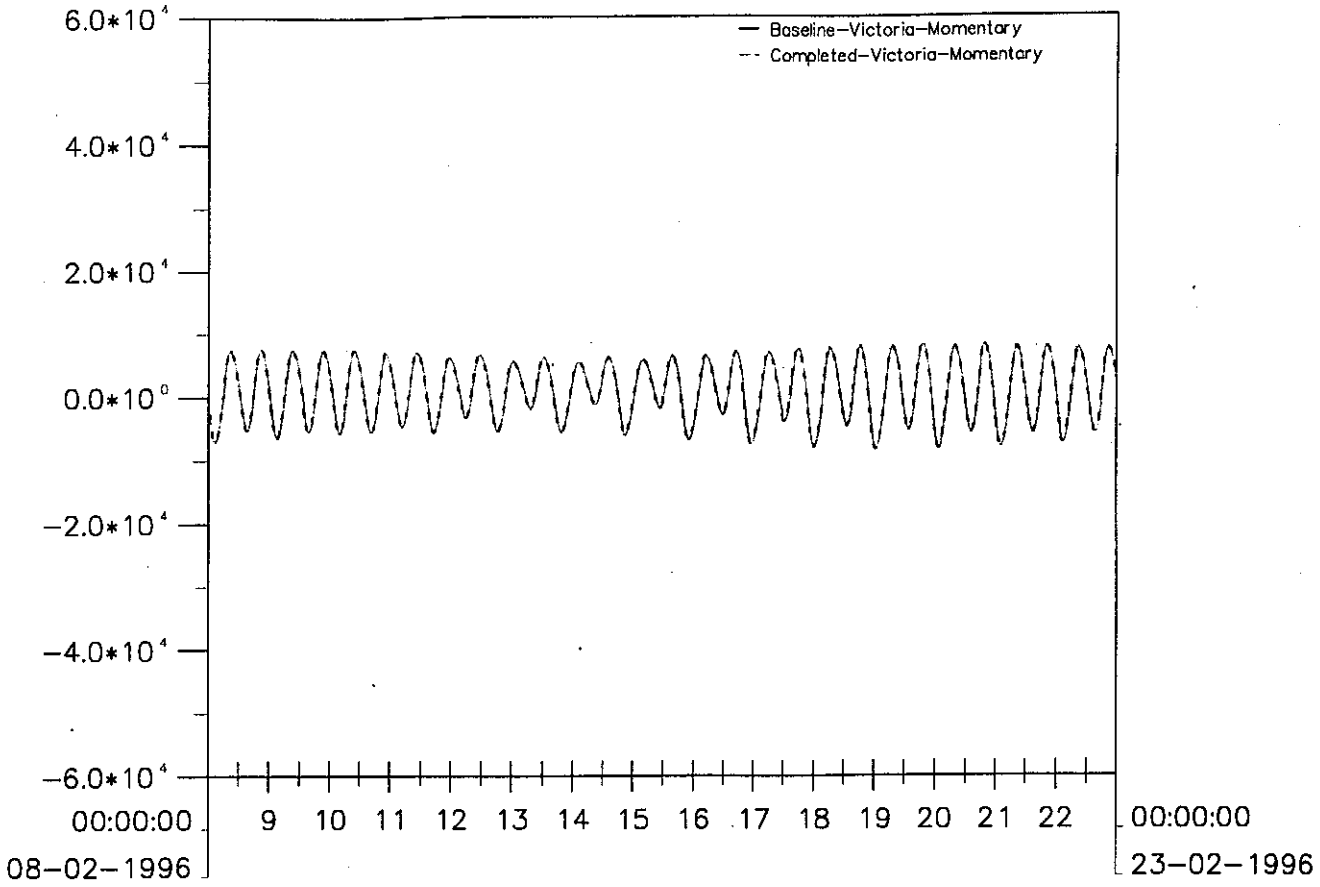

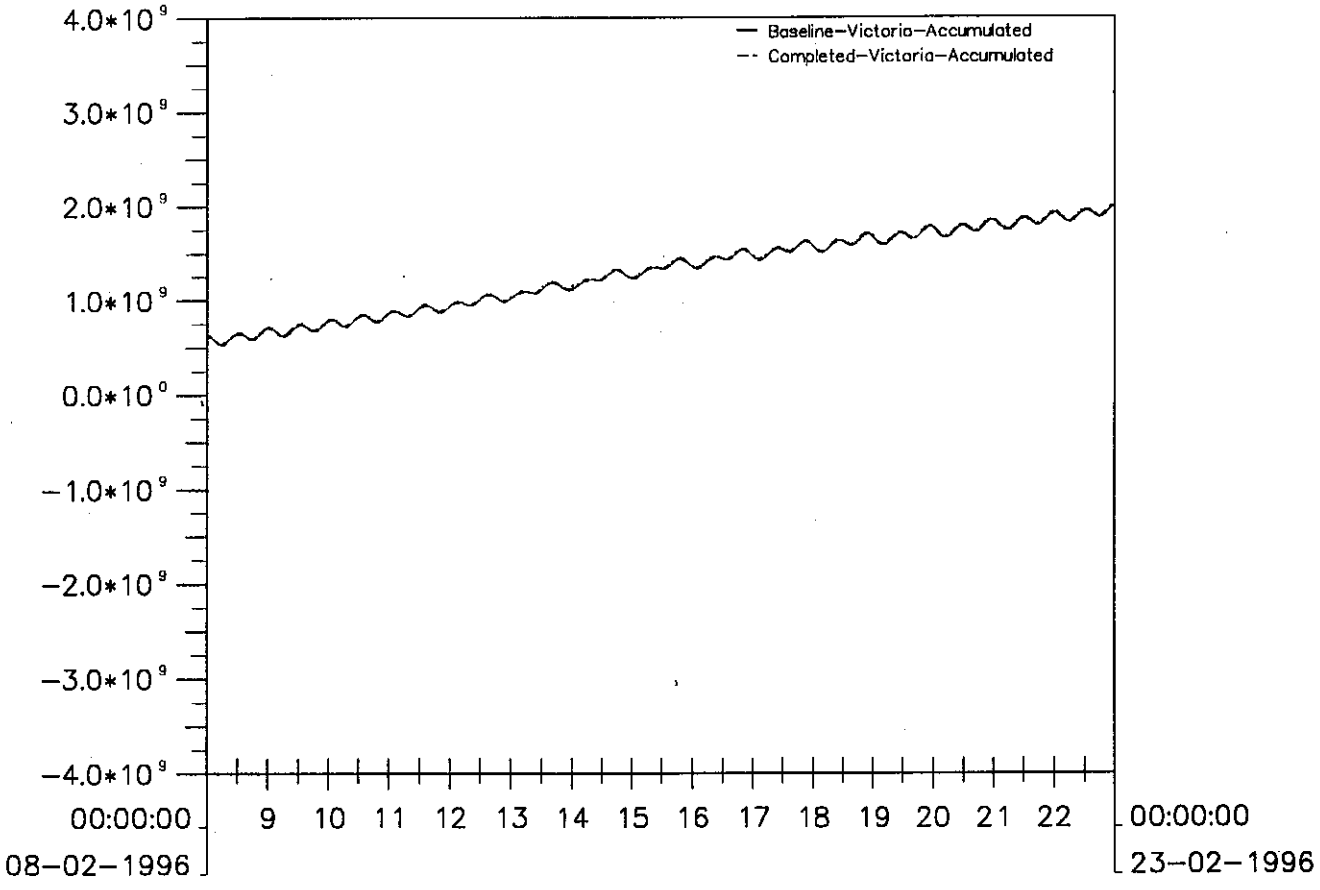

Figure D2i Momentary and Accumulated Discharges through Victoria Harbour - Dry Season

Environmental Resources Management

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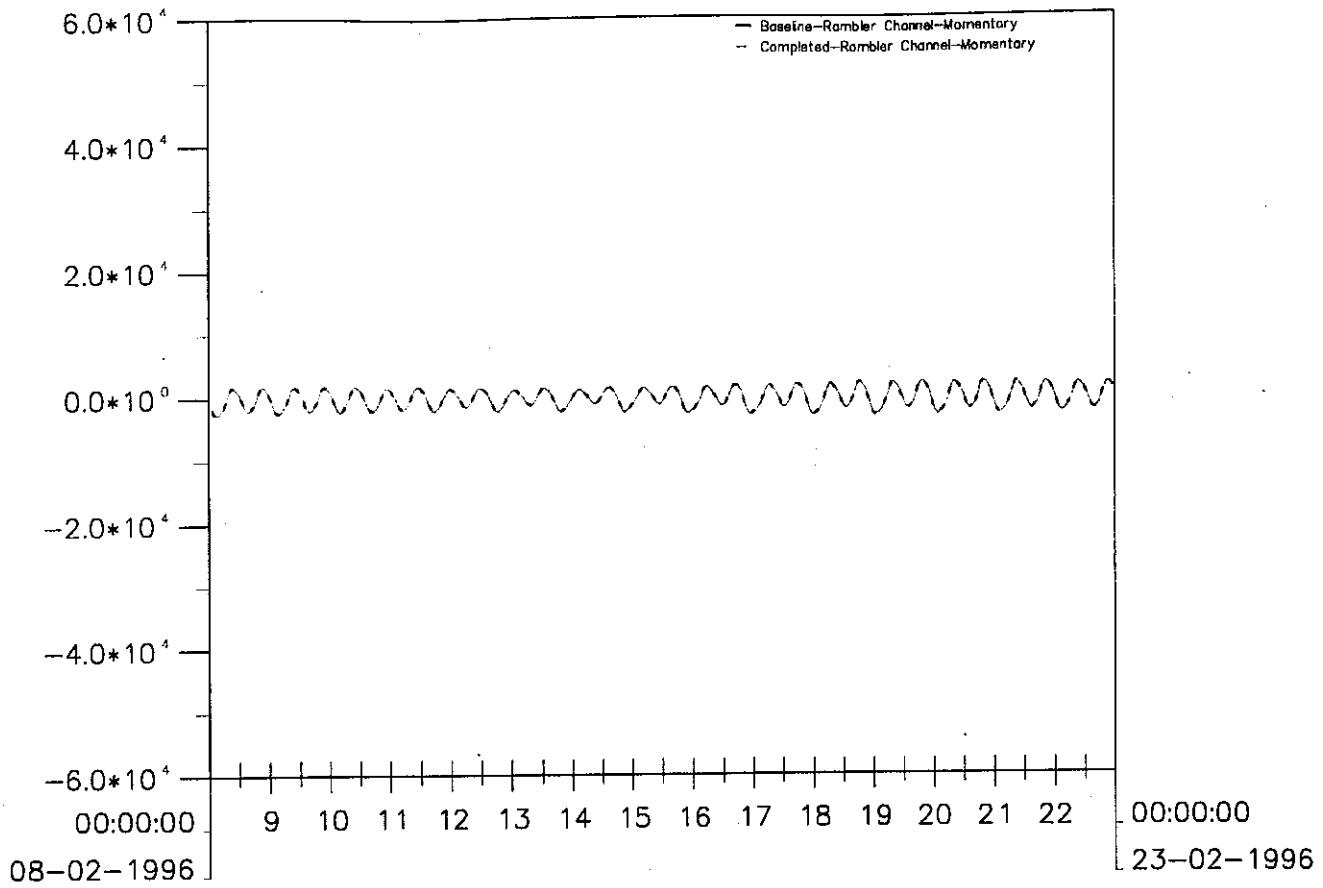


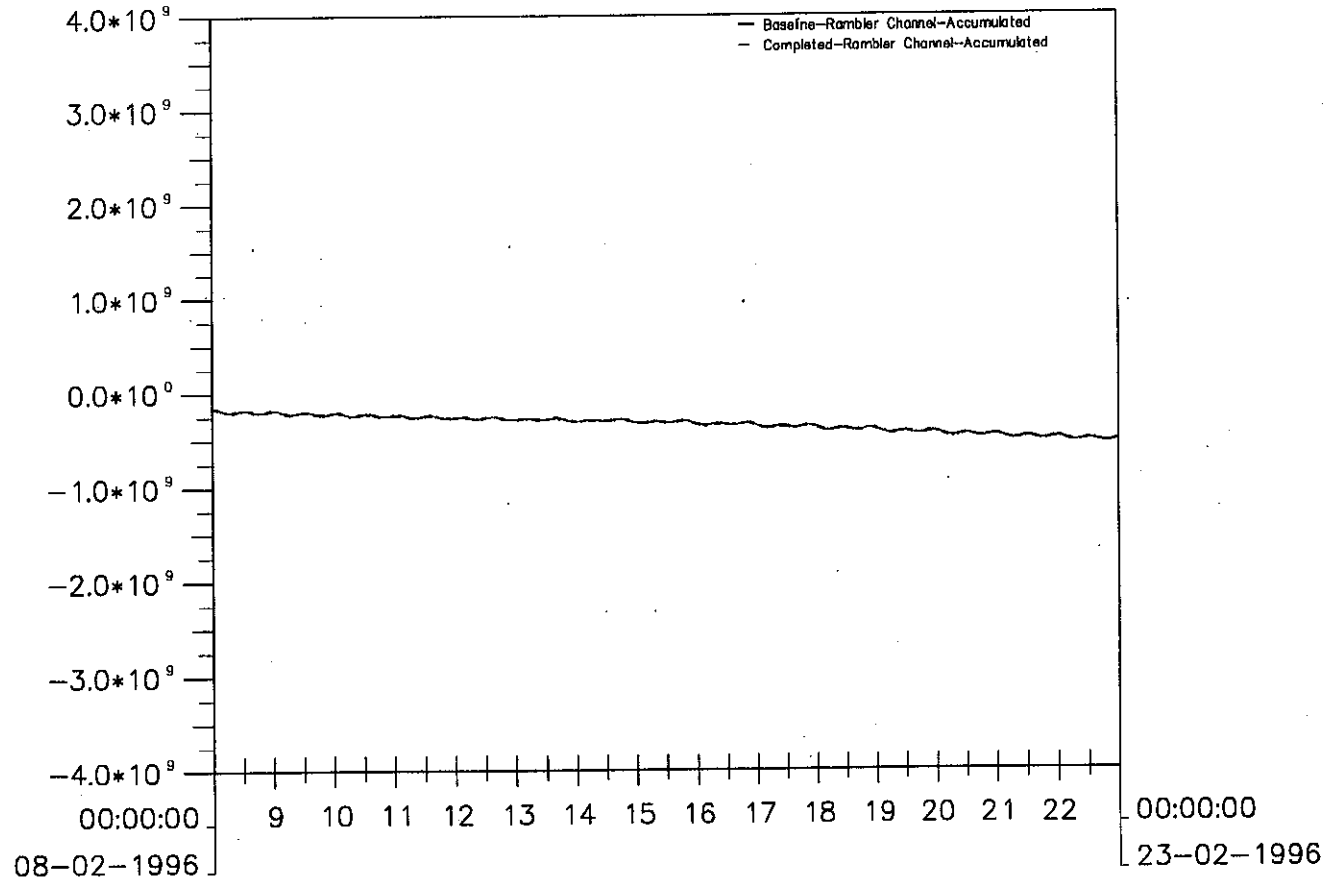


Figure D2j Momentary and Accumulated Discharges through Rambler Channel - Dry Season

