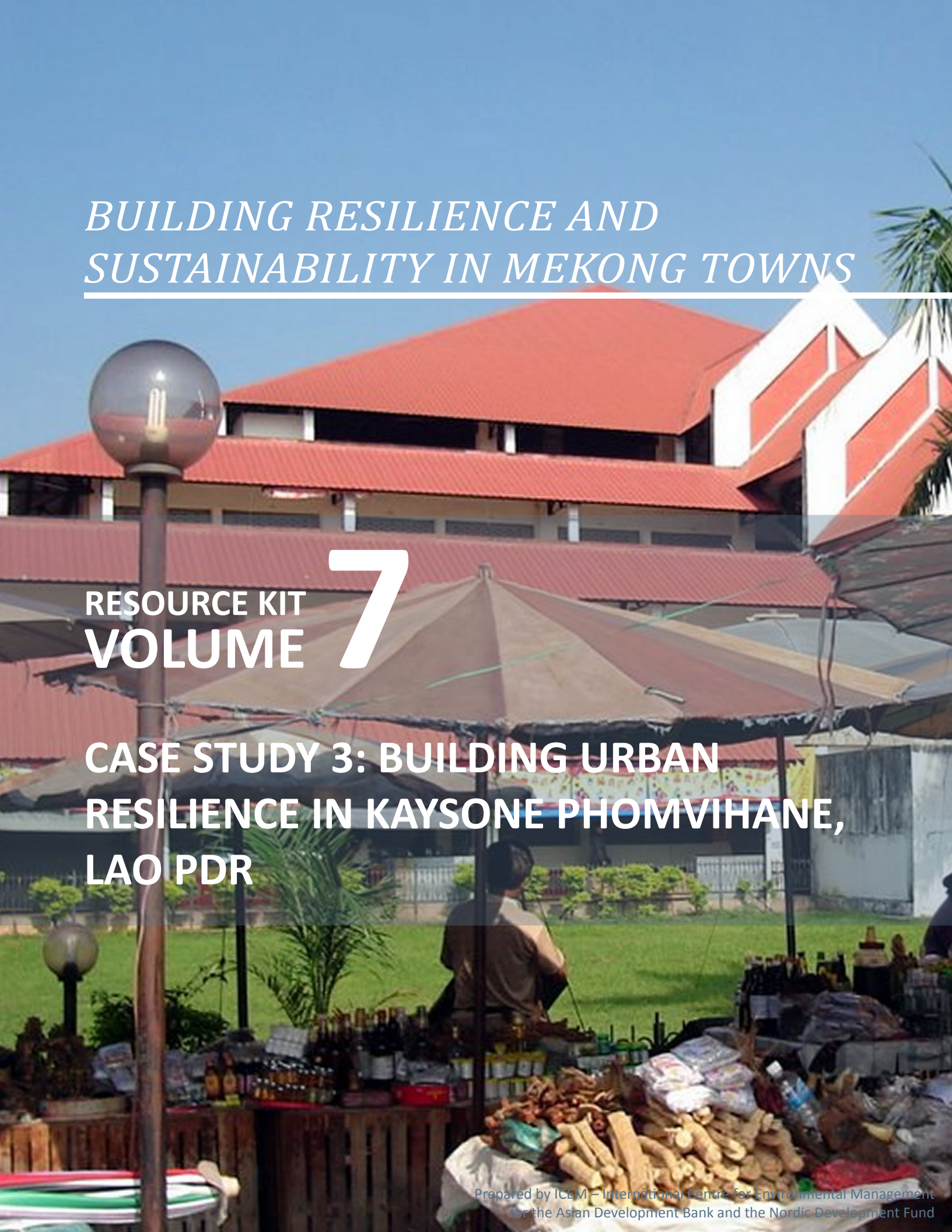
BUILDING RESILIENCE AND SUSTAINABILITY IN MEKONG TOWNS



RESOURCE KIT
VOLUME 7

CASE STUDY 3: BUILDING URBAN RESILIENCE IN KAYSONE PHOMVIHANE, LAO PDR

Prepared by ICEM – International Centre for Environmental Management
for the Asian Development Bank and the Nordic Development Fund

Resource Kit for Building Resilience and Sustainability in Mekong Towns

This volume is one in a series of seven volumes that together comprise the Resource Kit for Building Resilience and Sustainability in Mekong Towns. The Resource Kit was developed with the Climate Change Core Groups from each town to promote nature based solutions and integrated green infrastructure approaches for building resilience in Mekong towns. Each volume can be used alone or as an integrated whole.

The seven volumes in the Resource Kit are (**this volume in bold**):

1. Nature Based Solutions for Sustainable and Resilient Mekong Towns;
2. Green Infrastructure for Building Resilient Mekong Towns;
3. Urban Planning for Building Resilient Mekong Towns;
4. Vulnerability Assessment and Adaptation Planning Guide for Building Resilient Mekong Towns;
5. Case Study 1: Building Urban Resilience in Battambang, Cambodia;
6. Case Study 2: Building Urban Resilience in Dong Ha, Vietnam;
7. **Case Study 3: Building Urban Resilience in Kaysone Pomvihane, Lao PDR.**

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INTERNATIONAL ORGANISATIONS

Nordic Development Fund (NDF), Asian Development Bank (ADB), ICEM - International Centre for Environmental Management, Swedish International Development Agency (Sida), United States Agency for International Development (USAID), German International Development Agency (GiZ).

PART 1: TOWN WIDE CLIMATE CHANGE RESPONSES

1 TOWN WIDE BASELINE ASSESSMENT

1.1 TOWN OVERVIEW

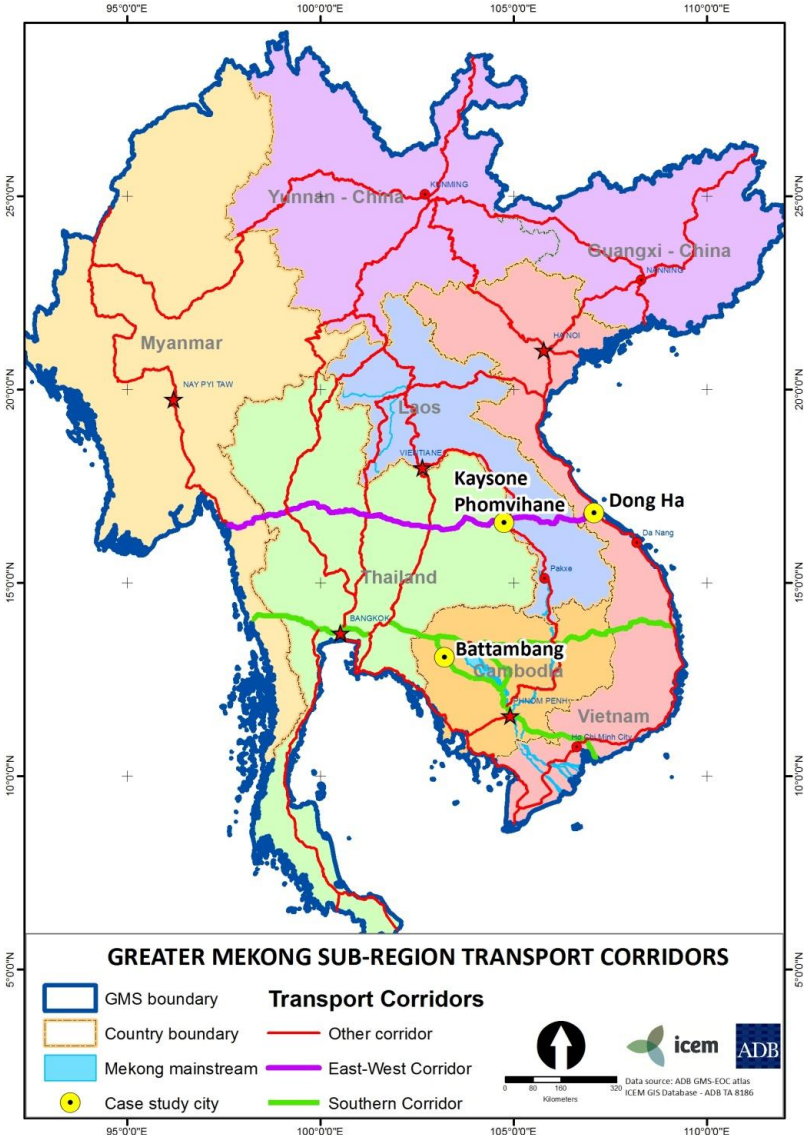
Kaysone Phomvihane is the capital of Savannakhet Province in Lao PDR. The town is the largest in Savannakhet (population of 76,307 in 2012), and is bounded to the west by the Mekong River and Thailand (Figure 1), to the east by Outhomphone district, to the south by Champhone district and to the north by Xaibouly district. The town is situated on the GMS East West Economic Corridor and is a focus of ADB corridor infrastructure investments (Figure 2).

Kaysone Phomvihane district comprises 67 villages of which 31 are within the jurisdiction of Kaysone Phomvihane town. The town covers an area of 779.03 km^2 and is mostly flat and undulating land. The western side of the town is bordered by the Mekong River which is the outlet for a number of small rivers and creeks from the town urban area.

Savannakhet has long been a centre of trade and power. The name *Savannakhet* derives from old Pali language, meaning “a land of gold”. People here have cultivated rice in the largest plain in the country, and fostered rich arts and culture. The province and town were developed significantly as the administrative and commercial centre of Southern Laos during the French era in 19th century. Today the average economic growth rate is 9.97% per annum (2011-12) and the share of production is: Services - 47.06%; Industry, Commerce and Handicraft sectors - 32.36%; Agriculture and Forestry sectors - 20.58%.

Figure 1: View of the Second Friendship Bridge, linking Kaysone Phomvihane with Thailand on the GMS East West Economic Corridor

Figure 2: The location of Kaysone Phomvihane on the GMS East West Economic Corridor (left) and an aerial view of Kaysone with proposed ADB infrastructure projects (right)



The Kaysone Climate Change Core Group was formally established by the Provincial and town government in response to this TA 8186-REG: Climate Resilience in Cities. It involves technical staff from town and provincial infrastructure, planning and environment departments as well as the Women's Union. The Core Group worked to identify past and future flood prone areas in the town through participatory mapping and reviewed the zoning arrangements set out in the Kaysone town master plan to identify what adjustments to boundaries and development controls were required to increase town resilience. The Core Group also assessed the vulnerability and adaptation requirements of two key strategic town infrastructure systems - the southern flood gate and canal system and the Savanxay Market and drainage network. The flood gate is intended to protect the town from Mekong River flooding. The canal discharges run-off, untreated effluents and upstream and localised floodwaters from the airport and town to the River. The market is a key centre of economic activity for the town used by a large proportion of the population. The Core Group has defined detailed adaptation actions for these two key locations summarised in this volume. If implemented the adaptation plans for the flood gate system and market have potential to be national and regional demonstrations for best practice.

1.2 PAST CLIMATIC VARIABILITY AND EXTREME EVENTS AND THEIR IMPACTS

Kaysone Phomvihane experiences flood and drought on an annual basis. Its location on the banks of the Mekong River make it susceptible to increased flooding from river bank overtopping and backing up of flood waters along tributaries and drainage corridors combined with regular intensive rainfall on the town and its catchment. It also experiences periodic tropical storms. These events severely constrain social and economic activity in the town and contribute to unsanitary conditions. The flooding is made worse by the increasing hardening of urban surfaces, reductions in green space and poorly designed and maintained drainage infrastructure, roads and culverts which limit natural drainage patterns.

Some of past extreme events that have impacted the town are listed below.

Floods

- **Mekong River Flooding:**
  - Major floods in 1966, 1978 and in the years from 1995 to 1998.
  - In 1995 and 1996 in particular, Ban Thahe and Xayamoungkhoun were severely affected by flood waters.
  - In the years 1997 and 1998 the Mekong flooded twice, mainly affecting Ban Thahe.
  - Major Mekong flooding in 2005, 2008 and 2011 exacerbated by non functioning northern and southern flood gates and linked constrictions in the natural drainage channels.
- **Localised flooding** (Figure 3):
  - Several times each year in low lying areas of the town caused by intensive rainfall exacerbated by poor drainage
  - In particular poor drainage in the Senna Rd area and around Dao Heung market leads to flooding of 30-50 cm depth every time it rains heavily.
  - Similarly, Huay Kilamang drainage canal overtops as water backs up through constricted and blocked culverts.

Figure 3: Pooling in the old town area 2011 (two images on the left) and 2013 (two images on the right)

Storms

- Tropical storm Nokten in 2011 caused extensive damage and flooding.
- In 2013 a large storm hit Kaysone Phomvihane destroying infrastructure, houses and utilities (Figure 4). Electricity supply was down for more than one week.

Figure 4: Damage caused by a tropical depression storm that hit Kaysone Phomvihane on 22 March 2013

Droughts

Droughts were experienced in 1961, 1966, 1971, 1978, 1984, 1994, 1995, 1996, 1988, 2007, 2010 (Figure 5) and 2012.

- In 2007 the average Mekong surface water was below the gauge minimum (125.022 m) at 124.842 m.
- In 2010 the average Mekong surface water was even lower at 124.422 m.
- Droughts occur in both the dry and wet seasons.

Figure 5: 2010 drought in Kaysone Phomvihane

Two extreme events that caused significant damage to the town and incurring large costs were:

- Flooding in Kaysone Phomvihane during 2011 that affected 23 villages, 318 households and 91% (419 ha) of rice fields (Source: Kaysone Phomvihane District, Agriculture and Forestry office, 28-9-2011).
- The storm that hit Kaysone on 22 March 2013 destroyed 20 villages, 607 houses and 28 offices. The estimated total cost of damages is: $220,493 USD (Source: Kaysone Phomvihane District, 22-4-2013).

1.3 PAST RESPONSE TO EXTREME EVENTS

Past responses to extreme events have focused on two of the town's key infrastructure systems: the Savanxay Market and the Southern Flood Gate because these areas have experienced severe flooding and impacts. For those two sites, there have been some institutional and community led responses to address problems with flooding with limited success including:

Savanxay Market:

- The flat wet market area was elevated but it has not solved the flooding problems;
- Vendors have raised their trading benches and tables during flooding periods;
- Shoppers have avoided using the market during periods of flooding – economic activity seriously inhibited;
- Vendors have looked for other venues to set up their activities;
- Vendors, surrounding residences and shoppers have made requests to improve conditions – but there has been little effort from the operator to facilitate cooperation between government and users to find solutions.

Southern Flood Gate:

- The dyke and the road over the flood gates and canal has been elevated from 6 m to 10 m with some gabion work either side of the flood gates embedded in the dyke embankment.
- The canal system from the town to the flood gates was straightened in some sections.
- The canal was dredged for 800 m along its length from the flood gate to Makhaveha Road.
- There was a campaign to raise the awareness of local people on protection of the system and on solid waste management.

