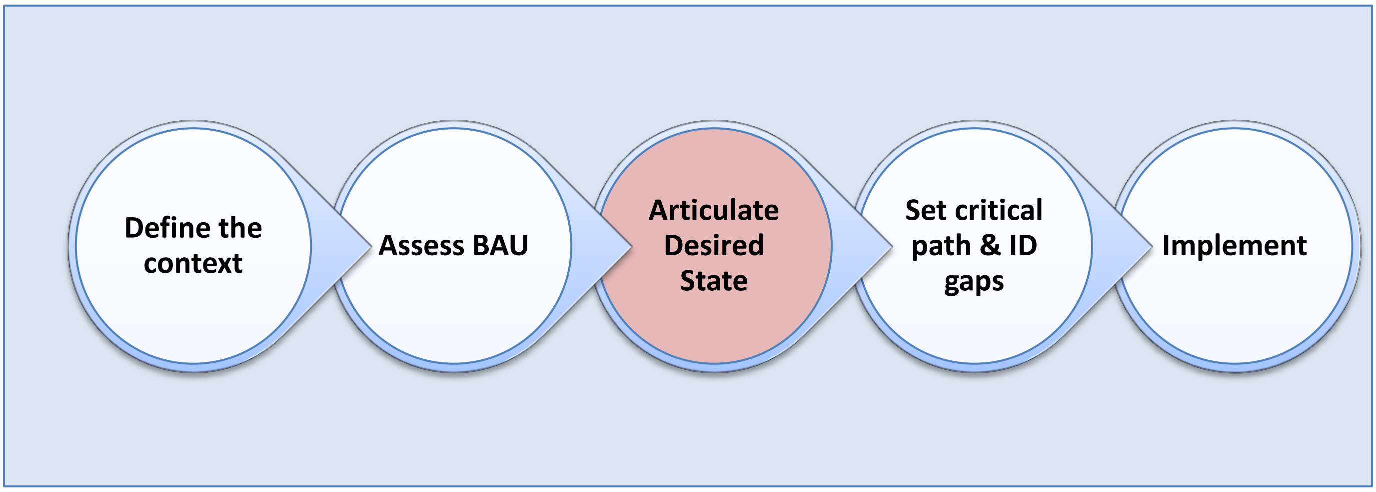
Scaling Up Investment for Ecosystem Services to Meet the Global Water Crisis



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Presented to:

Nature Conservation Research Centre

March 2014

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Abbreviations

%	Per cent
AWS	Alliance for Water Stewardship
BAU	Business As Usual
CCEMA	Cape Coast-Elmina Metropolitan Area
CDP	Carbon Disclosure Project
CREMA	Community Resource Management Area
Ca	Calcium
Cd	Cadmium
Cl	Chlorine
Cu	Copper
CT	Catchment Type Water System
DEG	German Investment and Development Corporation
DA	District Assembly
DBB	Densu Basin Board
EPA	Environmental Protection Agency
Fe	Iron
FC	Forestry Commission
FOS	Foundations of Success
FT	Forest Trends
GHc	Ghana Cedis
GIDA	Ghana Irrigation Development Authority
GMet	Ghana Meteorological Agency
GSA	Ghana Standards Authority
GWCL	Ghana Water Company Limited
GW	Ground Water
HCO_3	Bicarbonate
HCO_4	Orthocarbonate anion
Hg	Mercury
H_20	Water
ISEAL	International Social and Environmental Accreditation and Labelling Alliance
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resources Management
IWMI	International Water Management Institute

IWS	Investments in Watershed Services
Kdua	Koforidua
Km^2	Kilometre Square
M	Million
m	Metre
m^3	Cubic metre
m^3/d	Cubic Metres Per Day
M&E	Monitoring and Evaluation
mgd	Million Gallons Per Day
Mn	Manganese
N	Nitrogen
Na	Sodium
NO_2	Nitrogen Dioxide
NO_3	Nitrate
NCRC	Nature Conservation Research Centre
NTFP	Non-Timber Forest Products
P	Phosphate
Pb	Lead
PBB	Pra Basin Board
PES	Payment for Ecosystem Services
PURC	Public Utilities Regulatory Commission
SO_4	Sulfate
STMA	Sekondi-Takoradi metropolitan Area
TNC	The Nature Conservancy
TWQR	Target Water Quality Range
UNEP	United Nations Environment Program
US$	United States Dollar
WD	Wildlife Division
WQI	Water Quality Index
WRC	Water Resources Commission
WRI	Water Research Institute
WTP	Water Treatment Plant
WWF	World Wildlife Fund

Objective

The objective of this document is to propose a “Desired State” solution for the Pra and Kakum basins, including provision of water to the Sekondi-Takoradi and Cape Coast-Elmina Metropolitan Areas.

Executive Summary

Watershed degradation across the globe is negatively affecting water availability, quality and flow rates, resulting in increasing water scarcity and hardship for those living in the basins. New innovative mechanisms that recognize the value of services provided by watersheds and incentivise positive outcomes are needed to address these challenges. Such interventions are needed to ensure secure and sustainable water supply systems. Water insecurity has heightened the need for scaling up investment in ecological infrastructure, but water managers need to ensure that funds are used in a cost-effective and efficient manner to address the challenges in the water sector.

In Ghana, The Nature Conservation Research Centre (NCRC) with support from Forest Trends (FT) carried out an assessment of the Pra and Kakum River Basins to explore opportunities for Investment in Watershed Services (IWS), to ensure water availability, improved quality and appropriate flow. This assessment was part of a larger project to “Scale Up Investment for Ecosystem Services to Meet the Global Water Crisis”. A Business As Usual (BAU) scenario analysis revealed that, as a result of human activity, population growth, policy failure and inadequate law enforcement, the Pra and Kakum River Basins are being degraded and polluted to the extent that though water is largely available, it is not in the form that could be readily utilized, thus resulting in water stress.

According to Abraham et al, (2013) the Pra River Basin receives a total of 34,786 M m^3 of annual rainfall, with annual run-off of 4,174m m^3 (12%) and groundwater recharge of 5,566m m^3 (16%). However, only 143.6m m^3 representing 3.4% is utilized for both domestic urban, rural and industrial purposes with a greatest part (72%) contributing to evapotranspiration (25,046 M m^3). Unfortunately such data is not available on the Kakum River Basin, indicating a void in available information.

While Abraham et al (2013) indicated that 2,329 m^3/person/year could be mobilized and made available, Ansa-Asare et al (2013), established that since 2010, the Pra Basin has been experiencing a per capita water availability of less than 1,680m m^3/person. Since this is below the benchmark of 1,700m^3/person Water Stress Index, below which an area is said to be experience water stress, it is therefore a confirmation that the Pra River Basin is already water stressed and is expected to worsen towards water scarcity (<1000 m^3/person/yr) by 2020 and absolute scarcity (<500 m^3/person/yr) by 2050. Each group of authors presents a different picture of water availability in the Pra, but Abraham et al ignore the fact that when water is in a form that cannot be utilized, it is unavailable. A good example is water diverted away from the Daboase intake point and held in ponds or just being highly turbid such that it cannot be pumped at the intake point. The water is present in the basin, but unavailable.

Major challenges within the Pra and Kakum River Basins include increasing population, which is by far the biggest threat to water availability in both 2020 and 2050; and pollution and siltation caused by galamsy mining, which is the biggest single threat to water quality. Most studies have underestimated the water demand that will be driven by population growth and the growth of an expanding industrial base in the Sekondi / Takoradi Metropolitan Area (STMA) fuelled by the oil and gas industry, among others. These two factors will drive water demand above all future planned capacity increases for treating water in the STMA by 2025, and in some scenarios, as early as 2015. Climate change will exacerbate these challenges by reducing water availability in the medium to long-term.

The biggest single short-term threat to the river basins is galamsy mining, and no productive long-term solution to this challenge has yet been proposed. There is an increasing awareness among political leaders and the larger population, with increasing national security interventions in some areas, but these still serve as short-term tactics that temporarily disrupt mining actions, without solving the problem. Increased security measures in the basins are a necessary, but insufficient solution.

The desired state of the Pra and Kakum watersheds is one where water quality and availability are adequate for both environmental flows and human needs. Where the services of the watershed are valued by all users, and each inhabitant understands there impacts on the watershed and their role in protecting it. There is adequate enforcement of environmental regulations and effective coordination amongst national and local agencies responsible for protecting the integrity of the watersheds. Through a greater presence in the basin by the Water Resource Commission (WRC) there is an expanding base of water permit users, the revenue from which is being used to fund watershed restoration and replenishment projects across the basins. These funds are augmented by a PWS fund that collects contributions first from development and corporate partners taking greater responsibility as stewards of the watershed, and is eventually boosted by tariffs paid by individual customers of GWCL and other water providers. In the desired state, all users have a connection to and are invested in protecting the health of the watersheds.

To reach this desired state, more research and date are needed, including better data on the treatment costs and associated challenges of the GWCL due to decreasing water quality, in addition to a comprehensive water quality baseline and threat mapping for both the Pra and Kakum watersheds. WRC needs to lead an effort to better coordinate all concerned agencies actions in the water sheds, and a comprehensive inventory of urgent restoration and water replenishment projects is needed. Next partners in the watershed will need to prioritize interventions in the basins. Given the scale and immediacy of the threat, actions and interventions to improve water quantity are required now. This report recommends some options for prioritization that can be taken up in the next phase of this project, and also recommends a set of short term actions to move this effort forward.

The challenges in the Pra and Kakum watersheds are many, and the situation is rapidly worsening, but with the concerted collective effort of watershed partners, and sustained efforts to tip the political and public mind set towards the need for action, change for the better can begin. There are not short-term solutions here. The desired state can only be achieved through steady long-term commitment and action.

Assignment

The consultant team will undertake to answer the identified critical questions which remain as gaps in understanding and prepare a Desired State report that:

1) Summarizes the BAU, including any new data, analyses, and answers to the critical questions raised in the BAU report and noted below:

    a. What are the sources of lead and other heavy metal contaminants found in water quality data and what is the explanation of the "peak" periods?

    b. What is the cost associated with water treatment plant shut-downs, treatment expenses, and cost of treating water with respect to peaks in contaminants and sediment loads? David

    c. What are the demands/needs of upstream users, like agriculture and mining, and what are their downstream impacts?

    d. What role can Water Research Institute (WRI) and the Ghana Meteorological Authority (GMA) play in the process?

2) Describes water quality (or quantity) goals for the Pra and Kakum watersheds from the perspective of key watershed stakeholders such as water distribution utilities, agriculture, and industry; as well as goals related to how to ensure a more sustainable water infrastructure (addressing sediment overloads, treatment costs, invasive plant species, etc).

3) Describes the envisioned future condition of the ecological landscape and the water related ecosystem services that the landscape will furnish, provide various scenarios for sustainable water resources management; the institutional landscape and the mode of inter-agency collaboration; and the social landscape and the ways in which communities and other stakeholders should engage.

4) Describes the design specifications for a water fund/account mechanism to channel resources for "natural capital" investments to improve water quality/quantity, ideally in such a way that local contributors to the fund can appreciate benefits (returns) in terms of reduced water treatment costs, improved services, and improved health and well-being of impacted communities.

Chapter 1 Summary of the Business As Usual Report

1.1 Key Findings and conclusions

The Business As Usual Report (BAU) focused on a number of key issues related to Integrated Watershed Management. The report observed the following:

Water Quality: Water quality was found to be on the decline largely as a result of pollution from hazardous substances from industry and mining, organic matter from settlements as well as nutrients and waste water from farm lands. This has led to the proliferation of waterweeds in some of the reservoirs. The loss of vegetative cover has also contributed to decline in water quality. A water quality[1] assessment within the Pra Basin noted fairly clean water (Class II) at most sites except the Barikese and Owabi reservoirs where poor quality was noted (Class III). No site was found to be in good condition (Class I). The report particularly noted that Water Quality will continue to decline to even worse levels and that cost of water production will continue to increase, if no interventions are put in place to address the situation[2]. Under the status quo, the ability to meet the growing urban water demand will diminish.

***Water Quantity*:** The BAU report noted that water was largely available in most rivers and streams within the Pra Basin. However those of the Kakum Basin dry up and break up into pools during the dry season. The report noted that about 34,786 m m^3 of water from rainfall reaches the Pra Basin annually. Also recorded were:

- Run-off of 4,174m m^3 or 12%;
- Evapo-transpiration of 25,046m m^3 constituting about 76%;
- Ground water recharge (5,566m m^3) or 16%;
- water use 143.60m m^3 or 3.4%.

An assessment of the availability of surface and groundwater resources noted that about 2,329m^3/cap/year was available, thus indicating that the Pra Basin was not water stressed. It however noted that water scarcity may emerge and even worsen if no interventions are put in place to address the current challenges,

The BAU report also observed that diversion of water bodies and siltation by illegal mining activities has resulted in obstruction of water flow and thus insufficient raw water availability at some water treatment plants within the Pra Basin.

***Existing Maps for Pra and Kakum**:* Sufficient mapping information was available except for the Kakum River Basin where, with the absence of a management plan, mapped data was scarce.

Roles and Responsibilities of Institutions: About eight (8) key institutions with major roles related to water resources management within the two basins were recorded. These include: Ministry of Water Resources, Works and Housing, Environmental Protection Agency, Forestry Commission and District Assemblies. Also included were Public Utilities Commission and the Ghana Water Company Limited. However, the lack of an effective coordinating mechanism to ensure the delivery of the functions of the various institutions was noted as a major barrier to water resources management

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[1] The Water Quality Index, WQI, is an index that measures the suitability of water resources for domestic purposes based on the weighted concentrations of a set of parameters. There are various weights of calculating the WQI.

[2] Pra Water Resource Assessment & Baselines Study, pages 31-33.

within the basin. Most of the institutions were noted to be weak in terms of law enforcement, a situation blamed on inadequate human and logistic capacity.

***Water Management Initiatives*:** A number of watershed management initiatives were noted. These include the laws and acts related to water resources that were enacted in Ghana, the establishment of the Water Resources Commission and its water related activities within the basin such as the setting up of the Pra Basin Board and Secretariat in Kumasi. One major activity has been the administering and monitoring of compliance of water use permits and well drilling licenses within the two basins. It also included the formulation of an Integrated Water Resources Management Plan for the Pra Basin and implementing Water Quality Monitoring and Ecological Monitoring to establish trends.

Water Resources Management Account: The Water Resources Management Account was legally established to enable Water Resources Commission fund its operational expenses related to watershed management. It is mainly funded by through the issuance of Water Use Permits and the Drilling Licenses. The Water Resource Commission maintains a register of waters users and the stipulated amounts collected from them. A Water Use Register is also published annually. The report noted that the operation of the Water Resources Account was an aspect of Investment in Watershed Services. The issuance of Water Use Permits and Drilling Licenses was very limited since the Water Resources Commission did not have adequate staff on the ground to monitor ratable water users.

In addition, the BAU report concluded the following:

1. **Total freshwater** available (2,329m^3/cap/year) is far above current utilization;
2. **Insufficient raw water quantity** in some areas, particularly in the Kakum and Anakwari areas);
3. **Water quality** tests shows that most areas within the Pra Basin fall within the class II category, that is fairly clean;
4. **Steady deterioration of raw water quality**: turbidity, colour and pH are gradually reaching unacceptable levels ;
5. At **Barikese and Owabi**, water was within **Class III =“poor” water quality;**
6. Pollution through **illegal artisanal gold mining** was identified as the topmost threat to the basins;
7. Other unsustainable practices include farming, **fishing, timber logging, bush burning and waste disposal**, among others;
8. The **lack of enforcement, non-deterrent punitive measures**, and inadequate coordination and collaboration among institutions are key issues to be addressed within the two basins;
9. **Limited management capacity** and presence to support work in the basins (by WRC and others);
10. **Inadequate funding** for water resources management.

The BAU report recommended the need for:

- **Consensus building**: In-depth consultations and engagement of the various stakeholders was necessary to establish a an effective IWS;
- **Determine an IWS levy** to be charged by WRC as part of its abstraction fees;
- **Establish an IWS Account** focused on preventing watershed degradation and/or restoring the watersheds and as well as to supporting community livelihoods;
- **Water services** within the basin should be quantified and valued;
- Investigate the **relationship** between deteriorating vegetative cover, artisanal mining upstream and the cost of water treatment;
- Institute a **water quality monitoring** mechanism in the selected basins;
- Identify and **assess the critical ecosystems** of the Pra River and Kakum River basins;

- **Assess land cover /land use dynamics** of critical riparian areas of the basins.

