

## SSA 11 : Guadiana Estuary: Portugal and Spain : System Design

**Policy Issues Chosen by Stakeholders *via* Questionnaire**  
Increasing untreated wastewater discharges and decreasing freshwater discharges from dams impact estuarine water quality

**Goods and Services Provided by the Estuary**  
Salt farming; Aquaculture; Restaurants activity; Tourism settlement; Nautical recreation; Bathing; Fisheries

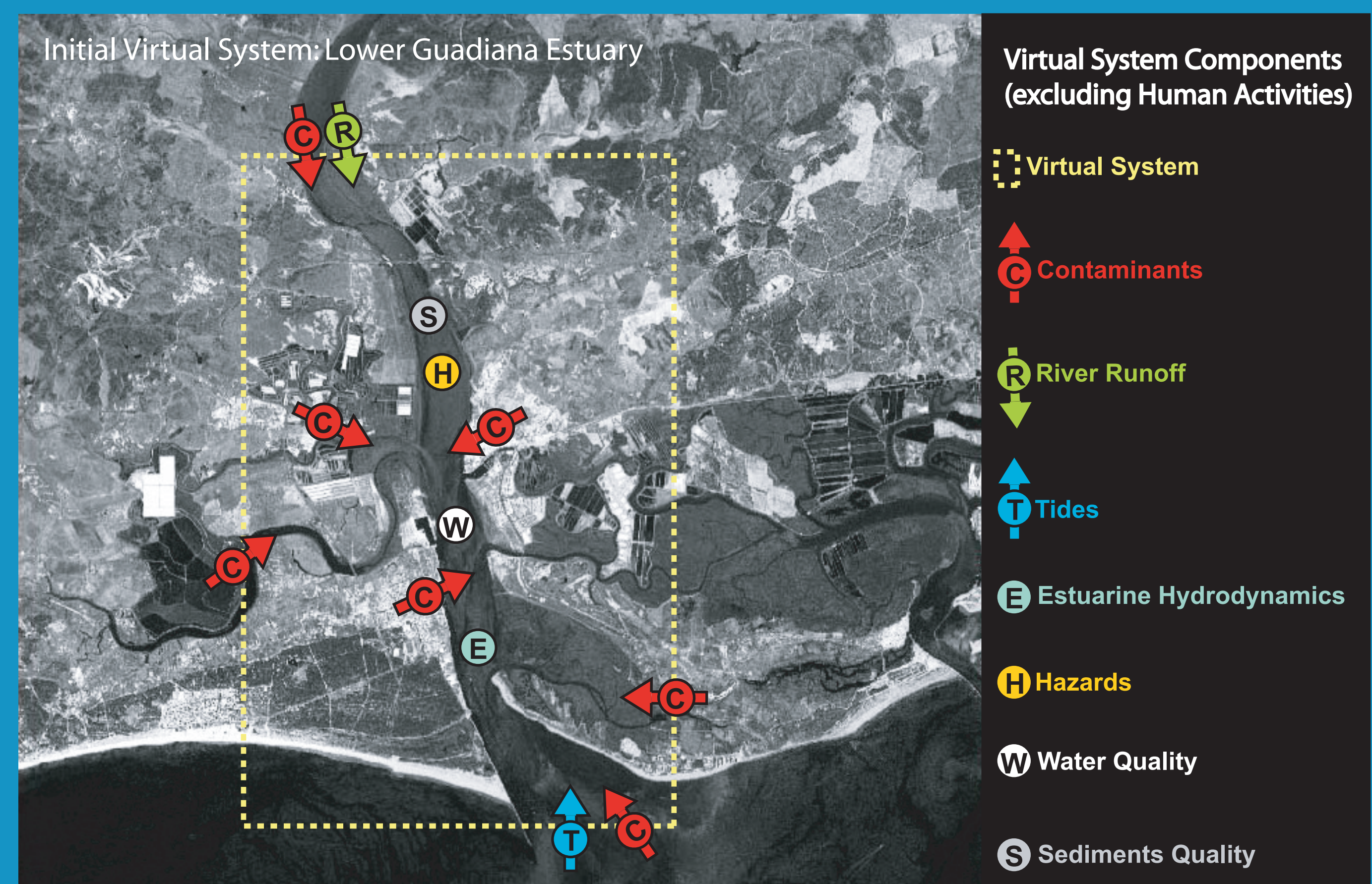
**System Ecological Components**  
Estuary water volume ( $m^3$ ); mass of pollutants (g); pollutants concentrations in water and sediment ( $g/m^3$  and  $mg/kg$ ); river runoff ( $m^3$ ); tidal prism ( $m^3$ ); flow velocity (m/s), rainfall (mm/year); wastewater treatment efficiency (% of removal)

