PROJECT SUMMARY

The focus of this project is hence to better understand the desalinization process by focusing on designing and manufacturing a single desalinization unit. The basis of this project will fall within the cleaning module/function of the Sustainable Water System roadmap family. This unit will serve the following purposes and criteria in Dubai desalinization efforts:

(1) An educational water desalinization tool for RIT and RIT Dubai students that will show the small scale operation of a desalinization unit
(2) Focus on the removal of sea salt from the Arabian Sea water, assuming no other contaminants exist
(3) This cleaning technology can later be placed in series with a biological cleaning system to achieve both a salt free and bio-contaminant free water stream
(4) This unit will focus on providing clean water for one person
(5) The means by which the desalination function will be achieved is left open for the MSD team to decide (e.g. distillation, reverse osmosis, solar distillation, filtration, chemical, etc.)
(6) The hardware product at the end should be appropriate for both USA and UAE student teams to build upon
(7) The hardware design should reflect both USA and UAE campus infra-structure (e.g. the teams should think carefully about English vs. Metric units)
(8) The primary application and objective for this project is educational so that MSD teams gain experience with desalination for subsequent MSD teams to build upon
(9) There is no desire to actually deploy the results from this project in a field environment, but the results obtained can be used to design a desalinization system for the future campus of RIT Dubai

ADMINISTRATIVE INFORMATION:

Project Name:	*Water Desalinization System for Dubai*	Faculty:	*TBD, Dr. Ghoneim (RIT Dubai)*
Project Number:	*(Leave this field blank, so that a number can be assigned when the project is launched)*	Industry Guide:	*Sarah Brownell, Gerry Garavuso*
		Project Customer:	*Dr. Edward Hensel, Dr. Mustafa Abushagur*
Project Track:	*Energy and Sustainable Systems*	Project Sponsor:	*TBD*
Project Family:	*Water Cleaning Systems*	Project Budget:	*TBD*
Parent Roadmap:	*Open Source/Open Architecture Sustainable Water Systems*		
Planning Term:	*2010-1*		
Start Term:	*2010-2*		
End Term:	*2010-3*		

PROJECT CONTEXT:

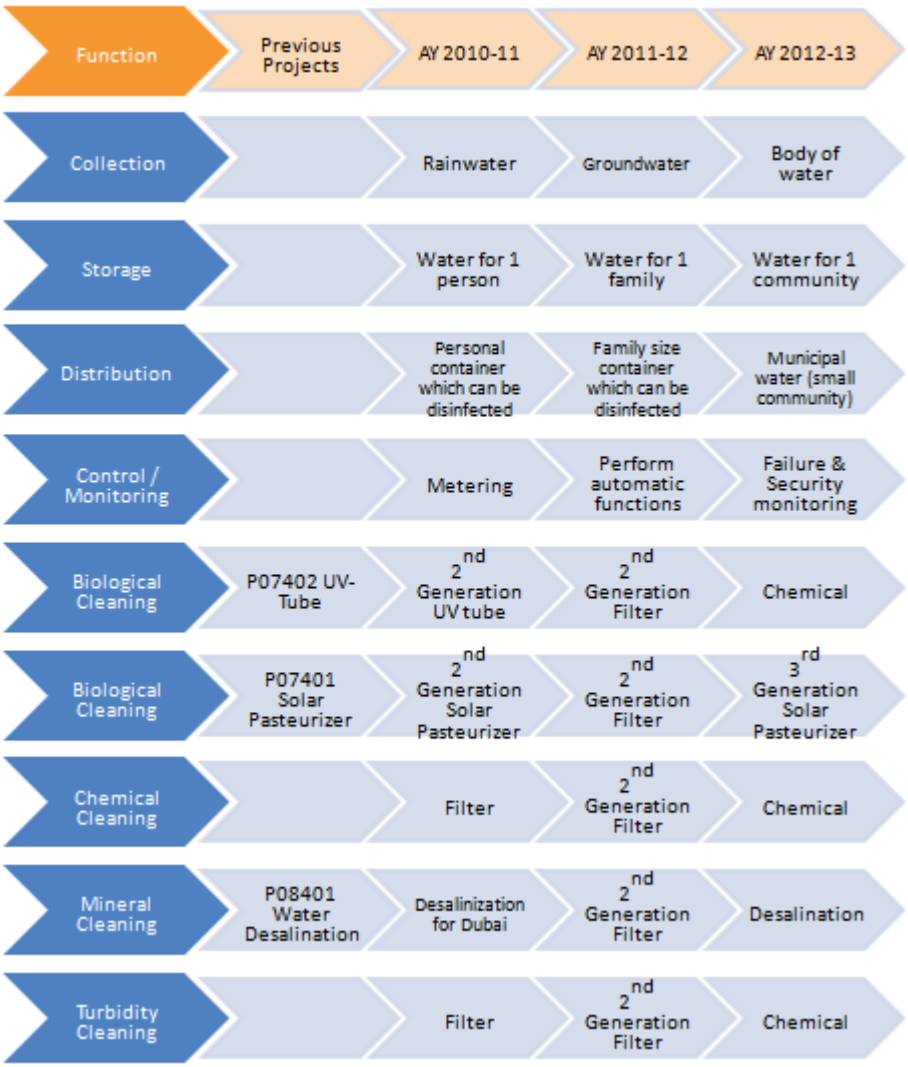
Water is one of the basic needs that the world's population relies upon in order to survive. Given the critical nature of water to humanities' survival and the manner in which numerous parts of the world struggles to provide water supplies to their citizens, RIT created a Sustainable Water Systems family roadmap to provide a compelling solution to the problem of sufficient, accessible, economical, and sustainable water supply.