Environmental Resources Management

ERM

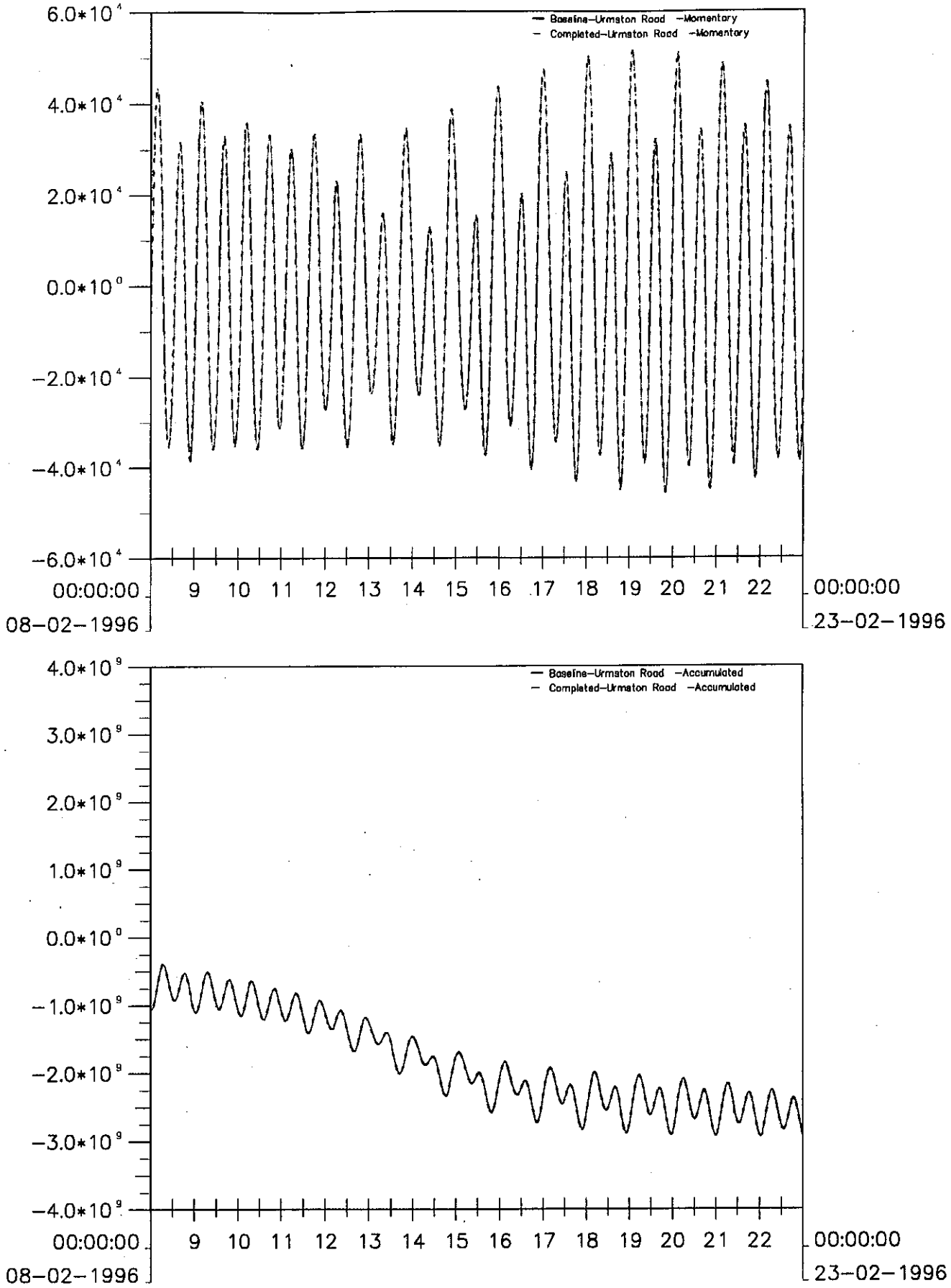
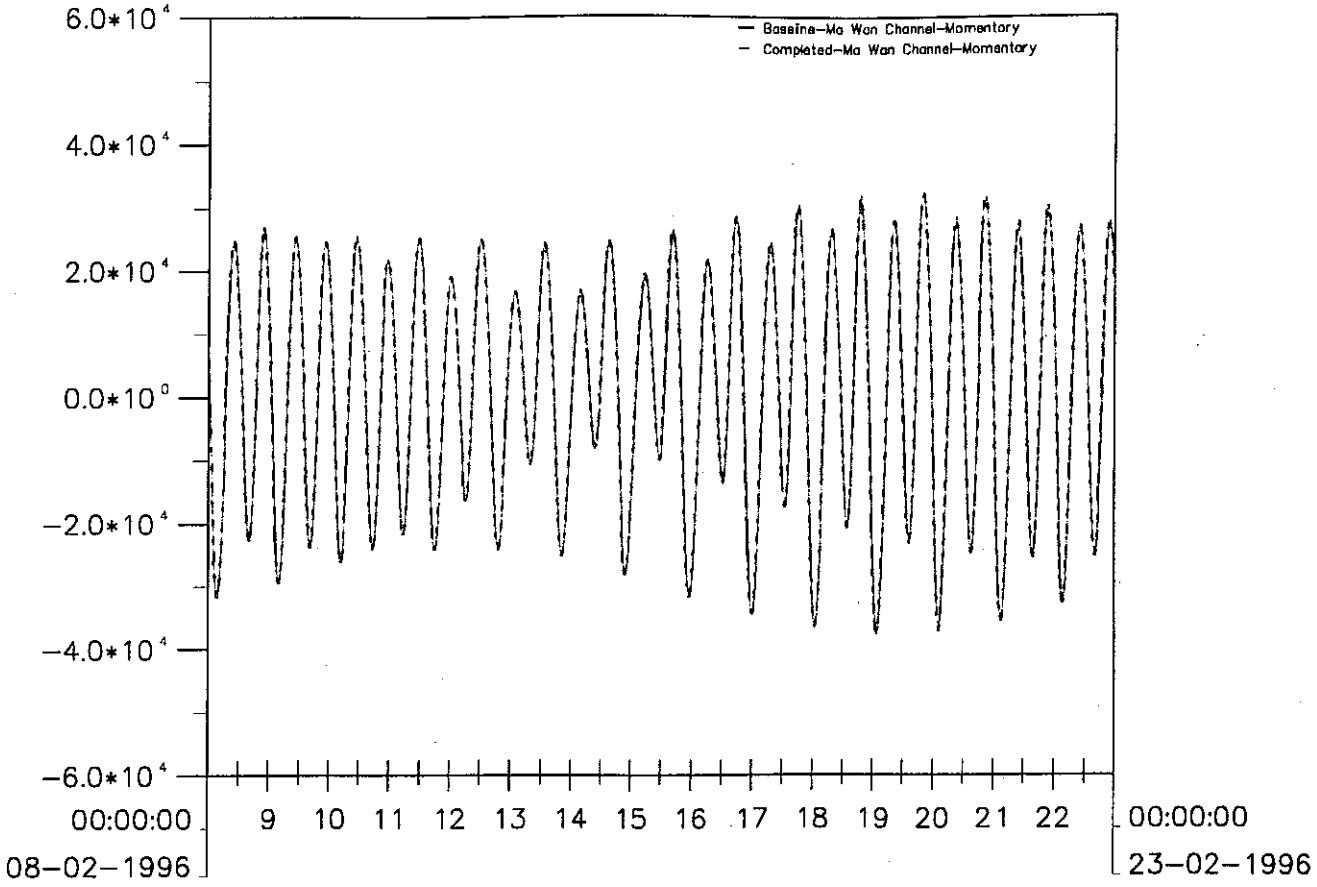


Figure D2k Momentary and Accumulated Discharges through Urmston Road - Dry Season

Environmental Resources Management

ERM



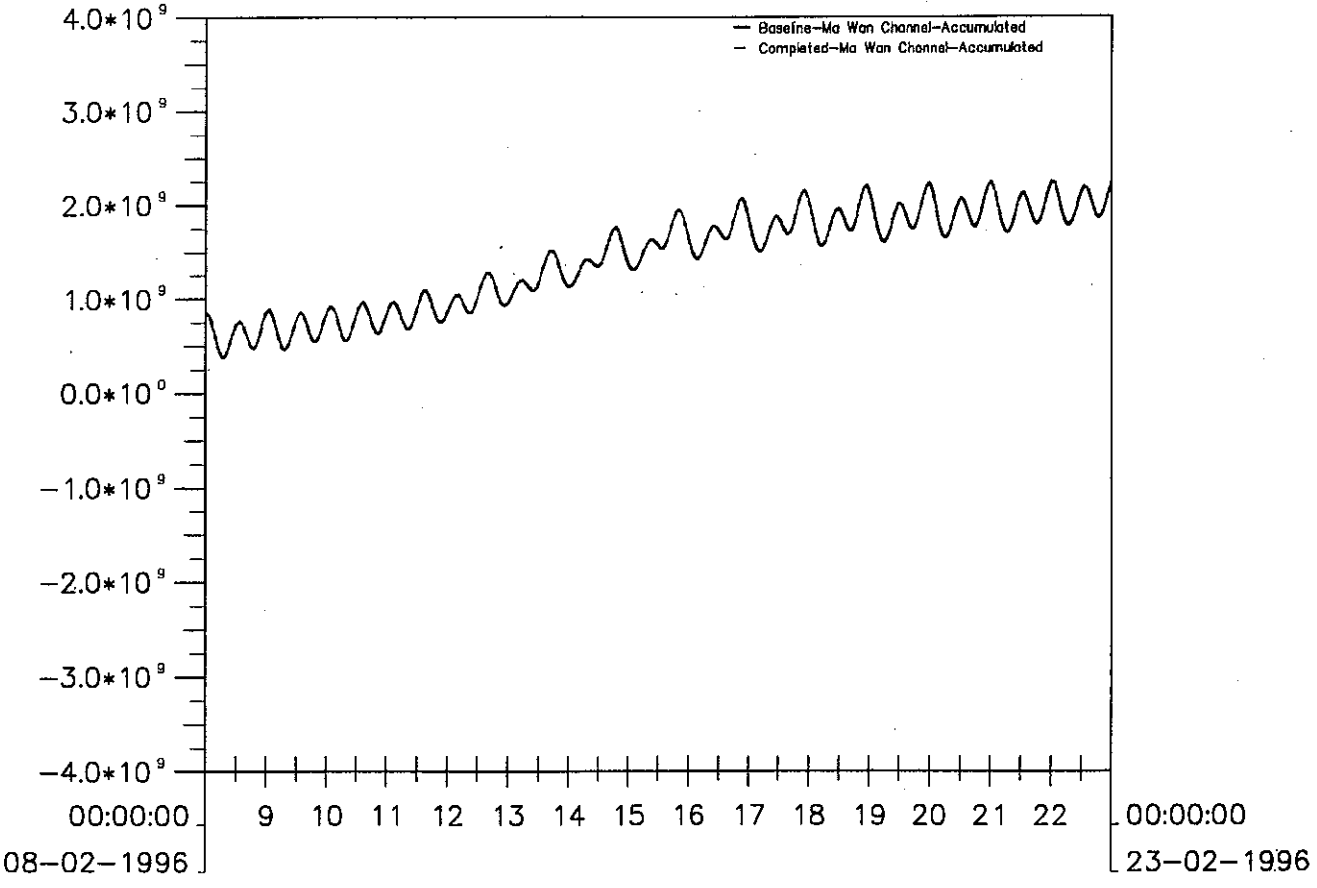


Figure D21 Momentary and Accumulated Discharges through Ma Wan Channel - Dry Season

Environmental Resources Management

ERM

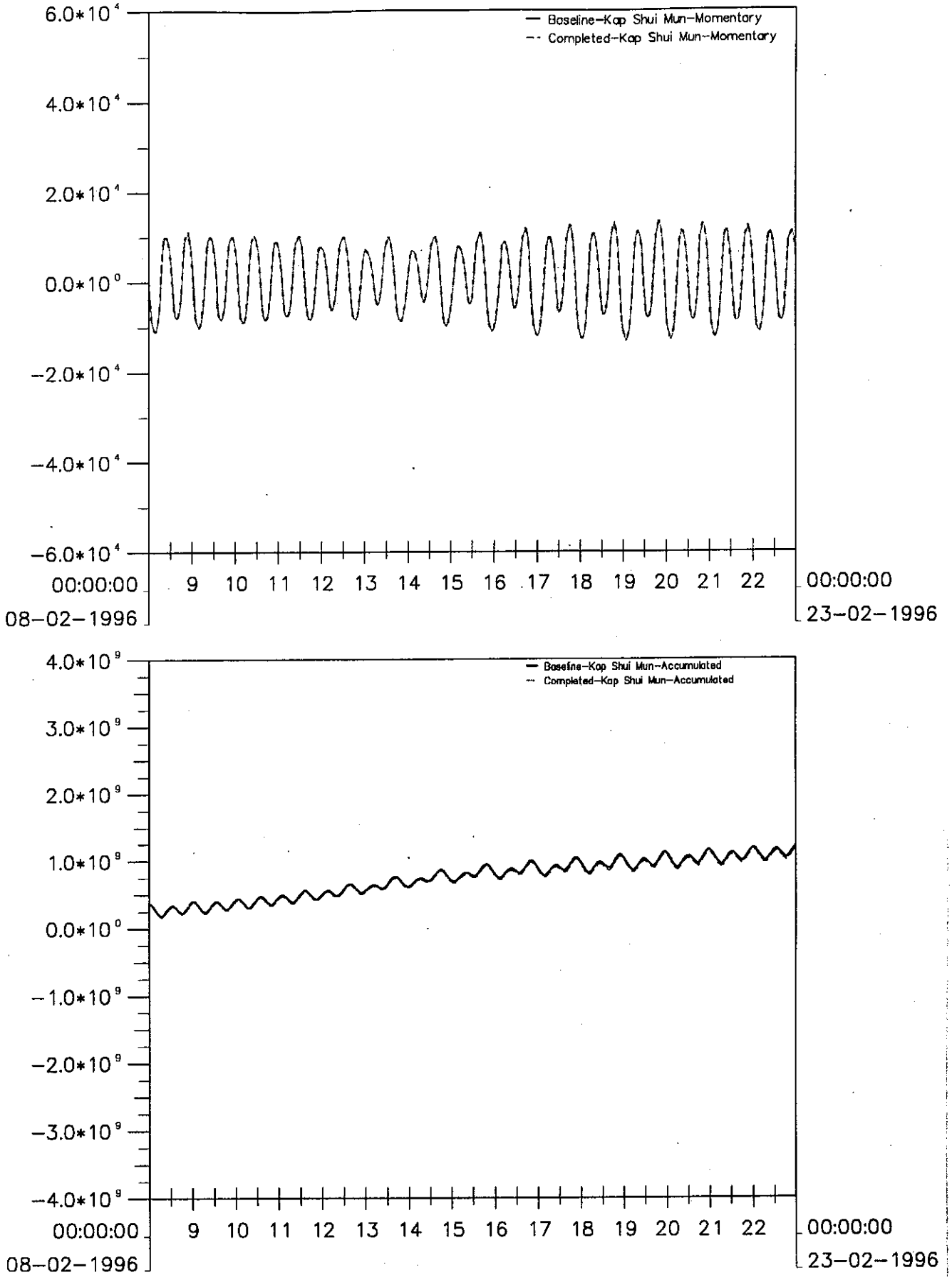


Figure D2m Momentary and Accumulated Discharges through Kap Shui Mun - Dry Season

