Chapter 34 Short-term Development Plan of Navigation Channel for 2010

34.1 Dimensions of navigation channel

Dimensions of navigation channel for 2010 are proposed as shown in **Table 34.1.1** and **Figure 34.1.1**. The grounds of each proposed dimension are mentioned in the following part.

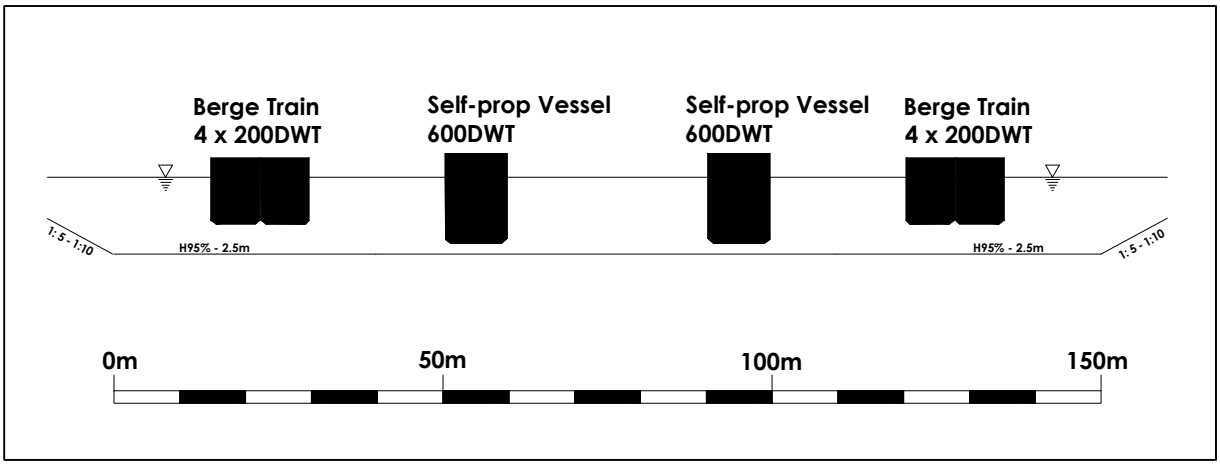
Table 34.1.1 Dimensions of Navigation Channel in Hanoi Segment (2010)

Section	Corridor	LAD	LAW	Bend Radius	Vertical Clearance of Bridge
Red River (Don Lai - Hanoi Port)	1 (Quang Ninh - Viet Tri)	2.5m	50m - 150m	500m-700m	H5% + 7m
Red River (Hanoi Port - Yen Mi)	4 (Sea - Hanoi)	2.5m	50m - 150m	500m-700m	H5% + 10m
Duong River (Bifurcation - Phu Dong)	1 (Quang Ninh - Viet Tri)	2.5m	> 50m	500m-700m	H5% + 7m

Note) Navigation channel in the Red River Hanoi segment shall be 4-lane channel.

Note) As to vertical clearance of bridge for Corridor 1, JICA Study Team proposes the vertical clearance of 7m, which is the same clearance as Vinh Bridge spanning over Kinh Thay River, although Class II requires 9m.

Source) JICA Study Team



Source) JICA Study Team

Figure 34.1.1 Typical Cross Section of Navigation Channel (2010) (Red River Hanoi Segment)

(1) Depth of navigation channel

Based on the Long-term Strategy for the IWT system in the Red River Delta, LAD (Least Available Depth) of navigation channel shall be 2.5m for class II (Corridor 1: Quang Ninh - Viet Tri) and 3.6m for class I (Corridor 4: sea - Hanoi). LAD of navigation channel for Corridor 4 (see - Hanoi), however, shall be 2.5m in 2010 since the introduction of SRVs is expected after 2010, although 3.6m is needed for class I.

(2) Width of navigation channel

Based on the Long-term Strategy for the IWT system in the Red River Delta, LAW (Least Available Width) of navigation channel shall be 50m in principle for double-way channel.

However, navigation channel in the Red River Hanoi segment shall be 4-lane channel with a LAW of 150m taking into account the future heavy vessel traffic, the existence of many ports/Berths in the segment and the future possible vessel congestion at Duong Bifurcation.

(3) Bend radius of navigation channel

Based on the Long-term Strategy for the IWT system in the Red River Delta, bend radius of navigation channel shall be 500m - 700m for class II (Corridor 1: Quang Ninh - Viet Tri). Bend radius of navigation channel for Corridor 4 (see - Hanoi) shall be 500m - 700m in 2010 since the introduction of SRVs is expected after 2010, although more than 700m is needed for class I.

(4) Vertical clearance of bridge

Based on the Long-term Strategy for the IWT system in the Red River Delta, vertical clearance of bridge shall be 10m for Class I (Corridor 4: Hanoi - sea).

As to vertical clearance of bridge for Corridor 1 (Quang Ninh - Viet Tri), JICA Study Team proposes the vertical clearance of 7m, which is the same clearance as Vinh Bridge spanning over Kinh Thay River, although Class II requires 9m. It should be noted, however, that Duong, Long Bien and Ho Bridges have lower vertical clearance than 7m.

