

## Da Nang, Vietnam

### RECOMMENDATIONS ON ADAPTIVE MEASURES FOR CAU DO AND HOA LIEN WATER SUPPLY FACILITIES

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## KEY FINDINGS

- Water supply for the city primarily relies on the Cau Do water supply plant. Should the plant fail, the impacts to the city would be severe. Diversifying the city water supply is needed to mitigate this risk.
- One of the highest risks of failure for the Cau Do water supply plant is water conveyance to the plant during dry periods, which relies on piping from An Trach through a single pipeline. This system is at high risk; mitigating this risk should begin immediately.
- Dry season flow in the Cau Do River is increasingly subject to salinity, which increases treatment costs. Salinity is projected to increase in the future due to both further reductions in flow and sea level rise. Actions should begin now to address potential future salinity issues.
- New hydropower operations in the upstream reaches of the Vu Gia River are reducing flows in the Cau Do River, increasing the salinity of raw water at Cau Do WP intake and resulting in higher treatment costs and associated pricing at An Trach Spillway. Formation and sanction of a River Basin Organization to research and propose management and operations options is critical.
- Operating upstream reservoirs in ways that support urban water supply in Da Nang is not currently being considered. Long-term water supply planning needs to be undertaken, and should include focused consideration on how the water storage and supply functions of reservoirs can be adjusted to support and enhance urban water supply.
- The proposed Hoa Lien water supply plant would draw water from the Cu De River, diversifying the Da Nang water supply and increasing city resilience. The plant should clearly be built. However, water reserves (both flow and volume) in the Cu De River are small, particularly in the dry season. To harvest this water source effectively in the future, appropriate construction solutions to control and augment flow are essential.

## Diversifying the Da Nang City water supply

Da Nang is currently almost 100% reliant on the Cau Do Water Supply Plant for city water. There are currently

several potential risks to the Cau Do supply, including particularly high risks to water inflow of the city, such as the deep erosion at Quang Hue and sedimentation at Ai Nghia, increasing salinity at the Cau Do intake, and the

risk of broken spillways or loss of the siphon. These water security risks need to be recognized and addressed by the relevant departments and agencies.

However, more broadly, these risks highlight the danger of relying on one source of water only. To ensure water security for the urban water supply, the city should prioritize investment for water supply in Cu De River. In considering options for the construction and operation of the Cu De WSP, options that move toward maintaining a more balanced division of supply between the Cau Do and Cu De plants should be prioritized if at all possible. This will increase water security for the city should one of the treatment plants be impacted.

## Securing the An Trach pipeline

One of the most significant short-term risks facing the city water supply is the 9km pipeline that brings raw water from the An Trach salinity prevention pumping station to Cau Do WSP. The pipeline is designed with a Dueker (a reverse siphon) buried under the riverbed. In recent years due to the impact of floods, the right bank of Cau Do River has been severely and deeply eroded and extended toward the south. Thus there is increasing risk of damage to the Dueker. Fixing a Dueker is very difficult and time consuming, as installation is underwater and the pipes needed for the task would need to be purchased abroad. The following solutions should be considered:

- Stabilize the riverside embankment to ensure security for the Dueker;
- Purchase and stockpile backup pipeline supplies to allow for immediate action should the Dueker be damaged;
- Have the plans and authorization in place to construct a temporary dam at Cau Do River so that if there is an emergency failure the city can respond immediately to ensure continuation of the city water supply.

Longer-term, the city should pursue development of the Hoa Lien WSP and explore upstream reservoir storage and operations for city water.

## Addressing increasing salinity

Low flows, due to the long dry season and exacerbated by hydropower water transfers, are the main cause of the river salinity that highly impact the operation of Cau Do WSP.