Environmental Resources Management

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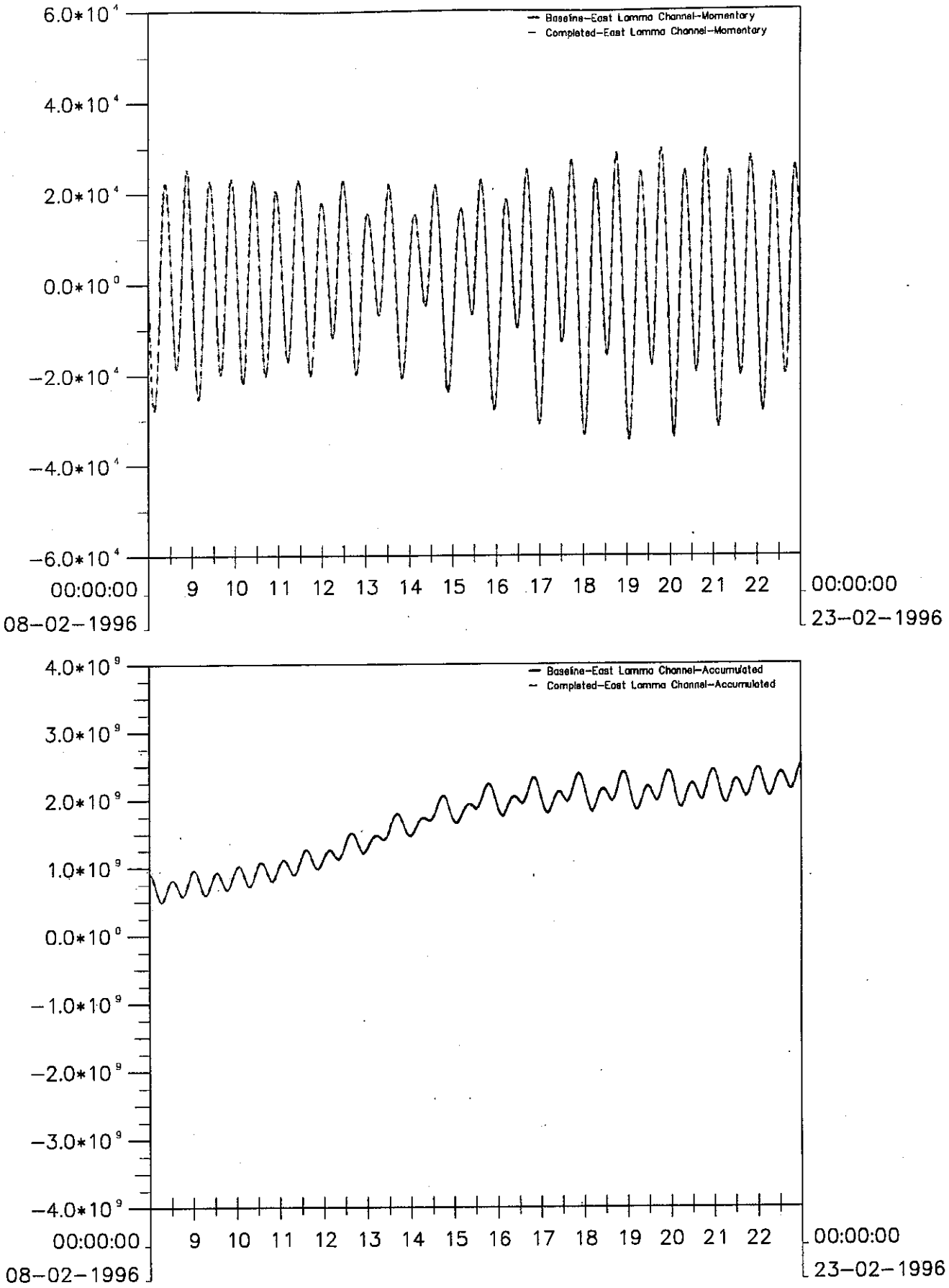

Figure D2n Momentary and Accumulated Discharges through East Lamma Channel - Dry Season

Environmental Resources Management

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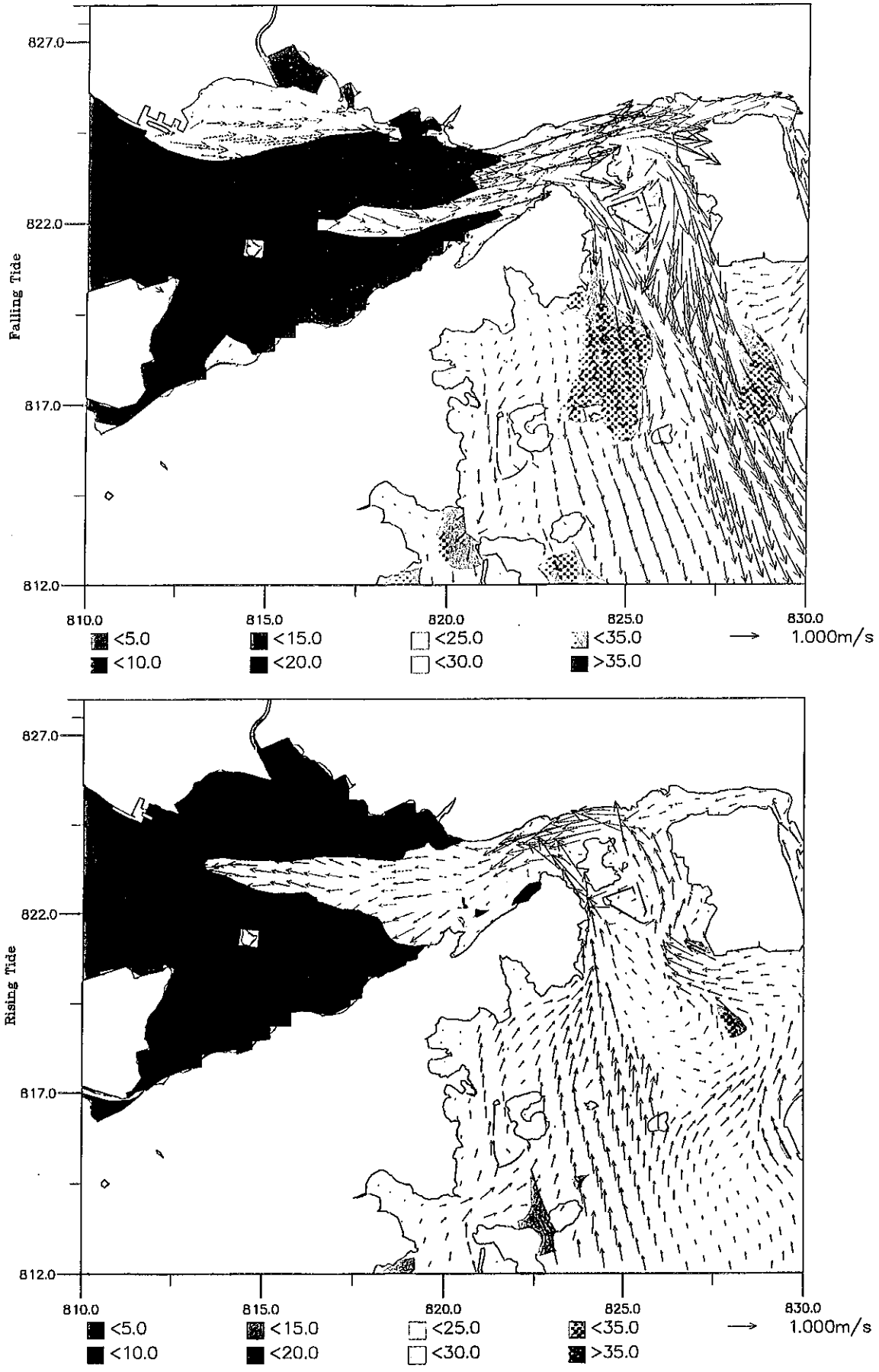

Figure D2o Velocity Vectors and Contours of Salinity
Baseline - Surface - Wet Season Spring Tide

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Management

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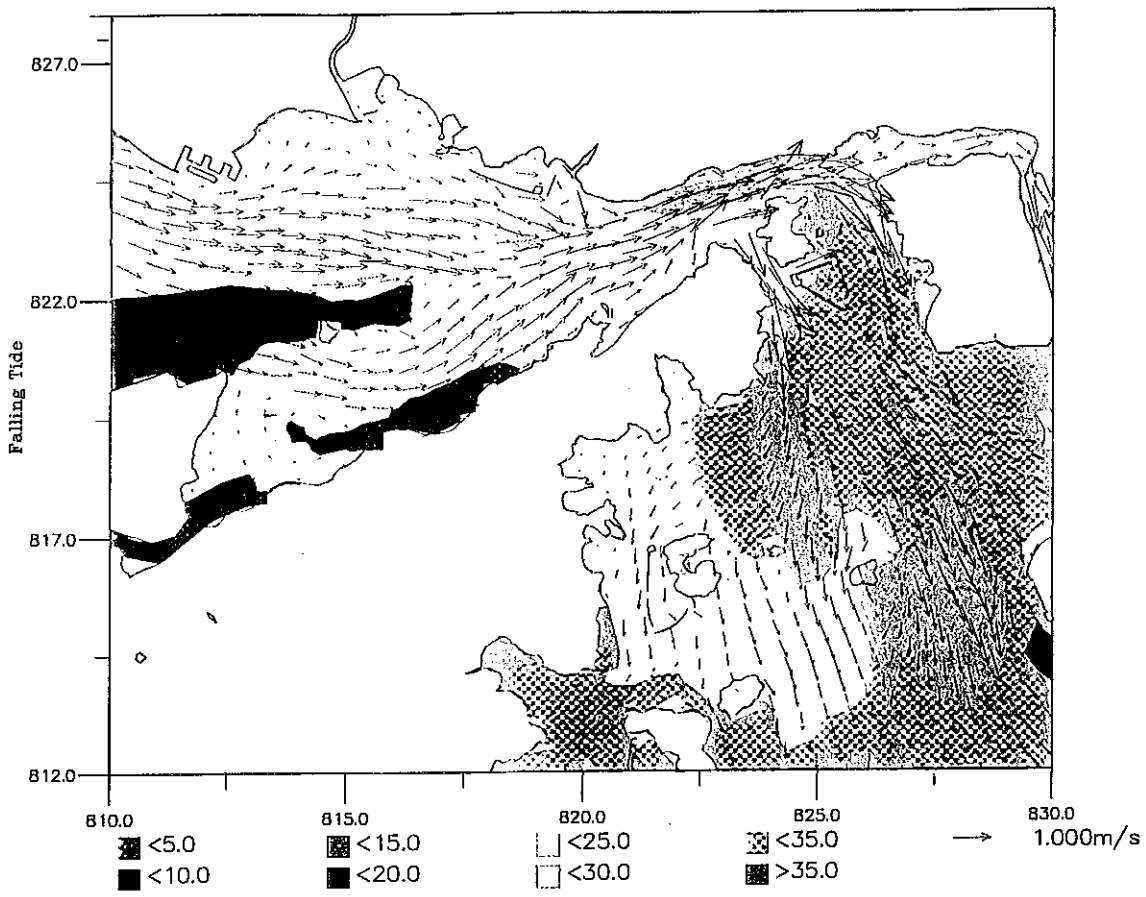

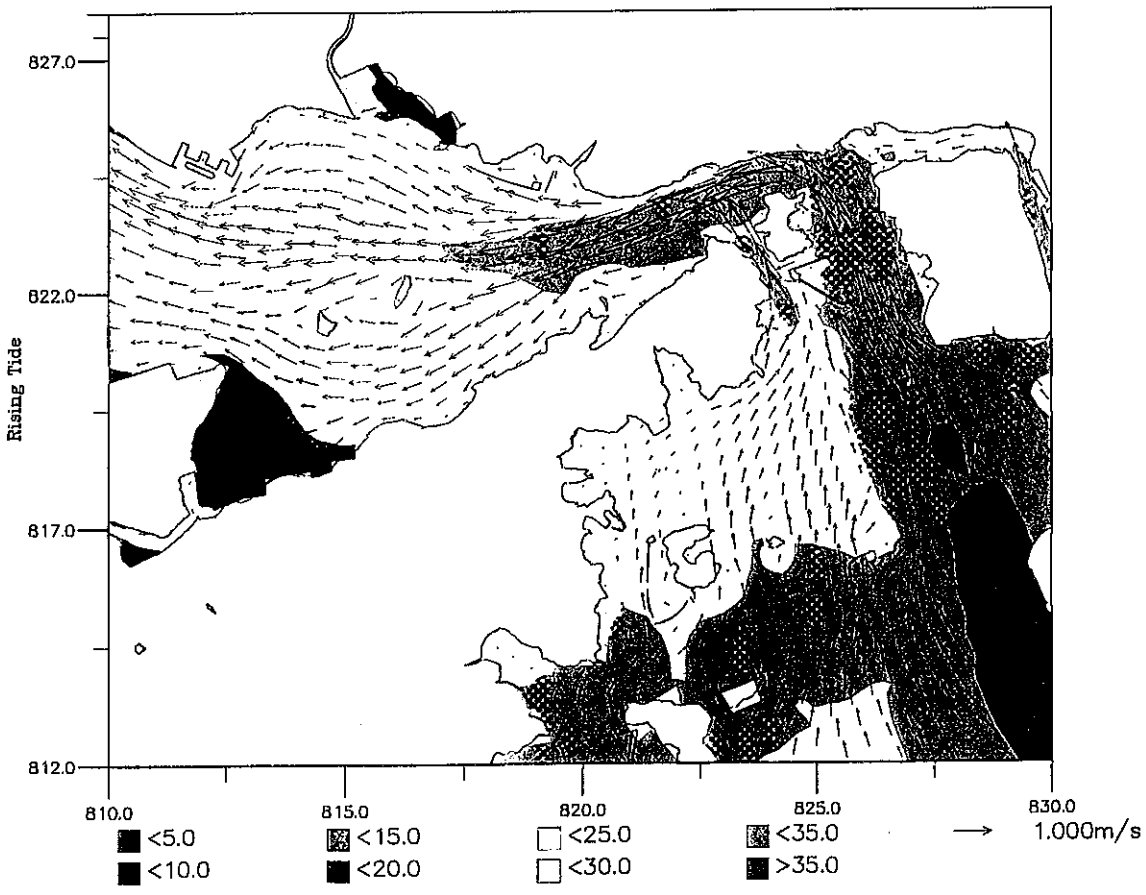

Figure D2p Velocity Vectors and Contours of Salinity
Baseline - Bed - Wet Season Spring Tide

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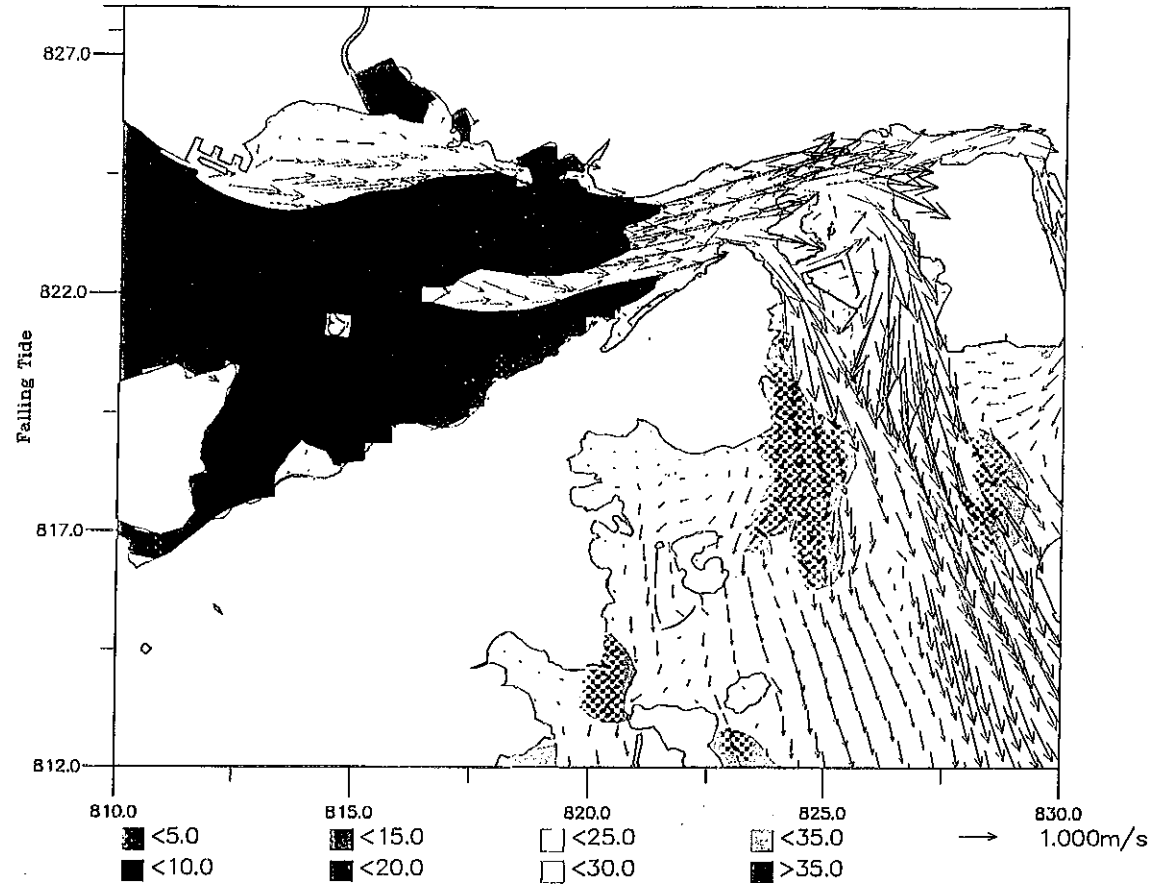