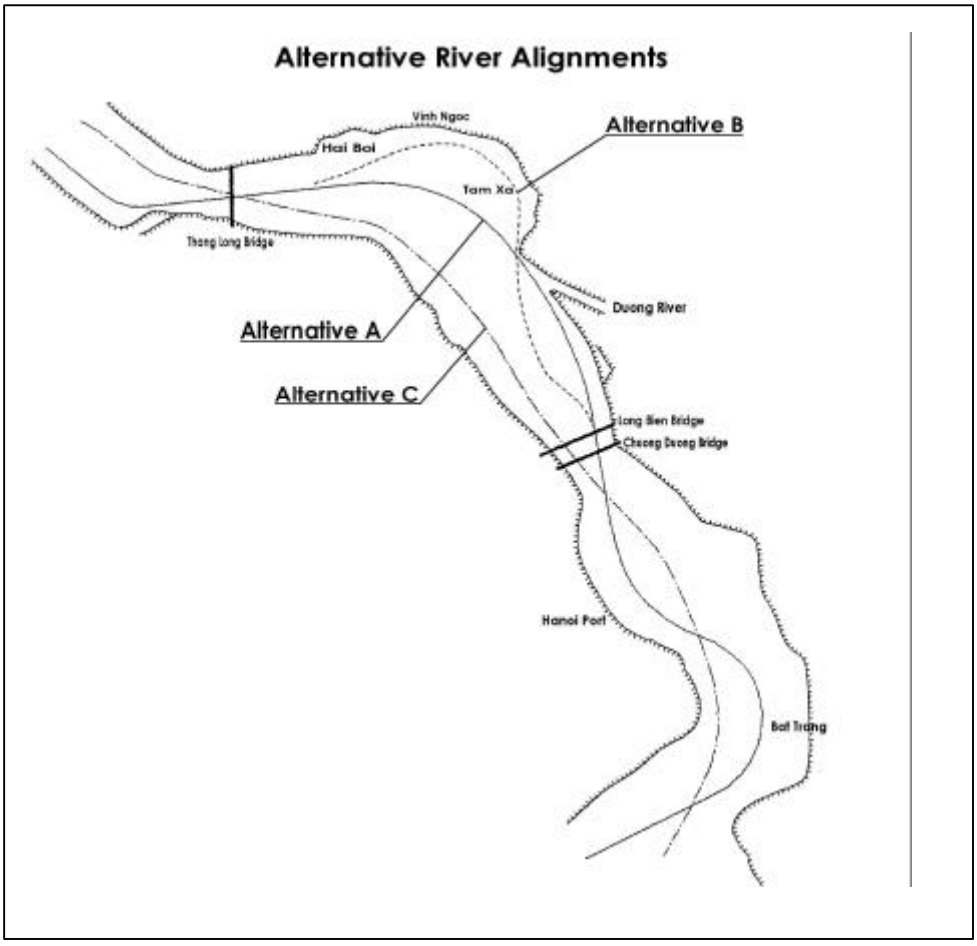
34.2 Alignment of navigation channel

According to the "Pre-F/S on Red River - Hanoi Section Rehabilitation Project", 3 main river forms have historically been observed (see **Figure 25.2.1**).

River Alignment A: The flow goes from Lien Mac to Tam Xa bank, and along the left bank up to Chuong Duong Bridge, and then moves to the right bank. This river form is the present one.

River Alignment B: The flow goes along the left dyke (Hai Boi - Vinh Ngoc - Tam Xa). This river form has not existed for more than 60 years.

River Alignment C: The flow goes along the right bank between Thang Long and Chuong Duong Bridges, and then moves to the left bank. When this river form appeared in around 1990, Hanoi Port experienced serious sedimentation and could not operate accordingly.



Source) Pre-F/S on Red River - Hanoi Section Rehabilitation Project

Figure 34.2.1 Alternative River Alignment

Among the 3 Alternatives, Alternative A is proposed as a future desirable river alignment from the viewpoints of the sedimentation at ports, bifurcation and sluices, possible erosion at resident quarters, making good use of existing constructions of river training works and investment scale.

Proposed alignments of navigation channel on condition that the talweg line will not change from that of January 2002 are as follows:

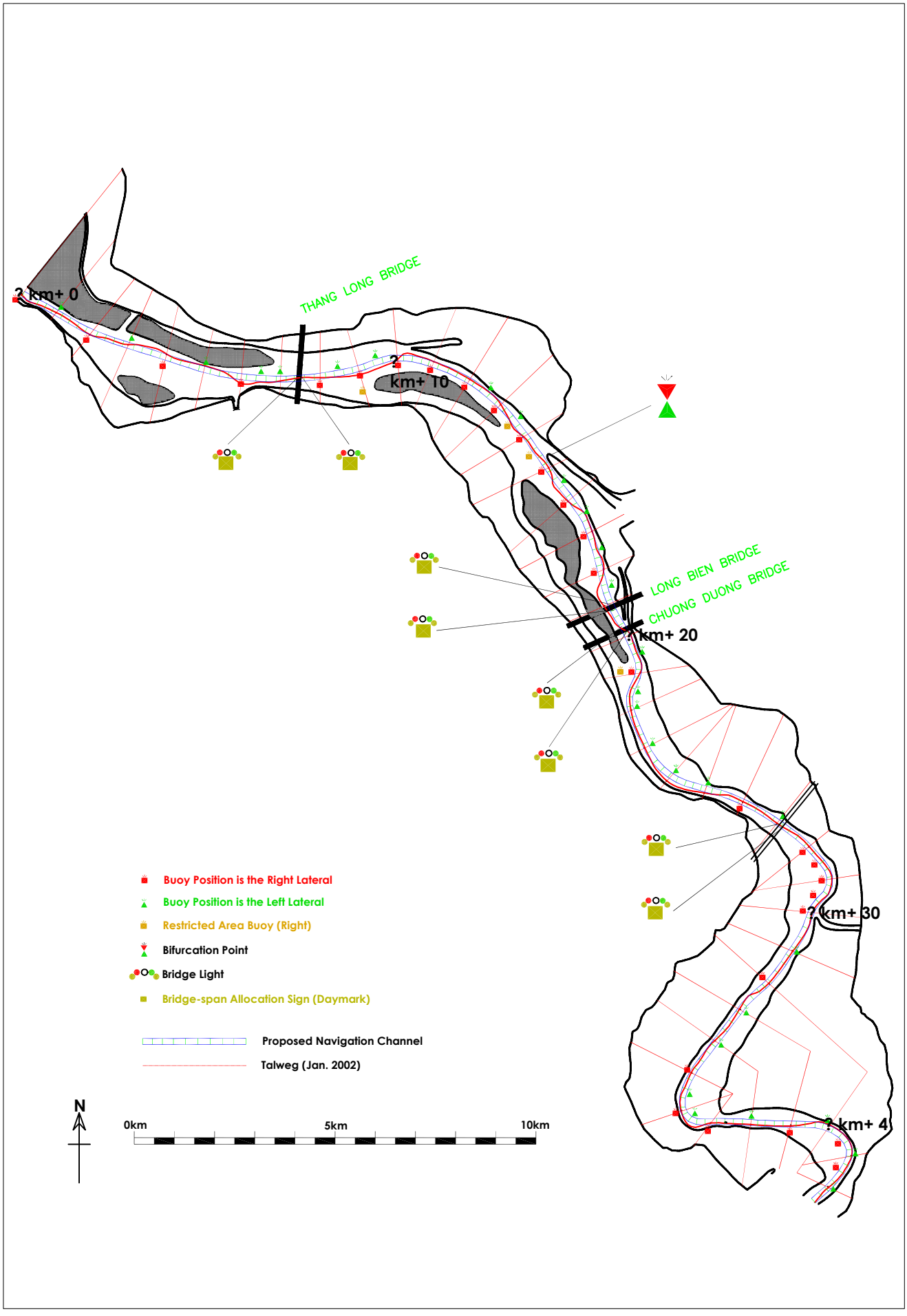
Case-1 (**Figure 34.2.2**)
Smooth alignment along the talweg line of January 2002.
Lateral clearance from ports is set at 150m.

Case-2 (**Figure 34.2.3**)
Modifying case-1 in order to minimize dredging volume makes case-2.
Minimum bend radius is set at 500m - 700m.
Lateral clearance from ports is set at 50m.

Case-1 is considered to be ideal in terms of vessel traffic capacity and safety. On the other hand, Case-2 is considered to be acceptable if ship crews are richly experienced in navigating this segment and are provided with accurate information on the navigation channel.