Finally, the BAU report recommended the following for WRC and other Stakeholders:

- **Consider Community based watershed restoration partnerships** in the Pra and Kakum basins;
- WRC should consider setting up **River Basin Secretariats** in the Kakum and the rest of the Pra basin;
- Ghana Standards Authority should assume responsibility for setting up raw water quality standards for compliance by WRC;
- Public-private partnerships investment in water supply should be promoted to ensure improvement in water supplies in the Western and Central Regions;

Note: The Densu Basin Secretariat is extending it's responsibility to the Birim segment of the Pra.

1.2 Additional Data & Analysis since BAU

The following data was collected and additional analysis conducted…

1.2.1 Sources of lead and other heavy metal contaminants:

What are the sources of lead and other heavy metal contaminants found in water quality data and what is the explanation of the "peak" periods?

Major Chemical Contaminants: According to Ansah-Asare et al (2013), abnormally high levels of heavy and trace metals were recorded in the Pra Basin. These include Calcium carbonate ($CaCO_3$), Iron (Fe), Manganese (Mn), Copper (Cu) and Lead (Pb). Additionally, Mercury (Hg), Cadmiun (Cd) and Zinc (Zn) were also recorded. Fe, Hg, Mn, Cu, Zn and Pb were all above their background levels or Target Water Quality Range (TWQR). It was noted that, except the Mercury (Hg) and Lead, these metals occurred naturally in the soil. The scooping of the soil in the river bed and washing of the sediments in the same water leads to the mineralization or release into the water of these naturally occurring metals held in the soil. Hence the elevated levels of the metal contaminants in the various water bodies within the Pra Basin where illegal mining or "galamsey" activities occurred. The high level of Mercury was, however as a result of the common practice of using the metal in liquid form to roast and extract gold from the ore. The washing off of the remnants into the water bodies accounted for the elevated presence of Mercury (Hg) in the water.

With regards to the "peak periods" of lead noted within the Pra Basin as recorded in the BAU Report, Ansah-Asare (per.com) observed that lead was used in welding the components of the machinery used in the illegal gold mining activities in the rivers. The increase in the number of machinery with lead components within the water bodies, as well as the run-off of the remains of the lead materials from the nearby welding stations, contributed to the noted "peak periods" of lead in the Pra River Basin. Medical authorities have noted that lead is responsible for the increase in blood pressure in adults as well as dizziness and tiredness.

Major ions: The major ions of the Pra River Basin recorded by other reports (Ansah-Asare et al, 2013) are Calcium, Magnesium, Sodium and Potassium. Others are Carbonates, Chloride and Sulphates. They noted that while the normal ionic pattern of water is Ca>Mg>Na and HCO_3>SO_4>Cl, that of Pra Basin exhibits the ionic dominance pattern of Na>Ca>Mg and HCO_4>SO_4>CL in the cation and anionic components respectively. The dominance of Na over Ca and Mg is very unusual and is largely attributed to major human disturbance of water and soil as a result of mining and farming practices. It is also attributable to sea water intrusion from the Pra Estuary, causing shut downs in the Daboase treatment plant at some times. This leads to unusual changes in pH and conductivity which negatively affects life-forms such as fish and hence livelihoods.

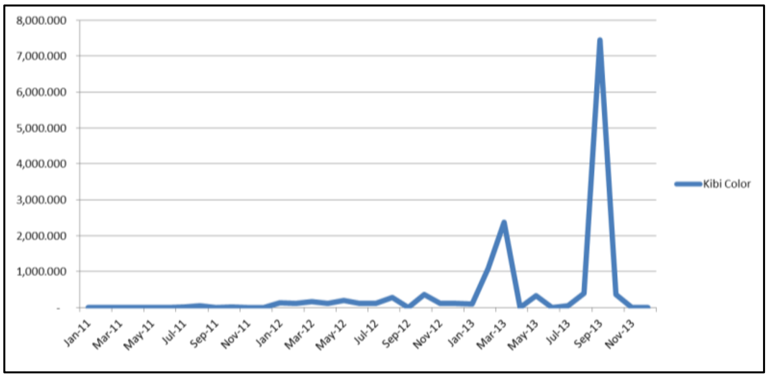
Nutrient Levels: Nutrient levels were also noted to be equally abnormally high as a result of agricultural practices such as the application of fertilizers and run-off from human settlements. This is reflected in high levels of NO_3-N, NO_2-N and PO_4-P. Nitrate-Nitrogen and Posphorus were particularly high, leading to eutrophication in some areas. Ansa-Asare et al (2013) indicated that this was attributable to nutrient laden run-off from areas of commercial activities of the inhabitants of nearby villages. The runoff negatively impacts the rivers.

1.2.2 Costs Associated with Treatment

Stakeholders and previous reports on the conditions of the Pra and Kakum watersheds have asserted that treatments costs of the Ghana Water Company (GWCL) are increasing as a result of pollution and other factors associated with the deteriorating raw water quality in the basins. Some data suggests that costs for alum use and other factors are increasing. The consultants had hoped to conduct analyses and make a business case that included all the associated costs that might be related to the increasingly poor raw water quality: increased input use, including alum and other chemicals; costs of plant shut down and impacts of inability to supply treated water, etc. However, only limited data on alum use at 5 selected treatment facilities was provided. The analysis that follows is based on that data.

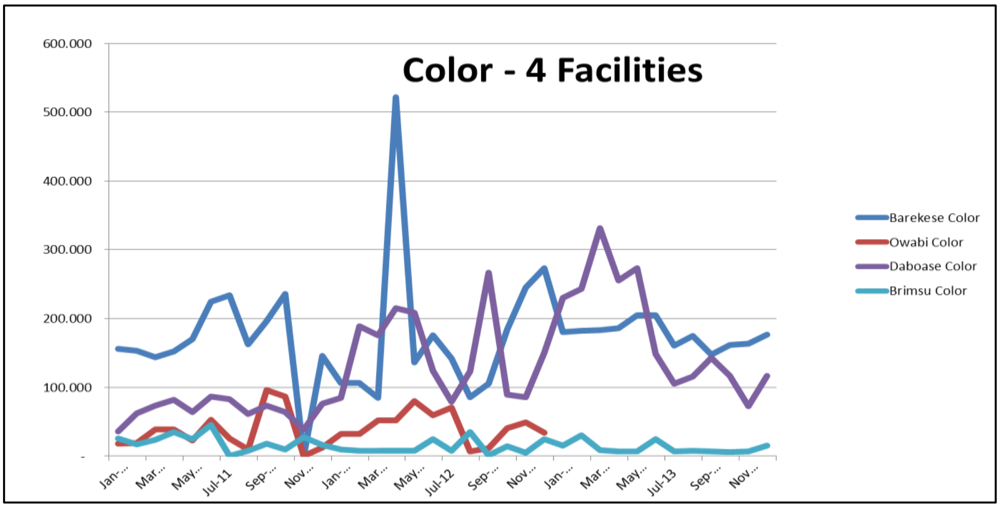
The costs of alum use, colour, and turbidity data were received for 5 treatment plants: Barekase, Owabi, Kibi, Daboase, Brimsu. Colour data for Kibi was removed from some of the analysis because there were extreme spikes in the color data in 2013. It was not possible to determine whether these spikes were data errors, or extreme cases of pollution.

Figure 1: Colour Data for Kibi WTP 2011-2013



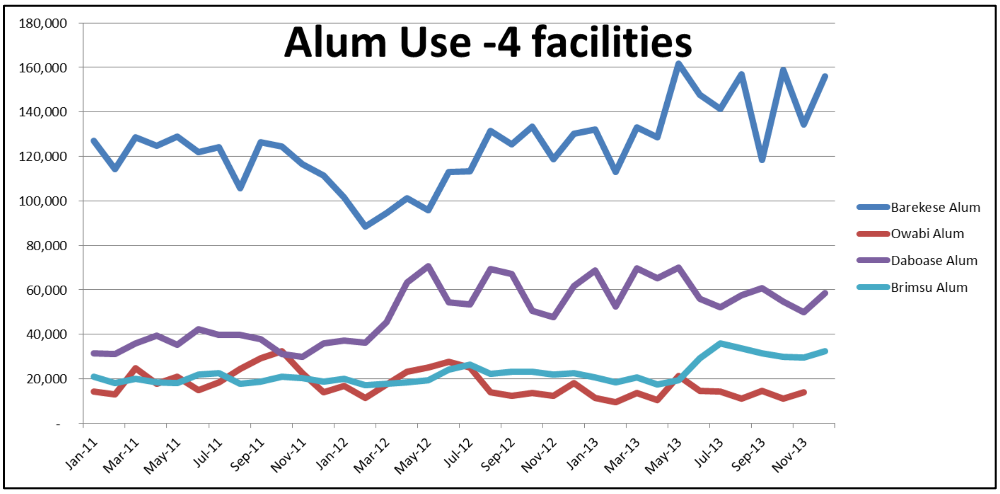
Data across the 4 facilities shows increasing trends for all parameters:

Figure 2: Colour data for 4 WTP facilities 2011-2013



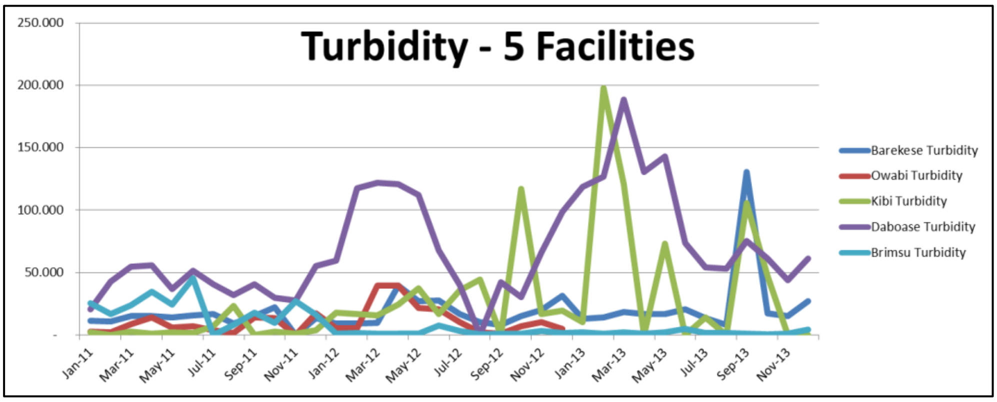
For alum use, there is a clearer increasing trend for both Barekese and Daboase.

Figure 3: Alum use for 4 WTP facilities 2011-2013



The overall increasing trend and volatility is most apparent in the turbidity data for all five facilities:

Figure 4: Turbidity data for 5 WTP facilities 2011-2013



However, when the data is averaged across the facilities to smooth out potential errors, there is more discernable increase in values across all 3 parameters:

Figure 5: Average Alum Use for 4 WTP facilities 2011-2013

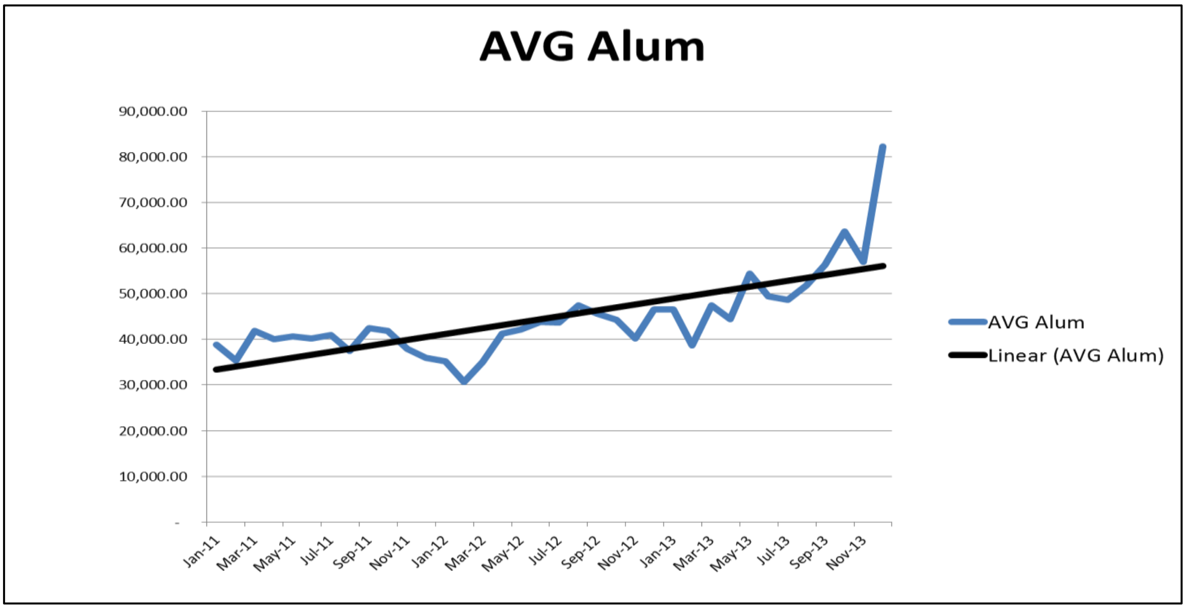
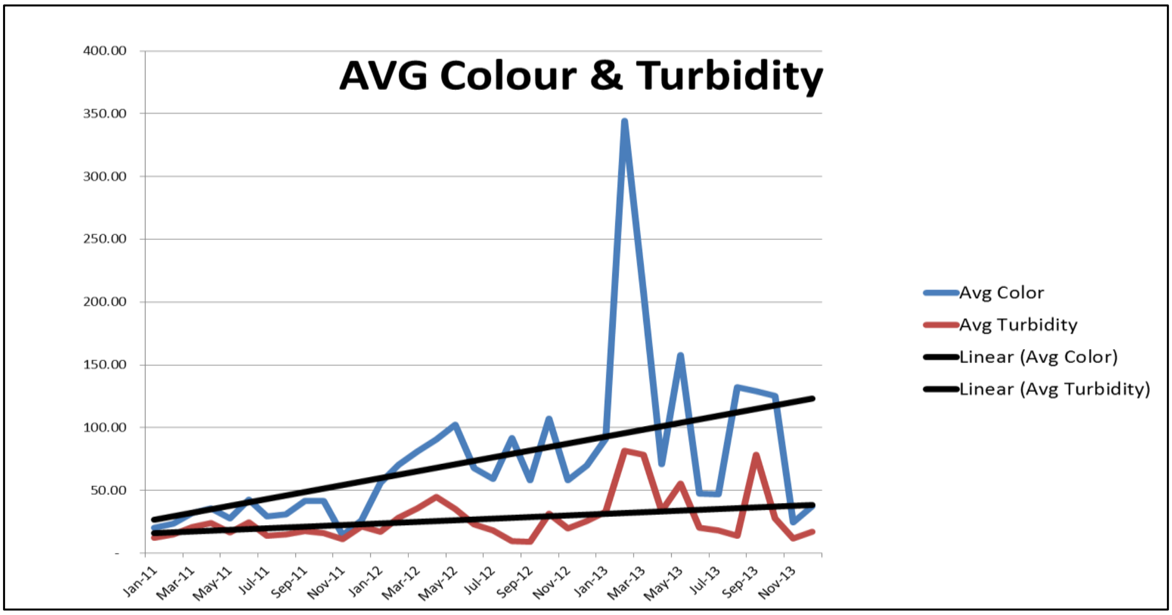


Figure 6: Average colour and turbidity data 5 WTP facilities 2011-2013



While the data demonstrates an increase across the parameters, it is not possible to establish a relationship between alum and either colour or turbidity. Table 1 below shows the correlations of the data provided, for both the averages, as well as the data parameters for each facility.