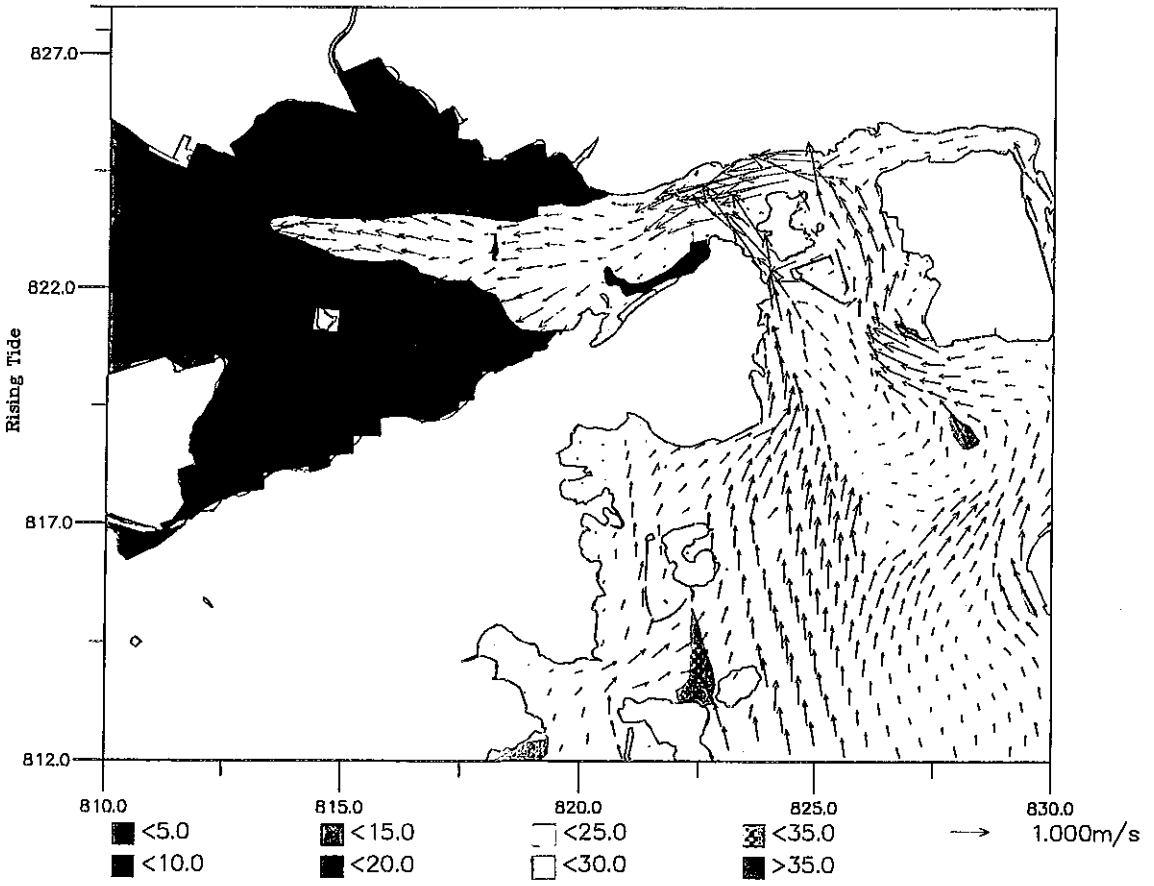

Figure D2q Velocity Vectors and Contours of Salinity Completed - Surface - Wet Season Spring Tide

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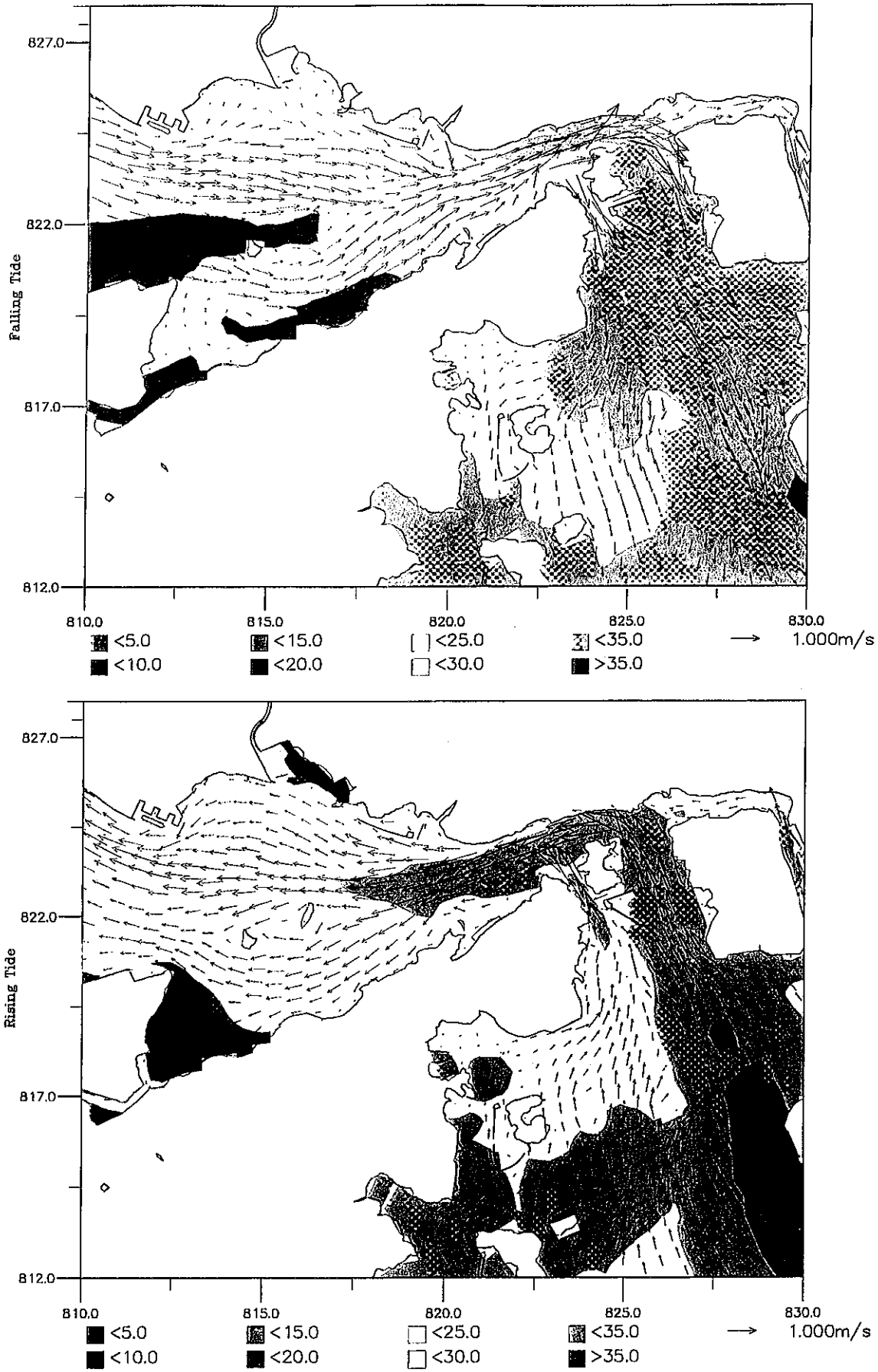

Figure D2r Velocity Vectors and Contours of Salinity
Completed - Bed - Wet Season Spring Tide

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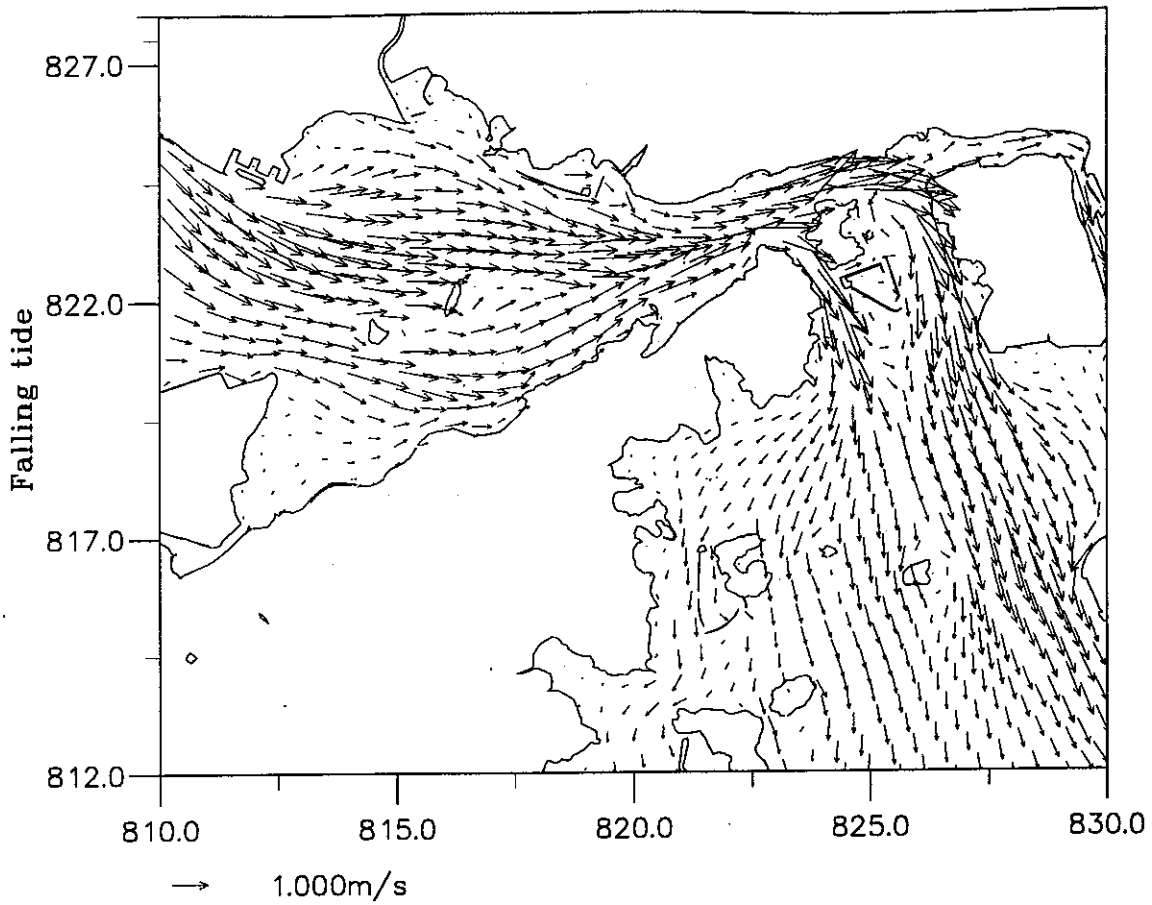

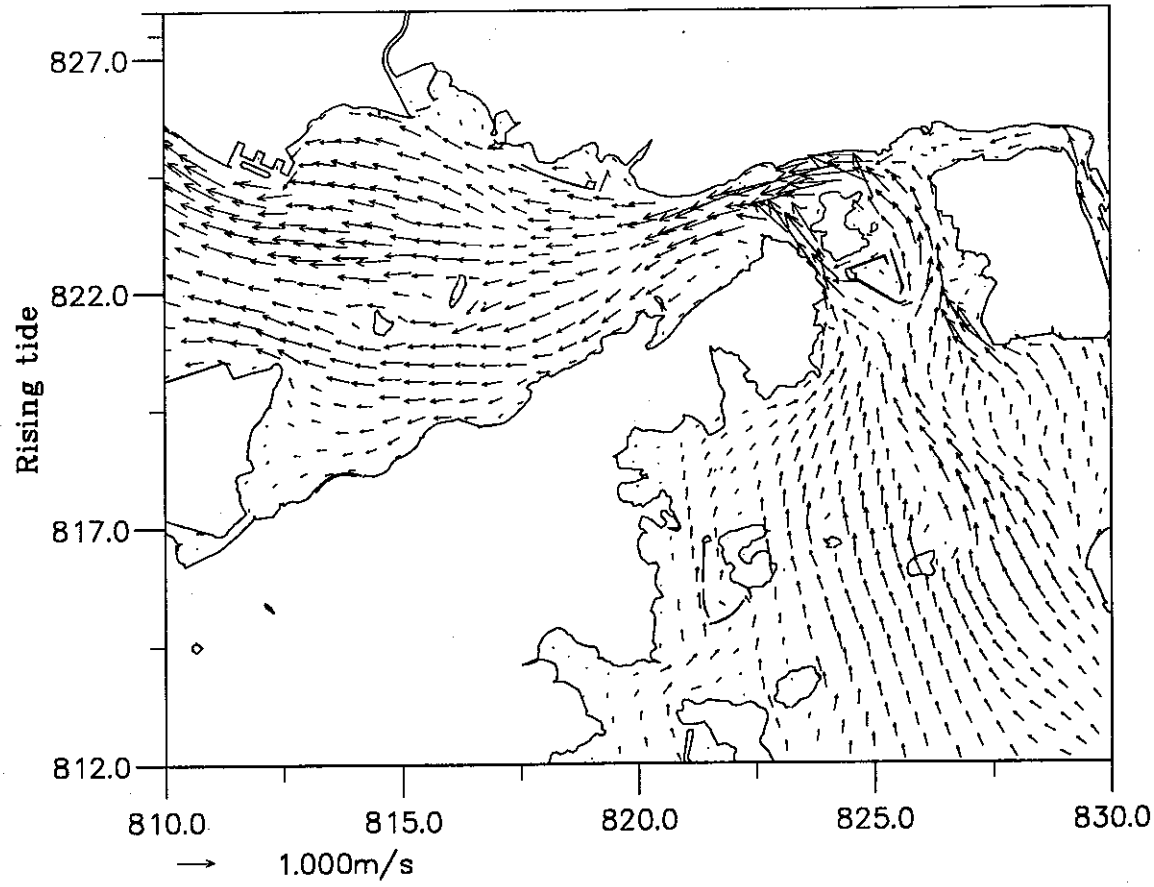

Figure D2s Velocity Vectors
Baseline - Surface - Dry Season Spring Tide

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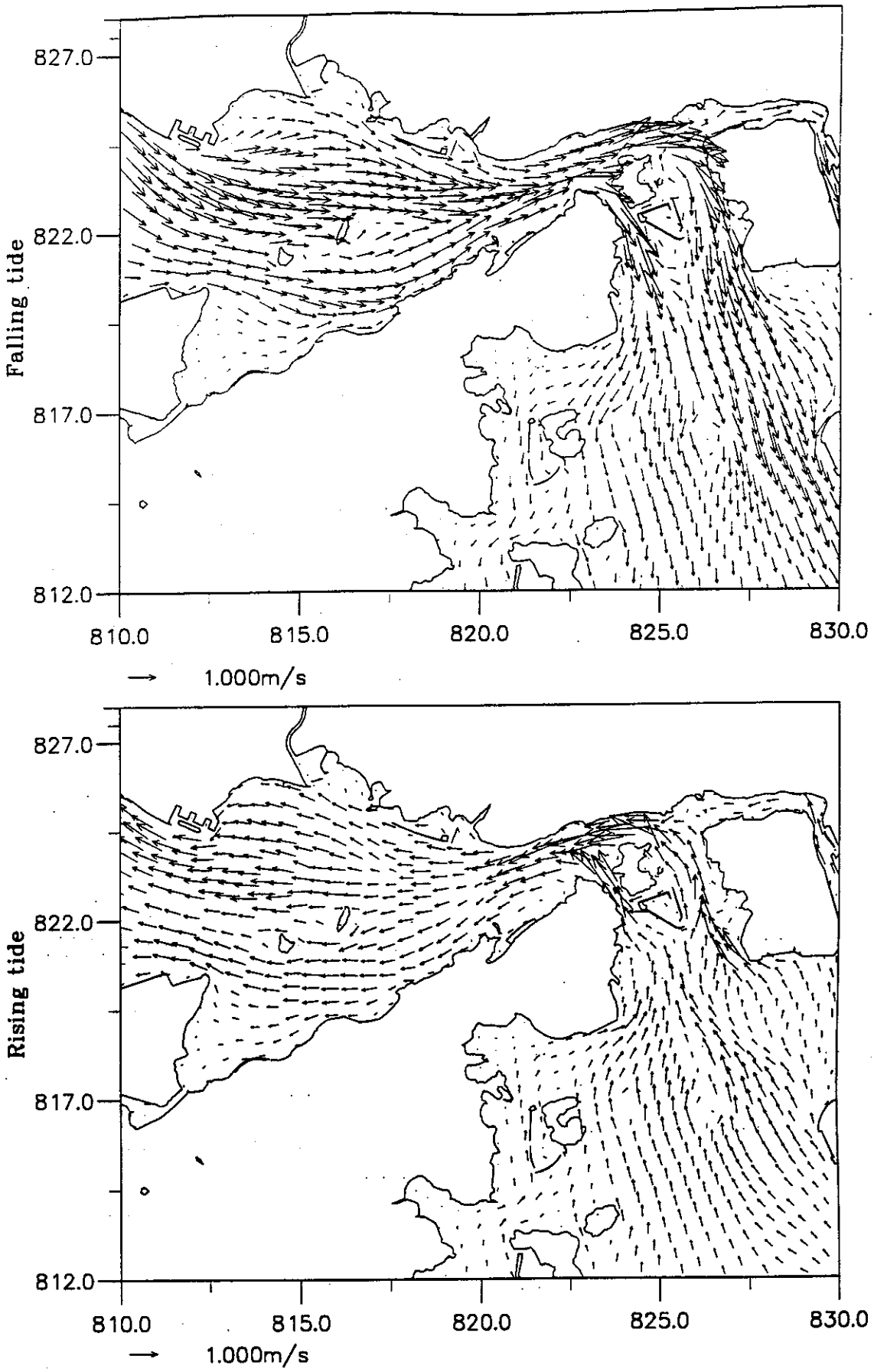