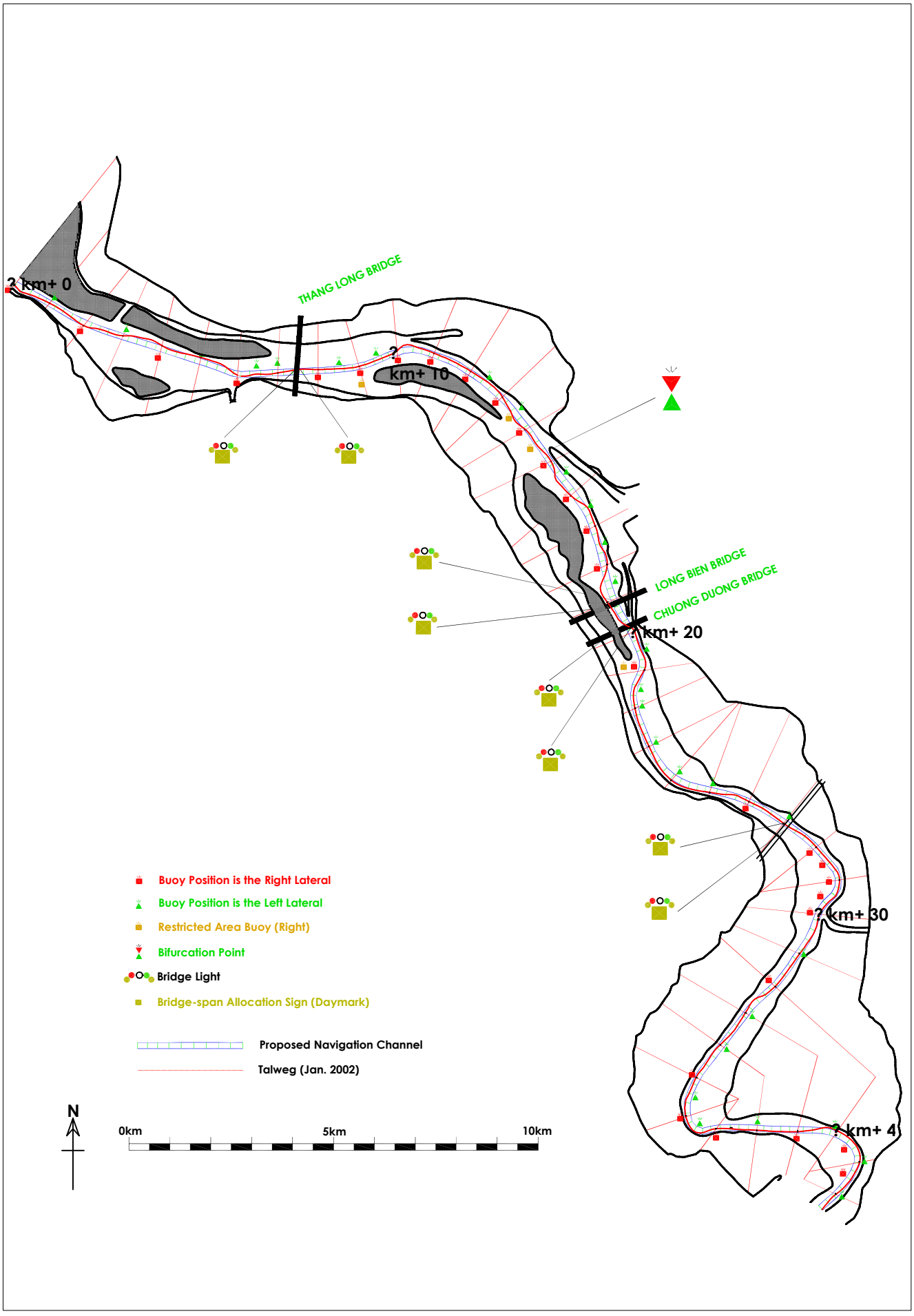
It should be noted that the talweg line changes year by year by natural forces, although change ratio will decrease by river training works. Therefore, perfect fixing of the navigation channel would be impracticable and costly.

Taking into account the above-mentioned factors, JICA Study Team proposes that Case-2 should be adopted in the beginning. In adopting Case-2, it is important above all that VIWA should properly manage and maintain the navigation channel, provide accurate information on the navigation channel as well as promote the skill-up of ship crews.



Note) Kilometerage goes downstream along the talweg of January 2002.
Source) JICA Study Team

Figure 34.2.2 Alignment of Navigation Channel in Hanoi Segment (case-1)



Note) Kilometerage goes downstream along the talweg of January 2002.
Source) JICA Study Team

Figure 34.2.3 Alignment of Navigation Channel in Hanoi Segment (case-2)

34.3 Navigation safety measures for Duong Bifurcation

(1) Distribution of roles and functions among ports/berths

The vessel traffic at three points in Hanoi Segment in 2010 is forecast as follows:

Dong Lai: approx. 320 vessels/day
Phu Dong: approx. 190 vessels/day
Yen My: approx. 50 vessels/day

Note) Vessels carrying containers are excluded.

Special attention should be paid to Duong Bifurcation in terms of vessel traffic capacity and traffic safety, since many of the above vessels will pass through Duong Bifurcation.

Therefore, distribution of roles and functions among ports/berths is carried out taking into account easing vessel traffic concentration at Duong Bifurcation.

However, a large number of vessels will still pass through Duong Bifurcation and thus prudent navigation safety measures should be implemented.

(2) Giving clear priority to vessel navigation

There are six patterns of vessel navigation at Duong Bifurcation:

(a) From upstream in the Red River to the Duong River
(b) From upstream to downstream in the Red River
(c) From the Duong river to upstream in the Red River
(d) From the Duong River to downstream in the Red River
(e) From downstream to upstream in the Red River
(f) From downstream in the Red River to the Duong River

The top priority shall be given to the vessel that goes from upstream in the Red River to Duong River (a) and to downstream in the Red River (b). Vessel that goes from upstream in the Red River to Duong River (a), in particular, is the most difficult case among these six patterns, where a vessel heading for downstream has to steer to the left in a water flow, cross the opposite water lane and enter the waterway in the Duong River.

The second priority shall be given to the vessel from Duong River to downstream in

the Red River (d). In other cases, ships shall navigate paying special attention to other vessels near Duong Bifurcation.

(3) Alternatives on additional navigation safety measures

There are four alternatives on additional navigation safety measures for Duong Bifurcation as follows:

Alternative-1

Every vessel that passes through Duong Bifurcation in the day time shall put up the international signal flag showing its destination and shall navigate according to the above mentioned priority rule. During the night, every vessel shall navigate with whistles according to the priority rule. In general a vessel going straight blows one short whistle continuously and a vessel turning to the left blows two short whistles continuously.