In terms of policy responses there have not been any significant changes. There is no climate change adaptation plan for implementation in Kaysone Phomvihane and climate change has not been taken into account in the plans for flood gates and market drainage renovations supported by ADB. Town master planning and infrastructure development in the town does not take climate change or a completed understanding of past flooding into consideration.

1.4 PROJECTED CLIMATE CHANGE

Kaysone is projected to experience significant changes in precipitation, temperature and water availability. Table 1 summarises some of the key climate changes projected to occur by 2050.

Table 1: Summary of key projected climate change impacts (2050) for Kaysone Phomvihane

Climate change parameter	Baseline	With CC	% Change
Annual precipitation	1570 mm	1758 mm	+12 %
Precipitation in wet season	1370 mm	1507 mm	+10 %
Precipitation in dry season	230 mm	260 mm	+13 %
T max	32.2 ^{o}C	34.3 ^{o}C	+2.1 ^{o}C
T max in wet season	32 ^{o}C	34.2 ^{o}C	+2.2 ^{o}C
T max in dry season	32.5 ^{o}C	34.5 ^{o}C	+2 ^{o}C

Water availability in surface soil (wet season)	80 mm	82 mm	+3 %
Water availability in surface soil (dry season)	12.8 mm	13 mm	-2 %
Water availability in deep soil (wet season)	900 mm	882 mm	-2 %
Water availability in deep soil (dry season)	800 mm	776 mm	-3 %
Surface water availability in wet season	6 mm	6.52 mm	+8.7 %
Surface water availability in dry season	1.2 mm	1.38 mm	+15 %

Source: ICEM 2014[1]

Rainfall is projected to increase by 10% in the wet season and by 13% in the dry season. Temperatures are also likely to increase. Average maximum temperatures are likely to increase by 2 ^{o}C in the dry season and 2.2 ^{o}C in the wet season. These changes are likely to have impacts on water availability and hydrology. Water availability in the deep soil is likely to decrease, whilst surface water availability is likely to increase in both the wet and dry seasons. Table 2 details some of the modelled changes to flow volumes in the key sub-catchments within and feeding streams flowing into Kaysone.

Table 2: Modelled water quantity (kL/s) increases in key Kaysone sub-catchments with climate change to 2050

Climate change parameter	Huai Northern KP	Huai Som Poy	Huai Long Kong	Huai Kilamany
Average annual water quantity (Baseline)	39.3	668.9	44.0	16.4
Water quantity in 2050	43.5	739.6	48.7	18.2
Change in annual water quantity	4.2	70.7	4.7	1.8
Water quantity in Dry Season (Baseline)	6.4	108.8	7.3	2.7
Water quantity in Dry Season (2050)	7.3	122.4	8.3	3.1
Change in Dry Season water quantity	0.8	13.6	1.0	0.4
Water quantity in Wet Season (Baseline)	32.9	560.0	36.7	13.7
Water quantity in Wet Season (2050)	36.3	617.1	40.4	15.1
Change in Wet Season water quantity	3.4	57.1	3.7	1.4

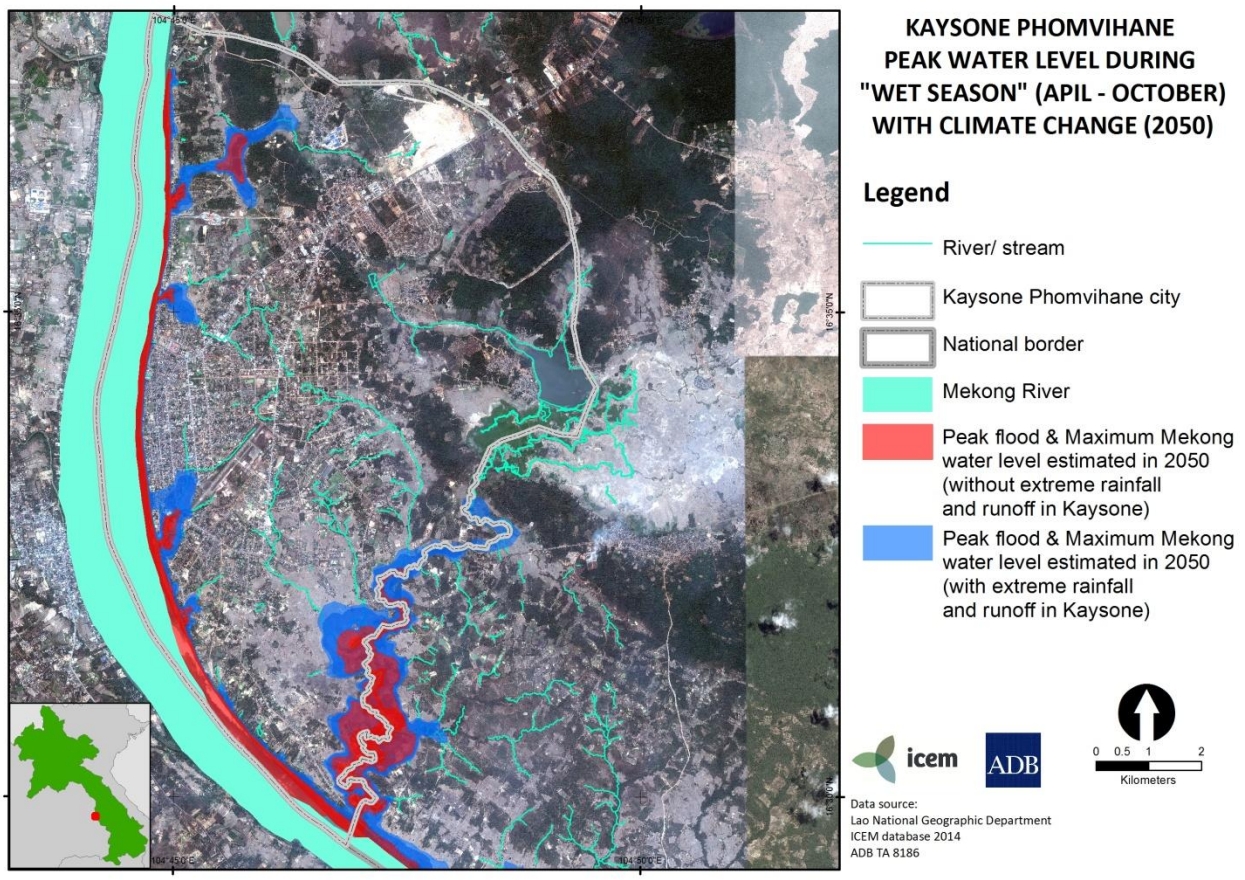
Source: ICEM 2014

These projected increases in runoff and stream flow could have significant impacts on the frequency and severity of flooding in Kaysone. Modelling of projected increases in Mekong stream flow and local rainfall in the catchment (Figure 6) indicate that the extent of flooding during peak periods in Kaysone will increase significantly with climate change.

In Figure 6, the red shading indicates the extent of inundation by Mekong overtopping alone and the blue shading indicates the extent of inundation by both Mekong overtopping and localised rainfall and runoff through the catchment. In order to reduce the impact of future flooding under climate change, there is a need to facilitate runoff through natural drainage corridors and to enhance infiltration to ground water and limit or accommodate river overtopping as much as possible through good urban planning and appropriate green infrastructure design.

[1] ICEM drew on its climate change and hydrological modelling with the Mekong River Commission and with various other partners such as USAID, the World Bank and ADB to prepare the climate change profiles for Kaysone.

Figure 6: Kaysone Phomvihane town showing projected flooding extent (overtopping and catchment rainfall and runoff) with climate change to 2050



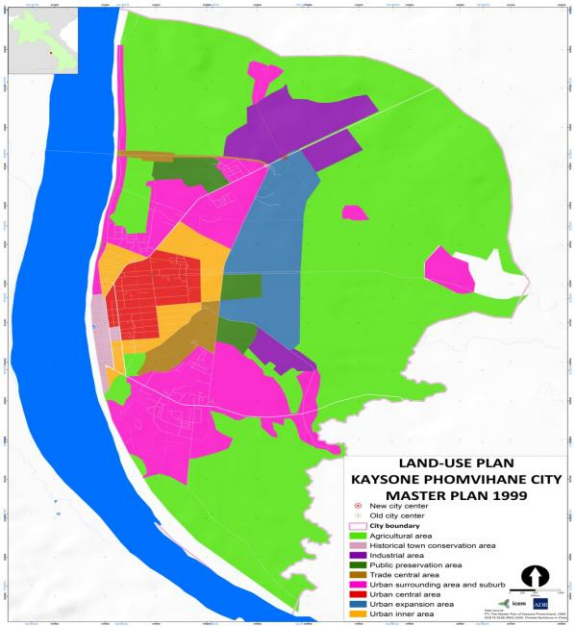
1.5 TOWN PLANNING CONTEXT

Kaysone Phomvihane Socio-Economic Development Plan for 2010-2014 identifies key infrastructure projects for priority investments. These include urban infrastructure for water supply and sanitation, road improvement and drainage and flood control. The plan also includes priority support to tourism development and environmental protection. The socio-economic development plan is supported by the town master plan that sets out zoning for the town, guiding where and how development can proceed.

The Master Plan of Kaysone Phomvihane sets out the land use and zoning scheme for the town. It was developed by the Public Works and Transport Institute (PTI) and approved for implementation by the national government in 2001. Within the plan there are different land use categories for agricultural production, industrial zones, commercial and residential areas (Figure 7). The zones are not supported by development controls or guidance and in practice have been ignored by incremental development and major infrastructure projects. The master plan is now being revised and updated by the Department of Public Works and Transport (DPWT) of Savannakhet with Japanese support in both technical assistance and funding (JICA).

Various agencies have responsibilities for defining and implementing the land use plan. The Kaysone Phomvihane Division of Natural Resources and Environment is responsible for land titling while town planning and land use zoning is mainly the responsibility of the Public Works and Transport Institute. The Department of Housing and Urban Planning-Town Planning Division defines the appropriate use of the lands within the administrative jurisdiction of the municipality.

Figure 7: Land use plan for Kaysone Phomvihane Master Plan 1999



Symbol	Description of Zone	Areas (hectares)
UAa	Historical town conservation zone	55.41
Ua	Urban central zone	259.87
Ub	Urban inner zone	229.45
Uc	Urban Surrounding Zone and suburb	1,096.7
A	Trade central zone	260.75
I	Industrial zone	415.66
Ncb	Public preservation zone	276.65
Nca	Agricultural zone	3,666.385
Na	Urban expansion zone	739.625
	Total	**7,000.00**

2 STEPS TO IMPROVE INTEGRATION OF CLIMATE CHANGE IN TOWN WIDE PLANNING

2.1 SETTING UP THE CORE GROUP AND OBJECTIVES

A Core Group of twenty senior technical experts from a range of provincial and town departments and the Women's Union was assembled by the Kaysone Phomvihane town authorities to participate in the project and as the future advisory group on climate change matters (Figure 8 and Appendix 1).

The project and Core Group concept sought to build the capacity of key individuals from relevant organisations and institutions to use analytical tools for assessing climate change threats and vulnerability and plan for adaptation strategies for town development overall and for strategic infrastructure. The intention was to create "champions" across government so that the knowledge and skills acquired by Core Group members would penetrate into their host organisations procedures and mandate. Climate change adaptation requires integrative solutions with inputs and coordination from across government sectors and with strong commitment and networks between key decision-makers. An important function of the Core Group is to build strong personal and institutional working relationships between key agencies responsible for town planning and development.

Figure 8: Kaysone Phomvihane Climate Change Core Group

2.2 THE ROLE OF THE CORE GROUP

The Savannakhet Province and Kaysone Phomvihane municipal governments are committed to the ongoing operations of the Kaysone Phomvihane Climate Change Core Group and for the implementation of its recommendations. The Core Group has been formally established as a permanent technical advisory group in town development.

The Core Group has been given the following functions - the study and provision of technical advice concerning building climate resilience in new infrastructure proposals and within the town economic and spatial plan, overseeing and advising on government spending on climate change resilience, coordinating internally with other departments in Kaysone Phomvihane on issues of climate resilience and convening regularly to exchange experiences within Kaysone Phomvihane and with Core Groups from other towns. The Core Group will work to improve human capacity and resources, and improve understanding of the need for climate change resilience in the town. It will need to consider introduction of formal regulations relating to climate change mainstreaming and the promotion of green infrastructure approaches to adaptation, and to keep their own mandate under review to minimise the potential for work duplication with other cross sector groups.

2.3 REVISING THE TOWN DEVELOPMENT VISION

As a first step in reviewing the town master plans and economic development plans against the imperatives of climate change, the Kaysone Phomvihane Core Group addressed the town development vision. The Group considered it was essential for the town to reorient its development vision to promote green infrastructure approaches and sustainability. The Group focused on the concepts of peace, environmental conservation, and sustainable development in formulating their 'green city vision statement' (Figure 9). The Group wished to see a stronger commitment to the protection of natural systems and resources and to raising awareness within their community of the need for environmental conservation as an important strategy for development and for building climate change resilience.

The Vision proposed by the Core Group is: "*Build Kaysone Phomvihane as a clean city with strong economic growth, environmental sustainability, awareness of environmental protection and improved natural resources conservation to reduce impacts of climate change*."

The Group considered that there would need to be further consultation on this vision between economic and town planners and infrastructure engineers as well as civil society to ensure consistency between the economic development plan and master plan and to make clear the need to conserve and enhance the natural systems foundation of the town as the key strategy for ecological sustainability and building resilience.