Figure D2t Velocity Vectors
Completed - Surface - Dry Season Spring Tide

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Annex D3

Water Quality Modelling

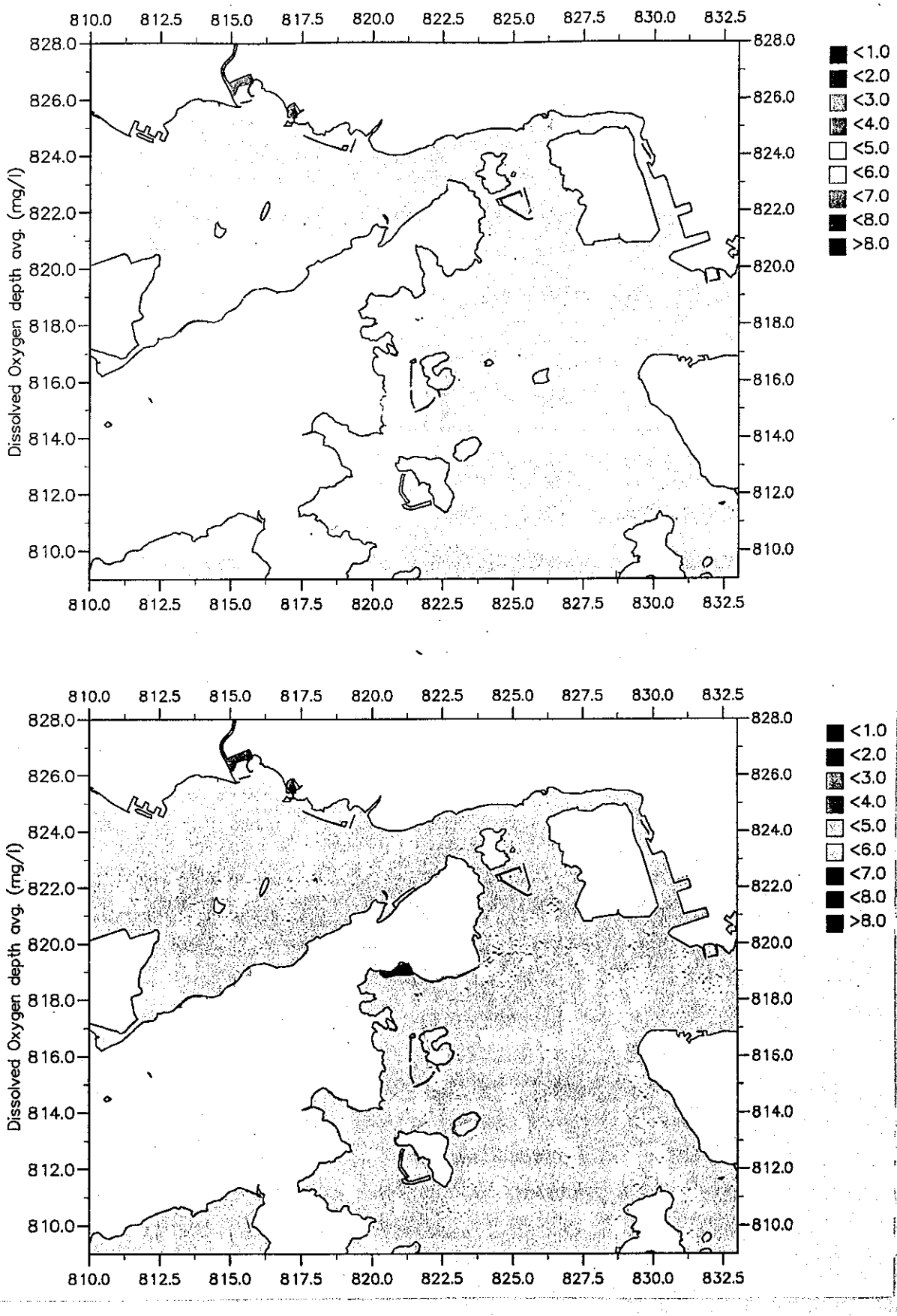

Figure D3a

10th Percentile Depth Averaged Dissolved Oxygen Concentrations

Wet Season

Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

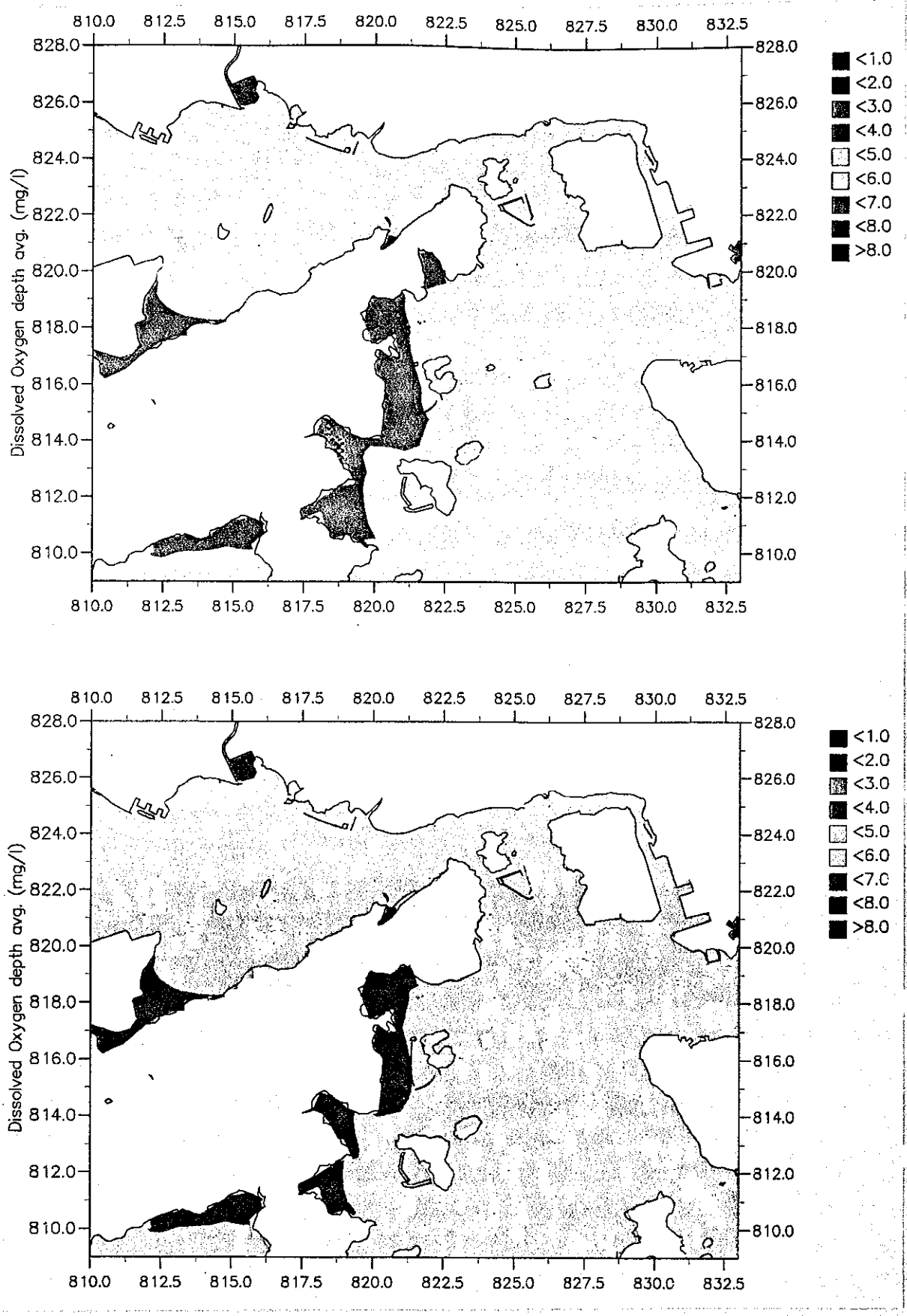

Figure D3b 10th Percentile Depth Averaged Dissolved Oxygen Concentrations
Dry Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

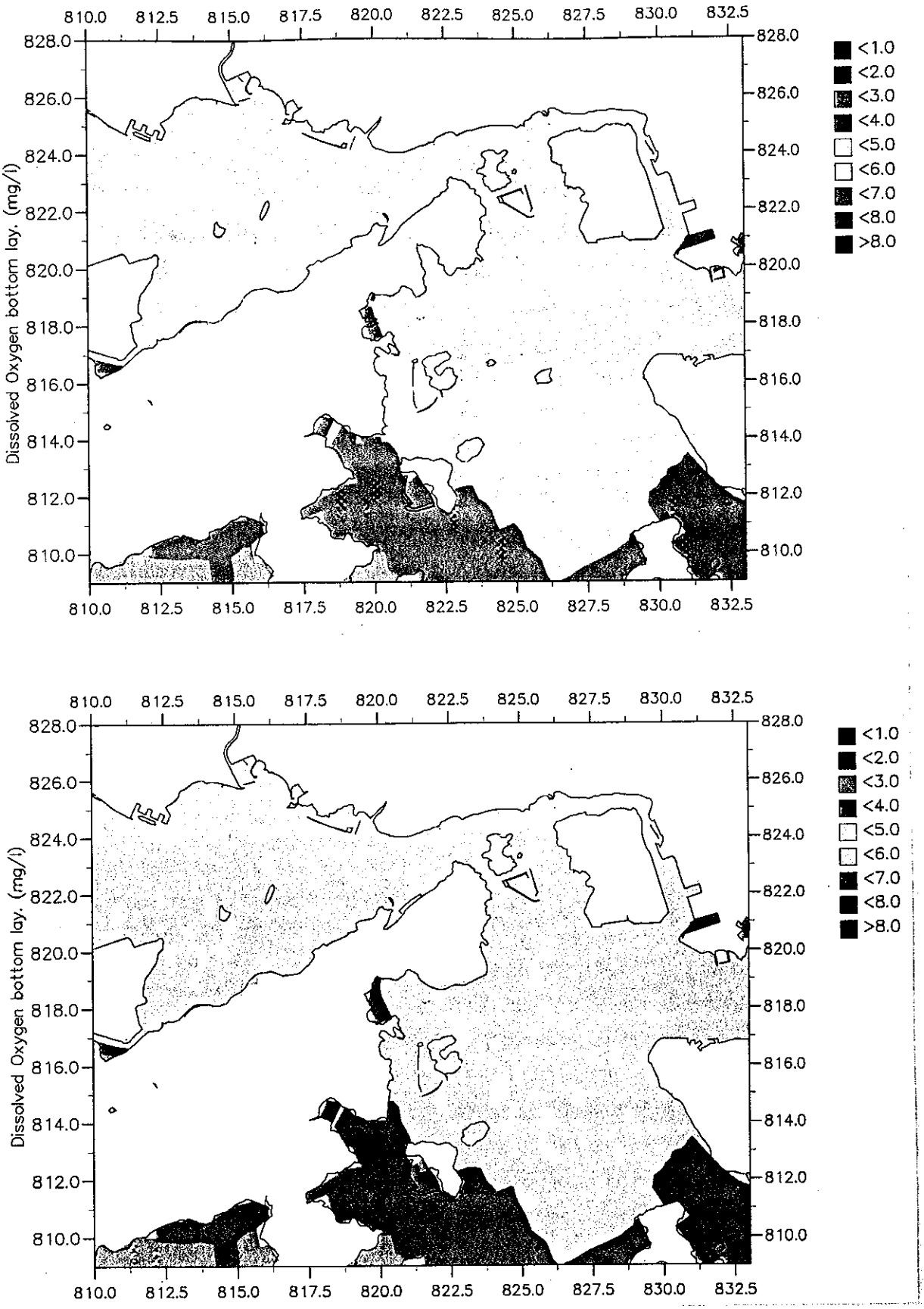

Figure D3c 10th Percentile Bottom Dissolved Oxygen Concentrations
Wet Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

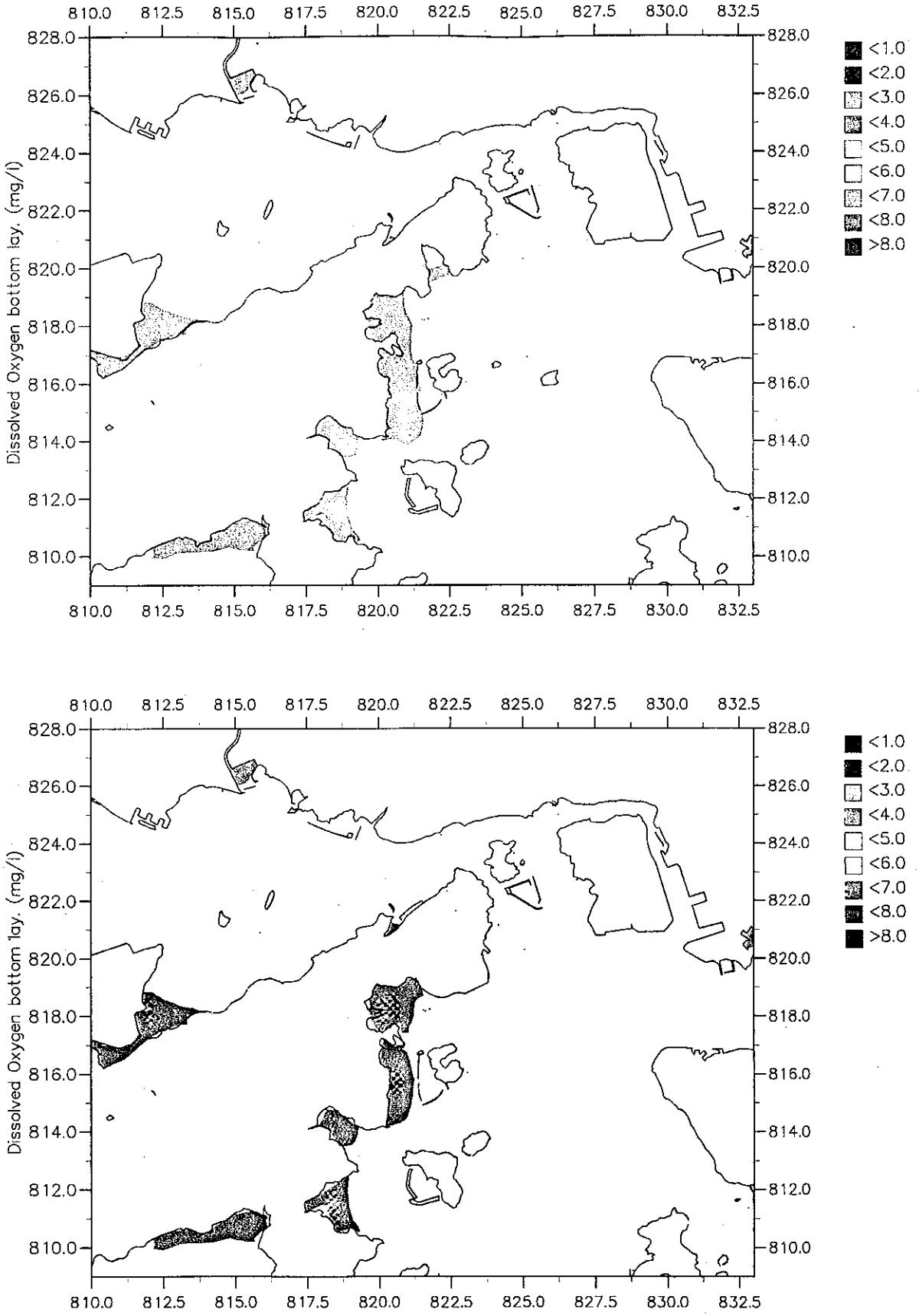

Figure D3d 10th Percentile Bottom Dissolved Oxygen Concentrations
Dry Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