In recent decades, Dubai (UAE) has seen a significant growth in its population that has caused tremendous growth in this region of the world as well as led to Dubai becoming a major metropolitan in the world. Hence, a growing need has risen to provide this region with a sustainable water source.

In order to meet their growing water demands, Dubai has been focusing on desalinization efforts due to their proximity to the Arabian Sea. Numerous desalinization plants have been built near or around Dubai in order to meet their water needs, and many more will be built as this region continues to grow.

Hence, this project is very important to not only the growing region of Dubai, but to the rest of the world as well. Majority of the world's population is within the walking distance of a body of water, and it will soon become very critical for the world's population to harvest these water supplies in order to meet the world's growing water needs. Understanding the desalinization process is therefore a critical component of these efforts.

This project is a pioneering project within the Sustainable Water Systems family roadmap, and first one to focus on desalinization water cleaning efforts. It is not a direct continuation of a previous senior design project, but an MSD team would find it useful to reference 'Water Desalination P08401' MSD project to gain a better perspective on this cleaning process. Ultimately, this projects objective is to develop a cleaning technology that will be placed in a series with a biological cleaning system to achieve both a salt free and bio-contaminant free water stream. Below is the family roadmap to reference the Sustainable Water Systems family of projects and their respective functions.



PROJECT HOUSE OF QUALITY:

Sustainable Water

		Cleaning						Storage				Distribution		
Number of different harmful contaminants filtered														
Number of environments it can work in (ex. Desert, ocean, jungle, tundra, etc.)		++												
Turbidity of the water (ex. Appearance, clarity, palatability)			+											
Amount of harmful biological contaminants		++	++											
Amount of harmful chemical contaminants		++	++											
Amount of harmful mineral contaminants		++	++											
Amount of water which can be stored			+											
Shelf life before contamination			+		++	++								
Input flow rate			+					++						
Output flow rate			+					++						
Flow rate (internal to distribution system)										+	+			
# of customers								++				++		
Distance covered												++		
Indication of working vs. not working, including early warning					+	+	+							
Measures the amount of flow through system														
Budgeting or Rationing of Supply														
Number of sources which can be collected from (ex. Flowing, Standing, Water Vapor , Rainwater, Animal Waste)														
Input flow rate								+					+	
Output flow rate													+	
	Spec	a.1	a.2	a.3	a.4	a.5	a.6	b.1	b.2	b.3	b.4	c.1	c.2	c.3
								Engineering Metrics						
Our mission is to provide compelling solutions to the problem of sufficient, accesible, economical, and sustainable potable water supplies for the world's population.	**Customer Weights**	Number of different harmful contaminants filtered	Number of environments it can work in (ex. Desert, ocean, jungle, tundra, etc.)	Turbidity of the water (ex. Appearance, clarity, palatability)	Amount of harmful biological contaminants	Amount of harmful chemical contaminants	Amount of harmful mineral contaminants	Amount of water which can be stored	Shelf life before contamination	Input flow rate	Output flow rate	Flow rate (internal to distribution system)	# of customers	Distance covered
VOC - Affinity Groups	**CO #**	**VOC - Customer Objectives**	**Preferred Direction**	Up	Up	Down	Down	Down	Down	Up	Down	Up	Up	Up	Up	Up
Economical	1.1	Supply water that will not exceed 15% of gross income and considered completed once below 5% of gross income.	**20.0%**												3	
Sustainable	2.1	Use a device that is compatible with multiple water sources.	**20.0%**	1	9	1										
	2.2	Minimized educational requirement for safe operation and environmental responsibilities.	**20.0%**													
	2.3	Incorporate a concise and well organized structured action plan.	**20.0%**													
	2.4	Utilize environment specific sustainable power source.	**20.0%**		9											
	2.5	Have products readily available where required and needed.	**20.0%**		3										1	3
	2.6	Ensure processed water is maintained at its cleaned condition.	**20.0%**			1	1	1	1	3	9					
Sufficient	3.1	Own a device to meet consumption demands (2 liters/person/day).	**60.0%**							3	3	3	3	3	3	
	3.2	Own a device to provide safe and clean drinking water (palatability (taste, smell, clarity)).	**60.0%**	3	3	3	3	3	3							
	3.3	Available testing methods to substantiate cleanliness.	**60.0%**				3	3	3		3					
	3.4	Device desingned for storage and water cleaning that is robust to damage.	**60.0%**	3	3	3	3	3	3	3	3	3	3			
Accessible	4.1	Strong societal support to assist with producing clean sustainable water.	**0.0%**	3	3	3	3	3	3							
	4.2	Operate a device that has simple usage.	**0.0%**													
	4.3	Operate a device that requires time efficient maintenance.	**0.0%**													
	4.4	Limit collection time to fit within the range of 50% to 5% of current collection time.	**0.0%**													
	4.5	Modified water transportation that requires less human effort.	**0.0%**											3	3	3
			Measure of Performance	#	#	NTU	ppm	ppm	ppm	L	day	L/day	L/day	L/day	#	m
			Nominal Value	0	0	0	0	0	0	0	0	0	0	0	0	0
			Marginal Value	1	1	0	0	0	0	2	1	0	0	2	1	0