Figure 9: The Kaysone Phomvihane Core Group formulating a 'green city vision statement' at the Regional Knowledge Sharing Workshop

2.4 DEFINING CLIMATE CHANGE HOT SPOTS

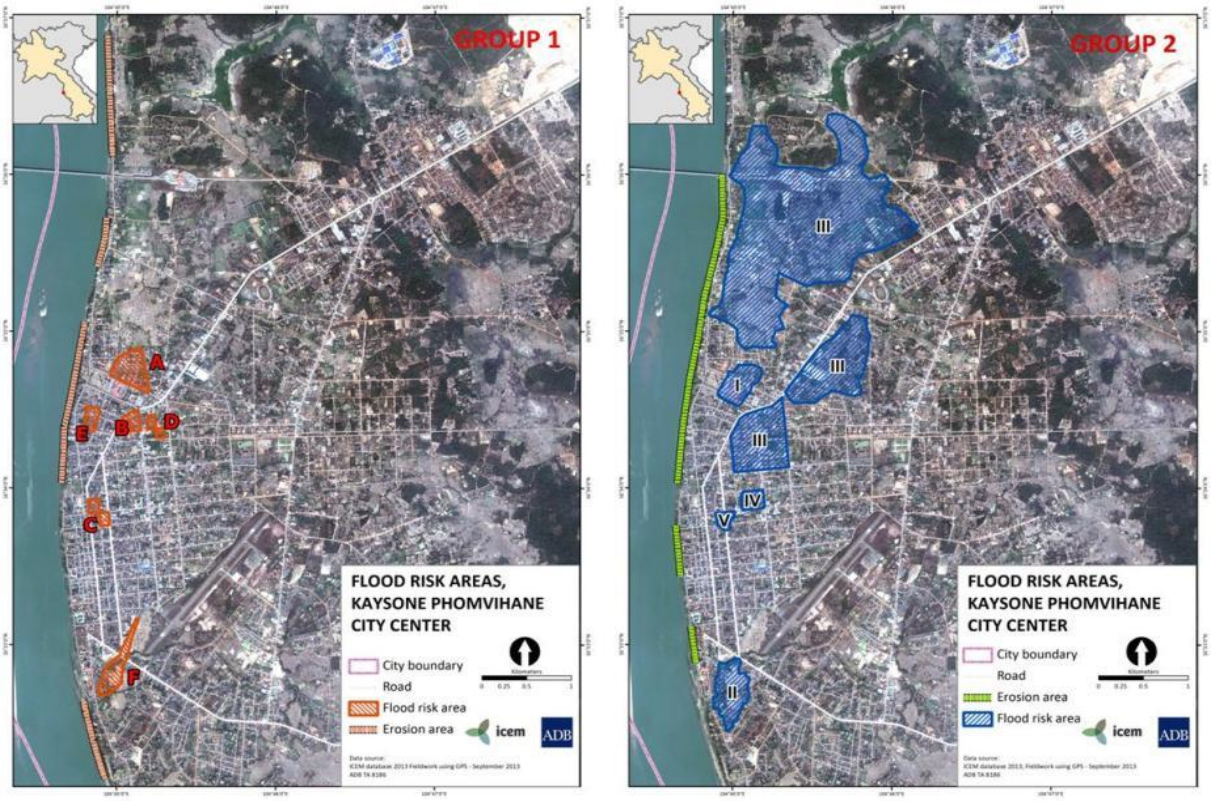
As a next step in the town wide planning for climate change, the Core Group concluded it was necessary to accurately document the extent, nature and impacts of past flooding events on the town and then to attempt to add the additional influences of climate change. Maps clearly defining the threat would provide a necessary input to effective zoning and development control. To 2013, no flood or climate change maps had been prepared for Kaysone – and the economic development plan and master plan did not have the benefit of accurate assessments of flooding potential and its implications for land uses.

The key steps taken to define the climate change hot spots were:

- Participatory mapping of past extreme events and flooding due to regular climate;
- Defining the climate change profile for the town and overlaying that on the mapping of past events.

During impact and vulnerability assessment workshops, the Core Group was divided into two sub-groups, each tasked with producing a map of areas subject to flooding in past extreme events (Figure 10). The technical experts from various government agencies had to rely on their past experience during flood events and extensive knowledge of the town. The idea of dividing the Core Group into two was to provide a cross check of results, which would need to be synthesised into a final set of flood prone areas agreed through a process of negotiation and discussion. For each flood prone area the group had to record flood duration, depth and source (localised rainfall or river overtopping for example). This is the first time such detailed maps had been prepared for the town.

Figure 10: Results of the participatory flood risk mapping exercise

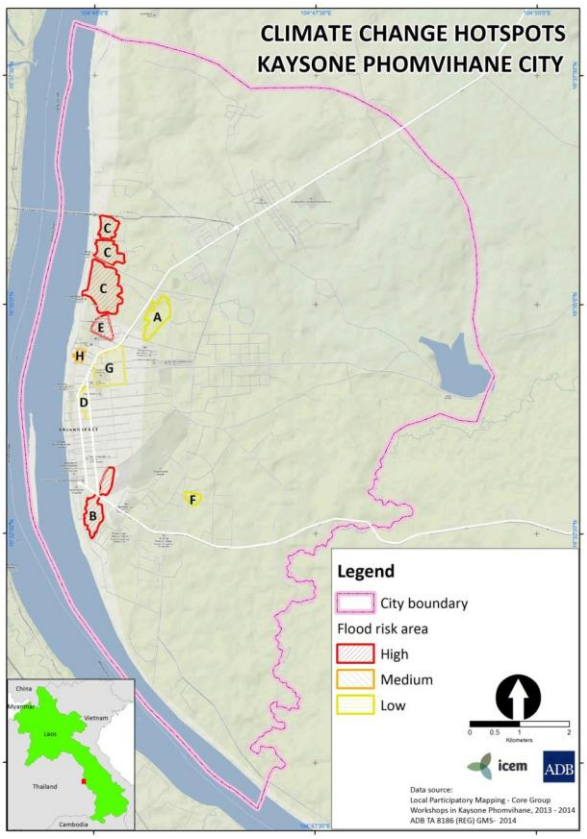


In follow-up work digitized results of the two Core Group sub-groups' flood maps were presented to the whole group, which then worked together to establish an agreed final version. Differences in recording the details of past extreme floods reflected the cumulative experience of group members and their familiarity with different parts of the town. The participatory mapping approach requires at least two groups initially working separately so that uncertainties and differences can be highlighted and resolved when the groups come together, leading to a more accurate consensus product.

The next step in the mapping process was to transpose available climate change information onto the map, and to identify flood risk areas that could be more severely affected with climate change. While only low resolution climate change projections were available for the town, the Core Group was encouraged to use expert judgments and make decisions based on the best available information. The Core Group examined topographical information, watersheds in and around the town, and down-scaled climate change and hydrological modelling results from ICEM, to determine which existing flood prone areas could become worse with projected increases in rainfall volume and intensity due to climate change. The Core Group also examined how climate change might affect riverine flows and catchment rainfall. All of this information was used to assign a level of 'severity' to flood prone areas reflecting the additional potential impact of climate change.

The result was a climate change 'hot spot' map for the town central area which integrated two main layers – areas subject to past extreme flooding and associated impacts, and the additional potential effect of climate change (Figure 11).

Figure 11: Climate change hot spots for Kaysone Phomvihane



The hot spot mapping exercise served as a rapid method of undertaking an initial threat or flood hazard assessment of the entire town with climate change.

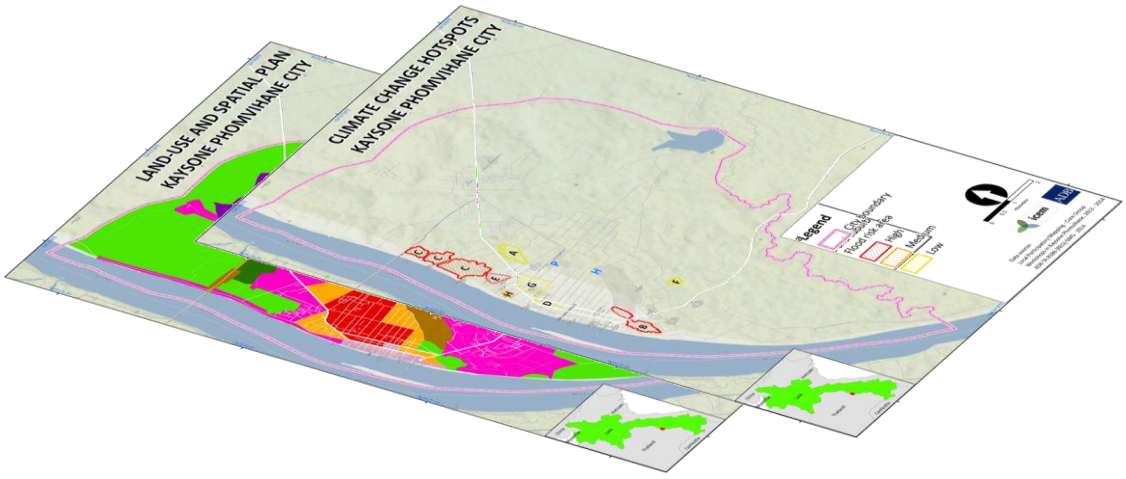
The hot spot map shows that *highly severe* flood spots are located to the north and south of the town, particularly in low-lying areas. Defining those hot spots identifies areas which would be exposed to the most severe flooding in terms of frequency, depth and duration. It does not rule out extensive flooding in other areas of the town under some climate change scenarios. The intention is to identify those areas which require priority attention either by special land use zoning and/or by defining special safeguards to guide and control development in the hot spots.

2.5 IDENTIFYING DEVELOPMENT CONTROLS

The hot spot maps are important as they underpinned a second key task in the town wide resilience building process – overlaying the hot spot maps on existing land use zones and defining town wide and zone safeguards and development controls.

For group work, transparent and very high resolution 1 m x 1.3 m versions of the hot spot maps were physically overlaid onto the town's land-use zoning map (Figure 12). The intention was to visually relate hot spots to existing and proposed development zones and to have the Core Group discuss the implications for zone boundaries and designated land uses. This was a critical step in helping the Core Group move beyond viewing climate change as a distant, nebulous threat, to consider impacts and the required practical development controls needed to safeguard the town and its infrastructure – and to steadily build resilience.

Figure 12: Overlaying climate change hot spots on land-use zoning maps



The Core Group worked through exercises to determine whether existing town land-use zones are appropriate in terms of boundaries and designation given past flood extremes and potential additional climate change threats. They were guided in making recommendations on needed changes to be reflected in revisions to the town Master Plan. Even if zone assigned land-uses and boundaries were considered appropriate, the Core Group was asked to formulate development controls that need to be applied to avoid or minimise unwanted climate change impacts.

Development controls (or safeguards as they are sometimes called) are regulatory measures that sit alongside land-use zones to ensure development within a zone proceeds with consideration of climate change. They can also be town wide, applying to all development planning and design. The Core Group was presented with international examples of safeguards to stimulate ideas applicable to Kaysone. The focus of the safeguards review and formulation was flooding, stormwater management and environmental protection.

In their analysis of the hot spots overlay on existing land-use zones (Figure 13), the Core Group was initially satisfied with the existing land-use regime – i.e. the zone boundaries and land use designations, reflecting a general willingness to 'live with the flood'. In part this was due to the very general nature of zone descriptions and the lack of existing detailed guidance on the nature of development permitted in each zone. Yet, the Group's reasoning for not proposing significant changes was often due to the fact that the hot spots were covering built up areas and it was therefore difficult to think beyond the practical realities of relocating existing uses. Had the hot spots applied to future growth areas, it is likely more significant zoning changes would have been proposed.

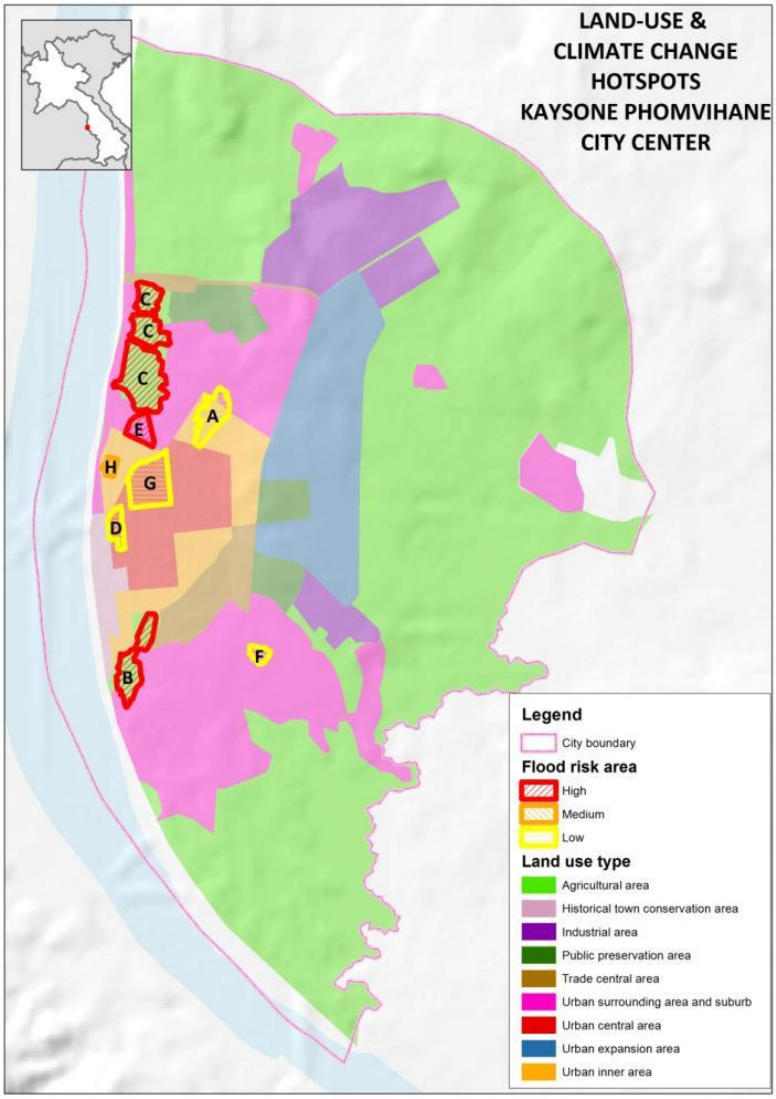


Figure 13: Climate change hot spots overlaid on current land-use zones in Kaysone Phomvihane

Beyond the hot spots, in areas zoned as agricultural land to the east of the city near the university and north of the Laos-Thailand Second Friendship Bridge, the Core Group proposed the creation of large green zones to protect remaining forested areas and natural drainage corridors to help control run off and downstream flooding, to protect against erosion and to increase groundwater recharge.

In reviewing the town plan the Core Group pointed to many instances where the zoning system had not been strictly complied with, resulting in steady incremental changes. Moreover several major new and planned roads and other infrastructure projects did not comply with the zoning and would have a significant impact on future land use. This trend in non-compliance led Core Group members to propose a series of changes to the zoning plan taking into account climate change.

The Core Group showed strong interest in the use of zone climate change safeguards, with many examples discussed for their application in Kaysone Phomvihane (for example, minimum surface permeability requirements, strict stormwater management controls, and monitorable tree canopy cover targets). The Group considered that such development controls needed to be kept under review and expanded as greater knowledge and experience of options and approaches was gained.

Central ideas behind the Core Group's proposed zone development controls were to:

- set green space targets and guidelines – i.e. promote achieving a 20% green space target by 2020;
- protect public green spaces from being lost to developments;
- increase public green spaces in areas where there are shortages;
- provide small grants to local community groups to improve the quality of existing or new green space;
- require all building and infrastructure development to adhere to minimum green space requirements on site and to apply green infrastructure approaches, and;
- amend the master plan to ensure local community health and wellbeing is a central consideration in developments.

Table 3 summarises the zone safeguards developed by the Core Group.