**System Socio-Economic Components**  
Direct impacts: Salt farming; aquaculture  
Indirect impacts: Tourism and related activities  
Induced impacts: Unemployment; Local population aging  
Socio-economics indicators: Total Economic Value; Income; Consumer Surplus; Employment; Added Value; Energetic Consumption; Willingness to pay; Willingness to accept

DPSIR		SPICOSA	
<b>Driver:</b>	Increasing human occupation (residential and tourism) around the estuary	<b>Human Activity:</b>	Human occupation (residential and tourism)
...rises...		...results in a...	
<b>Pressure:</b>	The production and discharge of urban waste waters into the estuarine environment	<b>Forcing:</b>	Increasing production of urban wastewater
...resulting in a shift of...		...which acts on...	
<b>State:</b>	The water and sediment quality in what refers to organic matter, nutrients and diverse pollutants	<b>System State:</b>	The concentration of organic matter, nutrients and diverse pollutants in the water and sediment of the estuary
...which may be diagnosed as an...		...bringing...	
<b>Impact:</b>	Inappropriate water and sediment quality for several Human Activities: salt farming, aquaculture, nautical recreation, bathing, etc,	<b>Response:</b>	A decrease in the estuarine water and sediment quality
...causing...		...causing a...	
<b>Response:</b>	The need for more/better wastewater treatment plants, and the full implementation of the Water Directive Framework	<b>Impact:</b>	Decrease of the Human Activities relying on the use of the estuarine water and sediment
		...requiring a...	
		<b>Policy Change:</b>	Larger/Better wastewater treatment operating capacity and a more effective ability to implement the WDF



Stakeholders	Activity	Country	Stakeholders	Activity	Country
Vila Real de Santo António City Council	Governance	Portugal	Guadiana Salt Farmers Association (Tradisal)	Non Governmental	Portugal
Castro Marim City Council	Governance	Portugal	Guadiana Salt Farmers Cooperative	Non Governmental	Portugal
Alcoutim City Council	Governance	Portugal	Almargem (Regional NGO)	Non Governmental	Portugal
Mértola City Council	Governance	Portugal	Quercus (National NGO)	Non Governmental	Portugal
Algarve Regional Development and Coordination Commission	Governance	Portugal	Odiana (Local NGO)	Non Governmental	Portugal
Alentejo Regional Development and Coordination Commission	Governance	Portugal	Alcance (Local NGO)	Non Governmental	Portugal
Water Institute (INAG)	Governance	Portugal	Nature Protection League (National NGO)	Non Governmental	Portugal
Ports and Maritime Transports Institute (IPTM)	Governance	Portugal	Isla Cristina City Council	Governance	Spain
Castro Marim and Vila Real de Santo António Saltmarshes Natural Reserve	Governance	Portugal	Ayamonte City Council	Governance	Spain
Guadiana Valley Natural Park	Governance	Portugal	Ayamonte City Council	Governance	Spain
Alqueva Dam Management Company (EDIA)	Governance	Portugal	Ayamonte Local Development Agency	Governance	Spain
Almada de Ouro and Corte Velho Golf Resorts Architect (Fausto Nascimento)	Private	Portugal	Punta Umbria City Council	Governance	Spain
Lands (Eco-tourism Company)	Private	Portugal	Sanlúcar de Guadiana City Council	Governance	Spain
			Odriel Saltmarshes Natural Park	Governance	Spain
			Environmental Department of the Andalusia Government	Governance	Spain
			Esuri Resort Company	Private	Spain
			Ambientalistas en Acción (Regional NGO)	Non Governmental	Spain