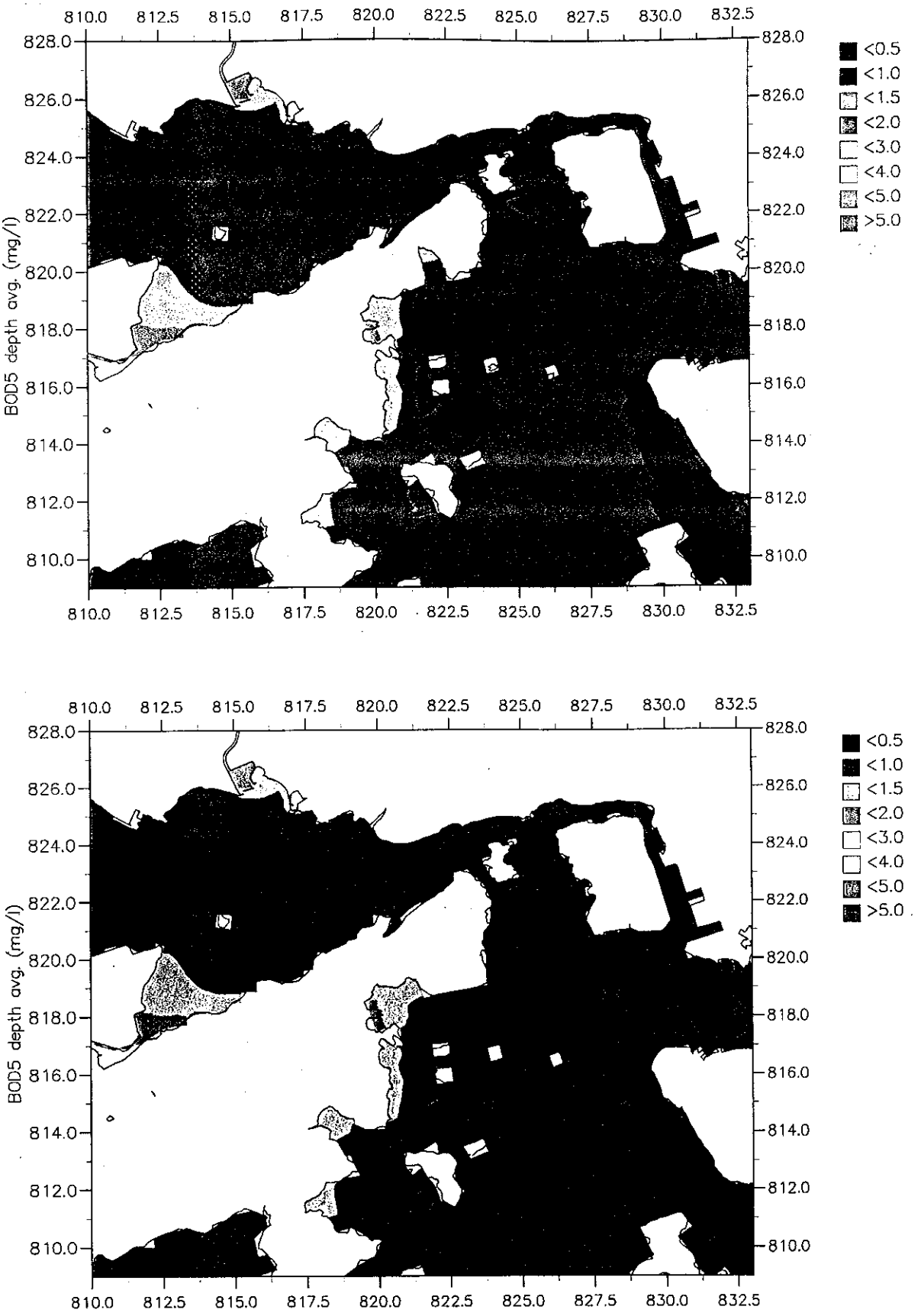

Figure D3e Mean Depth Averaged BOD_5 Concentrations
Wet Season
Upper : Baseline Lower : Completed

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Resources
Management

ERM

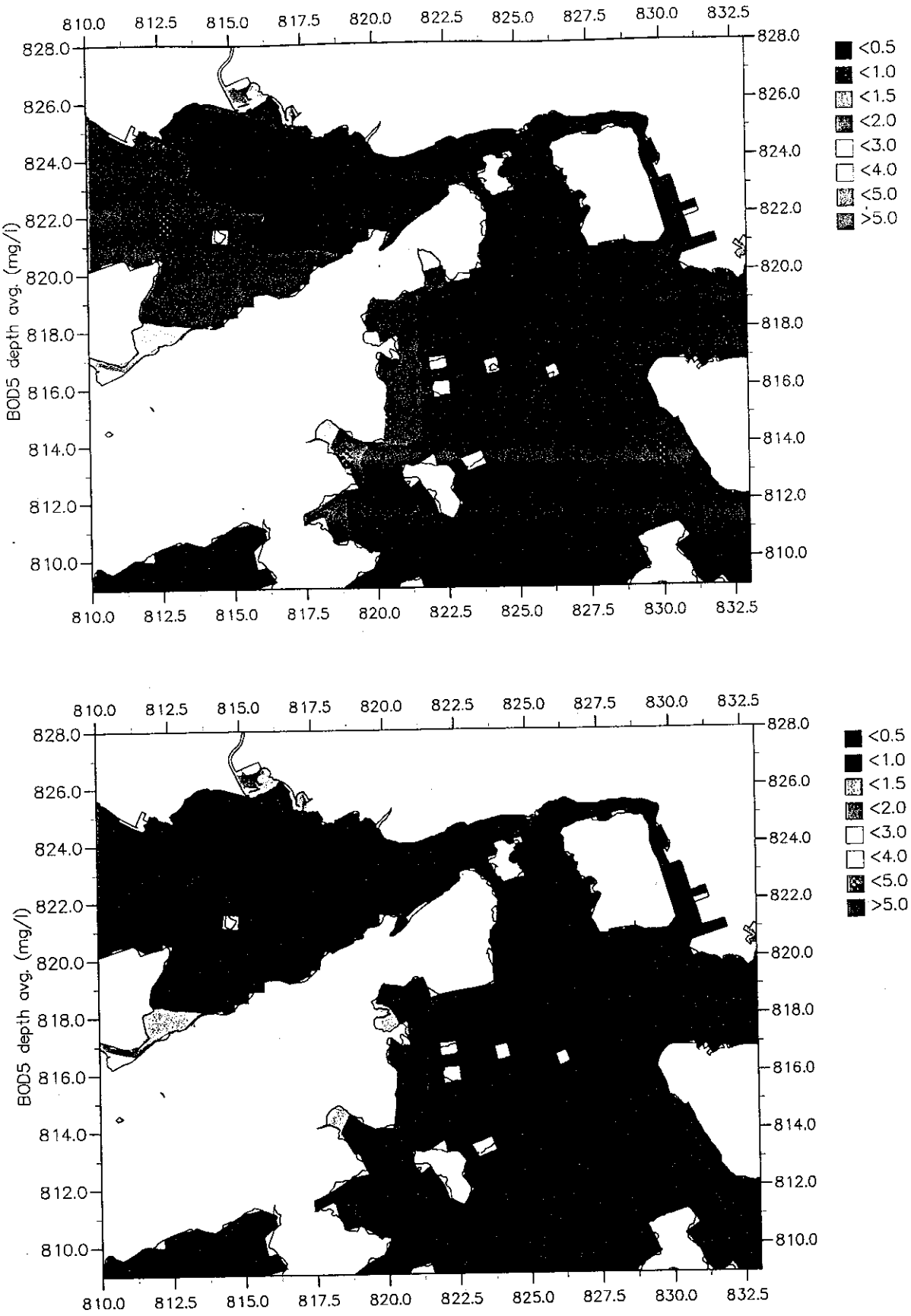

Figure D3f Mean Depth Averaged BOD_5 Concentrations
Dry Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

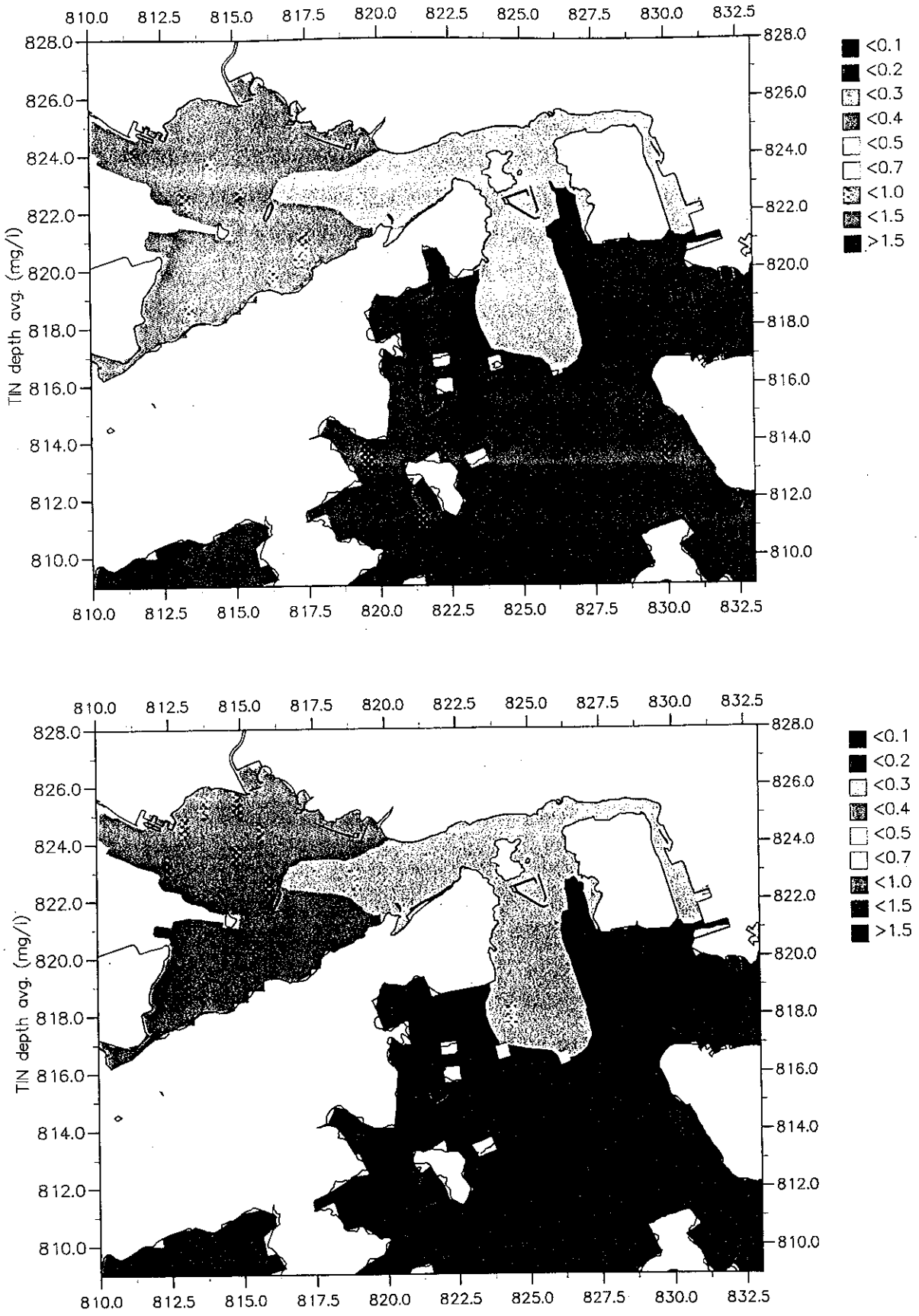

Figure D3g Mean Depth Averaged Total Inorganic Nitrogen Concentrations
Wet Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

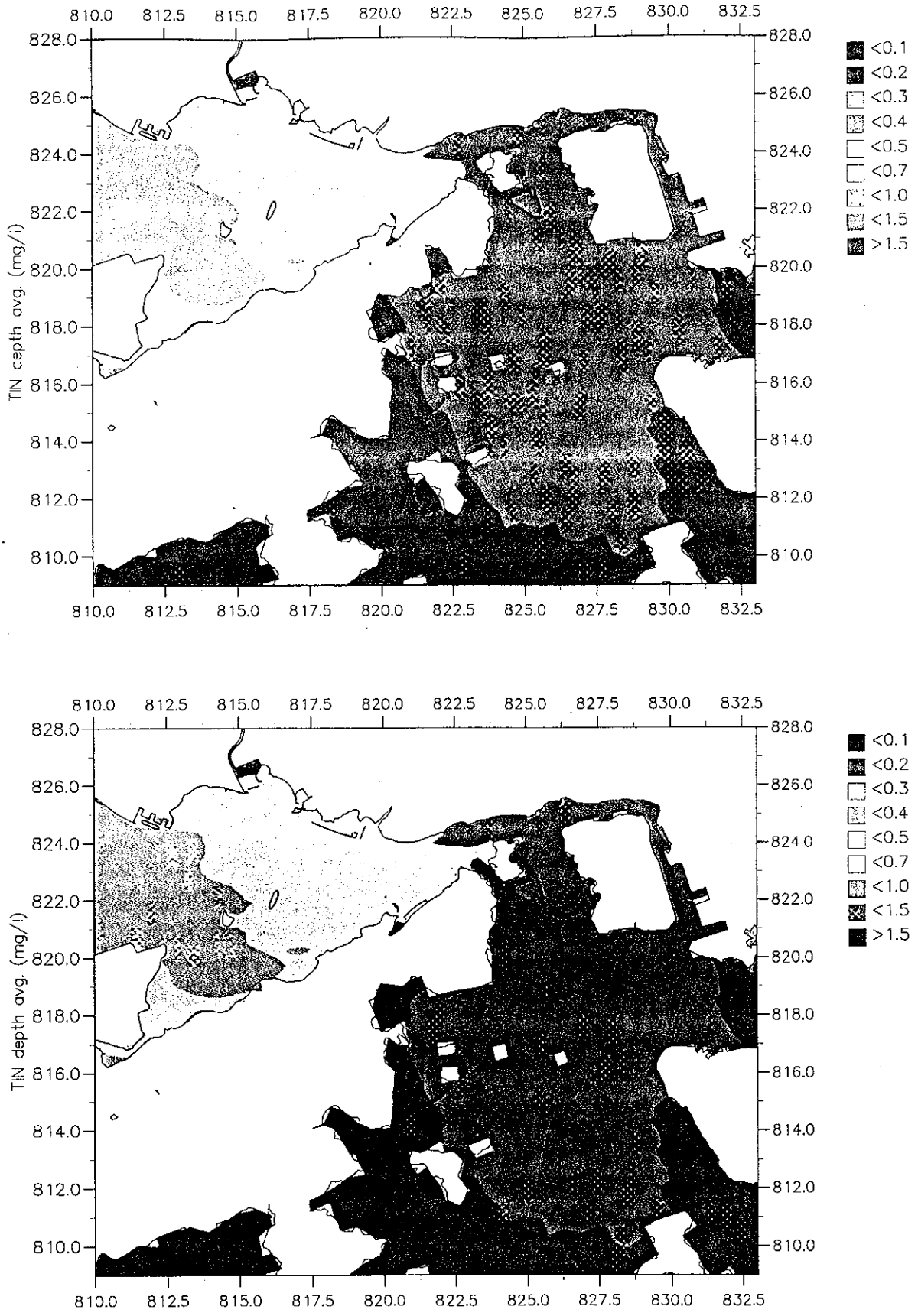

Figure D3h Mean Depth Averaged Total Inorganic Nitrogen Concentrations
Dry Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