Table 3: Zone safeguards and development guidelines for building climate change resilience

Zone ID	Type of safeguard	Description of safeguard/development control
Historical town conservation (UA-a)	Rehabilitate and protect old buildings	▪ Re-demarcate the area and identify heritage buildings and trees in a town heritage register, ▪ Place conservation covenants over those heritage properties ▪ No heritage trees are to be felled ▪ Minimise hard surfaces – require permeable technologies for parking areas, pathways and on building sites ▪ Develop detailed design and rehabilitation standards, ▪ Identify and expand green space and a network of green walkways ▪ Organize responsible heritage committee with local participation and develop zone as an ecotourism site.
Public preservation (Ncb)	▪ Reserve the area for public green space and natural drainage corridors ▪ Conservation of wetland at Boungva village, ▪ Create Mekong corridor and public park	▪ No construction is permitted in this zone ▪ To be developed as park land and recreational areas and facilities ▪ Conservation management plans to be prepared for the wetland at Boungva village and for a Mekong corridor park ▪ No land fill is permitted in this zone ▪ Natural drainage corridors to be rehabilitated and developed with bioengineering methods ▪ Soil erosion and drainage corridor maintenance programs to be initiated. ▪ Local community involvement in monitoring and management to be promoted
Peri-urban (Uc)	Reserve the area for future city expansion with strong green infrastructure foundation	▪ Natural drainage corridors to be demarcated, rehabilitated and protected – only green infrastructure approaches to be applied ▪ Identify forest protection and green space areas for protection with management regulations ▪ All development and infrastructure in the zone to apply green infrastructure approaches (detailed guidance is needed)

Urban expansion (Na)	Immediate and ongoing city expansion area including transport corridors	▪ All roads and related transport facilities to maintain natural drainage patters, to take flood projections into account and to follow green infrastructure methods ▪ Natural drainage corridors to be defined, rehabilitated and protected ▪ Green space and forest urban canopy cover areas to be demarcated and protected and green infrastructure drainage systems along streets to be applied such as bioswales
Agriculture (Nca)	Soil protection and flood management	▪ Develop agreements with farmers to allow agricultural land to be managed as flood retention areas in extreme events ▪ Introduce agro-forestry approaches to conserve soil, promote biodiversity and ecosystem services ▪ Define, rehabilitate and protect natural drainage areas with farmer involvement and establish walkway network for recreation and eco-tourism
Industry (I)	▪ Greening of industrial areas ▪ Water management and conservation	▪ Set strict green space to building ratios for industrial zones and each building/plant site ▪ Require rainwater capture and management on site ▪ Require raingardens, bioswale and other green infrastructure methods ▪ Ensure that parking, roads and drainage include detailed green infrastructure design safeguards
Central trading and commercial (A)	▪ Greening of commercial area ▪ Water mangement	▪ Establish green walkways along streets ▪ Require rainwater capture and management for each establishment ▪ Apply green infrastructure methods such as street and parking bioswales ▪ Apply building design standards which accommodate flood conditions such as elevation, orientation and drainage ▪ Establish monitoring and management committees involving enterprises for greening and maintenance of their shared areas
Urban central (Ua)	▪ Greening of CBD ▪ Water management ▪ Efficient transit within zone	▪ Establish green walkways along streets ▪ Ensure that bike paths and walk ways are established to facilitate ease of transit and maintain environmental quality ▪ Require rainwater capture and management for each establishment ▪ Apply green infrastructure methods such as street and parking bioswales ▪ Apply building design standards which accommodate flood conditions such as elevation, orientation and drainage
Inner urban (Ub)	▪ Preserve heritage ▪ Water management ▪ Greening of zone	▪ Build and maintain drainage system following green infrastructure methods ▪ Create green streets and walkways ▪ Place heritage convenants on the old town area and building ▪ Strict building design standards to maintain old town character and to promore effective on site water management

While the urban planning adaptation strategy of using zones and development controls were well received by the Core Group there was concern that the current institutional framework and urban planning processes were not strong enough for these measures to be fully applied and effective. The challenge will be in ensuring compliance with zones and safeguards. In general, it was thought that there would be little incentive for investors and developers in Kaysone Phomvihane to comply unless the legal framework for development control was strengthened and more substantial enforcement authority devolved to local levels. Many basic development decisions shaping the town were made by national government without adequate local consultation, even to the point of national sector agencies felling heritage trees and clearing land without prior local government approval and inconsistent with the existing town zoning scheme.

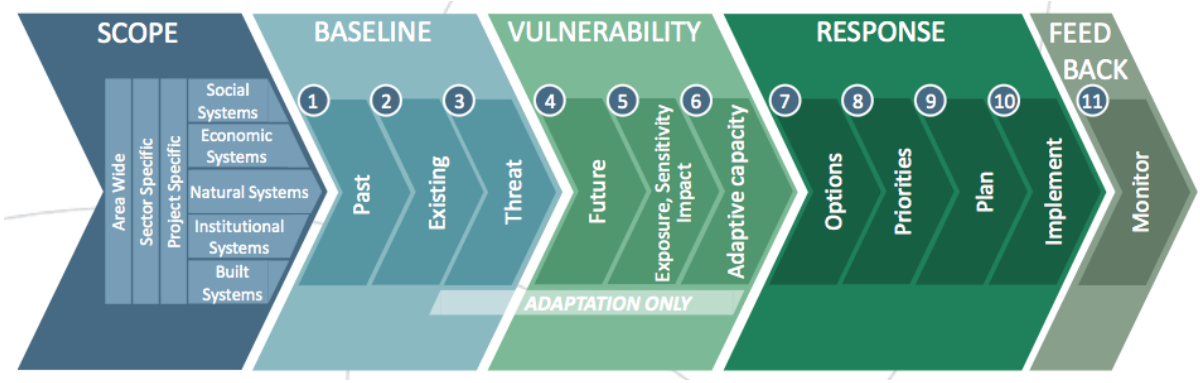
PART 2: SITE SPECIFIC VULNERABILITY ASSESSMENT AND ADAPTATION PLANNING

As part of the scoping process in setting priorities for detailed vulnerability assessments and adaptation planning, the Core Group selected two case study demonstration sites. They applied a set of criteria which emphasised areas and infrastructure of strategic importance for town development and which had been affected by past flooding. Infrastructure scheduled for support by ADB was also taken into account. The Core Group recognised that, in situations of scarce resources, it is necessary to set sharp priorities for adaptation. Each year only the most significant projects and areas of town could be the focus of detailed planning.

The Core Group applied the following steps of the vulnerability assessment and adaptation planning method to the two demonstration areas and infrastructure (Figure 14):

(i) Baseline assessment;
(ii) Impact and vulnerability assessment; and,
(iii) Definition and assessment of adaptation options.

Figure 14: Key steps in the vulnerability assessment and adaptation planning process



The two infrastructure systems identified as priorities for detailed vulnerability assessments and adaptation planning – both with a history of serious flooding and design and management failings were:

1. The southern Mekong River flood gates and linked canal system (funded by ADB).
2. The Savanxay Market and linked drainage system through to the Mekong River.

The locations of these sites are shown in Figure 15.

The Core Group spent time at the two sites meeting with local communities and users and completing baseline and impact assessment field reporting forms which were later converted to the formal vulnerability assessment matrix.

Then through a series of working sessions, the Core Group completed the detailed adaptation planning matrices for each site, outlining preliminary ideas for adaptation measures to respond to climate threats. Initially the Group had difficulties thinking beyond conventional hard engineering solutions – there was not the experience and knowledge on other infrastructure and planning options. However with discussions on alternative and additional approaches and ideas involving bioengineering, the role of natural systems in urban areas and community management of adaptation measures, the Group readily embraced alternative approaches which would contribute more substantially to resilience. The potential of green infrastructure approaches is now appreciated, but additional technical support will be required to continue strengthening the Core Group so it can effectively fulfil its function as the climate change technical advisory body in town development.

The first step in the adaptation planning process involved a 'hands on' discussion of the proposed adaptation measures. Core Group members divided into two sub-groups, one for each target area. They developed schematic diagrams of the case study site and its key components. The principle was to move beyond treating the target infrastructure as a separate and isolated asset to recognising the importance of planning and implementing adaptation actions for all closely linked components of the area – i.e. to take an area wide and not a site specific approach. The schematic diagram was projected onto a whiteboard as the basis for group discussion. Where a group's proposed adaptation measure involved physical treatments they were drawn on the white board and amended following negotiation and consensus among the members. This visual aid method supported by projected photos and Google map images and overlays of the sites facilitated understanding of the issues, the need for an integrated approach and the potential cross sector and area wide effects of alternative adaptation measures. The approach is another example of the role of participatory mapping in cross sector adaptation planning – in this case with a site or infrastructure specific focus.

The Core Group built on this work by developing adaptation measures in more detail and then integrating them into an adaptation plan outlining the overall vision for the target area and infrastructure system, the climate change impacts, the purpose of adaptation in addressing those impacts, the measures and their phasing, monitoring and maintenance provisions, consultation processes and needed supporting policies.

Over the course of adaptation planning process the Core Group significantly expanded their ideas for adaptation measures at the case study sites, with emphasis on conserving natural drainage networks, creating and extending green belts and canopy cover and combining bioengineering methods with all hard engineering options. Improved on-site storm water management was proposed for the market and surrounding lots, and slope and bank stabilisation using bioengineering closer to the Mekong River outlet. For the southern floodgate and canal, multiple use green space, agriculture and recreational areas were proposed, mimicking a natural waterway flowing from the town to the Mekong River as the centrepiece adaptation strategy.

The identification of supporting policies and mechanisms to ensure the proposed adaptation measures can be implemented was an important step and involved outlining needed reforms, for example, in institutional arrangements, development review procedures and economic incentives that might smooth the way for the successful implementation.

Figure 15: Locations of adaptation case study sites, Kaysone Phomvihane

3 CASE STUDY SITE 1: SOUTHERN FLOOD GATE AND CANAL

3.1 BASELINE ASSESSMENT

3.1.1 Brief description of the system

The Core Group conducted a detailed baseline assessment of the southern flood gates and linked canal system (Figure 16), including meetings with local residents and 'walking the canal' up to the airport which was identified as a feeder source of stormwater and one contributing factor of flooding.

Figure 16: Location of case study site 1, Kaysone Phomvihane

The system has seven linked components (Figure 17):

1. Canal banks
2. Flood gate
3. Agricultural fields
4. Fish ponds
5. Flood prone residential areas
6. Road dike passing over the flood gate and canal
7. Watershed feeding flood waters to the canal

The flood gate Houy Longkong is located in Thahae Village, under Khanthabouly Road (Figure 18), just 120m from the Mekong River. This structure was completed in 2001 under an ADB Loan Project and includes:

- Two reinforced concrete box culverts (Size 2.5 x 2.5 x 20 m) with two reinforced concrete wings and steel automatic flood gate installation.
- Automatic water inlet-outlet control gates that rely on water pressure and a floatation device to operate.

Figure 17: Southern floodgates system components

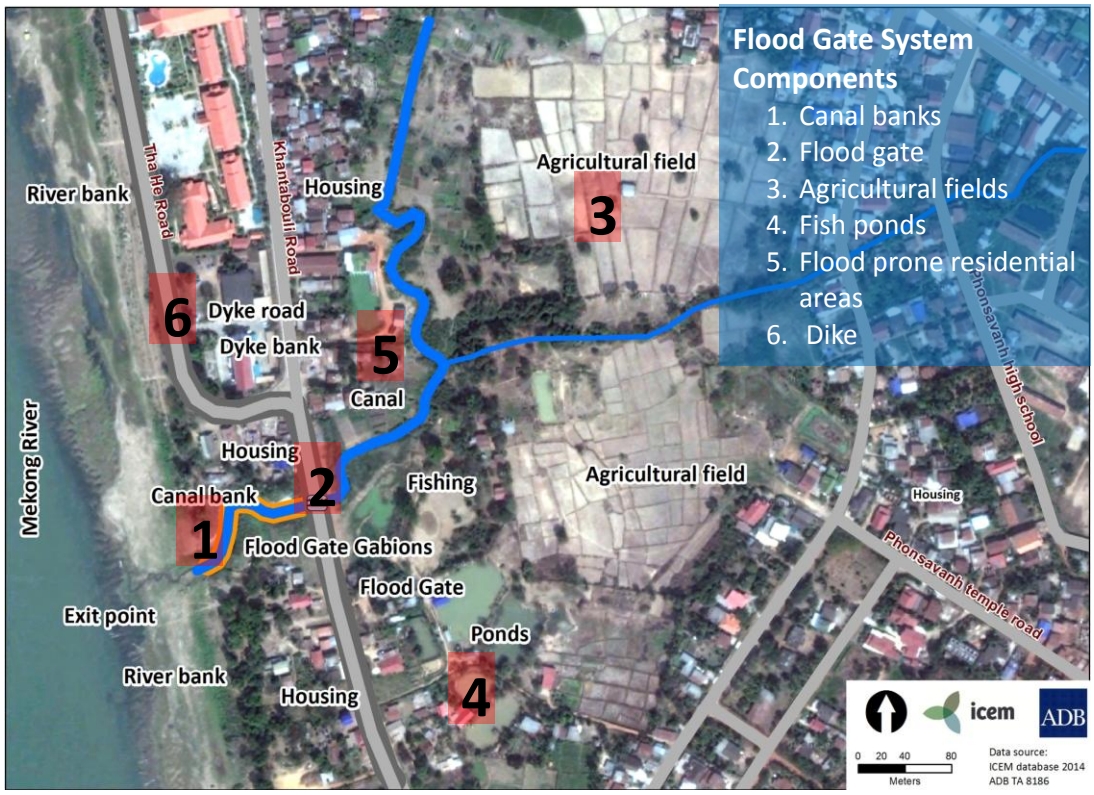


Figure 18: Case study site 1 - Southern floodgates, Mekong River side, Kaysone Phomvihane

In their current state and design, the existing culvert and floodgates have made flooding worse in the town with a range of contributing factors identified by the Core Group. The floodgates have never worked effectively and

ceased functioning altogether some months after installation. The narrow culverts and non-functioning southern floodgates encourage polluted and high flow water from the town to back up into agricultural and residential areas. The foam shown on the canal water surface in Figure 19 reflects the serious pollution conditions especially during the dry season. The gates were intended to operate automatically during periods of rising water level in the Mekong River, but with the theft of the floatation device and lack of maintenance the mechanism quickly seized up and has never operated as designed.

Figure 19: Southern floodgate, road, dyke and canal town side (top) and Mekong side (bottom) in Kaysone Phomvihane

The flood gate and canal system is on a natural creek that has a 450 ha catchment containing agricultural, forestry and urban land uses. The canal flows through temporary community housing and vegetable planting areas. The creek is prone to erosion and receives waste water from the city.

3.1.2 Status and condition of the system and its components

The system is in a poor condition and does not function effectively in meeting multiple demands such as town flood protection, agricultural water supply, town drainage, recreation and beautification. The road dyke does work effectively but has required its level to be raised twice size first constructed and its slopes are unstable.

The flood gate itself was designed to rely on the force of water to open and close through the use of weighted floats to keep it closed during high water level and open in the dry season. However the gate does not function as designed and is locked open since 2001 due to an improper design, no maintenance and repair program or budget. The Core Group concluded that if the gate were manual it would be much less susceptible to operational failure.

The canal is also in poor condition and attempts to improve it through straightening and bank hardening have not been successful. Large sections of the canal banks are actively eroding threatening adjacent agricultural plots and housing. There is a bad odour from untreated municipal waste water flowing through the canal and flood gate impacting on the living conditions of people in surrounding areas.