Table 1: Correlations between alum, colour and turbidity across 5 WTP

Average		Kibi	
Colour to turbidity	0.820	Colour to turbidity	0.520
Alum to colour	0.115	Alum to colour	-0.028
Alum to turbidity	0.081	Alum to turbidity	-0.109
Barekese		**Daboase**	
Colour to turbidity	0.227	Colour to turbidity	0.849
Alum to colour	0.059	Alum to colour	0.764
Alum to turbidity	-0.040	Alum to turbidity	0.523
Owabi		**Brimsu**	
Colour to turbidity	0.521	Colour to turbidity	0.706
Alum to colour	0.608	Alum to colour	-0.189
Alum to turbidity	0.303	Alum to turbidity	-0.279

While average colour and turbidity are highly correlated, as might be expected, there is little correlation between either alum and colour, or alum and turbidity. The only exceptions to this finding being a correlation of .764 between Alum and colour at Daboase, and a .608 correlation of alum and colour at Owabi. However, at Kibi, Barekese, and Brimsu, the correlation between alum use and other factors in often negative. These results may be skewed by the data, however in the absence of better information, it is not possible to conclude from the date provide that deteriorating water quality is leading to higher treatment costs, much less build a business case around such a statement.

In order to build a business case for addressing the increased cost of water treatment, more data with a greater level of consistency will be required. The data should include a longer time series of parameters across more facilities. In addition, data on the operational costs of treatment plants along with the corresponding costs of shutdowns of those plants will be needed. In the next phase of the project a specific work plan can be developed for the GWCL so they may dedicate the appropriate resources to gathering, organizing, and analyzing the data required.

1.2.3 Demands and Needs of Upstream Users

Currently about 34,786m m^3 of rain water is received annually in the Pra Basin. About 25,046 m m^3/yr (72%) goes into evapo-transpiration, groundwater recharge, 5,566 m m^3 (15%) and run-off constitutes 4,174 m m3 (12%). Water use consists of the following:

a. Urban water use: 42.3 m m^3/yr;

b. Rural water use: 31.7 m m^3/yr;

c. Irrigation : 17.4 m m^3/yr;

d. Livestock: 3.0 m m^3/yr; and

e. Industry: 49.2 m m^3/yr.

A total amount of 143.6 m m^3/yr constituting 3.4% was recorded in the BAU Report. It is worth noting that these figures denote only the documented water users. Since Water Resources Commission has very limited capacity to register all the water users within the basins this information is equally limited and is not a reflection of the actual number of water users within the two basins.

While there were no official documentation for additional demands or needs for water upstream, it is likely that an expansion in illegal mining activities will further impact water users downstream. The water treatment plants at Inchaban and Daboase continue to suffer from inadequate supply of raw water as a result of increased mining activities. Potential demand could arise from irrigated cocoa upstream and irrigated sugar cane around Komenda, if the sugar factory is rehabilitated and functional.

1.2.4 Role of WRI and Meteorological Institute

The Water Research Institute (WRI) of the Council for Scientific and Industrial Research (CSIR) and the Ghana Meteorological Authority (GMA), were not initially part of the Technical Working Group on the Investment in Watershed Services for the Pra and Kakum Basins. However, considering the fact that the personnel of WRI have enormous expertise in water related research and monitoring, it was realized that their role in the IWS process was crucial. Their inclusion will enable WRI personnel to provide water related information to support decision-making on the two basin.

Likewise, the Ghana Meteorological Authority (GMA) has the national mandate to monitor weather related conditions and assess their impact on water resources. As such they could also play the important role in providing information for decision making related to the management of the two basins.

1.2.5 Revisiting Population Assumptions

The Business As Usual Report highlighted discrepancies between previous population and water demand projections for the Secondi Takoradi Metropolitan Area (STMA) and the 2010 census data, but did not further elaborate the scale of the potential gap in demand projections and the likely future reality. The consultant team attempted to model likely demand to better understand the scale of the future supply water challenges for the STMA. The analysis required a method to estimate both expected population growth as well as the impacts of industrial growth on demand.

As seen in Table 2 below, the original population estimates predicted a 2.18% growth rate for the STMA between 2005 and 2025, with population topping 480,000 by 2015 and 590,000 by 2025. Corresponding water demand would exceed 34,000 million m^3/day in 2015 and 45,000 million m^3/day in 2025.

Table 2: Previous population and water demand estimates for STMA

Population / Demand analysis					
Original Projections	**2005**	**2007**	**2011**	**2015**	**2025**
S/T Populatiion	393,634	409,974	444,801	482,705	592,883
S/T Water Demand millions of m^3/day	25,518	27,222	30,541	34,233	45,487
Ratio of Water demand to population	6.48%	6.64%	6.33%	7.09%	7.67%

However, the 2010 Census estimated population for the STMA is 559,548, 25.8% higher than the original estimates for population in 2011, and 15.9% higher than projections for 2015. Given this new population baseline, what are the likely population growth scenarios to 2025? Four scenarios were used project population:

1. Using the previous projected growth rate of 2.18%
2. Using the previous intercensal growth rate for Greater Accra of 3.1% to mimic likely trends in the STMA since the advent of oil and gas in the region

3. Using a slightly more aggressive rate of 4% to suggest STMA may grow faster than Accra
4. A high end growth rate of 9.19% - The growth rate from the 2005 predictions to the actual 2010 census figure.

While we do not anticipate an actual growth rate of 9.19% after 2010, it is necessary to think through a worst-case scenario. As seen in table 3, in all but one case, the revised water demand projections for 2015 exceed the original demand projections for 2025.

Table 3: Revised population and water demand estimates for Secondi / Takoradi Metropolitan Area

Population & Water Demand Growth		Population Growth			Water Demand Projections (m m^3)		
Growth Scenarios	**Rate**	**2011**	**2015**	**2025**	**2011**	**2015**	**2025**
old growth projection	2.18%	571,741	623,228	773,154	36,174	44,199	59,318
Oil acceleration (Greater Accra actual)	3.1%	576,894	651,824	884,540	36,500	46,227	67,863
Oil acceleration (agressive)	4%	581,930	680,776	1,178,883	36,819	48,280	90,446
Worst case scenario	9.19%	610,975	868,497	2,092,330	38,657	61,593	160,527

However, this analysis only tracks population growth in the STMA and does not build in anticipated impacts of increased industrial demand for water. The challenge in estimating this is there is little reliable data on the expected increases from industrial demand. One method is to substitute a proxy with better data. We have reliable census data and water demand projections for towns in the STMA. If one makes an assumption that total industrial demand can be compared to a municipality, whether a small town, a city, or something in between, then future demand can be projected.

For this analysis, we selected a small, medium, and large town, as well as a city to show the range of potential industrial impact. Table 4 below shows the corresponding population estimates and water demand for these proxies:

Table 4: Estimates for water demand associated with industry growth in STMA.

Proxies at varied growth rates		Rate:	Population Growth			Water Demand Projections (m m3)		
Industrial growth (slow)		**2.18%**	**2011**	**2015**	**2025**	**2011**	**2015**	**2025**
small town	(Prince's Town)		3,980	4,432	6,125	252	314	470
Med town	(Agona Junctn)		9,203	10,251	14,164	582	727	1,087
Large town	(West Tanokram)		31,381	34,953	48,296	1,986	2,479	3,705
City	(Takoradi)		82,932	92,370	127,632	5,247	6,551	9,792
Industrial growth (medium)		**4.00%**	**2011**	**2015**	**2025**	**2011**	**2015**	**2025**
small town	(Prince's Town)		3,980	4,842	6,690	252	343	513
Med town	(Agona Junctn)		9,203	11,197	15,472	582	794	1,187
Large town	(West Tanokram)		31,381	38,180	52,756	1,986	2,708	4,047
City	(Takoradi)		82,932	100,899	139,417	5,247	7,156	10,696
Industrial growth (oil acc.)		**3.10%**	**2011**	**2015**	**2025**	**2011**	**2015**	**2025**
small town	(Prince's Town)		4,015	4,885	6,750	254	346	518
Med town	(Agona Junctn)		9,286	11,298	15,611	588	801	1,198
Large town	(West Tanokram)		31,664	38,524	53,231	2,003	2,732	4,084
City	(Takoradi)		83,679	101,809	140,674	5,294	7,220	10,793
Industrial growth (fast)		**9.19%**	**2011**	**2015**	**2025**	**2011**	**2015**	**2025**
small town	(Prince's Town)		3,980	6,177	8,535	252	438	655
Med town	(Agona Junctn)		9,203	14,285	19,738	582	1,013	1,514
Large town	(West Tanokram)		31,381	48,708	67,303	1,986	3,454	5,164
City	(Takoradi)		82,932	128,722	177,861	5,247	9,129	13,646

Industrial growth could add anywhere from .79% to the revised demand estimates for 2025 from the previous population analysis, to 23% at the extreme end. However, assuming growth is closer to 3.1% and industry has a demand impact similar to a medium to large town, industrial demand will increase overall water demand by anywhere from 2 % - 6% by 2025. In the case, population growth is the most important trend in terms of future water demand.

Table 5 below illustrates the challenges facing the STMA in supplying water to an increasing population and industrial base:

Table 5: Water demand relative to actual capacity in the Secondi / Takoradi Metropolitan Area

Max Actual Abstraction	26,200	**Low**	**36,426**	**44,513**	**59,788**
Dry Season Abstraction	23,888		19.3%	30.0%	31.4%
Combined Optimum Installed	45,487	**Oil Acc.**	**37,088**	**47,028**	**69,061**
*growth over projection*s:*			21.4%	37.4%	51.8%
Future Total Installed Capacity	58,954	**Medium**	**38,805**	**50,988**	**94,493**
			22.8%	37.9%	82.6%
		High	**43,904**	**70,722**	**174,173**
			36.3%	75.6%	142.3%
		* = % above projected water demand for that year			

In all cases, 2025 demand will out strip total current and planned future capacity. Even by 2015, with the exception of the expected growth rate of 2.18%, demand will outstrip combined optimum installed capacity in all cases. However, actual current abstraction is far lower than the optimum or planned future capacity. The limiting factor is max dry season abstraction. Even with the expected growth rate of 2.18% and a minimal industrial impact, 2015 demand is likely to be 1.7X larger than actual current abstraction and 1.86X above dry season abstraction. By 2025, this difference will climb to 2.3X for max actual demand and 2.5X for dry season abstraction. Clearly there are supply issues to be addressed.

However, the challenge of supply is only one part of the equation. What effect will climate change have on water supply? In their analysis of climate change's impact on water availability in the Pra Basin, Obuobie et al. estimated that stream flow could reduce by as much as 22.3% by 2020 and 46.3% by 2050 in the Pra basin. While some analysts estimate the Pra basin has enough water per capita, these estimates assume that all available water can be mobilized for such purposes. There is clearly an inability to mobilize water in an accessible and usable format in the Pra Basin, despite the relative abundance of water. Obuobie et al. take the analysis further to state that the combination of population growth and climate change will lead to water scarcity by 2025 and absolute scarcity by 2050.

Figure 7: Pra Basin water scarcity projections

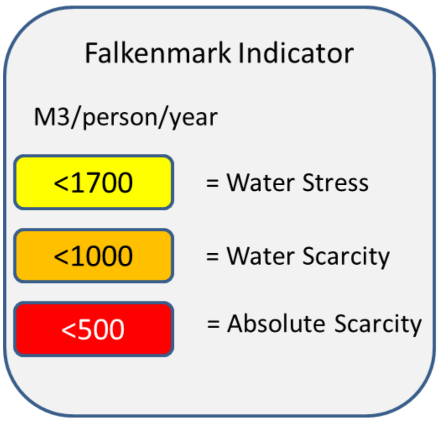


Table 5 | Dynamics of water availability per capita (m^3/person/year) in the White Volta and Pra basins, without climate change and with climate change (2000–2050)

Basin	2000	2020	2050
No climate change	1,160	681	306
With climate change	1,160	529	165

[a]Streamflow values for 2020 and 2050 were assumed to be the same as the value for the baseline for two basins.

In figure 7 above, population growth is the biggest challenge and climate change serves to exacerbate the scarcity conditions. Table 6 below demonstrates the role of each factor:

Table 6: Expected contributions to reduction to annual water availability in the Pra Basis

Table 6 | Reduction (%) in annual water availability per capita attributed to increased population and climate change, individually, in the White Volta and Pra basins

	2020			2050		
Basin	**Total**	**Population**	**Climate change**	**Total**	**Population**	**Climate change**
Pra	54.4	41.3	13.1	85.7	73.6	12.1

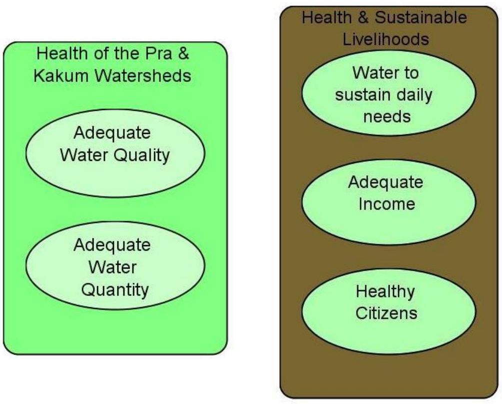
Oboubie et al. estimate a 54.4% drop in water availability in the Pra by 2020. 76% of this drop is attributed to population growth. By 20150, water availability drops by 85.7% in the Pra, with

1.3 Conceptual Model of current state (threats & drivers)

The challenges in the Pra and Kakum watersheds are complex and daunting, and they range over a vast geographical area. In such complexity it is easy to get lost in the details. Being able to see the big picture of the system is an important tool in identifying appropriate tools and interventions. To aid in this, a conservation planning software called Miradi was used to create conceptual model of the dynamics in the Pra and Kakum Watersheds. The conceptual model attempts to capture in 1 page all of the issues captured in this report and previous reports commissioned by NCRC and others on the watersheds.

The conceptual model starts with the targets, or desired end state, which for the Pra has been defined in terms of both human and ecological targets. Firstly, the watersheds should produce adequate water in terms of both quantity and quality for both environmental flows and for human needs. The ecological targets could be further defined in terms of species and other indicators of ecological health, but the quality quantity targets will suffice for this stage of planning

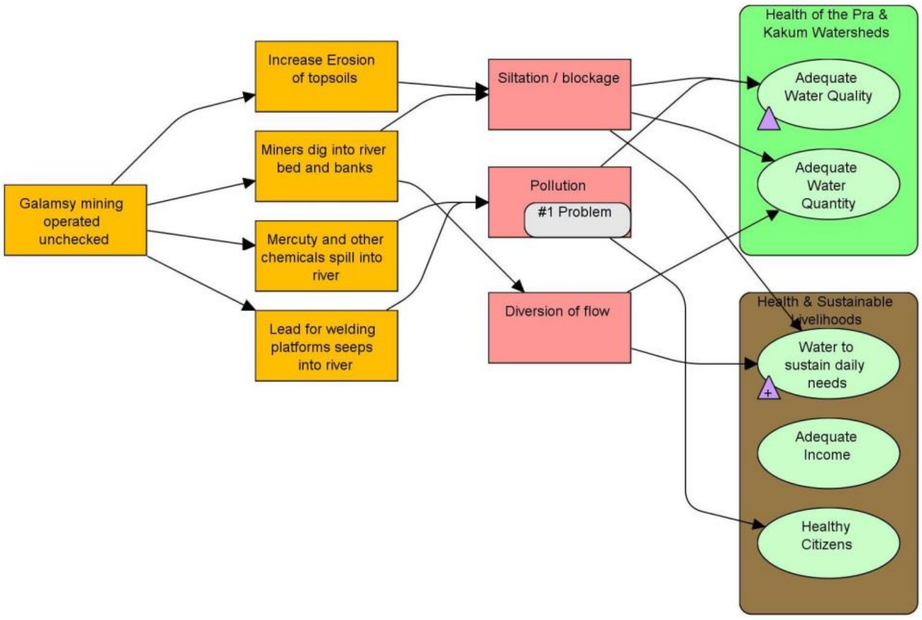
Figure 8: Ecological and Human Targets in the Pra and Kakum Basin Conceptual Model



The ecological targets are not complete without corresponding indicators of human wellbeing. For the Pra and Kakum watersheds, the most important factors are health, adequate income, and water to sustain daily needs. There are interrelations among these targets, but each is important for assessing the health of the overall system. If any one of these targets is being missed, then the desired state has not yet been achieved.