Alternative-2

Vessel navigation is limited to particular times. Vessels going in the Red River can navigate during a certain time and vessels in the Duong River during the other time. This method may be difficult if many vessels concentrate on Duong Bifurcation.

Alternative-3

"Traffic Control Center" will be set up at Duong Bifurcation. Vessels shall communicate with the Center through VHF and shall navigate according to the direction from the Center.

Alternative-4

Turning left point for vessels from the Duong River to downstream in the Red River is moved to upstream in the Red River by installing land signs of "No Left Turn". This method may be effective for the improvement of vessel traffic capacity and safety at the Duong Bifurcation, although the navigation length of the vessel becomes longer.

JICA Study Team proposes that Alternative-1 should be adopted in the beginning. In adopting Alternative-1, it is important that every vessel strictly observes the rule. It is also advisable to study the details of Alternative-4 as vessel traffic will increase. In addition to the above measures, navigation aids such as buoys should be installed at closer intervals near Duong Bifurcation, since a lot of vessels concentrate on Duong Bifurcation and vessel operators are forced to maneuver very carefully.

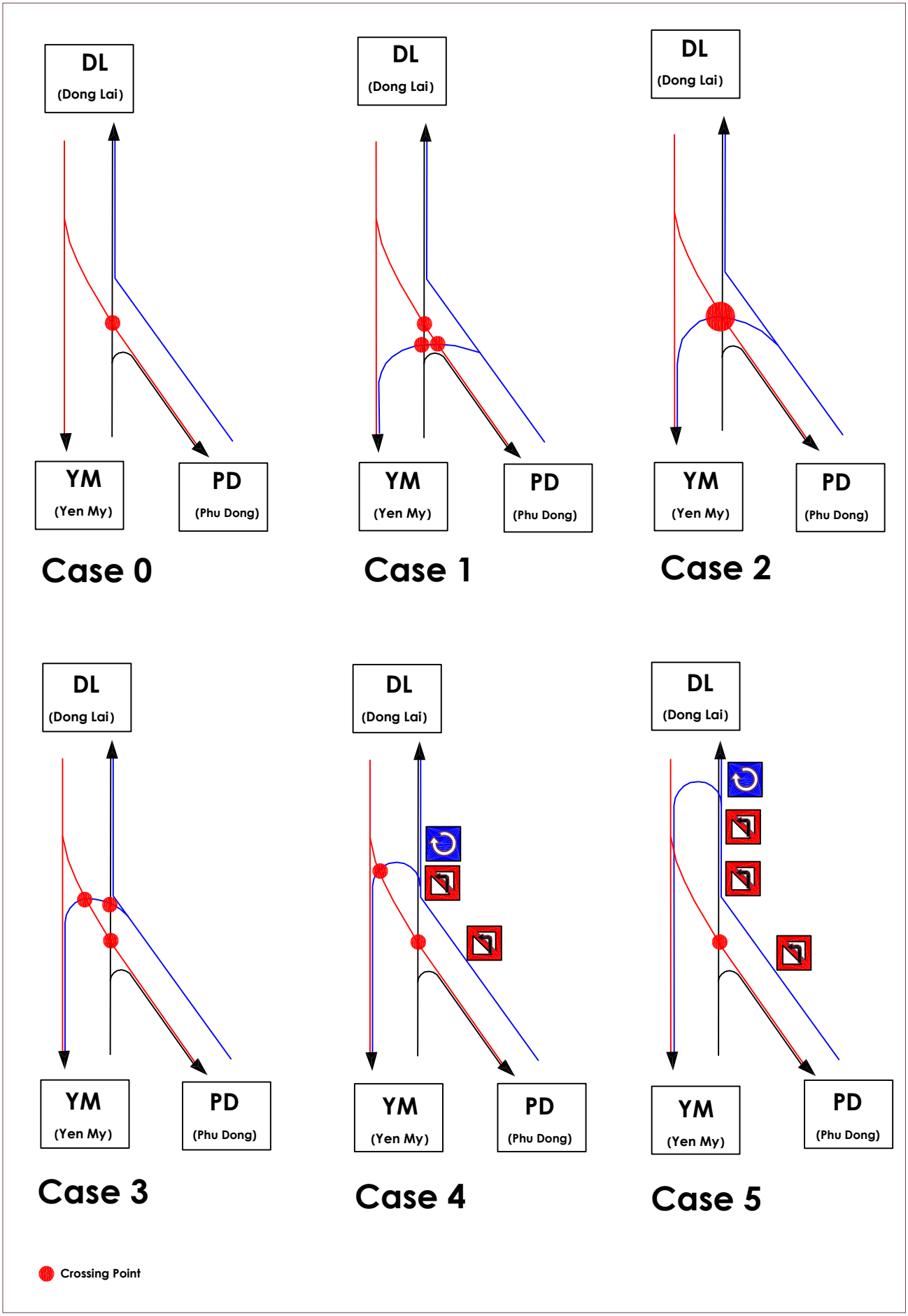


Figure 34.3.1 Crossing Point Alternatives at Duong Bifurcation

Table 34.3.1 Evaluation of Crossing Point Alternatives at Duong Bifurcation

Alternative	Description	Advantage	Disadvantage	Evaluation
Case 0	Base case without vessels PD-YM. There is one crossing point.			
Case 1	Vessels of PD-YM turn left before reaching the crossing point of Case 0.	Navigation length of PD-YM becomes the shortest.	There are two additional (total: three) crossing points. Visibility between vessels of PD-YM and YM-DL is the poorest.	Bad
Case 2	Vessels of PD-YM turn left at the crossing point of Case 0.	Navigation length of PD-YM becomes shorter.	There is no additional crossing point, but vessels from three directions may reach the unique crossing point at the same time. Visibility between vessels of PD-YM and YM-DL is poor.	Worst
Case 3	Vessels of PD-YM turn left beyond the crossing point of Case 0.		There are two additional (total: three) crossing points.	Bad
Case 4	Vessels of PD-YM turn left after merging with YM-DL.	There is only one additional (total: two) crossing point.	Navigation length of PD-YM becomes longer than those of case 1, 2 and 3. Land signs of "No Left Turn" shall be installed. Widening the navigation channel (required width = 300m) at turning zone is needed.	Acceptable
Case 5	Vessels of PD-YM turn left after merging with YM-DL and after passing the diverging point of DL-PD.	There is no additional crossing point.	Navigation length of PD-YM becomes the longest. Land signs of "No Left Turn" shall be installed. Widening the navigation channel (required width = 300m) at turning zone is needed.	Superior

Note) Case 0 to 5: see Figure 25.4.7

Source) JICA Study Team

34.4 Navigation aids

Planning fundamentals for providing navigation aids in the Red River Hanoi segment are proposed as follows:

- To install lateral/cardinal lighted marks conforming to the buoyage system for Vietnamese inland waterway (22 TCN 269-2000) as well as that of the International Association of Lighthouse Authority (IALA) zone A.
  + Each lateral mark (lighted buoy) should be placed 1000 meters apart (500 meters apart at sharp bends and near Duong Bifurcation) in a zigzag pattern as a general rule.
  + A lighted beacon should be placed at Duong Bifurcation as at present.
  + Cardinal marks should be placed at obstacles and restricted areas.
- To install bridge light sets and daymarks at bridges.
- To install jetty markers at ports. Each jetty marker should be placed 40m apart as a general rule.
- The source of light should be solar battery system with LED (light emitting diode) as a general rule.

Proposed number of navigation aids is listed in **Table 34.4.1** and layout plan of main navigation aids is depicted in **Figure 34.2.2** and **Figure 34.2.3**.

Table 34.5.1 Proposed number of main navigation aids

Type	Location	Interval	Required Number	Note
Lateral Mark(Lighted Buoy)	40km Red River Hanoi Segment	1000 m (500m) apart in a zigzag pattern	60	
Lateral Mark(Lighted Beacon)	Duong Bifurcation	(-)	1	Existing
Cardinal Mark(Lighted Buoy)	at obstacles and restricted areas	(-)	20	
Bridge Light set	Thang Long, Long Bien, Chuong Duong, Thanh Tri	(-)	8	
Bridge Daymark	Thang Long, Long Bien, Chuong Duong, Thanh Tri	(-)	8	Existing
Jetty Marker	Hanoi, Khuyen Luong, New North, New East	40 meters apart	80	

Note) Bridge Light set consists of a center light, a port edge light, a starboard edge light and two pier lights for both side of a bridge.
Source) JICA Study Team

Chapter 35 Short–term Development Plan of Channel Stabilization Measures

35.1 Selection of priority facilities

In the analyses and discussions presented in Chapter 26 above, **Alternative 1** is chosen as the most preferable base case of the river stabilization measures. Then, modification of Alternative 1 is made focused of the appropriate width of the main channel as **Alternatives 4** and **5** in the simulations. The facilities proposed in the **Alternative 5** are scrutinized in terms of the degree of necessity, importance, and urgency; step-wise execution while securing careful watching of their effects and side effects; local/site conditions and adoptability to the site; expected cost-effectiveness; and environmental impacts. The optimum width are also discusses by statistical and theoretical analyses. And, lastly **Alternative 5s** is selected as the best case among all the Alternatives discussed. Referring to **Figure 35.1.1**, Priority Projects targeting the year 2010 are selected as follows:

(1) Groin 1 (Vong La Groins) : This is essential in order to change the Talweg to the right bank to suit the basic sinusoid. Dredging should be simultaneously carried out in order that the main stream is guided to match to the basic sinusoid. To observe the effect, a half of the groins is first constructed and the rest is deferred to the next year.

(2) Groin 2 (Dong Ngoc Groins) : This is very essential to deviate the Talweg offshore and to secure the water depth at new North Port. It is also imperative to stop developing the secondary channel behind it. Parallel to the construction of the Groin 2, dredging should be carried out at shallow sinusoid to guide the flow to New North Port.