The canal embankments are soft and unstable. During the rainy season the Mekong River rises up and causes bank collapse and erosion. In front of the flood gate outlet, the Mekong River side lacks any form of protection against erosion (Figure 20). At the flood gate inlet, there are gabion boxes alongside both wings but they are in need of repair. Large amounts of solid waste block the gate culverts and reduce discharge capacity.

Figure 20: Condition of Southern flood gate, canal banks and adjacent settlements, Kaysone Phomvihane

3.1.3 Past extreme events and impacts on the system

Regular flooding occurs in the rainy season each year between August to September and is generally 0.5 to 1.5 meters deep, which flows through the flood gates into the canal. With this flooding there has been damage to property and agriculture along the canal.

In large flood events, significant erosion of the canal banks and overtopping of the dike occurs. This has had significant impacts on the surrounding settlements, local businesses and livelihoods, and transport.

3.1.4 Climate change threat profile

As presented in the town overview (Table 1), Kaysone is projected to experience a range of climate changes leading to increased incidence and severity of flooding at the site and more intensive drought and soil drying periods. These changes in wet season precipitation and water availability would increase the flow in the Longkong stream and duration and depth of flooding events (Table 2).

3.2 IMPACT AND VULNERABILITY ASSESSMENT

The Core Group's vulnerability assessment of the southern flood gate and canal system (Figure 21) found that it is highly vulnerable to the threat of flooding caused by increased rainfall in the canal catchment and higher Mekong water levels with climate change.

Figure 21: Core Group visiting the southern flood gate and canal, Kaysone Phomvihane


3.3 ADAPTATION PLANNING

3.3.1 Objectives and approach of the adaptation plan

In response to the very high level of vulnerability, the Core Group formulated a range of adaptation options for the site from the installation of operations and monitoring equipment like pumps and stream gauges, to rehabilitation of drainage canals and slopes around the flood gate culvert using bio-engineering techniques (Figure 22).

The Core Group's adaptation plan, which takes an area wide approach including the canal either side of the floodgates, the dyke and road, the steep banks and linked land uses, emphasises bio-engineering measures to reduce bank collapse and erosion, bringing back the natural stream drainage corridor and character and retrofitting the water gate to operate manually. The plan includes regular clearance of solid waste which builds up around the gate entrance. Adaptive measures also include raising houses in the area on stilts and instituting government and community monitoring and maintenance systems for the canal and dyke and to help manage the gates and canal.

Both the southern and the northern flood gates have similar operational and design challenges and great potential to be key components in the town's climate change adaptation response. They are both covered in the planned ADB infrastructure investment package for the town and are now at the early procurement stage for the design consultants. The contractors for that work should be required to work with the Core Group to implement the plan. Capacity building and awareness raising will be needed to ensure that local contractors and responsible line agencies follow through on the green infrastructure approaches recommended by the Core Group.

Figure 22: Kaysone Phomvihane Core Group working on their adaptation plans


Key objectives of the adaptation plan and how these will be achieved are presented in Table 4.

Table 4: Key objectives and broad adaptation strategies

Objective	Broad adaptation strategies
Contribute to sustaining the existing uses of the system and well being of local communities	▪ Maintain the natural creek with bioengineering along its corridor. ▪ Enhance and protect the various livelihood components such as the man-made fish ponds and agricultural areas. ▪ Preserve the entire system as a future green area and walkways and natural drainage corridor for the town.
Reduce or eliminate the vulnerability of the system to climate change	▪ Improve flood protection and flow capacity ▪ Conserve and stabilise soil and canal and dyke banks through bioengineering methods. ▪ Strengthen capacity of the local community in monitoring, management and maintenance of site.

3.3.2 Detailed adaptation measures

The following adaption measures are proposed for each component of the flood gate and canal system:

1. **Canal banks –** stabilisation and terracing using bioengineering methods on both sides of dyke – walkway network and green space along top, vegetation and tree planting (Figure 23). Special bank stabilisation, terracing, access points and walkways at canal mouth to Mekong River and along river banks. This adaptation response will build resilience while also providing improved ecosystem services such as water purification, food (edible plants) and tourism/ recreation facilities.
2. **Flood gate** - re-design with manual operation and water pump, clear debris from outlet and canal – establish regular monitoring and maintenance involving local communities.
3. **Agricultural fields –** agro-forestry methods, soil conservation, flood retention arrangements with farmers, stabilisation and access to aquaculture ponds, ecotourism walkway network through agricultural area connected with canal and along Mekong River.
4. **Fish ponds –** develop ponds as enhanced livelihood assets and for ecotourism and beautification through landscaping and vegetation. Banks at canal mouth onto the Mekong River are important boat landing and fishing area need to be enhanced and maintained.
5. **Flood prone residential areas** - re-settlement of some houses very close to the canal edge and subject to regular flooding may prove necessary, building controls to restrict development close to canal edge, design standards for all buildings in area including raising on stilts, minimum green space and well designed drainage.
6. **Dyke** - stabilisation of slopes using bioengineering and planting.
7. **Watershed –** carefully define watershed boundaries and prepare management plan for stabilisation, rehabilitation of natural drainage, revegetation, and pollution control.

1. Canal banks and river entry: A wide range of bioengineering methods are available for canal and river bank stabilisation and beautification (Figure 23). Different sections of the canal will need to be treated with different methods appropriate to the bank steepness, soil type and uses. Urban River Terracing allows for multiple uses and walkways as well as a progressive flooding regime. The point at which the canal enters the Mekong River will require special attention to maintain the existing boat landing areas and intensive fishing that occurs there. The area has significant potential as a tourism vantage point when linked to a river and canal walking network.

GI Guide 3.6, 4.1 – 4.12

Figure 23: The canal banks - examples of stabilisation and vegetation bio-engineering techniques that could be applied. Top right - treatment at canal entry to Mekong River to reduce erosion and create landing areas

2. **Flood gate** - re-design with a manual operation flood gate (Figure 24). The following design and management changes are proposed to ensure the flood gate operates as effectively as possible in reducing flood impacts:

   - The flood gate design needs to be fit-for-purpose and suitable for the local conditions. It should be simple but durable and easy to operate and maintain.

Figure 24: Flood gate (left at 2) with examples of more robust flood gates designed for manual operation (right)

   - A pump should be installed for pumping out flood waters from the canal to the Mekong River during the flooding period.
   - A management team should be established that is in charge of operation and maintenance with proper planning and budget allocation.
   - A gross pollution trap should be installed In front of the inlet and outlet of the flood gates to prevent blockages. This trap and the canal should be cleared of debris on a regular basis.
   - The reinforced concrete box culvert at Santiphap road needs to be enlarged to adequately serve as a flood reduction device.
   - Improve the area of the flood gate to be a public park and tourism vantage point.
   - Encourage local community participation and awareness in cleaning and operation and maintenance of the flood gate.

3. **Agricultural fields** – The agricultural fields are an important potential flood retention zone during extreme flood conditions. Management arrangements with local farmers and sleuth gates need to be set in place including compensation mechanisms if required. The agricultural fields are an ecotourism asset and the green walk way network should weave through this area. The fields are also an appropriate place to enhance biodiversity including the range of usable plants. Good maintenance and management of the agricultural fields adjacent to the canal will help to reduce runoff of sediments and water thereby reducing canal sedimentation and flood impacts (Figure 25).

Figure 25: Agricultural fields adjacent to the canal agro-forestry methods for enrichment, diversity and stability

4. **Fish ponds** – maintenance of the fish ponds adjacent to the canal will help to store runoff and sediments reducing flood impacts and provide an ecotourism asset (Figure 26). The pond network could also be developed as a constructed wetland to help filter and purify the canal water.

GI Guide 3.1

Figure 26: Fish ponds adjacent the canal and examples of constructed wetlands for water purification

5. **Flood prone residential areas** – through re-settlement and raised houses, the vulnerability of people living in these areas can be reduced (Figure 27). The canal banks (1) and dyke (6) stabilisation will also help to reduce flood impacts on these areas.

Figure 27: Flood prone residential areas (left) with examples of raised housing to live with flooding

6. **Dyke** - stabilisation of slopes along the dyke using bio-engineering techniques would limit erosion and flooding impacts and reduce the vulnerability of road and flood gate system (Figure 28).

GI Guide 4.1 – 4.12

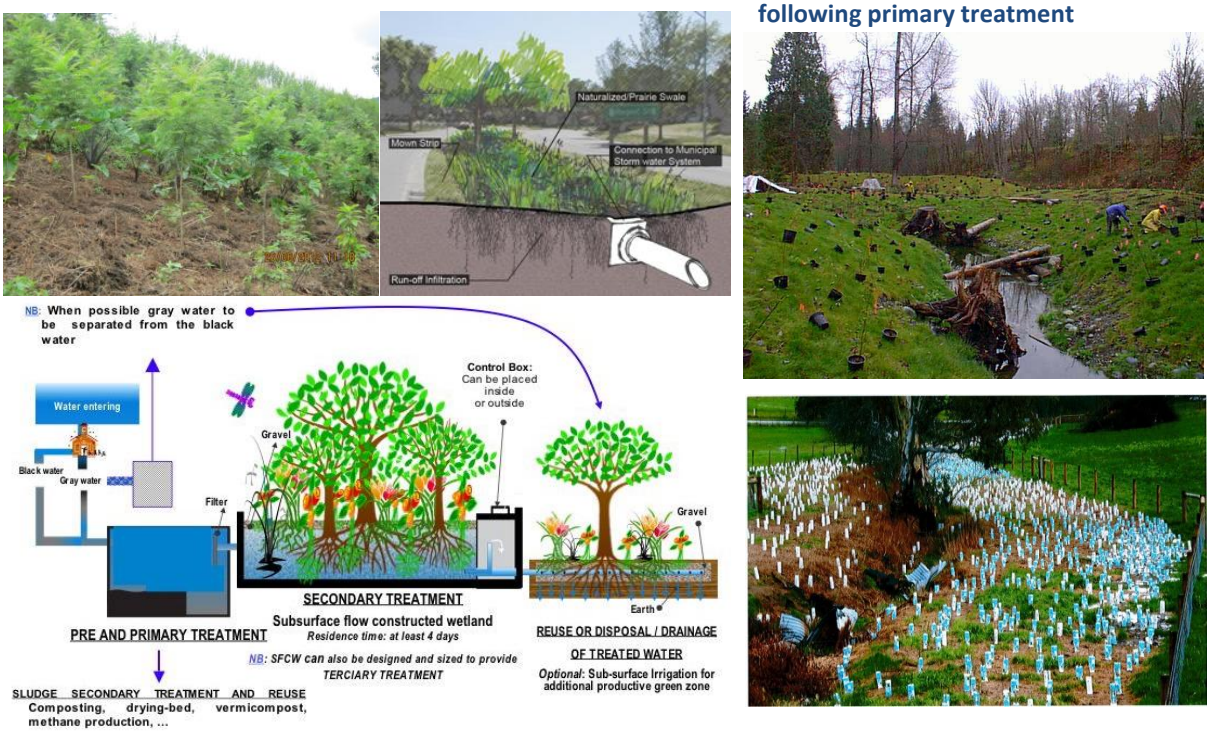
Figure 28: Dyke along Tha He road (left) with examples of slope stabilisation techniques (right)

7. **Watershed** – increasing water infiltration within the canal's catchment area will reduce runoff and flooding impacts. Better water and social management could be achieved through vegetating bare areas and through the use of water sensitive urban design involving constructed wetlands, bio-swales and rain gardens to collect, purify and store stormwater. These methods can also be used to reduce stormwater and wastewater pollution through filtration and nutrient uptake by plants. Examples of some of these

GI Guide 3.1, 5.2, 5.4

methods are shown in Figure 29.

Figure 29: Examples of watershed reforestation (top left), an urban bio-swale for collecting, storing and treating stormwater (top centre) and a subsurface flow constructed wetland (bottom) for treating domestic sewage following primary treatment



3.3.3 Phasing of adaptation implementation

The adaptation plans need to be put up for formal consultation with relevant government agencies, the private sector and the directly affected and broader Kaysone community to ensure they are effectively implemented. Already the Core Group represents a broad cross section of local line agencies and Women's Union members. In terms of the priority and feasibility of implementing individual measures, the Core Group defined the following broad phases to be refined once the detailed design and management arrangements are in process:

Phase 1 (1-2 years)

Measure / sub-measure
1. Construct new manual flood gate and install water pump.
2. Clear debris from the area around the flood gate and the canal and bioengineer the entry and exit and dyke slopes close to gate.
3. Bio-engineer and vegetate canal banks to stabilise slopes and prevent further erosion. Commence construction of canal and river walkway and green space network

Phase 2 (2-5 years)

Measure / sub-measure
1. Work with farmers and landowners to establish appropriate land management and aquaculture practices to increase production and promote runoff and pollution reduction.
2. Bio-engineer and vegetate remaining canal and dyke to stabilise banks and reduce erosion.

3. Work with local vulnerable residents on resettlement plans and potential for raising house levels where necessary.
4. Commence implementation of revegetation and stabilisation of catchment areas to reduce erosion and moderate runoff.

Phase 4 (Over 5 years)

Measure / sub-measure
1. Improve wastewater and stormwater treatment through constructed wetlands linked to the the canal
2. Include use of green infrastructure such as bio-swales, rain gardens and constructed wetlands in urban catchment areas and stormwater management system additions and upgrades

3.3.4 Impact assessment of adaptation plan

Table 5 summarises the results of the rapid adaptation impact assessment. In general, the adaptation plan will have positive environmental and community impacts. The main potential negative impact was the resettlement of residents living in highly vulnerable flood prone areas.

Table 5: Rapid adaptation impact assessment results

Measure	Potential environmental impacts	Potential community / livelihood impacts	Potential impacts on other sectors	Impact mitigation strategy (if required)
1. New flood gate, water pump and clearing of debris.	▪ Restrict mobility of fish and other aquatic organisms during flood season; restrict flushing of canal during Mekong flood; waste disposal.	▪ Reduced flooding impacts.	▪ Town budget; maintenance and operation required.	▪ Fish passes, flushing regime if deemed necessary.
2. Bio-engineering of canal banks.	▪ Habitat enhancement, reduced sedimentation of waterways.	▪ Recreation and food sources; reduced flooding impacts.	Establishment and maintenance costs cheaper than hard engineering solutions	Community monitoring and management arrangements
3. Maintenance and agroforestry in agricultural fields. 4. Construction and maintenance of fish ponds.	▪ Reduced sedimentation and pollution of waterways.	▪ Improved yields and/or reduced input costs. ▪ Improved flood retention during extreme events		

5. Re-settlement and house raising in flood prone areas.	▪ Habitat destruction/ pollution in resettlement areas.	▪ Reduced flooding impacts; ▪ Loss of livelihood and social impacts.	▪ Re-settlement management plan including compensation ▪ Long term support to resettled families
6. Dyke stabilisation.	▪ Habitat enhancement and reduced sedimentation of waterways.	▪ Recreation and food sources; reduced flooding impacts.	
7. Watershed measures.	▪ Habitat enhancement, reduced water pollution.	▪ Reduced flooding impacts; improved aquatic and terrestrial diversity/ productivity.	