From the targets, it is then possible to depict the threats to the system. While the threats to ecological and human wellbeing in the Pra and Kakum watersheds are many, the most consistently identified top priority has been the impacts of galamsy mining in terms of pollution, siltation, and impacts on water flow, as can be seen in Figure 9:

Figure 9: The role of mining in the Pra & Kakum Basins

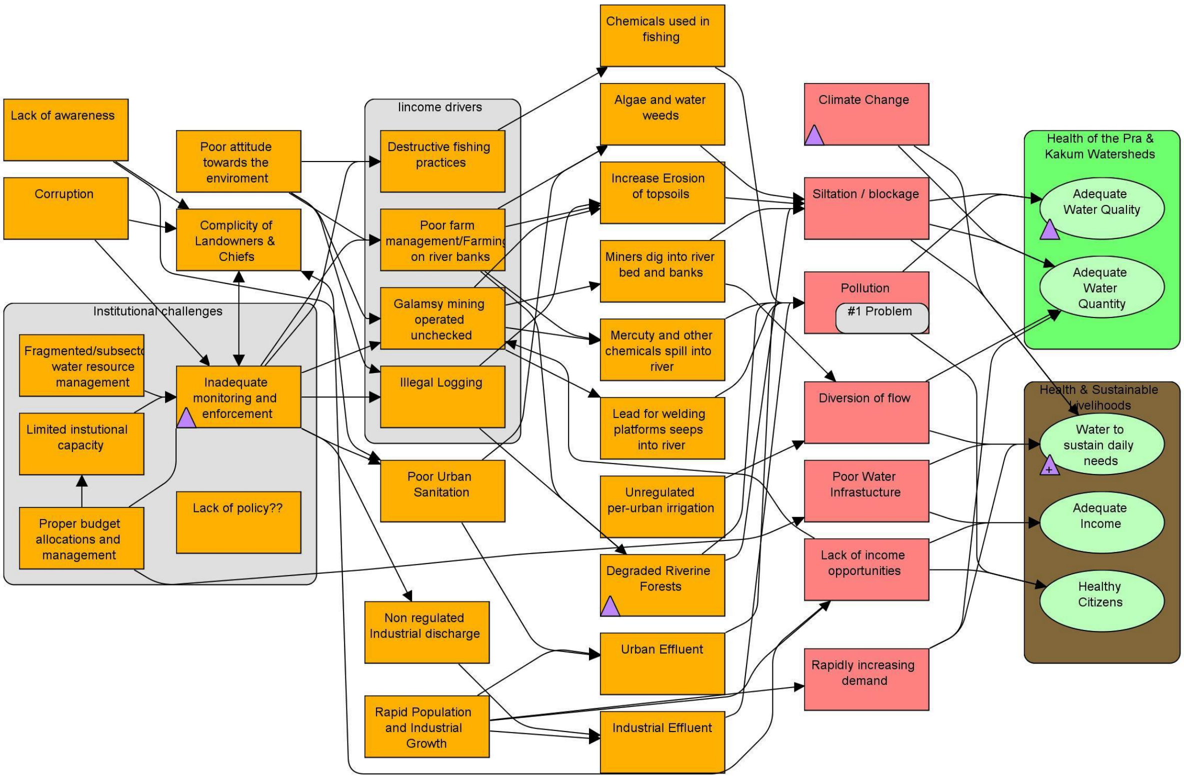


Every target in the watershed is impacted negatively by mining, from the spillage of mercury into the water, the seepage of lead from platform welding and the disturbance of riverbed sediments, to excessive turbidity cause by mining in the rivers, to actual diversion of water for mining purposes away from known water intake points, or worse, actual destruction of those intake points in the process of mining. Without a plausible solution to the mining crisis in the Pra and Kakum watersheds, it will be impossible to reach the desired state.

There is an income feedback loop taking place in the system. Lack of adequate income, or income generating opportunities, is a key driver behind destructive mining activities. For many individuals, it is simply put, the best alternative available to generate income in the watersheds. Any future suggestions for alternative livelihood strategies as an intervention in this system will need to overcome this hurdle. In addition, in looking at the full system, other destructive activities linked to lack of income are illegal logging, fishing with chemicals, farming on river banks.

The income effect and associated destructive practices are further exacerbated by other trends, namely climate change and population growth as described in a previous section of this report. These trends have the combined impact of ramping up demand for water in the short and long term while climate impacts will steadily erode the ability of the watershed to supply adequate water, which will in turn be further amplified by human activities in the watersheds. One corresponding results of increased population and economic growth is rapid increases in urban and industrial effluents entering the water system, especially near large urban centres such as Kumasi and Obuase.

Figure 10: Conceptual model of the Pra and Kakum Watersheds



Finally, in much the same way that pollution is the number one threat facing the watersheds, one of the primary contributing factors to the problem is the lack of consistent monitoring and enforcement in the watersheds. This problem applies to all agencies and departments with responsibilities in the districts and municipalities of the watersheds. Without adequate presence of the organizations responsible for ensuring the health of the watersheds, there will be no reaching the desired state. There needs to be adequate budgets to fund required activities, in addition to leadership and active coordination across agencies and regions. Figure 10 above depicts the role of enforcement in the overall system.

With the full view of the system dynamics at play in the watershed, we can now look to articulate the key elements of the desired state, and begin to elaborate and prioritize strategies and interventions that will move the system towards the desired state.

1.4 Final Comments on the BAU Report

1. Water scarcity challenges appeared sooner than originally predicted;
2. Water scarcity for the Pra Basin was determined based on how much water could be potentially mobilized, but not based on the fact that most of the water was available was not in a form that was accessible to water users;
3. These challenges will be driven primarily by population and industrial growth in the near future, and;

4. Will be exacerbated by climate impacts that reduce water availability in the long term;

5. Current water use level is far greater than what was recorded by Water Resources Commission

6. Better data is needed on water treatment costs and associated treatment plant shut downs to make the business case for alternative investments in both new infrastructure and ecosystem restoration.

7. The problems of the basin need to be addressed now. Key actors in the watersheds need to move on to identifying, prioritizing, and implementing interventions to improve water quantity & quality immediately.

8. The database on registered water users is currently very limited and is only a reflection of the limited capacity of WRC to reach out to all users.

The following sections of this report will define the goals of the desired state, describe the desired state, and outline initial ideas for prioritizing action in the basins and bridging the gaps between present reality and the desired state.

Chapter 2 Desired State of the Pra & Kakum Watersheds

2.1 Overview

This chapter presents the vision, goals and description of the Desired State for the Pra and Kakum Watersheds and reviews the necessary conditions and institutional arrangement required.

2.2 Vision for the watersheds

In ten years, under a Payment for Water Services (PWS) mechanism, STMA and/or CCEMA could expect to furnish domestic and industrial water users with clean water (sanitary, increased quality), an increased and steady flow (adequate supply throughout the year supported by full production capacity), and in collaboration with WRC and other partners, healthy and productive watersheds that support long-term water demand, rural enterprises, and livelihood choices. Payments for watershed services could lay the pathway to achieving this desired state in an economically efficient and linked manner such that the behaviour of upstream stakeholders and land-users is altered as a result of equitable and targeted incentive programs and levies, resulting in improved water quality and/or sustained flow for downstream domestic and industrial users.[3]

2.3 Goals of the Desired State

Multiple challenges currently confront the Pra and Kakum Basins, such as loss of vegetative cover through logging, farming and illegal mining activities. These activities lead to pollution, disruption of water flow, siltation and blockages, reduced raw water yield, as well as increased water production costs. Urgent action is needed to address the current situation to prevent it from getting worse. Accordingly, the following strategic goals are proposed for the Desired State of the Pra and Kakum Watershed, to improve water quality, flow and quantity to meet the increasing demand:

1. To ensure a healthy and functional ecosystem with adequate green infrastructure to facilitate effective groundwater recharge, filtration of pollutants and sediment and enhance the resilience of the watershed to climate change impact.

2. To ensure that the basin yields adequate raw water in a form that can be utilized by the respective users.

3. To ensure a sustainable financial mechanism that supports cost-effective clean water production and improved livelihoods

4. To strengthen human and institutional capacity to carry out IWRM in the watersheds.

2.3.1 Descriptions and Outcomes per Goal

The goals of the Desired State have been further broken down into outcomes per goal for consideration by the Working Group:

[3] Outlining the Case to Support Payments for Watershed Services in the Pra and Kakum river Basins, September 2012, page 18.

Goal 1: *To ensure a healthy and functional ecosystem with adequate green infrastructure to facilitate effective groundwater recharge and filtration of pollutants and sediments and enhance the resilience of the basin to climate change impact*

Vegetative cover, particularly forest cover is the most effective natural tool for facilitating under groundwater recharge and filtration of pollutants and sediments. The presence of good forest cover also enhances the resilience of the area to the impact of climate change. To enhance the ability of the Pra and Kakum Watershed to function effectively, it is necessary to carry out the following:

Outcome 1.1: Improved Land-use planning

a. Assess and map land-use practices
b. Liaise with Town and Country Planning Dept. to define and map appropriate land-use zones
c. Assess those portions of the watershed where forest/land degradation has occurred;
d. Identify critical areas and carry out forest cover restoration/rehabilitation
e. Identify and rehabilitate other critical aquifers
f. Define buffer zone area and implement buffer zone policy
g. Monitor pollutants and sediment levels at identified points

Outcome 1.2: Positive attitudinal change effected

a. Review the benefits sharing arrangements for forest and trees
b. Carry out education and awareness creation on best practices on forest, land and tree tenures;
c. Identify and implement appropriate incentives system to support attitudinal change

1. Assess those portions of the watershed where forest cover has been lost
2. Identify critical areas and carry out forest cover restoration
3. Define buffer zone area and implement the buffer zone policy
4. Review the benefit sharing arrangements for forest and trees
5. Identify incentives

Outcome 3: Resilience to climate change impact enhances

a. Remove plants with abnormally high water abstraction abilities, e.g. invasive weeds and other introduced alien plants
b. Rehabilitate degraded wetlands and mangroves
c. Establish early warning system and monitor trends of identified key parameters
d. Promote afforestation to increase tree cover and carbon stocks

Goal 2: *To ensure that the basins yield adequate raw water in a form that can be utilized by the respective users in and around the watersheds:*

Even though the potential exists for adequate water to be mobilized and made available to users, the entire basin is not able to yield adequate water in the right form to meet current and future demands. This is as a result of diversions and occurrence of high levels of sediments in the water bodies attributable to illegal mining activities.

To address the situation therefore the following actions are recommended:

Outcome 2.1: Yield from rivers and streams improved

a. Identify areas where normal water flow in rivers and streams has been disrupted;
b. Remove diversions and restore normal flow;
c. Identify and remove plants that exhibit abnormally high water abstraction
d. Dredge and remove sediments from rivers and stream to improve flow rate.
e. Establish sediment ponds for primary treatment of effluents from settlements before discharge into rivers and streams
f. Monitor water quality in streams and rivers
g. Enforce standards for discharge into rivers and streams

Outcome 2.2: Yield from Water treatment plants improved

a. Assess and identify obsolete and dysfunctional water treatments plant equipment
b. Rehabilitate and replace all obsolete water treatment plants with modernized equipment
c. Dredge and rehabilitate impoundments for water intake at treatment stations
d. Enforce permit system

Goal 3: *To ensure a sustainable financial mechanism that supports cost-effective clean water production and improved livelihoods*

Currently, the only financial mechanism to support the management of the two basins is the Water Resources Commission's Water Management Account. It is funded through the issuance of Water Use Permits and Drilling Licenses. The coverage is however very limited due to the low staff strength of the Commission, making it impossible to adequately fund operations related to water resources management in the two basins. There is therefore the need to put in place a sustainable financial mechanism that can support all the necessary operations related to water resources management within the basins.

To address the situation the following actions are proposed:

Outcome 3.1: Base of the WRC Water Management Account Expanded:

a. Identifying and registering all the water users within the two basins
b. Identify all ratable water users and levy appropriate rates
c. Monitor and enforce permissible limits
d. Identify investments upstream that result in downstream benefits
e. Target payments that achieve impacts
f. Develop partnerships with private sector to promote investment in watershed water exploitation to cater for the needs of emerging industries such as oil and gas.

Outcome 3.2: Complimentary Sustainable Financial Mechanism in place.

a. Establish a PWS fund to manage all watershed funds outside the WRS WMA

b. Fund managed by independent coordinating council of parties an partners working on the desired state
c. Identify investments upstream that result in downstream benefits
d. Develop partnerships with development partners to invest in the fund.
e. Develop partnerships with private sector to promote investment in watershed water exploitation to cater for the needs of emerging industries such as oil and gas
f. Develop other sources of revenue that can contribute to the fund.

Goal 4: *To strengthen human and institutional capacity to carry out Integrated Water Resources Management initiatives within the watersheds.*

The respective institutions whose activities are related to water resources management do not have the necessary human resources to carry out their mandates. There is also a lack of coordination of these institutions to improve benefits in water resources management. Accordingly the following actions are proposed:

Outcome 4.1: Human resources strengthened

a. Carry out human resource need assessment within the respective institutions related to water resources management.
b. Identify training needs
c. Develop a training programme and carry out training to enhance human resource capacity;
d. Define clear roles for the institutions;
e. Identify and, if possible, support budget requirement for institutions for their work in the Pra and Kakum Basins

Outcome 4.2: Effective Coordination mechanism in place

a. Establish Memorandum of Understanding with between WRC respective institutions
b. Establish a common platform for dialogue on issues related to the basin management
c. Establish secretariat for effective collaboration with institutions
d. Carry out education and awareness creation in the formal and informal sectors enhance understanding and effective participation

2.4 Description of the Desired State

If the appropriate actions are taken to achieve the outcomes and goals as outlined above, it will enhance progress towards maintaining a healthy and functional ecosystem that has the capacity to sustainably yield raw water in the acceptable form to meet the increasing demand and improve livelihoods. Therefore, in the desired state of the Kakum and Pra Watersheds, the two basins are able to effectively and efficiently perform their ecosystem functions and optimize their ecosystem services. Environmental flows are optimized and the watersheds are able to meet the needs of a growing base of individual and industrial users without compromising sustainability or ecological integrity.

In this desired state:

- There is an adequate quantity of water of acceptable quality available for environmental flows and to support ecosystem health;
- There is adequate water to sustain daily human needs;
- There are healthy individuals, with sufficient incomes, living in the watersheds whose daily practices contribute to the health of the watershed rather than cause harm to it. They understand the importance of the watershed and their role in protecting it. They understand the impacts their daily practices have on the watershed;
- Institutions and partners investing in the management of the watershed, appreciate the benefits from their investment in terms of observed improvements in water availability and quality;
- Industries operating in and abstracting water from the watershed value the service provided by the watershed and act as stewards of the watershed, seeking to protect the environment and replenish more water than they abstract;
- There is a well-coordinated central governance mechanism* comprised of all relevant national and local institutions that have a role in protecting watershed integrity and providing water;
- Rules and practices that promote the ecological health of the watersheds are monitored and enforced;
- Individuals and organizations having a positive impact on the health of the watershed are rewarded, and those having a negative effect are penalized and paying fines to compensate for their negative effects;
- There is a funding mechanism in place to channel government, user, and partner funds into projects and interventions aimed at improving and maintaining the ecological health of the watersheds.

The central co-ordinating mechanism would:

- Prevent overuse of ground and surface water resources (through employing the decision support system);
- Prevent over exploitation of all other resources of the watersheds;
- Ensure strong links and collaboration among primary and secondary stakeholders of the watersheds;
- Promote gender parity;
- Enforce watershed buffer zoning;
- Enforce compliance regulation on water use permitting and drilling licensing(business case);
- Ensure livelihoods and industry in the watershed have a net positive impact on the environment;
- Promote payment for watershed services to inspire the adoption of sound environmental practices beyond simply observing watershed regulations;
- Reward individuals and organizations acting to improve the ecosystem health of the watersheds;
- Oversee investments into interventions seeking to improve the water quantity and quality in the watersheds.