(3) Training wall 1 (Nhat Tan Training Wall): This is essential to keep and fix Nhat Tan Sand Bar. Construction is divided into three periods from the head to the tail, starting from the upstream portion.

(4) Training wall 2 (Tu Lien Trung Ha Training Wall): This is very important to fix the sand bar, to prevent a cut in the middle, and to guide the flow to the direction of Hanoi Port at the tail. Construction is divided into three periods from the head to the tail, starting from the upstream portion.

(5) Bank protection 2 & 3 (Hai Boi Groins): This is to prevent the score of the left bank, at around the New North Port. The portion of the port is constructed in the works of the port construction. The upper riverside portion to Thang Long Bridge is

remained untouched because of shallowness of the water.

(6) Bank protection 5 (Anh Ninh Bank Protection): This is to strengthen the entrance of the secondary channel.

(7) Bank protection 6 (Bac Cau-Bo De Bank Protection): This is to fix the left bank. The corner of the Bac Cau head at the mouth of the Duong River is protected in the Long Term Plan because of hard soil condition.

(8) Bank protection 7 (Ly Thai To-Bach Dang Bank Protection): This is imperial to protect the urban area on the right bank from the further erosion. The lower two thirds are already in dangerous state for the inhabitants living behind the cliff. The upper one third of the slope of the bank has rather steady condition with gentle slope, and will be deferred until Long-term Plan.

35.2 Staged construction plan

Taking account of the nature of river training works to be prudently executed while confirming the effects and side effects, the Priority Project facilities are proposed to construct in four periods, or in four consecutive dry seasons, taking into consideration that the Project is to finish by the end of 2009.

The groins should be executed a half number first, and watch the effects, then execute the remaining. Training walls are to be carefully constructed from the upstream portion in three periods. The Bank Protection at Ly Thai To- Bach Dang is to be started from downstream portion where erosion of the slope is serous. The bank protection at Bac Cau-BoDe is to be done from upstream.

The above staged-construction Plan is shown in **Table 35.2.1**.

35.3 Notes to be considered

The following notes should be considered before/in the execution stage:

(1) In general, the above facilities for channel stabilization should be constructed step by step, with careful monitoring of the effects and side-effects of the facilities by monitoring and follow up surveys, and review of the plan taking account of the priority, timing, and extent of the facilities.