3.3.5 Stakeholder identification and engagement

The main communities in the area

There are highly vulnerable communities living in the case study area along the banks of the canal. There is also the broader community behind the dyke including residential areas, shops and commercial developments.

Community involvement to date

Many local community members were involved in the vulnerability assessment and development of the adaptation plan. They come from different administrative levels and have different responsibilities (villages, local government sectors, central government sectors, NGOs and international organisations). Many local community members are part of the Kaysone Core Group. The implementation, management, monitoring and maintenance of the adaptation plan will include local residents, Core Group members and technical and administrative government agency staff working at the district and province level.

Community engagement plan

A community engagement plan should be further developed as part of the adaptation plan implementation process. Different community sectors will have different roles and responsibilities in terms of planning, approvals, implementation, management, monitoring and maintenance. As a priority, local community members that are directly affected by the adaptation measures should be engaged and consulted at the outset as their participation and buy-in will be critical in ensuring the adaptation measures are established, maintained and area sustainable.

3.3.6 Monitoring and maintenance

Regular monitoring of the adaptation measures will include:

- Checking condition of flood gate and surrounding infrastructure including bio-engineered canal banks and bio-engineered dyke (sign of erosion or instability and health of vegetation)
- Consultations with local residents and businesses to collect and assess any issues and concerns they may have
- Water quality and water level monitoring
- Consultation meetings with key decision makers such as local and provincial government.
- Assessment of site condition following major flood events.

Key maintenance measures to ensure the adaptation responses are successful include:

- Regular maintenance of the flood gate to ensure it is operating effectively
- Regular removal of solid waste and debris from pits and canals around the flood gate area
- Regular enrichment planting, tree pruning, and other maintenance to ensure bio-engineering and vegetated areas are kept in good condition
- Erection of signage to inform and educate local community members on proper disposal of waste and what the vision of the adaptation measures are and benefits they will bring if looked after
- Perform necessary rehabilitation and maintenance on impacted components following a major flood or storm event.

Maintenance should be performed monthly by the local administration agency (UDAAs/DPWT). However, local participation should be encouraged as much as possible in monitoring and maintaining the site. Key people/institutions involved in monitoring and maintenance and their roles and responsibilities are summarised in Table 6.

Table 6: Responsibilities for monitoring and maintenance of the southern flood gate and canal system

Stakeholder	Sector	Responsibility/ role
▪ Department of Public Works and Transportation ▪ City Development Agency ▪ DONRE ▪ Village ▪ Property owners	Town planning and environment divisions in collaboration with District Office of Public Works and Transportation. Cleaning and environment unit in collaboration with the district cabinet. Land division. Concerned sectors, village committee and local business.	▪ Design, building construction and management. ▪ Cleaning and maintenance. ▪ Raising awareness and disseminating maintenance procedures and schedules. ▪ The 3 parties will have a monthly meeting for monitoring and performance assessment.

4 CASE STUDY SITE 2: SAVANXAY MARKET

4.1 BASELINE ASSESSMENT

4.1.1 Brief description of the system

Savanxay Market (Figure 30 and 31) is located in Ban Houamouang, Kaysone Phomvihane covering 2 ha (Figure 32). It was completed and began service in 1991. There is a main road on either side of the market (Phonyotha and Visoukan). Market structure consists of 3 buildings (one three storey building) and surrounding hard surface area for stalls.

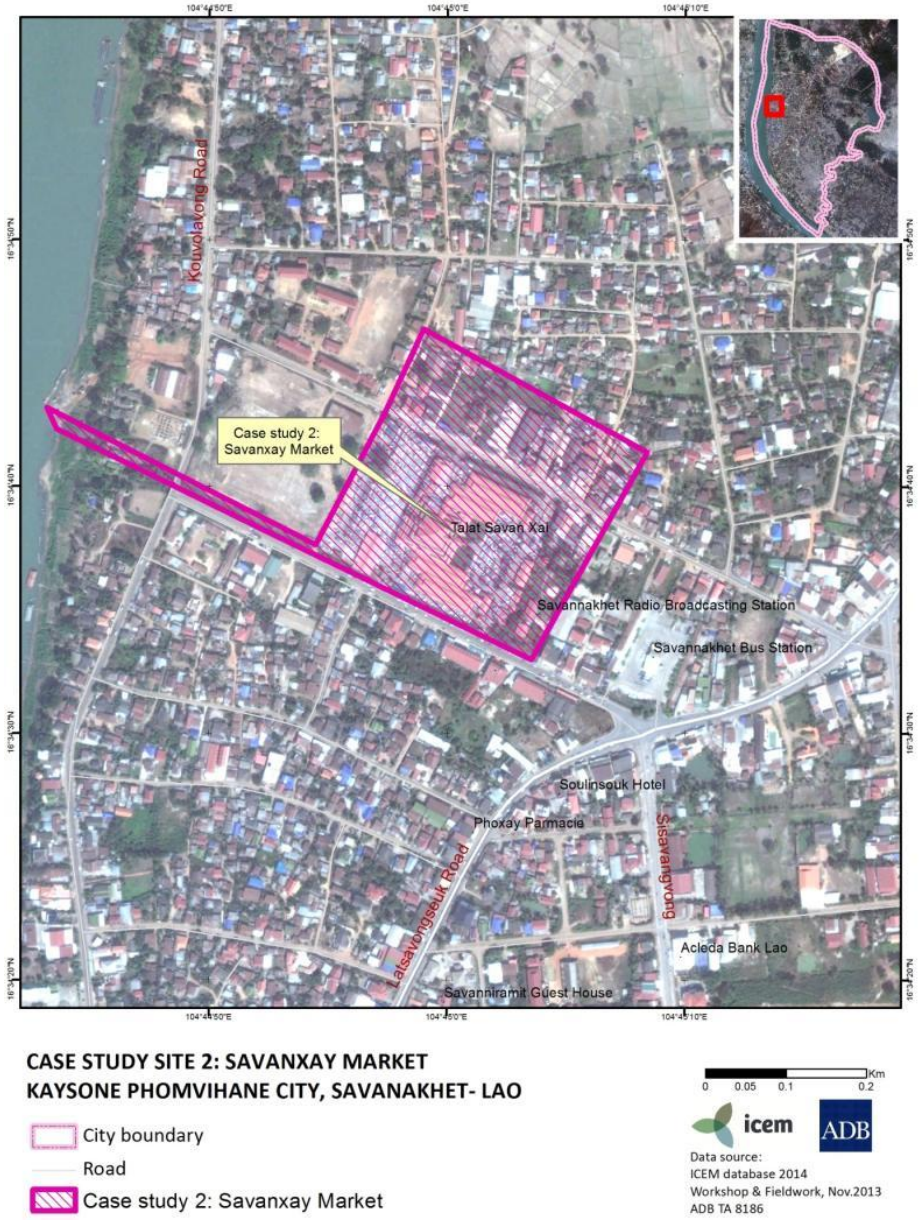
Figure 30: Case study site 2 – Savanxay Market, Kaysone Phomvihane

There is a drainage system inside and outside the market which has three components (Figure 31):

- a 50 cm wide and 50 cm deep drain surrounds the main market building
- a 30 cm wide and 50 cm deep drain surrounds the inner market
- a 1 meter wide and 200 meter long canal outside the market draining the south Houamouang sub-catchment

Figure 31: Savanxay Market drainage infrastructure, Kaysone Phomvihane

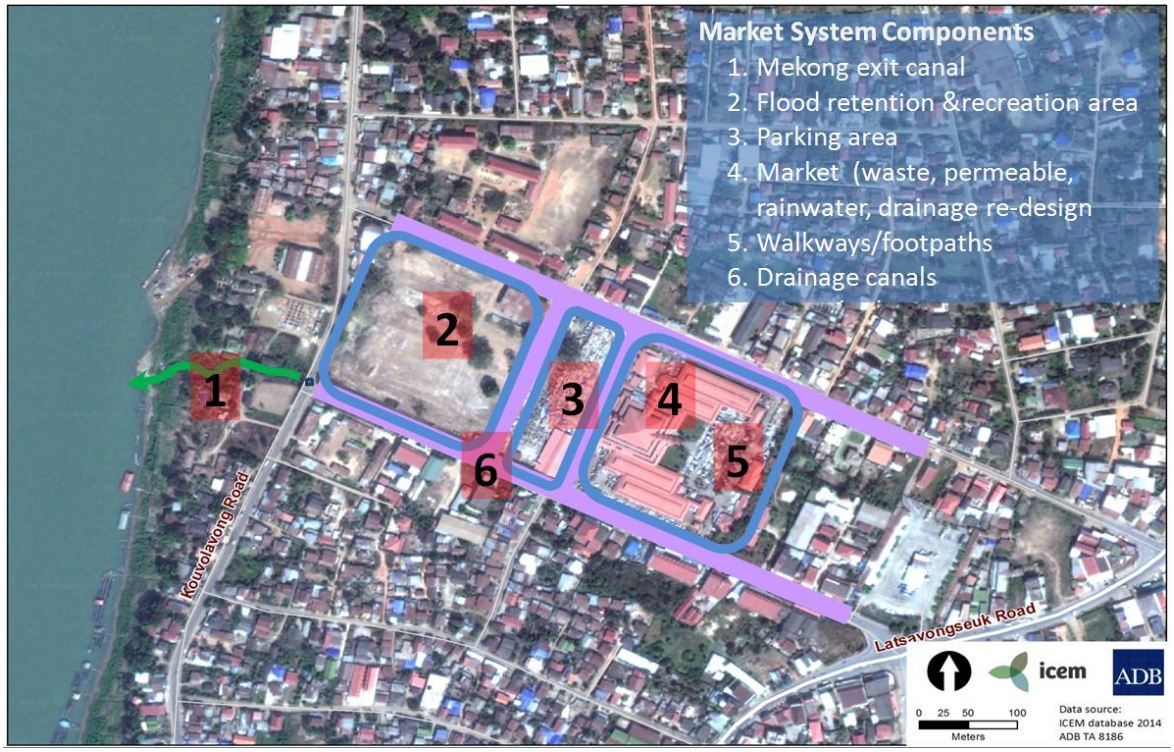
Figure 32: Location of case study site 2, Kaysone Phomvihane



The Savanxay Market case study area has the following seven components (Figure 33):

1. **Mekong exit canal** – where run-off and drainage from the market and surrounding area enters the Mekong River.
2. **Vacant block of land** west of the market.
3. **Parking area** – adjacent to the west side of the market.
4. **Market** – consisting of 3 buildings, open air stalls and drainage system.
5. **Walkways / footpaths** – within and surrounding the market.
6. **Open drainage canal** – collecting run-off and waste from the market and flowing down to the Mekong.
7. **Watershed** – the broader Houamouang sub-catchment area.

Figure 33: Individual components of the Savanxay Market system, Kaysone



4.1.2 Status and condition of the system and its components

Located in the heart of the town, the Savanxay Market is a hub of economic activity. Although the building itself is in fairly good condition, the surrounding access roads are seriously degraded, reflecting the drainage problems and intensive uses of the zone. The market and its drainage system have serious flooding and drainage challenges with implications for public health, amenity and mobility, as well as economic and livelihood impacts within the compound and surrounding area.

The entrances to market are lower than the main road and during the wet season run-off from heavy rain flows into the inner market and from the extensive roof area and causes flooding. There is insufficient storm drainage to absorb the volume of rains and wastewater discharged from the market and surrounding road. The market buildings lack gutters and downpipes to store or drain water away from on-site market areas that become locally flooded. Market operation and management is poor with lack of wastewater treatment, poor solid waste management, and an inadequate stormwater drainage system (Figure 34).

Figure 34: Poor drainage, maintenance and waste management at the Savanxay Market, Kaysone

The on-site drainage and boundary canals are blocked with debris and solid waste. Overall the drainage malfunctions due to inadequate design and lack of regular maintenance.

The components surrounding the market and drainage system such as the parking area, vacant lot of land and walkways footpaths are in poor condition and are not well integrated with the market in providing access, amenity and water management functions. The drainage gully at the Mekong exit canal is also seriously eroding, threatening nearby settlements and is filled with solid waste (Figure 35). In response to Core Group schematic redesign and recommendations, the Savannakhet Department of Public Works and Transport commenced a major upgrade of the open canal on the northern market boundary and across the car park (Figure 39). The new piping system is to connect with the planned ADB supported piping along the southern market boundary. This new system should substantially improve stormwater flow but on site drainage and the exit canal to the Mekong River remain a problem.

Figure 35: Mekong exit canal where drainage from the Savanxay Market enters the Mekong River

4.1.3 Past extreme events and impacts on the system

The market frequently floods during the wet season. The flood is typically 20-30 cm in height across the market wet areas and takes 2-3 hours for most of the water to drain out. Some flood waters remain in open drains and pools and become stagnant and odorous (Figure 36).

Figure 36: Flooding ponds at northern gate of Savanxay Market (top) and stagnant water and waste collecting in the drainage canal (bottom), Kaysone Phomvihane

On average flooding in market area occurs 6-10 times / year, from June to September. This includes both localised flooding from rainfall and run-off and flooding associated with overtopping of the Mekong River which causes more severe flooding of longer duration. In these overtopping events, inundation can last between 3 days to 3 weeks. The areas of localised and seasonal overtopping flooding are shown in Figure 37.

Figure 37: Areas of flooding from localised rainfall and Mekong overtopping affecting Savanxay Market, Kaysone

The impacts of these flooding events include:

- Flooding and waste build-up in the market area limiting access and market activity and impacting livelihoods and health (Figure 38).
- Flooding and waste in the northern village area impacting residents' mobility and health.
- Degradation of the road through erosion - inhibiting travel and commercial activity.
- Stagnant water promotes malaria and other diseases with subsequent health impacts.

Figure 38: Savanxay Market area flooding (left), stagnant water (middle) and drainage being used to channel service lines (right), Kaysone Phomvihane

In response to frequent flooding in the market, the flat area in the market was elevated but it did not solve the flooding problems. The Savannakhet Department of Public Works and Transport drainage works has helped to effectively drain water away from the market (Figure 39).

Figure 39: Savanxay Market drainage works following Climate Change Core Group recommendations

4.1.4 Climate change threat profile

As presented in the town overview, Kaysone is projected to experience significant climate changes (Table 1) leading to increased precipitation and water availability and increased run-off and flooding in and around the market.

4.2 IMPACT AND VULNERABILITY ASSESSMENT

The Core Group conducted a baseline assessment of the site and gathered information from market shopkeepers, local residents and market users, and walked the drainage system from the market to the Mekong River

completing the baseline assessment field forms. They then conducted an impact and vulnerability assessment using information on past climate events and climate change and hydrological projections developed by ICEM.

The group's conclusions were that the site is highly vulnerable to regular pluvial flooding resulting from increased rainfall and from Mekong River flooding in extreme events due to climate change. The potential impacts were aggravated by the inadequacy and poor design of the existing drainage system, as well as a lack of solid and liquid waste management.