2.5 Institutional Landscape of the desired state

Leaders and experts within the broader water supply system are highly interested in figuring out a way to use PWS to solve some of Ghana's biggest water challenges. Under the existing urban water supply system, rate payers are not being charged an environmental tariff on their monthly water bills from the GWCL. Upstream users from commercial, service-provider, and agricultural sectors pay the WRC for a permit to abstract "raw" water to support their activities and enterprises, and a portion of this money is placed into a water management account (see below). Among key stakeholders, it is widely agreed that abstraction rates are low and permit costs could be refined or a levy issued to ensure that "industrial" users are supporting water quality and quantity.

While no explicit PWS project exists, the WRC has set up a Water Management Account (WMA). Money paid into this account is used by the WRC, at times in collaboration with EPA, to support water quality monitoring, some operational costs, and small-scale projects that are viewed to have a positive watershed impact. To date, project costs are quite high and the project impacts are not very clear. Nonetheless, the WMA is an important mechanism and with the support of the overarching WRC Act Ghana has a good foundation upon which to continue to explore ways to integrate PWS.

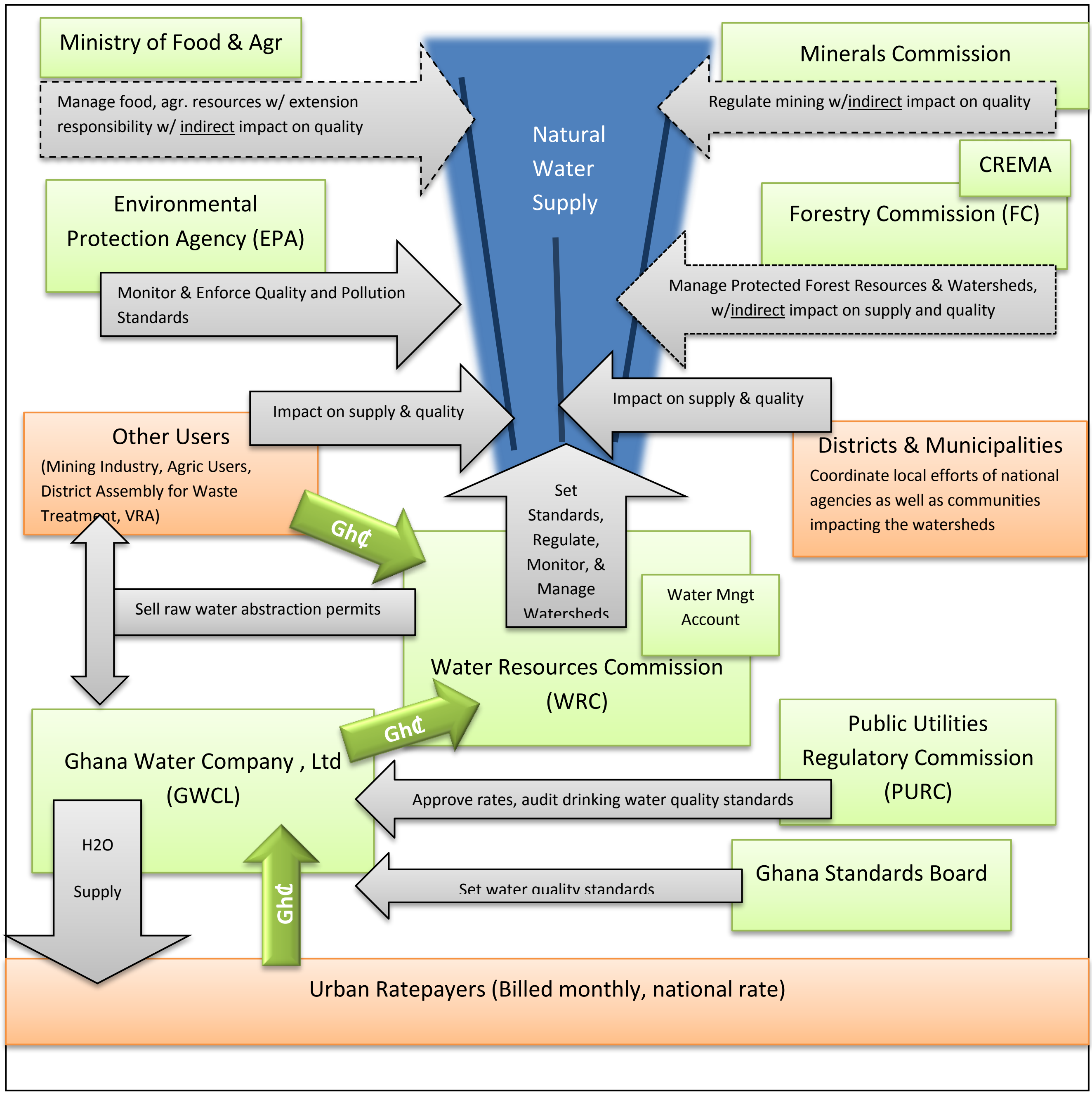
The concept of PWS also falls within the current and historical objectives of the Forestry Commission. During the colonial period, many Forest Reserves were created with watershed protection as one of the primary aims; as evidenced by the number of reserves and other protected areas which were named after important rivers and headwaters (e.g. Afram Headwaters Forest Reserve; Tano-Offin Forest Reserve, Kakum National Park, etc). In its language, the current Forest & Wildlife Policy, including the anticipated revisions, also value the ecosystem services provided by forests in key watersheds, despite the fact that management of forest reserves and off-reserve resources has primarily focused on timber production.

GWCL has clear interest in a PWS scheme. It is felt that improvement in water quality and a sustained supply throughout the year, as a result of better regulation of pollution and land use, and sustainable forest management practices could greatly reduce treatment and production costs.

Whether explicitly or implicitly stated in policy, at least five government agencies have an interest in PWS and already play a role in the provision of water quality and supply. In addition, a handful of key government institutions and private sector entities impact water quality and supply, whether intentionally or unintentionally[4]. Figure 11 outlines these agencies' and actor's respective roles, responsibilities, and general area of impact.

[4] Outlining the Case to Support Payments for Watershed Services in the Pra and Kakum river Basins, September 2012, pages 13-14.

Figure 11: Institutional Landscape of the Desired State



There two key elements missing in this framework:

1) The first is a central coordinating mechanism, described earlier in Goal 5, to ensure all actors in the basins are working in coordination with one another and at optimal efficiency. WRC's intent to expand the presence of Basin Boards in the watersheds should help with this, but an explicit central mechanism is still required
2) The team added in the Districts and Municipalities into this diagram. As important as central coordination is, an effective means to translate plans into action on the ground is required. Local authorities need to be involved in planning and also need to be resourced to help achieve the goals of the desired state.

2.6 Other ideas for consideration in the desired state

In achieving the desired state, there are a number of interventions that could be implemented in Ghana that are being used in other watershed and conservation projects globally. These ideas are presented here for consideration by the working group in the next phase of implementation of this project.

2.6.1 Miradi Conservation Planning software and the Open Standards

The software used to document the conceptual model of the Pra watershed is called Miradi, and was developed to support the Open Standards for the Practice of Conservation - A series of best practices for designing, managing, monitoring, and learning from conservation projects. The Open Standards were created by a consortium of global environmental organizations to create a consistent platform for conservation planning and monitoring. A copy of the Open Standards can be downloaded at www.ConservationMeasures.org

The conceptual model represents just one element of the functionality of the software. Miradi can also be used to define the project team, vision, scope, and targets for a project or programme. It can be also be used to assess the viability of targets and rank threats against targets. In addition to creating conceptual models, Miradi can also be used to identify strategies and document results chains that show the positive impacts of the strategies on the intended targets, as well as the theory of change behind them. Finally, Miradi can also be used to generate a strategic plan, work plan, and reports to manage and monitor projects. Miradi can be downloaded here: https://miradi.org/download.

Miradi and the Open Standards are best used when combined with experienced facilitation by practitioners familiar with both the standards and the software. As such, the conceptual model functionality was the only aspect used in this phase of the project, to demonstrate the efficacy of the tool without creating expectations moving forward. However, more extensive use of the software by this project and by other partners in the Pra and Kakum watershed collaboration, including NCRC, WRC, Forestry Commission, and others could prove invaluable. There are many practitioners capable of providing training and facilitation on Miradi and the Standards. However, Foundations of Success http://www.fosonline.org/ , was one of the lead organizations in creating Miradi and the Open standards, and has worked with many organizations, including the World Wildlife Fund and Moore Foundation, to plan large scale conservation programmes. FOS would be willing to partner with WRC or other partners in the watersheds to facilitate workshops in using Miradi and the Open Standards in Ghana.

2.6.2 Alliance for Water Stewardship

The Alliance for Water Stewardship (AWS) is the result of a collaboration between global and local conservation organizations, businesses and public sector agencies seeking to promote water stewardship among the worlds' largest water users promote healthy watersheds and more effective and collaborative watershed governance. A key tool of the AWS and its partners is the first International Water Stewardship Standard. The standards seeks to promote and recognize good behaviour at sites and within watersheds, and works much the same way as standards such as Forest Stewardship Council (FSC) does for sustainable forestry.

AWS, in conjunction with players such as WWF, UNEP, UN Global Compact, TNC, Veolia, CDP, Nestle and IWMI, has been leading a global effort since 2010 to draft its water stewardship standard, including pilot projects with partner organizations around the globe. In their own words,

> "The AWS Standard is designed to be an international, ISEAL-compliant, standard that defines a set of water stewardship outcomes, criteria, and indicators for how water should be stewarded at a site and watershed level in a way that is environmentally, socially, and economically beneficial. The Standard is intended to provide water stewards with an approach for evaluating the existing processes and performances within their sites and watersheds, and ensuring that responsible water stewardship actions are in place to minimize negative impacts and maximize positive impacts."[5]

The final version of the AWS standard will be released on April 8th, 2014. Piloting the AWS Water Stewardship Standard with key water users in the Pra and Kakum watersheds could be become part of a suite of tools used in the basins to promote and incentivise positive behaviour and would afford them the opportunity to become recognized as global leaders in water stewardship.

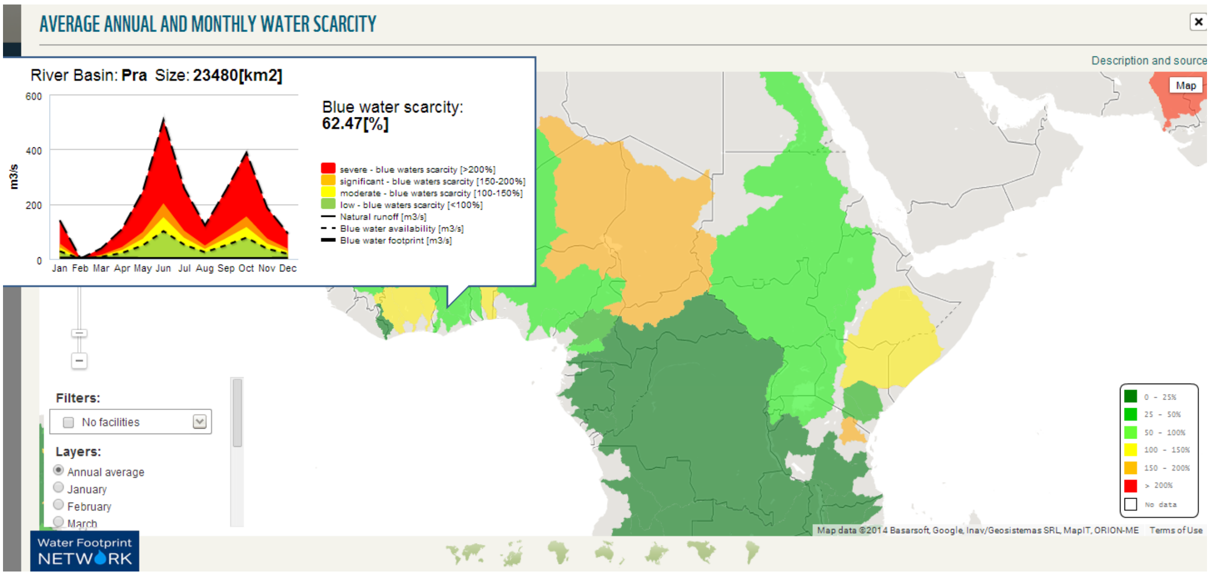
Figure 12: Companies and locations where the AWS standard has been piloted

2.6.3 Water Risk Filter

The World Wildlife Fund partnered with Germany's DEG and the Water Foot Print Network to create the global Water Risk Filter, an open source tool that allows companies or organizations to input data on their facilities to assess both facility level as well as basin level risk. The tool allows user to plot their own facilities, but also allows user to see global, regional, and local heat maps across multiple parameters ranging from monthly water scarcity to mercury pollution. It also has data on basins across the globe. Figure 13 below shows seasonal water scarcity map for the Pra.

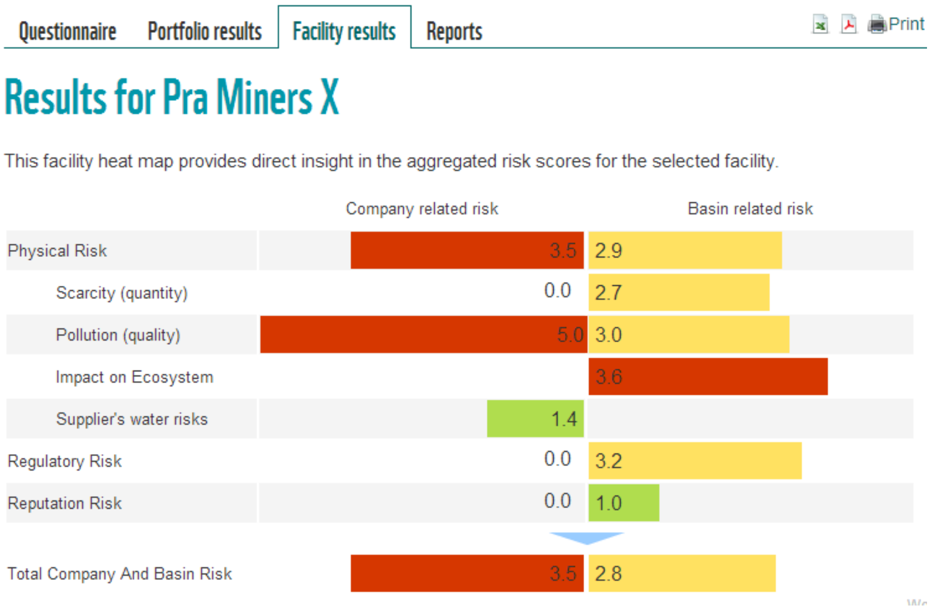
[5] http://www.allianceforwaterstewardship.org/what-we-do.html#water-stewardship-standard

Figure 13: Pra Blue Water Scarcity from the Water Risk Filter



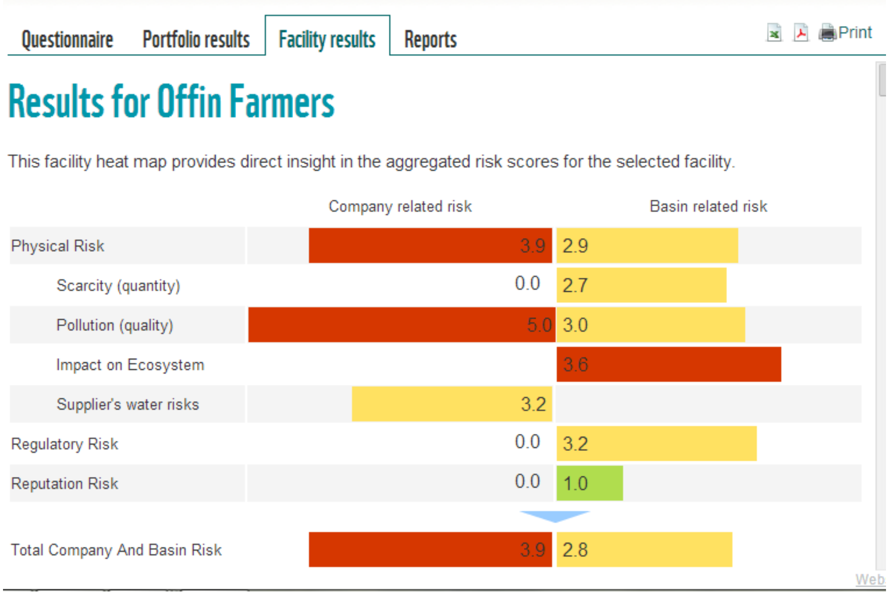
However, the true power of the tool is the ability to enter facility level data into the filter. This could be useful for individual companies operating in Ghana, plotting multiple facilities to across their portfolio to assess risk. For example, Figure 14 below shows the risk of a fictitious mining facility located at Twifo Praso:

Figure 14: Predicted company and basin risk for a mining facility located at Twifo Praso



We see that the biggest risks are associated with pollution of the mining industry and the corresponding impacts on the eco system. Figure 15 shows another set of results for a sample farming operation at Dunka-on-Offiin:

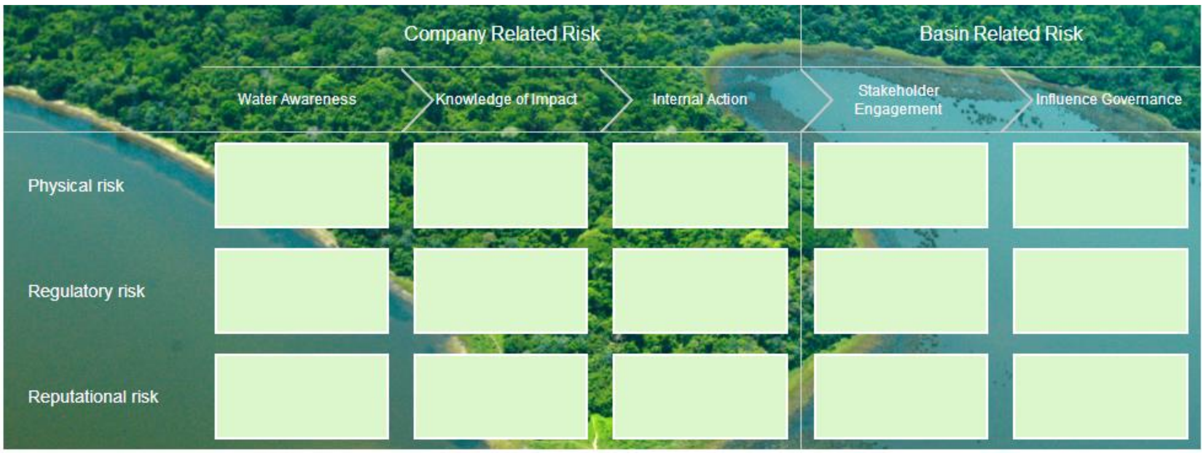
Figure 15: Predicted company and basin risk for a farming operation located at Dunkwa-on-Offin



Perhaps the greatest potential value the tool presents for the Pra & Kakum Watersheds is the ability to map all facilities in the basin across a common set of parameters. The tool allows for very detailed facility level input and allows a robust set of reports. An organization such as the WRC or its Basin Boards could use this tool as a way of tracking users across the watershed and mapping and communicating the associated risks to the companies, their industries, and for the basin and sub-basins as a whole.

Finally, the tool offers a range of mitigation responses that could be built into the detailed planning for the Pra and Kakum desired state implementation. Mitigation responses range across company level and basin level responses within three key areas of risk: Physical, Regulatory, and Reputational Risk.

Figure 16: Sample mitigation framework in the water risk filter



Mitigation responses range from awareness and knowledge of impact at the company level, to companies taking individual actions to address their own impacts before then engaging at the basin level through both stakeholder engagement and actively supporting and participating in the governance of the watershed. This framework could be a useful tool for WRC and its partners to engage stake holders in the Pra and Kakum Watersheds. The Water risk filter can be accessed here: http://waterriskfilter.panda.org/

2.6.4 Anchor partnerships with the Private Sector

A final idea to be considered in the planning for the desired state is engaging key private sector actors as partners in the watershed. There is a growing corporate awareness of water risks, and the need to act as good environmental stewards. Increasingly these actions have moved out of the realm of public relations and corporate social responsibility into a core strategy of the company's future success. Examples of companies that have engaged in global water partnerships that have operations in Ghana include The Coca-Cola Company, Nestle, Unilever, and SAB Miller amongst others. In addition, the global and regional mining companies increasingly recognize their reputations are tied to all impacts related to mining, and just those associated with their company's operations. NCRC, WRC, and their partners would do well to seek to engage large mining companies operating in the watersheds, as well as other global and local brands as key partners in the journey to the desired state.

Chapter 3 PWS Design

3.1 Overview

This chapter proposes a way forward for PWS in the Pra and Kakum basins. It builds on recommendations in previous reports commissioned by this project and outlines key considerations to be taken up in the gap analysis and implementation phase of the project.

3.2 Analysis of current design and function of WRC Water Account

The BAU report concluded that the WRC is the most appropriate body to implement a PWS scheme in Ghana, and that it's Water Management Account is likely the most appropriate starting point for channeling PWS investment. However, the following weaknesses were pointed out:

1) **Insufficient internal fund generated:** With the exception of 2011, in most years the combination of government subvention and fees into the WMA to not cover budgeted expenditure.
2) **Need for greater transparency:** The revenue break down between government subvention and funds generated through fees and license into the WMA is not provided. Without this information, it is difficult to determine how successful the WRC might be at generating funds for watershed investments through the WMA. In addition, on the expenditure side, spend is not broken out to show investments made in the watersheds, and as such determining the efficacy of such spend to date is not possible.

These transparency issues would need to be addressed before the potential of the WMA as a base for future PWS payments could be determined. A third weakness not identified in the BAU is a lack of understanding on the part of WRC as to how many potential licensees and/or permitees are out there. In business terms, there is no understanding on the part of WRC as to what the potential market for their services is. One of the strategies proposed by the WRC as they expand their presence in the Pra and Kakum Watersheds is to "expand the base" of the water management account by getting in more users, however, there is no data to show whether the user base can be expanded by 5% or 150%. A key next step in the implementation of PWS in the watersheds will be to assist the WRC to analyse the size of the market for drilling licenses and water use permits.

A simple analysis suggests there is a great deal of potential for expansion. In the 2012 Water Register, there were 151 organizations granted permits, as follows

Table 7: Water Permits by Category in the 2012 Water Register

Category	# of permits	%
Aquaculture	14	9%
Domestic / municipal	103	68%
Industrial	7	5%
Mining	26	17%
Power Generation	1	1%
Total	**151**	**100%**

68% of all permits issued were for domestic and municipal use and of these the majority were for GWCL. All of the aquaculture and the single power generation permits were located outside the Pra and most of the 7 industrial permits were as well. The 26 mining permits issued are spread across 14 companies, all located within the Pra Watershed, yet 4 of these are for groundwater extraction. A simple web search yields a list of 23 major mining companies operating in Ghana, 300 registered small scale mining groups, and 90 mining service companies. There is clearly room to expand the base in the mining sector.

It is also interesting to note there are no irrigation schemes listed on the Water register and only 3 of the total permits are for agriculture; 1 Cocoa company and 2 palm oil companies. A concerted, on the ground effort on the part of WRC and its partners would likely yield a substantial list of organizations to be permitted, many of whom have likely been abstracting water in the basins for some time already.

Another consideration for WRC is to also seek permits (or fines) for companies causing negative impacts on the watershed. Forestry companies limit the ability of the forests to filers and help recharge ground water. Excessive waste disposal by municipalities and other companies adds to pollution. A more comprehensive view of users impacting the watershed could yield a more robust set of potential payers from whom WRC could generate funds to invest back into the watershed.

3.3 Analysis of PWS Options and Requirements

The NCRC Report, "Outlining the Case to Support PWS" outlined two potential PWS plays in Ghana:

1) The first would be a mechanism to incentivize upstream landowners and land users that focuses on sustainable water supply and flow to the downstream users.

2) The second would use incentives or improved monitoring and auditing of upstream landowners, land users, and industrial enterprises to ensure an improved water quality, with a particular focus on reducing siltation and pollution.

The report suggested option 2 was of a more urgent need. However,in reality these options are not mutually exclusive. There is a need to improve both water quality and quantity in the watersheds, though acute pollution impacts from mining and other sources of sedimentation and effluent are the most pressing.

The report also proposed a major focus on improving water quality by:

- changing upstream environmental decision making behavior and land-use practices through the introduction of financial and/or non-financial incentives;
- as well as more comprehensive monitoring and auditing.

These recommendation present a rather binary solution, when the dynamics in the basin are quite complex, and there is a general lack of understanding on which types of incentives might work in the context of Ghana and the Pra Watershed.

From the previous chapter, it is clear that a number of activities in the Pra and Kakum Watersheds need to be funded through a PWS scheme or some other source funding:

1) Expansion of WRC's Presence in the Watersheds through establishing expanding, and strengthening Basin Boards in the Pra, Densu, and Kakum (See description Chapter 4). Including an analysis to "expand the base" of users paying into the water management account;
2) Funding a comprehensive assessment and mapping of the most urgent issues in the basin and a prioritized list of projects to address those issues;
3) Funding water quality base-line study and regular monitoring across the basins;
4) Ensuring the effective coordination of agencies across the basin and ensuring that each has the resources required to fulfil its mandate;
5) Continuing security operations to address the galamsy issue while proactively engaging the mining sector in a long-term solution
6) Upstream investment in pilot projects to reduce pollution and sedimentation into the rivers.
7) Further funding to scale-up the most successful pilots to other areas of the basin.

Further phases of this project will seek to expand on the issues to be addressed above, but this is a fairly comprehensive starting point. The next question is how to provide the resources for these activities

The ideal long-term solution would be a system in which internally generated funds from the users benefiting from the services of the watershed would be sufficient to fund upstream activities that ensured both water quality and quantity. These users would range from the largest abstractors and drillers, to potential polluters, to the average urban citizen, who currently has no connection to the effort required to provide them with safe water.

In much the same way that solutions to address the water quality and quantity problems in the basin need to be developed and implemented over time, so do the solutions for generating the appropriate level of funds to finance them. The following represents a step-wise approach to generating funds in the basin:

The first set of solutions fall within the remit of the WRC and the Water Management Account:

1) **First seek to allocate funds within the WMA to watershed restoration pilots** in priority areas. These pilots should have measurable targets and pre-implementation baselines that enable results to be easily monitored and thus the impacts of expanding such projects to other areas could be well understood. These funds should become a sub-account of the WMA and reported on separately to allow for analysis of the results of watershed-specifc investments
2) **Seek to expand the base of users paying into the water management account,** and project the likely resulting increase in funds that can be invested into activities in the watershed.

It is likely the expansion of the base of the WMA will fund additional watershed activities in the basin, but will not likely be sufficient to cover all the expenditures listed above, especially in light of the intention of the WRC to expand (and pay for) its presence in the Pra and Kakum Watersheds.

At the same time that WRC is expanding its base, and a central coordinating mechanism is being established, a PWS fund should be set-up to handle funds from other development and corporate partners. The following could be sources of revenue for the fund:

1) **Grants from Development partners** interested in launching the fund or partnering on specific watershed interventions focused on improving water quality and quantity, or in improving the capabilities to effectively treat and distribute water to users.
2) **Funds from Corporate Partners** willing to invest in specific watershed restoration projects.

3) **Fines** issued as a result of improved and expanded enforcement of regulations in the basins.
4) **A future tariff** on water bills that connects water users to the investments required to ensure their water is clean and safe.

The gap analysis and implementation phases of the project should project and model this potential revenue over time and seek to engage potential stakeholder's willingness to participate in such and effort.

3.4 Proposed Approach

Previous reports estimated that STMA would need to invest at least US$20.7M to expand the storage facilities, transmission and distribution system to meet the estimated 2015 growth demand. This estimate neither takes into account the rapidly growing industrial demand for water, nor the growing urban population, which has already reached the 2025 projections. Furthermore, it does not include increased expenditures by the Ghana Urban Water Company to support the future costs of water treatment in light of the declining water quality. Therefore, it is highly likely that BAU scenario of ensuring water quality and production over the next ten years will greatly exceed the above estimate.

PWS offers an alternative strategy which can address many of the same problems, but in a more economical, equitable, and sustainable manner. PWS is a tool that uses market and market-like mechanisms to encourage water users (downstream) to value the provision of clean water through payments and adoption of best practices. It concurrently provides incentives to upstream land-users to preserve and protect water quantity and quality. PWS not only changes the way that water is valued, but it also provides highly cost-effective solutions in comparison to costly engineering approaches. Furthermore, PWS can provide new revenue streams to rural – and often poor – communities around the world. Finally, the associated forest watersheds and forest-agro ecosystems, including biodiversity, benefit from these approaches creating a wide-ranging win-win scenario.

The critical element behind most PWS schemes is protection of forest watersheds. This is because forests act as natural filters and can provide high water quality supplies that have low levels of both nutrients and chemicals. Forest cover also helps regulate surface and groundwater flow, providing a natural buffer to flooding and landslides often linked to heavily deforested land. Forests also act as a regulator of water during dry and wet seasons, leading to an increase in minimum flows during dry seasons. With respect to aquatic productivity, it is known that the quality of fisheries is closely linked to the conditions of adjacent upstream watersheds.[6]

The implementation of a PWS scheme in Ghana will require adaption of pure incentive driven models. The long-term goal will be to achieve the win-win scenario described above where payments to upstream land owners and managers from downstream users result in investments that preserve water quality and quantity for the basin. However, in the beginning, there will need to be simultaneous investments in infrastructure improvements and in expanding the capacity of government and local institutions to enforce regulations and monitor progress. In addition,

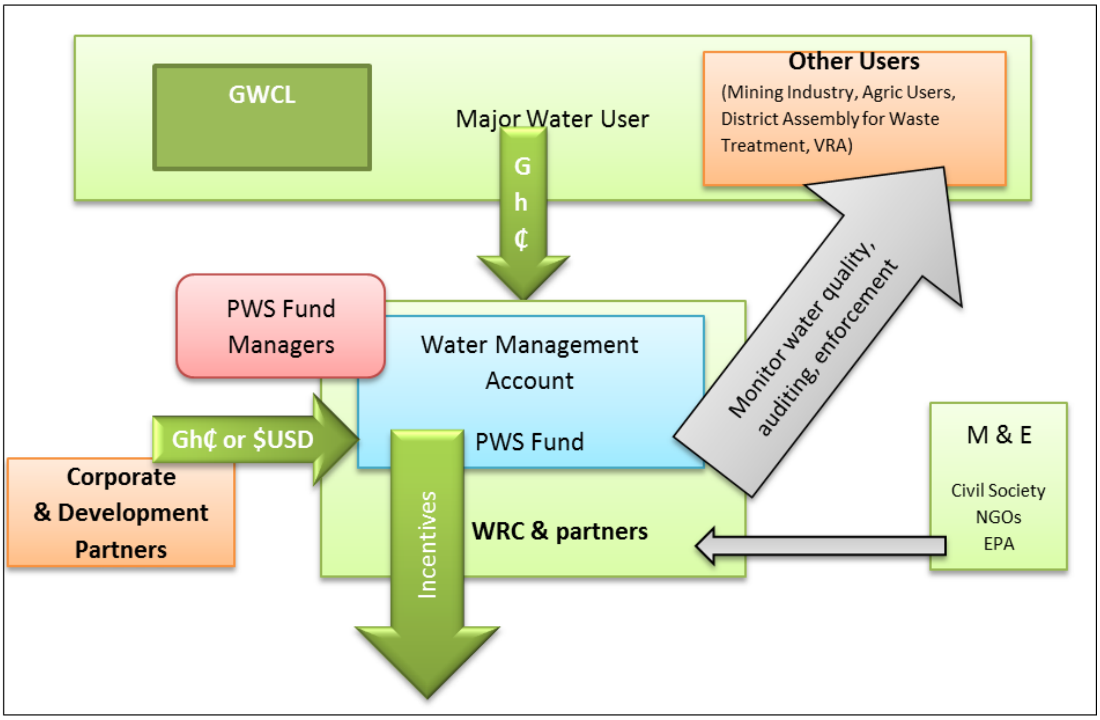
[6] First three paragraphs in the section pulled from the NCRC report: Outlining the Case for PWS, September 2012, Page 17.

investments in multiple pilot projects across the basin will be required to determine the approaches that will yield the best results for the multiple challenges in the basins.