### Initial Conceptual Model

3 interconnected blocks:

**Estuary Volume and Water Quality**  
Freshwater discharges from dams + Tides + Rainfall  
= Volume of the estuarine reservoir

Pollutants Mass / Volume of the estuarine reservoir  
= Pollutants Concentration >> Water Quality

**Human Activities**  
Pollutants Mass >> Impacts on HA >> HA incomes

**Management Tool**  
Water Quality vs HA Incomes

### Problems Encountered

Estuary volume does not change with more or less river runoff

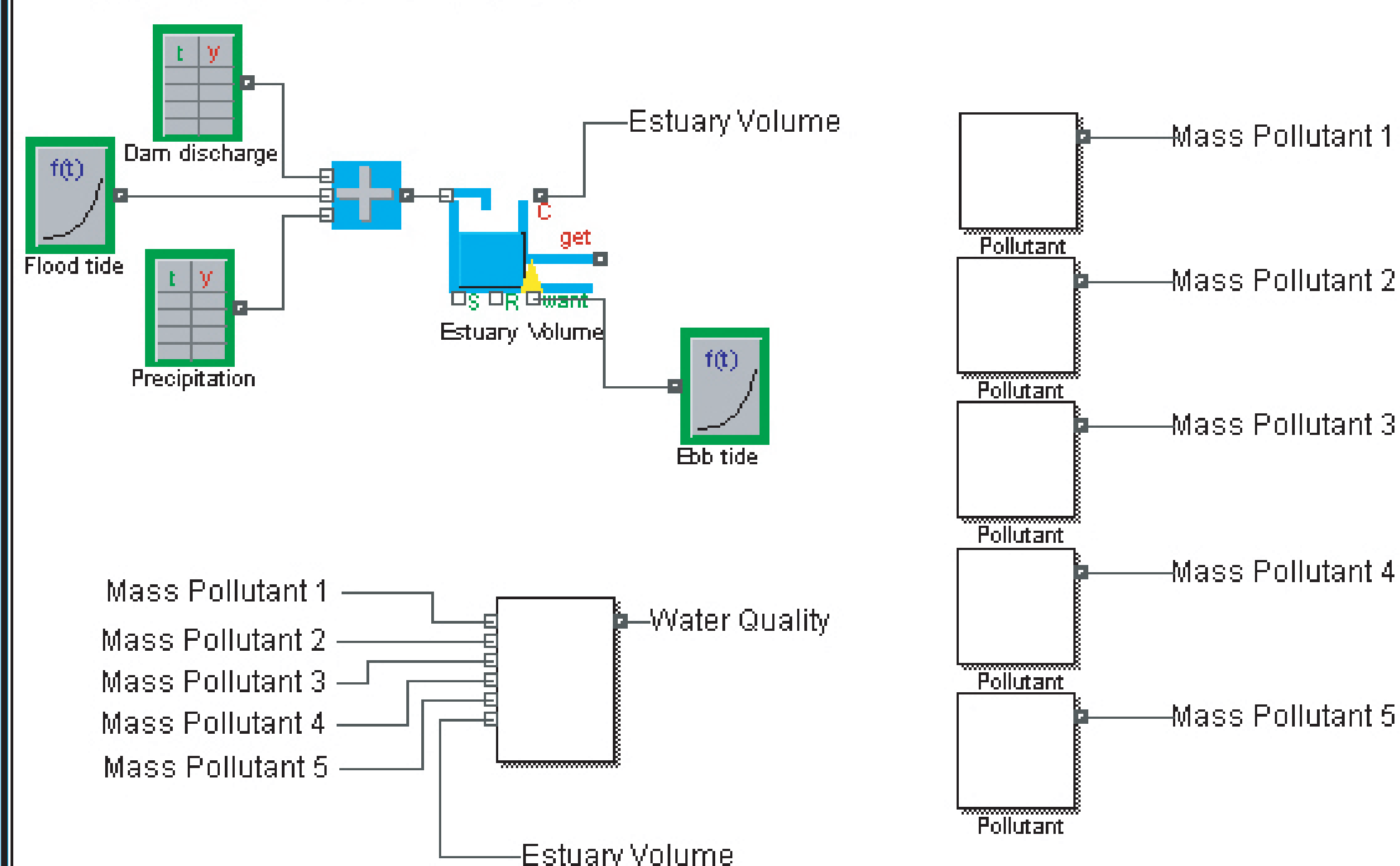
Pollutants concentrations can not be obtained by dividing pollutants mass by estuary volume