The poor drainage in the market and surrounding canals causes the market to flood several times each year with wastewater and stormwater. Climate change projections show that floods will worsen with the anticipated 12% increase in rainfall. The results of the vulnerability assessment are summarised in Table 7.

4.3 ADAPTATION PLANNING

The aim of the adaptation plans is to drain waste and stormwater into the Mekong and to improve onsite waste treatment and drainage. It is also, intended to provide an area of high quality amenity and beauty for vendors, users and tourists alike with green space and walkways to the Mekong River. The Core Group has developed a 7 point plan that includes wastewater recycling, walking paths, proper drainage and green space. It also includes an educational component to improve understanding of climate change impacts and adaptation among local people. The parking area is an important focus of bioengineering and green cover. There is an opportunity to use adjoining land as a constructed wetland and park for recreation, flood retention and storm water treatment. A key component of the recommended plan relating to the direction of flow in a drainage system and new piping was implemented during the project on one side of the market by the Kaysone Phomvihane Government. ADB is supporting connected piping on the other side leading to a waste treatment facility and then to the Mekong River. The most appropriate design of that treatment facility and its location requires further detailed assessment.

An integrated adaptation strategy is needed for the market. While it is a positive development that drainage is being improved around the market according to the Core Group recommendations, detailed modelling has not been undertaken to account for increased flows under climate change so actual performance under extreme flood conditions is not known. Topographical survey and hydrological modelling for the town under climate change was also recommended by the Core Group and high resolution topographical information would enable detailed flood mapping with projected Mekong flooding and intensive rainfall.

4.3.1 Objectives of the adaptation plan

The key objectives of the adaptation plan are to:

- Reduce flooding that affects local livelihoods and to strengthen capacity of the local community in adapting to climate change.
- Reduce duration and frequency of flooding.
- Reduce water pollution.
- Solve the issue of poor waste management.
- Increase knowledge and participation of the locals in responding to climate change impacts.
- Greatly enhance the beauty and amenity of the area as a recreational and touristic asset with links to the Mekong River.

Table 7: Vulnerability assessment summary results for the Savanxay Market, Kaysone Phomvihane

Threats	Interpretation of threat	Exposure	Sensitivity	Impact Level	Impact Summary	Adaptive Capacity	Vulnerability
Market Flooding from intensive rainfall (regular) and extreme Mekong River flows	▪ During the wet season there is heavy rainfall on average 4-5 times /year ▪ Flooding in market area of 20-30cm height for 2-3 hours. Remaining water quickly becomes polluted with bad odour. ▪ The flooding spreads out onto Phonyotha road. Roadside canal fills up and is blocked with debris. ▪ Transport/mobility of people in surrounding area becomes difficult.	▪ The flooding rises quickly and decreases within 20-40 minutes while residing water inside the market area becomes odorous and remains in pools. ▪ Height of flooding in that area is about 20-30 cm. Flooding is expected to worsen with a 12% projected increase in average wet season rainfall by 2050. The exposure of the market is **High**.	▪ The drainage system is not properly designed for existing or increasing rainfall and run-off volumes. ▪ The sensitivity of the market is considered to be **High**.	▪ There will be impacts on roads, drainage, communication, ecology and environmental pollution levels. ▪ This impact level is considered to be **High**.	▪ The flooding damages transportation infrastructure and the assets of vendors ▪ The flooding causes air and water pollution. The drainage system is blocked by solid waste. ▪ The flooding causes operation and maintenance cost increases. ▪ Constrains economic and livelihood activities	▪ Lack of budget for operation and maintenance improvement. ▪ The drainage system does not have capacity to cope with increasing volumes of water. ▪ Lack of gutters and downpipes to drain water into the main canal. ▪ The regulation for cooperation, coordination and communication between government and market operator and management is weak. ▪ Lack of regular drainage cleaning and maintenance. ▪ Adaptive capacity is **Very Low**.	▪ If the drainage system is not improved, the problems will worsen. ▪ Therefore regulations to ensure proper cooperation, coordination and communication between the government and the operator are required, including financial support. ▪ Vulnerability is **Very High**.

By meeting those objectives the plan will contribute to enhancing and sustaining the existing uses of the system and reduce or eliminate its vulnerability to climate change.

The Core Group's adaptation plan for the market would result in a fundamental reworking of how the drainage system is designed and managed – the Group proposed redirecting drainage flow to the Mekong River and a package of linked adaptation measures. Also it provided recommendations for improved on and off site solid waste management. Adaptive capacity at present was deemed low, and to rectify the situation would require funding support, and regulations to facilitate and promote good planning and proper design and management. It would also require close collaboration and cooperation of the private sector lease holder of the market.

4.3.2 Adaptation measures

Table 8 summarises some key adaptation strategies proposed to increase the resilience of the Savanxay market and system components.

Table 8: Key adaptation strategies for the Savanxay Market system

Strategy	**Description of the strategy**	**Climate change threats addressed by the strategy**
1	Improve natural drainage and water management system by installing appropriate drainage capacity and using bio-engineering and green infrastructure in the canal and around the market and its vicinity. This will include increasing permeable surfaces in and around the market on a walkway network and in the parking area, flood retention measures in the vacant lot using water capture and treatment devices such as constructed wetlands, bio-swales, a market water treatment facility to treat water before releasing to the Mekong River, a market rainwater collection system and bio-engineering of the Mekong River exit canal and establishment of constructed wetlands.	▪ To facilitate drainage of storm water to the Mekong River avoiding flooding of the market and local residential areas. ▪ To reduce run-off and increase infiltration and water treatment through natural filtration and nutrient uptake processes. ▪ To create public spaces for recreation, enjoyment, amenity and health. ▪ To reduce erosion and vulnerability of settlements at the Mekong exit canal. ▪ To reduce the influence of Mekong River flooding
2	Build and improve management of the market waste collection area to meets proper standards to avoid its contribution to water pollution, odour and drainage blockage.	▪ Reduced blockage of drainage and reduced incidence of flooding. ▪ Reduce associated community health problems ▪ Explore potential for waste recycling and energy production
3	Strengthen the capacity of human resources in both government and the community.	▪ Raise the awareness of the local community in adaptation to climate change and how to participate in monitoring, maintenance and management of the adaptation measures. This capacity building also includes increasing knowledge and skills of the local officers / staff to respond to climate change and drafting regulations for site management.

The specific adaptation measures for each of the individual system components are described below.

Adaptation measures for each of the system components (Figure 33):

1. **Mekong exit canal** – stabilisation through bio-engineering of banks and channel and bio-swale methods to treat stormwater and wastewater from the market before it enters the Mekong (Figure 40). Construction of walkway from market to Mekong River with access to river sandy flats when not in flood.

GI Guide 4.1 – 4.12, 5.2

ADB has planned a treatment facility on a vacant block close to the Mekong River and exit canal. The purpose, design and location of that facility need to be reassessed. That site would be flooded by increasing wet season water levels in the Mekong River with climate change. The Core Group has proposed a constructed wetland on the vacant block next to the market parking area to capture and treat stormwater. The Group has also recommended onsite treatment of waste water within the market compound.

GI Guide 3.1

Figure 40: Mekong exit canal (left) – with examples of stabilisation and bio-engineering of canal banks and constructed wetlands and walkways

2. **Vacant lot next to market parking area** – re-designed as a constructed wetland for stormwater treatment and flood retention and recreation area using green infrastructure (bio-swales, rain-gardens, ponds and permeable surfaces) to create a multi-functional green space (Figure 41).

GI Guide 3.1 – 3.3, 5.1, 5.2, 5.4

Two issues need to be addressed if this land is to be used for that proposed purpose – both relating to private sector leasehold and ownership. Part of the block is used as a modern showroom for Kia Motors. That

company would need to agree to a plan to green its allotment which is currently hard cement surfaces without any attempt to soften with green infrastructure. The other part is not developed but the government may need to buy back the allotment from the private leaseholder.

Figure 41: Vacant lot (left) that could be transformed into a constructed wetland, flood retention and recreation area (right)

3. **Parking area** adjacent to market – re-designed to maximise permeable surfaces and infiltration through the use of green infrastructure such as bio-swales, permeable paving and rain- gardens (Figure 42).

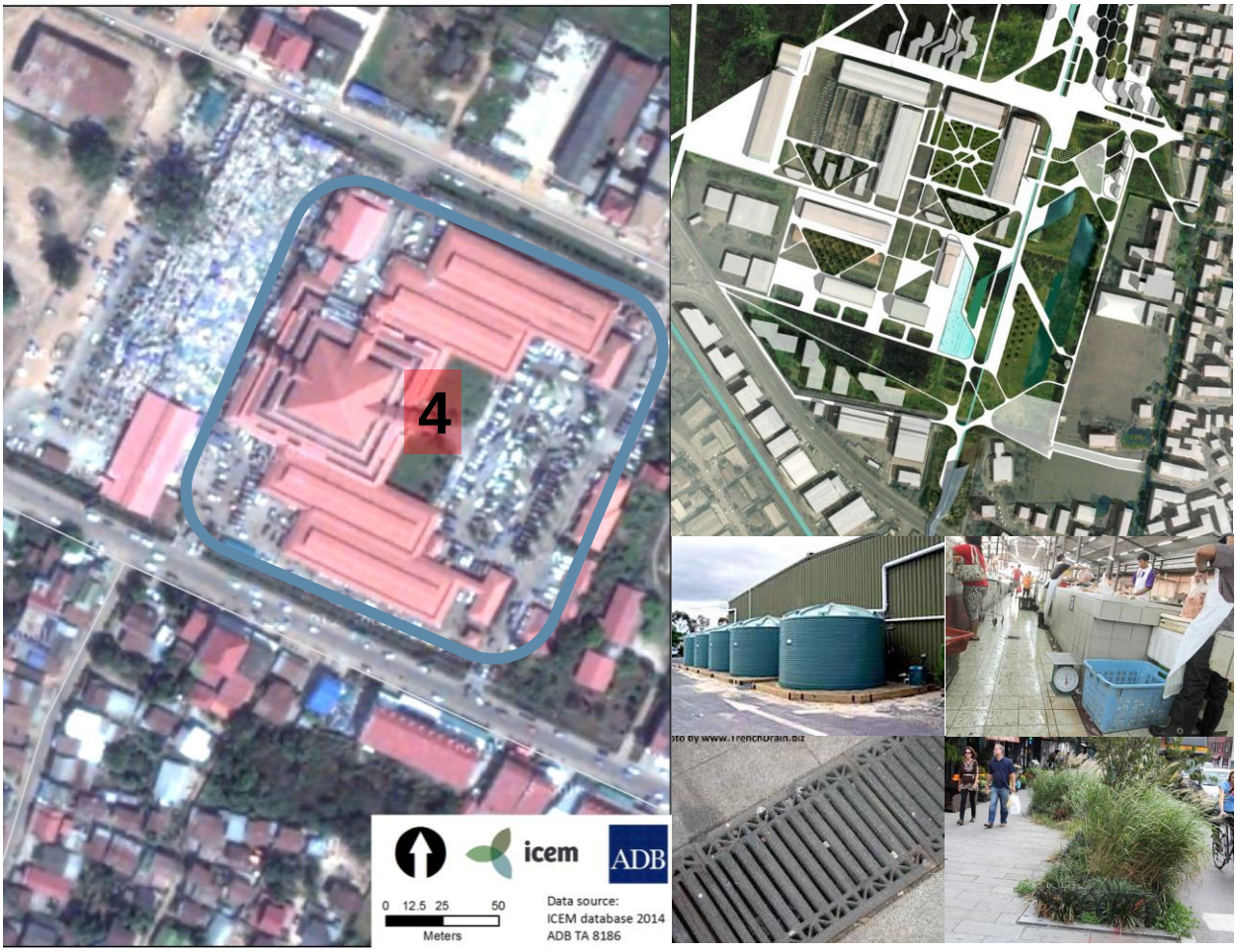
GI Guide 3.3, 5.2, 5.4

Figure 42: Parking area (left) with example of permeable paving, bio-swales and rain-gardens to increase infiltration and water purification

4. **Market –** re-design the drainage system to ensure adequate capacity; install and develop a waste management facility and plan to ensure liquid and solid waste is handled and treated correctly and does not block drains and cause pollution; maximise permeable surfaces and infiltration through installation of bio-swales, permeable paving and rain-gardens to reduce run-off and flooding; install guttering and a rainwater collection system that can provide water for cleaning, irrigation and toilets (Figure 43).

GI Guide
3.3, 3.4, 5.2, 5.4

Figure 43: Savanxay Market (left) with examples of increased permeable surfaces (top right), waste collection and treatment area, rainwater collection, adequate drainage and bio-swales



5. **Walkways / footpaths network –** increase permeable surfaces and infiltration through green infrastructure such as nature strips, stormwater tree pits, permeable paving, bio-swales and rain- gardens (Figure 44).

GI Guide 3.3, 3.5, 5.2, 5.4

Figure 44: Walkways and footpaths around the market (left) with examples of permeable paving (top right), vegetated nature strips and drainage (bottom right)

6. **Drainage canals** – re-design to ensure adequate drainage capacity and fall so that stormwater is directed to the Mekong River. The drainage canals should be designed to ensure waste does not block the system.

7. **Watershed** – maximise permeable surfaces to reduce run-off and absorb flood waters. Maximise tree canopy and vegetation cover to promote evapotranspiration and reduce run-off. Identify natural drainage corridors and rehabilitate using green infrastructure approaches.

GI Guide 3.1 – 3.3, 3.5, 5.1, 5.2, 6.1, 6.3

4.3.3 Phasing of adaptation implementation

The adaptation plans need to be put up for consultation with relevant government agencies, the private sector and the directly affected and broader Kaysone community to ensure it is effectively designed and implemented. In terms of the priority and feasibility of implementing individual measures, the following broad phases are proposed:

Phase 1 (1-2 years)

Measure / sub-measure
▪ Consultation meeting's with local community to increase understanding of climate change, its effects and the proposed adaptation responses. The role of the community in monitoring and maintenance will also be communicated including waste management.
▪ Completion of the drainage canal system upgrades. A maintenance plan will also need to be established.

▪ Internal drainage system upgrades including guttering and rainwater collection in the market including raising awareness and training of market vendors and users (signage). A maintenance plan will also need to be established.
▪ Improved liquid and solid waste management facilities in the market including an area for killing livestock and collection of waste. This will also include implementation of stricter regulations, monitoring and maintenance plan and implementation of cooperation mechanisms between the local government and the market operator including community complaint and response requirements. Raising the awareness and training of market vendors in proper use of new facilities and waste management will also be a key component.
▪ Upgrades to the car park increasing permeable surfaces through installation of gardens and permeable paving. A maintenance plan will also need to be established.