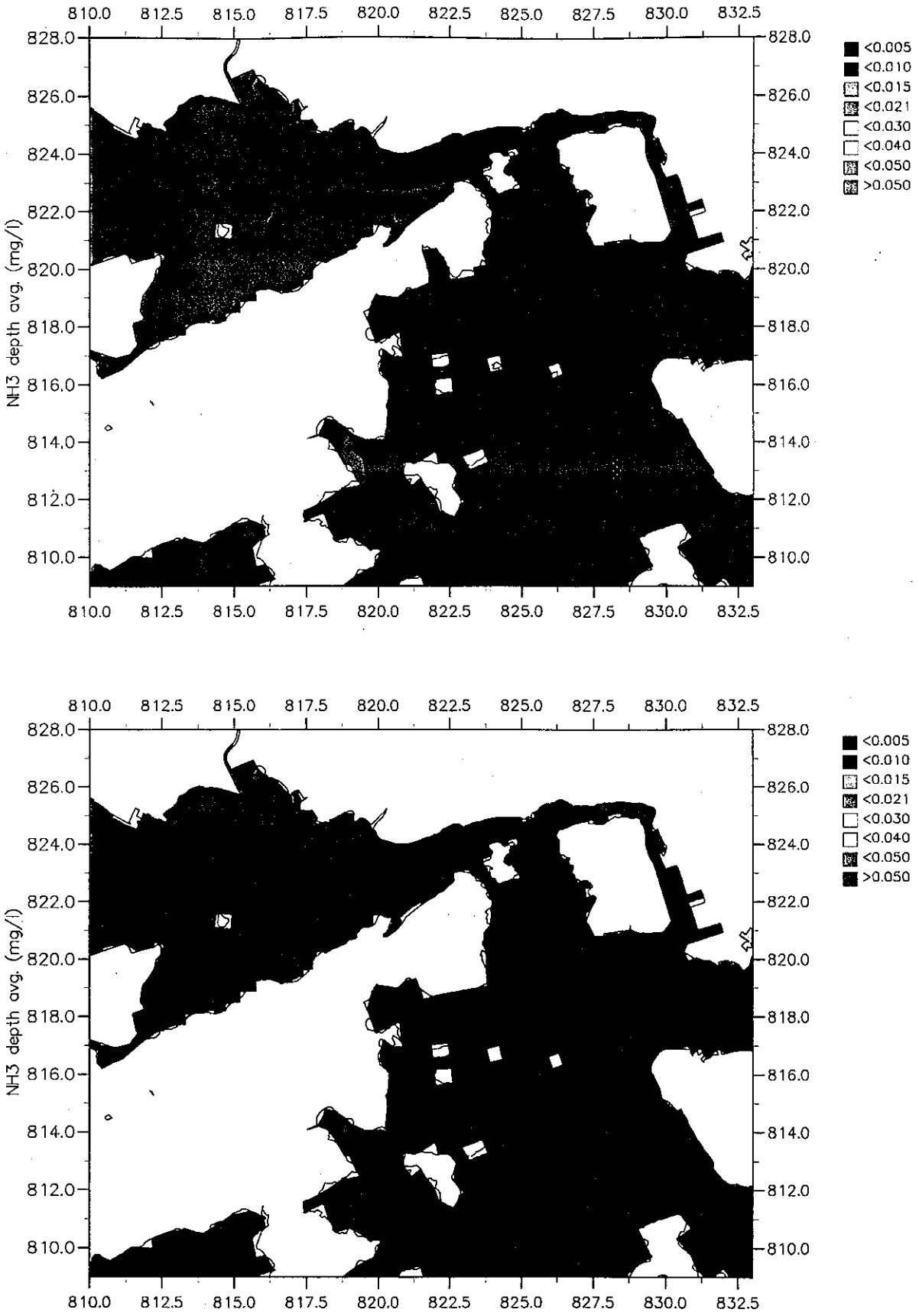

Figure D3i Mean Depth Averaged Unionised Ammonia Concentrations
Wet Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

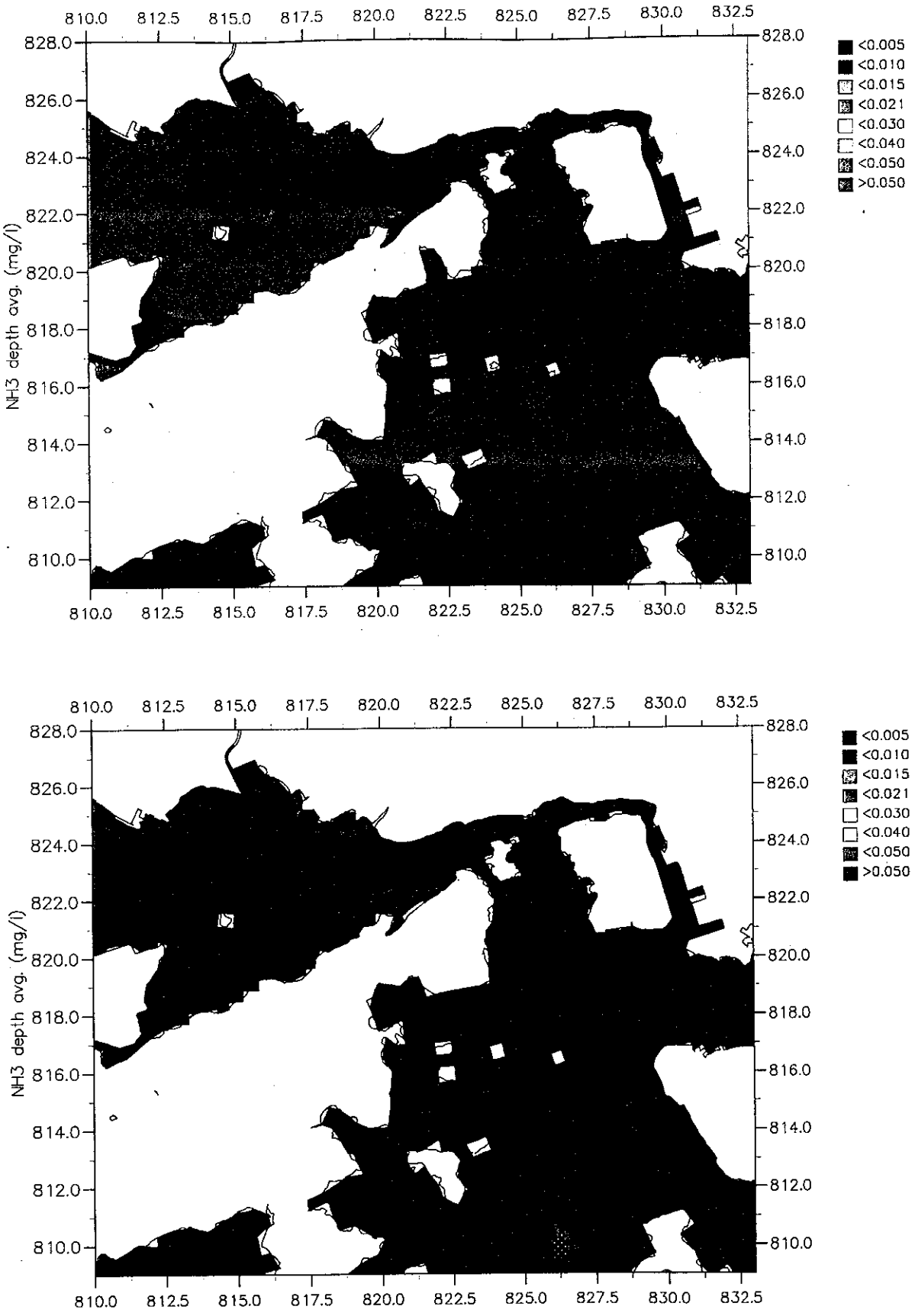

Figure D3j Mean Depth Averaged Unionised Ammonia Concentrations
Dry Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

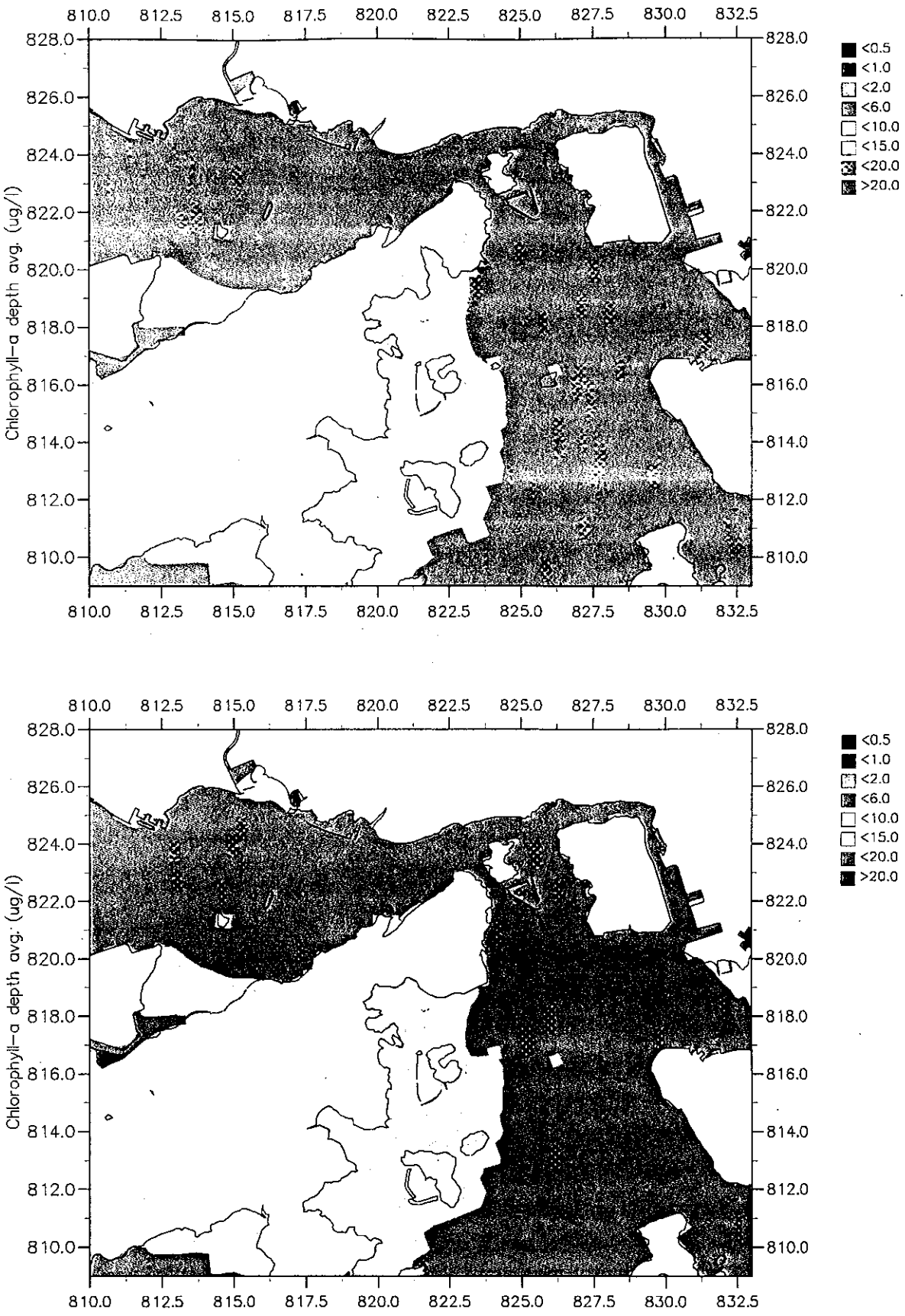

Figure D3k Mean Depth Averaged Chlorophyll-a Concentrations
Wet Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

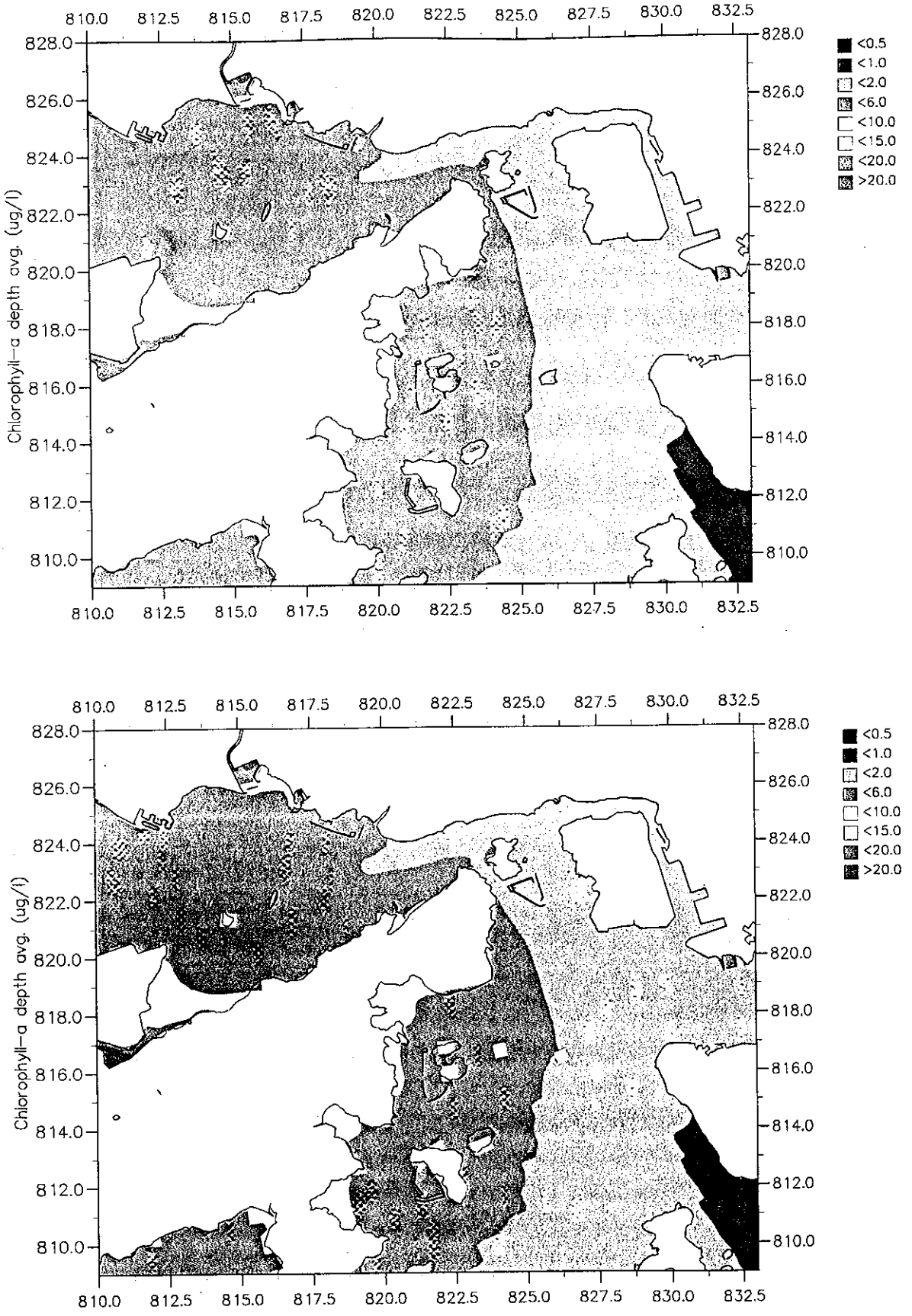

Figure D31 Mean Depth Averaged Chlorophyll-a Concentrations
Dry Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