Impact of pollutants on human activities is not direct, linear and evident and so it is not easy to model eventual bridges between the ecological, social and economic components

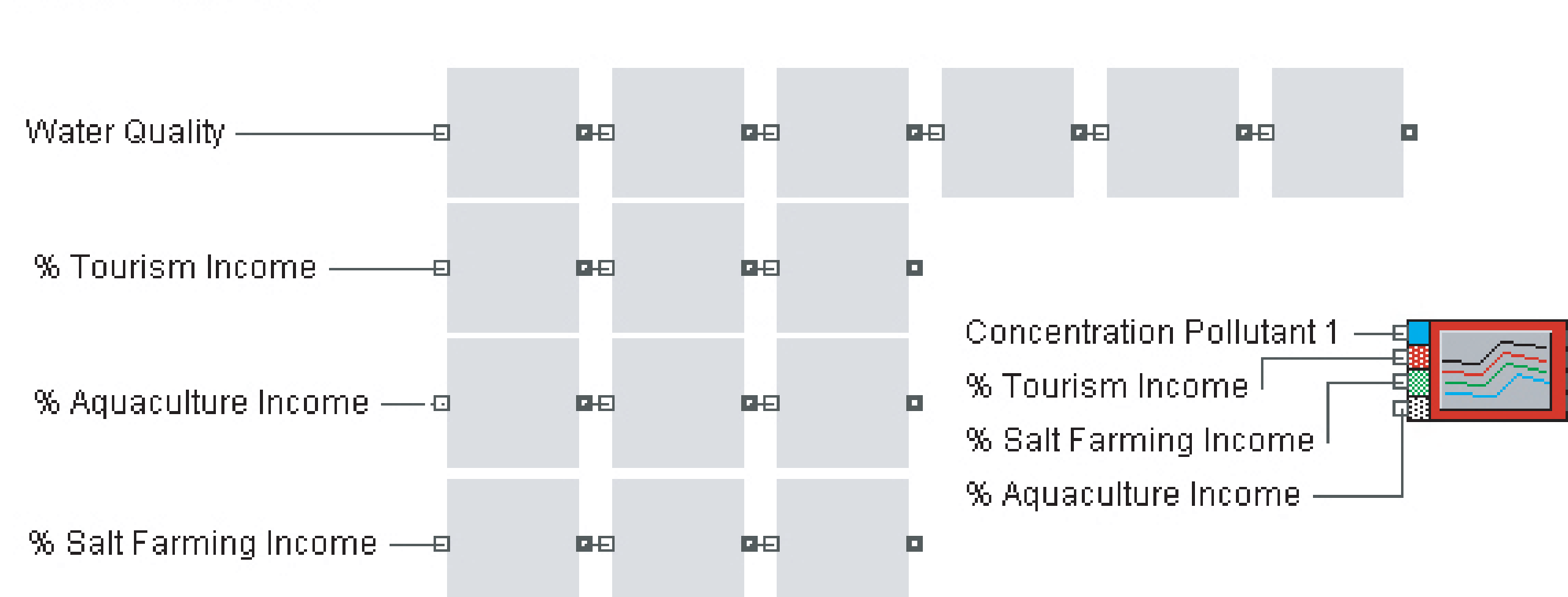
### Solution

Please consult our System Formulation poster

### Estuary Volume and Water Quality



### Management Tool



### Human Activities