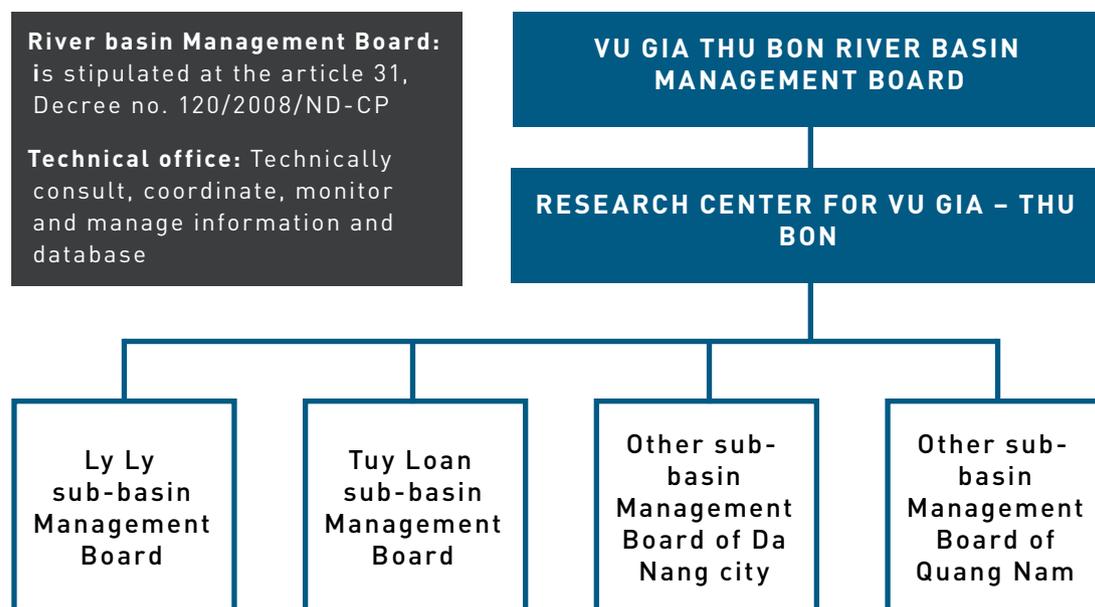
Though the Vu Gia-Thu Bon river system has abundant water, during the dry season river flows can be low enough to cause water shortage problems for the city. Dry weather significantly affect water withdrawals for both agriculture and city water supply. However, even with low flows, historically salinity has only been an issue 3-5 times a year, and even during those periods salinity levels were not high. However, since 2010, especially in 2013 and 2014, the number of days with salinity has considerably increased to almost 90 days per year. Measured salinity on some of these days reached 4,000 mg/l. This has increase operation costs at the Cau Do water supply plant. Additionally, the area of salinity has expanded to upstream areas, causing substantial impacts to agriculture production and well water supply for domestic use.

The significant increase in high salinity days in 2013 is due to hydropower operations. The Dak Mi 4 Hydropower went into operation in 2012 and began transferring water from the Dak Mi River (Cai River) to the Thu Bon River, intensifying dry season water shortages in downstream areas. About 1 billion m<sup>3</sup> of water from the Vu Gia River (upstream of the Cau Do River) has been diverted annually to the Thu Bon River in the dry season. The hydropower reservoirs of Song Bung 2 (stable flow for Song Bung 4 reservoir), Song Bung 4, A Vuong 1 and Song Con 2, which hold and release water that ultimately flows to Cau Do, can only compensate about 600 million m<sup>3</sup>. Consequently, there is an expectation of decreased flow relative to the historic record from upstream to Cau Do River.

Sea level rise, though not addressed explicitly in the project, will exacerbate salinity problems. Based on emissions to date, the world is committed to a half meter of sea level rise or more between now and 2100. This will slow river flows and increase the distance that saline water intrudes upstream. At fixed locations, such as the Cau Do intake, sea level rise alone will increase both measured salinity levels and the number of days when salinity exceeds standards.

Actions to address increasing future salinity levels need to begin now. Actions should include the development of

**FIGURE 1**  
**MULTILATERAL MANAGEMENT STRUCTURE IN INTEGRATED WATER RESOURCES MANAGEMENT ACCORDING TO DECREE NO. 120/2008/ND-CP**



collaborative water resource management mechanisms, review and negotiation of upstream hydropower operations to support city water supply usage, exploration of flow enhancement mechanisms including reservoir storage for water supply, and alternative water treatment plant intake options.

## Formation and sanction of a River Basin Organization

The Vu Gia – Thu Bon river basin is located in both Quang Nam and Da Nang city. Consequently, river basin management requires the participation of both provinces, relevant stakeholders and coordination of MONRE. An appropriate management model is a River Basin Organization (RBO).

According to the Decree no. 120/2008/ND-CP, RBO will be under MONRE and includes two divisions: the River Basin Commission and the Basin Technical Office, also known as the Center for VGTB Research (Figure 1).

The main objective of the Vu Gia – Thu Bon research center will be to:

1. Develop and implement VGTB river basin management strategies;
2. Enhance technical capacity;

3. Optimize development opportunities and water resource management in both upstream and downstream areas;
4. Provide the scientific basis to respond to requirements set by local leaders and VGTB River basin Management Board regarding optimal water resources management in the basin.