The diagram in Figure 17 outlines this scheme, indicating the flow of activities, financial payments and incentives, as well as the main stakeholders and their respective roles. Instead of having to develop new structures or institutions to support PWS, the Water Management Account at the WRC provides an existing mechanism that appears to already support PWS-like activities, and could be used now to fund upstream investment, especially if WRC is able to successfully expand the base of users paying for permits and licenses in the Pra and Kakum watersheds.

However, in order to enable other government institutions and their partners to contribute to investments in the watersheds, it is likely a separate, independently managed fund will need to be established to augment and compliments the functions of the water management account. Over time, if the WMA is able to fully cover investments in the watershed through the fees it collects and corresponding savings in treatments costs, the PWS fund could be either phased out or merged with the WMA. In the interim however, an independently managed PWS fund will enable a wider base of interest parties to participate in the launch of PWS in the Basins. Funds from interested development and corporate partners could be used to launch this fund once a full implementation action plan has been developed.

Figure 17: Model for Future PWS payments



What remains to be seen, however, is the viability of the proposed scheme given the large scale of the two watersheds, the diversity of variables and stakeholders (including polluters) and specifically the nature of illegal mining and its contribution to the decline in water quality. Whether these damaging land use practices could actually be reduced, and how, is a topic that will require greater thought and deliberation. For this reason, a development and phase is recommended to "test" initiatives on a localized pilot level to see which incentive-based, enforcement-based, and other capacity investments yield results that might be scaled-up across the basins.

3.4.1 Tackling Scale and Testing for Success

The area of the watershed serving the Sekondi-Takoradi and Cape Coast- Elmina areas is vast, encompassing hundreds of square kilometers across the high forest zone and including four major Administrative areas—Eastern, Ashanti, Central and Western Regions. Tackling this scale is one of the main challenges of this project, particularly at the pilot stage when the initiative needs to be tested but cannot mobilize to cover the entire basin. Consequently, if the piloting effort only focuses on the lower part of the catchment area, then benefits may not be realized because any improvements made "downstream" could be un-done or diluted by behaviors upstream.

Focusing on water quality is attractive because clear standards and parameters already exist by which to measure impact. It may even be advisable to choose only one or two standards of quality to test. Under this scenario, one option is to break the entire watershed into sub-basins and measure key parameters at various points within these major sub-basins; thus creating a water quality baseline for the entire watershed.

Various pilot projects could then be tested upstream to determine their impacts on downstream quality. Given the variability and seasonality in the data, pilots would need to be run over periods of 12 months or more to assess their impacts across the range of conditions in a given year.

3.4.2 Landscape planning, CREMA s, and other upstream partners

Critical to the success of a PWS strategy is landscape level planning of the targeted watersheds. To date in Ghana there is a total absence of local-level landscape planning with respect to land-use practices and decision making. Neither government nor traditional leadership has recognized the importance of such mechanisms. In fact there is no landscape level planning of any kind operating in the country with one exception.

The Wildlife Division of the Forestry Commission which resides within the jurisdiction of the Ministry of Land and Natural Resources, together with its partners, has developed the Community Resource Management Area (CREMA) mechanism. The CREMA mechanism is an innovative landscape-level planning and management tool for community initiatives on off-reserve (un-gazetted) lands. The process has taken almost 20 years to move from an intellectual concept to approved pilot initiative and finally to a legally approved CREMA mechanism. The average CREMA covers about 25,000 hectares, but CREMAs can range from approximately a few thousand to a few hundred thousand Hectares.

All CREMAs have approved constitutions and community management structures, including regulations backed by local government byelaws. CREMAs can incorporate under Ghanaian law and control their own revenue. As such CREMAs are an approved institutional structure for landscape planning, democratic decision-making by local leadership and benefit sharing with all stakeholders.

Early CREMAs were all focused on wildlife and habitat protection and developed revenues from tourism and from sustainable harvesting of NTFPs. More recently existing CREMAs have begun to ask if they could develop future revenues from Payments for Ecosystem Services (PES) mechanisms. The Forestry Commission has endorsed the principle of exploring the possibility of using the CREMA mechanism for managing carbon project landscapes, and NCRC and partners are in the advanced stage of establishing the 1st CREMA designed to manage forest and tree resources for climate and livelihood objectives. Thus, it may also be possible to establish CREMAs with the intent to foster PWS.

Future pilots in the Pra and Kakum Watersheds could link to CREMAs as a test case; still others could focus on other levels of organization, be it at the district level, community level, or level of a single traditional area. These could be organized into CREMAs, but could also be tested independently. At least one pilot should test a sub-basin or water treatment plant catchment level collaboration amongst all stakeholders in a given area, to explore the concept of developing an understanding the shared risk that exists for all users in a basin, and the corresponding need to take collective action to address key issues. Finally, a set of pilots focused on protecting and reforesting key forest reserves in conjunction with the Forestry Commission should be explored.

3.4.3 Linking downstream users

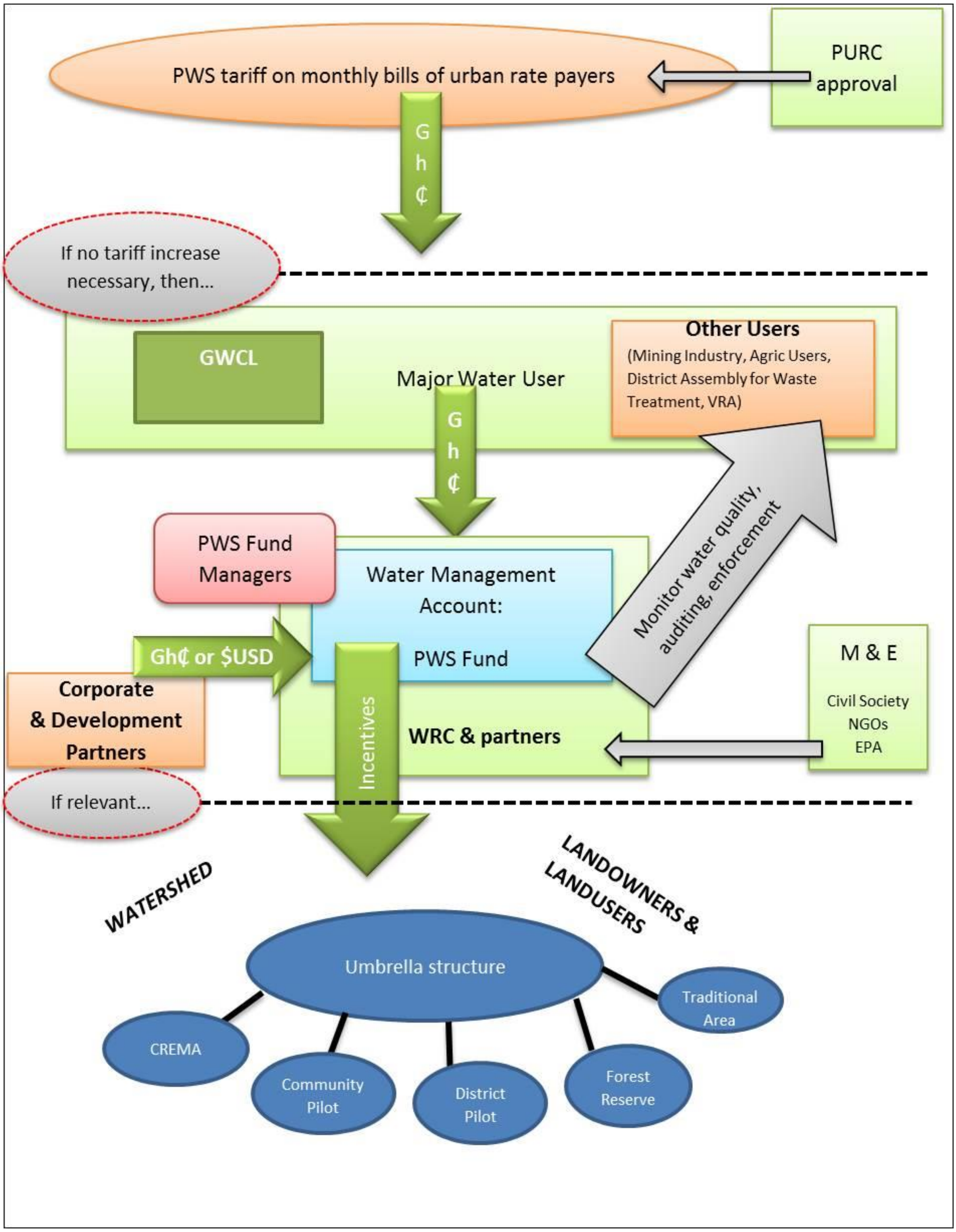
Finally, the long term success of PWS in Ghana rests on the users benefiting from the services of the watershed being directly connected to those services and valuing them. Currently direct abstractors, drillers, and large service providers are paying for the services of the watersheds. However, the customers of service providers are not. In time, a nominal tariff on GWCL water bills should be explored to both raise additional funds for upstream watershed investments and to ensure that each user is connected to the services they benefit from. In New York City, consumers pay a fee on each monthly water bill that goes directly into funding watershed protection activities in the Catskill Mountains of New York State that serve as the natural filter for New York City's Water supply. More in depth studies on willingness to pay and methods for introducing such a tariff are required that are beyond the scope of this report. However, the importance of inking users to the watershed cannot be overstated.

3.4.4 Proposed Model

Figure 18 on the next page was adapted from the previous NCRC report outlining the case for PWS and depicts the full proposed PWS scheme, starting with the joint WMA / PWS fund described previously. The full model also shows the linking of upstream users through a future tariff, as well as the various downstream pilot targets that could be tested.

Missing from this model is a corresponding feedback loop showing the expected improvements in water quality resulting from the upstream investments that lead to reduced treatments costs and greater water availability. These models can be built in the planning and implementation phase of the project.

Figure 18: Potential PWS Scenario(s) for STMA and CCEMA



3.5 Role of key actors in the system

The table in Appendix 4 outlines Key roles by actor, according to the goals outlined earlier in Chapter 2.

Chapter 4 Recommendations and Next Steps

4.1 Overview

This study has confirmed findings of previous reports commissioned by NCRC and Forest Trends and has expanded on them though additional analysis and more detailed recommendations for advancing PWS in Ghana. The chapter is designed to set the stage for the gap analysis and implementation planning phase of the project. It proposes options for prioritizing work in the basin moving forward, presents a framework for short, medium, and long-term planning in the basins, and finally, presents a short-term action plan as starting point for the next phase.

Before moving to recommendations, it is useful to review the key findings of this report.

Conclusions on the Business As Usual Scenario:

1. Water scarcity challenges appeared sooner than originally predicted;
2. Water scarcity for the Pra Basin was determined based on how much water could be potentially mobilized, but not based on the fact that most of the water was available was not in a form that was accessible to water users;
3. These challenges will be driven primarily by population and industrial growth in the near future, and;
4. Will be exacerbated by climate impacts that reduce water availability in the long term;
5. Current water use level is far greater than what was recorded by Water Resources Commission
6. Better data is needed on water treatment costs and associated treatment plant shut downs to make the business case for alternative investments in both new infrastructure and ecosystem restoration.
7. The problems of the basin need to be addressed now. Key actors in the watersheds need to move on to identifying, prioritizing, and implementing interventions to improve water quantity & quality immediately.
8. The database on registered water users is currently very limited and is only a reflection of the limited capacity of WRC to reach out to all users.

Recommendations for advancing PWS in Ghana

Action required in the basins:

1) Expansion of WRC's Presence in the Watersheds through establishing, expanding, and strengthening Basin Boards in the Pra, Densu, and Kakum, including an analysis to "expand the base" of the water management account;
2) Funding a comprehensive assessment and mapping of the most urgent issues in the basin and prioritized list of projects to address those issues;
3) Funding regular monitoring across the basins;
4) Ensuring the effective coordination of agencies across the basin and ensuring that each has the resources to fulfil its mandate;

5) Continuing security operations to dress the galamsy issue while proactively engaging the mining sector in a long-term solution.
6) Upstream investment in pilot projects to reduce pollution and sedimentation into the rivers.
7) Further funding to scale-up the most successful pilots to other areas of the basin.

The above funded through a PWS Fund that:

1) First builds from and expands the existing WMA account
2) Builds an independent PWS fund to channel partner resources, and additional fines and levies in the watershed into key basin priority investments.
3) Becomes the investment vehicle for a future water tariff that connects urban water users to the upstream service that provide them with water

The next challenge will be prioritizing pilots and actions in the Pra and Kakum watersheds amongst the diverse array of agencies and other stakeholders operating in the basins.

4.2 Prioritizing Pilot work in the basin moving forward

Many issues have been identified in the watersheds in this and previous reports, but no framework for prioritizing actions and pilots has been proposed. This section will offer several options for prioritizing future actions by threat, by sub-basin, water treatment plant, or some combination of the above. Additional variables to prioritize on may also be identified. In the gap analysis and implementation planning phase of the project, NCRC, WRC, and their partners will need to agree on a framework for prioritizing moving forward.

4.2.1 Prioritizing threats

A common sense approach would be to compile a list the threats in the watersheds and create a ranking based on severity and other issues. A matrix could be developed with several ranking factors such as severity and immediacy of impact, # of people affected, likelihood of the situation worsening, impacts to wildlife, proximity to human settlement, etc. Such a matrix could be drafted and reviewed in a working group meeting, but would require participants with a comprehensive view of the issues in the basin as well as a strong working knowledge of the plans of their agency or organization in the watershed.

The threats captured in previous reports are listed below as a starting point for future threat ranking:

Table 8: Threats in the Pra and Kakum Watersheds

Threats	Location
Mining	• Ampunyase (Jimi River, downstream from Obuasi) • Dunkwa-on-Offin – • Birim – similar to Dunkwa, especially in tributaries of Ghana Consolidates Diamonds concession • Dabuoase intake – siltation + low flow because miners restrict flow

Threats	Location
	through dykes/dams in river bed
Heavy metals	High arsenic at : • Apunyasi near Obuasi, • High arsenic in drinking water of lower Pra, • Dabuase and Twifo-Praso, • Mmuroneum (Annum River) –drains Konogo
Shut downs	Kibi system shut down for large portions 2009 & 2010
Water Weeds	Ajariago reservoir on River Anum, Barikese reservoir, Owabi reservoir
Urban Effluent	• Ampunyase (Jimi River, downstream from Obuasi) • Anwia-Nkwanta – (Oda River, downstream from Kumasi) • Owabi Reservoir from towns: Ohwim, Abrepo, Suame, and Bokankye, • KMS dumped sewage into the Owabi from 2009-2010
Industrial Effluent	• Anwia-Nkwanta – (Oda River, downstream from Kumasi) • Owabi Reservoir polluted by engine oil from magazine
High Nitrates	• Ampunyase (Jimi River, downstream from Obuasi) • Anwia-Nkwanta – (Oda River, downstream from Kumasi)
Forest Degradation	Barikese Reservoir – illegal chain sawing of the riparian forest
Low water quality	Berakese reservoir near Kumasi - <50 = poor water quality

4.2.2 Prioritizing sub-basins

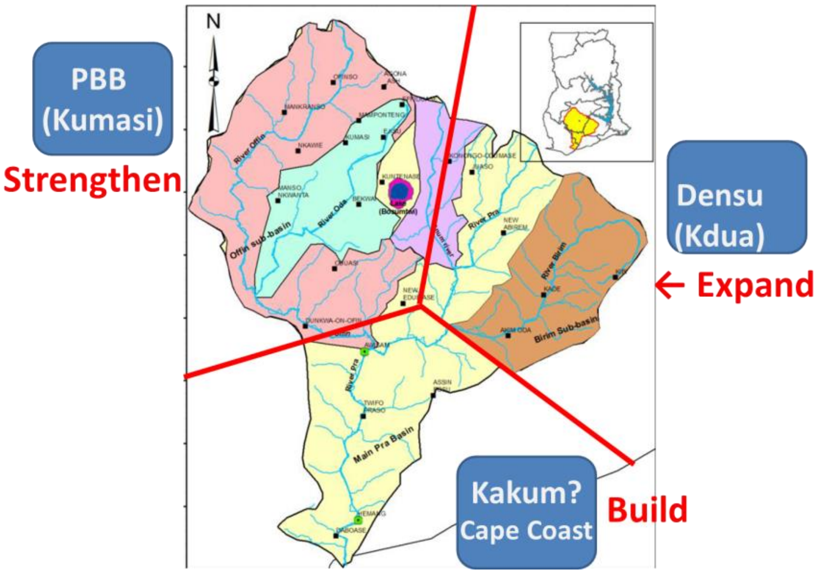
WRC has proposed an approach for expanding their presence in the Pra and Kakum Watersheds, that could be a useful organizing principle for other partners in the watersheds and the implementation of PWS.