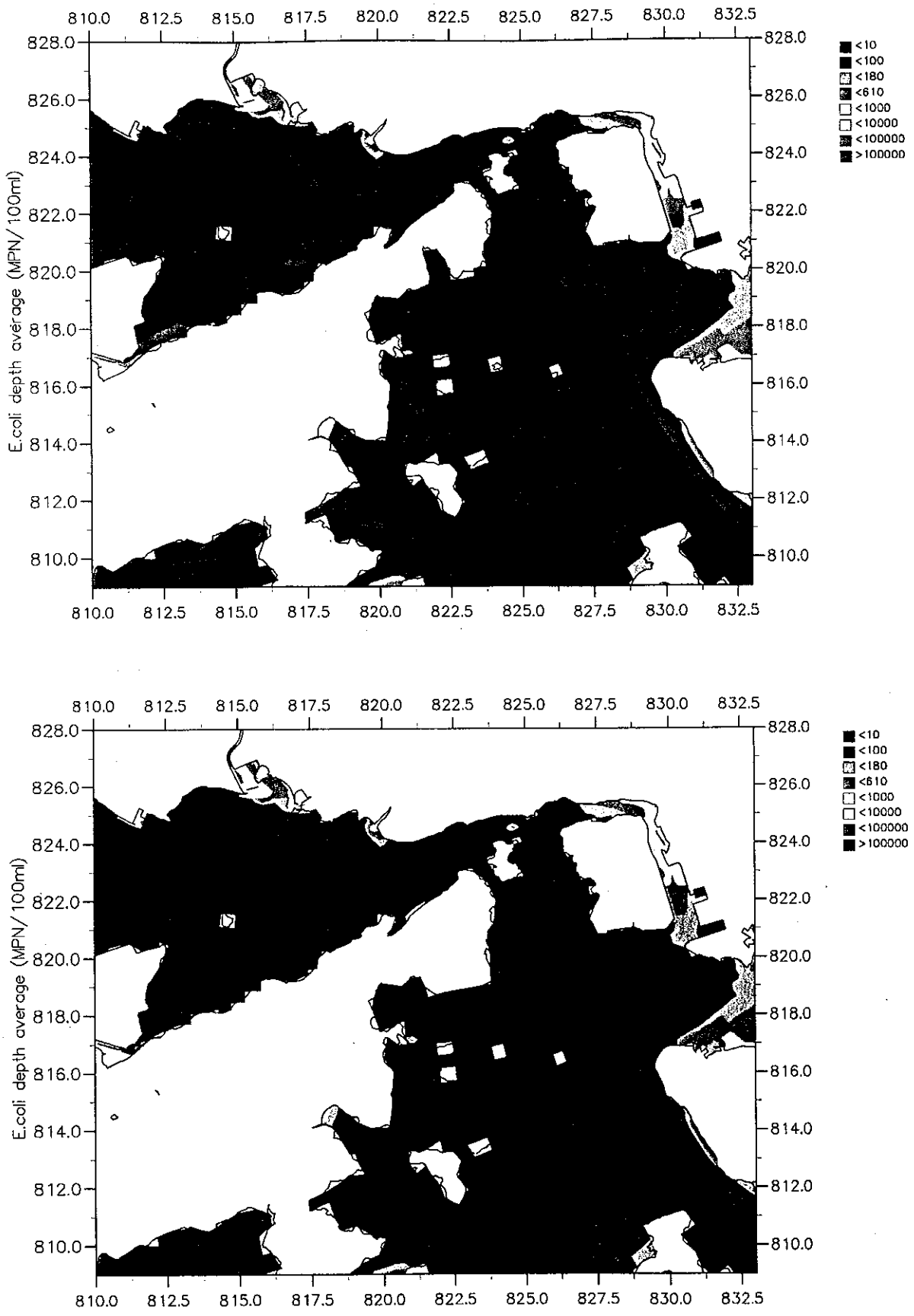

Figure D3m	Geometric Mean Depth Averaged *E. coli* Concentrations Wet Season Upper : Baseline Lower : Completed	**Environmental Resources Management** ERM

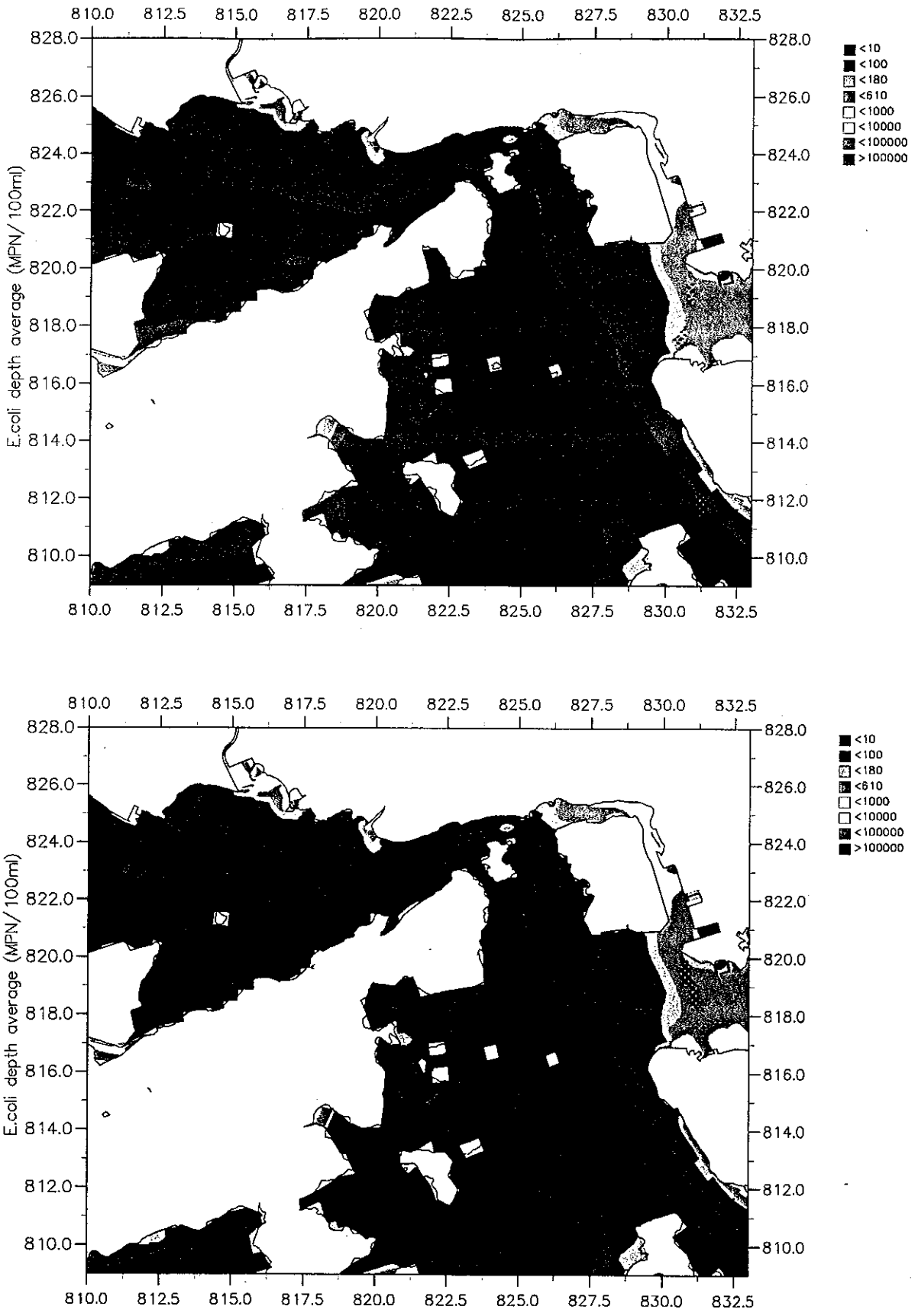

Figure D3n	Geometric Mean Depth Averaged *E. coli* Concentrations Dry Season Upper : Baseline Lower : Completed	**Environmental Resources Management** ERM

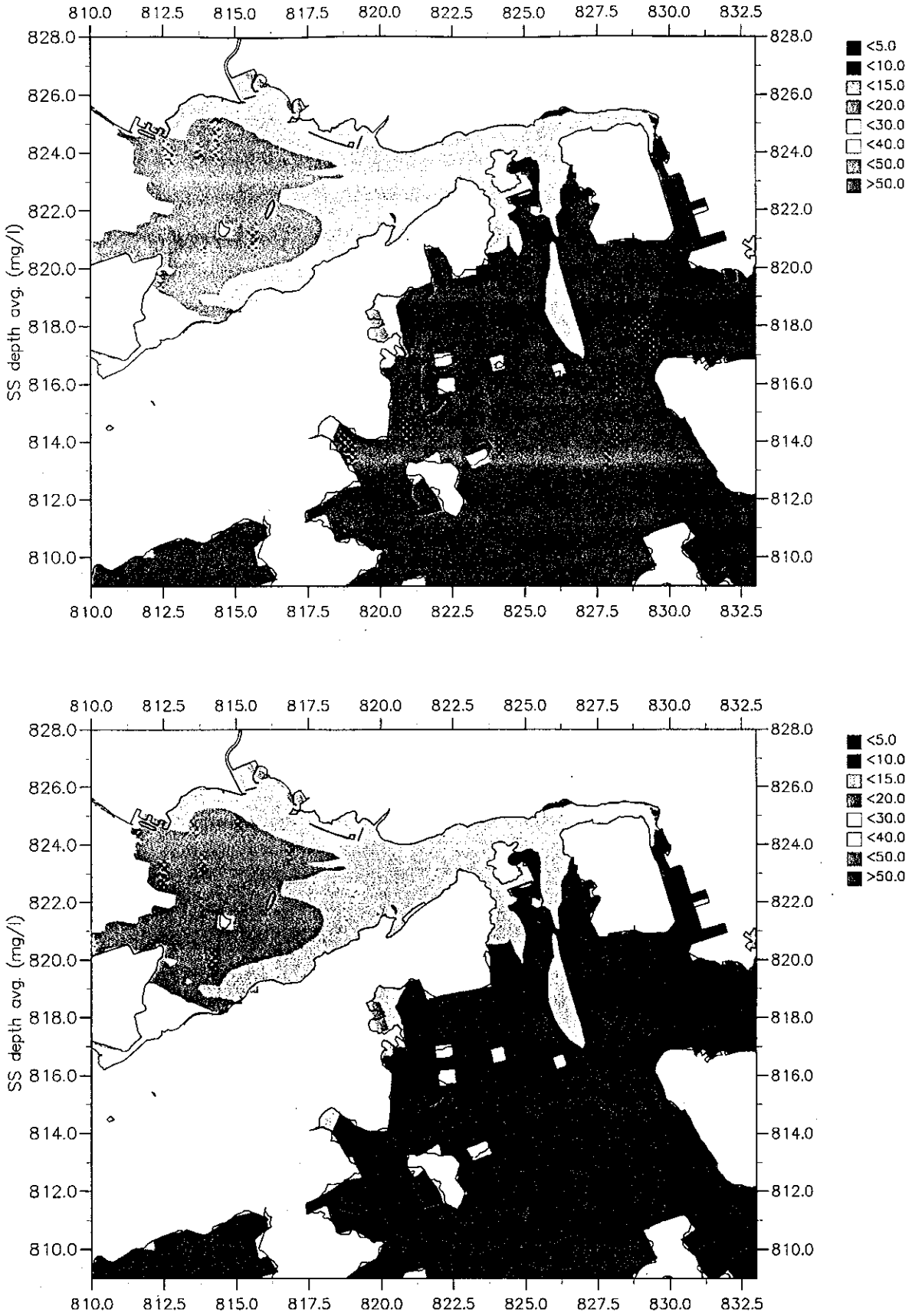

Figure D3o Maximum Depth Averaged Suspended Solids Concentrations Wet Season
Upper : Baseline Lower : Completed

Environmental Resources Management

ERM

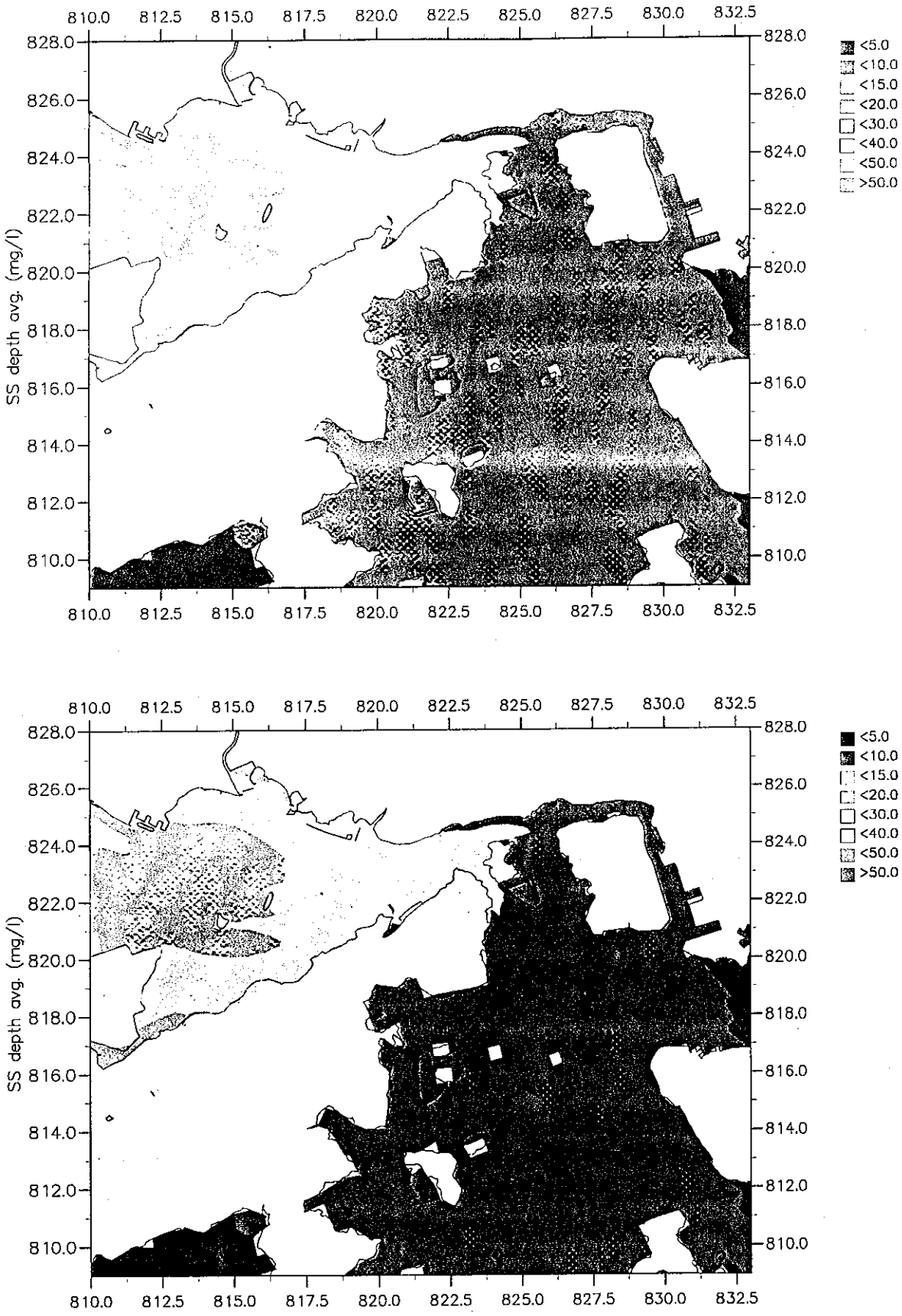

Figure D3p Maximum Mean Depth Averaged Suspended Solids Concentrations Dry Season
Upper : Baseline Lower : Completed

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