CUSTOMER NEEDS ASSESSMENT:

Customer Needs Ranking Table

Customer Need Number	Stakeholders	Description	Measure of Effectiveness (How will you demonstrate that you have met the need).
1.1	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Supply water that will not exceed 15% of gross income and considered completed once below 5% of gross income	Documentation: Analytical calculate the percentage of average regional gross income to cost of water, to determine effectiveness
4.2	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Operate a device that has simple usage	Documentation: Experiment with a representative group to observe simplicity.
4.3	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Operate a device that requires time efficient maintenance	Demonstration: Experimentally measure time required to maintain per period of time basis.
4.5	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Modified water transportation that requires less human effort	Demonstration: Experimentally measure effort required to transport water.
4.1	Users of Water, Charities/Church Groups, Government	Strong societal support to assist with producing clean sustainable water	Demonstration: Analytically calculate support of resources from government, churches, charities, etc…
3.2	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Own a device to provide safe and clean drinking water (palatability (taste, smell, clarity))	Demonstration: Experiment with operation of device with variable water sources and test cleanliness.
3.1	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Own a device to meet consumption demands (2 liters/person/day)	Documentation: Analytically calculate the region's available water sources and capacity of developed device.
3.3	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Available testing methods to substantiate cleanliness	Demonstration: Analytically determine effective testing methods for applications.
3.4	Water Purification Equipment Manufacturers, Dubai (Desalinization)	Device designed for storage and water cleaning that is robust to damage	Demonstration: Experimentally test robustness under different conditions.
2.1	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Use a device that is compatible with multiple water sources	Demonstration: Experiment with device's capability with multiple water sources.
2.2	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Minimized educational requirement for safe operation and environmental responsibilities	Demonstration: Experiment with users to see how much time it takes for them to learn the required content.
2.5	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization), Government, Charities/Church Groups	Have products readily available where required and needed	Documentation: Analytically calculate the distance/availability of products.
2.6	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization)	Ensure processed water is maintained as its cleaned condition	Demonstration: Experiment with representative group to continuously monitor condition of water.
2.3	Users of Water, Water Purification Equipment Manufacturers, Dubai (Desalinization), Government	Incorporate a concise and well organized structured action plan	Documentation: Design a structured action plan and experiment with a representative group.
2.4	Water Purification Equipment Manufacturers, Dubai (Desalinization)	Utilize environment specific sustainable power source	Demonstration: Experiment with compatibility of region specific power sources with designed device.