WRC has the following plans:

1. Established the Pra Basin Board, with one secretariat officer based in Kumasi. This is a start, but Pra Board and the WRC's presence needs to strengthened to be effective
2. The WRC intends to expand the remit of the Densu Basin Board in Koforidua in to the Brimsu sub-basin in order to address issues in the eastern portion of the Pra watershed.
3. Finally, WRC intends to set-up a Kakum Basin Board, based in Cape Coast that will cover the Kakum and the Lower Pra.

Figure 19 below shows this division of the watersheds and potential framework for organizing future work in the basin:

Figure 19: WRC planned expansion in the watersheds



4.2.2 Prioritizing Forest Reserves

There are a number of reserves, forest, and one National Park located in the watershed that provide valuable services to the eco-system through their forest cover. One organizing principle moving forward could be to focus first on ensuring these reserves are protected and/or reforested as needed as a base for future afforestation and habitat reclamation in the watersheds. These reserves need not be the exclusive focus of investment in the watersheds, but serve as a useful starting point given their importance, existing status, and the shared incentives of other partners, such as the Forestry Commission, in ensuring their protection. One key adjustment required in thinking for these reserves would be to ensure that FC manages these reserves for ecosystem services, and not just timber production.

The following is an example of some reserves in the watersheds:

Reserves protecting headwaters: Aram, Atewa, Brimsu, Kakum NP, Owabi, Sekondi, and Bia headwater forests

Forests next to reservoirs: Owabi game reserve, Barikese Catchments Area Forests, Brimsu Forest Reserve.

4.2.3 Prioritizing water treatment plants / systems

Another organizing principle for prioritization could be to focus on the water treatments plants with the most pressing issues. These could focus solely on improving the performance and capacity of the plant itself, or could have a wider focus on the immediate catchment areas supplying the plan.

Table 9 below shows the water systems in the Pra basin highlighted in yellow that already exceed the minimum flow capacities of the rivers they are based on for either their 2001 or 2015 demand projections, or both.

Table 9: Water systems that exceed supply

System No.	System Type	River	Region/System	2011 Demand, m3/day	2025 Demand, m3/day	Free Catchment Area, Km^2	Minimum Flow m3/d
6	CT	Offin River (dam)	Barikese	*123,286	*212,479	914	76,667
8	CT	Anunu River (Weir)	Konongo	8,987	15,832	507	2,938
11	CT	Odaso River	Obuasi	18,102	30,275	2,398	34,277
12	CT	Owabi River (Dam)	Owabi	*	*	72.8	5,430
22	GW	Ofin River	Dunkwa-Offin /Aboabo	2,947	4,381	5,879	58,920
28	CT	Birim River (Well)	Anyinam	866	1,324	103	1.343
34	CT	Birim River	Bunso	104	170	89.9	1,390
36	CT-GW	Birim River (Weir)	Kibi	996	1,550	58.0	876
38	CT	Awusu River (Weir)	Kwabeng	452	941	7.7	101
43	GW	Birim River	Oda-Akim	6,132	9,999	2,877	39,090
44	CT	Pra River (system)	Ofoase-Akim	137	407	2,086	27,520
45	CT	Asupong River	Osenase	491	1,023	30.9	412
46	CT	Birim River (Well)	Osino	351	563	189	2,709
78 + 80	CT	Anakwari & Pra Rivers	Inchaban & Daboase Systems	30,541	45,487	8,624.8	**127,724
TOTAL				193,392	324,431	23,837.1	

* Total demand for systems No.6 + System No. 12. ** Minimum flow values of Anakwari and Daboase intake points (968m^3/d + 126,756m^3/d)

4.3 Short, Medium and Long-term planning

This section outlines major planning areas to be considered over the short, medium, and long-term.

Table 10: Pra Kakum Watershed Planning Matrix

Category	Short-term	Medium Term	Long-term
WRC Presence in the basins	Pra Board strengthened; Densu Board remit expanded	Densu Board strengthened Cape Coast / Kakum Board established	Cape Coast Kumasi Board strengthened
Stake holder engagement	Extensive outreach at the regional district, and community level; Consider social	Establish district/local basin boards to support regional boards; Ensure key agency	Ensure community ownership in the benefits achieved through watershed investment.

Category	Short-term	Medium Term	Long-term
	media options for engaging communities "eyes on the basin"	capacity at the district level	
Coordination Mechanism	Establish Coordination Mechanism	Coordinate actions across the watershed	Coordinate actions across the watershed
Interventions	Pilot projects	More integrated pilots	Sub-basin/basin level interventions
Water Management Account	Fund some pilots from current funds	Expand the Base of the WMA	Expand the Base of the WMA
Partnerships	Donor + Corporate Funds at start	Gradually reduce reliance on outside funds	Phase out partner funds to rely internally
PWS Fund	Mechanism agreed to and established	Partner & Govt. funds channelled into fund	Users also contribute to fund
Monitoring	All baseline data gathered and analysed	Regular Monitoring Occurring	Regular Monitoring Occurring
Awareness & Education	Engage in awareness raising in focal pilot areas	Expand awareness programs	Develop social media strategy to engage users in the basin
Mining	TBD	TBD	TBD
Governance and Regulation	Buffer zone policy approved	Buffer zone policy implemented	Buffer zone policy improved
Value Ecosystem Services	Inventory Services; ID buyers and sellers	Implement system	Maintain system
Review Legal framework	ID gaps to be addressed	Fill gaps in legal framework	Enforce Legal Framework
Support sustainable livelihoods (reduce impacts)	Document better practices by income stream (mining, logging, etc.	Promote better practices in key pilots	Promote better practices basin wide
Implement water stewardship best practices in the basins	Pilot Water Risk Filter; Pilot AWS Water Stewardship Standard	Expand use of tools in basin	Expand use of tools in basin
Support Further research on the basins	See BAU reccs on studies	TBD	TBD

4.4 Short-term Action Plan

This section proposes a short-term action plan to guide next steps and the team conduction the gap analysis and implementation planning.

Short Term Action Plan

1. Identify & Prioritize Pilot projects for the Basin(s)
    - Comprehensive list for basin, divided by sub-basin
    - E.g. WASH Project at Nsawam
    - At the community, district, WTP, and site level
    - Prioritize by level of urgency
2. Deploy funds from WMA to address basin issues
    - ID short-term projects to be funded now
    - Analyze potential to expand base of WMA
    - Connect tariffs to users: Emerging water demand by oil companies
    - Comprehensive understanding of business expansion needed
    - Implement plans to add more users paying into WMA
3. Seek partner funds to augment initial funds from WMA
    - Identify partners
    - Develop proposals to interested parties
    - Outline set of projects and results to be funds
4. Establish monitoring baseline for the basin by sub-basin
    - Key water quality testing locations identified and established (if not already)
    - Mapping at sub-basin level for key hot spots / threats / & opportunities
    - Mapping of other initiatives and other organization's efforts.
    - System for gathering / analyzing / and sharing data across relevant agencies is established
    - GWCL supported to collected and produce consistent data across WTPs
5. Engage WRI to collaborate with GMA, FC and Minerals Commission to establish baseline
    - Fund regular monitoring of the basin.
6. Expand WRC presence on the ground in key locations
    - Strengthen Pra Basin Board (Kumasi)

- Expand remit of Densu Board to Brimsu (Koforidua)
- Establish Kakum/Lower Pra Basin Board (Cape Coast)

7. Support activities of key agencies at the basin and district level
8. Ramp up enforcement in the Basin

Appendices

Appendix 1: List of Stakeholders Contacted

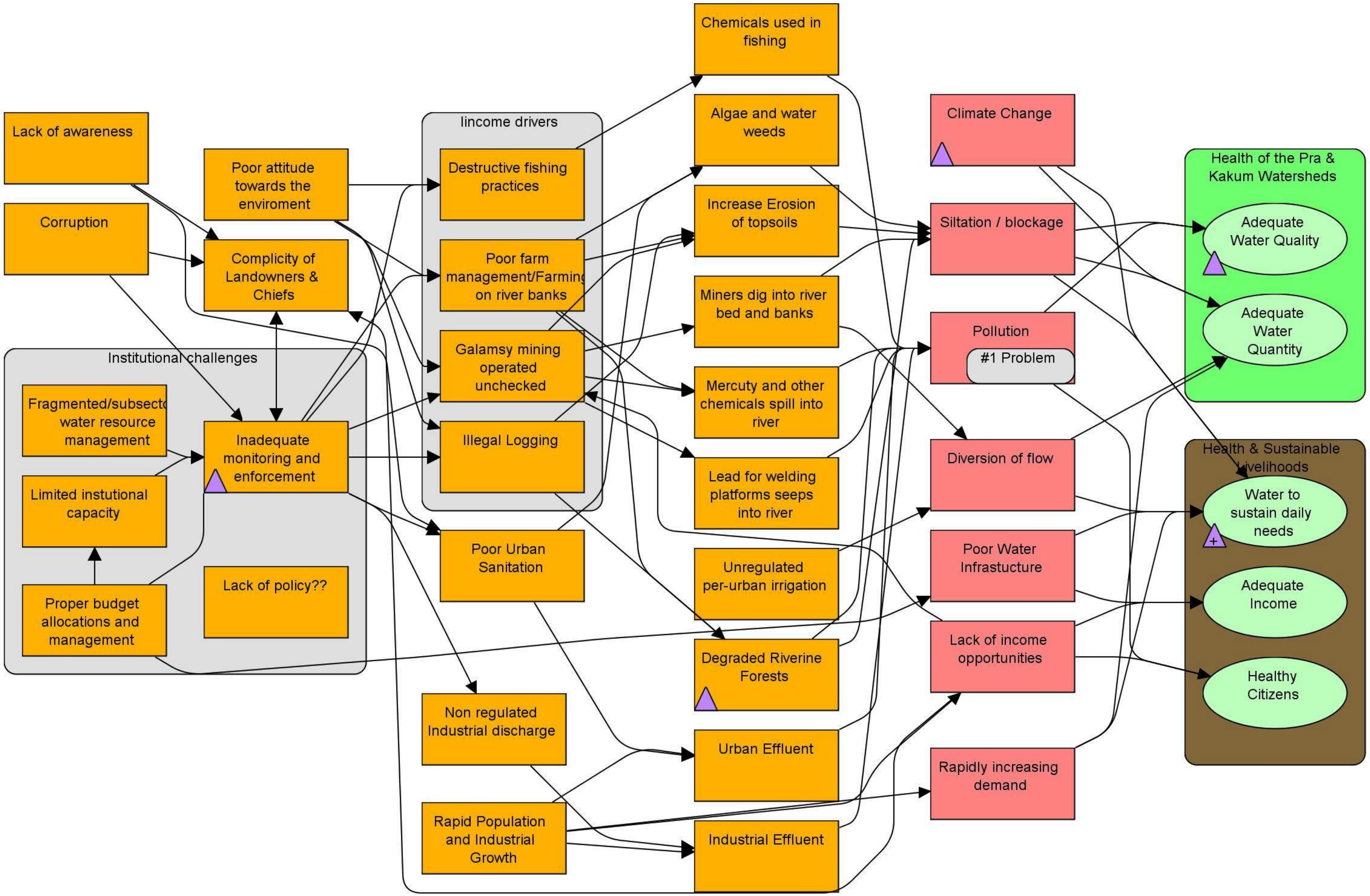
No	Name	Institution
1	Mr. Afreh	Minerals Commission
2	Margaret McCauley (2 times)	Ghana Water Company Ltd
3	Jonas Jablo	Ghana Water Company Ltd
4	Dr. Hudgeson	Water Research Institute
5	Dr. Ansah-Asare	Water Research Institute
6	Zachary Gbireh	Irrigation Development Authority (IDA)
7	Director General,	Ghana Meteorological Agency (GMA)
8	Selikem Setsofoa	Ghana Meteorological Agency
9	Ben Ampomah (2 times)	Water Resources Commission

Appendix 2: Key Stakeholders in the watersheds

1. Ministry of Water Resources, Works and Housing
2. Ministry of Local Government and Rural Development
3. Ministry of Lands and Natural Resources
4. Hydrology Services Department
5. Ghana Water Company Ltd
6. Community Water and Sanitation Authority
7. Regional Coordinating Councils
8. District Assemblies
9. Regional EPA
10. Water Resources Commission
11. Minerals Commission
12. Forestry Commission
13. Public Utilities Regulatory Commission
14. Ghana Chamber of Mines
15. Mining Companies
16. Timber Companies
17. Breweries
18. Traditional Authorities/Councils
19. Lands Commission
20. Landowners
21. Civil Society Groups
22. Community-Based Organizations
23. Faith-Based Organizations
24. Farmer Groups/Association
25. Oil Palm Plantation Companies: BOPP etc
26. Rubber Plantation Companies: GREL etc
27. Ghana Meteorological Authority
28. Water Research Institute
29. Oil Exploration/Exploitation Companies
30. Categories: Providers, Beneficiaries, Community Organizations

Ghana Tree Growers Association

Appendix 3: Conceptual Model of the Watersheds



Appendix 4: Matrix of Desired State Goals, Actions, and Key Actors

	GOAL	CURRENT STATE	DESIRED STATE	ACTIONS REQUIRED	KEY ACTORS
1	Ensure healthy ecosystem with adequate green infrastructure to facilitate effective groundwater recharge, filtration, sediment removal and resilience to climate change impact	Land Degradation such as eroding vegetation cover from agriculture and mining, logging and pollution from industrial and urban discharge, lack of buffers Excessive use of inorganic fertilizer in agricultural land use practices Presence of high water abstracting plants	Healthy and functional watershed with sustainable Green and appropriately engineered gray infrastructure	Vegetation cover: Rehabilitate degraded areas with recommended vegetation cover Pollution: sedimentation ponds and constructed wetalnds Buffer zones: Create 30 to 50m buffer zone along water bodies Inorganic fertilizers: Reduce Evapotranspiration: Remove unacceptable plants	Forestry Commission, NGOs, WRC, MOFA
2	To ensure that the basin yields adequate raw qater in a form that can be utilized by respective users	River flow diverted at some places, siltation blocked water flow. Where available high turbidity makes the water, though largely available, in most cases, is not in the form that it can be used. Kakum Basin experience insufficient raw water quantity throughout the year as the river dries up Treatment plants shut down when raw water quantities are reduced below plant capacity Treatment plants are obsolete and not able to handle current state of water Sea water intrusion at Daboase	Raw water is available in the right form for utilization by the respective users.	WRC should collaborate with appropriate stakeholders to ensure that water is available in the right form for utilization. Remove diversions, sediments and ensure river flows .WRC should collaborate with GWCL to replace obsolete water treatment plant and dredge impounds	WRC, GWCL

	GOAL	CURRENT STATE	DESIRED STATE	ACTIONS REQUIRED	KEY ACTORS
3	To ensure a sustainable financial mechanism that supports cost-effective clean water production and improved livelihood	Water Management Account derived from water user permits and drilling has limited coverage. Funding grossly inadequate to address challenges of IWRM in the two basins	A financial mechanism that can be sustained through tariffs and innovative investments to support water related management issues in the two basins	Comprehensive inventory of all water users in the basin forming the basis for identifying and levying all ratable water users. Effective monitoring and enforcement of permissible limits Develop partnerships with private sector to promote investment in development and management of water resources to meet increasing demand	WRC, PURC, Key private sector actors in water development
4	To strengthen human and institutional capacities to carry out IWRM in the watershed	Weak law enforcement, poor management and coordinating capacity for effective watershed management	Effective coordinating mechanism with enhanced human and institutional capacity in place with a common dialogue platform adequately addressing water related issues	Establish a common dialogue platform Develop MOU with Key Actors; Identify human and institutional training needs Carry out capacity building; Define institutional roles Carry education and awareness creation	WRC, EPA, WRI, FC, MWWH, MC, DAs.