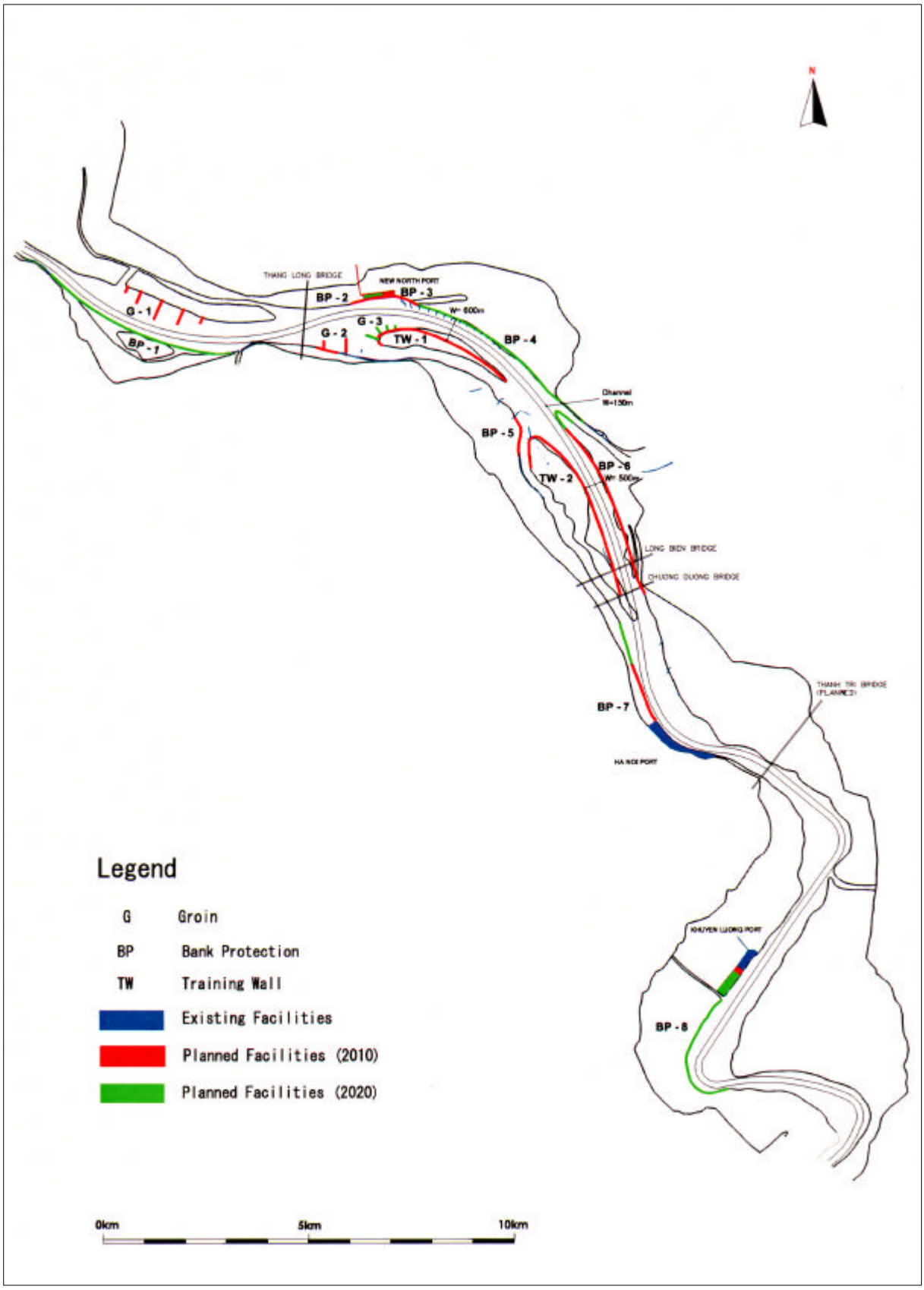


Figure 35.1.1 Arrangement of Channel Stabilization Facilities

Source) JICA Study Team

Table 35.2.1 Construction Sequences of Channel Stabilization Facilities

Unit: m

Facilities	Location	Short Term (2010)					Long Term -(2020)
		1st period	2 nd period	3 rd period	4 th period	Total	
Groin - 1	①	150				150	
(Vong La)	②	300				300	
	③	500				500	
	④		400			400	
	⑤		150			150	
	Total	950	550			***1,500***	
Groin - 2	①	200				200	
(Dong Ngoc)	②		400			400	
	Total	200	400			***600***	
	Foot Protecion	500				500	
Groin - 3	① - ④						***900***
(Nhat Tan)							
Training Wall - 1	Head		800			800	
(Nhat Tan)	Side		500	1,500	1,500	3,500	
	Total		1,300	1,500	1,500	***4,300***	
Training Wall - 2	Head		1,000			1,000	
(Tu Lien-Trung Ha)	Side (upstream)		1,500			1,500	
	Side (downstream)			1,500	1,500	3,000	
	Total		2,500	1,500	1,500	***5,500***	
Bank Protection - 1							***5,200***
(Thuong Cat)							
Bank Protection - 2					800	**800**	
(Hai Boi, N-Port)							
Bank Protection - 3					500	**500**	
(Hai Boi、N-Port)							
Bank Protection - 4							***4,300***
(Tam Xa)							
Bank Protection - 5		1,000				**1,000**	
(An Ninh)							
Bank Protection - 6	Head						1,000
(Bac Cau-Bo De)	Side (upstream)		1,500			1,500	
	Side (downstream)			1,500	1,500	3,000	
	Total		1,500	1,500	1,500	***4,500***	***1,000***
Bank Protection - 7	Upstream						1,000
(Ly Thai To-Bach Dang)	Middle			1,500		1,500	
	Downstream (H.N port)				800	800	
	Total			1,500	800	***2,300***	***1,000***
Bank Protection - 8							***2,500***
(Duyen Ha)							

(2) Although, **Alternative 5s** is chosen as the most preferable case of the channel stabilization measures, it is necessary to review and examine the plan during the Detailed Design works by means of monitoring surveys, detailed numerical simulations, hydraulic model tests with movable riverbed, etc.

The exact locations of Groin 2 (Dong Ngoc Groins) should be re-confirmed in view of its effect suitable to deviate the Talweg toward New North Port and, at the same time, to allow an appropriate amount of flow into the secondary channel.

Similarly, the exact locations of Training Walls 1 (Nhat Tan) and 2 (Tu Lien-Trun Ha) should be re-confirmed, specifically related to optimum width of the main channel to be controlled by the training walls.

(3) Monitoring surveys, including bathymetric, topographic, current and water level (or discharge) surveys, bed load and suspended load, etc., should be carried out in the related areas at intervals of half a year in the dry and flood seasons. Proposed surveys, analyses and monitoring works are summarized in **Table 38.3.1**.

(4) Taking account of the nature of river training works to be prudently executed while confirming the effects and side effects, the Priority Project facilities are proposed to construct in five periods, or in five consecutive dry seasons.

(5) A certain percentage of construction costs, e.g. 3% or more, should be reserved for unexpected expenditure for adjustment of the construction plan related to above 1), 2) and 3) in addition to the ordinary physical contingency. The item is named "Structural Maintenance" in the cost estimate.

(6) Taking account of the importance and the expected life span, the rehabilitation of the existing groins, e.g. Tam Sa and Thach Cau Groins, should be planned in the Long-term Plan.

(7) Capital dredging should be executed parallel to the construction of Groins 1 and 2 and Traing Walls 1 and 2. Flexible and mobile operations of dredging should be incorporated, if necessary, to maintain or adjust the channel in addition to construction of hard facilities.

(8) Prior to execution of the Project, final adjustment and agreement should be made with the other related projects, specifically with MARD on its River Training Program and HNPC of its Rigid Embankment Project.