The main objective of the river basin Management Board will be to develop water resources management strategies to reduce climate change impacts and ensure water security in the future as well as reduce potential tensions through the implementation of IWRM.

Previous attempts to establish a basin-wide management board and research center have been made. To re-establish VGTB River basin Management Board and VGTB Research Center, there must be a high determination and commitment of resources from Quang Nam and Da Nang city, and close collaboration among stakeholders including private sector, authorities at central and local levels, and community groups in the basin. In addition to financial resources to maintain its effective operation, the organization must be stipulated specifically for its feasibility.

Management and effective monitoring of water resources in the basin will bring benefits to all communities and socio-economic activities in the basin. Therefore, all people, agencies, organizations and enterprises in the basin

must be responsible for resource contribution to RBC and VGTB Research Center. In particular, to undertake in-depth study and resource mobilization, it is essential to have the participation of the two main local departments of DONRE in Quang Nam and Da Nang to exchange, consider and propose specific solutions.

## Long-term water supply planning

- Hydropower plant management and operations are increasingly causing significant downstream impacts. Some of the specific challenges include:
- Though hydropower plants are carefully planned and approved, implementation and enforcement of plans is lacking. Consequently, known potential impacts that could be avoided through enforcement are occurring. For example, it was explicitly stated that Song Bung 4 Hydropower must be constructed before Dak Mi 4 Hydropower to ensure water in the dry season for Da Nang city and Quang Nam. However, in reality Dak Mi 4 was completed before Song Bung 4, causing severe water shortage in the downstream.
- The Dak Mi 4 hydropower plant is diverting 1.2 million m<sup>3</sup> of water from the Cai River (tributary to the Vu Gia River) to the Thu Bon River. Da Nang city has requested the Dak Mi investor to install an additional discharge pipe with a flow of 25 m<sup>3</sup>/s to supplement water for Da Nang city in the dry season. However, in practice, due to lack of specific calculation of environmental flow and enforcement, Dak Mi 4 only releases water downstream to the Vu Gia when there are requests of stakeholders.
- In principle, hydropower reservoirs are responsible for reducing and slowing flood pulses during the rainy season. However, most of the hydropower plants in VG-TB do not operate with significant flood capacity (except A Vuong HP). Therefore, in the rainy season, the hydropower reservoirs do not play a role in reducing downstream flooding. Worse, they frequently operate such that they have difficulty meeting multi-reservoir operating rules in the rainy season, running the risk of cascading emergency dam releases during flood conditions.
- There is a lack of collaboration on the part of hydropower management to ensure common benefits between upstream and downstream areas resulting in conflicts and disputes. For example, in the rainy season natural flow in big rivers together with flooding discharge from reservoirs increases flood risks downstream. Similarly, water storage for electricity generation affect water supply

in the dry season because hydropower management only focuses on electricity generation during peak hours rather than also maintaining minimum flows for salinity control.

Resolving these issues is needed to assure the Da Nang water supply. There are no longer sufficient water resources in the Vu Gia- Thu Bon basin to add new water demands without considering the impacts to existing uses and downstream entities.

## Hoa Lien Water Supply Plant

The proposed Hoa Lien water supply plant (WSP) would have a capacity of 135,000 m<sup>3</sup>/day. All 3 proposed Hoa Lien intake locations are possible to ensure water supply for the plant. However, because the Cu De is close to the Nam O estuary, it is often affected by salinity, impacting downstream agricultural irrigation; Pho Nam is beginning to experience periods of salinity. The Hoa Lien WSP will require construction solutions for salinity control and flow adjustment.

In the long term, construction solutions (reservoirs, channels) should be considered to ensure water supply in the dry season, particularly to provide adequate flow volume and protect from saline intrusion. In particular, the Cu De River basin houses the Hoa Trung reservoir, with capacity of 11 million m<sup>3</sup> liters. By design, this reservoir is responsible for providing irrigation for 650 ha of agricultural land. However, due to urbanization, agricultural land in this area is currently reduced to only 300 ha. In the future, the water from this reservoir should be considered as a possible supplement water supply for domestic and industrial uses in the Cu De basin.

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## FURTHER READING

This policy brief does not provide the technical details of the water resource analysis for Da Nang. The following resources provide more information on Da Nang water resource activities:

The Climate Change Coordination Office of Da Nang City (CCCO Da Nang) [website](#)

Institute for Social and Environmental Transition-International (ISET-International) [website](#)

City project report can be found [here](#).

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