ENGINEERING SPECIFICATIONS:

List of Engineering Specifications

Engineering Spec.	Derives from Customer Needs	Relative Importance (-,1,3,9)	Description	Measure of Performance	Engineering Units	Marginal value	Ideal Value	Validation Method
a.1	2.1, 3.2, 3.3		Number of different harmful contaminants filtered	Measure quantity of contaminants removed from highly contaminated water source with minimal time allowance.	(integer)			Experimental
a.2	2.1, 2.4, 3.2,		Number of environments device can work in (ex. Desert, ocean, jungle, tundra, etc.)	Measure the device's effectiveness in extremely diverse environmental conditions.	(integer)			Experimental
a.3	2.6, 3.2, 3.3		Turbidity of the water (ex. Appearance, clarity, palatability)	Compare the water conditions under maximum capacity.	(NTU)			Experimental
a.4	2.1, 3.2, 3.3		Amount of harmful biological contaminants	Measure quantity of contaminant removed from highly contaminated water source with minimal time allowance.	(ppm)			Experimental
a.5	2.1, 3.2, 3.3		Amount of harmful chemical contaminants	Measure quantity of contaminant removed from highly contaminated water source with minimal time allowance.	(ppm)			Experimental
a.6	2.1, 3.2, 3.3		Amount of harmful mineral contaminants	Measure quantity of contaminant removed from highly contaminated water source with minimal time allowance.	(ppm)			Experimental

e.1	2.1, 3.1, 3.2		Number of sources which can be collected from (ex. Flowing, Standing, Water Vapor , Rainwater, Animal Waste)	Determine the number of extreme sources that may be utilized by device.	(integer)		Experimental
e.2	3.1, 3.2		Input flow rate	Measure flow rate under maximum capacity.	(liters/day)		Analytical
e.3	3.1, 3.2		Output flow rate	Measure flow rate under maximum capacity.	(liters/day)		Analytical

Customer Needs Descriptions:
2.1: Use a device that is compatible with multiple water sources.
2.4: Utilize environment specific sustainable power source.
2.6: Ensure processed water is maintained at its cleaned condition.
3.1: Own a device to meet consumption demands (2 liters/person/day)
3.2: Own a device to provide safe and clean drinking water (palatability (taste, smell, clarity)).
3.3: Available testing methods to substantiate cleanliness.

			Spec	a.1	a.2	a.3	a.4	a.5	a.6	b.1	b.2	b.3	b.4	c.1	c.2	c.3
				Engineering Metrics												
Our mission is to provide compelling solutions to the problem of sufficient, accesible, economical, and sustainable potable water supplies for the world's population.			Customer Weights	Number of different harmful contaminants filtered	Number of environments it can work in (ex. Desert, ocean, jungle, tundra, etc.)	Turbidity of the water (ex. Appearance, clarity, palatability)	Amount of harmful biological contaminants	Amount of harmful chemical contaminants	Amount of harmful mineral contaminants	Amount of water which can be stored	Shelf life before contamination	Input flow rate	Output flow rate	Flow rate (internal to distribution system)	# of customers	Distance covered
VOC - Affinity Groups	CO #	VOC - Customer Objectives	Preferred Direction	Up	Up	Down	Down	Down	Down	Up	Down	Up	Up	Up	Up	Up
Economical	1.1	Supply water that will not exceed 15% of gross income and considered completed once below 5% of gross income.	20.0%												3	
Sustainable	2.1	Use a device that is compatible with multiple water sources.	20.0%	1	9	1										
	2.2	Minimized educational requirement for safe operation and environmental responsibilities.	20.0%													
	2.3	Incorporate a concise and well organized structured action plan.	20.0%													
	2.4	Utilize environment specific sustainable power source.	20.0%		9											
	2.5	Have products readily available where required and needed.	20.0%		3										1	3
	2.6	Ensure processed water is maintained at its cleaned condition.	20.0%			1	1	1	1	3	9					
Sufficient	3.1	Own a device to meet consumption demands (2 liters/person/day).	60.0%							3	3	3	3	3	3	
	3.2	Own a device to provide safe and clean drinking water (palatability (taste, smell, clarity)).	60.0%	3	3	3	3	3	3							
	3.3	Available testing methods to substantiate cleanliness.	60.0%				3	3	3		3					
	3.4	Device desingned for storage and water cleaning that is robust to damage.	60.0%	3	3	3	3	3	3	3	3	3	3			
Accessible	4.1	Strong societal support to assist with producing clean sustainable water.	0.0%	3	3	3	3	3	3							
	4.2	Operate a device that has simple usage.	0.0%													
	4.3	Operate a device that requires time efficient maintenance.	0.0%													
	4.4	Limit collection time to fit within the range of 50% to 5% of current collection time.	0.0%													
	4.5	Modified water transportation that requires less human effort.	0.0%													
			Measure of Performance	#	#	NTU	ppm	ppm	ppm	L	day	L/day	L/day	L/day	#	m

Nine, Three, and One indicate high, medium, and lower importance, respectively.