Phase 2 (2-5 years)

Measure / sub-measure
▪ Bio-engineering works on the Mekong exit canal including stabilisation of slopes and establishment of walkway network and vantage points near river.
▪ Purchase and re-zone the vacant lot as a public recreation area. Consult with the community on the vision for the space. Re-design the area as green space including walkways, open grassy areas, ponds, bio-swales and gardens and constructed wetlands for treating stormwater prior to discharge into the Mekong. A monitoring and maintenance plan will also need to be established.
▪ Upgrades to walkways and roadsides increasing water infiltration and purification through permeable paving, bio-swales, nature strips and rain-gardens.

Phase 4 (Over 5 years)

Measure / sub-measure
1. Redesign of the market increasing permeable surfaces through permeable paving, rain-gardens and bio-swales.
2. Tree planting and green streets campaign for green city development.
3. Reduce run-off and improve water quality in the broader catchment through increasing permeable surfaces, vegetative cover and use of green infrastructure in drainage design and upgrades.

4.3.4 Impact assessment of adaptation plan

Table 9 summarises the results of the rapid adaptation plan impact assessment. In general, the adaptation plan will have positive environmental and community impacts and no significant negative effects.

Table 9: Rapid adaptation plan impact assessment results.

Measure	Potential environmental impacts	Potential community / livelihood impacts	Potential on other sectors	Impact mitigation strategy (if required)

Improve water management system by redesign of market drainage, canal, vacant lot, parking area and walkways including waste management facilities.	• Improved biodiversity and ecosystem function from new gardens, water bodies and reduced water pollution.	• Reduced flooding impacts on residents and merchants assets, amenity and livelihood. • Improved health of residents and market vendors. • Reduced road damage and improved traffic conditions.	• Issue of poor coordination among related sectors • No SEIA before investment and difficulties in monitoring	• Provide knowledge and raise awareness of community and merchants. • Set clear plans for coordination, monitoring and maintenance with clear roles and responsibilities.

4.3.5 Stakeholder identification and engagement

The main communities in the area

There are highly vulnerable communities living in flood areas around the market and adjacent to the Mekong exit canal. There is also the broader community who use the market and surrounding residential areas, shops and commercial developments. Both local residents and users of the market needs to be involved in defining the detailed design of adaptation measures and then in their construction and management. Other related provincial departments (e.g. DONRE) and Kaysone Phomvihane district office sectors (OPWT, TONRE, Women's Union, Youth Union, and Labour Union) will be included in implementation of the adaptation plan.

Community involvement to date

Many local community members were involved in the vulnerability assessment and development of the adaptation plan and come from different administrative levels and have different responsibilities (villages, local government sectors, central government sectors, NGOs and international organisations). Many local community members are part of the Kaysone Core Group. The implementation, management, monitoring and maintenance of the adaptation plan will include local residents, Core Group members and technical and administrative government agency staff working at the district and province level.

Community engagement plan

A community engagement plan should be developed as part of the adaptation plan implementation process. Different community stakeholders will have different roles and responsibilities in terms of planning, approvals, implementation, management, monitoring and maintenance. As a priority, local community members that are directly affected by the adaptation measures should be engaged and consulted at the outset as their participation and buy-in will be critical in ensuring the adaptation measures are established and maintained.

4.3.6 Monitoring and maintenance

Table 10: Monitoring and maintenance arrangements

Measure	I. Projected lifespan of measure	II. Projected maintenance required	III. Management and maintenance plan

Measure: adaptation responses to the current issues: flood, solid waste, erosion, water quality, amenity and health.	10 years	1) Regular removal of solid waste debris from drainage pits and rainwater collection system. 2) Watering and fertilisation of plants and gardens.	Perform monthly maintenance /Monthly removal of debris by City Administration Agency (UDAAs/DPWT)
		3) Replacement of information signboards. 4) Removal of weeds along the road and walkways 5) Regular consultation meetings for resolving problems/issues	Send waste to the designated area, tree pruning, cleaning up tree leaves monthly by City Administration Agency (UDAAs/DPWT) and local participation.

The regular monitoring in response to the current issues of flood, solid waste will be focused on:

- Performing monthly monitoring on all system components to ensure they are working properly including waste management, drainage (including green infrastructure components) and rainwater collection systems, gardens and wetlands.
- Regular consultation with market users and local community.

Key maintenance measures to ensure the adaptation responses are successful include:

- Tree pruning, cleaning up tree leaves monthly by City Administration Agency (UDAAs/DPWT) and local participation.
- Regular removal of solid waste debris from pits and canals around the market area by City Administration Agency (UDAAs/DPWT).
- Placement of signboards to notify people where they can and can't throw waste with properly marked rubbish bins.
- Removal of weeds along the nature strips, permeable paving, gardens, bio-swales etc.
- Consultation meetings for solving problems with three key parties: local government, market concessioner, shoppers and communities.

Maintenance should be performed monthly by the local Administration Agency (UDAAs/DPWT). However, local participation will be encouraged as much as possible in monitoring and maintaining the site. Key people/ institutions involved in monitoring and maintenance and their roles and responsibilities are described in Table 11.

Table 11: Responsibilities for monitoring and maintenance of the market and canal system.

Stakeholder	Sector	Stakeholder engagement measures
▪ Department of Public Works and Transportation	▪ Government	▪ Consult with the high ranking officers to issue regulation ▪ High-level provincial Government roundtable discussions
▪ DONRE ▪ City Development Agency ▪ Women's, Youth and Labour union's	▪ Government ▪ Government ▪ NGOs	▪ Disseminate regulations
▪ Village ▪ Property owners	▪ Community ▪ Private	▪ Regular "user group" meetings and workshops ▪ Provide knowledge on maintenance
▪ Shopkeepers	▪ Small business	▪ Public consultation sessions

▪ Local residents	▪ Public	▪ Involved in bioengineering works, in the monitoring program and in regular maintenance

5 SUPPORTING POLICIES AND PROGRAMS FOR ADAPTATION

Kaysone does not have an overall climate change adaptation plan. When the Core Group developed the adaptation measures and phasing for this case study site, they focused on the area wide system and its relationship to the town and not just the individual infrastructure items. The Core Group has made important progress in identifying the most vulnerable areas to flooding in the town and suggested development controls and actions which are needed. An overall adaptation plan for the town will include broad controls and approaches. Specific hotspot areas will require the preparation of more detailed adaptation plans of the kind demonstrated here – but that can be done progressively according to urgency for action and other priority setting criteria.

- To implement the adaptation plan for the market area, a number of issues will need to be addressed with appropriate regulatory, policy and programs. The current urban planning and development framework for Kaysone lacks processes for consultation with related sectors and with affected communities.
- Current infrastructure development planning in Kaysone does not take climate change adaptation or mitigation into consideration.
- There is a lack of the private sectors' participation in maintenance of the current system i.e. the Savanxay Market.
- There are unclear regulations, especially those that relate to the roles and responsibilities of local government, owners and operators of town infrastructure such as the Savanxay Market and drainage system.
- There is often very limited budget for maintenance of town infrastructure – levies/fees on system operators and/or users may need to be imposed to raise revenue.

5.1 INSTITUTIONAL ARRANGEMENTS

In Kaysone Phomvihane, the current organization and management structure for urban sector development is guided by the Provincial Government and often driven by the national government sector agencies. The Provincial DPWT is one of the Government line departments that supports the Province in the formulation of plans and programs and in the monitoring of the physical and financial progress of local development activities. In the management structure, the Kaysone Phomvihane Urban Development Administration Authority (UDAA) is at a level equivalent to a provincial department and has the right to formulate urban sector management and development plans within the urban area of Kaysone Phomvihane District. The Climate Change Core Group has members from both those agencies and needs now to have an active role in cross sector planning and development review. The Group will require secretariat support which would best be provided by DPWT. Continued support in capacity building and demonstration is needed for the Group to fully realise its potential as a technical advisory body for ecological sustainability and climate change reliance.

5.2 POLICIES AND PLANS

The Kaysone Phomvihane Climate Change Core Group will facilitate ongoing resilience building work in the city as the main technical advisors to policy makers at the town level in developing climate change adaptation measures to reduce vulnerability in infrastructure, areas and communities.

The initial policy and institutional changes needed are:

- The Provincial Government to build climate change adaptation into its policies and overall strategy.
- Policy makers in both local and central government to show how climate change adaptation is to be achieved in town and infrastructure development plans.

- A special unit responsible for climate change in Kaysone Phomvihane to provide ongoing responsibility and management of the climate change adaptation planning and to provide secretariat support for the Core Group.
- The Kaysone Phomvihane master plan to be adjusted or improved to ensure zoning and development controls build resilience.

The following specific regulations and management requirements for the market site are proposed:

- Regulations to support implementation of the market adaptation plan, its operation and management.
- Strict regulations on the obligations of private developers and operators to meet environmental and adaptation safeguards.
- Active participation in the management of the market by a management committee made up of vendors and users as well as local government and the market owner
- Communication, cooperation and coordination procedures between three parties: government, community, and market operator/concessioner to be developed including roles, responsibilities and penalties for non-compliance.

5.3 DEVELOPMENT CONTROLS AND SECTOR DESIGN STANDARDS

The design standards for town infrastructure (for example, buildings, drainage, canals, roadside drains, roads and bridges) need to be evaluated and updated to ensure they support green infrastructure and resilience building measures. For example drainage in the market must be upgraded and include complementary and necessary components such as gutters and downpipes to effectively drain water off the main building and surrounding smaller buildings inside the market place. These standards need to cover big, medium and small urban infrastructure development projects.

The regulations related to IEE/EIA and development control need to be reviewed to mainstream green infrastructure approaches to building climate change resilience and ecological sustainability. EIA has an essential role in promoting resilience. Yet, the EIA process is not capturing the cumulative and multiplier impacts of many projects and is not considering the effects of climate change. Most projects are moving to approval and implementation without any environmental assessment. The thresholds for triggering IEE/EIA and the guidance for their preparation need to be revised to bring in more small and medium town investments and to ensure that area wide considerations are built into environmental and adaptation plans as part of any development. Also, the EIA process must ensure adequate consultation with affected communities and line agencies.

5.4 ECONOMIC INSTRUMENTS

In order to successfully implement the climate change adaptation plan for Kaysone, adequate and timely budget allocations will be needed. There are various sources of funds that can be accessed for adaptation plan implementation but the first source needs to be the Kaysone and Provincial budgets. Best define what can be done within existing and special government sources before seeking external support..

There are various methods that could be employed for the Kaysone or Provincial government to raise revenue for adaptation. These include: official fees for solid waste collection and management, wastewater and potable water fees, electricity fees and taxes from regular collections and possibly a tax on all international passengers entering Kaysone by plane. A proportion of revenues from the existing tax base could be labelled to support adaptation plan implementation. The use of tax incentives, subsidies or fines should be carefully considered in the adaptation plan finance.

6 LESSONS LEARNED

1. **Broad consultation is key to adaptation success:** Town wide and site specific climate change vulnerability assessment and adaptation planning is a process that needs to involve local, provincial and national government, the private sector and local communities. All levels of government, local communities and the private sector will have an essential role in plan definition and implementation.
2. **Siting of strategic infrastructure away from flood prone areas:** Care is required in building resilience into the Mekong River exit points and proposed treatment plant near the market. The very important drainage gully and exit area to the Mekong River from the market is degraded and will require special treatment as part of ADB's support to the market boundary pipeline and area waste treatment. The Core Group questioned the wisdom of constructing a treatment works close the Mekong River as proposed in the ADB scheme – rather than requiring the private sector owner of the market to install and manage an on-site treatment facility. If an external treatment facility was to go ahead with ADB support, then the design should be modified to incorporate a constructed wetland component (as proposed above). Also, the plant site should only be confirmed once hydrology of the area has been modelled – recent flood waters from the Mekong River have covered the proposed site.
3. **Area wide approaches to adaptation in specific infrastructure assets:** Additional adaptation measures are required for the northern flood gates along the lines proposed for the southern flood gates. The Core Group took the opportunity to visit the northern flood gate constructed earlier with ADB support and now part of the new ADB investment focusing on rehabilitation of the flood gates. It was noted that the entire creek waterway leading from the town to the Mekong River through the flood gate was severely degraded. It would be essential that bioengineering and natural system rehabilitation take place as part of an overall adaptation strategy for this drainage system and flood control infrastructure of the town. Also, it was noted that large drainage pipes from the new concrete road have been constructed to exit onto the current flood gate culvert opening with potential to damage and undermine the flood gate structure. Adaptation responses to these key factors need to be included in the planned ADB project – otherwise it is likely that the new flood gates will have a similar short life span to the old one.
4. **National and local government collaboration on adaptation and urban planning**: Core Group members raised the problem of a lack of coordination and consultation between the national and provincial governments on urban planning and management issues in towns – especially important now with projected climate change. An example provided was the special economic development zone to the north of the town. While this development may provide economic opportunities, it will also have significant repercussions for the town in terms of water use, waste production and drainage. Some Core Group members felt that as it was designed and managed by the national government, the provincial government was largely powerless to impose their own adaptation measures and development controls on the site.
5. **Participatory mapping of past extreme events and flooding** and overlaying a defined climate change profile for the town enabled the Core Group to overcome the constraint that no flood or climate change maps had been prepared for Kaysone – and the economic development plan and master plan did not have the benefit of accurate assessments of flooding potential and its implications for land uses. Maps clearly defining the threat provide a necessary input to effective zoning and development control and allowed the Group to focus adaptation plans on vulnerable infrastructure systems.

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APPENDIX 1: KAYSONE PHOMVIHANE CORE GROUP MEMBERS

Core Group Member	Affiliation
Phavanh Bualuanglath	Deputy Director of Provincial Department of Public Works and Transport (PDPWT)
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Souvanh Sengchamphone	Vice Director of Road-Bridge Office, PDPWT
Khamsy Boulom	Vice Director of Housing, Urban Planning and Environment Office
Daovanh Phetphansy	Vice President of Kaysone Phomvihane Urban Development Administration Authority (UDAA)
Vanthong Xayphavong	Vice President of Kaysone Phomvihane UDAA
Hongkham Xayakhom	Vice-Chief of Kaysone Phomvihane Cabinet Office
Sanchone Dysameu	Chief of Kaysone Phomvihane Public Works and Transport Office (PWT)
Nuanlahong Inthilath	Vice-Chief of Kaysone Phomvihane Natural Resources and Environment Office
Bounthalangsy Khammanivong	President of Kaysone Phomvihane Women's Union
Orathai Chansity	Officer in Kaysone Phomvihane Women's Union
Oukham Phounprakorn	Chief of Meteorology and Hydrology Division - Natural Resources and Environment Department
Ounkham Phiewphachanh	Vice-Chief of Kaysone Phomvihane Agriculture and Forestry Office
Thoune Saychandy	Chief of Project Implementation Unit - UDAA
Lamphan Sangboutho	Officer in Kaysone Phomvihane PWT
Vatthana Pongvilay	Officer in Kaysone Phomvihane PWT
Lamkeo Souvannalat	Officer in Kaysone Phomvihane UDAA
Viengkham Sengsoulichanh	Officer in Housing, Urban Planning and Environment Office; Officer of GMS-Corridor Project, PDPWT