PROJECT INTERFACES:

This project is meant to be an individual system in its first iteration within the mineral cleaning function of the family roadmap. It should interface with a form of collection system in order to be able to clean collected water by utilizing an opening into which water is poured. It is very important that the water, after being cleaned, can interface with the user for consumption via a storage system that is being developed by another MSD group within the family roadmap. Given the one person scale of this project, the distribution and control/monitoring functions of the family roadmap do not require any interface with this cleaning process.

STAFFING REQUIREMENTS:

Position Title	Position Description
Mechanical Engineer	This individual will be responsible for providing design, analysis, implementation, and fabrication of the desalinization unit. The main focus will be to model and physically design the unit layout and structure while providing assistance to other engineers when required. - Knowledge of design software and packages will be required in order to create unit CAD drawings and perform structural analysis - Previous experience or interest in sustainable and simple design will be necessary - Strong knowledge of fluids and transport as well as computational techniques is preferable - Experience in machine shop is necessary - Experience with material selection and testing Must be able to interact and work well in a team environment
Mechanical Engineer	This individual will be responsible for the interfacing of the designed unit with appropriate collection and storage devices while assisting the design, analysis, implementation, and fabrication of the desalinization unit. - Strong knowledge of system dynamics and modeling - Previous experience or interest in sustainable and simple design will be necessary - Experience in machine shop is necessary - Experience with material selection and testing - Strong knowledge of distribution and storage efforts by other MSD teams in order to interface the desalinization cleaning with those efforts Must be able to interact and work well in a team environment
Mechanical Engineer	This individual will be responsible for doing investigation in Dubai while on study abroad. The main focus will be to gather information and gain first hand experience with Dubai desalinization efforts and continuously report this information to the rest of the MSD team during MSDI phase. During MSDII phase, this individual will be expected to contribute his knowledge of the Dubai region and help all team efforts as needed. - Must have strong communication skills - Must have gained strong knowledge of Dubai desalinization processes - Experience in machine shop is necessary - Gain strong knowledge of applicable materials for Dubai region - Experience with material selection and testing Must be able to interact and work well in a team environment

Industrial Systems Engineer	This individual will be responsible for the sustainability aspect of the designed desalinization unit. They will focus on the material selection, system adaptability to the Dubai region, and create a process for sustainable implementation of this unit for a single individual in Dubai. - Create system simulation models for Dubai region - Sustainability and lifecycle assessment

PROJECT CONSTRAINTS:

(1) This unit will focus on providing clean water for one person
(2) The hardware product at the end should be appropriate for both USA and UAE student teams to build upon
(3) The hardware design should reflect both USA and UAE campus infra-structure (e.g. the teams should think carefully about English vs. Metric units)
(4) The primary application and objective for this project is educational so that MSD teams gain experience with desalination for subsequent MSD teams to build upon
(5) There is no desire to actually deploy the results from this project in a field environment
(6) Teams will be expected to hold regular communication with their defined stakeholders, team guide, and customers
(7) Each team will be expected to produce an economically sustainable design, taking into account the economy of the target audience
(8) Each team will utilize materials which minimize adverse environmental impacts
(9) Supplies necessary for the fabrication of the single desalinization unit must be available in both Rochester and Dubai regions
(10) Each team in this roadmap is expected to produce outcomes and artifacts which improve the education of fellow students in desalinization cleaning process
(11) Teams are required to consider the safety of their product when it breaks or is ill-maintained
(12) This is intended to be a "Zero Landfill" project which includes documents as well as project materials

REQUIRED FACULTY / ENVIRONMENT / EQUIPMENT:

Category	Source	Description	Resource Available (*mark with X*)
Faculty	ME, ISE	Dr. Ghoneim, RIT Dubai professor with Desalinization knowledge ME faculty who have expertise in mineral cleaning processes ISE faculty who have expertise in sustainability principles	X
Environment	MSD Lab	The MSD team will utilize this area for meetings and work sessions	X
Equipment	RIT ME/ISE Departments	Design, analysis, fabrication, and testing performed with equipment available in the ME machine shop and other laboratories as well as software packages present at RIT	X
Materials	Local Supplies (Rochester and Dubai)	Supplies necessary for the fabrication of the single desalinization unit (must be available in both Rochester and Dubai regions)	X